PACIFIC SALMON COMMISSION
JOINT CHINOOK TECHNICAL COMMITTEE
1990 ANNUAL REPORT

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List of Acronyms

ACRONYM	DEFINITIONS
ADF&G	Alaska Department of Fish & Game
AEQ	Adult Equivalent
AWG	Analytical Working Group
CBC	Central British Columbia Fishing area - Kitimat to Cape Caution
CDFO	Canadian Department of Fisheries & Oceans
CNR	Chinook Non Retention - all species except chinook fisheries
CR	Columbia River
CRITFC	Columbia River Intertribal Fish Commission
CTC	Chinook Technical Committee
CWT	Coded Wire Tags
est+fw	Estuary Plus Fresh Water Area
FR	Fraser River
GS	Strait of Georgia
IDFG	Idaho Department of Fish & Game
mar	Marine Area
mar+fw	Marine Plus Fresh Water Area
MSY	Maximum Sustainable Yield for a stock, in adult equivalents
MSY ER	Exploitation Rate sustainable at the escapement goal for a stock, in adult equivalents
NA	Not Available
NBC	Northern British Columbia - Dixon Entrance to Kitimat including Queen Charlotte Islands
NCBC	North Central British Columbia - Dixon Entrance to Cape Caution
NMFS	National Marine Fisheries Service
NOC	Oregon Coastal North Migrating Stocks
NR	Not Representative
NWIFC	Northwest Indian Fisheries Commission
ODFW	Oregon Department of Fish & Wildlife
PFMC	Pacific Fisheries Management Council
PS	Puget Sound
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
QIN	Quinault Nation
SEAK	Southeast Alaska - Cape Suckling to Dixon Entrance
TBR	Transboundary Rivers
USFWS	U.S. Fish & Wildlife Service
UW	University of Washington
WA/OR	Ocean areas off Washington and Oregon North of Cape Falcon
WAC	North Washington Coastal Area (Grays Harbor northward)
WCVI	West Coast Vancouver Island - excluding Area 20
WDF	Washington Department of Fisheries

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INTRODUCTION
THE PACIFIC SALMON TREATY CHINOOK REBUILDING PROGRAM

The Pacific Salmon Treaty established a system of fishery-specific catch and harvest rate restrictions intended to:

> "halt the decline in spawning escapements of depressed stocks; and attain by 1998, escapement goals established in order to restore production of naturally spawning chinook stocks, as represented by indicator stocks identified by the Parties, based on a rebuilding program begun in 1984".

The goal of the program is to rebuild depressed naturally-spawning stocks and restore production through progressive increases in spawning escapements achieved through a combination of catch ceilings in selected mixed-stock fisheries and harvest rate restrictions in non-ceiling, pass-through fisheries. The Pacific Salmon Commission instructed the Chinook Technical Committee to "develop procedures to evaluate progress in the rebuilding of naturally spawning chinook stocks". The February 1987 Chinook Technical Committee Report, "Assessing Progress Toward Rebuilding Depressed Chinook Stocks", established an evaluation framework that documented an indicator stock program, identified information requirements, and recommended analytical procedures for the assessment of rebuilding. The Committee also identified a number of policy issues that had to be resolved before final conclusions could be reached regarding the status of rebuilding on a regional or coastwide basis. Agreement on those issues has not yet been reached.

In assessing the status of individual stocks under the rebuilding program, the Committee identified 3 main elements that must be examined: (1) spawning escapement levels; (2) fishery harvest and stock-specific exploitation rates; and (3) production responses to increases in spawning escapements. The Committee recommended that rebuilding assessment be stratified into 3 phases corresponding with three 5-year chinook life-cycles in the rebuilding period: 1984-1988; 1989-1993; and 1994-1998. The Committee felt that a three-phase approach to assessment would address the problems of changing data availability and quality over time.

This report provides an evaluation through the first phase and first years of the second phase of the rebuilding program using data through 1990. **In order to provide the CTC with additional time to work on other assignments, the scope of the report was slighlty reduced in comparison to the 1989 Annual Report.** However, the report still includes recent catch in fisheries of concern to the Pacific Salmon Commission (Chapter 1), an assessment of spawning escapements for 42 escapement indicator stocks (Chapter 2), and fishery harvest rates and survival indices based on the 37 exploitation rate indicator stocks (Chapter 3).

Adequate escapement information is not available for a number of naturally spawning chinook stocks. Stocks for which escapement information is considered reliable enough to allow assessment are referred to as "escapement indicator stocks".

Information is not available to permit direct measurement of exploitation rates for most naturally spawning stocks. However, exploitation rates measured for hatchery stocks are used to generate estimates for naturally spawning chinook stocks. Analysis of exploitation rates requires a time-series of coded-wire-tag data for a stock. Stocks with a useful time-series of coded-wire-tag data are referred

to as "exploitation rate indicator stocks". These stocks are not generally the same as the escapement indicator stocks.

EXECUTIVE SUMMARY

1990 CHINOOK SALMON CATCHES IN FISHERIES WITH CEILINGS

Estimates of 1990 catch for each fishery managed under a harvest ceiling established by the Treaty are presented below. These data are preliminary, but major changes are not expected.

Area/Fishery a/	Ceiling	Catch	Difference	
			Numbers	Percent
SE Alaska (T,N,S) b/	302	318.5	+16.5	+5.5%
North/Central B.C. (T,N,S) c/	302	254.0	-48.0	-15.9%
West Coast Vancouver Island (T)	360	295.4	-64.6	-17.9%
Georgia Strait (T,S)	275	144.3	-130.7	-47.5%

(Compiled with information available as of October 9, 1991)
a/ T=Troll; N=Net; S=Sport; ceiling and catch reported in thousands.
b/ The actual total catch was 366,800 chinook, including a hatchery addon of 48,300.
c/ Excludes 5,549 chinook caught in terminal areas in 1990, which are excluded from the ceiling.

Catches in all chinook fisheries of interest to the PSC are documented in Table 1.

CUMULATIVE DEVIATIONS FROM CATCH CEILINGS

A 7.5% cumulative management range was established by the Commission in 1987. Catches and deviations from catch ceilings since 1987 (in thousands of fish) are as follows:

Area/Fishery	Ceiling	Catch /a				Total Deviations	Difference	
		1987	1988	1989	1990		Numbers	Percent
SE Alaska (T,N,S) b/	263 e/	265.2	255.2	264.4	318.5	+12.3	+12.3	+4.7%
North/Central B.C. (T,N,S)	263 e/	283.0	245.6	303.0 c/	254.0 c/	-5.4	-5.4	-2.1%
West Coast Vancouver Island (T)	360	378.9	408.7	203.7	295.5	-153.2	-27.0	-7.5% d/
Georgia Strait (T,S)	275	159.0	138.7	162.0	144.3	-496.0	-20.6	-7.5% d/

a/ Compiled with information available as of October 10, 1991.
b/ S.E. Alaska catches exclude hatchery addons of 16,700, 28,700, 26,700, and 48,300 for 1987, 1988, 1989, and 1990 respectively.
c/ Excludes 4,819 chinook caught in terminal areas in 1989, and 5,549 chinook caught in 1990, for a total of 10,368.
d/ Negative deviations below the 7.5% management range can not be accumulated.
e/ The 1990 ceiling was 302,000.

ESCAPEMENT ASSESSMENT

Spawning escapement data were evaluated for a total of 42 indicator stocks to determine their rebuilding status. For the 33 stocks with escapement goals that were classified, 14 (42%) were classified as "Rebuilding" or "Probably Rebuilding" and no stocks were classified as "Not Rebuilding". However, for the second consecutive year, the overall rebuilding status has not improved. Nine (27%) of the indicator stocks were classified as "Indeterminate" (compared to 28% in the 1989 analysis) and 10 (30%) were classified as "Probably Not Rebuilding" (compared to 28% in the 1989 analysis).

	1990		1989	
Category	Number	Percent	Number	Percent
Rebuilding	4	12%	8	22%
Probably Rebuilding 1/	10	30%	7	19%
Indeterminate	9	27%	10	28%
Probably Not Rebuilding	10	30%	10	28%
Not Rebuilding	0	0%	1	3%
	--	----	--	----
Total 2/	33	100%	36	100%

1/ The Stikine (assessed as Rebuilding and Probably Rebuilding based upon the two countries' estimates) was included as Probably Rebuilding for this table.

2/ In 1990, three stocks were not classified, two because their base period average escapements were above their escapement goals and one because escapement data were not provided.

The rebuilding response of the escapement indicator stocks has been highly mixed, with some stocks consistently exceeding their goals and others with recent escapements even below base period levels. Given that most stocks are halfway and the remainder are two thirds through their rebuilding programs, it is of serious concern to the CTC that only 42% (14 of 33) of the escapement indicator stocks with goals are currently classified as Rebuilding or Probably Rebuilding. This percentage is especially discouraging since, in 1987, 70% (23 of 33) were in these top two categories. Of particular concern are the 10 stocks classified as Probably Not Rebuilding. For 7 of these 10 stocks, the average escapement during the rebuilding period has actually declined from the base period level and, for the remaining three stocks, the average escapements have increased by only 16% or less.

The SEAK and TBR stocks have a target rebuilding date of 1995 and are entering the final phase of their 15-year rebuilding program with 56% of the stocks (5 of 9) classified as either Indeterminate (4) or Probably Not Rebuilding (1). Three of these Indeterminate stocks, Blossom, Chickamin, and Unuk, are located in Behm Canal. These three stocks were showing a good rebuilding response up through 1986 and were classified as either Rebuilding or Probably Rebuilding. Since that time, escapements of these stocks have shown a steady decline and, in 1990, their status declined to Indeterminate. Chinook returning in years prior to 1988 may have benefitted from above average survival rates for the 1982 and 1983 broods; survival rates for subsequent broods have declined.

The 31 stocks with a target rebuilding date of 1998 are midway through their rebuilding program and also show a mixed response. Of the seven stocks without goals, the 5 Washington Coastal stocks have shown steady escapement increases while the Lewis River and Oregon Coastal stocks show

recent escapement declines. Of the remaining 24 stocks, 58% (14 of 24) were assessed as Indeterminate (5) or Probably Not Rebuilding (9). None of the stocks assessed as Probably Not Rebuilding shows indications of improving escapement trends.

The lack of a clear, positive, response to the rebuilding program by many of the escapement indicator stocks elevates concerns that all stocks may not achieve their escapement goals by the target dates. The mixed response seen in the SEAK and TBR group in 1990 is of particular concern to the CTC since this group has only 5 years remaining in its rebuilding program. While the other stocks have 8 years remaining to rebuild, the CTC is very concerned by the large number of these stocks that are classified as Probably Not Rebuilding. Even for stocks in the top categories, the future rate of rebuilding is likely to decrease under current management regimes, since survival rates have declined for recent broods.

In view of these survival problems and the failure to achieve even the minimum expected harvest rate reductions in many fisheries, the CTC concludes that a number of stocks will not achieve their escapement goals by the target dates in the absence of additional management actions.

EXPLOITATION RATE ASSESSMENT

The Exploitation Rate Analysis relies upon CWT release and recovery data to estimate indices of fishery harvest rates and the survival of CWT tag groups. The utility of the indices is dependent on how representative the indicator stocks are of the actual populations harvested in the fisheries.

The primary purpose of the analysis of harvest rates is to assess the effectiveness of management measures in PSC fisheries. The PST established ceilings for the SEAK, NCBC, WCVI, and GS fisheries and constrained the catch in other fisheries which harvest depressed natural stocks (pass-through fisheries). The ceilings were expected to result in an immediate reduction in harvest rates (the "1985 target" level). In subsequent years, it was expected that the fixed ceilings and increases in chinook abundance would act in concert to continually reduce harvest rates until rebuilding was completed.

For 1990, the initial 1985 target reductions for total fishing mortalities in PSC ceilinged fisheries were achieved only in the NCBC troll fishery. In 1989, initial 1985 target reductions were achieved for the SEAK, NCBC, and WCVI troll fisheries. When 1985-1990 averages are considered, only the NCBC troll fishery met the 1985 target reduction.

		CHANGE IN FISHERY HARVEST RATE FROM BASE Total Mortality							1985
Fishery	Age(s)	1985	1986	1987	1988	1989	1990	1985-90 Average	Target Reduction
SEAK Troll	3,4,5	9%	-22%	0%	-35%	-34%	-8%	-15%	-22%
NCBC Troll	3,4,5	-21%	-8%	-18%	-49%	-35%	-37%	-28%	-16%
WCVI Troll	3,4	-9%	-1%	-22%	4%	-53%	-6%	-15%	-24%
GS Troll/Sport	3,4,5	-47%	-22%	-32%	-29%	-8%	-34%	-29%	-47%
WA/OR Ocean S/T	3,4	-39%	-49%	-29%	-26%	25%	49%	-12%	[a/]

[a/] No target reductions were established for Washington and Oregon ocean fisheries.

Trends in the fishery indices for the SEAK and NCBC troll fisheries were consistent with expectations through 1989. The trend was not maintained in the SEAK troll fishery in 1990, where the harvest rate index increased by 39% relative to 1989. The increase in the harvest rate most likely resulted from the increase in the ceiling in 1990 and a reduction in abundance. The fishery index for the NCBC troll fishery in 1990 was 37% below the base period and near the value observed for 1989. Although the ceiling for all gear in this fishery was also increased in 1990, the catch in the troll fishery actually declined by 20% to compensate for the NCBC cumulative deviation through 1989.

Harvest rates in the WCVI troll fishery have varied considerably since 1985. The 1985-1990 average reduction in the harvest rate of 15% is 9 percentage points above the 1985 target reduction. The 1990 Letter of Transmittal indicated that the fishery would be managed in 1990 to achieve the average harvest rate in the years 1985-1987. The 1990 estimated reduction in the fishery index of 6% fell short of the 11% reduction that would have been consistent with the intent of the Letter of Transmittal.

Harvest rates in the combined GS sport and troll fishery continued to exceed the initial 1985 target reduction by a substantial margin. After increasing in 1989, harvest rates in 1990 in these combined fisheries declined by 34% relative to the base period. The index remains 13 percentage points above the 1985 target reduction.

The fishery index for the WA/OR sport and troll fisheries exceeded base period levels for the second consecutive year. Harvest rates for this fishery have been increasing since 1986, and the 1990 index is 49% above the base period level. Stock specific indices for this fishery indicate that harvest rates for Puget Sound stocks have increased significantly more than for Columbia River stocks.

The abundance of chinook in the fishing areas must exceed recent abundances to further reduce brood year ocean exploitation rates under a fixed catch ceiling policy. Below-average survivals are projected for 10 of 11 major stock groups contributing to fisheries operating under PSC ceilings. Only one stock group, WCVI fall, is expected to have above average survival. Survivals for 4 of the 5 major stock groups contributing to the SEAK and NCBC fishery are projected to range from approximately 50% to 80% below their long-term averages. Survivals for all 6 major stock groups contributing to the WCVI fisheries are projected to range from 22% to 73% below average. Lastly, survival for the 5 major stock groups contributing to Strait of Georgia fisheries is projected to range from 22% to 73% below average.

RECOMMENDATIONS

1. ***Additional management actions should be undertaken in order to increase the probability that stocks achieve their spawning escapement goals by the end of the rebuilding program.*** The failure to achieve even the 1985 target reduction in harvest rates in all ceiling fisheries except NCBC, the lack of progress toward rebuilding by many stocks, and the expectations for reduced survival indicate that additional management actions will be required if stocks are to meet their escapement goals by their target dates. The management actions required will depend upon the stocks involved and the definitions ultimately adopted by the PSC for successful completion of the rebuilding program. Two complementary types of management actions should be considered:

a) The management regimes in ceiling fisheries should be reassessed to determine if additional management actions are required to achieve expected reductions in harvest rates. Management actions in pass-through fisheries should be checked for consistency with an agreed upon definition of pass-through.

b) Stock specific alternative management actions should be considered for stocks which will not rebuild with PST management actions following from a) above.

2. ***Policy issues of what constitutes rebuilding/rebuilt should be resolved.*** Southeast Alaska and Transboundary stocks are entering the final phase of the 15 year rebuilding program, and the remaining stocks will be past the midpoint of the program in 1991. The advanced status of the rebuilding program, and the poor progress of some stocks, make it imperative that rebuilding/rebuilt be defined immediately. The definition should include provisions for stocks without escapement goals, or escapement goals should be established for all escapement indicator stocks.

3. ***Policy issues and information needs for interpretation of the pass-through provision should be resolved.*** A definition of pass-through is required in order to assess if this provision of the PST has been met.

4. ***Data limitations which are compromising the ability of the CTC to complete the escapement and exploitation rate analyses should be eliminated.*** General research needs of the CTC will be addressed in detail in a report which is currently under preparation. Data needs for the annual report which have not been completely satisfied include the following:

   a) ***Report estimated CWT recoveries to the PSMFC by July of the year following the fishery.*** As requested by the PSC, the CTC is currently conducting the Exploitation Rate analysis on a year-out basis. However, estimated recoveries for the 1988 and 1989 Puget Sound sport fisheries were not available from the PSMFC, nor were final expansions available for the Puget Sound net fishery in 1989 or 1990.

   b) ***Collect and provide information on the age and sex composition of escapement.*** Age specific escapement data is essential to evaluate brood production and escapement goals. Age specific data also improves the quality of the calibration of the CTC Chinook Model.

   c) ***Tag representative Exploitation Rate indicator stocks at sufficient levels.*** The CTC is especially concerned about the adequate representation of spring and summer stocks and the lack of an indicator stock (with escapement data) for the Harrison River stock.

   d) ***Establish consistent and standardized recovery programs for CWT fish at hatcheries and on spawning grounds.*** Accurate estimates of escapement are essential for the Exploitation Rate Analysis. The CTC is concerned that 1) pilot studies have indicated that many tagged fish may not be successfully identified at hatcheries, 2) CWT fish which do not return to the hatchery may not be accounted for on a consistent basis, and 3) standard procedures to estimate escapement are not used by some hatcheries in SEAK. In addition, standardized procedures should be instituted for enumeration of marked and unmarked releases and tag retention rates.

e) ***Provide estimates of sublegal encounter rates in troll fisheries and legal and sublegal encounter rates in chinook non-retention fisheries.*** The CTC has estimated that non-landed catch mortality is approximately 30-50% of the reported catch (TCCHINOOK (87)-5). However, sampling programs to determine the magnitude and stock composition of the non-landed catch mortality are nearly nonexistent.

5. ***A consistent procedure for CTC review of proposed changes in escapement goals should be established.*** The escapement goals established by the management agencies provide the basis for the CTC assessment of rebuilding. Modification of an escapement goal can affect the results of the assessment, and hence, the perceived progress toward rebuilding. To assure consistency with the objectives of the PST, a standard procedure for CTC review of changes in escapement goals should be established.

CHAPTER 1. 1990 CHINOOK CATCH

1.1 1990 CHINOOK SALMON CATCHES IN FISHERIES WITH CEILINGS

Estimates of 1990 catch for each fishery managed under a harvest ceiling established by the Treaty are presented below. These data are preliminary, but major changes are not expected.

Area/Fishery a/	Ceiling	Catch	Difference	
			Numbers	Percent
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Georgia Strait (T,S)	275	144.3	-130.7	-47.5%~

(Compiled with information available as of October 9, 1991)

a/ T=Troll; N=Net; S=Sport; ceiling and catch reported in thousands.

b/ The actual total catch was 366,800 chinook, including a hatchery addon of 48,300.

c/ Excludes 5,549 chinook caught in terminal areas in 1990, which are excluded from the ceiling.

Catches in all chinook fisheries of interest to the PSC are documented in Table 1.

1.2 CUMULATIVE DEVIATIONS FROM CATCH CEILINGS

A 7.5% cumulative management range was established by the Commission in 1987. Catches and deviations from catch ceilings since 1987 (in thousands of fish) are as follows:

Area/Fishery	Ceiling	Catch /a				Total Deviations	Difference	
		1987	1988	1989	1990		Numbers	Percent
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Georgia Strait (T,S)	275	159.0	138.7	162.0	144.3	-496.0	-20.6	-7.5% d/

a/ Compiled with information available as of October 10, 1991.

b/ S.E. Alaska catches exclude hatchery addons of 16,700, 23,700, 26,700, and 48,300 for 1987, 1988, 1989, and 1990 respectively.

c/ Excludes 4,819 chinook caught in terminal areas in 1989, and 5,549 chinook caught in 1990, for a total of 10,368.

d/ Negative deviations below the 7.5% management range can not be accumulated.

e/ The 1990 ceiling was 302,000.

1.3 REVIEW OF FISHERIES WITH CATCH CEILINGS

1.3.1 S.E. Alaska Fisheries

In 1990, Southeast Alaska fisheries were managed under the following provisions established by the Pacific Salmon Commission:

1. an all-gear base catch ceiling of 263,000 plus 39,000 chinook salmon;

2. an Alaska hatchery addon calculated on the basis of coded-wire-tag sampling; and

3. a 7.5% management range, calculated in numbers of fish, for cumulative deviations from the base catch ceiling beginning in 1987. This is equivalent to +/- 19,700 chinook for a 263,000 base catch ceiling.

Preliminary data for 1990 indicate the following:

1. The total all-gear catch (commercial and recreational) was 366,800 chinook salmon, including a hatchery addon of 48,300.

2. The 1990 Alaska hatchery addon, calculated on the basis of coded-wire-tag recoveries, was 48,300 chinook. This yielded a total 1990 catch ceiling of 350,300 chinook. The addon was calculated as the estimated total Alaska hatchery harvest of 59,000 chinook reduced by 5,000 for pre-Treaty hatchery harvest and 5,700 for estimation error risk adjustment.

3. The deviation of the 1990 Southeast Alaska chinook catch from the base ceiling was +16,500. Combined with a positive deviation of 2,200 in 1987, a negative deviation of -7,800 in 1988, and a positive deviation of 1,400 in 1989, the cumulative deviation for Southeast Alaska is 12,300 chinook or +4.7%.

The 1990 Southeast Alaska all-gear harvest of 366,800 chinook salmon consisted of a commercial harvest of 315,600 and a recreational harvest of 51,200. Alaska hatcheries contributed an estimated 59,000 chinook salmon or 16.1% of the total harvest.

Troll Fisheries: The troll fishery harvest of 287,900 chinook included 33,100 harvested in the winter fishery (October 1, 1989 to April 14, 1990), 7,200 in experimental and terminal hatchery fisheries (June 5-June 29), 34,800 in June special hatchery access fisheries (June 5-7 and June 21-23), and 212,800 during the general summer season (July 1-July 22 and August 23 and 24). The 1990 winter troll catch was similar to the 1985 to 1989 average of 33,700. The 1990 general summer troll season opened July 1 and remained open for 22 days through July 22. Approximately 201,000 chinook were harvested during this period for an average catch rate of 9,100 chinook per fleet day. This was lower than the 1988 and 1989 summer season rates of 13,500 and 12,900 chinook per fleet day. The summer troll season opened for an additional 2 days on August 23 and 24. A total of 11,800 were harvested (6,000 per fleet day). About 6.8% of the chinook harvested during the summer troll season were produced by Alaska hatcheries, compared to 13.4% and 26.8% harvested during the winter troll season and the June openings, respectively.

Chinook non-retention regulations were implemented from July 23-August 12 and August 25-September 20. The troll fishery was closed to all fishing August 13-22 and September 21-30. As in past years during non-retention periods, several outer coastal areas with high chinook abundance were closed to all trolling to reduce chinook salmon hook and release mortality. Troll harvest of other species during the summer season included 1.8 million coho, 0.8 million pink, 63,100 chum, and 9,200 sockeye salmon.

Net Fisheries: The 1990 commercial catch included 27,700 chinook harvested incidentally in net fisheries. Chinook represent less than 0.1% of the total net harvest of 35 million salmon. Net fisheries are managed for a guideline harvest level of 20,000 chinook (excluding Alaska hatchery harvest) established by the Alaska Board of Fisheries. The 1990 incidental net harvest was 14% above the 1989 harvest of 24,300, 29% above the 1988 catch of 21,500 and 79% above the 1987 catch of 15,500. Net harvest of chinook is limited for the purse seine fishery by a 28-inch minimum size limit and non-retention regulations. Net harvest for the gillnet fisheries is limited by early season closures and some night closures.

Recreational Fisheries: Recreational fisheries are managed under a two-chinook-per-day bag limit and a 28-inch minimum size limit. No recreational harvest guideline has been established by the Alaska Board of Fisheries. The 1990 harvest of 51,200 chinook is about 25,400 fish above the 1985 to 1989 average.

1.3.2 Canadian Fisheries

The minimum size limit for troll fisheries in all areas except the Strait of Georgia remained at 67 cm fork length. Catch statistics for commercial fisheries are based on sales slips accumulated through the week ending October 9, 1991. These data are preliminary.

North/Central B.C.: The 1990 North/Central B.C. fisheries were managed under the following provisions:

1. An all gear base catch ceiling at 302,000.

2. A 7.5% management range, with cumulative deviations calculated since 1987. Based on preliminary 1989 catch estimates and terminal exclusion calculation procedures, the cumulative deviation was estimated at 38,000. The 1990 management goal, therefore, was 264,000.

Preliminary 1990 results were:

1. The total all gear catch was 259,000.

2. Terminal exclusions, estimated at 5,549 (TCChinook 91-2).

Area	Base Catch	Catch		Exclusion		
		1989	1990	1989	1990	Total
Skeena	2,400	6,902	6,844	4,502	4,444	8,946
Bella Coola	2,800	3,117	3,905	317	1,105	1,422
Total				4,819	5,549	10,368

3. Annual deviations were recalculated using final 1989 data and revised terminal exclusion estimation procedure. Deviations were +20,000 in 1987, -17,400 in 1988, +40,000 in 1989 and -48,000 in 1990, for a cumulative deviation of -5,400 (-2.1%).

Troll Fisheries: The 1990 troll fishery opened for all species on June 28 and closed September 30, with chinook non-retention after August 18 (43 days of chinook non-retention). Exceptions were:

1. A portion of northern Hecate Strait adjacent to the Skeena River (Area 4) was closed to trolling from August 5 to August 14 as a coho conservation measure.

2. The majority of the west coast of the Queen Charlotte Islands closed to trolling August 14.

3. All North/Central Coast areas closed to chinook trolling August 18.

4. The western portion of northern Hecate Strait closed to trolling August 25 to reduce chinook shakers.

Net Fisheries: Catch of chinook in North/Central areas was 46,400. Catch by fishery was 8,100 in the Queen Charlotte Island, 19,800 for the Skeena/Nass and 10,800 in the Central Coast.

Recreational Fisheries: The tidal water sport fishery catch was 32,000. Catch by fishery was 16,800 in the Queen Charlotte Islands, 4,300 for the Skeena/Nass and 10,800 in the Central Coast catch.

West Coast Vancouver Island Troll:

The 1990 management objective for the WCVI troll fishery was the base catch ceiling of 360,000. However, management was constrained by a conservation concern for Harrison chinook which required that harvest rate not exceed the 1985-87 average. This harvest rate average translated into a season of about 77 days open for chinook retention.

The fishery opened on June 28 with all areas open, except Areas S and G (Fig. 1). There were four major area/time closures on the west coast of Vancouver Island in 1990:

1. Areas 127 and 130-1 were closed from August 3 until August 23. This action was taken to prevent shaker and enforcement problems with sockeye and pink salmon.

2. Complete closure to all trolling from August 17 to August 22 followed attainment of the sockeye allocation.

3. Conservation Areas F1, F2, G and B were closed September 1 (Fig. 1). This action was taken to reduce the coho catch rate.

4. The same areas as in (3) above, plus chinook conservation area A and waters shoreward of chinook conservation area B closed on September 7 (Fig. 1). This action was taken to reduce coho and juvenile chinook shaker catches.

Chinook fishing closed on September 13, for a total of 72 days open to chinook fishing. There was no chinook non-retention period in 1990. Chinook catch in 1990 for the WCVI troll fishery was 295,400.

Strait of Georgia:

Troll: The management objective was a catch ceiling of 31,000 chinook. The ceiling was reduced to this level in 1988 to achieve a 20% harvest rate reduction as part of a conservation plan for lower Strait of Georgia chinook.

The troll fishery opened for chinook on June 28 and continued through September 30. Chinook non-retention fisheries did not occur in 1990. Chinook catch by trollers was 32,400.

Recreational: The 1990 management objective for the Strait of Georgia recreational fishery was to maintain a 20% harvest rate reduction on lower Strait of Georgia chinook. Consequently, the management plan implemented in 1989 was continued in 1990. This plan consists of the following management actions:

1. An annual bag limit of 15 chinook and a size limit of 62 cm was implemented for the area north of Cadboro Point (north of Victoria in Statistical area 19B), including Johnstone Strait. These measures represent an increase in the bag limit (from 8 to 15) for the Strait of Georgia recreational fishery compared to 1988.

2. For Johnstone Strait, the daily bag limit was reduced from 4 to 2 chinook, the season limit was reduced from 30 to 15, and the size limit was increased from 45 cm to 62 cm.

The estimated 1990 catch in the creel survey area (including the Victoria area but excluding Johnstone Strait) was 111,900. Effort in 1990 totalled 543,400 boat trips. Recreational effort in the Strait was similar to 1986 and 1987, but reduced from 1988 and 1989.

An evaluation of the lower Strait of Georgia chinook conservation program is currently in progress.

1.4 REVIEW OF OTHER FISHERIES

1.4.1 Canadian Fisheries

Transboundary Rivers: Chinook catch in the Canadian gillnet fishery was: Taku River - 1,258 chinook adults and 128 jacks; and Stikine River - 1,617 chinook adults and 700 jacks.

Southern B.C. Commercial Net:

Area (Stat. Area)	Catch (chinook > 5 lb.)
Johnstone Strait (11-13)	18,000
Strait of Georgia (14-19)	1,200
Fraser River (28,29)	13,500
Juan de Fuca Strait (20)	7,200
Barkley Sound (23)	29,000
Other WCVI (21,22,24-27)	400

The fishery in Barkley Sound is a terminal gillnet fishery that operates in Alberni Inlet.

Area 12 Troll: Catch is reported as 2,300 chinook.

Tidal Recreational: Catch estimate for the 1990 Barkley Sound recreational fishery is 61,000, of which 19,500 were taken in the terminal fishery inside Alberni Canal and 41,800 in Barkley Sound. The catch in Alberni Canal was 19,500 and in Barkley Sound was 41,800. The survey period covered from July 15 to September 30. Catch estimates for sport fisheries off WCVI and in Johnstone Strait are not available.

Non-tidal Recreational: Non-tidal recreational fisheries occur in most B.C. rivers, including the Alsek, Skeena, Nass, Kitimat, Bella Coola, Somass and Fraser Rivers and various streams on the east coast of Vancouver Island. Chinook catch was estimated at 555 in the Alsek, 9,700 in northern B.C. rivers (Areas 1-10), and 1,813 in the Fraser River. Chinook fisheries occurred in 9 areas of the Fraser River (Bowron, Quesnel, Bridge, Clearwater, Shuswap, South Thompson, Thompson, Vedder-Chilliwack and Lower Fraser Rivers). However, catch estimates were unavailable for the lower Fraser River and Vedder-Chilliwack.

Indian Food Fisheries:

Fishing Area	Adult Catches	Jack Catch
North/Central B.C.	28,000	-
Somass River	6,500	-
Fraser River	17,900	-
Stikine	663	259
Alsek	173	-
Cowichan + Squamish	1,676	-

The 1990 Fraser River catch was slightly above the 1980's average of 16,700. Catches in the Cowichan and Squamish Rivers were up 34% from the 1,253 reported for 1989. The higher catch in 1990 was attributable to increased fishing effort in the Squamish River. The fishery operated from June 1 to September 30 with a two week closure in August, which applied to off-reserve areas.

1.4.2 U.S. Fisheries

Strait of Juan de Fuca: Estimates of 1990 net catch in the Strait of Juan de Fuca total 5,100 chinook, compared to 9,900 in 1989. The tribal troll fishery harvested a total of 45,700 chinook, 30% below the 65,300 harvested in 1989. Tribal catch in Area 4B during the May 1 - September 30 PFMC management period has been included in the North of Cape Falcon troll summary.

Recreational catch estimates for 1990 in Areas 5 and 6 are not available at this time. After the PFMC fishery closed, about 400 chinook were caught in the Area 4B state waters fishery, compared to 500 in 1989. Preliminary 1989 recreational chinook catch for all three areas is estimated at 52,500, compared to 39,400 in 1988.

San Juan Islands: Preliminary 1990 estimates of chinook net catch in the San Juan Islands total 8,800, compared to 16,100 in 1989.

Recreational catch estimates for 1990 in Area 7 are not available at this time. In 1989, about 9,500 chinook were caught in this area, compared to 9,400 in 1988.

Puget Sound: Recreational and commercial fisheries in Puget Sound were regulated by time and area closures to protect depressed spring chinook stocks. Preliminary estimates of 1990 net catch in Puget Sound total 179,300, compared to 156,400 in 1989. Puget Sound recreational catch estimates for 1990 are not available at this time. Recreational chinook catch for 1989 in Areas 8-13 is estimated at 69,900, compared to 62,700 in 1988.

Washington Coast: Ocean escapements of northern Washington coastal stocks were above minimum spawning levels, allowing both commercial and recreational fisheries. Preliminary 1990 estimates of

Grays Harbor and Willapa Bay net catch total 41,500 chinook, compared to 52,700 in 1989. The 1990 commercial net fisheries in north coastal rivers harvested an estimated 16,300 chinook, compared to 32,200 in 1989.

Columbia River: The 1990 Columbia recreational and commercial gillnet fisheries again experienced a substantial reduction in harvest, continuing the recent decline from peak catches in 1988. The commercial gillnet fisheries catch is estimated at 150,900 chinook compared to 274,900 in 1989 and 491,300 in 1988. The freshwater recreational fisheries including the Buoy 10 fishery, harvested 77,900 chinook compared to 84,300 in 1989 and 94,000 in 1988. Treaty Indian ceremonial and subsistence fisheries harvested an additional 6,900 upriver spring chinook in mainstem Columbia River fisheries. The commercial gillnet fisheries were directed primarily at surplus Lower River Spring and Upriver Bright Fall chinook stocks, while providing protection for depressed Upriver Spring, Summer and Tule hatchery fall chinook stocks. No incidental commercial impacts on the Upriver Summer chinook run occurred in 1990 or 1989 because of the lack of a summer sockeye fishery. This is in contrast to 1988 when 1,200 adult summer chinook were incidentally harvested during the target sockeye fisheries.

Ocean Fisheries North of Cape Falcon: In 1990, ocean commercial and recreational fisheries operating in the Pacific Fisheries Management Council (PFMC) region north of Cape Falcon were constrained by domestic chinook quotas. Separate quotas were established for the tribal troll and non-tribal fisheries.

Under PFMC quota management, ocean fisheries are terminated either when coho or chinook quotas are achieved or when seasons expire. Overall, in 1990, chinook catch success was poor, consistent with 1990 pre-season expectations for low abundance of key stocks. Most chinook quotas were not fully harvested. Preliminary estimates of 1990 tribal troll chinook catch total 31,200, 100% of the quota. Preliminary estimates of non-tribal chinook catch total 66,900, about 89% of the quota. Recreational catches are estimated at 33,100 (3,300 Oregon and 29,800 Washington). Non-tribal troll catches are estimated at 33,800 (2,500 Oregon and 31,300 Washington), of which approximately 25,900 were taken during the early season chinook fishery.

In 1990, an experimental fishery was conducted in the ocean waters inside three miles and north of Destruction Island to Cape Alava. This was a limited participation fishery designed to collect GSI data for fall chinook off the Quillayute River and to determine if target harvesting of local chinook stocks was possible. The fishery ran from September 15 to October 31 and a total of 11 chinook were landed.

Ocean Fisheries Cape Falcon to Humbug Mountain: Ocean fisheries in Oregon's central coast area harvest a mixture of chinook primarily from southern stocks not involved in the PSC rebuilding program. These stocks do not migrate to any great extent north into PSC jurisdiction. Some stocks that spawn in Oregon coastal streams do migrate into PSC fisheries and include the North Oregon Coastal (NOC) stock aggregate. These north migrators are harvested only incidentally (probably $< 10\%$) in Oregon fisheries in this area.

An all salmon except coho troll fishery began on May 1; the major species harvested is chinook. The all species troll fishery (chinook and coho) opened as follows: July 4 for the area Cascade Head (Lat. 45 05"N) to Humbug Mt. (Lat. 42 40"N) and July 16 Cape Falcon (Lat. 45 45"N) to Cascade Head

along the central coast. Measures were taken to decrease coho incidental mortality during chinook only fishing, to reduce harvest impacts on Klamath stock chinook, and to distribute the catch equitably between ports. The troll fishery for coho was closed on July 31 south of Cascade Head and August 31 from Cape Falcon to Cascade Head, while chinook fishing continued in both areas until October 31. Troll chinook catch in this area was substantially below the last five year average as only 232,500 chinook were landed in 1990. This is considerably less than the past two years when 469,700 and 353,400 chinook were landed in 1988 and 1989.

Sport angling was conducted as follows: May 1 to May 28 in state waters, May 28 to September 16 all waters with two one week closures intended to reduce coho incidental mortality and to extend the season until mid September. The sport catch of chinook in this area was 10,400 in 1990. This compares to the sport catch of 16,100 and 9,400 in 1988 and 1989.

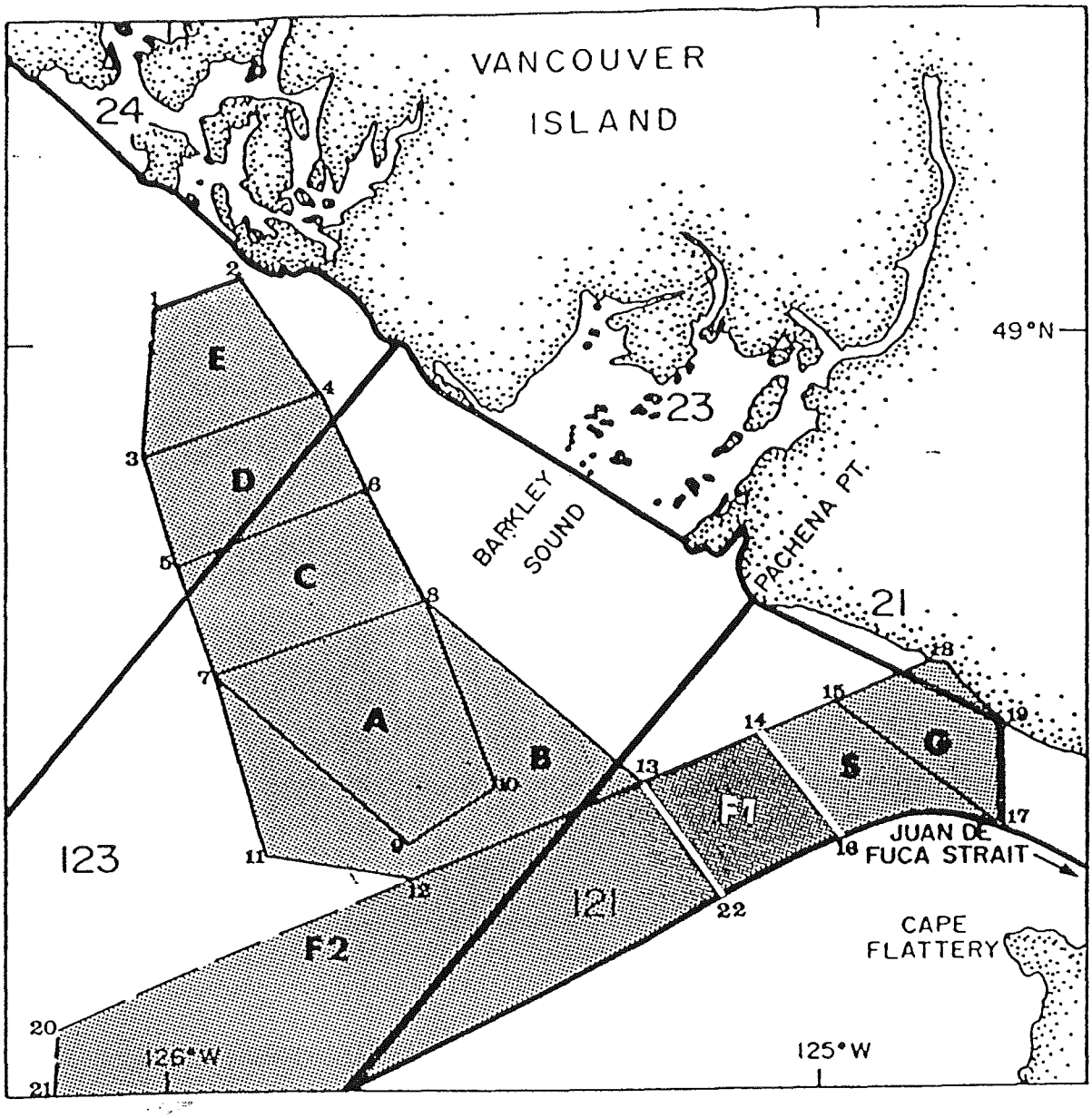
The only troll fishery harvesting predominately NOC stocks is the late season near-shore fishery off the mouth of Elk River (Lat. 43 N), which was not conducted in 1990 due to conservation concerns. This fishery harvested 4,500 chinook in 1989.

Table 1-1. Summary of the 1987-1990 Chinook catches in fisheries relevant to the U.S./Canada Pacific Salmon Treaty (numbers in thousands of fish). Note: Catches for 1990 are preliminary (estimates as of 9 - Oct - 91).

	Troll				Net				Sport				Total			
Area	1990	1989	1988	1987	1990	1989	1988	1987	1990	1989	1988	1987	1990	1989	1988	1987
S.E. ALASKA a/	288	236	231	242	28	24	21	16	51	31	26	24	367	291	278	282
BRITISH COLUMBIA b/c/																
North/Cent. Coast	181	225	182	240	41	42	44	29	32	36	19	14	254	303	245	283
W. Vanc. Island	296	204	409	379	29	40	15	1	61	48	33	32 d/	386	292	457	412
Georgia St./Fraser	32	29	20	38	15	24	8	13	112	133	119	121 e/	159	186	147	172
Johnstone St.	2	2	2	2	18	29	6	14	10	10	10	10	30	41	18	26
Juan de fuca Strait	0	0	0	0	7	22	4	7				e/	7	22	4	7
sub-total	511	460	613	659	110	157	77	64	215	227	181	177	836	844	871	900
WASHINGTON INSIDE																
Strait (mar) f/	46	65	49	45	5	10	10	11	NA	52	39	53 i/	NA	127	98	109
San Juans (mar) g/	1	1	0	0	9	16	32	29	NA	9	9	14 i/	NA	26	41	43
Other PS (mar+fw) h/	0	0	0	0	179	156	133	127	NA	70	63	59 i/	NA	226	196	186
Coastal (mar+fw) h/	0	0	0	0	58	85	74	51	NA	6	7	3 i/	NA	91	81	54
sub-total	47	66	49	45	251	267	249	218	NA	137	118	129	NA	470	416	392
COLUMBIA RIVER j/k/	-	-	-	-	151	275	491	483	78	84	94	84	229	359	585	567
WA/OR N OF FALCON	65	75	108	81	0	1	3	4	33	21	19	45	98	97	130	130
OREGON																
Inside Waters l/	0	5	4	3	-	-	-	-	NA	42	49	47	NA	47	53	50
GRAND TOTAL	911	842	1005	1030	540	724	841	785	NA	542	487	506	NA	2108	2333	2321

a/ Southeast Alsaka troll chinook catches shown for Oct. 1 - Sep 30 catch counting year.
b/ British Columbia net catches includes only fish over 5 lb. round weight. Native food fishery catches are not included. 1989 and 1990 exclude catch from terminal gillnet fisheries (2 year total of 10,368) which are excluded from the catch ceiling.
c/ Sport catches are for tidal waters only.
d/ Estimates of tidal sport catches are from creel surveys in Barkely Sound only. Survey times and areas may vary from year to year.
e/ Georgia Strait sport catches include Juan de Fuca Striat sport catches.
f/ Strait troll catch includes all catch in areas 5 and 6C and catch in area 4B outside of the PFMC management period (May - September).
g/ San Juan net catch includes catch in areas 6, 6A, 7 and 7A; sport catch includes area 7.
h/ Coastal and Puget Sound sport catches include marine and freshwater, but only adults freshwater.
i/ Numbers adjusted for punch card bias. See "1988 WA State Sport Catch Report" for details.
j/ Columbia River net catches include Oregon, Washington and treaty catches, but not ceremonial.
k/ Columbia River sport catches include adults only, for Washington, Oregon, Idaho and Buoy 10 anglers.
l/ Troll = late season troll off Elk River mouth (Cape Blanco); sport = estuary and inland (preliminary for 1987-89).

FIGURE 1. 1990 CONSERVATION AREAS



Conservation Area A
Conservation Area B
Conservation Area C
Conservation Area D
Conservation Area E
Conservation Area F1
Conservation Area F2
Conservation Area G
Swiftsure Bank S

CHAPTER 2. ESCAPEMENT ASSESSMENT OF REBUILDING THROUGH 1990

2.1 INTRODUCTION

Escapement information has been compiled for a set of indicator stocks representing the majority of naturally spawning chinook stocks from central Oregon to Southeast Alaska. Spawning escapements of these stocks were assessed as one measure of rebuilding progress since implementation of conservation actions under the Pacific Salmon Treaty (PST). Assessment focused on: (1) changes in average escapements since the base period years; (2) comparison of recent escapements with a linear trend from the escapement base period to the goal at the rebuilding target date; and (3) trends in escapements since PST implementation.

For SEAK and transboundary (TBR) stocks, conservation actions began in 1981 as part of a 15-year rebuilding program. For all other stocks, a 15-year rebuilding program was implemented in 1984. These rebuilding programs were divided into three 5-year Phases (TCCHINOOK (87)-2) with slightly more stringent assessment criteria used in each successive Phase. In 1990, all stocks were in Phase II, with SEAK and TBR stocks in the tenth year and the remainder in the seventh year of their rebuilding program.

In this chapter, we present the results of a rebuilding assessment based upon escapement information. Our objective here was to assess the rebuilding status of each escapement indicator stock. Escapement variability, however, can be influenced by a variety of factors such as: brood year abundance, freshwater and marine survival rates, fishery harvest rates, and counting or estimation errors. Consequently, to determine if PST management actions have been effective in initiating rebuilding, the results of this escapement assessment should be considered together with the Exploitation Rate Assessment in Chapter 3.

2.2 FRAMEWORK

2.2.1 Escapement Indicator Stocks

Forty-two naturally spawning escapement indicator stocks were included in the assessment; this is one fewer than in previous years, due to the exclusion of the Chilkat (see section 2.2.2.). These stocks represent distinct naturally spawning populations or management groups that originate from individual rivers or watersheds. Some stocks represent several populations aggregated by region and life history type. Distribution of the indicator stocks by run timing and area of origin is:

	RUN TIMING [1]					
Area	Spring	Spring/ Summer	Summer	Summer/ Fall	Fall	Total
Southeast Alaska	4					4
Transboundary	6					6
Northern British Columbia	1	3	3			7
Southern British Columbia	1	1	1	1	3	7
Washington/Oregon/Idaho	3	2	2	3	8	18
Totals	15	6	6	4	11	42

[1] These run timings are determined by management agencies; criteria used for categorization may differ among agencies.

2.2.2 Escapement and Terminal Run Data

Data Sources: The escapement and terminal run data used in this report were provided by management agencies in each jurisdiction. These data are presented in Appendix A and graphed in Appendix B.

Estimation Methods: The escapement estimates used were measures of actual spawner abundance, where available, or estimates (or indices) of abundance measured at a point of migration beyond the effect of major fisheries. Escapements were estimated using weirs, counting fences, aerial or foot surveys, dam passage counts, electronic counting devices, and mark-recapture studies. Methods depended on river characteristics and agency resources.

Caution is urged against directly comparing escapement levels or goals between stocks since escapements are measured in different units. Escapement estimates are relative measures; differences in escapements may not represent differences between stocks in population abundance or fishery contribution levels.

Some estimation techniques and concerns include:

1. For upper Columbia River spring and summer stocks, Bonneville Dam counts were used but were reduced by the estimated catch of natural fish upriver of the dam.

2. For Columbia Upriver Brights, the McNary Dam count was used; this count was not reduced by estimated catches of Brights by the sport fishery in the Hanford Reach area. It is estimated that this sport fishery has taken between 2,500 and 5,000 fish in recent years.

3. For some stocks, adjustments were made to reduce enhancement related bias. Methods used include: using coded-wire tag (CWT) data to subtract hatchery-origin fish from the escapement estimate (e.g., some Puget Sound stocks), excluding spawners removed for hatchery brood stock (e.g., Upper Georgia Strait, Lower Georgia Strait), or excluding rivers with major enhancement influence (e.g., Kitimat River and adjacent tributaries in Area 6 and Bella Coola River in Area 8).

4. For the Quillayute summer stock, escapements represent a composite of naturally spawning fish from the summer stock and strays from spring stock enhancement. Data are not sufficient to allow complete separation of naturally spawning fish (see Section 2.6.1).

5. Escapements of Oregon coastal north-migrating stocks are not numerical estimates of abundance; instead they are estimates of the density of spawners per river mile for standard survey areas.

6. Management actions taken in the terminal area to protect the Stillaguamish stock have been in effect since 1985. However, run-reconstruction methods used to estimate terminal harvest have not yet been updated to reflect these management changes. As such, reported terminal run sizes for 1985-1990 are likely overestimated.

Changes Relative to the 1989 Annual Report: Changes in escapement data relative to the 1989 Annual Report (TCCHINOOK (90)-3) are summarized below. Minor updates to catch and

escapement data, including updates to preliminary estimates for the most recent years, are not described.

Chilkat: The escapement estimation methods for the Chilkat River are presently under review by the Alaska Department of Fish & Game (ADF&G). No estimates are provided for this system this year, since ADF&G expects that the escapement goal and historical escapement estimates may be revised. For this report, the stock has been removed from all tables and is not assessed.

West Coast Vancouver Island: Following a stock assessment of all chinook salmon populations along the west coast of Vancouver Island, the populations included as the WCVI indicator stock have been revised. The Kennedy River chinook data were omitted since the methods and survey effort for escapement estimation could not be documented. Eight populations are now included: 5 involving enhancement programs (Gold, Burman, Leiner, Tahsis, Marble) and 3 natural populations (Artlish, Kaouk, Tahsish). Programs to estimate the contribution of enhanced chinook to the natural spawning in the former 5 populations are to be implemented. The 3 natural populations are limited to one channel in Kyuquot Sound (Stat. Area 26), but CDFO is also investigating the inclusion of other natural populations in Clayoquot Sound (Stat. Area 24).

Grays Harbor and Quillayute falls: Changes were made to historical Grays Harbor and Quillayute terminal run size estimates to reflect numbers recently agreed upon by the Washington Department of Fisheries and the affected tribes.

2.2.3 Escapement Goals

Origin of Goals: The escapement goals provided by each management agency define long-term stock rebuilding objectives. These goals were established by managers associated with the respective stock's region of origin. Where possible, these goals were based on estimates of stock productivity, usable spawning habitat, or other factors, and represent estimates of escapement levels that produce maximum average production or sustained harvest (e.g., Columbia Upriver spring, summer and bright). For most stocks, interim escapement goals were developed recognizing the uncertainty in data used for establishing goals. For example, Canadian goals are interim targets based on a doubling of base period average escapements. Stock escapement goals may change as new information is acquired.

Seven of the indicator stocks have no escapement goals: Lewis River, Oregon Coastal, Quillayute fall, Hoh spring/summer, Hoh fall, Queets spring/summer and Queets fall. These 7 stocks, referred to as "stocks without goals," are discussed separately from stocks with goals throughout this report. The 5 Washington coastal stocks are managed on the basis of escapement floors and inriver harvest rates; when terminal runs exceed the floor, terminal fisheries are managed on the basis of harvest rates.

Changes Relative to the 1989 Annual Report: Two stocks had escapement goal changes in 1990.

Situk River: The escapement goal for the Situk River was changed from 2,100 to 600 chinook salmon. This change was based upon a spawner-recruit analysis of 1976-1984 data. This change is reflected in the management guidelines outlined in the "1991-1993 Southeast-Yakutat Commercial Fishing Regulations" provided by the Alaska Board of Fisheries.

West Coast Vancouver Island: The escapement goal for this stock was revised to reflect the new populations included as the WCVI indicator stock. The escapement goal of 11,665 is calculated as twice the base period (1979-1982) average escapement.

2.2.4 Assessment Time Frame

For assessment purposes, a base period and a rebuilding assessment period were established for each stock. The rebuilding assessment period included all years, to date, when conservation actions were taken as part of a chinook rebuilding program. The base period included years prior to implementation of conservation actions. Base and rebuilding assessment periods differed among stocks as follows:

SEAK and TBR Stocks: For SEAK and TBR stocks, a 15-year rebuilding program was initiated in 1981, prior to implementation of the PST. The target date for completion of rebuilding is 1995. For these stocks, the base period included the years 1975-1980 and the rebuilding assessment period included the years 1981-1990.

Other Stocks: For all other stocks except the Harrison stock, a 15-year rebuilding program was established for the years 1984-1998. For these stocks, the base period included the years 1979-1982 and the rebuilding assessment period included the years 1984-1990. For the Harrison River stock, pre-1984 escapement data are unavailable; consequently the Harrison base period was defined as 1984 and the rebuilding assessment period included the years 1985-1990.

2.3 ASSESSMENT METHOD

2.3.1 Stock Assessment and Scoring

Stocks With Escapement Goals: Three assessment criteria were used to evaluate the rebuilding progress of stocks with escapement goals:

1. The mean criterion assessed the magnitude of escapement changes by comparing averages of base period and rebuilding assessment period escapements for each stock. A difference between the two time periods of greater than 10% was accepted as a change between periods. Stocks were scored as follows: (a) stocks with increases of greater than 10% were scored +1; (b) stocks with decreases of greater than 10% were scored -1; and (c) stocks with changes of 10% or less were judged to show an uncertain response and scored 0.

2. The line criterion assessed escapements for consistency with a linear approximation of the expected rebuilding schedule. For each stock, a base period average escapement was established. A straight line was drawn from this base period average across the 15-year rebuilding program to the escapement goal in 1995 for SEAK and TBR stocks and in 1998 for all other stocks.

   For each stock, the most recent 3 escapements (1988-1990) were compared with the linear approximation. Stocks were scored as follows: (a) stocks with all three escapement values on or above the line were scored +1; (b) stocks with all three points below the line were scored -1; and (c) stocks that did not meet either condition were scored 0.

Regardless of escapement levels at the initiation of the rebuilding program, the linear approximation assumes for each stock that, (a) the escapement goal will be achieved at the target date (not before or after), and (b) escapement will increase by a constant number in each year until that time. Neither assumption is consistent with theoretical stock-recruit models or observed escapement trends. Development of more realistic rebuilding schedules would require numerous assumptions about stock productivity and future marine survivals, as well as policy decisions concerning rebuilding. The straight line was selected as an acceptable alternative.

3. The trend criterion identified escapement trends since PST implementation. Slopes were calculated for 1984-1990 escapement data. R-squared values were used as a measure of the strength of a linear trend in the data. R-squared values vary from 0 to 1, with a higher value indicating a stronger linear trend. Stocks were scored as follows: (1) stocks that had positive slopes with r-squared values of greater than 0.25 were scored +1; (2) stocks that had negative slopes with r-squared values of greater than 0.25 were scored -1; and (3) all other stocks were scored 0.

   An r-squared value was selected to identify stocks with and without minimal positive or negative trends in escapement during the rebuilding assessment period. The selection of the r-squared value was not intended to measure statistical confidence in the slope values.

Stocks Without Escapement Goals. Stocks without escapement goals were assessed using the mean and the trend criteria. Evaluation of these 2 criteria was the same as for stocks with escapement goals. These stocks could not be assessed for the line criterion since base-to-goal lines could not be drawn.

2.3.2 Stock Classification

Stocks With Escapement Goals: Because each criterion addresses a different aspect of stock status, a classification system based on all 3 criteria was developed:

1. For each stock, scores were summed across all three criteria.

2. Stocks were classified according to the following system (all stocks are currently in Phase II):

Status of Stock	Total Score of Criteria		
	Phase I	Phase II	Phase III
Rebuilding	+3	+3	+3
Probably Rebuilding	+2	+2	+2
Indeterminate	+1,0,-1	+1,0	+1
Probably Not Rebuilding	-2	-1,-2	0,-1
Not Rebuilding	-3	-3	-2,-3

   This system uses more stringent criteria in Phases II and III, reflecting our recognition that as the rebuilding target date approaches, our expectations for improvement increase and the time remaining for rebuilding diminishes.

3. After completing steps (1) and (2), the resulting classifications were evaluated by the CTC; stocks classified as Indeterminate were considered for possible status changes.

Stocks Not Classified: The following stocks with escapement goals were not classified in one of the five rebuilding categories.

Quillayute summer and Situk: Due to updates in the escapement goals for these two stocks, they now have base period average escapement levels that are higher than their respective escapement goals (see section 2.2.3 for explanation of Situk, see TCCHINOOK (90)-3, Chapter 2, Page 12, for explanation of Quillayute). Because these stocks were not depressed at the beginning of the rebuilding period, it is inappropriate to evaluate their rebuilding progress. Changes in average escapement from base period years and trends in escapements since Treaty implementation for these stocks were calculated and are reported in Table 2-3a. However, the rebuilding status of these two stocks was not assessed. An evaluation system needs to be developed to monitor the status of stocks such as these that are not depressed.

Chilkat: The Chilkat stock was not evaluated because ADF&G determined that the escapement numbers should not be used until the review of estimation methods has been completed.

Stocks Without Escapement Goals: For the 7 stocks without escapement goals, classifieations such as Rebuilding or Not Rebuilding are inappropriate. Stocks were evaluated as follows:

1. For each stock, scores were summed across the mean and trend criteria.

2. Stocks were classified according to the following system:

Phase II Status	Total Score of Criteria
Increasing	+2,+1
Indeterminate	0
Decreasing	-1,-2

2.3.3 Assessment by Run Type

The assessment by run type is currently under review and is not reported this year.

2.3.4 Changes in Assessment Procedures Relative to 1989 Report

No changes in assessment procedures were made, although 2 stocks (Situk and Quillayute summer) were not assessed because they had base period escapements above their escapement goals and one stock (Chilkat) was not assessed because escapement data were not provided.

2.4 RESULTS

2.4.1 Rebuilding Categories

Stocks With Escapement Goals: Individual stock results for the 3 rebuilding criteria are shown in Table 2-1a. Of the 35 stocks with escapement goals, 33 were categorized. Based upon these results, the 33 stocks were distributed among the 5 rebuilding categories as follows:

Rebuilding and Probably Rebuilding: Forty-two percent of the stocks were assessed in these 2 categories (Tables 2-2a, 2-3a), the same as in 1989. These included of 4 of 9 stocks (44%) in the tenth year of rebuilding and 10 of 24 stocks (42%) in the seventh year of rebuilding. The Nass stock was included in this group; this stock was moved by the CTC from Indeterminate to Probably Rebuilding (see Section 2.5).

Indeterminate: Twenty-seven percent of the stocks were classified as Indeterminate (Tables 2-2a, 2-3a), compared to 28% in 1989. These included 4 of 9 stocks (44%) in the tenth year of rebuilding and 5 of 24 stocks (21%) in the seventh year of rebuilding.

Probably Not Rebuilding: Thirty percent of the stocks were classified as Probably Not Rebuilding (Tables 2-2a, 2-3a,), compared to 28% in 1989. These included 1 of 9 stocks (11%) in the tenth year of rebuilding and 9 of 24 stocks (38%) in the seventh year of rebuilding. The Harrison and Columbia Upriver summer stocks were included in this group; these stocks were moved by the CTC from Indeterminate to Probably Not Rebuilding (see Section 2.5).

Not Rebuilding: No stocks were classified as Not Rebuilding. In 1989, the Harrison River was the only stock that received this classification.

STOCKS WITH ESCAPEMENT GOALS

	1990		1989	
Category	#	%	#	%
Rebuilding	4	12%	8	22%
Probably Rebuilding 1/	10	30%	7	19%
Indeterminate	9	27%	10	28%
Probably Not Rebuilding	10	30%	10	28%
Not Rebuilding	0	0%	1	3%
TOTAL 2/	33	100%	36	100%

1/ The Stikine (assessed as Rebuilding and Probably Rebuilding based upon the two countries' estimates) was included as Probably Rebuilding for this table.

2/ In 1990, three stocks were not classified, two because their base period average escapements were above their escapement goals and one because escapement data were not provided.

Stocks Without Escapement Goals: Individual stock results for the two assessment criteria are shown in Table 2-1b. Based upon these results, stocks were distributed among the three status categories as follows:

Increasing: All seven of the stocks (100%) were classified as Increasing (Tables 2-2b, 2-3b), the same number as in 1989. These stocks showed increasing trends since implementation of the PST rebuilding program.

Indeterminate: None of the seven stocks were classified as Indeterminate. In 1989, the Lewis River stock was incorrectly assessed as Indeterminate. It should have been assessed as Increasing.

STOCKS WITHOUT ESCAPEMENT GOALS

Category	1990 #	1990 %	1989 #	1989 %
Increasing	7	100%	7	100%
Indeterminate	0	0%	0	0%
Decreasing	0	0%	0	0%
TOTAL	7	100%	7	100%

TABLE 2-1a. Assessment results through 1990 for natural chinook indicator stocks with escapement goals.

						MEAN CRITERION				LINE CRITERION		TREND CRITERION	
						Mean Escapement		Change		Comparison			
			Esc.	1990	1990	Base	Rebuild.	Between Periods		with line		1984-1990 Trend	
Stock Name	Region	Run type	Goal	Esc.	% of Goal	Period	Period	Number	Percent	# Above	# Below	Slope	r2
Situk	SEAK	spring	600	700	117%	1299	1116	-183	-14%			-214	0.61
King Salmon	SEAK	spring	250	168	67%	92	212	120	131%	2	1	-5	0.11
Andrew Creek	SEAK	spring	750	1062	142%	379	721	343	90%	3	0	86	0.40
Blossom	SEAK	spring	1280	411	32%	163	947	784	481%	0	3	-136	0.17
Keta	SEAK	spring	800	970	121%	407	1109	702	172%	3	0	54	0.13
Alsek (US est)	TBR	spring	5000	2264	45%	4028	2925	-1103	-27%	0	3	95	0.06
Alsek (Can est)	TBR	spring	12500	3102	25%	5255	3882	-1373	-26%	0	3	127	0.07
Taku (US est)	TBR	spring	25600	21278	83%	7978	11775	3796	48%	1	2	1977	0.78
Taku (Can est)	TBR	spring	30000	24498	82%	9575	14232	4656	49%	1	2	2168	0.77
Stikine (US goal)	TBR	spring	13440	17568	131%	7887	17316	9429	120%	3	0	1859	0.39
Stikine (Can goal)	TBR	spring	25000	17568	70%	7887	17316	9429	120%	2	1	1859	0.39
Unuk	TBR	spring	2880	946	33%	1469	2210	741	50%	1	2	-239	0.34
Chickamin	TBR	spring	1440	902	63%	338	1374	1036	306%	2	1	-146	0.33
Yakoun	NBC	summer	1580	2000	127%	788	1586	798	101%	3	0	329	0.63
Nass	NBC	spr/sum	15890	12103	76%	7944	12010	4066	51%	2	1	4	0.00
Skeena	NBC	spr/sum	41770	55976	134%	20883	56024	35141	168%	3	0	2538	0.34
Area 6 Index	CBC	summer	5520	281	5%	2761	1721	-1039	-38%	0	3	-192	0.18
Area 8 Index	CBC	spring	5450	2385	44%	2725	2948	224	8%	0	3	-453	0.56
Rivers Inlet	CBC	spr/sum	4950	4039	82%	2475	4195	1720	70%	2	1	161	0.03
Smith Inlet	CBC	summer	2110	510	24%	1055	624	-431	-41%	0	3	-10	0.00
W. Coast Van. Is.	WCVI	fall	11665	6110	52%	5832	5558	-274	-5%	0	3	260	0.20
Upper Geor. St.	GS	sum/fall	5100	2200	43%	2546	4090	1545	61%	1	2	-55	0.00
Lower Geor. St.	GS	fall	22280	7605	34%	11139	6075	-5064	-45%	0	3	-75	0.00
Upper Fraser	FR	spring	24460	35907	147%	12229	33222	20994	172%	3	0	590	0.03
Middle Fraser	FR	spr/sum	21130	26060	123%	9216	21650	12434	135%	3	0	1004	0.14
Thompson	FR	summer	55710	41995	75%	22059	39843	17784	81%	3	0	1214	0.21
Harrison	FR	fall	241700	177375	73%	120837	117632	-3205	-3%	1	2	-5645	0.05
Skagit spring	PS	spring	3000	1902	63%	1217	1982	766	63%	1	2	21	0.00
Skagit sum/fall	PS	sum/fall	14900	17206	115%	13265	13321	56	0%	1	2	-476	0.06
Stillaguamish	PS	sum/fall	2000	842	42%	817	964	148	18%	0	3	-13	0.01
Snohomish	PS	sum/fall	5250	4209	80%	5028	4245	-782	-16%	0	3	-77	0.07
Green	PS	fall	5800	7035	121%	5723	6847	1124	20%	3	0	1123	0.53
Quillayute summer	WAC	summer	1200	1300	108%	1250	1029	-221	-18%			214	0.57
Grays Harbor spr.	WAC	spring	1400	1500	107%	450	1757	1307	290%	3	0	161	0.15
Grays Harbor fall	WAC	fall	14600	16500	113%	8575	18643	10068	117%	3	0	1343	0.16
Col. UpR. spring	CR	spring	84000	28800	34%	28050	30657	2607	9%	0	3	1029	0.09
Col. UpR. summer	CR	summer	85000	25000	29%	23100	26657	3557	15%	0	3	861	0.26
Col. UpR. bright	CR	fall	40000	57600	144%	28325	98643	70318	248%	3	0	-86	0.00

TABLE 2-1b. Assessment results through 1990 for natural chinook indicator stocks without escapement goals.

				MEAN CRITERION				TREND CRITERION	
				Mean Escapement		Change			
Stock Name	Region	Run type	1990 Esc.	Base Period	Rebuild. Period	Between Periods Number	Percent	1984-1990 Trend Slope	r2
Quillayute fall	WAC	fall	13700	5850	10929	5079	87%	957	0.45
Hoh spr/summer	WAC	spr/sum	3900	1325	2429	1104	83%	568	0.75
Hoh fall	WAC	fall	4200	2875	3714	839	29%	457	0.51
Queets spr/summer	WAC	spr/sum	1800	925	1329	404	44%	246	0.56
Queets fall	WAC	fall	10700	3875	6929	3054	79%	1068	0.85
Lewis	CR	fall	17506	13021	12901	-120	-1%	2093	-0.80
Oregon Coastal 1/	NOC	fall	125	91	142	51	56%	7	0.16

1/ Oregon Coastal assessment is based upon index escapement.

TABLE 2-2a. Assessment scores and status through 1990 of natural chinook indicator stocks with escapement goals.

Stock Name	Region	Run type	Assessment Scores				Rebuilding Status Through 1990	Status Change from 1989
			Mean	Line	Trend	Total		
Situk 1/	SEAK	spring					Unclassified	
King Salmon	SEAK	spring	1	0	0	1	Indeterminate	Decline
Andrew Creek	SEAK	spring	1	1	1	3	Rebuilding	
Blossom	SEAK	spring	1	-1	0	0	Indeterminate	
Keta	SEAK	spring	1	1	0	2	Probably Rebuilding	Decline
Alsek (Can. & US est)	TBR	spring	-1	-1	0	-2	Probably Not Rebuilding	
Taku (US & Can est)	TBR	spring	1	0	1	2	Probably Rebuilding	Improvement
Stikine (US est)	TBR	spring	1	1	1	3	Rebuilding	
Stikine (Can est)	TBR	spring	1	0	1	2	Probably Rebuilding	Decline
Unuk	TBR	spring	1	0	-1	0	Indeterminate	
Chickamin	TBR	spring	1	0	-1	0	Indeterminate	Decline
Yakoun	NBC	summer	1	1	1	3	Rebuilding	
Nass	NBC	spr/sum	1	0	0	1	Probably Rebuilding 2/	
Skeena	NBC	spr/sum	1	1	1	3	Rebuilding	
Area 6 Index	NBC	summer	-1	-1	0	-2	Probably Not Rebuilding	
Area 8 Index	CBC	spring	0	-1	-1	-2	Probably Not Rebuilding	
Rivers Inlet	CBC	spr/sum	1	0	0	1	Indeterminate	
Smith Inlet	CBC	summer	-1	-1	0	-2	Probably Not Rebuilding	
W. Coast Van. Is.	WCVI	fall	0	-1	0	-1	Probably Not Rebuilding	
Upper Geor. St.	GS	sum/fall	1	0	0	1	Indeterminate	
Lower Geor. St.	GS	fall	-1	-1	0	-2	Probably Not Rebuilding	
Upper Fraser	FR	spring	1	1	0	2	Probably Rebuilding	
Middle Fraser	FR	spr/sum	1	1	0	2	Probably Rebuilding	
Thompson	FR	summer	1	1	0	2	Probably Rebuilding	
Harrison	FR	fall	0	0	0	0	Probably Not Rebuilding 2/	Improvement
Skagit spring	PS	spring	1	0	0	1	Indeterminate	
Skagit sum/fall	PS	sum/fall	0	0	0	0	Indeterminate	Improvement
Stillaguamish	PS	sum/fall	1	-1	0	0	Indeterminate	
Snohomish	PS	sum/fall	-1	-1	0	-2	Probably Not Rebuilding	
Green	PS	fall	1	1	1	3	Rebuilding	
Quillayute summer 1/	WAC	summer					Unclassified	
Grays Harbor spr.	WAC	spring	1	1	0	2	Probably Rebuilding	Decline
Grays Harbor fall	WAC	fall	1	1	0	2	Probably Rebuilding	Decline
Col. UpR. spring	CR	spring	0	-1	0	-1	Probably Not Rebuilding	
Col. UpR. summer	CR	summer	1	-1	1	1	Probably Not Rebuilding 2/	
Col. UpR. bright	CR	fall	1	1	0	2	Probably Rebuilding	

1/ These stocks had base period average escapements above goal and were not classified. See text for details.
2/ The status of these stocks was changed from Indeterminate due to stock-specific circumstances.

TABLE 2-2b. Assessment scores and status through 1990 of chinook indicator stocks without escapement goals.

Stock Name	Region	Run type	Assessment Scores			Status	
			Mean	Trend	Total	Through 1990	Change from 1989
Quillayute fall	WAC	fall	1	1	2	Increasing	None
Hoh spr/summer	WAC	spr/sum	1	1	2	Increasing	None
Hoh fall	WAC	fall	1	1	2	Increasing	None
Queets spr/summer	WAC	spr/sum	1	1	2	Increasing	None
Queets fall	WAC	fall	1	1	2	Increasing	None
Lewis	CR	fall	0	1	1	Increasing	None
Oregon Coastal	NOC	fall	1	0	1	Increasing	None

2.4.2 Status Changes Relative to 1989

Stocks With Escapement Goals: Of the stocks with escapement goals that were classified, 10 of 33 (30%) changed status relative to 1989 (Table 2-2a). Three stocks (9%) moved to higher categories and 7 stocks (21%) moved to lower categories.

Stocks Without Escapement Goals: No stocks showed status changes relative to 1989 (Table 2-2b).

2.4.3 1990 Escapements Relative to Escapement Goals

In 1990, 12 of the 35 stocks with goals had 1990 escapements that were 52% or less of their escapement goal (Table 2-1a). Of the remaining stocks, 13 had 1990 escapements that were above their escapement goals (the Stikine was above the U.S. but below the Canadian goal). One stock above goal, Situk, achieved this status due to a reduction in the escapement goal (see section 2.2.3).

2.5 STOCKS WITH STATUS CHANGED BY THE CTC

The CTC looked at each stock in the Indeterminate category and considered whether or not to change its status to Probably Rebuilding or Probably Not Rebuilding. The decision was made to change the status of the following stocks:

2.5.1 Nass

The initial classification of Indeterminate resulted from a relatively low 1988 escapement value. This 1988 value, however, reflected poor enumeration conditions in one of the major tributaries. Given the uncertainty of this value and the long term increasing trend in escapement, the CTC revised the Nass status to Probably Rebuilding.

2.5.2 Harrison

The initial classification of Indeterminate was an improvement of two categories from 1989. This improvement resulted from a large 1990 escapement that reflected elevated 1986 brood survival as well as benefits of reduced WCVI harvest rates. A poor age 3 escapement in 1990 and reduced 1988 brood survival indicate escapement will decline in 1991. In view of the above, and the marginal Line Criterion test result, the CTC revised the Harrison status to Probably Not Rebuilding.

2.5.3 Columbia Upriver Summers

The initial stock classification of Indeterminate was thought to be overly optimistic. Escapement levels for this stock have been well below the rebuilding goal and have declined in recent years. Escapement for the summer stock in 1990 was down from 1989 and just 29% of the goal. For these reasons, the CTC revised the Columbia Upriver Summer status to Probably Not Rebuilding.

2.6 OTHER STOCK SPECIFIC NOTES

2.6.1 Quillayute Summers

The designation "summer" is used to distinguish this native stock from an earlier run non-native enhanced spring stock that is managed for hatchery production. Because run timing overlaps to some extent and data are not available to separate naturally spawning fish from the enhanced component, future inclusion of this stock as an escapement indicator stock is currently under review.

2.7 DISCUSSION AND CONCLUSIONS

The rebuilding response of the escapement indicator stocks has been highly mixed, with some stocks consistently exceeding their goals and others with recent escapements even below base period levels. Given that most stocks are halfway and the remainder are two thirds through their rebuilding programs, it is of serious concern to the CTC that only 42% (14 of 33) of the escapement indicator stocks with goals are currently classified as Rebuilding or Probably Rebuilding. This percentage is especially discouraging since, in 1987, 70% (23 of 33) were in these top two categories (Figure 2-1). Of particular concern are the 10 stocks classified as Probably Not Rebuilding. For 7 of these 10 stocks, the average escapement during the rebuilding assessment period has actually declined from the base period level and, for the remaining three stocks, the average escapements have increased by only 16% or less (Table 2-1a).

The SEAK and TBR stocks have a target rebuilding date of 1995 and are entering the final phase of their 15-year rebuilding program with 56% of the stocks (5 of 9) classified as either Indeterminate (4) or Probably Not Rebuilding (1). Three of these Indeterminate stocks, Blossom, Chickamin, and Unuk, are located in Behm Canal. These three stocks were showing a good rebuilding response up through 1986 and were classified as either Rebuilding or Probably Rebuilding. Since that time, escapements of these stocks have shown a steady decline and, in 1990, their status declined to Indeterminate. Chinook returning in years prior to 1988 may have benefitted from above average survival rates for the 1982 and 1983 broods; survival rates for subsequent broods have declined.

The 31 stocks with a target rebuilding date of 1998 are midway through their rebuilding program and also show a mixed response. Of the seven stocks without goals, the 5 Washington Coastal stocks have shown steady escapement increases while the Lewis River and Oregon Coastal stocks show recent escapement declines. Of the remaining 24 stocks, 58% (14 of 24) were assessed as Indeterminate (5) or Probably Not Rebuilding (9). None of the stocks assessed as Probably Not Rebuilding shows indications of improving escapement trends.

The lack of a clear, positive, response to the rebuilding program by many of the escapement indicator stocks elevates concerns that all stocks may not achieve their escapement goals by the target dates. The mixed response seen in the SEAK and TBR group in 1990 is of particular concern to the CTC since this group has only 5 years remaining in its rebuilding program. While the other stocks have 8 years remaining to rebuild, the CTC is very concerned by the large number of these stocks that are classified as Probably Not Rebuilding. Even for stocks in the top categories, the future rate of rebuilding is likely to decrease under current management regimes, since survival rates have declined for recent broods.

In view of these survival problems and the failure to achieve even the minimum expected harvest rate reductions in many fisheries (documented in Chapter 3), the CTC concludes that a number of stocks will not achieve their escapement goals by the target dates in the absence of additional management actions.

Table 2-3a. Rebuilding Status Through 1990 of Natural Chinook Indicator Stocks with Escapement Goals

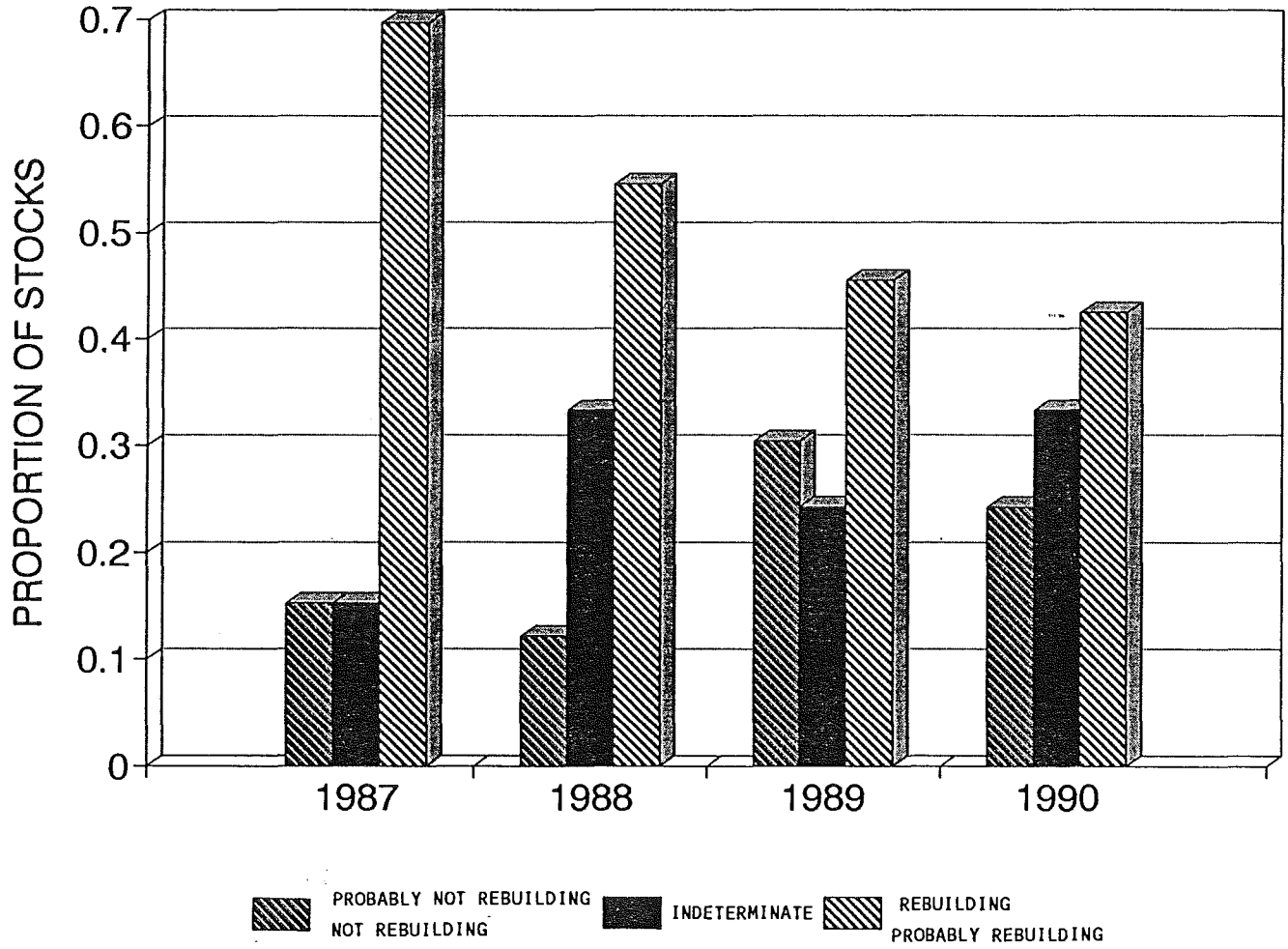
REBUILDING	REGION	RUN TYPE
STOCKS IN 10TH YEAR OF REBUILDING		
Andrew Creek 1/	SEAK	spring
Stikine (US est)	TBR	spring
PROBABLY REBUILDING		
Keta 1/	SEAK	spring
Taku (US & CAN est)	TBR	spring
Stikine (CAN est)	TBR	spring
INDETERMINATE		
King Salmon	SEAK	spring
Blossom	SEAK	spring
Unuk	TBR	spring
Chickamin	TBR	spring
PROBABLY NOT REBUILDING		
Alsek (Can and US est)	TBR	spring
STOCKS IN 7TH YEAR OF REBUILDING		
REBUILDING		
Yakoun 1/	NBC	summer
Skeena 1/	NBC	spring/summer
Green 1/	PS	fall
PROBABLY REBUILDING		
Nass 2/	NBC	spring/summer
Upper Fraser 1/	FR	spring
Middle Fraser 1/	FR	spring/summer
Thompson	FR	summer
Grays Harbor spring 1/	WAC	spring
Grays Harbor fall 1/	WAC	fall
Col. Upriver bright 1/	CR	fall
INDETERMINATE		
Rivers Inlet	CBC	spring/summer
Upper Georgia Strait	GS	summer/fall
Skagit spring	PS	spring
Skagit summer/fall	PS	summer/fall
Stillaguamish	PS	summer/fall
PROBABLY NOT REBUILDING		
Area 6 Index	CBC	summer
Area 8 Index	CBC	spring
Smith Inlet	CBC	summer
W. Coast Van. I.	WCVI	fall
Lower Georgia Strait	GS	fall
Harrison 2/	FR	fall
Snohomish	PS	summer/fall
Col. Upriver spring	CR	spring
Col. Upriver summer 2/	CR	summer

1/ Escapement of these stocks has been above the escapement goal for at least 4 of the last 5 years.
2/ Status of these stocks was altered from Indeterminate (see text for details).

Table 2-3b. Rebuilding Status Through 1990 of Natural Chinook Indicator Stocks without Escapement Goals

STOCK STATUS	REGION	RUN TYPE
INCREASING		
Quillayute fall	WAC	fall
Hoh spring/summer	WAC	spring/summer
Hoh fall	WAC	fall
Queets spring/summer	WAC	spring/summer
Queets fall	WAC	fall
Lewis	CR	fall
Oregon Coastal	NOC	fall

FIGURE 2.1 NUMBER OF ESCAPEMENT INDICATOR STOCKS BY REBUILDING CATEGORY.



CHAPTER 3. EXPLOITATION RATE ANALYSIS
Based on CWT Recovery Data Through Calendar Year 1990

3.1 INTRODUCTION

The Exploitation Rate Analysis provided in this report relies upon coded wire tag (CWT) release and recovery data to estimate indices of fishery harvest rates and the survival of CWT tag groups. The index for fishery harvest rates is used to assess effectiveness of management measures in PSC fisheries. Reduced survival rates can result in increased harvest rates in fisheries with ceilings and reductions in escapement. Assuming constant production, the analysis of survival indices provides a short-term projection of stock abundance for broods contributing to fisheries in future years.

3.1.1 Overview

A total of 37 "exploitation rate indicator stocks" with usable time series of CWT recovery data was used in the analysis for 1990 (Table 3-1). Stocks in the analysis include 1 from Southeast Alaska, 8 from British Columbia, 15 from Puget Sound, 4 from the Washington Coast, and 9 from-the Columbia River. As in previous years, these indicators are dominated by fall-type stocks.

The indicator stocks employed include 5 stocks which were not used in last year's analysis. The 5 stocks added in 1990 are Snootli Creek (a tributary to the Bella Coola River in central B.C.), the Kitimat River (located in north B.C.), the Hoko River (located on the U.S. side of the Juan de Fuca Strait), the Sooes River (located near Cape Flattery on the north coast of Washington), and Lyons Ferry Hatchery (located on the Snake River). Additional stocks from all areas are likely to be added as data needs are identified and recoveries become available.

The two new stocks from British Columbia are the first to provide information for stocks originating from north/central British Columbia. Although no escapement data are available, the CWT recovery data can be used to estimate the catch distribution and indices of survival. The Snootli Creek program was initiated as a pilot project in 1975; full production was implemented in 1981. The Kitimat program provides supplementary production for a number of rivers in the upper Kitimat Arm area. Although the hatchery utilizes a number of sources for brood stock, only fish originating from the Kitimat River were used in this analysis.

The Sooes and Hoko stocks are tagged as part of a harvest rate indicator program initiated in Washington in 1985 and discussed in an earlier report (TCCHINOOK (87)-2, Appendix 3, Summary of Chinook Escapement and Harvest Rate Indicator Stocks For Puget Sound and Washington Coast). Tagging of the Lyons Ferry stock was initiated in 1984. This stock is currently thought to be representative of fall chinook from the Snake River, a stock which is currently proposed for listing as Threatened under the U.S. Endangered Species Act.

Available data for individual stocks are not adequate for use in all of the exploitation rate analyses. Table 3-2 identifies the stocks used for each type of analysis and Table 3-3 indicates the brood years with available CWT data for each exploitation rate indicator stock.

Table 3-1. List of exploitation rate indicator stocks.

Stock Name	Location	Description
Southeast Alaska	Southeast Alaska	Spring Run
Snootli Creek *	North/Central BC	Spring/Summer Run
Kitimat River *	North/Central BC	Spring/Summer Run
Robertson Creek	WCVI	Fall Run
Quinsam	Georgia Strait	Fall Run
Big Qualicum	Georgia Strait	Fall Run
Capilano	Georgia Strait	Fall Run
Chehalis	Lower Fraser River	Fall Run (Harrison Stock) Fingerling
Chilliwack	Lower Fraser River	Fall Run (Harrison Stock) Fingerling
South Puget Sound Yearling	South Puget Sound	Summer/Fall Run
University of Washington Accelerated	Central Puget Sound	Summer/Fall Run
Samish Fingerling	North Puget Sound	Summer/Fall Run
Lummi Ponds Fingerling	North Puget Sound	Summer/Fall Run
Stillaguamish Fingerling	Central Puget Sound	Summer/Fall Run
George Adams Fingerling	Hood Canal	Summer/Fall Run
South Puget Sound Fingerling	South Puget Sound	Summer/Fall Run
Kalama Creek Fingerling	South Puget Sound	Summer/Fall Run
Elwha Fingerling	Strait of Juan de Fuca	Summer/Fall Run
Hoko Fingerling *	Strait of Juan de Fuca	Summer/Fall Run
Skagit	Central Puget Sound	Spring Yearling
Nooksack	North Puget Sound	Spring Yearling
Skookum	North Puget Sound	Spring Yearling
Quilcene	Hood Canal	Spring Yearling
White River	South Puget Sound	Spring Yearling
Sooes *	North Washington Coast	Fall Fingerling
Quinault	North Washington Coast	Fall Fingerling
Queets	North Washington Coast	Fall Fingerling
Humptulips	Grays Harbor	Fall Fingerling
Cowlitz	Columbia River (WA)	Fall Tule
Spring Creek	Columbia River (WA)	Fall Tule
Bonneville	Columbia River (OR)	Fall Tule
Stayton Pond	Columbia River (OR)	Fall Tule
Upriver Bright	Upper Columbia River	Fall Run
Lewis River	Lower Columbia River	Fall Run
Wells Hatchery	Upper Columbia River	Summer/Fall Run
Lyons Ferry *	Snake River	Fall Run
Willamette	Lower Columbia River	Spring Run

* Indicates stocks added for the 1990 analysis.

Table 3-2. Indicator stocks used by stock group, analyses in which each indicator stock is used, and the availability of escapement and base period tagging data.

Stock Name	Stock Group[1/]	Fishery Index	Survival	Esc	Base Period Tagging
Southeast Alaska	SEAK Spring	yes	yes	yes	
Snootli Creek	NCBC Spring/Summer	- -	yes	no	
Kitimat River	NCBC Spring/Summer	- -	yes	no	
Robertson Creek	WCVI Fall	yes	yes	yes[2/]	
Quinsam	Upper GS Summer/Fall	yes	yes	yes	
Big Qualicum	Lower GS Fall	yes	yes	yes	
Capilano	Lower GS Fall	- -	yes	unusable	
Chehalis	Lower FR Fall	- -	yes	no	
Chilliwack[3/]	Lower FR Fall	- -	yes	no	
South Puget Sound Yearling		yes	yes	yes	
Univ of Washington Accelerated		yes	yes	yes	
Samish Fingerling	North PS Summer/Fall	yes	yes	yes	
Lummi Ponds Fingerling	North PS Summer/Fall	- -	yes	unusable	
Stillaguamish Fingerling	North PS Summer/Fall	- -	yes	unusable	None
George Adams Fingerling	South PS Summer/Fall	yes	yes	yes	
South Puget Sound Fingering	South PS Summer/Fall	yes	yes	yes	
Kalama Creek Fingerling	South PS Summer/Fall	- -	yes	unusable	
Elwha Fingerling		- -	yes	unusable	None
Hoko Fingerling		- -	yes	yes	None
Skagit	North PS Spring	- -	yes	yes	None
Nooksack	North PS Spring	- -	yes	yes	None
Skookum	North PS Spring	- -	yes	yes	None
Quilcene		- -	yes	yes	None
White River		yes	yes	yes	
Sooes		- -	yes	yes	None
Quinault	WAC[4/]	- -	yes	unusable	
Queets	WAC	- -	yes	unusable	
Humptulips	WAC	- -	yes	unusable	
Cowlitz	CR Hatchery Tule Fall	yes	yes	yes	
Spring Creek	CR Hatchery Tule Fall	yes	yes	yes	
Bonneville	CR Hatchery Tule Fall	yes	yes	yes	
Stayton Pond	CR Hatchery Tule Fall	yes	yes	yes	
Upriver Bright	WAC	yes	yes	yes	
Lewis River	WAC	yes	yes	yes	
Wells Hatchery		yes	yes	yes	
Lyons Ferry		- -	yes	yes	None
Willamette		yes	yes	yes	

[1/] Stock groupings are used for regional survival indices (Table 3-6).

[2/] Only hatchery rack recoveries are included in escapement.

[3/] Harrison stock only.

[4/] WAC - Washington Coastal Spring/Summer/Fall, Columbia River Fall.

Table 3-3. Brood years included by stock for Exploitation Rate Analysis (x = valid; o = tagged but no recoveries).

Stock Name	Youngest Age	Oldest Age	Brood Year 71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
Southeast Alaska	3	6	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	-
Snootli Creek	2	6	-	-	-	-	x	x	x	x	-	-	x	x	x	x	x	x	x	x
Kitimat River	2	6	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
Robertson Creek	2	5	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Quinsam	2	6	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Big Qualicum	2	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Capilano	2	5	x	x	x	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Chehalis	2	5	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x
Chilliwack	2	5	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x
South Puget Sound Yearling	2	5	-	-	-	-	-	-	-	x	x	x	x	-	-	-	-	x	-	-
Univ of Washington Accelerated	2	5	-	-	-	-	x	x	x	x	x	x	x	x	x	x	-	-	-	-
Samish Fingerling	2	5	-	-	-	-	x	-	-	-	x	-	-	-	-	-	x	x	x	x
Lummi Ponds Fingerling	2	5	-	-	-	-	x	x	x	x	x	x	x	-	-	-	x	x	x	x
Stillaguamish Fingerling	2	5	-	-	-	-	-	-	-	-	-	x	x	x	x	-	-	x	x	x
George Adams Fingerling	2	5	-	-	-	-	x	-	-	x	x	x	x	-	-	-	x	x	x	x
South Puget Sound Fingerling	2	5	-	-	-	-	x	-	-	x	x	x	x	x	x	x	x	x	x	x
Kalama Fingerling	2	5	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x
Elwha Fingerling	2	5	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	-	o
Hoko Fingerling	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-
Skagit	2	5	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	-
Nooksack	2	5	-	-	-	-	-	-	-	-	-	-	x	x	-	x	-	x	x	x
Skookum	2	5	-	-	-	-	-	-	-	-	-	x	-	x	x	x	x	x	o	o
Quilcene	2	5	-	-	-	-	-	-	-	-	-	-	x	x	x	-	x	x	x	x
White River	2	5	-	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	o
Sooes	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	-
Quinault	2	6	-	-	-	-	x	x	x	x	x	x	-	x	x	x	x	x	x	x
Queets	2	6	-	-	-	-	-	-	x	x	x	x	x	x	x	-	x	x	x	o
Humptulips	2	6	-	-	-	-	-	-	-	-	-	-	-	x	-	x	x	x	x	x
Cowlitz	2	5	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x
Spring Creek	2	5	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bonneville	2	5	-	-	-	-	-	x	x	x	x	x	x	x	x	x	-	-	-	-
Stayton Pond	2	5	-	-	-	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x
Upriver Bright	2	5	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lewis River	2	5	-	-	-	-	-	-	x	x	x	-	-	x	x	x	x	x	x	x
Wells Hatchery	2	5	-	-	-	-	-	x	x	-	-	-	-	-	x	x	x	x	-	-
Lyons Ferry	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	x	x	x	x	x
Willamette	3	6	-	-	-	-	x	x	x	x	x	x	x	x	x	x	x	x	x	-

The Exploitation Rate Analysis presented in this report consists of 2 major parts:

1. Fishery Indices: stock and age specific exploitation rates in a fishery are combined across the indicator stocks to develop indices of fishery harvest rate changes under PST chinook management regimes relative to a 1979-1982 base period. A fishery index less than 1.0 represents a decrease in harvest rate from the base period while a fishery index greater than 1.0 indicates an increase. The relative magnitude of the change is the difference of the index from 1.0.

   Fishery indices are presented for both reported catch and total (reported catch plus incidental loss) mortalities, both expressed in terms of "adult equivalents." Adult equivalence is defined as the probability that, in the absence of fishing, a fish of a given age would return to its natal river. The total mortality index provides a consistent means of representing changes in unreported mortalities associated with regulatory measures, such as size limits and non-retention periods.

   Fishery indices were calculated separately for the Strait of Georgia sport and troll fisheries, with the PSC catch ceiling apportioned to the two fisheries according to Canadian domestic allocation decisions.

2. Survival Indices: A survival index was computed for ocean age 2 and 3 fish of each stock using CWT release and recovery data. The survival index was calculated as the total fishing mortality plus escapement of fish of a given age divided by the number of tagged fish released for the brood. For stocks with no escapement data, the survival index was computed using only catch recoveries, but this should not affect the validity of the index as long as changes in harvest rates are small compared to changes in survival rates.

   Separate indices for the two ages were used instead of a single estimate based on total survival in order to include recent (1987 and 1988) brood years in the analysis and provide indications of short-term abundance expectations. On average, the ocean age 3 estimate provides a better index for total survival; however, the ocean age 2 estimate projects survival for an additional brood year. Past experience has shown that the 2 indices fluctuate in a similar manner although fluctuations are more pronounced for the older age return.

   The stock specific indices were combined to provide a projection of survival trends for regional stock groups (stocks included in each stock group are indicated in Table 3-2). The index provides an indication of survival trends for broods contributing to fisheries in 1991-1992.

In addition, tables depicting the distribution of adult equivalent mortality for the new stocks included in the analysis which have at least 3 years of catch data (Snootli Creek, Kitimat River, and Lyons Ferry) are included in Appendix G.

3.1.2 CWT Data Used

Sources of CWT recovery data employed in the Exploitation Rate Analysis are summarized below.

Canadian Commercial Fisheries: Estimated recoveries for commercial fisheries in Canada were obtained from the Mark-Recovery Database maintained by the CDFO at the Pacific Biological Station.

Canadian Sport Fisheries: Observed recoveries for sport fisheries in Canada were obtained from the Mark-Recovery Database maintained by the CDFO at the Pacific Biological Station. As in the 1989 analysis, estimated recoveries were computed using the following procedures. Starting in 1980, recoveries made in the Strait of Georgia during the summer months (May-September) were expanded as documented in Kuhn *et al.*[2] Recoveries made in other months were expanded using the average expansion factor for the summer period in the same recovery year. Recoveries in areas outside of the Strait of Georgia used the corresponding expansion factor for the Strait of Georgia, unless an expansion factor based on creel survey data was available. Recoveries made prior to 1980 continued to be expanded by the default value of 4.

Strait of Georgia sport recoveries were expanded using these procedures because of potential tag expansion biases associated with inadequate sampling and infrequent overflights of the sport fishery during winter months. The application of Strait of Georgia expansion factors to sport recoveries in other areas was necessary because reliable catch and mark incidence estimates are normally unavailable for these areas.

Alaskan Fisheries: Recoveries by Alaskan fisheries were obtained from the ADF&G database. Data anomalies were corrected using procedures discussed in Appendix II of the 1987 CTC Annual Report (TCCHINOOK (88)-2). Several of the more important adjustments are summarized below.

a. CWT recoveries from commercial fisheries were expanded to account for unsampled catches using the following procedures. Recoveries were adjusted by multiplying by the ratio of the total catch to the sampled catch. For troll gear, the stratum for adjustment was the total accounting year (1 Oct.-30 Sept.) catch for SEAK. For net and trap gear, adjustments were computed for a district or group of districts by calendar year.

b. In a few cases, small samples have resulted in very large expansion factors. Expansion factors for commercial fisheries were constrained to the range of 1 to 50 to prevent the overestimation of total tag recoveries.

c. CWT recovery data for the SEAK sport fishery during the 1979-1982 base period are of poor quality due to very limited sampling. The sport fishery sampling program expanded substantially from 1983 to 1986, resulting in more reliable estimates in recent years. To estimate CWT recoveries for this fishery in years prior to 1986, sport recoveries were estimated from troll recoveries using the methods described in TCCHINOOK (90)-2.

Washington/Oregon Fisheries: Recoveries by Washington and Oregon fisheries were obtained from the database maintained by the Pacific States Marine Fisheries Commission (PSMFC) with the exception of recoveries in the 1989 and 1990 Puget Sound sport fishery. In the PSMFC database, recoveries in the 1989 Puget Sound sport fishery were expanded using 1988 catch/sample ratios and 1990 recoveries were not expanded. Therefore, to improve the quality of the data used in these analyses, expansions for 1989 were computed utilizing preliminary estimates of the sport catch and expansions for 1990 recoveries were computed using an average of the expansion factors for 1987 through 1989.

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[2] Kuhn, B.R., L.Lapi, and J.M. Hamer. 1988. An introduction to the Canadian database on marked Pacific salmon. Can. Tech. Rep. Fish. Aquat. Sci. 1649:56p.

Recovery data are available on the PSMFC database in both an old and new PSC format. As agencies provide data in the new format, recovery data is verified and catch sample expansion factors are recomputed. As a result, the estimated recoveries present in the two databases frequently are not identical. In order to obtain the most current estimates of CWT recoveries, data from the new format were used where possible. Recoveries for Oregon fisheries were available in the PSC format for all years, but were considered preliminary for 1989 and 1990. Washington recoveries were available for the new format for the years 1984-1990. Estimated recoveries for net fisheries in 1989 and 1990 were preliminary and relied upon inseason estimates of catch.

Quinault Fisheries: Preliminary estimates of recoveries by the Quinault Indian Nation for the Washington coastal net fisheries for 1987-1990 were provided by the Quinault Indian Nation.

Alaskan Escapement:

Deer Mountain. For the Deer Mountain facility, total returns of CWT were known for all years. However, returns in 1980, 1982, and 1983 were broken down only by brood year (1978, 1979, and 1980) and not by tag code. Therefore, the recoveries by tag code were estimated as follows:

1) For each return year-brood year combination, an initial estimate of the recoveries by tag code was obtained by multiplying the total recoveries of the brood by the proportion of the tagged brood release that belonged to each tag code.

2) The estimated recoveries for each tag code were then expanded by the ratio of the tagged release to the total production associated with that release and summed over the tag codes.

3) The estimate of the total recoveries for the entire brood was made by dividing the total tagged recoveries by the proportion of the brood which was tagged.

4) The sum of the tag code recoveries obtained in (2) above was modified to equal the estimate obtained in (3) by adjusting the estimates of the tagged recoveries by code until the two sums matched.

This method assumes that all tag codes in a brood year had equal survival from release.

SSRAA. The sampling for marks in Southern Southeast Regional Aquaculture Association (SSRAA) hatcheries was performed using one of the two following methods:

A) Random sampling of fish for marks was conducted during each distinct time period (the length of the periods varied) throughout the return. The target number of CWT's was 200, but the actual numbers varied. Unfortunately, the number of fish examined for marks was not always recorded.

B) Marked fish were deliberately selected from the return during each time period. The number of fish examined to obtain this select sample was not recorded. These marked fish were then randomly sampled for approximately 200 CWT's.

Neither of these methods provides a usable estimate of mark incidence. Hence the recoveries by tag code for these hatcheries were estimated as follows:

1) The tagged recoveries in each sample were expanded by the marked to total release ratio and summed across tag codes.

2) The total return (tagged and untagged) during each time period was then multiplied by the proportion of the expanded sum which belonged to each tag code. These estimates were then summed for all the return periods to obtain a total estimated return for each tag code.

3) As a result of this estimation procedure, the return estimates for each tag code include both the marked and unmarked portions of the release. To estimate the number of returning tags, this total estimate was divided by the release ratio.

This method assumes that the survival of marked and unmarked fish was equal.

Canadian Escapement: Escapement data for Canadian stocks were determined directly from hatchery records, from the Salmon Stock Assessment database at the Pacific Biological Station, and from documents prepared through the Canadian "key stream" program.[3] Details regarding the source of escapement data for each of the three Canadian hatcheries used in the fishery index analysis are as follows.

Robertson Creek. Escapement recovery data for Robertson Creek come mainly from hatchery swim-ins and from brood stock capture. All fish encountered are automatically checked for the presence of CWT. Since 1987, there has been a recovery program for CWT on the Stamp River near the hatchery. Recoveries from this program have not been included in the exploitation rate analysis as comparable recoveries were not available throughout the entire time series.

Big Qualicum. Almost the entire escapement for the Big Qualicum River passes through a counting fence which has been in place since the beginning of the time series. All fish passing through the fence are checked for the presence of CWT. There are two exceptions to this procedure: 1) prior to 1988, the early part of the run was allowed to escape without examining it for CWT and to spawn naturally. This was accounted for by expanding the sampled fraction of the run to represent the total run (expansions were stratified by adult and jacks); 2) a few hundred fish occasionally spawn below the fence (which is less than 1 kilometer above tidewater). These are unsampled and the total number is only visually estimated. No adjustment was made to account for these fish.

Quinsam Hatchery. The Quinsam Hatchery has obtained most of its brood stock by seining spawning adults from both the Campbell River (the main river) and the Quinsam River (a relatively small

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[3] Shardlow, T.F., T.Webb, and D.T. Lightly. 1986. Chinook salmon escapement estimation of the Campbell and Quinsam Rivers in 1984: accuracy and precision of mark/recapture techniques using tagged salmon carcasses. Can. Tech. Rep. Fish. Aquat. Sci. 1507:52p.

Andrew, J.H., M. Lightly, and T.M. Webb. 1988. Abundance, age, size, sex and coded-wire tag recoveries for chinook salmon escapements of Campbell and Quinsam Rivers, 1985. Can. MS Rep. Fish. Aquat. Sci. 2007:46p.

Bocking, R.C., K.K. English, and T.M. Webb, 1990. Abundance, age, size, sex, and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam Rivers, 1986-1988. Can. MS Rep. Fish. Aquat. Sci. 2065:136p.

Bocking, R.C. *in prep.* Abundance, age, size, sex, and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam Rivers, 1989-90. Can. MS Rep. Fish. Aquat. Sci. xxxx:99p.

tributary). Hatchery swim-ins have not been an important factor until 1989. In addition, hatchery staff have walked the river looking for carcasses containing CWT since 1978. In 1984, this system was designated a "key stream" and a quantitative Petersen-type escapement estimate has been obtained for each year since then.[2] Estimates of the CWT escapement to each river was made by expanding the CWT recovered during the dead pitch by the fraction of the estimated total escapement which was sampled. Both the escapement and the dead pitch were stratified by sex, combining adult and jack males into a single stratum. Brood stock captures are usually fully checked for marks and are added to the estimates of CWT escapement to the rivers. These are also stratified by sex for the purposes of sample expansions and for adjustments for lost pins and no data recoveries. CWT recovered during carcass recovery prior to 1984 were expanded by using the average fraction sampled from the period 1984 to 1990, stratified by river with both sexes combined.

Lyons Ferry Escapement: The number of fish escaping to Lyons Ferry Hatchery is defined as the number of Lyons Ferry hatchery tagged fish crossing Ice Harbor Dam. Lyons Ferry hatchery is located above Ice Harbor and Lower Monumental Dams on the Snake River.

As with escapements of other upper Columbia River stocks, Lyons Ferry Hatchery escapement also must be adjusted for inter-dam loss. Because of the additional Snake River dams that Lyons Ferry fish must pass, adjustment for inter-dam loss was done in two stages. First, the inter-dam loss factor for upriver bright chinook was used to adjust recoveries for inter-dam loss from Bonneville Dam to McNary Dam. Next, recoveries from Lyons Ferry Hatchery had to be adjusted for inter-dam loss between Ice Harbor Dam and Lyons Ferry Hatchery to estimate the total escapement over Ice Harbor Dam. The following calculations were used to adjust Lyons Ferry tag recoveries for inter-dam loss and estimate the number of tagged fish passing Ice Harbor Dam.

1990, Age 4 and 5. In 1990, Lyons Ferry Hatchery tag recoveries for age 4 and 5 fish were available from three recovery sites: fish which voluntarily entered Lyons Ferry Hatchery, fish trapped at Ice Harbor Dam, and fish which spawned in Hanford Reach (mainstem Columbia). A 1990 WDF study estimated that the trap at Ice Harbor Dam caught 28.54% percent of the adults crossing the dam (Tom Cooney WDF and Howard Schaller ODFW, pers. comm.). All trapped fish were sampled for tags. To estimate the total number of tagged fish crossing Ice Harbor Dam, the number of tagged fish recovered in the trap was expanded using the estimated trap efficiency. The number of Lyons Ferry tagged adults found among Hanford natural spawners were added to the expanded number of trap recoveries. The Lyons Ferry hatchery recoveries were not incorporated because the expansion for fish not trapped already incorporates returns of Lyons Ferry fish over Ice Harbor Dam.

1988-1989, Age 4 and 5. In 1988 and 1989, age 4 and 5 recoveries were from fish trapped at Ice Harbor Dam and fish which returned voluntarily to the Lyons Ferry Hatchery. Unfortunately, trapped fish were taken to Lyons Ferry hatchery and mixed with hatchery volunteers prior to tag recovery. It was therefore not possible to distinguish between the two sources of fish. For this reason, a conversion rate was needed to estimate the number of tagged fish crossing Ice Harbor Dam from the total number of tag recoveries.

Using the 30% sampling rate (28.54% rounded) estimated in the WDF study on the 301 adults trapped at Ice Harbor Dam yields a total estimate of 1,003 fish at the dam (jacks were not included in these calculations). Because the trapped fish were taken directly to the hatchery, 301 adults were subtracted from the total estimate of 1,003 to yield an estimate of 702 adults crossing the dam. At Lyons Ferry Hatchery all 201 volunteers and 301 trapped fish were sampled. The expansion rate for Ice Harbor and Lyons Ferry hatchery recoveries becomes:

$$\frac{\textit{Ice Harbor Total}}{\textit{Lyons Ferry Return + Ice Harbor Trap}} = \frac{1{,}003}{201 + 301}$$

$$= 1.998$$

The 1.998 expansion rate was used to calculate the number of tagged fish which crossed Ice Harbor Dam. This method assumes that sampling rates, hatchery volunteer rates, stray rates and interdam loss rates were all constant for the time period.

1987-1990, Age 3. A conversion rate was also calculated to estimate total escapement of tagged 3 year old fish in 1987 through 1990. Any fish > 56 cm is classified as an adult; smaller fish were counted as jacks. An estimated 25% of age 3 fish are > 56 cm. Again using the estimated trap efficiency of 30% for adult fish at Ice Harbor Dam, the Ice Harbor trap should have caught 7.5% (25% * 30%) of age 3 fish passing Ice Harbor Dam. The remaining 92.5% of age 3 fish are expected to continue their migration.

For ages 4-6, 29% of Lyons Ferry Hatchery fish passing Ice Harbor Dam reach the hatchery. Assuming age 3 fish reach the hatchery at the same rate as age 4-6 fish, the percentage of age 3 fish that pass Ice Harbor trap and return to Lyons Ferry would equal 26.8% (92.5% * 29%). The percentage of age 3 fish accounted for by both Ice Harbor trap and Lyons Ferry volunteers therefore equals 7.5% plus 26.8%, or 34.3%. An expansion rate of 2.915 (1 / 0.343) is used to convert the total number of age 3 tag recoveries into age 3 tagged fish crossing Ice Harbor. Recovery data for 1987-1990 reported by WDF was multiplied by 2.915 to provide an estimate of age 3 escapement.

1986-1990, Age 2. For 1986-1990, age 2 trap and volunteer recoveries were combined to estimate escapement. It was estimated that no 2 year olds were vulnerable to the Ice Harbor trap. It was not possible to calculate an improved estimate of escapement due to the lack of information on age 2 fish and due to different definitions of the term "jack" at the hatchery and dam. For these reasons, the raw recoveries provided by WDF were not expanded or converted. Age 2 escapement is therefore underestimated. Total brood year exploitation rates will be biased high because of the underestimation of age 2 escapement. Individual exploitation rates for ages 3-5 will not be biased as age 2 escapements are not involved in their calculation. Exploitation rates for age 2 will be biased high.

3.1.3 Estimates of Nonlanded Catch Mortality

Parameters used to estimate nonlanded catch mortality have been provided by regional management agencies and are listed in Appendix C.

3.1.4 Errors in 1989 Analysis

During the compilation of data, the following errors in TCCHINOOK (90)-3 were noted and have been corrected for the 1990 analysis.

1. Recoveries of CWTs in the Columbia River net fisheries in 1989 were inadvertently doubled. This error affected all analyses involving Columbia River stocks. Specific affects are addressed in the discussion.

2. Catch distribution tables for the Quinault fall fingerling and Queets fall fingerling stocks did not include catch in U.S. terminal net fisheries in 1987 through 1989.

3.2 ESTIMATION OF EXPLOITATION RATES

3.2.1 Theory and Procedures

For fisheries operating under PSC ceiling management, successful completion of the rebuilding program depends upon a substantial initial reduction in fishery harvest rates and stock exploitation rates combined with progressive reductions over time. Components of the Exploitation Rate Analysis were developed to assess the effectiveness of management measures and trends in stock survival. Theory and procedures employed in the Exploitation Rate Analysis were presented in TCCHINOOK (88)-2 and TCCHINOOK (90)-3 (Chapter 4).

3.2.2 Assumptions of the Analyses

Assumptions for the cohort analysis and other procedures used in the Exploitation Rate Analysis are summarized below. Detailed discussions of assumptions and parameter values may be found in TCCHINOOK (88)-2. Assumptions are discussed in relation to each type of analysis.

Cohort Analysis: Cohort analysis is the computational procedure used to reconstruct a cohort from CWT recoveries. All subsequent analyses rely upon parameters estimated from the cohort analysis. The primary assumptions of the cohort analysis are listed below.

1. Fishery and escapement CWT recovery data are obtained in a consistent manner from year to year or can be adjusted to make them comparable. Many of the analyses rely upon indices which are computed as the ratio of a statistic in a particular year to the value associated with a base period. Use of ratios may reduce or eliminate the effect of data biases which are consistent from year to year.

2. For age 2 and older fish, natural mortality is constant for each age class in all years.

3. All stocks within a fishery have the same size distribution for each age and the size distribution at age is constant among years.

4. The distribution of sub-legal sized fish is the same as legal-sized fish.

5. Incidental mortality rates per encounter are constant and are equal to 30% for troll and sport fisheries and 90% for net fisheries.

6. In the absence of an independent estimate of incidental mortality loss during non-retention periods, the procedure for estimating the mortality of CWT fish of legal size assumes that the stock distribution remains unchanged from the period of legal catch retention. Gear and/or area restrictions during the CNR fishery are believed to reduce the number of encounters of legal sized fish. To account for this, the number of legal encounters during the nonretention fishery was adjusted by a selectivity factor. A factor of 0.34 was used for the SEAK, WCVI, and GS troll fisheries. This value is the average selectivity factor calculated from 3 years of observer data in the Alaska troll fishery (Mel Seibel, personal communication). A factor of 0.20 is used in the NCBC troll fishery. This factor roughly corresponds to the proportion of fishing areas which remain open during nonretention periods.

Fishery Indices: The temporal and spatial distributions of stocks in and between fisheries are assumed to be stable from year to year.

Survival Rate Indices: Fishery exploitation rates, incidental mortality rates, and stock maturation rates are constant from year to year. Variations in fishery exploitation rates which are small compared to changes in survival should not adversely effect the survival index. This assumption may not be true for the 2 NCBC stocks, where considerable variation in even/odd year harvest rates may occur in net fisheries.

3.2.3 Reported Catch Versus Total Mortalities

Fishery indices are presented for both reported catch and total mortality. Management strategies have changed considerably for fisheries constrained by PSC catch ceilings since implementation of the PST. Regulatory changes which have been implemented include size limit changes and extended periods of CNR. These changes are not reflected in CWT recovery data, yet are crucially important for assessment of total fishery impacts. Procedures to estimate these incidental mortality losses and incorporate them into the Exploitation Rate Analysis were described in Supplement B of TCCHINOOK (88)-2.

3.3 FISHERY INDICES

3.3.1 Overview

Detailed results from the analysis of fishery exploitation rates are provided in Appendix D. The appendix includes stock specific indices for landed catch and total mortality for each fishery. A summary of the fishery indices for total fishing mortality is presented in Table 3-4. The table provides a comparison of estimated fishery indices for each year since 1985 as well as the 1985 target reduction.

The "1985 target reductions" indicated in the last column were computed by subtracting the ratio of the 1985 catch ceiling to 1979-1982 average catch from 1. The 1985 target reduction represents the expected change in the fishery index which would result from imposition of the ceiling if stock abundance were equal to the 1979-1982 average. Further reductions in harvest rates for PSC ceilinged fisheries were expected as the rebuilding program progressed due to decreases in fishing mortality and increases in production resulting from higher spawning escapements. The 1985 target reduction is used as a minimum expectation and is compared with present reductions because a method has not been developed to compute the time trend of expected reductions in harvest rates.

Table 3-4. Changes in fishery harvest rate from the 1979-82 base period (adult equivalents) and 1985 target reductions.

Fishery	Age(s)	CHANGE IN FISHERY HARVEST RATE FROM BASE Total Mortality 1985	1986	1987	1988	1989	1990	1985-90 Average	1985 Target Reduction
SEAK Troll	3,4,5	9%	-22%	0%	-35%	-34%	-8%	-15%	-22%
NCBC Troll	3,4,5	-21%	-8%	-18%	-49%	-35%	-37%	-28%	-16%
NBC Troll	3,4,5	31%	11%	-8%	-22%	5%	-16%	-0%	a/
CBC Troll	3,4	-76%	-25%	-49%	-82%	-90%	-73%	-66%	a/
WCVI Troll	3,4	-9%	-1%	-22%	4%	-53%	-6%	-15%	-24%
WCVI Troll	3	-10%	-4%	-19%	-9%	-59%	7%	-16%	-24%
WCVI Troll	4	-9%	1%	-27%	12%	-51%	-13%	-14%	-24%
Strait of Georgia									
Troll & Sport	3,4,5	-47%	-22%	-32%	-29%	-8%	-34%	-29%	-47%
Troll	3,4	-84%	-44%	-72%	-91%	-85%	-60%	-73%	-79% b/
Sport	3,4,5	-28%	-4%	-15%	-11%	29%	-22%	-9%	-20% b/
WA/OR Ocean S/T	3,4	-39%	-49%	-29%	-26%	25%	49%	-12%	c/
WA/OR Ocean S/T	3	-27%	-33%	-23%	-23%	1%	20%	-14%	c/
WA/OR Ocean S/T	4	-76%	-76%	-49%	-35%	79%	83%	-12%	c/

a/ Target reductions were not specified independently for the NBC and CBC troll fisheries.
b/ Using Canadian domestic catch allocation decisions.
c/ No target reductions were established for Washington and Oregon ocean fisheries.

Figures and tables of fishery indices are presented for all ages combined, individual ages, fisheries and gear (Appendix D and E). Separate indices are presented for the NBC and CBC troll fisheries in order to evaluate effects of effort shifts between the 2 regions. Separate fishery indices were computed for age 3 and age 4 fish in the WCVI troll fishery to evaluate the impact of the size limit change in 1987.

Figures presented in Appendix E depict fishery indices based on total fishing mortality over time. The heavy black line indicates the estimated fishery index; the light vertical bars are used to display the central range[4] of fishery indices observed among individual stocks. For reference, tabular results of the analysis for individual stocks and the fishery as a whole are presented below each figure. Large variability is often evident when comparing indices of several stocks. This variation may be due to sampling, departures from assumptions, and differential harvest rates.

3.3.2 Southeast Alaska

Consistent with expectations, harvest rates in the fishery exhibited a declining trend through 1989. Indices for 1988 and 1989 indicated that harvest rates had dropped by approximately 35% from the base period level. The 1990 index indicates that harvest rate for the SEAK troll fishery increased

[4] The central range is defined as follows:

Stock-Age Combinations	Central Range
<10	the range of indices
10 to 19	the range remaining after the lowest and highest values are excluded
20 to 29	the range remaining after the two lowest and two highest values are excluded

from those of 1988 and 1989 and was only 8% below base period levels. The 1985 target reduction has been achieved in the SEAK troll fishery for index stocks in 3 of the 6 years under PSC regimes.

The 1985-1990 average fishery index showed a reduction of 15% from the base period level, 7 percentage points above the 1985 target reduction under the PSC regimes.

3.3.3 North/Central B.C.

The estimated fishery indices are consistent with expectations that greater reductions would be evident as the rebuilding program proceeded. The average reduction in the first three years of the treaty was 16% (equal to the 1985 target reduction), while a 40% average reduction was attained for the years 1988-1990. The 1990 total mortality index for stocks in the NCBC troll fisheries decreased by 37% from base period levels. The 1985 target reduction has been achieved in 5 of the 6 years under the PSC regime.

The reduction has been disproportionate between the NBC and CBC troll fisheries. The greatest reduction in harvest rates has been observed in the CBC fishery, where reductions have ranged from 25% to 90% since 1985. In contrast, harvest rates in the NBC troll fishery have ranged from a decrease of 22% from the base period level to an increase of 31%. This trend was maintained in 1990, when the indices showed a 16% and 73% reduction for the NBC and CBC fisheries, respectively.

3.3.4 West Coast Vancouver Island Troll

Ages 3 & 4 Combined: Combined fishery indices for age 3 and 4 fish in the WCVI troll fishery have been above the 1985 target reduction for 5 of the 6 years since implementation of the PSC ceiling. Since 1985, harvest rates have been reduced on average by 15%, 9 percentage points above the 1985 target reduction.

Age 3: 1990 is the first year since implementation of the PST that the age 3 fishery index for the WCVI troll fishery has exceeded the base period level. The increase of 7% was substantially greater than the levels observed from 1985-1989. The average reduction observed from 1985-1990 was 16%, which is 8 percentage points above the 1985 target reduction.

Age 4: The fishery index for age 4 stocks in the WCVI troll fishery did not attain the 1985 target reduction in 1990. The 1985-1990 average indicates that harvest rates decreased by 14% relative to the base level value, which is 10 percentage points above the 1985 target reduction.

3.3.5 Strait of Georgia

Sport and Troll Combined: Fishery indices for ages 3, 4, and 5 year old fish in the combined GS sport and troll fisheries have declined from base period levels, but not nearly to the 1985 target level. After increasing in 1989, harvest rates in 1990 in these combined fisheries declined by 34% relative to the base period. While this is a substantial improvement, the index remained 13 percentage points above the 1985 target reduction. The 1985-1990 average reduction of 29% is approximately 60% of the expected 1985 target reduction.

Troll: The fishery index for ages 3 and 4 for the GS troll fishery has declined substantially from the base period level. The 1990 index value indicated a reduction from the base period of 60%, which is 19 percentage points less than the reduction anticipated from implementing domestic allocation decisions. The 1985-1990 average reduction in harvest rates has been 73%, which is also slightly (6 percentage points) above the 1985 target reduction expected under Canadian domestic allocation policy.

Sport: 1990 was the second year since the inception of the PST that the GS sport fishery achieved the 1985 target reduction. In 1990, the harvest rate declined by 22% from the base period level. This exceeded the 1985 target reduction by 2 percentage points. However, the average reduction observed in 1985-1990 of 9% remains 11 percentage points above the expected initial reduction.

3.3.6 Washington/Oregon Ocean Fisheries

Ages 3 & 4 Combined: The Washington/Oregon (WA/OR) ocean troll and sport fishery index for ages 3 and 4 fish in 1990 substantially exceeded the base period level. The analysis indicates that harvest rates have been increasing since 1986. Harvest rates in 1990 were the largest observed since the inception of the PST, and were 49% greater than the base period. A dichotomy was evident in the fishery indices for stocks used in the analysis for this fishery. Indices for stocks from the Columbia River were generally near or below base period levels, while indices for Puget Sound stocks ranged from 4.4 to 20.9 times higher than the base period.

Age 3: The age 3 fishery indices for the combined WA/OR ocean troll and sport fisheries in 1990 exceeded the base period level by 20 percentage points. The 1985-1990 average fishery index for age 3 fish remained below the base period level.

Age 4: The age 4 fishery index stocks for the combined WA/OR ocean troll and sport fisheries substantially exceeded the base period level for the second consecutive year. Increases of 79% and 83% were observed in 1989 and 1990 for this age class. During the years 1985-90, harvest rates have ranged from a decrease of 76% from the base period level to an increase of 83%; the average index indicates a decrease in the estimated fishery harvest rate of 12% from the base period level.

3.3.7 Comparison Of Total Mortality and Reported Catch Indices

The fishery index can be computed for either reported catch or total mortality. The total mortality index includes the mortality component contributed by CNR fisheries and the discarding of fish that are smaller than the legal size limit. Given a stable age structure, the reported catch index and the total mortality index should give similar results in the absence of major regulatory changes. Results from the comparison of the 2 indices are consistent with this expectation. In all instances where the incidental mortalities have not changed, the indices based on the 2 methods are extremely close (Table 3-5). For example, from 1979 through 1986, the indices for catch and total mortality in the NCBC fishery were approximately equal.

The effect of CNR regulations on total mortalities are apparent for the SEAK troll fishery, and the effects of CNR and size limit changes are apparent for the NCBC troll fishery, the WCVI troll fishery, and the GS sport and troll fisheries. The largest difference between the catch and total mortality indices occurred in the SEAK fishery. In 1987, the CNR fishery resulted in a 17 percentage point difference between the indices. While CNR fisheries in the NCBC fishery have

generally been of shorter duration than in the SEAK fishery, CNR fisheries have resulted in an average increase in the harvest rate index of 3 percentage points since 1987. In the 1987 WCVI troll fishery, a CNR fishery and the increase in the minimum size limit resulted in a 10 percentage point difference in the indices for catch and total mortality. The change in the minimum size limit for the GS sport fishery in 1989 resulted in a 10 percentage point increase in the GS troll and sport fishery index for 1989 and a 8 percentage point increase in the subsequent year.

Table 3-5. Comparison of fishery indices based on reported catch and total mortality.

	SEAK Troll All Ages		NCBC Troll Age 4-5		WCVI Troll Age 3-4		GS Sport/Troll Age 3-5		WA/OR Spt/Troll Age 3-4	
Year	Rept Catch	Total Mort	Rept Catch	Total Mort	Rept Catch	Total Mort	Rept Catch	Total Mort	Rept Catch	Total Mort
1979	0.99	0.95	0.97	0.97	0.98	0.98	0.78	0.78	0.79	0.78
1980	1.01	0.98	1.08	1.09	1.02	1.02	1.19	1.19	1.05	1.05
1981	1.07	1.05	1.18	1.17	0.84	0.84	1.56	1.56	0.94	0.94
1982	0.93	1.01	0.75	0.75	1.11	1.12	0.60	0.60	1.13	1.14
1983	1.29	1.34	0.97	0.96	1.18	1.18	0.78	0.78	0.65	0.64
1984	0.97	1.05	0.81	0.80	1.52	1.50	1.06	1.07	0.27	0.27
1985	0.94	1.09	0.80	0.79	0.89	0.91	0.53	0.53	0.58	0.61
1986	0.73	0.78	0.92	0.92	1.01	0.99	0.75	0.78	0.52	0.51
1987	0.83	1.00	0.78	0.82	0.68	0.78	0.68	0.68	0.71	0.71
1988	0.61	0.65	0.47	0.51	0.95	1.04	0.71	0.71	0.72	0.74
1989	0.57	0.66	0.64	0.65	0.43	0.47	0.81	0.91	1.23	1.25
1990	0.77	0.92	0.60	0.63	0.88	0.94	0.58	0.66	1.48	1.49

3.4 SURVIVAL RATE INDICES

Projected survival indices of major stock groups are provided in Table 3-6 (survival indices for individual stocks are graphed in Appendix F). For each stock group, the table includes projections of survival indices for the 1986-87 broods (1989 analysis, TCCHINOOK (90)-3, Table 4-2) and 1987-88 broods (1990 analysis). Fisheries with PSC ceilings which account for at least 10% of a stock group's total fishing mortality are also noted. For the SEAK and the NCBC fisheries, only the survival index of the WCVI fall stock is indicated to be above average, while survival indices of the other 4 stock groups are well below average. All 6 stock groups for the WCVI and GS fisheries indicate survival index projections below the long term average.

Since these projections are for survival indices of major hatchery stocks, their applicability to associated wild stocks is uncertain. However, at the very least, reduced abundance of hatchery stocks contributing to fisheries operating under PSC ceilings suggests that exploitation rates on commingled natural stocks would be expected to increase in the short-term.

Table 3-6. Short-term survival index projections of stock groups to fisheries operating under PSC ceilings.

Stock Group	1989 Analysis	1990 Analysis	Fisheries			
			SEAK	NCBC	WCVI	GS
SEAK Spring	-75%	-47%	X			
NCBC Spring/Summer	NA	-79%	X	X		
WCVI Fall	+14%	+28%	X	X		
Upper GS Summer/Fall	-55%	-56%	X	X		
Lower GS Fall	-76%	-73%		X		X
Lower FR (Harrison) Fall	-22%	-40%			X	X
North PS Spring	NA	-22%			X	X
North PS Summer/Fall	-23%	-26%			X	X
South PS Summer/Fall	-47%	-73%			X	X
WAC Spring/Summer/ Fall, CR Fall	-44%	-59%	X	X	X	
CR Hatchery Tule Fall	NA	-65%			X	

3.5 DISCUSSION AND SUMMARY

The Exploitation Rate Analysis included in this report is based on CWT recoveries for 37 indicator stocks having usable time series of data. These stocks are referred to as the "exploitation rate indicator stocks." Analyses in this Chapter are specific to these stocks; the extrapolation of results to similar stocks and/or generalizations about fishery impacts will only be appropriate to the extent that these indicator stocks are representative.

3.5.1 Fishery Indices

For 1990, the initial 1985 target reduction for total fishing mortalities in PSC ceilinged fisheries was achieved only in the NCBC troll fishery. In 1989, initial 1985 target reductions were achieved for the SEAK, NCBC, and WCVI troll fisheries. When 1985-1990 averages are considered, only the NCBC troll fishery met the 1985 target reduction.

A basic premise of the rebuilding program is that fixed ceilings would act in concert with increases in the abundance of chinook to continually reduce harvest rate until rebuilding was completed. Trends in the fishery indices for the SEAK and NCBC troll fisheries were consistent with this expectation through 1989.

The trend was not maintained in the SEAK troll fishery in 1990, where the harvest rate index increased by 39% relative to 1989. The adjustment to the ceiling in 1990 is one potential explanation for the increase in the index. If abundance remained constant in 1989 and 1990, the 17% increase in the troll catch in 1990 could be expected to increase the fishery index by a similar percentage. The fact that the index increased by more than 17% may indicate that the abundance of fish available to the fishery declined. Survival trends and observed terminal run sizes also indicate that abundance declined in 1990.

The fishery index for the NCBC fishery in 1990 was 37% below the base period and near the value observed for 1989. Since the ceiling was also increased for the NCBC fishery, the lack of change in the index initially might seem inconsistent with the previous discussion for the SEAK fishery. However, the 1990 troll catch in the NCBC troll fishery actually declined by 20% to compensate for the NCBC cumulative deviation through 1989. The decrease in catch and the stability of the index from 1989 to 1990 indicate that the abundance of chinook available to this fishery may also have declined in 1990.

The 1990 index for the CBC troll fishery continues to be substantially lower than the index for the NBC troll fishery. This is likely due to significant shifts in fishing patterns (e.g., increased effort off the north and west coasts of the Queen Charlotte Islands in response to chinook abundance) and conservation actions for lower Strait of Georgia natural chinook caught in Queen Charlotte Sound. Analysis of historical CWT recoveries of hatchery stocks in the lower Strait of Georgia indicated that this stock was more abundant in Queen Charlotte Sound than in other portions of the NCBC troll fishery. Accordingly, management actions have been implemented since 1988 to limit troll catch in the CBC waters immediately north of Vancouver Island.

Harvest rates in the WCVI troll fishery have varied considerably since 1985. This variation has resulted from changes in abundance as well as from changes in the catch. The 1985-1990 average reduction in the harvest rate of 15% is 9 percentage points above the 1985 target reduction. In response to the reduced abundance of chinook available to this fishery and an overage in 1988, management actions were taken in 1989 to constrain the catch below the ceiling of 360,000 fish. These actions were quite successful in 1989, when the harvest rate was reduced by 53% percent from the base level. The 1990 Letter of Transmittal stated that "it is Canada's intention in 1990 to manage this fishery in a manner so as not to exceed the 1985-87 average troll fishery harvest rate." The 1990 estimated reduction in the fishery index of 6% fell short of the 11% reduction that would have been consistent with the intent of the Letter of Transmittal.

In 1990, harvest rates in the combined GS sport and troll fishery continued to exceed the initial 1985 target reduction by a substantial margin. In contrast to 1988 and 1989, the initial target reduction was achieved in the sport fishery in 1990 but not in the troll fishery. This may be due in part to changes in the catch in each fishery relative to 1989; the catch in the troll fishery increased by 10% while the catch in the sport fishery declined by 16%.

The fishery index for the WA/OR sport and troll fisheries exceeded base period levels for the second consecutive year. Harvest rates for this fishery have been increasing since 1986, and the 1990 index is 49% above the base period level. Stock specific indices for this fishery indicate that harvest rates for Puget Sound stocks have increased significantly more than for Columbia River stocks. This may be due to differences in the distribution of the stocks and changes in the structure of the fishery. Columbia River stocks are present in all areas along the Washington coast, while Puget Sound stocks are generally more prevalent in northern Washington coastal areas and in the Strait of Juan de Fuca. CWT recoveries of Puget Sound stocks in this fishery during the base period were limited since the catch in the Strait of Juan de Fuca was relatively small. However, as the Strait of Juan de Fuca catch increased relative to the total Washington troll catch, the number of recoveries for Puget Sound stocks has increased. For this reason, fishery indices for Puget Sound stocks have increased more than the indices for Columbia River stocks.

The fishery index reported for the Washington/Oregon troll/sport fishery for 1989 is 37% greater (1.25 versus .91) than the index previously reported in TCCHINOOK (90)-3. The change in the index resulted primarily from 1) a decrease in the cohort size of Columbia River stocks, and 2) the inclusion of additional Puget Sound stocks in the index. As was discussed in Section 3.4.1, recoveries-from net fisheries in the Columbia River stocks, and reducing the estimated exploitation rates in all fisheries except the Columbia River net fishery. Fishery indices for the three Columbia River stock-age classes increased by an average of 45%.

The increase in the index was also due in part to the inclusion of additional Puget Sound stocks. The criteria used to select stocks and age classes for the fishery index utilizes the average number of recoveries in the fishery. As the harvest of tagged Puget Sound stocks has increased in the Washington troll fishery, the average number of recoveries has increased. In 1990, this resulted in the inclusion of 3 additional stock-age classes from Puget Sound in the index for the Washington/Oregon sport/troll fishery. As discussed above, the indices for Puget Sound stocks in this fishery tend to be greater than those for Columbia River stocks.

3.5.2 Short-term Outlook for Stock Survival

The Committee emphasizes that to maintain reductions or further reduce brood year exploitation rates under a fixed catch ceiling policy, the abundance of chinook in the fishing areas must equal or exceed recent abundances. Future abundances will be determined by the escapement of natural stocks, hatchery production, and survival rates. The Exploitation Rate analysis provides a measure of survival rates for indicator stocks and broods which will contribute to fisheries in 1991 and 1992. Although most of the indicator stocks are of hatchery origin, natural stocks will display a similar trend if factors regulating survival are similar to those of hatchery stocks.

The results of the Exploitation Rate analysis indicate that survival rates for most stocks will be well below the long term average for broods contributing to fisheries in 1991 and 1992. Only one stock group, WCVI Fall, is projected to have a survival rate above the long-term average.

The abundance of fish in a particular fishery will also depend upon the mixture of stocks present. For the SEAK fishery, reduced survivals ranging from 47% to 79% below average are projected for 4 of 5 major stock groups contributing to this fishery. For the NCBC fishery, reduced survivals ranging from 56% to 79% below average are projected for 4 of the 5 major stock groups contributing to this fishery. For the WCVI fishery, survival for the six stock groups contributing to this fishery are projected to

range from 22% to 73% below average. For the Strait of Georgia, survival of the 5 major stocks groups contributing to these fisheries is projected to range from 22% to 73% below average.

APPENDIX A

Tables of Escapements and Terminal Runs

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Escapements and terminal runs of PSC Chinook Technical Committee natural chinook escapement indicator stocks, 1975-1990.

Year	Southeast Alaska					
			King			
		Situk	Salmon	Andrew	Blossom	Keta
	esc.	t.run	esc.	esc.	esc.	esc.
1975	1510	2099	53	416	234	325
1976	1433	2676	81	404	109	134
1977	1732	2833	168	456	179	368
1978	814	1456	71	388	229	627
1979	1400	2735	89	327	86	682
1980	905	2284	88	281	142	307
1981	702	1752	113	511	254	526
1982	434	772	286	635	552	1206
1983	592	1033	245	366	942	1315
1984	1726	2434	250	355	813	976
1985	1521	2380	171	510	1134	998
1986	2067	2356	245	1131	2045	1104
1987	1884	2873	193	1042	2158	1229
1988	885	1450	206	752	614	920
1989	652	682	238	848	550	1848
1990	700	1110	168	1062	411	970
Goal	600		250	750	1280	800

Year	Transboundary Rivers												
	U.S. Alsek		Can. Alsek		U.S. Chilkat	U.S. Taku		Can. Taku		U.S. & Can. Stikine		U.S. Unuk	U.S. Chickamin
	esc.	t.run	esc.	t.run	esc.	esc.	t.run	esc.	t.run	esc.	t.run	esc.	esc.
1975	4214	5593			NA	4609	4609	5800	5800	5800	6401	1469	588
1976	1672	2509	2231	3068	NA	8278	8278	10300	10300	3300	3840	1469	147
1977	4363	6315	5738	7690	NA	10000	10000	11342	12500	6600	6681	1558	363
1978	4050	7091	5352	8393	NA	4987	4987	6610	6200	5200	5450	1770	290
1979	6101	9406	8028	11333	NA	6593	6690	8312	8409	9328	10465	922	224
1980	3770	5502	4924	6656	NA	13402	13627	15088	15313	17096	18212	1626	418
1981	2837	4081	3761	5005	NA	17900	18059	19572	19731	26672	27451	1170	614
1982	3078	4234	4114	5270	NA	8398	8452	9626	9680	22640	23834	2162	1015
1983	3352	4058	4462	5168	NA	3020	3176	4124	4280	4752	5815	1800	922
1984	2038	2673	2769	3404	NA	6307	6601	7818	8112	10352	10703	2939	1763
1985	1853	2491	2491	3129	NA	10851	11177	14416	14732	12456	13536	1894	1530
1986	3966	4711	5151	5896	NA	12178	12453	15040	15315	11564	13500	3402	2683
1987	3598	4435	4742	5579	NA	8951	9078	11486	11613	19132	21309	3157	1560
1988	2865	3406	3756	4297	NA	13411	13635	16954	17509	29168	31520	2794	1258
1989	3399	4066	4473	5140	NA	15451	16346	18784	19579	18860	21529	1838	1494
1990	2264	3070	3102	3908	NA	21278	22584	24498	25804	17568	20049	946	902
Goal	5000		12500		NA	25600		30000	U.S. =	13440		2880	1440
									Can. =	25000			

Escapements and terminal runs of PSC Chinook Technical Committee natural chinook escapement indicator stocks, 1975-1990 (cont.).

Year	Northern B.C.								
	AREA 1 Yakoun	AREA 3 Nass		AREA 4 Skeena		AREA 6	AREA 8	AREA 9 Rivers	AREA 10 Smith
	esc.	esc.	t.run	esc.	t.run	Index	Index	Inlet	Inlet
1975	1500	6025		20319		2225	4425	3280	960
1976	700	5590		13078		2765	3550	1640	1000
1977	800	9060	11518	29018	35716	1820	3600	2225	1050
1978	600	10190	12250	22661	32574	3912	4000	2800	2100
1979	400	8180	10153	18488	23741	3455	4600	2150	500
1980	600	9072	11423	23429	35714	1935	2529	2325	1200
1981	750	7950	9567	24523	36634	1502	3550	3175	1020
1982	1400	6575	8726	17092	31022	4150	220	2250	1500
1983	600	8055	14319	23562	38204	2845	650	3320	1050
1984	300	12620	15010	37598	50042	1914	4700	1400	770
1985	1500	8002	11938	53599	69054	1509	4550	3371	230
1986	500	17390	22608	59968	82911	2615	3362	7623	532
1987	2000	11431	16210	59120	73038	1566	1456	5239	1050
1988	2000	10000	14248	68705	89745	3165	1650	4429	1050
1989	2800	12525	17470	57202	83439	998	2535	3265	225
1990	2000	12103	15405	55976	82248	281	2385	4039	510
Goal	1580	15890		41770		5520	5450	4950	2110

Year		Southern B.C.			Fraser River				
	W. Coast Vancouver I	Upper Georgia St.	Lower Georgia St.		Upper Fraser	Middle Fraser	Thompson		Harrison
	esc.	esc.	esc.	t.run	esc.	esc.	esc.	esc.	t.run
1975	1400	11800	11022	11537	7028	15050	37035		
1976	1125	15150	9240	9640	7612	10975	14875		
1977	3905	3880	10655	14165	10135	13320	30321		
1978	6260	6150	8035	9475	14015	13450	28465		
1979	3048	3610	12281	13652	12495	8595	25145		
1980	7044	1367	10835	14652	15796	9625	19330		
1981	5610	1945	10970	12536	9021	8175	23375		
1982	7627	3260	10470	11905	11603	10470	20385		
1983	4250	3820	8950	9989	17185	15404	20381		
1984	5557	4600	11022	12167	21938	13957	29972	120837	131757
1985	5300	4600	4796	6342	34527	17595	39997	174778	179255
1986	4950	1630	2830	4817	41207	27349	45130	162596	176740
1987	3545	5700	2530	4569	39420	27330	36730	78038	81025
1988	5725	3300	6914	9343	34248	24164	47103	35116	39487
1989	7720	6600	6830	9692	25310	15095	37975	74685	75090
1990	6110	2200	7605	10090	35907	26060	41995	177375	180758
Goal	11665	5100	22280		24460	21130	55710	241700	

Escapements and terminal runs of PSC Chinook Technical Committee natural chinook escapement indicator stocks, 1975-1990 (cont.).

Year	Puget Sound									
	Skagit spring		Skagit sum/fall		Stillaguamish		Snohomish		Green	
	esc	t.run	esc	t.run	esc	t.run	esc	t.run	esc	t.run
1975	804	804	11555	24625	1198	1635	4485	6123	3394	6217
1976	763	763	14479	23306	2140	4002	5315	9889	3140	7679
1977	716	716	9497	17693	1475	2549	5565	9618	3804	5339
1978	1079	1079	13209	20030	1232	1959	7931	12591	3304	4337
1979	1032	1032	13605	21243	1042	2366	5903	12706	9704	10725
1980	1842	1842	20345	28938	821	2647	6460	16688	7743	10537
1981	1306	1306	8670	19675	630	2783	3368	8968	3606	4898
1982	686	686	10439	21022	773	3058	4379	8470	1840	3822
1983	710	710	9080	14671	387	925	4549	10386	3679	13244
1984	765	765	13239	15005	374	883	3762	8480	3353	5339
1985	3265	3265	16298	25075	1409	2641	4873	9005	2908	7417
1986	1995	1995	18127	21585	1277	2416	4534	8267	4792	5770
1987	2108	2108	9647	13037	1321	1906	4689	6670	10338	11666
1988	1988	1988	11954	14647	717	1176	4513	7389	7994	9185
1989	1853	2262	6776	12787	811	1642	3138	6142	11512	14993
1990	1902	1937	17206	19159	842	1732	4209	8275	7035	14957
Goal	3000		14900		2000		5250		5800	

Year	Washington Coast															
	Quillayute summer		Quillayute fall		Hoh spr/sum		Hoh fall		Queets spr/sum		Queets fall		Grays Harbor spring		Grays Harbor fall	
	esc	t.run	esc	t.run	esc	t.run	esc	t.run	esc	t.run	esc	t.ru	esc	t.run	esc.	t.run
1975																
1976	1300	1700	2500	4700	600	1300	2500	3100	500	700	1200	2500	600	1000	1800	8900
1977	3800	5300	3300	7600	1000	2000	2100	3800	700	1200	3600	5500	800	1700	5200	13200
1978	2300	2700	4700	6200	1400	2500	1900	2900	1100	1400	2200	3100	1000	1600	4600	10700
1979	2100	3900	3900	6600	1400	2300	1700	2200	900	1400	3900	4700	400	1100	9400	12200
1980	900	1500	6700	7600	800	1000	2200	2800	1000	1200	3200	5800	200	600	11700	22000
1981	800	1700	5700	7100	1500	2100	3100	4000	1000	1300	4300	8000	600	900	7600	12400
1982	1200	2700	7100	9700	1600	2300	4500	5800	800	1200	4100	6200	600	700	5600	13700
1983	1400	1800	2900	5500	1800	1800	2500	3300	1000	1200	2600	3800	800	900	5500	9000
1984	600	1000	9100	10400	1500	2400	1900	2600	1000	1200	3900	5300	1100	1100	21000	22600
1985	600	700	6100	8400	1000	1400	1700	3500	700	900	3900	5300	1200	1200	9400	15000
1986	600	1000	10000	13500	1500	2500	5000	6000	900	1200	7700	8900	2000	2000	10500	17600
1987	600	1600	12400	20700	1700	2600	4000	5200	600	1600	6000	9600	900	1100	18800	31100
1988	1300	2600	15200	22200	2600	3900	4100	6900	1800	2300	7600	10400	3500	3600	28200	39200
1989	2200	3300	10000	17100	4800	7200	5100	8700	2500	3900	8700	11300	2100	2400	26100	55700
1990	1300	1500	13700	16800	3900	5800	4200	6400	1800		10700		1500	1600	16500	37900
Goal	1200		NA		NA		NA		NA		NA		1400		14600	

Escapements and terminal runs of PSC Chinook Technical Committee natural chinook escapement indicator stocks, 1975-1990 (cont.).

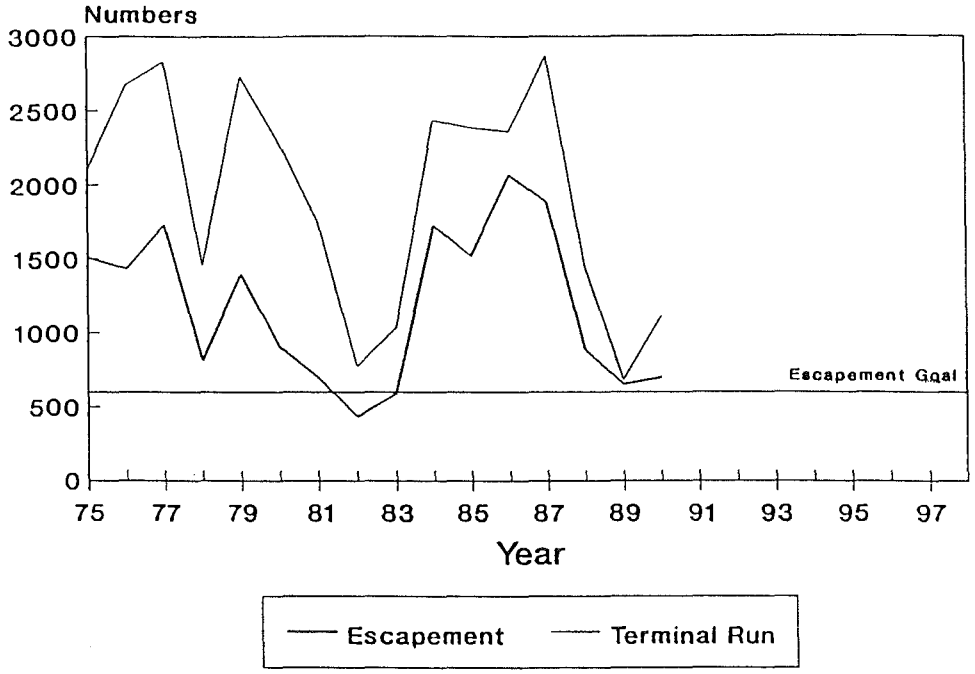
Year	Columbia River								Oregon
	Col. Upriver spring		Col. Upriver summer		Col. Upriver bright		Lewis River		Oregon Coastal
	esc.	t.run	esc.	t.run	esc.	t.run	esc.	t.run	Index esc.
1975			33000	33000	29600	112500	13859	36800	60
1976			26600	26700	28800	115100	3371	14900	50
1977	64900	92700	33300	34300	37600	95100	6930	29800	73
1978	89600	95300	37600	38700	27300	85300	5363	18500	77
1979	22300	23300	26700	27800	31200	89200	8023	32700	90
1980	26700	27600	25800	27000	29900	76800	16394	38800	95
1981	31500	33700	21100	22400	21100	66600	19297	25000	81
1982	31700	34800	18800	20100	31100	79000	8370	13000	99
1983	23600	25200	17700	18000	48700	86100	13540	16800	49
1984	18600	20400	22100	22400	61000	131400	7132	13300	100
1985	27200	28800	23200	24200	93300	195600	7491	13300	133
1986	36500	39800	25700	26200	113300	281500	11983	24500	135
1987	41400	45000	31800	33000	154100	419400	12935	37900	131
1988	35100	40700	30100	31300	114700	339900	12059	41700	221
1989	27000	30000	28700	28800	96500	257500	21199	38600	151
1990	28800	32800	25000	25000	57600	156100	17506	20900	125
Goal	84000		85000		40000		NA		NA

APPENDIX B

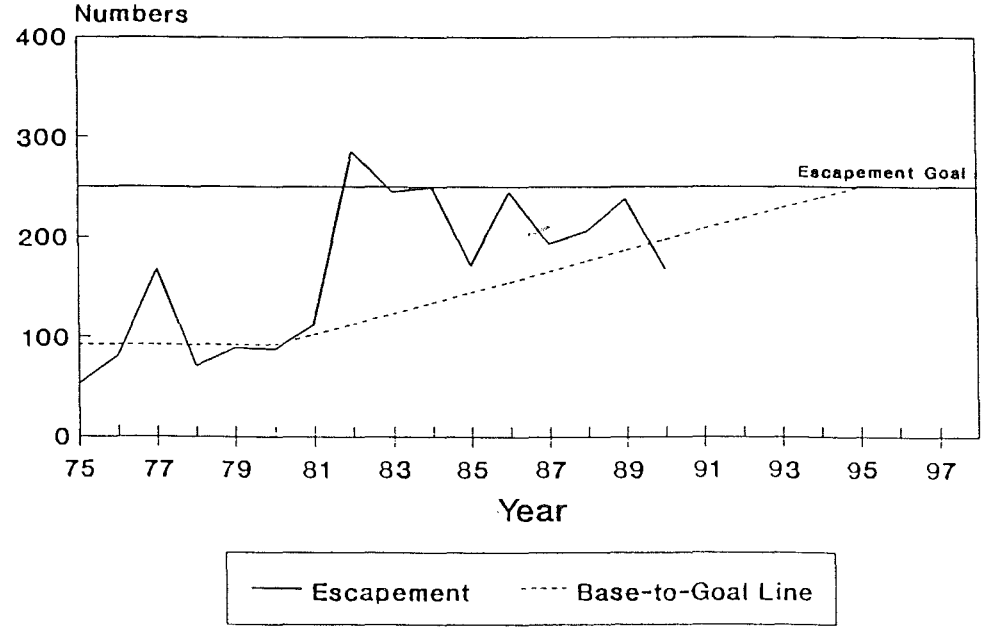
Stock Specific Chinook Escapement Graphs

Situk B-1
King Salmon B-1
Andrew Creek B-2
Blossom River B-2
Keta River B-3
Alsek (U.S. Estimate) B-4
Alsek (Canadian Estimate) B-4
Taku (U.S. Estimate) B-5
Taku (Canadian Estimate) B-5
Stikine River (U.S. Estimate) B-6
Stikine River (Canadian Estimate) B-6
Unuk River (U.S. Estimate) B-7
Chickamin River (U.S. Estimate) B-7
Yakoun River B-8
Nass River B-8
Skeena River B-9
Area 6 Index B-9
Area 8 Index B-10
Rivers Inlet B-10
Smith Inlet B-11
WCVI B-11
Upper Strait of Georgia B-12
Lower Strait of Georgia B-12
Upper Fraser River B-13
Middle Fraser River B-13
Thompson River B-14
Harrison B-14
Skagit Spring B-15
Skagit Summer/Fall B-15
Stillaguamish River B-16
Snohomish River B-16
Green River B-17
Quillayute Summer B-17
Grays Harbor Spring B-18
Grays Harbor Fall B-18
Columbia River Spring B-19
Columbia River Summer B-19
Columbia River Bright B-20
Quillayute Fall B-20
Hoh Spring/Summer B-21
Hoh Fall B-21
Queets Spring/Summer B-22
Queets Fall B-22
Lewis River Fall B-23
Oregon Coastal B-23

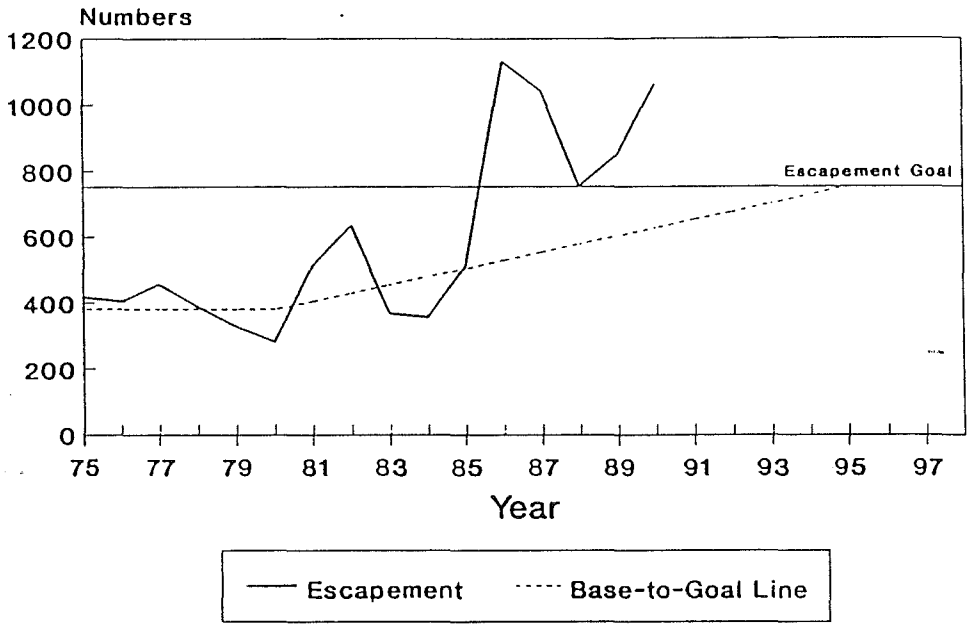
Situk Chinook Escapements



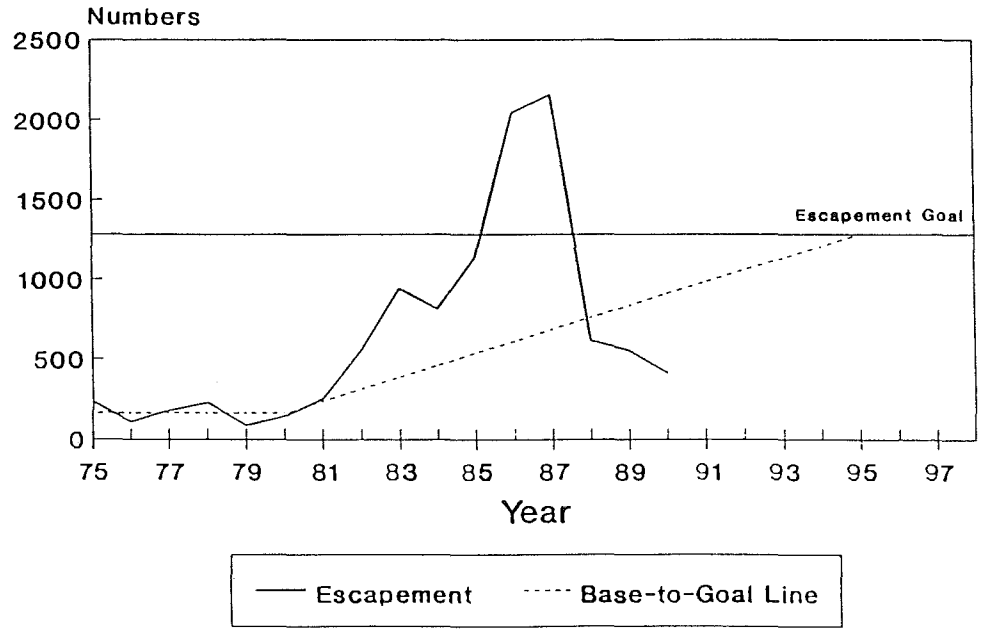
King Salmon Chinook Escapements Indeterminate



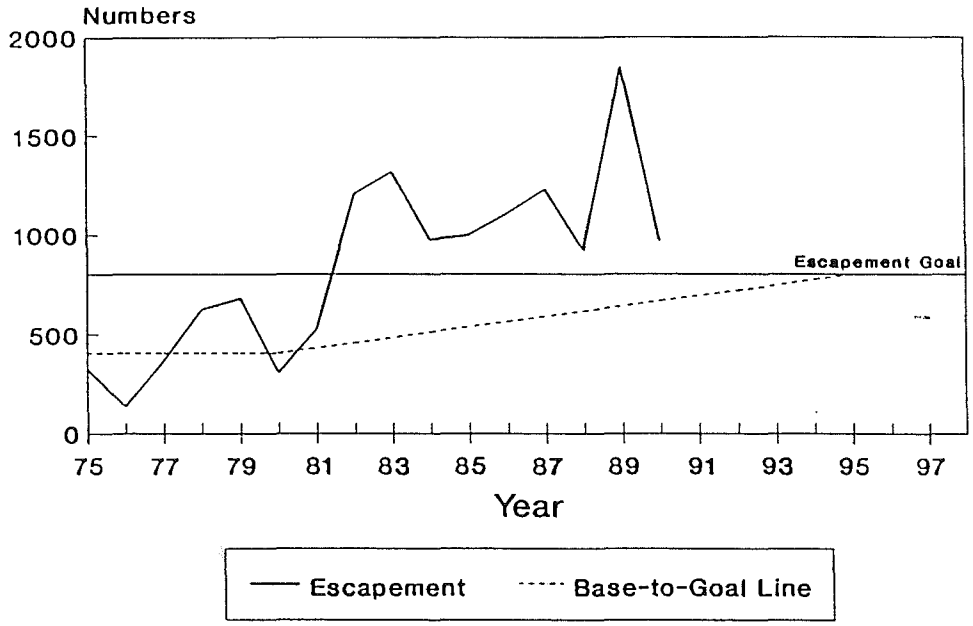
Andrew Creek Chinook Escapements
Rebuilding



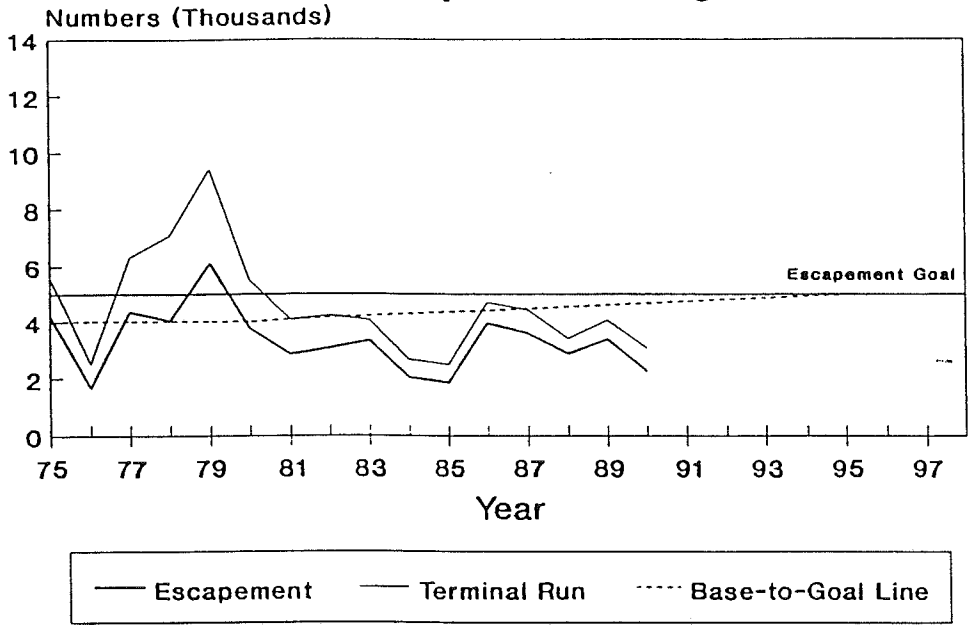
Blossom River Chinook Escapements
Indeterminate



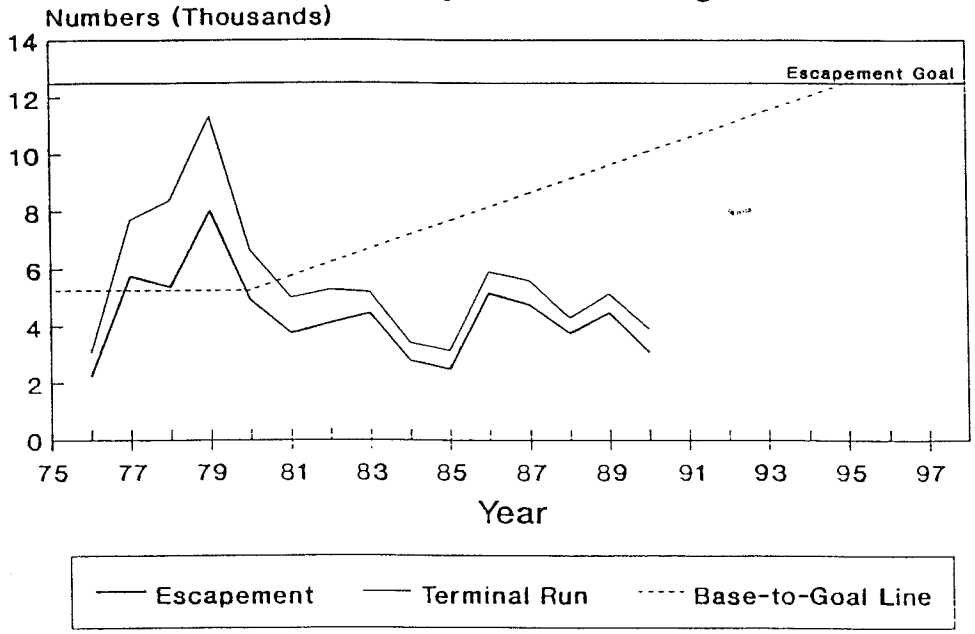
Keta River Chinook Escapements
Probably Rebuilding



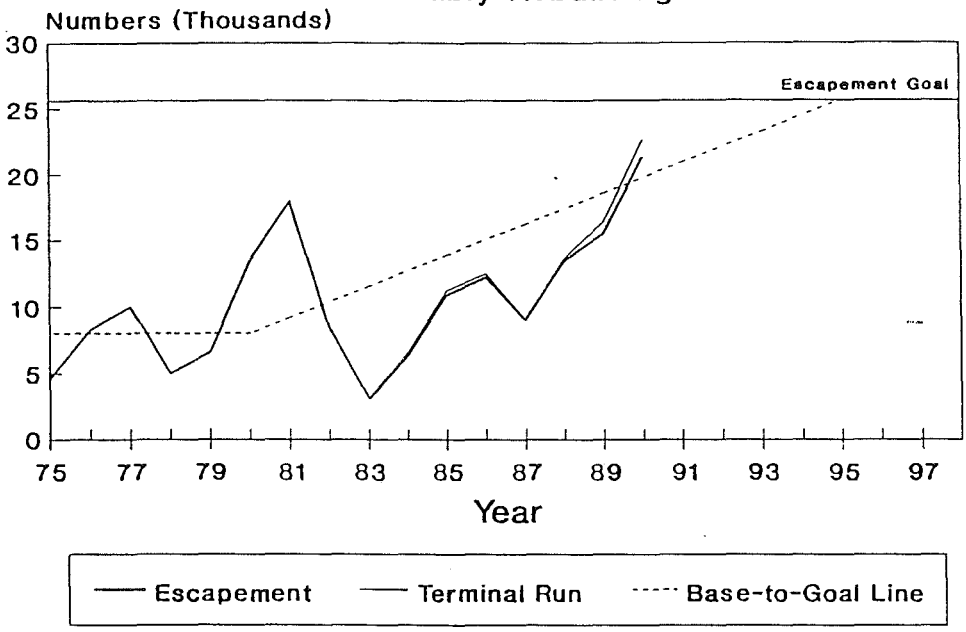
Alsek R. Chinook Escapements
U.S. Estimates and Goal
Probably Not Rebuilding



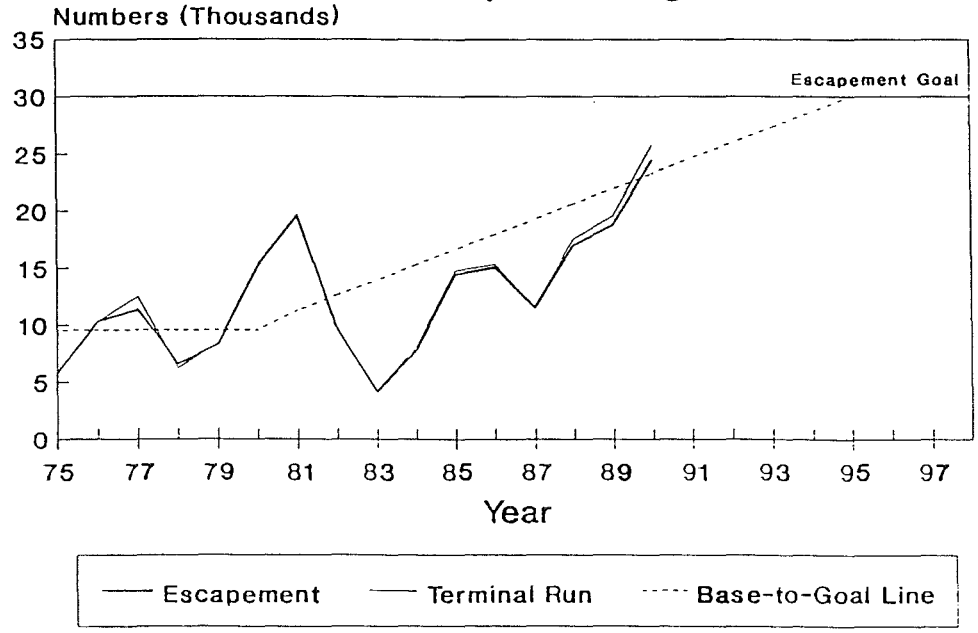
Alsek R. Chinook Escapements
Canadian Estimates and Goal
Probably Not Rebuilding



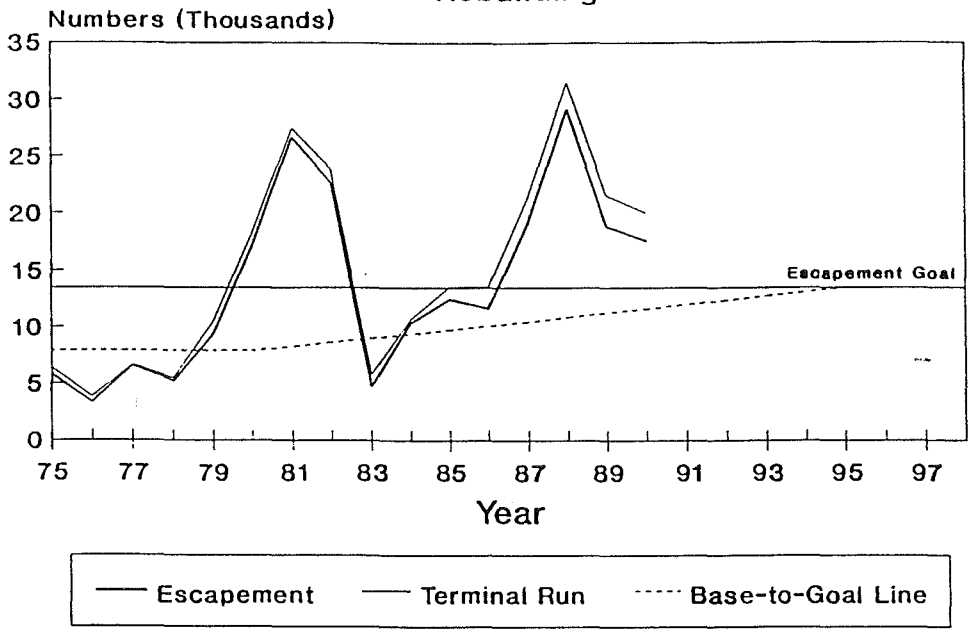
Taku Chinook Escapements
U.S. Estimates and Goal
Probably Rebuilding



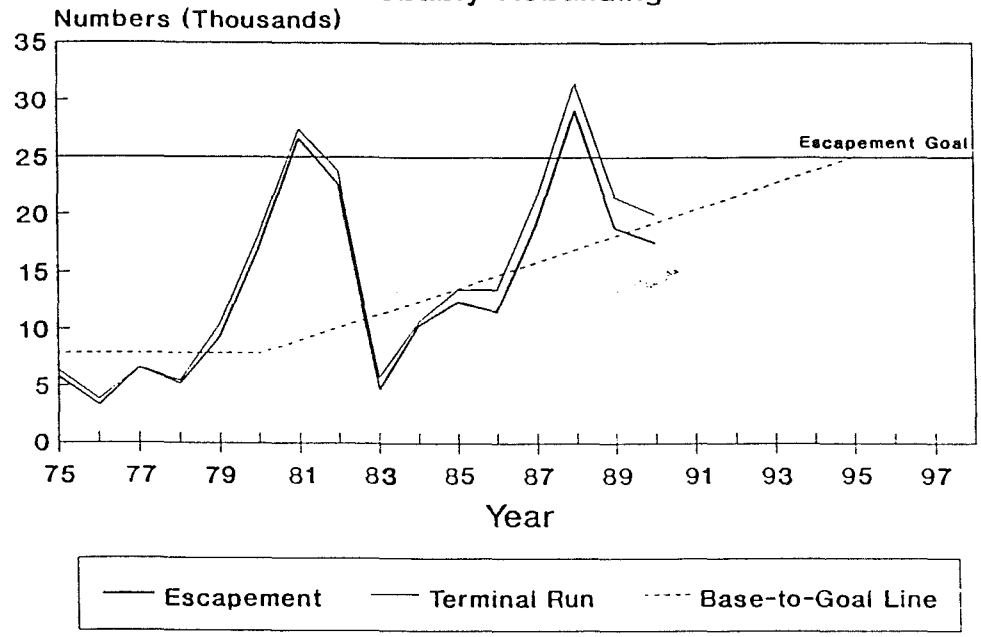
Taku Chinook Escapements
Canadian Estimates and Goal
Probably Rebuilding



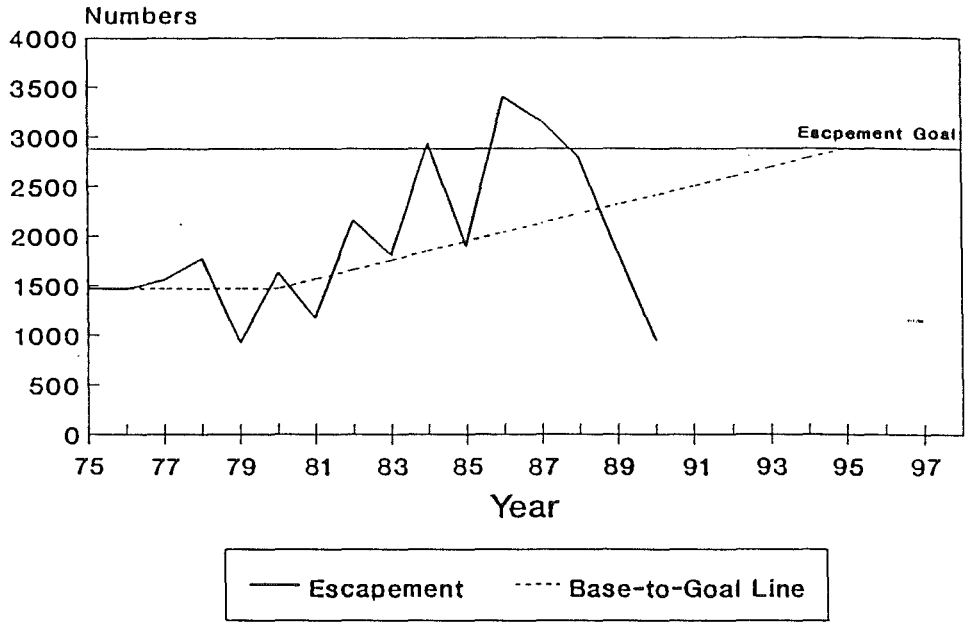
Stikine River Chinook Escapements
U.S. Estimates and Goal
Rebuilding



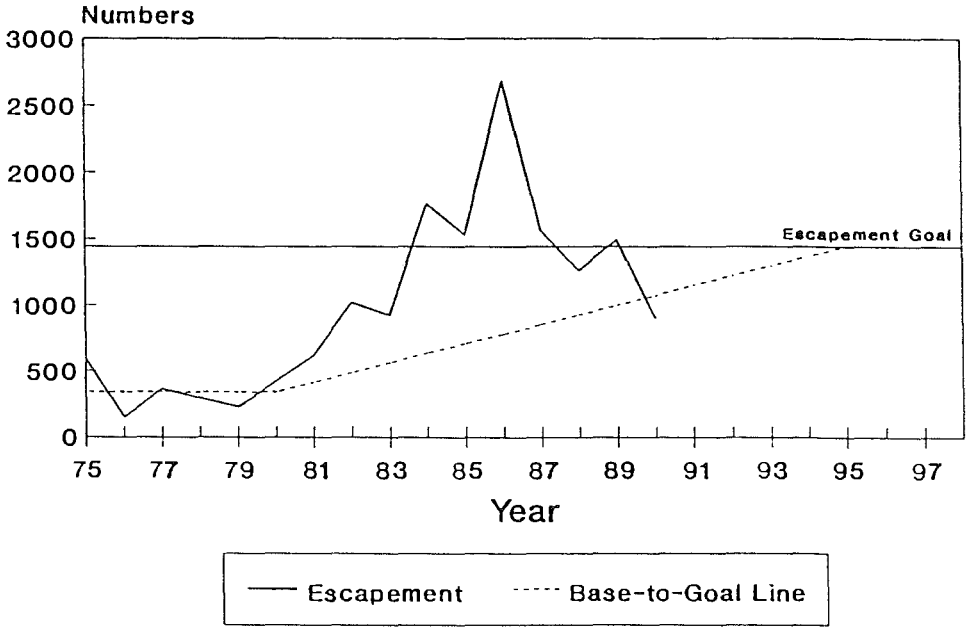
Stikine River Chinook Escapements
Canadian Estimates and Goal
Probably Rebuilding



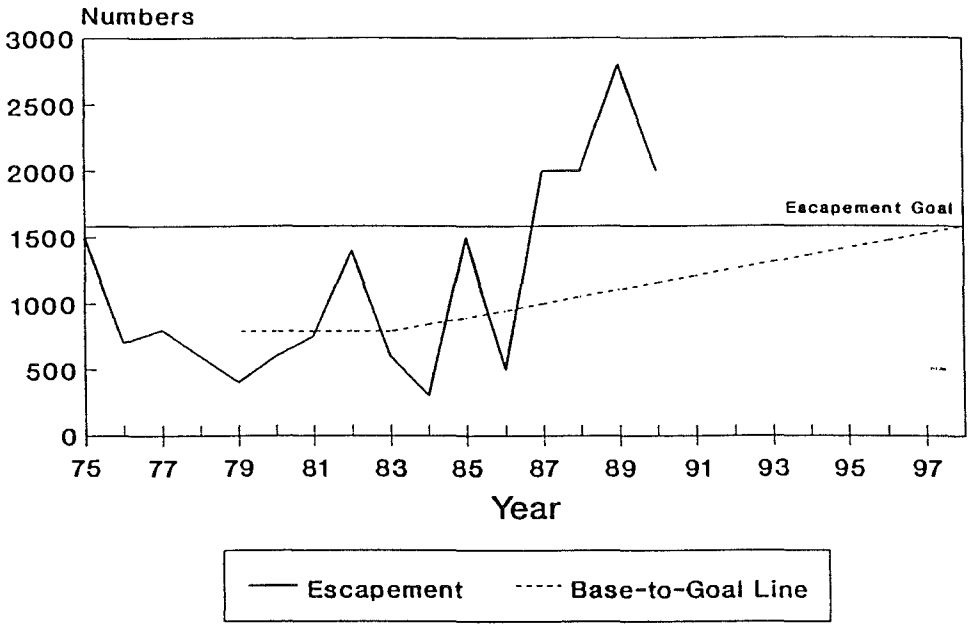
Unuk River Chinook Escapements
U.S. Estimates and Goal
Indeterminate



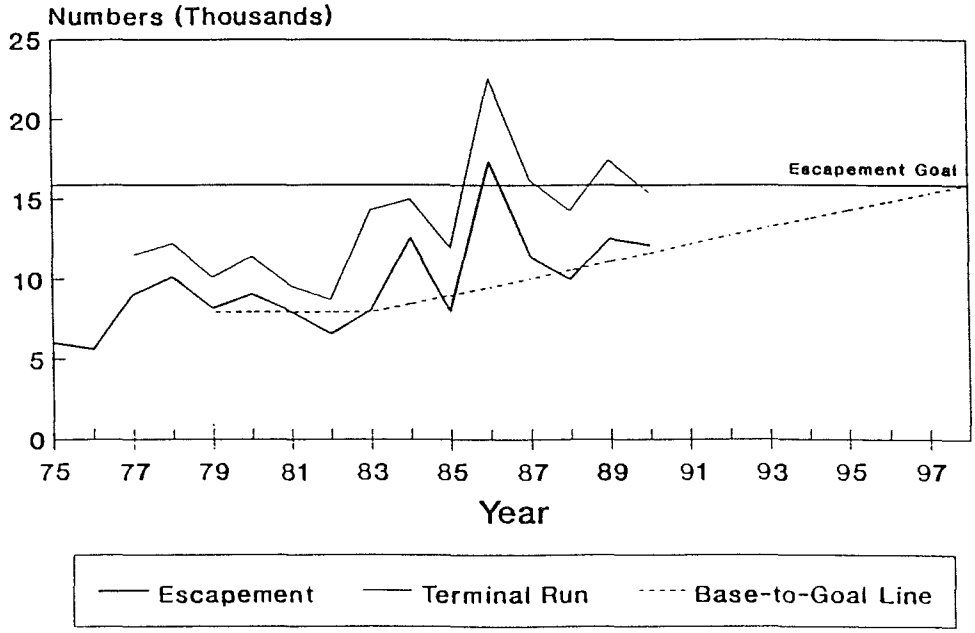
Chickamin River Chinook Escapements
U.S. Estimates and Goal
Indeterminate



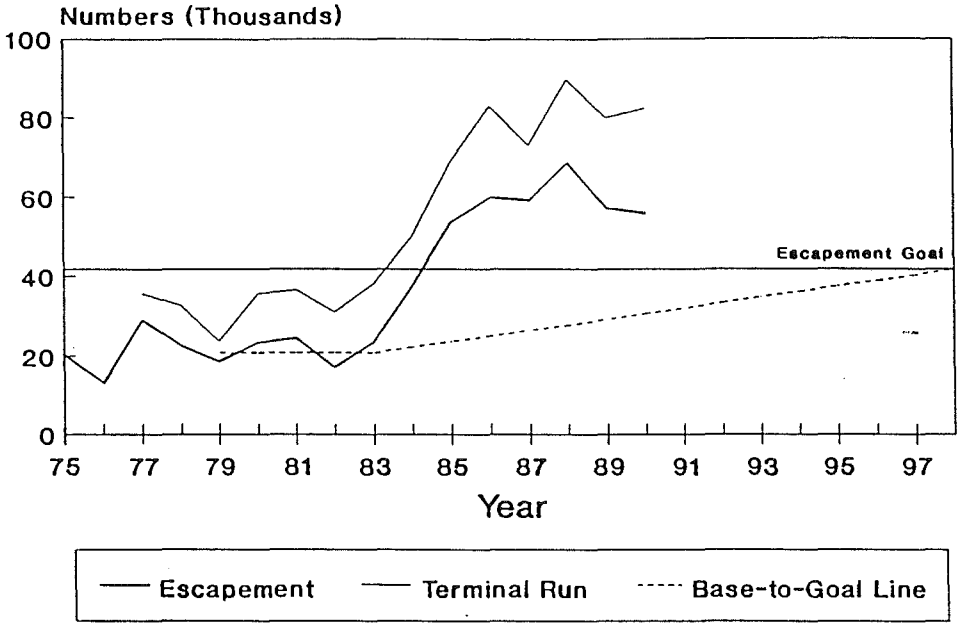
Yakoun River Chinook Escapements
Rebuilding



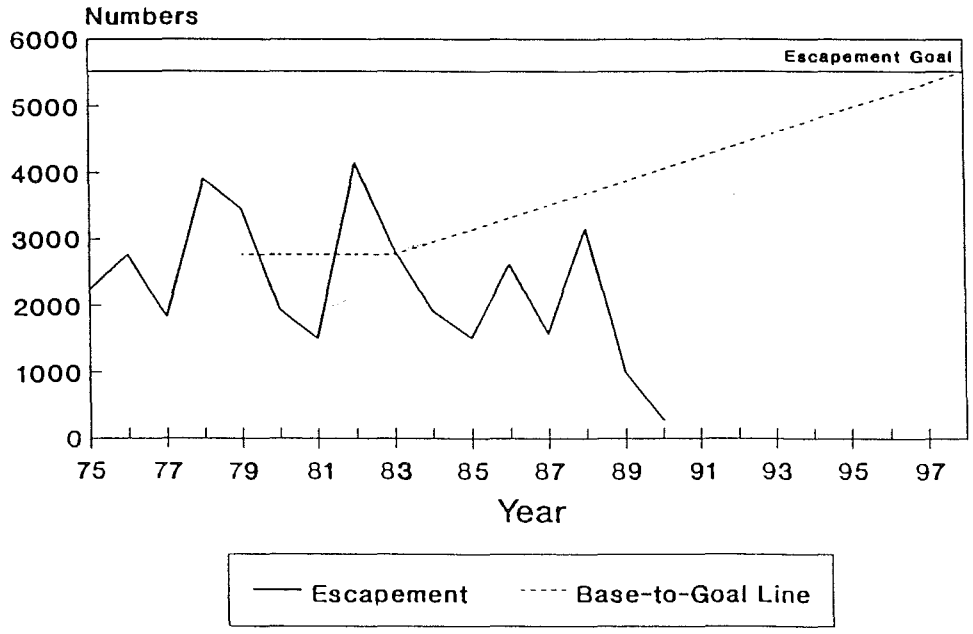
Nass River Chinook Escapements
Probably Rebuilding



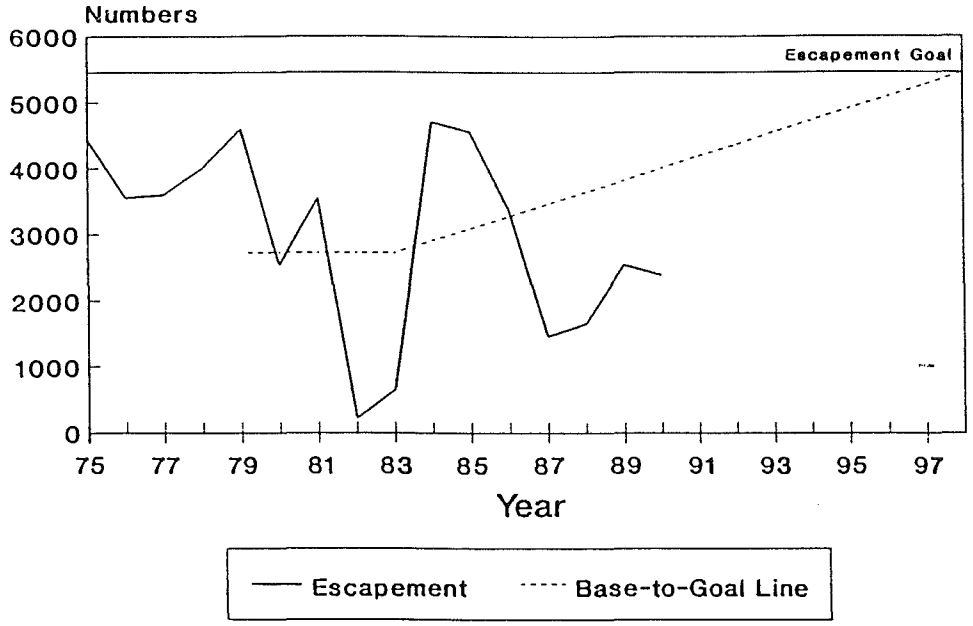
Skeena River Chinook Escapements
Rebuilding



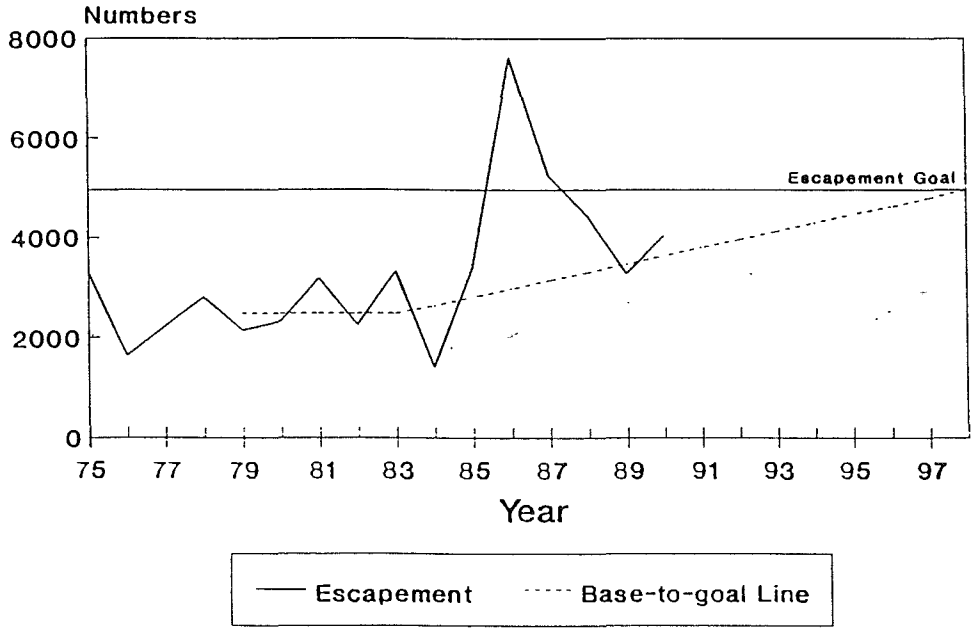
Area 6 Index Chinook Escapements
Probably Not Rebuilding



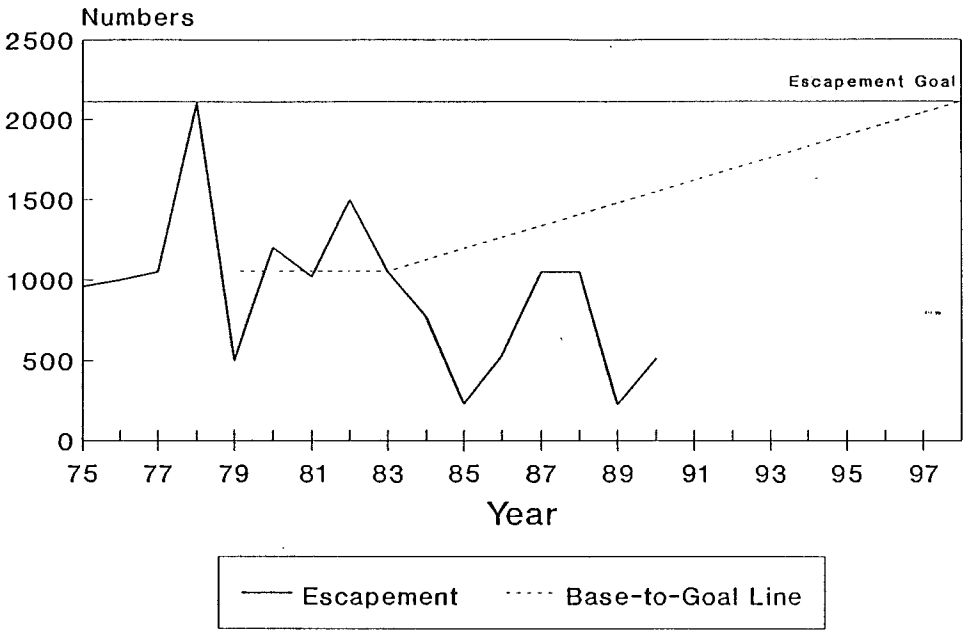
Area 8 Index Chinook Escapements
Probably Not Rebuilding



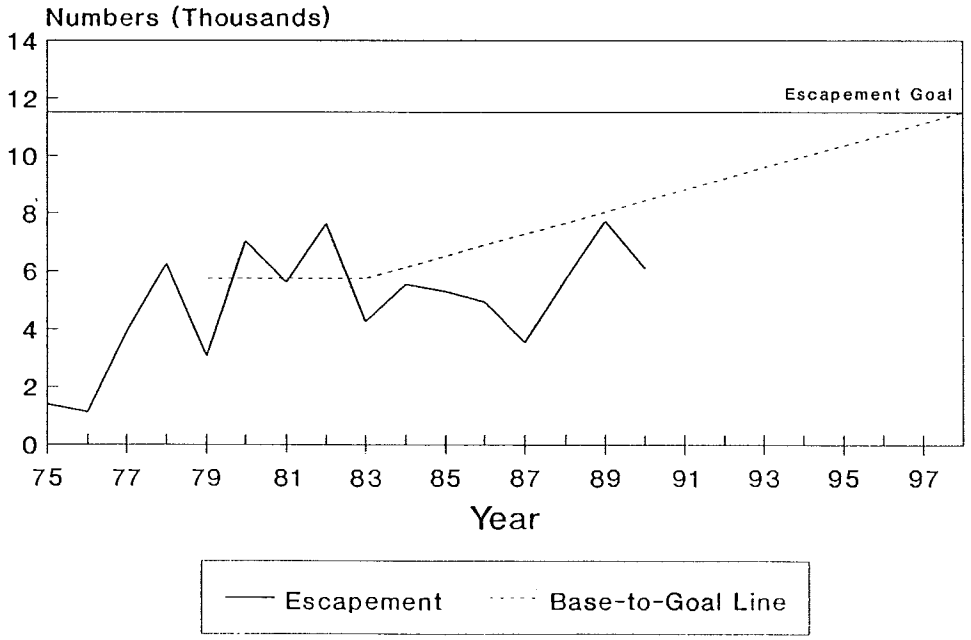
Rivers Inlet Chinook Escapements
Indeterminate



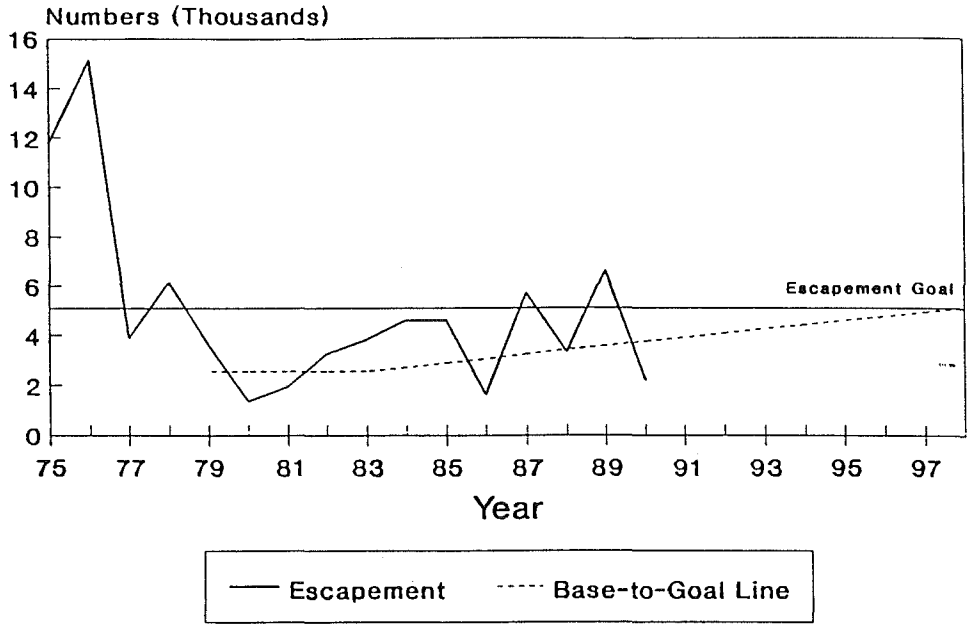
Smith Inlet Chinook Escapements
Probably Not Rebuilding



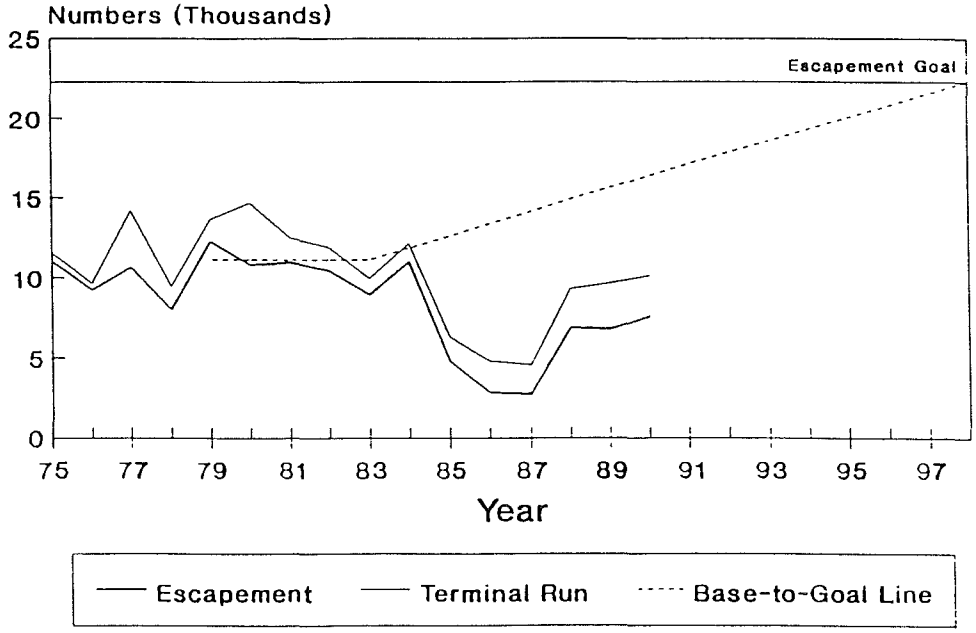
WCVI Chinook Escapements
Indeterminate



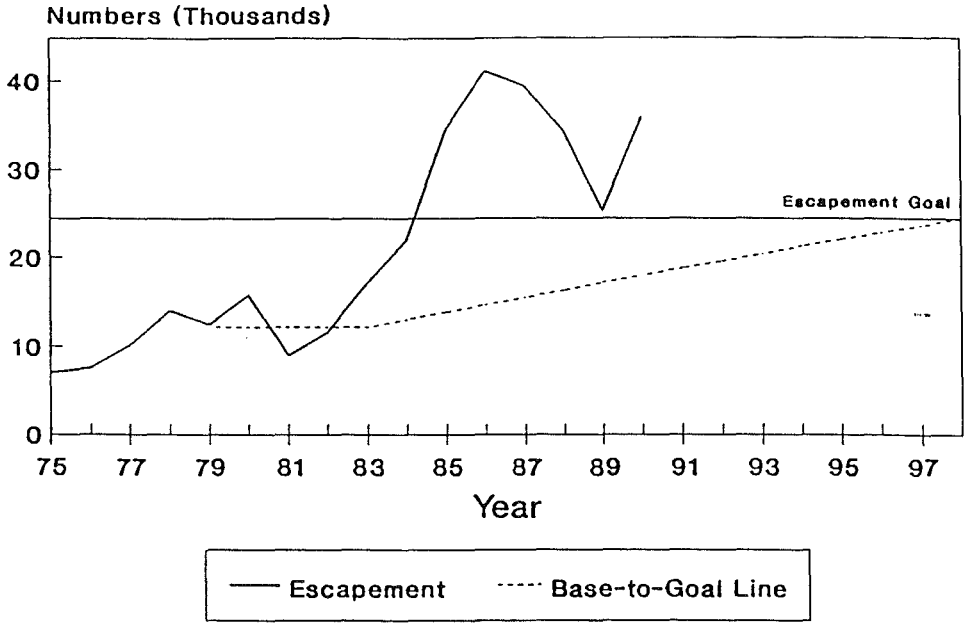
Upper Georgia Str. Chinook Escapements
Indeterminate



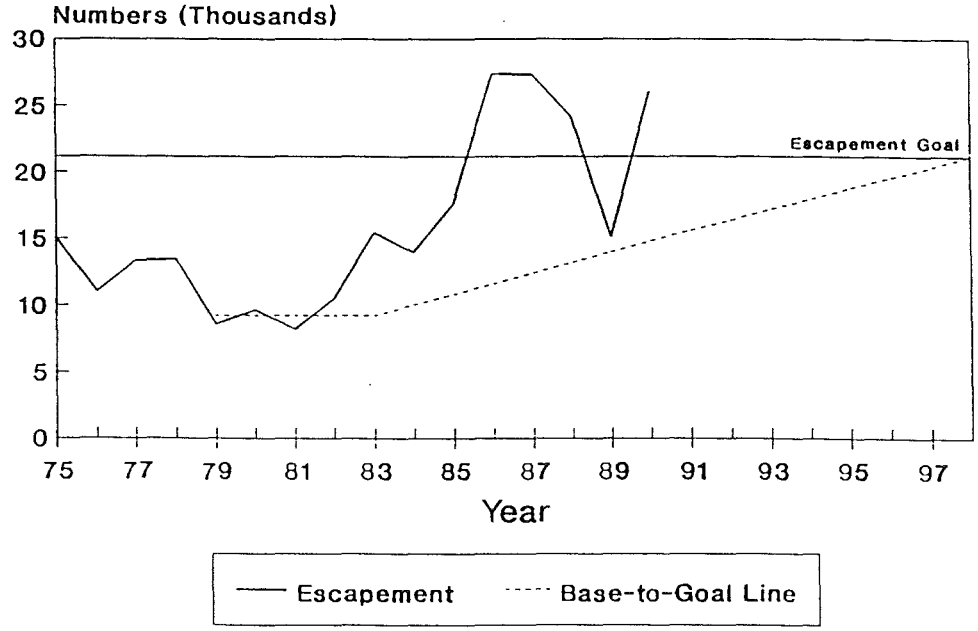
Lower Georgia Str. Chinook Escapements
Probably Not Rebuilding



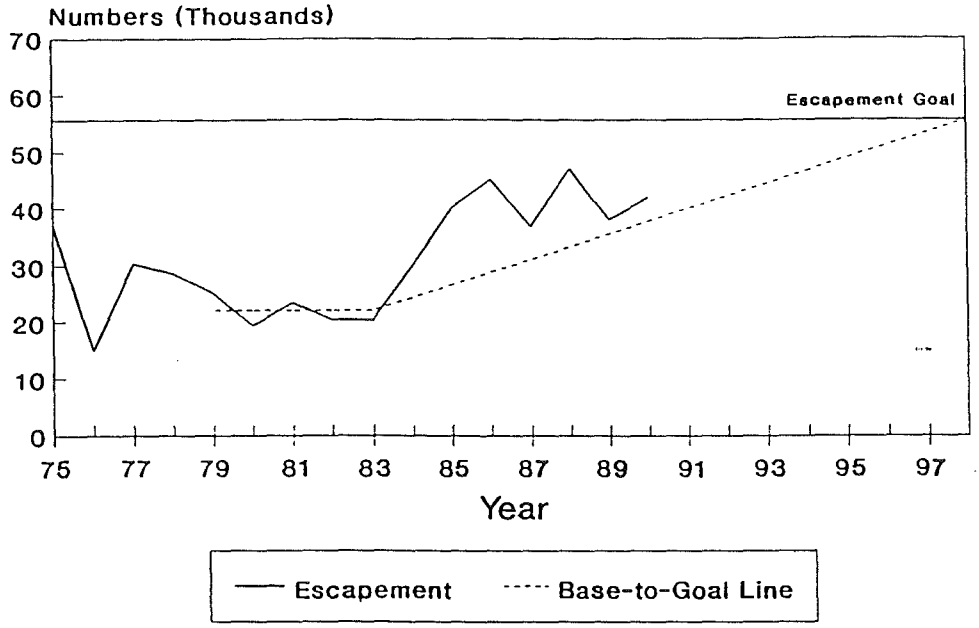
Upper Fraser R. Chinook Escapements
Probably Rebuilding



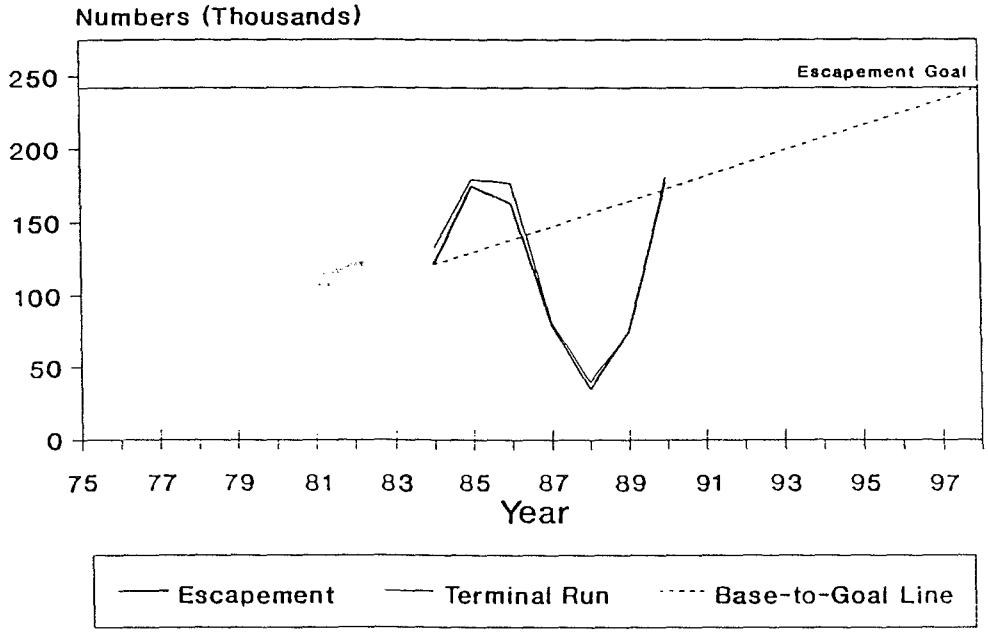
Middle Fraser R. Chinook Escapements
Probably Rebuilding



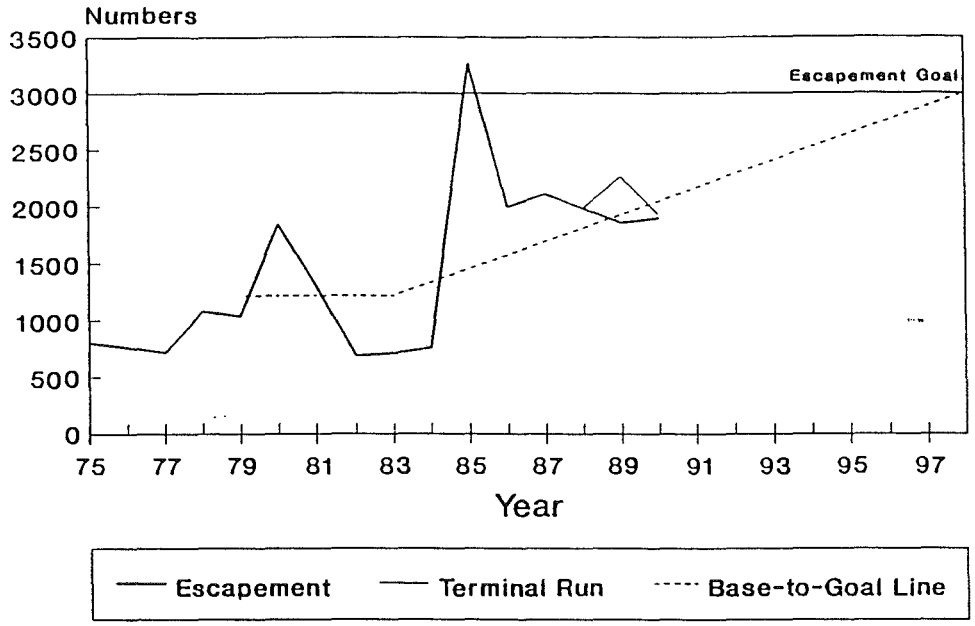
Thompson R. Chinook Escapements
Probably Rebuilding



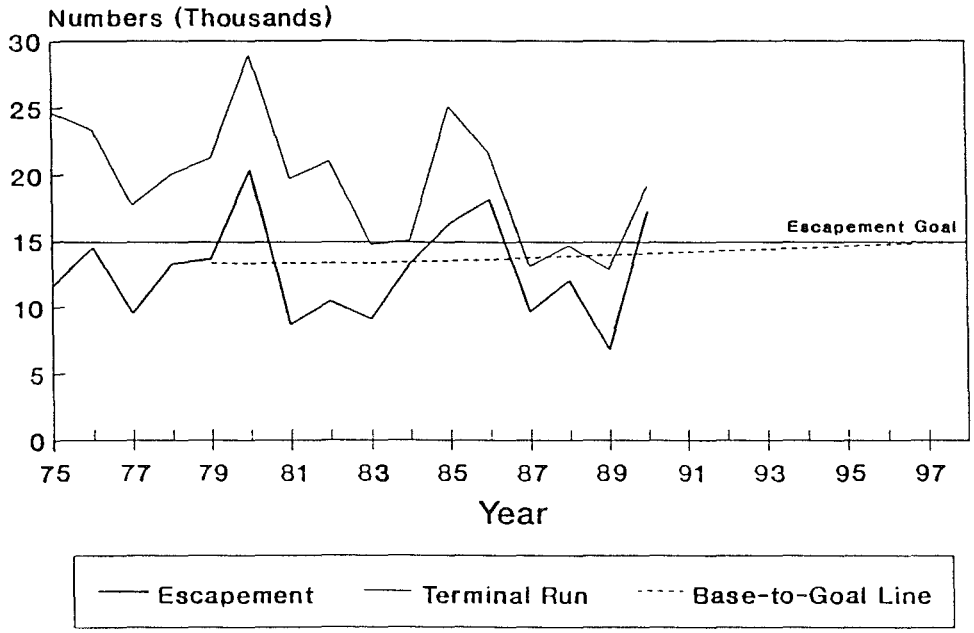
Harrison R. Chinook Escapements
Probably Not Rebuilding



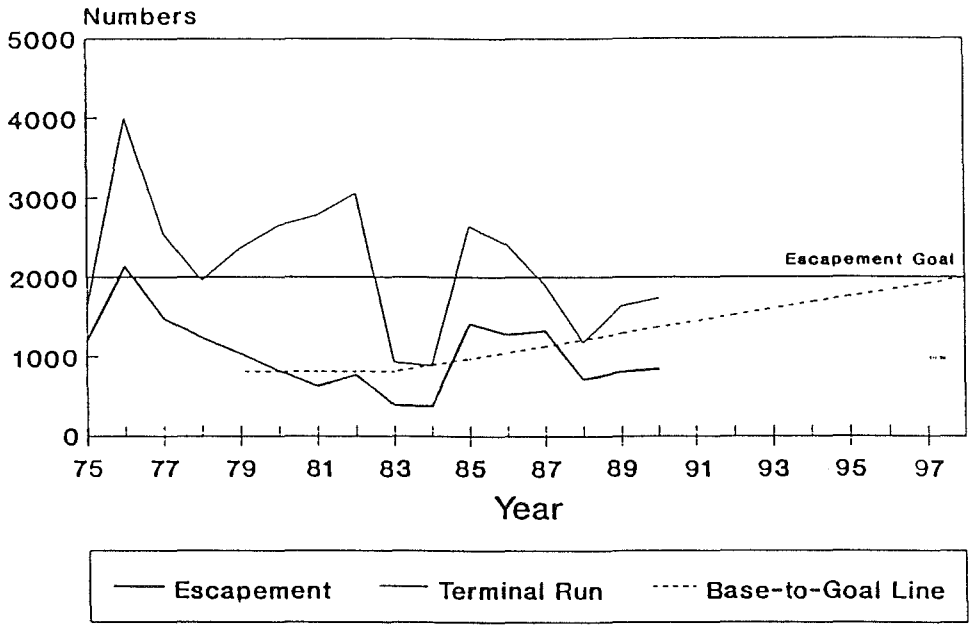
Skagit Spring Chinook Escapements
Indeterminate



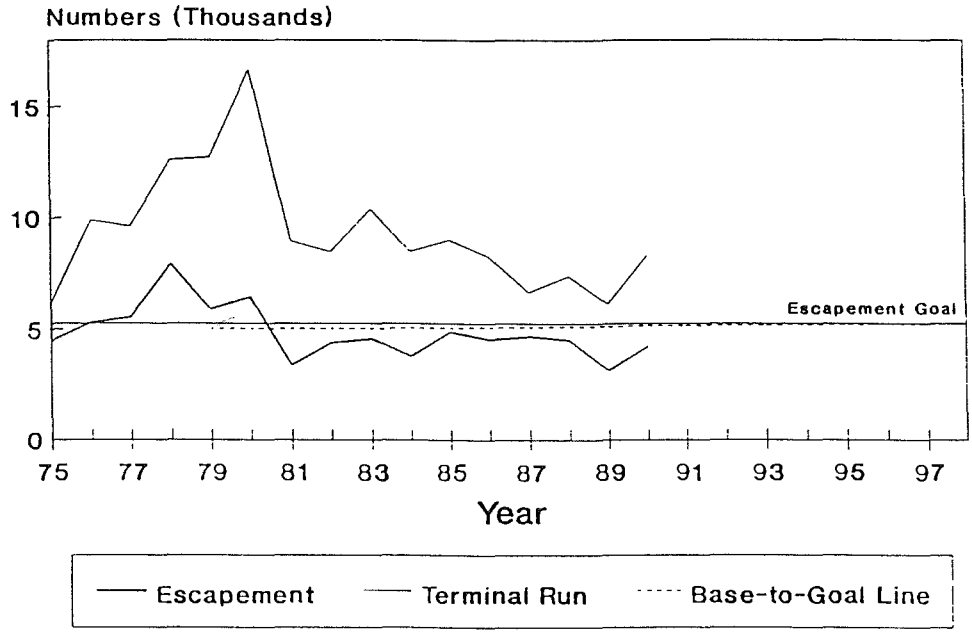
Skagit Sum./Fall Chinook Escapements
Indeterminate



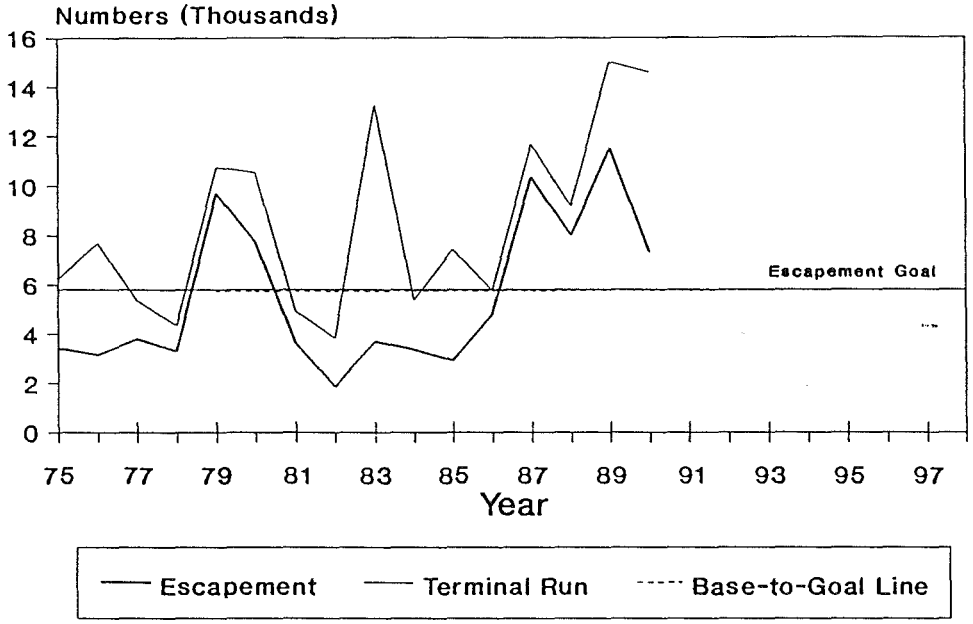
Stillaguamish River Chinook Escapements
Indeterminate



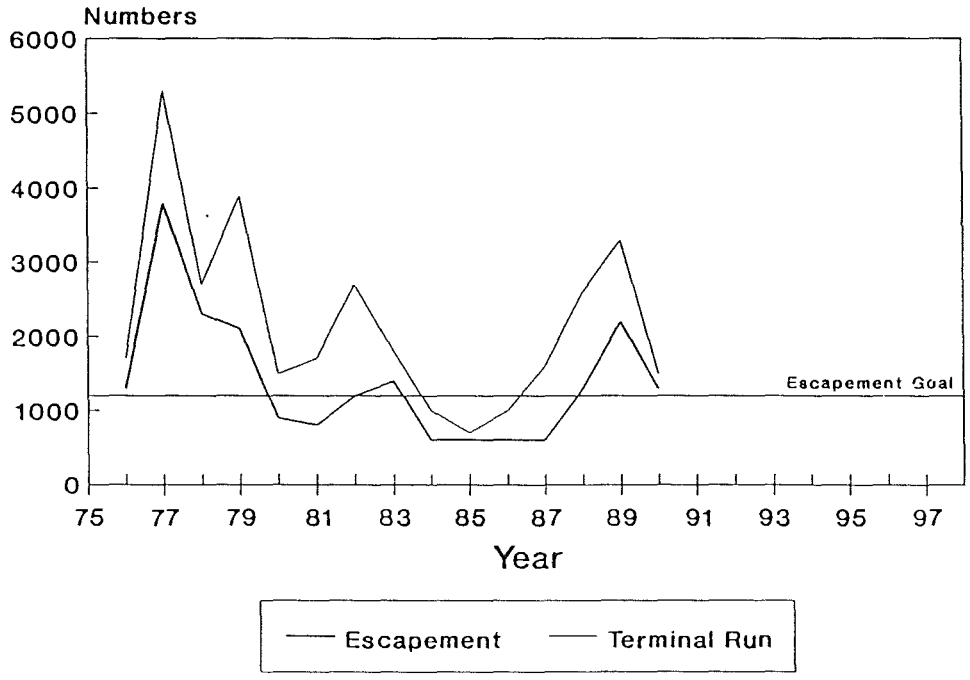
Snohomish River Chinook Escapements
Probably Not Rebuilding



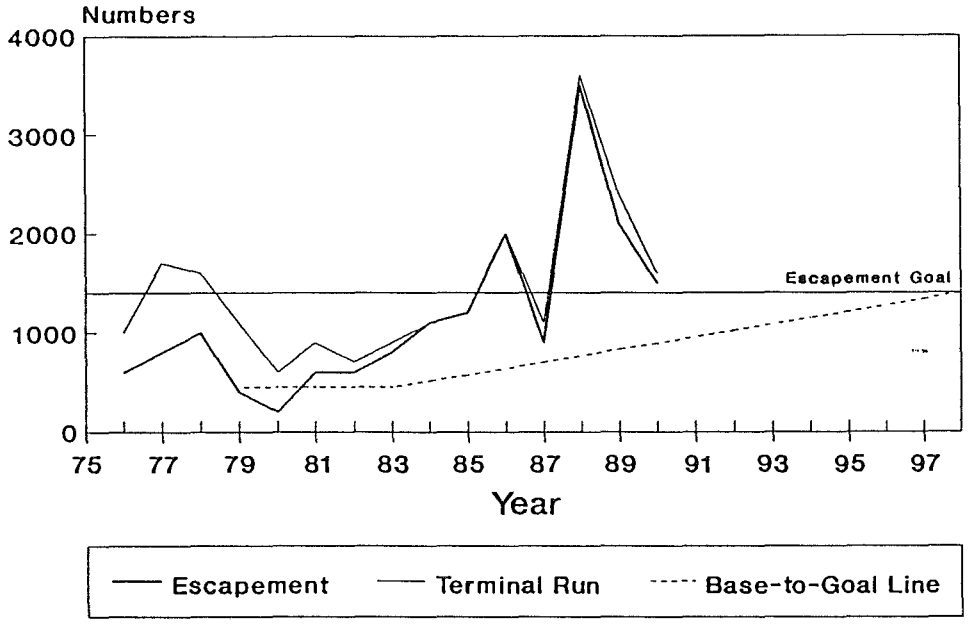
Green River Chinook Escapements
Rebuilding



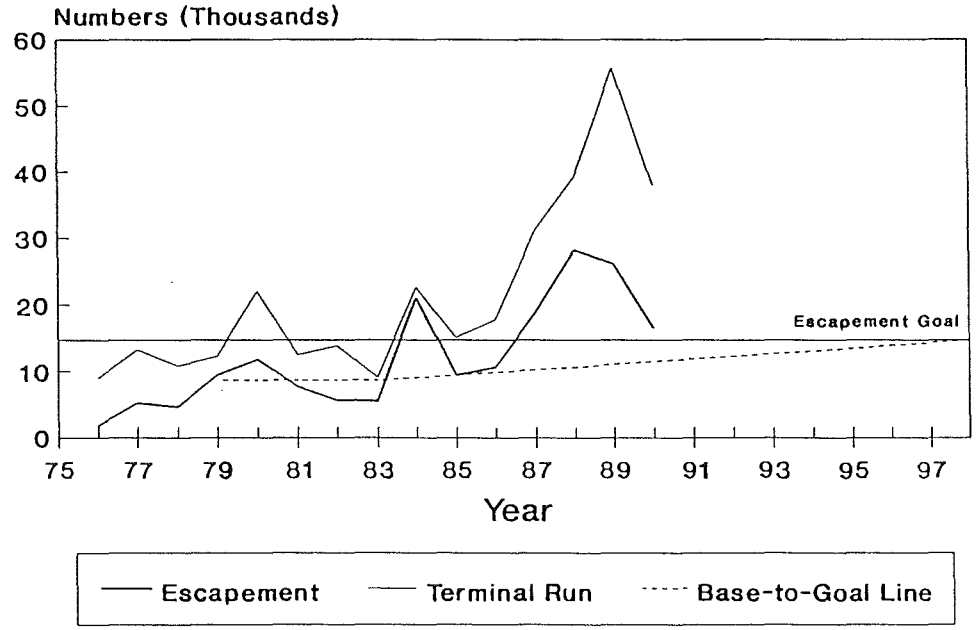
Quillayute Summer Chinook Escapements



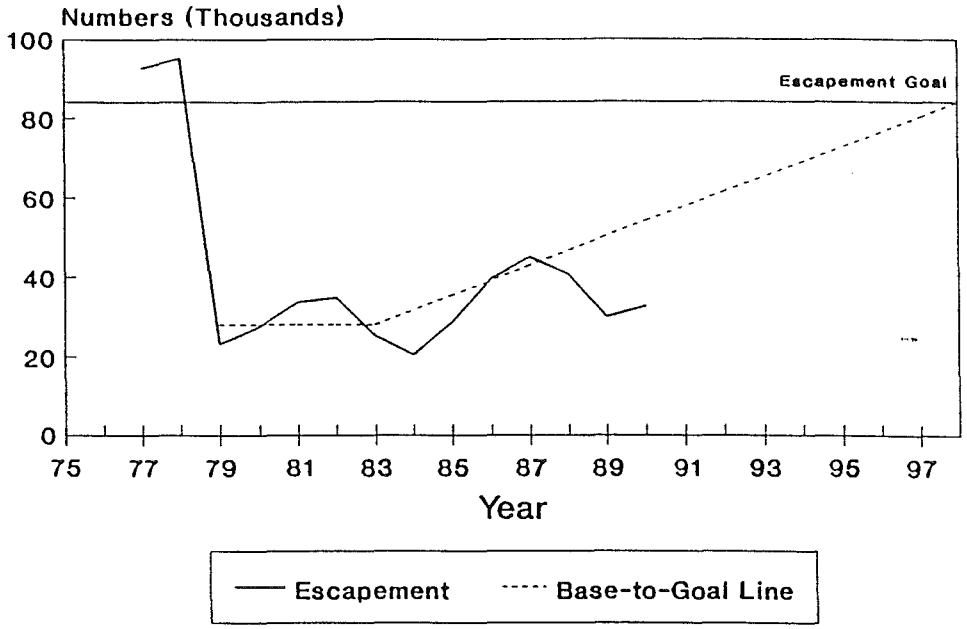
Grays Harbour Spring Chinook Escapement
Probably Rebuilding



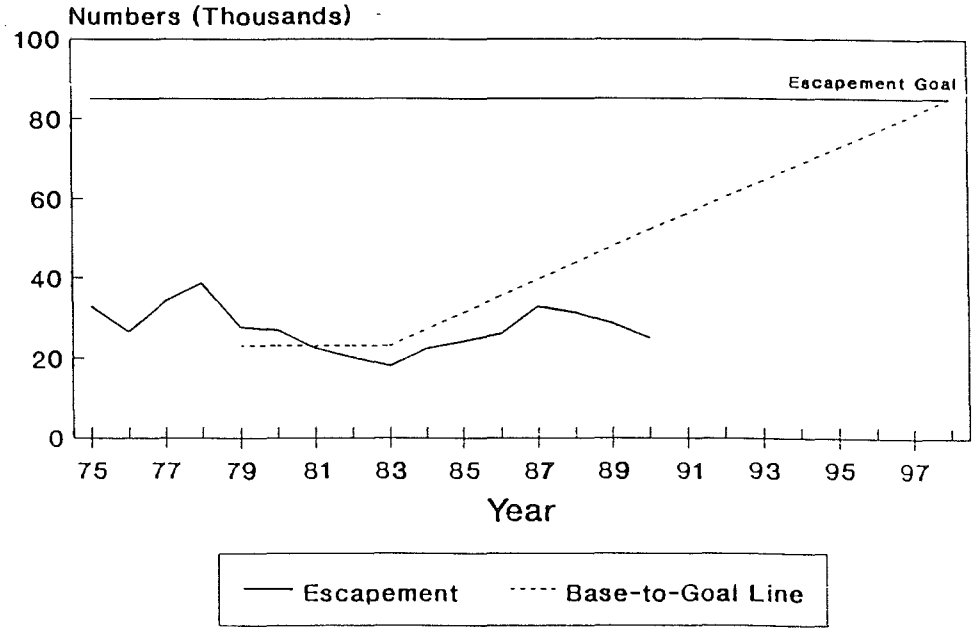
Grays Harbor Fall Chinook Escapements
Probably Rebuilding



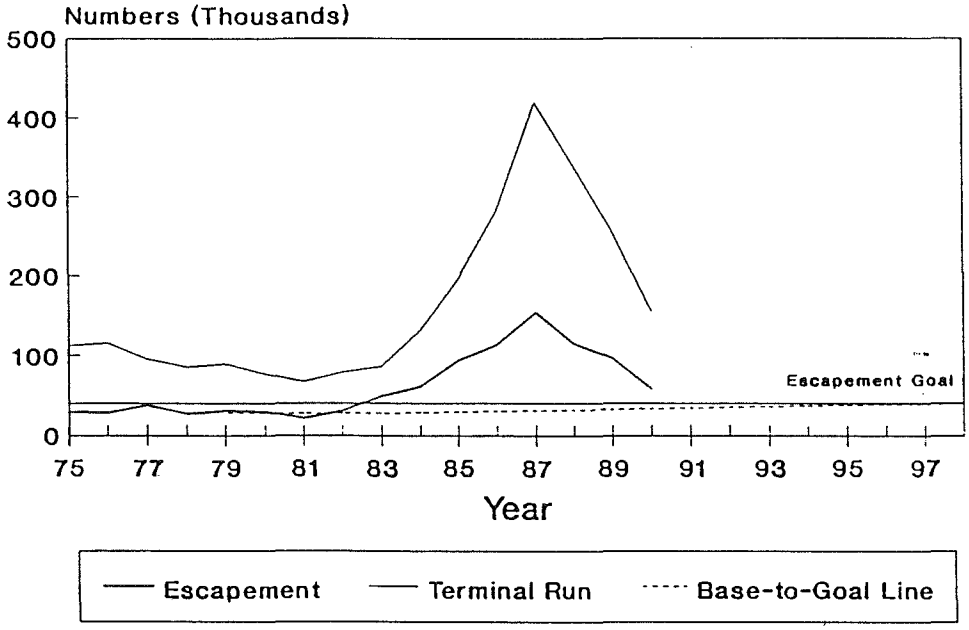
Columbia R. Spring Chinook Escapements Probably Not Rebuilding



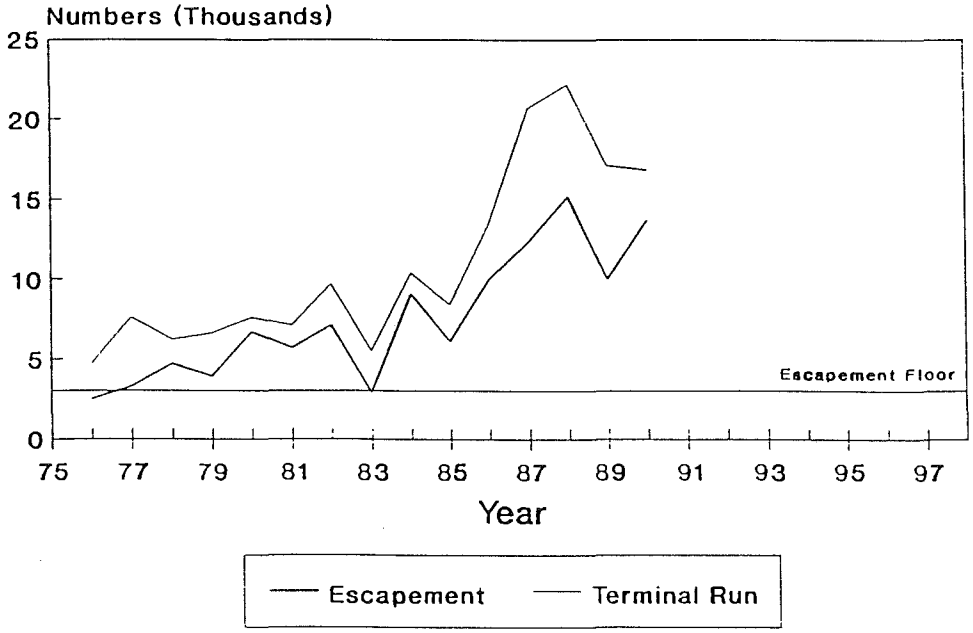
Columbia R. Summer Chinook Escapements Probably Not Rebuilding



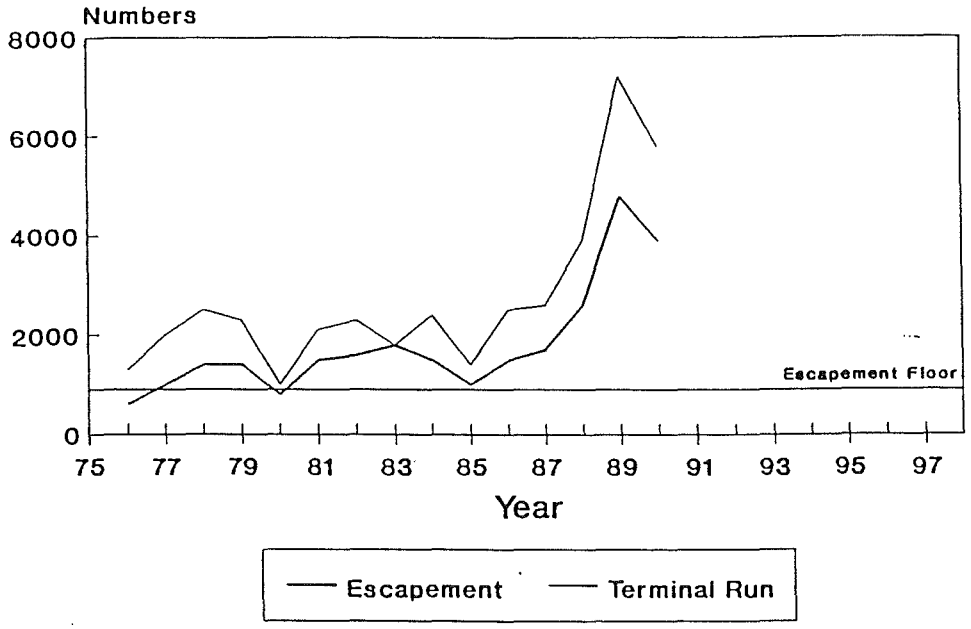
Columbia R. Bright Chinook Escapements Probably Rebuilding



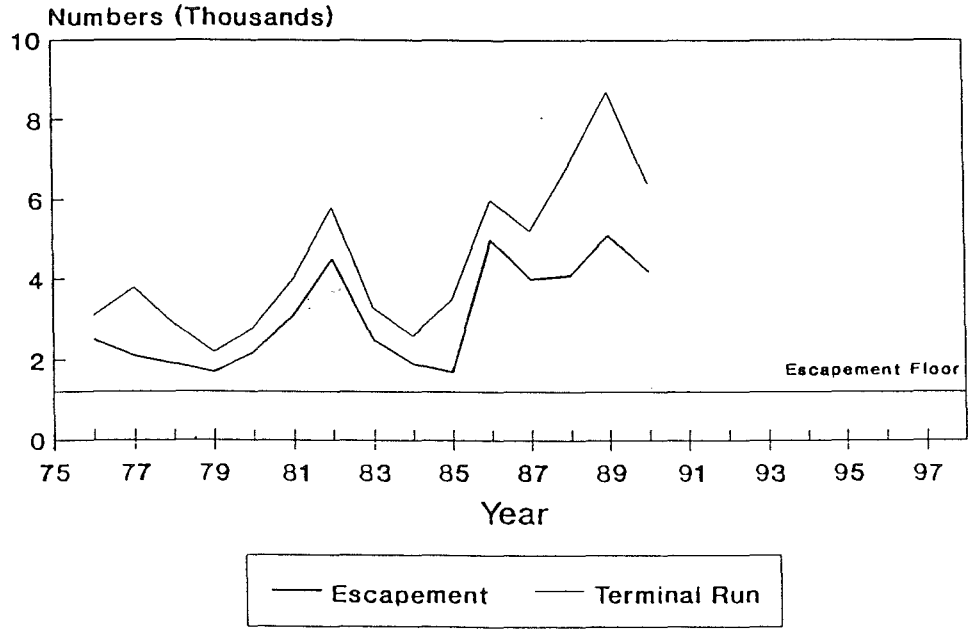
Quillayute Fall Chinook Escapements Increasing



Hoh Spr/Sum Chinook Escapements Increasing



Hoh Fall Chinook Escapements Increasing



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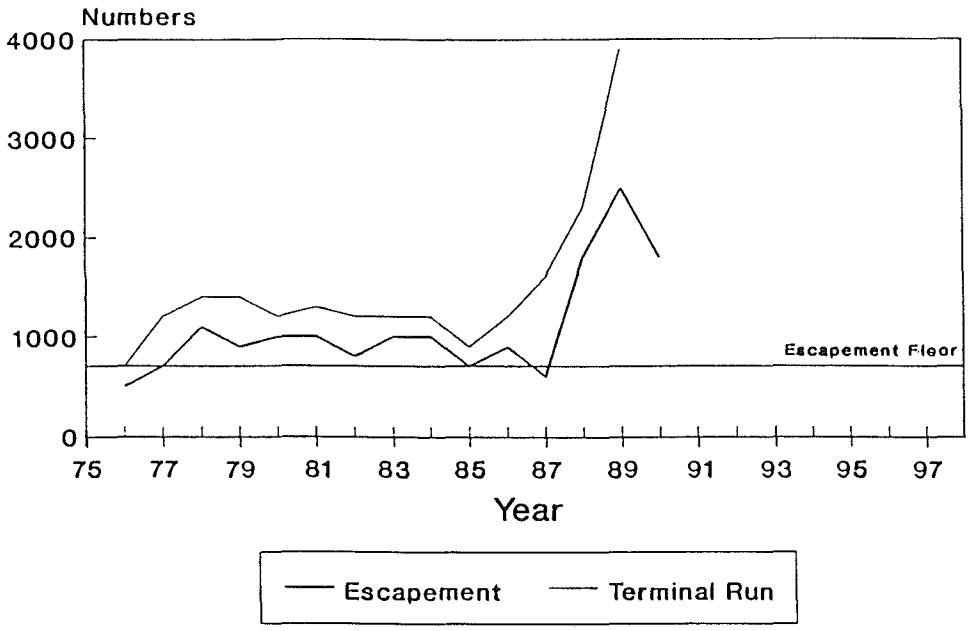
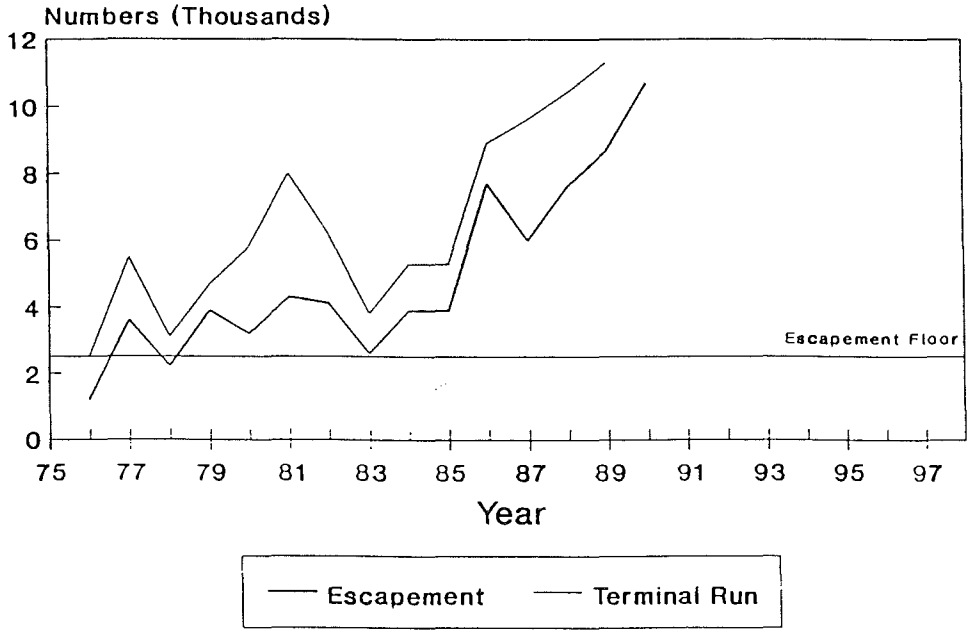
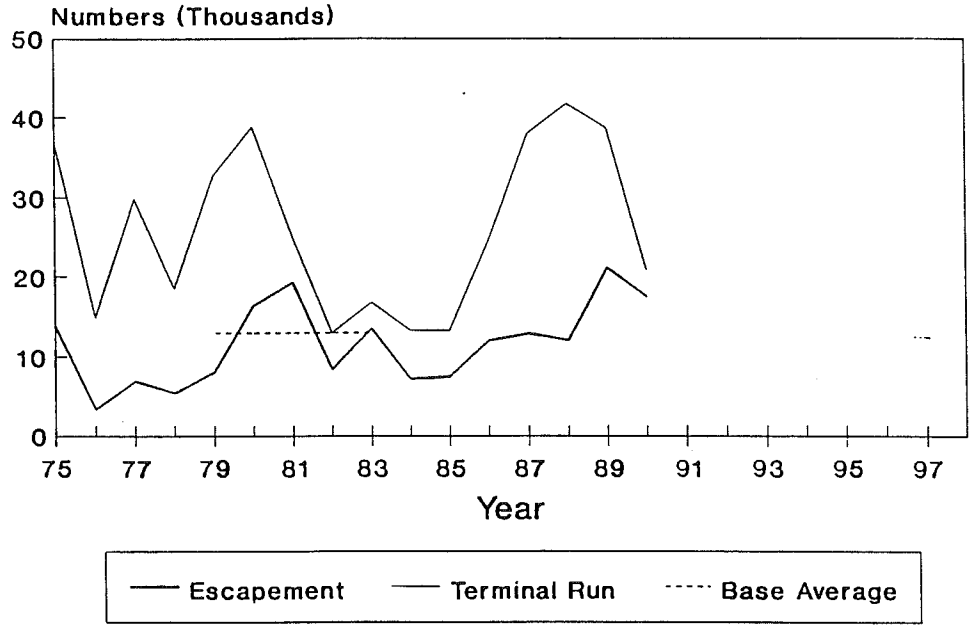


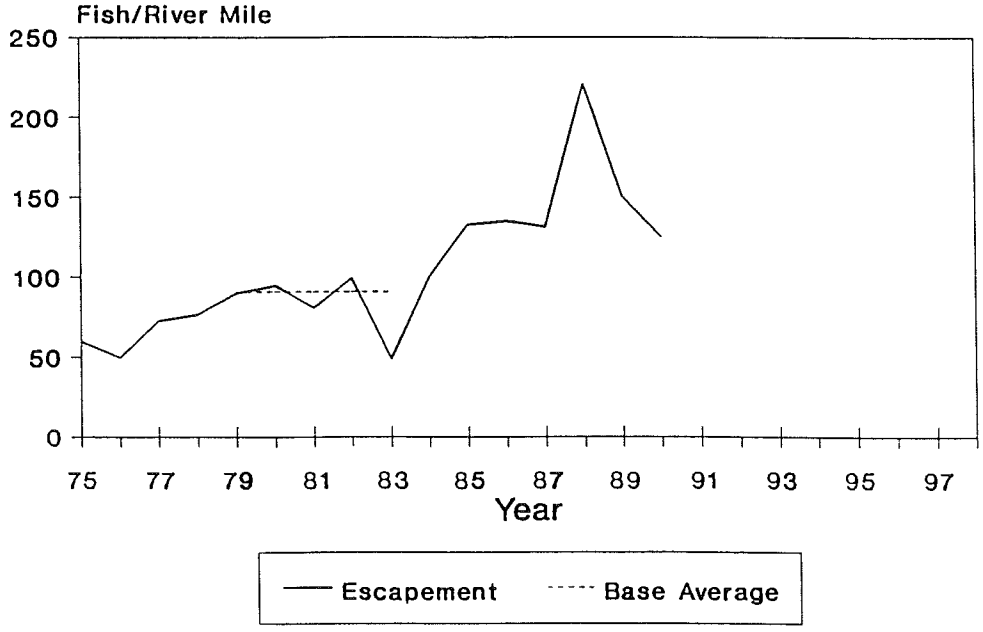
Queets Fall Chinook Escapements Increasing



Lewis R. Fall Chinook Escapements
Indeterminate



Oregon Coastal Chinook Escapements
Increasing



APPENDIX C

Estimates and Sources of Nonlanded Catch Mortality

Page

Sources and estimates of legal and sublegal encounters in the SEAK troll fishery during chinook nonretention fisheries C-1

Number of days of chinook retention, chinook nonretention fishery, and source of information for the NBC troll fishery C-2

Number of days of chinook retention, chinook nonretention fishery, and source of information for the CBC troll fishery C-3

Number of days of chinook retention, chinook nonretention fishery, and source of information for the WCVI troll fishery C-4

Sources and estimates of legal and sublegal encounters in the GS troll fishery during chinook nonretention fisheries C-5

Sources and estimates of legal and sublegal encounters in the SEAK troll fishery during chinook nonretention fisheries.

Year	Legal CNR Encounters	Sublegal CNR Encounters	Source
1981	18,225	18,578	a/
1982	89,100	90,827	a/
1983	74,925	76,378	a/
1984	87,075	88,763	a/
1985	118,191	131,011	b/
1986	78,763	104,820	c/
1987	191,956	171,156	d/
1988	60,900	91,200	e/
1989	150,600	162,900	f/
1990			g/

a/ Alaska Dept. Fish and Game and National Marine Fisheries Service. 1987. Associated fishing induced mortalities of chinook salmon in southeast Alaska. Alaska Dept. Fish Game, unpublished report.

b/ Davis, A., J. Kelley, and M. Seibel. 1986. Observations on chinook salmon hook and release in the 1985 southeast Alaska troll fishery. Alaska Dept. Fish Game, unpublished report.

c/ Davis, A., J. Kelley, and M. Seibel. 1987. Observations on chinook salmon hook and release in the 1986 southeast Alaska troll fishery. Alaska Dept. Fish Game, unpublished report.

d/ Seibel, M., A. Davis, J. Kelley, and J.E. Clark. 1988. Observations on chinook salmon hook and release in the 1987 southeast Alaska troll fishery. Alaska Dept. Fish Game, unpublished report.

e/ Seibel, M., A. Davis, J. Kelley, and J.E. Clark. 1989. Observations on chinook salmon hook and release in the 1988 southeast Alaska troll fishery. Alaska Dept. Fish Game, unpublished report.

f/ Based on 1985-1988 average CNR encounters per gear day times the gear days for 1989. (Spreadsheet CNR90.WQ1, J. Carlile ADFG, 2/2/91)

g/ The number of encounters during the CNR fishery in 1990 were estimated from the length of the chinook retention and nonretention periods. As reported in TCCHINOOK (91)-1, there were 48 days of chinook nonretention fishing in 1990. The number of days of chinook retention were computed in "summer day" equivalents by multiplying the number of days of summer fishing by the ratio of the total troll catch (287,400) to the catch during the summer fishery (212,300).

Number of days of chinook retention, chinook nonretention fishery, and source of information for the NBC troll fishery.

Year	Chinook Retention	Chinook Nonretention	Source
1987	60	9	a/
1988	43	17	b/
1989	66	9	c/
1990	52	14	d/

a/ Chinook Technical Committee. 1987. Chinook Technical Committee report to the November, 1987 meeting of the Pacific Salmon Commission. Pacific Salmon Commission, TCCHINOOK (87)-5.

b/ Chinook Technical Committee. 1988. Preliminary review of 1988 fisheries. Pacific Salmon Commission, TCCHINOOK (88)-3.

c/ Chinook Technical Committee. 1990. 1989 annual report. Pacific Salmon Commission, TCCHINOOK (90)-3.

d/ Personal communication Dave Peacock, CDFO. Computed by multiplying the number of days during the chinook retention fishery by the ratio of the number of boat days during the nonretention fishery to the number of boat days during the chinook retention fishery.

Number of days of chinook retention, chinook nonretention fishery, and source of information for the CBC troll fishery.

Year	Chinook Retention	Chinook Nonretention	Source
1987	60	9	a/
1988	43	17	b/
1989	66	9	c/
1990	52	23	d/

a/ Chinook Technical Committee. 1987. Chinook Technical Committee report to the November, 1987 meeting of the Pacific Salmon Commission. Pacific Salmon Commission, TCCHINOOK (87)-5.

b/ Chinook Technical Committee. 1988. Preliminary review of 1988 fisheries. Pacific Salmon Commission, TCCHINOOK (88)-3.

c/ Chinook Technical Committee. 1990. 1989 annual report. Pacific Salmon Commission, TCCHINOOK (90)-3.

d/ Personal communication Dave Peacock, CDFO. Computed by multiplying the number of days during the chinook retention fishery by the ratio of the number of boat days during the nonretention fishery to the number of boat days during the chinook retention fishery.

Number of days of chinook retention, chinook nonretention fishery, and source of information for the WCVI troll fishery.

Year	Chinook Retention	Chinook Nonretention	Source
1985	105	5	a/
1987	47	7	b/
1988	55	15	c/

a/ Anonymous. 1986. 1985 Canadian agency report on chinook salmon. Canadian Department of Fisheries and Oceans, unpublished report.

b/ Chinook Technical Committee. 1987. Chinook Technical Committee report to the November, 1987 meeting of the Pacific Salmon Commission. Pacific Salmon Commission, TCCHINOOK (87)-5.

c/ Chinook Technical Committee. 1988. Preliminary review of 1988 fisheries. Pacific Salmon Commission, TCCHINOOK (88)-3.

Sources and estimates of legal and sublegal encounters in the GS troll fishery during chinook nonretention fisheries.

Year	Legal CNR Encounters	Sublegal CNR Encounters	Source
1985	12,412	12,184	a/
1986	5,151	17,834	a/

a/ Anonymous. 1986. Data Report on Unaccounted for Sources of Fishing Associated Mortalities of Chinook Salmon in B.C. Fisheries (1977-1986). Canadian Department of Fisheries and Oceans, unpublished report. 47p.

APPENDIX D

Detailed Exploitation Rate and Fishery Index Data

	Page
Southeast Alaska Troll, Total Mortality	D-1
North/Central Troll, Total Mortality	D-2
West Coast Vancouver Island Troll, Total Mortality	D-3
Strait of Georgia Sport and Troll Combined, Total Mortality	D-4
Strait of Georgia Sport, Total Mortality	D-5
Strait of Georgia Troll, Total Mortality	D-6
Washington/Oregon Sport and Troll Combined	D-7

Fishery: Southeast Alaska Troll

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	AKS Age 4	LRW Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4
79	NA	NA	0.015	0.025	0.090	0.055	0.253	0.492	0.014	0.151	NA	NA
80	NA	NA	0.013	0.107	0.058	0.074	0.272	0.342	0.047	0.143	0.266	0.138
81	NA	0.074	0.013	0.111	0.107	0.082	0.343	0.364	NA	0.195	0.251	0.078
82	0.128	0.079	0.023	0.142	0.163	0.070	0.279	0.352	0.026	0.154	0.228	0.071
83	0.184	0.075	0.025	0.218	0.228	0.074	0.318	0.480	0.019	0.221	NA	0.104
84	0.100	NA	0.013	0.120	0.212	0.116	0.309	0.245	0.023	0.181	0.331	0.049
85	0.087	NA	0.032	0.176	0.242	0.125	0.146	0.363	0.017	0.160	0.251	0.178
86	0.168	0.052	0.024	0.111	0.161	NA	0.350	0.037	0.013	0.105	0.181	NA
87	0.085	0.024	0.023	0.138	0.168	0.043	NA	NA	0.027	0.136	0.252	0.131
88	0.104	0.011	NA	0.120	0.091	0.014	0.179	NA	0.019	0.067	0.192	0.048
89	0.097	0.010	0.016	0.120	0.167	0.029	0.175	0.226	NA	0.043	0.185	0.039
90	0.250	0.013	0.024	0.108	0.114	0.089	0.268	0.305	NA	0.135	0.119	0.121
Base	0.128	0.077	0.016	0.096	0.104	0.070	0.287	0.388	0.029	0.161	0.248	0.096

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	LRW Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4	Fishery
79	NA	NA	0.933	0.257	0.862	0.788	0.884	1.270	0.478	0.941	NA	NA	0.952
80	NA	NA	0.814	1.113	0.560	1.060	0.949	0.883	1.630	0.891	1.072	1.441	0.978
81	NA	0.968	0.835	1.152	1.021	1.161	1.195	0.938	NA	1.211	1.012	0.815	1.048
82	1.000	1.032	1.417	1.478	1.558	0.991	0.972	0.909	0.892	0.957	0.916	0.744	1.008
83	1.437	0.973	1.576	2.267	2.183	1.052	1.109	1.238	0.652	1.376	NA	1.088	1.341
84	0.781	NA	0.813	1.246	2.031	1.654	1.077	0.633	0.811	1.122	1.333	0.516	1.047
85	0.681	NA	1.987	1.831	2.318	1.779	0.510	0.936	0.582	0.992	1.010	1.857	1.094
86	1.313	0.680	1.533	1.151	1.541	NA	1.221	0.096	0.458	0.655	0.727	NA	0.784
87	0.661	0.318	1.460	1.439	1.612	0.614	NA	NA	0.935	0.846	1.014	1.371	1.003
88	0.813	0.147	NA	1.246	0.870	0.195	0.623	NA	0.679	0.414	0.772	0.501	0.651
89	0.760	0.126	1.008	1.249	1.602	0.416	0.610	0.584	NA	0.265	0.746	0.409	0.663
90	1.950	0.169	1.497	1.122	1.090	1.272	0.933	0.786	NA	0.840	0.479	1.259	0.924

Stock Identifiers

AKS = ALASKA SPRING
LRW = LEWIS RIVER WILD
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

Fishery: North/Central Troll

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	AKS Age 4	BQR Age 3	BQR Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4
79	NA	0.083	0.099	0.047	0.170	0.112	0.093	0.166	0.109	0.012	0.091	NA	NA
80	NA	0.085	0.079	0.050	0.161	0.216	0.087	0.131	0.158	0.029	0.073	0.075	0.138
81	NA	0.091	0.081	0.079	0.173	0.185	0.062	0.144	0.265	NA	0.086	0.090	0.102
82	0.005	0.069	0.101	0.034	0.082	0.124	0.070	0.167	0.066	0.030	0.050	NA	0.029
83	0.013	NA	0.104	0.062	0.148	0.230	0.080	0.121	0.081	0.033	0.080	NA	0.031
84	0.006	0.062	NA	0.011	0.064	0.074	0.041	0.149	0.252	0.026	0.100	NA	0.025
85	0.004	0.033	NA	0.018	0.045	0.036	0.089	0.242	0.208	0.020	0.085	0.066	0.023
86	0.009	0.064	0.196	0.052	0.094	0.088	NA	0.139	NA	0.020	0.063	0.073	NA
87	0.002	NA	0.070	0.029	0.079	0.141	0.055	NA	NA	0.038	0.105	0.116	0.023
88	0.009	NA	NA	0.018	0.052	0.022	0.036	0.098	NA	0.017	0.057	0.097	0.031
89	0.002	0.028	NA	0.019	0.035	0.038	0.037	0.108	0.169	NA	0.051	0.192	0.017
90	0.016	0.023	0.092	0.019	0.062	0.049	0.035	0.144	0.108	NA	0.061	0.098	0.021
Base	0.005	0.082	0.090	0.053	0.147	0.159	0.078	0.152	0.149	0.024	0.075	0.083	0.089

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	BQR Age 3	BQR Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4	Fishery
79	NA	1.011	1.098	0.892	1.158	0.703	1.188	1.092	0.733	0.489	1.211	NA	NA	0.973
80	NA	1.039	0.874	0.956	1.102	1.358	1.119	0.860	1.055	1.222	0.978	0.907	1.539	1.086
81	NA	1.111	0.902	1.501	1.180	1.160	0.796	0.950	1.774	NA	1.141	1.093	1.138	1.174
82	1.000	0.839	1.126	0.651	0.560	0.780	0.897	1.099	0.439	1.289	0.670	NA	0.323	0.750
83	2.816	NA	1.150	1.178	1.011	1.445	1.027	0.796	0.544	1.418	1.071	NA	0.341	0.964
84	1.284	0.752	NA	0.214	0.434	0.462	0.526	0.983	1.684	1.095	1.330	NA	0.278	0.799
85	0.843	0.399	NA	0.340	0.310	0.228	1.140	1.593	1.395	0.860	1.129	0.797	0.253	0.793
86	1.917	0.775	2.179	0.998	0.640	0.554	NA	0.916	NA	0.851	0.835	0.881	NA	0.919
87	0.477	NA	0.774	0.560	0.537	0.884	0.700	NA	NA	1.601	1.396	1.397	0.258	0.819
88	1.993	NA	NA	0.341	0.355	0.137	0.461	0.644	NA	0.742	0.762	1.170	0.350	0.506
89	0.338	0.344	NA	0.364	0.238	0.238	0.479	0.708	1.129	NA	0.678	2.326	0.190	0.649
90	3.612	0.275	1.019	0.364	0.422	0.306	0.455	0.949	0.725	NA	0.816	1.180	0.237	0.627

Stock Identifiers

AKS = ALASKA SPRING
BQR = BIG QUALICUM
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

Fishery: West Coast Vancouver Island Troll

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	BON Age 3	BON Age 4	CWF Age 4	GAD Age 3	GAD Age 4	LRW Age 4	RBT Age 3	RBT Age 4	SAM Age 3	SAM Age 4	SPR Age 3	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	STP Age 4	URB Age 3	URB Age 4	UWA Age 3	UWA Age 4	WSH Age 4
79	0.222	NA	NA	NA	NA	NA	0.035	0.074	NA	0.312	0.202	0.158	NA	0.256	NA	NA	0.047	0.093	0.070	0.167	NA
80	0.110	0.152	NA	NA	NA	NA	0.043	0.100	NA	NA	0.248	0.289	NA	NA	NA	NA	0.045	0.055	0.152	0.131	0.062
81	0.174	0.159	0.147	0.046	NA	0.061	0.020	0.026	NA	NA	0.188	0.183	0.051	NA	0.212	NA	NA	0.056	0.091	0.174	0.011
82	0.283	0.352	0.203	0.079	0.221	0.087	0.024	0.035	0.065	NA	0.190	0.246	0.106	0.253	0.204	0.190	0.035	0.031	0.142	0.220	0.036
83	0.349	0.333	0.229	0.103	0.274	0.070	0.012	0.035	NA	0.203	0.301	0.283	0.121	0.201	0.286	0.341	0.010	0.023	0.086	0.207	0.006
84	0.282	0.596	0.220	0.118	NA	NA	0.049	0.052	NA	NA	0.268	0.350	0.108	0.228	0.368	0.393	0.024	0.059	0.201	0.160	0.022
85	0.268	NA	0.151	NA	0.180	NA	0.031	NA	NA	NA	0.134	0.268	0.060	0.158	0.187	0.155	0.023	0.050	0.102	0.216	0.015
86	NA	NA	0.213	NA	NA	0.033	NA	NA	NA	NA	0.243	0.188	0.067	0.268	0.174	0.152	0.041	0.058	0.100	0.246	NA
87	0.219	NA	0.138	NA	NA	0.109	0.015	NA	NA	NA	0.096	NA	0.075	0.147	0.230	NA	0.034	0.050	0.055	0.094	0.020
88	NA	0.273	0.151	0.037	NA	0.086	0.022	0.049	0.062	NA	0.216	NA	0.030	0.199	0.264	0.316	0.016	0.100	NA	0.174	0.017
89	NA	NA	0.084	0.028	0.117	0.047	0.009	0.021	0.022	0.094	0.140	0.150	0.034	0.103	0.038	0.111	0.015	0.045	NA	NA	0.014
90	NA	NA	0.145	0.121	0.212	0.119	0.027	0.052	0.068	0.200	0.204	0.194	0.090	0.195	0.197	NA	NA	0.082	NA	NA	0.027
Base	0.197	0.221	0.175	0.062	0.221	0.074	0.031	0.059	0.065	0.312	0.207	0.219	0.078	0.255	0.208	0.190	0.042	0.059	0.114	0.173	0.037

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	BON Age 4	CWF Age 4	GAD Age 3	GAD Age 4	LRW Age 4	RBT Age 3	RBT Age 4	SAM Age 3	SAM Age 4	SPR Age 3	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	STP Age 4	URB Age 3	URB Age 4	UWA Age 3	UWA Age 4	WSH Age 4	Fishery
79	1.126	NA	NA	NA	NA	NA	1.152	1.251	NA	1.000	0.975	0.721	NA	1.005	NA	NA	1.105	1.588	0.613	0.964	NA	0.981
80	0.556	0.687	NA	NA	NA	NA	1.403	1.705	NA	NA	1.197	1.319	NA	NA	NA	NA	1.064	0.928	1.332	0.757	1.703	1.020
81	0.884	0.718	0.840	0.739	NA	0.818	0.662	0.446	NA	NA	0.908	0.837	0.649	NA	1.020	NA	NA	0.949	0.803	1.008	0.311	0.836
82	1.433	1.595	1.160	1.261	1.000	1.182	0.784	0.599	1.000	NA	0.919	1.122	1.351	0.995	0.980	1.000	0.832	0.535	1.252	1.271	0.986	1.118
83	1.767	1.509	1.307	1.648	1.240	0.945	0.397	0.594	NA	0.652	1.453	1.294	1.540	0.788	1.376	1.789	0.240	0.395	0.760	1.197	0.171	1.184
84	1.429	2.697	1.254	1.883	NA	NA	1.599	0.891	NA	NA	1.297	1.600	1.379	0.895	1.767	2.067	0.571	1.011	1.765	0.922	0.611	1.503
85	1.357	NA	0.862	NA	0.816	NA	1.022	NA	NA	NA	0.649	1.224	0.768	0.620	0.900	0.813	0.534	0.857	0.898	1.245	0.401	0.906
86	NA	NA	1.214	NA	NA	0.451	NA	NA	NA	NA	1.174	0.857	0.856	1.053	0.838	0.800	0.980	0.994	0.881	1.420	NA	0.994
87	1.110	NA	0.785	NA	NA	1.471	0.502	NA	NA	NA	0.462	NA	0.955	0.575	1.107	NA	0.802	0.850	0.483	0.543	0.546	0.777
88	NA	1.234	0.863	0.585	NA	1.163	0.713	0.831	0.964	NA	1.047	NA	0.388	0.782	1.268	1.661	0.382	1.702	NA	1.004	0.460	1.040
89	NA	NA	0.481	0.451	0.529	0.638	0.296	0.353	0.348	0.300	0.676	0.684	0.437	0.404	0.181	0.584	0.345	0.759	NA	NA	0.386	0.467
90	NA	NA	0.829	1.943	0.959	1.611	0.875	0.885	1.050	0.640	0.984	0.885	1.148	0.767	0.947	NA	NA	1.388	NA	NA	0.744	0.938

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
LRW = LEWIS RIVER WILD
RBT = ROBERTSON CREEK
SAM = SAMISH FALL FING
SPR = SPRING CREEK TULE
SPS = SO SOUND FALL FING
STP = STAYTON POND TULE
URB = COL RIVER UPRIVER BRIGHT
UWA = U OF W FALL ACCEL
WSH = WILLAMETTE SPRING

Fishery: Strait of Georgia Sport and Troll Combined

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	SPS Age 4	UWA Age 3
79	0.228	0.179	0.060	NA	0.094	NA	0.060	0.041
80	0.316	0.316	NA	NA	NA	NA	NA	0.042
81	0.324	0.484	0.254	NA	NA	0.097	NA	0.037
82	0.152	0.135	0.092	0.063	NA	0.027	0.053	0.012
83	0.294	0.207	0.053	NA	0.081	0.020	0.032	0.026
84	0.379	NA	0.048	NA	NA	0.057	0.045	0.051
85	0.176	0.120	0.044	NA	NA	NA	0.045	0.022
86	0.261	0.215	0.056	NA	NA	NA	NA	0.017
87	0.155	0.270	0.014	NA	NA	0.054	NA	0.028
88	0.232	0.208	0.058	0.055	NA	0.010	NA	NA
89	0.216	0.317	0.067	0.073	0.125	0.017	0.043	NA
90	0.154	0.204	0.016	0.078	0.118	0.016	0.035	NA
Base	0.255	0.279	0.135	0.063	0.094	0.062	0.056	0.033

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	SPS Age 4	UWA Age 3	Fishery
79	0.895	0.644	0.444	NA	1.000	NA	1.067	1.232	0.778
80	1.240	1.133	NA	NA	NA	NA	NA	1.284	1.190
81	1.269	1.738	1.877	NA	NA	1.561	NA	1.112	1.565
82	0.595	0.485	0.679	1.000	NA	0.439	0.933	0.371	0.605
83	1.151	0.744	0.389	NA	0.861	0.329	0.568	0.775	0.779
84	1.485	NA	0.352	NA	NA	0.921	0.792	1.539	1.069
85	0.689	0.430	0.323	NA	NA	NA	0.798	0.662	0.535
86	1.023	0.771	0.415	NA	NA	NA	NA	0.516	0.782
87	0.608	0.968	0.102	NA	NA	0.874	NA	0.859	0.682
88	0.908	0.747	0.431	0.870	NA	0.154	NA	NA	0.708
89	0.849	1.136	0.492	1.156	1.324	0.269	0.762	NA	0.907
90	0.605	0.732	0.120	1.231	1.254	0.266	0.621	NA	0.659

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL YEAR
UWA = U OF W FALL ACCEL

Fishery: Strait of Georgia Sport

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	^] '*5^\^U*3A Age 4	Age 3
79	0.085	0.119	0.060	NA	0.035	NA	0.051	0.026
80	0.179	0.244	NA	NA	NA	NA	NA	0.040
81	0.215	0.413	0.228	NA	NA	0.090	NA	0.033
82	0.072	0.059	0.092	0.045	NA	0.023	0.017	0.012
83	0.124	0.163	0.053	NA	0.071	0.019	0.028	0.016
84	0.255	NA	NA	NA	NA	0.047	0.045	0.045
85	0.157	0.120	0.044	NA	NA	NA	0.041	0.022
86	0.196	0.212	0.056	NA	NA	NA	NA	0.017
87	0.122	0.266	0.014	NA	NA	0.054	NA	0.019
88	0.221	0.168	0.058	0.054	NA	0.009	NA	NA
89	0.202	0.317	0.067	0.068	0.125	0.015	0.038	NA
90	0.107	0.204	0.016	0.038	0.094	0.012	0.032	NA
Base	0.138	0.209	0.127	0.045	0.035	0.056	0.034	0.028

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	SPS Age 4	UWA Age 3	Fishery
79	0.618	0.569	0.474	NA	1.000	NA	1.496	0.951	0.661
80	1.301	1.168	NA	NA	NA	NA	NA	1.437	1.236
81	1.558	1.980	1.802	NA	NA	1.599	NA	1.187	1.757
82	0.523	0.284	0.724	1.000	NA	0.401	0.504	0.425	0.502
83	0.898	0.783	0.416	NA	2.019	0.333	0.803	0.584	0.755
84	1.851	NA	NA	NA	NA	0.841	1.302	1.642	1.534
85	1.142	0.574	0.344	NA	NA	NA	1.197	0.793	0.717
86	1.419	1.015	0.443	NA	NA	NA	NA	0.619	0.960
87	0.882	1.275	0.109	NA	NA	0.962	NA	0.702	0.853
88	1.606	0.804	0.460	1.204	NA	0.152	NA	NA	0.888
89	1.463	1.518	0.526	1.507	3.550	0.273	1.114	NA	1.291
90	0.779	0.978	0.128	0.854	2.676	0.216	0.941	NA	0.784

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL FING
UWA = U OF W FALL ACCEL

Fishery: Strait of Georgia Troll

TOTAL MORTALITY EXPLOITATION RATES BY STOCK			
	BQR	SAM	SAM
Year	Age 3	Age 3	Age 4
79	0.143	NA	0.059
80	0.137	NA	NA
81	0.109	NA	NA
82	0.080	0.019	NA
83	NA	NA	0.010
84	0.124	NA	NA
85	0.018	NA	NA
86	0.065	NA	NA
87	0.033	NA	NA
88	0.010	NA	NA
89	0.015	0.006	NA
90	0.047	NA	0.024
Base	0.117	0.019	0.059

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK				
	BQR	SAM	SAM	
Year	Age 3	Age 3	Age 4	Fishery
79	1.221	NA	1.000	1.147
80	1.169	NA	NA	1.169
81	0.930	NA	NA	0.930
82	0.680	1.000	NA	0.724
83	NA	NA	0.173	0.173
84	1.054	NA	NA	1.054
85	0.157	NA	NA	0.157
86	0.558	NA	NA	0.558
87	0.285	NA	NA	0.285
88	0.086	NA	NA	0.086
89	0.126	0.309	NA	0.151
90	0.402	NA	0.409	0.404

Stock Identifiers

BQR = BIG QUALICUM
SAM = SAMISH FALL FING

Fishery: Washington/Oregon Sport and Troll Combined

TOTAL MORTALITY EXPLOITATION RATES BY STOCK

Year	BON Age 3	CWF Age 3	CWF Age 4	GAD Age 3	GAD Age 4	SAM Age 3	SAM Age 4	SPR Age 3	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	UWA Age 3
79	0.126	NA	NA	NA	NA	NA	0.009	0.187	0.167	NA	0.021	NA	0.015
80	0.210	0.132	NA	NA	NA	NA	NA	0.296	0.130	NA	NA	NA	0.031
81	0.202	0.099	0.173	0.013	NA	NA	NA	0.274	0.214	0.007	NA	0.167	0.024
82	0.178	0.156	0.275	NA	0.036	0.009	NA	0.327	0.125	0.008	0.048	0.297	0.028
83	0.130	0.074	0.182	NA	0.015	NA	0.041	0.119	0.057	0.006	0.026	0.164	0.017
84	0.069	0.010	0.039	0.019	NA	NA	NA	0.079	NA	0.008	0.025	0.041	0.007
85	0.173	0.078	0.043	NA	0.011	NA	NA	0.171	NA	NA	0.018	0.179	0.014
86	NA	0.113	0.053	NA	NA	NA	NA	0.105	0.039	NA	NA	0.208	NA
87	0.155	0.064	0.115	NA	NA	NA	NA	0.252	NA	NA	NA	0.142	0.026
88	NA	0.070	0.145	0.046	NA	0.028	NA	0.129	NA	0.026	NA	0.208	NA
89	NA	0.099	0.293	0.032	0.126	0.010	0.052	0.238	NA	0.021	0.070	0.270	NA
90	NA	NA	0.162	0.073	0.238	0.065	0.184	0.214	0.110	0.061	0.154	0.223	NA
Base	0.179	0.129	0.224	0.013	0.036	0.009	0.009	0.271	0.159	0.007	0.035	0.232	0.025

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	CWF Age 3	CWF Age 4	GAD Age 3	GAD Age 4	SAM Age 3	SAM Age 4	SPR Age 3	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	UWA Age 3	Fishery
79	0.707	NA	NA	NA	NA	NA	1.000	0.691	1.049	NA	0.614	NA	0.602	0.776
80	1.172	1.023	NA	NA	NA	NA	NA	1.092	0.818	NA	NA	NA	1.272	1.048
81	1.129	0.767	0.772	1.000	NA	NA	NA	1.011	1.345	0.972	NA	0.720	0.998	0.947
82	0.993	1.210	1.228	NA	1.000	1.000	NA	1.206	0.788	1.028	1.386	1.280	1.129	1.138
83	0.724	0.572	0.814	NA	0.418	NA	4.708	0.439	0.356	0.779	0.763	0.706	0.688	0.636
84	0.385	0.074	0.173	1.444	NA	NA	NA	0.291	NA	1.066	0.724	0.176	0.285	0.266
85	0.965	0.602	0.191	NA	0.296	NA	NA	0.630	NA	NA	0.509	0.774	0.553	0.606
86	NA	0.877	0.237	NA	NA	NA	NA	0.388	0.246	NA	NA	0.899	NA	0.511
87	0.869	0.496	0.512	NA	NA	NA	NA	0.931	NA	NA	NA	0.612	1.081	0.712
88	NA	0.542	0.646	3.395	NA	2.986	NA	0.477	NA	3.512	NA	0.899	NA	0.736
89	NA	0.764	1.311	2.406	3.519	1.038	5.917	0.877	NA	2.838	2.025	1.167	NA	1.254
90	NA	NA	0.724	5.471	6.655	6.870	20.911	0.791	0.690	8.408	4.439	0.962	NA	1.492

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
SAM = SAMISH FALL FING
SPR = SPRING CREEK TULE
SPS = SO SOUND FALL FING
STP = STAYTON POND TULE
UWA = U OF W FALL ACCEL

APPENDIX E

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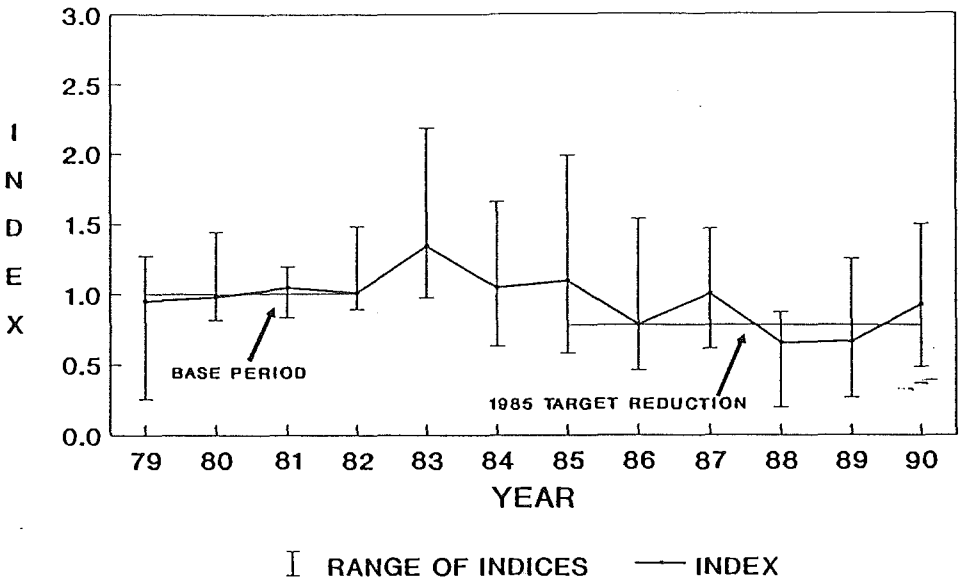
ALASKA TROLL (ALL AGES)



Fishery: Alaska Troll, All Ages

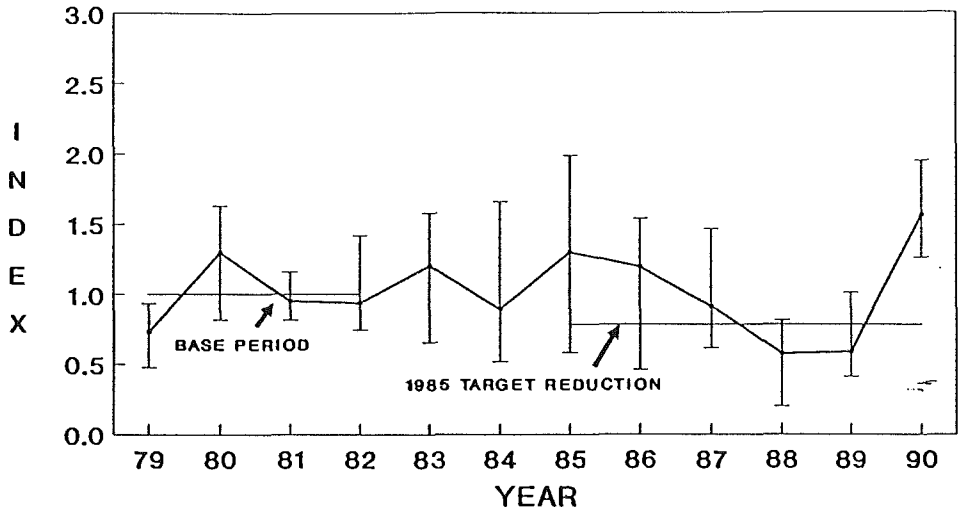
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	LRW Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4	Fishery
79	NA	NA	0.933	0.257	0.862	0.788	0.884	1.270	0.478	0.941	NA	NA	0.952
80	NA	NA	0.814	1.113	0.560	1.060	0.949	0.883	1.630	0.891	1.072	1.441	0.978
81	NA	0.968	0.835	1.152	1.021	1.161	1.195	0.938	NA	1.211	1.012	0.815	1.048
82	1.000	1.032	1.417	1.478	1.558	0.991	0.972	0.909	0.892	0.957	0.916	0.744	1.008
83	1.437	0.973	1.576	2.267	2.183	1.052	1.109	1.238	0.652	1.376	NA	1.088	1.341
84	0.781	NA	0.813	1.246	2.031	1.654	1.077	0.633	0.811	1.122	1.333	0.516	1.047
85	0.681	NA	1.987	1.831	2.318	1.779	0.510	0.936	0.582	0.992	1.010	1.857	1.094
86	1.313	0.680	1.533	1.151	1.541	NA	1.221	0.096	0.458	0.655	0.727	NA	0.784
87	0.661	0.318	1.460	1.439	1.612	0.614	NA	NA	0.935	0.846	1.014	1.371	1.003
88	0.813	0.147	NA	1.246	0.870	0.195	0.623	NA	0.679	0.414	0.772	0.501	0.651
89	0.760	0.126	1.008	1.249	1.602	0.416	0.610	0.584	NA	0.265	0.746	0.409	0.663
90	1.950	0.169	1.497	1.122	1.090	1.272	0.933	0.786	NA	0.840	0.479	1.259	0.924

Stock Identifiers

AKS = ALASKA SPRING
LRW = LEWIS RIVER WILD
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

FISHERY INDEX
ALASKA TROLL (AGE 3)



I RANGE OF INDICES —— INDEX

Fishery: Alaska Troll, Ocean Age 3

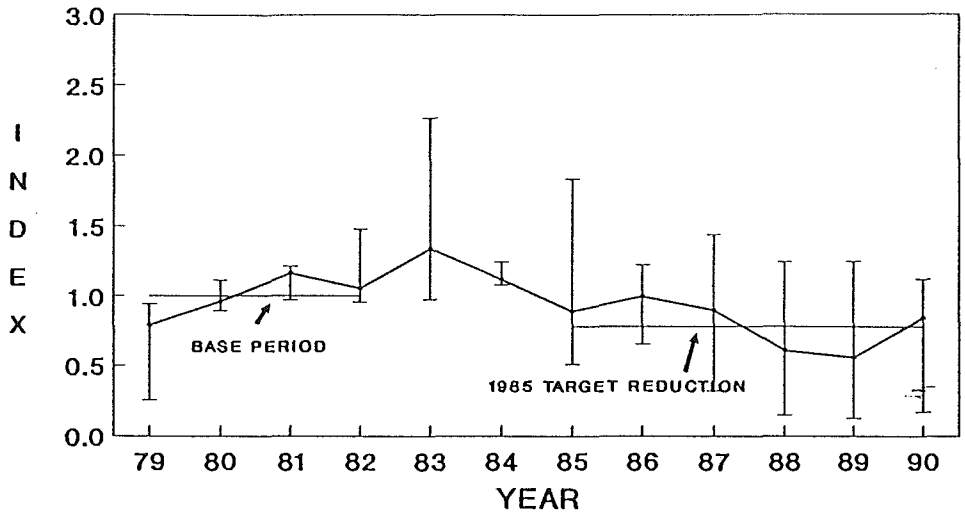
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	QUI Age 3	RBT Age 3	URB Age 3	WSH Age 4	Fishery
79	NA	0.933	0.788	0.478	NA	0.731
80	NA	0.814	1.060	1.630	1.441	1.292
81	NA	0.835	1.161	NA	0.815	0.951
82	1.000	1.417	0.991	0.892	0.744	0.936
83	1.437	1.576	1.052	0.652	1.088	1.198
84	0.781	0.813	1.654	0.811	0.516	0.891
85	0.681	1.987	1.779	0.582	1.857	1.294
86	1.313	1.533	NA	0.458	NA	1.191
87	0.661	1.460	0.614	0.935	1.371	0.913
88	0.813	NA	0.195	0.679	0.501	0.574
89	0.760	1.008	0.416	NA	0.409	0.586
90	1.950	1.497	1.272	NA	1.259	1.560

Stock Identifiers

AKS = ALASKA SPRING
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

FISHERY INDEX
ALASKA TROLL (AGE 4)



I RANGE OF INDICES —— INDEX

Fishery: Alaska Troll, Ocean Age 4

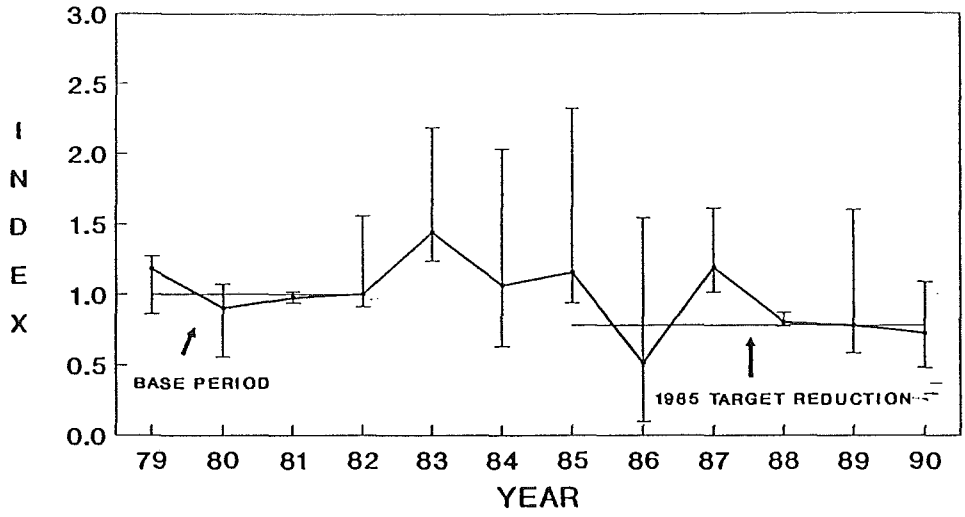
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	LRW Age 4	QUI Age 4	RBT Age 4	URB Age 4	Fishery
79	NA	0.257	0.884	0.941	0.790
80	NA	1.113	0.949	0.891	0.961
81	0.968	1.152	1.195	1.211	1.164
82	1.032	1.478	0.972	0.957	1.054
83	0.973	2.267	1.109	1.376	1.341
84	NA	1.246	1.077	1.122	1.121
85	NA	1.831	0.510	0.992	0.886
86	0.680	1.151	1.221	0.655	0.997
87	0.318	1.439	NA	0.846	0.896
88	0.147	1.246	0.623	0.414	0.606
89	0.126	1.249	0.610	0.265	0.559
90	0.169	1.122	0.933	0.840	0.844

Stock Identifiers

LRW = LEWIS RIVER WILD
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT

FISHERY INDEX
ALASKA TROLL (AGE 5)



I RANGE OF INDICES —— INDEX

Fishery: Alaska Troll, Ocean Age 5

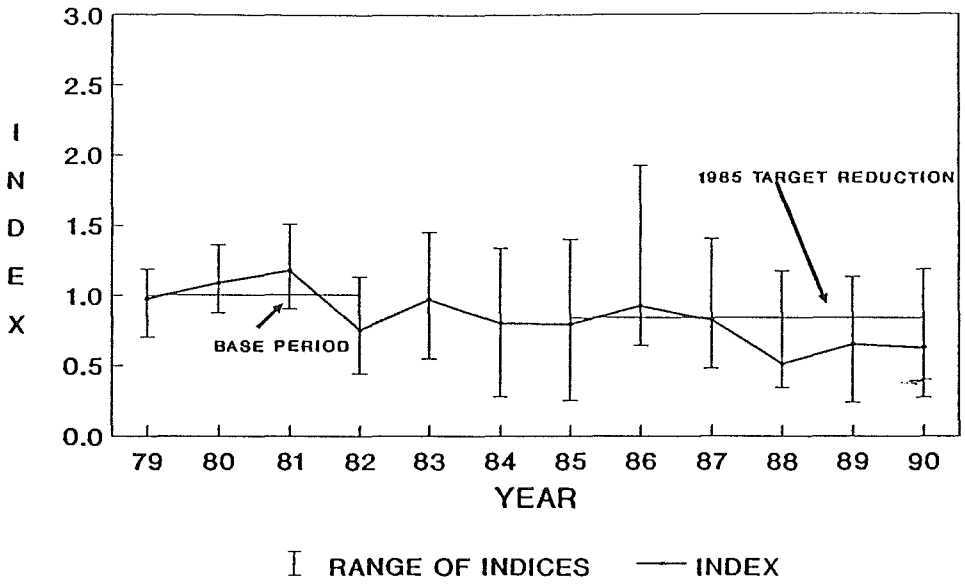
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	QUI Age 5	RBT Age 5	URB Age 5	Fishery
79	0.862	1.270	NA	1.183
80	0.560	0.883	1.072	0.901
81	1.021	0.938	1.012	0.974
82	1.558	0.909	0.916	1.003
83	2.183	1.238	NA	1.439
84	2.031	0.633	1.333	1.065
85	2.318	0.936	1.010	1.156
86	1.541	0.096	0.727	0.511
87	1.612	NA	1.014	1.191
88	0.870	NA	0.772	0.801
89	1.602	0.584	0.746	0.782
90	1.090	0.786	0.479	0.726

Stock Identifiers

QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT

FISHERY INDEX
NORTH/CENTRAL B.C. TROLL (ALL AGES)



Fishery: North/Central B.C. Troll, All Ages

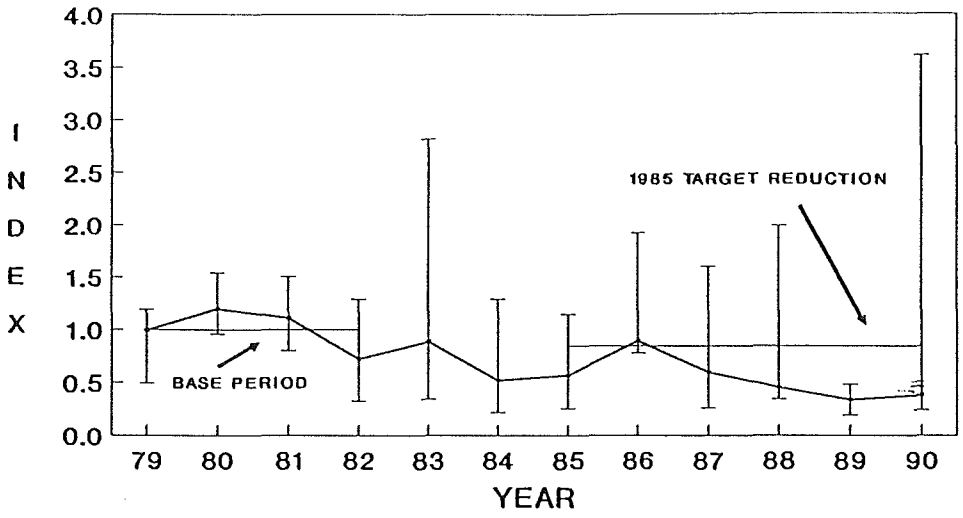
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	BQR Age 3	BQR Age 4	QUI Age 3	QUI Age 4	QUI Age 5	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4	Fishery
79	NA	1.011	1.098	0.892	1.158	0.703	1.188	1.092	0.733	0.489	1.211	NA	NA	0.973
80	NA	1.039	0.874	0.956	1.102	1.358	1.119	0.860	1.055	1.222	0.978	0.907	1.539	1.086
81	NA	1.111	0.902	1.501	1.180	1.160	0.796	0.950	1.774	NA	1.141	1.093	1.138	1.174
82	1.000	0.839	1.126	0.651	0.560	0.780	0.897	1.099	0.439	1.289	0.670	NA	0.323	0.750
83	2.816	NA	1.150	1.178	1.011	1.445	1.027	0.796	0.544	1.418	1.071	NA	0.341	0.964
84	1.284	0.752	NA	0.214	0.434	0.462	0.526	0.983	1.684	1.095	1.330	NA	0.278	0.799
85	0.843	0.399	NA	0.340	0.310	0.228	1.140	1.593	1.395	0.860	1.129	0.797	0.253	0.793
86	1.917	0.775	2.179	0.998	0.640	0.554	NA	0.916	NA	0.851	0.835	0.881	NA	0.919
87	0.477	NA	0.774	0.560	0.537	0.884	0.700	NA	NA	1.601	1.396	1.397	0.258	0.819
88	1.993	NA	NA	0.341	0.355	0.137	0.461	0.644	NA	0.742	0.762	1.170	0.350	0.506
89	0.338	0.344	NA	0.364	0.238	0.238	0.479	0.708	1.129	NA	0.678	2.326	0.190	0.649
90	3.612	0.275	1.019	0.364	0.422	0.306	0.455	0.949	0.725	NA	0.816	1.180	0.237	0.627

Stock Identifiers

AKS = ALASKA SPRING
BQR = BIG QUALICUM
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

FISHERY INDEX
NORTH/CENTRAL B.C. TROLL (AGE 3)



I RANGE OF INDICES —— INDEX

Fishery: North/Central B.C. Troll, Ocean Age 3

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	BQR Age 3	QUI Age 3	RBT Age 3	URB Age 3	WSH Age 4	Fishery
79	NA	1.011	0.892	1.188	0.489	NA	0.991
80	NA	1.039	0.956	1.119	1.222	1.539	1.195
81	NA	1.111	1.501	0.796	NA	1.138	1.106
82	1.000	0.839	0.651	0.897	1.289	0.323	0.717
83	2.816	NA	1.178	1.027	1.418	0.341	0.882
84	1.284	0.752	0.214	0.526	1.095	0.278	0.516
85	0.843	0.399	0.340	1.140	0.860	0.253	0.564
86	1.917	0.775	0.998	NA	0.851	NA	0.890
87	0.477	NA	0.560	0.700	1.601	0.258	0.592
88	1.993	NA	0.341	0.461	0.742	0.350	0.450
89	0.338	0.344	0.364	0.479	NA	0.190	0.337
90	3.612	0.275	0.364	0.455	NA	0.237	0.374

Stock Identifiers

AKS = ALASKA SPRING
BQR = BIG QUALICUM
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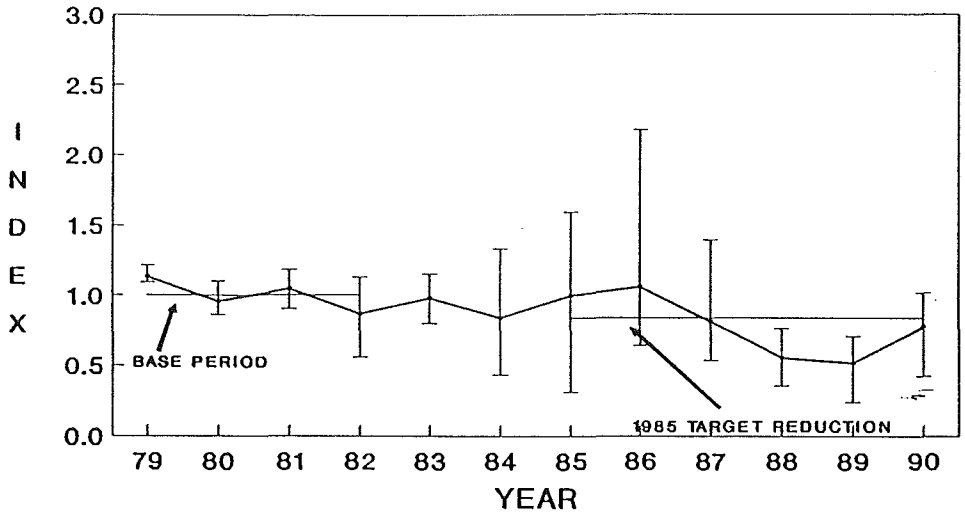
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

FISHERY INDEX
NORTH/CENTRAL B.C. TROLL (AGE 4)



Fishery: North/Central B.C. Troll, Ocean Age 4

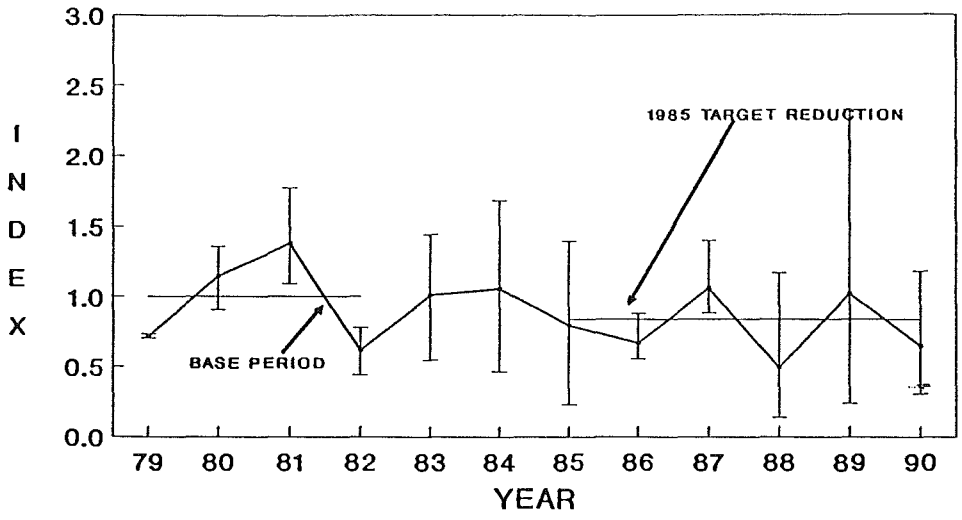
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 4	QUI Age 4	RBT Age 4	URB Age 4	Fishery
79	1.098	1.158	1.092	1.211	1.133
80	0.874	1.102	0.860	0.978	0.958
81	0.902	1.180	0.950	1.141	1.044
82	1.126	0.560	1.099	0.670	0.864
83	1.150	1.011	0.796	1.071	0.977
84	NA	0.434	0.983	1.330	0.838
85	NA	0.310	1.593	1.129	0.997
86	2.179	0.640	0.916	0.835	1.061
87	0.774	0.537	NA	1.396	0.812
88	NA	0.355	0.644	0.762	0.554
89	NA	0.238	0.708	0.678	0.517
90	1.019	0.422	0.949	0.816	0.775

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT

FISHERY INDEX
NORTH/CENTRAL B.C. TROLL (AGE 5)



I RANGE OF INDICES —— INDEX

Fishery: North/Central B.C. Troll, Ocean Age 5

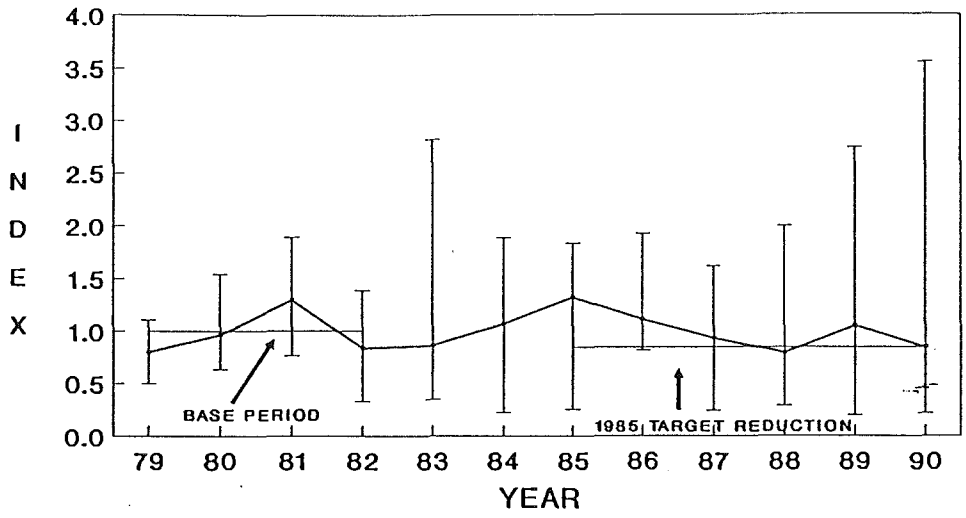
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	QUI Age 5	RBT Age 5	URB Age 5	Fishery
79	0.703	0.733	NA	0.717
80	1.358	1.055	0.907	1.147
81	1.160	1.774	1.093	1.380
82	0.780	0.439	NA	0.615
83	1.445	0.544	NA	1.009
84	0.462	1.684	NA	1.053
85	0.228	1.395	0.797	0.793
86	0.554	NA	0.881	0.666
87	0.884	NA	1.397	1.059
88	0.137	NA	1.170	0.490
89	0.238	1.129	2.326	1.019
90	0.306	0.725	1.180	0.651

Stock Identifiers

QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT

FISHERY INDEX
NORTH B.C.TROLL (ALL AGES)



Fishery: North B.C. Troll, All Ages

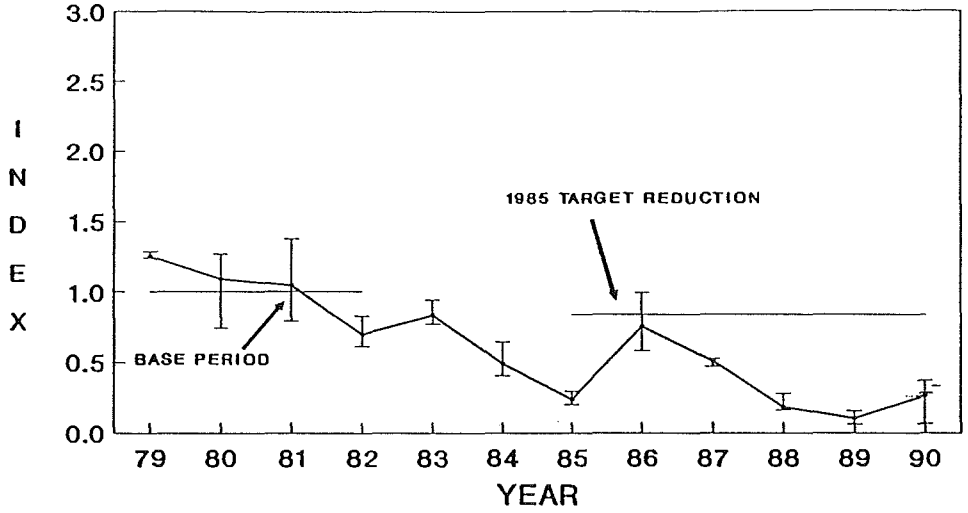
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	AKS Age 4	QUI Age 3	QUI Age 4	RBT Age 3	RBT Age 4	RBT Age 5	URB Age 3	URB Age 4	URB Age 5	WSH Age 4	Fishery
79	NA	0.549	NA	1.108	0.972	0.599	0.497	0.971	NA	NA	0.796
80	NA	0.782	1.007	1.106	0.629	0.763	1.120	0.950	0.891	1.540	0.960
81	NA	1.889	1.436	0.764	1.079	1.638	NA	1.218	1.109	1.129	1.290
82	1.000	0.780	0.557	1.022	1.320	NA	1.384	0.862	NA	0.331	0.835
83	2.816	1.087	1.508	1.094	0.750	0.518	1.425	1.162	NA	0.345	0.857
84	1.284	0.220	0.471	0.703	1.457	1.886	0.878	1.475	NA	0.263	1.063
85	0.843	0.249	0.516	1.827	2.896	1.785	0.966	1.403	0.939	0.234	1.314
86	1.917	0.868	0.812	NA	1.666	NA	0.883	1.019	0.890	NA	1.107
87	0.477	0.455	0.625	0.887	NA	NA	1.468	1.612	1.586	0.241	0.924
88	1.993	0.286	0.692	0.607	1.038	NA	0.778	0.902	1.324	0.335	0.785
89	0.338	0.353	0.436	0.737	1.227	1.306	NA	0.818	2.739	0.195	1.046
90	3.554	0.308	0.609	0.638	1.423	0.830	NA	0.961	1.288	0.212	0.843

Stock Identifiers

AKS = ALASKA SPRING
QUI = QUINSAM
RBT = ROBERTSON CREEK
URB = COLUMBIA RIVER UPRIVER BRIGHT
WSH = WILLAMETTE SPRING

FISHERY INDEX
CENTRAL B.C. TROLL (ALL AGES)



I RANGE OF INDICES —— INDEX

Fishery: Central B.C. Troll, All Ages

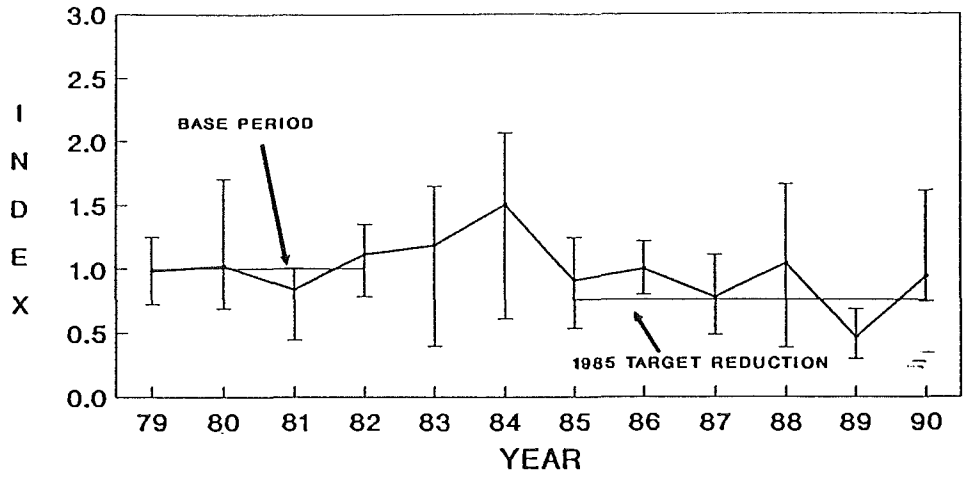
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	QUI Age 4	RBT Age 3	RBT Age 4	Fishery
79	1.241	NA	1.287	1.239	1.250
80	0.745	1.268	1.135	1.142	1.090
81	1.378	1.117	0.836	0.791	1.048
82	0.636	0.614	0.741	0.828	0.697
83	NA	0.769	0.944	0.852	0.832
84	0.646	0.450	NA	0.405	0.489
85	0.295	0.200	NA	NA	0.239
86	0.991	0.583	NA	NA	0.751
87	NA	0.528	0.467	NA	0.510
88	NA	0.161	0.279	0.162	0.183
89	0.064	0.126	0.158	0.074	0.101
90	0.065	0.335	0.226	0.371	0.266

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
RBT = ROBERTSON CREEK

FISHERY INDEX
WEST COAST VANCOUVER ISLAND TROLL
(ALL AGES)



Fishery: West Coast Vancouver Island Troll, All Ages

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	BON Age 4	CWF Age 4	GAD Age 3	GAD Age 4	LRW Age 4	RBT Age 3	RBT Age 4	SAM Age 3	SAM Age 4	SPR Age 3
79	1.126	NA	NA	NA	NA	NA	1.152	1.251	NA	1.000	0.975
80	0.556	0.687	NA	NA	NA	NA	1.403	1.705	NA	NA	1.197
81	0.884	0.718	0.840	0.739	NA	0.818	0.662	0.446	NA	NA	0.908
82	1.433	1.595	1.160	1.261	1.000	1.182	0.784	0.599	1.000	NA	0.919
83	1.767	1.509	1.307	1.648	1.240	0.945	0.397	0.594	NA	0.652	1.453
84	1.429	2.697	1.254	1.883	NA	NA	1.599	0.891	NA	NA	1.297
85	1.357	NA	0.862	NA	0.816	NA	1.022	NA	NA	NA	0.649
86	NA	NA	1.214	NA	NA	0.451	NA	NA	NA	NA	1.174
87	1.110	NA	0.785	NA	NA	1.471	0.502	NA	NA	NA	0.462
88	NA	1.234	0.863	0.585	NA	1.163	0.713	0.831	0.964	NA	1.047
89	NA	NA	0.481	0.451	0.529	0.638	0.296	0.353	0.348	0.300	0.676
90	NA	NA	0.829	1.943	0.959	1.611	0.875	0.885	1.050	0.640	0.984

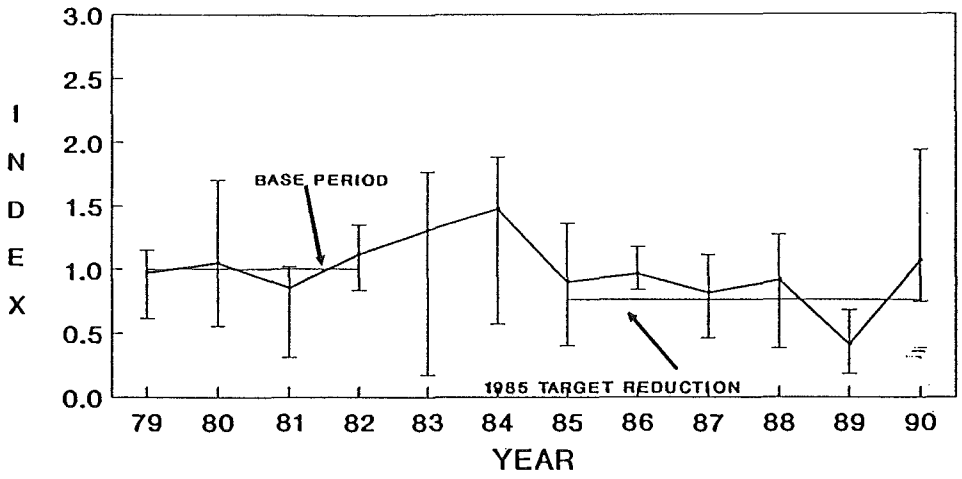
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	STP Age 4	URB Age 3	URB Age 4	UWA Age 3	UWA Age 4	WSH Age 4	Fishery
79	0.721	NA	1.005	NA	NA	1.105	1.588	0.613	0.964	NA	0.981
80	1.319	NA	NA	NA	NA	1.064	0.928	1.332	0.757	1.703	1.020
81	0.837	0.649	NA	1.020	NA	NA	0.949	0.803	1.008	0.311	0.836
82	1.122	1.351	0.995	0.980	1.000	0.832	0.535	1.252	1.271	0.986	1.118
83	1.294	1.540	0.788	1.376	1.789	0.240	0.395	0.760	1.197	0.171	1.184
84	1.600	1.379	0.895	1.767	2.067	0.571	1.011	1.765	0.922	0.611	1.503
85	1.224	0.768	0.620	0.900	0.813	0.534	0.857	0.898	1.245	0.401	0.906
86	0.857	0.856	1.053	0.838	0.800	0.980	0.994	0.881	1.420	NA	0.994
87	NA	0.955	0.575	1.107	NA	0.802	0.850	0.483	0.543	0.546	0.777
88	NA	0.388	0.782	1.268	1.661	0.382	1.702	NA	1.004	0.460	1.040
89	0.684	0.437	0.404	0.181	0.584	0.345	0.759	NA	NA	0.386	0.467
90	0.885	1.148	0.767	0.947	NA	NA	1.388	NA	NA	0.744	0.938

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
LRW = LEWIS RIVER WILD
RBT = ROBERTSON CREEK
SAM = SAMISH FALL FING
SPR = SPRING CREEK TULE
SPS = SO SOUND FALL FING
STP = STAYTON POND TULE
URB = COL RIVER UPRIVER BRIGHT
UWA = U OF W FALL ACCEL
WSH = WILLAMETTE SPRING

FISHERY INDEX
WEST COAST VANCOUVER ISLAND TROLL
(AGE 3)



Fishery: West Coast Vancouver Island, Ocean Age 3

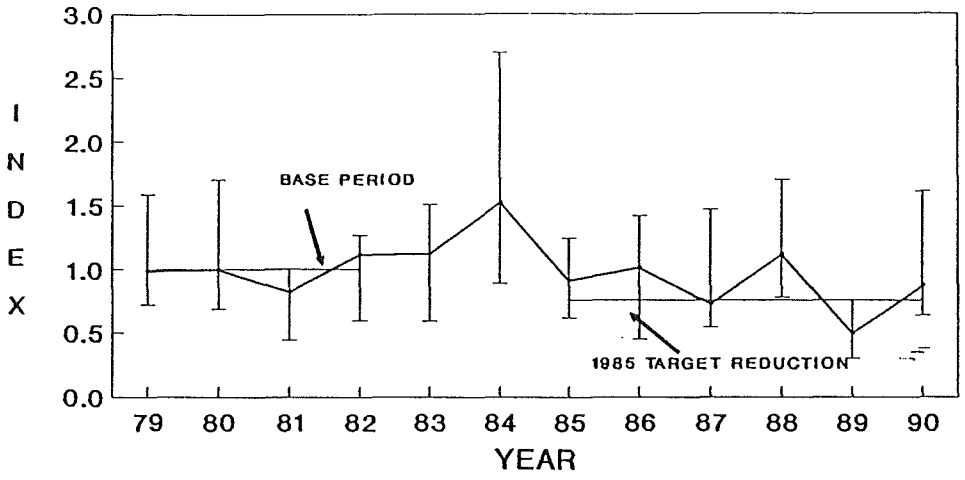
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	GAD Age 3	RBT Age 3	SAM Age 3	SPR Age 3	SPS Age 3	STP Age 3	URB Age 3	UWA Age 3	WSH Age 4	Fishery
79	1.126	NA	1.152	NA	0.975	NA	NA	1.105	0.613	NA	0.974
80	0.556	NA	1.403	NA	1.197	NA	NA	1.064	1.332	1.703	1.051
81	0.884	0.739	0.662	NA	0.908	0.649	1.020	NA	0.803	0.311	0.850
82	1.433	1.261	0.784	1.000	0.919	1.351	0.980	0.832	1.252	0.986	1.118
83	1.767	1.648	0.397	NA	1.453	1.540	1.376	0.240	0.760	0.171	1.305
84	1.429	1.883	1.599	NA	1.297	1.379	1.767	0.571	1.765	0.611	1.475
85	1.357	NA	1.022	NA	0.649	0.768	0.900	0.534	0.898	0.401	0.898
86	NA	NA	NA	NA	1.174	0.856	0.838	0.980	0.881	NA	0.964
87	1.110	NA	0.502	NA	0.462	0.955	1.107	0.802	0.483	0.546	0.814
88	NA	0.585	0.713	0.964	1.047	0.388	1.268	0.382	NA	0.460	0.910
89	NA	0.451	0.296	0.348	0.676	0.437	0.181	0.345	NA	0.386	0.411
90	NA	1.943	0.875	1.050	0.984	1.148	0.947	NA	NA	0.744	1.067

Stock Identifiers

BON = BONNEVILLE TULE
GAD = G ADAMS FALL FING
RBT = ROBERTSON CREEK
SAM = SAMISH FALL FING
SPR = SO SOUND FALL FING
SPS = SO SOUND FALL YEAR
STP = STAYTON POND TULE
URB = COLUMBIA RIVER UPRIVER BRIGHT
UWA = U OF W FALL ACCEL
WSH = WILLAMETTE SPRING

FISHERY INDEX
WEST COAST VANCOUVER ISLAND TROLL
(AGE 4)



Fishery: West Coast Vancouver Island, Ocean Age 4

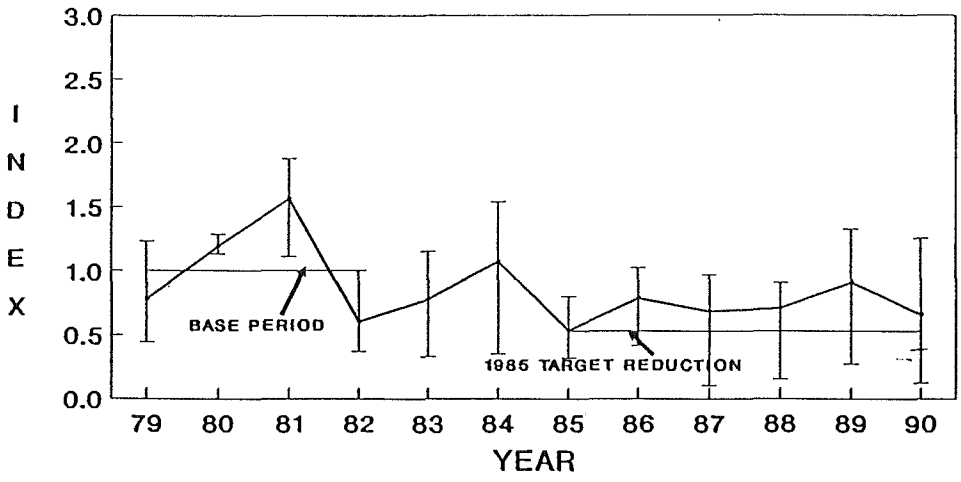
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 4	CWF Age 4	GAD Age 4	LRW Age 4	RBT Age 4	SAM Age 4	SPR Age 4	SPS Age 4	STP Age 4	URB Age 4	UWA Age 4	Fishery
79	NA	NA	NA	NA	1.251	1.000	0.721	1.005	NA	1.588	0.964	0.985
80	0.687	NA	NA	NA	1.705	NA	1.319	NA	NA	0.928	0.757	0.994
81	0.718	0.840	NA	0.818	0.446	NA	0.837	NA	NA	0.949	1.008	0.823
82	1.595	1.160	1.000	1.182	0.599	NA	1.122	0.995	1.000	0.535	1.271	1.118
83	1.509	1.307	1.240	0.945	0.594	0.652	1.294	0.788	1.789	0.395	1.197	1.123
84	2.697	1.254	NA	NA	0.891	NA	1.600	0.895	2.067	1.011	0.922	1.524
85	NA	0.862	0.816	NA	NA	NA	1.224	0.620	0.813	0.857	1.245	0.912
86	NA	1.214	NA	0.451	NA	NA	0.857	1.053	0.800	0.994	1.420	1.012
87	NA	0.785	NA	1.471	NA	NA	NA	0.575	NA	0.850	0.543	0.730
88	1.234	0.863	NA	1.163	0.831	NA	NA	0.782	1.661	1.702	1.004	1.118
89	NA	0.481	0.529	0.638	0.353	0.300	0.684	0.404	0.584	0.759	NA	0.493
90	NA	0.829	0.959	1.611	0.885	0.640	0.885	0.767	NA	1.388	NA	0.873

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
LRW = LEWIS RIVER WILD
RBT = ROBERTSON CREEK
SAM = SAMISH FALL FING
SPR = SO SOUND FALL FING
SPS = SO SOUND FALL YEAR
STP = STAYTON POND TULE
URB = COLUMBIA RIVER UPRIVER BRIGHT
UWA = U OF W FALL ACCEL

FISHERY INDEX
STRAIT OF GEORGIA TROLL & SPORT
(ALL AGES)



I RANGE OF INDICES —— INDEX

Fishery: Strait of Georgia Sport and Troll Combined, All Ages

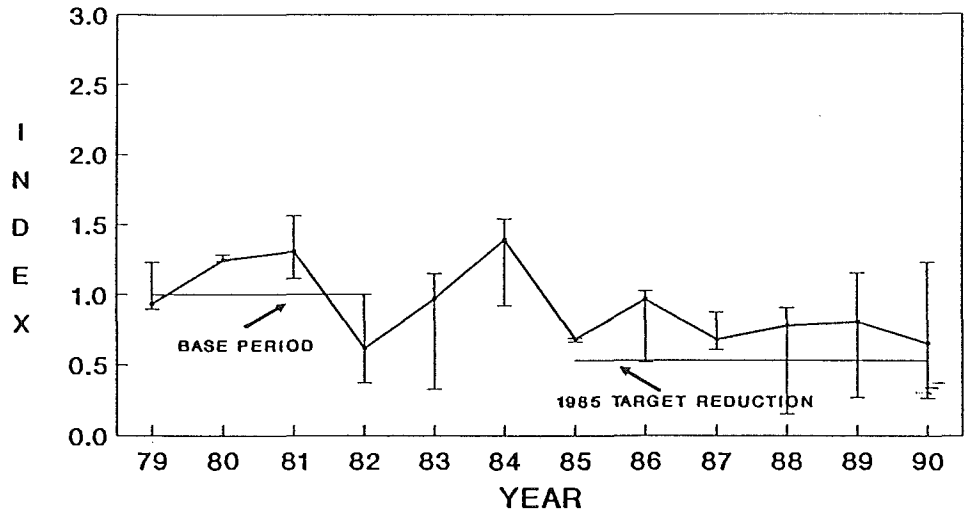
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	SPS Age 4	UWA Age 3	Fishery
79	0.895	0.644	0.444	NA	1.000	NA	1.067	1.232	0.778
80	1.240	1.133	NA	NA	NA	NA	NA	1.284	1.190
81	1.269	1.738	1.877	NA	NA	1.561	NA	1.112	1.565
82	0.595	0.485	0.679	1.000	NA	0.439	0.933	0.371	0.605
83	1.151	0.744	0.389	NA	0.861	0.329	0.568	0.775	0.779
84	1.485	NA	0.352	NA	NA	0.921	0.792	1.539	1.069
85	0.689	0.430	0.323	NA	NA	NA	0.798	0.662	0.535
86	1.023	0.771	0.415	NA	NA	NA	NA	0.516	0.782
87	0.608	0.968	0.102	NA	NA	0.874	NA	0.859	0.682
88	0.908	0.747	0.431	0.870	NA	0.154	NA	NA	0.708
89	0.849	1.136	0.492	1.156	1.324	0.269	0.762	NA	0.907
90	0.605	0.732	0.120	1.231	1.254	0.266	0.621	NA	0.659

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL YEAR
UWA = U OF W FALL ACCEL

FISHERY INDEX
STRAIT OF GEORGIA TROLL & SPORT (AGE 3)



Fishery: Strait of Georgia Sport and Troll Combined, Ocean Age 3

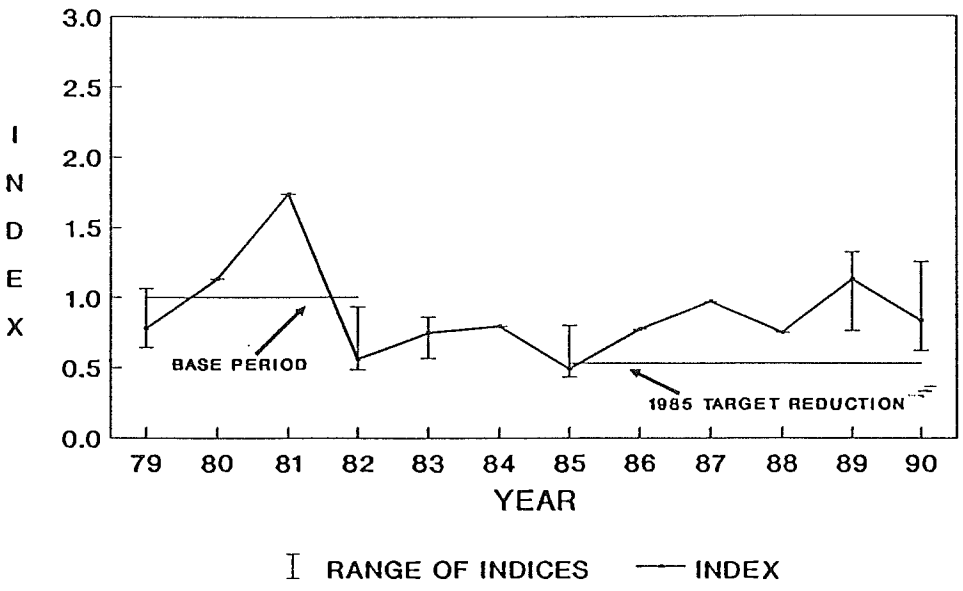
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	SAM Age 3	SPS Age 3	UWA Age 3	Fishery
79	0.895	NA	NA	1.232	0.934
80	1.240	NA	NA	1.284	1.245
81	1.269	NA	1.561	1.112	1.306
82	0.595	1.000	0.439	0.371	0.616
83	1.151	NA	0.329	0.775	0.970
84	1.485	NA	0.921	1.539	1.390
85	0.689	NA	NA	0.662	0.686
86	1.023	NA	NA	0.516	0.965
87	0.608	NA	0.874	0.859	0.678
88	0.908	0.870	0.154	NA	0.779
89	0.849	1.156	0.269	NA	0.806
90	0.605	1.231	0.266	NA	0.655

Stock Identifiers

BQR = BIG QUALICUM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL YEAR
UWA = U OF W FALL ACCEL

FISHERY INDEX
STRAIT OF GEORGIA TROLL & SPORT (AGE 4)



Fishery: Strait of Georgia Sport and Troll Combined, Ocean Age 4

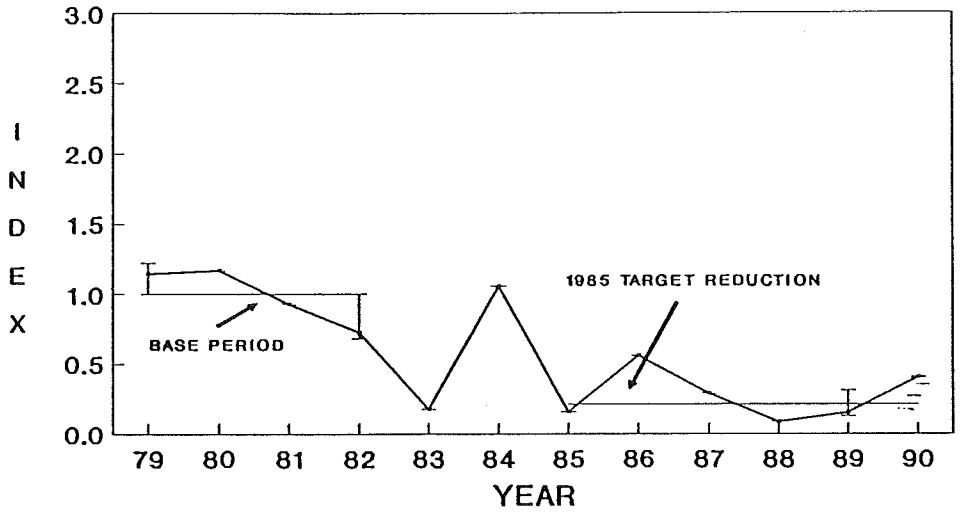
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 4	SAM Age 4	SPS Age 4	Fishery
79	0.644	1.000	1.067	0.778
80	1.133	NA	NA	1.133
81	1.738	NA	NA	1.738
82	0.485	NA	0.933	0.561
83	0.744	0.861	0.568	0.746
84	NA	NA	0.792	0.792
85	0.430	NA	0.798	0.492
86	0.771	NA	NA	0.771
87	0.968	NA	NA	0.968
88	0.747	NA	NA	0.747
89	1.136	1.324	0.762	1.128
90	0.732	1.254	0.621	0.832

Stock Identifiers

BQR = BIG QUALICUM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL YEAR

FISHERY INDEX
STRAIT OF GEORGIA TROLL (ALL AGES)



Fishery: Strait of Georgia Troll, All Ages

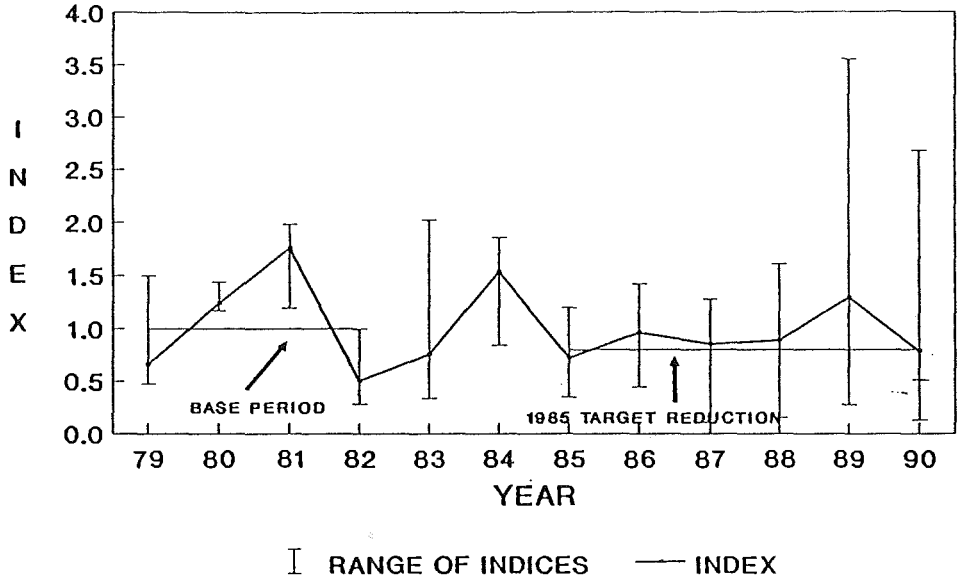
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	SAM Age 3	SAM Age 4	Fishery
79	1.221	NA	1.000	1.147
80	1.169	NA	NA	1.169
81	0.930	NA	NA	0.930
82	0.680	1.000	NA	0.724
83	NA	NA	0.173	0.173
84	1.054	NA	NA	1.054
85	0.157	NA	NA	0.157
86	0.558	NA	NA	0.558
87	0.285	NA	NA	0.285
88	0.086	NA	NA	0.086
89	0.126	0.309	NA	0.151
90	0.402	NA	0.409	0.404

Stock Identifiers

BQR = BIG QUALICUM
SAM = SAMISH FALL FING

FISHERY INDEX
STRAIT OF GEORGIA SPORT (ALL AGES)



Fishery: Strait of Georgia Sport, All Ages

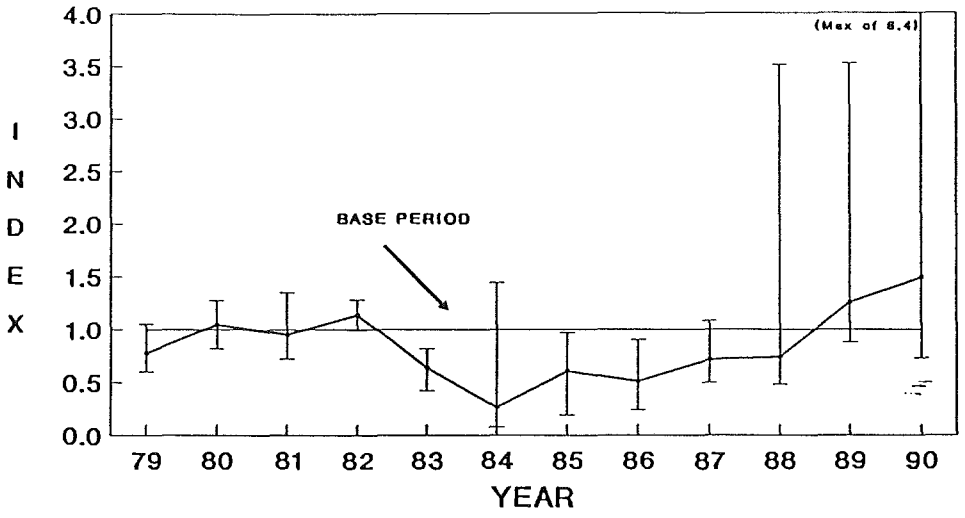
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BQR Age 3	BQR Age 4	QUI Age 5	SAM Age 3	SAM Age 4	SPS Age 3	SPS Age 4	UWA Age 3	Fishery
79	0.618	0.569	0.474	NA	1.000	NA	1.496	0.951	0.661
80	1.301	1.168	NA	NA	NA	NA	NA	1.437	1.236
81	1.558	1.980	1.802	NA	NA	1.599	NA	1.187	1.757
82	0.523	0.284	0.724	1.000	NA	0.401	0.504	0.425	0.502
83	0.898	0.783	0.416	NA	2.019	0.333	0.803	0.584	0.755
84	1.851	NA	NA	NA	NA	0.841	1.302	1.642	1.534
85	1.142	0.574	0.344	NA	NA	NA	1.197	0.793	0.717
86	1.419	1.015	0.443	NA	NA	NA	NA	0.619	0.960
87	0.882	1.275	0.109	NA	NA	0.962	NA	0.702	0.853
88	1.606	0.804	0.460	1.204	NA	0.152	NA	NA	0.888
89	1.463	1.518	0.526	1.507	3.550	0.273	1.114	NA	1.291
90	0.779	0.978	0.128	0.854	2.676	0.216	0.941	NA	0.784

Stock Identifiers

BQR = BIG QUALICUM
QUI = QUINSAM
SAM = SAMISH FALL FING
SPS = SO SOUND FALL FING
UWA = U OF W FALL ACCEL

FISHERY INDEX
WA/OR TROLL & SPORT (ALL AGES)



Fishery: Washington/Oregon Sport and Troll Combined, All Ages

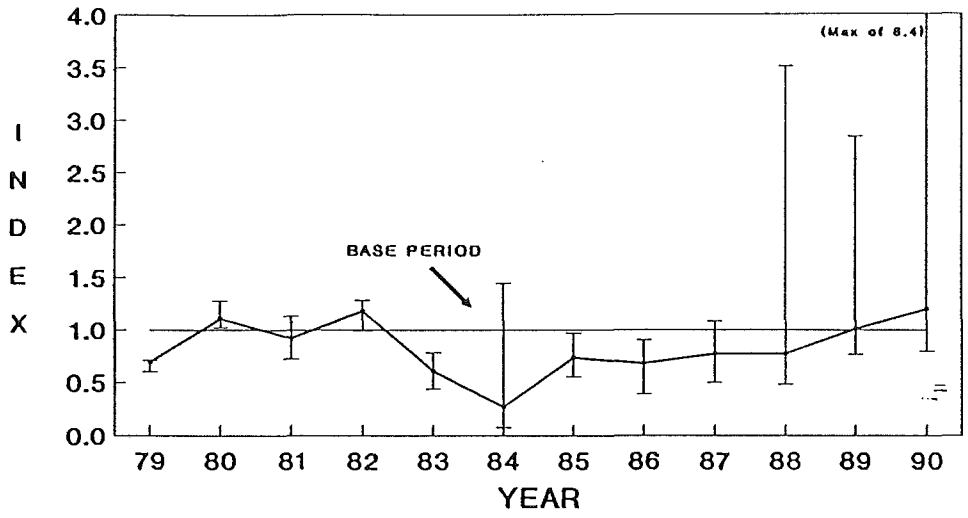
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	CWF Age 3	CWF Age 4	GAD Age 3	GAD Age 4	SAM Age 3	SAM Age 4	SPR Age 3	SPR Age 4	SPS Age 3	SPS Age 4	STP Age 3	UWA Age 3	Fishery
79	0.707	NA	NA	NA	NA	NA	1.000	0.691	1.049	NA	0.614	NA	0.602	0.776
80	1.172	1.023	NA	NA	NA	NA	NA	1.092	0.818	NA	NA	NA	1.272	1.048
81	1.129	0.767	0.772	1.000	NA	NA	NA	1.011	1.345	0.972	NA	0.720	0.998	0.947
82	0.993	1.210	1.228	NA	1.000	1.000	NA	1.206	0.788	1.028	1.386	1.280	1.129	1.138
83	0.724	0.572	0.814	NA	0.418	NA	4.708	0.439	0.356	0.779	0.763	0.706	0.688	0.636
84	0.385	0.074	0.173	1.444	NA	NA	NA	0.291	NA	1.066	0.724	0.176	0.285	0.266
85	0.965	0.602	0.191	NA	0.296	NA	NA	0.630	NA	NA	0.509	0.774	0.553	0.606
86	NA	0.877	0.237	NA	NA	NA	NA	0.388	0.246	NA	NA	0.899	NA	0.511
87	0.869	0.496	0.512	NA	NA	NA	NA	0.931	NA	NA	NA	0.612	1.081	0.712
88	NA	0.542	0.646	3.395	NA	2.986	NA	0.477	NA	3.512	NA	0.899	NA	0.736
89	NA	0.764	1.311	2.406	3.519	1.038	5.917	0.877	NA	2.838	2.025	1.167	NA	1.254
90	NA	NA	0.724	5.471	6.655	6.870	20.911	0.791	0.690	8.408	4.439	0.962	NA	1.492

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
SAM = SAMISH FALL FING
SPR = SPRING CREEK TULE
SPS = SO SOUND FALL FING
STP = STAYTON POND TULE
UWA = U OF W FALL ACCEL

FISHERY INDEX
WA/OR TROLL & SPORT (AGE 3)



Fishery: Washington/Oregon Sport and Troll Combined, Ocean Age 3

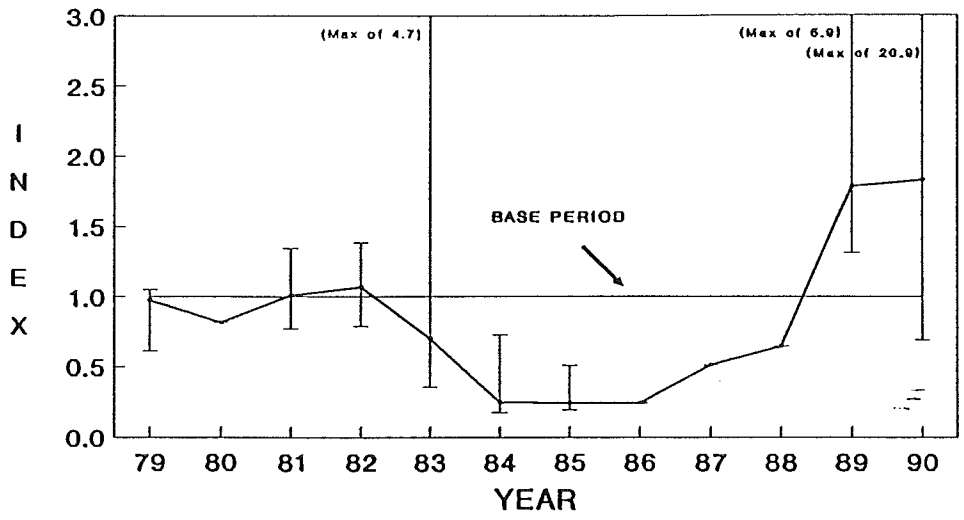
TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	BON Age 3	CWF Age 3	GAD Age 3	SAM Age 3	SPR Age 3	SPS Age 3	STP Age 3	UWA Age 3	Fishery
79	0.707	NA	NA	NA	0.691	NA	NA	0.602	0.692
80	1.172	1.023	NA	NA	1.092	NA	NA	1.272	1.108
81	1.129	0.767	1.000	NA	1.011	0.972	0.720	0.998	0.919
82	0.993	1.210	NA	1.000	1.206	1.028	1.280	1.129	1.176
83	0.724	0.572	NA	NA	0.439	0.779	0.706	0.688	0.604
84	0.385	0.074	1.444	NA	0.291	1.066	0.176	0.285	0.271
85	0.965	0.602	NA	NA	0.630	NA	0.774	0.553	0.735
86	NA	0.877	NA	NA	0.388	NA	0.899	NA	0.675
87	0.869	0.496	NA	NA	0.931	NA	0.612	1.081	0.766
88	NA	0.542	3.395	2.986	0.477	3.512	0.899	NA	0.766
89	NA	0.764	2.406	1.038	0.877	2.838	1.167	NA	1.011
90	NA	NA	5.471	6.870	0.791	8.408	0.962	NA	1.196

Stock Identifiers

BON = BONNEVILLE TULE
CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
SAM = SAMISH FALL FING
SPR = SO SOUND FALL FING
SPS = SO SOUND FALL YEAR
STP = STAYTON POND TULE
UWA = U OF W FALL ACCEL

FISHERY INDEX
WA/OR TROLL & SPORT (AGE 4)



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Fishery: Washington/Oregon Sport and Troll Combined, Ocean Age 4

TOTAL MORTALITY EXPLOITATION RATE INDEX BY STOCK

Year	CWF Age 4	GAD Age 4	SAM Age 4	SPR Age 4	SPS Age 4	Fishery
79	NA	NA	1.000	1.049	0.614	0.972
80	NA	NA	NA	0.818	NA	0.818
81	0.772	NA	NA	1.345	NA	1.010
82	1.228	1.000	NA	0.788	1.386	1.068
83	0.814	0.418	4.708	0.356	0.763	0.696
84	0.173	NA	NA	NA	0.724	0.247
85	0.191	0.296	NA	NA	0.509	0.241
86	0.237	NA	NA	0.246	NA	0.241
87	0.512	NA	NA	NA	NA	0.512
88	0.646	NA	NA	NA	NA	0.646
89	1.311	3.519	5.917	NA	2.025	1.786
90	0.724	6.655	20.911	0.690	4.439	1.833

Stock Identifiers

CWF = COWLITZ FALL TULE
GAD = G ADAMS FALL FING
SAM = SAMISH FALL FING
SPR = SO SOUND FALL FING
SPS = SO SOUND FALL YEAR

APPENDIX F

Survival Rate Figures

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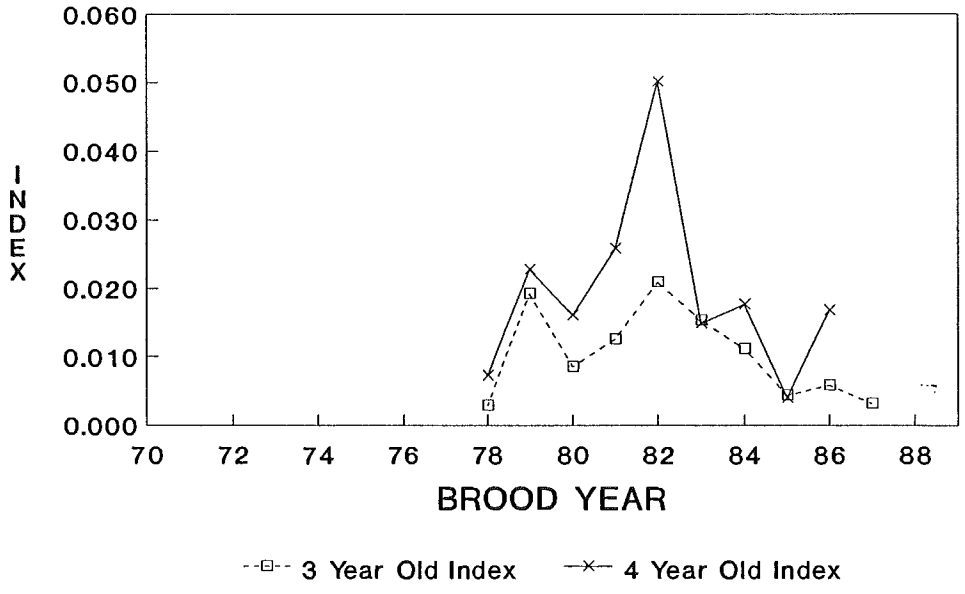

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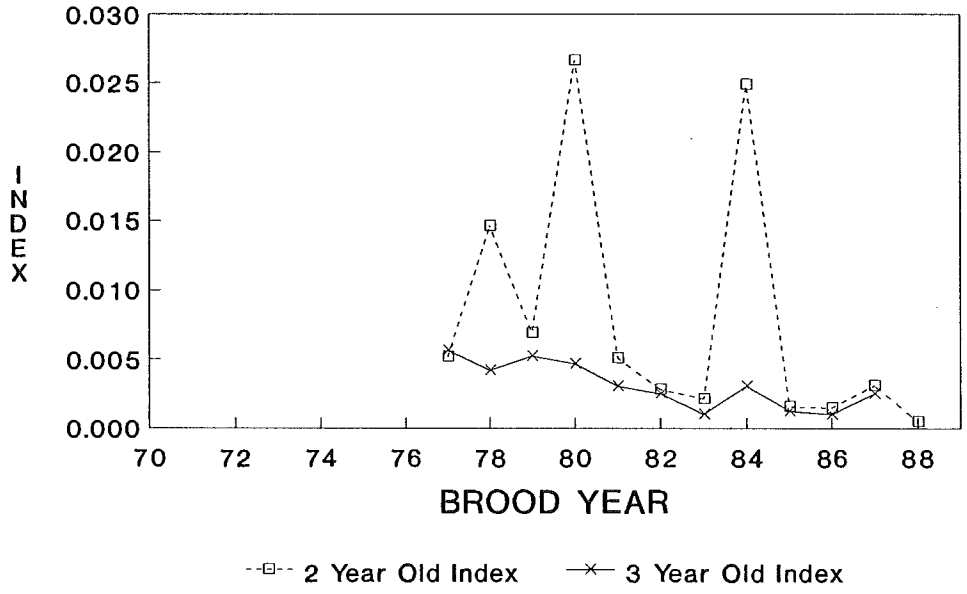

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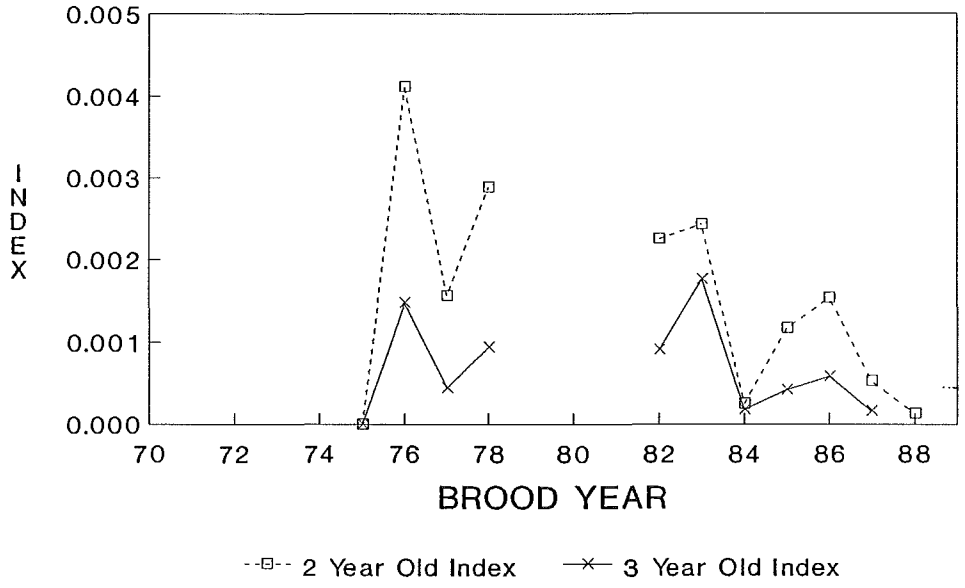

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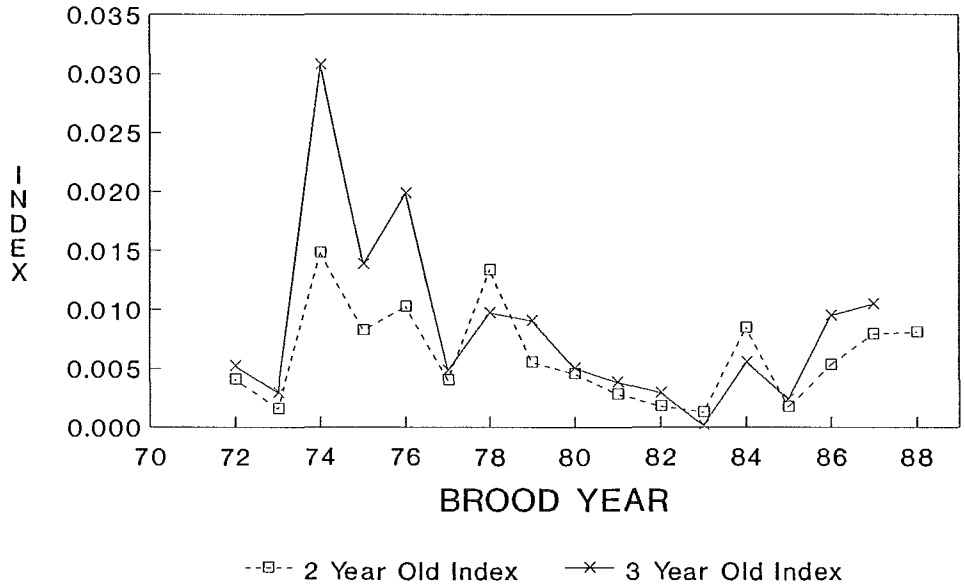

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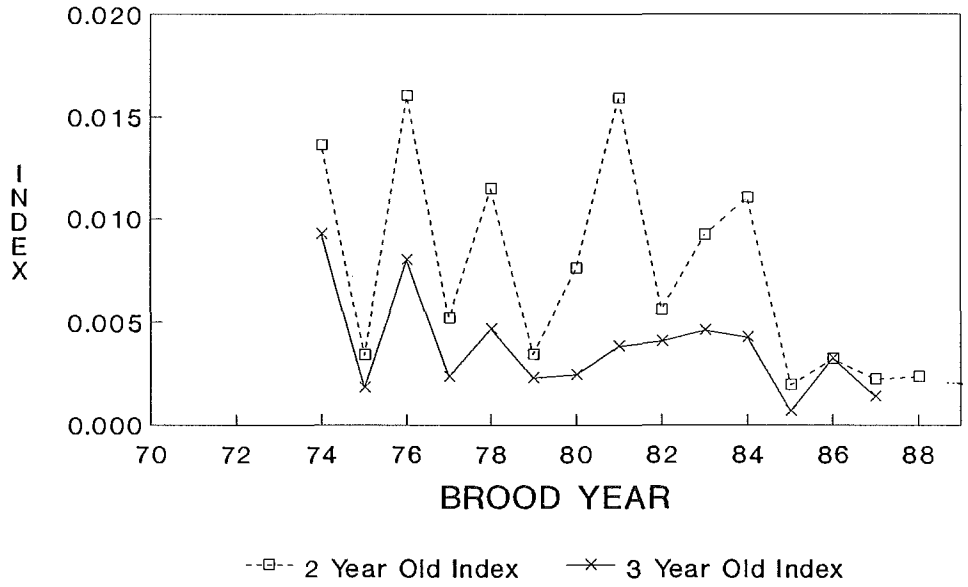

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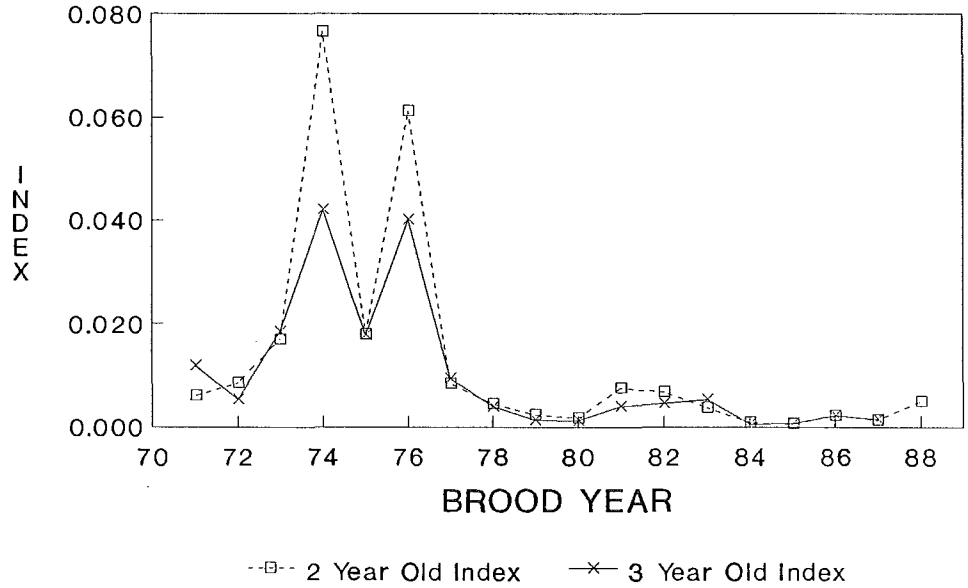

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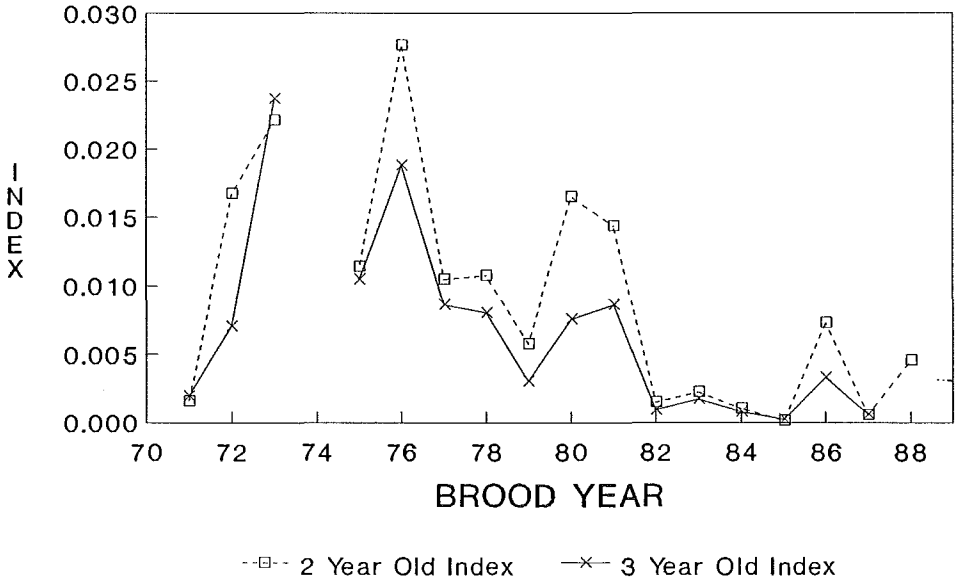

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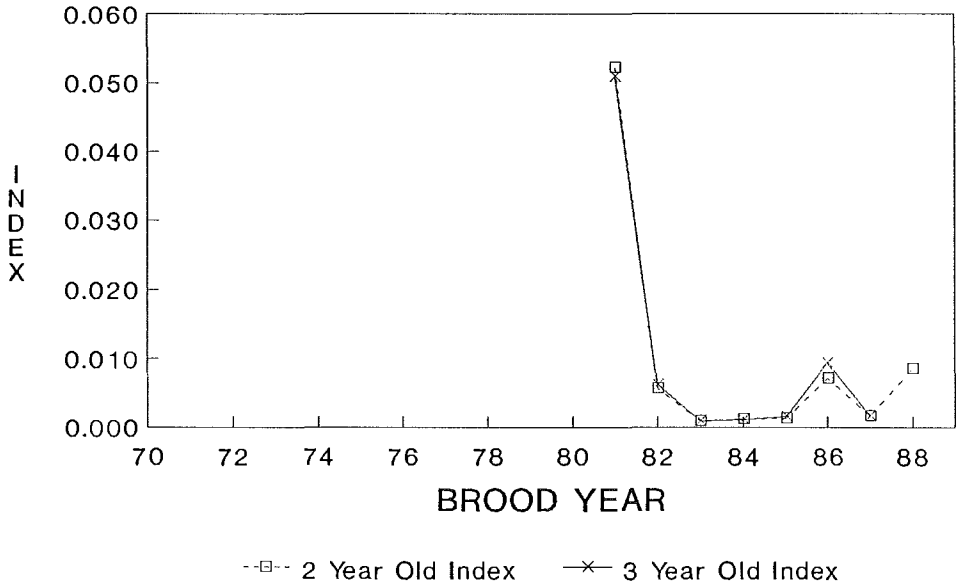

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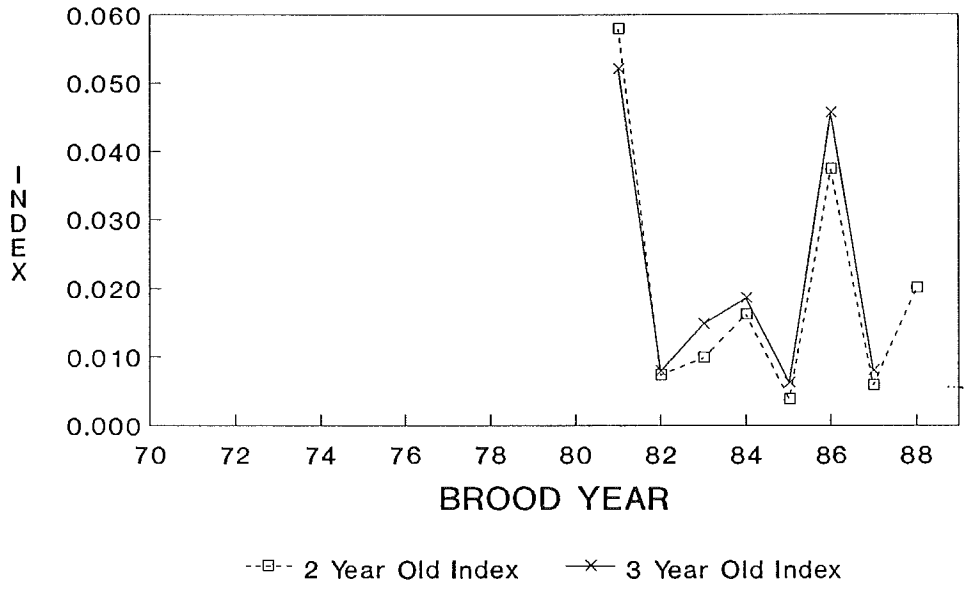

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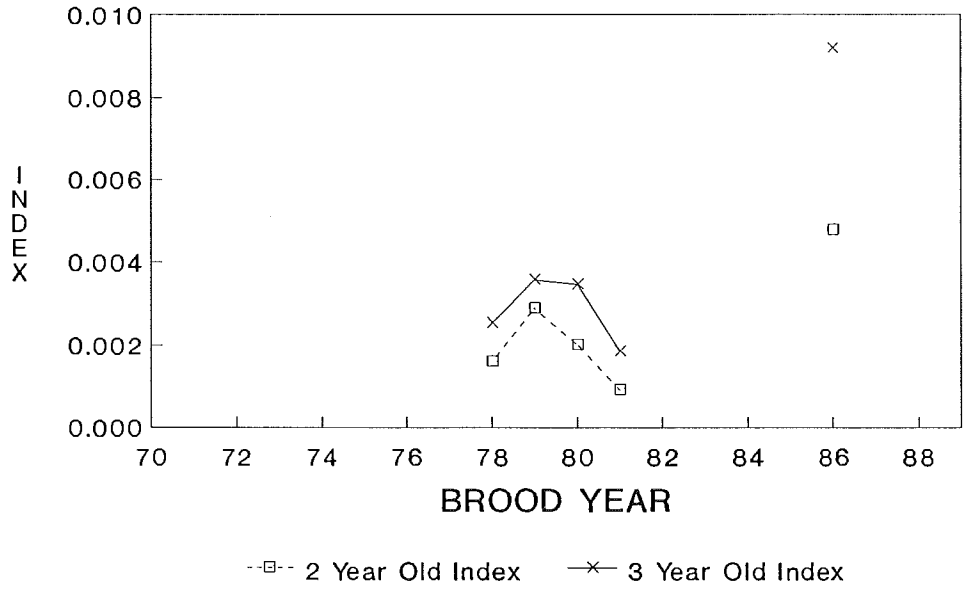

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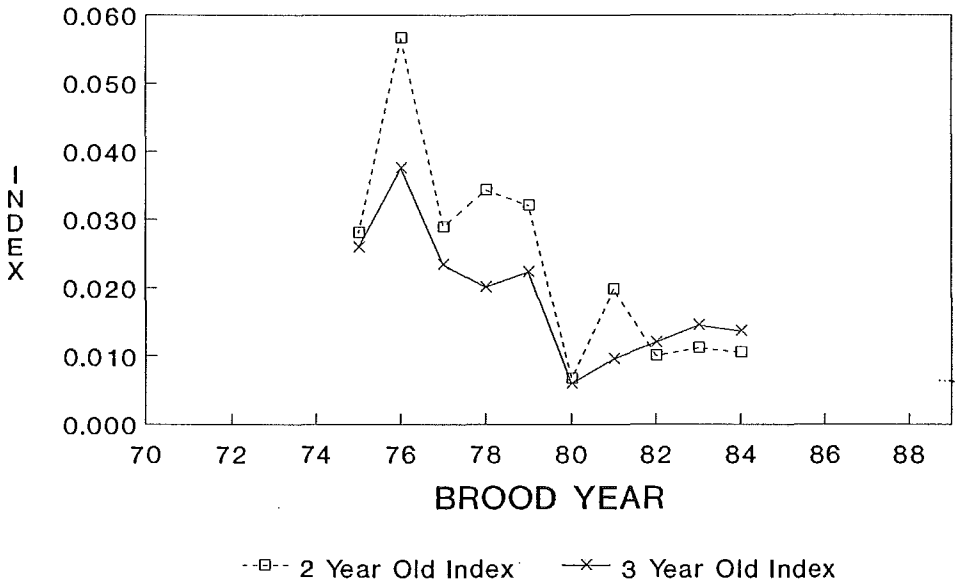

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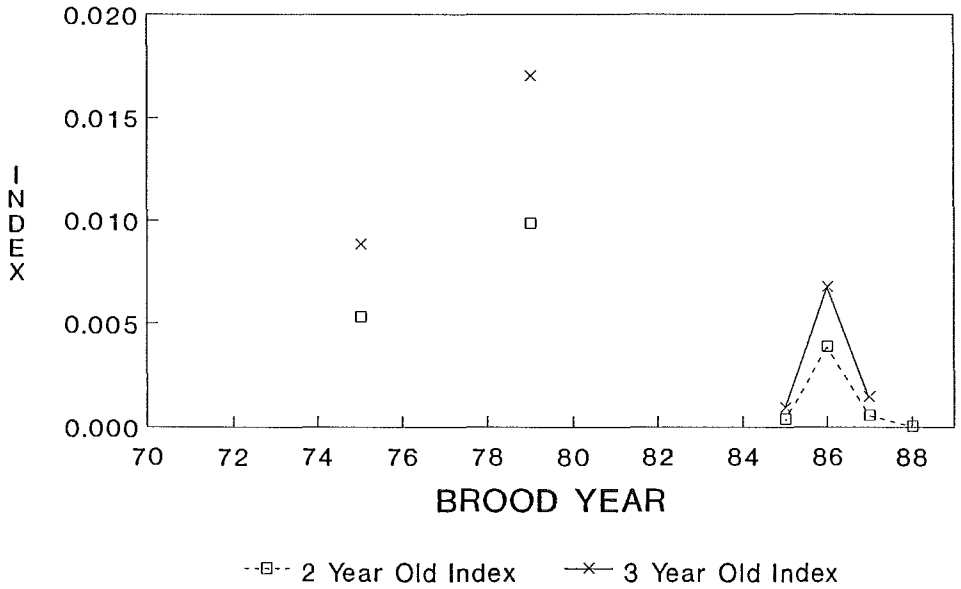

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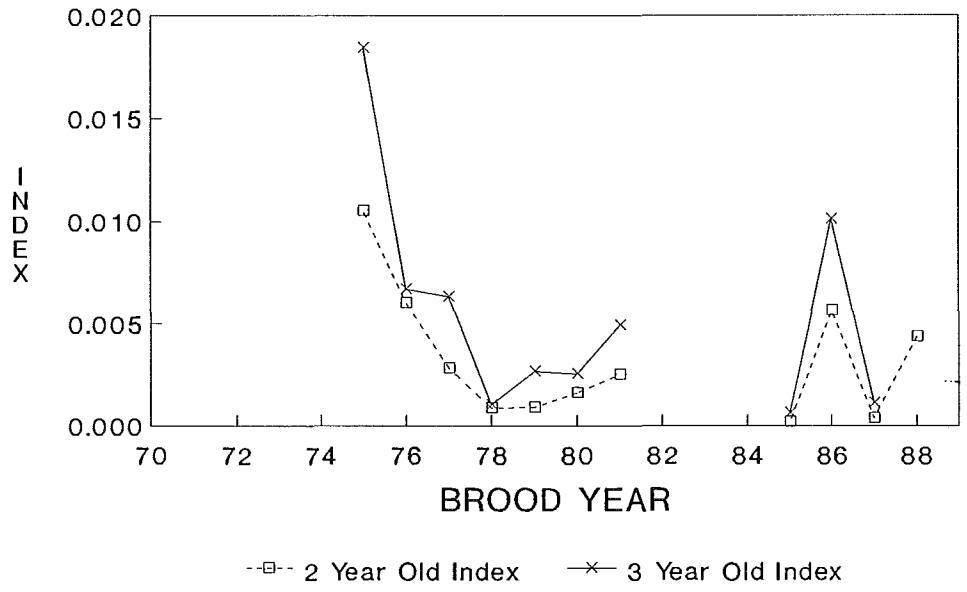

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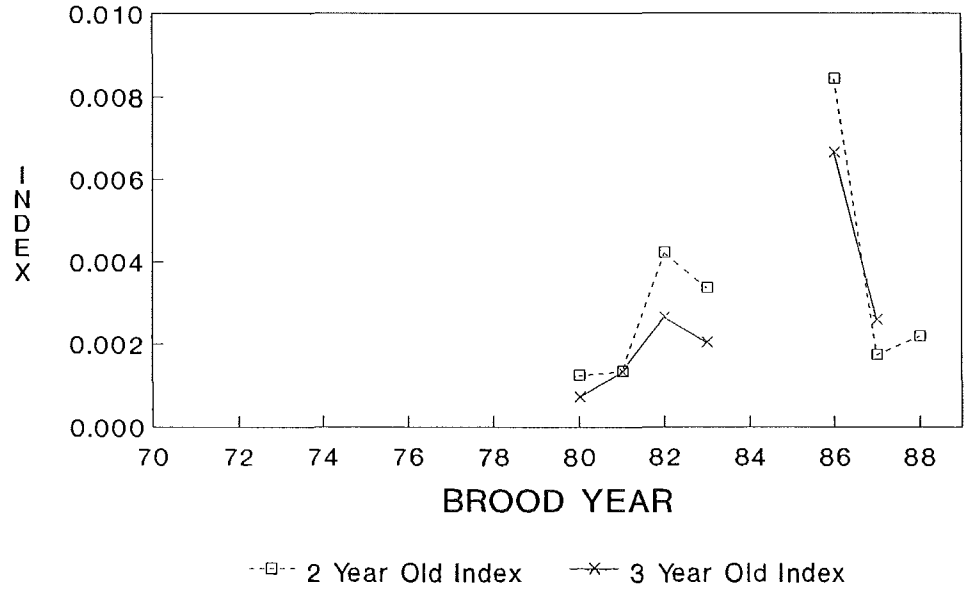

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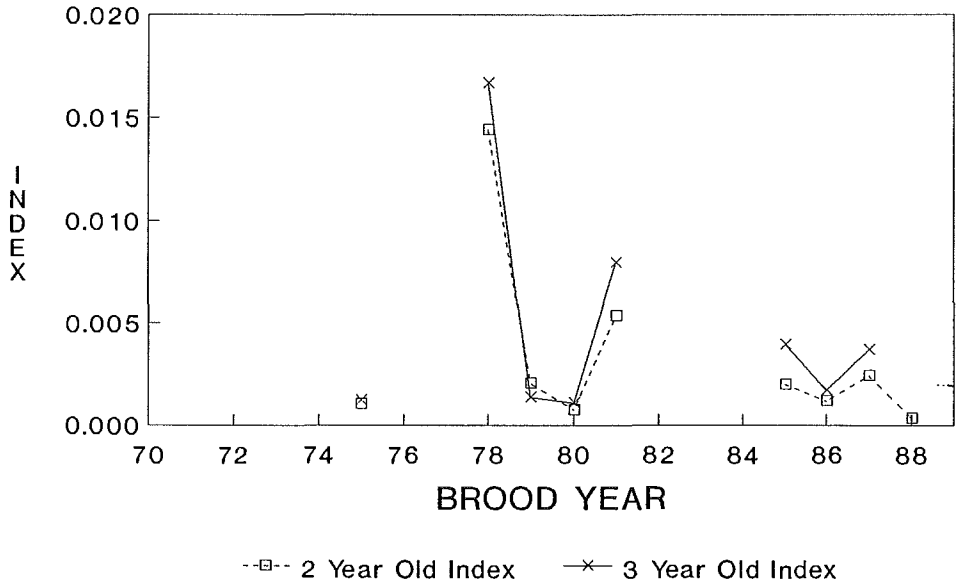

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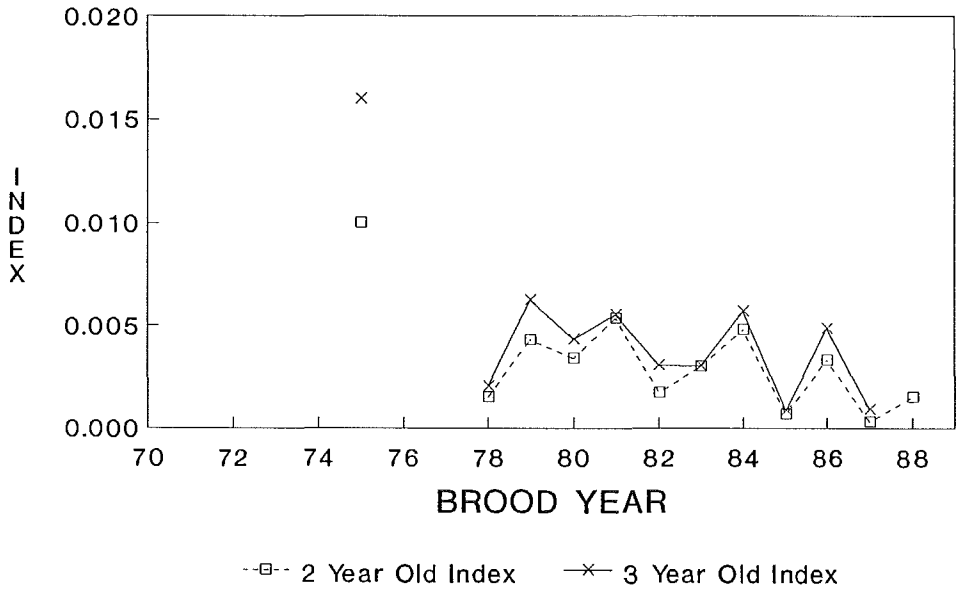

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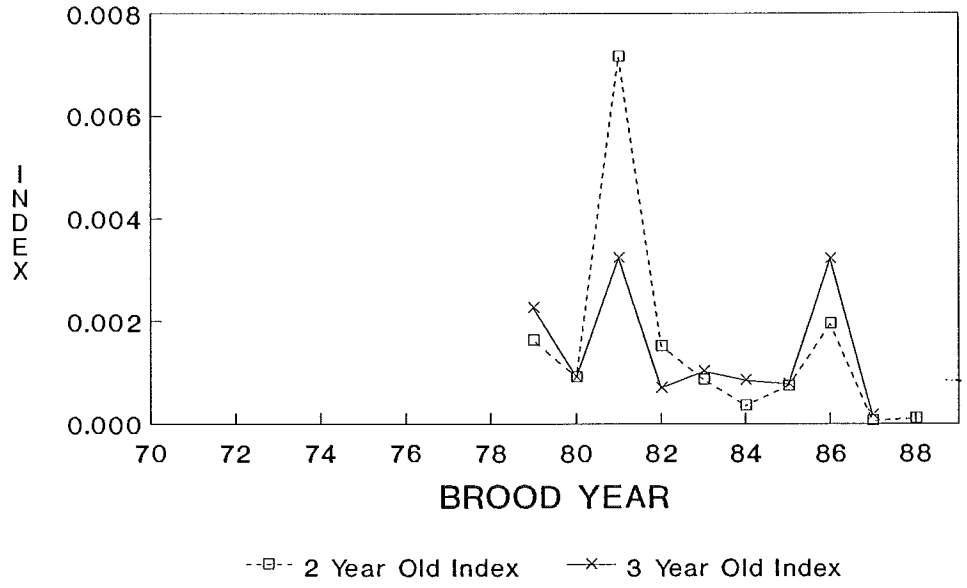

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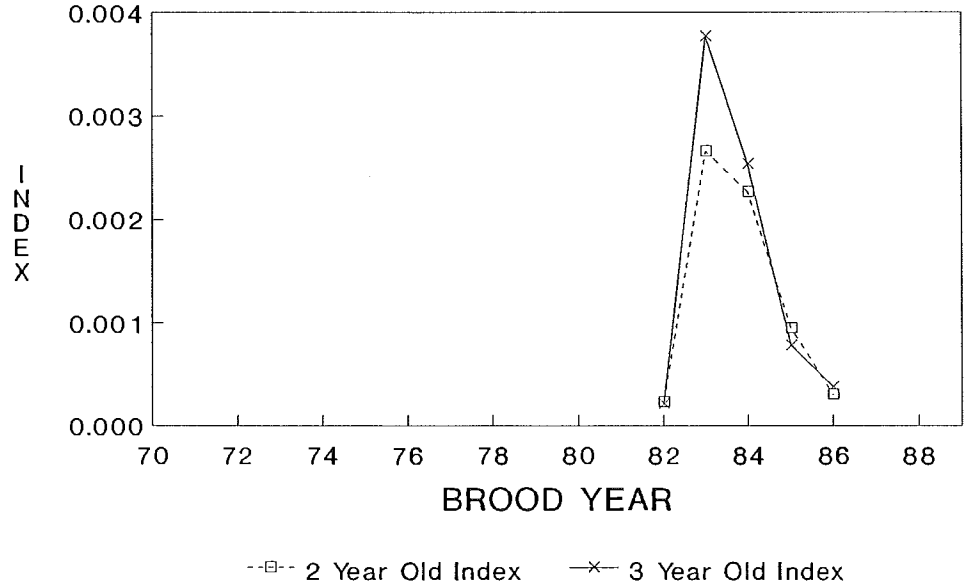

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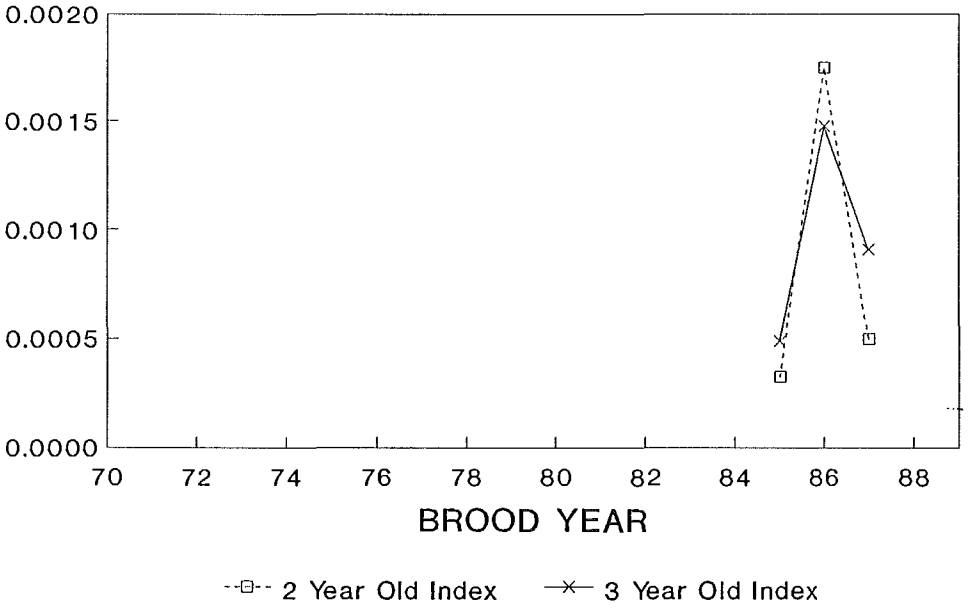

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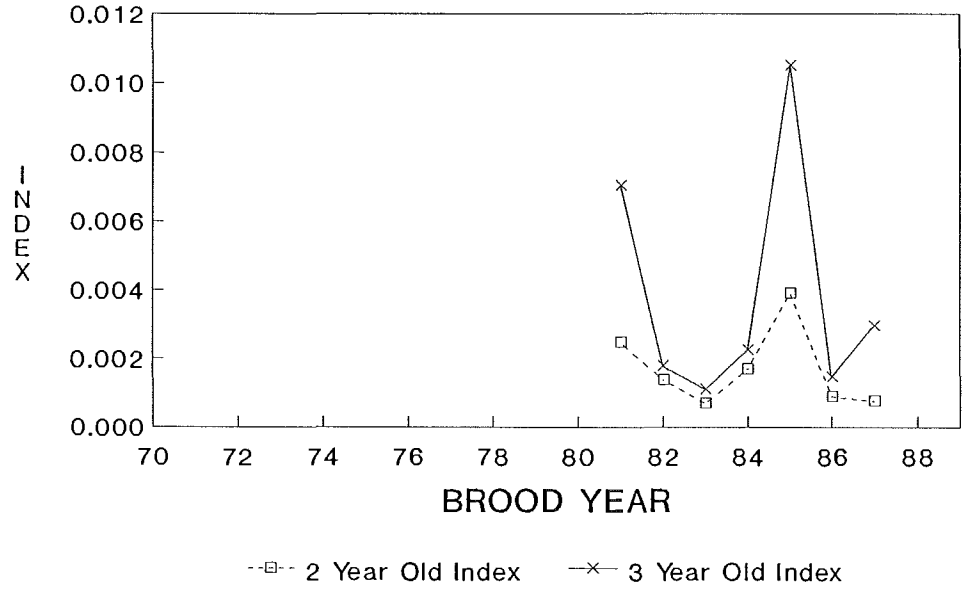

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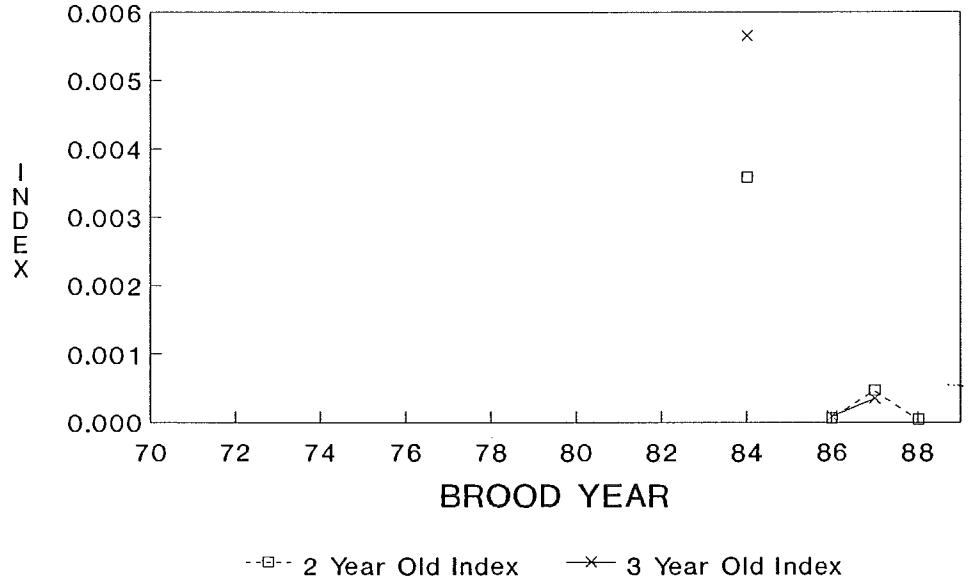

SKOOKUM SPRING FINGERLING
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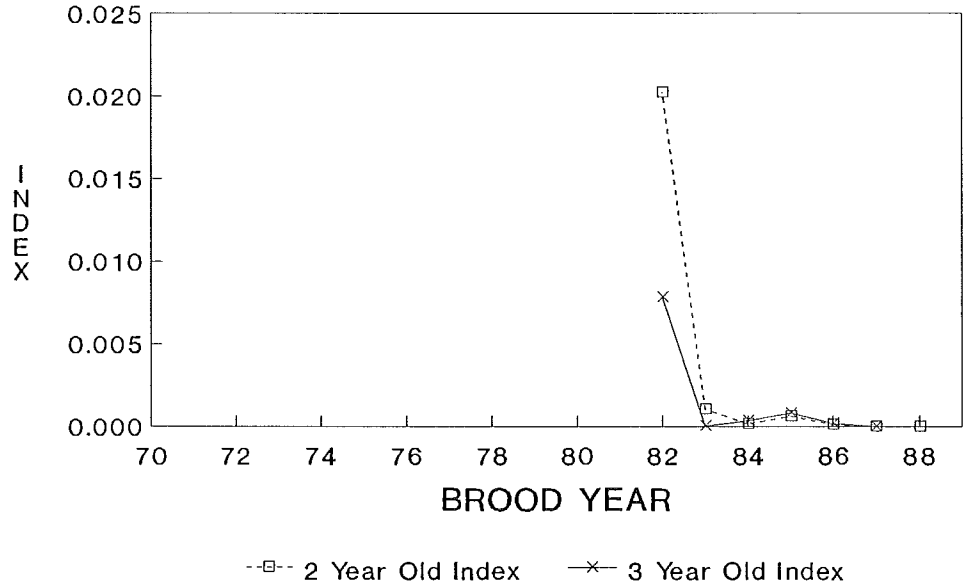

QUILCENE SPRING YEARLING
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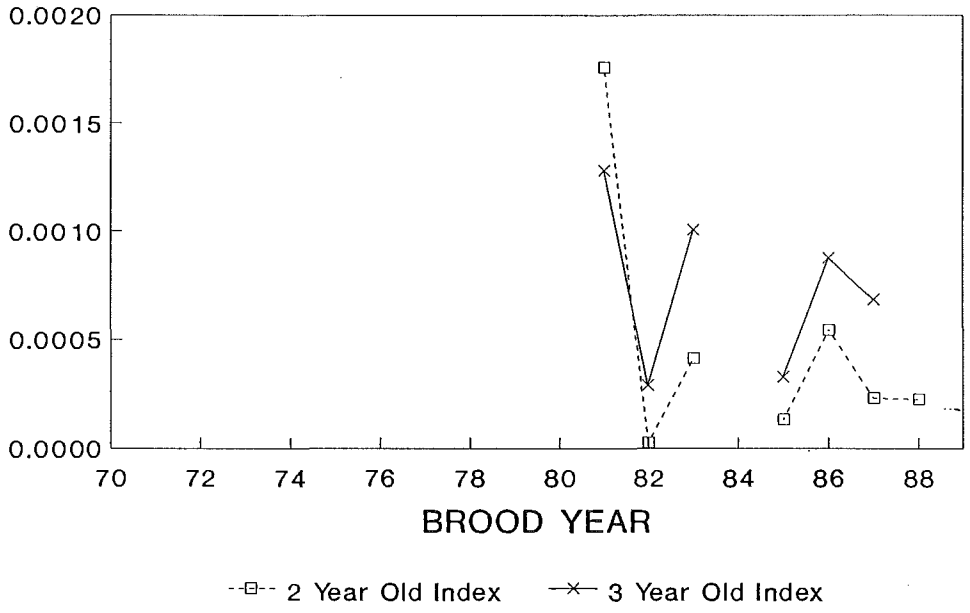

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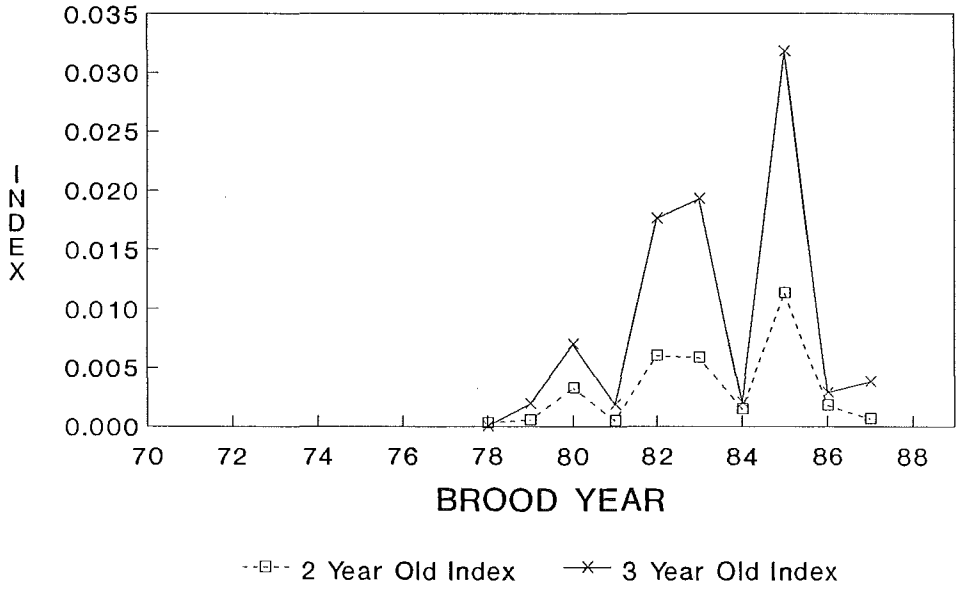

SOOES FALL FINGERLING
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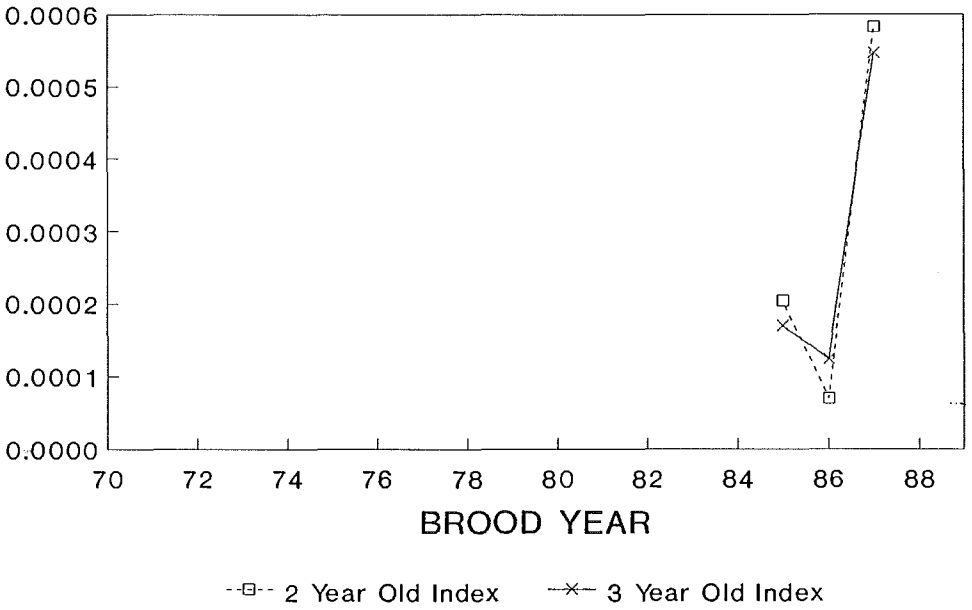
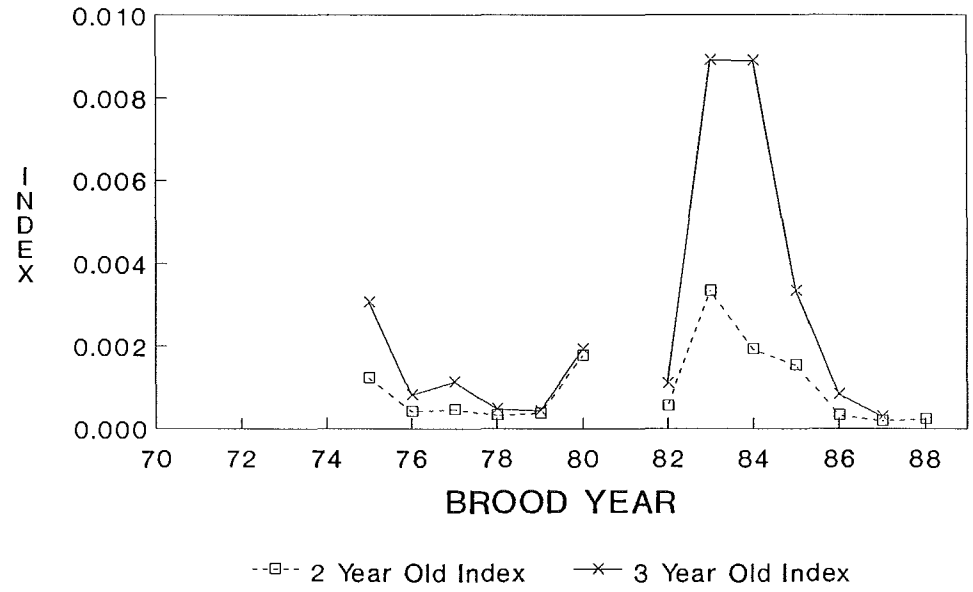
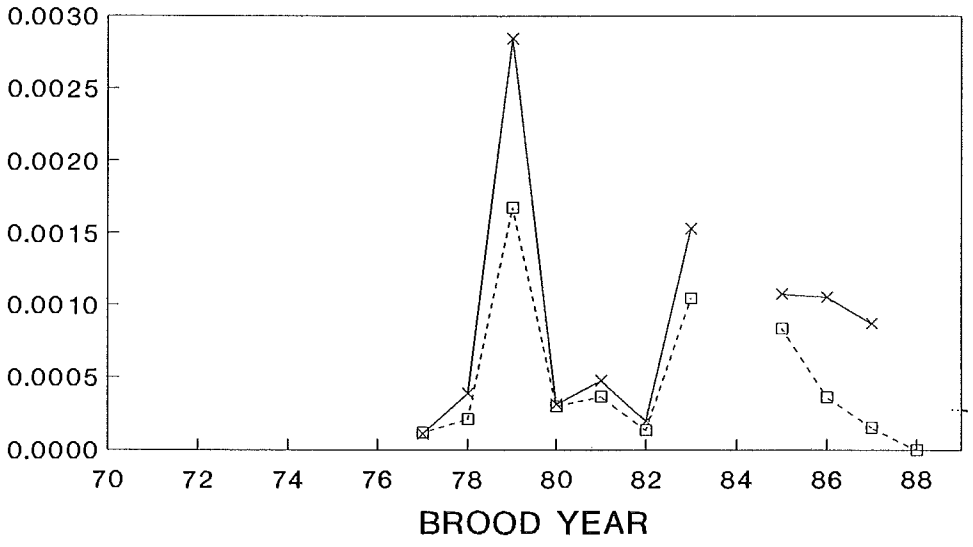


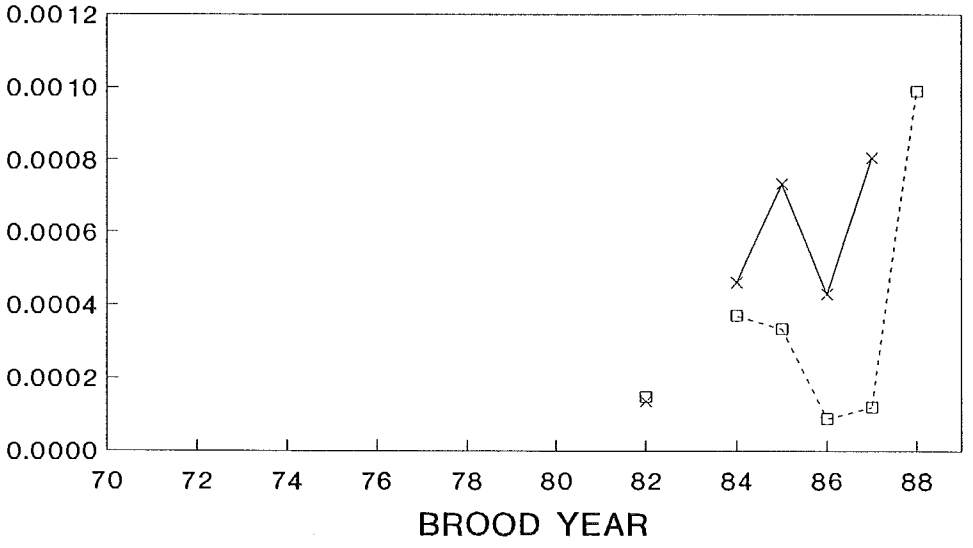
QUINAULT FALL FINGERLING
INDEX OF SURVIVAL



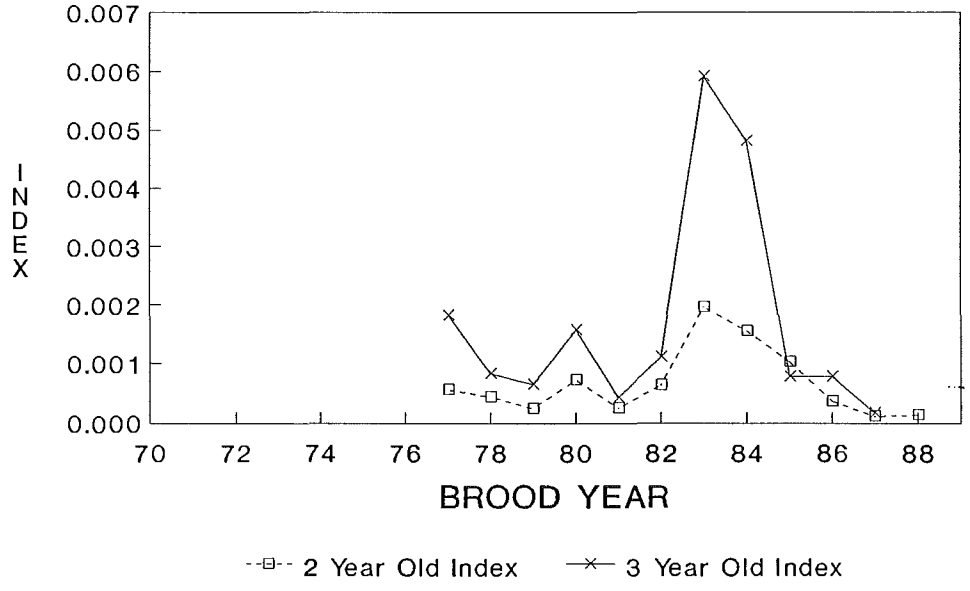
QUEETS FALL FINGERLING
INDEX OF SURVIVAL



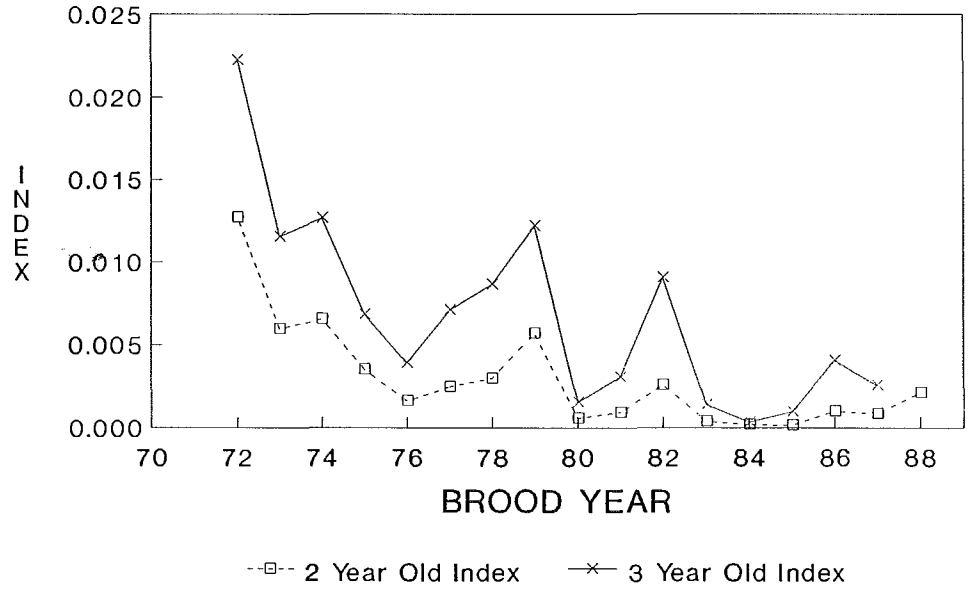
HUMPTULIPS FALL FINGERLING
INDEX OF SURVIVAL



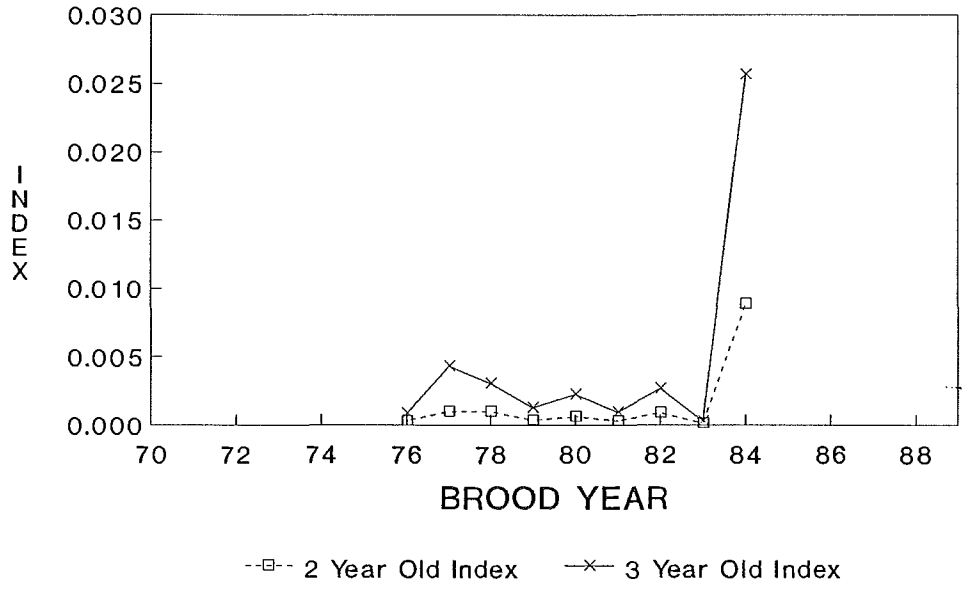
COWLITZ TULE
INDEX OF SURVIVAL



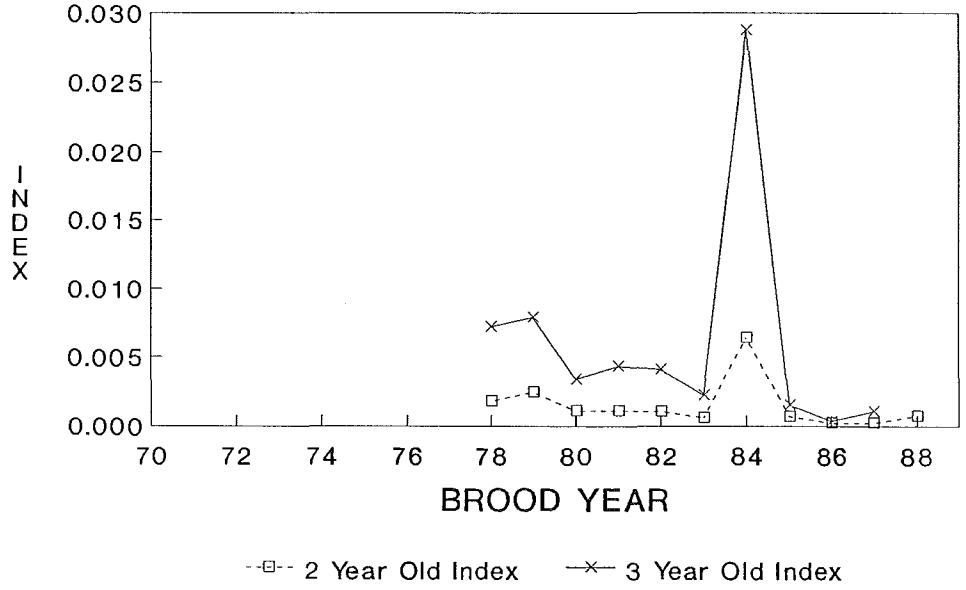
SPRING CREEK TULE
INDEX OF SURVIVAL



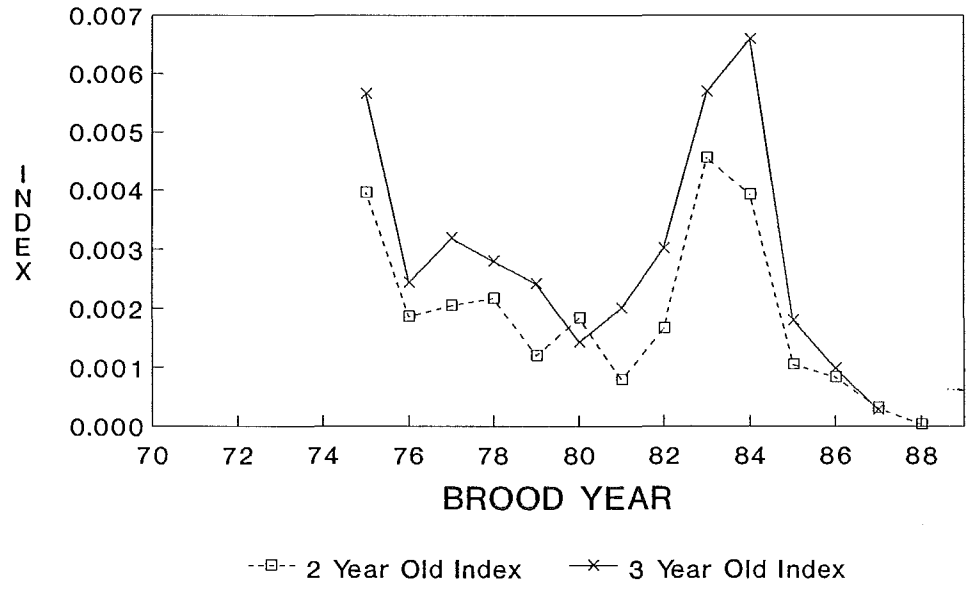
BONNEVILLE TULE
INDEX OF SURVIVAL



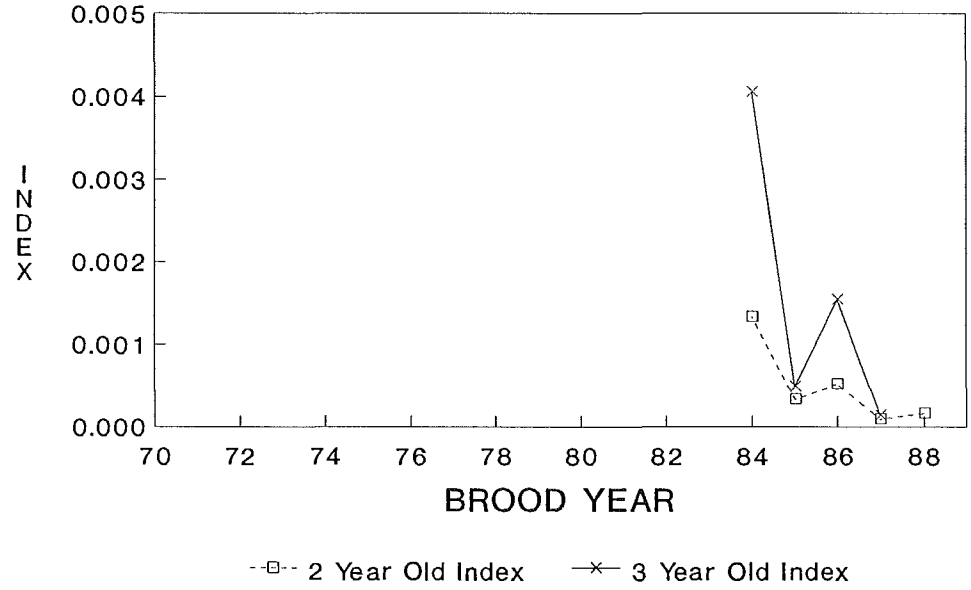
STAYTON POND TULE
INDEX OF SURVIVAL



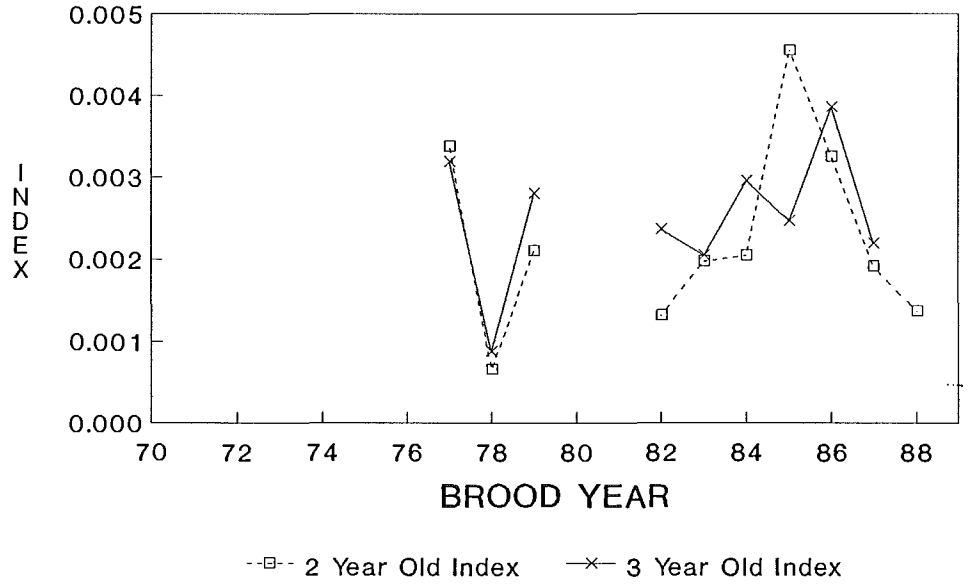
COLUMBIA RIVER UPRIVER BRIGHT
INDEX OF SURVIVAL



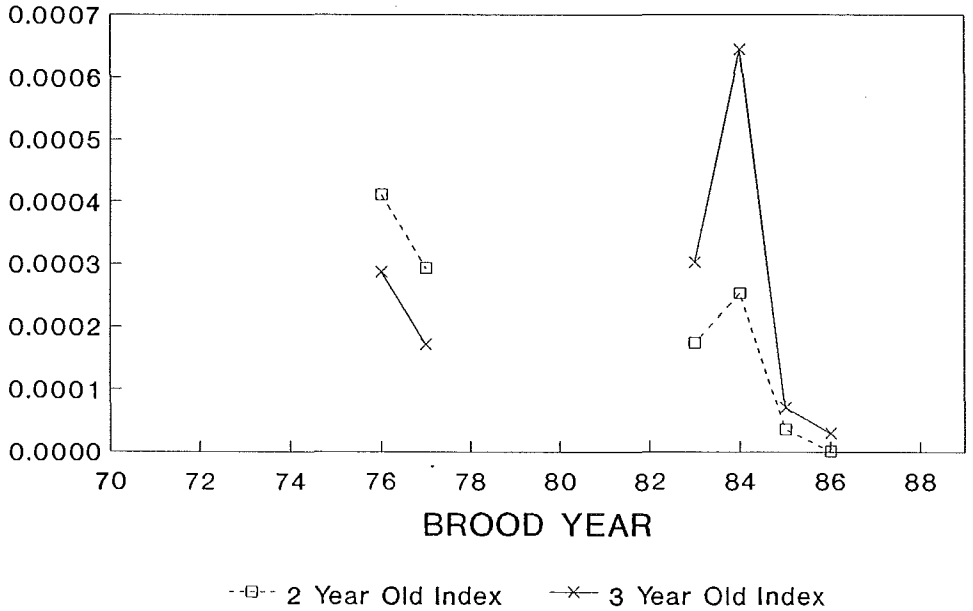
LYON'S FERRY
INDEX OF SURVIVAL



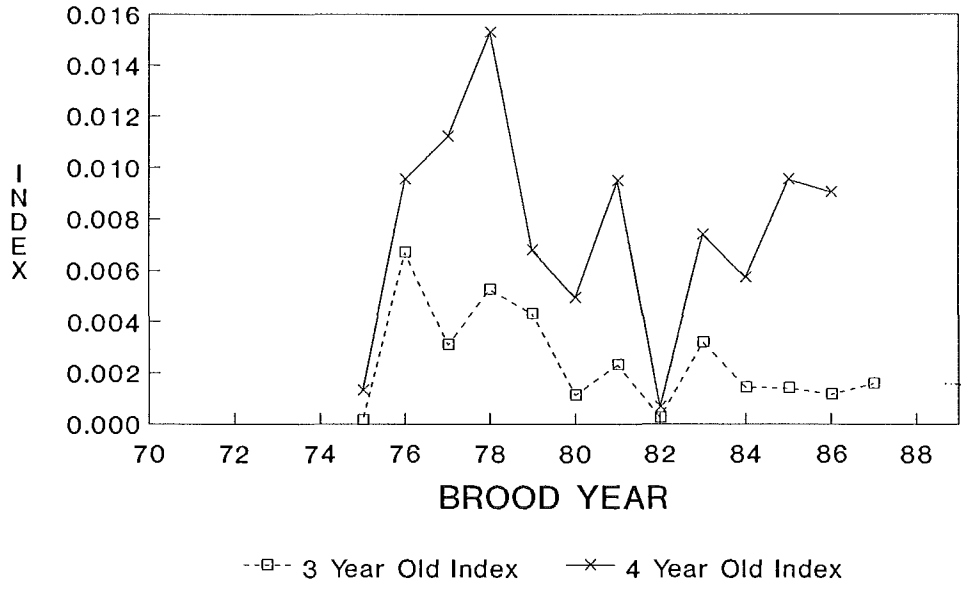
LEWIS RIVER WILD
INDEX OF SURVIVAL



WELLS HATCHERY SUMMER/FALL
INDEX OF SURVIVAL



WILLAMETTE SPRING
INDEX OF SURVIVAL



APPENDIX G

Annual Distribution of Reported Catch and Total Fishing Mortality by Stock

Snootli Creek (Central Coast) G-1
Kitimat (Central Coast) G-2
Lyons Ferry G-3

Stock: Snootli Creek (Central Coast)

Reported Catch Only

Catch Year	Fisheries with ceilings: All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
79	49.4%	17.3%	0.0%	21.7%	11.6%	0.0%	0.0%	0.0%	0.0%
80	25.4%	71.4%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%
81	33.2%	52.8%	0.0%	4.4%	9.6%	0.0%	0.0%	0.0%	0.0%
82	32.6%	62.7%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
83	47.5%	52.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
84	27.8%	72.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
85	37.7%	60.7%	0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
86	18.0%	82.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
87	24.8%	75.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
88	26.0%	73.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
89	16.8%	81.5%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
90	30.1%	69.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(79-90)	30.8%	64.3%	0.5%	2.4%	1.9%	0.0%	0.0%	0.0%	0.0%
(85-90)	25.6%	73.9%	0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%

Total Mortalities

Catch Year	Fisheries with ceilings: All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
79	37.1%	42.2%	0.0%	13.3%	7.4%	0.0%	0.0%	0.0%	0.0%
80	18.5%	79.4%	0.4%	1.2%	0.6%	0.0%	0.0%	0.0%	0.0%
81	39.5%	48.7%	0.2%	3.7%	8.0%	0.0%	0.0%	0.0%	0.0%
82	37.5%	58.0%	4.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
83	41.3%	58.3%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%
84	32.9%	67.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
85	35.8%	63.6%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%
86	18.0%	81.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
87	30.9%	69.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
88	29.7%	70.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
89	21.3%	76.9%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
90	33.5%	66.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(79-90)	31.3%	65.1%	0.6%	1.5%	1.4%	0.0%	0.0%	0.0%	0.0%
(85-90)	28.2%	71.3%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%

Stock: Kitimat (Central Coast)

Reported Catch Only

Catch Year	------Fisheries with ceilings------- All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
81	27.5%	67.8%	0.0%	4.4%	0.3%	0.0%	0.0%	0.0%	0.0%
82	43.8%	56.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
83	41.8%	58.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
84	58.3%	41.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
85	73.1%	26.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
86	17.0%	83.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
87	39.4%	60.5%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
88	59.2%	40.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
89	24.7%	75.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
90	43.8%	56.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-90)	42.9%	56.6%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
(85-90)	42.9%	57.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Total Mortalities

Catch Year	------Fisheries with ceilings------- All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
81	31.3%	64.9%	0.0%	3.6%	0.2%	0.0%	0.0%	0.0%	0.0%
82	30.5%	69.3%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
83	40.0%	60.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
84	64.4%	35.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
85	73.7%	26.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
86	17.0%	83.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
87	53.4%	46.5%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
88	60.2%	39.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
89	36.3%	63.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
90	55.8%	44.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
(81-90)	46.3%	53.3%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
(85-90)	49.4%	50.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Stock: Lyons Ferry

Reported Catch Only

Catch Year	Fisheries with ceilings: All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
88	4.1%	6.0%	27.3%	0.0%	0.1%	0.0%	14.6%	42.6%	5.3%
89	4.3%	9.7%	19.6%	0.0%	1.4%	0.9%	13.5%	40.4%	10.2%
90	7.0%	4.9%	20.5%	0.0%	0.0%	0.0%	14.9%	44.8%	7.8%
(88-90)	5.1%	6.9%	22.5%	0.0%	0.5%	0.3%	14.3%	42.6%	7.8%
(88-90)	5.1%	6.9%	22.5%	0.0%	0.5%	0.3%	14.3%	42.6%	7.8%

Total Mortalities

Catch Year	Fisheries with ceilings: All Alaska	All Nth/Cent	WCVI Troll	Total Geo St	Other Canada Net	Other Canada Sport	Other U.S. Troll	Other U.S. Net	Other U.S. Sport
88	4.5%	6.8%	28.7%	0.0%	0.4%	0.0%	14.7%	39.7%	5.1%
89	5.9%	10.7%	22.2%	0.0%	1.8%	0.8%	14.5%	35.2%	9.0%
90	9.9%	5.6%	22.2%	0.0%	0.0%	0.0%	15.4%	39.9%	7.0%
(88-90)	6.8%	7.7%	24.4%	0.0%	0.7%	0.3%	14.9%	38.3%	7.0%