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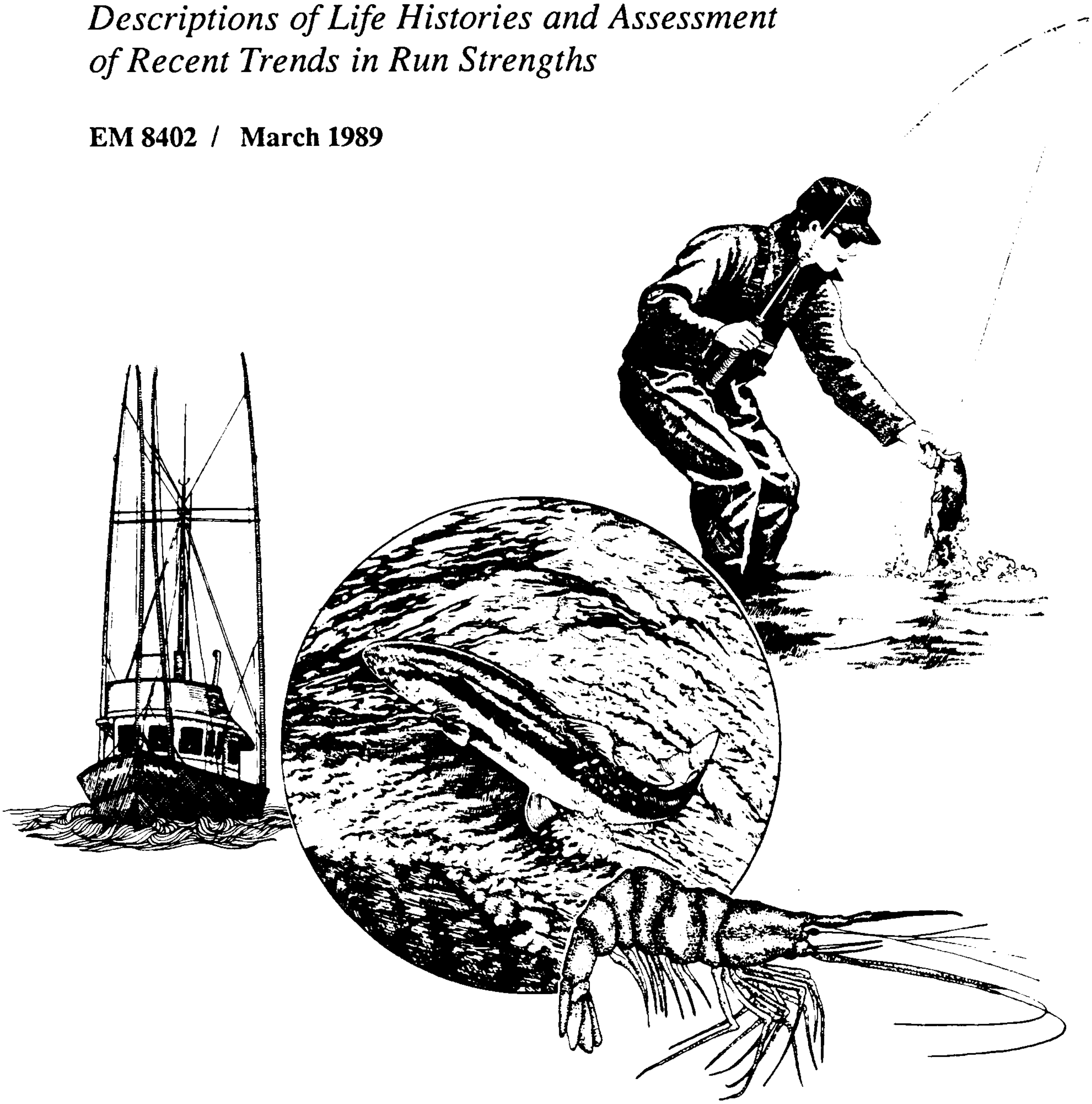
Chinook Salmon Populations in Oregon Coastal River Basins

Descriptions of Life Histories and Assessment of Recent Trends in Run Strengths

EM 8402 / March 1989



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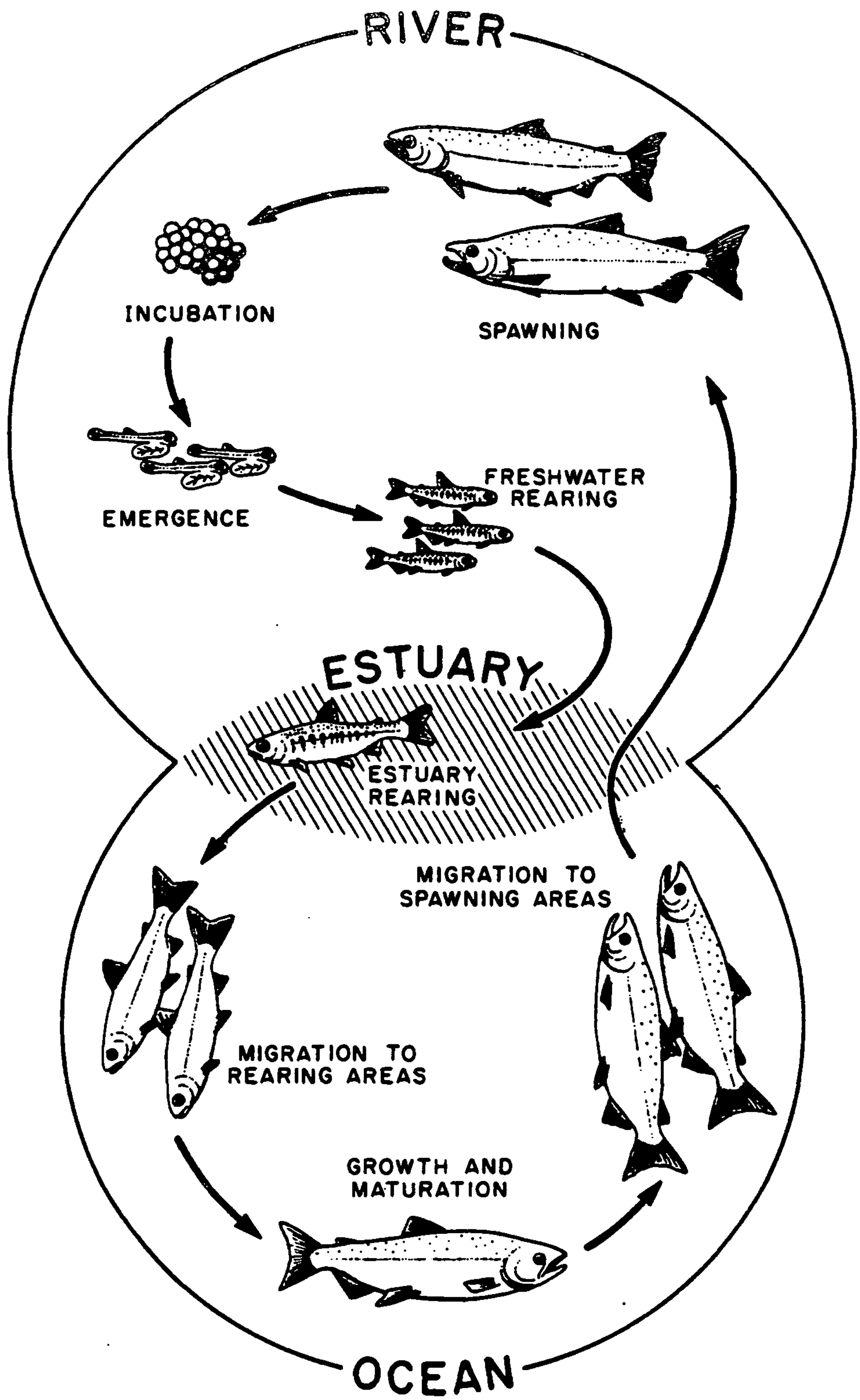
Chinook Salmon Populations in Oregon Coastal River Basins: Description of Life Histories and Assessment of Recent Trends in Run Strengths



LIFE CYCLE OF OREGON COASTAL
CHINOOK SALMON

Chinook Salmon Populations in Oregon Coastal River Basins: Description of Life Histories and Assessment of Recent Trends in Run Strengths

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CONTENTS

ADDENDUM

This ADDENDUM has been placed prominently so that the reader will be less likely to overlook it. For the reader unfamiliar with PART III and PART IV of this report, it would probably be a mistake to read the ADDENDUM first, because it will not make much sense out of context. New information that has become available since 88-1 was first printed (in January 1988) is presented here.

Run Strengths

Revised assessments of the status of runs of chinook salmon in Oregon coastal river basins are summarized in Tables 1 and 2. With a few exceptions, these revisions are minor. One exception is the recognition of several stocks that are classified as being depressed. Another exception is the notation that returns of spring-run fish to the North Umpqua and the Rogue River, and of fall-run fish to the Rogue River have been exceptionally strong during 1986, 1987, and 1988.

The count of spawning chinook salmon in many coastal river basins has been at or near a record high level during the past four years, and almost certainly confirms that returns to coastal river basins are now generally at higher levels than indicated in Table 1. Figure 1 shows the average peak count of chinook salmon in index spawning streams supporting north-migrating stocks during 1977-88. Table 3 presents estimates of the contemporary abundance of fall-run chinook salmon returning to coastal river basins supporting north-migrating stocks. These estimates were made by increasing the run-size estimates for the 1977-85 period (Table 1) by a factor of 1.75. This factor represents the difference between the average peak count of spawning adults in river basins that support north-migrating stocks during the 1977-85 period and during the 1986-88 period.

Table 4 contains estimates of the contemporary contribution of hatchery reared fish to returns of fall-run chinook salmon in five Oregon coastal river basins. These estimates indicate that, in recent years, hatchery reared chinook salmon have made relatively insignificant contributions to returns of fall-run fish to Tillamook Bay tributaries, the Nestucca and the Alsea. Table 1 has been revised to include these estimates of the contribution of hatchery chinook salmon to runs in the Tillamook, Nestucca, and Alsea basins.

A series of unnumbered graphs that display current data on escapements of chinook salmon to selected Oregon coastal river basins are on pages *xvi-xx*. The majority of these graphs were presented in the first edition of this report, and have been updated to show the latest available information.

Although new data are not yet available for formal analysis, interviews with management district biologists and research project personnel indicate that the return of fall-run chinook salmon to the Chetco River has been extremely strong in 1988. Further, early surveys of spawners and anecdotal observations indicate that returns of fall-run chinook salmon to several of the south coast river basins have improved considerably during 1988. As noted in the main body of this report, runs of south-migrating chinook salmon in the North Umpqua River and in the Rogue River basins increased dramatically in the post-El Nino period, and have remained at very high levels since 1985. The many "depressed" stocks of fall-run chinook salmon supported by relatively small river basins on the southern Oregon coast and within the Rogue River basin did not show a similar rapid increase, but are apparently beginning to recover now. A delayed recovery period would be expected for most of these small populations, because spawning stock numbers declined to extremely low levels during the late 1970's and early to mid 1980's. In addition, management district biologists and research project personnel have expressed the opinion that spawning and rearing habitats in many of these small river basins have been degraded within the last decade, and that these habitat changes may have been interfering with the ability of the stocks to recover to the level of production they exhibited during the 1950's and 1960's. If future returns of chinook salmon to coastal river basins remain as strong as they have been in 1988, the assessments of run-strength trend for several stocks will be upgraded from "stable" to "increasing" or from "depressed" to "stable."

In-river Fisheries

Anecdotal observations by anglers and management district biologists indicate that recreational fisheries in all coastal river basins supporting healthy stocks from border to border have ranged from "very strong" to "spectacular". Contemporary catch by the in-river recreational fishery has almost certainly increased over the level experienced during 1977-85. An increase in the number of chinook salmon returning to coastal river basins, and an increase in the number of older age, "trophy" size fish in recent years, is consistent with concurrent restrictions of ocean fisheries in regions where both south- and north- migrating coastal stocks are harvested. However, estimates of recreational catch based on angler "punch-cards" are only available through 1985.

Ocean Fisheries

Oregon ocean landings of chinook salmon were at historic high levels during 1986, 1987, and 1988. Figure 2 has been updated to include 1988 estimated commercial landings of about 485 thousand chinook salmon. Ocean recreational landings of chinook salmon were about 52 thousand in 1987 and about 38 thousand in 1988.

Exploitation Rates in Ocean Fisheries

Figure 4 displays current estimates of the annual exploitation-rate experienced by fully vulnerable, age 4 Klamath River fall-run chinook salmon during the fishery years 1980-87. Figure 5 displays current estimates of the annual exploitation-rate experienced by fully vulnerable, age 4 Rogue River fall-run chinook salmon during the fishery years 1979-86. In both of these figures, the region between 40 and 45% is shaded to display the annual exploitation rate range that has been recommended in a draft management plan for chinook salmon in the Oregon ocean fishery area. The reader should note that exploitation rate data for Klamath River fish have received extensive critical review; data for Rogue River fish,on the other hand, have not received critical review, and are reproduced here from an Oregon Department of Fish and Wildlife draft report. Recent estimates of annual exploitation rate experienced by Oregon coastal chinook salmon stocks in the ocean to the north of Oregon are not yet available. Presumably, Oregon coastal stocks of chinook salmon that are present in the ocean off the coast of British Columbia and Alaska have experienced a lower average annual exploitation since the 1985 fishing season, due to the U.S.-Canada Fishery Treaty.

Table 1.
(On pages *x* and *xi*)

Status assessment summaries for chinook salmon in Oregon coastal river basins. Entries are organized by oceanic migration pattern, run timing, and river basin (river basins are listed from north to south). Parentheses indicate that entries are based on limited data, are based on anecdotal observations, or are calculated values dependent on assumed parameters; as such these entries are presented as the best currently available information and should be considered provisional working hypotheses.

Footnotes for Table 1.

[a] "Wild" indicates that few or no public hatchery chinook salmon were released in the river basin during the last decade and that the population is believed to consist almost entirely of wild fish.

[b] Average adult run size calculated by dividing recreational catch by assumed harvest rate, except where noted.

[c] Average adult run size based on population estimates.

[d] Average adult run size based on counts at dams.

[e] Estimate by management district biologist.

[f] Rapidly expanding releases of presmolts and smolts in 1987 and 1988.

NORTH MIGRATING FALL-RUN STOCKS

River Basin	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate In-river	Average adult run size,[b] 1977-85	Run strength trend	Comment
Nehalem	Wild	700	(0.15)	(4,700)	Increase since mid-1950s, but depressed compared with 1890-1920 populations	Gradual improvement in habitat since mid-1950s; summer-run stock apparently increasing but very depressed compared with historic abundance
Tillamook Bay	>90	3,500	(0.25)	(14,000)	Strong return to system in 1986-88; no current catch data	This entry accounts for fish caught in the Bay that are destined for tributary streams
Miami	Wild	110	(0.20)	(550)	No trend; variable abundance	
Kilchis	Wild	350	(0.20)	(1,750)	No trend; variable abundance	
Wilson	Wild	3,000	(0.25)	(12,000)	Increasing since early 1970s	
Trask	>80	3,700	(0.25)	(14,800)	No trend; variable abundance	
Tillamook	Wild	250	(0.20)	(1,250)	No trend; variable abundance	
Nestucca	>95	3,200	(0.25)	(12,800)	No trend; variable abundance; population currently at high average abundance	Summer-run stock apparently stable or increasing
Salmon	25	750	(0.25)	(3,000)	Greater average abundance since 1978 is due to hatchery fish returns	Indicator stock for monitoring US/Canada Fishery Treaty
Siletz	Wild	1,100	(0.20)	(5,500)	No trend; variable abundance; population currently at high average abundance	
Yaquina	Wild	450	(0.15)	(3,000)	Greater average abundance since 1977	Straying by private hatchery fish poorly documented; Rogue spring-run fish released in 1987, 1988
Alsea	>90	1,850	(0.20)	(9,200)	Increasing since mid-1970s	
Yachats	Wild	0	?	(400)[e]	Run strength trend unknown	Severe habitat damage during winter of 1987-88; poor database
Siuslaw	Wild	850	(0.20)	(4,250)	Increasing since 1950s	
Umpqua	Wild	400	(0.15)	(2,700)	Increasing since mid-1970s in South Fork and Smith River, but very depressed compared with 1920s populations	
Coos	Wild[f]	450	(0.10)	(4,500)	Increasing since mid-1950s, but depressed compared with 1890-1920 populations	Returns of Rogue stock to private hatchery now dominate system; straying may be extensive; gradual improvement in habitat since mid-1950s
Coquille	Wild	750	(0.15)	(5,000)	Increasing since mid-1950s	
Floras	Wild	110	(0.15)	(735)	No trend; variable abundance	
Sixes	90	600	(0.20)	(3,000)	No trend; variable abundance; possible decline in wild fish population	Stray fish from Elk River Hatchery
Elk	40	1,900	0.25	(7,600)	Greater average abundance since 1970 is due to hatchery fish returns; wild fish stable; large variation in hatchery fish returns	"Target" commercial fishery in ocean at river mouth

NORTH MIGRATING SPRING-RUN STOCKS

River Basin	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate in-river	Average adult run size,[b] 1977-85	Run strength trend	Comment
Wilson	(65)	350	(0.25)	(1,400)	No trend; depressed compared with pre-1935 populations	Hatchery-wild composition of population poorly documented
Trask	(35)	1,150	(0.25)	(4,600)	No trend; depressed compared with pre-1935 populations	Hatchery-wild composition of population poorly documented
Nestucca	(50)	700	(0.25)	(2,800)	No trend; currently at high average abundance level	Hatchery-wild composition of population poorly documented
Siletz	Wild	70	(0.20)	(350)	No trend	Depressed compared with pre-1935 populations
Alsea	Wild	40	(0.10)	(400)	No trend	Very depressed compared with pre-1935 populations
Coquille	Wild	0	0	(<200)[e]	Depressed	STEP restoration project

SOUTH MIGRATING FALL-RUN STOCKS

River Basin	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate in-river	Average adult run size,[b] 1977-85	Run strength trend	Comment
Euchre	?	?	?	<100	Depressed since 1970s	Poor database
Rogue	Wild	2,300	0.06	40,000[c]	No trend; large variation in run size, 1986-88 returns ≥ 100,000	(Overharvest in ocean fisheries 1977-83); El Niño effect on 1983-84 returns
Misc. Rogue Tributaries	Wild	?	?	?	Depressed since mid 1970s	Poor database
Hunter	Wild	40	(0.15)	(270)	Depressed since mid-1970s	(Overharvest in ocean fisheries 1977-83); (habitat damage)
Pistol	Wild	50	(0.15)	(330)	Depressed since mid-1970s	(Overharvest in ocean fisheries 1977-83); (habitat damage)
Chetco	(40)	2,000	(0.25)	(8,000)	Depressed since 1979; wide variation in survival of hatchery fish	(Overharvest in ocean fisheries 1977-83); status of wild fish poorly documented
Winchuck	Wild	110	(0.15)	(730)	Depressed since 1979	(Overharvest in ocean fisheries 1977-83)

SOUTH MIGRATING SPRING-RUN STOCKS

River Basin	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate in-river	Average adult run size,b 1977-85	Run strength trend	Comment
N. Umpqua	60	1,950	0.23	8,500[d]	No trend; moderate variation in abundance of wild fish and large annual variation in abundance of hatchery fish	El Niño effect on 1983-84 returns; 1986-88 returns ~14,000 annually
S. Umpqua	?	?	?	<100	Depressed	Efforts to rehabilitate run with North Umpqua stock
Rogue	60	6,100	0.20	30,000[d]	No trend; large variation in run size; 1986-88 returns ~100,000 annually	El Niño effect on 1983-84 returns;

Depressed	No trend	Increasing
North-Migrating, Fall-run		
Yachats	Miami Kilchis Trask [b,c] Tillamook Nestucca [b] Siletz [b] Floras Sixes	Nehalem [a] Wilson Salmon [c] Yaquina Alsea Siuslaw Umpqua [a] Coos [a] Coquille Elk [c,d]
North-Migrating, Spring-run		
Coquille	Wilson [c] Trask [c] Nestucca [c,e] Siletz [a] Alsea [a]	
South-Migrating, Fall-run		
Euchre Misc. Rogue Tribs. Hunter Pistol Chetco [c,e] Winchuck	Rogue [b]	
South-Migrating, Spring-run		
S. Umpqua	Rogue [b,c] N. Umpqua [b,c]	

[a] *Depressed compared with historic run strength.*
[b] *Run strength currently at high average level.*
[c] *Significant production of hatchery fish.*
[d] *Wild fish no trend.*
[e] *Wild fish status uncertain.*

Revised December 1, 1988

Table 2. Summary of assessments of run strength for chinook salmon populations in Oregon coastal rivers. Populations are organized by oceanic migration pattern and season of return. River basins are listed from north to south.

Table 3. Estimates of run-size for north-migrating fall-run chinook salmon returning to Oregon coastal river basins.

River basin	Estimated run-to-river 1977-85 average[a]	Estimated run-to-river 1986-88 average[b]
Nehalem	4,700	8,230
Tillamook Bay	44,350	77,610
Nestucca	12,800	22,400
Salmon	3,000	5,250
Siletz	5,500	9,630
Yaquina	3,000	5,250
Alsea	9,200	16,100
Siuslaw	4,250	7,440
Umpqua	2,700	4,730
Coos	4,500	7,880
Coquille	5,000	8,750
New River	735	1,290
Sixes	3,000	5,250
Elk	7,600	13,300
Total	110,335	193,110

[a] See pages 203-207.
[b] 1986-88 average run-to-river estimates were obtained by multiplying the 1977-85 estimated value by 1.75; this constant represents the average increase in the peak count of adult chinook in standard spawning survey index areas during 1986-88 versus 1977-85.

Table 4. Summary of data used to estimate contemporary contribution of hatchery fall-run chinook salmon to runs in several Oregon coastal river basins.

River basin	Estimated[a] run-to-river 1986-88 average	Average no. smolts 1982-84 broods (Thousands)	Assumed[b] return to river	Estimated contribution of hatchery fish, 1986-88 No.	% of run
Tillamook Bay	77,610	325[c]/140[d]	.01/.005	3,950	5
Nestucca	22,400	113	.005	565	3
Salmon	5,250	207	.02	4,140	79
Alsea	16,100	197	.005	1,000	6
Elk	13,300	475	.02	9,500	71

[a] From Table 3
[b] Probably an optimistic value; assumption based on PFMC database and on return data from Salmon and Elk rivers
[c] Presmolts.
[d] Smolts.

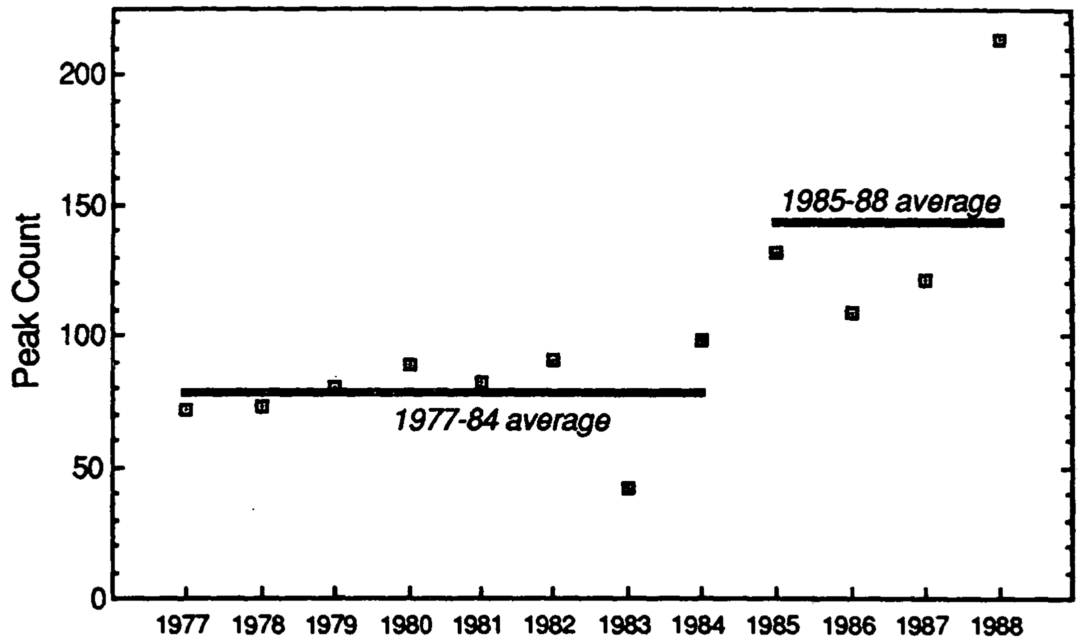


Figure 1. Average annual peak count of adult chinook salmon in standard index survey sections of Oregon coastal river basins that support north migrating stocks. Values represent average of counts made in nine river basins; datum for 1988 is preliminary. Returns of chinook salmon to streams supporting north-migrating stocks should have been improved by restrictions of ocean fisheries northward of Oregon beginning in 1985, due to the U.S.-Canada Fishery Treaty.

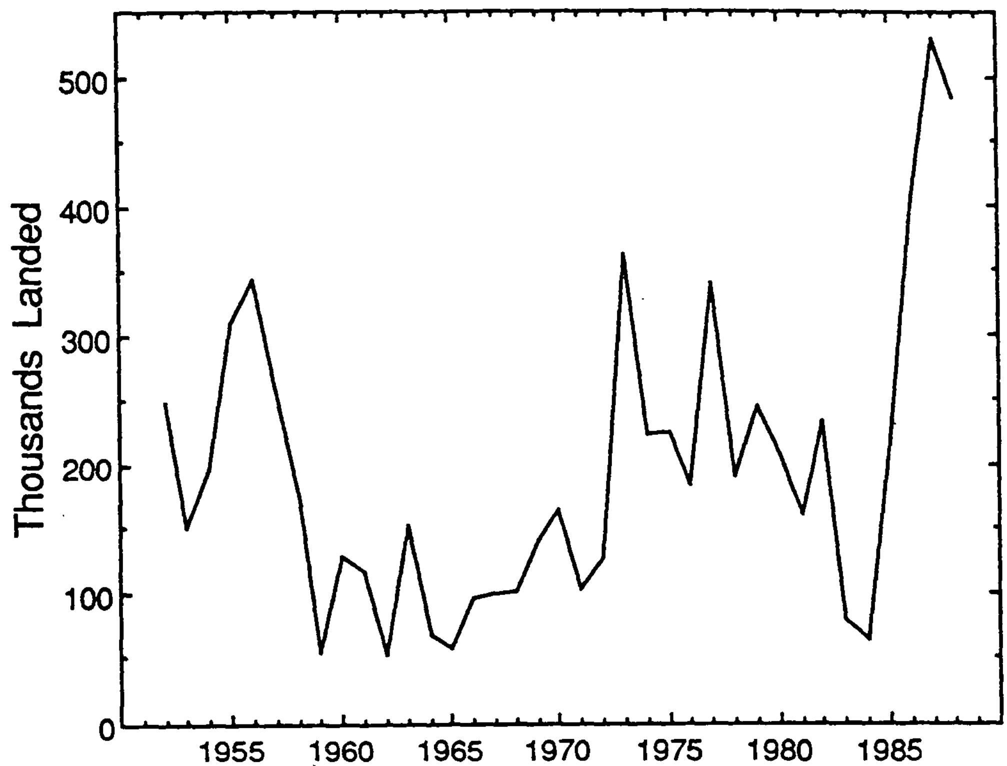


Figure 2. Oregon ocean commercial landings of chinook salmon, 1952-88. (Revised 12/88)

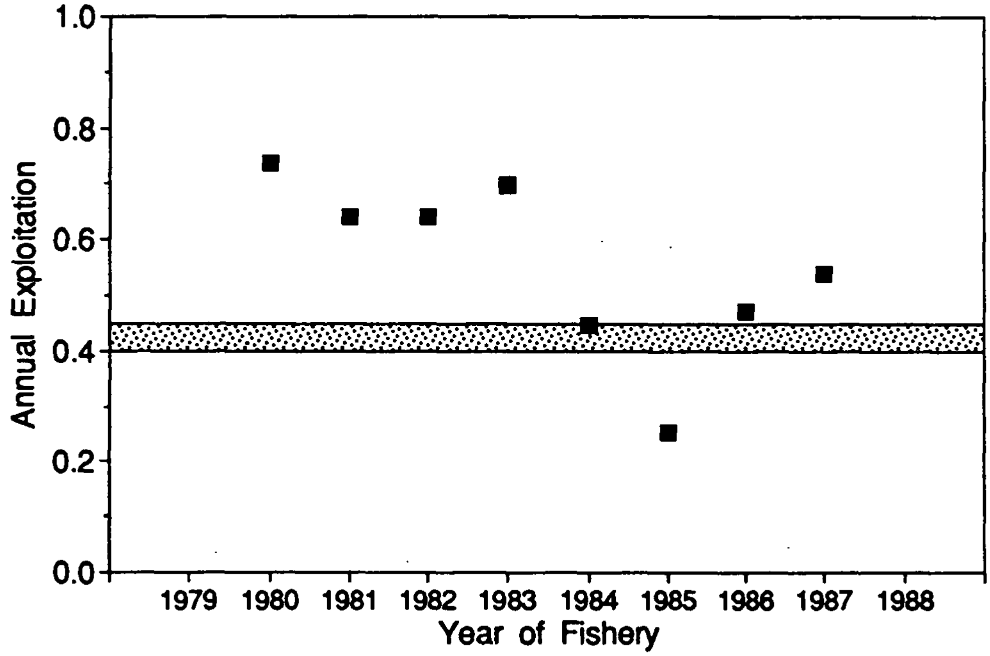


Figure 3. Estimated annual exploitation rate in ocean fisheries, for fully vulnerable, age 4 chinook salmon. Values are for Klamath River fall-run fish. (Source: PFMC February 1988 Preseason Report I).

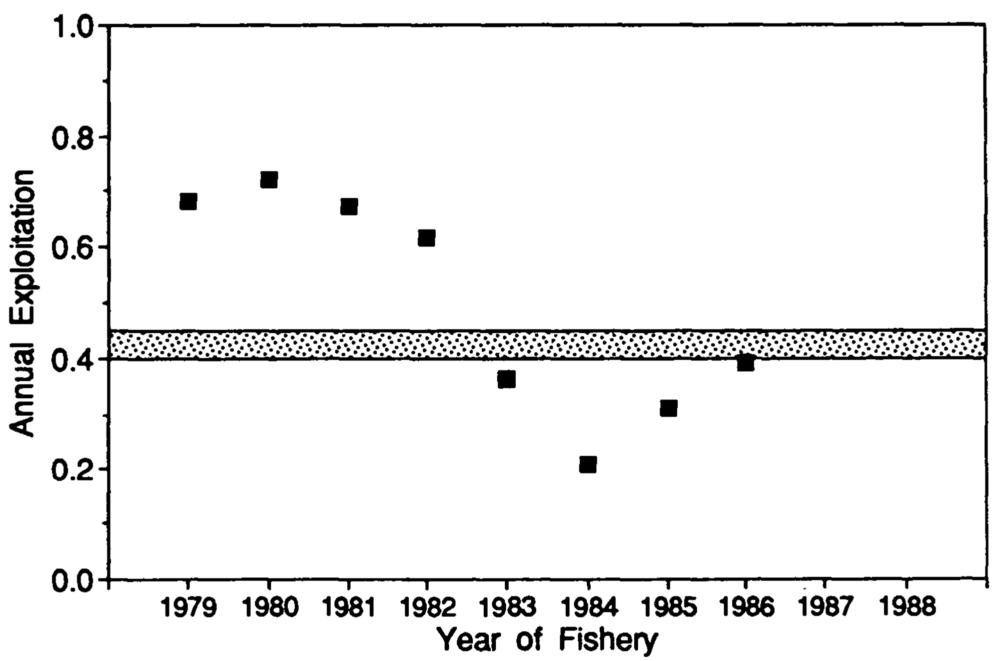
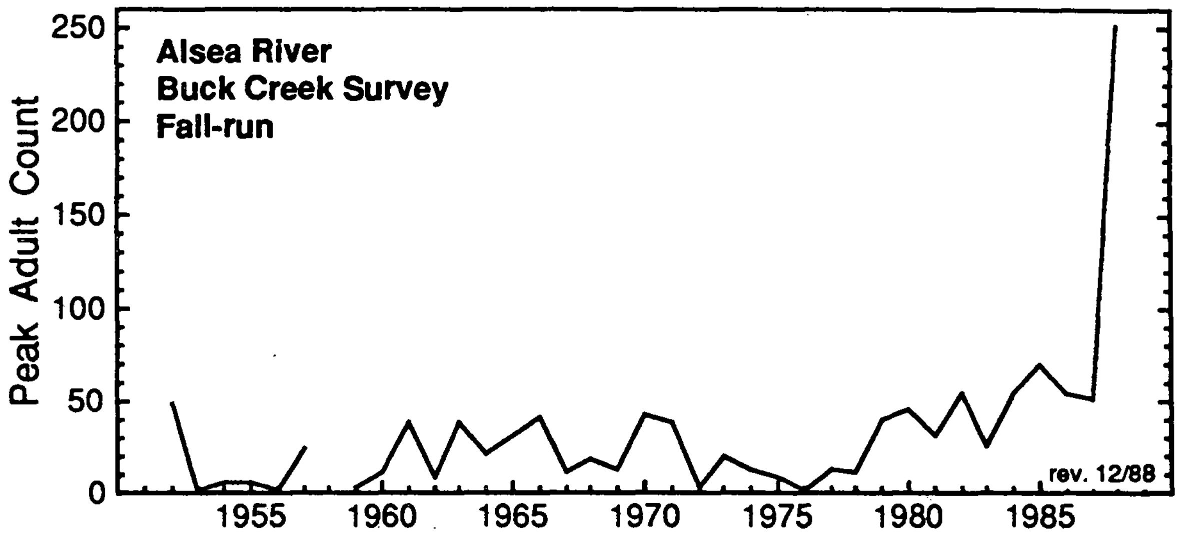


Figure 4. Estimated annual exploitation rate in ocean fisheries, for fully vulnerable, age 4 chinook salmon. Values are for Rogue River fall-run fish. (Source: Satterthwaite, T. D., 1988 Draft. Influence of Lost Creek Dam on Fall Chinook Salmon in the Rogue River and Recommendations for Reservoir Operation.)


Alsea River
Buck Creek Survey
Fall-run
Peak Adult Count
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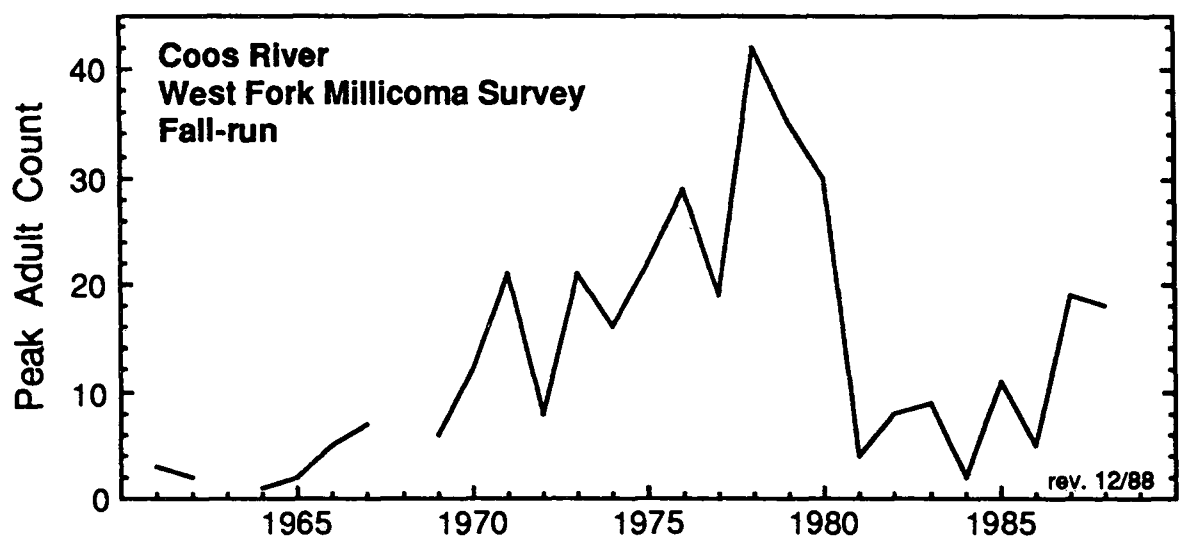
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West Fork Millicoma Survey
Fall-run
Peak Adult Count
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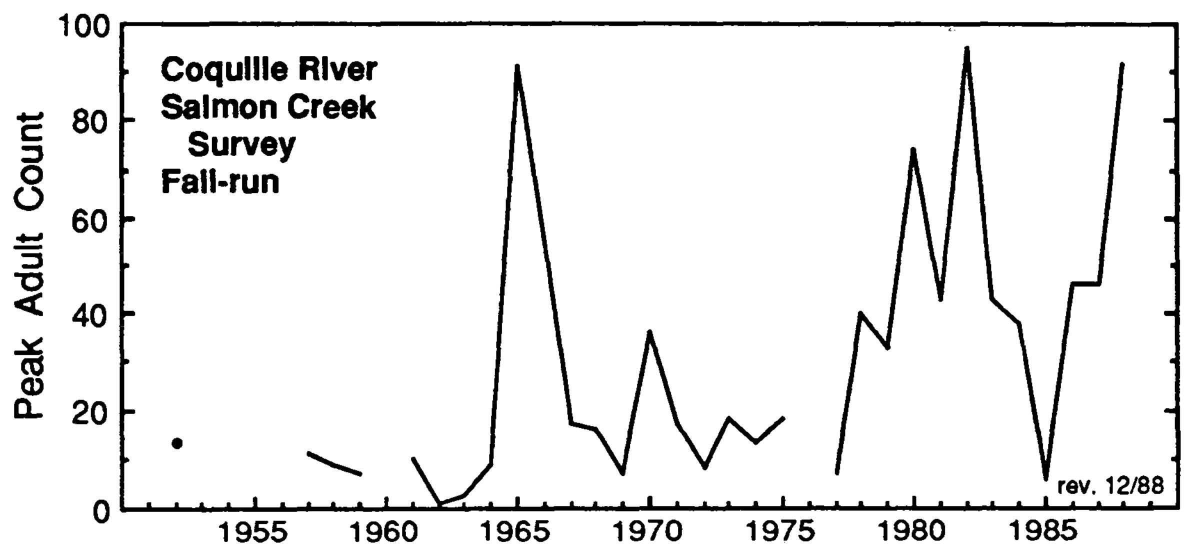
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Salmon Creek
Survey
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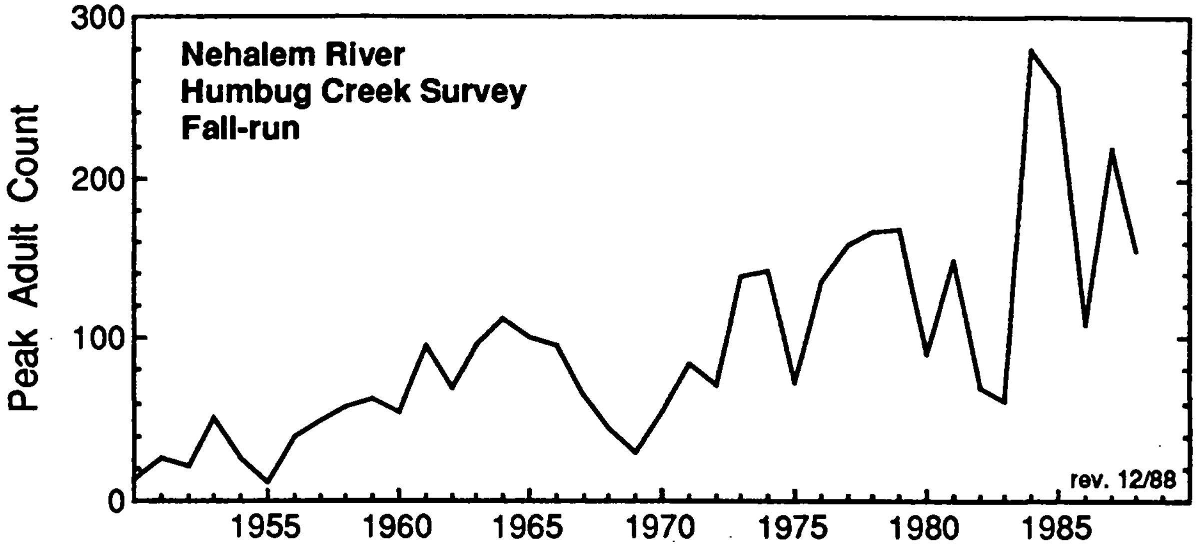
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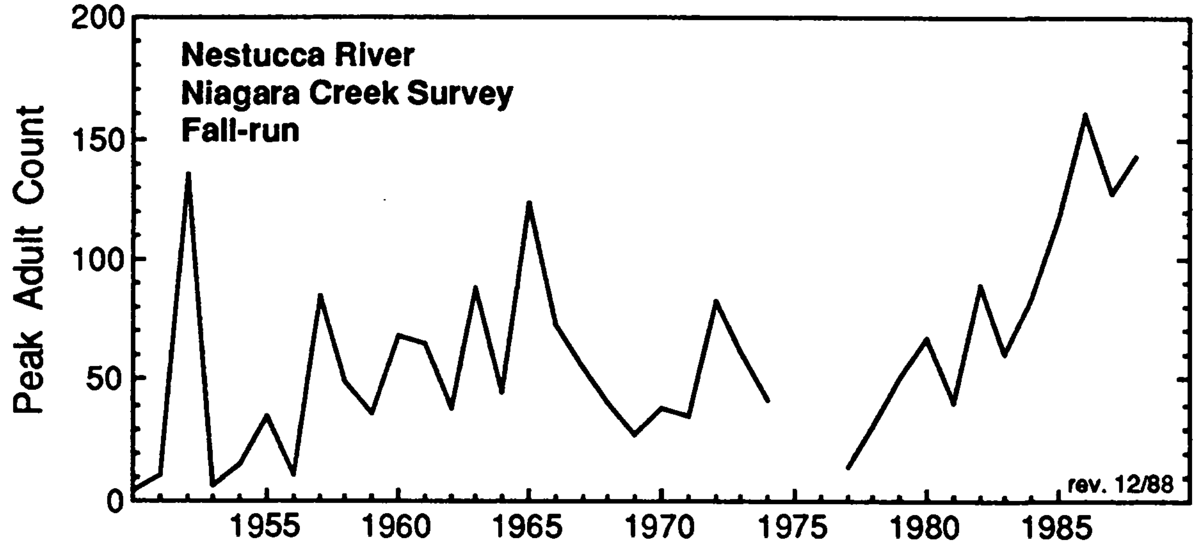
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Fall-run
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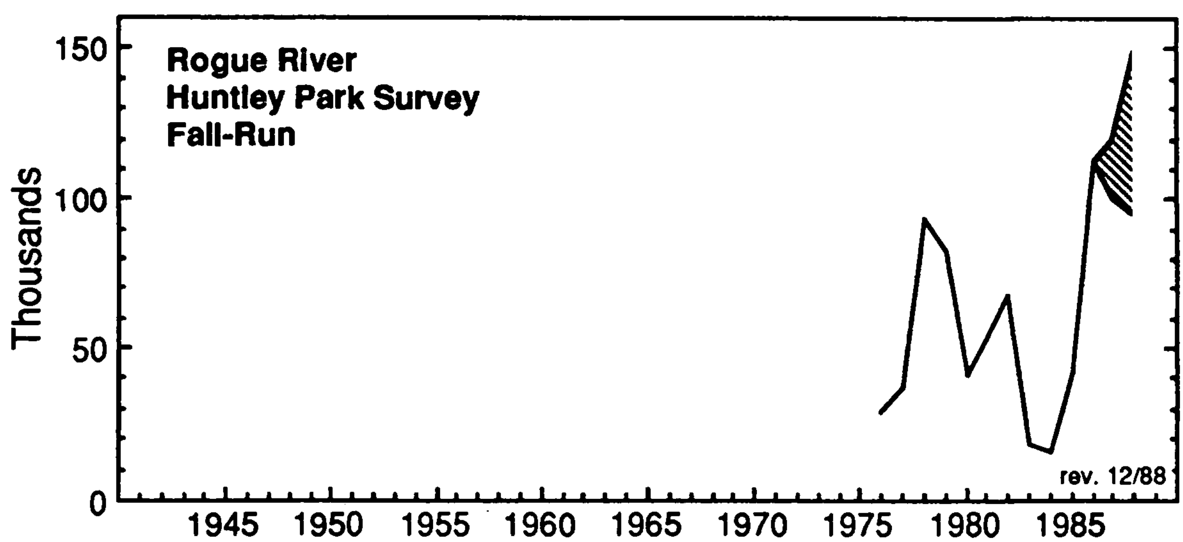
Rogue River
Huntley Park Survey
Fall-Run
Thousands
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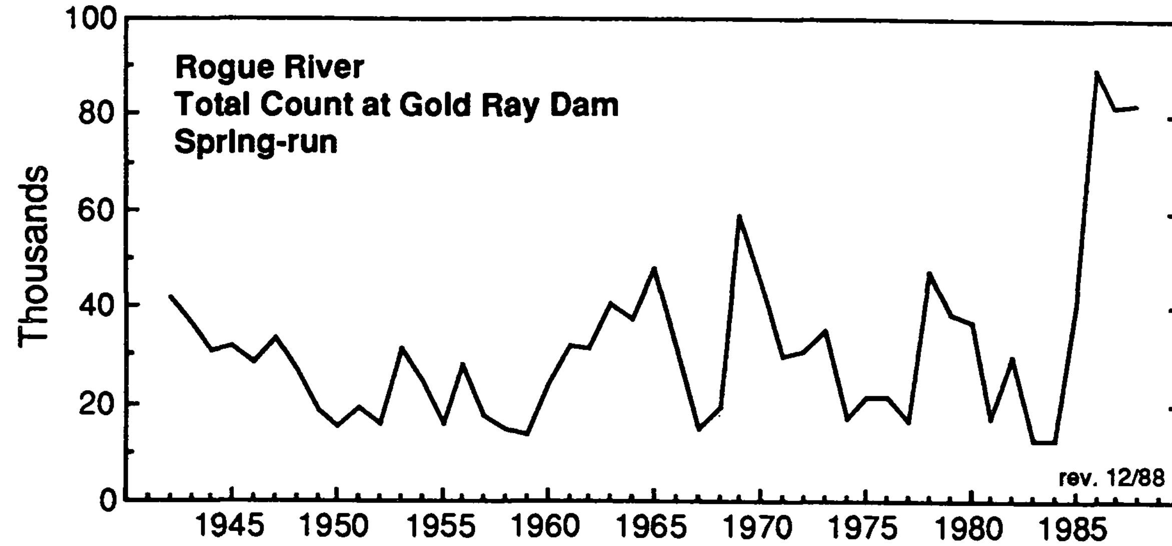
Rogue River
Total Count at Gold Ray Dam
Spring-run
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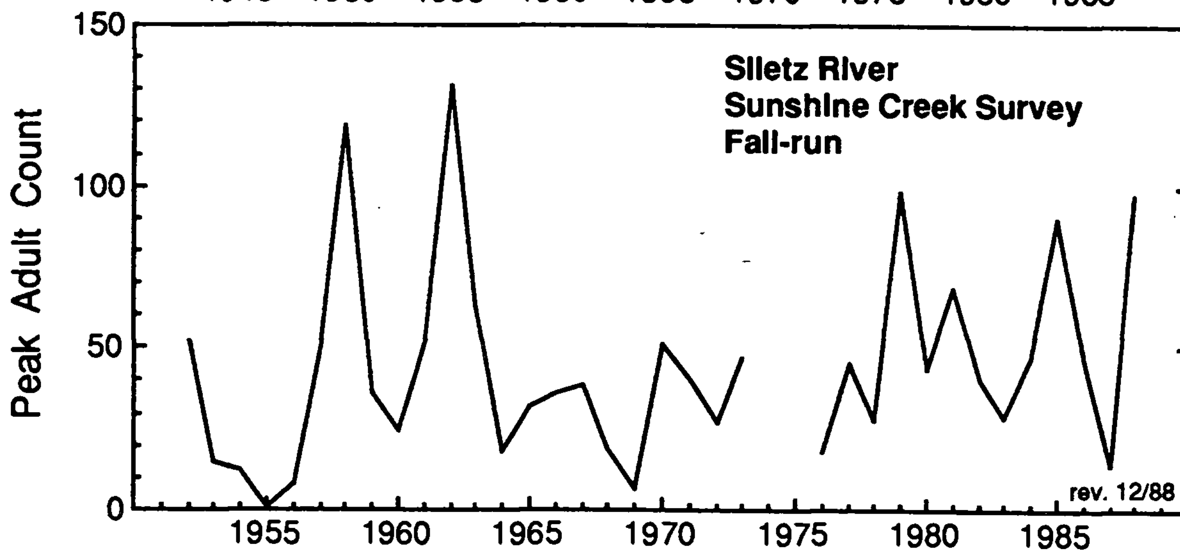
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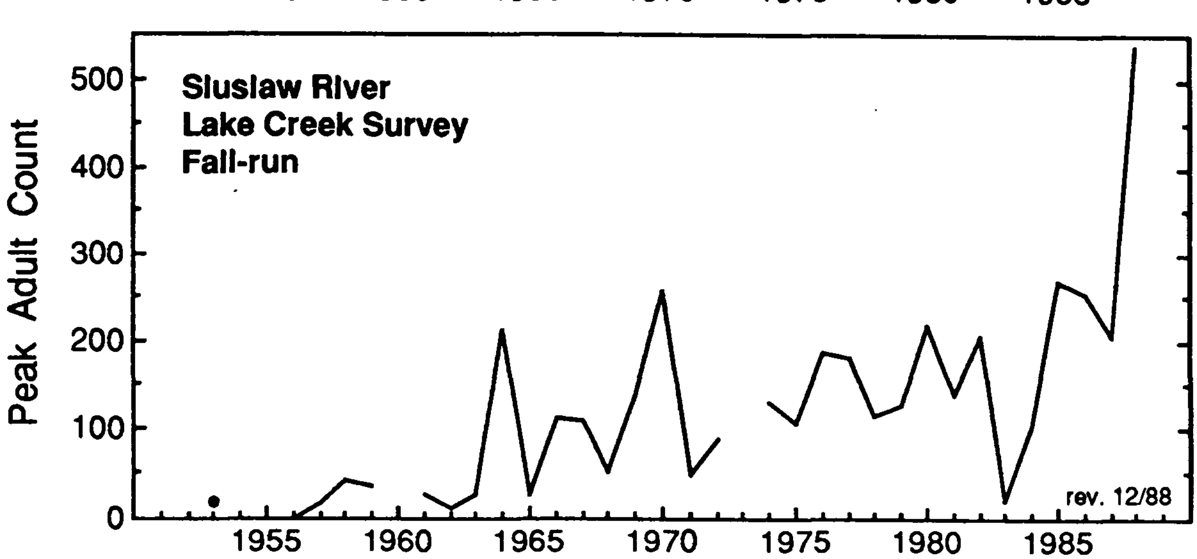
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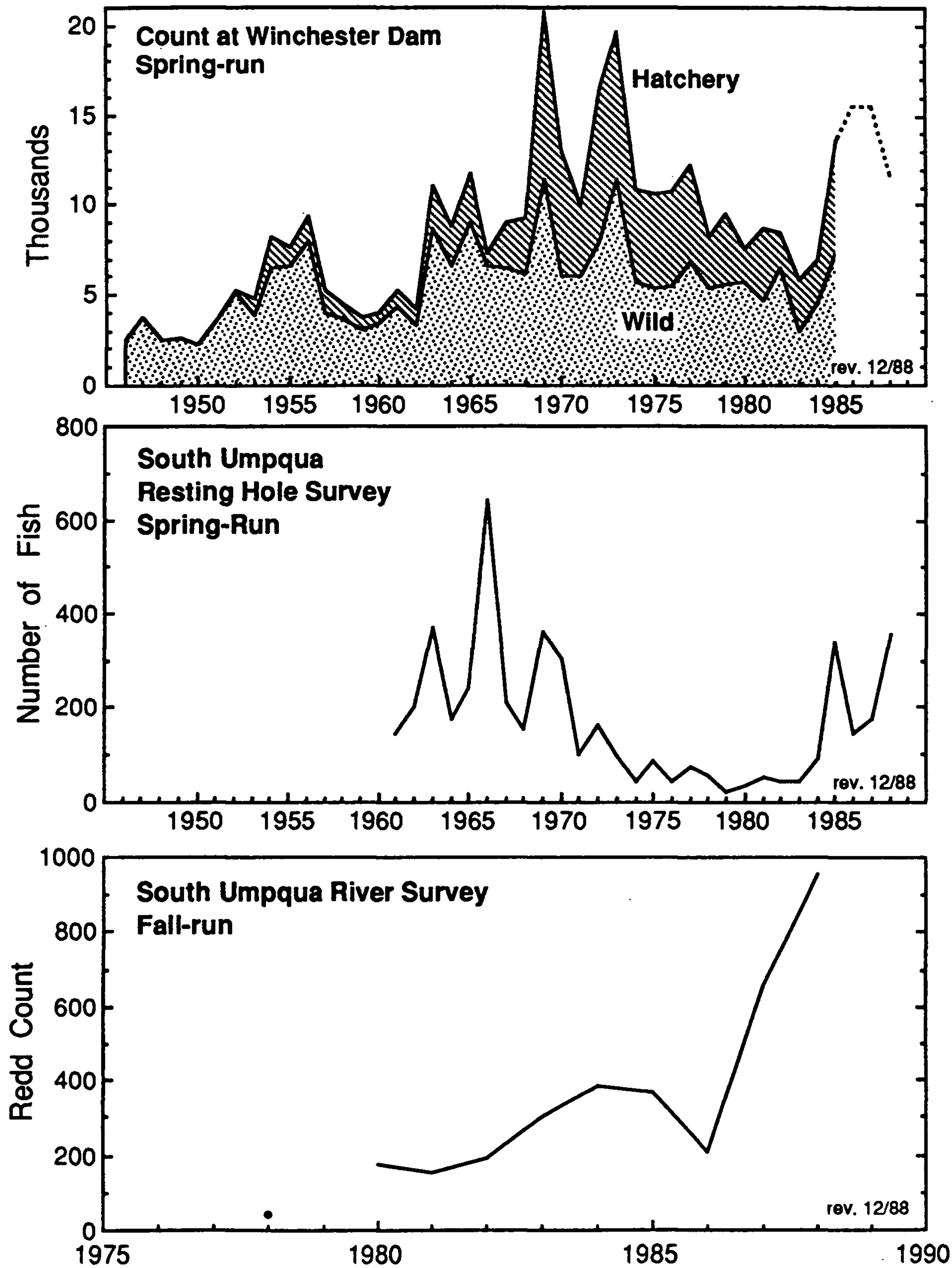

Count at Winchester Dam
Spring-run
Hatchery
Wild
Thousands
rev. 12/88
0
5
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South Umpqua
Resting Hole Survey
Spring-Run
Number of Fish
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Fall-run
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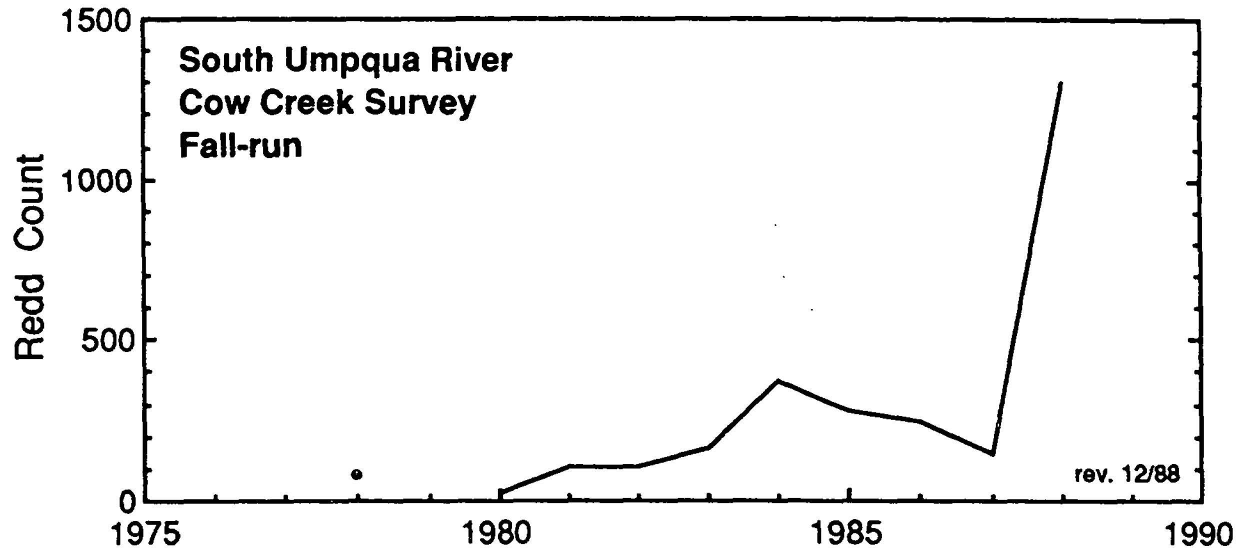
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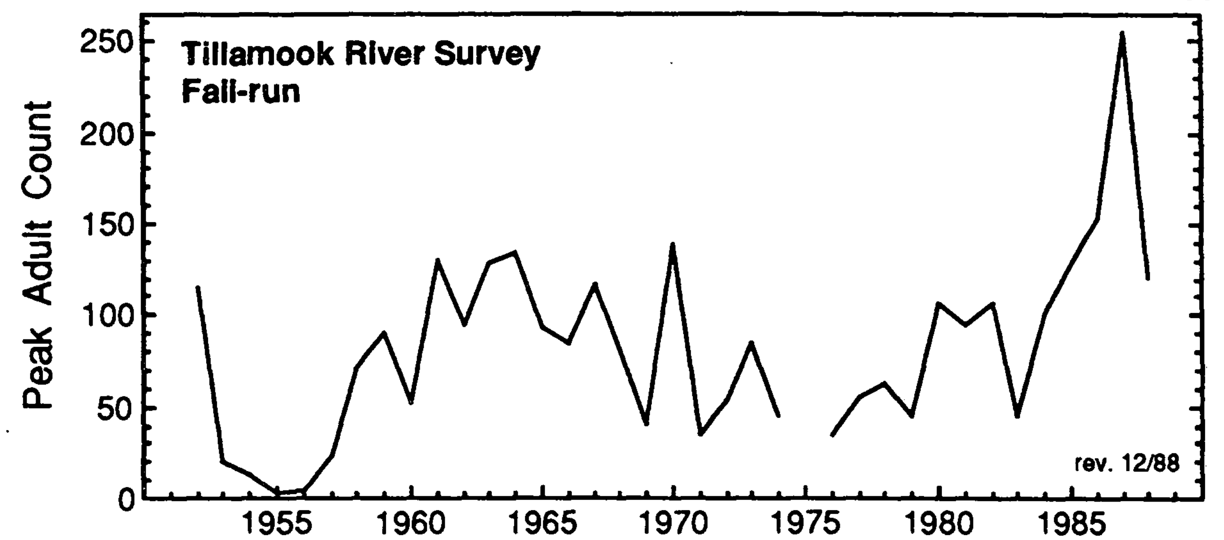
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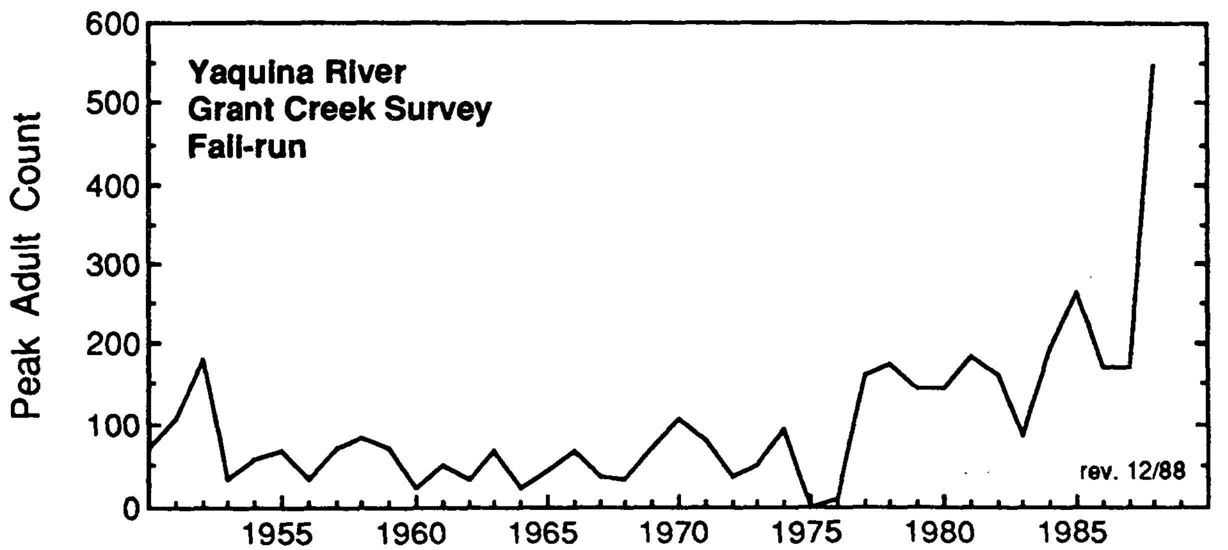
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Grant Creek Survey
Fall-run
Peak Adult Count
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PREFACE

Historically, robust populations of chinook salmon *Oncorhynchus tshawytscha* were produced in nearly all Oregon coastal river basins, and for the most part, current production of chinook salmon remains strong in these coastal river basins. As a species, Oregon's chinook salmon comprise a great many distinct, geographically isolated, self-perpetuating stock units. These stock units exhibit a broad and striking range of life history diversity, including variation in date, size, and age of ocean entrance; pattern of ocean catch distribution; timing of return to freshwater; timing of spawning; age at maturity; and age-specific size.

In the first document published by the Department of Research of the Fish Commisson of Oregon, Willis Rich[1] addressed the issue of species conservation as it relates to maintenance of a diversity of distinct stock units:

> In the conservation of any natural, biological resource it may, I believe, be considered self-evident that the population must be the unit to be treated. By population I mean an effectively isolated, self-perpetuating group of organisms of the same species regardless of whether they may or may not display distinguishing characters and regardless of whether these distinguishing characters, if present, be genetic or environmental in origin. Given a species that is broken up into a number of such isolated groups or populations, it is obvious that the conservation of the species as a whole resolves into the conservation of every one of the component groups; that the success of efforts to conserve the species will depend, not only upon the results attained with any one population, but upon the fraction of the total number of individuals in the species that is contained within the populations affected by the conservation measures.

We believe today, as Rich believed many years ago, that conservation of this species depends on the success of efforts to conserve these many distinct component populations. Rich's eloquent remarks also provide a frame of reference from which to introduce the objectives of this report:

1. To document the variation in life histories of chinook salmon populations in Oregon coastal rivers.

2. To assess recent trends in the freshwater escapement of mature chinook salmon in Oregon coastal rivers.

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[1] *Rich, W.W. 1939. Local populations and migration in relation to the conservation of Pacific Salmon in the western states and Alaska. Fish Commission of Oregon Contribution 1.*

We hope to nurture an appreciation of the rich life history diversity that exists among these chinook salmon populations, and of the biological principles that affect their abundance. We also expect that this report will:

1. Provide a basis for developing long-range fishery management plans.

2. Provide a basis for contemporary harvest management decisions.

3. Provide a basis for developing operational plans for enhancement projects.

4. Provide a model for long-term data collection and analysis systems.

5. Stimulate future research.

This report is divided into four parts. **PART I** is an overview of life history characteristics of chinook salmon in Oregon coastal river basins. **PART II** is a summary of available data on the life history characteristics of individual populations. **PART III** is an overview of our assessment of recent trends in run strength of coastal chinook salmon populations. **PART IV** is a summary of data we reviewed and our assessment of trends in the run strength of individual populations. **PART II** and **PART IV** are organized by major river basin, listed alphabetically. Data for fall- and spring-run races of chinook salmon are presented separately (if available) when both races are present.

We define "run strength" as the abundance or number of mature fish in the spawning run of a particular stock. We use the term "freshwater" in reference to the recreational catch of fish in spawning runs, recognizing that much of the catch is made in bays and estuaries. Our intention is to clearly distinguish abundance and catch of chinook salmon returning to their home streams from abundance and catch in the ocean. Whenever we use the word "abundance" alone in reference to adult fish, it refers implicitly to run strength.

Our assessments of trends in run strength generally pertain to the period from 1950 through the present. In some instances we comment on contemporary run strength in comparison with "historic" (i.e., 1890s through 1930s) run strength. The historic database is so poor that it is impossible, in all but a few river basins, to confidently compare historic with contemporary chinook salmon populations.

Throughout this report, unless clearly stated otherwise, our use of the terms run(s), stock(s), population(s), race(s), return(s), fish, salmon, fry, fingerling, juvenile(s), and adult(s) refers implicitly to naturally-produced (wild) chinook salmon in Oregon coastal rivers. An "underyearling" juvenile is in its first year of life, from emergence in the spring until the end of December. A "yearling" juvenile is in its second year of life and is expected to migrate to the ocean sometime in the spring after over-wintering in fresh water. "Year" indicates return or run year unless we state that data have been analyzed by brood year. "Age" indicates the total age of fish, without regard to the combination of years spent in freshwater and in the ocean. Unless we state otherwise, a chinook salmon jack or simply a "jack" is an age 2 male, regardless of whether it was classified as such by the angling regulations in any given year.

To prepare this report, we retrieved and reviewed data collected by hundreds of individuals during a period of more than one hundred years. Most of these data were collected during the course of a variety of very general surveys, few of which were designed to precisely document life history characteristics. The data we have chosen to present in **PART II** and in **PART IV** of this report are representative. However, for populations for which we found very little data, we included essentially all the information that was available. For populations that have been studied in minute detail (such as Rogue River spring-run and Elk River fall-run chinook salmon) we have presented general descriptions of life history traits and examples of the types of data that are available. Although data on various aspects of life history are sparse or lacking for some coastal populations, they are sufficient to document important traits for many individual populations, to define the likely range of variation in traits within and between populations, and to demonstrate distinctions between some populations.

Many of the analyses presented herein are based on raw, tabulated, or summarized data that we obtained from the files of Oregon Department of Fish and Wildlife (ODFW) biologists, from internal reports processed by ODFW, and from reports of the Fish Commission of Oregon (FCO), the Oregon State Game Commission (OSGC) and the Oregon Wildlife Commission (OWC). We endeavored to verify the validity of the data we analyzed and presented here. Consequently, we excluded some data sets that we could not validate.

In order to make it easier for the reader to compare the life history traits of different populations, we made a determined effort to present data in a standard format throughout this report. In some instances, however, we determined that it was not feasible or that it was not desirable to use a standard format, so the layout or content of some tables will vary. Usually, we provide some indication of sampling effort or sample size. We avoided presenting data based on samples that we judged as inadequate. Where sample size is not given, we were unable to precisely determine sample size, it was relatively large, or both.

We do not cite authorities or references in the text of this report. **APPENDIX A** is a list of ODFW biologists who provided information for this report. **APPENDIX B** is a bibliography of internal reports that contain information regarding coastal chinook salmon populations. Many of these are out of print and are not readily available. Many of the older documents listed in **APPENDIX B** are especially interesting. They occasionally provide specific information regarding abundance, distribution, or some aspect of the life history of particular salmon stocks. They also provide rare insight into the conceptual frameworks within which fishery scientists and managers have operated during different time periods.

We made a determined effort to distinguish between conclusions that were based on strong data sets; conclusions based on strong inference; and speculations based on weak data sets, weak inference, or both. We have endeavored to present a complete and accurate description of the life histories and run strength trends of chinook salmon in Oregon coastal rivers. This effort will allow readers to review the database and the conceptual framework within which present-day management decisions are being made.

Undoubtedly, we have made some misinterpretations of life histories and of run strength trends, because some available data were biased, or were based on invalid assumptions, or both. Nevertheless, this document represents a comprehensive description of Oregon's coastal chinook salmon populations, based on the best information currently available. There is no guarantee that more or better data will be collected or analyzed in the near future. Meanwhile, management goes on.

Jay W. Nicholas
David G. Hankin

PART I

Life Histories of Chinook Salmon in Oregon Coastal River Basins

CONTENTS FOR PART I

INTRODUCTION TO PART I

PART I of this report presents an overview of the characteristic life history traits of chinook salmon *Oncorhynchus tshawytscha* populations in Oregon coastal rivers (Figure I.1). For juveniles we discuss spatial and temporal patterns of distribution in coastal river basins, length and relative abundance during the rearing period, age at ocean entrance, size and date of ocean entrance, and food resources in estuaries. For adults we discuss distribution of catch in the ocean; timing of return and spawning; distribution of spawners in river basins; age composition of spawners; age-specific size of spawners; length-weight, fecundity, and egg size relationships of spawners; and flesh color.

Table I.1 presents a summary of life history data that are available for chinook salmon populations in Oregon coastal rivers, as well as our assessment of the quality of the data. A description of data available to document life histories, methods that were used to collect data, and methods we used to analyze data is presented in the introduction to **PART II**. To provide a basis for the general discussion of life histories in this part of the report, we prepared several illustrative figures and tables that depict general aspects of habitat use, life history, ocean migration, age composition of spawners, age-specific size of spawners, and life history "classifications" that we have made. These figures and tables serve as a convenient reference base for the overview of life history diversity presented in **PART I**. We conclude by presenting a list of management implications of the life history diversity that we documented and a list of recommended actions that we believe would improve future management of these coastal chinook salmon populations.

JUVENILE LIFE HISTORIES

Juvenile chinook salmon have been sampled in Oregon coastal river basins on an irregular basis since at least the mid-1940s, but they have been the focus for detailed study in only a few river basins in recent years. In the following narrative, we will refer to studies that have been done in the Rogue, Elk, Sixes, Salmon, Coquille, and Siuslaw rivers. We believe that these studies provide general examples of juvenile chinook life histories in other coastal rivers that have not been studied in as great a detail.

Spatial and Temporal Distribution Patterns

The spatial and temporal distribution patterns of juvenile chinook salmon in coastal river basins vary between rivers and, to a lesser degree, between years. Overall, we believe that underyearling juveniles rear in riverine reaches of coastal rivers for periods ranging from about 3 to about 6 months and rear in estuarine reaches for periods of up to 5 months. Immediately after emergence from the gravel, distribution of juveniles is restricted to the areas within the river basin where adults spawned, which usually include low to moderate gradient reaches of the mainstems and larger tributaries. By late spring, underyearlings are usually well distributed downstream throughout the mainstem riverine reaches and the freshwater tidal reaches of estuaries.

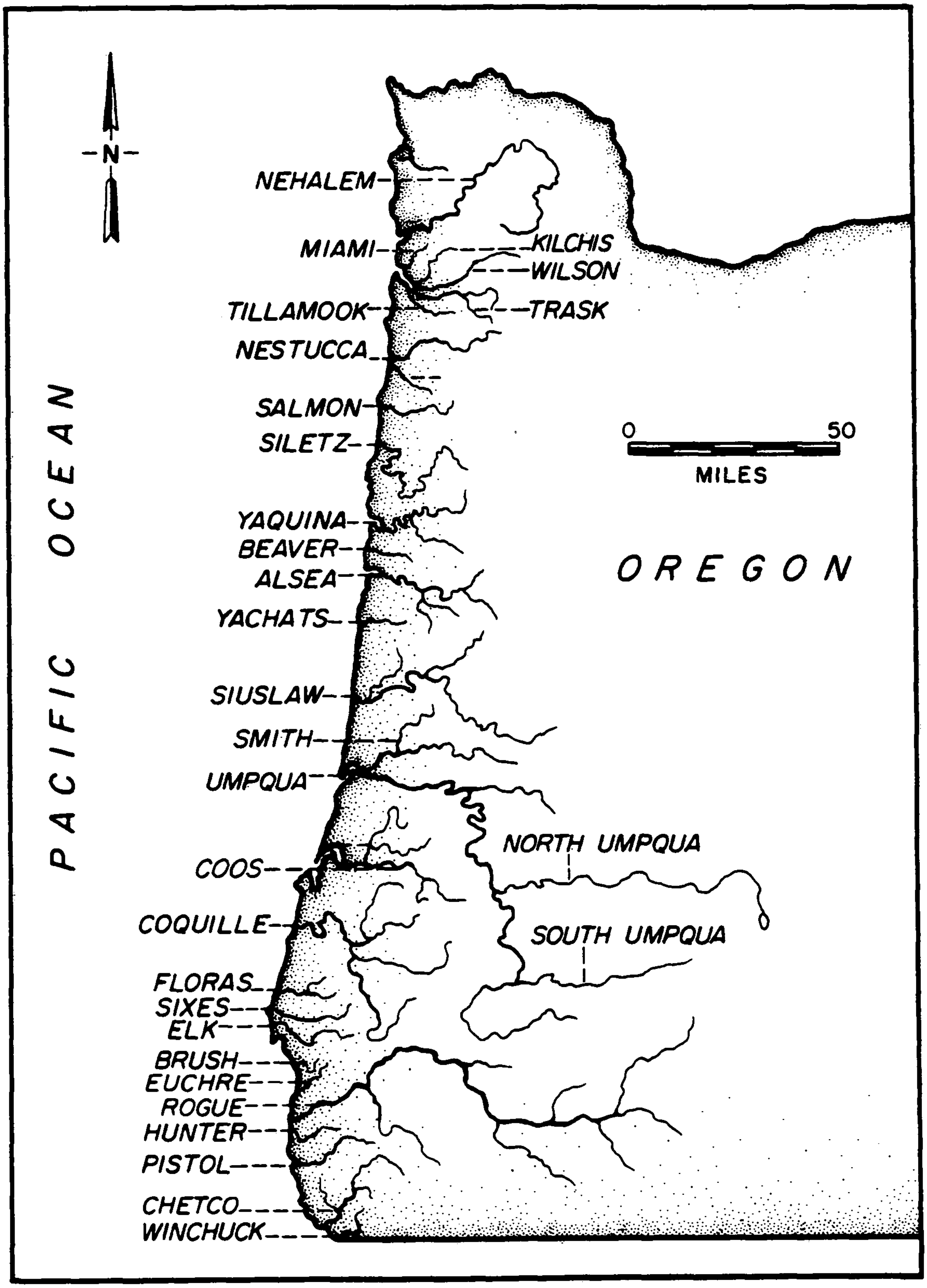

Figure I.1. Map of Oregon showing coastal river basins that support populations of chinook salmon.

Table I.1. Quality of life history data for chinook salmon in Oregon coastal river basins. Ranking is based on the judgment of the authors. A = excellent, B = good, C = fair, D = poor, blank = none. A's and B's are shaded for emphasis. Rivers that support populations of chinook salmon are listed alphabetically.

JUVENILES					ADULTS				
Distribution	Length and abundance	Age at ocean entrance	Size at ocean entrance	**Fall-run**	Ocean catch distribution	Timing of return and spawning	Age composition	Size at age	Fecundity and egg size
C	D	D	D	Alsea	D	C	D	D	D
C	C	B	C	Chetco	B	C	D	D	A
C	C	B	D	Coos	D	C	D	D	
C	C	B	C	Coquille		C	B	B	
D				Euchre		C			
A	A	A	B	Elk	A	A	A	A	A
D	D	D		Floras-New		D			
D	D	D	D	Hunter		D	D	D	
				Kilchis		C			
				Miami		C			
D	D	D	D	Nehalem		D	D	D	
C	C	D	D	Nestucca	C	C	D	D	D
D	D	D	D	Pistol		D	D	D	
A	A	A	A	Rogue	D	A	C	C	C
B	B	A	D	Salmon	B	B	B	B	D
C	C	C	D	Siletz		D	D	D	
C	C	B	C	Siuslaw	D	C	C	C	
B	B	A	C	Sixes		A	A	A	D
				Smith		D			
		D		Tillamook		C	D	D	
C	D	C		Trask	C	B	D	D	D
D	D	D	D	Umpqua		D	D	D	
D		C	D	Wilson		C	D	D	D
D	D	D	D	Winchuck		D			
				Yachats		D			
D	D	C	D	Yaquina	D	C	D	D	

Spring-run

				Alsea		D			
		D		Nestucca	D	C	D	D	
A	A	A	A	Rogue	A	A	B	B	C
				Siletz		D			
				Trask	D	C			D
D	D	D		Umpqua	B	A	D	D	D
				Wilson		C			

During June and July many juveniles migrate from the mainstem riverine reaches and upper tidal reaches to the saline lower reaches of estuaries. In some rivers, relatively few or essentially no juveniles remain in upriver rearing areas during the remainder of the summer. In other rivers juveniles are still relatively abundant in upriver rearing areas.

We believe that the extent to which some juveniles remain in the riverine reaches during the summer is related to water temperature, with relatively "cooler" systems supporting rearing juveniles over a more extended duration. Data on migration timing and water temperature from the majority of coastal river basins have not been systematically collected, however, so at present our assessment is based on cursory observations of juvenile distribution and water temperature in several rivers during a variety of summer months. Based on these observations, we have classified the "duration of upriver rearing" for several coastal chinook salmon populations (Figure I.2). Populations classified as having a "short" duration of upriver rearing are generally characterized by an essentially complete migration of juveniles from mainstem riverine rearing areas to the lower estuary by midsummer (July-August). In populations classified as having an "extended" duration of upriver rearing, juveniles are relatively abundant throughout mainstem riverine and estuary rearing areas during the summer months. In populations classified as having a "moderate" duration of upriver rearing, juveniles are present in mainstem reaches during July and August but the abundance of juveniles in the riverine reaches is relatively low. The Nestucca River population, for example, is classified as exhibiting an extended duration of mainstem riverine rearing. This means that juvenile chinook salmon are relatively abundant in the Nestucca River from the river mouth to the upriver range of the species in the system (about 7 miles of tidewater and about 33 miles of river) during August and early September. Rearing in the Siuslaw River, in contrast, is almost exclusively restricted to the lower 6 to 8 miles of the estuary by mid-July. Here, juveniles are classified as exhibiting a short duration of mainstem riverine rearing.

Even in rivers that support a population of rearing juveniles for extended periods, an essentially constant "flow" of juveniles migrating downstream probably occurs. We believe that larger juveniles have a greater tendency than smaller juveniles to move downstream. Data collected by seining in a number of coastal rivers and estuaries frequently revealed an increase in the mean fork length of juveniles as sample sites neared the river mouth (Figure I.3). Data from downstream migrant traps in Elk River and the Rogue River basin also support the concept of a "relative-size" or a "growth-rate" related migration.

Most of the references to distribution of juvenile chinook salmon in this report are to rearing in the mainstem river and estuarine reaches. We note in **PART** II that juveniles are also present in many tributaries during spring, but that most juveniles migrate from these tributaries by early summer and continue to rear in either the mainstem or estuarine reaches. Some juveniles do remain in tributaries throughout the summer months, and then may migrate to the ocean during September-October, or may remain in the tributaries over winter and migrate to the ocean during the following spring as yearlings.

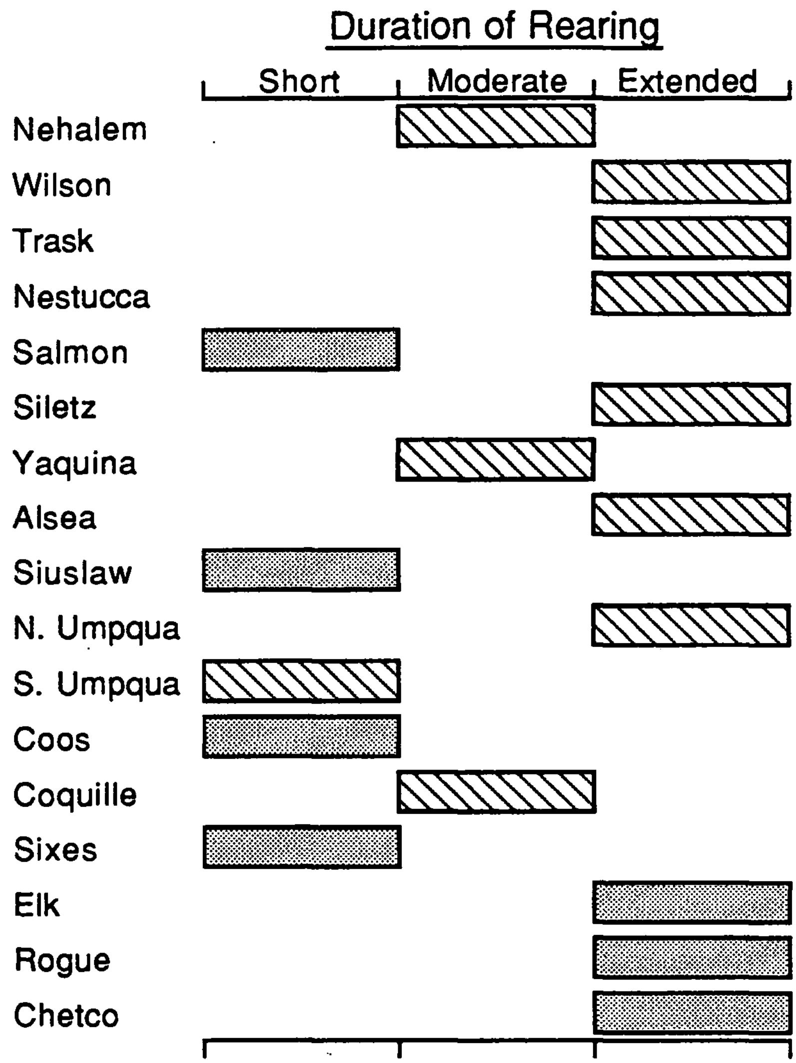

Figure I.2. Duration of rearing in mainstem riverine reaches of Oregon coastal rivers by juvenile chinook salmon. Hatched bar indicates a provisional classification based on limited data.

Data are not available to judge the extent to which interspecific competition by juveniles may influence "rearing" migrations by juvenile chinook salmon. Records of the species composition in seine hauls made in mainstem reaches of many of the short-reach coastal rivers indicate that juvenile chinook salmon were by far the most abundant salmonid species present. This pattern generally shifted in higher gradient reaches of the rivers, where juvenile coho salmon *Oncorhynchus kisutch* and steelhead *Salmo gairdneri* became more abundant than juvenile chinook salmon. We recognize, however, that spawning populations of coho salmon in Oregon coastal rivers were judged as being underescaped in most of the river basins and years represented by the database we reviewed.

Juvenile chinook salmon apparently make extensive use of Oregon estuaries for rearing, although we noted a great deal of variation in the temporal and spatial distribution of juveniles in different estuaries. All the major river basins north of Sixes River have well-developed estuaries, whereas river

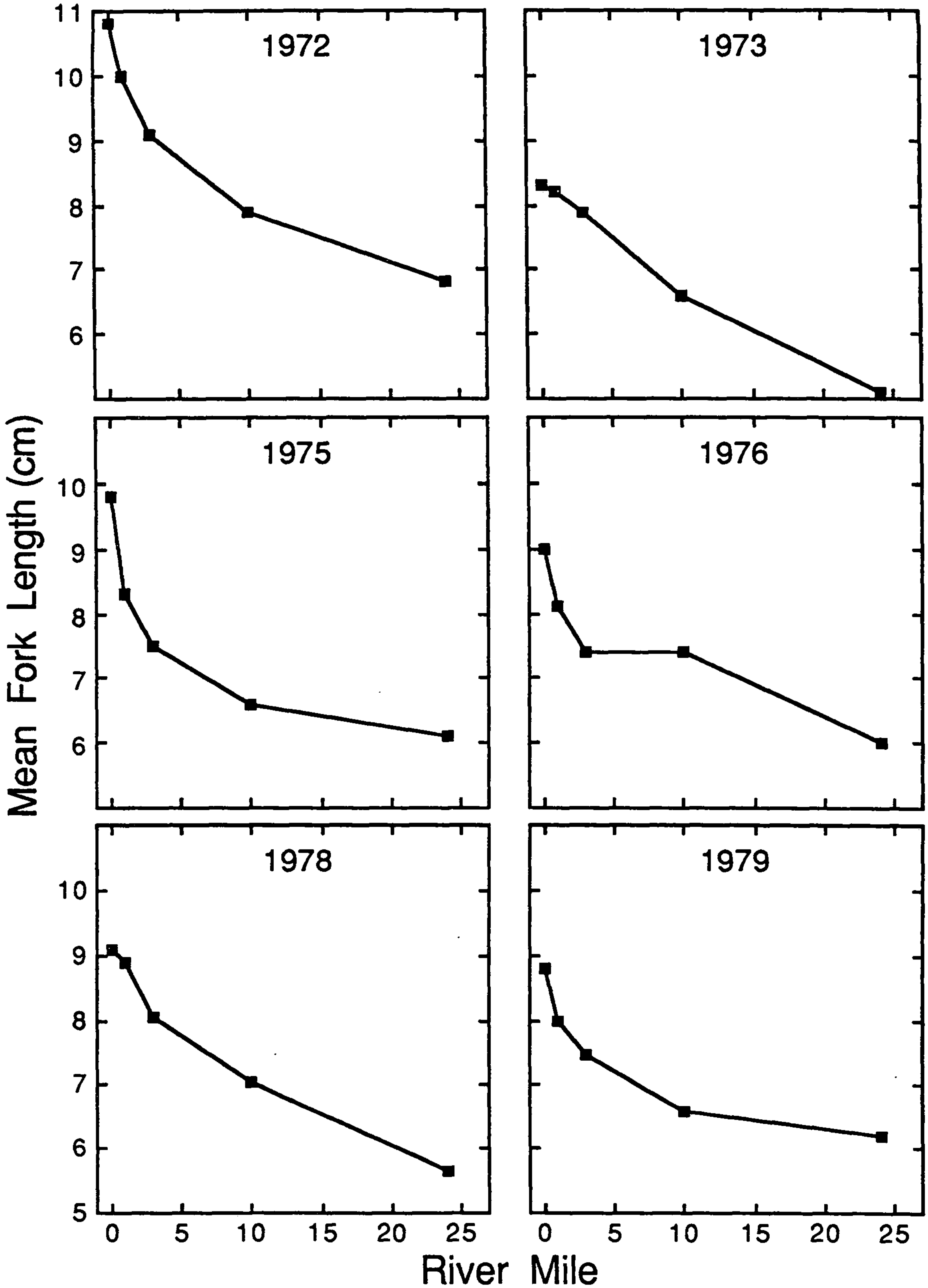

Figure I.3. Relationship between mean fork length (cm) and sample location for juvenile chinook salmon in Elk River during August in several years.

basins from Sixes River through the Winchuck River have relatively small or ephemeral estuaries. The well-developed estuaries north of Sixes River are characterized by regions we refer to as the "lower" and the "upper" reaches of the estuary. Although both regions are influenced by tidal flow, the lower estuarine region is a saline, "marine-type" environment, whereas the upper estuarine region is brackish or entirely freshwater and is usually contained within a diked channel. The Coquille River, for example, has about 44 river miles of tidal-influenced estuary. Most of this habitat, however, is a freshwater-dominated, channelized system. In contrast, the lower 4 to 7 river miles of the system, which contains tide flats, is strongly influenced by the inflow of ocean water during flood tides.

Juvenile chinook salmon are generally present in the upper reaches of estuaries by at least May but are usually not present in more than very small numbers in the lower reaches of estuaries before late May or early June. Juveniles continue to be present in the lower reaches of all estuaries, and in the upper reaches of some estuaries, from midsummer through fall. The actual duration of estuarine residence by individuals is poorly understood but probably varies from a few weeks to 5 months.

In the Rogue River, for example, juvenile chinook salmon apparently remain in the estuary for periods ranging from as short as 1 week to as long as 1 month. The duration of residence is apparently related to fish size. In years when juveniles were relatively small their duration of estuarine residence tended to be longer than in years when juveniles were relatively large. Elk River has a small, ephemeral estuary at the river mouth in some years, but in other years the river simply flows across the beach through a shallow (0.5 m) sandy channel into the ocean. Judging from catches in a Humphreys trap near the river mouth, some juveniles migrate into the ocean as early as June or July at a size barely exceeding 7 cm. When a well-developed estuary is present at the river mouth, many juveniles apparently remain there for periods of 1-6 weeks before they migrate into the ocean. Analysis of scales collected from mature chinook salmon that returned to Sixes River indicated that survivors reared in the estuary for about 3 months. Finally, judging from seining data and scale patterns on mature chinook salmon that returned to the Siuslaw River, many juveniles rear in the Siuslaw estuary from June through at least early September.

The tidal reach of many estuaries is often in excess of 10 river miles, yet this reach of many estuaries apparently does not provide suitable rearing habitat for juvenile chinook salmon after midsummer. In the Siuslaw River, juvenile rearing is apparently restricted to lower tidewater after about mid-July. A similar pattern exists in the Coos River system, where practically all juveniles move from the upper tidal reaches to the lower estuary by late July. Figure I.4 illustrates our concept of the general temporal patterns of distribution of juvenile chinook salmon in Oregon coastal river basins.

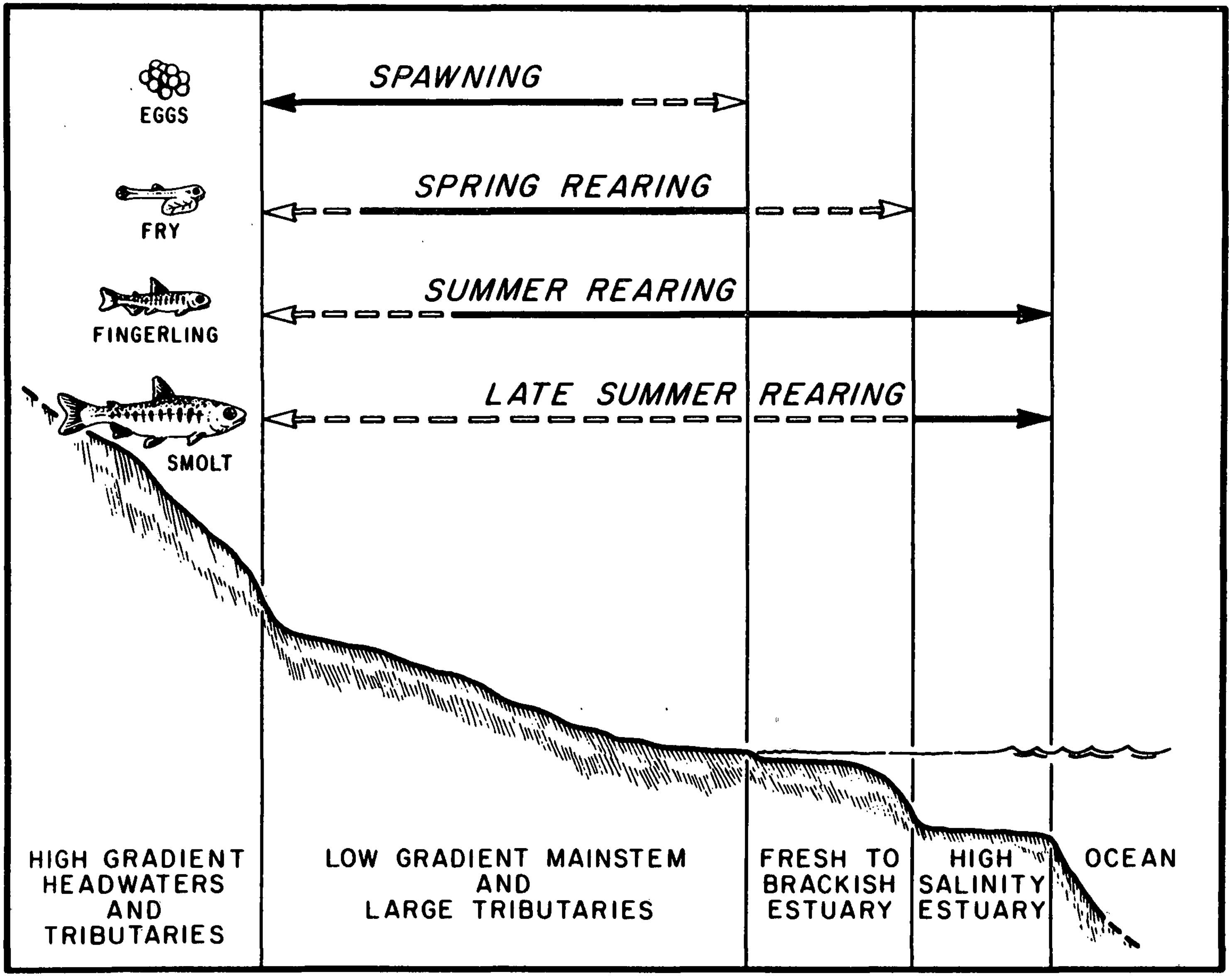

Figure I.4. Illustration of temporal patterns of distribution of juvenile chinook salmon in Oregon coastal rivers. The bold lines indicate areas where juveniles are most abundant, and the open dashed lines indicate areas where juveniles are present but are relatively less abundant during different developmental stages.

Growth and Abundance

We believe that the growth rate of juveniles is directly influenced by the abundance of juveniles in the system, probably through competition for food. Juveniles in the Rogue and Elk rivers tend to be smaller during summer and fall in years when the juvenile abundance "index" is higher. In the Sixes River estuary, juveniles often experience a midsummer period of "reduced growth" associated with peak abundance of juveniles in the estuary. Longer periods of "reduced growth" were associated with smaller average size of juveniles in September and October. Finally, data on the mean length of juveniles sampled in the lower estuary of several river basins during September indicate that juvenile chinook were larger in estuaries where they were relatively less abundant.

The lengths of juvenile chinook salmon in the upriver reach of different coastal rivers are generally similar at a similar time of the year, but the lengths of juveniles in the lower estuary of different rivers are often quite different. The long-term mean fork length of juveniles sampled in the lowermost reaches of coastal river basins during September ranged from less than 10 cm to more than 13 cm (Figure I.5).

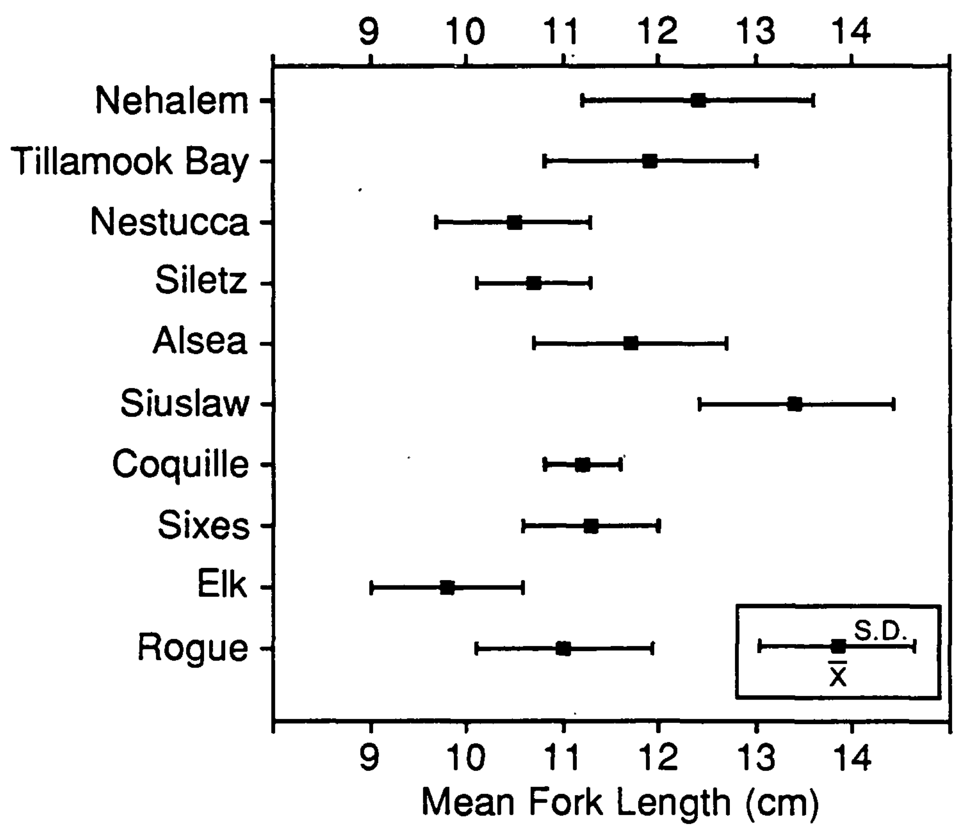

Figure I.5. Mean fork length of juvenile chinook salmon sampled in Oregon estuaries in September during the general period from 1978 to 1987. Values represent the average of annual means listed in **PART II** of this report. River basins are listed from north to south.

Juvenile chinook salmon are most abundant in Oregon estuaries during the general period from late June through August. As Figure I.6 illustrates, considerable variation exists in the shape of the abundance curve between river systems and between years in the same river system. Peaks in abundance of juveniles in estuaries during June to August are followed by a gradual decline in abundance and a gradual increase in the mean fork length of juveniles, which usually continues through September or October. We do not know the degree to which the perceived decline in abundance is caused by migration of juveniles to the ocean, migration of juveniles to deeper water in the estuary where they were less vulnerable to sampling, or natural mortality in the estuary. A study in Yaquina Bay indicated that larger juveniles did move offshore to deeper areas where they were not effectively sampled with a beach seine. Limited sampling by angling with small (3/4-inch) lures in the Alsea, Coos, Nehalem, Nestucca, and Salmon river estuaries suggests that sample bias may be small or negligible in all but the large systems (Tillamook, Yaquina, Umpqua, and Coos).

In our judgment, presently available data are not adequate to predict "optimum" juvenile stocking densities in coastal river basins. Studies in the Elk, Rogue, and Sixes rivers have indicated that juvenile abundance fluctuates considerably more than the abundance of returning survivors. Compensatory growth and mortality may produce a similar number of returning survivors (given equal ocean fishery exploitation rates) over a considerable range of juvenile abundance. However, we believe that opportunities exist to rear more juvenile chinook salmon in some coastal river basins. Based on a broad review of (1) estimates of adult spawning populations, (2) estimates of available spawning areas, (3) estimates of suitable freshwater and estuarine rearing areas, and (4) data on the mean fork length and catch-per-seine-haul of juveniles in estuaries, we have classified the stocking density of juvenile chinook salmon in several Oregon estuaries (Figure I.7). We stress that these classifications are based on qualitative assessment of many factors and should be regarded as provisional working hypotheses. Classification of the Yaquina, Umpqua, and Coos estuaries as "low density" rearing populations indicates that we believe that a "significant" (but unquantified) additional number of juvenile chinook salmon could rear in the estuary, thereby increasing the number of returning adults. These classifications do not indicate that all river systems in a single classification have equal potential for supporting additional rearing juveniles, nor do these classifications take into account contemporary releases of juvenile coho and chinook salmon into Coos Bay and Yaquina Bay by private hatcheries. Systems classified as "high stocking density" probably provide relatively little opportunity to increase the population of juveniles rearing in the estuaries. As these classifications indicate, we believe that at present the majority of Oregon estuaries are relatively well seeded with rearing juveniles.

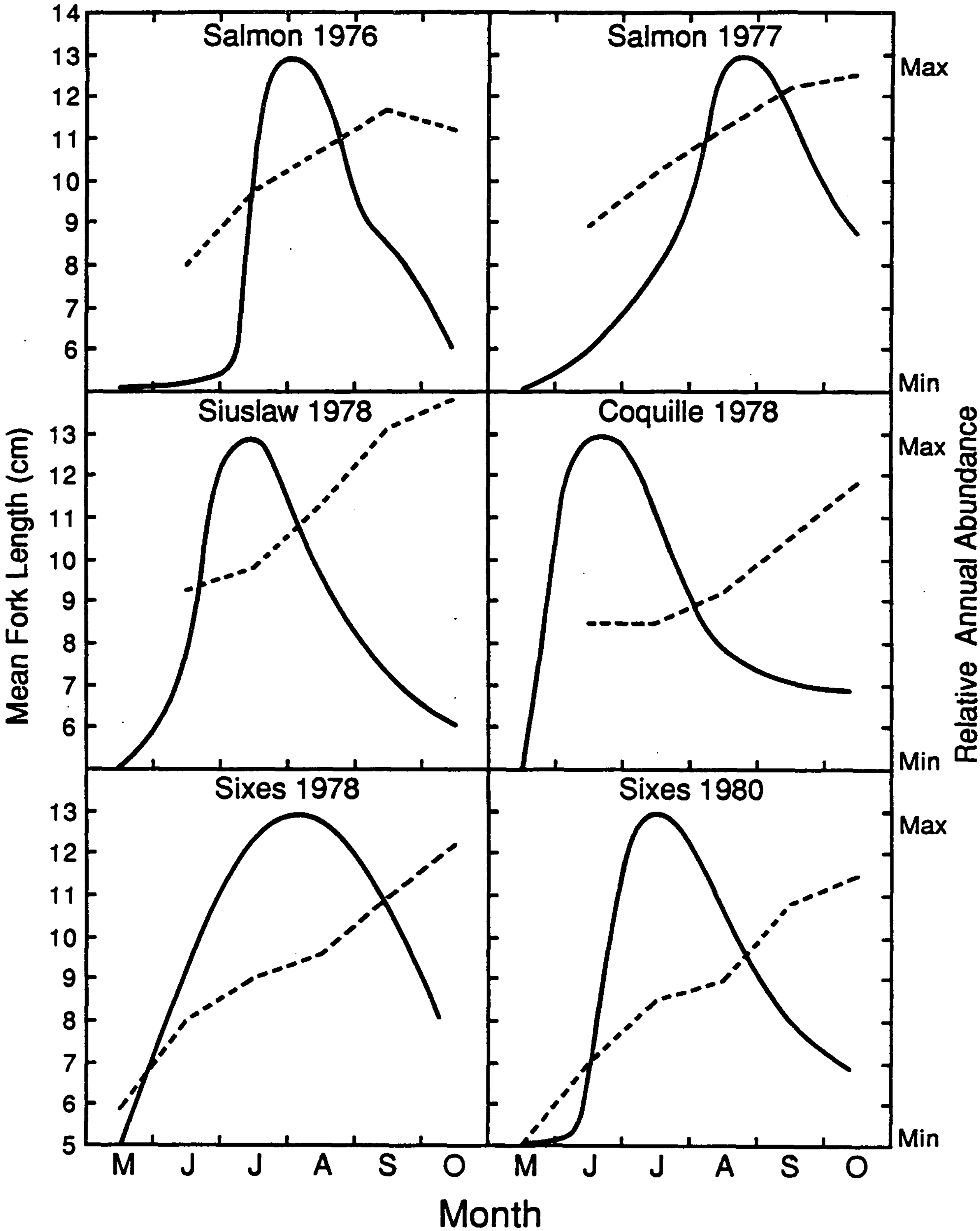

Figure I.6. Changes over time in relative abundance and in mean fork length of juvenile chinook salmon in several Oregon estuaries. Dashed lines were drawn through the mean fork length at midmonth. Solid lines were fitted by eye to represent trend in catch-per-seine haul at midmonth.

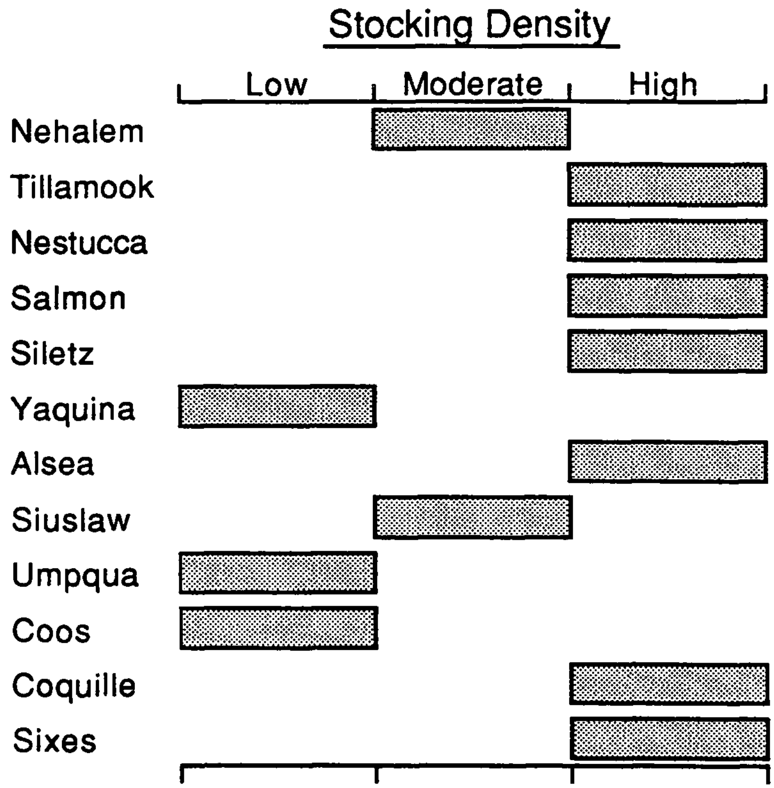

Figure I.7. Classification of the relative stocking density of juvenile chinook salmon in several Oregon estuaries. Classifications are based on the judgment of the authors and should be considered as provisional working hypotheses. River basins are listed from north to south.

Age at Ocean Entrance

Nearly all mature chinook salmon that return to Oregon coastal river basins entered the ocean as underyearlings. Among individual populations for which data on age at ocean entrance are available, the proportion of fish in a return year that had an underyearling life history was usually greater than 95%. Umpqua River spring-run chinook salmon were a striking exception to this generality. Although available data are not sufficient to reliably characterize the typical age at ocean entrance of Umpqua River spring-run fish, they are sufficient to indicate that this population probably depends strongly on both underyearling and yearling juvenile life histories.

Although the percentage contribution of a yearling life history to adult return is relatively small in most populations, this juvenile life history is a consistent feature of many populations. An extensive data set from the Rogue River indicates that yearlings consistently contributed to both fall- and spring-run returns from 1974 through 1986. Yearling migrants generally compose a greater proportion of age 5 and age 6 spawners than of age 3 and age 4 spawners.

Size and Date of Ocean Entrance

We chose to combine a discussion of size and date of ocean entrance because the two characteristics are closely related. This section is primarily concerned with estimates of the mean size and mean date of ocean entrance of "survivors" rather than just the sizes and dates at which juveniles migrate to the ocean. The term survivor refers to an individual that lives to mature and return to the river on a spawning migration. This is an important distinction because we believe that many juveniles may migrate to the ocean at sizes or times that are less than optimum for survival.

Estimates of size at ocean entrance are available for about 20% of Oregon's coastal chinook salmon populations. Estimates of date of ocean entrance are usually inferred from estimates of size at ocean entrance. The term "ocean entrance" is partly conceptual because underyearling juveniles may rear in the lower reaches of estuaries for periods ranging from weeks to months. These high salinity environments may be similar to nearshore ocean environments. Scales taken from juvenile chinook salmon that are rearing in these high salinity estuary sampling sites do not exhibit the ocean entrance "check" that scale analysts use as a reference point for estimating the size at which an individual entered the ocean.

Yearling juveniles have occasionally been captured in seines in the lower reaches of coastal rivers during late winter and spring. So few of these yearlings have been sampled that we cannot reliably describe a peak period during which the majority of yearlings migrate into the ocean, or speculate about whether this period might vary between river systems. Limited samples of yearling juveniles and scale analysis both suggest that the size of yearling juveniles at ocean entrance is usually similar to the size of underyearling juveniles at ocean entrance. Occasionally, yearling juveniles were smaller at ocean entrance than were underyearling juveniles (from the same cohort) that migrated to the ocean during the previous year. Yearling juveniles commonly range from about 10 to about 14 cm (fork length) at ocean entrance and may often represent individuals that experienced exceptionally slow growth during their first year of life.

Where underyearling juveniles are concerned, a single "threshold" size or time at which most survivors migrate into the ocean does not seem to exist. Limited data from Elk and Sixes rivers indicate that juveniles barely exceeding 7 cm (length fork) may migrate into the ocean as early as June. In contrast, samples of juvenile chinook salmon collected from the high salinity reaches of the Coquille and Siuslaw estuaries during May and June rarely contained juveniles less than 8 cm. The estimated fork lengths at ocean entrance of survivors from all populations where data are available indicate that the mean length of survivors in individual populations ranged from about 10 to about 16 cm. Within samples from all populations, the estimated fork length at ocean entrance was rarely less than 10 cm.

The best long-term data set regarding estimates of size and date of ocean entrance (of survivors) is from the Rogue River. Characterized by relatively high summer streamflow (1,500 to 3,000 cfs) and a relatively small estuary, the Rogue River is unique among Oregon coastal rivers. The database for Rogue River chinook salmon includes analyses of size at ocean entrance predicted from scale radius at the ocean entrance "check" and regressions of number of scale circuli versus date. The mean fork length of surviving fall- and spring-run fish ranged from about 10 to about 11 cm over a period of 10 brood years. The peak period of ocean entrance of surviving fall- and spring-run fish is apparently in mid-August or early September.

The abundance of juvenile chinook salmon usually "peaks" in the lower reaches of estuaries sometime during June-August and then declines gradually through the remainder of the summer and early fall. One possible interpretation is that the peak period of migration by juveniles into the ocean coincides with the period of peak abundance in the estuary. Although this conclusion may be accurate, several analyses suggest that the majority of survivors may migrate into the ocean months later than the perceived period of peak migration.

A study of the population dynamics of Sixes River chinook salmon documented that the vast majority of survivors were produced by juveniles that had migrated to the ocean at a relatively large size (about 10 cm) in September or October, well after the peak in juvenile population density in the estuary. In another study, hatchery-reared juveniles were released into Elk River in late June at a mean fork length of about 9 cm. These fish were about 2 cm larger than wild juveniles in Elk River at this time, and apparently many of these hatchery juveniles migrated to the ocean within weeks of being released. Analysis of scales from marked juveniles that remained in Elk River for the remainder of the summer, and of scales from marked survivors that returned to Elk River, indicated that survivors had reared in the river, had grown to an average of about 12.4 cm, and had entered the ocean during late September. In a third experiment, marked hatchery juveniles that were released in Trask River during midsummer at a mean fork length of about 12 cm migrated rapidly from the river to Tillamook Bay. Judging from recoveries of marked juveniles in the Bay and from analysis of scales from marked adults, most survivors migrated to the ocean at a mean fork length of about 14 cm sometime from late September through November.

Judging from sampling during June through October, many juveniles remain in the lower estuaries and achieve a mean fork length, depending on the population, ranging from about 10 to about 14 cm by mid-September. In the Coquille, Siletz, and Siuslaw populations, scale analysis indicated that the mean fork length of survivors was 2 to 3 cm larger than the mean fork length of juveniles sampled in the lower estuary during mid-September.

We believe that the evidence supports a hypothesis that optimum survival is achieved by juvenile chinook salmon that enter the ocean in late summer or early fall at a relatively large size. Because juveniles in estuaries could migrate to the ocean but often do not, and because individuals rearing in estuaries commonly achieve a size of from 10 to 16 cm, we conclude that extended estuarine rearing must provide a survival advantage.

Optimum size and date of ocean entrance for specific populations may also be related to ecological or oceanographic factors. For example, juvenile chinook salmon in populations from Elk River and north migrate northward and rear in the ocean from Oregon to Alaska. Differences in migration timing of juveniles from different populations may have evolved to optimize survival in relation to oceanographic as well as estuarine or upriver environments and biological communities. Achieving a relatively large size prior to ocean entrance may be more important to juveniles that undertake ocean migrations from Oregon to Alaska than to juveniles that migrate a relatively short distance and rear in the ocean off the coast of northern California and southern Oregon.

Food Resources of Juveniles in Estuaries

Juvenile chinook salmon that rear in Oregon estuaries apparently rely on a wide variety of food resources. Data regarding diet and consumption rate have not been systematically collected; consequently, only general remarks on the topic are presented here. Juvenile chinook salmon in estuaries are known to consume algae, gammarid amphipods, fishes, and insects. The typical content of stomachs of a sample of juveniles varied greatly between estuaries and between sample dates in an estuary. Any single sample could be dominated by any of the four food types listed above. Material classified as algae was usually *Enteromorpha* spp., amphipods were usually *Corophium* spp., and insects included adult Diptera, ants, and winged adult termites. Fishes identified in stomachs included northern anchovy *Engraulis mordax*, Pacific herring *Clupea harengus*, and Pacific sand lance *Ammodytes hexapterus*. The extent to which stomach content indicates food preference or availability is not known.

MARINE AND ADULT LIFE HISTORIES

Written descriptions of fisheries for chinook salmon in Oregon coastal rivers date back more than 100 years, but these contain only scant descriptions of the fish that supported the fisheries. Only in recent years has sampling been sufficient to describe several features of the adult life history of populations, or to compare life history characteristics of different populations. In the following narrative, we will refer to examples of the marine and adult life histories of specific chinook salmon populations. We believe that these provide general examples of the marine and adult life histories of chinook salmon in other populations that have not been studied in as great a detail.

Distribution of Catch in the Ocean

Data on recoveries of coded-wire tagged chinook salmon in ocean fisheries are often considered to be synonymous with descriptions of the geographic distribution of these fish in the ocean. However, since fisheries occur in relation to tradition, environment, technology, and regulations we view these data as only generally indicative of the geographic distribution of oceanic rearing by immature chinook salmon. Fish may also be present in areas where they have not been caught or where their capture was not reported.

About one-half of Oregon's coastal chinook salmon stocks have been coded-wire tagged to assess their ocean catch distribution. Among the stocks that have been tagged we noted three basic distribution patterns and classified the direction of ocean migration of the majority of stocks (Figure 1.8):

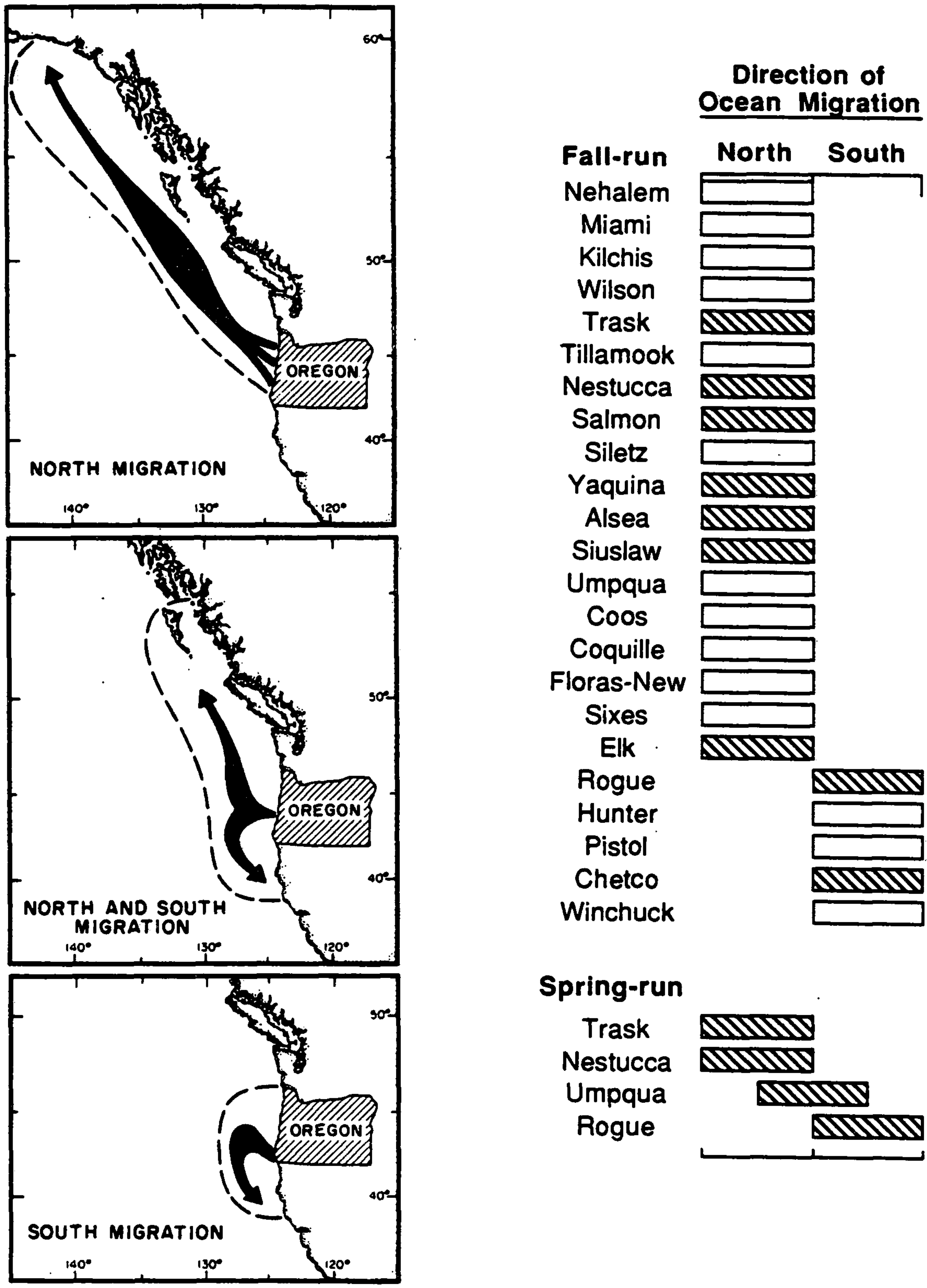

Figure I.8. Illustration of three general oceanic migration patterns that have been hypothesized for populations of chinook salmon in Oregon coastal river basins and classifications of migration pattern for individual populations. Open boxes indicate provisional classifications based on geographic location, limited data, or both. River basins are listed from north to south.

1. Stocks from Elk River and north generally rear in the ocean from Oregon through Alaska. Stocks included in this group, listed from north to south are: Trask fall- and spring-run, Nestucca fall- and spring-run, Salmon fall-run, Alsea fall-run, Yaquina fall-run, Siuslaw fall-run, Coos fall-run, Coquille fall-run and Elk fall-run. We refer separately and collectively to these stocks as north-migrating.

2. Stocks from Rogue River and south generally rear in the ocean off southern Oregon and northern California. Stocks included in this group are Rogue fall- and spring-run and Chetco fall-run. We refer separately and collectively to these stocks as south-migrating.

3. Umpqua River spring-run fish apparently rear in the ocean from northern California to Alaska and are caught in the ocean at all ages throughout this wide geographic area. We refer to Umpqua River spring-run chinook salmon as a north-and-south-migrating stock.

Judging from presently available tag recovery data, some north-migrating stocks make a modest contribution to Oregon ocean landings, whereas others apparently are caught almost exclusively to the north of Oregon. Stocks that make modest contributions to Oregon ocean landings include Trask spring-run, Nestucca spring-run, Yaquina fall-run, Siuslaw fall-run, Coos fall-run, and Elk fall-run. Although tag recovery data are limited for the majority of these north-migrating stocks, some indicated a general tendency for older-aged fish from these stocks to be caught in more northerly fisheries. We believe that Oregon ocean landings of chinook salmon also include a modest contribution of fish from the following untagged stocks that we classify as north-migrating: Nehalem summer-run, Wilson spring-run, Siletz spring-run, Alsea spring-run, Yachats fall-run, Smith fall-run, Umpqua fall-run, Floras fall-run, and Sixes fall-run.

The ocean migration pattern of stocks is apparently a heritable characteristic. Several stock transfer experiments have been done that involved rearing and release of a south-migrating stock from the coastal region that supports north-migrating populations. Rogue fall-run fish released in the lower Columbia River, Rogue spring-run fish released in Coos Bay, and Chetco fall-run fish released in Coos Bay and in the lower Columbia River all made ocean fishery contributions primarily to Oregon. Judging from these experiments, we surmise that the direction and distance that fish migrate after they enter the ocean is heritable. When these fish were reared and released northward of their "native range" their ocean catch distribution shifted slightly northward, but they did not exhibit a catch distribution pattern typical of north-migrating stocks. Rearing of Chetco and Elk River stocks at Elk River Hatchery has demonstrated that rearing location does not influence ocean migration pattern. Chetco River fish reared at Elk River Hatchery and released into the Chetco River are a south-migrating stock, whereas Elk River fish released at Elk River are a north-migrating stock.

Timing of Return and Spawning

The vast majority of chinook salmon enter Oregon coastal rivers from about April through December, although a few fish are probably entering some rivers during every month of the year. Customarily, however, anglers and biologists have loosely distinguished races of chinook salmon by the season of the year during which they return to their home stream. Thus, spring-run fish enter the rivers during the spring, summer-run fish enter the rivers during the summer, fall-run fish enter the rivers during the fall, and winter-run fish enter the rivers during the winter. Among the Oregon coastal rivers that support populations of chinook salmon, all support fall-run populations, about one-fourth support spring-run populations, and only a few support populations that could properly be referred to as a summer or winter run. In this report we generally refer to both fall- and winter-run fish as fall-runs, and to both spring- and summer-run fish as spring-runs.

Considerable variation exists in timing of return and timing of spawning among both fall-run and spring-run populations in Oregon coastal rivers. Figure I.9 summarizes information on timing of return and Figure I.10 summarizes information on timing of spawning that is contained in **PART II** of this report. The peak date of return of fall-run jacks (age 2 males) usually precedes the peak date of return of fall-run adults by about one month. The peak date of return of spring-run jacks (age 2 or age 3 males), in contrast, usually follows the peak date of return of spring-run adults by about two to three weeks.

We surmise that variation in run timing is, in part, related to the streamflow conditions likely to be encountered by upstream migrants and to the distance fish must travel before they reach spawning areas. For example, some Umpqua River and Rogue River fall-run fish enter these systems and begin their upstream migration as early as mid-July. These fish encounter mainstem streamflow during summer sufficient to allow them to make relatively long migrations to reach spawning areas. Similarly, some chinook salmon enter all of the north and central coast estuaries beginning in about July or August. These fish apparently enter the estuaries, migrate rather slowly through the tidal reaches of the system, and then move upriver to spawning areas when streamflow increases in the fall. Many of the fall-run fish that enter these estuaries from July through September may remain in the tidal reaches of these systems for a period of from 1 to 4 months and become nearly "ripe" (sexually mature) before they finally move above tidewater to spawning areas. This migratory behavior pattern was noted in descriptions of commercial fisheries in Oregon coastal rivers that were written during the 1800s.

In contrast, the characteristically low streamflow in small south coast rivers is probably at least partly responsible for the relatively late dates of return for these populations. Many or all of these small systems (including Floras and Hunter creeks and Sixes, Elk, Pistol, Chetco, and Winchuck rivers) historically were blocked at the river mouth in summer by a sand bar, and returning adults were unable to enter the streams until after fall rains increased streamflow. Judging from the catch of marked fish in ocean fisheries, mature fish do not congregate near the mouth of Elk River until mid- to late October, but they congregate at that time regardless of streamflow conditions. The interval between river entrance and spawning is probably shorter for these late-returning fall-run populations than it is for the early-returning fall-run populations. For example, Elk River fall-run fish (age 3 to age 6) were tagged as they entered the river mouth and were recovered during spawning surveys as spawned-out carcasses after an average of about 45 days.

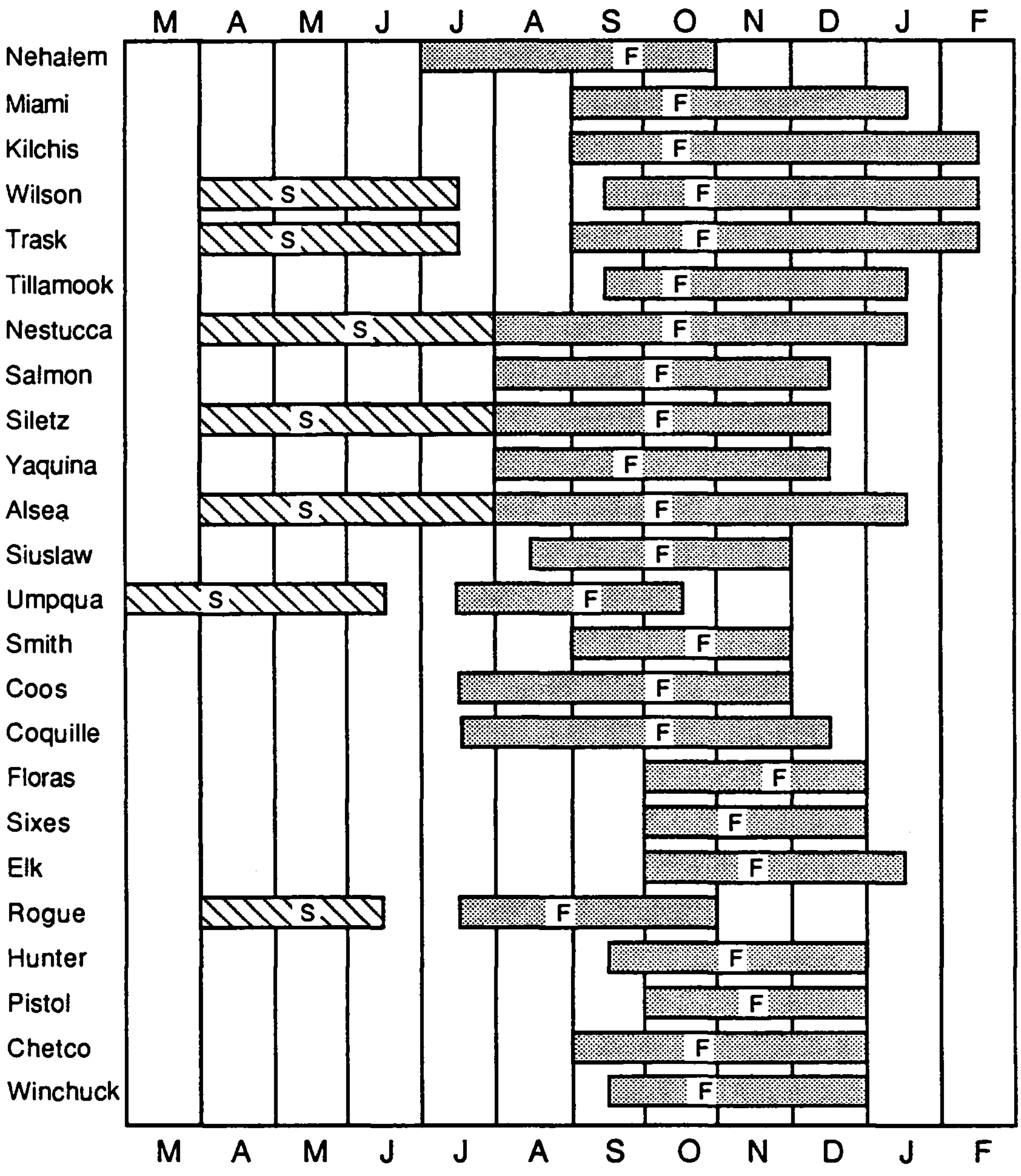

Figure I.9. Timing of return for chinook salmon to Oregon coastal rivers, based on information in **PART** II of this report. F and S indicate the perceived peak return of fall-run and spring-run fish, respectively. River basins are listed from north to south.

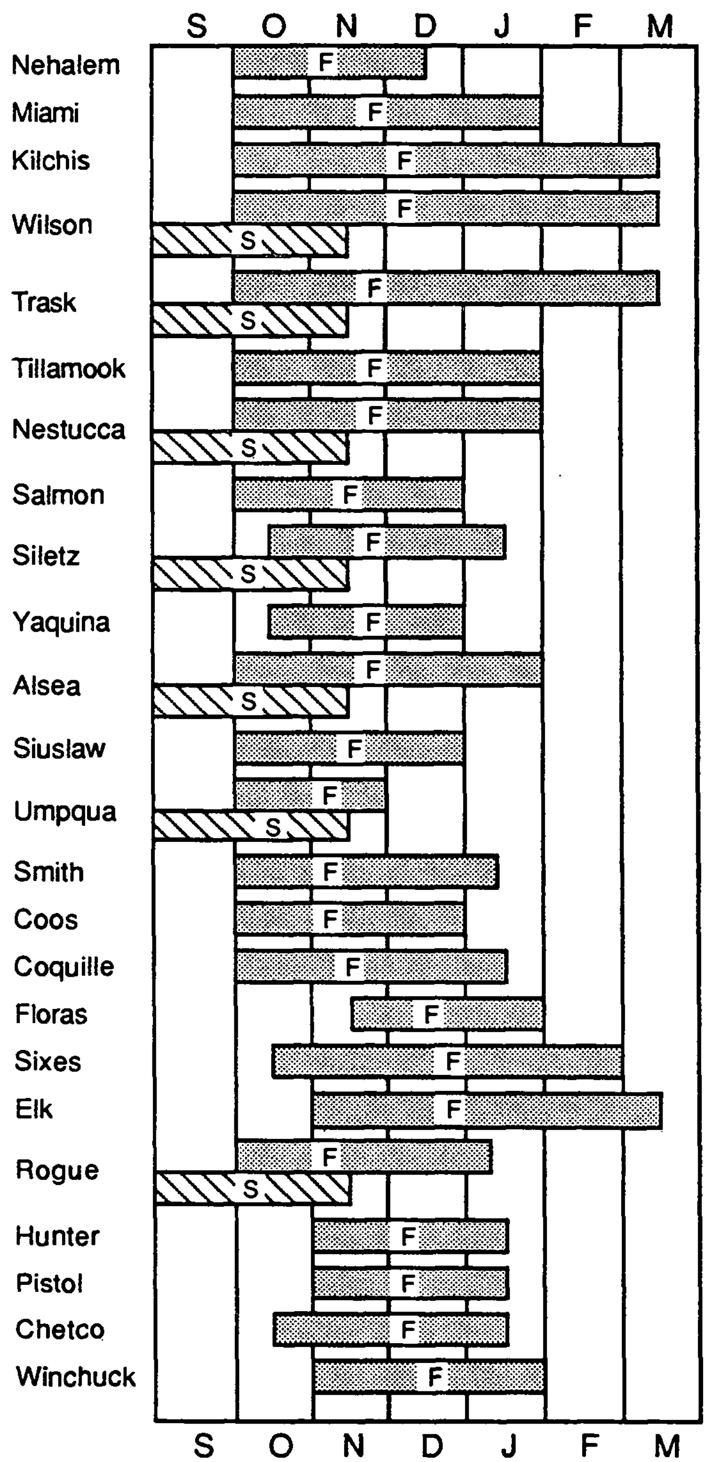

Figure I.10. Timing of spawning for chinook salmon in Oregon coastal rivers, based on information in **PART II** of this report. F and S indicate the perceived peak spawning period for fall-run and spring-run fish, respectively. River basins are listed from north to south.

The interval between the date of river entrance and the date of spawning is generally greater for populations of spring-run fish than for populations of fall-run fish. Spring-run fish generally enter coastal rivers during March, April, and May. These fish typically migrate upriver fairly rapidly until they reach the vicinity of spawning areas, where they may lie in "holding" pools for 3-4 months before they spawn. Rogue River and Umpqua River spring-run fish make upstream migrations of more than 125 miles, whereas spring-run fish in short-reach coastal rivers may only migrate from 25 to 60 miles before reaching "holding" areas. Spring-run fish in Oregon coastal rivers typically spawn during the months of September and October. Thus, some fish may be in freshwater for from 5 to 7 months before they spawn. Fall-run chinook salmon generally enter coastal rivers from August through December and spawn usually from October through January. The interval between estuary or river entrance and spawning in fall-run fish probably ranges from about 1 to 4 months.

More variation exists between fall- and spring-run populations in the timing of onset of migrations and in the duration of migration periods, than exists in the timing of onset of spawning and in the duration of spawning periods. Although the peak spawning periods for spring-run fish occur 3 to 9 weeks earlier than the peak periods for fall-run fish, considerable overlap usually exists during which fall- and spring-run fish both spawn. We surmise that fall- and spring-run races endemic to a river system must have relied primarily on spatial rather than on temporal segregation of spawning populations to maintain their respective population "identities."

Evidence that the timing of return and the timing of spawning are directly related to each other and are heritable traits was provided by experiments at Elk River Hatchery. During two brood years, eggs were taken from parents spawned "early" and from parents spawned "late" during the spawning season. Offspring from these two groups were reared to an equal size, given distinct Ad+CWT marks, and released at the same time. Recoveries of these fish were monitored (1) by date of capture in a "target" troll fishery at the mouth of Elk River and (2) by date of spawning at Elk River Hatchery. Recoveries of these fish were made at ages 3 through 5 and then the (1) mean date of capture in the fishery at the river mouth and (2) mean date of spawning at the hatchery was calculated for each "early" and for each "late" group. The mean date of capture for the two "early" groups was 6 and 11 days earlier than the mean date for the respective "late" groups; the mean date of spawning for the two "early" groups was 19 and 26 days earlier than the mean date for the respective "late" groups. Differences in mean dates of capture at the river mouth and of spawning at the hatchery were statistically significant ($P < 0.01$ and $P < 0.001$, respectively) for both brood years.

Distribution of Spawners in River Basins

Chinook salmon spawn throughout long reaches of Oregon coastal river basins, but the species is characterized by dense aggregations of spawners in short stream reaches rather than by an even distribution of spawners throughout river basins. This statement is based on interviews with management district biologists, anecdotal notations in internal reports, ODFW file data, and personal observations. Estimates of the spawning range (in river miles) of chinook salmon in coastal river basins have been made by noting distributions identified on maps published by the State Water Resources Board and on maps contained in ODFW internal reports. We believe that estimates calculated in this manner overlook the vital importance of short stream reaches that support a relatively high density of spawners in many coastal rivers. For example, reference maps indicate that Elk River contains about 32 river miles, Sixes River contains about 37 river miles, Nehalem River contains about 135 river miles, and Siuslaw River contains about 73 miles of spawning habitat for chinook salmon. Interviews with management district biologists and ODFW file data, however, indicate that only about 12 river miles in Elk River, about 8 river miles in Sixes River, about 12 river miles in Nehalem River, and about 18 river miles in Siuslaw River support relatively high densities of spawners.

Stream reaches where chinook salmon spawn in high density have not been systematically identified. Consequently, data on the distribution of spawners within river basins are not presented in **PART** II of this report. These general remarks about the distribution of spawners are presented to emphasize the great importance that relatively short stream reaches may have for the productive capacity of chinook salmon populations in many watersheds.

Age Composition of Spawners

Populations of chinook salmon exhibit a broad range of ages at return, and the range is typically greater for males than for females. Among Oregon coastal stocks as a whole, males mature from ages 2 to 6 and females mature from ages 3 to 6. An age 7 fish of either sex has been observed only very rarely. Chinook salmon populations exhibit variation between years and between river basins in the age composition of returning fish. Table I.2 summarizes the percentage age composition of male and female spawners in all coastal rivers where data are available, and our classifications (see INTRODUCTION TO PART II) of "age of maturity" of Oregon coastal stocks are summarized in Figure I.11. Figure I.12 illustrates examples of the variation in age composition of female spawners between four populations for which data are available. The Applegate (Rogue River) population is an early-maturing stock dominated by age 3 and age 4 females. Only in Applegate fall-run and Cow Creek (Umpqua River) fall-run populations is maturation of age 3 females common. The Elk River population is a typical mid-maturing stock, with female maturation from ages 3 to 6, strongly dominated by age 4. The Salmon River population is a typical late-maturing stock with female maturation primarily from ages 4 to 6, strongly dominated by age 5. The Nestucca population is also a late-maturing stock but exhibits a relatively high proportion of age 6 females. Viewed collectively, several aspects of age composition of coastal chinook populations become apparent:

1. Age 2 males are more common in stocks from Salmon River and south.

2. Age 3 females are rare in stocks north of Salmon River.

3. Return of females is generally greatest at age 5 in stocks from Siuslaw River and north. Return of age 6 females in these stocks was often common and almost always exceeded return at age 3.

Table I.2. Average percent age composition of chinook salmon in Oregon coastal rivers. Values represent data listed in PART II of this report. Shaded values are for a pooled sample of unsexed fish. River basins are listed from north to south.

Females: Age					Males: Age				
3	4	5	6	Fall-run	2	3	4	5	6
0	20	73	7	Nehalem	4	23	31	42	0
2	20	56	22	Wilson	3	16	34	39	9
2	33	43	21	Trask	0	12	62	20	6
0	43	48	9	Tillamook	7	17	47	23	7
0	29	49	22	Nestucca	8	11	42	26	13
4	30	58	9	Salmon	35	22	28	13	2
2	11	58	30	Siletz	1	13	42	35	9
5	53	42	1	Yaquina	14	37	42	7	0
0	34	60	6	Alsea	54	20	21	5	1
3	39	54	4	Siuslaw	26	29	26	18	tr
47	52	2	0	Umpqua	35	44	21	0	0
7	60	32	1	Coquille	35	26	28	10	1
7	53	38	2	Sixes	11	23	40	25	1
11	60	27	2	Elk	52	22	19	7	1
				Rogue	27	27	40	6	tr
50	44	5	1	Applegate	33	39	26	2	tr
5	84	11	0	Pistol	12	13	50	25	0
3	39	57	0	Chetco	43	35	13	8	1
				Spring-run					
2	35	62	2	Nestucca	9	16	41	34	
5	69	24	2	Umpqua					
1	87	12	0	Rogue	16	35	43	6	

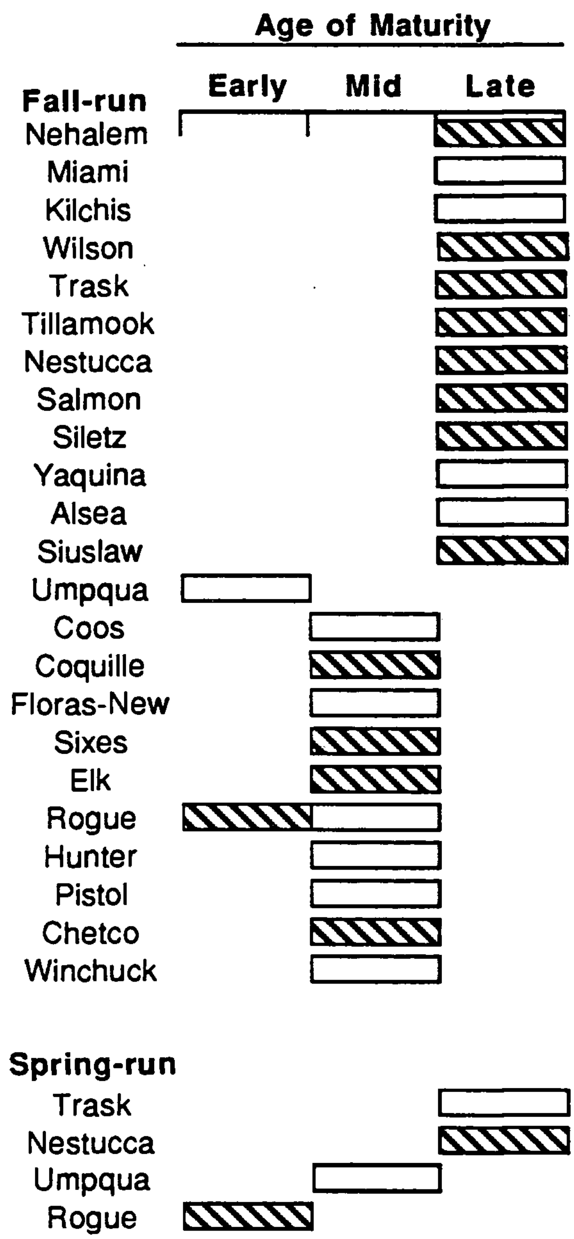

Figure I.11. Classifications of age of maturity for populations of chinook salmon in Oregon coastal river basins. Open boxes indicate a provisional classification based on geographic location, limited data, or both. River basins are listed from north to south.

4. Age 6 males are rare in stocks south of the Siletz River.

5. Female maturation at age 3 is common only in Applegate River and Umpqua River fall-run stocks.

6. The range of age at return of females in the Rogue River spring-run stock is more compressed than for any Oregon stock for which data are available. The vast majority return at age 4.

7. The occurrence of age 2 males is apparently not directly tied to the average age of females in the population. Alsea and Salmon river populations, for example, had a high percentage of age 2 males, whereas female maturation was greatest at age 5.

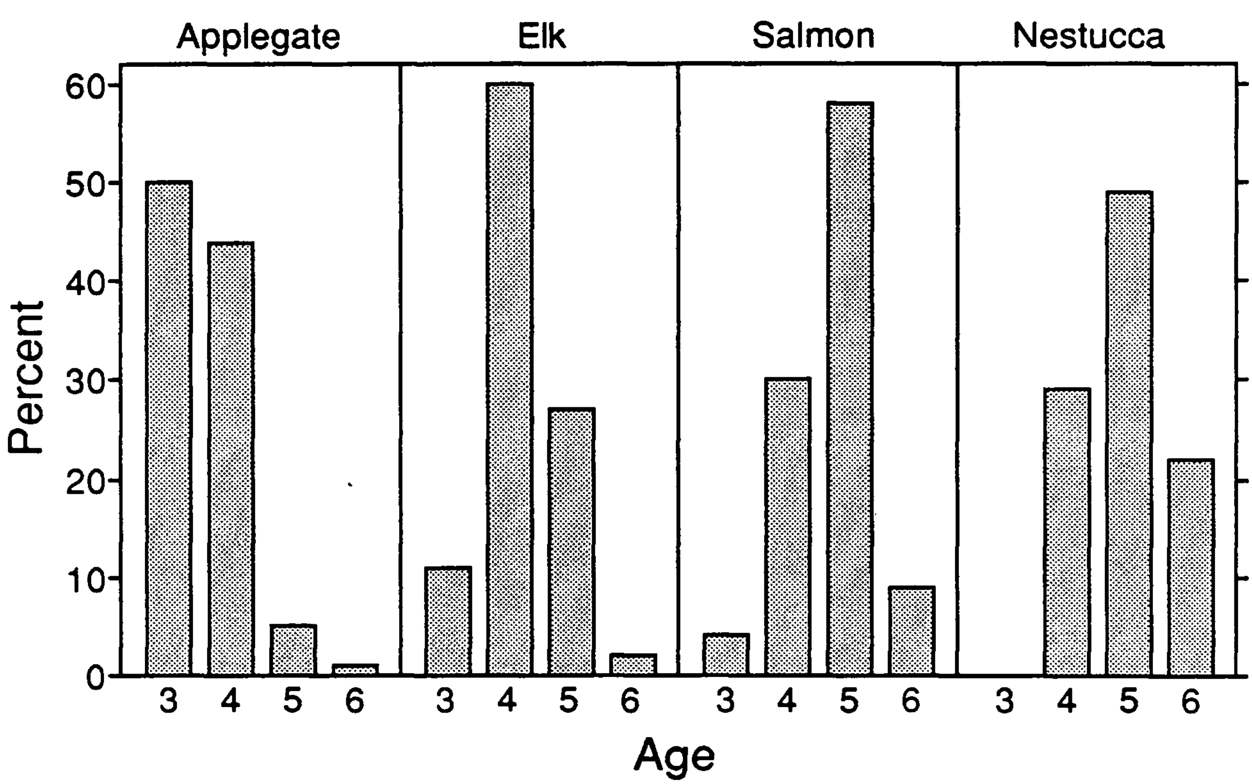

Figure I.12. Average percent age composition of female chinook salmon in four Oregon coastal river basins, illustrating early (Applegate), mid-(Elk), and late (Salmon, Nestucca) maturation schedules.

Selective breeding experiments that used known-age parents at Elk River Hatchery demonstrated that age of maturation of chinook salmon is a heritable stock characteristic. In one experiment, the average age of progeny that returned from age 3 parents was 2.5 for males and 3.6 for females, whereas the average age at return from age 5 parents was 3.5 for males and 4.3 for females. A separate experiment included matings of age 2 males with age 4 and age 5 females and matings of age 4 and age 5 males with age 4 and age 5 females. The average age of male progeny that returned from the parental group that included age 2 males was about 1.3 years younger than the average age of male progeny that returned from the parental group that included age 4 and age 5 males. The average age of female progeny that returned from the two groups was essentially identical. Together, these experiments indicate that age of maturity is a heritable, sex-linked characteristic.

Size at Age of Spawners

Table I.3 presents a summary of data on the age-specific size of mature chinook salmon in Oregon coastal river basins based on **PART II** of this report. Size at age is a phenotypic trait that may be influenced by (1) size of juveniles at ocean entrance, (2) date of ocean entrance by juveniles, (3) geographic distribution of rearing fish in the ocean, (4) date of river entry by returning fish, and (5) heritable potential for growth. We do not have reliable information to determine the relative influences that genetics and environment may exert on the age-specific size of chinook salmon that return to Oregon coastal rivers. Nevertheless, Table I.3 provides evidence that chinook salmon populations in north Oregon coastal rivers tend to exhibit a larger age-specific size than do populations in south Oregon coastal rivers. Variation in size at age within a given chinook salmon stock is substantial. For example, Figure I.13 illustrates variation in size at age of Elk River fall-run chinook salmon.

Rogue River spring-run fish were considerably shorter at an equivalent age than Rogue River fall-run fish because they spend less time in the ocean. Although supporting data are sparse, Nestucca River and Trask River spring-run chinook salmon are apparently much larger at age than Rogue River spring-run fish. This difference between south- and north-migrating spring-run populations may reflect the general environmental conditions in the ocean where the respective stocks rear, a difference in the average date of return to the river, a heritable difference in potential for growth, or some combination of these and other factors.

During a review of size at age data we noted a consistent tendency for the length of males to be greater than the length of females at ages 4-6 whereas the length of females occasionally exceeded that of males at age 3. An extensive data set of MEPS (mid-eye-to-posterior-scale) lengths of chinook salmon sampled at Elk River revealed this same pattern, demonstrating that this difference is apparently not an artifact of secondary sexual characteristics in males associated with maturation.

Table I.3. Average fork length (cm) at age for chinook salmon in Oregon coastal rivers. Values represent data listed in PART II of this report. Shaded values are for a pooled sample of unsexed fish. River basins are listed from north to south. U = underyearling life history; Y = yearling life history.

Females: Age					Males: Age				
3	4	5	6	Fall-run	2	3	4	5	6
	92.4	97.8	101.4	Nehalem		77.4	93.7	105.5	
	92.9	101.0	102.5	Wilson		70.6	97.2	107.8	107.0
	90.5	98.9	102.6	Trask			92.3	103.7	
	89.5	97.5		Tillamook			89.2	103.5	
	87.4	97.7	101.1	Nestucca		69.8	93.3	108.3	116.6
	88.4	96.1	101.6	Salmon	47.6	67.3	84.5	96.6	
	97.3	98.6	101.0	Siletz		70.6	91.8	102.9	114.1
76.7	88.6	94.5		Yaquina	47.8	75.1	90.1	99.5	
	87.2	101.0	107.0	Alsea	47.8	63.6	81.9	100.0	
72.7	91.1	97.3	101.5	Siuslaw	49.3	76.9	93.2	106.2	
76.6	87.2			Umpqua	49.8	74.7	93.9		
72.6	86.5	94.7		Coquille	47.6	75.0	90.1	101.8	
74.6	86.8	93.6	98.5	Sixes	50.7	73.2	91.2	102.7	
76.8	87.4	94.2	98.0	Elk	48.9	74.4	90.4	102.2	105.0
				Rogue	47.7	70.3	84.6	91.1	
				Applegate	50.5	72.5	86.2	92.3	
	80.8			Pistol			82.9		
76.6	88.3	94.5		Chetco	51.6	72.2	87.7	93.8	
				Spring-run					
	83.8	94.1		Trask		66.2	89.2	94.1	
	88.9	95.3		Nestucca		71.7	89.1	97.8	
73.6	84.4	89.0		Umpqua(U)		68.9	88.1		
	79.5	84.4		Umpqua(Y)			82.3		
				Rogue	40.4	58.8	77.2	85.9	

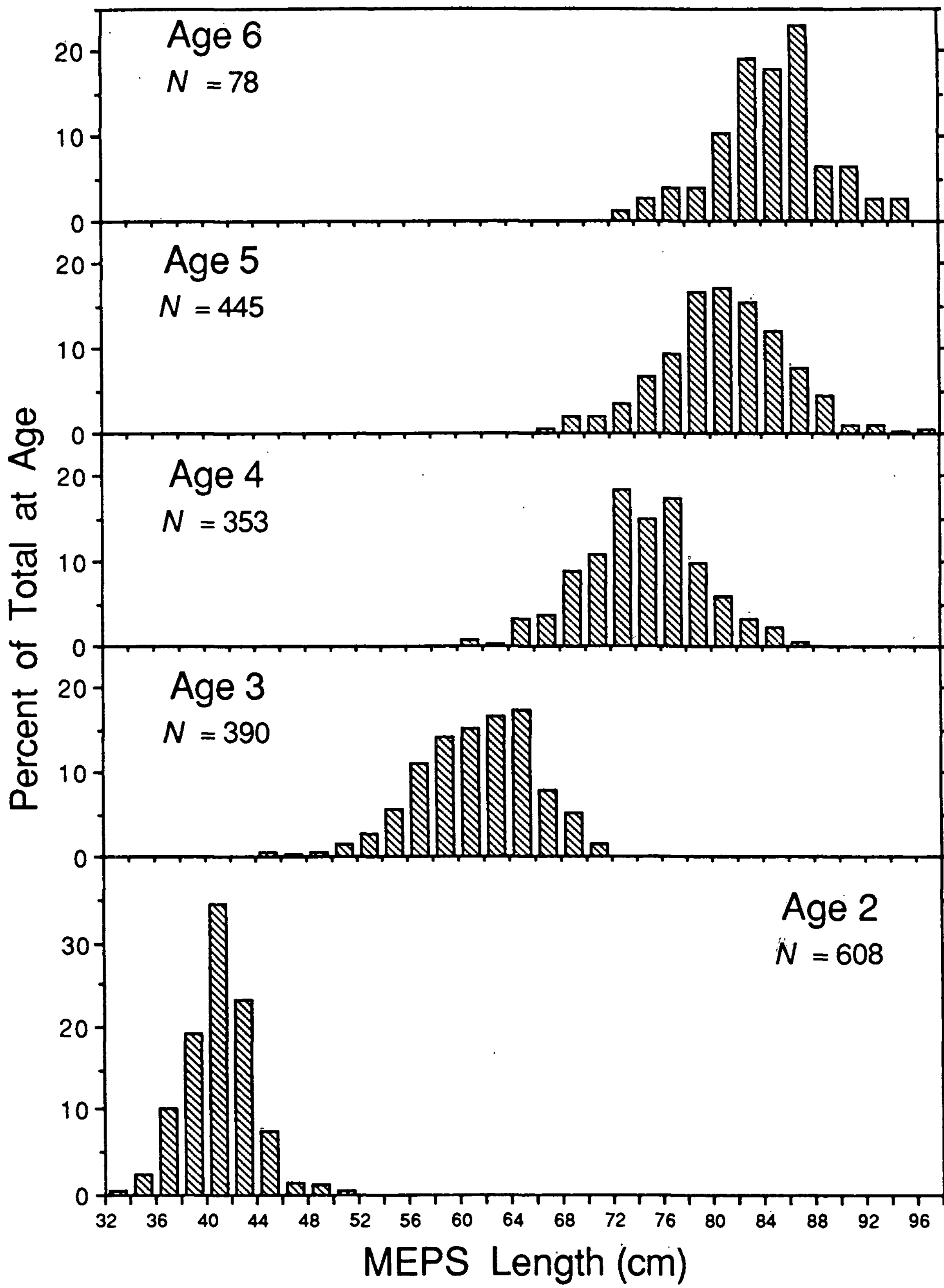

Figure I.13. Length-frequency distributions by age for Elk River fall-run chinook salmon. Fish were sampled at Elk River Hatchery and on spawning ground surveys during 1980 and 1981. All samples include both wild and hatchery fish.

Length-Weight Relationship of Spawners

Data on the weight of chinook salmon that return to Oregon coastal rivers have not been routinely or systematically collected. One extensive data set, however, is available for Elk River fall-run fish. The prespawning weight of chinook salmon has been sampled at Elk River Hatchery since the hatchery began operation in 1968. Ripe fish that were selected for spawning were killed, their MEPS length was recorded to the nearest 0.5 cm, and their weight was determined to the nearest 0.1 kg, prior to spawning. Some statistically significant ($P \leq 0.01$) differences in length-weight relationships have been detected between males and females within a return year as well as between males and between females sampled in different return years. In practical terms, these differences were slight, especially over the typical size range of age 3 and age 4 fish. Differences in mean (predicted) weights of individuals less than 50 cm (MEPS) occasionally differed by 0.5 kg; and mean (predicted) weights of individuals greater than 85 cm (MEPS) occasionally differed by 2.0 kg between specific return years. Figure I.14 illustrates the length-weight relationship for chinook salmon sampled at Elk River Hatchery. Data are not available to determine if length-weight relationships are different for different populations of chinook salmon in Oregon coastal rivers or to compare the length-weight relationship of fish sampled at "river entry" with those sampled at spawning.

Fecundity and Egg Size

Compared with other species of fishes, chinook salmon are distinguished by a relatively gradual increase in fecundity as fish size increases. In most stocks of chinook salmon, fecundity increases at a rate proportional to no more than the square of fish length, whereas in most other species of fishes fecundity increases according to the cube of fish length. For example, a 100 cm (fork length) age 6 female from Elk River will usually produce about 6,000 eggs, whereas a 70 cm (fork length) age 3 female from this same stock will usually produce about 3,000 eggs. Although the fecundity of a 100 cm fish is about twice that of a 70 cm fish in Elk River, the weight of a 100 cm female will average about 13.0 kg whereas the weight of a 70 cm female will average about 4.3 kg. With these fish a threefold increase in fish weight results in a twofold increase in fecundity, whereas in most fishes, a threefold increase in weight results in a threefold increase in fecundity.

A corresponding increase in egg size is associated with this relatively gradual increase in fecundity with increasing fish length. For the Elk River stock, for example, the average egg diameter for a 100 cm (fork length) female will be about 8.9 mm as compared with an average diameter of about 7.7 mm for a 70 cm (fork length) female. Although this difference in sizes of egg diameters may appear relatively small, the result is a substantial difference in egg volume and egg weight. The weight of an egg from a 70 cm fish would be about 0.28 g, whereas the weight of an egg from a 100 cm fish would be almost 60% heavier (about 0.44 g). The weight of an egg from the largest female in a chinook salmon stock commonly averages about twice that of an egg from the smallest female in the stock.

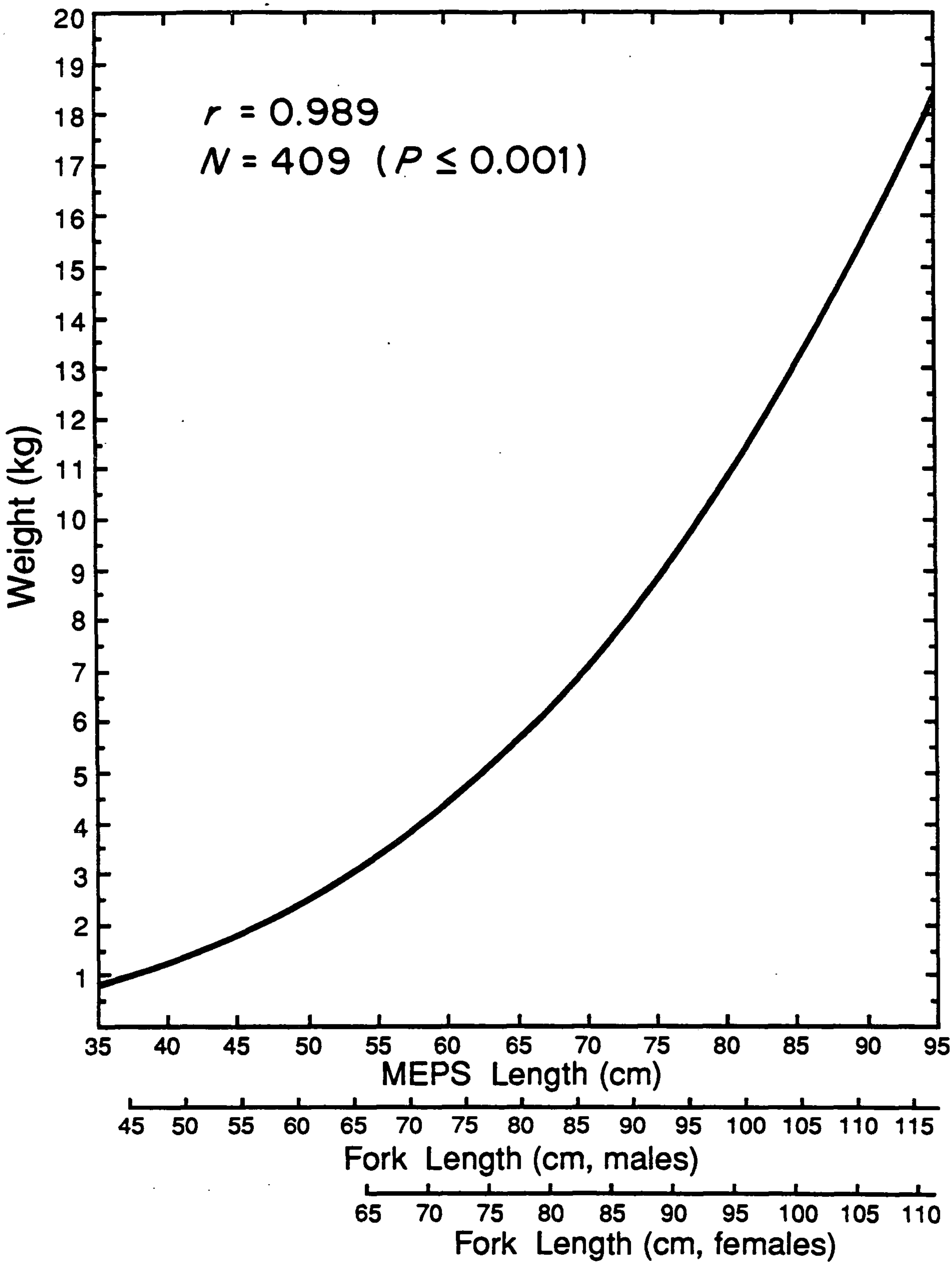

Figure I.14. Length-weight relationship for chinook salmon sampled at Elk River Hatchery in 1977, 1980, 1981, and 1985. Samples were pooled from several years to include adequate representation of individuals over the range of lengths sampled. Samples are primarily of hatchery fish but include some wild fish in most years. Original data on fish length was mid-eye-to-posterior-scale (MEPS). A conversion scale to fork length is shown here for males and females.

The ecological significance of the increase in egg size with increasing fish length in chinook salmon is unclear. Stock-specific trends of egg size and fecundity may represent important adaptations to local spawning and rearing conditions faced by chinook salmon in individual coastal streams. Smaller eggs, with reduced oxygen requirements, may be favored in streams having substantial sediment loads during winter incubation periods, whereas larger eggs may be favored in streams that carry little sediment after storm events. Larger female chinook salmon may deposit their eggs in larger spawning gravels than used by smaller female chinook salmon, thus suggesting that female size and "optimal" egg size may somehow be related. At present, these and other possibilities can best be described as intriguing, but speculative and untested.

Regardless of the possible adaptive significance of stock-specific fecundity and egg size trends, these trends may provide valuable information regarding phenotypic variation among chinook salmon stocks. The very best information on reproductive traits of chinook salmon has been collected for two stocks of fall-run chinook salmon that have been reared at Elk River Hatchery. Measurements of fecundity and egg diameter have been made annually for Chetco River and Elk River stocks of fall-run fish in most years since 1968. Preliminary analyses of these data suggest that between-year variation in size-specific fecundity or egg size is significant but relatively small compared with the differences in reproductive traits between these two stocks. On average, Chetco River fish have significantly larger eggs but fewer of them at a given fish length than do Elk River fish. Limited measurements of size-specific fecundity and egg size for other Oregon coastal chinook salmon stocks suggest that other significant differences in reproductive traits may exist among Oregon coastal stocks, and that Columbia River stocks may be clearly distinguishable from coastal stocks on the basis of their reproductive traits. We also have evidence that the 1983 El Nino event reduced size-specific fecundity of Rogue River fall-run chinook salmon by about 500 eggs per fish, but had little effect on egg size.

Overall, current information on reproductive traits of Oregon coastal chinook salmon stocks is fairly limited, and analyses of most existing data are preliminary. Nevertheless, as Figure I.15 illustrates, differences between stocks can often be substantial. We believe that these differences are, to some degree, a reflection of stock-specific adaptations to local spawning and rearing conditions faced by individual stocks of chinook salmon.

Flesh Color

All chinook salmon populations in Oregon coastal river basins are apparently characterized by a "red-orange" flesh color while in their ocean phase. This is in contrast to some chinook salmon populations, primarily in British Columbia and Alaska, that are characterized by "white" flesh color throughout their life cycle. We have classified Oregon coastal populations as "red-orange fleshed" on the basis of interviews with management district biologists, interviews with anglers, and personal observations. Data to categorize the flesh color of chinook salmon populations in Oregon coastal rivers have not been systematically collected; consequently, data on flesh

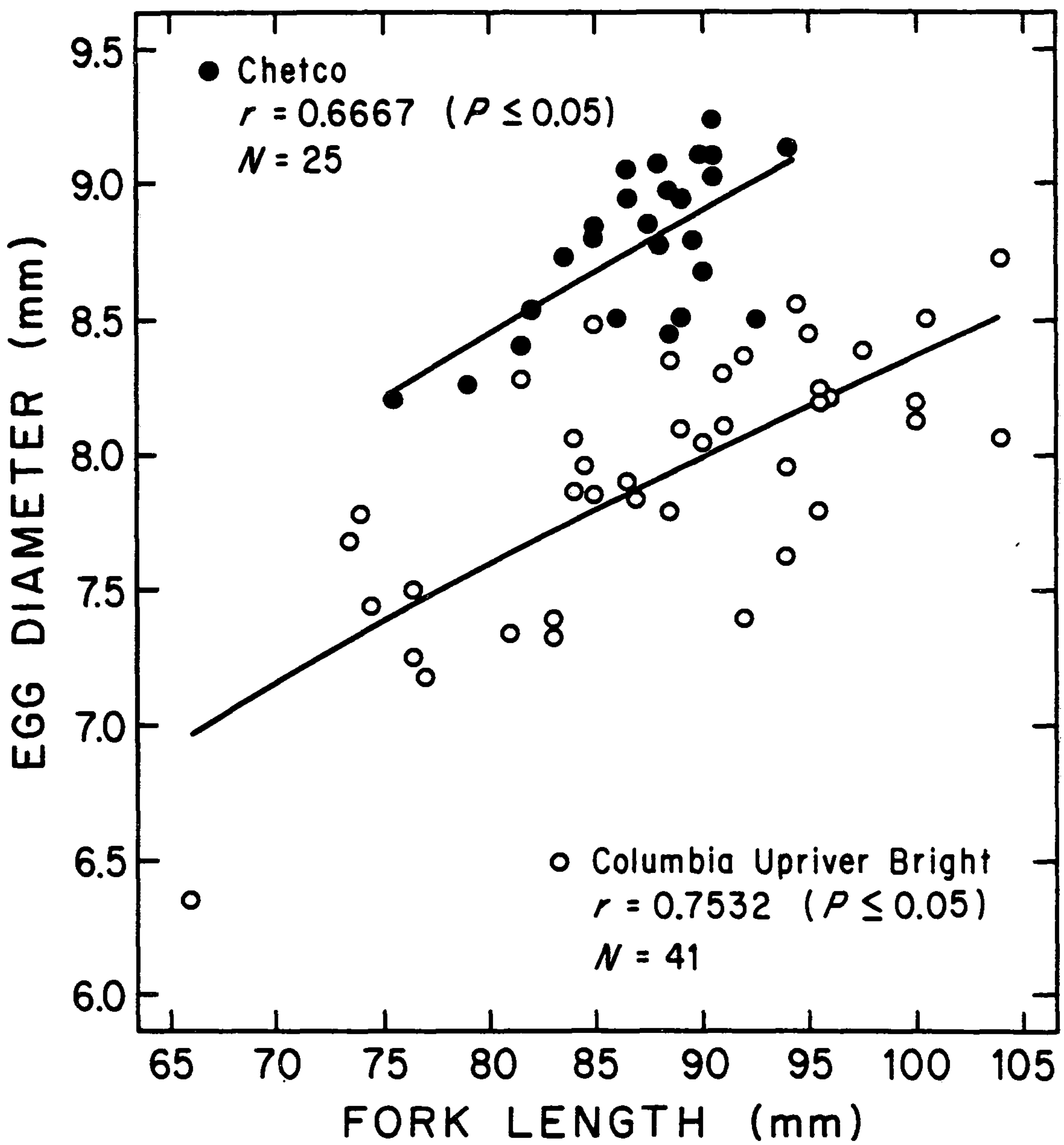

Figure I.15. Relationship between egg diameter (mm) and fork length (cm) for Chetco River fall-run chinook salmon and Columbia River upriver bright fall-run chinook salmon. Data were collected at Elk River Hatchery (Chetco stock) and at Bonneville Hatchery (upriver bright stock) in 1985. Egg diameter of most Oregon coastal chinook salmon stocks appears to generally fall within the extremes depicted by these two trends.

color are not presented in PART II of this report. The flesh color of chinook salmon pales progressively during the process of sexual maturation, however, so that spent fish from all populations may have flesh that could appropriately be described as "very pale orange," "cream," "grey-white," "white," or "mottled orange-white."

Chinook salmon in some populations may retain the "red-orange" flesh color characteristic of their ocean phase for a longer duration after they enter freshwater on their spawning migration than do fish in other populations. We believe that spring-run fish generally retain a "red-orange" flesh color for at least 4 months before an obvious paling of flesh color occurs. Thus, spring-run fish entering Oregon coastal rivers in April will normally have "red-orange" flesh in June or in July, but by August or September their flesh will have paled noticeably. In contrast, the flesh of fall-run fish apparently pales shortly after river entrance. Fall-run fish that enter estuaries during August or September may have relatively pale flesh when they are caught by anglers near the head of tidewater during October or November. These fish probably had "red-orange" flesh when they entered the estuary, however, and many fish with "red-orange" flesh are caught from these fall-run populations during October, November, and December. Finally, we believe that some fall-run fish return to freshwater close to sexual maturity, spawn very quickly, and still retain most of the "red-orange" flesh color even though they are spent.

MANAGEMENT IMPLICATIONS OF LIFE HISTORY DIVERSITY

Contemporary fish management programs for chinook salmon consist of three essential components: (1) efforts to maintain, restore, or enhance natural production; (2) efforts to produce fish through various artificial propagation programs; and (3) efforts to manage harvest. The relative degree of success that can be achieved in these efforts depends directly on the reliability of life history information that is available to guide the design of management programs. The life history information presented in PART I and PART II of this report can continue to provide a basis for present and future management programs for chinook salmon in Oregon. The following list presents examples of implications of life history diversity of Oregon's coastal chinook salmon stocks to the three general types of management activities listed above.

Implications to Natural Production

1. Any activities that alter instream or riparian habitats in mainstem reaches of coastal rivers could alter the productive capacity of the chinook salmon population in the respective river basins.

2. Any activities that alter habitats or fish population assemblages in estuaries could alter the productive capacity of the chinook salmon population in the respective river basins.

3. Any activities that reduce the suitability of spawning habitat in certain limited stream reaches of coastal rivers could greatly reduce the productive capacity of the chinook salmon population in the respective river basins.

4. The majority of Oregon coastal river basins are apparently well seeded with rearing chinook salmon juveniles. Opportunities to increase natural production of chinook salmon may exist in some coastal river basins, however. These opportunities may be relatively greater in systems that offer a relatively large amount of suitable freshwater and estuarine rearing area and that appear to be relatively "lightly" stocked by natural spawning at present.

5. Releases of hatchery-reared juvenile chinook salmon into reaches of coastal rivers where wild juveniles are relatively abundant could cause a reduction in growth and survival of the wild fish.

6. Transfers of chinook salmon from one river to another or from one subbasin to another subbasin within a watershed may reduce natural production of the recipient population if interbreeding occurs and if the juvenile or adult life history characteristics of the two populations differ in any substantive manner. The degree of reduction in production will depend on the nature and extent of life history differences between the "native" and "introduced" populations, the degree of interbreeding between "native" and "introduced" populations, and the number of years in which interbreeding occurs.

Implications to Hatchery Production

1. A shift in the average timing of return or timing of spawning could either purposefully or inadvertently be produced in a hatchery population of chinook salmon. Such a change would alter the contribution rate of the stock to ocean or to in-river fisheries, or to both; might reduce the fitness of the hatchery population to reproduce naturally; and might reduce the fitness of the wild fish in the river basin through interbreeding with stray hatchery fish.

2. A shift in the average age at maturity could either purposefully or inadvertently be produced in a hatchery population of chinook salmon. Such a change would alter the contribution rate of the stock to ocean or to in-river fisheries, or to both; might reduce the ability of the hatchery population to reproduce naturally; and might reduce the fitness of the wild population in the river basin through interbreeding with stray hatchery fish.

3. A conflict may exist between hatchery production goals and natural production goals in certain river basins, because efforts to maximize survival of the hatchery fish by releasing them into reaches of coastal rivers during the time periods when wild juveniles are most abundant may place them in direct competition with wild juveniles.

Implications to Harvest Management

1. Oregon recreational fisheries should benefit if efforts to reduce the exploitation rate of chinook salmon fisheries in the ocean north of Oregon are successful. The net result should be an increase in the number and in the average age of chinook salmon that return to coastal rivers that support populations of north-migrating fish. The magnitude of the potential increase is not known.

2. Oregon recreational fisheries should benefit if efforts to reduce ocean exploitation rate on Klamath River chinook salmon are successful. The net result should be an increase in the number and in the average age of chinook salmon that escape ocean fisheries to return to coastal rivers that support populations of south-migrating fish. The magnitude of the potential increase is not known.

3. Mid-maturing stocks of south-migrating fall-run chinook salmon that return to south coast streams should be expected to contribute to ocean fisheries at a higher rate, on the average, than early-maturing stocks of fall-run fish and spring-run fish that rear in the ocean off the coast of northern California and southern Oregon.

4. A number of north-migrating stocks of chinook salmon make modest contributions to Oregon ocean fishery landings. An additional number of north-migrating stocks that have not been coded-wire tagged probably also make modest contributions to Oregon ocean fishery landings. Because of the cumulative contribution of these stocks, efforts to maintain or enhance production of these north-migrating stocks may add stability to Oregon's ocean fishery landings during years when south-migrating stocks experience poor survival.

5. Opportunities may exist to increase the abundance of chinook salmon that rear in the ocean off Oregon by enhancing populations of south-migrating or south-and-north-migrating (Umpqua River spring-run) stocks.

6. The periodic reoccurrence of El Nino events in the ocean off northern California and southern Oregon should be expected to make production of south-migrating populations of chinook salmon more variable than production of north-migrating populations.

7. As a consequence of the extremely high proportion of female spawners in one age class, the Rogue River spring-run chinook salmon population may be relatively more unstable than populations that have females returning in greater proportions at several ages.

RECOMMENDATIONS

On the basis of observations we made while preparing this report, we have concluded that (1) the reliability of life history assessments for many fish populations is reduced because of differences in the database that were caused by inconsistent sampling equipment, effort, and methodologies; (2) important life history data are absent or scarce for several populations that are extremely important to Oregon commercial and recreational fisheries; and (3) contemporary management programs do not adequately incorporate existing knowledge of life history characteristics in routine operational procedures or decision-making processes. The following recommended actions address these concerns.

Improve Reliability of Life History Database

RECOMMENDATION I.1. Prepare a written sampling plan to standardize collection of biological data from adult chinook salmon sampled (1) during spawning ground surveys, (2) during creel surveys, (3) during STEP broodstock collection, (4) during spawning at hatcheries, and (5) during special sampling activities of research or district personnel. The plan should specify (1) equipment, procedures, units, accuracies, and sample size goals for measuring fish; (2) equipment, procedures, and sample size goals for sampling scales; (3) equipment and procedures for sampling "snouts" from fish to recover coded-wire tags; (4) procedures for determining species; (5) procedures for determining sex; and (6) procedures for recording biological data.

RECOMMENDATION I.2. Collect and analyze data to determine the mathematical relationship between MEPS length and fork length of chinook salmon in Oregon coastal rivers. The database should be sufficient to examine annual variation as well as stock variation. Prepare a written report documenting the results of this work.

Relatively subtle differences in the age, sex, or size compositions of chinook salmon populations are more difficult to document when equipment, methodologies, and effort are inconsistently applied to sampling, and when biological data are inaccurately observed, inaccurately recorded, or both. **RECOMMENDATIONS I.1** and **I.2** are designed to improve the reliability of the life history database by overcoming these problems.

Expand Life History Database

RECOMMENDATION 1.3. Undertake research to more thoroughly document the juvenile and adult life histories of specific stocks of coastal chinook salmon. Stocks that merit special attention are (listed in priority order) (1) Rogue River fall-run (at least three major subraces); (2) Umpqua River spring-run; (3) depressed fall-run stocks in Euchre and Hunter creeks and in Pistol and Winchuck rivers; (4) North-migrating stocks of spring-run fish in Alsea, Siletz, Trask, and Wilson rivers; and (5) Umpqua River fall-run. Special emphasis should be placed on work (1) that will document aspects of life history that are likely to be most useful to efforts to maintain or enhance natural production of the specific populations, and (2) that will identify distinctions between the life history of these and other populations.

As noted in **PART III** and **PART IV** of this report, the Rogue fall-run population (collectively) is the largest of any in Oregon coastal rivers and is apparently the most important single contributor to Oregon ocean fisheries. Much information is available regarding the life history of Rogue River fall-run chinook salmon, but most of the information is based on surveys of the population as a whole rather than on individual surveys of the three or more subraces that compose the population. Juvenile life history, marine distribution, age at return, and run timing may vary among these subraces, and these differences might be crucial to future efforts to maintain or enhance production of one or more of the subraces.

The Umpqua River spring-run population is second in size only to the Rogue River spring-run population, contributes primarily to Oregon ocean fisheries, and has supported an important recreational fishery that apparently declined to a relatively low level during the late 1970s and early 1980s. The juvenile life history of this population may be unique among Oregon coastal populations, but very few life history characteristics of this population are well documented.

Efforts to rehabilitate depressed stocks of fall-run chinook salmon in small south coast rivers might be more successful if they were based on a more thorough understanding of the life history of these fish. However, some or all of these populations may presently be depressed to such a low level that life history studies might be impractical.

Life histories of north-migrating stocks of spring-run fish are very poorly documented, and most of these stocks are apparently depressed compared with historic levels (**PART III, PART IV**). These stocks have not exhibited the general increasing trends noted in north-migrating fall-run stocks. Efforts to rehabilitate or enhance these populations might be more effective if they were based on an understanding of the life history of these fish.

Although the Umpqua River fall-run population has apparently been increasing since the mid-1970s (**PART III** and **PART IV**) this population is well below its historic production levels. In addition, this stock may have strong potential to contribute to Oregon ocean fisheries. Efforts to rehabilitate or enhance this population might be more effective if they were based on an understanding of the life history of these fish.

RECOMMENDATION I.4. Undertake experiments to more thoroughly investigate the heritability of age at maturity, timing of return, and timing of spawning, and the affect of these stock characteristics on fishery contribution and on survival. These experiments should be replicated using Ad+CWT-marked fish from several north- and south-migrating stocks of fall- and spring-run chinook salmon.

Contemporary hatchery breeding programs are capable of causing profound changes in age at maturity, time of return, and time of spawning of hatchery chinook salmon populations, as well as causing changes in the susceptibility of hatchery fish to commercial and recreational fisheries. Only relatively vague guidelines presently exist regarding hatchery breeding programs. Written operational plans to guide breeding programs are needed (**RECOMMENDATION I.10**). **RECOMMENDATION I.4** will provide data needed to refine these operational plans for specific populations.

> **RECOMMENDATION I.5.** Analyze existing collections of scales from juvenile and adult chinook salmon in coastal river basins to estimate size at ocean entrance of juveniles in different river basins. Prepare a written report summarizing results of this and all previous work on size at ocean entrance of juvenile chinook salmon in Oregon coastal rivers.

Reliable information regarding the size that surviving wild fish achieved prior to ocean entrance could prove to be extremely valuable to future habitat protection and population enhancement programs. However, "size at ocean entrance" studies have received only passing interest, the assumptions of the scale analyses have not been sufficiently documented, and the accuracies of the analyses have not been verified. This recommendation represents an effort to improve the reliability of analyses of "size at ocean entrance" and to expand the number of populations that have been examined.

> **RECOMMENDATION I.6.** Continue efforts that are presently underway to annually collect and age scale samples from a number of coastal chinook salmon stocks. Summarize data, in a manner that is consistent with PART II of this report, in an annual report.

A general requirement to collect scale samples and biological data from chinook salmon carcasses during spawning surveys did not exist prior to 1986. Except for sampling that occurred during research projects in specific river basins, management district biologists collected biological data from chinook salmon carcasses on a voluntary basis. Starting in 1986, however, as part of the U.S.-Canada Treaty agreements, chinook salmon spawning surveys were expanded to include sampling of carcasses observed on selected surveys. These scale collections, together with counts of fish in spawning survey index areas, will serve as a basis for assessing changes in abundance or age structure of the populations that may be caused by future changes in the intensity of ocean fisheries.

> **RECOMMENDATION I.7.** Collect and analyze data to evaluate between-population variation in the length-weight relationship of chinook salmon. The database for this work should be sufficient to examine annual variation as well as stock variation of several north- and south-migrating fall- and spring-run populations located along the Oregon coast. Prepare a written report documenting the results of this work.

RECOMMENDATION I.8. Collect data on fecundity and egg size from each coastal chinook salmon population that is spawned to provide eggs for hatchery and STEP programs. Sampling should be conducted in a standard manner during at least 3 years. Prepare a written report documenting the results of this work.

RECOMMENDATIONS I.7 and **I.8** represent an effort to document biological characteristics of coastal chinook salmon populations. This information, along with other descriptive population data, represents a database that would be useful to document phenotypic distinctions between populations and that may reveal trends through time. Data on fish length, fish weight, fecundity, and egg diameter can be collected during spawning activities.

RECOMMENDATION I.9. Conduct stream surveys to identify specific stream reaches that support relatively high densities of spawning chinook salmon. Sampling should be sufficient to determine whether these reaches vary annually depending on streamflow during the spawning period. Prepare a written report documenting the results of this work.

This recommendation represents an effort to document stream reaches that are apparently critical to natural production of chinook salmon in coastal river basins. Once this type of information is formally documented it could provide a basis for providing extra protection to particularly "sensitive" spawning habitats.

Increase Application of Life History Database to Management

RECOMMENDATION I.10. Develop a written breeding plan for each chinook salmon stock that is artificially propagated in coastal rivers. These operational plans should be prepared for all fish that are spawned artificially regardless of whether they are ultimately stocked as fertilized eggs or are released as fry, fingerling, or smolts. These breeding plans should (1) be based on a review of the biological characteristics of the chinook salmon population in the respective river basin and written management goals for the group of fish that is being propagated; and (2) be designed to maintain the stock characteristics of the hatchery and wild populations in the river basin. Breeding plans should specify at least the following: (1) a minimum effective population size; (2) the ratio of males to females spawned; (3) the procedures for fertilizing eggs; (4) the desired ages of females and of males to be spawned; (5) the desired distribution of the egg take, by number of females, during specified time periods throughout the spawning season; and (6) the desired ratio of hatchery to wild fish spawned.

RECOMMENDATION I.11. Develop a written fish-release plan for each chinook salmon stock that is propagated in coastal rivers. These operational plans should be prepared for all groups of fish that will be released, regardless of whether they are ultimately stocked as fertilized eggs, or are released as fry, fingerling, or smolts. The plans should describe the desired number of fish to be released, location of release, and anticipated range of dates for release. The fish-release plans should (1) be based on a review of the spatial and temporal distribution of wild juvenile chinook rearing in the respective river basin and the wild fish management designation of the chinook salmon population in the basin, and (2) be designed to minimize competition between wild and hatchery juveniles consistent with the wild fish management policy.

RECOMMENDATION I.12. Review existing policies, guidelines, and practices related to transfer of chinook salmon stocks within and between Oregon coastal river basins. Revise policies, guidelines, or both to (1) reflect comprehension of the life history information contained in this report, (2) require a more thorough review of life history characteristics prior to approving stock transfers, and (3) require more thorough written documentation of the review process.

We believe that **PART II** of this report contains ample evidence that a diverse array of populations with a variety of life history characteristics exists in Oregon coastal river basins. Given the generally healthy condition of the majority of coastal chinook salmon populations, we believe that few (if any) of these populations would benefit from, and that most would be harmed by, introductions of fish from other populations.

Rehabilitation (of a specific population) that relied strictly on harvest management might be difficult, and might require many generations if the population in question has declined to an extremely small number of spawners. Under this circumstance, the rehabilitation process might be accelerated by the introduction of nonnative fish with similar life history characteristics that are believed to be "preadapted" to survival in the recipient system. This hypothetical situation may already exist in several small south coast chinook salmon populations (**PART III** and **PART IV**). If so, and if nonnative chinook salmon stocks are introduced into one or more of these populations in an effort to rehabilitate them, then an extensive effort should be made to use fish with life history characteristics that are expected to be "preadapted" to survival in the recipient river system.

RECOMMENDATION I.13. Develop a reference retrieval database in which all ODFW-produced reports are listed. The database should include standard reference citations for all reports, "key word" references, and notations regarding the location where copies may be obtained.

This recommendation is designed to improve awareness of and access to information that has been gathered and documented in ODFW internal reports. During the process of preparing this report, we made a determined effort to find all available data regarding the life history characteristics and abundance of chinook salmon in coastal rivers. The process of finding these data was extremely complicated and inefficient. Data that we reviewed were contained in a wide variety of "report" type documents that were prepared by the Research Section, several Management Region offices, several Management District offices, and the Fish Division staff. Only the Research Section, apparently, maintains a list of reports, and this list is currently several years out-of-date.

PART II

Basin by Basin Presentation of Life History Data

CONTENTS FOR PART II

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INTRODUCTION TO PART II

PART II of this report contains information about the life history of chinook salmon in each Oregon coastal river, listed alphabetically. We do not mean to imply by this organization that chinook salmon in a particular river basin exhibit a single homogeneous life history. On the contrary, we believe that important life history variations probably exist between subpopulations of chinook salmon within most of these river basins. The opportunity (and perhaps the necessity) for life history variation within river basins is probably greater in large river basins (such as the Rogue River) than in small river basins (such as Hunter Creek). However, the existing database is usually not sufficient to document variation within populations.

For each river basin we present a brief statement noting the run(s) present and the life history information that is available. For juveniles we present available information on distribution, length and abundance, age at ocean entrance, and size at ocean entrance. For adults, we present available information on distribution of catch in the ocean, timing of return and spawning, age composition of spawners, size at age of spawners, and fecundity and egg size.

For some of these life history topics we present information, interpret data, make judgments about life history "types," or otherwise speculate about the life history traits of chinook salmon in the particular basin. For others (especially sections on "size at age of spawners" and "fecundity and egg size") we simply present one or more tables of data without narration. Unless we specify otherwise, the life history data presented are for wild fish.

Information about distribution of juvenile chinook salmon is primarily based on data from seining. Seining was accomplished in the estuaries near low tide with a beach seine (125 feet x 8 feet, 3/8 inch stretch mesh) and in the rivers with a pole seine (30 feet x 5 feet, 1/4 inch stretch mesh). Seining in the Rogue River was accomplished with a beach seine (200 feet x 8 feet, 3/8 inch stretch mesh). Data on mean fork length of juveniles are presented with acknowledgment that the seines or seining methods may be biased toward capture of smaller individuals. The lengths of juveniles are reported to the nearest 0.1 cm. All original measurements were taken from anesthetized fish, using measuring boards, to the nearest mm fork length. Judgments about abundance of juveniles within various reaches of a river basin are usually based on whether it was relatively "easy" or relatively "difficult" to collect a sample by seining. Data on age and size at ocean entrance are based on analysis of scale patterns. With one exception, information about the juvenile life history of coastal chinook salmon stocks was obtained from work conducted by ODFW, OFC, OSGC, or OWC. Some data regarding juveniles in Yaquina Bay were obtained from an Oregon State University Master's thesis.[1]

We feel that several remarks about the use of "scale analysis" are appropriate to evaluating some of the data and conclusions presented in this report. Three general types of scale analyses were used to provide most of

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[1] *Myers, K.W.W. 1980. An investigation of the utilization of four study areas in Yaquina Bay, Oregon, by hatchery and wild juvenile salmonids. Master's thesis. Oregon State University, Corvallis.*

the data presented in this report: (1) estimates of age at ocean entrance of juveniles, (2) estimates of size at ocean entrance of juveniles, and (3) estimates of age at return of mature fish. We are not, at this time, making extensive use of life history "type" analysis based on scale "pattern types." One underlying assumption of this sort of analysis is that juveniles would display "unique" scale patterns as a consequence of rearing in tributaries, mainstems, or estuarine habitats. Observations of scale patterns of juvenile chinook salmon in several coastal river basins indicate, however, that scale pattern analysis should not be broadly applied to these populations. The scale-growth patterns of juveniles rearing in some estuaries, for example, were indistinguishable from the scale-growth patterns of juveniles rearing above the tidal reaches of the system. As another example, juveniles rearing in the lower reaches of some estuaries were growing so well that the estuarine scale-growth pattern was barely distinguishable from "ocean" growth. We believe that scale pattern analyses can provide useful interpretative information related to life history studies if they include reference collections of scales from juveniles sampled from representative habitats throughout the rearing period.

Age at ocean entrance was usually evaluated on the basis of whether a "freshwater" annulus was present prior to the ocean entrance "check" and on the distance from the ocean entrance "check" to the first marine annulus. The latter factor was often critical in classifying a yearling versus an underyearling life history because "freshwater annuli" could in many instances be interpreted as freshwater-to-estuary "transition zones," and vice-versa. Yearling smolts always had a much greater amount of scale growth between the ocean entrance check and the first marine annulus than did underyearling smolts.

Size at ocean entrance was estimated by projecting a magnified (88X) image of the adult scale, measuring the radius from the scale focus to the ocean entrance "check" and then converting the scale radius measurement to a predicted fork length using a regression equation. For Elk, Rogue, and Sixes fish we used the equation

$$\text{Fork length (cm)} = 2.51755 + 0.18099 \text{ scale radius (mm)}.$$

This equation is based on a scale radius-fork length regression calculated using data from Rogue River juveniles (sampled at river mile 5) during 1974-78. For the Coquille, Siletz, and Siuslaw fish we used the equation

$$\text{Log fork length (cm)} = -0.189849 + 0.824905 \log \text{scale radius (mm)}.$$

This equation is based on a scale radius-fork length regression calculated using data from a composite sample of juveniles sampled in the Coquille, Siletz, and Siuslaw estuaries during 1977. The accuracy of these estimates has not been determined, and, while we have no specific reason to doubt the results obtained to date, we view these analyses as being preliminary.

Assessments of age at return were based on examination of scales from fish that varied in condition from "fresh-run" fish to spent carcasses recovered during spawning ground surveys. Although the scales taken from carcasses of spent fish displayed a great degree of resorbtion, we are generally confident in the results of these analyses. Ages determined by scale analysis for Ad+CWT-marked fish were generally accurate. Assignment of age for spent spring-run fish was particularly difficult, and often included a judgment that one ocean annulus had been "lost" by resorbtion.

Judgments about whether a stock is north- or south-migrating in the ocean are based on a review of Ad+CWT recovery data that we obtained from Robert Garrison (ODFW). We identified specific code groups that we felt could be used to document patterns of ocean catch distribution, and Garrison provided a summary of tag recovery data that were current at the time we wrote this report. In general, we did not include tag code groups that had experienced very low survival. The average catch distribution analyses we present are intended to convey a general picture of where and at what ages various stocks of chinook salmon are caught in ocean fisheries. Throughout this report we refer to "area of catch." These data partly represent area of catch and partly represent area of landing, because fishermen cross geographic boundaries, and area of catch has not always been differentiated from area of landing in past data summaries. The actual percentage of each brood that is caught in each fishery at each age can vary depending on hatchery rearing and release practices, ocean fishery regulations in different geographic regions, and environmental conditions. A list of the tag codes for which we received summaries is in **APPENDIX C.**

The statements we make about the timing of return and spawning by adults are based on our evaluation of information obtained from four sources:

1. A questionnaire that was answered by coastal district management biologists.

2. Data collected by research projects.

3. Records of commercial gillnet fisheries in coastal rivers.

4. Estimates of recreational catch in coastal rivers.

Data we present on age and sex composition of spawners are based on analysis of scales collected from chinook salmon sampled from spawning ground surveys, creel surveys, fish ladders, and returns to hatchery collection sites. The source of each sample is specified. We recognize that each of these data sources may be biased. However, we believe that these data are sufficient to demonstrate that striking differences exist in the maturity schedules between stocks of chinook salmon and to generally classify these as early-, mid-, or late-maturing stocks. Our classifications of relative age of maturity for fall-run fish are as follows:

1. Early-maturing stocks of fall-run fish are characterized by female maturation primarily at ages 3 and 4.

2. Mid-maturing stocks of fall-run fish are characterized by female maturation from ages 3-5 with age 4 strongly dominant.

3. Late-maturing stocks of fall-run fish are characterized by female maturation from age 4-6 with age 5 usually dominant.

We had more difficulty classifying the relative age of maturity of spring-run fish for several reasons. First, age composition data are much scarcer for sexed samples of spring-run fish than for fall-run fish. Second, the potential is great for spring-run fish of equal total age from different populations to have spent a different period of time in the ocean. This situation depends on the date at which the juveniles migrated to the ocean and the date at which the adults returned to enter the home stream. Since the age of female maturation is influenced by duration of ocean residence as well as by total age, this difference complicates the process of classifying relative age of maturity of spring-run fish.

In light of these vagaries and after reviewing data that were available for the Rogue, Umpqua, and Nestucca River populations, we decided on the two following classifications for spring-run fish:

1. Early-maturing stocks of spring-run fish are characterized by female maturation from ages 3-6 with age 4 dominant.

2. Late-maturing stocks of spring-run fish are characterized by female maturation from ages 3-6 with age 5 dominant.

Where they are available, we present data on the mean size at age for chinook salmon returning to individual river basins. Usually this is presented in a table without discussion. We do not know the extent to which any differences in age-specific size data between stocks may be due to (1) sampling error, (2) brood year variation, (3) genetic potential for growth, (4) differences in the duration of ocean rearing (for equal-aged fish from different populations), or (5) regional differences in environmental conditions in ocean rearing areas.

For the sake of consistency, age-specific size information for mature chinook salmon is presented as mean fork length. The original data we reviewed for each stock included a mixture of fork and mid-eye-to posterior-scale (MEPS) length measurements. Fish were measured using a variety of devices, including cloth measuring tapes, plastic measuring tapes, retractable metal tapes, wood "yard-sticks," and wood "meter-sticks." Only rarely was the type of measuring device indicated. The majority of measurements, regardless of type, were taken in centimeters. Some original measurements were in inches. Measurement accuracies were usually not described, but when specified, were usually taken to the nearest 0.5 unit (cm or inch), and were occasionally specified to the nearest higher unit. MEPS-to-fork-length conversions were made using the following equations:

for females -- fork length = 2.5383 + 1.1461 (MEPS);

for males -- fork length = -1.4808 + 1.2451 (MEPS).

Data on fecundity and egg size presented in this report were obtained from a long-term research project at Elk River Hatchery, from a study conducted by ODFW to investigate the effects of an El Nino event on maturing coho and chinook salmon, and from an Oregon Sea Grant project conducted by David G. Hankin. Collectively, these sources have provided fecundity and egg size data for about one-third of Oregon's coastal chinook salmon stocks. Egg size measurements reported are standardized or transformed to diameters of unfertilized, water-hardened eggs preserved in Ringers 5% formalin solution. R^2 values for regression of fecundity or egg size against fish length are for log-log transformations. Table I.1 **(PART I)** presents a summary and evaluation of the data that are available for chinook salmon in Oregon coastal river basins.

ALSEA RIVER

The Alsea River supports populations of spring- and fall-run chinook salmon. However, we have no information regarding the juvenile or the adult life history of spring-run fish in this system. Consequently, the following narrative will be restricted to information about fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon rear throughout the entire mainstem, in larger tributaries such as Five Rivers, Fall Creek, and Drift Creek, and throughout the estuary. Sampling of juveniles in the basin has been very limited, but has documented that rearing occurred from the river mouth to the mouth of Mill Creek (river mile 42) in June and in September of 1980.

Length and Abundance

The mean fork length of juveniles sampled in the Alsea River estuary ranged from about 10 to about 13 cm during September 1978-86 (Table II.1). The mean annual (September) fork length of juveniles in the lower estuary was 11.7 cm. The mean fork length of juveniles sampled by angling with nickel-plated trolling spoons about 3/4-inch long in mid-channel during September 1980 was 12.0 cm, whereas the mean fork length of juveniles sampled with a beach seine on the same date was 10.6 cm. The ranges in length of juveniles sampled by the two methods were similar, however. In June 1980 juveniles were abundant in the river and in the estuary, but in September 1980 juveniles were abundant only in the estuary.

Table II.1. Data on catches of juvenile chinook salmon in the Alsea River estuary, 1978-86.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (27)	115	12.7	2	71
1979 (19)	35	11.5	8	4
1980 (5)	179	10.6	1	269
1981 (15)	141	12.4	3	123
1982 (16)	89	11.6	8	11
1983 (7)	141	12.1	3	71
1984 (9)	73	12.1	3	92
1985 (12)	149	9.8	3	50
1986 (18)	85	12.5	2	43

Age at Ocean Entrance

Juveniles sampled in the Alsea estuary during September in 1978-87 were underyearlings. We believe that practically all of these fish migrated to the ocean as underyearlings. A very small proportion of the entire population of juveniles probably remains upstream in the riverine reaches of the basin and migrates to the ocean in the spring as yearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of surviving adults. Judging from the juveniles present in the estuary in September during 1978-86, many juveniles rear in the Alsea basin and enter the ocean at sizes between 10 and 14 cm.

Adults--Fall run

Distribution of Catch in the Ocean

Ocean tag-recovery data for Alsea River fall-run fish are scarce; however, the stock is apparently a north-migrating stock. One Ad+CWT group was caught at ages 2-5 in British Columbia and Alaska. By far the greatest part of the catch occurred in British Columbia at ages 3 and 4 (Table II.2).

Table II.2. Distribution of ocean catch of Alsea River fall-run chinook salmon released in the Alsea River. Values are percentages of the total estimated catch (137 fish) from 1 release group. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		4	13	1		18
British Columbia	9	36	26	9		80
Washington						
Oregon						
California						
Total at age	9	40	39	10		

Timing of Return and Spawning

Chinook salmon enter the Alsea River from at least May through early January. We have no data or criteria to distinguish fall-run fish; however, local anglers commonly identify fall-run fish as those that enter the river from about September through January. Judging from recreational catches, the peak of entry probably occurs sometime in early October. Spawning takes place from early October through January and probably peaks in late November.

Age Composition of Spawners

We tentatively classify Alsea River fall-run fish as late-maturing. Limited age composition data indicate that jacks are common in the returning population, fish return through age 6, and females most commonly mature at ages 4 and 5 (Table II.3).

Table II.3. Percent age composition for Alsea River fall-run chinook salmon, 1977. This sample was collected during a creel survey; most of these were probably wild fish, but some hatchery fish may be included.

Number, age	Males	Females
Number of fish in sample	159	53
Age 2	54	0
Age 3	20	0
Age 4	21	34
Age 5	5	60
Age 6	1	6

Size at Age of Spawners

Information on the age-specific size of fall-run chinook salmon from the Alsea River is presented in Table II.4.

Table II.4. Mean fork length (cm) at age for Alsea River fall-run chinook salmon. This sample was collected during a creel survey in 1977. Most of these were probably wild fish, but some hatchery fish may be included.

Number, age	Males	Females
Number of fish in sample	158	53
Age 2	47.8	--
Age 3	63.6	--
Age 4	81.9	87.2
Age 5	100.0	101.0
Age 6	--	107.0

Fecundity and Egg Size

Table II.5 contains a regression equation that relates fecundity to fork length of fall-run fish from the Alsea River. Table II.6 contains examples of values predicted by this equation. The diameter of eggs (from the same fish sampled in 1985) was not significantly correlated with fork length, possibly because the sample was from a relatively restricted range of sizes of fish (most were between 90 and 110 cm fork length). Egg diameters for the fish in this sample ranged from 8.68 to 9.61 mm.

Table II.5. Regression equation relating fecundity (F, number of eggs) to fork length (L, cm) for Alsea River fall-run chinook salmon, 1985. The sample was probably of hatchery fish.

N	Regression equation	R^2
23	$F = 6.481\ L^{1.454}$	0.489

Table II.6. Examples of number of eggs of Alsea River fall-run chinook salmon, predicted from the regression equation listed in Table II.5.

Fork length (cm)				
70	80	90	100	110
3,122	3,790	4,498	5,243	6,342

CHETCO RIVER

The Chetco River supports a population of fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout the mainstem and estuary from roughly May through September, and are present in the lower reaches of tributaries such as the South Fork, Emily Creek, and Jack Creek at least through June.

Length and Abundance

The mean fork length of juveniles sampled in the Chetco River estuary during 1973-75 is listed in Table II.7.

Table II.7. Data on catches of juvenile chinook salmon in the Chetco River estuary, 1973-75. FL = fork length.

1973			1974			1975		
Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)
17 May	65	5.3	25 Apr	50	4.3	29 Jul	21	8.0
18 Jul	142	6.9	30 May	16	6.1	19 Aug	78	8.4
2 Aug	112	7.3	2 Jul	20	7.2	2 Sep	32	8.8
20 Sep	26	9.0	22 Aug	9	8.9	29 Sep	53	10.2

Juveniles were abundant in the river and in the estuary during sampling conducted in 1973-75 but were abundant only in the river during sampling conducted in 1983-85.

Age at Ocean Entrance

Sampling of juveniles in the Chetco River basin, which has been extensive, has demonstrated that practically all migrate to the ocean as underyearlings. Yearlings have been observed in the spring months, however, and we believe that a very small proportion of the adults returning to the Chetco are produced by this life history pattern. A sample of 30 wild adults collected in 1970 was composed entirely of fish that entered the ocean as underyearlings.

Size at Ocean Entrance

Little work has been done to estimate the size at which surviving adults entered the ocean. These analyses are complicated by the presence of unmarked hatchery fish in all recent returns to the Chetco. A preliminary analysis of scales collected from spawning grounds in 1981 was conducted to identify wild fish and estimate their size at ocean entrance. This analysis indicated that surviving Chetco River fish entered the ocean at sizes from about 9 to about 13 cm fork length. The mean fork length at ocean entrance was about 11 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Chetco River chinook salmon are a south-migrating stock. Catch is restricted almost exclusively to Oregon and California, and fish are caught about equally at ages 3 and 4 (Table II.8a). Chetco River chinook salmon that were reared and released at Klatskanine Hatchery (lower Columbia River) were caught in the ocean from northern California to Alaska, with Oregon and Washington together accounting for about 78% of the total catch in the ocean (Table 8b). The northward shift in the catch distribution of this stock is consistent with the distance that the stock was moved, rather than with the ocean catch distribution of north coastal or lower Columbia River stocks, thus indicating that the ocean migration pattern of this stock is heritable.

Timing of Return and Spawning

Chinook salmon enter the Chetco River from early September through late December with a peak usually during the last week in October. Spawning takes place from mid-October through mid-January with a peak usually during the last week in November or the first week in December.

Age Composition of Spawners

We have tentatively classified Chetco River chinook salmon as mid-maturing, even though female maturation was greater at age 5 than at age 4 in the two age composition data sets that are presently available for this stock (Table II.9). These two samples plus anecdotal observations of chinook salmon broodstock collected from the Chetco River indicate that female maturation at ages 3 and 6 is rare, and most females are either age 4 or age 5. Although one age 2 female was noted in the 1966 sample, we believe that notation may have been an error. We found no instance of an age 2 female chinook salmon in the hatchery spawning records for this stock from approximately 1968 to 1986.

Table II.8a. Distribution of ocean catch of Chetco River fall-run chinook salmon released in the Chetco River. Values are percentages of the total estimated catch (4,525 fish) from 7 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska						
British Columbia	<0.5	1	1	<0.5		2
Washington		<0.5	2	<0.5		2
Oregon	1	38	17	1		57
California		6	33	<0.5		39
Total at age	1	45	53	1		

Table II.8b. Distribution of ocean catch of Chetco River fall-run chinook salmon released in the Klatskanine River. Values are percentages of the total estimated catch (1,379 fish) from 1 release group. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska					<0.5	
British Columbia	<0.5	3	6	1		10
Washington		16	15	6		37
Oregon		18	22	1	<0.5	41
California			8	2		10
Total by age		37	51	10		

Table II.9. Percent age composition for Chetco River fall-run chinook salmon, 1966 and 1986. Samples were from spawning ground surveys. Sample for 1966 was for wild fish. Sample for 1986 may have included some hatchery fish.

Number, age	1966 Males	1966 Females	1986 Males	1986 Females
Number of fish in sample	51	40	21	22
Age 2	57	3	29	0
Age 3	27	5	43	0
Age 4	12	33	14	45
Age 5	2	60	14	55
Age 6	2	0	0	0

Size at Age of Spawners

The size at age of Chetco River spawners is shown in Table II.10.

Table II.10. Mean fork length (cm) at age for Chetco River fall-run chinook salmon. All samples for 1969, 1970, and for ages 4 and 5 in 1971 are for wild fish. Samples for age 3 in 1971 and all samples for 1980 and 1985 include both hatchery and wild fish.

Number, age	1969 Males	1969 Females	1970 Males	1970 Females	1971 Males	1971 Females
Number of fish in sample	0	21	0	24	41	120
Age 2	--	--	--	--	--	--
Age 3	--	--	--	--	73.8	75.5
Age 4	--	89.2	--	87.9	--	89.0
Age 5	--	--	--	94.4	--	96.3

Number, age	1980 Males	1980 Females	1985 Males	1985 Females
Number of fish in sample	132	94	172	169
Age 2	49.7	--	53.6	--
Age 3	67.8	75.4	75.0	78.9
Age 4	84.6	86.7	90.7	88.9
Age 5	94.5	92.6	93.0	94.6

Fecundity and Egg Size

Table II.11 contains regression equations that relate fecundity and relate egg diameter to fork length of fall-run fish from the Chetco River. Table II.12 contains examples of values predicted by these equations. This stock has relatively low size-specific fecundity and large size-specific egg diameter when compared with other Oregon coastal chinook salmon.

Table II.11. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Chetco River fall-run chinook salmon.

Variable, year	*N*	Regression equation	R^2
Fecundity:			
1972	123	$F = 15.098\ L^{1.26054}$	0.230
1973	17	$F = 30.883\ L^{1.0856}$	0.307
1984	85	$F = 0.0922\ L^{2.3839}$	0.463
Egg diameter:			
1972	117	$D = 1.2193\ L^{0.4421}$	0.465
1984	97	$D = 1.2075\ L^{0.4414}$	0.321
1985	25	$D = 1.1820\ L^{0.4489}$	0.445

Table II.12. Examples of number and of diameter (mm) of eggs of Chetco River fall-run chinook salmon predicted from regression equations listed in Table II.11.

Variable, year	Fork length (cm)				
	60	70	80	90	100
Number of eggs:					
1972	2,632	3,196	3,783	4,388	5,011
1973	2,630	3,110	3,595	4,085	4,580
1984	1,597	2,307	3,178	4,200	5,399
Diameter of eggs:					
1972	7.45	7.98	8.46	8.92	9.34
1984	7.36	7.87	8.35	8.80	9.22
1985	7.43	7.96	8.45	8.91	9.34

COOS RIVER

The Coos River basin supports a population of wild chinook salmon that has been increasing in number and in distribution throughout the system from an extremely depressed condition during the mid-1950s. In addition to these wild fish, a private hatchery located on Coos Bay has been propagating an increasing number of chinook salmon during the last decade. This hatchery has released native Coos River and nonnative stocks but is now emphasizing production of Rogue River spring-run fish. The total return of chinook salmon to the Coos River basin is dominated by Rogue stock fish returning to the private hatchery. Some of these hatchery fish stray and spawn in the system, and some are probably interbreeding with wild Coos River chinook salmon. These events may cause changes in the life-history characteristics of naturally spawned and reared Coos River chinook salmon. We will only present information on fall-run Coos River fish.

Juveniles--Fall-run

Distribution

In the spring, juvenile chinook salmon are present throughout the Coos River basin including the lower reaches of West Fork Millicoma River, East Fork Millicoma River, South Fork Coos River, Williams River, and Tioga Creek. Sampling conducted throughout the basin has been sufficient to demonstrate that nearly all juveniles migrate from the riverine to the tidal reaches of the Millicoma and South Coos rivers from late May through June, and then continue to migrate downstream through the tidal reaches of the system into the lower bay. Very few juvenile chinook salmon remain in the upper tidal reaches of the system after July. Juveniles are present in lower Coos Bay from at least June through September.

Length and Abundance

Most of the information about the length and abundance of juveniles in the Coos River basin is based on fish sampled in the upper tidal reaches of the Millicoma and South Coos rivers. The mean fork length of juveniles typically ranges from 6 to 8 cm when they are most abundant in the upper tidal reaches of the system (Table II.13). The mean fork length of juveniles sampled with standard seines in the lower estuary during September 1980 was about 13 cm. The mean fork length of juvenile chinook salmon sampled by angling with nickel-plated trolling spoons about 3/4-inch long in the shipping channel during September was about 16 cm, including individuals up to 21 cm. The difference in the size of juveniles sampled onshore and offshore in Coos Bay suggests that juveniles may move offshore as they grow larger. Juveniles are abundant only in the lower riverine reaches of the basin in April and May and in the upper tidal reaches in May and June.

Table II.13. Data on catches of juvenile chinook salmon in three sections of the Coos River estuary, 1980. FL = fork length.

Upper estuary			Middle estuary			Lower estuary		
Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)
20 May	179	6.4	2 Jul	28	8.3	11 Jul	30	9.4
5 Jun	106	6.6	29 Jul	16	7.9	30 Jul	17	9.8
3 Jul	118	7.9	12 Aug	25	9.3	13 Aug	58	11.0
16 Jul	123	8.0	27 Aug	28	10.5	28 Aug	35	11.6
15 Aug	24	8.2				12 Sep	13	13.0

Age at Ocean Entrance

Sampling in the tidal reaches of the Millicoma and South Coos rivers in May has been extensive, and although yearling coho salmon are commonly captured in seines here, no yearling chinook salmon have been observed in catches. We believe that practically all juvenile chinook salmon in this river basin migrate to the ocean as underyearlings. A sample of 169 adults that returned to the Coos system in 1980 was examined to evaluate age at ocean entrance. Preliminary analysis indicated that 168 fish from this sample entered the ocean as underyearlings.

Size at Ocean Entrance

No analyses have been conducted to estimate the size at which Coos River juveniles enter the ocean. These analyses will probably be complicated by the similarity of the physical environment in the lower estuary with the environment in the ocean. Wild underyearling juveniles as large as 21 cm have been sampled in lower Coos Bay during early September. Thus, some juveniles are reaching an unusually large size by rearing within the Coos estuary before migrating to the ocean.

Adults--Fall-run

Distribution of Catch in the Ocean

Ocean tag recovery data are limited for Coos River fish; however, data are sufficient to demonstrate that this is generally a north-migrating stock. Collective recoveries from three Ad+CWT groups occurred at ages 2-6 from California to Alaska. By far the greatest part of the catch occurred in British Columbia at ages 3 and 4 (Table II.14).

Table II.14. Distribution of ocean catch of Coos River fall-run chinook salmon released in Coos Bay. Values are percentages of the total estimated catch (197 fish) from 3 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska	2	1				3
British Columbia	6	36	25	4		71
Washington		3				3
Oregon	4	15	1			20
California		3				3
Total at age	12	58	26	4		

Timing of Return and Spawning

Coos River fish enter the system from mid-July through November, and peak return to the system probably occurs in early October. Spawning takes place from early October through December and usually peaks in early November.

Age Composition of Spawners

We tentatively classify Coos River chinook salmon as mid-maturing, with a strong tendency to produce age 2 males. Scales have been collected from spawning grounds and at a fish trap in the Coos River system in most years since about 1980. Preliminary analysis of these scales has demonstrated that whereas some females mature at age 3, most mature at age 4, and that most males mature at ages 2 through 4. We do not present a table of these data because we are not sure to what extent the samples may include stray hatchery chinook salmon from a variety of stocks.

Size at Age of Spawners

Collections of scales from chinook salmon in the Coos River basin have not been analyzed to document the average age-specific size of spawners.

Fecundity and Egg Size

Size-specific fecundity and egg size data are not available for this stock.

COQUILLE RIVER

The Coquille River supports populations of spring- and fall-run chinook salmon. Spring-run fish are rare in the system, however, and we have no information regarding their juvenile or adult life history. Consequently, the following narrative will be restricted to information about fall-run chinook salmon in this basin.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present in the low gradient reaches of the North, East, Middle, and South forks of the Coquille River through at least June, but we believe that most of these fish have migrated to the estuary by mid-July. Although limited sampling of juveniles has occurred throughout the basin, most of this work was done in the South Fork and in tidal-influenced reaches of the mainstem. Juveniles were present in freshwater tidal reaches of the mainstem as early as mid-March but were not present in the high salinity lower estuary until late May or early June. Juveniles were present in the lower estuary through at least September.

Length and Abundance

The mean fork length of juveniles sampled in the lower Coquille River estuary was about 8-9 cm during June in 1978 and 1979 (Table II.15), and ranged between 11 and 12 cm during September in 1978-87 (Table II.16). The mean annual (September) fork length of juveniles in the lower estuary was 11.2 cm. The mean length of juveniles was almost always greater at sample sites lower in the river system than at sample sites higher in the system.

In June, juveniles were abundant in riverine, upper tidal, and lower tidal reaches of the basin, but by August juveniles were abundant only in the lower estuary. Limited sampling in recent years indicates that abundance of chinook salmon juveniles may have remained higher in riverine and upper tidal reaches during summers that were relatively "cool" in response to slightly lower water temperature.

Age at Ocean Entrance

Yearling juveniles have been observed only rarely during sampling in the estuary in late May. Several collections of scales from Coquille River chinook salmon have been examined to evaluate age at ocean entrance. Approximately 1% of the scale samples examined may have had a yearling ocean-entrance life history pattern (Table II.17).

Table II.15. Data on catches of juvenile chinook salmon in the Coquille River estuary, 1978 and 1979.

Date	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978:				
8 Jun	247	8.6	5	62
6 Jul	206	8.4	4	107
3 Aug	153	8.6	5	57
29 Aug	106	9.7	7	15
15 Sep	118	10.8	7	17
18 Oct	82	12.1	8	10
1979:				
15 Jun	76	8.4	4	19
28 Jun	121	8.4	3	45
25 Jul	145	9.3	5	29
7 Aug	171	9.9	4	43
7 Sep	53	10.3	5	11
21 Sep	55	11.0	5	11

Table II.16. Data on catches of juvenile chinook salmon in the Coquille River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (15)	118	10.8	7	17
1979 (21)	55	11.0	5	11
1980 (15)	104	10.9	6	17
1981 (17)	112	11.3	8	18
1982 (18)	100	11.1	2	61
1983 (9)	52	11.1	6	9
1984 (10)	47	11.3	7	7
1985 (13)	69	10.7	4	17
1986 (16)	64	11.9	2	32
1987 (21)	78	11.5	2	39

Table II.17. Data on the occurrence of a yearling life history pattern in samples of scales from Coquille River chinook salmon, 1978, 1980, and 1986. Data are for samples collected from spawning ground surveys.

Year	Number of samples examined	Samples that may have yearling life history pattern	
		Number	Percent
1978	300	5	1.7
1980	237	2	0.8
1986	222	1	0.5

Size at Ocean Entrance

A preliminary scale analysis study indicated that returning 1976 brood chinook salmon entered the ocean as underyearlings at a mean fork length of about 13.7 cm. Judging from the size of juveniles sampled in the estuary during September in 1978-87, many fish were not migrating to the ocean until they exceeded 11 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Reliable data on ocean recoveries of Ad+CWT marked Coquille River fish are not available.

Timing of Return and Spawning

Fall-run chinook salmon enter the Coquille River basin from mid-July through mid-December with a peak usually in early October. Spawning takes place from early October through mid-January with a usual peak in mid-November.

Age Composition of Spawners

We classify Coquille River fall-run fish as mid-maturing. Age 2 males are common in the returning population. Very few females mature at age 3, and most usually mature at age 4 (Table II.18).

Table II.18. Percent age composition for Coquille River fall-run chinook salmon, 1978, 1980, and 1986. Data are for samples collected from spawning ground surveys.

Number, age	1978		1980		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	97	123	142	53	120	91
Age 2	29	0	61	0	15	0
Age 3	23	8	14	4	42	8
Age 4	42	69	24	79	18	32
Age 5	5	22	1	17	24	58
Age 6	1	1	0	0	1	2

Size at Age of Spawners

The size at age of Coquille River spawners is shown in Table II.19.

Table II.19. Mean fork length (cm) at age for Coquille River fall-run chinook salmon, 1978, 1980, and 1986. Data are for samples collected from spawning ground surveys. The original MEPS length measurements have been converted here to fork length.

Number, age	1978		1980		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	93	120	142	53	119	89
Age 2	48.0	--	47.3	--	47.4	--
Age 3	75.4	75.4	75.5	--	74.1	69.8
Age 4	90.8	86.3	89.1	85.6	92.9	87.5
Age 5	102.6	95.4	--	94.4	100.9	94.3
Age 6	--	--	--	--	--	--

Fecundity and Egg Size

Size-specific fecundity and egg size data are not available for this stock.

ELK RIVER

Elk River supports a population of fall-run chinook salmon; however, the run timing of this stock is so late in the year that it is often referred to as a winter run. In this report we will only refer to Elk River chinook salmon as fall-run fish.

The Elk River basin has been the focus of research since 1968 to document the life history traits and population dynamics of wild and hatchery chinook salmon. The information presented in this section represents a brief sample of data that are available and is limited to a discussion of wild fish. Information about the studies done at Elk River and about many experiments with hatchery fish is available in ODFW files and internal reports.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon rear throughout the entire mainstem and accessible reaches of tributaries such as North Fork Elk River, Red Cedar Creek, Panther Creek, Bald Mountain Creek, Anvil Creek, and Rock Creek, and in the small, ephemeral estuary. Juveniles are usually present throughout the river basin at least through mid-September.

Length and Abundance

The mean fork length of juvenile chinook salmon sampled in Elk River estuary is usually 7-8 cm in July and 9-11 cm in September (Tables II.20 and II.21).

Table II.20. Data on catches of juvenile chinook salmon in lower Elk River, 1977, 1979, and 1985. FL = fork length.

1977			1979			1985		
Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)	Date	*N*	Mean FL (cm)
6 Jul	69	8.4	5 Jul	94	6.7	26 Jun	120	7.7
28 Jul	95	9.0	25 Jul	133	8.1	9 Jul	189	7.5
17 Aug	87	9.3	14 Aug	235	8.8	24 Jul	132	8.6
9 Sep	66	10.3	7 Sep	117	9.4	9 Aug	205	8.7
28 Sep	71	10.2	4 Oct	84	10.5	23 Aug	136	8.8
						5 Sep	112	8.7

Table II.21. Data on catches of juvenile chinook salmon in the Elk River estuary, 1979, 1981-82, and 1984-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1979 (7)	117	9.4	1	1,044
1981 (18)	99	9.8	2	148
1982 (14)	200	11.0	1	461
1984 (4)	100	9.7	2	1,500
1985 (5)	112	8.7	1	510
1986 (15)	38	10.1	5	8
1987 (17)	408	9.5	2	390

Sampling in Elk River basin has been extensive and has shown several characteristic features of the juvenile population.

1. Juveniles are most abundant in the system as a whole during early May, corresponding with peak emergence.

2. Annual variation in abundance is large. For example, a Humphreys trap was operated at river mile 13 during 1985, 1986, and 1987 to estimate the number of juvenile chinook salmon migrating downstream. Estimates in the three consecutive years indicated that about 240 thousand, 25 thousand, and 92 thousand juveniles, respectively, migrated downstream past the trap location. A Humphreys trap located about 1/2 mile above the head of tidewater was also operated during 1986 and 1987. This work indicated that about 118 thousand juvenile chinook salmon migrated downstream past the trap location in 1986 and about 413 thousand juveniles migrated past the trap in 1987.

3. Size and abundance of juveniles are inversely correlated. In years with higher abundance, juveniles are smaller during mid- and late summer.

4. The mean length of juveniles was almost always greater at sample sites lower in the river system than it was at sample sites higher in the river system. This difference was commonly 2-3 cm within the lower 20 miles of the mainstem.

5. Some juveniles are migrating downstream throughout the summer. Many juveniles may be entering the ocean as early as July at a size barely exceeding 8 cm.

6. When the estuarine environment is available, many juveniles will reside in the estuary for periods exceeding 1 month.

Age at Ocean Entrance

Nearly all the mature chinook salmon that return to Elk River entered the ocean as underyearlings; however, yearling migrants consistently compose a small percentage of the returning population (Table II.22). Although data are not conclusive, a yearling life history pattern in Elk River may be less common in recent years than it was in the period 1968-75. Yearling migrants tend to return to the river at ages 5 or 6.

Table II.22. Data on the occurrence of a yearling life history pattern in samples of scales from Elk River chinook salmon, 1968-85.

Year	Number of samples examined	Samples that may have yearling life history pattern: Number	Samples that may have yearling life history pattern: Percent
1968	296	54	18.2
1969	254	22	8.7
1970	924	25	2.7
1971	327	13	4.0
1972	260	8	3.1
1973	238	9	3.8
1974	144	3	2.1
1975	80	3	3.8
1976	90	0	0
1977	440	0	0
1978	460	0	0
1979	439	1	0.2
1980	224	1	0.4
1981	141	2	1.4
1982	390	0	0
1983	318	0	0
1984	232	0	0
1985	157	1	0.6

Size at Ocean Entrance

Our information is based on data from seining in the river and estuary, data from a Humphreys trap located a short distance above the estuary, and analysis of scales taken from returning adults. Seining and trap data indicate that juveniles migrate to the ocean at a size greater than 7 cm from as early as May through October, with a peak usually during July.

Scale analysis indicates that returning 1974 brood-year fish entered the ocean at a size ranging from about 8 to about 17 cm (fork length) with a mean of about 11 cm (fork length). Table II.23 shows the results of an analysis of size at ocean entrance for the 1974 brood.

Table II.23. Estimated fork length (cm) at ocean entrance of Elk River fall-run chinook salmon, 1974 brood year.

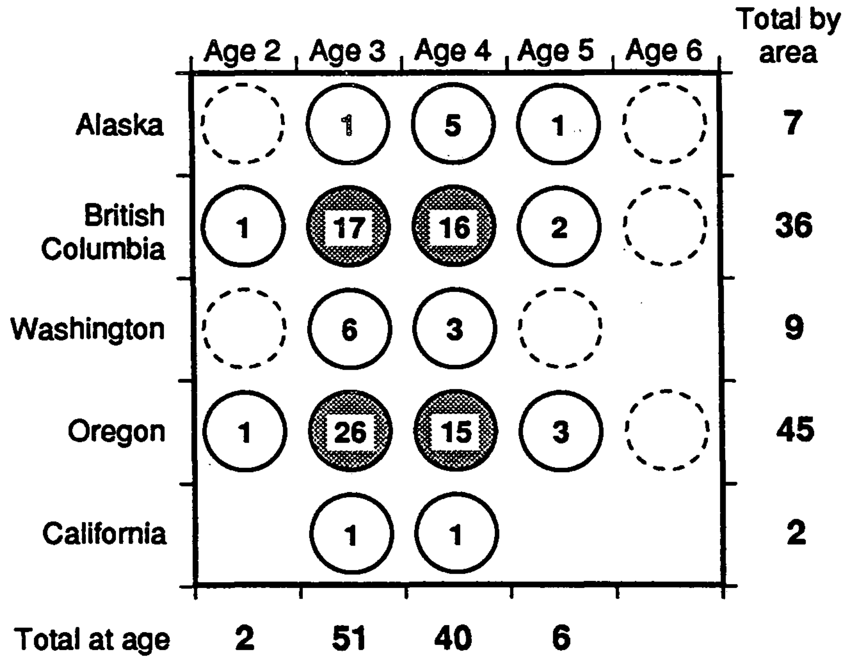
Age at return	*N*	Minimum length	Maximum length	Mean length
2	51	8.9	16.6	11.4
3	39	8.3	15.4	11.3
4	70	8.9	17.5	11.3
5	25	9.8	14.1	11.4

Adults--Fall-run

Distribution of Catch in the Ocean

Elk River chinook salmon are a north-migrating stock and are caught from California to Alaska at ages 2-6. The greatest part of the catch occurs in Oregon and British Columbia at ages 3 and 4 (Table II.24). Contribution of this north migrating stock to Oregon ocean fisheries is unusually large in relation to other stocks for which we have data to make comparisons. We believe that the catch of these fish in Oregon coastal waters is due to two factors. First, we believe that Elk River fish that are destined to mature at age 3 have a more southerly ocean distribution and are therefore more accessible to capture in Oregon fisheries than fish that are destined to mature at older ages. Second, a geographically localized ocean commercial season at the mouth of Elk River catches maturing wild and hatchery chinook salmon during October and November. Almost all Oregon landings of age 4 and age 5 fish are made during this late season fishery at the mouth of Elk River. In contrast, many age 3 fish are caught in the ocean off Oregon during the normal (June-September) commercial fishing season.

Table II.24. Distribution of ocean catch of Elk River fall-run chinook salmon released in Elk River. Values are percentages of the toal estimated catch (7,359 fish) from 10 release groups. Values >10% are shaded for emphasis. Dashed circles indicate < 0.5%.



Timing of Return and Spawning

Chinook salmon enter Elk River from early October through mid-January with a peak usually during mid-November. These fish spawn from early November through mid-March with a peak usually during late December. A commercial troll fishery usually operates near the mouth of Elk River in October and November. Judging from the catch of coded-wire tagged fish landed in this fishery, maturing Elk River fish do not begin congregating near the river mouth until mid- to late October.

Age Composition of Spawners

We classify Elk River chinook salmon as mid-maturing. Extensive age composition data are available for wild fish from brood years 1968-77. Age 2 males composed from 10% to 76% of males that returned from individual brood years, no females matured at age 2, and only 6% to 19% of females returned at age 3. Age 4 was always the dominant age of return for females. The average age composition for these 10 brood years is presented in Table II.25.

Table II.25. Average percent age composition for Elk River fall-run chinook salmon, 1968-77 brood years. Values represent overall average of annual percentages for each brood year.

Number, age	Males	Females
Number of fish in sample	21,616	10,346
Age 2	51.5	0
Age 3	21.6	10.8
Age 4	18.7	60.3
Age 5	6.9	27.3
Age 6	1.3	1.6

Size at Age of Spawners

The size at age of Elk River spawners is shown in Table II.26.

Table II.26. Mean fork length (cm) at age for Elk River fall-run chinook salmon, 1968-70, and 1980-81. The samples included fish observed on spawning grounds, fish spawned at Elk River Hatchery, and fish captured and released at the mouth of the river. Some MEPS lengths were converted to fork lengths.

Number, age	1968		1969		1970	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	169	233	120	183	544	167
Age 2	49.8	--	48.2	--	50.4	--
Age 3	74.7	76.1	75.1	77.6	76.6	78.6
Age 4	91.3	87.3	88.2	86.4	93.4	89.8
Age 5	102.6	92.5	101.6	94.2	104.4	95.2
Age 6	--	--	--	98.0	--	--

Number, age	1980		1981	
	Males	Females	Males	Females
Number of fish in sample	128	57	124	125
Age 2	48.0	--	48.2	--
Age 3	72.2	73.3	73.5	78.5
Age 4	87.1	84.5	91.9	89.0
Age 5	101.1	93.8	101.5	95.3
Age 6	105.0	97.9	--	--

Fecundity and Egg Size

Table II.27 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish from Elk River. Table II.28 contains examples of values predicted by these equations. Much additional data for this stock are presently being analyzed and will be the subject of a forthcoming report by Hankin and others.

Table II.27. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Elk River fall-run chinook salmon. Fecundity regressions calculated from 1972, 1973, and 1984 returns. Egg diameter regressions calculated from 1972, 1984, and 1985 returns. All samples probably contain both wild and hatchery fish.

Variable, year	*N*	Regression equation	R^2
Fecundity:			
1972	182	$F = 0.6887\ L^{1.9711}$	0.522
1973	271	$F = 14.872\ L^{1.2912}$	0.334
1984	205	$F = 1.1636\ L^{1.8555}$	0.433
Egg diameter:			
1972	186	$D = 1.1800\ L^{0.4411}$	0.431
1984	182	$D = 2.2814\ L^{0.2923}$	0.193
1985	32	$D = 1.0796\ L^{0.4560}$	0.636

Table II.28. Examples of egg number and of diameter (mm) of eggs of Elk River fall-run chinook salmon predicted from regression equations listed in Table II.27.

Variable, year	Fork length (cm)			
	70	80	90	100
Number of eggs:				
1972	2,984	3,882	4,897	6,028
1973	3,587	4,262	4,693	5,686
1984	3,085	3,953	4,918	5,981
Diameter of eggs:				
1972	7.69	8.15	8.59	9.00
1984	7.90	8.21	8.50	8.77
1985	7.49	7.96	8.40	8.81

EUCHRE CREEK

The Euchre Creek system supports a population of fall-run chinook salmon. Few data are available with which to document the life history traits of this stock. Fall-run adults are present in the system from at least October through January and spawn in at least November, December, and January.

FLORAS CREEK-NEW RIVER

The Floras Creek-New River system supports a population of fall-run chinook salmon. Few data are available with which to document characteristic life history traits of this stock. Underyearling juveniles are present in Floras Creek at least in spring and early summer, and are present in New River estuary through at least early fall. Adults enter the system from October through December with a peak usually in late November. These fish spawn from mid-November through January with a peak usually during mid-December. Based on the geographic location of this system, we surmise that these chinook salmon are north-migrating and mid-maturing.

HUNTER CREEK

Hunter Creek supports a population of fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout most of the mainstem from emergence in April or May through at least early summer. They are present in the estuary from about May through at least mid-September.

Length and Abundance

The mean fork length of juveniles sampled in the estuary during September in 1973 and 1974 was about 7.5 and 8.5 cm, respectively. Data that are available regarding sampling in the Hunter Creek system are not sufficient to allow us to comment on the abundance of juveniles in particular stream reaches.

Age at Ocean Entrance

All of the juvenile chinook salmon sampled in the system during 1973 and 1974 were underyearlings. We believe that practically all juveniles in this system migrate to the ocean as underyearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of surviving adults. Judging from the juveniles present in the estuary in 1973 and 1974, many entered the ocean as early as July at a fork length barely exceeding 7 cm, and some entered the ocean as late as October at a fork length between 8 and 10 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Hunter Creek chinook salmon have not been coded-wire tagged to assess geographic distribution of catch.

Timing of Return and Spawning

Chinook salmon enter Hunter Creek from mid-September through late December with a peak usually during early November. These fish spawn from November through mid-January with a peak usually during early December.

Age Composition of Spawners

We tentatively classify Hunter Creek fish as mid-maturing. Analysis of scales taken from 72 unsexed fish examined during spawning ground surveys in 1972 indicated that age 2, 3, 4, and 5 fish composed 15%, 3%, 67%, and 15%, respectively, of the sample.

Size at Age of Spawners

Data on the age-specific size of Hunter Creek chinook salmon are not available.

Fecundity and Egg Size

Fecundity and egg size data are not available for this stock.

KILCHIS RIVER

The Kilchis River system supports a population of fall-run chinook salmon and may also produce a small population of spring-run fish. Few data are available to document the characteristic life history traits of this stock. Underyearling juveniles are present in the system through at least early summer and probably also rear in Tillamook Bay prior to entering the ocean. Fall-run adults enter the system from September through mid-February with a peak usually during mid-October. These fish spawn from October through mid-March with a peak usually during early December. Based on the geographic location of this system, we surmise that these chinook salmon are north-migrating and late-maturing.

MIAMI RIVER

The Miami River system supports a population of fall-run chinook salmon. Few data are available to document the life history traits of this stock. Underyearling juveniles are present in the system through at least early summer and probably also rear in Tillamook Bay prior to entering the ocean. Adults enter the system from September through mid-January with a peak usually during mid-October. These fish spawn from October through February with a peak usually during late November. Based on the geographic location of this system, we surmise that these chinook salmon are north-migrating and late-maturing.

NEHALEM RIVER

The run-timing of chinook salmon in the Nehalem River system is so early that it is often referred to as a summer- rather than a fall-run stock. We believe that the run of chinook salmon in this system includes discrete summer- and fall-run segments. However, we have no data with which to distinguish between life histories of summer- and fall-run fish. We have chosen to present available life history data under the heading fall-run even though the distinction is not clear.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout at least the lower 100 miles of the mainstem at least through mid-September and are present in the lower estuary from late spring through at least mid-September.

Length and Abundance

The mean fork length of juveniles sampled in the Nehalem River estuary ranged from about 11 to about 15 cm during September 1978-87 (Table II.29). The mean annual September fork length was 12.4 cm. During September 1980 the mean fork length of juveniles sampled in the mainstem above the head of tide and of juveniles sampled in the lower estuary was about 9 cm and about 12 cm, respectively. The mean fork length of juveniles sampled by angling with nickel-plated trolling spoons about 3/4-inch long in mid-channel during September 1980 was 13.7 cm, whereas the mean fork length of juveniles sampled with a beach seine on the same date was 12.1 cm. The ranges in length of juveniles sampled by the two methods were similar, however. Sampling in the basin has not been sufficient to comment on the relative abundance of juveniles in various stream reaches.

Age at Ocean Entrance

Juveniles sampled in the Nehalem estuary during July and September wereunderyearlings. We believe that practically all of these fish migrate to the ocean as underyearlings. Analysis of scales collected from a total of 127 spawned-out carcasses in 1985 and 1986 indicated that 126 fish had migrated to the ocean as underyearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of mature fish that return to the Nehalem River. Judging from the juveniles present in the estuary in September, many juveniles that rear in the Nehalem basin enter the ocean at a fork length between 10 and 16 cm.

Table II.29. Data on catches of juvenile chinook salmon in the Nehalem River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (25)	55	12.1	8	7
1979 (17)	53	12.1	4	13
1980 (8)	106	12.0	5	21
1981 (13)	89	12.4	9	10
1982 (14)	126	11.4	7	18
1983 (5)	12	14.5	14	1
1984 (7)	52	13.7	5	10
1985 (10)	74	10.5	5	15
1986 (18)	22	12.0	3	7
1987 (20)	114	13.4	3	38

Adults--Fall-run

Distribution of Catch in the Ocean

Nehalem River chinook salmon have not been coded-wire tagged to assess geographic distribution of catch.

Timing of Return and Spawning

Chinook salmon enter Nehalem Bay from at least July through October with a peak entrance into the Nehalem River usually during late September. These fish spawn from early October through mid-December with a peak usually in early November.

Age Composition of Spawners

We tentatively classify Nehalem River chinook salmon as late-maturing. Limited age composition data indicate that females mature predominantly at age 5 and that production of age 2 males is relatively low in this stock (Table II.30).

Table II.30. Percent age composition for Nehalem River fall-run chinook salmon. Values represent combined samples from spawning grounds in 1985 and 1986.

Number, age	Males	Females
Number of fish in sample	52	75
Age 2	4	0
Age 3	23	0
Age 4	31	20
Age 5	42	73
Age 6	0	7

Size at Age of Spawners

The size at age of Nehalem River spawners is shown in Table II.31.

Table II.31. Mean fork length (cm) at age for Nehalem River fall-run chinook salmon. Values represent combined samples from spawning grounds in 1985 and 1986. The original MEPS lengths have been converted to fork length.

Number, age	Males	Females
Number of fish in sample	50	75
Age 2	--	--
Age 3	77.4	--
Age 4	93.7	92.4
Age 5	105.5	97.8
Age 6	--	101.4

Fecundity and Egg Size

Fecundity and egg size data are not available for this stock.

NESTUCCA RIVER

The run-timing of chinook salmon in the Nestucca River basin covers a broad period of time. Local anglers often refer to runs of spring-, summer-, and fall-run fish in this system, and we believe that these represent essentially distinct stocks within the overall population. Fall-run fish are much more abundant than either spring- or summer-run fish. However, we have few data with which to clearly distinguish characteristic life history traits for these three runs of chinook salmon in the Nestucca. The following narrative presents the information that is available for Nestucca River chinook salmon, organized under headings for fall-run and for "early-run" fish.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout at least the lower 40 miles of the Nestucca River through September, the lower mainstem of Three Rivers and the Little Nestucca River through at least June, and the lower estuary from late spring through at least October.

Length and Abundance

The mean fork length of juveniles sampled in the Nestucca River estuary ranged from about 9 to about 12 cm during September 1978-87 (Table II.32). The mean annual (September) fork length was 10.5 cm.

Table II.32. Data on catches of juvenile chinook salmon in the Nestucca River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (26)	113	11.8	1	113
1979 (18)	79	10.1	3	26
1980 (9)	100	9.7	1	130
1981 (14)	50	10.0	1	125
1982 (15)	208	10.0	3	176
1983 (6)	152	10.8	3	106
1984 (8)	89	11.7	4	33
1985 (11)	112	9.4	2	56
1986 (17)	99	10.8	3	80
1987 (19)	180	11.0	2	101

Juveniles usually are abundant in riverine, upper tidal, and lower tidal reaches of the basin in June and September, although in September juveniles are relatively more abundant in the lower river than in the upper river. By mid-October, juveniles usually are only abundant in the estuary.

Age at Ocean Entrance

Juveniles sampled in the Nestucca River and estuary in June, September, and October during 1978-87 were underyearlings. We believe that practically all surviving fall-run fish enter the ocean as underyearlings. We also believe that yearling migrants are a small (perhaps 5%-10%) but consistent component of the fall-run population that returns to the system. A recent analysis of scales from 80 fall-run fish indicated that 5 had migrated to the ocean in the spring as yearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of returning Nestucca River chinook salmon. Judging from the juveniles present throughout the system in September, many juveniles rear in freshwater and estuarine reaches of the basin and enter the ocean at a size between 9 and 13 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Ocean tag recovery data are limited for Nestucca River fish. However, data are sufficient to demonstrate that this is a north-migrating stock. Collective recoveries of three Ad+CWT groups of fall-run fish released in the Nestucca were made exclusively in Alaska and British Columbia (Table II.33). When Nestucca River fall-run fish were released at Coos Bay, some were caught in Washington, Oregon, and California fisheries as well as in Alaska and British Columbia fisheries, and almost 90% of the catch occurred at ages 3 and 4 (Table II.34).

Timing of Return and Spawning

Chinook salmon enter the Nestucca River system from about April through mid-January. The peak entrance of fall-run fish apparently occurs in mid-October. Chinook salmon spawn in the system from September through January. The peak spawning period is apparently in mid-December.

Age Composition of Spawners

We tentatively classify Nestucca River fall-run fish as late maturing. The recreational fishery typically produces catches of 50- and 60-pound fish each year from August through November. The age distribution of catch of fall-run fish in the ocean indicates a late maturing stock, as does the age

Table II.33. Distribution of ocean catch of Nestucca River fall-run chinook salmon released in the Nestucca River. Values are percentages of the total estimated catch (441 fish) from 3 release groups. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska	1	17	33	21	3	75
British Columbia		6	12	5	1	24
Washington						
Oregon						
California						
Total at age	1	23	45	26	4	

Table II.34. Distribution of ocean catch of Nestucca River fall-run chinook salmon released in Coos Bay. Values are percentages of the total estimated catch (197 fish) from 1 release group. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		4	5	4		13
British Columbia	7	25	33	2		67
Washington		5	4			9
Oregon		10				10
California		2				2
Total at age	7	46	42	6		

distribution of a sample of fish collected from spawning grounds in 1986 (Table II.35). Females matured predominantly at age 5 and were almost as common at age 6 as they were at age 4.

Table II.35. Percent age composition for Nestucca River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986, and may include some hatchery fish.

Number, age	Males	Females
Number of fish in sample	47	73
Age 2	8	0
Age 3	11	0
Age 4	42	29
Age 5	26	49
Age 6	13	22

Size at Age of Spawners

Data on age-specific size of fall-run fish from the Nestucca River are presented in Table II.36.

Table II.36. Mean fork length (cm) at age for Nestucca River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986, and may include some hatchery fish.

Number, age	Males	Females
Number of fish in sample	43	73
Age 2	--	--
Age 3	69.8	--
Age 4	93.3	87.4
Age 5	108.3	97.7
Age 6	116.6	101.1

Fecundity and Egg Size

Table II.37 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish from the Nestucca River. Table II.38 contains examples of values predicted by these equations. The relationship between fecundity and fork length was not significant for the 1986 sample, which consisted of fish from about 90 to about 110 cm fork length.

Table II.37. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Nestucca River fall-run chinook salmon, 1985-86. All samples probably contain both hatchery and wild fish.

Variable, year	*N*	Regression equation	R^2
Fecundity:			
1985	23	$F = 14.140\ L^{1.299}$	0.308
Egg Diameter:			
1985	23	$D = 0.9434\ L^{0.4901}$	0.679
1986	32	$D = 0.461\ L^{0.643}$	0.582

Table II.38. Examples of number and of diameter (mm) of eggs of Nestucca River fall-run chinook salmon, predicted from regression equations listed in Table II.37.

Variable, year	Fork length (cm)				
	70	80	90	100	110
Number of eggs:					
1985	3,525	4,193	4,886	5,603	6,342
Diameter of eggs:					
1985	7.57	8.08	8.56	9.02	9.44
1986	7.08	7.72	8.32	8.91	9.47

Juveniles--Early-run

Age at Ocean Entrance

Scales from a total of 87 early-run fish sampled in 1957 and 1958 were examined to evaluate age at ocean entrance. This analysis indicated that all of these fish entered the ocean as underyearlings. These scale samples were re-examined in 1987 and the conclusion of the original scale reader (Mr. Francis Sumner) was confirmed. We have no data or scale samples from contemporary early-run fish from the Nestucca River.

Adults--Early-run

Distribution of Catch in the Ocean

Ocean tag-recovery data are very limited for early-run Nestucca River fish. Tentatively, they appear to be north migrating. In contrast to fall-run fish, however, early-run fish were caught from Oregon through to Alaska, primarily at ages 3 and 4 (Table II.39).

Table II.39. Distribution of ocean catch of Nestucca River early-run chinook salmon released in the Nestucca River. Values are percentages of the total estimated catch (230 fish) from 1 release group. Values ≥10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		1	16	4		21
British Columbia	3	28	10	6		47
Washington	3	5	5	1		14
Oregon		1	15	2		18
California						
Total at age	6	35	46	13		

Timing of Return and Spawning

Chinook salmon enter the Nestucca River system from about April through mid-January. The peak entrance of early-run fish apparently occurs in June. Chinook salmon spawn in the system from September through January. The peak spawning period for early-run fish is apparently in late September.

Age Composition of Spawners

We tentatively classify Nestucca River early-run fish as late maturing. The recreational fishery commonly produces catches of 30- to 55-pound fish in the May-July period. Limited age composition data for early-run fish sampled in 1957-58 are presented in Table II.40. Female maturation was dominant at age 5.

Table II.40. Percent age composition for Nestucca River early-run chinook salmon. Data are for fish sampled during creel surveys and on spawning grounds in 1957 and 1958.

Number, age	Males	Females
Number of fish in sample	32	55
Age 2	9	0
Age 3	16	2
Age 4	41	35
Age 5	34	62
Age 6	0	2

Size at Age of Spawners

Data on age-specific size of early-run fish from the 1957-58 sample are in Table II.41. These data indicate that early-run chinook salmon in the Nestucca River are much larger than Rogue River spring-run fish of equal age.

Table II.41. Mean fork length (cm) at age for Nestucca River early-run chinook salmon. Data are for fish sampled during creel surveys and on spawning grounds in 1957 and 1958.

Number, age	Males	Females
Number of fish in sample	29	53
Age 2	--	--
Age 3	71.1	--
Age 4	89.1	88.9
Age 5	97.8	95.3

Fecundity and Egg Size

Data on fecundity and egg size are not available for early-run Nestucca River chinook salmon.

PISTOL RIVER

The Pistol River system supports a population of fall-run chinook salmon. Few data are available to document characteristic life history traits of this stock. Underyearling juveniles are present in Pistol River in at least spring and early summer, and are present in the small estuary through at least early fall. Adults enter the system from October through December with a peak usually during mid-November. These fish spawn from November through mid-January with a peak usually during early December.

Based on the geographic location of this system, we surmise that these chinook salmon are south-migrating and mid-maturing. Few jacks have been counted in spawning surveys.

Information on the age composition and age-specific size of Pistol River fish sampled on spawning grounds is presented in Tables II.42 and II.43, respectively.

Table II.42. Percent age composition for Pistol River fall-run chinook salmon. Samples were collected during spawning ground surveys in 1983.

Number, age	Males	Females
Number of fish in sample	16	44
Age 2	12	0
Age 3	13	5
Age 4	50	84
Age 5	25	11

Table II.43. Mean fork length (cm) at age for Pistol River fall-run chinook salmon. Samples were collected during spawning ground surveys in 1983.

Number, age	Males	Females
Number of fish in sample	8	36
Age 2	--	--
Age 3	--	--
Age 4	82.9	80.8
Age 5	--	--

ROGUE RIVER

The Rogue River contains both spring- and fall-run chinook salmon. Although some overlap exists in the time and area of spawning of these runs in the Rogue, they constitute reproductively discrete components of the overall chinook salmon population in the basin. Further, we believe that several reproductively discrete stocks occur within the fall-run segment of the population. Chinook salmon are more abundant in the Rogue River than in any other coastal river basin. A great deal of research has been done in this basin in an effort to evaluate and manage the effects of several dams that were constructed in the basin. One of the benefits of the research studies is that the life histories of chinook salmon in the basin are comparatively well documented. We present information in this section with the intent of providing a "thumbnail sketch" of characteristic life history traits of Rogue River chinook salmon. A great deal of additional data are available in ODFW files and internal reports, and we have not attempted to capture the full scope of this entire body of information. We have chosen to present separate organizational headings for fall- and spring-run fish in this river basin.

Juveniles--Fall-run

Distribution

Fall-run juveniles are present throughout the entire mainstem below Gold Ray Dam through at least September, and are also present in the mainstems of a number of large and small spawning tributaries including the Illinois and Applegate rivers, and Lobster, Evans, and Quosatana creeks, usually through at least June.

Length and Abundance

The mean fork length of juvenile chinook salmon sampled in the lower Rogue River (5 miles above the river mouth) in September 1974-82 ranged from 9 to 12 cm. These samples contained both fall- and spring-run juveniles. The mean annual (September) fork length of juveniles at this lower river location was 11.0 cm.

Juvenile fall-run fish are abundant in the entire mainstem below Gold Ray Dam where they comingle with juvenile spring-run fish, usually through September. Criteria are not available to distinguish juvenile fall-run from spring-run fish. Many or all of the general statements we make about juvenile spring-run fish in the Rogue River are probably true for fall-run fish as well.

Age at Ocean Entrance

Nearly all mature fall-run fish entered the ocean as underyearlings, but yearling migrants consistently composed a small percentage of the returning population (Table II.44). From 1974 through 1986 an average of 4.5% of the returning fall-run fish had a yearling life history.

Table II.44. Percentage of yearling migrants among fall-run chinook salmon that returned to the Rogue River, 1974-86.

Return year	Yearling migrants
1974	8.5
1975	3.6
1976	5.6
1977	4.6
1978	7.3
1979	2.6
1980	4.8
1981	3.5
1982	2.7
1983	2.7
1984	5.1
1985	1.3
1986	5.7

Size at Ocean Entrance

Estimates of the size at ocean entrance of surviving fall-run adults are available for brood years 1971-80. Underyearling juveniles typically entered the ocean at a fork length between 9 and 13 cm, with a mean of about 10.8 cm. Table II.45 presents information on estimated size at ocean entrance organized by age at return.

Table II.45. Estimated fork length (cm) at ocean entrance of underyearling fall-run chinook salmon from the Rogue River, brood years 1971-80. Minimum and maximum values are the shortest and longest annual mean values. The mean value represents the unweighted mean of all annual mean values.

Age at return	Minimum length	Maximum length	Mean length
2	10.0	11.6	10.7
3	10.2	11.5	10.8
4	10.0	11.3	10.7
5	10.2	11.7	10.9

Adults--Fall-run

Distribution of Catch in the Ocean

Ocean tag-recovery data are very scarce for Rogue fall-run fish; however, the available information indicates that they are a south-migrating stock. Catch of both Applegate and upper Rogue fish was split about evenly between California and Oregon, and more fish were caught at age 4 than at age 3 (Table II.46). Rogue River fall-run fish released in the lower Columbia River were caught primarily off Oregon, indicating that the south-migrating tendency of this stock is heritable (Table II.47).

Timing of Return and Spawning

Fall-run fish generally enter the Rogue from mid-July through at least October with a peak usually during late August or early September. Some of these fish will spawn in the mainstem above and below Gold Ray Dam, some will spawn in major tributaries such as the Applegate and Illinois rivers, and some will spawn in small tributaries such as Lobster, Evans, and Quosatana creeks. Based on tagging studies, the earliest entering fall-run fish are destined for the upriver mainstem spawning areas, and the latest entering fish are destined for the small spawning tributaries.

Spawning takes place from October through late November in the upper mainstem with a peak usually during late October. Applegate and Illinois fish apparently spawn from October through early January with a peak usually during November. Fall-run fish in small tributaries usually begin spawning after fall rains have increased streamflow, usually in late October or November.

Age Composition of Spawners

We believe that both early- and mid-maturing stocks of fall-run chinook salmon occur in the Rogue River basin.

Age composition data are available for the 1974-79 brood years from fish seined in the mainstem about 8 miles above the river mouth. These data are for unsexed fish and probably represent at least three substocks of fall-run fish (Table II.48). Returns in these brood years were strongest from ages 2 to 4. On the average, return at age 4 was dominant, and about 5% of the return was at age 5.

Table II.46 Distribution of ocean catch of Rogue River fall-run chinook salmon released in the Rogue River. Values are percentages of the total estimated catch (480 fish) from 1 release group. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska						
British Columbia						
Washington						
Oregon		28	21			49
California		37	13			50
Total at age		65	34			

Table II.47. Distribution of ocean catch of Rogue River fall-run chinook salmon released in the lower Columbia River. Values are percentages of the total estimated catch (2,574 fish) from 2 release groups. Recovery data are available only through age 4. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska						0
British Columbia	1	6	2			9
Washington		5	3			8
Oregon		58	11			69
California		7	7			14
Total at age	1	76	23			

Table II.48. Percent age composition for unsexed fall-run chinook salmon from the Rogue River, brood years 1974-79. Samples were collected from fish seined in the mainstem about 8 miles above the river mouth. Data are only for fish with underyearling life history.

Age	Brood year					
	1974	1975	1976	1977	1978	1979
Age 2	30.1	17.7	38.1	23.4	20.3	35.1
Age 3	9.1	24.6	22.5	22.2	36.8	46.3
Age 4	55.0	49.9	29.5	45.2	41.9	17.4
Age 5	5.7	7.5	9.7	9.1	0.9	1.2
Age 6	0	0.3	0.2	0	0.1	0

Age composition data are also available for sexed samples collected during spawning ground surveys on the Applegate River in 1981-83 (Table II.49). The age composition of these fish is unique among all samples that we examined from Oregon coastal river basins: on the average, age 3 females were more numerous than age 4 females.

Table II.49. Percent age composition for Applegate River fall-run chinook salmon. Data are for fish sampled on spawning grounds, 1981-83 and include underyearling and yearling life histories. Tr = <0.5%.

Number, age	1981		1982		1983	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	220	191	167	186	210	285
Age 2	33	tr	43	0	22	0
Age 3	49	72	37	40	32	39
Age 4	16	17	19	55	42	61
Age 5	2	9	1	5	4	tr
Age 6	tr	2	0	0	0	0

On the basis of anecdotal observations of spawned-out carcasses of fall-run fish in the mainstem Rogue River and in several tributaries, we believe that these fall-run fish are better characterized as mid-maturing, while Applegate fall-run fish are better characterized as early maturing.

Size at Age of Spawners

Size-at-age data are available for Rogue River fall-run fish seined in the mainstem about 8 miles above the river mouth. These data probably represent at least three substocks of fall-run fish and, unfortunately, are for unsexed fish (Table II.50).

Table II.50. Mean fork length (cm) at age for unsexed fall-run chinook salmon from the Rogue River, 1974-85. Fish were sampled by seining in the mainstem about 8 miles above the river mouth. Data are only for fish with underyearling life history.

Number, age	1974	1975	1976	1977	1978	1979
Number of fish in sample	191	349	312	330	363	355
Age 2	46.5	49.0	45.3	49.5	46.0	49.0
Age 3	70.5	71.9	68.7	69.0	71.6	73.2
Age 4	85.8	84.0	84.2	84.9	86.0	88.3
Age 5	95.0	90.9	91.3	88.4	89.9	91.9
Number, age	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**
Number of fish in sample	325	394	360	204	202	278
Age 2	47.3	50.3	49.9	41.9	46.4	51.8
Age 3	69.8	73.7	75.6	64.8	66.4	67.9
Age 4	83.1	87.1	88.4	79.5	77.7	85.7
Age 5	92.4	90.8	91.9	--	--	89.0

Size-at-age data for unsexed samples are also available for Applegate River fall-run fish sampled on spawning grounds in 1977-85 (Table II.51). On the average, these lengths are slightly larger than the lengths of fall-run fish sampled by seining in the mainstem. This length difference may represent a stock difference or may simply be related to the development of secondary sexual characteristics in maturing fish.

Tables II.50 and II.51 document the apparent effect of the 1983 El Nino on growth of chinook salmon. The age-specific size of Rogue River fall-run fish was noticeably smaller for 1983 and 1984 returns.

Table II.51. Mean fork length (cm) at age for unsexed fall-run chinook salmon from the Applegate River, based on samples collected during carcass surveys, 1977-85. Data are only for fish with underyearling life history.

Number, age	1977	1978	1979	1980	1981	1982	1983	1984	1985
Number of fish in sample	97	50	313	280	399	345	480	334	401
Age 2	51.2	--	52.8	49.9	51.7	52.6	44.4	47.3	54.2
Age 3	71.6	72.7	75.8	72.0	74.6	75.8	67.3	68.6	74.3
Age 4	87.1	85.9	89.4	86.9	86.4	90.2	83.1	79.7	87.5
Age 5	--	--	--	93.8	91.1	97.2	--	88.3	91.3

Fecundity and Egg Size

Table II.52 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish collected at Savage Rapids Dam. Table II.53 contains examples of values predicted by these equations.

Table II.52. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for fall-run chinook salmon from the upper Rogue River, 1983 and 1985-86. These samples were probably from wild fish.

Variable, year	N	Regression equation	R^2
Fecundity:			
1983	41	$F = 0.6786\ L^{1.913}$	0.642
1985	28	$F = 2.9750\ L^{1.617}$	0.614
1986	45	$F = 2.631\ L^{1.648}$	0.505
Egg Diameter:			
1983	41	$D = 0.7375\ L^{0.54604}$	0.553
1985	31	$D = 1.2340\ L^{0.42715}$	0.475
1986	45	$D = 0.479\ L^{0.633}$	0.606

Table II.53. Examples of number and of diameter (mm) of eggs of fall-run chinook salmon from the Rogue River, predicted from regression equations listed in Table II.52.

Variable, year	Fork length (cm)				
	60	70	80	90	100
Number of eggs:					
1983	1,711	2,298	2,967	3,717	4,548
1985	2,232	2,864	3,555	4,300	5,099
1986	2,241	2,890	3,601	4,372	5,201
Diameter of eggs:					
1983	6.90	7.50	8.07	8.61	9.17
1985	7.09	7.58	8.02	8.43	8.82
1986	6.40	7.05	7.67	8.27	8.84

Juveniles--Spring-run

Distribution

Spring-run juveniles are present throughout 156 miles of the mainstem below Lost Creek Dam through at least September. They are also present in the lower 12 miles of Big Butte Creek through at least June.

Length and Abundance

The mean fork length of juvenile chinook salmon sampled in the lower Rogue River (5 miles above the river mouth) in September 1974-82 ranged from 9 to 12 cm. These samples contained both fall- and spring-run juveniles.

Juvenile spring-run fish are most abundant in the mainstem above Savage Rapids Dam through about July. They are then most abundant in the lower mainstem, where they comingle with juvenile fall-run fish through September. Relatively few remain in October.

Sampling of juvenile spring-run fish in the Rogue River basin has been extensive and has revealed several characteristic features of the juvenile population.

1. Annual variation in abundance has been large. Annual indexes of abundance varied 15- to 20-fold during 1974-86.

2. Size and abundance of juveniles are inversely correlated. In years with higher abundance, juveniles are smaller during mid- and late summer.

3. The mean length of juveniles was usually greater at sample sites lower in the river system than it was at sample sites higher in the river system.

4. Some juveniles migrate slowly downstream throughout the summer. This gradual migration towards the ocean has been termed a "rearing migration."

5. The timing of emergence of juveniles and their subsequent early survival rate is strongly influenced by water temperature during the fall-winter incubation period.

6. The migration rate or speed with which juveniles migrate to the ocean may be directly related to their size. Larger fish migrate more quickly than smaller fish.

Age at Ocean Entrance

Nearly all mature spring-run fish entered the ocean as underyearlings, but yearling migrants consistently composed a small percentage of the returning population (Table II.54). From 1974 to 1986, an average of 6.2% of the returning spring-run fish had a yearling life history.

Table II.54. Percentage of yearling migrants among spring-run chinook salmon that returned to the Rogue River, 1974-86.

Return year	Yearling migrants
1974	8.0
1975	6.8
1976	7.9
1977	9.7
1978	4.9
1979	5.1
1980	3.7
1981	5.0
1982	2.2
1983	2.9
1984	1.5
1985	3.7
1986	9.2

Size at Ocean Entrance

Estimates of the size at ocean entrance of surviving spring-run fish are available for brood years 1971-80. Underyearling juveniles typically entered the ocean at a fork length between 8 and 13 cm, with a mean of about 10.4 cm. Table II.55 presents information on estimated size at ocean entrance organized by age at return.

Table II.55. Estimated fork length (cm) at ocean entrance of underyearling spring-run chinook salmon from the Rogue River, brood years 1971-80. Minimum and maximum values are the shortest and longest annual mean values. The mean value represents the unweighted mean of all annual mean values.

Age at return	Minimum length	Maximum length	Mean length
2	9.1	11.5	10.4
3	9.4	11.7	10.4
4	9.3	11.3	10.4
5	9.5	11.4	10.4
6	9.3	11.0	10.1

Adults--Spring-run

Distribution of Catch in the Ocean

Rogue River spring-run fish are a south-migrating stock. The overall catch of 13 groups of spring-run fish released in the Rogue River occurred almost exclusively in California and Oregon, primarily at age 3 (Table II.56). The catch of 13 groups of spring-run fish released by a private hatchery in Coos Bay showed essentially the same distribution of catch (Table II.57).

Timing of Return and Spawning

Spring-run fish enter the system generally from mid-March through mid-June with a peak usually during mid-May. These fish spawn above Gold Ray Dam from September through mid-November with a peak usually during early October.

Age Composition of Spawners

We classify Rogue River spring-run fish as early-maturing. Extensive age composition data are available for wild fish from brood years 1972 through 1980 (Table II.58).

Table II.56. Distribution of ocean catch of Rogue River spring-run chinook salmon released in the Rogue River. Values are percentages of the total estimated catch (12,543 fish) from 13 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska						
British Columbia	<0.5	<0.5	<0.5			
Washington	<0.5	1	<0.5			1
Oregon	1	30	9	<0.5	<0.5	40
California	<0.5	37	22	<0.5		59
Total at age	1	68	31			

Table II.57. Distribution of ocean catch of Rogue River spring-run chinook salmon released in Coos Bay. Values are percentages of the total estimated catch (882 fish) from 13 release groups. Values ≥10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska						
British Columbia		1				1
Washington		<0.5	<0.5			
Oregon	2	36	10			48
California	1	43	7		<0.5	51
Total at age	3	80	17			

Table II.58. Percent age composition for unsexed spring-run chinook salmon from the Rogue River, brood years 1972-80. Samples were collected from fish migrating upstream over Gold Ray Dam. Values represent only fish that migrated to the ocean as underyearlings.

Age	Brood year								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
Age 2	1.9	14.3	8.8	1.6	23.9	15.7	30.8	8.3	34.2
Age 3	19.1	13.3	9.1	22.9	17.9	14.3	14.3	35.4	11.9
Age 4	59.6	44.3	67.4	57.9	45.1	53.1	48.9	50.6	25.8
Age 5	19.0	27.7	14.4	15.8	12.5	16.9	5.9	5.7	26.8
Age 6	0.4	0.3	0.3	1.8	0.7	0	0.1	0	1.3

Age composition data for sexed samples are available from returns of spring-run hatchery fish from brood years 1975-79. The age composition analysis presented here was accomplished by selecting data from groups of fish that were released at the hatchery in October, and calculating an average age composition for each brood year. These values may closely approximate the age composition for wild spring-run fish returning to the Rogue River. On the average, brood year returns of females were almost entirely dominated by returns at age 4. This is the only Oregon coastal chinook salmon stock we have examined that has had 80%-90% of female returns in one age class (Table II.59).

Table II.59. Percent age composition for spring-run chinook salmon from the Rogue River, 1975-79 brood years. Data are for hatchery fish recovered at Cole Rivers Hatchery. Juveniles were released in October. M = males, F = females.

Number, age	Brood year									
	1975		1976		1977		1978		1979	
	M	F	M	F	M	F	M	F	M	F
Number of marked groups	2		3		1		4		5	
Age 2	2	0	12	0	24	0	25	0	20	0
Age 3	30	0	23	1	38	0	32	4	50	2
Age 4	56	83	57	79	37	94	40	88	27	90
Age 5	12	17	8	21	2	6	3	8	3	8

Size at Age of Spawners

The size at age of Rogue River spring-run fish is shown in Table II.60. The age-specific size or Rogue River spring run fish was noticeably smaller at ages 2 and 3 in 1983 and 1984, probably reflecting the influence of the 1983 El Nino on growth.

Table II.60. Mean fork length (cm) at age for unsexed spring-run chinook salmon from the Rogue River, 1974-85. Fish were sampled while migrating upstream over Gold Ray Dam. Values represent only fish that migrated to the ocean as underyearlings.

Number, age	1974	1975	1976	1977	1978	1979
Number of fish in sample	260	330	266	252	310	240
Age 2	38.0	38.7	38.1	40.2	39.6	43.7
Age 3	56.3	54.8	56.2	58.7	54.4	60.4
Age 4	75.9	76.5	76.5	76.9	77.5	78.3
Age 5	84.4	86.8	87.6	83.8	84.9	86.8

Number, age	1980	1981	1982	1983	1984	1985
Number of fish in sample	285	304	301	301	234	250
Age 2	41.6	42.0	42.0	37.3	39.2	43.5
Age 3	59.2	63.0	66.2	58.6	54.9	65.5
Age 4	75.1	75.1	82.8	79.9	74.2	83.3
Age 5	86.5	86.3	89.4	90.2	78.9	89.0

Fecundity and Egg Size

Table II.61 contains regression equations that relate fecundity and relate egg size to fork length of spring-run fish from the Rogue River. Table II.62 contains examples of values predicted by these equations.

Table II.61. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Rogue River spring-run chinook salmon, 1985-86. All samples were probably from hatchery fish.

Variable, year	N	Regression equation	R^2
Fecundity:			
1985	33	$F = 9.924\ L^{1.348}$	0.631
1986	41	$F = 0.887\ L^{1.909}$	0.568
Egg diameter:			
1985	34	$D = 0.5505\ L^{0.6198}$	0.639
1986	41	$D = 1.596\ L^{0.364}$	0.330

Table II.62. Examples of number and of diameter (mm) of eggs of Rogue River spring-run chinook salmon, predicted from regression equations listed in Table II.61.

Variable, year	Fork length (cm)				
	60	70	80	90	100
Number of eggs:					
1985	2,475	3,047	3,648	4,275	4,928
1986	2,175	2,919	3,767	4,716	5,768
Diameter of eggs:					
1985	6.96	7.67	8.32	8.95	9.56
1986	7.08	7.49	7.87	8.21	8.53

SALMON RIVER

The Salmon River supports a population of fall-run chinook salmon and may also support a very small population of spring-run fish. Because we have no information regarding the juvenile or the adult life history of spring-run fish in this system, the following narrative will be restricted to information about fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juveniles are present throughout the mainstem, upper estuary, and lower reaches of larger tributaries in the spring, but most have probably migrated to the estuary by mid-July. They are present throughout the estuary from June through October.

Length and Abundance

The mean fork length of juveniles sampled in the lower estuary in 1977 ranged from about 9 cm in June to about 12 cm in September. During this period, the mean fork length of juveniles sampled in the lower estuary was about 2 cm longer than that of juveniles sampled in the upper estuary. The mean fork length of juveniles sampled by angling with nickel-plated trolling spoons about 3/4-inch long during September 1980 was 12.6 cm, whereas the mean fork length of juveniles sampled with a beach seine on the same date was 13.2 cm. The ranges in length of juveniles sampled by the two methods were similar, however.

Juveniles were abundant in the mainstem and upper estuary in early summer, but after mid-July were only abundant in the estuary. As the summer progressed they became relatively less abundant in the upper estuary.

Age at Ocean Entrance

Sampling of juveniles in the Salmon River system was extensive during 1975-77, but no yearling chinook salmon were observed in seine hauls throughout that period. The juveniles sampled in the system from June through October were all underyearlings, and we believe that practically all juveniles migrate to the ocean during their first year of life. Scale samples from 812 chinook salmon that returned to Salmon River in 1975-77 and 1986 were examined to evaluate age at ocean entrance. All of these fish had entered the ocean as underyearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of surviving adults. Judging from the juveniles present in the estuary during 1975-77, many juveniles rear in the estuary and then migrate to the ocean at a size between 10 and 13 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Salmon River chinook salmon are a north-migrating stock and are caught primarily in British Columbia and Alaska at ages 3-5. Catch of this stock in the ocean was, on the average, almost equal at ages 3, 4, and 5 (Table II.63).

Table II.63. Distribution of ocean catch of Salmon River fall-run chinook salmon released in the Salmon River. Values are percentages of the total estimated catch (2,170 fish) from 8 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		7	**15**	**11**	◌	33
British Columbia	1	**24**	**20**	**15**	1	61
Washington	1	◌	1	◌		2
Oregon	◌	1	◌	◌		1
California		1	◌	◌		1
Total at age	2	33	36	26	1	

Timing of Return and Spawning

Fall-run chinook salmon generally enter the Salmon River from early August through mid-December with a peak usually during early October. These fish spawn from October through December with a peak usually during mid-November.

Age Composition of Spawners

We classify Salmon River chinook salmon as late maturing. Age composition data are available for wild that fish returned in 1975-77 and 1986. Age 2 jacks composed about 50% of the male return in two years, but return of females was generally dominated by age 5 fish (Table II.64).

Table II.64. Percent age composition for Salmon River fall-run chinook salmon. Values are for a composite of fish sampled during netting in the estuary (1975-77), spawning surveys (1975-77, 1986), creel surveys (1976, 1986), and at the hatchery trap (1986). M = males, F = Females.

Number, age	1975 M	1975 F	1976 M	1976 F	1977 M	1977 F	1986 M	1986 F
Number of fish in sample	82	52	276	135	112	41	58	56
Age 2	49	0	38	0	50	0	7	0
Age 3	22	0	27	0	20	14	19	2
Age 4	21	29	23	31	20	39	48	19
Age 5	8	69	12	62	6	32	24	68
Age 6	0	2	0	7	4	15	2	11

Size at Age of Spawners

The size at age of Salmon River spawners is shown in Table II.65.

Fecundity and Egg Size

Table II.66 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish from Salmon River. Table II.67 contains examples of values predicted by these equations. Relationships between fecundity and fork length, and between egg size and fork length, were not significant for a sample of 21 Salmon River fish in 1986. The sample consisted of fish from about 90 to about 110 cm.

Table II.65. Mean fork length (cm) at age for Salmon River fall-run chinook salmon. Values are for a composite of fish sampled during netting in the estuary (1975-77), spawning surveys (1975-77, 1986), creel surveys, (1976, 1986), and at the hatchery trap (1986). M = males, F = Females.

Number, age	1975 M	1975 F	1976 M	1976 F	1977 M	1977 F	1986 M	1986 F
Number of fish in sample	81	49	265	133	112	41	58	56
Age 2	46.9	--	45.6	--	47.2	--	50.7	--
Age 3	63.7	--	66.6	--	67.1	--	71.8	--
Age 4	82.3	87.3	80.5	87.1	82.5	85.7	92.8	93.6
Age 5	86.5	92.4	97.0	94.8	100.4	96.0	102.6	101.0
Age 6	--	--	--	99.1	--	98.1	--	107.7

Table II.66. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Salmon River fall-run chinook salmon, 1985. These samples probably contain both wild and hatchery fish.

Variable	N	Regression equation	R^2
Fecundity	23	$F = 81.353\ L^{0.9102}$	0.178
Egg diameter	25	$D = 0.5865\ L^{0.5949}$	0.408

Table II.67. Examples of number and of diameter (mm) of eggs of Salmon River fall-run chinook salmon, predicted from regression equations listed in Table II.66.

Variable	Fork length (cm) 70	80	90	100	110
Number of eggs	3,888	4,391	4,887	5,379	5,867
Diameter of eggs	7.34	7.95	8.53	9.08	9.61

SILETZ RIVER

The Siletz River supports populations of spring- and fall-run chinook salmon. We have no information regarding the juvenile or the adult life history of spring-run fish, however. The following narrative will be restricted to information about fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present in the entire mainstem and the lower North Fork through at least early September. Juveniles are present at least through late spring and early summer in many small tributary streams including Buck, Cedar, Euchre, and Sunshine creeks. Juveniles are present throughout the tidal reaches of the system in July and September and are still present in the lowermost reaches of the estuary in mid-October.

Length and Abundance

The mean fork length of juveniles sampled in the Siletz River estuary ranged from about 10 to about 11 cm during September 1978-87 (Table II.68). The mean annual September fork length was 10.7 cm.

Table II.68. Data on catches of juvenile chinook salmon in the Siletz River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (27)	55	11.3	4	14
1979 (19)	113	11.1	2	57
1980 (10)	126	9.6	1	829
1981 (15)	134	11.0	2	306
1982 (16)	100	10.3	4	50
1983 (7)	162	10.7	2	160
1984 (9)	97	11.3	1	105
1985 (12)	177	9.7	2	243
1986 (18)	183	10.4	1	193
1987 (20)	212	11.2	2	212

Sampling of juveniles in the basin has been limited, but appearances are that juveniles are abundant throughout the entire mainstem and estuary in June, and are abundant throughout the entire estuary in September.

Age at Ocean Entrance

Juveniles sampled in the Siletz basin from June through October in several years were underyearlings. We believe that practically all of these fish migrated to the ocean as underyearlings, and that only a very small proportion remained upstream in riverine reaches of the basin and migrated to the ocean the following spring as yearlings.

Scales collected from 235 adults sampled on spawning ground surveys in the Siletz system in 1986 were examined to evaluate age at ocean entrance. This analysis indicated that 233 fish from this sample entered the ocean as underyearlings.

Size at Ocean Entrance

Judging from the size of juveniles sampled in the estuary during September, many fish are not migrating to the ocean until they exceed 10 cm fork length. A preliminary analysis indicates that 1976-brood chinook salmon entered the ocean as underyearlings at a mean fork length of about 13.4 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Siletz River chinook salmon have not been coded-wire tagged to assess geographic distribution of the catch.

Timing of Return and Spawning

Chinook salmon enter the Siletz River from at least May through mid-December. We have no data or criteria to distinguish fall-run fish; however, local anglers commonly identify fall-run fish as those that enter from about September through mid-December. Judging from recreational catch in the Siletz, the peak of entry probably occurs sometime in late September or early October. These fish probably spawn from mid-October through mid-January with a usual peak during late November.

Age Composition of Spawners

We tentatively classify Siletz River fall-run fish as late maturing. Limited age composition data indicate that females mature predominantly at age 5 and that production of age 2 males is relatively low in this stock (Table II.69).

Table II.69. Percent age composition for Siletz River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986.

Number, age	Males	Females
Number of fish in sample	117	122
Age 2	1	0
Age 3	13	2
Age 4	42	11
Age 5	35	58
Age 6	9	30

Size at Age of Spawners

Information on the age-specific size of fall-run chinook salmon from the Siletz River is presented in Table II.70.

Table II.70. Mean fork length (cm) at age for Siletz River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986.

Number, age	Males	Females
Number of fish in sample	115	120
Age 2	--	--
Age 3	70.6	--
Age 4	91.8	97.3
Age 5	102.9	98.6
Age 6	114.1	101.0

Fecundity and Egg Size

Fecundity and egg size data are not available for this stock.

SIUSLAW RIVER

Although the Siuslaw River apparently supported a modest population of spring- or summer-run fish in the early 1900s, the run today consists almost entirely of fall-run fish.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout at least the lower 70 miles of the mainstem, the lower reaches of the North Fork and Lake Creek, and the lower reaches of other minor spawning tributaries through at least mid-June. By mid-July, however, essentially all juveniles have migrated to the estuary where many remain through September.

Length and Abundance

The mean fork length of juveniles sampled at several locations in the lower Siuslaw River estuary ranged from about 9 to about 10 cm in June 1978 and ranged from about 11 to about 15 cm during September in 1978-87 (Table II.71). The mean annual (September) fork length of juveniles in the lower estuary was 13.4 cm.

Table II.71. Data on catches of juvenile chinook salmon in the Siuslaw River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (19)	41	14.4	5	8
1979 (20)	52	13.9	17	3
1980 (24)	28	14.1	5	6
1981 (16)	83	14.5	9	9
1982 (17)	106	13.0	6	18
1983 (8)	63	13.0	6	11
1984 (11)	27	13.8	11	3
1985 (13)	154	11.0	4	40
1986 (20)	74	13.2	5	15
1987 (21)	196	12.8	3	95

Sampling in riverine reaches of the system has not been sufficient to allow comment on the relative abundance of juveniles throughout the basin. However, sampling throughout the tidal reaches of the system has indicated that juveniles are most abundant in the lower 5-10 miles of the estuary from June through September. The period of peak abundance in the estuary was July-August.

Age at Ocean Entrance

Sampling in the tidal reaches of the Siuslaw River has been extensive, and on occasion, a few yearling chinook salmon have been captured in seines during late May and early June. The vast majority of juveniles sampled in the system have been underyearlings, and we believe that practically all migrate to the ocean during their first year of life. We examined 283 scale samples collected from fish on spawning ground surveys in 1980-82 and in 1986 to evaluate age at ocean entrance. All of these fish had entered the ocean as underyearlings.

Size at Ocean Entrance

A preliminary scale analysis study indicates that returning 1977 brood chinook salmon entered the ocean as underyearlings at a mean fork length of 16.3 cm. Judging from the size of juveniles sampled in the estuary in September, many are reaching a size of 10-18 cm before they migrate to the ocean.

Adults--Fall-run

Distribution of Catch in the Ocean

Ocean tag recovery data are limited for Siuslaw River fish; however, data are sufficient to demonstrate that this is generally a north-migrating stock. Collective recoveries from four Ad+CWT groups occurred at ages 2-6 from California to Alaska. By far the greatest part of the catch occurred in British Columbia at ages 3 and 4; however, catch was about equal in Alaska and Oregon (Table II.72).

Table II.72. Distribution of ocean catch of Siuslaw River fall-run chinook salmon released in the Siuslaw River. Values are percentages of the total estimated catch (428 fish) from 4 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska	1	2	6	2		11
British Columbia	3	43	21	7	<0.5	74
Washington		3	<0.5			3
Oregon		9	2	<0.5		11
California			1			1
Total at age	4	57	30	9		

Timing of Return and Spawning

Chinook salmon enter the Siuslaw River estuary from August through November with a peak usually during early October. These fish spawn from October through December with a peak usually in mid-November.

Age Composition of Spawners

We classify Siuslaw River chinook salmon as late-maturing. Age composition data obtained from spawning ground surveys indicate that female maturation is dominant at age 4 and at age 5. On the average, female maturation at age 5 was greater than at age 4 and maturation at age 6 was greater than at age 3 (Table II.73).

Table II.73. Percent age composition for Siuslaw River fall-run chinook salmon, 1980, 1982, and 1986. Samples were collected during spawning ground surveys.

Number, age	1980		1982		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	54	53	47	66	72	92
Age 2	28	0	30	0	21	0
Age 3	32	0	26	3	29	7
Age 4	33	49	25	51	20	18
Age 5	7	49	19	41	29	71
Age 6	0	2	0	5	1	4

Size at Age of Spawners

The size at age of Siuslaw River spawners is shown in Table II.74.

Table II.74. Mean fork length (cm) at age for Siuslaw River fall-run chinook salmon, 1980, 1982, and 1986. Samples were collected during spawning ground surveys.

Number, age	1980		1982		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	54	53	47	66	71	92
Age 2	48.7	--	53.0	--	46.3	--
Age 3	74.1	--	80.2	--	76.3	72.7
Age 4	89.1	89.6	92.9	90.2	97.6	93.4
Age 5	106.5	98.5	107.6	96.7	104.4	96.8
Age 6	--	--	--	100.6	--	102.4

Fecundity and Egg Size

Fecundity and egg size data are not available for this stock.

SIXES RIVER

Sixes River supports a population of fall-run chinook salmon. The Sixes River basin has been the focus of several research studies designed to document the life history characteristics and population dynamics of wild chinook salmon. The information presented in this section is a brief sample of data that are available (in ODFW files and internal documents) for this population.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout the entire mainstem, the lower reaches of the North, Middle, and South forks, the lower reaches of Dry Creek, and the lower reaches of other spawning tributaries including Crystal, Edson, and Crafton creeks through at least May. Apparently a general migration of juveniles occurs during June from the tributaries to the mainstem and during July from the mainstem to the estuary. A very small proportion of the juveniles remain in the tributaries (which tend to be cooler than the mainstem) throughout the summer. Practically all juveniles have migrated from the mainstem to the estuary by late July or early August. Juveniles are present in the estuary usually from about April through September or October.

Length and Abundance

The mean fork length of juvenile chinook salmon sampled in the Sixes River estuary ranged from about 10 to about 12 cm during September in 1978-87 (Table II.75). The mean annual (September) fork length of juveniles in the estuary was 11.3 cm.

Table II.75. Data on catches of juvenile chinook salmon in the Sixes River estuary, 1978-87.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1978 (20)	369	11.4	13	96
1979 (19)	355	12.1	4	355
1980 (10)	237	10.3	5	118
1981 (16)	135	9.9	7	27
1982 (18)	92	11.5	5	18
1983 (9)	77	11.9	5	66
1984 (10)	76	10.8	4	26
1985 (13)	160	11.6	4	265
1986 (16)	50	11.6	5	10
1987 (25)	168	12.0	3	56

Sampling of juveniles in the Sixes River estuary has been extensive. Generally, the work documented an inverse correlation between size of juveniles and their abundance, indicating compensatory regulation of growth.

Mark-recapture estimates of the peak number of juvenile chinook salmon in the estuary during midsummer have been made in several years. These juvenile population levels varied considerably, were not generally related to the abundance of female parents that produced the brood, and were not a good predictor of the abundance of mature fish that would return to the river in succeeding years. The peak population of juveniles in the estuary was estimated to be about 270 thousand fish in 1968 and about 45 thousand fish in 1978. These peak population levels typically occur in the estuary during July. We concur with reported assertions that growth of juvenile chinook in Sixes estuary is density dependent, although the density dependent relationship varies somewhat on an annual or even weekly basis because the productive capacity of the estuary is unstable.

Age at Ocean Entrance

Nearly all the chinook salmon that return to Sixes River entered the ocean as underyearlings; however, yearling migrants compose a small percentage of the returning population. Among a stratified sample of 160 spawners that originated from the 1965 brood, including an equal number of age 2, 3, 4, and 5 fish, about 3.5% had entered the ocean as yearlings. Among a sample of 218 spawners of all ages that returned to Sixes River in 1985, 3 were judged to have entered the ocean as yearlings. A few yearling migrants have been sampled in the estuary in April and May. These yearlings reached a size in June that was similar to the size of underyearlings that were present in the estuary during the preceding September-October.

Size at Ocean Entrance

Our information on size at ocean entrance is based on data from seining in the estuary and both subjective and quantitative analysis of scales collected from spawners. Judging from seining data and anecdotal observations, some underyearling juveniles enter the ocean (either inadvertently or purposefully) at least as early as June at a mean fork length of about 8 cm. Pattern-recognition analysis of scales collected from 1965-brood spawners indicates that survivors generally reared for about 3 months in the riverine and for about 3 months in the estuarine reaches of the basin before migrating to the ocean in September-October at a size of about 10 cm. A preliminary analysis of scales taken from spawners in 1985 indicated that returning Sixes River fish entered the ocean at sizes ranging from 9.2 to 16.9 cm (fork length) with a mean fork length of 11.9 cm (Table II.76).

Table II.76. Estimated fork length (cm) at ocean entrance of Sixes River fall-run chinook salmon, 1985 return year. Scales were examined in an effort to exclude unmarked hatchery strays from Elk River from this analysis.

Age at return	*N*	Minimum length	Maximum length	Mean length
2	4	10.4	14.2	12.3
3	--	--	--	--
4	76	9.2	16.9	12.7
5	95	9.4	13.9	11.2
6	5	10.1	14.7	12.3

Adults--Fall-run

Distribution of Catch in the Ocean

Sixes River chinook salmon have not been coded-wire tagged to evaluate the geographic distribution of catch in the ocean. A few Sixes River chinook salmon were marked with fin-clips during the 1960s; however, recoveries of these fish in the ocean were insufficient to characterize the geographic distribution of ocean catch. Based on geographic distribution, we surmise that Sixes River chinook salmon are north-migrating, and probably also make an important contribution to the Oregon ocean catch at age 3 and to the catch off the mouth of Elk River in October and November.

Timing of Return and Spawning

Chinook salmon enter Sixes River from early October through December with a peak usually during early November. These fish spawn from mid-October through February with a peak usually during late December.

Age Composition of Spawners

We classify Sixes River chinook salmon as mid-maturing. Age composition data are available for several return years, and other scale collections that have not yet been analyzed are available also. Age 3 fish are usually less than 10% of female spawners, and age 4 fish are usually the majority of female spawners (Table II.77).

Table II.77. Percent age composition for Sixes River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1967-68, 1970, 1979-80, and 1982-85. Some unmarked strays from Elk River Hatchery may have been included in 1983-85. Tr <0.5%.

Number, age	1967 Males	1967 Females	1968 Males	1968 Females	1970 Males	1970 Females
Number of fish in sample	179	145	209	184	119	185
Age 2	19	0	11	0	23	0
Age 3	38	10	44	16	8	2
Age 4	34	46	32	51	44	55
Age 5	9	43	14	34	26	43
Age 6	0	1	0	0	0	0

Number, age	1979 Males	1979 Females	1980 Males	1980 Females	1982 Males	1982 Females
Number of fish in sample	418	593	139	242	113	110
Age 2	6	0	9	0	9	0
Age 3	9	4	24	8	16	10
Age 4	60	62	11	15	50	83
Age 5	24	33	52	71	24	6
Age 6	0	1	4	6	1	1

Number, age	1983 Males	1983 Females	1984 Males	1984 Females	1985 Males	1985 Females
Number of fish in sample	84	102	162	209	93	139
Age 2	5	0	2	0	17	0
Age 3	30	7	33	4	3	1
Age 4	49	64	43	56	39	49
Age 5	17	27	21	40	39	47
Age 6	0	2	0	tr	2	3

Size at Age of Spawners

The size at age of spawners is shown in Table II.78.

Table II.78. Mean fork length (cm) at age for Sixes River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1967-68, 1970, 1979, and 1985. Some unmarked strays from Elk River Hatchery may have been included in the 1985 sample.

Number, age	1967 Males	1967 Females	1968 Males	1968 Females	1970 Males	1970 Females
Number of fish in sample	179	143	209	184	119	182
Age 2	45.7	--	48.9	--	53.3	--
Age 3	70.7	72.0	76.2	74.1	73.5	--
Age 4	85.7	83.6	92.6	85.9	92.2	88.5
Age 5	96.1	90.3	103.2	92.8	106.5	94.7
Age 6	--	--	--	98.3	--	--

Number, age	1979 Males	1979 Females	1985 Males	1985 Females
Number of fish in sample	417	594	71	134
Age 2	51.4	--	54.3	--
Age 3	72.5	77.8	--	--
Age 4	94.2	86.2	91.5	89.7
Age 5	101.2	92.9	106.6	97.5
Age 6	--	98.0	--	99.3

Fecundity and Egg Size

Table II.79 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish from Sixes River. Table II.80 contains examples of values predicted by these equations.

Table II.79. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Sixes River fall-run chinook salmon. Fecundity regression calculated from 1969 return. Egg diameter regression calculated from 1985 return. The sample for 1969 was from wild fish, the sample from 1985 was probably from wild fish.

Variable	*N*	Regression equation	R^2
Fecundity	55	$F = -2{,}790.56 + 86.98L$	0.389
Egg diameter	14	$D = 1.4197\ L^{0.3933}$	0.625

Table II.80. Examples of number and of diameter (mm) of eggs of Sixes River fall-run chinook salmon, predicted from regression equations listed in Table II.79.

Variable	Fork length (cm)				
	70	80	90	100	110
Number of eggs	3,298	4,161	5,038	5,907	6,777
Diameter of eggs	7.55	7.96	8.33	8.69	9.02

TILLAMOOK BAY

The Tillamook Bay drainage basin supports populations of chinook salmon in five major subbasins: the Kilchis, Miami, Tillamook, Trask, and Wilson rivers. Fall-run fish are present in all of these rivers, and at least the Trask and Wilson also support populations of spring-run fish. Collectively, these chinook salmon represent the second largest fall-run and the third largest spring-run populations on the Oregon coast. The purpose of this section is to provide life history information that pertains generally to chinook salmon in the Tillamook Bay drainage basin but is not attributable specifically to the population in any individual river. Life history data that are attributable to chinook salmon populations in specific Tillamook Bay tributaries are presented separately.

Juveniles

We believe that virtually all of the tidal reaches of Tillamook Bay provide rearing habitat for juvenile chinook salmon. Unfortunately, criteria are not established to distinguish fall-run from spring-run juveniles in sampling that has occurred in the system. Thus, we tend to discuss the life history of juvenile chinook salmon in this system in a general sense. Most of our understanding of the juvenile life history phase is probably accurate for fall-run fish, but we do not know precisely how spring-run juveniles might differ.

Underyearling juveniles are present in the bay from January through at least November, and yearling juveniles are present in the bay from about January through late May or early June. Yearling juveniles are rare in comparison with underyearlings. A few underyearling juveniles are found in the less saline reaches of the estuary in late winter and early spring. By June, they are common throughout the estuary, although larger individuals are more common in higher salinity reaches near the mouth of the bay. Underyearlings are most abundant in the bay from about June through early-October. We believe that practically all of these underyearlings migrate to the ocean by the end of November.

Juvenile chinook salmon were sampled near the mouth of Tillamook Bay in September 1980-85 (Table II.81). The mean fork length of underyearling juveniles in these samples ranged from about 11 to about 14 cm. The range in size within each annual sample (from about 8 to about 16 cm) was generally greater than for any other Oregon estuary that has been sampled.

Table II.81. Data on catches of juvenile chinook salmon in Tillamook Bay, 1980-85. The samples were sorted in an effort to eliminate marked hatchery fish; however, some unmarked hatchery fish may have been included.

Year (day in September)	Number measured	Mean fork length (cm)	Number of seine hauls	Catch per seine haul
1980 (9)	119	11.5	1	236
1981 (14)	125	11.8	5	25
1982 (15)	141	10.6	6	24
1983 (6)	58	13.6	7	10
1984 (8)	91	12.6	6	17
1985 (11)	135	11.0	2	77

Tillamook Bay is Oregon's third largest estuary (behind the Coos and Umpqua estuaries) in the average submerged acreage at low tide. Although the estuary provides a relatively large area for rearing juveniles, the rearing area is used by juveniles from five major river systems. Compared with Coos Bay, the Umpqua estuary, and Yaquina Bay, juvenile chinook are very abundant and are easily captured in beach seines throughout Tillamook Bay from June through October. We believe that this is an indication of generally strong recruitment of juveniles in tributaries to the bay, and of the importance of this rearing habitat to the populations in the tributaries.

Adults

Timing of Return

Adult chinook salmon probably return to and enter Tillamook Bay in every month of the year. We have no criteria or data to separate subraces of these fish, but local anglers commonly refer to a "spring run" that typically begins entering the bay during April-May and a "fall run" that typically begins entering the bay in August-September. Of these two runs, fall fish are by far the most numerous. We believe that very small runs of winter- and summer-run chinook salmon also enter Tillamook Bay. The winter run enters the system during January-February. This winter run mostly includes very late fall-run fish that will usually spawn in about one month, and may also include very early spring-run fish that will spawn in about seven months. Summer-run fish enter the system in June-July and spawn in early fall.

Age Composition and Size at Age

The recreational fishery in Tillamook Bay has a widespread reputation for annually producing chinook salmon in the 50- to 70-pound range. Although the occurrence of large chinook salmon in Tillamook Bay is common knowledge among anglers, it has received only passing study by biologists.

We have compiled available data from a variety of sources to provide information on the age and age-specific size composition of fall-run chinook salmon that enter the Tillamook Bay system. Even though each of these data sets may have its own inherent biases, collectively these data indicate that age 5 is the dominant age of female maturation, that age 6 females are often as common as age 4 females, and that age 3 females are rare (Table II.82). These data support our general classification of Tillamook Bay system chinook salmon as late maturing.

Table II.82. Percent age composition of fall-run chinook salmon from Tillamook Bay. Data for 1960 are from a commercial net fishery. Data for 1978 are from a creel survey in Tillamook Bay. Values for 1986 are a composite of fish sampled on spawning grounds of the Kilchis, Miami, Tillamook, Trask, and Wilson rivers. All samples may include some hatchery fish.

Number, age	1960		1978		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	41	58	87	70	135	154
Age 2	2	0	6	0	1	0
Age 3	17	2	11	3	10	2
Age 4	15	10	53	39	46	25
Age 5	51	71	25	59	36	51
Age 6	15	17	5	0	7	21

Age-specific size data for Tillamook Bay chinook salmon are summarized in Table II.83. The size of Tillamook Bay chinook salmon does not appear to be obviously greater at age than the size of chinook salmon in other north coast populations. A few scale samples from 50- to 70-pound chinook salmon from Tillamook Bay have been examined in recent years. These have typically been age 5 or age 6 fish that migrated to the ocean as underyearlings.

Table II.83. Mean fork length (cm) at age for fall-run chinook salmon from Tillamook Bay. Data for 1960 are from the Tillamook Bay commercial net fishery. Data for 1978 are from a creel survey in Tillamook Bay. Data for 1986 are a composite of fish sampled on spawning grounds of the Kilchis, Miami, Tillamook, Trask, and Wilson rivers. All samples may include some hatchery fish.

Number, age	1960		1978		1986	
	Males	Females	Males	Females	Males	Females
Number of fish in sample	33	57	86	68	132	151
Age 2	--	--	46.8	--	--	--
Age 3	--	--	70.1	--	78.7	--
Age 4	79.2	84.3	88.7	88.6	92.5	91.4
Age 5	100.8	94.5	105.8	99.6	103.2	99.0
Age 6	106.2	100.1	107.5	--	110.3	104.3

TILLAMOOK RIVER

The Tillamook River system supports a population of fall-run chinook salmon and may contain a small population of spring-run fish. Overall, the run of chinook salmon in this stream is composed almost entirely of fall-run fish.

Few data are available to document the characteristic life history traits of this stock. Underyearling juveniles are present in the system at least through early summer and probably also rear in Tillamook Bay prior to entering the ocean. Fall-run adults enter the system from mid-September through mid-January with a peak usually in mid-October. These fish spawn from October through January with a peak usually in late November.

Based on the geographic location of this system, we surmise that these chinook salmon are north-migrating. We tentatively classify Tillamook River fall-run fish as late-maturing. Information on their age composition and age-specific size based on fish sampled on spawning grounds in 1986 is presented in tables II.84 and II.85.

Table II.84. Percent age composition for Tillamook River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986.

Number, age	Males	Females
Number of fish in sample	30	23
Age 2	7	0
Age 3	17	0
Age 4	47	43
Age 5	23	48
Age 6	7	9

Table II.85. Mean fork length (cm) at age for Tillamook River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1986.

Number, age	Males	Females
Number of fish in sample	26	21
Age 2	--	--
Age 3	--	--
Age 4	89.2	89.5
Age 5	103.5	97.5
Age 6	--	--

TRASK RIVER

The Trask River supports populations of spring- and fall-run chinook salmon. We have more information about the life history of fall-run than of spring-run fish in this system. The following narrative presents the information that is available for both races.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout the entire mainstem, in the lower reaches of the North Fork, and in the tidal reaches of the Trask River channel through at least mid-September. We believe that many of these juveniles migrate from the Trask River channel and continue rearing in Tillamook Bay throughout this period.

Length and Abundance

Sampling of juveniles in the Trask River basin has not been sufficient to allow us to characterize their size or relative abundance throughout the system. Juveniles were abundant in the lowermost reaches of the mainstem in September 1980, however.

Age at Ocean Entrance

Few data are available to document the age at which surviving Trask River fish migrated into the ocean. We believe that nearly all returning adults are produced by juveniles that enter the ocean as underyearlings. We also believe that yearling migrants are a small (perhaps 5%-10%) but consistent component of the chinook salmon population in the system. We examined 76 scale samples from chinook salmon that returned to the spawning grounds in 1986 to evaluate age at ocean entrance, and 74 of these fish had entered the ocean as underyearlings.

Size at Ocean Entrance

We have no estimates of the size at which surviving Trask River chinook salmon entered the ocean.

Adults--Fall-run

Distribution of Catch in the Ocean

Trask River fall-run fish are a north-migrating stock. Recovery data are available for fall-run fish released in the Trask River (Table II.86) and released in the Alsea River (Table II.87). In both instances, catch was strongest at ages 3-5 and most of the catch occurred in British Columbia (50%)

Table II.86. Distribution of ocean catch of Trask River fall-run chinook salmon released in the Trask River. Values are percentages of the total estimated catch (1,537 fish) from 2 release groups. Values >10% are shaded for emphasis. The dashed circle indicates <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		6	15	12	<0.5	33
British Columbia	2	33	15	3		53
Washington	4	6	2	1		13
Oregon		1				1
California						
Total at age	6	46	32	16		

Table II.87. Distribution of ocean catch of Trask River fall-run chinook salmon released in the Alsea River. Values are percentages of the total estimated catch (937 fish) from 2 release groups. Values >10% are shaded for emphasis. The dashed circle indicates <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		1	16	11	<0.5	28
British Columbia		31	18	2		51
Washington	1	8	3			12
Oregon	1	7				8
California					1	1
Total at age	2	47	37	13	1	

and Alaska (30%). We noted a consistent tendency in the catch data that indicated a more northerly distribution of older aged fish. At age 3, catch was greatest off British Columbia; but catch at age 5 was greatest off Alaska.

Timing of Return and Spawning

Chinook salmon enter the Trask River from April through mid-February. We have no criteria and only limited data to distinguish fall-run fish; however, local anglers commonly refer to fall-run fish as entering from early September through mid-February. Judging from recreational catches, peak entry into the Trask River probably occurs in mid-October. These fish spawn from October through mid-March.

Age Composition of Spawners

We classify Trask River fall-run fish as late-maturing. Limited age composition data from spawning ground surveys indicate that female maturation is rare at age 3, dominant at age 5, and almost as strong at age 6 as at age 4 (Table II.88).

Table II.88. Percent age composition for Trask River fall-run chinook salmon. Data are for fish sampled on spawning grounds in 1986. Some hatchery fish may be included.

Number, age	Males	Females
Number of fish in sample	34	42
Age 2	0	0
Age 3	12	2
Age 4	62	33
Age 5	20	43
Age 6	6	21

Size at Age of Spawners

The age-specific size of Trask River spawners is shown in Table II.89.

Table II.89. Mean fork length (cm) at age for Trask River fall-run chinook salmon. Data are for fish sampled on spawning grounds in 1986. Some hatchery fish may be included.

Number, age	Males	Females
Number of fish in sample	32	41
Age 2	--	--
Age 3	--	--
Age 4	92.3	90.5
Age 5	103.7	98.9
Age 6	--	102.6

Fecundity and Egg Size

Table II.90 contains regression equations that relate fecundity and relate egg size to fork length of fall-run fish from Trask River. Table II.91 contains examples of values predicted by these equations. The relationship between fecundity and fork length was not significant for the 1986 sample, which consisted of fish from about 90 to about 110 cm fork length.

Table II.90. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Trask River fall-run chinook salmon, 1983 and 1985-86. All samples probably contain both wild and hatchery fish.

Variable, year	*N*	Regression equation	R^2
Fecundity:			
1983	30	$F = 15.261\ L^{1.2812}$	0.475
1985	30	$F = 1.8813\ L^{1.7571}$	0.410
Egg Diameter:			
1983	30	$D = 0.860\ L^{0.4999}$	0.656
1985	30	~~D = 2.056~~ $L^{0.3163}$	0.330
1986	40	$D = 0.834\ L^{0.515}$	0.562

Table II.91. Examples of number and of diameter (mm) of eggs of Trask River fall-run chinook salmon, predicted from regression equations listed in Table II.90.

Variable, year	Fork length (cm)				
	70	80	90	100	110
Number of eggs:					
1983	3,527	4,185	4,867	5,570	6,294
1985	3,283	4,151	5,106	6,144	7,264
Diameter of eggs:					
1983	7.19	7.69	8.18	8.60	9.02
1985	7.88	8.22	8.53	8.82	9.09
1986	7.47	7.97	8.47	8.94	9.39

Adults--Spring-run

Distribution of Catch in the Ocean

Ocean recovery data are limited for Trask River spring-run fish, but are sufficient to indicate that they are a north-migrating stock. Collective recoveries from three release groups occurred from California through Alaska at ages 2-6 (Table II.92). However, over 60% of the catch occurred in British Columbia at ages 3 and 4.

Table II.92. Distribution of ocean catch of Trask River spring-run chinook salmon released in the Trask River. Values are percentages of the total estimated catch (392 fish) from 3 release groups. Values >10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska	1	2	11			14
British Columbia	3	37	23	3		66
Washington	1	6	5	1		13
Oregon		1	3	1	1	6
California			1			1
Total at age	5	46	43	5	1	

Timing of Return and Spawning

Spring-run fish enter the Trask River from about April through June. The peak of river entrance probably occurs in May. We believe that these fish begin spawning as early as the first week of September, with a peak usually during the last week of September or the first week of October.

Age Composition of Spawners

Available data are not sufficient to characterize the age composition of Trask River spring-run fish.

Size at Age of Spawners

Available data regarding the age-specific size of Trask River spring-run fish are based on a relatively small sample of fish that were spawned at Trask River Hatchery in 1983. The sample presumably contains both wild and hatchery fish. All of these fish entered the ocean as underyearlings. These data indicate that Trask River spring-run spawners are nearly as large as Trask River fall-run spawners, and that they are considerably larger than Rogue River spring-run spawners of a similar age (Table II.93).

Table II.93. Mean fork length (cm) for Trask River spring-run chinook salmon. Samples were taken from fish spawned at Trask River Hatchery in 1983 and probably include both wild and hatchery fish.

Number, age	Males	Females
Number of fish in sample	19	11
Age 2	--	--
Age 3	66.2	--
Age 4	89.2	83.8
Age 5	106.3	94.1

Fecundity and Egg Size

Table II.94 contains regression equations that relate fecundity and relate egg size to fork length of spring-run fish from the Trask River. Table II.95 contains examples of values predicted by these equations.

Table II.94. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Trask River spring-run chinook salmon, 1986. The sample probably contains both wild and hatchery fish.

Variable	N	Regression equation	R^2
Fecundity	44	$F = 4.917\ L^{1.551}$	0.392
Egg diameter	44	$D = 1.989\ L^{0.327}$	0.499

Table II.95. Examples of number and of diameter (mm) of eggs of Trask River spring-run chinook salmon, predicted from regression equations listed in Table II.94.

Variable	Fork length (cm)					
	60	70	80	90	100	110
Number of eggs	2,819	3,576	4,399	5,281	6,219	7,209
Diameter of eggs	7.59	7.98	8.34	8.66	8.97	9.25

UMPQUA RIVER

The Umpqua River supports populations of chinook salmon in at least four major subbasins: Smith River, North Umpqua River, South Umpqua River, and Cow Creek. All contain fall-run fish and the North and South Umpqua also support populations of spring-run fish. Considering the traditional vigor of the recreational fishery that is supported by North Umpqua spring-run fish, surprisingly little is known of the juvenile or of the adult life history of these fish. Even less is known about the less abundant fall-run race. We will present available life history information for both fall- and spring-run fish in this section, noting the subbasin that the information represents.

Juveniles--Fall-run

Very little is known about fall-run juveniles in the Umpqua River basin. We assume that they are present in the system downstream from all areas where fall-run fish spawn. Downstream migrants have been sampled at a Humphreys trap in Cow Creek where practically all fall-run juveniles migrate to the estuary by about June. The peak migration period is usually sometime in May, and most of these fish are 8-10 cm at that time. Data on the age and size of fall-run juveniles at ocean entrance (based on returning fish) are not available for Smith River, North Umpqua, or South Umpqua, and only very limited data are available for Cow Creek fish.

Data from seining in the mainstem Umpqua River, from the Humphreys trap, and from scale analysis of a small sample of adults that spawned in Cow Creek indicate that fall-run juveniles grow very rapidly in the spring and migrate rapidly downstream in late spring and early summer to continue rearing in the estuary prior to entering the ocean. Identifying an "ocean entrance check" on the scales of returning fish is particularly difficult because growth in the estuary is similar to growth in the ocean. Underyearling juveniles sampled in the lower estuary in September 1983 ranged from about 11 to about 18 cm fork length and averaged 14.2 cm fork length. We believe that juveniles in other parts of the Umpqua River basin (North Umpqua, South Umpqua, Smith) probably migrate to the estuary fairly early in the summer, rear for a period of time, and migrate to the ocean as underyearlings, in a manner similar to the one we have postulated for Cow Creek fish.

Adults--Fall-run

Distribution of Catch in the Ocean

Fall-run Umpqua River fish have not been coded-wire tagged to evaluate the geographic distribution of catch in the ocean. However, several broods of fall-run chinook salmon were marked by fin-clips during the 1950s, and some of these marked fish were apparently recovered in ocean fisheries from California to Alaska. We are not confident interpreting the results of these early studies because source of the broodstock was not always clearly identified, fin marks may have been duplicated by other fishery agencies, and mark recovery programs were sporadic. Depending on the assumptions we make, Umpqua

River fall-run fish may have shown a northern or a northern and southern migration pattern in these early studies. Based on the geographic location of the system and on limited ocean-catch distribution data for nearby fall-run stocks, we tentatively classify these fish as north-migrating.

Timing of Return and Spawning

Fall-run fish may enter the Umpqua River from as early as mid-July through about October. The earliest returning fish are probably destined for upriver reaches of the North Umpqua and of the South Umpqua and for Cow Creek. Peak entrance of these "upriver" fall-run fish is probably in early September. These "upriver" fall-run stocks spawn in October-November with a usual peak in early November.

Fall-run fish that return to Smith River may enter the Umpqua system a little later, on the average, and are usually entering the Smith River system in September, October, and November, with a peak usually in late October. These "downriver" fish spawn from October through mid-January, with a peak usually in early November.

Age Composition of Spawners

Data regarding the age composition of fall-run chinook salmon in the Umpqua River basin are only available from Cow Creek. Only about 40 fish were sampled in each of 3 years; however, age 3 fish composed 29% to 83% of the females sampled in individual years. Overall, age 3 females were very nearly as common as age 4 females, and age 5 females were rare (Table II.96). On the basis of this information, we tentatively classify Cow Creek fish as an early-maturing stock. Anecdotal observations by management district biologists of fall-run fish in the Smith River suggest that it is a mid-maturing stock.

Table II.96. Percent age composition for Cow Creek (Umpqua River) fall-run chinook salmon. Values are for a composite of fish sampled on spawning ground surveys in 1980 and fish collected for broodstock in 1986-87.

Number, age	Males	Females
Number of fish in sample	63	58
Age 2	35	0
Age 3	44	47
Age 4	21	52
Age 5	0	1

Size at Age of Spawners

Data on age-specific size of Cow Creek spawners are shown in Table II.97.

Table II.97. Mean fork length (cm) for Cow Creek (Umpqua River) fall-run chinook salmon. Values are for a composite of fish sampled on spawning ground surveys in 1980 and fish collected for broodstock in 1986-87.

Number, age	Males	Females
Number of fish in sample	63	57
Age 2	49.8	--
Age 3	74.7	76.6
Age 4	93.9	87.2
Age 5	--	--

Fecundity and Egg Size

Data on fecundity and egg size are not available for this stock.

Juveniles--Spring-run

Distribution

Available data are insufficient to characterize the distribution of juvenile spring-run fish in the Umpqua River basin.

Length and Abundance

Available data are insufficient to characterize the length and abundance of juvenile spring-run fish in the Umpqua River basin.

Age at Ocean Entrance

Records of seining and trapping during the 1940s and 1950s indicate that juvenile chinook salmon from the North Umpqua underwent three phases of a downstream migration. First, some underyearling juveniles migrated downstream during late spring and early summer. By mid-summer these juveniles had migrated from the mainstem and upper estuary into the cooler reaches of the lower estuary. Underyearling juveniles also migrated from the North Umpqua to the estuary during September, October, and November when water temperature was lowering and early fall rains increased streamflow. Finally, yearling juveniles migrated from the North Umpqua to the ocean during spring of their second year of life. These early studies were not sufficient to establish the relative proportion of juveniles that exhibited these three migratory patterns.

A study of scales of Umpqua River spring-run fish in 1951 concluded that most juveniles migrated to the ocean after spending "about a year" in freshwater. However, the report of the study was written using language that did not distinguish between an underyearling juvenile that migrated to the ocean after a period of river residence (during its first year of life) and a yearling juvenile that migrated to the ocean in the spring after over-wintering in the river. Based on a careful review of this study, we believe that the scale readers would not have distinguished between a juvenile that entered the ocean in the fall (after about a year of freshwater and estuarine rearing) and a juvenile that entered the ocean during the spring (after over-wintering in the river). Consequently, this early study does not provide a reliable assessment of the age at ocean entrance of this stock.

Two recent data sources indicate that returning of Umpqua River spring-run fish are produced by both underyearling and yearling (as we define the terms for this report) life histories. A downstream migrant trap was operated at Winchester Dam during part of 1985 to evaluate effects of a new hydropower project on fish. Many juvenile chinook salmon were apparently migrating downstream out of the North Umpqua from June through November (Table II.98). Most of the fish that moved downstream during this period ranged from 8 to 11 cm and by September many fish had reached a size of about 12 cm. We do not have information on the age of these fish, but we believe that essentially all that were sampled from June through December were underyearlings.

Table II.98. Estimated number of juvenile chinook salmon that migrated downstream through two fish-bypass units at Winchester Dam Hydro Project on the North Umpqua, 6 May-16 December 1985.

Sample dates	Fork length	
	5-12 cm	>12 cm
6 May-31 May	470	1
1 Jun-15 Jul	36,314	2
16 Jul-31 Aug	14,240	0
1 Sep-15 Oct	11,383	3,412
16 Oct-26 Nov	13,201	953
27 Nov-16 Dec	1,088	0

A sample of scales was obtained from Umpqua River spring-run fish in 1986. These scale samples were examined to evaluate the rearing origin (hatchery or wild), age at ocean entrance (underyearling or yearling), and total age. Of 62 females that were judged to be wild fish, 25 (40%) were also judged to have migrated to the ocean as underyearlings.

On the basis of the entire body of information we reviewed, we surmise that both underyearling and yearling juveniles make important contributions to the return of wild spring-run chinook salmon in the North Umpqua. If so, age at ocean entrance for this stock is unique among Oregon coastal cinook salmon stocks. Every other population that we have data for, regardless of whether it is a spring- or a fall-run, apparently is composed of over 90% underyearling migrants.

Size at Ocean Entrance

We have no data on size at ocean entrance for Umpqua River spring-run fish.

Adults--Spring-run

Distribution of Catch in the Ocean

Recoveries of coded-wire tagged Umpqua River spring-run fish indicate that they have an ocean distribution pattern that is unique among Oregon coastal stocks. Umpqua River spring-run fish are caught primarily off Oregon, but they also make important contributions to catch in the ocean off northern California and off British Columbia (Table II.99). Thus, these fish appear to be both north-and-south migrating.

Table II.99. Distribution of ocean catch of Umpqua River spring-run chinook salmon released in the Umpqua River. Values are percentages of the total estimated catch (2,668 fish) from 6 release groups. Values >10% are shaded for emphasis. Dashed circles indicate <0.5%.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska	<0.5	<0.5	<0.5	<0.5		
British Columbia	1	15	7			23
Washington		12	3			15
Oregon	2	43	6			51
California	<0.5	6	4			10
Total at age	3	76	20			

Timing of Return and Spawning

Spring-run fish probably enter the Umpqua River from about March through mid-July with a peak usually during early April. These fish spawn from about September through October with a peak usually during mid-October.

Age Composition of Spawners

Few data are available to characterize the age composition of Umpqua River spring-run fish. A composite sample of angler-caught fish collected during 1946-51 indicated that females matured from ages 4 to 6 with age 5 strongly dominant. Males were about equally represented at ages 3 to 5 and about 10% were age 6 (Table II.100). The only contemporary data that are available indicate that females mature from ages 3 to 6 with age 4 strongly dominant (Table II.101). These two data sets present strikingly different pictures of the age composition of spawners.

Table II.100. Percent age composition for Umpqua River spring-run chinook salmon. Values are for a composite of fish caught by recreational anglers during 1946-51.

Number, age	Males	Females
Number of fish in sample	84	75
Age 3	33.3	0
Age 4	22.6	10.7
Age 5	34.5	84.0
Age 6	9.5	5.3

Table II.101. Percent age composition for female Umpqua River spring-run chinook salmon, 1986. Data are for a composite of fish sampled at Rock Creek Hatchery, fish sampled during a survey of recreational catch, and fish sampled during spawning ground surveys. Determination of rearing origin was based on fin-clip or scale analysis. Determination of juvenile life history was based on scale analysis.

Number, age	Hatchery		Wild	
	Underyearling	Yearling	Underyearling	Yearling
Number of fish in sample	48	81	19	30
Age 3	29	0	11	0
Age 4	65	91	68	70
Age 5	6	9	21	27
Age 6	0	0	0	3

Size at Age of Spawners

The age-specific size of Umpqua River spring-run fish is shown in Tables II.102 and II.103. Discussing apparent differences in age specific lengths shown by these two samples is difficult. The values obtained from the 1946-51 sample may not be comparable to the values obtained from the 1986 sample because of undocumented differences that may have occurred in measuring fish, or because of errors in assigning ages.

Table II.102. Mean fork length (cm) for Umpqua River spring-run chinook salmon. Values are for a composite of fish caught by recreational anglers during 1946-51. Measurements in inches were converted to cm for this table.

Number, age	Males	Females
Number of fish in sample	89	69
Age 3	47.4	--
Age 4	69.0	78.3
Age 5	89.2	88.5
Age 6	105.4	97.8

Table II.103. Mean fork length (cm) for Umpqua River spring-run chinook salmon, 1986. Data are for a composite of fish sampled at Rock Creek Hatchery, fish sampled during a survey of recreational catch, and fish sampled during spawning ground surveys. Values represent a combination of hatchery and wild fish. Determination of juvenile life history was based on scale analysis.

Number, age	Males		Females	
	Underyearling	Yearling	Underyearling	Yearling
Number of fish in sample	18	20	67	110
Age 3	68.9	--	73.6	--
Age 4	88.1	82.3	84.4	79.5
Age 5	--	--	89.0	84.4

Fecundity and Egg Size

Table II.104 contains regression equations that relate fecundity and relate egg size to fork length of spring-run fish from the North Umpqua. Table II.105 contains examples of values predicted by these equations.

Table II.104. Summary of regression equations relating fecundity (F, number of eggs) and relating egg diameter (D, mm) to fork length (L, cm) for Umpqua River spring-run chinook salmon, 1986. The sample probably contains both wild and hatchery fish.

Variable	N	Regression equation	R^2
Fecundity	46	$F = 0.220\ L^{2.215}$	0.489
Egg diameter	46	$D = 1.704\ L^{0.358}$	0.448

Table II.105. Examples of number and of diameter (mm) of eggs of Umpqua River spring-run chinook salmon, predicted from regression equations listed in Table II.104.

Variable	Fork length (cm)					
	60	70	80	90	100	110
Number of eggs	1,919	2,687	3,612	4,689	5,921	7,313
Diameter of eggs	7.38	7.80	8.18	8.53	8.86	9.17

WILSON RIVER

The Wilson River supports populations of spring- and of fall-run chinook salmon. However, we have no information on the juvenile and little information on the adult life history of spring-run fish in this system. The following narrative will be restricted to information about fall-run chinook salmon.

Juveniles--Fall-run

Distribution

Juvenile chinook salmon are present throughout the entire mainstem, the lower reaches of the North Fork, and in the tidal reaches of the Wilson River Channel through at least mid-September. We believe that many of these juveniles migrate from the Wilson River Channel to continue rearing in Tillamook Bay throughout this period.

Length and Abundance

Sampling of juveniles in the Wilson River basin has not been sufficient to allow us to characterize their size or relative abundance throughout the system. Juveniles were abundant in the lowermost reaches of the mainstem in June and in September 1980, however.

Age at Ocean Entrance

Few data are available to document the age at which surviving fish migrated into the ocean. We believe that nearly all returns are produced by juveniles that enter the ocean as underyearlings; however, we also believe that yearling migrants are a small (perhaps 5%-10%) but consistent component of the chinook salmon population in this system. A total of 233 scale samples from chinook salmon that returned to the Wilson River spawning grounds in 1982-83 and 1986 were examined to evaluate age at ocean entrance, and 231 of these fish had entered the ocean as underyearlings.

Size at Ocean Entrance

We have no estimates of the size at which surviving Wilson River chinook salmon entered the ocean.

Adults--Fall-run

Distribution of Catch in the Ocean

Wilson River chinook salmon have not been coded-wire tagged to assess geographic distribution of catch.

Timing of Return and Spawning

Chinook salmon enter the Wilson River from April through mid-January. We have no criteria and only limited data to distinguish fall-run fish; however, local anglers commonly refer to fall-run fish as entering from about mid-September through mid-February. Judging from recreational catches, the peak of entry probably occurs sometime in late October. These fish spawn from October through mid-March with a peak usually in early December.

Age Composition of Spawners

We classify Wilson River fall-run fish as late maturing. Limited age composition data from spawning ground surveys indicate that return of females is dominated by age 5 fish and, on the average, returns at age 4 and age 6 are about equal (Table II.106). Production of age 2 males is apparently low in this stock.

Table II.106. Percent age composition for Wilson River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1982 and 1986.

Number, age	1982		1986	
	Males	Females	Males	Females
Number of fish in sample	35	43	64	77
Age 2	6	0	0	0
Age 3	26	2	5	3
Age 4	31	23	37	16
Age 5	26	58	52	54
Age 6	11	12	6	27
Age 7	0	5	0	0

Size at Age of Spawners

The age-specific size of Wilson River spawners is shown in Table II.107.

Table II.107. Mean fork length (cm) at age for Wilson River fall-run chinook salmon. Data are for fish sampled on the spawning grounds in 1982 and 1986.

Number, age	1982		1986	
	Males	Females	Males	Females
Number of fish in sample	33	40	56	75
Age 2	--	--	--	--
Age 3	70.6	--	--	--
Age 4	100.6	91.8	93.8	93.9
Age 5	112.5	102.0	103.1	100.0
Age 6	107.0	99.4	--	105.5

Fecundity and Egg Size

Only very limited data on the egg size of Wilson River chinook salmon are available. Table II.108 contains a regression equation relating egg size to fork length of fall-run fish sampled during spawning surveys. Table II.109 contains examples of values predicted by this equation.

Table II.108. Regression equation relating egg diameter (D, mm) to fork length (L, cm) for Wilson River fall-run chinook salmon, 1985.

N	Regression equation	R^2
18	$D = 2.6616\ L^{0.25379}$	0.233

Table II.109. Examples of diameter (mm) of eggs of Wilson River fall-run chinook salmon predicted from the regression equation listed in Table II.108.

Fork length (cm)				
70	80	90	100	110
7.83	8.09	8.34	8.57	8.77

WINCHUCK RIVER

The Winchuck River supports a population of fall-run chinook salmon. Few data are available to document the life history characteristics of this stock.

Underyearling juveniles have been found in the lower mainstem in early summer and in the small estuary from late spring through September in several years, when their mean fork length ranged between 8.5 and 9.0 cm. A few yearlings have been observed in the system in late spring. Underyearlings apparently migrate to the ocean from as early as July through at least September.

Adults enter the system from mid-September through December and spawn from November through January. Some age data are available from carcasses sampled on the spawning grounds, but they are not sufficient to characterize age composition of the stock. We surmise, based on these limited data and on the geographic location of the system, that this is a south-migrating, mid-maturing stock.

YACHATS RIVER

The Yachats River system supports a population of fall-run chinook salmon. Few data are available with which to document the characteristic life history traits of this stock. Fall-run adults are present in the system from at least October through December and spawn in at least November and December. Fish were observed spawning primarily in the North and South forks in 1986. Anecdotal observations indicate that fish may spawn primarily in the mainstem during periods of relatively low streamflow.

YAQUINA RIVER

The Yaquina River supports a population of fall-run chinook salmon. A few spring-run fish are also present in the system, but we have no information on their life history characteristics. The following narrative will be restricted to information about fall-run fish.

Juveniles--Fall-run

Distribution

Juveniles are present in late spring and early summer throughout approximately the lower 40 miles of the mainstem, the lower 25 miles of Big Elk Creek, and the lower reaches of several spawning tributaries including Simpson, Grant, Salmon, Little Elk, Deer, and Feagles creeks. Sampling of juveniles in the basin has been limited, but we believe that most juveniles migrate to the lowermost mainstem and tidal reaches of the system by mid-July. Juveniles have been sampled from the head of tide to the river mouth through October.

Length and Abundance

Most of the information about the length and abundance of juveniles in the Yaquina River basin is based on fish sampled in the estuary. Generally, this work indicates that:

1. At any point during the summer months, larger juveniles are found closer to the river mouth and smaller juveniles are found farther upstream.

2. Larger juveniles are found farther offshore in the estuary; smaller juveniles are found nearer to the shore.

3. Juveniles are probably most abundant in the estuary in July-August.

4. Many juveniles remain in the estuary for an extended period of time during the summer and migrate to the ocean in September or October at a size of 11 to 17 cm.

Age at Ocean Entrance

We believe that practically all mature chinook salmon that return to the Yaquina River basin are produced by juveniles that migrated to the ocean as underyearlings. We examined 374 scale samples from chinook salmon that returned to the Yaquina River in 1981 and 1982 to evaluate age at ocean entrance, and all had entered the ocean as underyearlings.

Size at Ocean Entrance

We have no data on the size at ocean entrance of surviving adults. Judging from the size of juveniles that have been sampled in the estuary, some were rearing in Yaquina Bay for an extended period during the summer and migrating to the ocean at fork lengths of 11-17 cm.

Adults--Fall-run

Distribution of Catch in the Ocean

Limited recoveries of Ad+CWT-marked fish indicate that Yaquina River chinook salmon are north-migrating and are caught primarily in British Columbia and Alaska at ages 3 and 4 (Table II.110).

Table II.110. Distribution of ocean catch of Yaquina River fall-run chinook salmon released in the Yaquina River system. Values are percentages of the total estimated catch (191 fish) from 4 release groups. Values ≥10% are shaded for emphasis.

	Age 2	Age 3	Age 4	Age 5	Age 6	Total by area
Alaska		10	24	3		37
British Columbia	2	42	6	2		52
Washington	2					2
Oregon	2	8				10
California						
Total at age	6	60	30	5		

Timing of Return and Spawning

Fall-run chinook salmon enter the Yaquina from early August through mid-December with a peak usually during late September. These fish spawn from mid-October through December with a peak usually during late November.

Age Composition of Spawners

We tentatively classify Yaquina River fall-run chinook salmon as late maturing, although the data are not compelling. Age composition data are available based on spawning ground surveys in 1980 and 1981 (Table II.111). The dominant age of female maturation was age 5 in 1980 and age 4 in 1981. Part of our decision to classify these fish as late-maturing is based on the age composition of spawners, and part is based on the relatively strong catch of Yaquina River fish off Alaska at age 4 (Table II.110).

Table II.111. Percent age composition for Yaquina River fall-run chinook salmon. Data are for fish sampled on spawning grounds in 1980 and 1981. Some hatchery fish may be included.

Number, age	1980		1981	
	Males	Females	Males	Females
Number of fish in sample	73	73	99	129
Age 2	14	0	13	0
Age 3	62	8	13	2
Age 4	12	19	73	86
Age 5	12	73	1	10
Age 6	0	0	0	2

Size at Age of Spawners

The size at age of Yaquina River spawners is shown in Table II.112.

Table II.112. Mean fork length (cm) at age for Yaquina River fall-run chinook salmon. Data are for fish sampled on spawning grounds in 1980 and 1981. Some hatchery fish may be included.

Number, age	1980 Males	1980 Females	1981 Males	1981 Females
Number of fish in sample	73	73	97	124
Age 2	46.9	--	48.6	--
Age 3	76.0	76.7	74.1	--
Age 4	91.0	89.9	89.2	87.3
Age 5	99.5	94.7	--	94.3
Age 6	--	--	--	--

Fecundity and Egg Size

Fecundity and egg size data are not available for this stock.

PART III

Recent Trends in Run Strengths

CONTENTS FOR PART III

CONTENTS FOR PART III (Concluded)

INTRODUCTION TO PART III

The goal of PART III is twofold: first, to present an overview of our assessment of recent trends in the run strength of chinook salmon in Oregon coastal rivers; and second, to discuss factors that may be responsible for these trends.

The term "recent trends" refers generally to the post-1950s period because most available run strength indicator data represent this period. For the Rogue and Umpqua systems, counts of fish at dams are available back into the 1940s. For many coastal systems, however, indicator data are just that: indirect indications of the number of chinook salmon that return to the system. Data for many of these systems represent only the post-1960 or post-1970 period rather than the post-1950 period. Where records of commercial fishery catch in a river basin are available, and where such records clearly indicated a greater historic abundance level, we judged that population as "currently depressed compared with historic abundance," in addition to assessing recent trends in run strength of the population.

By "run-strength" we mean the abundance or number of mature fish in the spawning run of a particular stock. We use the term "freshwater" in reference to the recreational catch of fish in spawning runs, recognizing that much of the catch is made in bays and estuaries. Our intention is to clearly distinguish abundance and catch of chinook salmon returning to their home streams from abundance and catch in the ocean. Whenever we use the term "abundance" alone, it refers implicitly to run strength.

We chose to emphasize use of the term "run strength" rather than "abundance" because the former term is commonly thought of on a relative rather than on an absolute scale. We do present provisional estimates of the 1977-85 average number of chinook salmon that returned to individual river basins in Tables III.1 and III.2. We propose that these estimates (except for the few that are based on counts at dams) should be regarded as "working hypotheses" until such time as they can be verified. We feel that it is of immediate concern, however, to determine whether individual stocks are declining, stable, or increasing, and this is the emphasis we place on the run strength assessments contained in this report.

The general assessment of coastal chinook salmon populations presented in **PART III** is based on run strength assessments for all of the individual stocks, which are contained in **PART IV**. We assessed trends in the run strength of salmon stocks by examining available time-series data for Oregon coastal river systems that support populations of chinook salmon (Figure I.1). For most of these populations, available data included at least estimates of annual freshwater recreational catch based on angler "punch cards" and annual peak count of adults in spawning survey index areas. For a few small populations (from Beaver, Brush, Euchre, and Neskowin creeks, and from Yachats and Necanicum rivers), however, available data were too limited to allow assessment of trends in abundance. Additional information was available for some stocks and included one or more of the following: counts of fish at dams, estimates of freshwater recreational catch based on creel surveys, estimates of adult run size, and packing and landings records for chinook salmon caught commercially. Since our assessments of the run strength of Oregon coastal chinook salmon populations are based on a variety of run strength "indicator" data, we provide a discussion of the nature of each type of run strength indicator included in this report.

Trends in the run strength of chinook salmon populations can only be understood, as management of the stocks can only be achieved, within the context of a complex system that contains at least the following elements:

1. The chinook salmon population.

2. The freshwater rearing environment.

3. The ocean rearing environment.

4. The fisheries that harvest chinook salmon.

To provide a system perspective for understanding the trends we observed, we will review the following:

1. Aspects of chinook salmon life history that are especially relevant to abundance trends.

2. Habitat requirements of chinook salmon in Oregon coastal streams.

3. Theoretical effects of ocean fisheries on early- and on late-maturing chinook salmon populations.

4. Trends in freshwater habitat quality.

5. Trends in hatchery production of chinook salmon.

6. Trends in harvest of chinook salmon by commercial and recreational fisheries during the last 2-3 decades, and preliminary evaluations of stock composition of Oregon ocean fishery landings.

Although we recognize the influence that the ocean rearing environment can exert on survival, catch, and return of chinook salmon populations, we do not specifically discuss this phenomena, except for an occasional mention of the obvious effects of the 1983 El Nino event.

To provide an organizational framework for discussing general trends in the run strength of coastal populations, we have provided several tables (III.1, III.2, and III.3) that summarize the individual assessments of run strength that are presented in PART IV. These tables serve as a convenient reference base for our discussion of general trends in run strength of coastal chinook salmon populations and provide an outline for defining several "groupings" of stocks that apparently have exhibited similar recent trends. We conclude this part of the report with a list of recommendations for actions that will improve future assessments and management of these coastal chinook salmon populations.

A SYSTEM PERSPECTIVE ON RUN STRENGTH TRENDS

Chinook salmon populations in Oregon coastal streams exhibit great diversity in juvenile and adult life history patterns, are produced in a wide variety of rivers with differing physical characteristics, include varying proportions of hatchery-reared fish, and experience different rearing conditions and exploitation rates in the ocean. The run of chinook salmon returning to its home stream is the end product of complex interactions, during an entire life cycle, among these biological and environmental factors. As one or more of the factors in this system changes, so will the abundance of the returning run of fish change. The following narrative provides an introduction to the relationships between these factors and the run strength assessments that are the focus of this part of the report.

Life Histories

Four features of life history are particularly important because of their influence on stock productivity (and ultimately run strength) and on our understanding of any trends that might occur. These life history features are:

1. Duration of freshwater residence of juveniles.

2 Ages of maturation of adults.

3. Timing of return (to the home stream) of adults.

4. Ocean migration routes and rearing distributions of immature and maturing fish.

The duration of freshwater residence probably influences stock productivity. Ages of maturation and timing of return to the home stream determine the duration to which the stock is exposed to ocean fisheries and the average size of returning fish. Finally, ocean migration routes and rearing distributions determine the geographic regions and the intensity of ocean fisheries that the stock is exposed to. Information on these features of life history is presented for the majority of chinook salmon populations in Oregon coastal streams in **PART II** of this report.

Habitat Requirements

Habitat requirements of chinook salmon in Oregon coastal river basins differ in many respects from those of other anadromous salmonids. Although contemporary knowledge of specific habitat requirements is best described as qualitative rather than quantitative, some special features of habitat use can be pointed out.

Juvenile chinook salmon are most notably distinguished from coho salmon and steelhead by their extensive use of mainstem coastal rivers and estuaries as rearing habitat. Early rearing generally takes place in relatively low gradient reaches of larger tributary streams and throughout the mainstem of most coastal rivers. In some coastal rivers, nearly all juveniles migrate from these areas by mid-July to the lower reaches of estuaries where they continue to rear for several months prior to ocean entrance. In other coastal rivers, some juveniles continue to rear throughout the riverine reaches through the early fall and then rapidly migrate through estuaries prior to ocean entrance.

One noteworthy aspect of habitat use by adults is the tendency of an extremely high number of spawners to congregate in very short reaches of coastal streams. In many streams, reaches of very high spawning density can be readily identified by management district biologists, and spawners return to these areas every year. Presumably, the particular requirements for spawning habitat are met only in these limited reaches. However, these preferred reaches for spawning are often unsuitable for extended rearing of juveniles. In such situations, juveniles migrate downstream to larger tributaries or mainstem reaches almost immediately after they hatch. Adults (particularly adult spring chinook salmon, which may hold in freshwater for up to 6 months before spawning) often congregate in relatively deep "holding" pools during their upstream migration. Finally, adult chinook salmon cannot migrate up fish ladders, through culverts, or over falls as easily as can coho salmon and steelhead.

Although brief, this description of special freshwater and estuarine habitat requirements of chinook salmon allows identification of habitat alterations that might be most likely to adversely affect populations and of promising directions for habitat restoration and preservation efforts. For example, maintenance of adequate flow and low water temperature during summer months are probably critical to migration and survival of adult spring-run fish. Stream reaches that support high density spawning deserve special recognition and protection. Removal of barriers to upstream migration will increase available spawning habitat. Finally, degradation of estuarine and mainstem rearing areas will reduce the capacity of a river system to produce chinook salmon.

Hatchery Production

Runs of chinook salmon in Oregon coastal rivers are predominantly composed of wild fish; only about one-third of these populations are supplemented with hatchery fish. "Supplemented with hatchery fish," in this context, refers to the process of releasing hatchery-reared juveniles into a river system with the expectation of increasing the number of fish available to catch and the number of fish that return to the system. The actual contribution of hatchery-reared chinook salmon (released in coastal rivers) to fisheries and to returns is unknown in roughly two-thirds of the populations that receive "hatchery supplementation."

We recognize at least two major problems associated with the failure to monitor the hatchery-wild composition of hatchery supplemented runs. The first problem is the inability to recognize situations in which the hatchery fish are not surviving well or are not surviving at all. We encountered numerous examples in the history of hatchery supplementation programs in

Oregon coastal rivers in which a general optimism about hatchery programs delayed recognition that the particular programs were ill conceived and, at best, unproductive. The second problem is the inability to detect a deterioration in the return of wild fish in a system that is periodically dominated by a large (but unknown) proportion of hatchery fish. This is more subtle but is ultimately a more serious problem because the future production potential of the entire system is at risk.

We made provisional estimates of the proportion of wild fish present in runs that are currently being supplemented with hatchery fish and, whenever possible, relied on anecdotal observations to surmise the status of wild fish in these runs. These provisional estimates are in Tables III.1 and III.2 and in the basin by basin assessments of run strength contained in **PART IV**.

Fisheries

Of all the Pacific salmon, the chinook salmon is the only species for which a large proportion of ocean fishery harvest consists of fish not destined to mature in the year of capture. Chinook salmon reach a size at which they become vulnerable to ocean commercial and recreational fishery harvest late in their second or early in their third year of life. Fish destined to mature during their third year of life will be exposed to a single ocean fishing season during which they could be caught. However, fish destined to mature at age 5 will first be exposed to ocean fisheries at age 3, and if not caught will be exposed at age 4, and if not caught at age 4 will be exposed at age 5 until they return to freshwater to spawn. Thus, the average number of years during which fish from a particular stock are vulnerable to ocean fisheries depends on the average age of maturation for that stock. Fish from late-maturing stocks are, on average, vulnerable to ocean harvest for a greater number of years than are fish from early-maturing stocks (Figure III.1).

The timing of return to the "home stream" also exerts strong influence on vulnerability to harvest in ocean fisheries. Spring-run fish that mature at age 3 are essentially not harvested in ocean fisheries because they migrate to freshwater during April and May when they are still below the legal size limit. Spring-run fish that mature at age 4 will become vulnerable later in the season as immature age 3 fish, but vulnerability at age 4 is restricted to the early part of the fishing season, prior to their return to freshwater. In contrast, fall-run fish are vulnerable to ocean fisheries for essentially the entire ocean fishing season because they do not migrate to freshwater until early fall, often after ocean fishing seasons have closed. A fall-run fish that is destined to mature at age 4 would thus have two full seasons of vulnerability to ocean fishery capture, whereas a spring-run fish destined to mature at age 4 would only have slightly more than one full season of vulnerability.

Maturing chinook salmon that are not caught in ocean fisheries become vulnerable to harvest in freshwater during spawning migrations. Contemporary freshwater recreational fisheries often harvest 20%-35% of the fish in a spawning run. The opportunity to harvest chinook salmon in these recreational fisheries is directly dependent on the intensity of ocean fisheries. If a

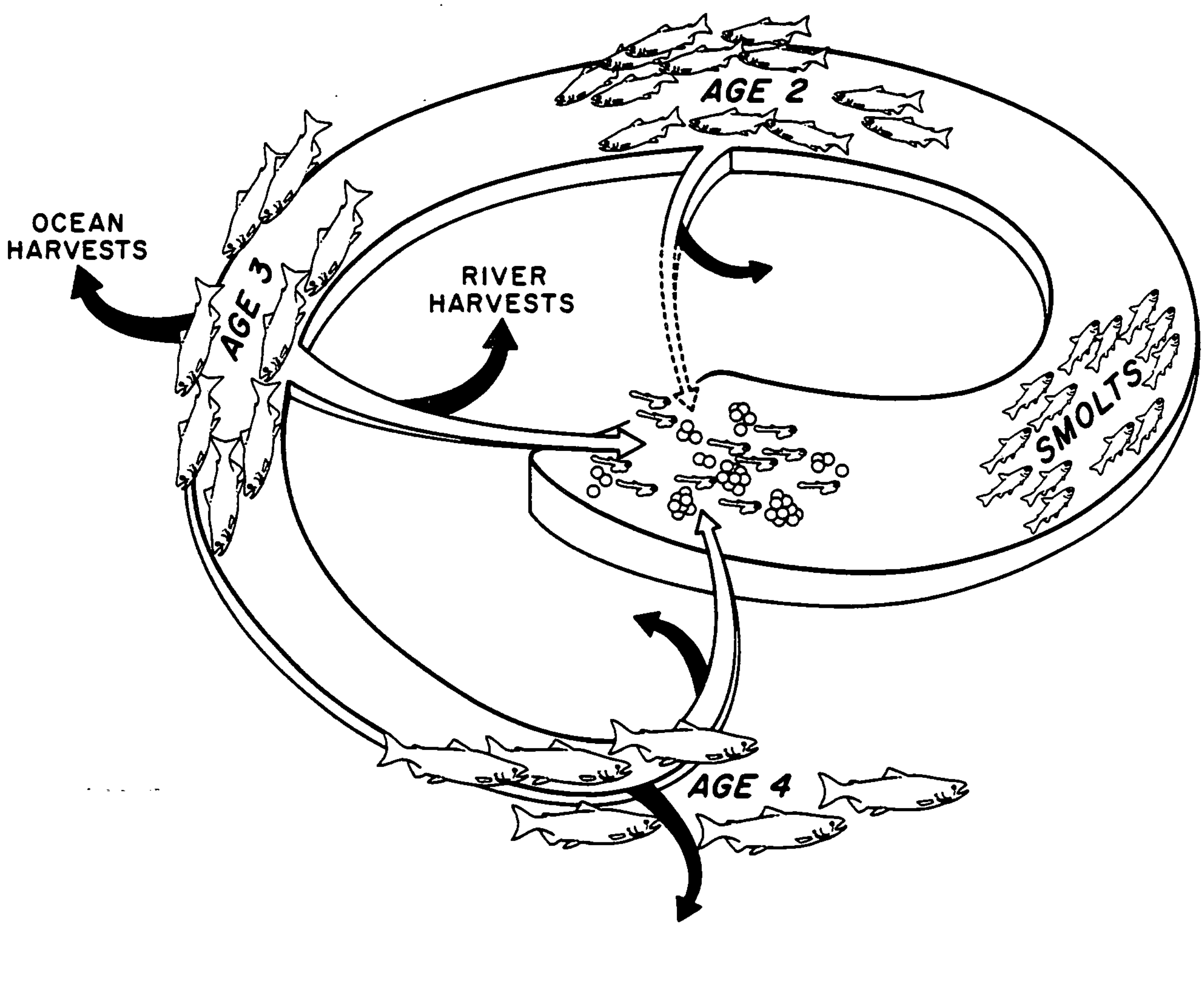


Figure III.1. Comparison of vulnerability to ocean fisheries of early-maturing (left-panel) and late-maturing (right-panel) fall-run chinook salmon. Note that the early-maturing stock is vulnerable to ocean fisheries for from 1-2 years, while the late-maturing stock is vulnerable to ocean fisheries for from 1-4 years.

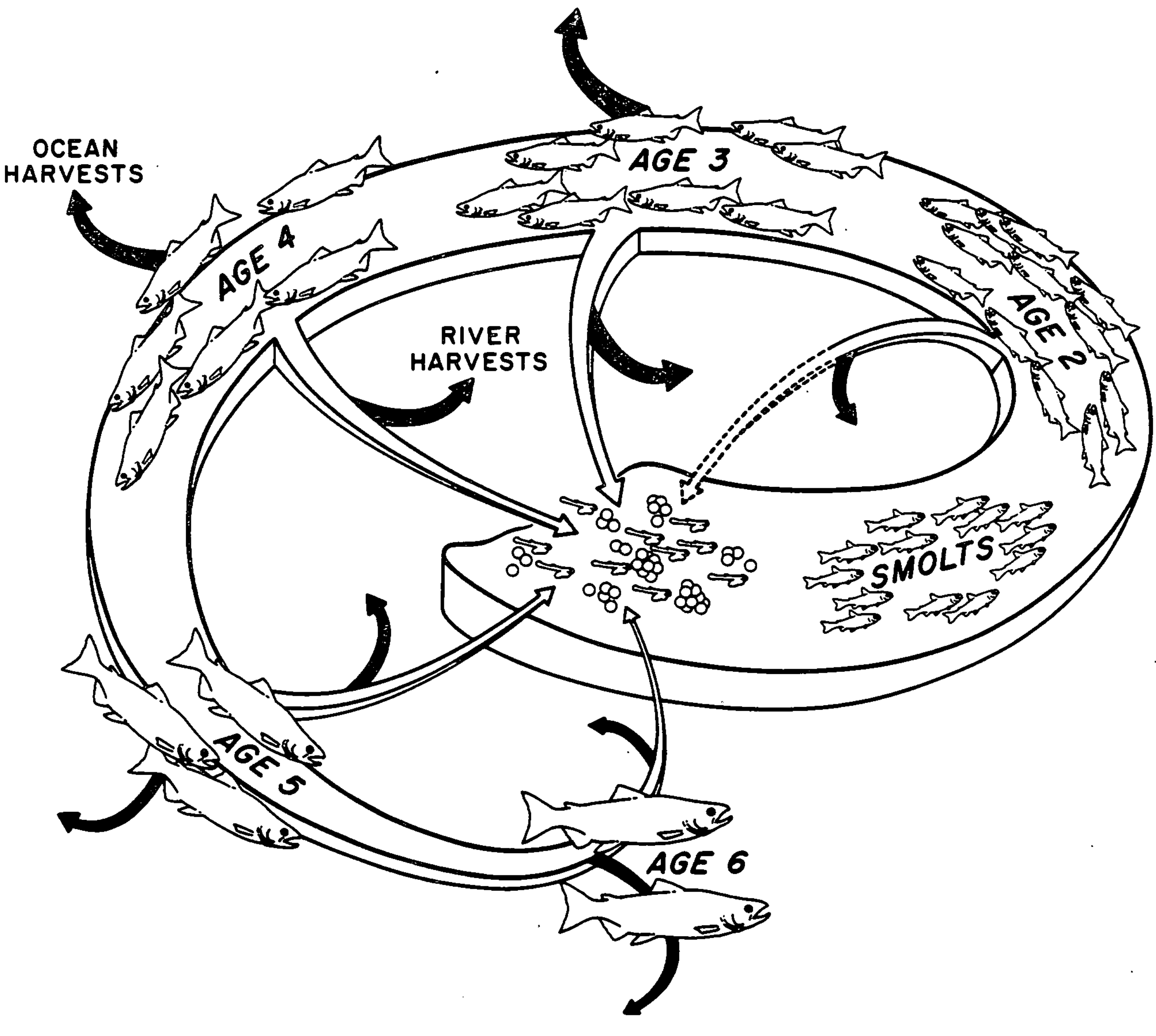


Figure III.1. Continued.

large percentage of the fish are caught by offshore fisheries, then fewer will be available for harvest in freshwater. The critical distinctions between ocean and freshwater fisheries are that an ocean fishery may harvest immature and maturing fish from many different stocks, whereas a freshwater fishery may harvest only mature fish that have survived to return in the spawning run of a single stock.

A direct relationship exists between the average age of maturation of a stock and the average size of fish caught in freshwater recreational fisheries. "Trophy-sized" chinook salmon, those that weigh more than 50 pounds, are usually at least 5 years of age. The opportunity to catch such large fish is much greater from late-maturing stock types, in which females predominantly mature at age 5 and in which age 6 fish are frequent, than from early-maturing stock types, in which nearly all fish mature before age 5. The average size of fish available to freshwater fisheries will always be greater from a late-maturing stock than from an early-maturing stock. Thus, Oregon's late maturing, north-migrating stocks provide the best opportunities for catches of "trophy-sized" chinook salmon in Oregon's freshwater recreational fisheries.

The great variety in life history patterns exhibited by chinook salmon populations, and the sequential intercepting nature of ocean and freshwater fisheries, make assessment and analysis of fishery-related effects complex. If early- and late-maturing stocks are harvested in the same ocean fisheries, ocean fishery effects may dramatically differ between stocks. Total ocean fishery removals, when calculated over an entire brood, will be much greater for the late-maturing stock than for the early-maturing stock. For example, imagine a simplified late-maturing fall-run stock type in which all fish mature at age 5, and a simplified early-maturing fall-run stock type in which all fish mature at age 3. Suppose that each stock is exposed to the same ocean fisheries in which the annual ocean fishery exploitation rate is 50% at ages 3 through 5. Finally, assume no natural mortality of these fish so that all deaths are attributable to removals by the ocean fishery. If 1,000 fish from each stock were alive at age 3, prior to the beginning of the ocean fishery, then 500 age 3 fish from the early-maturing stock type would be expected to escape ocean fisheries and return to freshwater for spawning. For the late-maturing stock, however, 500 fish would be expected to survive ocean fisheries at age 3, but these fish would again be exposed to ocean fisheries at age 4 and at age 5 prior to maturation and return to freshwater. For the late-maturing stock type, only 125 fish would be expected to return to freshwater at age 5. Thus, for the same annual ocean fishery exploitation rate, cumulative ocean fishery removals would account for 87.5% of the original number (at age 3) for the late-maturing stock, whereas they would account for only 50% of the original number of the early-maturing stock.

The simplified example provided above overlooks some important factors such as run timing, growth rate, stock productivity, and multiple ages of maturation, but it conveys one of the more critical problems in management of mixed stock ocean fisheries for chinook salmon. If the ocean fishery exploitation rate is set so as to maximize sustainable harvest from an early-maturing stock type, it will likely exceed the rate that can be tolerated by late-maturing stocks. Under this scenario the late-maturing stock would be expected to collapse. If ocean fishery exploitation rate is instead set so as to maximize sustainable harvest from a late-maturing stock type, then an early-maturing stock type will be harvested at a lower rate than would produce maximum ocean harvest for this stock.

TRENDS IN HABITAT

Quantitative data with which to assess trends in amount, availability, or suitability of habitat for chinook salmon in Oregon coastal river basins do not exist. Land use practices since the mid-1800s have greatly altered the character of freshwater and estuarine habitats that are used by juvenile and adult chinook salmon. These alterations probably caused a substantial reduction in the total amount and quality of habitat suitable for production of chinook salmon, but such alterations remain unquantified.

Contemporary land uses in most coastal river basins are typically dominated by (1) forestry-related activities in headwater areas; (2) light agricultural and residential activities in mainstem floodplain areas; and (3) intense commercial-industrial, residential, or recreational activities in many of the estuarine areas. Prior to the 1960s, splash dams, gravel removal, sawdust dumping, logging, road building, mining, and irrigation projects created serious barriers to migration of adult and juvenile chinook salmon and seriously degraded spawning and rearing habitats in many coastal streams. Since that time, environmental legislation, habitat management programs, and increased involvement of concerned public citizens have collectively slowed the rate of habitat degradation and in some cases have reversed these trends. Particularly important was legislation that established gravel removal (1967) and fill (1971) permit systems and the Forest Practices Act (1971). These legislative actions have decreased negative effects resulting from recent gravel removal, estuarine fill, and logging operations in chinook salmon habitat throughout Oregon coastal river basins. Habitat loss from construction of dams and dikes and from filling of estuaries remains largely unreclaimed, however, and some habitat suitable for chinook salmon has been irreparably lost.

Interviews with coastal management district biologists yielded agreement that the condition of most coastal river habitats has generally improved over the past 30 years, in part because of the above-mentioned legislation. Relatively few widespread habitat alterations have been noted during the past 30 years, the time period over which we have focused our assessments of chinook salmon population trends. Most of those habitat alterations that have been noted have taken place in south coast river basins.

Management district biologists have noted the following recent habitat effects as having special significance for production of chinook salmon:

1. The floods of 1964-65 apparently had greatest negative effects on south coast streams, particularly the Chetco River.

2. Commercial-recreational development has been especially rapid and dramatic in the relatively small Chetco River estuary at Brookings.

3. Logging activities during the 1960s and 1970s led to a general degradation of habitat in some south coast streams, Euchre and Hunter creeks and Pistol River in particular.

4. Significant alterations in streamflow and temperature patterns in the Rogue River have resulted from operation of Lost Creek Dam beginning in 1977.

For the most part, the extent of these recent habitat alterations has not been quantified, and only general and brief comments regarding habitat are presented in the individual stock assessments provided in **PART IV** of this report. The exception is for the Rogue River basin. Dam-induced habitat alterations have been the subject of much research in this river basin, and we have presented an extensive discussion of recent and historical habitat alterations for this large and important river basin in **PART IV**.

TRENDS IN HATCHERY PRODUCTION

During the more than one hundred years in which the state of Oregon has been funding salmon management programs, hatchery production has continually been viewed as a relatively simple technological solution to persistent problems of environmental degradation and overfishing. During the late 1800s and early 1900s, mature salmon were captured, eggs were taken, and unfed or fed fry were released in many Oregon coastal river basins. This practice was widely accepted as being beneficial to fish production, but the emphasis was strictly on number of fish released. Racks were constructed to block the upstream migrations of anadromous fish (chinook salmon were the primary target) and thereby provide a convenient source of eggs for hatchery propagation. These racks were constructed on (at least) the Nehalem, Wilson, Trask, Nestucca, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille rivers. During the period from 1919 to 1929, for example, an average of about 13 million chinook salmon fry were released annually in coastal rivers from the Nehalem to the Rogue. Little attention was given to selection of stock type, race, or even species propagated for release into particular rivers, and little or no attempt was made to document results. Hatchery programs were judged, on a prima facie basis, as successful.

More recent estimates of survival rates for hatchery releases of chinook salmon fry, fingerling, and smolts have suggested that few of these early coastal releases of native and nonnative fry produced returns of adults. For example, extensive releases of Columbia River stock fry and fingerling were made in the Alsea River during the 1920s and 1930s. These were discontinued because no apparent relationship between hatchery release and subsequent return was detected. Similarly, Columbia River stock fingerling were released from Rock Creek Hatchery in the Siletz River system for four brood years from 1947 to 1951. This program was also discontinued because no chinook salmon returned to the hatchery stream. The extensive system of "egg-taking" racks in the coastal rivers was gradually abandoned when runs of chinook salmon declined to levels at which it became impractical to sustain hatchery activities.

Hatchery programs during the 1920s began a gradual trend towards retaining and feeding juveniles for a longer period of time prior to release. But the number of eggs taken and of juveniles released gradually declined from a high level during the 1920s to a very low level in the late 1940s and 1950s. This decline was apparently caused by a serious decline in the escapement of chinook salmon in coastal river basins and a shortage of "surplus" eggs at hatcheries on the Willamette and Columbia river systems.

The general emphasis of hatchery programs for chinook salmon was on production and release of fingerling fish in the 1960s although a few individual hatchery programs were already releasing full-term smolts (underyearling and yearling) during this period. The trend towards a larger size and older age at release continued, encouraged by improvements in feed quality and by improvements in treatment of fish diseases. Releases of fingerling in coastal rivers declined to a relatively low level by the mid-1970s (Figure III.2). Current programs emphasize production and release of full-term smolts and native broodstocks. The emphasis on native broodstocks was in part stimulated by an extremely successful new program (beginning in 1968) at Elk River Hatchery that was based on native stocks of Elk River and Chetco River fall-run chinook salmon. The use of native broodstocks was further reinforced by a series of stock transfer experiments in Oregon coastal rivers in the 1970s. These experiments indicated that superior survival and fishery contribution would generally be achieved by using native stocks.

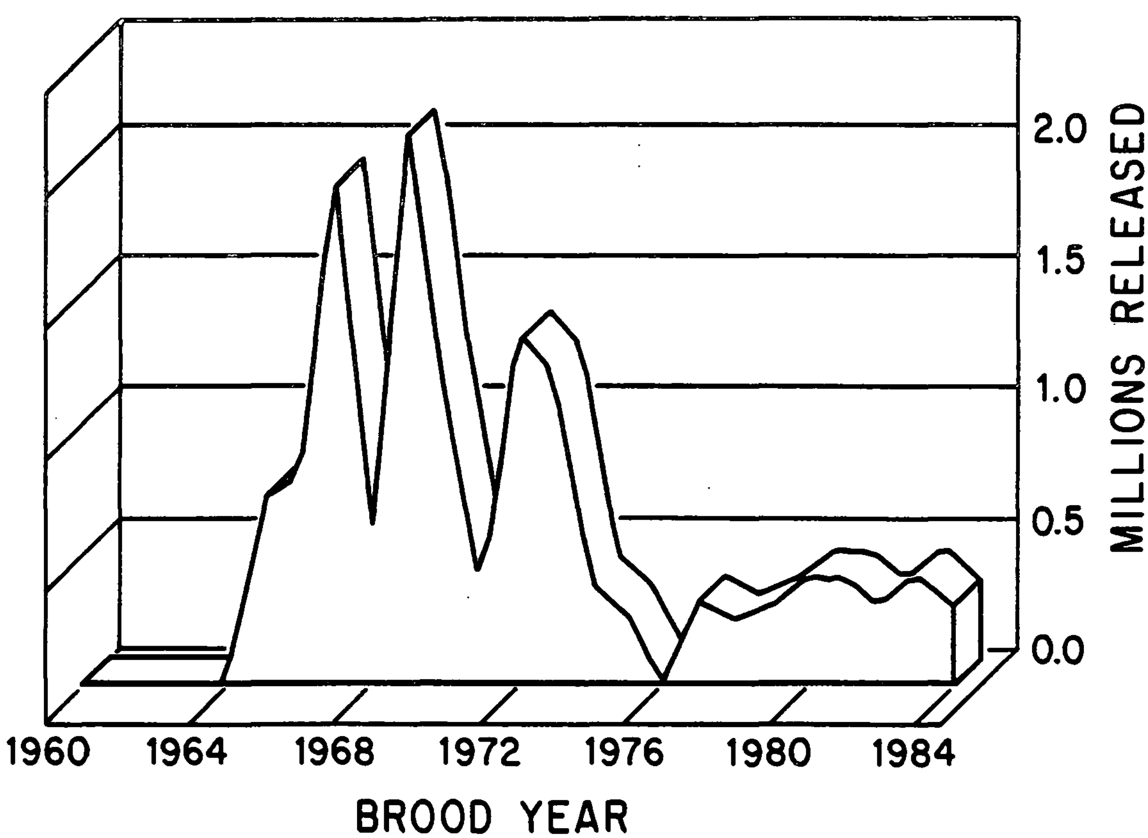


Figure III.2. Releases of north-migrating fall-run chinook salmon fingerling by public hatcheries in Oregon coastal river basins, 1961-84 brood years.

Public hatchery releases of chinook salmon smolts in Oregon coastal river basins have been relatively stable during the past decade. Releases of north-migrating fall-run fish have averaged about 1 million smolts annually, and releases of south-migrating fall-run fish have averaged about 500 thousand smolts annually (Figure III.3). Releases of north-migrating spring-run stocks have generally been about 200 thousand smolts annually, but releases of spring-run stocks that make strong contributions to Oregon ocean fisheries (Rogue and Umpqua) have averaged more than 1 million smolts annually (Figure III.4). Most of the releases of south-migrating spring-run stocks have been from Cole Rivers Hatchery on the Rogue River and have been designed to mitigate for upstream spawning habitat that was blocked by Lost Creek Dam.

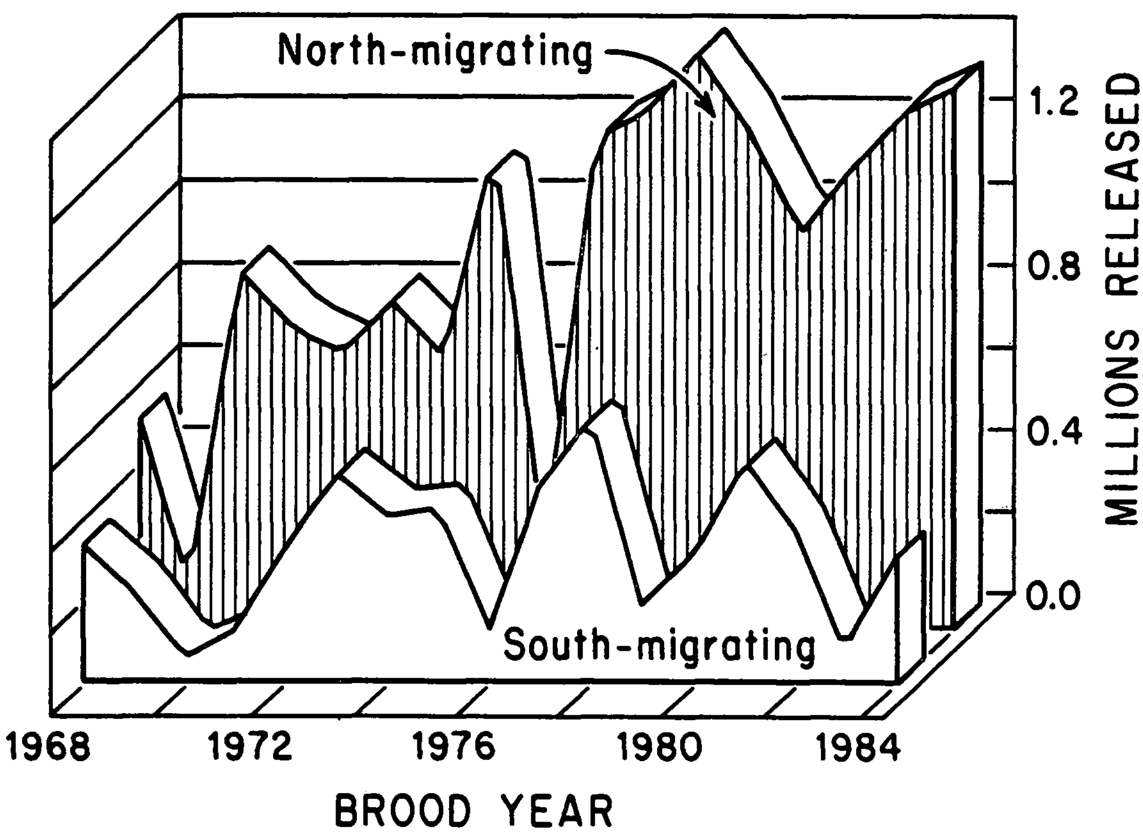


Figure III.3. Releases of north- and south-migrating, fall-run chinook salmon smolts by public hatcheries in Oregon coastal river basins, 1968-84 brood years.

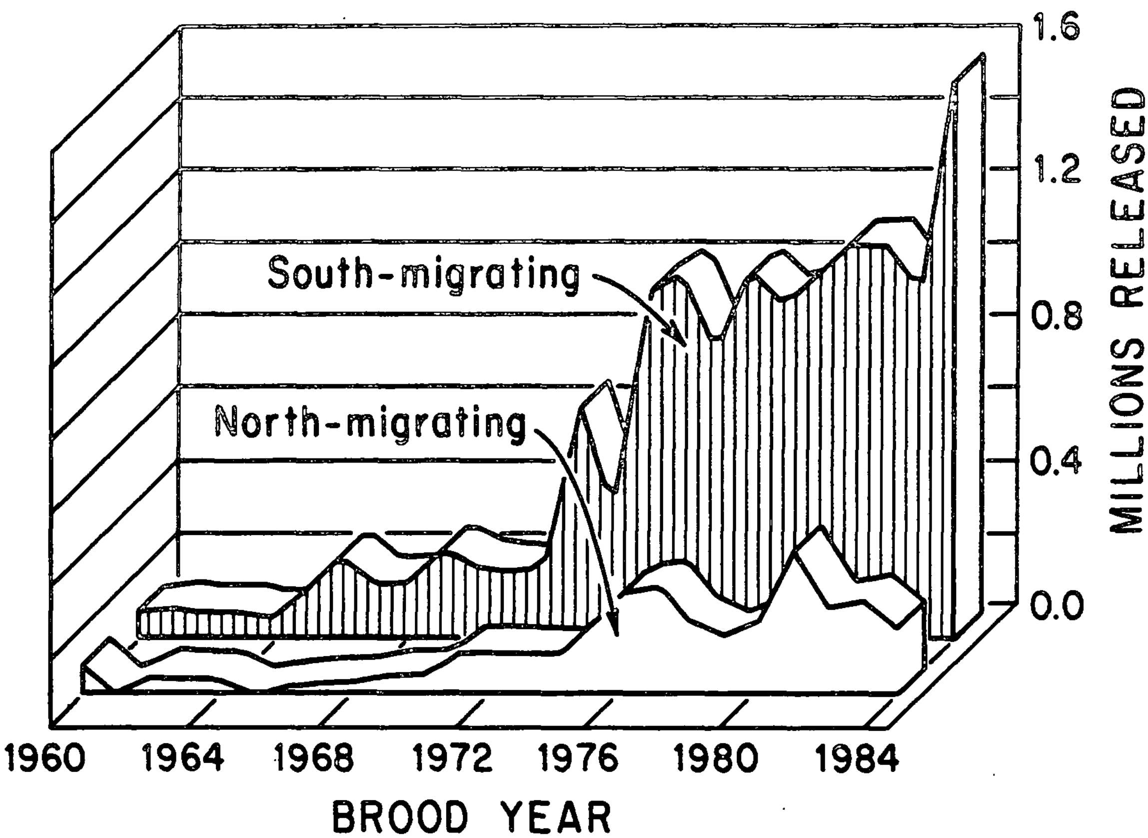


Figure III.4. Releases of north- and south-migrating, spring-run chinook salmon smolts by public hatcheries in Oregon coastal river basins, 1960-84 brood years. Values for south-migrating smolts include Umpqua River stock because it contributes primarily to the Oregon ocean fishery.

In addition to public hatchery releases of chinook salmon, several private hatcheries and Oregon's Salmon and Trout Enhancement Program (STEP) have also released chinook salmon in coastal river basins. Both of these sources of hatchery fish production are relatively recent.

Private salmon hatcheries first released chinook salmon in 1974. Currently authorized permits allow the release of chinook salmon at Burnt Hill Creek (5.0 million), Coos Bay (9.4 million), Siuslaw estuary (12.0 million), and Yaquina Bay (10.6 million). Private hatcheries have thus far released a variety of primarily nonnative stocks and have emphasized release of smolts. Annual releases of chinook salmon from private hatcheries have ranged from 2 to 3 million fish during 1982-84 brood years (Figure III.5) and are still below maximum permitted releases. As of 1987, private hatchery operators with permits in Coos Bay, Yaquina Bay, and Siuslaw estuary have expressed the general intention of eliminating production of native stock fall-run chinook salmon, greatly reducing production of coho salmon, and greatly increasing production of Rogue stock spring-run chinook salmon. Releases of spring-run chinook salmon by private hatcheries averaged about 1.3 million fish annually during 1979-86 and increased to about 10 million in 1987.

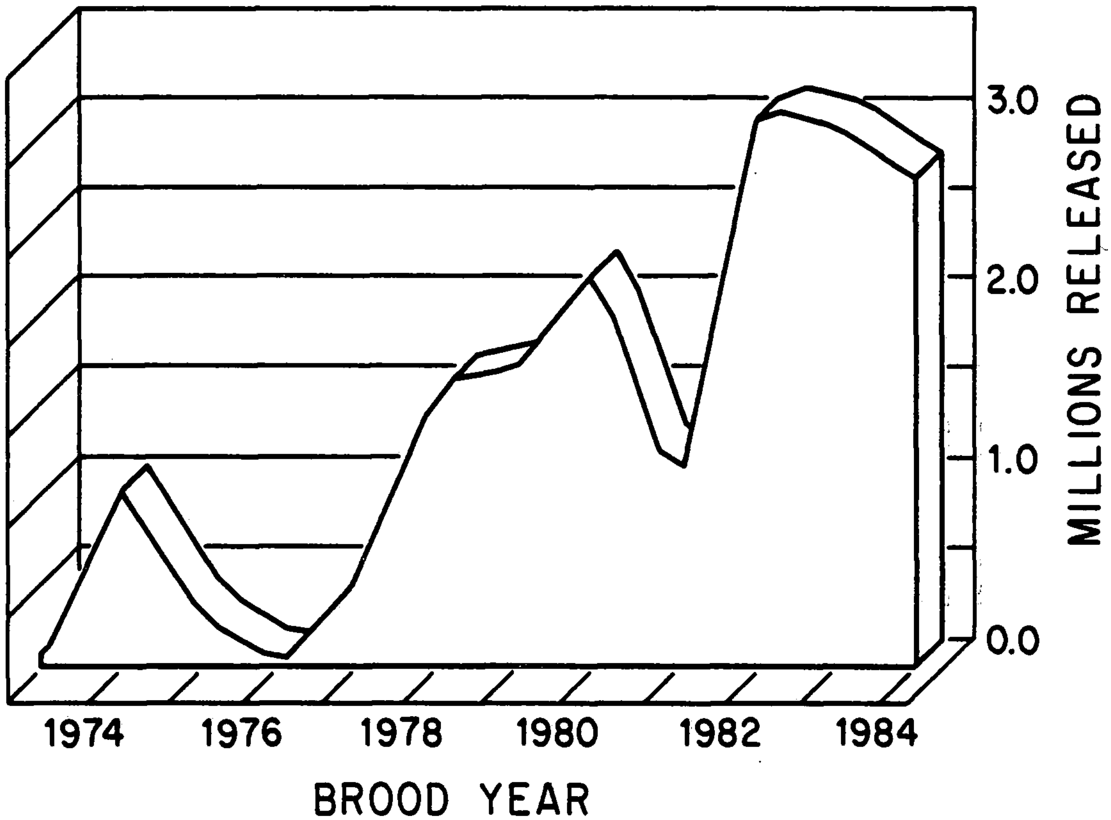


Figure III.5. Releases of chinook salmon smolts by private hatcheries in Oregon, 1973-84 brood years.

The STEP program made its first releases in 1980. In addition to releasing chinook salmon, STEP carries out a variety of habitat restoration programs in a broad-based attempt to restore or enhance self-sustaining populations. STEP has thus far emphasized releases of relatively small numbers of native-stock fry. Releases have averaged about 1 million fry annually from the 1983 to 1985 brood years (Figure III.6).

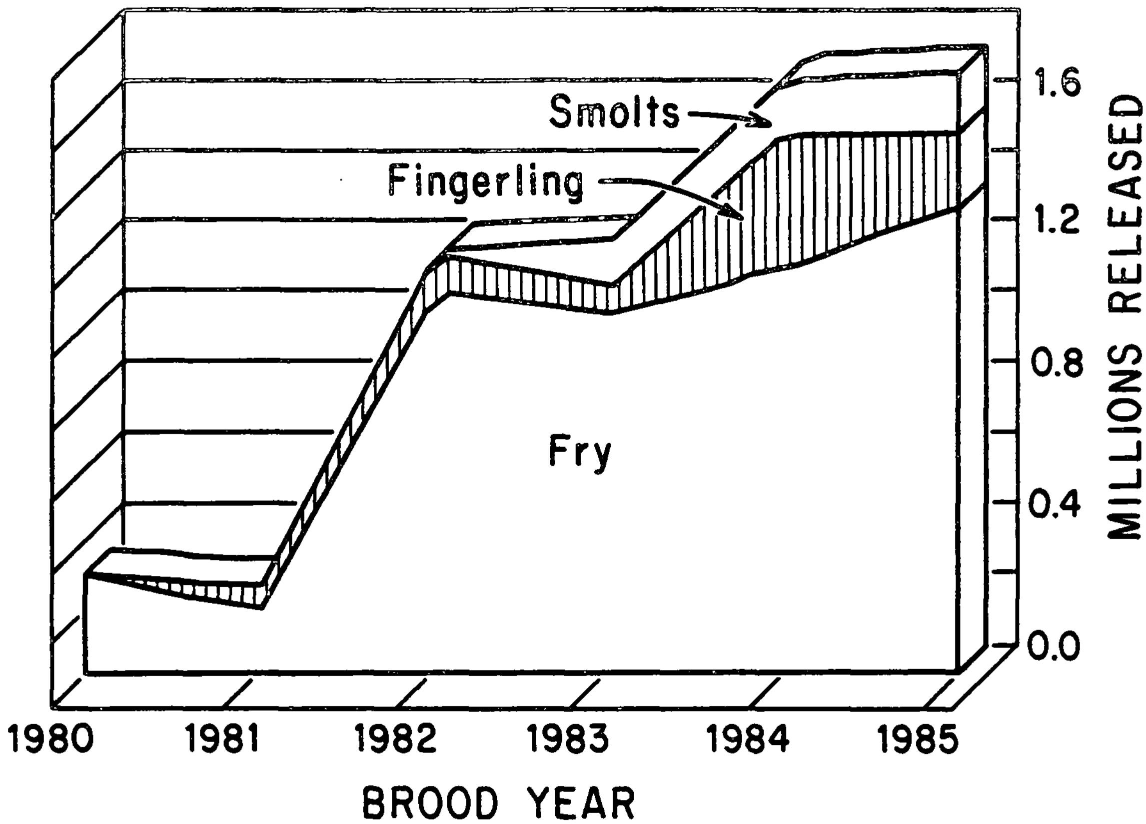


Figure III.6. Releases of chinook salmon by the Salmon and Trout Enhancement Program in Oregon coastal river basins, 1980-85 brood years.

TRENDS IN FISHERY HARVEST

Ocean Commercial Fisheries

Harvest

Total landings of chinook salmon made at Oregon coastal ports since 1952 have ranged from about 50 thousand fish in 1962 to about 525 thousand fish in 1987 (Figure III.7). Although landings have fluctuated greatly between years, "high" and "low" periods of production for stocks harvested in Oregon fisheries have been recognizable. Landings were high from about 1952 through 1958, were low from 1959 through 1972, and were again high from 1973 through 1982. Variation in landings within these periods was relatively small compared with variation in landings between periods. For example, annual landings ranged from about 60 thousand to about 160 thousand fish and averaged about 105 thousand fish for the period 1959 through 1972, whereas landings ranged from about 160 thousand to about 360 thousand fish and averaged about 238 thousand fish for the period 1973 through 1982. Landings during 1959, 1983, and 1984 were among the lowest that have been recorded and reflected (1) the effects of two separate El Nino events and (2) the 1984 closure of the coho salmon fishery south of Cape Falcon. The 1983 El Nino event resulted in very poor ocean growth rates and probably resulted also in very poor ocean survival rates for south-migrating chinook salmon stocks. Closure of the 1984 coho salmon fishery probably reduced fishing effort for chinook salmon during that season. Although ocean commercial harvest of chinook salmon was essentially prohibited in Oregon fisheries south of Cape Blanco during 1985, statewide landings during 1985 were relatively high (about 220 thousand fish). All Oregon ports were open for commercial chinook salmon harvest during 1986 and 1987, and landings in these consecutive years set two new Oregon records of about 400 thousand and 525 thousand fish, respectively.

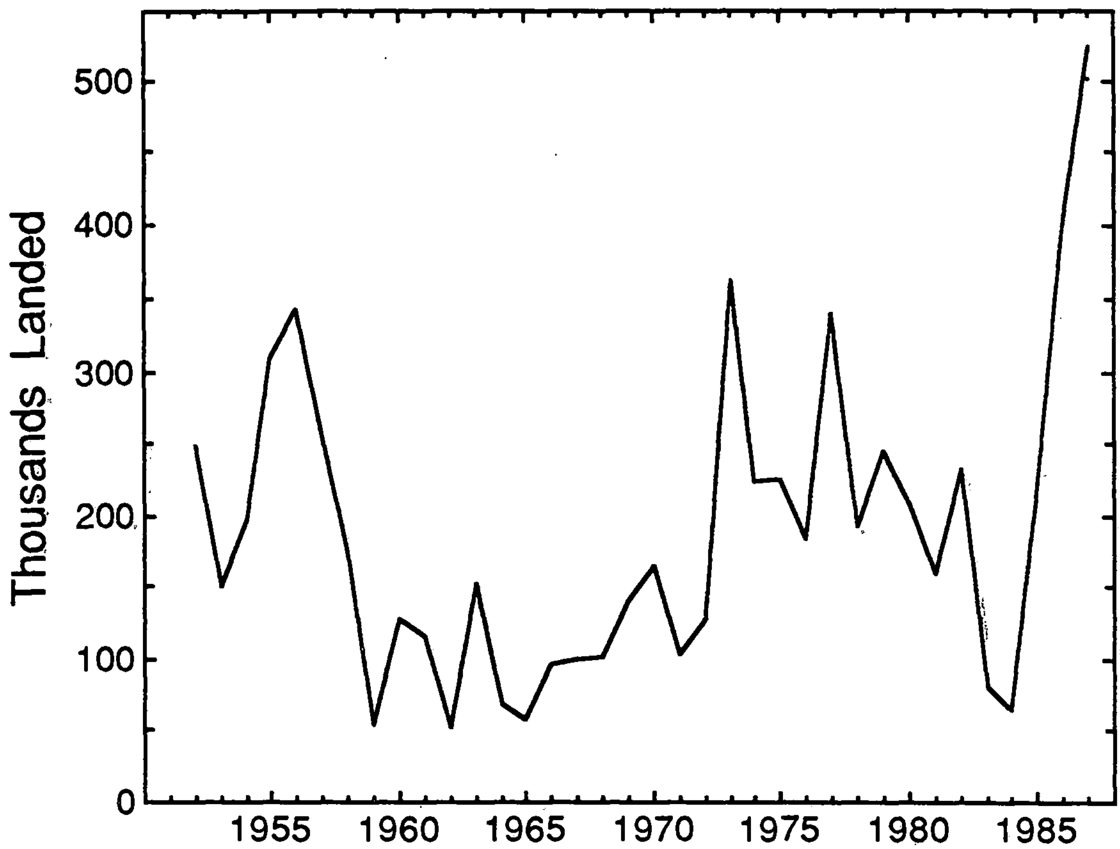


Figure III.7. Oregon ocean commercial landings of chinook salmon, 1952-87.

Although ports from Newport and north accounted for about 70% of the total ocean landings prior to 1957, since that time an average of about 70% of total Oregon ocean landings have occurred in ports from Coos Bay south (Figure III.8). The most important individual ports in recent years have been Coos Bay, Newport, and Brookings. These three ports together have accounted for from about 55% to about 70% of coastwide landings over the past decade.

Average Age and Size in the Catch

Preliminary estimates of age composition of Oregon's ocean commercial fishery landings indicate that age 3 and age 4 fish have accounted for more than 95% of the catch of chinook salmon since 1970 (**APPENDIX F**). Age 3 fish have accounted for an average of about 70% of the ocean catch, but have ranged

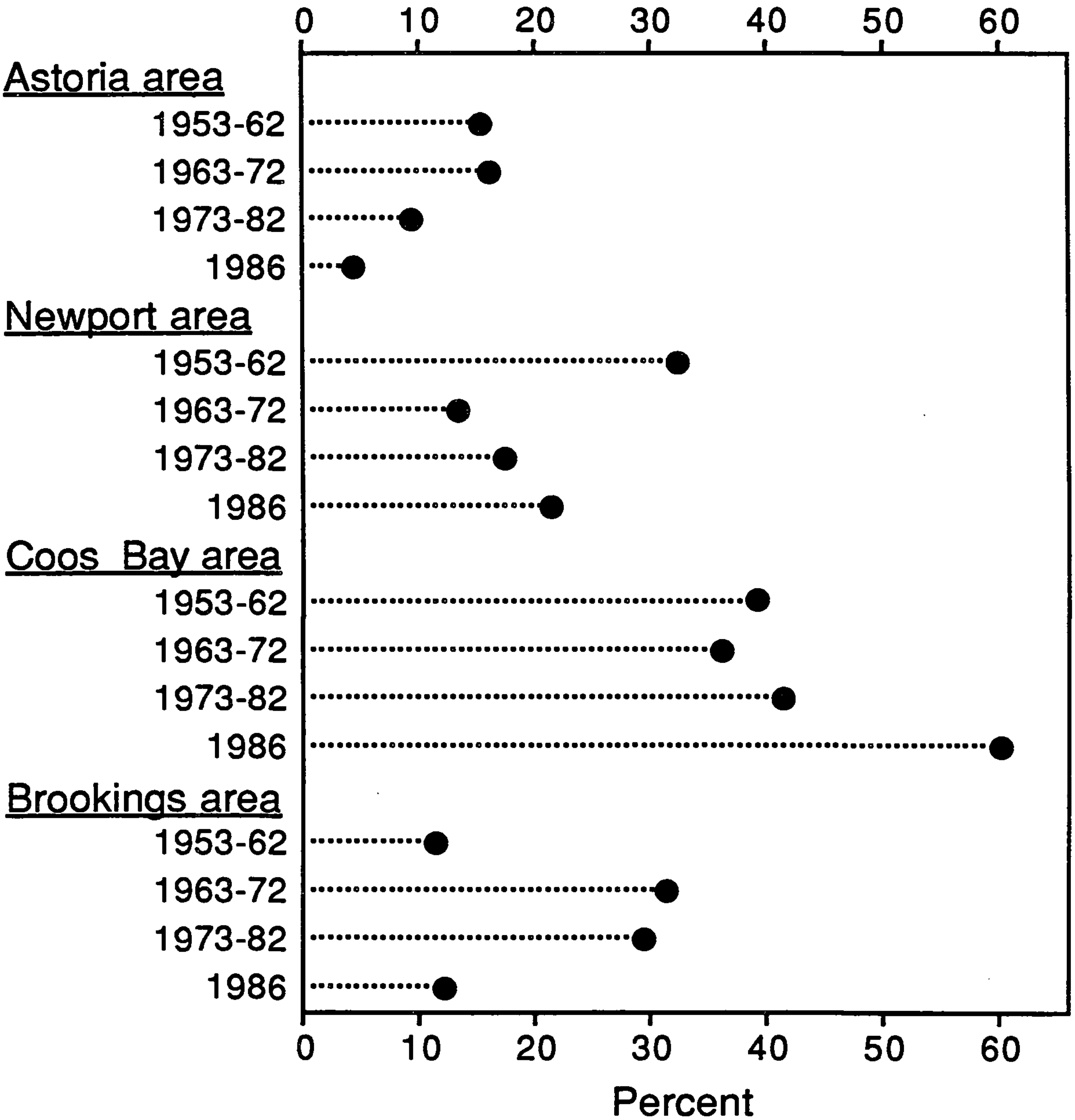


Figure III.8. Percent distribution of commercial landings of chinook salmon among Oregon ports for the periods 1953-62, 1963-72, 1973-82, and in 1986. Astoria area includes ports from Astoria through Pacific City; Newport area includes ports from Depoe Bay through Yachats; Coos Bay area includes ports from Florence through Bandon; Brookings area includes ports from Port Orford south.

from as low as about 43% in 1972 to as high as about 94% in 1986. Average dressed weight of fish landed has generally reflected annual age composition of landings and has ranged from about 8 to about 11 pounds. Average weight of fish during 1983 and 1984 seasons (8.2 and 8.4 pounds, respectively) was exceptionally low when compared with the estimated age composition of ocean landings. These low average weights reflected reduced growth rates caused by the 1983 El Nino event.

Ex-Vessel Value

With the exception of 1985 and 1986, total ex-vessel value of commercial landings has roughly followed the trend in total landings. Total ex-vessel value of catch (in 1986 dollars) has ranged from about $1.5 million to about $13.5 million since 1971 and has averaged about $5.6 million annually (Figure III.9). Although 1986 total landings set a record, the total ex-vessel value (about $6 million) was only average because of the second lowest real (i.e., in 1986 dollars) price per pound since 1971. Real market price has ranged from a low of $1.48 per pound in 1971 to a high of $3.75 per pound in 1979. The fluctuation in market price has modified the relationship between total landings and total ex-vessel value.

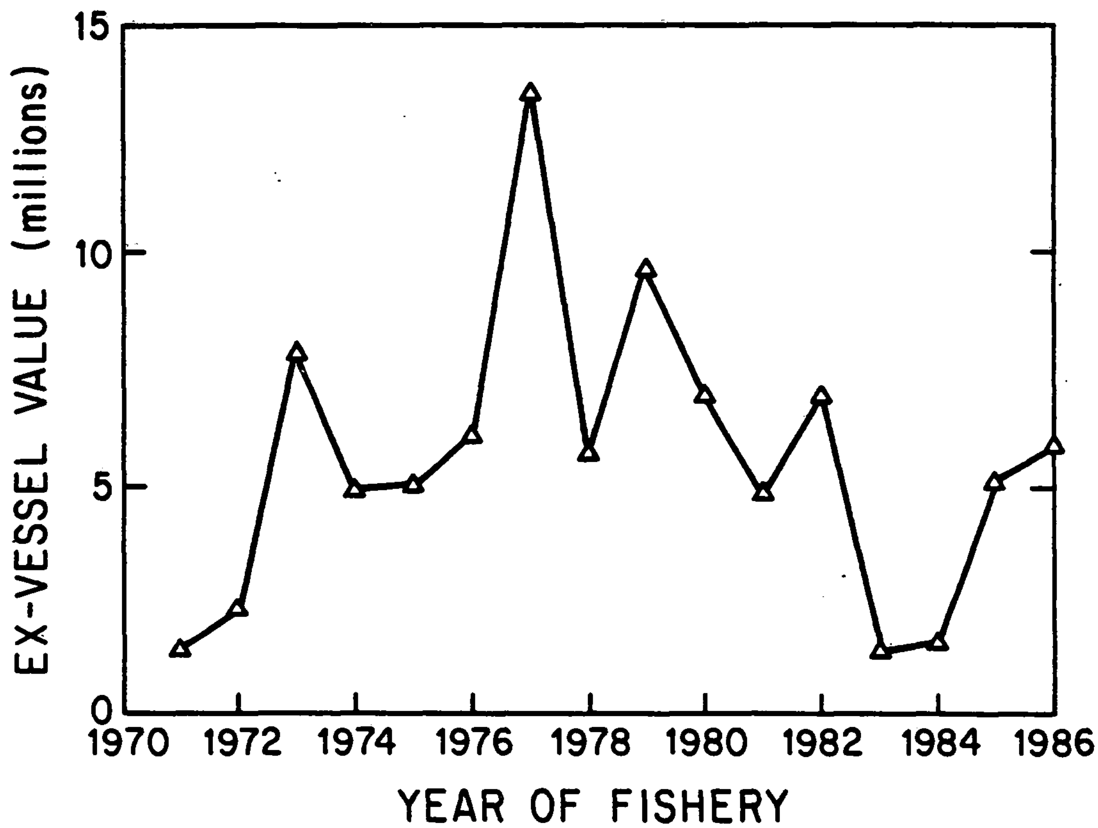


Figure III.9. Ex-vessel value (in 1986 dollars) of Oregon commercial landings of chinook salmon, 1971-86.

Fishing Effort

The number of vessels holding permits that allow participation in Oregon ocean salmon fisheries increased from about 2,200 vessels in 1974 to about 4,300 in 1980 when a permit system was established to curb a further increase in vessel participation. Vessels have steadily declined since 1980 to about 2,700 during 1986. The commercial vessels that have actually participated in the fishery have usually numbered about 500 fewer than the number of permits issued. About 85% of the permits have been issued to Oregon-based vessels. The remainder have been principally for California- and Washington-based vessels.

About 50% of the vessels that participate in ocean commercial fisheries are relatively small (20 to 29 feet). About 25% of the vessels are from 30 to 39 feet, and 15% are from 40 to 49 feet. Because larger vessels usually take longer trips and have larger and more elaborate on-board fish preservation systems, annual landings have been similar for each of these vessel-size categories. Together, vessels from 20 to 49 feet have accounted for about 95% of all Oregon commercial landings of chinook salmon.

Exploitation Rate

Based on coded-wire tag recovery data for stocks from northern California, southern Oregon, and the Columbia River, the 1977-83 ocean fishery annual exploitation rate for fully-vulnerable age 4 fish has been greater for south-migrating stocks than for north-migrating stocks. Estimated exploitation rate for age 4 south-migrating Klamath River fall-run stock and immature Rogue River spring-run stock reached a peak of about 80% in 1980, when the number of Oregon commercial vessel permits reached a peak. Exploitation rate for these south-migrating stocks has since dropped to about 45% in 1984 as a result of reductions in vessel participation and restrictions on season length (Figure III.10, top panel). Ocean fishery exploitation rate for age 4 north-migrating fall-run stocks (Elk River, and Columbia River tule and upriver bright stocks) has generally been lower and has ranged from about 30% to 45% since 1977 (Figure III.10, bottom panel). Current Pacific Fishery Management Council regulations that are designed to manage ocean harvest of Klamath River chinook salmon should maintain the annual exploitation rate in the northern California-southern Oregon fishery area at well below the level that occurred in the late 1970s and early 1980s. Thus, future ocean fishery exploitation rates for south-migrating and for north-migrating chinook salmon stocks should be similar. These ocean fishery exploitation rate estimates include modest catches in ocean recreational fisheries.

Stock Composition

The subject of who catches whose fish has generated spirited discussion since at least the 1930s when biologists had only a glimmer of information about the ocean migration patterns of chinook salmon. At that time, extended ocean migrations and ultimate return to the "home stream" were exciting concepts to be explored, tested, and debated. Since that time we have learned that chinook salmon do not pay particular attention to state or international

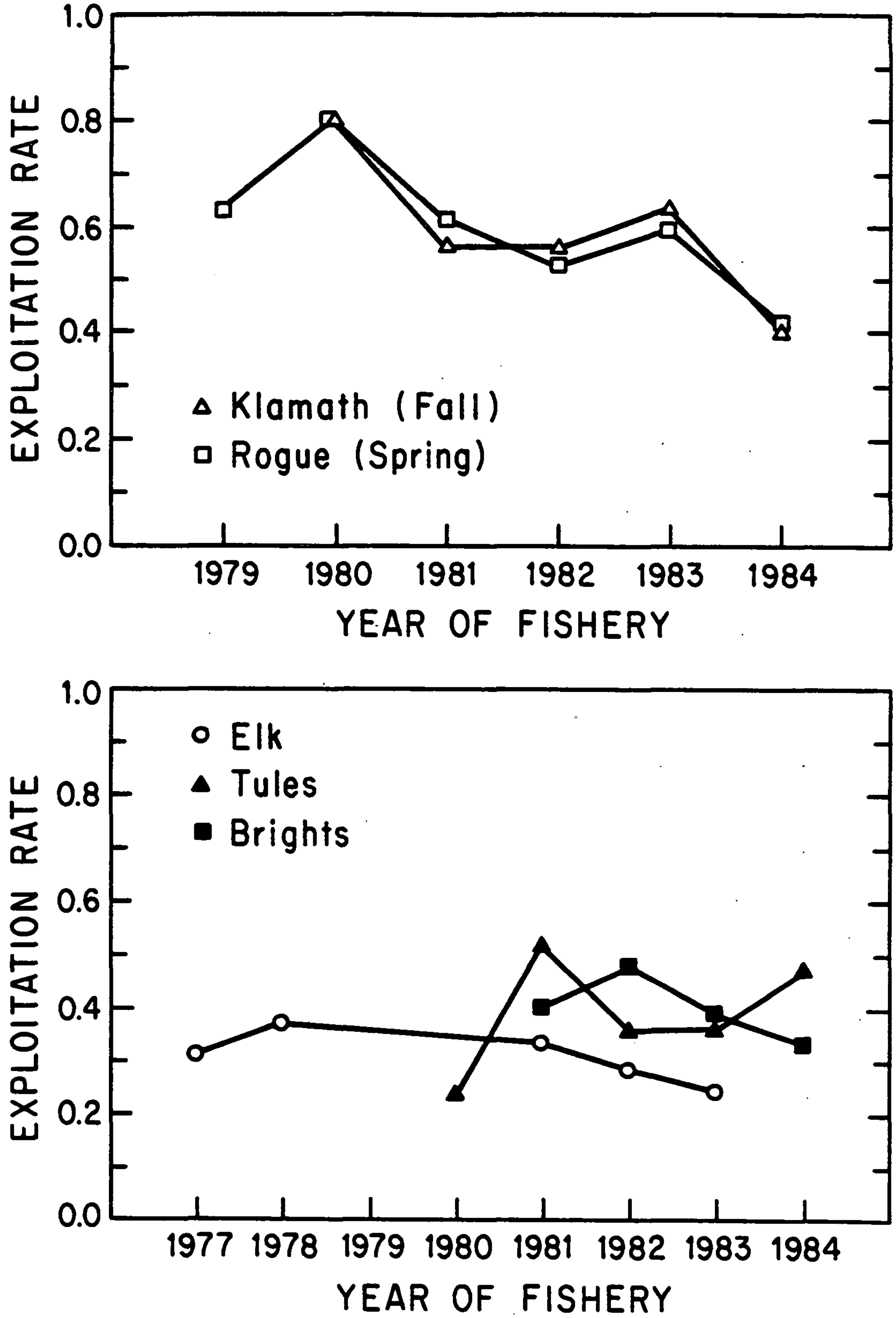


Figure III.10. Estimated ocean fishery exploitation rates for age 4 south-migrating chinook salmon stocks from the Klamath and Rogue rivers (top), and for north-migrating stocks from the Elk and Columbia rivers (bottom) based on coded-wire tag recovery data. Estimates for Rogue River are for immature spring-run fish; estimates for Columbia River are for tule and for upriver bright stocks of fall-run fish.

boundaries. California fish are caught in Oregon and Washington, Oregon fish are caught from California to Alaska, and so on. Much effort has been expended in recent years to document the ocean catch distribution of many stocks of chinook salmon, and the results of this work have formed a basis for negotiating ocean fishing seasons in both interstate and international forums.

Preliminary estimates of the stock composition of chinook salmon landed by trollers in Oregon have only recently been made. We caution that these estimates should be viewed with healthy skepticism because they involve a complex series of assumptions and mathematical calculations that will undoubtedly be revised in the future as new information becomes available. Nevertheless, this work represents an assessment of the best information currently available on the origin of chinook salmon landed by commercial trollers in Oregon ports. The estimates are based on recoveries of coded-wire tagged fish sampled during 1979-86. The following narrative pertains to this work.

Roughly two-thirds of the Oregon landings of chinook salmon originated from three river basins, two of which are in California (the Sacramento-Central Valley and the Klamath) and one of which is in Oregon (the Rogue). Figure III.11 also shows the average stock composition during 1979-86 in the Brookings (Oregon ports from Port Orford south), Coos Bay (ports from Bandon through Florence), and Newport-north (ports from Waldport through Astoria) areas.

Chinook salmon from the Rogue River basin composed about one-third of the commercial landings in Oregon during 1979-86. Landings of fall-run fish were about four times greater than landings of spring-run fish. Judging from the estimated catch and escapement of these fish during 1979-86, Rogue fall-run fish contributed to the commercial catch at over twice the rate of Rogue spring-run fish.

Klamath River chinook salmon generally composed a declining proportion of landings in ports north of Brookings, but Central Valley fish made similar proportional contributions along the entire coast. This difference may indicate a broader northward distribution of Central Valley than of Klamath fish.

The origin of roughly one-fourth of the Oregon commercial landings of chinook salmon during 1979-86 was not specifically identified. We surmise that chinook salmon from the following river basins routinely contribute fish to the Oregon fishery: in California, the Eel and Smith rivers; and in Oregon (listed from south to north) the Sixes, Coquille, Coos, Umpqua, Siuslaw, Alsea, Yaquina, Siletz, Salmon, Nestucca, Trask, Wilson, and Nehalem rivers. We surmise that the contribution by these stocks is relatively greater for stocks located in the south central and central Oregon coast than it is for stocks on the north Oregon coast.

Other stocks specifically identified as routinely contributing to Oregon landings of chinook salmon during 1979-86 include Umpqua, Chetco, Elk, a variety of Columbia River stocks, and both north- and south-migrating stocks released by private hatcheries. Prior to 1986, chinook salmon released by

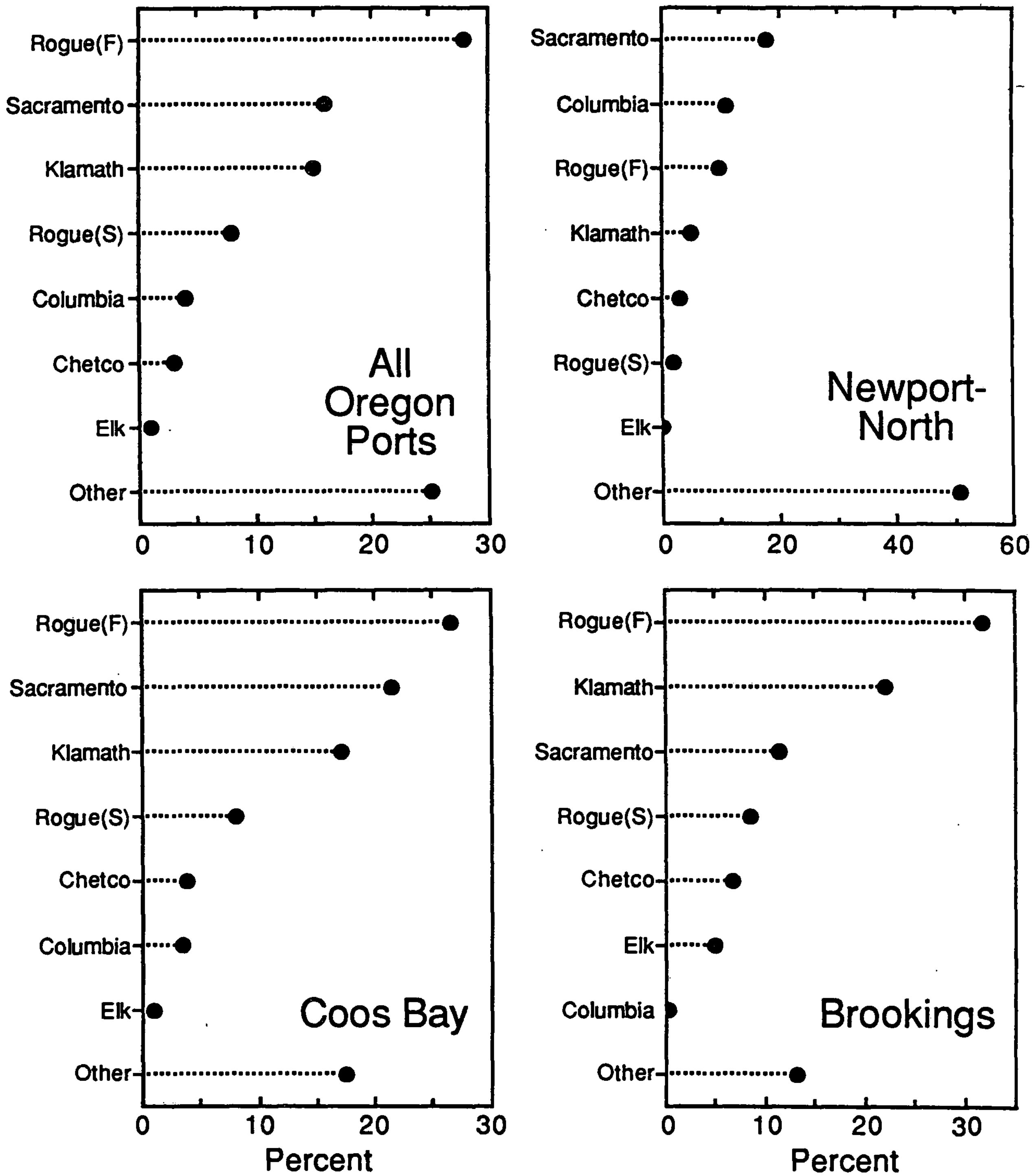


Figure III.11. Preliminary estimates of stock composition of Oregon commercial fishery landings of chinook salmon: all Oregon ports; in the Newport area (ports from Waldport through Astoria); in the Coos Bay area (ports from Bandon through Florence); and in the Brookings area (Oregon ports from Port Orford-south), 1979-86.

private hatcheries were a small (typically less than 5%) component of Oregon landings. A preliminary estimate indicates that chinook salmon released by private hatcheries were about 8.7% of Oregon's landings in 1986 (about 6.1% were south-migrating stocks and about 2.6% were north-migrating stocks).

No estimate of the overall contribution of hatchery chinook salmon to Oregon ocean fishery landings has yet been made. Based on "probable" hatchery fish proportions in the Sacramento, Klamath, and Rogue river basins, we surmise that public hatchery chinook salmon account for about one-third of the Oregon landings.

Ocean Recreational Fisheries

Oregon's ocean recreational catch of chinook salmon has generally been small compared with commercial fishery landings. Annual ocean recreational fishery landings have ranged from about 17 thousand fish to about 79 thousand fish and have averaged about 39 thousand fish annually since 1974. For the period 1973 through 1980, about 50% of these landings were at ports in the Tillamook and Astoria areas, but from 1981 through 1986 these ports accounted for less than 20% of coastwide ocean recreational landings of chinook salmon. Almost 50% of all recreational ocean landings of chinook salmon from 1981-86 were made in the Brookings area, and most of these were made in the port of Brookings itself (Figure III.12). In 1985, when ocean commercial fishing for chinook salmon was closed south of Cape Blanco, more than 36 thousand fish were landed in the Brookings area recreational ocean fishery.

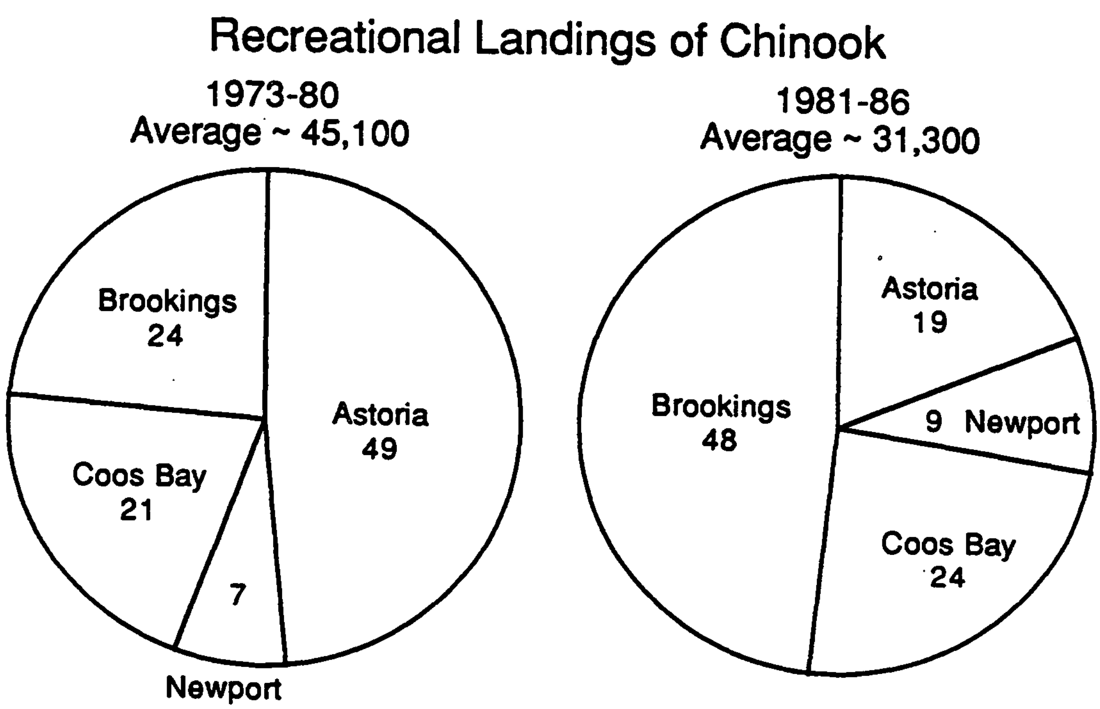


Figure III.12. Percent distribution of recreational landings of chinook salmon by area of catch in the ocean among Oregon ports for the periods 1973-80 and 1981-86. Astoria includes ports of Astoria, Garibaldi, Hammond, Pacific City, and Warrenton; Newport includes ports of Depoe Bay and Newport; Coos Bay includes ports of Coos Bay, Florence, and Winchester Bay; Brookings includes ports of Port Orford, Gold Beach, and Brookings.

Most ocean recreational salmon fishing takes place in individually-owned vessels, but Oregon also supports a charterboat fleet of from 200 to 250 licensed vessels. Most of these charter boats are usually licensed by Oregon residents, but from 5% to 25% annually have been licensed to Washington residents in the Columbia River area.

Freshwater Recreational Fisheries

Harvest

Recreational fisheries for chinook salmon have existed in Oregon coastal rivers for over one hundred years. Fisheries achieved early notoriety in the Rogue and Umpqua rivers, but only sketchy accounts of recreational fisheries in other coastal rivers are available. Apparently these fisheries flourished in most of the short-reach coastal rivers during at least the 1940s and 1950s, based on the existence of numerous private boat moorages in the tidal reaches of the Nehalem, Nestucca, Salmon, Siletz, Yaquina, Alsea, Siuslaw, and Coquille rivers and on Tillamook Bay. For example, approximately 13 private moorages operated on the Nehalem River in 1947. The catch in these recreational fisheries included both coho and chinook salmon. Of these, coho salmon were by far the greatest part of the catch. The popularity of many of these fisheries gradually waned during the late 1950s and 1960s when fishing effort shifted to offshore interception of coho salmon by commercial troll, charter, and recreational fleets. This shift signaled a slow decline in these tidewater fisheries because fewer and fewer coho salmon were escaping from ocean fisheries and therefore fewer returning fish were available to catch. In recent years, coho salmon escapement in most Oregon coastal rivers has offered only sparse opportunity for recreational fishing. However, rebuilding runs of chinook salmon in many river basins are apparently stimulating renewed popularity of the once vigorous tidewater salmon fisheries.

Estimates of the recreational catch of chinook salmon in several Oregon coastal rivers are available as early as 1947 (Appendix Table E-1). Judging the accuracy of these estimates is difficult; nevertheless, they indicate that the catch of adult chinook salmon in many of these tidewater fisheries was in the neighborhood of several hundred fish annually.

Contemporary recreational fisheries, targeting primarily on chinook salmon, occur in all major Oregon coastal river basins. The regions in which the greatest number of chinook salmon have been harvested annually include the Tillamook Bay watershed (about 11 thousand fish annually), the Rogue River (about 8 thousand fish annually), and the Nestucca River (about 4 thousand fish annually).

Collectively, annual recreational harvest of fall-run fish has been greater and has been more stable than that of spring-run fish during the 1969-85 period (Figure III.13). The annual catch of fall-run fish ranged from about 20 thousand to about 43 thousand, and has averaged about 27 thousand fish. The collective catch of spring-run fish from coastal streams apparently declined from an annual level of about 26 thousand in 1969 to about 4 thousand in 1984 (Figure III.13) but has shown substantial recovery during 1985-87.

The general decline in catch of spring-run fish and the very poor catch of spring-run fish in 1983 and 1984 apparently reflect a general decline in annual catch of Umpqua River spring-run fish and extremely poor returns of both Umpqua and Rogue river stocks in 1983 and in 1984.

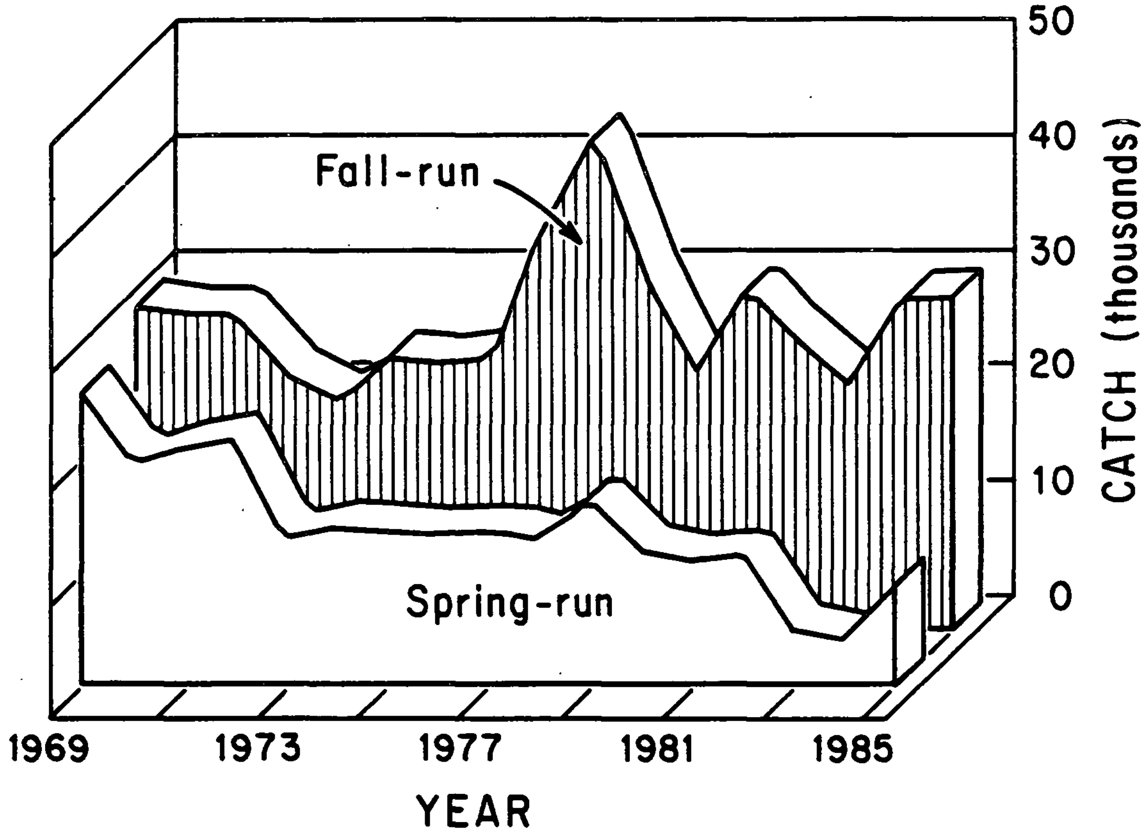


Figure III.13. Estimated recreational catch of fall- and spring-run chinook salmon in Oregon coastal river basins, 1969-85, based on angler returns of "punch card" catch records.

The apparent trends in freshwater recreational harvest of fall- and spring-run chinook salmon must, to some extent, be influenced by changes made in reporting requirements for "punch cards." The shift in 1977 from a 20-inch to a 24-inch minimum size limit for reporting catch must have resulted in fewer jacks being included in estimated recreational catch since 1977. The change in 1978 (identifying salmon by species) probably improved the accuracy of catch estimates; however, the extent of the improvement is undocumented. Based on estimated recreational harvest from 1978 through 1986, harvest of fall-run chinook salmon has been relatively stable, whereas that for spring-run chinook salmon appears to have declined.

The recreational catch of fall-run fish is supported by about 15 river basins with an annual catch of 500 or more fish and an additional 10 or more river basins with an annual catch of fewer than 500 fish. The recreational catch of spring-run fish is supported by only five river basins. Listed in descending order of catch these are the Rogue, Umpqua, Trask, Nestucca, and Wilson. Recent trends in the recreational catch of chinook salmon in Oregon coastal rivers are discussed in the basin by basin assessments in **PART IV** of this report.

Exploitation Rate

Estimates of exploitation rate in freshwater recreational fisheries are available for Rogue River spring-run, Elk River fall-run, and Salmon River fall-run chinook salmon. These estimates indicate that a substantial proportion of the spawning run is harvested by recreational fishermen. An estimated 11% to 40% of the total run of adult spring chinook salmon in the Rogue River was harvested annually by recreational fishermen from 1964 through 1981. The average exploitation rate was about 24%, but the exploitation rate from 1974 through 1981 averaged about 28%. These estimates relied on estimates of recreational harvest based on "punch cards" separated by probable area of catch (below and above Gold Ray Dam) and on counts of spring chinook salmon at Gold Ray Dam. Estimates of exploitation rate for Elk River fall-run chinook salmon, which are available from 1972 through 1979, are based on creel survey estimates and on mark-recapture estimates of run size. The estimated exploitation rate ranged from about 10% to about 32% and averaged about 22% of the entire run that entered Elk River. Mark-recapture population estimates and creel surveys on Salmon River in 1976 and in 1986 indicated that exploitation rate was about 25% in 1976 and about 35% in 1986.

These estimates of exploitation rate provide a contrast to estimates made on the Alsea and Siletz rivers in the early 1950s that indicated that recreational anglers harvested less than 5% of the run of chinook salmon that entered these streams. We surmise that contemporary recreational fisheries for chinook salmon in most coastal rivers are capable of harvesting 20%-30% of the returning run of chinook salmon. One striking exception occurs with fall-run fish returning to the Rogue River. Apparently the recreational fishery there only harvests an average of about 6% of the run that enters the river. The factors responsible for this low exploitation of fall-run chinook salmon in the Rogue have not been clearly identified. However, we believe that ample opportunity exists to increase harvest by this recreational fishery.

These exploitation rates should be taken into account in harvest management programs designed to produce a specific harvest rate for a group of chinook salmon stocks. They also demonstrate that chinook salmon are a desirable and vulnerable species that makes a substantial contribution to Oregon's freshwater recreational fisheries.

RUN STRENGTH INDICATORS

Data that may be used to assess trends in the run strength of Oregon's coastal chinook salmon stocks include (1) the peak count of adults in annual spawning survey index areas (fall-run fish) or in holding pools (spring-run fish), (2) estimates of freshwater recreational harvest based on "punch cards," (3) counts of fish at dams, (4) mark-and-recapture estimates of run size, and (5) historic commercial fishery packing (1892-1922) and landings (1923-61) records. These data vary among stocks in their availability, reliability, and time-series duration, and they range from excellent to poor in terms of their use for assessing trends in run strength. In this section we briefly review the nature, availability, and reliability of these run strength indicators.

Counts of Adults During Spawning Surveys and in Holding Pools

The annual peak count of adults observed during spawning surveys provides the most extensive time-series data for most stocks of Oregon coastal fall-run chinook salmon. These data have been collected annually in most river basins north of and including the Coquille River basin since about 1950-55. Before 1975 and starting again in 1986, several index areas in different spawning tributaries within a single river basin were often surveyed, but during 1975-85, surveys were often limited to a single standard "index" area within a particular river basin. Index areas are usually from 0.5 to 2.0 miles in length and are intended to represent the more important spawning areas in individual streams. Streams are now surveyed on a weekly or biweekly basis during the anticipated period of peak spawning activity in individual river basins, and the annual index of abundance is based on the peak count during these surveys. In many of the earlier years, however, surveys may have been done from 1 to 3 times per season in an effort to obtain a "peak" count of adults during the period that was perceived to be the "height" of the spawning season. Spawning survey data for coastal streams south of the Coquille River are much less extensive than that for north and central coast streams, and for most streams these data are available only since about the 1960s.

Assessment of trends of abundance based on the peak annual count in spawning surveys for fall-run chinook salmon rests on the validity of several critical assumptions regarding spawning survey data. These assumptions have not been directly tested for chinook salmon spawning survey data, but we can describe conditions under which these assumptions most likely would be met. The first assumption is that the peak count in the spawning survey index area must be "representative" of the peak count throughout the river system. If a river system is large and complex, with many different spawning tributaries with highly variable habitat quality (e.g., the Coquille River basin), then it is less likely that this requirement would be met if only a single tributary stream index area were surveyed. Conversely, if an index area is located in the area of highest spawning use in a tributary that supports almost all of the spawning fish in a river system, then peak counts in the index area are much more likely to reflect trends in total stock abundance. Thus, spawning survey index areas in a small, simple, river system dominated by a single important tributary are more likely to meet the requirement of "representativeness" than index areas in a large, complex river system with many distinct and equally important spawning tributaries.

The second assumption is that the visual count of spawners must be proportional to the true spawner abundance, and that this proportionality factor must remain constant between surveys within and between years. Generally, this means that visibility must be similar within and between years for a given index area. The most frequent reason for violations of this assumption would likely be high streamflow and high turbidity that coincide with true peak spawning abundance. Visibility and fish presence could both be affected by such an event. Thus, streams with fairly stable flow and turbidity during the spawning season would have the greatest chance of meeting this second requirement.

The third assumption is that the variation in spawning dates and the "flow" of spawners through time must be very similar between years so that peak counts are proportional to the total "area under the curve." Also, the peak of this distribution of flow through time must be fairly flat so that the 1- or 2-week intervals between surveys will not result in undercounting of the true peak density.

Counts of spring chinook salmon in selected holding pools in the Trask, Wilson, Nestucca, and South Umpqua rivers have been made in most years since 1965. Although these surveys represent a relatively small effort when compared with spawning surveys for fall chinook salmon, they do provide additional information about the run strength of a limited number of spring-run populations.

Estimates of Recreational Catch Based on "Punch Cards"

Since 1953, an annual estimate of freshwater recreational catch of salmon in Oregon has been derived by means of a "report card" system that requires purchase of a "tag" on which salmon catch must be reported. Information reported has always included date, location, and type of fish (salmon or steelhead), but more recent requirements have included species of salmon (coho, chinook, chum, or pink). The original "tag" was actually a card on which a circular punch was removed for each fish caught. The term "punch card," which is now obsolete, has nevertheless remained in use as a descriptor for the reporting requirement.

Anglers are required to turn in their "punch cards" at the end of each calendar year, but reporting (response) rate is usually only about 30% of the "tags" actually sold. Because the more-successful anglers are apparently more likely to return their "punch cards" than the less-successful anglers, estimation of recreational catch from returns of "punch cards" includes a correction for nonresponse bias.

Reporting requirements and methods used to estimate freshwater recreational catch from "punch cards" have changed considerably since the system was established. These changes complicate interpretation of trends in estimated recreational harvest. For chinook salmon, the more important changes included a shift in the size at which the catch must be reported on the "punch cards" from 20 inches to 24 inches (1977), and a requirement that salmon catch be identified by species (1978). Because many age 2 males (jacks) exceed 20 inches, the estimated recreational catch before 1977 probably includes many jacks. Because salmon were reported without regard to species prior to 1978, estimation of the catch of chinook salmon prior to 1978 required supplementary information to sort out coho salmon. Additional complications include the need to distinguish between spring-run and fall-run fish within a single river system, and to separate ocean from freshwater recreational catch at locations such as Brookings, Coos Bay, Florence, Newport, and Winchester Bay.

Separate estimates of the catch of chinook and coho salmon in Oregon coastal streams prior to 1978, and of the catch of spring-run and fall-run chinook salmon catches in all years were made by applying knowledge of the management district biologists regarding run timing and species composition. For both situations, management district biologists were asked to provide month-by-month estimates for individual streams of (1) the proportion of the catch that was chinook and that was coho salmon, and (2) the proportion of chinook salmon catch that was spring- and that was fall-run fish. District biologists are now asked to update these estimates of racial composition annually so that changes can be accounted for. These estimated monthly proportions were then applied to monthly estimates of salmon catch (prior to 1978) or of chinook salmon catch (since 1978) based on returned "punch cards." Estimated monthly catch was then summed across all months to obtain estimated total catch for a particular year. Because few chinook salmon are caught during the months of January through March, estimated annual catch is essentially equivalent to catch from a single return year.

Based on methods used to separate recreational harvest of spring- and fall-run fish and on changes in reporting requirements for "punch cards," estimates of recreational catch must be regarded as most useful since 1978 and for streams that are dominated by a single race. Estimated recreational catch of salmon in many south coast streams probably consists almost exclusively of chinook salmon. Therefore, "punch card" estimates of recreational catch prior to 1978 may provide useful indicators of abundance in these streams, even though the estimates are subject to the shift in reporting size limit that began in 1977. Finally, the use of estimated recreational catch as a valid indicator of run strength rests on an assumption that anglers catch a consistent proportion of the adult run each year. If the freshwater recreational fishery exploitation rate fluctuates greatly from year to year, then estimated annual catch would not be proportional to run size. If exploitation rate remains fairly constant, however, then estimated recreational catch has the advantage of representing the entire run of fish in a stream. In most river systems, recreational catch of chinook salmon takes place throughout a broad reach of a river system, and most of the components of a run are available to fishermen. In contrast, spawning survey index areas allow access to only a small component of the run of any particular river system.

Counts of Fish at Dams

The estimated number of chinook salmon migrating upstream over dams is available at Gold Ray Dam on the upper Rogue River and at Winchester Dam on the North Umpqua River. A partial count of fish at these locations is expanded based on sampling fractions to estimate the total number of fish that migrate upstream over the dam. Fish are distinguished by species and size (jacks and adults), and fin clips are noted to allow estimation of the percentage of hatchery fish in runs.

Counts at Gold Ray dam, which are available since 1942, have until recently consisted almost entirely of spring-run fish. In recent years, the count of fall-run chinook salmon passing Gold Ray Dam has increased. Almost all Rogue River spring-run fish spawn above Gold Ray Dam, so these counts provide an excellent indicator of escapement for this stock.

Counts at Winchester Dam, which are available since 1946, consist almost entirely of spring-run fish. Because almost all Umpqua River spring chinook salmon spawn above Winchester Dam, these counts provide an excellent indicator of escapement for this stock.

Population Estimates

Estimates of run size have been made in several coastal streams, but such estimates are useful for assessment of trends in abundance only when carried out for a number of years. A fairly long-term series of estimates is available for fall-run fish from Elk River and from the Rogue River.

Mark-recapture estimates of run size for adults and for jacks are available for the Elk River stock for each year from 1972 through 1980. Separate estimates of hatchery and wild fish run size are available, as are estimates of age composition of runs. Estimates of total run size for Rogue River fall-run chinook salmon are available since 1974 based on extensive seining data collected in the lower river. These are general estimates for the entire population of fall chinook salmon that enter the river, but they may not adequately represent stocks that enter relatively late in the run or that spawn in lower river tributaries.

Freshwater Commercial Fishery Records

Chinook salmon were at one time harvested commercially in almost all Oregon coastal river basins. The harvest methods typically practiced in coastal rivers included gillnetting, angling with handline or rod and reel, and seining. Many salmon were harvested in the tidal reaches of coastal rivers, but some were harvested from river mouths to the headwaters, depending on annual conditions of streamflow, access, and market demand. The earliest of these coastal fisheries probably began during the mid-1800s, but quantitative records of production from these fisheries were not kept until the late 1800s.

Before 1892, records did not usually identify fish caught by species. From 1892 to 1922 the only records kept were of the annual output of individual canneries, measured in "cases of cans," by all species, and not all canneries submitted records of annual production in all years. From 1923 until commercial fishing was prohibited in coastal streams (from about 1935 through 1961, depending on the individual stream), a landings reporting system was required for tax purposes. Total weight of landings was reported by species, month, and location. Judging from numerous remarks in annual reports published during the period when the landings record system was in effect, the landings figures usually represent only a part of the actual number of chinook salmon caught. Although few officials were engaged in the task of enforcing laws, many citations were issued to individuals for practices including fishing in closed seasons or areas, buying or selling salmon without a license, fishing without a license, and dynamiting fish.

We make reference in **PART IV** of this report to estimates of the number of chinook salmon that were packed annually from 1892 to 1922, and to estimates of the number that were landed annually after 1922 in specific coastal rivers where such records were kept. Methods used to convert cases of cans packed and pounds of fish landed to estimated numbers of fish consisted of assuming an average pack (in cans) per fish for the earlier period, and an average landed weight (in pounds) per fish for the latter period. Because of uncertainties about the reliability of the early cannery reporting system and about the validity of assumptions used to convert cannery packs to fish numbers, estimates of the number of fish packed before 1923 are probably less reliable than records of commercial landings after 1923. In addition, the early cannery packing records, in many instances, provide only minimum estimates of number of fish caught because not all fish caught were packed. An undocumented number of additional fish were marketed fresh, salt cured, smoked, or discarded. Finally, cannery output was probably influenced as much by availability of transportation, local and regional product demand, and operational limits of individual canneries as it was by abundance of fish, and often a single cannery packed fish caught in different streams.

Despite serious limitations, these early commercial fishery records give insight into the relative magnitude of coastal runs of chinook salmon prior to the 1950s, and they also give valuable insight into the relative abundance of different races from individual river systems. When viewed collectively, freshwater commercial fishery landings of chinook salmon from coastal rivers declined rapidly from a level of about 150 thousand fish in the mid-1920s to about 20 thousand fish in the late 1940s. The decline in commercial fishery landings was the result of three principal factors: (1) decline in the abundance of many spring- and fall-run races of coastal chinook salmon, (2) progressively shorter fishing seasons, and (3) progressively larger offshore harvest of fish (that would otherwise return to spawning streams) by the developing ocean commercial troll fishery.

Discussion

Abundance indicator data generally available for coastal streams include estimates of recreational catch (based on "punch card" returns) and annual peak counts of adults in spawning survey index areas. The general properties of these indicators of abundance are not firmly established, and their valid use as indexes of abundance rests on many critical assumptions. We believe that these assumptions may be met in some river systems, whereas they may not be met in other river systems. For these reasons, we believe that making general statements regarding either of these two types of indicator data is virtually impossible. Questions of reliability and validity are most appropriately answered by: "It depends."

Some overall average coastwide measure of salmon abundance has customarily been obtained by "aggregating" peak counts from spawning surveys across groups of stocks. Spawning survey counts have been made for about the last 35 years in many Oregon coastal streams. When viewed broadly, these counts indicate that the run strength of north-migrating stocks has generally increased over this period and that the run strength of south-migrating stocks has not shown a consistent trend but has recently declined (especially during about 1978-84).

Peak counts of adults from spawning surveys may be sufficient to monitor the average condition of major stock groupings of Oregon's coastal chinook salmon. Spawning survey data have some notable shortcomings, however, that include (1) the absence of spawning survey data for two major stocks of spring chinook salmon--the Umpqua and the Rogue; (2) the inadequacy of survey data for the largest single stock of fall-run chinook salmon (Rogue) and for most south coast stocks of chinook salmon; (3) the inability to separate stray hatchery fish from wild fish; and (4) the occurrence of poorly correlated survey counts from different tributaries within complex river systems.

Because of these shortcomings and the fact that an average assessment of run strength for a number of populations could overlook variation in run strength of individual populations, we have refrained from presenting an "average" assessment of trend in run strength of Oregon's coastal chinook salmon. Instead, we based our overall assessment of trends in run strength on a synthesis of trends for individual stocks. Individual assessments presented in **PART IV** of this report include a discussion of trends in spawning survey counts when those data are available.

In order to assess trends in the run strength of a particular chinook salmon stock, the data that are available must be assessed, regardless of the limitations of these data. What is most important in this context is not the general behavior of a certain class of indicator, but the specific behavior of an indicator for a particular stock. Where possible, we calculated the statistical correlation between estimates of sport catch and the peak count of adults. When these alternative indicators have been significantly and positively correlated with one another, we have regarded both sets of indicator data as providing a valid time series for evaluation of abundance trends. In these cases, both sets of indicator data usually suggested similar trends of abundance.

For some stocks, spawning survey data were not available or existing survey data were flawed in some respect, and only estimates of recreational catch were available. For these stocks, our assessment of abundance trends has been based solely on estimates of freshwater catch. Although we regard these assessments of abundance trends as less reliable than others, we believe that estimates of recreational catch often provide a valid indicator of run size.

For some stocks, existing spawning survey data and estimates of recreational catch were not significantly correlated, or peak counts of adults in different index areas were not significantly correlated. We reported these findings in the individual stock assessments, and we made assessments of trends in abundance based on the best information available. Occasionally we augmented data with subjective or anecdotal observations.

When counts of fish at dams or when mark-recapture or other estimates of run size have been available, our ability to assess trends in abundance has been enhanced. When data regarding the contribution of hatchery fish to returns have been poor, we examined available information on trends in number released and survival rate of hatchery fish to aid our assessment of the probable contribution of returns of hatchery fish to total (hatchery plus wild) stock abundance trends. Finally, we have occasionally used historic commercial packing and landings records to document formerly abundant races of chinook salmon that appear to be currently depressed relative to their historic abundance. These early commercial fishery data were particularly useful in streams that support runs of fall and of spring chinook salmon.

RECENT TRENDS IN RUN STRENGTH

Early in **PART III** we stated that the run strength of each chinook salmon stock is the end product of a complex system equation involving interactions among a number of physical and biological elements. We then went on to report the following:

1. Only general notions of the freshwater habitat requirements of coastal chinook salmon are available.

2. Only qualitative generalizations about trends in the availability of habitat suitable for production of chinook salmon in coastal streams are available.

3. The affects of changes in biological and physical properties of the ocean environment on chinook salmon abundance are poorly understood.

4. Reliable estimates of annual or total brood-year exploitation rates for ocean and freshwater fisheries are scarce.

5. The actual contribution of hatchery fish to the run strength in coastal populations is undetermined in about two-thirds of the river systems where hatchery fish are released.

6. Assessment of run strength must usually be made by evaluating a variety of indicator data and anecdotal observations.

Given the present state of affairs, we may provide, at best, a perspective on the conditions that may be responsible for the recent trends in the run strength of chinook salmon populations in Oregon coastal river basins.

We prepared several tables that summarize run strength assessments for individual stocks of chinook salmon in Oregon coastal rivers: Table III.1 includes north-migrating fall- and spring-run stocks; Table III.2 includes south-migrating fall- and spring-run stocks; and Table III.3 is an abstract summary of the status of all the stocks that we assessed. Even though we classified it as a north- and-south migrating stock (**PART II**), we included Umpqua River spring-run stock with the south migrating stocks for convenience, because Umpqua river spring-run fish are caught primarily off Oregon. Several useful generalizations about recent trends in run strength are apparent from Table III.3.

North-migrating Fall-run Stocks

Trends in Run Strength

Among north-migrating fall-run stocks, we judged that none were depressed, eight exhibited no clear trend, and ten have apparently increased during the post-1950s period. Of the stocks that exhibited no clear trend, three were judged to currently be at relatively high levels of abundance.

Stocks exhibiting increasing run strength are produced in larger watersheds, generally, than stocks exhibiting no clear trend. We attributed improvements primarily to returns of hatchery fish in only Elk and Salmon rivers. Stocks that we judged as increasing and that consisted primarily of wild fish were the Coos, Coquille, Nehalem, Siuslaw, Umpqua, and Yaquina.

Stocks that exhibit no clear trend in run strength are produced in both small and moderate sized watersheds. Stocks produced in the small watersheds of Floras Creek and Kilchis, Miami, and Tillamook rivers consist entirely of wild fish. Of stocks produced in the moderate sized watersheds of the Nestucca, Siletz, Sixes, and Trask rivers, all but the Trask consisted predominantly of wild fish.

Possible Causes of Observed Trends

All 18 north-migrating fall-run stocks were judged to have either increased (10 stocks) or exhibited no clear trend (8 stocks) during the post 1950s period. The most obvious increases in run strength among stocks in this group occurred in the largest river basins (Coos, Nehalem, and Umpqua). Anecdotal observations by management district biologists suggest that six of the runs that we judged as exhibiting no clear trend actually have increased in recent years although available indicator data were not sufficient to support such a conclusion.

We believe that these stocks have been exposed to overall (ocean fishery plus in-river fishery) exploitation rates that would have allowed the stocks to either maintain or increase their number. Anecdotal observations by management district biologists, although qualitative, indicate that many of these watersheds have experienced modest recovery of mainstem rearing habitat. We surmise that the combination of moderate fishery exploitation

Table III.1. Individual assessments of run strength for north-migrating stocks of chinook salmon in Oregon coastal river basins. Parentheses indicate that entries are based on limited information and should be considered provisional working hypotheses.

Run, stock	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate	Average adult run size,[b] 1977-85	Run strength trend	Comment
Fall-run:						
Alsea River	(80)	1,850	(0.20)	(9,200)	Increasing since mid-1970s	Hatchery-wild composition of population poorly documented
Coos River	Wild	450	(0.10)	(4,500)	Increasing since mid-1950s, but depressed compared with 1890-1920 populations	Returns of Rogue stock to private hatchery now dominate system; straying may be extensive; gradual improvement in habitat since mid-1950s
Coquille River	Wild	750	(0.15)	(5,000)	Increasing since mid-1950s	
Elk River	40	1,900	(0.25)	(7,600)	Greater average abundance since 1970 is due to hatchery fish returns; wild fish stable; large variation in hatchery fish returns	"Target" commercial fishery in ocean at river mouth
Floras Creek	Wild	110	(0.15)	(735)	No trend; variable abundance	
Kilchis River	Wild	350	(0.20)	(1,750)	No trend; variable abundance	
Miami River	Wild	110	(0.20)	(550)	No trend; variable abundance	

[a] *Wild indicates that few or no public hatchery chinook salmon were released in the river basin during the last decade and that we believe the population consists almost exclusively of wild fish.*

[b] *Average adult run size calculated by dividing recreational catch by assumed harvest rate.*

Table III.1. Continued.

Run, stock	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate	Average adult run size,[b] 1977-85	Run strength trend	Comment
Fall-run (continued):						
Nehalem River	Wild	700	(0.15)	(4,700)	Increase since mid-1950s, but depressed compared with 1890-1920 populations	Gradual improvement in habitat since mid-1950s
Nestucca River	(85)	3,200	(0.25)	(12,800)	No trend; variable abundance; population currently at high average abundance	Hatchery-wild composition of population poorly documented
Salmon River	(25)	750	(0.25)	(3,000)	Greater average abundance since 1978 is due to hatchery fish returns	Status of wild population poorly documented
Siletz River	Wild	1,100	(0.20)	(5,500)	No trend; variable abundance; population currently at high average abundance	
Siuslaw River	Wild	850	(0.20)	(4,250)	Increasing since 1950s	
Sixes River	Wild	600	(0.20)	(3,000)	No trend; variable abundance; possible decline in wild fish population	Stray fish from Elk River Hatchery may be 10% of Sixes River population
Tillamook River	Wild	250	(0.20)	(1,250)	No trend; variable abundance	
Trask River	(40)	3,700	(0.25)	(14,800)	No trend; variable abundance	Hatchery-wild composition of population poorly documented

Table III.1. Concluded.

Run, stock	%wild[a]	Average recreational catch 1977-85	Assumed harvest rate	Average adult run size,[b] 1977-85	Run strength trend	Comment
Fall-run (continued):						
Umpqua River	Wild	400	(0.15)	(2,700)	Increasing since mid-1970s in South Fork and Smith River, but very depressed compared with 1920s populations	
Wilson River	Wild	3,000	(0.25)	(12,000)	Increasing since early 1970s	
Yaquina River	Wild	450	(0.15)	(3,000)	Greater average abundance since 1977	Straying by private hatchery fish poorly documented
Spring-run:						
Alsea River	Wild	40	(0.10)	(400)	No trend; very depressed compared with pre-1935 populations	
Nestucca River	(50)	700	(0.25)	(2,800)	No trend; currently at high average abundance level	Hatchery-wild composition of population poorly documented
Siletz River	Wild	70	(0.20)	(350)	No trend; depressed compared with pre-1935 populations	
Trask River	(35)	1,150	(0.25)	(4,600)	No trend; depressed compared with pre-1935 populations	Hatchery-wild composition of population poorly documented
Wilson River	(65)	350	(0.25)	(1,400)	No trend; depressed compared with pre-1935 populations	Hatchery-wild composition of population poorly documented

Table III.2. Individual assessments of run strength for south-migrating stocks of chinook salmon in Oregon coastal river basins. The Umpqua River spring-run stock is included here for convenience and because it exhibits a pattern of ocean catch distribution that is similar to that of south-migrating stocks. Parentheses indicate that entries are based on limited information and should be considered provisional working hypotheses.

Run, stock	%wild [a]	Average recreational catch 1977-85	Assumed harvest rate	Average adult run size,[b] 1977-85	Run strength trend	Comment
Fall-run:						
Chetco River	(40)	2,000	(0.25)	(8,000)	Depressed since 1979	(Overharvest in ocean fisheries 1977-83); (wide variation in survival of hatchery fish); status of wild fish poorly documented
Hunter Creek	Wild	40	(0.15)	(270)	Depressed since mid-1970s	(Overharvest in ocean fisheries 1977-83); (habitat damage)
Pistol River	Wild	50	(0.15)	(330)	Depressed since mid-1970s	(Overharvest in ocean fisheries 1977-83); (habitat damage)
Rogue River	Wild	2,300	0.06	40,000[c]	No trend ; large variation in run size, e.g., 1983-84 returns were very low and 1986-87 returns were very high	(Overharvest in ocean fisheries 1977-83); El Niño effect on 1983-84 returns; several lower Rogue stocks are depressed; increase in numbers passing above Gold Ray Dam
Winchuck River	Wild	110	(0.15)	(730)	Depressed since 1979	(Overharvest in ocean fisheries 1977-83)

[a] *Wild indicates that few or no public hatchery chinook salmon were released in the river basin during the last decade and that we believe the population consists almost exclusively of wild fish.*

[b] *Average adult run size calculated by dividing recreational catch by assumed harvest rate except where footnoted.*

[c] *Average adult run size based on population estimates.*

Table III.2. Concluded.

Run, stock	%wild [a]	Average recreational catch 1977-85	Assumed harvest rate	Average adult run size,[b] 1977-85	Run strength trend	Comment
Spring-run:						
Rogue River	60	6,100	0.20	30,000 [d]	No trend; large variation in run size, e.g., 1983-84 returns were very low and 1986-87 returns were very high	(Overharvest of ocean fisheries 1977-83);El Niño effect on 1983-84 returns; progressive decline in % of wild fish in run (decline in wild fish caused by Lost Creek Dam)
Umpqua River	60	1,950	0.23	8,500 [d]	No trend; moderate variation in abundance of wild fish and large annual variation in abundance of hatchery fish	El Niño effect on 1983-84 returns; (large decline in recreational fishery catch)

[d] *Average adult run size based on counts at dams.*

Table III.3. Summary of assessments of run strength for chinook salmon populations in Oregon coastal rivers. Populations are organized by ocean migration pattern and time of return. The Umpqua River spring-run stock is included with south-migrating stocks for convenience and because it exhibits a pattern of ocean catch distribution that is similar to that of south-migrating stocks.

Depressed	No trend	Increasing
	North-Migrating, Fall-run	
	Floras	Alsea
	Kilchis	Coos[a]
	Miami	Coquille
	Nestucca[b]	Elk[c,d]
	Siletz[b]	Nehalem[a]
	Sixes	Salmon[c,e]
	Tillamook	Siuslaw
	Trask[c,e]	Umpqua[a]
		Wilson
		Yaquina
	North-Migrating, Spring-run	
	Alsea[a]	
	Nestucca[c,e]	
	Siletz[a]	
	Trask[c]	
	Wilson[c]	
	South-Migrating, Fall-run	
Chetco[c,e]	Rogue	
Hunter		
Pistol		
Winchuck		
	South-Migrating, Spring-run	
	Rogue[c]	
	Umpqua[c]	

[a] *Depressed compared with historic run strength.*
[b] *Run strength currently at high average level.*
[c] *Significant production of hatchery fish.*
[d] *Wild fish no trend.*
[e] *Wild fish status uncertain.*

rates, generally favorable rearing environment in the ocean off the coast of British Columbia and Alaska, and gradual recovery of some damaged freshwater habitats has allowed many of the runs in this grouping to increase.

Increased or stable run strength was apparently due to returns of hatchery fish in only the Elk, Salmon, and Trask rivers, so the overall satisfactory condition of north-migrating fall-run stocks was not generally attributable to hatchery supplementation.

North-migrating Spring-run Stocks

Trends in Run Strength

Among north-migrating spring-run stocks, we judged that none exhibited any clear trend during the post 1950s period. Of the stocks in this category, the Alsea and Siletz consist entirely of wild fish, and the Nestucca, Trask, and Wilson apparently include many hatchery fish in the run. Of these, only the Nestucca was judged to be currently at a high average abundance level. The runs of chinook salmon in all but the Nestucca are apparently very depressed compared with pre-1935 populations.

Possible Causes of Observed Trends

The five north-migrating spring-run stocks are all produced in "medium sized" river basins. The Alsea and Siletz consist entirely of wild fish, and the Nestucca, Trask, and Wilson apparently include many hatchery fish in the run. Of stocks in this group, only the Nestucca was judged to currently be at a high average level of abundance. The runs of chinook salmon in all but the Nestucca are apparently very depressed compared with pre-1935 populations.

Presumably, these stocks have been exploited in ocean fisheries at a lower rate (which we believe would have allowed stocks to be either stable or to increase) than have north-migrating fall-run stocks. Management district biologists did not note any general deterioration in freshwater habitat quality in these river basins. In contrast to current runs of spring-run fish, fall-run stocks in the Alsea and Wilson were judged as increasing and those in the Nestucca and Siletz were judged as being recently at high average abundance levels.

The fact that none of these stocks has exhibited an increasing trend may indicate that they are being constrained by some factor that is not similarly constraining fall-run stocks in the same river basins. We are not aware of aspects of the life history of these stocks that would make them either innately less productive or more vulnerable to ocean fishery exploitation. In reviewing historic commercial fishery landings records for coastal river basins, we noted that runs of "early-run" chinook salmon declined more rapidly than runs of fall-run fish and fell to remnant population levels by the mid-1930s.

Management district biologists have proposed that perhaps conflict between human recreational activities and adult spring-run fish in these coastal rivers has been increasing in recent years. They note that many of the pools that are popular with recreational swimmers are also preferred "holding pools" used by spring-run fish, and that the conflict has resulted in the fish leaving the pools. Other observations of conflict involve the illegal harvest of these spring-run fish in the low, clear streamflow that characterizes these streams in summer. Although poaching may be a current problem with these stocks, it is not a new one. Anecdotal accounts of poaching of spring-run chinook salmon in Oregon coastal rivers date back at least into the 1920s.

The absence of an increasing trend in the three systems that receive releases of hatchery fish suggests that these fish are not surviving as well as expected. Further, returns of hatchery fish in these systems may have masked a concurrent decline in production of wild fish.

South-migrating Fall-run Stocks

Trends in Run Strength

Among south-migrating fall-run stocks, we judged that four were depressed and one exhibited no clear long term trend during the post 1950s period. Runs that we judged as depressed are produced either in small- (Hunter, Pistol, and Winchuck) or moderate-sized (Chetco) watersheds. Only the Chetco River run is directly supplemented with hatchery fish. Of the four depressed stocks, the Chetco may have made a modest recovery in 1986, but the remaining three stocks apparently continue to be extremely depressed.

The run of south-migrating fall-run chinook salmon in the Rogue River is the largest run entering any Oregon coastal river, includes several substocks, and consists almost entirely of wild fish. Returns of this stock have exhibited wide variation between periods of years with relatively low and relatively high run strength. For example, a decline in returns from about 1978 through 1984 has been followed by very strong returns in 1986 and 1987.

Possible Causes of Observed Trends

If this report had been prepared in 1985 we would have concluded that all five of the stocks in this category were extremely depressed. More recently, however, the Rogue fall-run stock staged a strong recovery, but the remaining stocks (plus, according to management biologists, Euchre Creek, which we did not assess) apparently remain at a depressed level. Runs in the smallest streams (Hunter, Pistol) apparently declined as early as 1973. In the Chetco and Winchuck the decline was apparent in 1979 and 1980, respectively, whereas the decline in the Rogue was really only obvious in 1983 and 1984.

We believe that several factors caused the depressed run strength of these stocks. First, these stocks were exposed to extremely high ocean fishery exploitation rates from at least 1979 through 1983. These exploitation rates would have had a more severe effect on mid-maturing stocks than on early-maturing stocks and, in either case, were great enough to cause a decline in returns of these stocks. Second, the 1983 El Nino event produced severe effects on growth and probably on survival of south-migrating chinook salmon stocks that rear in the ocean off the coast of northern California and southern Oregon, thus exerting a negative effect on all of these stocks. Finally, management district biologists provided anecdotal accounts that indicate the occurrence of habitat damage or alteration in the Hunter Creek, Pistol River, and Chetco River drainage basins.

Since 1984, the El Nino has receded and ocean fishery exploitation rates have been constrained to levels that should allow chinook salmon populations to rebuild. In spite of these improved conditions, only the Rogue River population has improved. The Rogue fall-run population consists of a number of substocks including both early and mid-maturing stocks. Of these, the mid-maturing stocks that spawn in relatively small tributaries have not recovered as well as have the early-maturing stocks that spawn in large tributaries.

We surmise that mid-maturing stocks that spawn in small tributaries may have been depleted by the effects of overfishing and El Nino to the level where they may be unable to easily or quickly recover. Stocks that spawn and rear in very small watersheds may be intrinsically less productive than stocks that spawn and rear in the Illinois, the Applegate, or the mainstem Rogue River. Degradation of the productive capacity of these watersheds would also delay or prevent recovery of these runs.

South-migrating Spring-run Stocks

Trends in Run Strength

We judged that both Rogue River (south-migrating) and Umpqua River (north- and south-migrating) spring-run stocks exhibited no clear long-term trend during the post-1950s period. Both are relatively large populations that are produced in very large watersheds, and both consist of roughly 60% wild and 40% hatchery fish. Returns of these stocks have exhibited wide variation between periods of years with relatively low and relatively high run strength. For example, a decline in returns from about 1978 through 1984 has been followed by very strong returns in 1986 and 1987.

Possible Causes of Observed Trends

We believe that the very strong returns of these stocks in 1986 and in 1987 represent a general recovery of these stocks, stimulated by two important system changes. First, as a result of ocean harvest restrictions after 1984, chinook salmon stocks that rear in the ocean off Oregon and northern California apparently are no longer exploited to the excessive extent that they were in the late 1970s and early 1980s. Second, the El Nino event in 1983 has receded, and the ocean rearing environment has returned to a condition that is generally more favorable to survival of salmonids. Recovery of the Umpqua stock may also have been helped somewhat by a recent improvement in survival of hatchery fish.

RECOMMENDATIONS

Our assessments of recent trends in the run strength of chinook salmon populations were usually based on an assortment of indirect indicators rather than on direct estimates of the number of fish in the runs. During the process of compiling and reviewing data for this report and of judging the available data in order to assess trends in run strength, we identified the three following processes of run strength assessment in which significant improvements could be made if the future database were improved:

1. The process of assessing run strength of populations in different river basins.

2. The process of distinguishing trends in run strength of hatchery and of wild fish in a single river system.

3. The process of determining the cause(s) of any trend in run strength that may be observed.

The following narrative presents several recommended actions that we believe would make needed improvements to future management of chinook salmon populations in Oregon coastal streams.

Assessing Run Strength

RECOMMENDATION III.1. Evaluate the accuracy of procedures currently used to estimate the number of chinook salmon that migrate upstream over Gold Ray (Rogue) and Winchester (Umpqua) dams. If necessary, accomplish procedural changes, technological changes, or both, that will improve the reliability of these estimates. Document the results of this review in a written report.

Spring-run chinook salmon populations in the Rogue and Umpqua rivers are by far the largest of any in Oregon coastal streams and both are important contributors to Oregon ocean fishery landings. The future availability of accurate estimates of the number of fish migrating upstream over these dams is essential to future assessments of their run strength.

RECOMMENDATION III.2. Evaluate the accuracy of procedures currently used to estimate the overall run of fall-run chinook salmon that enter the Rogue River. Develop an ongoing program to estimate the abundance of fall-run fish that enter the Rogue River annually. Document the results of this work in a written report.

Rogue River fall-run chinook salmon populations, collectively, make the single largest contribution to Oregon's ocean fishery landings of chinook salmon. A routine program that will accurately monitor the run strength of these fish should be a basic element of future management programs.

RECOMMENDATION III.3. Test the validity of the assumptions of the annual spawning fish surveys for chinook salmon. If necessary and feasible, make improvements in the annual spawning survey database for chinook salmon in Oregon coastal streams. Document the results of this work in a written report.

RECOMMENDATION III.4. Test the validity of procedures currently used to estimate recreational catch of chinook salmon in individual coastal rivers from returns of "punch cards." If necessary and feasible make improvements in the procedure. Document the results of this work in a written report.

RECOMMENDATION III.5. Develop a procedure to annually estimate the recreational catch of chinook salmon jacks in coastal river basins. Document the results of this work in a written report.

Future assessments of run strength trends are likely to rely on many of the same kinds of indicator data that we presented, discussed at length, and ultimately judged in **PART IV** of this report. **Recommendations III.3, III.4,** and **III.5** represent efforts to improve the accuracy of future judgments based on these run strength indicators.

RECOMMENDATION III.6. Annually publish an updated summary of the run strength indicators that are available for chinook salmon in Oregon coastal rivers.

Revised summaries of run strength indicator data are apparently only infrequently being prepared, published, or both. This is in contrast with some previous years in which estimates of recreational catch and spawning ground counts were routinely reported on an annual basis. In addition, some types of run strength indicator data are given only a very limited distribution. The availability of current summaries of indicator data sets is essential to timely assessment of run strength trends.

Distinguishing Trends of Hatchery and Wild Fish

RECOMMENDATION III.7. Determine appropriate procedures and accomplish necessary sampling required to estimate the proportion of hatchery and of wild chinook salmon that enter each coastal river basin in which hatchery chinook salmon are stocked. Annually document the results of this work as noted in Recommendation III.6.

The actual contribution of hatchery chinook salmon to catch and to return is undocumented in about two-thirds of the river basins where hatchery fish are presently stocked. Such evaluations are needed to increase efficiency in hatchery programs, to maintain production of wild fish at optimum levels, and to permit the detection of trends in return of hatchery and of wild fish. "Constant fractional marking programs" appear to offer the greatest promise to achieve this action at the present time.

Determining Cause(s) of Run Strength Trends

RECOMMENDATION III.8. Develop on-going programs to estimate the ocean fishery exploitation rate for several representative stock types. These stock types should include at least the following: (1) Rogue spring-run (south-migrating), (2) Rogue fall-run (south-migrating), (3) Umpqua spring-run (south- and north-migrating), (4) Elk River fall-run (north-migrating with important Oregon fishery contribution), and (5) Salmon River fall-run (north-migrating). These exploitation rate estimates should allow comparison of the annual as well as the total brood-year exploitation rate experienced by each stock type. A written report that summarizes the interim results of this work as well as exploitation rates that have been calculated for complete brood year groups should be prepared annually.

Changes in the exploitation rate of ocean fisheries can directly cause returns of chinook salmon to increase or decline, all other factors being equal. Routine monitoring of the exploitation rates that these stocks are exposed to will probably be necessary in order to establish and maintain a balance between achieving a desired level of harvest in ocean fisheries, harvest in inland recreational fisheries, harvest in treaty fisheries (in some regions), and spawning escapement.

RECOMMENDATION III.9. Continue to explore techniques to estimate the stock origins of chinook salmon caught in the ocean off Oregon. Preliminary estimates that are based on coded-wire tag recoveries should be reviewed annually, and attempts should be made to estimate the stock composition of chinook salmon caught off Oregon using independent techniques, perhaps including genetic stock identification methods. Reports of progress in this work should be prepared annually, and could be incorporated in the annual reports of exploitation rate estimates (Recommendation III.8).

RECOMMENDATION III.10. Develop methods to estimate the collective contribution of chinook salmon from Oregon coastal rivers to ocean fisheries in Alaska, British Columbia, and Washington. Once such estimates have been obtained and verified, annual summaries could be incorporated in the annual reports of exploitation rate estimates (Recommendation III.8).

Interstate and international agreements to cooperate in regional management of chinook salmon populations can be aided by the availability of reliable information on the contribution that each stock unit makes to each existing fishery. In addition, such information is important to understanding the cause(s) of run strength trends in individual river systems.

RECOMMENDATION III.11. Develop quantitative techniques to monitor the availability of habitat that is critical to production of chinook salmon in coastal rivers.

Habitats critical to production of chinook salmon in coastal rivers have not been precisely defined; consequently, no quantitative estimates of available habitat have ever been made. Such information is needed now and will be needed in the future to guide habitat protection recommendations, to form the basis for habitat restoration efforts, and to improve understanding of natural production trends.

PART IV

Basin by Basin Assessment of Run Strength

CONTENTS FOR PART IV

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INTRODUCTION TO PART IV

This part of the report contains our assessment of trends in run strength of individual stocks of Oregon coastal chinook salmon, organized alphabetically by river system. The following data are summarized for most stocks: (1) records of freshwater commercial fishery pack (1892-1922) and landings (1923-1961); (2) records of releases of hatchery fish (1960-84 brood years); (3) records of the annual peak count of adults in spawning surveys (1950s-1986); and (4) estimates of freshwater recreational catch based on angler returns of "punch cards" (1962-85). We have indicated each instance when data are absent for a particular stock. For a few stocks we present relevant anecdotal information or review additional data including counts of fish at dams (Rogue and Umpqua rivers), estimates of run size (Elk, Rogue, Salmon, Siletz, Sixes rivers, and Tillamook Bay), and estimates of recreational catch based on creel surveys (Elk River).

In our summaries of releases of hatchery-reared chinook salmon in Oregon coastal streams, we have distinguished between releases of fry, fingerling, and smolts. We have characterized releases as "fry" if the number of fish per pound at release was greater than 125; as "fingerling" if the number of fish per pound ranged between 20 and 125; and as "smolts" if the number of fish per pound was less than 20. Fry are typically released from February through May, fingerling from May through August, and smolts from August through November. Almost all hatchery releases of smolts have been of underyearlings released during late summer or fall, but some smolts have been released as yearlings during the following spring. Yearling smolt releases have been most common in the Umpqua River spring-run program.

We frequently report ranges in annual recreational harvest for the period 1969 through 1985, but report annual averages for the period 1977 through 1985. Estimated recreational catch since 1977 has been of adults only because the minimum size limit for reporting catches has consistently been 24 inches. Prior to 1977, the minimum size limit for reporting catch was 20 inches, and an unknown number of jacks was included in the estimates. Proportions of jacks included in these earlier estimates likely varied according to the relative tendency of particular stocks to produce jacks, as well as the relative abundance of jacks in particular years.

We have not, generally, provided much information about estimates of the recreational catch of chinook salmon in these basins in the late 1940s-early 1950s time-frame, even though such estimates are available (APPENDIX E-1). We concluded that the methods used to develop these catch estimates varied so much (both between years and between systems) that the information was more interesting from a sociological rather than from a biological point of view.

Indicator data for 1976 may be biased because extreme drought conditions existed on the Oregon coast that year. For example, many spawning ground counts were very low because chinook salmon were unable to migrate upstream in extremely low streamflows. Conversely, recreational harvest in many rivers was high because fish were congregated and more vulnerable to anglers than is usual. For these reasons we have usually treated data for 1976 as an outlier, and even when we plot it in graphs, we did not include it in statistical analyses of correlation.

Following our review of available indicator data, we present our assessment of trend in run strength of stocks. For the most part, we have provided graphs of available indicator data to help the reader evaluate the merits of our assessment and to allow independent judgement regarding trend in abundance. Appendix tables summarize releases of hatchery fish (APPENDIX D) and estimates of recreational catch (APPENDIX E). Peak count of adults in spawning surveys and records of freshwater commercial fisheries are available in other ODFW documents included in the Bibliography (APPENDIX B). When several abundance indicator data sets were available for one system, we tested for statistical correlation using standard regression analysis and using $P \leq 0.05$ as a threshold for a significant correlation. We usually present graphic comparisons of peak count of adults from spawning surveys and estimates of recreational catch, or estimates of recreational catch and estimates of run size. These alternative indicators may suggest similar trends or they may suggest different trends. Each graph has an explanatory "caption." The graphs are not numbered, however, and are not specifically referenced in the text.

ALSEA RIVER

The Alsea River system supports populations of chinook salmon in at least four major subbasins or stream reaches: Drift Creek, Five Rivers, the North Fork, and the mainstem. We surmise that the run into each of these areas is an important component of the overall run into the system. The following narrative pertains to the Alsea River population as a whole.

Estimates of Commercial Catch

Records indicate that about 1 thousand to about 14 thousand fish were packed each year from 1892 through 1920, with a peak during the 1914 season. From 1923 through 1956, the commercial catch ranged from about 1 thousand to about 6 thousand fish with a peak in 1934. From 1923 through 1935, an average of 62% of the total catch was taken from May through July indicating the presence of a significant run of spring- or summer-run fish. The May-July catch declined rapidly from about 1935 to 1948, after which the fishery was closed during spring and summer.

Releases from Hatcheries

Upstream passage of chinook salmon was completely blocked from 1916 to 1928 by a dam located less than a mile upstream from the head of tidewater. This dam was designed to block fish passage and thereby provide easy access to brood fish for hatchery propagation. The dam apparently caused a serious decline in the coho and chinook salmon populations in the system. After the dam was removed (anecdotal accounts indicate that Alsea Valley residents blew it up with dynamite), the run of chinook salmon improved somewhat as indicated by commercial landings, but never recovered to its predam level.

Hatchery-reared chinook salmon have routinely been released in the Alsea River basin since the 1960s, with emphasis on fall-run fish. Experimental releases of nonnative stocks, including Bonneville, Trask, and Elk stocks, were made from brood years 1964-75, but were relatively unsuccessful. Releases beginning with the 1976 brood year have all been of Alsea River stock. Smolt releases of Alsea River stock have ranged from 50,000 to 210,000 fish annually, and from 60,000 to 110,000 fry or fingerling have been released from three brood years.

Estimates of Population Size

A mark and recapture population estimate indicated that about 5,000 chinook salmon were in the run into the Alsea River in 1951, and that about 44% of the run was harvested by a commercial net fishery.

Surveys of Spawners

The peak count of adult fall chinook salmon has been obtained in Buck Creek in most years since 1952. Survey data are also available for four other areas, but these data end after 1974. Survey data from Buck Creek suggest that stock abundance was at a low level during the mid-1950s and increased through 1970. From 1970 through 1978 the stock appears to have had much smaller runs, but since then peak count has increased to the highest average number recorded over any 5-year period. Survey data for other tributaries suggest the same increase in abundance from 1952 through about 1970.

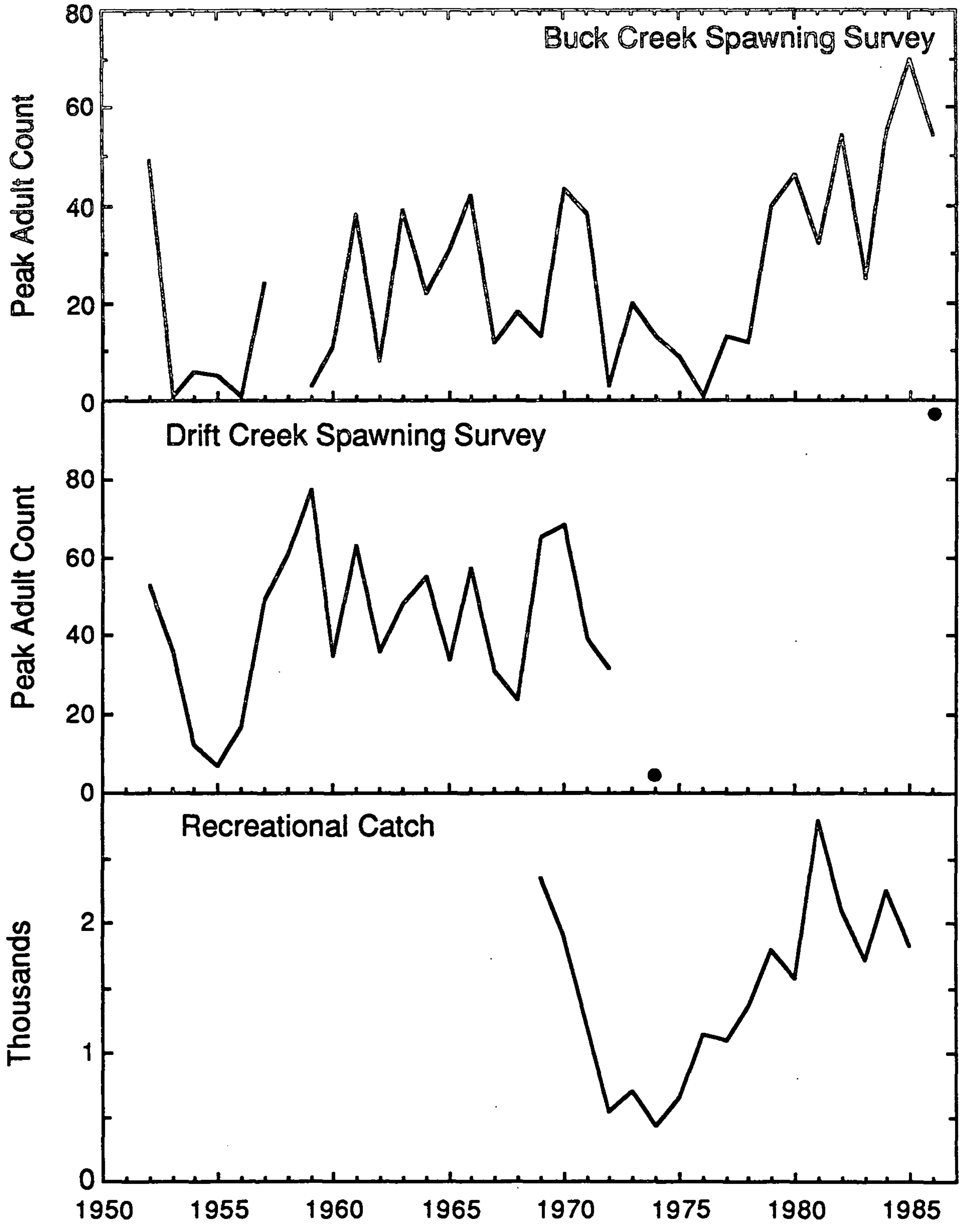
Estimates of Recreational Catch

The Alsea has recently supported one of the more important north coast freshwater recreational fisheries for fall chinook salmon. "Punch card" estimates of catch ranged from about 400 to about 2,800 fish from 1969 through 1985 and averaged about 1,800 fish per year from 1977 through 1985. Trend in recreational catch has been similar to that suggested by spawning survey data. The lowest estimates of recreational catch were for the period 1972 through 1975, when spawning survey counts were low; estimated catches have increased since that period, as have peak counts in spawning surveys. Estimated annual catch of spring chinook salmon has ranged from about 5 to about 80 fish and has averaged about 40 fish per year since 1977.

Assessment of Run Strength

"Punch card" estimates of catch and peak count of adults in spawning surveys were significantly correlated over the period 1969 to 1985. Both sets of indicator data suggest a similar trend in abundance. Stock abundance was low from about 1972 through 1978, but both recreational catch and peak count of adults have increased since 1979. Improved catch and increased spawning survey counts coincided with the start of production-level releases of Alsea stock chinook salmon that began with the 1975 brood year. This suggests that returning hatchery fish may be partially responsible for recent improvements in abundance. However, direct assessments of the proportion of hatchery fish in recent spawning runs have not been made, and a similar increase was noted at about the same time in the Siletz, where no hatchery fish are released, and in the Yaquina, where only stray hatchery chinook salmon could have accounted for the increase.

Together, available data suggest that the run of Alsea River fall-run chinook salmon has been increasing over the past 10 years and that escapement is currently at a higher level than it has been since the mid-1950s. We regard contemporary runs of spring-run fish as relatively stable but at an extremely depressed level of abundance during the past 30-40 years. Spring-run fish are probably entirely wild.



Indicators of Run Strength for Alsea River Chinook Salmon

CHETCO RIVER

We surmise that several distinct subpopulations of chinook salmon may be supported by local stream reaches or tributaries within the Chetco River basin. We do not have reliable information upon which to judge the geographic distribution of chinook salmon within the basin or the relative number of fish that might comprise different runs within the basin. The following narrative pertains to the Chetco River populations as a whole.

IHN virus was first detected among Chetco River juveniles at Elk River Hatchery in 1975, and surveys since that time have detected IHN in most subsequent years. Release of hatchery-reared Chetco River stock has been restricted to the Chetco River since 1975 as a consequence. From 1974 through 1984 a special, late season, ocean fishery targeted on maturing chinook salmon returning to the Chetco River.

Estimates of Commercial Catch

The Chetco River was open to commercial fishing with nets at various locations and dates through about 1934. No records of catch are available, however.

Releases from Hatcheries

Chetco River chinook salmon have been reared at Elk River Hatchery and released in the Chetco River beginning with the 1968 brood year. Hatchery fish have always been released as smolts in fall, and the number released has ranged from about 60,000 to more than 600,000 annually. A relatively small number of fry and smolts have been released by STEP beginning with the 1982 brood year.

Surveys of Spawners

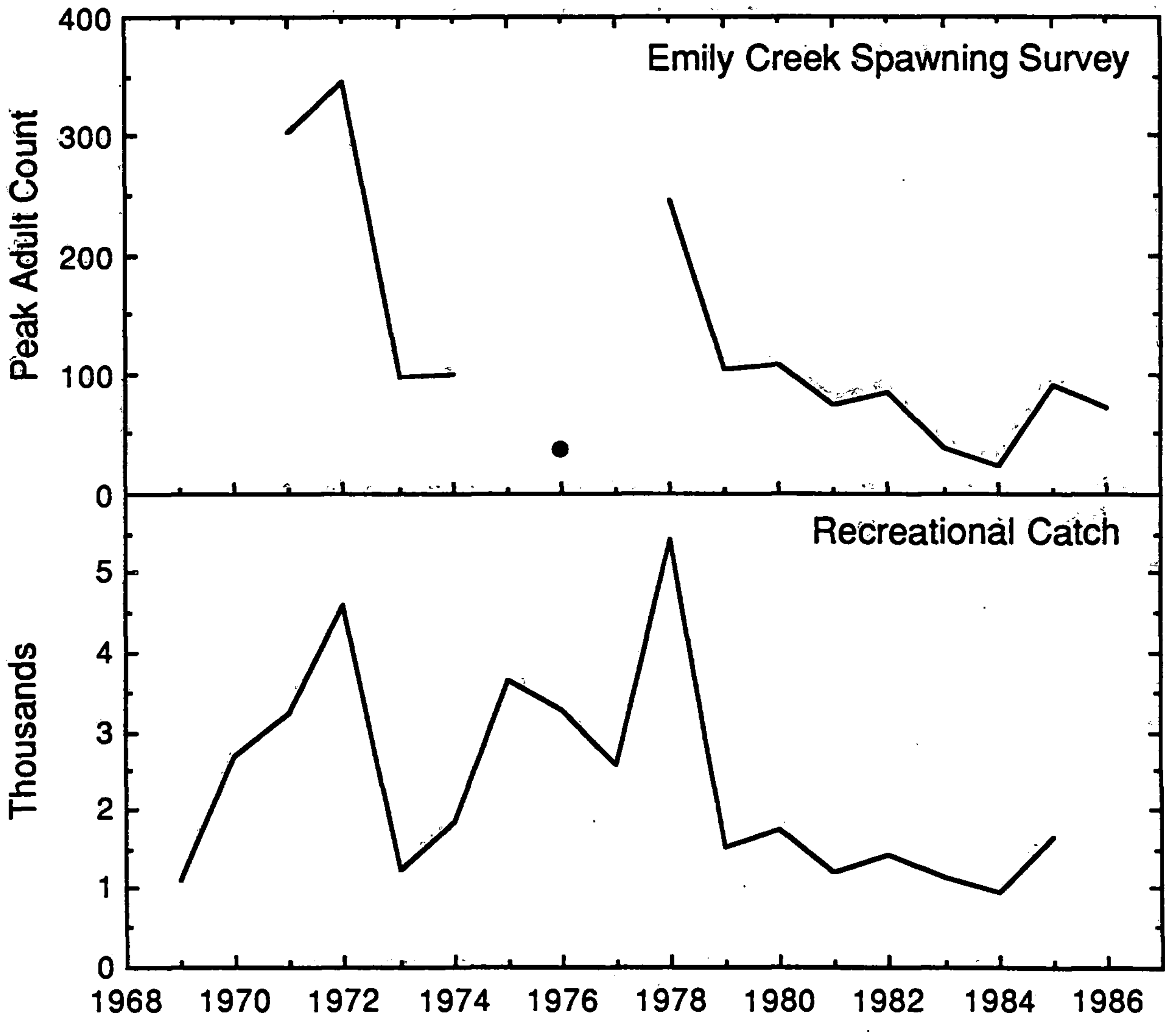
The peak count of adults has been obtained in Emily Creek in most years since 1971. These data suggest that total stock abundance has declined since 1978.

Estimates of Recreational Catch

"Punch card" estimates are available since 1969 and the trend in catch is consistent with the trend in spawning survey data. Estimated annual catch averaged about 3,000 fish through 1978, but has declined to an average of only 1,400 fish since 1978. That this decline was caused by the shift in reporting size limits (1977) is unlikely. The estimated catch for both 1977 (2,557) and for 1978 (5,436) was much higher than the catch during subsequent years.

Assessment of Run Strength

"Punch card" estimates of recreational catch and peak adult counts in spawning surveys were significantly correlated. The trend in both indicators of stock abundance suggests a decline in total stock abundance from 1979 through the present. Adult hatchery fish began contributing to the runs of chinook salmon in 1971; therefore, estimates of recreational catch for 1969 and 1970 were for wild fish only. Catch estimates for these two years averaged about 2,000 fish. This is less than the 3,000 fish average for the period 1969 through 1978, but more than the 1,400 fish average since 1978. The estimated percentage of hatchery fish in the freshwater recreational catch was about 70% during 1972; ranged from 40% to 90% among spawners in various Chetco tributaries during 1973; and based on seining data was 60%, 41%, and 83% during 1980, 1981, and 1983, respectively. These estimates suggest that hatchery fish may dominate the present run of Chetco River fall chinook salmon. We regard abundance of wild chinook salmon in the Chetco River as depressed since at least 1979.



Indicators of Run Strength for Chetco River Chinook Salmon

COOS RIVER

The Coos River system supports populations of chinook salmon in at least five major subbasins: East Fork Millicoma River, West Fork Millicoma River, South Coos River, Williams River, and Tioga Creek. We surmise that the collective run into the South Fork is larger, on the average, than the run into the Millicoma system. The following narrative pertains to the Coos River system as a whole.

Estimates of Commercial Catch

Cannery packing records (1892-1922) suggest that Coos River once supported a very large run of chinook salmon. A pack of about 39 thousand fish was recorded for 1896. From 1923 through 1946, commercial landings ranged from more than 16 thousand to less than 1 thousand fish annually. The largest catches were recorded during 1923-25, and annual catch steadily decreased from that time until the fishery was closed. Monthly records of pounds landed suggest that catch was almost exclusively of fall-run chinook salmon.

Releases from Hatcheries

Releases of chinook salmon in the Coos River basin are primarily from a private hatchery located in lower Coos Bay. This hatchery began releasing chinook salmon in Coos Bay with the 1977 brood. Almost all of these releases have been of nonnative stocks including Alsea, Trask, and Nestucca fall-run fish; Rogue River spring-run fish; and "hybrid" stocks. Native Coos River fall-run chinook salmon were released for the 1978 through 1981 and the 1984 brood years, but releases were all less than 50,000 fish. The private hatchery permit currently allows the release of 9.4 million chinook salmon per brood year.

In addition to the private hatchery program, chinook salmon were released in recent years by ODFW and STEP hatcheries. Experimental releases of Elk River and Chetco River fall-run fish were made from the 1972-74 brood years. Coos River smolts (25,000-60,000 fish) were released annually from brood years 1978-84. Some of these Coos River fish were released to mitigate for eggs that were taken from the natural spawning population to establish a broodstock for the private hatchery. STEP has been developing fish release programs using Coos River fall-run chinook salmon since 1983. Releases of fry (25,000-30,000) and fingerling (15,000-55,000) have been made by STEP in several recent years.

Surveys of Spawners

A splash dam on the South Coos River, which was in place from 1941 through 1956, prevented fall chinook salmon from reaching spawning areas in this subbasin. Spawning surveys for chinook salmon in the Coos River basin had a relatively low operational priority during the 1950s because the run into the river was so small that few or no spawners were observed in spawning areas. Surveys were reestablished on a more routine basis in the 1960s when the run apparently began recovering.

The peak count of adults in spawning surveys is available in most years since 1961 for the West Fork Millicoma River, since 1974 for South Fork Coos River and Williams River, and since 1980 for Tioga Creek. The trend in peak count suggests that escapement increased steadily from the 1960s through 1978 in West Fork Millicoma River, but then rapidly declined through 1986. The drop after 1980 in the West Fork Millicoma River count is obvious, but a similar decline is not apparent from other survey data. We do not believe that spawning survey data for the West Fork Millicoma reflect the trend in stock abundance for the entire Coos River basin.

Spawning surveys conducted in the fall of 1986 indicate that many chinook salmon returning from the private hatchery strayed and spawned in a number of Coos Bay tributaries. The occurrence of these hatchery strays in natural spawning areas will complicate future assessments of spawning escapement of wild chinook salmon in the Coos River basin.

Estimates of Recreational Catch

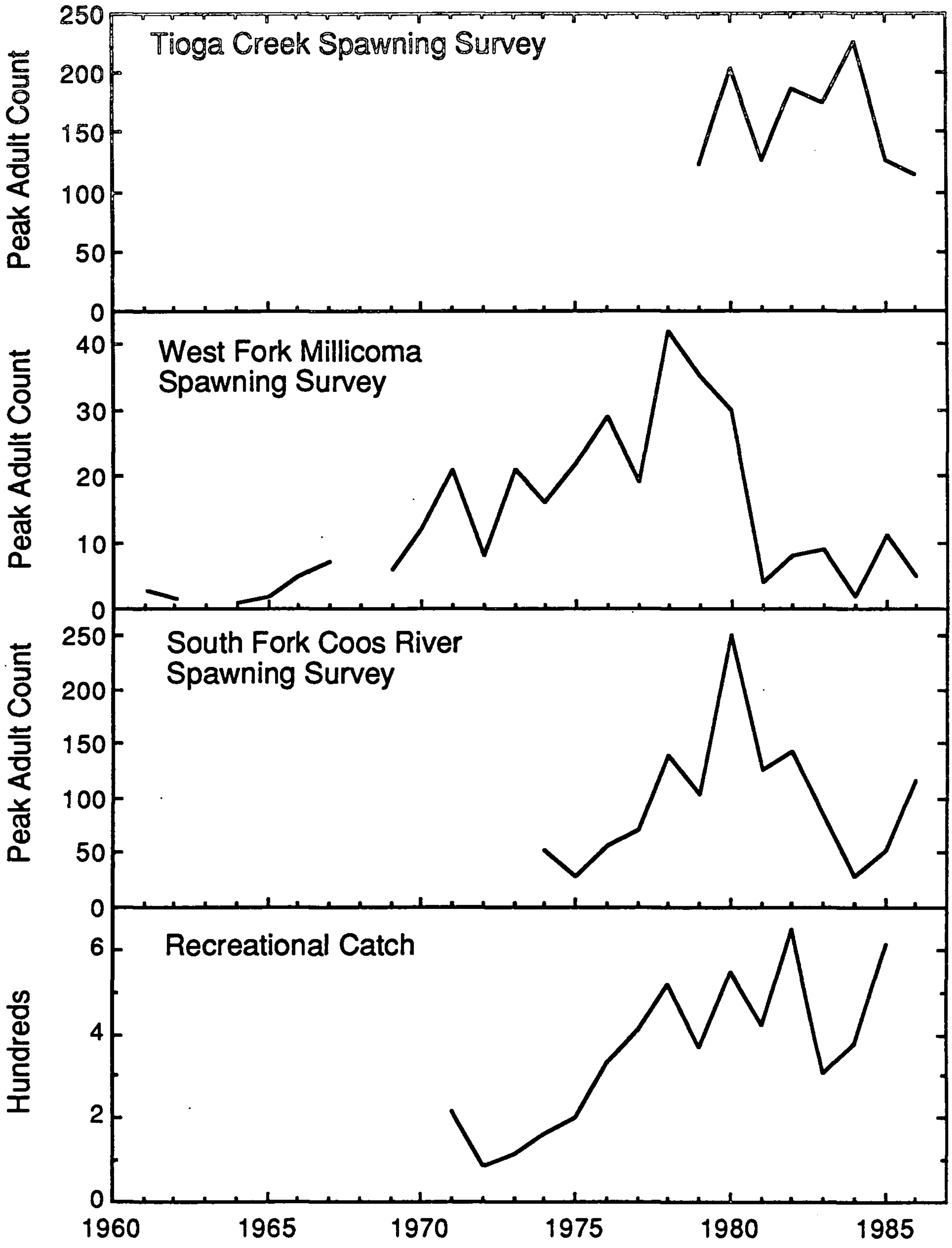
"Punch card" estimates of the catch in Coos Bay and in the Coos River basin ranged from about 100 to about 650 (primarily wild) fall-run chinook salmon annually from 1971 through 1985. These data give no clear indication of any trend in abundance, although they indicate that Coos River fish support a minor freshwater recreational fishery when compared with other coastal stocks. The public has limited access to fishing areas in the South Fork Coos River, and the river is often muddy during the fall months.

Rogue River stock spring-run chinook salmon returned to the private hatchery on Coos Bay in 1986 and 1987. These fish supported a recreational fishery in lower Coos Bay that was perhaps two or three times the previous average level for fall-run fish in the Coos River basin. This fishery will probably continue to respond directly to the population of chinook salmon that returns to the private hatchery.

Assessment of Run Strength

"Punch card" estimates of recreational catch and the only available long-term spawning survey data set (West Fork Millicoma River) provide conflicting information regarding the status of Coos River fall-run chinook salmon. Although the Millicoma River spawning survey data suggest a recent and significant decline in abundance from 1978 through 1986, other spawning surveys and estimates of freshwater catch do not clearly suggest this decline. Reasons for the decline in the West Fork Millicoma River are unknown.

Judging from historic commercial fishery packing and landings records, the Coos River basin supported a population of chinook salmon from the late 1800s through the early 1920s that was comparable to or greater than that of the Alsea River. The wild population of fall-run chinook salmon in the South Coos River basin was reduced to an extremely low level in the 1940s and 1950s, but it has been slowly increasing and has partially recovered during the past 20 years. The basin as a whole is currently dominated by returns of nonnative chinook salmon released by a private hatchery.



Indicators of Run Strength for Coos River Chinook Salmon

COQUILLE RIVER

The Coquille River system supports populations of chinook salmon in at least four major subbasins: the North Fork, the East Fork, the Middle Fork, and the South Fork. We surmise that the run into the South Fork is larger, on the average, than the run into each of the other subbasins. The following narrative pertains to the Coquille River population as a whole.

Estimates of Commercial Catch

The commercial pack ranged from less than 1 thousand to about 8 thousand fish annually for the period 1895 through 1920, and a catch of about 19 thousand fish was made in 1924. From 1930 until the fishery was closed in 1957, annual commercial landings rarely exceeded more than about 3 thousand fish. Monthly landings data suggest that catch consisted almost exclusively of fall-run chinook salmon.

Releases from Hatcheries

Until recently, routine releases of hatchery chinook salmon have not been made in the Coquille River, and recent releases have been relatively modest in number. Elk River stock fall-run chinook salmon (100,000 smolts per year) were released for the 1972, 1973, and 1974 brood years. These fish are believed to have survived poorly. A modest program of hatchery releases in the Coquille River was established in 1984. Coquille stock fall-run (70,000 and 120,000) and spring-run (5,000 and 30,000) smolts were released from the 1983 and 1984 brood years. STEP has been developing fish release programs in the Coquille River basin since the 1980 brood year, and has used Coquille stock exclusively from brood years 1981-85. STEP has emphasized release of fry (50,000-160,000 annually), but a small number of fingerling (20,000) has also been released in 2 years during this period.

Surveys of Spawners

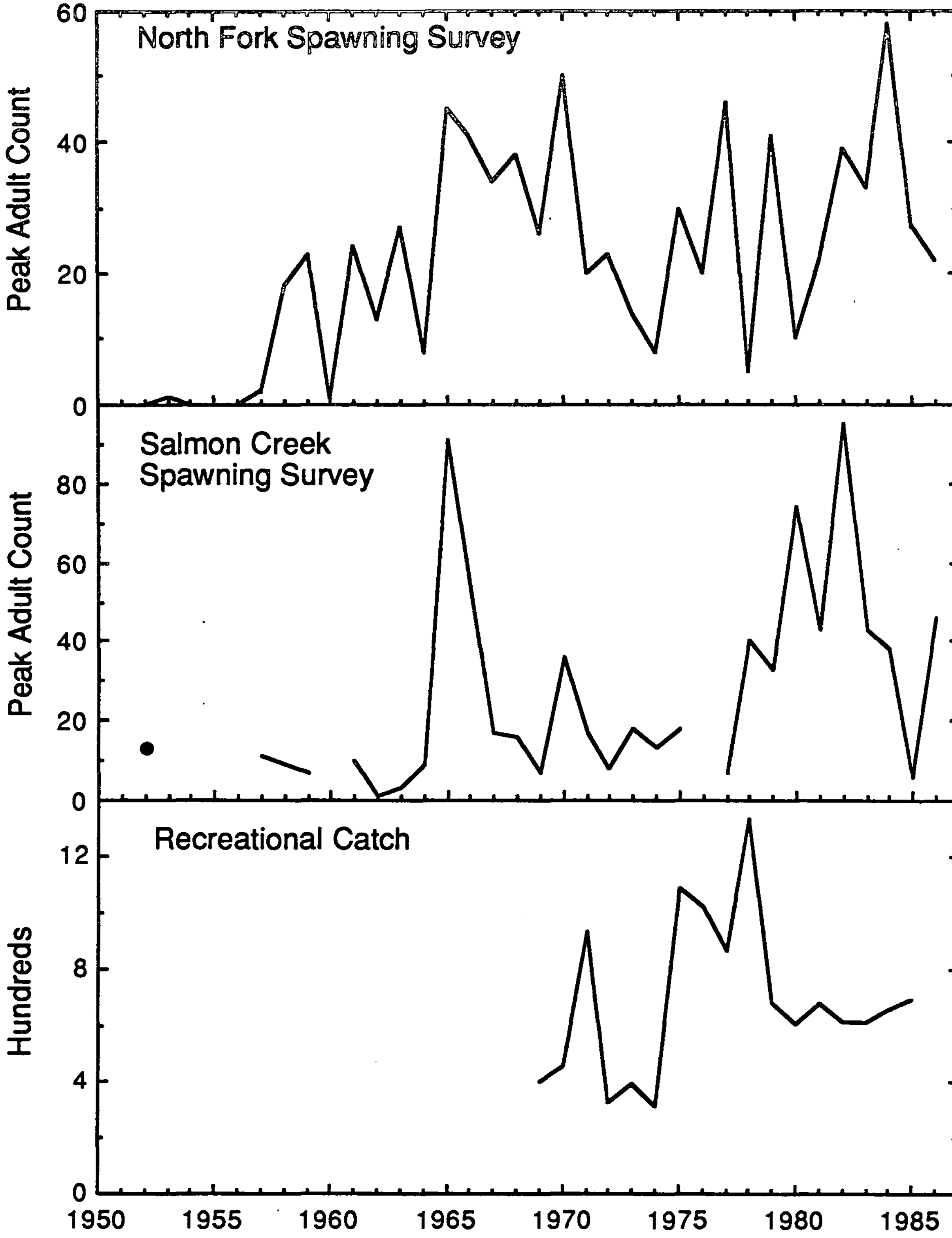
The peak count in annual spawning surveys is available for most years since 1957 in index areas of the North, East, Middle, and South forks of the Coquille River. Of the available survey data, peak count for surveys conducted in the South Fork (Salmon Creek survey) and the North Fork (Area A) are believed to be the most useful for assessment of long-term trends in run strength. Spawning survey data for the North Fork and for the South Fork suggest that stock abundance was at a low level from 1957 through 1964, and from about 1971 through 1976, but was at a higher level from about 1964 through 1970. From 1976 through 1984, the peak count of adults increased in both the North and South forks. The count in the South Fork was unusually low during 1985, but rebounded to a more typical level during 1986. Based on these spawning survey data, we judge that current abundance of Coquille River fall-run chinook salmon is relatively high compared with the average survey count since 1957.

Estimates of Recreational Catch

Compared with other coastal streams, the Coquille River has supported a modest freshwater recreational fishery for chinook salmon. Estimated catch of Coquille River fall-run fish ranged from about 300 to about 1,300 fish since 1969 and has averaged about 800 fish per year from 1977 through 1985. Variation in annual catch estimates has been small since 1969, suggesting that any possible change in stock abundance has been relatively minor.

Assessment of Run Strength

Although spawning survey data for the North Fork and South Fork surveys were not significantly correlated with each other or with estimated sport catch, available indicators suggest that current abundance of Coquille River fall-run chinook salmon is slightly greater than the average abundance level for the past 20 years. Recreational catch has been stable, and spawning survey data for the past 10 years suggest increased abundance. The stock is considered to consist almost exclusively of wild fish.



Indicators of Run Strength for Coquille River Chinook Salmon

ELK RIVER

We surmise that Elk river supports populations of chinook salmon in at least two geographic areas of the system. We refer to these fish loosely as "lower river" and "upper river" populations, without direct evidence that they are reproductively isolated. The run of "lower river" fish has been larger, by far, than the run of "upper river" fish in recent years. The following narrative pertains to the Elk River population as a whole.

IHN virus was first detected among Elk River juveniles from the 1975 brood year and since then has been detected in hatchery spawners in most years. The presence of this disease has restricted out-of-basin releases of the Elk River stock since 1975.

Stock status, hatchery contribution, and life history are better documented for Elk River fall-run chinook salmon than for any other Oregon coastal chinook salmon stock with the possible exception of Rogue River spring-run fish. In addition to spawning survey data and "punch card" estimates of recreational catch that are available for most Oregon coastal chinook salmon stocks, creel survey estimates of freshwater catch, population estimates, and data from ongoing sampling programs designed to allow separation of returns of hatchery and wild fish are also available.

Estimates of Commercial Catch

Elk River was open to commercial fishing with nets at various locations and dates through 1934. No records of catch are available, however.

Releases from Hatcheries

Elk River fall-run chinook salmon have been reared and released at Elk River Hatchery beginning with the 1968 brood year. Most fish have been released as smolts in the fall months, although occasionally some have been released as fingerling during June. Annual release of smolts has ranged from about 100,000 fish to about 800,000 fish and has averaged about 420,000 fish (excluding the 1976 brood year). Estimated survival rates for the 1973 and 1974 brood years are among the highest recorded for chinook salmon released by any Oregon public hatchery. Available data suggest a that similar survival rate (20-25% survival to age 2) may also have been achieved for at least the 1970 brood.

Estimates of Population Size

Estimated total river return of adult chinook salmon to Elk River has ranged from about 2,200 to about 12,000 fish for the 1970 through 1978 brood years. Over this period of time, estimated return of wild adults ranged from about 1,400 to about 4,400 fish, whereas return of hatchery adults ranged from less than 400 to more than 9,000 fish. The large between-brood variation in total return of adults primarily reflects year to year variation in survival rate of hatchery fish. Estimated survival rate (for Ad+CWT groups) to age 2 was more than 20% for 1973 and 1974 brood year smolts, whereas it was from 2% to 7% for 1977 through 1979 brood year smolts.

Estimates of Recreational Catch

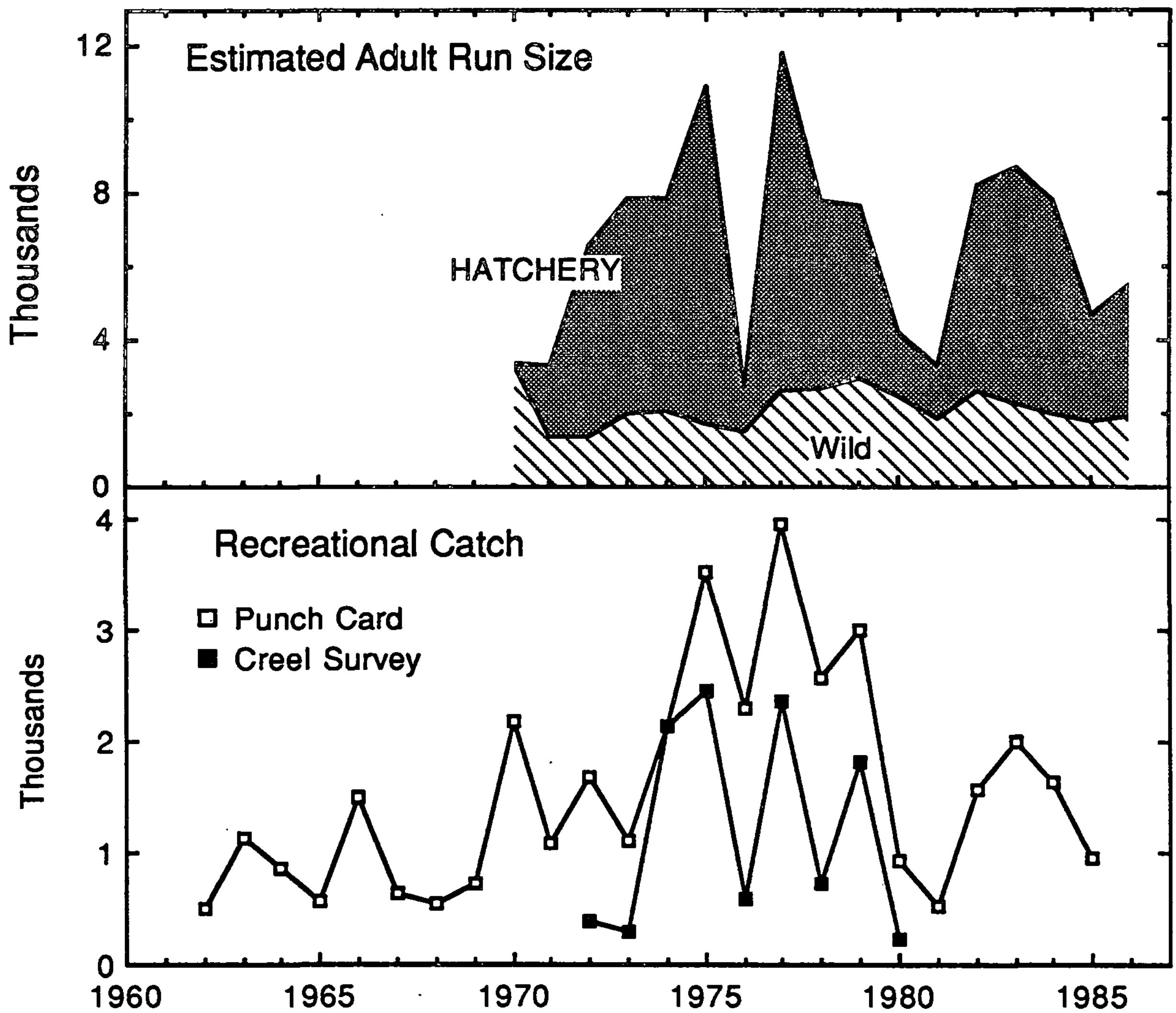
Elk River supports one of the more important south coast freshwater recreational fisheries for chinook salmon. "Punch card" estimates of catch ranged from about 500 to almost 4,000 fish per year from 1962 through 1985 and averaged about 1,700 fish per year. These catch estimates were significantly correlated with mark and recapture population estimates of total adult run size for return years 1972 through 1980.

Creel survey estimates of the catch of jacks and of adults were also made for the 1972 through 1980 seasons and provide independent estimates that can be compared with "punch card" estimates of recreational catch. Comparison of these two estimates revealed that "punch card" estimates were significantly correlated with creel survey estimates of adult catch, but were not correlated with creel survey estimates of jack catch or of the total catch of jacks and adults. "Punch card" estimates averaged about 1.5 times the creel survey estimates of adult catch, however.

Assessment of Run Strength

"Punch card" catch estimates can be used as an index for adult returns to Elk River, noting that catch prior to 1970 was of wild fish only, whereas catch since 1970 included hatchery fish. Average annual catch for the period 1963 through 1969 was about 800 fish, whereas average annual catch was about 2,000 fish for 1971 through 1985. Based on these two averages, Elk River hatchery releases have increased the average annual abundance of Elk River chinook salmon by about 150%. Because catch estimates prior to 1977 may include many jacks, this comparison may underestimate the actual average contribution by hatchery fish. However, if the average exploitation rate has increased since the hatchery program began, then this comparison may overstate the actual increase in abundance. Fluctuations in brood year survival rate of hatchery fish have been dramatic, however, and have lead to increased variation in the total run size. The run of wild fish has remained relatively stable when compared with the run of hatchery fish. For brood years exhibiting poor survival of hatchery fish, wild fish have made up almost 85% of the total return of adults, whereas for brood years exhibiting very good survival of hatchery fish, wild fish have made up about 16% of the total return of adults.

Wild Elk River fall-run chinook salmon appear to have had a stable abundance over the past twenty years. Releases of smolts from Elk River Hatchery have increased the average total abundance of wild plus hatchery fish by about 150%, but have also produced extreme annual fluctuations in abundance. The run is dominated by hatchery fish, but wild fish still account for an average of about 40% of the annual return. Wild fish are particularly important when hatchery fish have had a poor survival rate for several consecutive brood years.



Indicators of Run Strength for Elk River Chinook Salmon

FLORAS CREEK-NEW RIVER

New River receives water from Floras Creek, Floras Lake, and several unnamed lakes and tributaries. New River is essentially a very narrow foredune lake constricted at the northern end where it flows into New River estuary. Chinook salmon that enter the system spawn in Floras Creek. We have no information regarding subpopulations of chinook salmon in this stream. Distinctions may exist, however, based on date rather than on area of spawning. The following narrative pertains to the New River-Floras Creek population as a whole.

Estimates of Commercial Catch

The Floras Creek-New River basin was open to commercial fishing with nets at various locations and dates through about 1937. No records of catch are available, however.

Releases from Hatcheries

Very few hatchery fish have been released in the Floras Creek-New River basin. About 100,000 fingerling of Elk River fall-run stock were released from the 1972 and from the 1973 broods. About 10,000 fry of Floras Creek stock were released by STEP during 1983 and 1984.

Surveys of Spawners

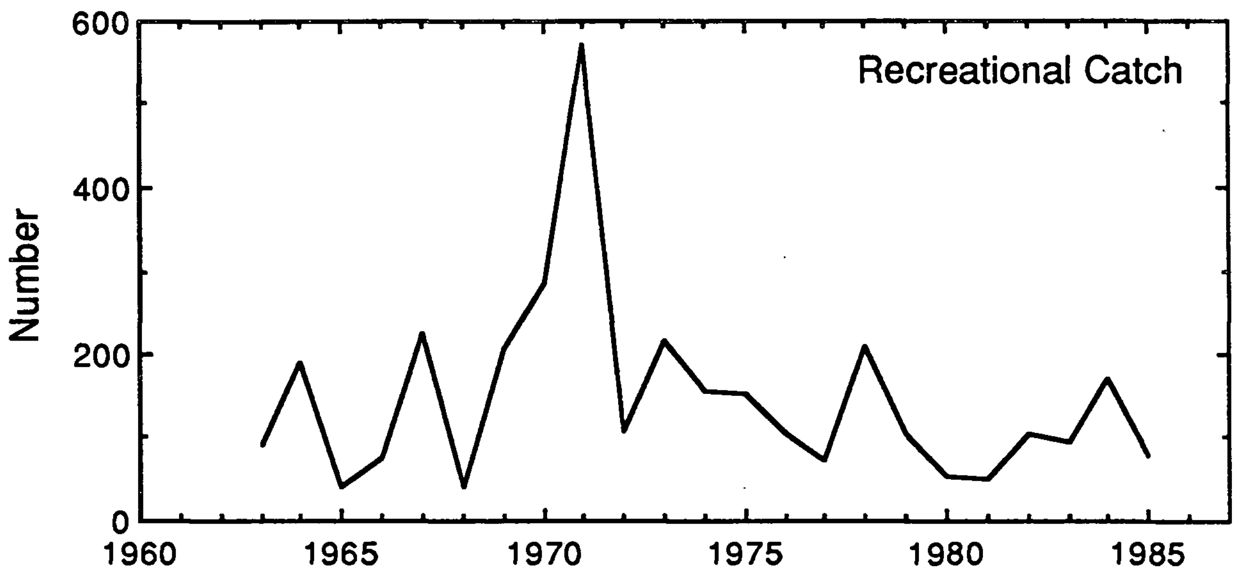
Spawning survey index areas in the Floras Creek-New River basin have not been consistently monitored and are not included here.

Estimates of Recreational Catch

Floras Creek-New River fall-run chinook salmon have supported a relatively small freshwater recreational fishery in most years. "Punch card" estimates of catch have ranged from about 10 fish to almost 600 fish annually since 1963 and have averaged about 110 fish per season from 1977 through 1985.

Assessment of Run Strength

"Punch card" estimates of catch provide the only quantitative basis whereby the status of Floras Creek-New River chinook salmon may be judged. Catch during 1971 was unusually large (about 600 fish) when compared with the estimated range of 50-200 fish caught since 1972. Catch estimates since 1972 suggest that a stable but small population of fall chinook salmon is present in the Floras Creek-New River basin. This stock probably consists almost entirely of wild fish.



Indicators of Run Strength for Floras-New River Chinook Salmon

HUNTER CREEK

Hunter Creek drains a relatively small watershed on the southern Oregon coast and flows through a small ephemeral estuary on the beach at the river mouth. We have no information regarding subpopulations of chinook salmon in this stream. Distinctions may exist, however, based on date rather than on area of spawning. The following narrative pertains to the Hunter Creek population as a whole.

Estimates of Commercial Catch

Hunter Creek was open to commercial fishing with nets at various locations and dates through about 1937. No records of catch are available, however.

Releases from Hatcheries

Very few hatchery chinook salmon have been released in the Hunter Creek basin. Releases have been limited to an unplanned release of about 8,000 Chetco River stock smolts from the 1973 brood year and to STEP releases of about 1,000 to about 12,000 Hunter Creek fry or fingerling annually from 1984 through 1986.

Surveys of Spawners

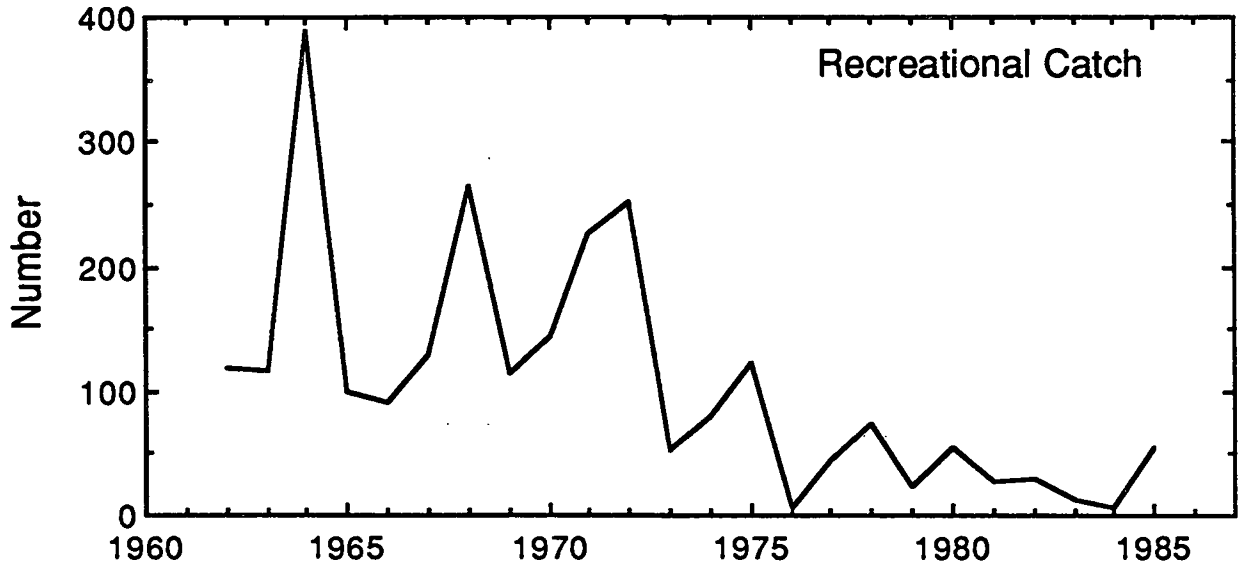
Spawning survey index areas in Hunter Creek have not been consistently monitored and are not included here.

Estimates of Recreational Catch

Hunter Creek has supported a relatively small recreational fishery for chinook salmon. From 1963 through 1972, "punch card" estimates of catch in Hunter Creek ranged from about 90 fish to almost 400 fish annually and averaged about 200 fish per season. Since 1973, catch has ranged from 6 fish to 123 fish and has averaged about 45 fish per season.

Assessment of Run Strength

"Punch card" estimates of catch provide the only basis whereby the status of Hunter Creek chinook salmon may be judged. A decline in estimated recreational catch was evident prior to 1977, thus it is unlikely that the 1977 shift in reporting size limit for "punch cards" is responsible for the apparent decline in catch. Based on these data and on anecdotal observations by management district biologists, we regard this stock as depressed since the mid-1970s. The stock is believed to consist almost entirely of wild fish.



Indicators of Run Strength for Hunter Creek Chinook Salmon

KILCHIS RIVER

The Kilchis River is one of five major tributaries that flow into Tillamook Bay. Information pertaining specifically to the run strength of chinook salmon in this river is presented here. The reader should also refer to information pertaining generally to the run strength of chinook salmon in the Tillamook Bay watershed (<u>see</u> TILLAMOOK BAY).

Estimates of Commercial Catch

The Kilchis River was open to commercial fishing with nets at various locations and dates through about 1946. No records of catch in this river are available, however. Records of commercial catch of chinook salmon in this river and other Tillamook Bay tributaries were combined in an overall Tillamook Bay reporting area (<u>see</u> TILLAMOOK BAY).

Releases from Hatcheries

Hatchery chinook salmon have not been released in the Kilchis River basin on a routine basis; however, both fall- and spring-run Trask River stock chinook salmon have infrequently been released in the Kilchis River. From 35,000 to 80,000 spring-run fingerling were released annually from the 1973 through 1975 brood years, and about 45,000 spring-run smolts were released from the 1981 brood. About 30,000 fall-run smolts were released from the 1980 brood year. STEP releases of from 20,000 to 100,000 spring- or fall-run chinook salmon fry were made from 1983 through 1986.

Surveys of Spawners

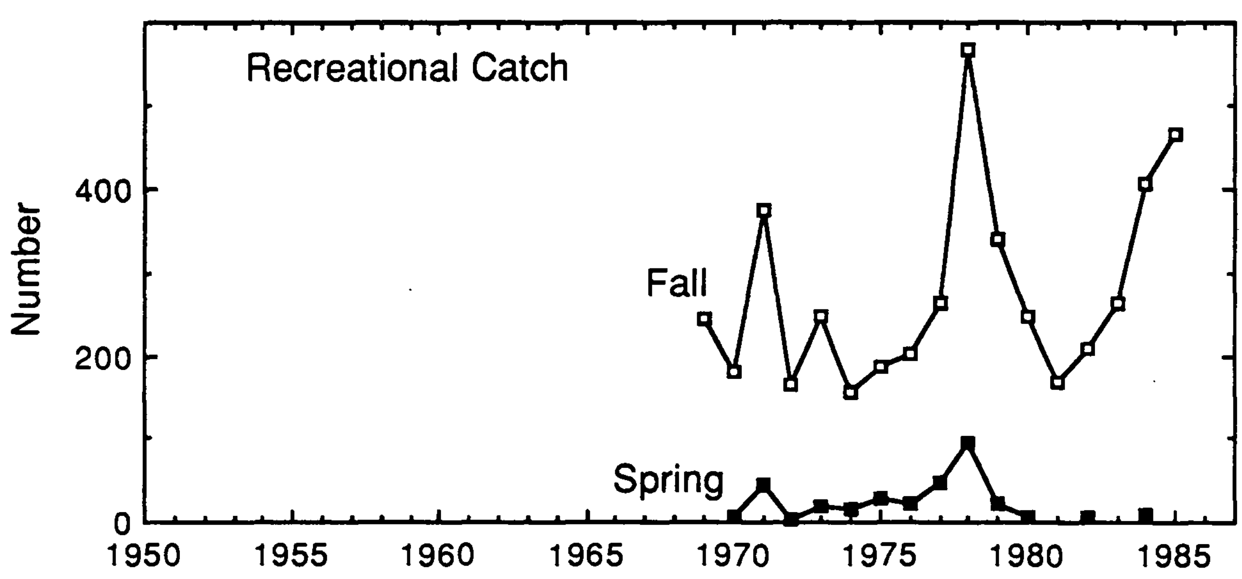
Spawning survey index areas in the Kilchis River have not been consistently monitored and are not discussed here.

Estimates of Recreational Catch

"Punch card" estimates of the recreational catch of fall- and spring-run chinook salmon indicate that fall-run fish dominate the catch in the Kilchis River. Catch of fall-run chinook salmon has ranged from about 150 to about 600 fish annually and has averaged about 325 fish per year from 1977 through 1985. Catch of spring-run chinook salmon has been as high as 94 fish per year, but in most years catch has been no more than about 20 fish. Estimated catch of spring-run chinook salmon has been significantly correlated with catch of fall-run chinook salmon, suggesting that much of the spring chinook salmon catch may have actually consisted of early fall-run fish.

Assessment of Run Strength

"Punch card" estimates of freshwater catch provide the only basis whereby status of Kilchis River fall- and spring-run chinook salmon stocks may be be judged. Catch estimates for fall-run fish suggest that the stock has exhibited large fluctuations in abundance since 1969, but the time series suggests no obvious trend in abundance. The success of various hatchery releases in the Kilchis River is unknown, but we believe that at least part of the fluctuation in recreational catch may be attributable to returns from various hatchery releases or from stray hatchery chinook salmon that returned from releases elsewhere in the Tillamook Bay watershed. Estimated catch of Kilchis River spring-run chinook salmon has been small compared with estimated catch of fall-run fish and likely includes some fall-run chinook salmon caught early in the fall. The population of fall-run chinook salmon in the Kilchis River is believed to be principally of wild fish, but stray hatchery fish may make a small contribution to total abundance.



Indicators of Run Strength for Kilchis River Chinook Salmon

MIAMI RIVER

The Miami River is one of five major tributaries entering Tillamook Bay. Information pertaining specifically to the run strength of chinook salmon in this river is presented here. The reader should also refer to information pertaining generally to the run strength of chinook salmon in the Tillamook Bay watershed (see TILLAMOOK BAY).

Estimates of Commercial Catch

The Miami River was open to commercial fishing with nets at various locations and dates through about 1924. No records of catch in this river are available, however. Records of commercial catch of chinook salmon in this river and other Tillamook Bay tributaries were combined in an overall Tillamook Bay reporting area (see TILLAMOOK BAY).

Releases from Hatcheries

Hatchery chinook salmon have only infrequently been released in the Miami River. About 40,000 Trask River fall-run smolts were released from the 1980 brood year. STEP releases of from 50,000 to 350,000 Trask River fall-run fry were made annually from 1982 through 1986.

Surveys of Spawners

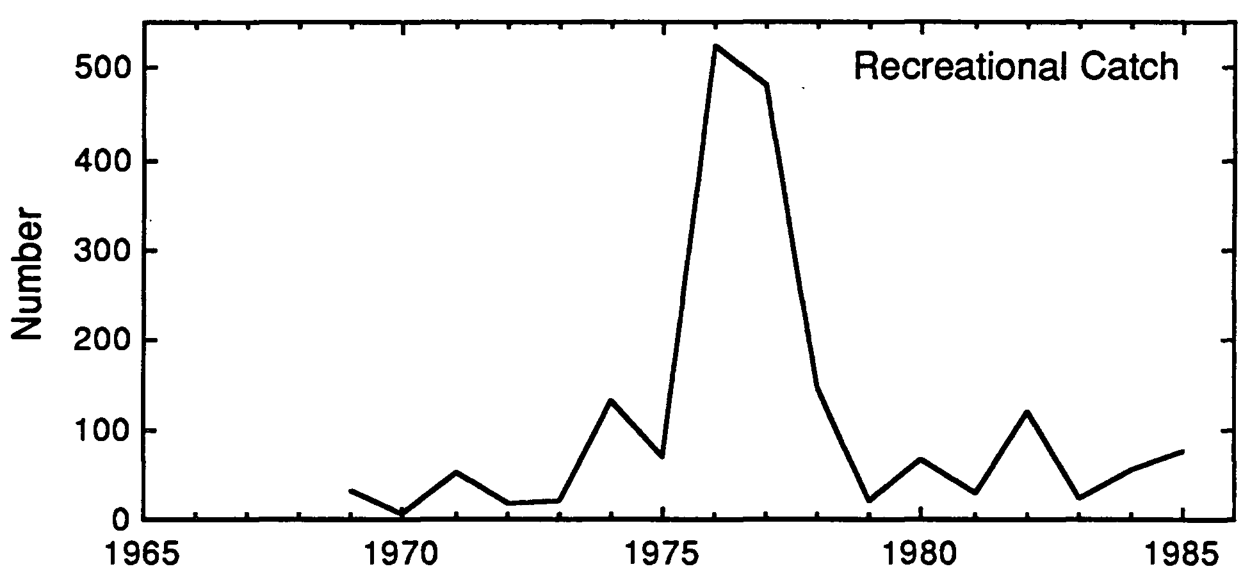
Spawning survey index areas in the Miami River have not been consistently monitored and are not included here.

Estimates of Recreational Catch

The Miami River supports a relatively small recreational fishery for fall-run chinook salmon. "Punch card" estimates of the catch of fall- and spring-run fish indicate that fall-run fish dominate the catch. Catch of fall-run chinook salmon has ranged from 10 fish to more than 500 fish annually, but averaged only about 110 fish per year from 1977 through 1985. Catch of spring-run chinook salmon has been less than 10 fish per year.

Assessment of Run Strength

"Punch card" estimates of freshwater catch provide the only basis whereby status of Miami River fall-run chinook salmon may be be judged. Catch estimates suggest that the stock has exhibited large fluctuations in abundance since 1969, but the time series suggests no obvious trend. The success of various hatchery releases in the Miami River is unknown, but we believe that at least part of the fluctuation in catch may be attributable to return from hatchery releases or to strays that returned from releases in other areas of the Tillamook Bay watershed. Catch prior to October 1 has been negligible, and we believe it is unlikely that the stream maintains more than a very small population of spring-run fish. The fall-run stock is probably composed primarily of wild fish, but hatchery fish released elsewhere in the Tillamook Bay watershed may make a small contribution to total abundance.



Indicators of Run Strength for Miami River Chinook Salmon

NEHALEM RIVER

The Nehalem River system is a relatively large drainage basin compared with others on the Oregon coast. We surmise that several distinct subpopulations of chinook salmon may be supported by local stream "reaches" or tributaries within the system. We do not have reliable information upon which to judge either the geographic distribution of chinook salmon within the basin or the relative number of fish that might comprise different runs within the basin. The following narrative pertains to the Nehalem River population as a whole.

Estimates of Commercial Catch

Approximately 8 thousand to 18 thousand chinook salmon were packed annually in most years on the Nehalem River from 1896 through 1916. From 5 thousand to 11 thousand fish were caught annually during 1923-40, but relatively few fish were caught in the 1940s and in the 1950s before the commercial fishery was closed. Commercial catch was typically greatest from August through October and peaked during August and September prior to the mid-1930s. After the mid-1930s, very few fish were caught during August and September, although the season remained open during these months.

Releases from Hatcheries

Recent releases of hatchery-reared chinook salmon in the Nehalem River have consisted almost entirely of Trask River fall-run stock. Releases from brood years 1966-69 emphasized fingerling (average about 425,000 fish annually), whereas releases from brood years 1970-80 emphasized smolts (average about 100,000 fish annually). STEP releases of Nehalem River stock chinook salmon have consisted of 9,000 fry and 42,000 fry released during 1984 and 1985, respectively.

Because the Nehalem River is known to have *Ceratomyxa shasta* and because this organism is not present in the Trask River, releases of Trask River stock chinook salmon fingerling and smolts have probably made little (if any) contribution to the runs of chinook salmon in the Nehalem River.

Surveys of Spawners

The peak count of adults in annual spawning surveys is available for an index area in Humbug Creek from 1950 to the present. The counts suggest a steady increase in abundance with the exception of a short period of relatively low abundance from 1967 through 1971. The counts of adults for the 1984 and 1985 spawning seasons were the highest recorded for Nehalem River chinook salmon. Anecdotal observations indicate that chinook salmon may also spawn in some mainstem reaches of the river that are not adequately represented by surveys in these small tributaries.

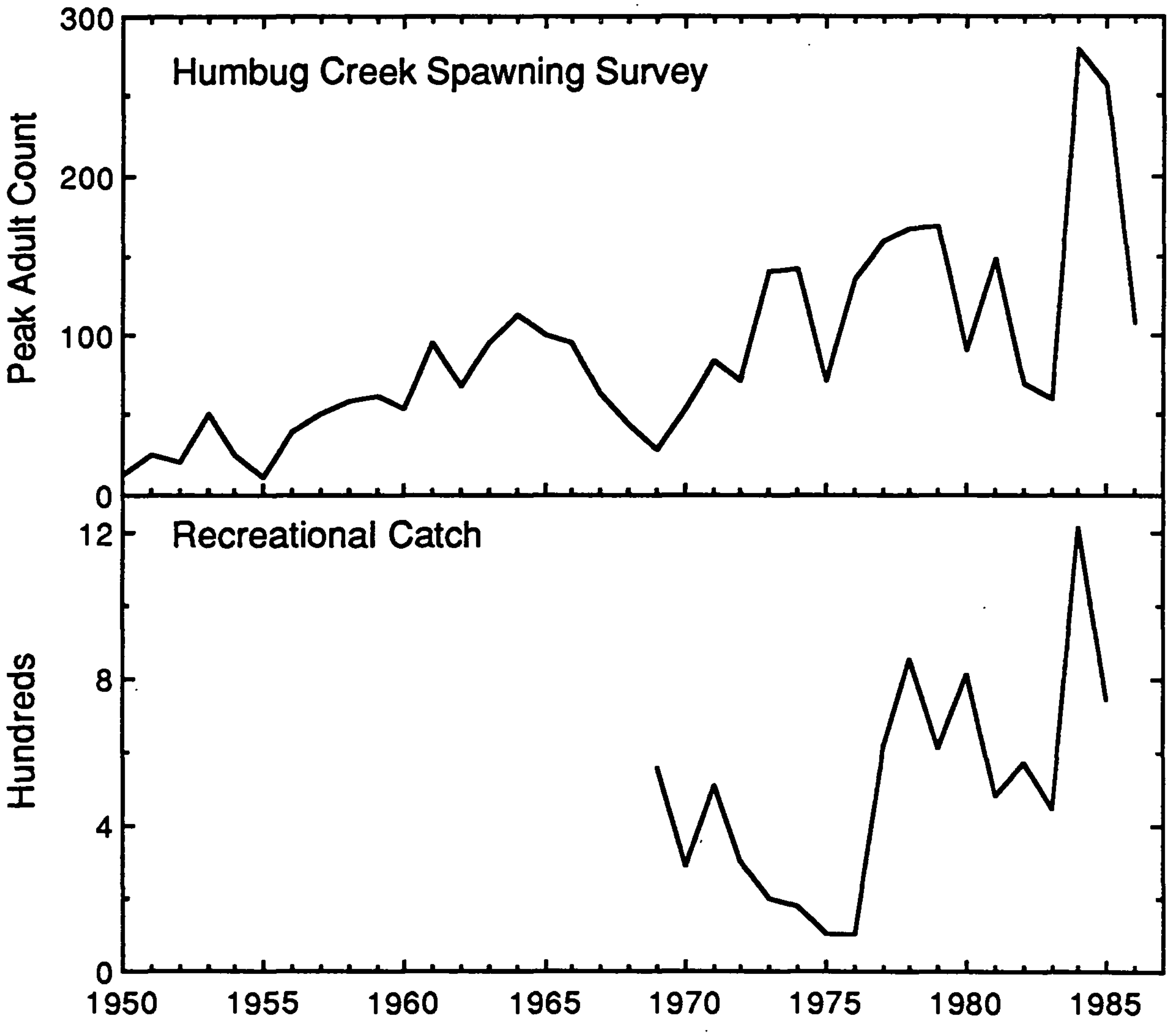
Estimates of Recreational Catch

"Punch card" estimates of the recreational catch of Nehalem River chinook salmon suggest a low stock abundance from about 1969 through 1976 followed by increased abundance. The recreational catch in 1984 (about 1,200 fish) was the highest recorded. The annual average catch has been about 700 fish from 1977 through 1985.

Assessment of Run Strength

Estimates of recreational catch and peak counts of adults in spawning surveys were significantly correlated over the period 1969 through 1985 and over the more recent period 1977 through 1985. The significance of these correlations seems largely attributable to a record count of adults and a record recreational catch during 1984, however.

The run of Nehalem River fall-run chinook salmon was extremely depressed during the early 1950s. Spawning survey data suggest that the stock has been slowly and steadily increasing in abundance. Although the river basin is one of the largest, in terms of total stream miles, in Oregon's north coast, stock abundance remains relatively low compared with historic Nehalem River populations and with contemporary populations in other north coastal streams. We believe that the stock consists almost exclusively of wild fish.



Indicators of Run Strength for Nehalem River Chinook Salmon

NESTUCCA RIVER

The Nestucca river system supports populations of chinook salmon in at least two major subbasins: the Nestucca River and the Little Nestucca River. The population returning to the Nestucca River basin is, by far, the larger of the two. The following narrative pertains to the Nestucca River population as a whole.

Estimates of Commercial Catch

Commercial packing records indicate that in most years during the period 1905 through 1919, approximately 6 thousand to 11 thousand fish were packed annually on the Nestucca River. Commercial landings data indicate that from 7 thousand to 12 thousand fish were caught annually from 1923 through 1926. Catch was often substantial from July through October, but the fishery was usually closed during the months of April and May. The river was closed to commercial fishing in 1927.

Releases from Hatcheries

Chinook salmon are routinely reared at Cedar Creek Hatchery (a Three Rivers-Nestucca River tributary) for release into the Nestucca River. From 20,000 to 120,000 native stock fall-run smolts have been released into the Nestucca River annually since the 1975 brood year. The average release has been about 80,000 smolts per year. Releases of Trask River spring-run fingerling began with the 1972 brood year. Since that time, from 50,000 to 100,000 spring-run smolts have been released annually and, in some years, from 100,000 to 200,000 fingerling have also been released. Releases in most recent years have consisted of "early-run" chinook salmon trapped from returns to the Nestucca River and of Trask River spring-run chinook salmon. STEP has released about 100,000 Trask River and Nestucca River stock fall-run fry annually since 1982.

Surveys of Spawners

Spawning survey data are available for fall-run chinook salmon in East Beaver and Moon Creeks from 1950 through 1974, and in Niagara Creek from 1950 through the present. All survey data sets were significantly correlated with one another for the period 1950 through 1974. During this time period we observed no clear trend in abundance, although the count was subject to strong annual variation. More recent Niagara Creek survey data suggest that the fall-run stock has been steadily increasing in size from a very low level in 1977 through the present. The highest peak count on record was obtained in 1986.

Spring-run chinook salmon have been counted in from 7 to 16 resting pools in the Nestucca River in most years since 1965 to obtain an annual index of average abundance. The count was relatively low in 1983 and 1984 and was relatively high in 1986 and 1987.

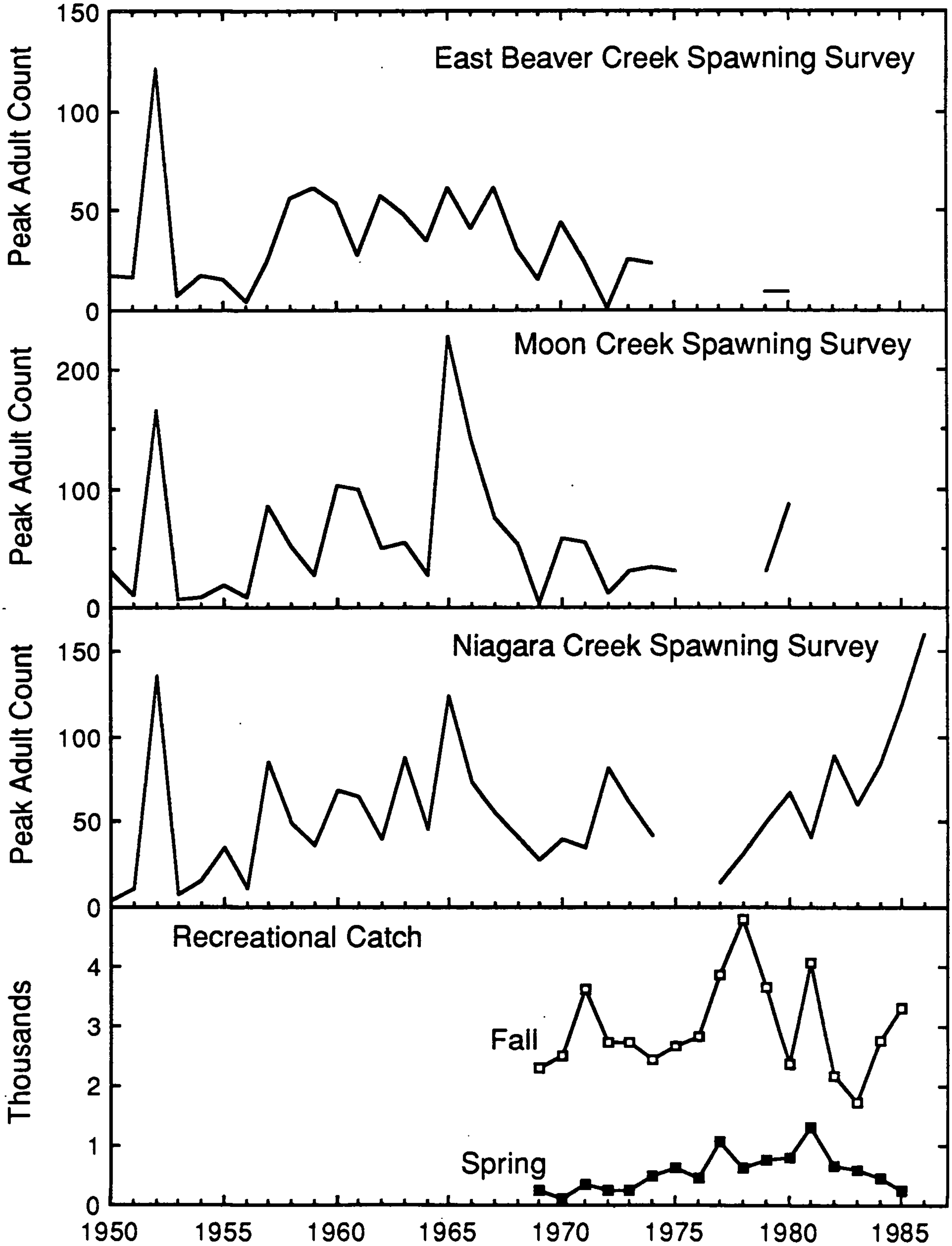
Estimates of Recreational Catch

The Nestucca River supports one of the more important freshwater recreational fisheries for fall-run chinook salmon. Annual catch has ranged from about 1,700 to about 4,800 fish and has averaged about 3,200 fish from 1977 through 1985. Annual catch of "early-run" chinook salmon has been smaller and has averaged about 700 fish during this period, but in some years more than 1,000 "early-run" chinook salmon have been caught.

Assessment of Run Strength

Interpretation of available data for Nestucca River chinook salmon is complicated by a poor understanding of the contribution that hatchery fish have made to total stock abundance and freshwater catch. Although recent increases in the peak count of adult fall-run chinook salmon in Niagara Creek coincide with releases of hatchery fish, average catch from 1969 through 1978 (which is for wild fish only) exceeded a more recent average catch (which includes an unknown number of hatchery fish); however, this difference could be caused by differences in reporting jacks on "punch cards" before and after 1977. In addition, although spawning survey data sets are highly correlated with one another, peak adult count in Niagara Creek spawning surveys since 1974 has not been significantly correlated with the annual "punch card" estimate of freshwater catch. Thus, although contemporary abundance of fall-run chinook salmon appears relatively high compared with past levels of abundance, the strength of the wild run cannot be separated from the strength of the hatchery run. We believe that hatchery fish have made a modest contribution to total stock abundance, but the stock is probably dominated by wild fish.

Available indicator data indicate that the early-run stock has not exhibited any clear long-term trend in abundance, although returns in 1986 and 1987 were relatively strong. For "early-run" chinook salmon, estimated recreational catch prior to 1976 should have been almost entirely of wild fish, whereas catch in recent years should also include some hatchery fish. Average annual catch of "early-run" chinook salmon was about 325 fish per year and annual catch never exceeded 625 fish prior to 1975, whereas catch has averaged about 700 fish annually since 1976. Since catch prior to 1977 may include an unknown number of jacks, we believe that this difference between periods is real. Average pool count prior to 1976 was also lower than average pool count since 1976. These comparisons suggest that hatchery fish may compose as much as 50% of today's total return of spring- or summer-run chinook salmon to the Nestucca River.



Indicators of Run Strength for Nestucca River Chinook Salmon

PISTOL RIVER

Pistol River drains a relatively small watershed on the southern Oregon coast and flows through a small ephemeral estuary on the beach at the river mouth. We have no information regarding subpopulations of chinook salmon in this stream. Distinctions may exist, however, based on date rather than on area of spawning. The following narrative pertains to the Pistol River population as a whole.

Estimates of Commercial Catch

The Pistol River was open to commercial fishing with nets at various locations and dates through about 1937. No records of catch are available, however.

Releases from Hatcheries

Hatchery chinook salmon have not been regularly released in Pistol River. STEP released Pistol River stock smolts from 1983 through 1986 (average about 20,000 fish annually). No other recent releases of chinook salmon have been reported in the Pistol River.

Surveys of Spawners

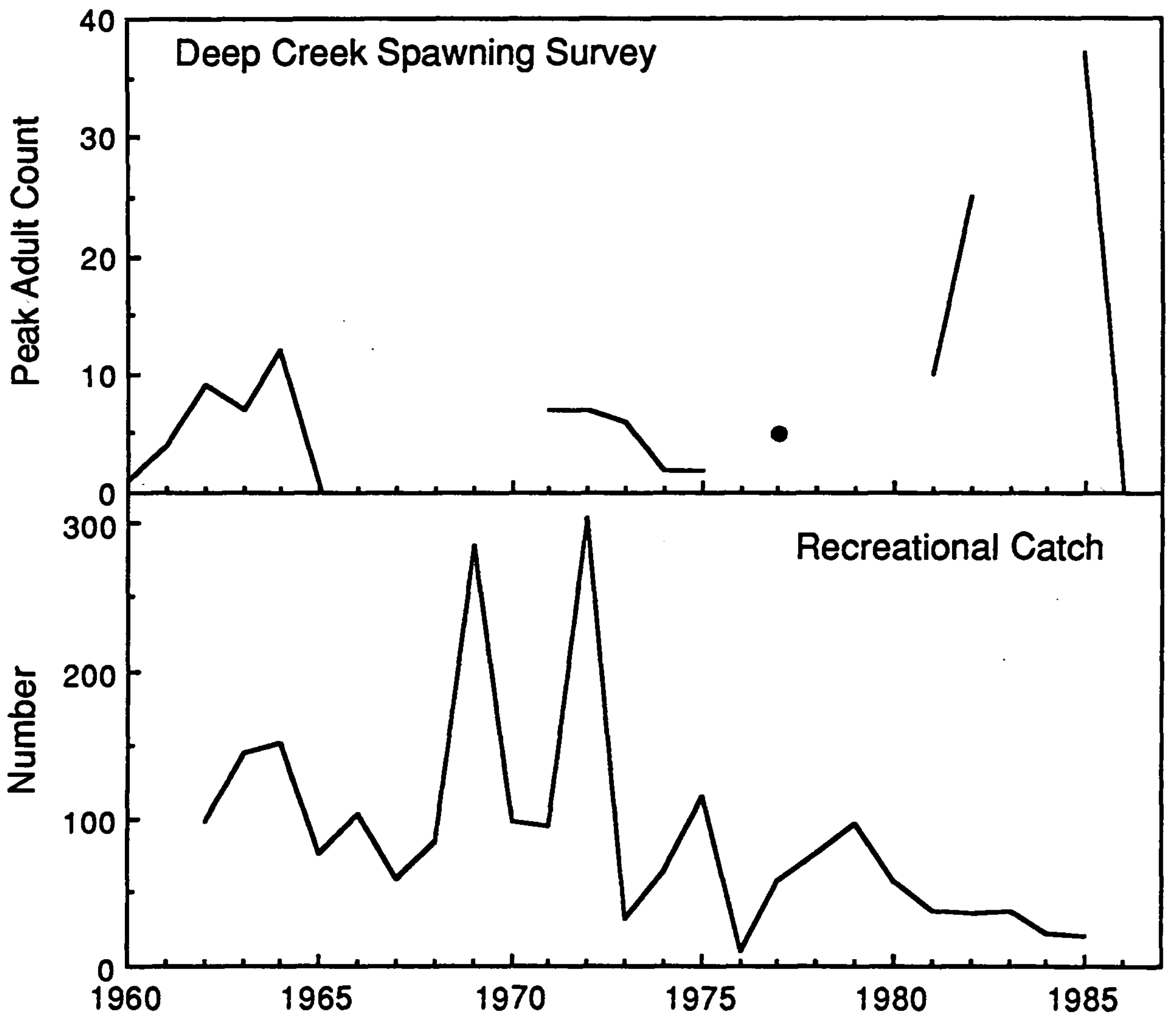
Spawning surveys have been carried out in Deep Creek in most years since 1960. With the exception of 1966, peak count prior to 1981 has been very low relative to that in other coastal spawning surveys. The improved count since 1981 apparently reflects improved access to the upstream spawning survey index areas resulting from culvert repair. No spawners were counted during surveys in 1986 because of slope failures and resulting debris and siltation in index areas. Prior to 1981, survey data indicate a consistently low level of spawners, although this low level may be attributable to fish migration problems rather than to low stock abundance. Because conditions are known to have changed in the survey area after 1980, the recent trend in run strength cannot be judged from available spawning survey data.

Estimates of Recreational Catch

"Punch card" estimates of catch suggest that the Pistol River supports a relatively small recreational fishery for chinook salmon. Catch ranged from about 30 to about 300 fish and averaged about 120 fish per year from 1962 through 1975. From 1977 through 1985 catch ranged from about 20 to about 100 fish and averaged about 50 fish per year. The 1977 change in reporting size limits for "punch cards" could account for some of the decline in catch if the Pistol River stock produces strong returns of jacks, but we doubt that the reporting change would result in a decline of the magnitude observed. The average catch for the most recent 5-year period (1981-85) was only about 30 fish per year.

Assessment of Run Strength

Available evidence suggests that Deep Creek spawning survey data cannot provide reliable information about the trend in abundance of Pistol River chinook salmon. Catch estimates suggest that recent stock abundance is low compared with previous abundance, and that catch has been consistently low (less than 40 fish) for the past 5 years. We regard the stock as depressed since the mid-1970s. We believe that this stock consists almost entirely of wild fish.



Indicators of Run Strength for Pistol River Chinook Salmon

ROGUE RIVER

The Rogue River system supports populations of chinook salmon in at least five major subbasins or geographic reaches of the watershed: the mainstem above Gold Ray Dam, the mainstem below Gold Ray Dam, the Illinois River, the Applegate River, and several relatively small lower river tributaries such as Indian, Lobster, and Quosatana creeks. Spring-run fish are essentially confined to the mainstem above Gold Ray Dam, but fall-run fish are supported by all five areas of the system. The following narrative pertains generally to fall- and spring-run chinook salmon in the Rogue River basin. Stocks of Rogue River spring- and fall-run chinook salmon are the largest among Oregon's coastal chinook salmon populations, and they are believed to make the largest contribution of any Oregon stock to Oregon ocean fisheries (see Stock Composition, PART III).

For decades, columnaris *(Flexibacter columnaris)* and furunculosis *(Aeromonas salmonicida)* have been blamed for periodically killing large numbers of adult and juvenile chinook salmon during summer in the Rogue River. Mortality among adult spring-run chinook salmon was particularly severe during June and July of 1977, a drought year and the first year that Lost Creek reservoir was available to supplement natural summer flow. Columnaris and furunculosis organisms were most prevalent, as in past years, and *Ceratomyxa shasta* organisms were isolated for the first time. Ceratomyxosis has been shown to be infective from Grants Pass to the river mouth, but has not caused epizootics. Mortality of adult fall-run chinook salmon in August and September was high in 1978-81 (peaking sharply in 1979 with an estimated 76% of the run being killed) despite the fact that Lost Creek reservoir provided higher flow and lower temperature than were historically present. Studies in 1978-82 revealed *F. columnaris* to be by far the most prevalent organism responsible for these mortalities of adult chinook salmon. Hatchery adults in the river have been found to die at a higher rate than wild adults during epizootics affecting the spring run, and all of the organisms listed above have periodically been isolated from chinook salmon at Cole Rivers Hatchery. No viral diseases have as yet been detected in the Rogue River basin.

The earliest large dams on the mainstem Rogue River were Savage Rapids Dam (1921) at river mile 107 and Gold Ray Dam (1940) at river mile 125. Gold Ray Dam is about 20 feet high. These dams are now believed to cause only minor passage problems for chinook salmon runs in most years, but unscreened irrigation diversions at Savage Rapids Dam caused extensive mortality of juvenile chinook salmon until the mid-1950s.

Two headwater dams of over 240 feet were built in the Rogue River basin during the last decade, and a third is under construction. Lost Creek Dam (river mile 157) was completed in 1977 on the main river and blocked off about one-third of the spawning area historically used by spring-run chinook salmon. Applegate Dam, on the Applegate River, was completed in 1981 and blocked off an area that was not used by chinook salmon. Elk Creek Dam is presently under construction on Elk Creek.

Peaks in flow and turbidity below these dams have been reduced considerably during winter, but turbidity has increased slightly during the summer. Summer flow, augmented through reservoir storage, has increased approximately twofold in the Rogue River and fivefold in the Applegate River, and has helped lower river temperature. Multiple-level outlets in the reservoirs have permitted the rivers to be cooled by release of hypolimnetic water from late spring through early fall, the effects diminishing with distance downstream. The multiple outlets have not prevented residual heat in the reservoirs from warming the rivers in late fall, thereby causing a premature emergence of fry in winter. Spring-run fish spawn closer to Lost Creek Dam and have been more affected by this phenomenon. We see indications that fall-run salmon, with later spawning and emergence timing, may be replacing some of the spring-run salmon in the upper river. The spawning and rearing distribution of fall-run fish in the Applegate River has spread farther upstream as a result of increased flow from the dam during the spawning migration, and also because of improved fish passage structures at two small dams (Murphy and McKee dams) downstream. Higher flow and lower temperature from Applegate Dam in late spring have permitted fall-run chinook salmon to rear longer in the Applegate River.

Estimates of Commercial Catch

The annual pack of chinook salmon on the Rogue River commonly exceeded 30 thousand fish in the period 1892 through 1922, with a peak of 74 thousand fish packed in 1917. These numbers may include some fish that were caught in other south coast streams but were packed on the Rogue. Available records for this early period are not sufficient to estimate the extent to which the catch may have been of spring- or fall-run fish.

Commercial fishing in the Rogue River basin was progressively constrained by gear, season, and location restrictions from 1923 on, and was finally prohibited in 1935. Nevertheless, commercial landings of chinook salmon commonly ranged from 30 thousand to 60 thousand fish annually during the mid-1920s. Catch during this period was good from May through September, with a tendency for the August-September catch to surpass that made during June-July.

Releases from Hatcheries

Hatchery chinook salmon have been released into various parts of the Rogue River basin on a fairly routine basis since at least the 1890s. Recent releases of hatchery chinook salmon in the Rogue River basin have principally been of spring-run fish. Prior to the 1973 brood year, less than 100,000 smolts were released per year, first at Butte Falls Hatchery and later at Cole Rivers Hatchery. These fish were released at various points in the upper Rogue River. Cole Rivers Hatchery is the only mitigation hatchery on an Oregon coastal stream and is used to compensate for spring-run chinook salmon production that was lost above Lost Creek Dam. Releases of spring-run chinook salmon at Cole Rivers Hatchery increased to an average of about 700,000 smolts per year from 1977 through 1981 brood years, and since then have reached the planned, full hatchery production level of about 1.6 million smolts per year. About 800,000 fingerling were released during June from the 1983 and from the 1985 brood years. March releases of yearling smolts, which have been small in number compared with releases of subyearling smolts during fall, were discontinued after 1983.

Releases of fall-run chinook salmon have been made principally for stock assessment purposes rather than for mitigation or enhancement. Some of these releases have included mitigation for eggs taken to the lower Columbia River for rearing and release since 1983. About 20,000 to 70,000 Rogue River or Applegate River fall-run smolts marked Ad+CWT have been released annually since 1978. Rogue River fall-run chinook salmon fry, fingerling, and smolts have been released in the lower Rogue River since 1983 in an attempt to rebuild the population of fall-run chinook salmon in lower river tributaries. Cole Rivers Hatchery stock, based on upper Rogue fall-run chinook salmon, has been used for these releases, however.

Estimates of Population Size and Counts at Gold Ray Dam

The total count (adults plus jacks) of Rogue River spring- and fall-run chinook salmon at Gold Ray Dam is available since 1942 and, since 1970, is available separately for wild and hatchery spring-run fish. The count of spring-run chinook salmon has fluctuated greatly since 1942 but without exhibiting any clear, long-term trend in abundance. The total count of about 90,000 spring-run chinook salmon in 1986 was a record, and the count of about 81,500 in 1987 was close behind. Although the total count of spring-run chinook salmon has shown no clear trend, average abundance of wild fish has been relatively low since about 1976, with the exception of 1986 (about 44,000 fish). The percentage of wild fish at Gold Ray Dam has steadily declined from nearly 100% in 1970, when the hatchery program began to increase, to about 50% in 1985 and 1986.

From 1942 through 1959, the count of fall-run fish (counted after August 15) at Gold Ray Dam was small and averaged fewer than 1,400 fish annually. This count gradually increased from about 3,000 in 1960 to about 14,000 fish in 1986.

The vast majority of Rogue River fall-run chinook salmon spawn in the mainstem and in tributaries below the counting station at Gold Ray Dam. Consequently, we have no long-term records of stock abundance for fall-run fish. Estimates (based on seining) of total run size of fall-run fish at Huntley Park (river mile 8) are available since 1974, however. These estimates have ranged from about 16,000 to about 113,000 fish annually. Total run size declined from 1978 through 1984, and increased to the 113,000 fish level estimated for 1986. The preliminary estimate of the run in 1987 is in the range of 80,000-120,000 fall-run fish.

Estimates of Recreational Catch

Rogue River chinook salmon have supported Oregon's largest freshwater recreational fishery for spring-run chinook salmon and one of the more important fisheries for fall-run fish. Spring-run fish are caught in the lower river from mid-March through mid-June, and above Gold Ray Dam from late April through July. The catch of fall-run chinook salmon is primarily made in the lower and middle river from July through November, with peak catch usually occurring during September.

"Punch card" estimates of total catch of spring-run chinook salmon ranged from about 2,500 to more than 12,000 fish and averaged about 6,500 fish annually from 1964 through 1985. During this time, catch in the upper river (represented by June and July catch) has become relatively more important when compared with catch in the lower river (represented by April and May catch). Upper river catch during 1983 and 1984 was the lowest within the 1964-85 period, about 900 fish and 1,500 fish, respectively, and coincided with the the lowest counts of spring chinook salmon at Gold Ray Dam since 1960 (about 13,000 fish). Total recreational catch during 1985 was about 5,800 fish reflecting improved stock abundance during 1985.

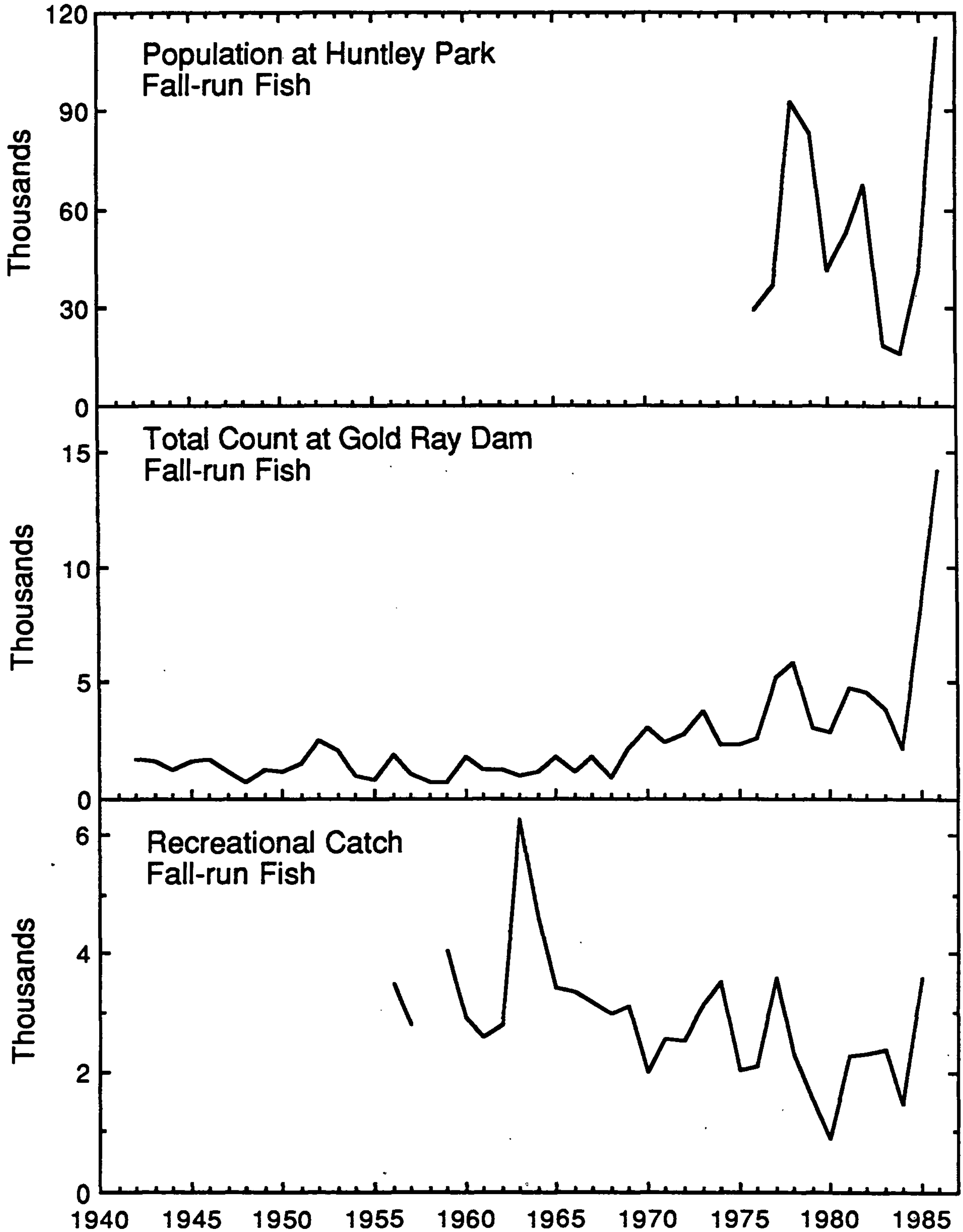
"Punch card" estimates of the catch of fall-run chinook salmon (represented by August through November catch) have gradually declined since 1956, and catch appears also to have become more concentrated during the month of September. Annual catch has ranged from less than 1,000 fish to more than 6,000 fish and has averaged about 3,000 fish annually since 1956. Interpretation of this apparent decline is complicated by an apparent shift of anglers from a lower river and bay fishery to an offshore recreational fishery beginning about 1963 that occurred because construction of the Rogue River jetties improved access by recreational boats to the ocean. This shift may have reduced intensity of fishing effort within the Rogue River itself.

Assessment of Run Strength

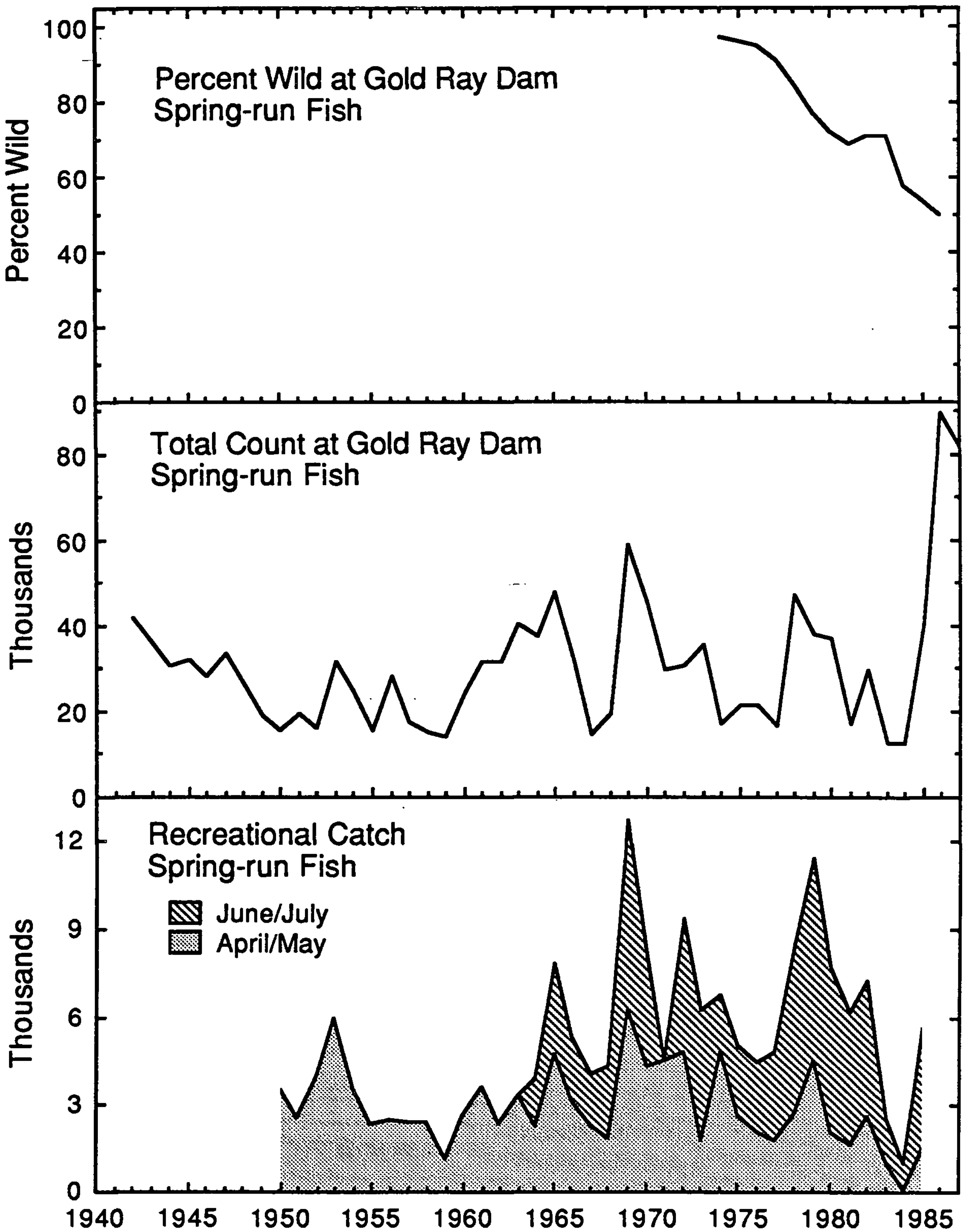
The counts of spring-run chinook salmon at Gold Ray Dam provide the longest abundance-data time series for any Oregon coastal chinook salmon stock. These data suggest that total freshwater abundance of Rogue River spring-run chinook salmon has not exhibited any clear, long-term trend. However, recognizable periods of relatively high and of relatively low return have occurred, and increased production of hatchery fish has recently masked a real decline in abundance of wild spring-run chinook salmon. For example, estimated count of wild spring-run chinook salmon during 1983 and 1984 was only about 8,600 and 7,000 fish, respectively, which is well below previous annual counts of wild fish. Abundance of wild spring-run chinook salmon was higher during 1985 and during 1986, however. Wild fish currently account for about 50% of the Rogue River's spring-run stock.

In contrast to Rogue River spring-run chinook salmon, abundance of Rogue River fall-run fish is maintained almost exclusively through natural production. Abundance of fall-run fish above Gold Ray Dam has increased since the 1960s, but accounts for only a small fraction of the Rogue's total run of fall-run chinook salmon. Recent estimates of total run size at Huntley Park suggest that abundance of fall-run chinook salmon peaked in 1978 and then declined through 1984, was exceptionally strong during 1986, and appears to be strong again in 1987. This time series is probably too short, however, to distinguish natural fluctuations in abundance from any real trend. Estimated recreational catch of fall-run chinook salmon in the Rogue River has declined since the mid-1950s, but this decline may reflect shifts in intensity of fishing effort rather than abundance of fall-run chinook salmon.

Stocks of fall-run chinook salmon that spawn in small, lower Rogue tributaries, in contrast to the more abundant "mainstem spawning" stocks, are apparently at very depressed levels and have apparently been producing poor returns since at least the mid-1970s.



Indicators of Run Strength for Rogue River Chinook Salmon



Indicators of Run Strength for Rogue River Chinook Salmon

SALMON RIVER

We surmise that several distinct subpopulations of chinook salmon may be supported by local stream reaches or tributaries within the Salmon River basin. We do not have reliable information upon which to judge the geographic distribution of chinook salmon or the relative number of fish that might comprise different runs within the basin. The following narrative pertains to the Salmon River population as a whole.

Estimates of Commercial Catch

Salmon River chinook salmon supported a very minor commercial fishery. Landings records indicate that about one hundred to about five hundred fish were caught annually in most years in the period 1923-46. Most of these fish were caught during September and October.

Releases from Hatcheries

Salmon River stock chinook salmon have been reared at Salmon River Hatchery since the 1976 brood year. From about 50,000 to about 200,000 smolts have been released annually in Salmon River. A small number of fingerling (60,000-85,000) have also been released for several brood years. Releases of about 40,000 Salmon River stock fry were made by STEP in 1984 and 1985.

Estimates of Population Size

The run of chinook salmon entering Salmon River was estimated in 1976 and in 1986 using mark and recapture techniques. The run consisted entirely of wild fish in 1976, but the run in 1986 consisted of a very large but imprecisely documented proportion of hatchery fish. The estimates indicated that about 1,400 chinook returned to the river in 1976, and about 3,900 returned in 1986. We do not have a reliable assessment of the hatchery-wild composition of the run in 1986. A preliminary classification of scales taken from Salmon River fish in 1986 suggests that wild fish may have composed only about 15% of the run.

Surveys of Spawners

Spawning survey index areas in Salmon River have not been consistently monitored and are not presented here.

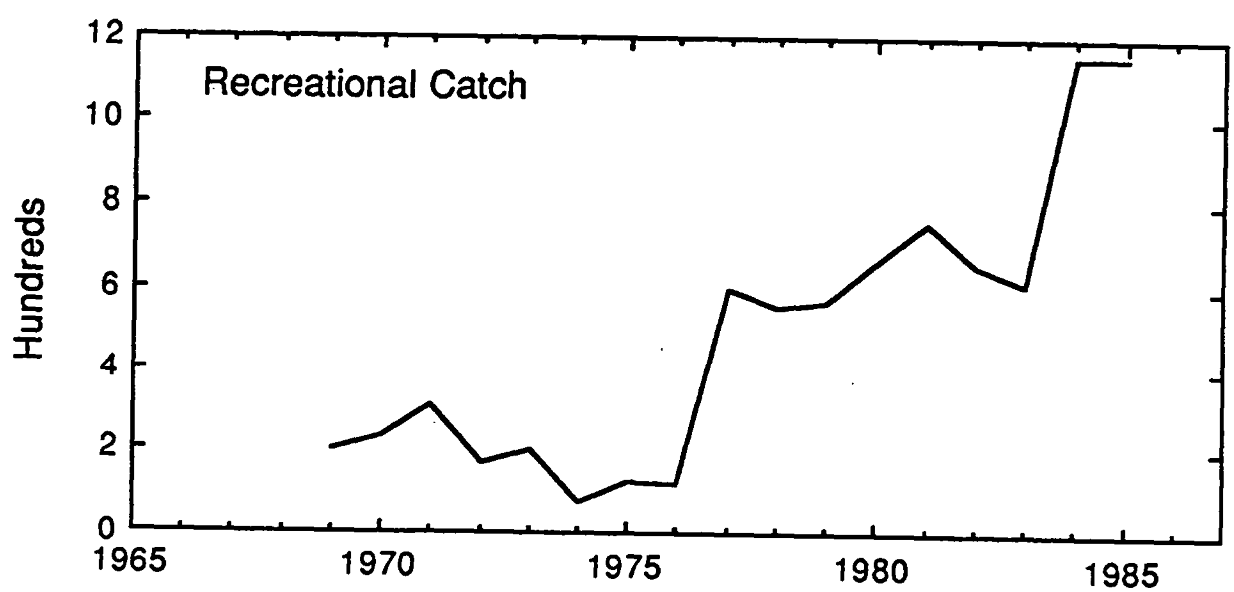
Estimates of Recreational Catch

Salmon River chinook salmon supported a relatively minor freshwater recreational fishery until very recently. "Punch card" estimates of catch ranged from about 80 to about 600 fish from 1969 through 1978 and averaged about 260 fish per year. Fish caught during this period were all wild. From 1979 through the present, however, the catch also included hatchery fish.

Catch since 1979 has ranged from about 600 to about 1,200 fish and has averaged about 800 fish per year. The difference in adult catch between the two periods is probably greater than that indicated by the difference between these average values because estimates prior to 1977 probably also include some jacks. Estimated catch of spring-run chinook salmon has usually been less than 30 fish per year since 1971. Anecdotal observations indicate that many of these fish are early-returning fall-run fish rather than a distinct race of spring-run chinook salmon.

Assessment of Run Strength

Based on commercial landings records, the Salmon River historically supported a relatively small run of fall-run chinook salmon. "Punch card" estimates of recreational catch from 1969 through 1978, prior to significant returns of adult hatchery fish, suggest that abundance of wild fish was small but was stable or possibly increasing during that period. We believe that the run of wild chinook salmon returning to Salmon River may have declined since the hatchery began operation in 1976, although data are not sufficient to make a strong statement to this effect. The overall abundance of chinook salmon returning to the system has certainly increased because of the hatchery program.



Indicators of Run Strength for Salmon River Chinook Salmon

SILETZ RIVER

We surmise that several distinct subpopulations of chinook salmon may be supported by local stream reaches or tributaries within the Siletz River basin. We do not have reliable information upon which to judge the geographic distribution of chinook salmon within the basin or the relative number of fish that might comprise different runs within the basin. The following narrative pertains to the Siletz River population as a whole.

Estimates of Commercial Catch

Approximately 5 thousand to 13 thousand chinook salmon were packed on the Siletz River in most years during the period 1896 through 1922. Landings records indicate that 10 thousand to 11 thousand fish were caught annually from 1923 through 1925, but catches in the period 1926 through 1956 declined rapidly to approximately 1 thousand to 2 thousand fish annually. The timing of commercial landings indicates that a strong run of chinook salmon entered the Siletz during July through October, although catch during July and August declined to a relatively low level by the mid-1930s.

Releases from Hatcheries

Hatchery-reared chinook salmon have not been routinely released in the Siletz River. About 45,000 Trask River stock fall-run fingerling were released from the 1967 and 1968 brood years, and about 100,000 Trask River spring-run fry were released from the 1973 brood year. About 13,000 Trask River spring-run fry were released annually by STEP from 1983 through 1986.

Estimates of Population Size

The population of chinook salmon returning to the Siletz River in 1954 was estimated using mark and recapture techniques. This work indicated that the run of chinook salmon consisted of about 4,700 fish. A commercial net fishery harvested an estimated 36% and recreational and Indian fisheries together harvested an estimated 4% of the run.

Surveys of Spawners

The peak count of adult fall-run chinook salmon made during spawning surveys is available for index areas in Euchre Creek and North Fork Rock Creek from 1952 through 1974, and for index areas in Sunshine Creek from 1952 through the present. Pair-wise correlations between peak adult count in all surveys from 1952 through 1974 were significant only for Sunshine and Euchre creeks. All survey data suggest highly variable stock size throughout the period, and no individual survey suggests any strong trend of abundance over this time period. Peak count of adults in Sunshine Creek suggests that stock size has gradually increased since 1970. Anecdotal observations indicate that many Siletz River chinook salmon spawn in several mainstem reaches of the river that are not represented by surveys in these small tributary streams.

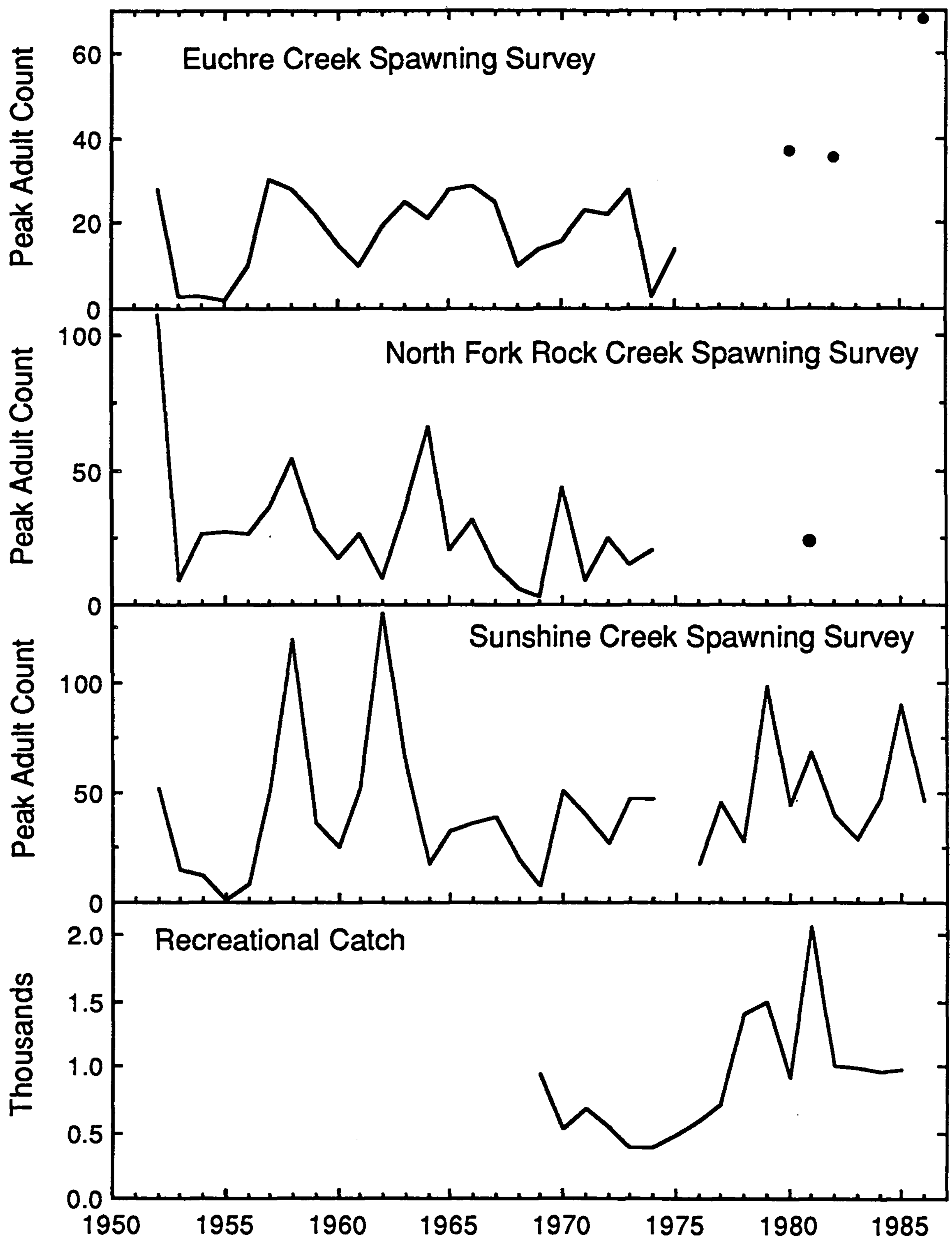
Estimates of Recreational Catch

The Siletz River has supported a moderate recreational fishery for fall-run chinook salmon and a minor fishery for spring- or summer-run fish. "Punch card" estimates of catch of fall-run fish have ranged from about 300 to about 2,000 fish and have averaged about 1,100 fish annually from 1977 through 1985. Estimated catch of spring- or summer-run chinook has ranged from about 20 to about 200 fish and has averaged about 70 fish annually from 1977 through 1985. Estimated catch of fall-run fish has not been significantly correlated with estimated catch of spring- or summer-run fish.

Assessment of Run Strength

Although spawning survey data sets for three separate tributary surveys were not significantly correlated with one another, and "punch card" estimates of fall-run chinook salmon catch were not significantly correlated with the peak adult count in Sunshine Creek spawning surveys, no data set suggests any long-term trend in abundance. Fluctuations in abundance of fall-run chinook have been large, when judged either by estimated recreational catch or by spawning survey data. We regard recent runs of fall-run chinook salmon in the Siletz River as relatively strong, based on the time series for spawning survey counts and recreational catch estimates.

We believe that the Siletz River contains distinct spring-run and fall-run races of chinook salmon. Early-run fish may be better characterized as summer- rather than spring-run chinook salmon. The overall abundance of early-run fish is much smaller than that of fall-run fish. We regard the contemporary run of spring-or summer-run chinook salmon in the Siletz as relatively stable but at a very low abundance compared with historic population levels.



Indicators of Run Strength for Siletz River Chinook Salmon

SIUSLAW RIVER

The Siuslaw River system supports populations of chinook salmon in at least three major subbasins: North Fork Siuslaw, Lake Creek, and the upper mainstem. During the last 40 years, the population returning to Lake Creek has been the largest, by far, of the three. The following narrative pertains to the Siuslaw River population as a whole.

Estimates of Commercial Catch

Approximately 4 thousand to 14 thousand chinook salmon were packed on the Siuslaw River in most years in the period 1893 through 1906. The commercial catch in the river averaged about 10 thousand chinook salmon annually from 1889 through 1896. Commercial landings averaged about 3 thousand fish annually during the period 1923 through 1940, but thereafter declined to less than 1 thousand fish annually through 1956. Commercial landings were commonly made from June through November. Peak catch was usually during September, but many chinook salmon were caught during August.

Releases from Hatcheries

Hatchery chinook salmon were not regularly released in the Siuslaw River, except for a brief period from 1979-83 when a private hatchery released fish in the system. These releases of Siuslaw stock smolts declined from 120,000 to 20,000 fish annually from brood years 1978 through 1982. In addition to smolts released by the private hatchery, an average of 24,000 smolts was stocked annually from brood years 1978-81 as part of a program to evaluate ocean catch distribution for this stock and to mitigate for eggs that were taken from the natural population to establish a broodstock at the private hatchery. The private hatchery permit currently allows the release of 10.6 million chinook salmon per brood year.

Surveys of Spawners

The peak count of adults is available in most years since 1955 for North Fork Siuslaw River, Esmond Creek, and Lake Creek. The count in the Lake Creek survey has consistently been much higher than the count in the other index areas. This tributary is believed to provide some of the best spawning habitat in the entire basin.

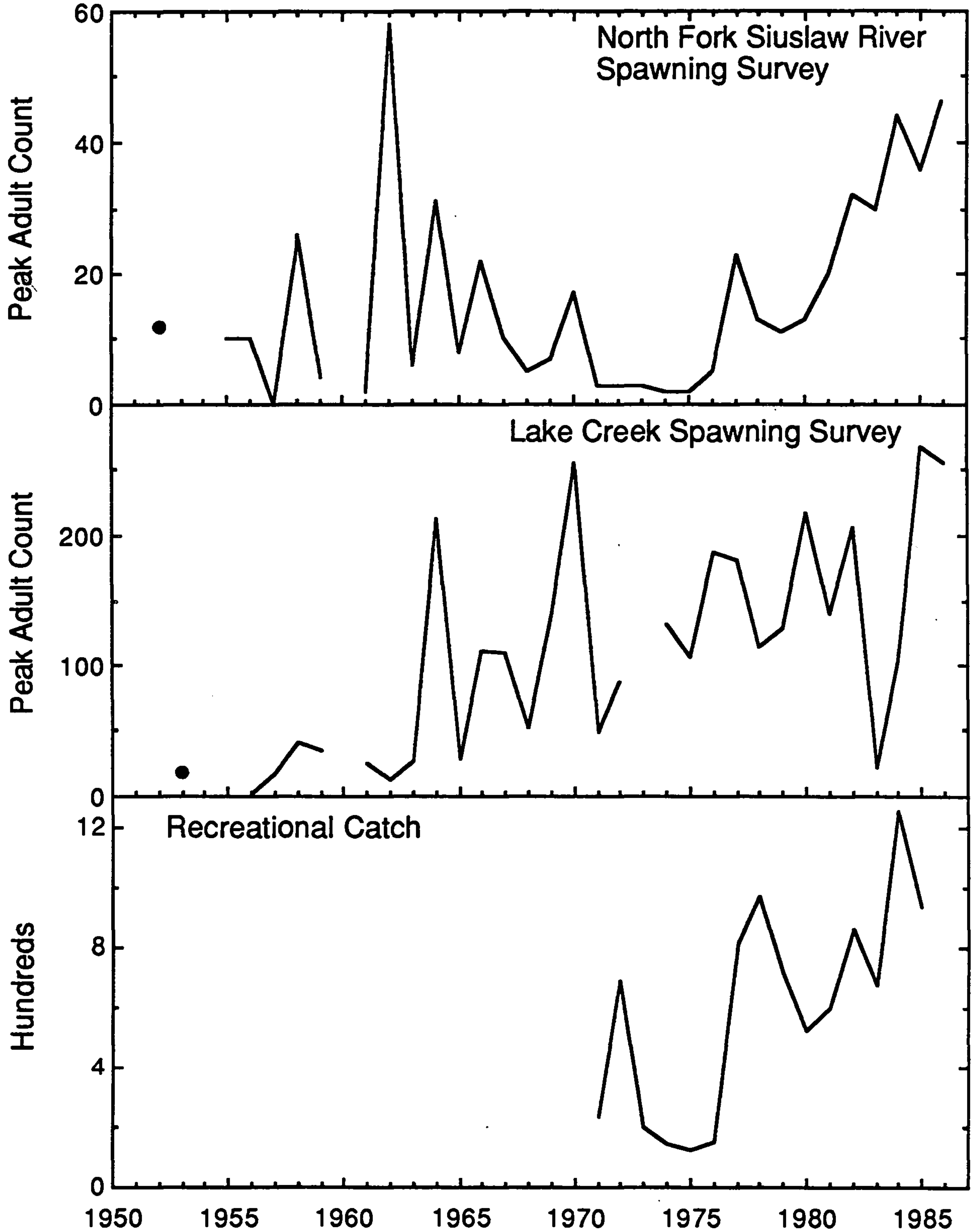
Survey data for all index areas suggest that stock abundance has fluctuated greatly over the past 30 years. The peak count of adults was lowest from 1971 through 1975 in North Fork and Esmond Creek surveys, but lowest counts were from 1956 through 1962 in the Lake Creek survey. The peak count during 1985 and 1986 in the Lake Creek survey was among the highest recorded since 1955. Alone, the Lake Creek survey data suggest that the Siuslaw stock has gradually been increasing since survey data were first collected, but this apparent slow increase is not suggested by the other two surveys. We believe that the Esmond Creek survey is not representative of the system in general because it is a relatively small tributary and because it has suffered from extensive habitat damage in the past.

Estimates of Recreational Catch

The Siuslaw River has supported a modest freshwater recreational fishery for fall-run chinook salmon. "Punch card" estimates of catch have ranged from about 125 to about 1,300 fish from 1971 through 1985 and have averaged about 800 fish annually from 1977 through 1985. Estimates of recreational catch for 1984 and 1985 were among the highest on record.

Assessment of Run Strength

Together, available data suggest that freshwater abundance of Siuslaw River fall-run chinook salmon has been increasing over the past 30 years. Although estimates of catch and peak count of adults in the Lake Creek spawning survey have not been significantly correlated, the most recent spawning survey count and the most recent estimate of catch have been among the highest that have been recorded for this system. Also, "punch card" estimates of catch probably include many jacks prior to 1977. Real increases in catch since 1977 may therefore exceed the apparent increase indicated by the recreational catch. Returns from private hatchery releases would have occurred first during the 1981 spawning season. Strays from the hatchery could perhaps have accounted for a very small component of recent runs, but the upward trend of peak count of adults in spawning surveys began well in advance of returns from the hatchery program. We believe that this stock presently consists almost exclusively of wild fish.



Indicators of Run Strength for Siuslaw River Chinook Salmon

SIXES RIVER

The Sixes River system supports populations of chinook salmon in at least three major subbasins: Dry Creek, the Middle Fork, and the North Fork. The population returning to Dry Creek is, by far, the largest of the three. The following narrative pertains to the Sixes River population as a whole.

The close geographic proximity to Elk River has resulted in moderate straying of Elk River Hatchery chinook salmon into Sixes River. Based on spawning survey data, strays from Elk River Hatchery have constituted from about 3% to about 27% of adult Sixes River spawners since 1972. Spawners in Sixes River have been examined for the presence of IHN virus during the 1978-80, and 1984-86 spawning seasons. IHN virus was detected in 1985 and in 1986.

Estimates of Commercial Catch

The Sixes River was open to commercial fishing with nets at various locations and dates through about 1934. No records of catch are available, however.

Releases from Hatcheries

No recent releases of hatchery chinook salmon have been reported in the Sixes River.

Estimates of Population Size

The population of chinook salmon returning to Sixes River in 1967-69 and 1978-80 was estimated using mark and recapture techniques. The estimated run into Sixes River during these years averaged about 2,600 adults (ages 3-6) and ranged from 1,600 to 4,200. The highest and lowest returns occurred in 1979 and 1980, respectively.

Surveys of Spawners

The peak total count of adults (live plus dead) per mile is available for upper and lower Dry Creek index areas since 1967. These data suggest that spawner abundance has fluctuated very slightly when compared with spawning survey data for other coastal stocks, and that spawner abundance has decreased from 1967 through the present.

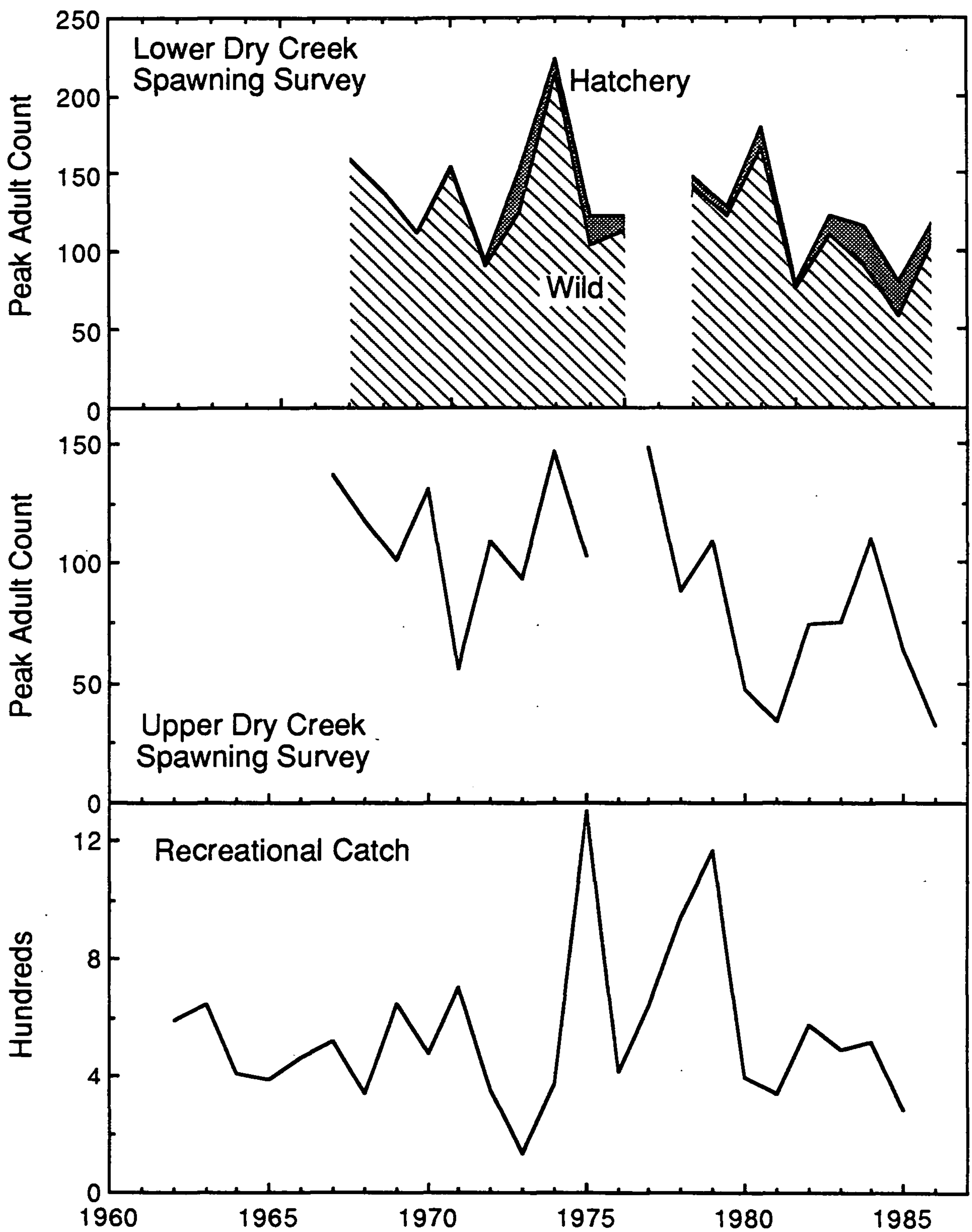
Estimates of Recreational Catch

The Sixes River supports a modest freshwater recreational fishery for fall-run chinook salmon, but in some years catch has exceeded 1,000 fish. "Punch card" estimates of catch have ranged from about 150 to about 1,300 fish and have averaged about 600 fish annually from 1977 through 1985. The time series of catch estimates suggests no trend of abundance, although average catch since 1980 (about 450 fish per year) has been slightly below the long-term average.

Assessment of Run Strength

Although counts of adults in Dry Creek spawning surveys suggest that abundance of Sixes River chinook salmon may have slowly declined since 1967, "punch card" estimates of catch do not suggest such a trend of abundance, and these two possible indicators of stock abundance are not significantly correlated. In addition, population estimates of total adults that returned to freshwater were made for the 1967-69, and 1978-80 return years. These estimates ranged from 1,600 to 4,200 adults. Peak counts from Dry Creek spawning surveys for these years were not significantly correlated with these population estimates whereas "punch card" estimates of recreational catch were highly correlated with population estimates. Therefore, we may more appropriately infer stock status from trends in "punch card" estimates than from spawning survey data.

On the basis of "punch card" estimates of catch, stock abundance since 1980 has been slightly below the 1967-85 average. Although hatchery chinook salmon have not been released in Sixes River, stray fish from Elk River Hatchery have accounted for 10% to 27% of the adult spawners during 1981-85. Anecdotal observations indicate that stray hatchery fish may have constituted an even larger percentage of the recreational catch, thus making it difficult to infer status of wild fish based on available data. Considering all available indicator data, we judge that overall abundance of chinook salmon in Sixes River has been relatively stable, but we believe that the run of wild fish has declined slightly.



Indicators of Run Strength for Sixes River Chinook Salmon

TILLAMOOK BAY

The Tillamook Bay watershed supports populations of chinook salmon in at least five major subbasins: the Kilchis, Miami, Tillamook, Trask, and Wilson rivers. Information pertaining generally to the run strength of chinook salmon in the Tillamook Bay system rather than to a specific tributary stream is presented here. This section provides the only appropriate location to present information on historic cannery packing and commercial landings records that are available for Tillamook Bay but not for individual rivers entering the bay. We also present a brief summary of recreational catch in the Tillamook Bay system in this section. Together this information helps provide a frame of reference for discussing the overall run of chinook salmon in the system. Assessments of run strength in specific river systems are provided separately.

Estimates of Commercial Catch

As many as 28 thousand chinook salmon were packed annually on Tillamook Bay during the period from 1893 through 1919. The pack of chinook salmon was extremely erratic during this period and was frequently less than 5 thousand fish or was not reported. From 1923 through 1946, commercial landings records indicate a relatively stable catch ranging from 12 thousand to 31 thousand fish and averaging about 17 thousand fish annually. The timing of these landings indicates that chinook salmon were probably entering Tillamook Bay during every month of the year. Catch during the 1920s and 1930s was substantial during June through October, although peak monthly catch was usually made during September and October. Annual catch declined substantially from 1947 through 1961, but since progressively more restrictive regulations and seasons were being applied during this time, the decline may not reflect a trend in run strength.

Releases from Hatcheries

Releases of chinook salmon from public hatcheries and by STEP in individual tributaries are summarized in accounts for the Kilchis, Miami, Tillamook, Trask, and Wilson rivers.

Estimates of Population Size

A mark and recapture population estimate conducted in 1953 indicated that 15,500 chinook salmon were in Tillamook Bay between about September and mid-November. About 36% of these fish were harvested by the commercial net fishery.

Surveys of Spawners

Available spawning survey data for major tributaries entering Tillamook Bay are provided individually in accounts for the Kilchis, Miami, Tillamook, Trask, and Wilson rivers.

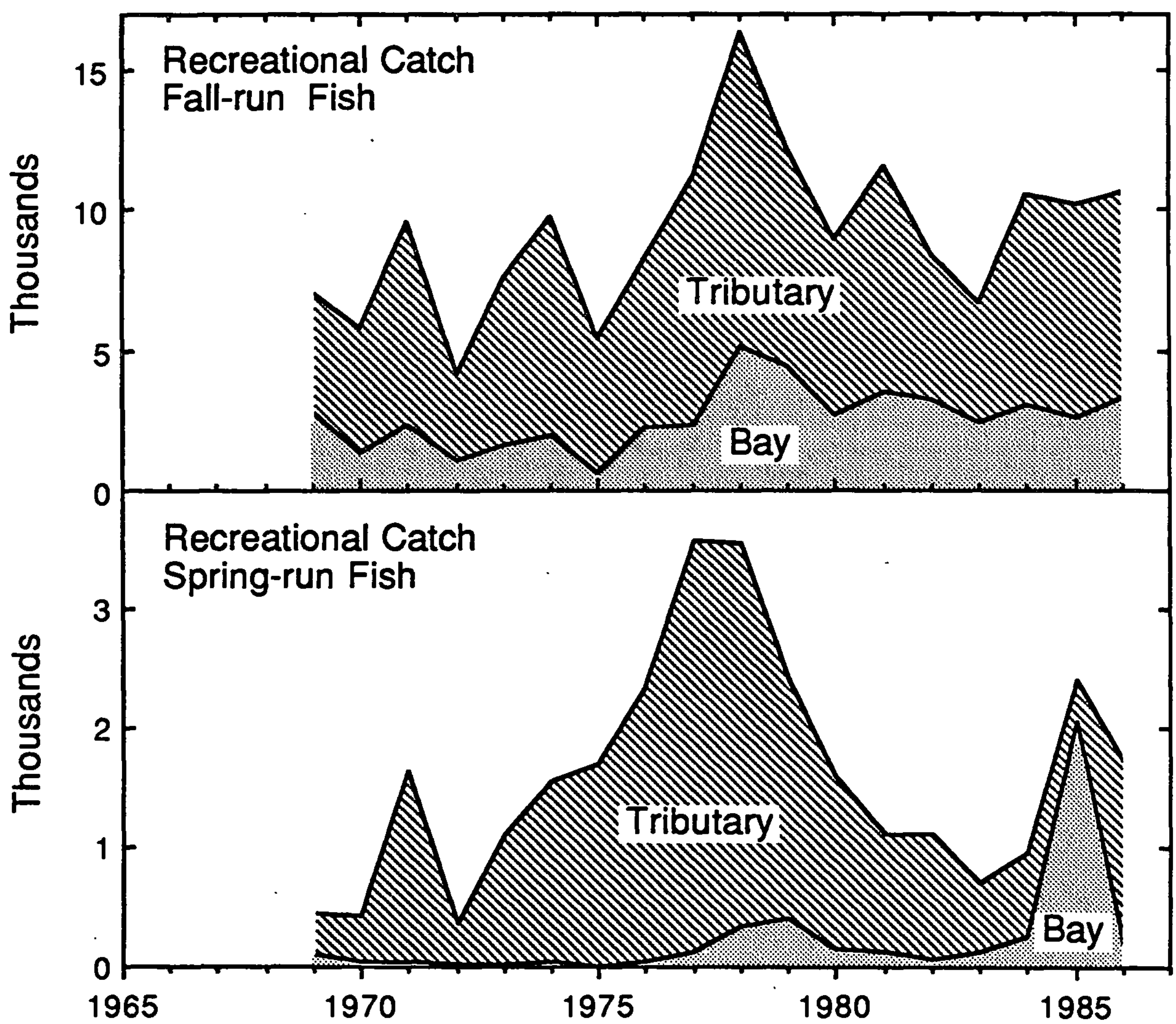
Estimates of Recreational Catch

Collectively, chinook salmon that return to Tillamook Bay tributaries support the largest recreational fishery for fall-run and the third largest recreational fishery for spring-run fish in Oregon coastal rivers. The greatest proportion of the recreational catch of chinook salmon occurs in the tributary streams rather than in Tillamook Bay proper. For the period 1977 through 1985, the average annual catch of spring- and fall-run fish combined was about 12,400 fish, of which about 8,900 were caught in tributary streams and about 3,500 were caught in the bay. For fall-run fish alone, an annual average of about 7,400 fish were caught in tributary streams and about 3,300 were caught in the bay. For spring-run fish alone, an annual average of about 1,500 were caught annually in tributary streams and about 200 were caught in the bay.

Assessment of Run Strength

The recreational catch of chinook salmon in the Tillamook Bay system has averaged about 12,400 fish annually since 1977, with fall-run fish accounting for about 85% of the catch. When judged by average commercial landings of about 17,000 fish annually from 1923 through 1946, we regard recent recreational catch of fall-run chinook salmon as remarkably strong and stable. Total fall-run stock size for combined collective populations in Tillamook Bay is probably similar to historic abundance of fall-run chinook salmon in the basin. Hatchery fish probably make an important contribution to the return of fall-run fish in the system, but wild production appears to be strong in tributaries throughout the basin.

Recreational catch of spring-run chinook salmon has been small and has fluctuated strongly compared with that of fall-run chinook salmon. We regard current abundance of spring-run chinook salmon as depressed when judged by commercial landings that were taken during the months of May through July during the 1930s. Except in the Wilson River, existing runs of spring-run chinook salmon are probably dominated by hatchery fish.



Indicators of Run Strength for Tillamook Bay Chinook Salmon

TILLAMOOK RIVER

The Tillamook River is one of five major tributaries that enters Tillamook Bay. Information pertaining specifically to the run strength of chinook salmon in this river is presented here. The reader should also refer to information pertaining generally to the run strength of chinook salmon in the Tillamook Bay watershed (see TILLAMOOK BAY).

Estimates of Commercial Catch

The Tillamook River was open to commercial fishing with nets at various locations and dates through about 1946. No records of catch in this river are available, however. Records of commercial catch of chinook salmon in this river and other Tillamook Bay tributaries were combined in an overall Tillamook Bay reporting area (see TILLAMOOK BAY).

Releases from Hatcheries

Very few hatchery chinook salmon have been released in the Tillamook River basin. Approximately 30,000 to 90,000 fry (Trask River fall-run stock) were released annually by STEP from 1982 through 1986.

Surveys of Spawners

Spawning surveys for fall-run chinook salmon were made in most years since 1952 in a standard index area of the Tillamook River. The peak count of adults was exceptionally low from 1953 through 1957, and since 1957 has fluctuated widely without suggesting any trend in abundance. The peak count for 1986 was the highest that has been recorded.

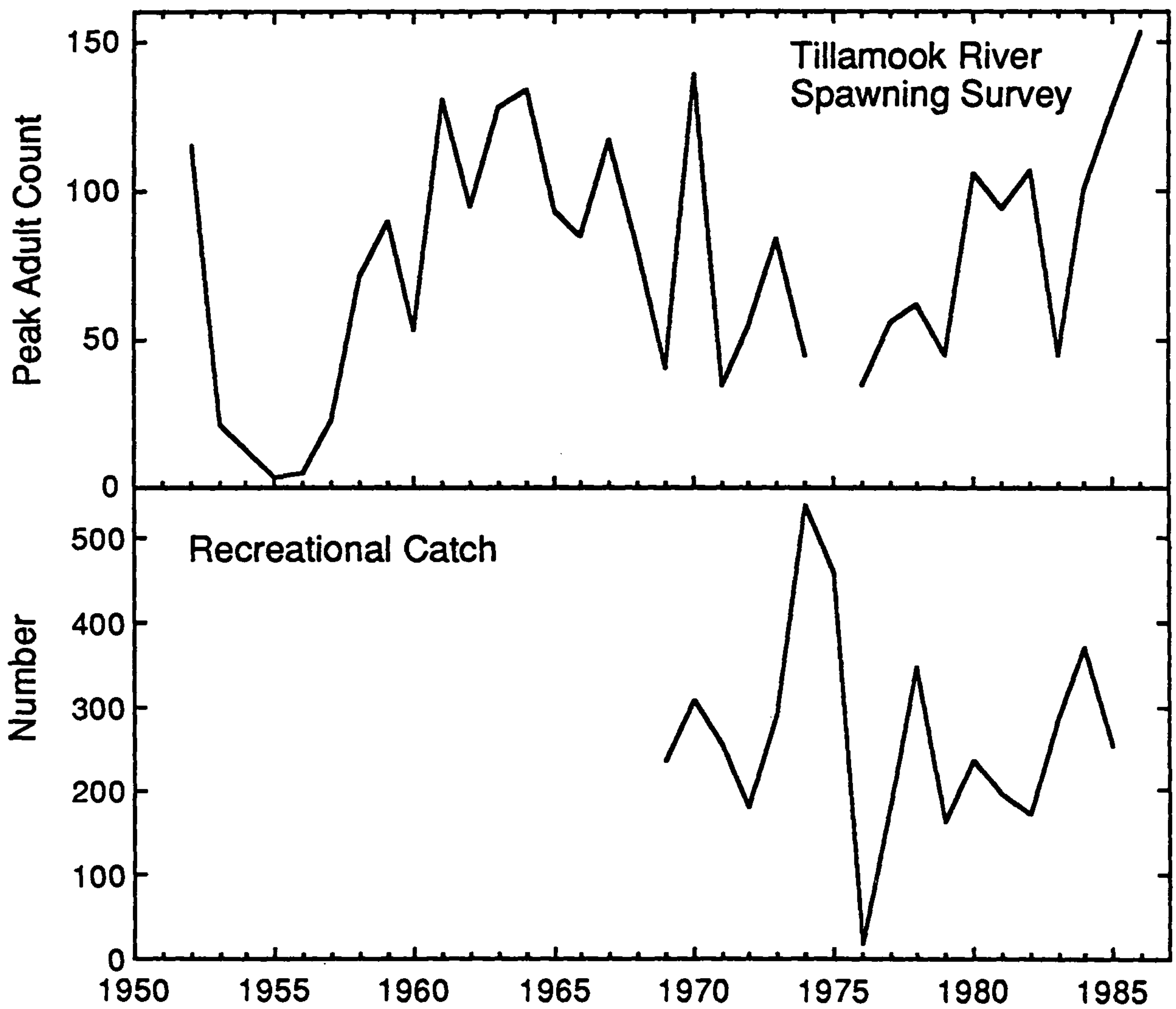
Estimates of Recreational Catch

The Tillamook River has supported a relatively minor recreational fishery for chinook salmon. "Punch card" estimates of fall chinook salmon catch have ranged from about 20 to about 540 fish and have averaged about 250 fish annually from 1977 through 1985. Estimated catch of spring-run fish has been less than 30 fish in all years, and has been no more than 10 fish in 13 of the past 17 years.

Assessment of Run Strength

"Punch card" estimates of fall chinook salmon catch since 1969 and peak count of adults in spawning surveys since 1960 suggest that abundance of fall chinook salmon in the Tillamook River has fluctuated without any clear trend. Estimates of catch and peak count of adults from spawning surveys are not significantly correlated, however. We believe that this fall-run stock consists almost exclusively of wild fish.

Estimates of spring-run chinook salmon catch have usually been no more than 10 fish. Anecdotal observations support the existence of a very small run of spring-run chinook salmon in the Tillamook River, but we do not know whether these fish are wild or are stray hatchery fish from elsewhere in the Tillamook Bay basin.



Indicators of Run Strength for Tillamook River Chinook Salmon

TRASK RIVER

The Trask River is one of five major tributaries entering Tillamook Bay. Information pertaining specifically to the run strength of chinook salmon in this river is presented here. We surmise that several distinct subpopulations of chinook salmon may be supported by local stream reaches or tributaries within the Trask River basin. We do not have reliable information upon which to judge the geographic distribution of chinook salmon or to judge the relative number of fish that might comprise different runs within the basin. The reader should also refer to information pertaining generally to the run strength of chinook salmon in the Tillamook Bay watershed (see TILLAMOOK BAY).

Estimates of Commercial Catch

The Trask River was open to commercial fishing with nets at various locations and dates through about 1947. No records of catch in this river are available, however. Records of commercial catch of chinook salmon in this and other Tillamook Bay tributaries were combined in an overall Tillamook Bay reporting area (see TILLAMOOK BAY).

Releases from Hatcheries

Releases of hatchery-reared chinook salmon have been more frequent and more numerous in the Trask River than in any other Oregon coastal river except the Rogue River. Since at least 1960, releases of chinook salmon have been exclusively of Trask River stock. Annual releases of fall-run fish have usually included about 300,000 fingerling and about 150,000 smolts, and releases of spring-run fish have always included about 150,000 smolts, annually, during the past decade. In many years these have been augmented by releases of about 180,000 fry or fingerling. STEP has released an average of about 20,000 Trask River spring-run fry annually since 1982.

Surveys of Spawners

The peak count of adult fall-run fish is available in Edwards Creek since about 1978. Although this data set represents a relatively short period, it suggests a stable or increasing trend for the Trask River fall-run population. Spring-run chinook salmon have been counted in resting pools in most years since 1965. These counts generally increased from 1965 through 1983, but then declined to low levels in 1984 and 1985. The average count in 1986 and 1987 was relatively high, however.

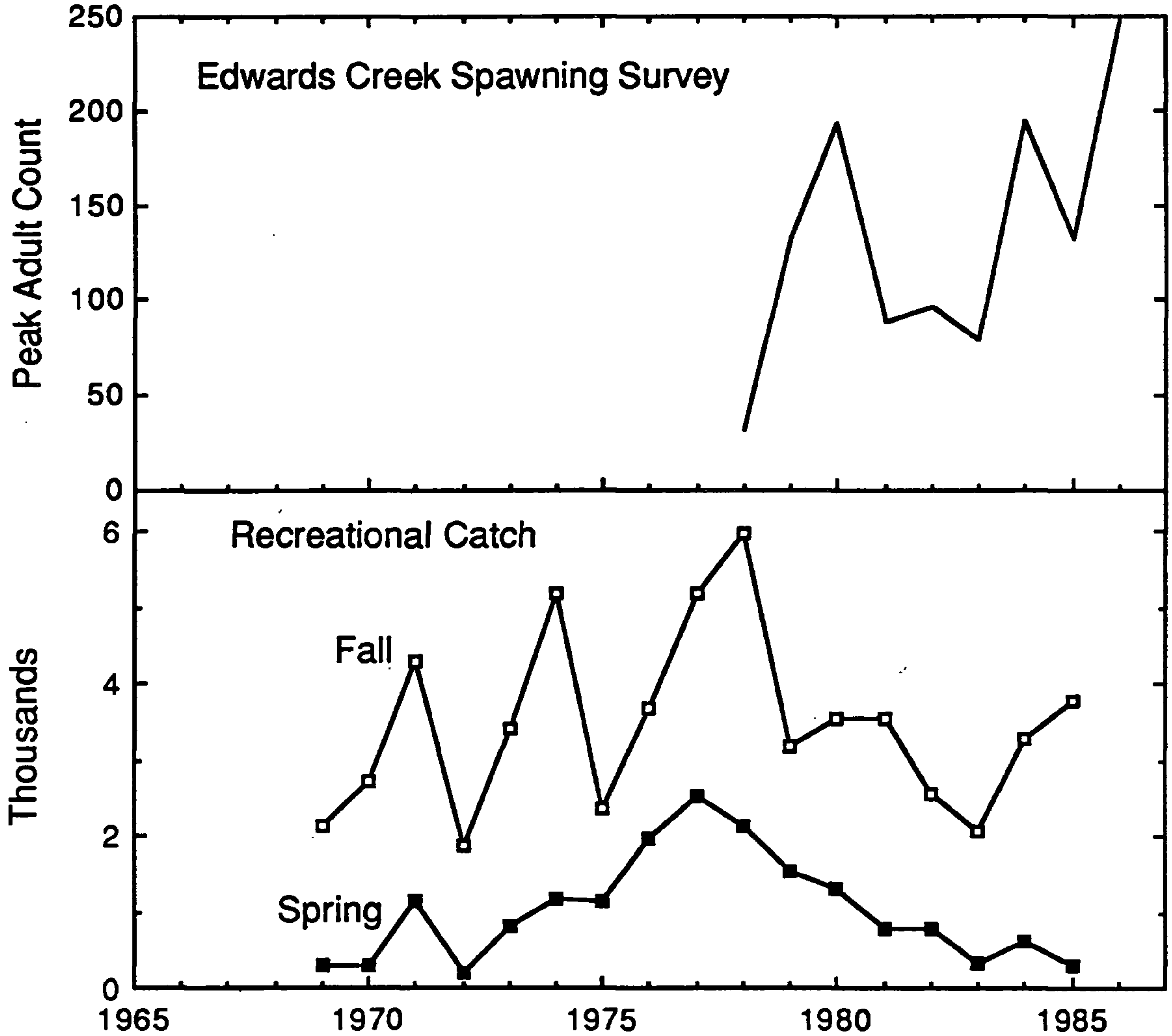
Estimates of Recreational Catch

The Trask River has supported one of the largest coastal recreational fisheries for fall-run chinook salmon and one of the largest north coastal recreational fisheries for spring-run fish. "Punch card" estimates of the catch of fall-run chinook salmon have ranged from about 2,000 to about 6,000 fish annually from 1969 through 1985 and have averaged about 3,700 fish annually from 1977 through 1985. Annual catch of spring-run fish has ranged from about 200 to about 2,500 fish annually from 1969 through 1985, and averaged about 1,100 fish annually from 1977 through 1985. Total catch of spring- and fall-run chinook salmon has averaged about 4,800 fish annually from 1977 through 1985.

Catch of fall-run chinook salmon has been relatively stable and suggests no obvious trend in abundance. Catch of spring-run fish increased to a peak in 1977 and has steadily declined since that year.

Assessment of Run Strength

Status of wild Trask River chinook salmon stocks cannot be determined from available data. Although we have no direct estimates of the proportion of hatchery chinook salmon in Trask River, we believe that hatchery fish make an important contribution to these returns. All estimates of recreational catch are for years during which returning hatchery fish were expected, so we cannot separate trend in abundance of wild fish as compared with trend of hatchery fish. Total (wild plus hatchery fish) abundance of fall-run chinook salmon appears relatively stable, when viewed over the post 1950s period. The abundance of spring-run fish apparently fluctuates considerably in short time periods, but has not exhibited any clear long term trend. Judging from commercial landings of spring-run fish in Tillamook Bay in the 1920s and 1930s, we regard the run of these fish in the Trask River as very depressed compared with historic populations.



Indicators of Run Strength for Trask River Chinook Salmon

UMPQUA RIVER

The Umpqua River system supports populations of chinook salmon in at least four major subbasins: Smith River, North Umpqua River, South Umpqua River, and Cow Creek. During the last 40 years, the population of spring chinook salmon in the North Umpqua has been the largest of the four. The following narrative pertains generally to fall- and spring-run chinook salmon in the Umpqua River basin.

Estimates of Commercial Catch

Approximately 18 thousand chinook salmon were packed on the Umpqua River during 1905, but in most years prior to 1923 only 1 thousand to 3 thousand fish were packed annually. Landings records indicate that from 5 thousand to 29 thousand chinook salmon were caught annually from 1923 through 1942. Catch was usually less than 1 thousand fish annually from 1943 through 1947. Landings records for the 1920s suggest that chinook salmon were probably entering the Umpqua River during nearly every month of the year. Many fish were caught from April through October, but most fish were usually caught during August and September indicating that fall-run fish were probably the dominant race during the 1920s.

Releases from Hatcheries

Hatchery-reared chinook salmon have routinely been released in the Umpqua River basin since the 1950s. Releases during this period have emphasized spring-run fish although about 400,000 Bonneville stock fall-run chinook salmon fingerling were released annually from brood years 1966 through 1970. Releases of spring-run fish have been almost exclusively of Umpqua River stock. About 225,000 smolts have been released annually during the past decade.

Since 1983, STEP has been developing release programs that use three sub-stocks of Umpqua River chinook salmon. These substocks are (1) North Umpqua spring-run chinook salmon; (2) Cow Creek fall-run chinook salmon; and (3) Smith River fall-run chinook salmon. Releases of both fry (from 10,000 to 160,000 fish annually) and fingerling (from 10,000 to 40,000 fish annually) have been made in several recent years.

Counts at Winchester Dam

Counts of spring-run chinook salmon (jacks plus adults) at Winchester Dam on the North Umpqua River are available from 1946 through the present. Counts since 1952 provide separate estimates for wild and hatchery fish. The number of fish counted increased from about 1950 through 1956, but then decreased during the period 1957 through 1962. During 1957-62, the count of hatchery fish was always fewer than 2,000 fish. From 1963 through 1986, the count of wild fish ranged from about 3,000 to about 11,500 fish and averaged about 7,000 fish annually. Although a slight decline occurred through 1984, these counts suggest no obvious trend. The count of hatchery fish since 1963, which has been much more variable than the count of wild fish, has ranged from about 600 to about 8,500 fish and has averaged about 4,300 fish annually. The count of hatchery fish was unusually low from 1978 through 1984 and contributed to a decline in the total count of hatchery plus wild fish from about 1974 through 1984. Total count for both wild and hatchery fish increased during 1985, 1986, and 1987. The total count for 1987 was approximately 15,600 spring-run fish.

Surveys of Spawners

Spawning survey index areas for fall- or spring-run chinook salmon in the Umpqua River basin have not been consistently monitored and are not presented here. Aerial counts of spawning redds since 1978 indicate that more fall-run chinook salmon are spawning in the South Umpqua and in Cow Creek than were present during the 1950s, 1960s, and early 1970s.

Estimates of Recreational Catch

The Umpqua River once supported a large recreational fishery for spring-run chinook salmon that was exceeded only by the Rogue River. "Punch card" estimates of recreational catch of Umpqua River spring-run chinook salmon have steadily declined, however, from about 11 thousand fish during 1972, to about 2,000 fish annually since 1978. Most of this decline appears attributable to decreased catch in the Umpqua River estuary and in the lower Umpqua River, but catches have also declined in the North Umpqua River. The apparent decline may be exaggerated however, because of the change in size limits for reporting on "punch cards." Catch prior to 1977 includes an unknown number of jacks that would not have been reported on "punch cards" in subsequent years. We doubt that this shift in reporting of jacks could have lead to a decrease of the magnitude observed, however. In addition, decline in catch was evident prior to 1977. Also, ocean-caught chinook salmon landed in the Winchester Bay recreational and charter boat fishery may have been incorrectly assigned to in-river catch of spring-run fish during the early 1970s.

The Umpqua River presently supports a small recreational fishery for fall-run chinook salmon. "Punch card" estimates of catch were greatest during 1971 (1,400) and 1972 (2,000). We believe that most of the catch in 1971 and 1972 was of ocean-caught fish incorrectly assigned to the Umpqua River. Anecdotal observations indicate that an in-river fishery for fall-run fish simply did not exist on the order of magnitude that these estimates would suggest. Catch declined through 1977, remained relatively stable at 400 to 500 fish per year through 1981, and increased to an average of 600 to 700 fish annually since 1982. Most of the catch has come from the Umpqua River estuary and the lower Umpqua River. Catch of fall-run chinook salmon in the Smith River was consistently less than 10 fish annually prior to 1978, but has averaged about 100 fish annually from 1978 through 1985.

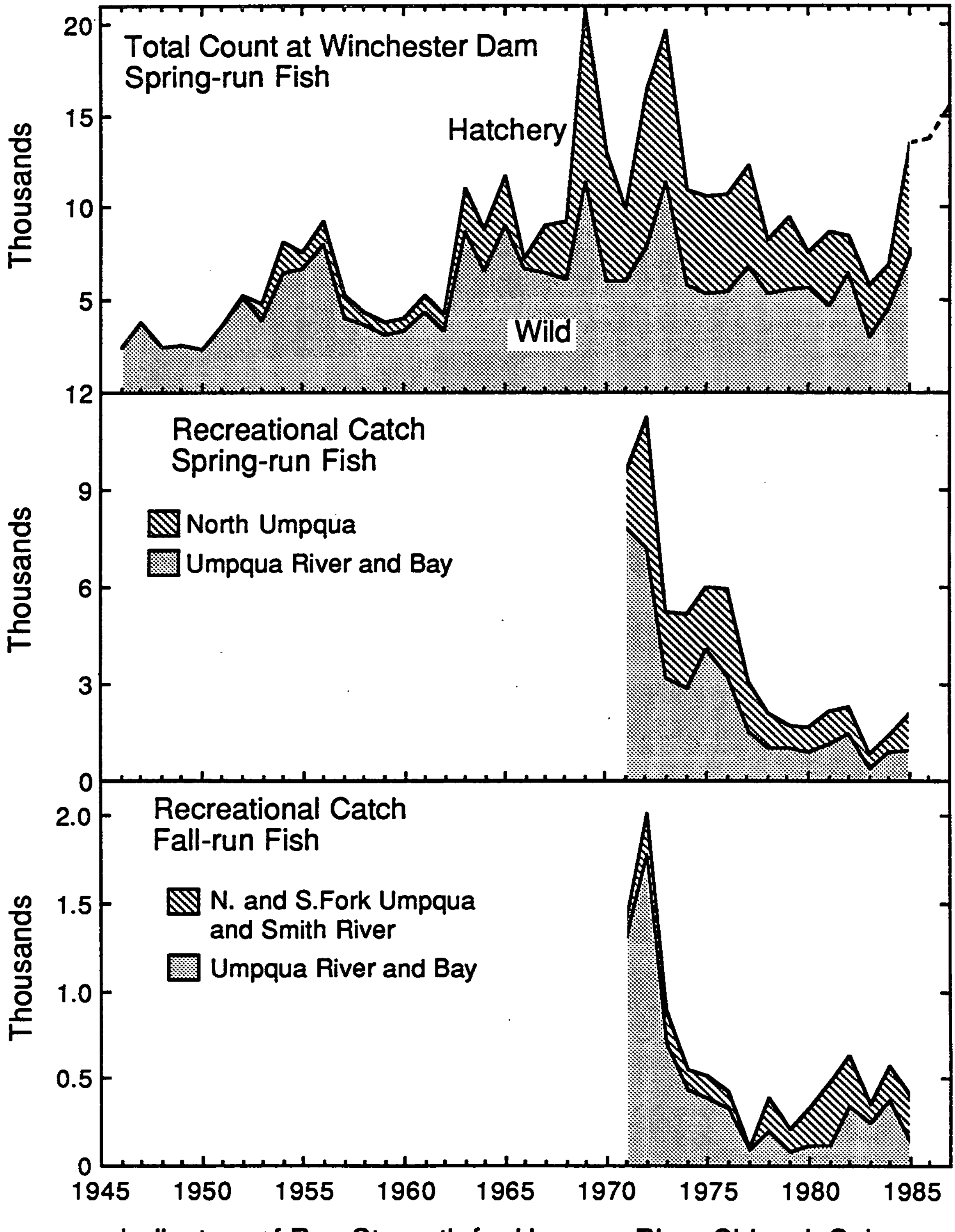
Assessment of Run Strength

The extremely depressed level of chinook salmon runs in the Umpqua River system during the late 1940s and early 1950s was the stimulus for extensive "restoration" efforts in the basin. Much of this restoration program consisted of rearing and releasing hatchery fish in the system. Both native and imported stocks of fall- and spring-run fish were used in the early years of the program. Apparently, very little ever resulted from the efforts to rebuild the fall-runs at that time. Moderate but variable success was achieved with the hatchery program for spring-run fish, however, and the wild spring-run apparently staged a concurrent improvement in run strength during the 1950s and early 1960s.

Counts of spring-run fish at Winchester Dam indicate that the population in the North Fork has been relatively stable since about 1963. The run of wild fish has been more stable than the run of hatchery fish and always composed over 50% of the run. The runs in 1983 and 1984 were relatively weak, reflecting severe El Nino effects on chinook salmon stocks rearing in the ocean off Oregon and poor survival of hatchery fish; but the runs in 1985-87 were relatively strong, reflecting generally improved post-El Nino ocean survival.

Estimates of recreational catch of chinook salmon in the Umpqua present a real dilemma. If we judged solely from "punch card" catch estimates, we would conclude that recreational harvest of both spring- and fall-run fish in the system has declined drastically since the early 1970s. We believe that these estimates were severely inflated during this early period, however, by ocean-caught fish landed at Winchester Bay incorrectly being assigned as Umpqua River fish. In addition, chinook and coho salmon were not distinguished on "punch cards." Apportionment of a "generic-salmon" catch estimate into an estimate for each species relied partly on the judgement of management district biologists regarding the species composition of the catch in 2-week intervals throughout the season. Relatively small errors in the percentages applied to a robust catch of salmon by the recreational fishery working out of Winchester Bay could have produced an overestimate of the catch of Umpqua River chinook salmon.

After reviewing available indicator data and considering anecdotal observations in management district annual reports, we believe that there has actually been a decline in the in-river catch of spring-run fish in the Umpqua River. We believe that the extent of the decline has been somewhat over-stated by the "punch card" catch estimates, however. In contrast, we believe that fall-run fish have only recently begun to recover from an extremely depressed condition during the 1950s-1960s. We found absolutely no evidence to support an estimated catch of several thousand Umpqua River fall-run chinook salmon in the late 1960s and the early 1970s. Anecdotal observations (including "punch card" catch estimates, field observations by management district biologists, and helicopter redd counts) indicate that the runs of fall-run fish into the South Umpqua and into Smith River have been increasing gradually since the late 1970s. Although we judge that runs of fall-run fish in the Umpqua System are presently increasing, we still regard these fish as extremely depressed in comparison with their historic run strength.



Indicators of Run Strength for Umpqua River Chinook Salmon

WILSON RIVER

The Wilson River is one of five major tributaries entering Tillamook Bay. Information pertaining specifically to the run strength of chinook salmon in this river is presented here. We surmise that several distinct subpopulations of chinook salmon may be supported by local stream reaches or tributaries within the Wilson River basin. We do not have reliable information upon which to judge the geographic distribution of chinook salmon or to judge the relative number of fish that might comprise different runs within the basin. The reader should also refer to information pertaining generally to the run strength of chinook salmon in the Tillamook Bay watershed (see TILLAMOOK BAY).

Estimates of Commercial Catch

The Wilson River was open to commercial fishing with nets at various locations and dates through about 1947. Records of catch in this river are not available, however. Records of commercial catch of chinook salmon in this and other Tillamook Bay tributaries were combined in an overall Tillamook Bay reporting area (see TILLAMOOK BAY).

Releases from Hatcheries

Hatchery fish have not been released in the Wilson River on a regular basis. About 200,000 Trask River fall-run fry were released for the 1982 brood year, about 100,000 Trask River spring-run fingerling were released annually for the 1973 through 1975 brood years, and from 60,000 to 130,000 Trask River Hatchery spring-run smolts were released for brood years 1976, 1977, and 1981. STEP has released 16,000 to 110,000 Trask River stock spring- and fall-run fry annually since 1983.

Surveys of Spawners

A spawning survey index area for chinook salmon in the Little North Fork Wilson River has not been consistently monitored. Spring-run chinook salmon have been counted in resting pools in most years since 1965. The average annual count has ranged between 0.1 and 10.2 fish/pool. These counts were relatively high from 1979 through 1983, but were very low in 1984 and 1985. The count in 1986 and 1987 was higher than those made in 1984 and 1985.

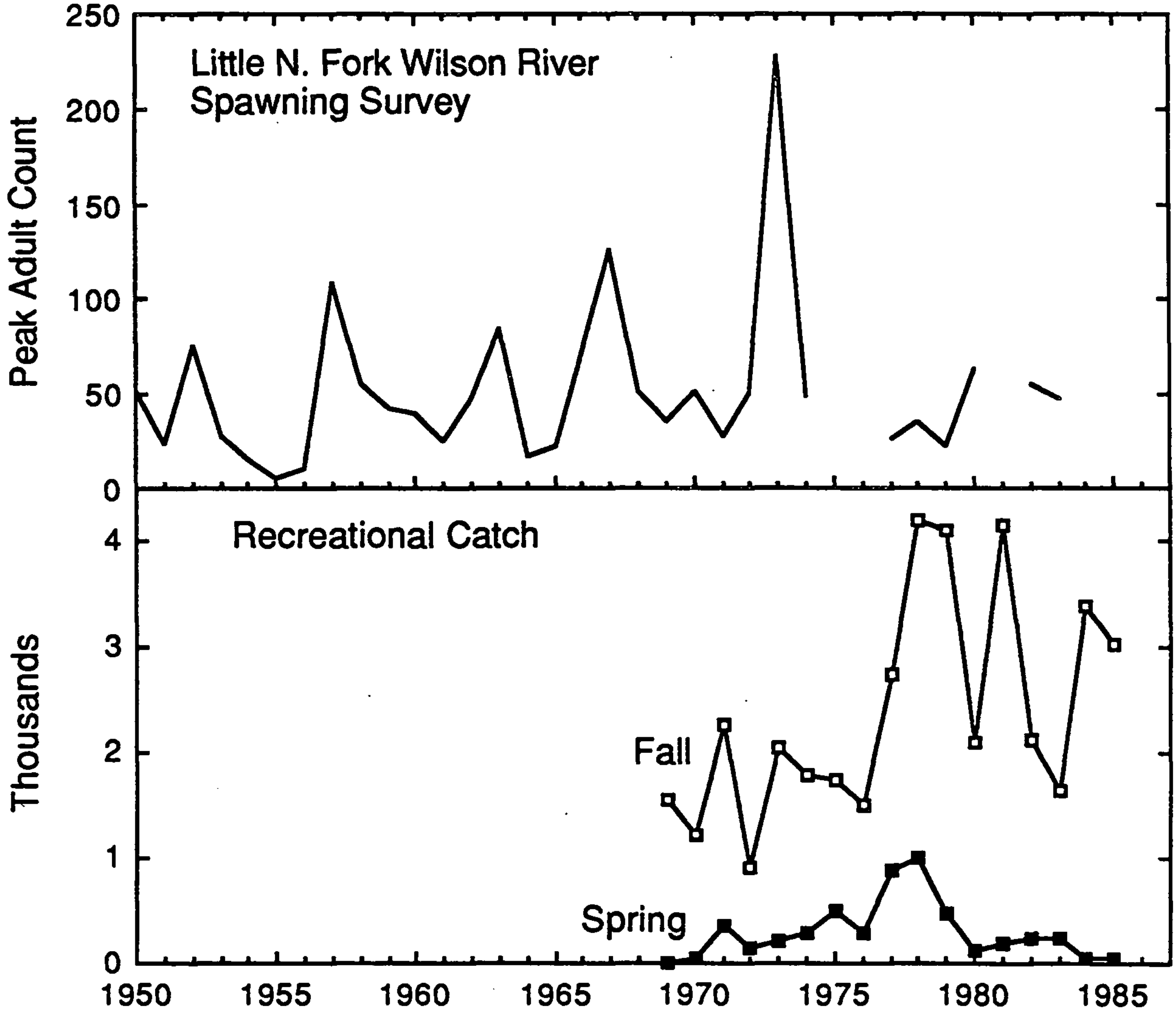
Estimates of Recreational Catch

The Wilson River has supported freshwater recreational fisheries for both fall- and spring-run chinook salmon. "Punch card" estimates of catch of fall-run fish have ranged from about 1,000 to about 4,000 fish from 1969 through 1985 and have averaged about 3,000 fish annually from 1977 through 1985. Recently, catch of fall-run fish has been relatively strong. Catch of spring-run fish has ranged from about 10 to about 1,000 fish and has averaged about 400 fish annually from 1977 through 1985. Catch of spring-run fish was unusually high during 1977 and 1978 and was unusually low in 1969 and 1970 and in 1984 and 1985.

Assessment of Run Strength

Based on "punch card" estimates of recreational catch, we believe that abundance of Wilson River fall-run chinook salmon has increased since the late 1960s and early 1970s. Almost all are probably wild fish, although we have no direct estimates of the proportion of hatchery fish in the run. The most likely potential source of stray hatchery fish would be from Trask River Hatchery. If Trask River Hatchery strays are common in the Wilson River run, then we would expect that recreational catch in the Trask and Wilson rivers would be positively correlated with one another. Catch of fall-run chinook salmon in the Trask and Wilson rivers was not significantly correlated, however.

The abundance of spring-run chinook salmon in the Wilson River is small compared with that of fall-run fish, but spring-run chinook salmon have supported an active recreational fishery in many years. We surmise that, in some years, hatchery spring-run chinook salmon have made important contributions to the catch in the Wilson River. We note that releases of hatchery spring-run chinook salmon have been greater than those of fall-run fish in the Wilson River, and that estimates of the catch of spring-run fish in the Trask and in the Wilson rivers were significantly correlated with one another. We have no direct estimates of the proportion of hatchery fish in spawning runs of Wilson River spring-run chinook salmon, however. Estimates of spring-run chinook salmon catch suggest no obvious trend of abundance, even though catch and average count in resting pools during 1984 and 1985 were extremely low. The resting pool count during 1986 and 1987 was higher than counts for 1984 and 1985.



Indicators of Run Strength for Wilson River Chinook Salmon

WINCHUCK RIVER

The Winchuck River drains a relatively small watershed on the southern Oregon coast and flows through a small ephemeral estuary on the beach at the river mouth. We have no information regarding subpopulations of chinook salmon in this stream. Distinctions may exist, however, based on date rather than on area of spawning. The following narrative pertains to the Winchuck River population as a whole.

Estimates of Commercial Catch

The Winchuck River was open to commercial fishing with nets at various locations and dates through about 1934. No records of catch are available, however.

Releases from Hatcheries

No recent releases of hatchery chinook salmon have been made in the Winchuck River.

Surveys of Spawners

The peak count of adult fall-run chinook salmon in an index area of Bear Creek is available for most years since 1964. These data suggest that the stock may have declined in abundance through at least 1980. Peak count from 1979 through the present has been quite stable, but has been well below the early average count.

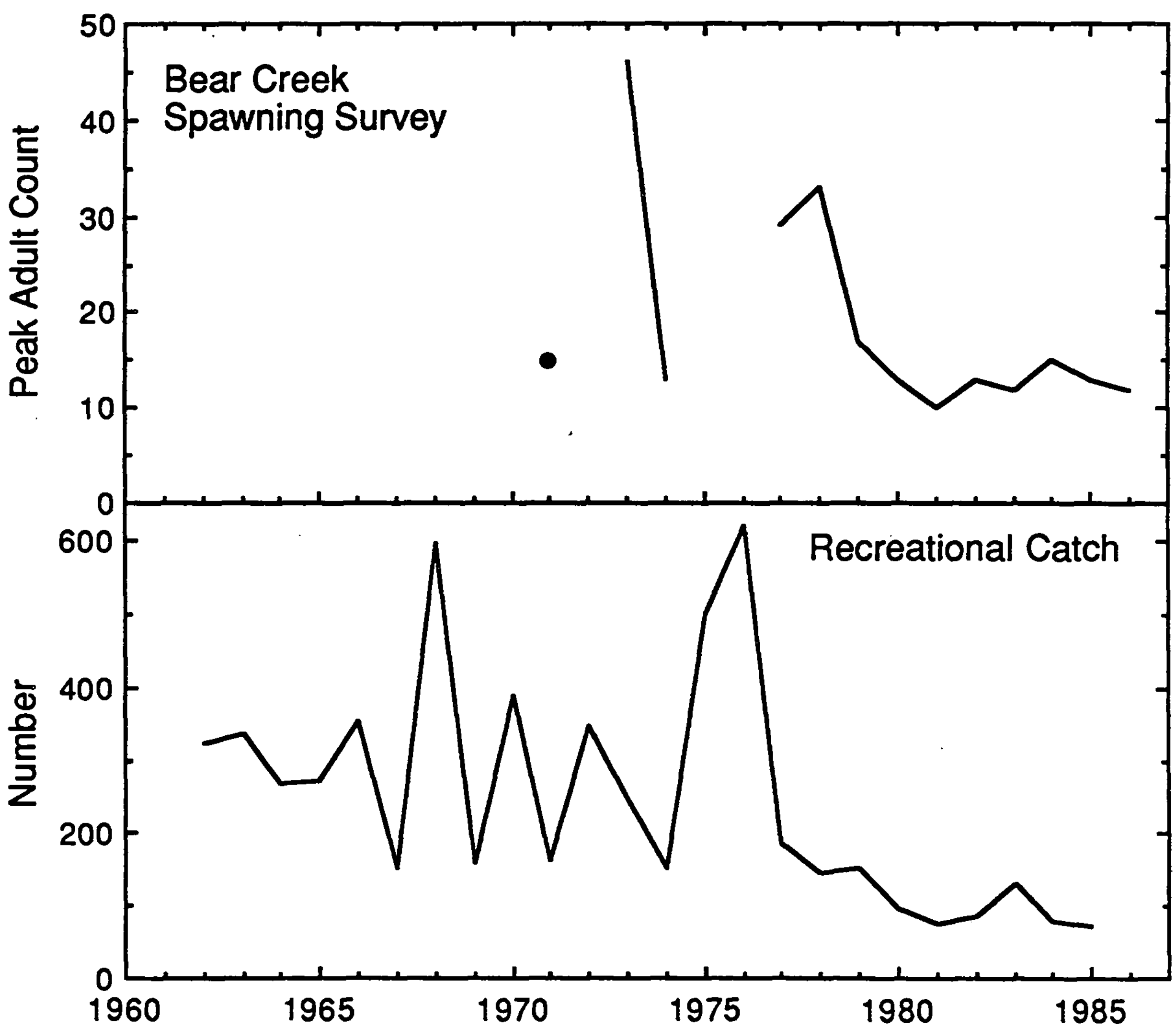
Estimates of Recreational Catch

The Winchuck River has supported a relatively small freshwater recreational fishery for chinook salmon. From 1962 through 1976, estimated catch ranged from about 150 to about 600 fish and averaged about 325 fish annually. The peak catch of about 600 fish was made in the drought year of 1976 when essentially no fish reached spawning survey index areas. Catch since 1976 has been much lower and has averaged only about 115 fish annually. The low proportion of jacks in most spawning surveys indicates that the decline in average catch since 1976 is probably due to more than just the change in reporting size limits. The shift in reporting size limits may have exaggerated the actual difference between periods, however. Fewer than 100 fish have been caught annually in 5 of the past 6 years.

Assessment of Run Strength

The peak count of adults in spawning surveys and estimates of annual recreational catch suggest that abundance of Winchuck River fall-run chinook salmon has declined since the early 1960s. Estimates of recreational catch have been significantly correlated with peak count in spawning surveys.

However, estimated recreational catch does not indicate any declining trend prior to 1979, whereas smoothed peak counts of adults in spawning surveys suggest a possible decline. From 1979 through 1985, peak count in spawning surveys and annual estimates of sport catch have been quite stable, but both indicators of stock status have been low when compared with earlier data. We regard Winchuck River fall-run fish as depressed since about 1979. The stock is considered to consist almost exclusively of wild fish.



Indicators of Run Strength for Winchuck River Chinook Salmon

YAQUINA RIVER

The Yaquina River system supports populations of chinook salmon in at least two major subbasins: the Yaquina River and Big Elk Creek. We surmise that the run into each of these areas is an important part of the overall run into the system. The following narrative pertains to the Yaquina River population as a whole.

Estimates of Commercial Catch

Approximately 5 thousand chinook salmon were packed on the Yaquina River in 1896, but the pack from 1897 through 1907 only averaged about 1 thousand fish annually. Landings records for the period 1923 through 1956 indicate that annual catch generally declined from a peak of about 7 thousand fish in 1923 to fewer than 1 thousand fish by 1956. Catch was made primarily from August through October, with a peak during September. Of salmon caught in Yaquina Bay, far more were apparently shipped inland to the Willamette Valley for sale as fresh fish than were packed in cans. Although some records of the number of salmon caught annually during the late 1800s are available, we were unable to determine the proportion of the catch that was chinook salmon because the species composition of the catch was poorly documented.

Releases from Hatcheries

Releases of chinook salmon in the Yaquina River basin are currently dominated by the operation of a private hatchery located near the mouth of Yaquina Bay. This hatchery began releasing modest numbers of nonnative chinook salmon stocks in 1974. Private hatchery releases of fall-run chinook salmon have varied both in total number released and in stock origin. Six nonnative stocks of chinook salmon have been released in addition to Yaquina River stock fall-run chinook salmon. The first large releases (150,000 smolts each) were of Trask River stock spring- and fall-run chinook salmon from the 1975 brood year. At least 300,000 fall-run chinook salmon smolts have been released annually since the 1981 brood year. Maximum permitted releases of chinook salmon by this private hatchery are 10.6 million fish per brood year. About 15,000 Yaquina River stock fall-run chinook salmon have also been released upriver in the basin annually from brood years 1977 through 1979 as part of a program to mitigate for eggs that were taken from the wild population to establish a broodstock for the private hatchery.

As of 1987, the private hatchery has apparently terminated production of fall-run chinook salmon, greatly reduced production of coho salmon, and plans to greatly increase production of spring-run (Rogue River) chinook salmon.

Surveys of Spawners

Extensive spawning survey data are available for chinook salmon in the Yaquina River basin, but the most complete survey data are for Grant Creek since 1950. Peak count of adults was quite stable from about 1953 through 1974, but since then has increased to an average of two or three times the former level. Peak count of adults since 1978 may have been influenced by stray hatchery chinook salmon released from the private hatchery. Stray private hatchery salmon have been observed in natural spawning areas, but we have no existing quantitative estimates of the proportion of hatchery fish in the spawning runs.

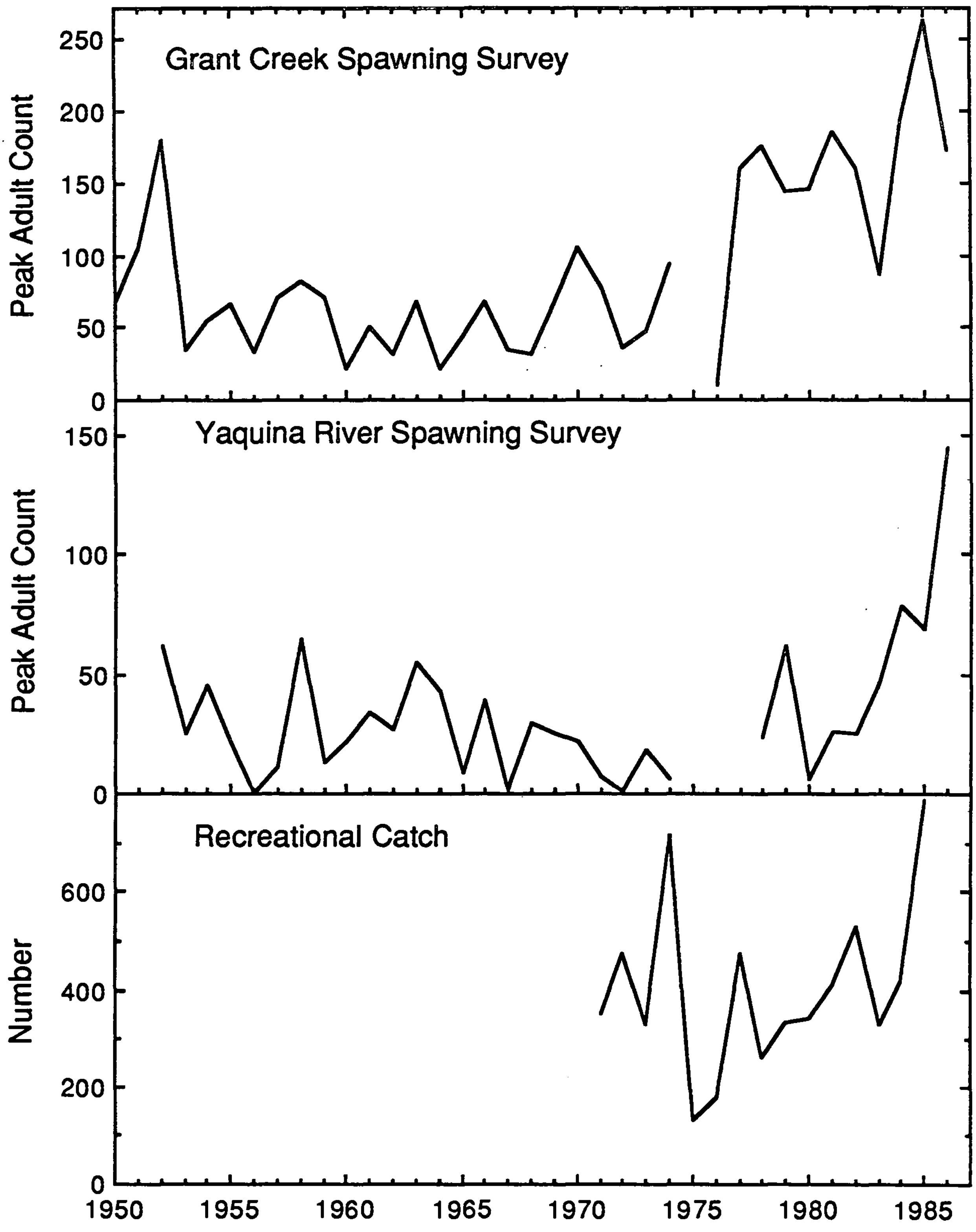
Estimates of Recreational Catch

The Yaquina River has supported a modest freshwater recreational fishery for fall-run chinook salmon. "Punch card" estimates of the catch have ranged from about 125 to about 800 fish and have averaged about 400 fish annually from 1977 through 1985. Estimated catch since 1971 suggests no obvious trend in abundance, even though the estimated catch in 1985 was the highest on record for the Yaquina River.

Assessment of Run Strength

Peak count of adults in spawning surveys suggests that abundance of Yaquina River fall-run chinook was relatively stable from 1950 through 1974, but has since then increased to at least twice its former level. "Punch card" estimates of catch do not indicate the same pattern of increasing abundance, but "punch card" data for Yaquina River stock chinook salmon may be affected by the 1977 change in reporting size limit. "Punch card" estimates of catch were not significantly correlated with peak counts in spawning surveys for the period 1971 through 1985, but they were significantly correlated with peak counts for the period 1977 through 1985. "Punch card" data prior to 1977 may include many jacks, so estimated recreational catches prior to 1977 may give an inflated index of adult abundance.

Available data strongly suggest that a recent increase in the total freshwater abundance of adult fall chinook salmon in the Yaquina River has occurred. Part of this increase may be caused by stray returns of fall-run chinook salmon released from the private hatchery at Yaquina Bay, however. Since the 1981 brood year, private hatchery releases of fall-run chinook salmon have been greater than 300,000 smolts. The observed increase in peak count of adults could be caused by a relatively low straying rate of chinook salmon returning from private hatchery releases.



Indicators of Run Strength for Yaquina River Chinook Salmon

APPENDIX A

List of Oregon Department of Fish and Wildlife Biologists
Who Can Provide Access to File Data
on Oregon Coastal Chinook Salmon

Borgerson, Lisa. Scale analysis data from juvenile and adult chinook salmon in all coastal rivers except the Rogue. Catalog of all scale samples from chinook salmon that are available for analysis.

Bottom, Daniel. Data on studies of food consumption by juvenile chinook salmon in Sixes estuary. Summaries of available biological and physical data from Oregon estuaries.

Downey, Timothy. Long-term data sets covering all aspects of research on juvenile and adult chinook salmon at Elk and Sixes rivers, and some data from Chetco River.

Garrison, Robert. Central source of data on recoveries of coded-wire tagged salmon.

Jacobs, Steven. Contemporary spawning ground survey data and analysis.

McGie, Alan. Long-term data sets on spawning ground surveys in coastal rivers. Analyses of stock and recruitment relationships of coastal chinook salmon.

McPherson, Barry. Long-term data sets covering all aspects of research on salmonids in the Rogue River.

Mullen, Robert. Data on commercial landings of chinook salmon in coastal rivers, 1893-1960. Data on research on salmonids in Tillamook Bay and Salmon River.

Nicholas, Jay. Long-term data sets on surveys of juvenile chinook salmon in coastal rivers, except the Rogue. Analyses of age composition and age-specific size of adults from coastal rivers except the Rogue. Analyses of juvenile scale patterns and life histories in coastal rivers except the Rogue. Data on timing of returns and spawning in all coastal rivers.

APPENDIX B

Bibliography of Oregon Department of Fish and Wildlife Reference Documents That Contain Information on Coastal Chinook Salmon

Information about chinook salmon in Oregon coastal rivers is contained in many reference reports printed over the years by the Oregon Department of Fish and Wildlife and its predecessor agencies. This bibliography represents a determined effort to locate and list all the important references on this subject. Undoubtedly, some have been inadvertently omitted. Nevertheless, this bibliography provides examples of the types of the reports that have been prepared on this topic.

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Berry, R.L. 1975. Rearing spring chinook salmon *(Oncorhynchus tshawytscha)* in J.W. Barney Reservoir, Trask River, Oregon, 1973-74. Oregon Department of Fish and Wildlife, Coastal Rivers Investigations Information Report 75-6, Portland.

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Campbell, C.J., and F.E. Locke, editors. 1961. Annual Report Fishery Division 1961. Oregon State Game Commission, Portland. [See page 12 for a summary of the Winchester Bay salmon catch during 1952-61, page 40 for comments on fish passage problems in the Rogue River and other south coast river basins, and pages 226-298 for information about recreational fisheries, catch estimates, and life history notes pertaining to chinook salmon.]

Campbell, C.J., and F.E. Locke, editors. 1962. Annual Report Fishery Division 1962. Oregon State Game Commission, Portland. [See pages 30-31 for spawning ground counts of chinook salmon in several south coast river basins, page 278 for remarks on spawning by chinook salmon in the Nestucca River, pages 310-311 for salmon catch estimates from the Alsea and Siletz rivers, and page 332 for estimated catch of salmon in the Siuslaw River 1949-1962.]

Campbell, C.J., and F.E. Locke, editors. 1963. Annual Report Fishery Division 1963. Oregon State Game Commission, Portland. [See page 12 for discussion of Rogue River salmon catch census, pages 29-30 for information on Brookings salmon fishery, pages 280-301 for notes on flood-caused habitat damage in Nestucca River, page 304 for holding pool counts of chinook salmon in the Siletz River, pages 322-323 for chinook salmon spawning ground counts in the Coos and Coquille rivers 1958-1963, and pages 358-360 for summary of chinook salmon egg taking in 1963.]

Campbell, C.J., and F.E. Locke, editors. 1964. Annual Report Fishery Division 1964. Oregon State Game Commission, Portland. [See page 20 for chinook salmon spawning ground counts in south coast streams, page 223 for chinook salmon spawning ground counts on the Nehalem River 1960-1964, page 229 for holding pool counts of chinook salmon in Tillamook district streams, page 237 for holding pool counts of chinook salmon in the Siletz River, page 242 for estimate of catch by the Alsea tidewater recreational fishery, and pages 247-249 for spawning ground counts in the Coos and Coquille.]

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Hoy, M.T. 1940. Biennial Report, 1939-1940. Fish Commission of Oregon, Portland. [See page 33 for an assertion that the catch of chinook salmon in the ocean off California was correlated to the runs into the Columbia and an assertion that the origin of fish caught in the ocean must be studied.]

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Kruse, T.E., A.L. Oakley, R.N. Breuser, and A.M. McGie. 1962. Coastal Rivers Investigations annual progress report 1 July 1960-30 June 1961. Fish Commission of Oregon, Portland. [See pages 22-23 for salmon recreational catch estimates for five coastal streams.]

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McGuire, H.D. 1894. First and Second Annual Reports of the Fish and Game Protector, 1893-1894. Portland. [See pages 27-28 for remarks about the operation of a new hatchery at Knowles Creek (Siuslaw River), pages 40-41 for an accounting of the commercial harvest on certain coastal rivers, and pages 42-43 for information on the number of canneries operating, persons employed, and wages paid.]

McGuire, H.D. 1896. Third and Fourth Annual Reports of the State Fish and Game Protector, 1895-1896. Portland. [See pages 18-21 for a general assessment of the commercial catch of salmon, the disposition of catch, and the economic value of the industry, page 52 for a description of problems with a fishway on Elk Creek (Umpqua), pages 54-55 for a discussion on fishing closures to protect spawning chinook salmon in coastal rivers, page 62 for a remark that it required 68 pounds of raw fish to fill 48 one-pound cans for processing, pages 64-81 for a description of salmon fisheries in all coastal rivers including information on catches, value of commercial property and equipment, number of men employed, wages earned, and the distribution of fish to various types of markets, and pages 95-108 for notes on the taxonomy, biology, and natural history of chinook salmon by David Starr Jordon.]

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Oregon State Game Commission. 1954. Annual Report Fishery Division 1953. Portland. [See pages 1-12 for information on the Umpqua River Salmon Restoration Program, page 16 for discussion of the strong run of chinook salmon in the Rogue River in 1953, page 27 for information on the recreational fishery on the Rogue River, and pages 249-322 for description of recreational fishery for chinook salmon in the Astoria, Tillamook, and Lincoln fishery districts.]

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Rayner, H.J., editor. 1957. Annual Report Fishery Division 1956. Oregon State Game Commission, Portland. [See pages 9-10 for information on Umpqua recreational salmon fishery, pages 12-14 for information on the Umpqua River Restoration Program, page 19 for comments on the good counts of spring-run chinook salmon in the Rogue River, page 30 for comments on screening projects to protect downstream migrants in the Rogue River, and pages 198-239 for information on recreational salmon fisheries in coastal rivers from the Nehalem to the Coquille.]

Rayner, H.J., editor. 1958. Annual Report Fishery Division 1957. Oregon State Game Commission, Portland. [See pages 1-21 for remarks on studies in the Umpqua River basin, pages 34-35 for information on screening projects designed to protect downstream migrants in the Rogue River, and pages 174-235 for information about chinook salmon recreational fisheries in coastal rives from the Nehalem to the Coquille and for other remarks on the life history of chinook salmon in the Nestucca River and other coastal rivers.]

Rayner, H.J., editor. 1960. Annual Report Fishery Division 1960. Oregon State Game Commission, Portland. [See pages 1-22 for general information on Umpqua River chinook salmon, page 24 for timing of juvenile chinook salmon migration at Gold Ray Dam, pages 42-44 for discussion of measures designed to protect salmon and steelhead on the Rogue River, and pages 232-291 for information on recreational fisheries, for catch estimates, and for a life history note pertaining to chinook salmon.]

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Van Dusen, H.G. 1903. Annual Reports of the Department of Fisheries of the State of Oregon, 1901-1902. Portland. [See pages 21-26 for a discussion about prospects for building hatcheries on several coastal rivers, pages 38-48 for reports of hatchery operations on several coastal rivers, pages 50-60 for an accounting of the salmon fishery in coastal rivers, pages 68-78 for a description of sport and commercial fishing for chinook salmon in Monterey Bay (California), page 82 for concerns about use of dynamite to harvest salmon, and pages 123-141 for description of coastal hatchery operations and an accounting of the coastal salmon fishery.]

Van Dusen, H.G. 1904. Annual reports of the Department of Fisheries of the State of Oregon 1903-1904. Portland. [See pages 20-24, 54-63, and 158-175 for an accounting of the operation of salmon hatcheries in coastal rivers, page 122 for description of changes in the configuration of the Columbia River entrance caused by jetty construction and a recommendation that no fishing be allowed at the mouth of the river, pages 126-128 for comments on the effect of numerous dams on salmon populations, and pages 136-157 for comments on the extinction of subraces of chinook salmon and a report on the natural history of chinook salmon in the Sacramento River.]

Van Dusen, H.G. 1907. Annual Reports of the Department of Fisheries of the State of Oregon, 1905-1906. Portland. [See pages 7-9 and 128-129 for an overview of the salmon fisheries, pages 14-17 for a report on an improved type of rack that could be built to block the upstream passage of salmon in order to collect eggs for hatchery production, pages 25-26 for a discussion of several mining dams blocking salmon migrations in the Rogue River basin, pages 37-46 for a report of opinion relating to the enforcement of fishing laws by the Attorney General, and pages 46-65, 97-105, and 160-186 for information regarding the operation of hatcheries including records of the number of females spawned by date.]

Van Dusen, H.G. (1907), and H.C. (1908) McAllister. 1908. Annual Reports of the Department of Fisheries of the State of Oregon, 1907-08. Portland. [See pages 6-13 for general remarks on the salmon fishery, and a caution that the state should not yet put all its faith in hatchery production of salmon, but should ensure that natural production is also maintained, pages 27-40, 69-75, 90-107, and 147-149 for detailed comments regarding the operation of specific hatcheries, pages 62-68 for a summary of opinions rendered by the Attorney General on matters pertaining to enforcing fishing laws, and pages 136-137 for a recommendation that no fishing for salmon be allowed on the Columbia River bar or in the ocean outside the bar.]

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APPENDIX C

List of Ad+CWT Code Groups That Were Used to Assess
Ocean Catch Distribution for Chinook Salmon
From Oregon Coastal Streams

Run, donor stock	Release location	Code groups		
Fall-run:				
Alsea	Alsea	07 18 55		
Chetco	Chetco	07 11 10 07 12 10 07 16 45	07 20 07 07 22 46	07 23 40 07 25 39
Chetco	Klatskanine	07 11 12		
Coos	Coos	62 24 03	62 35 04	62 50 02
Elk	Elk	07 10 13 07 10 15 07 11 09	07 12 09 07 22 42 07 22 43 07 22 44	07 22 45 07 25 35 07 25 36
Elk	Alsea	07 10 12	07 11 15	
Nestucca	Nestucca	07 16 41	07 22 30	07 25 32
Nestucca	Coos Bay	62 40 03		
Rogue	Rogue	07 18 53		
Rogue	Columbia River	07 28 57	07 28 58	
Salmon	Salmon	07 16 43 07 16 44 07 18 50	07 22 05 07 22 39 07 22 40	09 16 38 09 16 37
Siuslaw	Siuslaw	07 16 63 07 18 58	07 22 41	62 48 32
Trask	Trask	07 10 10	07 11 13	
Trask	Alsea	07 10 11	07 11 14	
Yaquina	Yaquina	07 16 28 60 31 11	60 31 13	60 31 30

Run, donor stock	Release location	Code groups		
Spring-run:				
Nestucca	Nestucca	07 16 42		
Rogue	Coos Bay	62 17 02	62 26 04	62 51 04
		62 17 03	62 27 02	62 52 04
		62 20 02	62 31 03	62 53 04
		62 23 04	62 37 04	62 54 04
		62 25 04		
Rogue	Rogue	07 16 29	07 22 36	09 04 01
		07 19 31	07 25 09	09 04 02
		07 19 32	07 25 12	09 16 17
		07 22 09	07 25 14	09 16 20
		07 22 35		
Trask	Trask	07 16 40	07 21 21	07 25 03
Trask	Yaquina Bay	60 35 01	62 60 01	
Umpqua	Umpqua	07 16 49	07 22 28	07 25 01
		07 16 50	07 22 29	07 25 02

APPENDIX D

Tables of Data on Releases of Chinook Salmon in Oregon Coastal River Basins

A single source document in which releases of hatchery-reared chinook salmon are reported does not exist, nor is there a complete listing of source documents from which the information may be obtained. Many source documents were reviewed to compile these summaries; extensive effort has been made to ensure that they are complete and accurate. Where source documents presented conflicting accounts of the stock, race, size, or number of fish released, the conflict was resolved through interviews with ODFW staff or by personal judgment of the authors. Minor errors or omissions may remain in these summaries; however, they capture the essential character of the recorded history of releases of hatchery chinook salmon in Oregon coastal rivers.

Appendix Table D-1. Releases of transferred stocks of chinook salmon in Oregon coastal river basins, in thousands of fish. This summary incudes the period from roughly 1900 to 1960. Fish were generally released as fry (>125 fish/lb). Col = Columbia, Nes = Nestucca, Ump = Umpqua, Wil = Willamette, Unk = Unknown.

Recipient system	Donor stock, fall-run			
	Col	Coos	Trask	Unk
Alsea	18,402	--	--	--
Chetco	35	--	--	--
Coos	7,251	--	106	--
Coquille	1,581	17,968	--	--
Elk	85	--	--	--
Nehalem	11,204	--	--	--
Nestucca	2,183	--	--	58
Rogue	4,460	--	--	--
Salmon	10	--	--	--
Siletz	2,668	--	--	--
Siuslaw	5,847	--	--	--
Tillamook	13,305	--	--	--
Umpqua	4,451	--	--	--
Winchuck	10	--	--	--
Yachats	66	--	--	--
Yaquina	5,432	--	--	--

Recipient system	Donor stock, spring run						
	Col	Nes	Rogue	Trask	Ump	Wil	Unk
Alsea	1,000	761	--	748	450	3,361	--
Chetco	--	--	50	50	--	--	--
Coos	--	--	--	--	--	2,740	--
Coquille	--	--	--	--	--	--	304
Nehalem	1,965	2,000	--	3,957	--	3,914	2,500
Nestucca	--	--	--	20	--	--	1,518
Rogue	967	--	--	3,106	--	4,216	--
Salmon	--	--	--	50	--	--	--
Siletz	--	--	--	83	--	190	20
Siuslaw	--	828	--	--	858	1,741	--
Tillamook	940	340	194	--	2,984	512	7,155
Umpqua	1,050	--	50	--	--	--	--
Yachats	--	--	--	--	--	50	--
Yaquina	--	--	--	206	500	234	--

Appendix Table D-2. Releases of fall-run chinook salmon from public hatcheries in Oregon coastal river basins, 1961-84 brood years. Fry = >125 fish/lb; fingerling = 20-125 fish/lb; smolts = <20 fish/lb.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		ALSEA		
1964	Bonneville	--	11[a]	--
1966	Bonneville	--	56[a]	--
1967	Bonneville	--	57[a]	--
1969	Bonneville	--	525[a]	--
1970	Bonneville	--	130[a]	--
1971	Bonneville	--	229[a]	--
1972	Bonneville	--	230[a]	--
1972	Trask	--	--	98
1973	Trask	--	--	106
1973	Elk	--	--	99
1974	Trask	--	--	43
1974	Elk	--	--	43
1975	Bonneville	--	500[a]	--
1975	Alsea	--	--	44
1976	Alsea	--	--	48
1977	Alsea	59	--	101
1978	Alsea	--	--	123
1979	Alsea	--	--	183
1980	Alsea	--	--	147
1981	Alsea	--	--	72
1982	Alsea	80	--	209
1983	Alsea	--	112	212
1984	Alsea	--	--	171
		CHETCO		
1968	Chetco	--	--	333
1969	Chetco	--	--	226
1970	Chetco	--	--	68
1971	Chetco	--	--	135
1972	Chetco	--	--	334
1973	Chetco	--	--	440
1974	Chetco	--	--	319
1975	Chetco	--	--	429
1976	Chetco	--	--	131
1977	Chetco	--	--	460
1978	Chetco	--	--	624
1979	Chetco	--	--	195
1980	Chetco	--	--	298
1981	Chetco	--	--	435
1982	Chetco	--	--	348
1983	Chetco	--	--	60
1984	Chetco	--	--	275

[a] *These fish were reared in Lint Slough.*

Appendix Table D-2. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		COOS		
1972	Elk	--	783	--
1973	Elk	--	889	110
1973	Chetco	--	--	100
1974	Elk	392	--	111
1974	Chetco	3	--	103
1978	Coos	--	--	24[b]
1980	Coos	--	--	25[b]
1981	Coos	--	--	25[b]
1983	Coos	--	--	52
1984	Coos	--	--	58
		COQUILLE		
1972	Elk	--	99	111
1973	Elk	--	--	104
1974	Elk	--	72	80
1983	Coquille	--	--	116
1984	Coquille	--	--	71
		ELK		
1968	Elk	--	--	321
1969	Elk	--	--	108
1970	Elk	--	409	269
1971	Elk	--	--	545
1972	Elk	--	103	333
1973	Elk	--	44	264
1974	Elk	--	--	240
1975	Elk	--	--	771
1976	Elk	--	--	21
1977	Elk	551	--	499
1978	Elk	313	--	521
1979	Elk	497	--	540
1980	Elk	--	123	457
1981	Elk	--	--	382
1982	Elk	--	--	449
1983	Elk	--	--	416
1984	Elk	--	--	560

[b] *These fish were reared in private hatcheries and released in the recipient stream to mitigate for eggs that were removed from the natural spawing population.*

Appendix Table D-2. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		FLORAS		
1972	Elk	--	107	--
1973	Elk	23	103	--
		HUNTER		
1973	Chetco	--	--	8
		KILCHIS		
1980	Trask	--	--	26
		MIAMI		
1980	Trask	--	--	37
		NECANICUM		
1975	Trask	--	--	39
1977	Trask	--	--	98
1978	Trask	--	--	71
1979	Trask	--	--	110
1980	Trask	--	59	100
		NEHALEM		
1966	Trask	--	162	--
1967	Trask	--	964	--
1968	Trask	--	149	192
1969	Trask	--	232	--
1970	Trask	--	--	206
1974	Trask	--	110	--
1975	Trask	--	--	100
1977	Trask	--	--	104
1978	Trask	--	--	67
1979	Trask	--	--	103
1980	Trask	--	--	22

Appendix Table D-2. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		NESTUCCA		
1975	Nestucca	--	--	69
1976	Nestucca	--	--	17
1977	Nestucca	--	--	94
1978	Nestucca	--	--	86
1979	Nestucca	--	--	82
1980	Nestucca	--	--	50
1981	Nestucca	--	--	96
1982	Nestucca	--	--	112
1983	Nestucca	--	--	118
1984	Nestucca	--	--	116
		ROGUE		
1977	Rogue	--	--	36
1978	Rogue	--	--	28
1980	Rogue	--	--	26
1981	Rogue	--	--	113
1982	Rogue	--	--	27
1983	Rogue	--	--	30
1984	Rogue	--	--	37
SALMON				
1976	Salmon	--	--	49
1977	Salmon	--	--	50
1978	Salmon	--	--	177
1979	Salmon	--	--	219
1980	Salmon	76	--	178
1981	Salmon	60	--	218
1982	Salmon	83	--	213
1983	Salmon	--	--	201
1984	Salmon	--	--	206
		SILETZ		
1967	Trask	--	45	--
1968	Trask	--	45	--

Appendix Table D-2. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		SIUSLAW		
1978	Siuslaw	--	--	22[b]
1979	Siuslaw	--	--	24[b]
1980	Siuslaw	--	--	25[b]
1981	Siuslaw	--	--	25[b]
		TRASK		
1961	Trask	461	--	--
1962	Trask	361	--	--
1963	Trask	359	--	--
1964	Trask	64	--	--
1965	Trask	--	725	--
1966	Trask	--	426	--
1967	Trask	--	443	--
1968	Trask	--	368	--
1969	Trask	--	349	--
1970	Trask	--	--	404
1971	Trask	--	115	100
1972	Trask	--	47	137
1973	Trask	97	170	124
1974	Trask	--	217	153
1975	Trask	--	296	150
1976	Trask	--	--	49
1977	Trask	--	326	146
1978	Trask	--	257	150
1979	Trask	--	319	137
1980	Trask	--	307	153
1981	Trask	--	420	151
1982	Trask	--	325	137
1983	Trask	--	331	143
1984	Trask	--	180	141
		UMPQUA		
1966	Bonneville	--	165[c]	--
1967	Bonneville	--	447[c]	--
1968	Bonneville	--	92[c]	--
1969	Bonneville	--	915[c]	--
1970	Bonneville	--	568[c]	--

[c] *These fish were reared in Whistlers Bend Pond and released in the Umpqua River basin. During these same years, several hundred Rogue stock spring-run chinook salmon were also released from the pond as yearlings.*

Appendix Table D-2. Concluded.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		WILSON		
1982	Trask	219	--	--
1984	Trask	--	138	--
YAQUINA				
1977	Yaquina	--	--	18[b]
1978	Yaquina	--	--	26[b]
1979	Yaquina	--	--	3

Appendix Table D-3. Releases of spring-run chinook salmon from public hatcheries in Oregon coastal river basins, 1960-84 brood years. Fry = >125 fish/lb; fingerling = 20-125 fish/lb; smolts = <20 fish/lb.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		ALSEA		
1973	Trask	100	--	--
		COQUILLE		
1983	Coquille	--	--	32
1984	Coquille	--	--	5
		KILCHIS		
1973	Trask	35	--	--
1974	Trask	50	--	--
1975	Trask	80	--	--
1981	Trask	--	--	45
		NEHALEM		
1965	Trask	--	--	5
		NESTUCCA		
1972	Trask	40	--	--
1973	Trask	156	--	--
1974	Trask	150	--	--
1975	Trask	152	--	--
1975	Nestucca	--	--	57
1976	Trask	99	--	60
1976	Nestucca	--	--	56
1977	Trask	192	--	25
1977	Nestucca	--	--	56
1978	Trask	198	--	--
1978	Nestucca	--	31	71
1979	Trask	156	--	--
1979	Nestucca	--	--	52
1980	Trask	170	--	--
1980	Nestucca	--	--	66
1981	Trask	--	--	52
1981	Nestucca	--	--	44
1982	Nestucca	--	--	68
1983	Nestucca	--	--	64
1984	Nestucca	140	--	53

Appendix Table D-3. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		ROGUE[a]		
1965	Rogue	--	--	56
1966	Rogue	--	--	65
1967	Rogue	--	--	64
1968	Rogue	--	--	68
1969	Rogue	--	--	52
1970	Rogue	--	--	57
1971	Rogue	--	--	57
1972	Rogue	--	--	60
1973	Rogue	--	--	551
1974	Rogue	--	--	227
1975	Rogue	--	--	704
1976	Rogue	--	210	701
1977	Rogue	--	--	634
1978	Rogue	--	--	876
1979	Rogue	--	--	824
1980	Rogue	--	--	768
1981	Rogue	--	--	771
1982	Rogue	--	--	924
1983	Rogue	--	--	776
1984	Rogue	--	--	1,275
		SILETZ		
1973	Trask	100	--	--
		TRASK		
1960	Trask	--	--	85
1961	Trask	806	101	--
1962	Trask	361	--	60
1963	Trask	--	--	50
1964	Trask	--	--	50
1965	Trask	65	47	4
1966	Trask	71	--	27
1967	Trask	32	--	35
1968	Trask	24	--	38
1969	Trask	--	--	62
1970	Trask	--	--	58

[a] *In addition to the fish listed here, spring-run chinook salmon were also reared in Libby Pond and released in the Rogue River basin in the general period from 1960 to 1967.*

Appendix Table D-3. Continued.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		TRASK (continued)		
1971	Trask	--	--	116
1972	Trask	53	--	125
1973	Trask	248	--	120
1974	Trask	250	--	115
1975	Trask	251	--	136
1976	Trask	--	--	177
1977	Trask	--	--	170
1978	Trask	--	--	128
1979	Trask	--	--	114
1980	Trask	--	--	149
1981	Trask	174	--	131
1982	Trask	--	181	179
1983	Trask	219	--	176
1984	Trask	--	38	131
		UMPQUA		
1960	Umpqua	--	--	81
1961	Umpqua	--	--	91
1962	Umpqua	--	--	80
1963	Umpqua	--	--	86
1964	Umpqua	--	--	66
1965	Umpqua	--	--	91
1966	Umpqua	--	--	171
1967	Umpqua	--	--	95
1968	Umpqua	--	--	99
1969	Umpqua	--	--	203
1970	Umpqua	--	--	151
1971	Umpqua	--	--	138
1972	Umpqua	--	--	148
1973	Umpqua	--	--	116
1974	Umpqua	--	--	134
1975	Umpqua	--	63	262
1976	Umpqua	--	--	323
1977	Umpqua	--	--	170
1978	Umpqua	--	8	152
1979	Umpqua	--	--	112
1980	Umpqua	--	--	237
1981	Umpqua	50	--	322
1982	Umpqua	--	--	173
1983	Umpqua	--	--	195
1984	Umpqua	--	--	303

Appendix Table D-3. Concluded.

Brood year	Donor stock	Thousands released		
		Fry	Fingerling	Smolts
		WILSON		
1973	Trask	134	--	--
1974	Trask	75	--	--
1975	Trask	99	--	--
1976	Trask	--	--	89
1977	Trask	--	--	59
1981	Trask	--	--	132
1984	Trask	--	9	--

Appendix Table D-4. Releases of chinook salmon from STEP programs into Oregon coastal river basins, 1980-85 brood years. Fry = >125 fish/lb; fingerling = 20-125 fish/lb; smolts = <20 fish/lb.

Brood year	Donor stock, race	Thousands released: Fry	Fingerling	Smolts
		CHETCO		
1980	Chetco, fall	25	--	--
1982	Chetco, fall	<1	--	--
1984	Chetco, fall	58	--	--
1985	Chetco, fall	69	14	--
		COOS		
1982	Coos, fall	24	15	--
1983	Coos, fall	29	15	--
1984	Coos, fall	30	24	--
1985	Coos, fall	--	55	--
		COQUILLE		
1980	Rogue, spring	250	--	--
1981	Coquille, fall	65	18	--
1982	Coquille, fall	115	20	--
1983	Coquille, fall	163	--	--
1984	Coquille, fall	89	--	--
1985	Coquille, fall	50	--	--
		ELK		
1984	Elk, fall	--	270	--
		EUCHRE		
1981	Elk, fall	12	--	11
1982	Elk, fall	42	--	6
1983	Elk, fall	25	2	3
1984	Elk, fall	78	--	26
1985	Elk, fall	78	--	26
		FLORAS		
1982	Floras, fall	10	--	--
1983	Floras, fall	11	--	--

Appendix Table D-4. Continued.

Brood year	Donor stock, race	Thousands released		
		Fry	Fingerling	Smolts
		HUNTER		
1984	Hunter, fall	--	--	2
1985	Hunter, fall	--	10	--
		KILCHIS		
1982	Trask, fall	17	--	--
1983	Trask, fall	101	--	--
1984	Trask, fall	44	--	--
1984	Trask, spring	62	--	--
1985	Trask, fall	19	--	--
1985	Trask, spring	57	--	--
		MIAMI		
1981	Trask, fall	48	--	--
1982	Trask, fall	343	--	--
1983	Trask, fall	166	--	--
1984	Trask, fall	103	--	--
		NECANICUM		
1983	Trask, fall	96	--	--
1984	Trask, fall	194	--	--
1985	Trask, fall	282	--	--
		NEHALEM		
1983	Nehalem, fall	9	--	--
1984	Nehalem, fall	42	--	--
		NESTUCCA		
1981	Trask, fall	48	--	--
1982	Trask, fall	57	--	--
1982	Nestucca, fall	258	--	--
1983	Trask, fall	165	--	--
1984	Trask, fall	97	--	--
1985	Trask, fall	63	--	--
1985	Nestucca, fall	6	--	--

Appendix Table D-4. Continued.

Brood year	Donor stock, race	Thousands released Fry	Fingerling	Smolts
		PISTOL		
1982	Pistol, fall	--	--	7
1983	Pistol, fall	3	--	22
1984	Pistol, fall	--	--	15
1985	Pistol, fall	7	--	35
		ROGUE (Lower)		
1982	Rogue, spring	25	--	--
1982	Rogue, fall	94	90	28
1983	Rouge, fall	108	--	130
1984	Rouge, fall	--	--	140
1985	Rouge, fall	118	36	120
		ROGUE (Upper)		
1984	Rogue, fall	134	--	--
1985	Rogue, fall	124	--	--
		SALMON		
1983	Salmon, fall	58	--	--
1985	Salmon, fall	26	--	--
		SILETZ		
1982	Trask, spring	--	9	--
1983	Trask, spring	--	13	--
1984	Trask, spring	--	12	--
1985	Trask, spring	--	18	--
		TILLAMOOK		
1981	Trask, fall	47	--	--
1982	Trask, fall	87	--	--
1983	Trask, fall	33	--	--
1984	Trask, fall	37	--	--
1985	Trask, fall	30	--	--
		TRASK		
1981	Trask, fall	10	--	--
1983	Trask, fall	16	--	--
1984	Trask, fall	15	--	--
1984	Trask, spring	17	--	--
1985	Nestucca, fall	12	--	--
1985	Trask, spring	53	--	--

Appendix Table D-4. Concluded.

Brood year	Donor stock, race	Thousands released		
		Fry	Fingerling	Smolts
	UMPQUA (North and South)			
1984	North Umpqua, spring	66	--	--
1984	South Umpqua, fall	--	13	--
1985	North Umpqua, spring	162	--	--
1985	South Umpqua, fall	9	--	--
	UMPQUA (Smith River)			
1982	Smith, fall	--	7	--
1983	Smith, fall	--	25	--
1984	Smith, fall	--	26	--
1985	Smith, fall	--	38	--
	WILSON			
1982	Trask, fall	32	--	--
1983	Trask, fall	33	--	--
1984	Trask, fall	16	--	--
1984	Trask, spring	105	--	--
1985	Trask, fall	86	--	--
1985	Trask, spring	110	--	--
	WINCHUCK			
1985	Winchuck, fall	12	--	--

Appendix Table D-5. Releases of chinook salmon from private hatcheries in Oregon coastal river basins, 1973-84 brood years. Except where noted, the average size of fish released was generally larger than 20 fish/lb. OAF = Oregon Aqua Foods; UW = University of Washington; Anad = Anadromous, Inc.

Brood year	Donor stock, race	Thousands released
	BURNT HILL CREEK	
1979	Rogue, fall	99
1979	Rogue, spring	635
1980	Rogue, spring	939
1981	Rogue, fall	59
1981	Rogue, spring	258
1982	Rogue, spring	860
1982	Burnt Hill, spring	146
1983	Burnt Hill, spring	194
1984	Burnt Hill, spring	18
	COOS	
1977	Alsea, fall	129[a]
1978	Coos, fall	19
1978	Rogue, spring	511
1979	Nestucca, fall	25
1979	Trask, fall	76
1979	Alsea, fall	30
1979	Coos, fall	1
1979	Rogue, spring	650
1980	Trask, fall	122[a]
1980	Anad, fall	16
1980	Coos, fall	43
1980	Rogue, spring	712[a]
1981	Anad, fall	140
1981	Coos, fall	19
1981	Rogue, spring	85
1981	Anad, spring	8
1982	Anad, fall	311
1982	Anad, spring	1,052
1983	Anad, fall	815
1983	Anad, spring	1,159
1984	Anad, fall	518[b]
1984	Coos, fall	30
1984	Coos X Anad, fall[c]	490
1984	Anad, spring	427[b]
	SIUSLAW	
1978	Siuslaw, fall	120
1979	Siuslaw, fall	34
1980	Siuslaw, fall	34
1981	Siuslaw, fall	74
1982	Domsea, fall	22
	YAQUINA	
1973	Trask, fall	27[a]
1973	Elk, fall	13
1974	Trask, fall	5
1974	Trask, spring	18
1975	Trask, fall	148
1975	Trask, spring	149
1976	Trask, spring	42[a]
1977	Trask, fall	97
1977	Alsea, fall	99
1977	OAF, fall	39
1977	UW, fall	157
1977	Trask, spring	16
1978	Yaquina, fall	68
1978	OAF, fall	73
1978	Trask, spring	887
1979	Trask X OAF, fall[c]	152[a]
1980	OAF, fall	88
1980	Trask, fall	161
1980	OAF, spring	89
1981	OAF, fall	338
1982	OAF, fall	861
1982	OAF, spring	55
1983	OAF, fall	520
1983	OAF, spring	354
1984	OAF, fall	957[b]
1984	OAF, spring	312

[a] *Some of these fish were smaller than 20 fish/lb.*
[b] *Some of these fish were acclimated to seawater at the listed location and were then transported offshore and released directly in the ocean.*
[c] *The symbol "X" indicates that two stocks were mixed during breeding to produce a "hybrid" stock.*

APPENDIX E

Tables of Data on Estimated Catch of Chinook Salmon by Recreational Anglers in Oregon Coastal River Basins

A single source document in which recreational catch of chinook salmon is reported does not exist, nor is there a complete listing of source documents from which the information may be obtained. Several source documents were reviewed to compile these summaries; extensive effort has been made to ensure that they are complete and accurate. Where source documents presented conflicting accounts of catch, the conflict was resolved through personal judgment of the authors. We make no judgment here on the accuracy of the individual catch estimates that are listed here; however, these lists accurately summarize catch estimates that have been prepared for use by biologists and the public over about the last 40 years.

Appendix Table E-1. Estimates of the catch of chinook salmon in certain Oregon coastal rivers 1947-60. A = adult chinook salmon and J = jack chinook salmon as defined by angling regulations; during this time fish of 20 inches or greater in total length were classified as adults.

[These estimates were obtained by extrapolating from angler catch records (compiled by one or more moorages in the tidal reaches of each river) to periodic counts of boats (made from car or an airplane). The estimates were usually made in weekly periods and then compiled over the period sampled (usually about September-October) to obtain an annual catch estimate. Anecdotal observations by anglers, game wardens, and biologists served as a basis for judgmental estimates of additional catch that occurred in the rivers above tidewater.]

Year	Alsea		Coquille		Nehalem		Nestucca	
	A	J	A	J	A	J	A	J
1947[a]	150	--	--	--	380	--	590	--
1948[a]	150	--	--	--	570	--	470	--
1949[a]	150	--	190	--	350	--	130	--
1950	130	95	113[b]	41[b]	282	86	221	28
1951	149	50	40[b]	7[b]	176	73	232	16
1952	286	154	107[b]	15[b]	308	92	675	146
1958[c]	475	843	--	--	--	--	--	--
1959[c]	286	198	--	--	--	--	--	--
1960[a]	188	--	--	--	--	--	--	--

Year	Siletz		Siuslaw		Tillamook Bay and tributaries	
	A	J	A	J	A	J
1947[a]	--	--	--	--	340[d]	--
1948[a]	--	--	--	--	270[d]	--
1949[a]	--	--	240	--	760[d]	--
1950	137	38	38[b]	21[b]	558	46
1951	264	41	43[b]	17[b]	496	101
1952	309	42	61[b]	233[b]	1,257	132
1958[c]	723	469	398	249	--	--
1959[c]	2,069	541	1,614	1,535	--	--
1960	761	--	--	--	--	--

[a] *Jacks were not estimated.*
[b] *No data from bank fishery.*
[c] *June or July to November, tidewater catch only.*
[d] *Boat estimate based on upper bay fishery only.*

Appendix Table E-2. Estimates of the annual catch of chinook salmon by recreational anglers in Oregon coastal river basins, 1962-85.

[These estimates were based on "punch card" catch records and were obtained from several source documents, which are listed in **APPENDIX B**: 1962-68 from Phelps (1973); 1969-78 from Berry (1980); and 1979-85 from ODFW (1987). All estimates presented here have been corrected for nonresponse bias, even though estimates reported for 1969 and 1970 were uncorrected in the source document. Minor differences exist between the catch estimates reported in these documents for some individual river basins and years. These differences were avoided by limiting the years in which estimates were taken from each source document to prepare this summary.]

Year, mean	Alsea Fall-run	Alsea Spring-run	Chetco (Fall-run)	Coos (Fall-run)	Coquille (Fall-run)	Elk (Fall-run)	Floras (Fall-run)
1962	--	--	--	--	--	493	10
1963	--	--	--	--	--	1,129	92
1964	--	--	--	--	--	859	190
1965	--	--	--	--	--	573	42
1966	--	--	--	--	--	1,498	77
1967	--	--	--	--	--	643	226
1968	--	--	--	--	--	556	42
1969	2,344	76	1,099	--	398	727	207
1970	1,881	25	2,709	--	460	2,175	286
1971	1,188	30	3,224	215	936	1,099	571
1972	534	10	4,590	87	329	1,685	109
1973	706	5	1,243	113	390	1,118	217
1974	424	11	1,855	163	308	2,144	156
1975	652	17	3,642	199	1,092	3,535	151
1976	1,147	7	3,269	331	1,022	2,290	105
1977	1,102	25	2,557	414	868	3,961	72
1978	1,345	4	5,436	517	1,330	2,561	211
1979	1,799	21	1,538	369	685	3,003	105
1980	1,579	31	1,749	546	608	925	54
1981	2,795	55	1,215	421	683	527	52
1982	2,088	53	1,436	645	616	1,574	105
1983	1,709	50	1,145	307	614	2,003	95
1984	2,250	50	966	378	662	1,647	171
1985	1,824	44	1,656	616	696	956	78
Mean, 1977-85	1,832	37	1,966	468	751	1,906	105

Appendix Table E-2. Continued.

Year, mean	Hunter (Fall-run)	Nehalem (Fall-run)	Nestucca Fall-run	Nestucca Spring-run	Pistol (Fall-run)	Rogue Fall-run	Rogue Spring-run
1962	118	--	--	--	98	2,781	--
1963	116	--	--	--	145	6,254	--
1964	390	--	--	--	152	4,586	3,916
1965	100	--	--	--	76	3,417	7,829
1966	92	--	--	--	104	3,359	5,361
1967	129	--	--	--	59	3,175	4,046
1968	265	--	--	--	84	2,976	4,356
1969	114	558	2,303	247	285	3,117	12,737
1970	143	288	2,516	99	99	1,993	8,118
1971	226	506	3,627	340	94	2,557	9,456
1972	251	300	2,751	245	303	2,512	9,367
1973	53	198	2,737	242	32	3,145	6,301
1974	80	178	2,434	482	64	3,527	6,804
1975	123	106	2,681	624	115	2,032	5,088
1976	7	101	2,850	430	11	2,100	4,471
1977	44	615	3,856	1,045	57	3,590	4,838
1978	75	850	4,781	627	77	2,310	8,366
1979	24	609	3,652	741	96	1,531	11,421
1980	55	815	2,351	789	58	889	7,778
1981	28	480	4,085	1,308	37	2,270	6,225
1982	30	568	2,160	648	36	2,296	7,254
1983	12	449	1,711	568	38	2,381	2,521
1984	6	1,208	2,771	437	22	1,478	1,018
1985	55	741	3,312	242	20	3,598	5,810
Mean, 1977-85	37	704	3,187	712	49	2,260	6,137

Appendix Table E-2. Continued.

Year, mean	Salmon Fall-run	Salmon Spring-run	Siletz Fall-run	Siletz Spring-run	Siuslaw Fall-run	Siuslaw Spring-run	Sixes (Fall-run)
1962	--	--	--	--	--	--	593
1963	--	--	--	--	--	--	645
1964	--	--	--	--	--	--	411
1965	--	--	--	--	--	--	389
1966	--	--	--	--	--	--	462
1967	--	--	--	--	--	--	521
1968	--	--	--	--	--	--	340
1969	204	0	846	93	--	--	649
1970	234	0	485	40	--	--	480
1971	309	0	590	89	237	10	703
1972	170	28	495	39	687	389	350
1973	204	7	372	15	198	25	136
1974	76	0	268	118	146	39	376
1975	127	24	378	100	121	0	1,305
1976	122	26	484	94	148	0	418
1977	598	33	470	237	814	0	637
1978	555	5	1,363	47	968	0	945
1979	568	8	1,441	58	714	0	1,168
1980	658	22	897	18	526	46	394
1981	755	21	2,000	65	597	103	337
1982	654	16	957	42	857	0	577
1983	607	2	915	68	677	0	493
1984	1,154	34	893	62	1,250	0	520
1985	1,157	23	921	49	937	0	279
Mean, 1977-85	745	18	1,095	72	815	17	594

Appendix Table E-2. Continued.

Year, mean	Tillamook Bay and tributaries							
	Bay		Kilchis		Miami		Tillamook	
	Fall-run	Spring-run	Fall-run	Spring-run	Fall-run	Spring-run	Fall-run	Spring-run
1969	2,824	114	246	0	31	6	238	6
1970	1,353	53	181	6	7	4	309	18
1971	2,353	51	374	43	53	0	255	28
1972	1,046	29	166	3	17	0	181	1
1973	1,615	29	248	19	19	4	289	10
1974	1,960	40	155	16	131	0	539	18
1975	658	0	186	29	70	8	458	4
1976	2,266	45	204	22	525	4	17	0
1977	2,395	122	264	48	481	6	184	3
1978	5,180	334	567	94	145	0	346	2
1979	4,445	396	341	22	21	0	162	0
1980	2,750	148	249	6	67	0	237	0
1981	3,531	124	168	0	28	0	195	3
1982	3,244	63	210	6	119	0	173	2
1983	2,450	128	262	0	22	0	287	0
1984	3,116	259	405	9	54	0	369	12
1985	2,645	207	467	0	75	0	255	5
Mean, 1977-85	3,306	198	326	21	112	1	245	3

Appendix Table E-2. Continued.

Year, mean	Tillamook Bay and tributaries (continued)					
	Trask		Wilson		Grand total	
	Fall-run	Spring-run	Fall-run	Spring-run	Fall-run	Spring-run
1969	2,126	303	1,553	10	7,018	439
1970	2,707	295	1,203	51	5,760	427
1971	4,301	1,150	2,253	363	9,589	1,635
1972	1,878	190	901	147	4,189	370
1973	3,413	828	2,054	218	7,638	1,108
1974	5,174	1,182	1,777	287	9,736	1,543
1975	2,357	1,149	1,740	503	5,469	1,693
1976	3,688	1,980	1,492	286	8,192	2,337
1977	5,177	2,516	2,745	887	11,246	3,582
1978	5,976	2,122	4,196	1,004	16,410	3,554
1979	3,177	1,541	4,088	469	12,234	2,428
1980	3,534	1,321	2,097	122	8,934	1,597
1981	3,550	798	4,146	187	11,618	1,112
1982	2,554	798	2,128	232	8,428	1,101
1983	2,077	329	1,633	237	6,731	694
1984	3,280	619	3,383	54	10,607	953
1985	3,765	285	3,019	49	10,226	546
Mean, 1977-85	3,677	1,148	3,048	368	10,715	1,730

Appendix Table E-2. Continued.

Year mean	Umpqua Bay and tributaries: Bay and mainstem Fall-run	Bay and mainstem Spring-run	North Fork Fall-run	North Fork Spring-run	South Fork Fall-run	South Fork Spring-run	Smith (Fall-run)	Grand total Fall-run	Grand total Spring-run
1969	--	--	351	3,600	0	3	3	--	--
1970	--	--	112	1,431	4	14	5	--	--
1971	1,302	7,854	79	1,659	8	4	2	1,391	9,517
1972	1,778	7,236	228	3,973	3	11	3	2,012	11,220
1973	706	3,193	169	2,052	14	0	2	891	5,245
1974	438	2,854	103	2,286	12	5	1	554	5,145
1975	388	4,092	118	1,902	5	37	2	513	6,131
1976	325	3,252	90	2,691	0	57	5	420	6,000
1977	89	1,505	8	1,568	0	14	3	97	3,087
1978	198	1,008	87	1,124	66	3	36	387	2,137
1979	81	1,010	19	737	72	3	42	214	1,750
1980	122	892	15	753	160	6	30	327	1,651
1981	121	1,125	43	1,056	95	32	217	476	2,213
1982	343	1,441	22	848	104	6	162	631	2,295
1983	244	380	18	468	6	6	78	346	854
1984	373	879	37	532	29	3	138	577	1,414
1985	144	944	39	1,161	0	31	216	399	2,136
Mean, 1977-85	191	1,020	32	916	59	12	102	384	1,948

Appendix Table E-2. Concluded.

Year, mean	Winchuck (Fall-run)	Yaquina (Fall-run)
1962	322	--
1963	337	--
1964	269	--
1965	271	--
1966	355	--
1967	153	--
1968	595	--
1969	159	--
1970	388	--
1971	160	351
1972	347	474
1973	248	331
1974	153	715
1975	499	131
1976	619	176
1977	185	472
1978	145	264
1979	150	336
1980	95	342
1981	74	409
1982	86	529
1983	130	329
1984	79	421
1985	71	787
Mean, 1977-85	113	432

APPENDIX F

Percent Age Composition and Average Dressed Weight (Pounds) of Chinook Salmon Landed in Oregon Commercial Ocean Fisheries, 1970-77 and 1982-86

(These are preliminary estimates that were available when this report was prepared.)

Catch year	Age 2	Age 3	Age 4	Age 5	Age 6	Weight
1970	0.1	69.8	28.2	1.8	--	10.2
1971[a]	0.2	68.7	28.3	2.2	0.1	9.7
1972	--	42.8	52.7	4.5	--	10.2
1973	tr	67.7	30.1	2.1	0.1	9.4
1974	1.1	51.2	41.8	5.3	0.5	10.2
1975[a]	0.6	65.5	29.0	3.4	0.1	11.5
1976	0.3	63.9	32.4	3.3	0.1	10.4
1977	0.3	69.7	26.8	3.2	0.1	10.2
1982	1.5	84.3	13.4	0.8	tr	10.1
1983	0.5	70.8	28.2	0.4	--	8.2
1984	0.4	74.8	23.4	1.3	0.1	8.5
1985	2.1	66.1	25.4	6.0	0.4	9.4
1986	0.4	93.5	5.5	0.5	0.1	8.4

[a] *The deviation of the cumulative percent from 100 is unexplained.*

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