

REGIONAL INFORMATION REPORT NO. 5J91-14



**Status of Western and Central Alaska Coho Salmon Stocks
and Interceptions of Coho Salmon in Fisheries South
of Unimak Island and in the Shumagin Islands**

Edited by

Doug Eggers

Larry Buklis

Beverly Cross

and

Bruce Barrett

November 1991

The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

Status of Western and Central Alaska Coho Salmon Stocks
and Interceptions of Coho Salmon in Fisheries South
of Unimak Island and in the Shumagin Islands

by

Doug Eggers, Larry Buklis, Beverly Cross, Bruce Barrett

Regional Information Report¹ No. 5J91-14

Alaska Department of Fish and Game
Division of Commercial Fisheries
Juneau, Alaska

November 1991

¹The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

ABSTRACT

Catches of coho salmon in western and central Alaska were low during the period, 1960 - 1978. Coho catches increased throughout western and central Alaska beginning in 1979, with average coho catches, 1979 - 1991, almost seven times those of the earlier period. These increases in catches appears to have resulted, in part, from reductions in interception western and central Alaska coho salmon by high seas salmon fisheries.

The status of all stocks of western and central Alaska coho salmon from Norton Sound to Upper Cook Inlet was reviewed. Catches are at or near historical maximum levels in all areas except the Nushagak and Togiak Districts, Bristol Bay. The available information on coho salmon escapements suggest that escapements are stable if not increasing in all of the other areas, and stocks appear to be healthy.

Coho salmon on the south side of the Alaska Peninsula are harvested from mid-July to early August in fisheries directed at other species of salmon. These coho catches occur primarily in mixed stock (i.e. cape fisheries) harvest areas well in advance of the time that coho enter terminal harvest areas. These catches during July and August are of maturing coho salmon that are migrating through these areas and occur in the south Unimak and Shumagin Islands areas. Average annual catches of coho salmon in these "intercept" areas, also greatly increased during 1979 - 1991; however the relative magnitude of the increased catches over the earlier period is greater for the "intercept" areas than for the more terminal harvest areas of western and central Alaska.

Trends in catches and fishing effort during July-August, within the recent period, 1979 - 1991 were examined in detail for each of the "intercept" areas. For the south Unimak area, catches of coho have increased due to increasing fishing effort. For the Shumagin Islands area, no significant increasing trend in catches of coho salmon has occurred, although salmon catches are variable and reflect variable fishing effort directed at variable runs of pink salmon. For the South Peninsula management area the bycatch of coho salmon is much higher in the "intercept" areas than in fisheries in other areas.

The potential for various coho stocks to be in the South Peninsula areas was evaluated based on whether the calculated timing of various western and central Alaska coho stocks in these areas coincided with the timing of coho catches in these areas. Based on these results it is highly likely that catches in the South Peninsula areas are a complex mixture of stocks, and potential exists for all western and central Alaska coho stocks to contribute to coho catches in these areas. However, timing information cannot be used to estimate the specific magnitude of stock composition and great caution should be exercised in attributing actual interception of particular stocks to the respective degree of coincidence in calculated timing and timing of catches in the South Peninsula areas.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iii
LIST OF FIGURES	v
INTRODUCTION	1
HISTORICAL ABUNDANCE OF WESTERN AND CENTRAL ALASKA COHO	1
COHO SALMON STOCK STATUS BY AREA	2
<i>Norton Sound, Yukon River, and Kuskokwim River</i>	2
<i>Bristol Bay</i>	4
<i>North Alaska Peninsula</i>	6
<i>South Alaska Peninsula</i>	6
<i>Aleutian Islands</i>	7
<i>Chignik</i>	7
<i>Kodiak</i>	8
<i>Upper Cook Inlet</i>	8
SOUTH ALASKA PENINSULA AREA COHO FISHERIES	9
<i>South Alaska Peninsula</i>	9
South Unimak	10
Shumagin Islands	10
CALCULATED TIMING OF VARIOUS WESTERN AND CENTRAL ALASKA STOCKS OF COHO SALMON IN THE SOUTH PENINSULA AREA	11
LITERATURE CITED	13

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Commercial coho salmon catches (thousands of fish) in western and central Alaska, by management area, for the years 1960 - 1991	14
2. Catches of coho salmon in metric tons for the North Pacific Region, 1960 - 1989, broken into 5 regional areas: 1. Southeast Alaska; 2. Prince William Sound and Cook Inlet, and 3. W. Alaska, Alaska Peninsula, Chignik and Kodiak; 4. Japanese high seas driftnet fisheries; and 5. U.S.S.R. coastal fisheries	15
3. Minimum estimates of Yukon River coho salmon escapement based upon passage estimates at the Pilot Station sonar site and up- river harvests, 1986 - 1989	16
4. Commercial coho salmon harvest by district and year, Bristol Bay, 1960-1991	17
5. Subsistence catch of coho salmon by district, Bristol Bay, 1969-1991	18
6. Escapement of coho salmon in the Nushagak and Togiak Districts, Bristol Bay, 1980-1991	19
7. North Alaska Peninsula coho salmon escapement, subsistence, and commercial catch, 1970-91	20
8. North Alaska Peninsula estimated total coho escapement, 1985-91	21
9. Chignik Bay District coho salmon escapement, catch, total run, and rate of exploitation, 1973 - 1991	22
10. Estimated total coho salmon escapement, catch, and total run, for the Kodiak management area, 1984-91	23
11. Coho salmon harvest (thousands of fish) by area and time for the South Peninsula management area	24

LIST OF TABLES (continued)

<u>Table</u>	<u>Page</u>
12. Pink salmon harvest (thousands of fish) by area and time for the South Peninsula management area	25
13. Weekly catches (thousands) of pink salmon, coho salmon, and ratio of coho salmon to pink salmon in the Shumagin Islands area fishery. Presented are values for years 1981- 1991, in addition to the average over years 1981 - 91	26
14. Travel times assumed for coho salmon migrating from South Peninsula fishing areas to various terminal harvest areas. Travel times based on recoveries of tagged chum and sockeye salmon released in the South Peninsula area during the 1987 June fishery	27
15. Timing statistics for coho salmon commercial catches in various terminal harvest areas	28
16. Timing statistics for coho salmon commercial catches during July and August in the south Unimak and Shumagin Islands areas	31

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. South Peninsula coho salmon catches (thousands of fish) for the years 1914 - 1991	32
2. Coho salmon catches (metric tons) in Alaska, 1960 - 1989, for: 1. Southeast Alaska; 2. Prince William Sound and Cook Inlet, and 3. W. Alaska, Alaska Peninsula, Chignik and Kodiak	33
3. Coho salmon catches (metric tons), 1960 - 1989, for: 1. W. Alaska, Alaska Peninsula, Chignik and Kodiak; 2. Japanese high seas driftnet fisheries; and 3. U.S.S.R. coastal fisheries	34
4. Coho salmon commercial harvest by area in the Arctic-Yukon-Kuskokwim region, 1975-1991	35
5. Commercial harvest of fall chum and coho salmon in the Yukon Area, 1975-1991	36
6. Coho salmon escapement to the Krogrukluk River in the Kuskokwim area, and to the Delta Clearwater River in the Yukon Area, 1975-1991	37
7. Coho salmon commercial catch in Bristol Bay, by district and year, 1960-1991	38
8. Map of the Chignik management area with statistical fishing districts and some prominent locations identified	39
9. Coho salmon catch, 1960-1991, for the Kodiak management area	40
10. Relationship between total season catch of coho salmon and total season catch of pink salmon in the South Peninsula management area salmon fisheries	41
11. South Peninsula fishing districts (stippled area are the Ikutan Bay section of the Southwestern District, Unimak District, and the Shumagin Section of the Southeastern District)	42
12. Average catch, 1979-88, of salmon by statistical week and by species for the south Unimak area	43

LIST OF FIGURES (Continued)

<u>Figure</u>	<u>Page</u>
13. Commercial salmon catch during July and August (thousands of fish) by species, 1979 - 1991, for the south Unimak area	44
14. Fishing effort (number of vessels fishing); by setnet, purse seine, and driftnet gear; during July and August for the south Unimak area, 1980 - 1990	45
15. Catch of coho salmon (thousands of fish); by setnet, purse seine, and driftnet gear; during July and August for the south Unimak area, 1980 - 1990	46
16. Commercial salmon catch during July and August (thousands of fish) by species, 1979 - 1991, for the Shumagin Islands area	47
17. Purse seine and set gillnet fishing effort (number of vessels fishing) during July and August for the Shumagin Islands area, 1979 - 1989	48
18. Purse seine and set gillnet catch of coho salmon (thousands of fish) during July and August, 1979 - 1989, for the Shumagin Islands area	49
19. Average catch of coho salmon, average catch of pink salmon, and average ratio of coho to pink salmon in the catches, by statistical week, for the Shumagin Islands area. Note that averages taken over years 1981 - 1991	50
20. Relationship between catch of coho salmon and catch of pink salmon during July and August, in the south Unimak and Shumagin Islands area salmon fisheries. Shown are years 1979 - 1991	51
21. Relationship between catch of coho salmon and catch of pink salmon during July and August. Shown are 1. combined south Unimak and Shumagin Islands area salmon fisheries and 2. other areas (i.e., Bay areas). Data plotted are years, 1979-1991	52
22. Timing of the central 90% of the commercial catch for various terminal harvest areas in western and central Alaska	53
23. Calculated timing of the central 90% of the run in the south Unimak area for various western and central Alaska coho stocks	54

LIST OF FIGURES (Continued)

<u>Figure</u>		<u>Page</u>
24.	Calculated timing of the central 90% of the run in the Shumagin Islands area for various western and central Alaska coho stocks	55

INTRODUCTION

There has been widespread concern over catches of coho salmon in fisheries in the areas south of the Alaska Peninsula. Catches of coho salmon in the South Peninsula fishery unit have increased markedly since 1979 (Table 1), with annual catches averaging 283 thousand, since 1979. In contrast to the recent high catches, catches averaged only 14 thousand during the period 1960 -1978. These catches of coho occur during mid-July to early August, and are of migrating fish spawning in other areas. This report provides information to assist the Board of Fisheries in its deliberation on South Peninsula coho issues.

This report reviews 1. historical abundance of western and central Alaska coho salmon, 2. effects of high seas fisheries on inshore coho catches, 3. current status of western and central Alaska coho stocks, 4. South Alaska Peninsula coho fisheries, and 5. potential stocks composition of South Peninsula catches based on run timing consideration.

HISTORICAL ABUNDANCE OF WESTERN AND CENTRAL ALASKA COHO

Since processing capacity for coho salmon fisheries in A-Y-K, Bristol Bay and the North Alaska Peninsula have only recently been fully developed, historical coho catches in those fisheries were not, necessarily, indications of low coho abundance. In contrast, the South Peninsula pink salmon fishery has been operating since the early part of this century. Consequently, the coho catches in the South Peninsula fishery is longest and most consistent indicator of the historical coho abundance in western and central Alaska (Figure 1). The coho catches were very high during the mid-1920's to the mid-1940's. Catches declined and were very low from the late 1950's through the late 1970's. Catches have been large since 1979 and have consistently exceeded the peak catches of the earlier period. If one assumes that the South Peninsula pink salmon fishery intercepts coho of western and central Alaska origin, then the abundance of coho in the inshore areas of western and central Alaska was very low during the 1960's and most of the 1970's.

To check the consistency of this pattern of inshore abundance of coho with those of other areas, catches of coho salmon, 1960 - 1989 were compared for five broad geographical areas (Table 2), including Southeast Alaska; Cook Inlet and Prince William Sound; Western Alaska, Alaska Peninsula, Chignik, and Kodiak; Japanese high seas salmon fisheries; and U.S.S.R. coastal fisheries. These data indicate that no significant increasing trend in (except for high catches 1982 -1986) in catches of coho, has occurred during the period, 1960 - 1989, for Southeast Alaska, Upper Cook Inlet, and Prince William Sound fisheries (Figure 2). Catches of coho salmon in U.S.S.R. coastal fisheries were also very stable during the period, 1960 - 1987 (Figure 3). In contrast, there has occurred a seven-fold increase in coho catches in Western Alaska, Alaska Peninsula, Chignik, and Kodiak fisheries from the early period 1960 - 1978, to the recent period since 1978 (Figure 2). Coincident with the increased coho catches in western and central Alaska

there occurred a parallel reduction in catches of coho salmon in Japanese high seas salmon fisheries (Figure 3). It is very significant that the combined catches of coho in fisheries west of Kodiak (Figure 3), have been stable during the period 1960 - 1987.

This pattern of catches suggests that the abundance of coho in the North Pacific region west of Southeast Alaska has been relatively stable, since 1960. Thus, the low inshore abundance of coho in western and central Alaska, prior to 1979, was likely due to interception of coho salmon bound for western and central Alaska in the Japanese high seas salmon fisheries.

This deduction is also consistent with research, to date, on origin of coho catches in high seas salmon fisheries, (Harris 1987). The few tag recoveries from the early INPFC tagging effort suggests that Asian stocks predominate throughout the pre-1977 mothership and landbased fishery areas, and that Alaskan stocks range only into the eastern sectors which were closed by the 1978 North Pacific Treaty Annex. However, this conclusion is very provisional, due to the paucity of data and the fact that many western and central Alaska coho stocks were not heavily exploited by inshore fisheries during the early INPFC tagging effort.

More recent research using scale pattern analysis techniques (Myers et al. 1981; Walker and Harris 1982; and Walker and Davis 1983) to estimate stock composition of landbased fishery catches, have showed that western and central Alaskan stocks of coho occurred farther to the west and southwest than the earlier tagging effort showed. The Alaskan stocks were predominant in the landbased area during 1981 and 1982. There are problems with the scale pattern analysis studies due to the lack of comprehensive collections of standard samples from Asian and some Alaskan stocks of coho salmon. These problems have been recently solved and new analyses of origins of high seas coho catches will be available during the next year. Harris (1987) concludes based on research through 1982 that major intermingling of Asian and Alaskan coho in the western north Pacific occurs primarily in areas which were excluded from the high seas fisheries by the 1978 North Pacific Treaty Annex. High seas interceptions of North American coho may have been considerable before 1978, especially by the landbased driftnet fishery and in some years by the mothership fishery. If Alaskan coho migrate west of 175° E, as suggested by scale pattern studies, there is opportunity for significant interception of Alaskan coho salmon. However, in the present area of the fisheries, the potential is much less than before 1978.

COHO SALMON STOCK STATUS BY AREA

Norton Sound, Yukon River, Kuskokwim Area

Coho salmon returns in AYK appear to be stabilizing in recent years following a period of general increase in the 1980's, although comprehensive run assessment programs are lacking. Coho salmon commercial fisheries are managed primarily based on commercial and test fishery catch statistics due to a general lack of adequate escapement information. Escapement

information obtained by aerial surveys of selected index areas is very incomplete due to poor weather, fall flooding, and inadequate funding for coho salmon monitoring. Some information is available for coho salmon based on sonar and weir projects. On the Kuskokwim River, commercial CPUE in District W-2 is an important escapement index.

The Kuskokwim Area, which includes the Kuskokwim, Kanektok, and Goodnews River districts, supports the largest commercial coho salmon fishery in AYK, followed by much smaller harvests in the Yukon and Norton Sound Areas (Table 1 and Figure 4). Commercial harvest in the Kuskokwim Area has increased from an average of 285 thousand coho salmon annually during 1977-81 to 532 thousand during 1987-91, while average annual harvest during these same periods has grown from 23 to 68 thousand in the Yukon Area, and from 21 to 45 thousand in the Norton Sound Area. Growth in harvest is due to the combined effects of fishery development and greater run abundance. Disparity between relatively higher harvests in even numbered years and lower harvests in odd numbered years in the Kuskokwim Area appears to be stabilizing at a level in excess of 500 thousand fish annually. However, the commercial harvest in some recent years has been associated with less than optimal escapement indices.

In the Kuskokwim and Norton Sound Areas coho salmon are the target species during August, but in the Yukon Area they overlap with more abundant fall chum salmon. Salmon management in the Yukon Area during the fall season is based largely on the status of fall chum salmon runs. In recent years coho salmon have accounted for a greater share of the Yukon Area fall season harvest due to increasing run sizes and catches of coho salmon (Figure 5).

A sonar project has been operated on the Yukon River near Pilot Station since 1986 to enumerate passage of all salmon species from June through late August or early September, but the project is terminated prior to the conclusion of the coho salmon migration. Minimum escapement estimates are obtained by subtracting the estimated upriver harvest from the Yukon River sonar passage estimates. The resulting escapement estimates are a minimum since coho salmon passage occurs after termination of the sonar project. These estimates ranged from a low of 104 thousand coho salmon in 1989 to a high of 172 thousand in 1990 (Table 3). Data for 1991 are under analysis and not yet available. A sonar project is in the development stage on the Kuskokwim River near Bethel, but estimates of coho salmon passage are not yet available.

A weir on the Kogrukluk River in the Kuskokwim Area, and boat surveys on the Delta Clearwater River in the Yukon Area provide some of the most complete historical information on coho salmon escapements. Escapement estimates for the Kogrukluk River weir during the period 1981-91 have ranged from a low of 8.5 thousand coho salmon in 1983 to a high of 40 thousand in 1982, with incomplete weir information for 1989 and 1990 (Figure 6). Weir passage counts for 1988 and 1991 fell short of the escapement objective of 25 thousand coho salmon. District W-2 CPUE indicates that, had the weir been fully operational in 1989 and 1990, the weir escapement objective would have been reached in 1989 but not in 1990. It should be noted that this is only one spawning stock in the vast Kuskokwim River drainage. Escapement indices for the Delta Clearwater River based upon boat surveys of the spawning grounds during the period 1975-91 have ranged from a low of 2 thousand coho salmon in 1976 to a high of 24 thousand

in 1991 (Figure 6). It should be noted that this is only one spawning stock in the vast Yukon River drainage.

Bristol Bay

The commercial harvest of coho salmon (Table 4) is documented back to 1893 in the Nushagak District. Catch records prior to 1923 reflect the period when traps were legal gear in Bristol Bay and late season fishing was extensive. With the elimination of traps in 1923 and the advent of late season closures for the protection of sockeye, the coho harvest was substantially reduced from 1923-53. Catches from 1954 through 1976 remained low, primarily due to the lack of late season markets in the Bay. Most salmon were still canned at the time and the low volume of the coho catch did not economically warrant keeping the large crews employed that were necessary to operate the canning lines. Beginning in 1977, late season markets became available in the form of freezer-processor ships. Those vessels were able to move freely between districts, and a healthy market for frozen coho resulted in increased prices paid to the fishermen and an expanded fishing effort.

The majority of the Bristol Bay coho harvest occurs in the Nushagak and Togiak Districts. However, there has been a noticeable decline in coho abundance in both the Nushagak and Togiak Districts since 1984 (Figure 7). The decline in coho abundance was particularly evident in 1991 when only 5,400 and 4,300 coho salmon were harvested in the Nushagak and Togiak Districts, respectively. During the same time period, Naknek-Kvichak, Egegik, and Ugashik Districts were experiencing above average harvests (Figure 7). Large catches in those areas were in part the result of increased fishing effort, and the availability of markets. A number of fishing vessels and processors moved out of the Nushagak and Togiak districts, where fishing time was reduced to achieve escapement goals, to avail themselves of the more liberal fishing schedule in the East side districts. Without quantifiable escapement data, it is not possible to determine whether the increased catches in those systems were the result of large runs or simply a higher rate of exploitation.

Sport harvests of coho have been documented through a statewide sport fish harvest questionnaire since 1977. Current sport coho harvests average 4,800 fish in the Naknek-Kvichak district, 100 fish in Egegik, 200 fish in Ugashik, 2,100 in Nushagak, and 1,400 in Togiak. In recent years there has been a substantial increase in effort and the resultant harvest in all districts, particularly the Naknek-Kvichak, Nushagak, and Togiak. A Bristol Bay coho salmon derby has generated much interest in recent years and the level of participation in this contest has increased each season.

Subsistence coho harvests (Table 5) from 1969 - 90 averaged 726 fish in the Naknek-Kvichak district, 331 in Egegik, 280 in Ugashik, 5,919 in Nushagak, and 1,111 in Togiak. With the increase in rural population, and the growth in popularity of sport mushing dog teams, there has been an increase in the subsistence harvest of coho salmon in all districts. The recent 10 year average (1981-91) coho subsistence harvest in Bristol Bay is 10,150. Because of the very poor

return of coho salmon to the Nushagak District in 1991, subsistence fishing was reduced from 7 to 3 days a week, on August 19.

Escapement data on coho salmon are very limited in most of the rivers in Bristol Bay. With the exception of the sonar project at Portage Creek in the Nushagak District, there is no daily measure of coho escapement on any of the other river systems. Therefore, fishery managers rely on aerial surveys to index the escapement. Because coho salmon tend to run in the fall of the year, surveys are often hampered by bad weather and resulting high muddy water. Some coho salmon migrate in glacially turbid rivers and surveys are further complicated by the duration of spawning which has been documented from August to early December. Most spawning areas have been identified. With the exception of the Nushagak River, escapement estimates are only an index of the abundance. Coho escapement data for the Nushagak and Togiak Districts are presented in Table 6.

For even years, in the Nushagak District, which is the primary producer of coho salmon in Bristol Bay, there is nearly a complete overlap in the run timing of the pink and coho salmon. The Bristol Bay even year pink run has been highly variable, with extremely low runs since the very large 1984 run. Recently it has been very difficult to harvest coho in excess of escapement needs while providing additional protection to these weak pink salmon run. This occurred in 1988, and the by-catch of pinks was reduced considerably by requiring the fleet to use 5 3/8 inch or larger gillnet gear. It is also conceivable that the coho run could be weak and the pink run strong. Full exploitation of a strong pink salmon run would be expected to negatively impact a weak coho run.

In the Nushagak, coho salmon tend to hold and mill in the commercial district for extended periods making them vulnerable to the harvest. Therefore even a short fixed fishing schedule can result in a high rate of exploitation and low escapement.

The provisional escapement goal of 150,000 coho salmon for Nushagak River was established in 1984. The provisional goal was based on estimated escapements that produced the large coho salmon runs of 1980 - 1984. Recent analysis of the more broadly based spawner-return information from 1980 - 91, suggest that 90,000 coho spawners would be optimum in the Nushagak River and would produce higher sustainable yields than the provisional goal. The Nushagak River coho escapement goal will be reviewed and finalized during the January, 1992 Board of Fisheries meeting. From 1980 - 91 the coho returns to the Nushagak River averaged 216,000, the return-per-spawner averaged 2.05, and the exploitation rate averaged 44%.

Coho salmon runs to Togiak District have declined since 1984. From 1980 - 91 in the Togiak District, coho runs averaged 133,000 fish, returns-per-spawner averaged 1.5, and the exploitation rate averaged 37%. Provisional escapement goals for the Togiak River (50,000) and the Kulukak River (15,000) were also established in 1984. Evaluation of available spawner-return data suggests that the provisional goals are within the range of the estimated optimal escapement goal.

Department biologists and the public are very concerned about the decline in coho salmon runs to the Nushagak and Togiak Districts. In addition, there is also considerable concern over the increased catches of coho salmon in the other Bristol Bay districts where estimates of escapements are not available.

North Alaska Peninsula

Coho salmon are the third most important salmon species, economically and numerically, on the North Peninsula. Commercial fishing on coho salmon virtually did not begin on North Peninsula coho stocks until 1948 and then only at limited locations (Shaul et al. 1991). In recent years (1985-91), the average catch has been about 196 thousand fish, which is an eight fold increase over the 1970-78 average (27 thousand) and a 50% increase above the 1979-84 average (151 thousand) catch (Table 7). Several factors have contributed to the increase including: (1) improved market conditions; (2) more effort; (3) higher stock abundance. The subsistence harvest has averaged 500 fish per year, since 1970 (Table 7).

Coho salmon generally enter the commercial fishery in the first week of August, peak during the last week of August and the first week in September, and are through by mid September. Based on the timing of escapement, which is similar among local stocks, the fishery is directed at local stocks of coho. More than eighty North Peninsula streams likely have coho escapement annually; the most important spawning areas are in the Nelson River, Ilnik Creek, Meshik River, and Cinder River drainages (Table 8).

Rough escapement estimates are available for recent years, (Table 8). These estimates are expanded peak aerial survey counts (i.e., 2.4x expansions) and are generally of poor quality due to the poor aerial survey conditions (i.e., bad weather and poor visibility) that typically occur in the North Peninsula area during the fall. The expanded coho escapement estimates are thought to be minimal estimates due to the protracted nature of coho runs and the potential for under-counting the coho escapement due to the poor conditions under which aerial surveys are conducted. Rates of exploitation have averaged 47 % during the period, 1985 - 1989 (Table 9), and indicate that North Peninsula coho runs may be under-harvested in some years.

The estimated total escapement to the North Peninsula has averaged 225 thousand for the years 1985-1991. The runs are stable if not increasing and appear to be healthy.

South Alaska Peninsula and Aleutian Islands

Coho salmon are believed to spawn throughout the South Alaska Peninsula and Aleutian Islands management area. There are 165 salmon spawning streams in the South Peninsula and many more in the Aleutian Islands area. Coho salmon are thought to spawn in most if not all of these streams. However, there are no very large coho producing river systems in the South Peninsula and Aleutian Islands management area.

These local stocks are harvested primarily from late-August to mid-September. Catches of coho salmon, during this period, in the South Peninsula management area have ranged from 6 to 30 thousand and averaged 17 thousand per year, 1979 -1991. Some areas are managed concurrent with late runs of pink salmon, which have similar run timing, while in other areas, fishing is directed at milling coho salmon. Fishing time is set based on run strength of both coho and pink salmon, however, fishing effort is often low during this period.

While coho escapement likely occurs in nearly all 165 South Peninsula salmon streams, none of the streams are considered major production areas. Because coho spawn late in the year, escapement surveys are often limited by weather, aircraft availability, and operating budget. Stream escapement counts obtained typically range from less than a hundred to a few thousand (less than 5,000) fish. Annual South Peninsula coho escapement (i.e. based on 1:2.4 expansion of counts of streams surveyed) since 1988, have ranged from 20 to 124 and averaged 65 thousand fish. Since every stream is not surveyed and repetitive surveys are not usually conducted, total escapement is very likely under-estimated. The year to year stability of coho escapement level in the South Peninsula areas is not known.

Aleutian Islands

Coho salmon are present in limited abundance in the Aleutian Islands. Because of this, there is no commercial coho catch, and escapement is not monitored.

Chignik

The Chignik commercial salmon management area encompasses all coastal waters and inland drainages of the northwest Gulf of Alaska between Kilokak Rocks and Kupreanof Point. The area includes the Chignik River system and approximately 90 other salmon producing streams. The management area is divided into five districts which are, from east to west, the Eastern, Central, Chignik Bay, Western and Perryville Districts (Figure 8). All species of Pacific Salmon are commercially harvested. Purse seines are the only legal gear type for the Chignik Area commercial salmon fishery. Typically, between 100 and 103 permit holders are active in the commercial salmon fisheries.

The coho salmon harvests have averaged 156 thousand during the period, 1979-91, (Table 1). Coho salmon normally enter the Chignik commercial fishery in a bimodal pattern. Early coho salmon appear in late July during the targeted pink and chum fishery and late coho salmon appear from the end of August through the remainder of the season. The early coho salmon are considered to be mixed local and non-local stocks and late coho salmon are considered local stocks.

Coho salmon spawn throughout the Chignik area, however, most local coho production comes from the Chignik Lakes system. These fish are primarily harvested from mid-August to the end

of the season in the Chignik Bay District. They are managed concurrent to second run sockeye which have similar timing. The amount of fishing time is based on the run strength of both coho and sockeye salmon. A portion of the coho escapement are enumerated at the Chignik weir. Total escapements (Table 9) were estimated by summing weir counts and post weir escapements, estimated from catch per unit effort (CPUE) data from the Chignik Lagoon fishery (Ruggerone 1989). Chignik Lake coho escapements are at least stable and may be increasing. Rates of exploitation are generally low and have averaged 45% during the period 1973 - 1991. These rates of exploitation suggest that Chignik coho salmon may be under-utilized in some years.

Kodiak

Coho salmon are primarily taken incidental to other species in the Kodiak area, except directed coho fisheries occur in terminal harvest locations from early August to late September. There have been dramatic increases in coho catches in recent years. Catches have averaged 33.6 thousand, 1950 - 1978, and have averaged 208 thousand per year since 1979 (Figure 9).

At least 171 of the 386 Kodiak salmon producing systems have runs of coho. Escapement estimates for Kodiak stocks of coho, 1984 - 1991, are given in Table 10. These estimates are based on weir counts, expanded weir counts, and expanded aerial survey counts. These escapement estimates are considered minimal because weirs must be taken out before the end of the coho run and aerial survey conditions are poor during the fall because of high water and poor visibility. Escapement levels have been relatively stable since 1984, and rates of exploitation have ranged from 33% to 61%, indicating that Kodiak coho runs may be under-utilized in some years. Note that the low exploitation rate for 1989 (1%) was the result of the *Exxon Valdez* oilpill. Because of the large catches and stable escapement levels the status of the Kodiak coho runs appears to be excellent.

Upper Cook Inlet

Upper Cook Inlet is one of the major producers of coho salmon in the state, with an annual commercial harvest averaging in excess of 300 thousand fish and an annual recreational harvest in excess of 100 thousand fish. Coho salmon are produced by nearly every stream draining into Cook Inlet with the Susitna River and Kenai River having the largest returns. Escapement is not currently measured in any of the major systems, due to budget limitations.

Because of the strong interest in coho salmon among recreational anglers, the Upper Cook Inlet Salmon Management Plan directs the Department to minimize the incidental harvest of the major coho salmon stocks. Because the major Upper Cook Inlet coho salmon runs overlap with runs of sockeye salmon and chum salmon, and the commercial fishery is directed at sockeye and chum salmon, meaningful reduction of the commercial coho salmon catch has been difficult, if not impossible, to achieve.

The current status of coho salmon appears to be excellent. Harvest in recent years are the highest in the history of the fishery and appear to be within sustained yield limits. Increased pressure from the growing southcentral Alaska recreational fisheries and an increasingly efficient commercial fishery, however, are causes for concern and development of escapement enumeration technologies and accompanying escapement objectives are considered necessary for sustained health of Cook Inlet coho salmon stocks.

SOUTH ALASKA PENINSULA AREA COHO FISHERIES

Coho salmon on the south side of the Alaska Peninsula are harvested in mid-July to early August in fisheries directed at other species of salmon. These coho catches occur primarily in mixed stocks (i.e., cape fisheries) harvest areas well in advance of the time that coho enter terminal harvest areas. The catches during July and August are of maturing coho salmon that are migrating through these areas.

South Alaska Peninsula

Coho salmon are caught incidental to pink salmon in the South Peninsula salmon fisheries during July and August (Figure 10). The bycatch rate of coho for the aggregate South Peninsula fishery was very low during the period, 1960 - 1978 (i.e., 0.0092 coho per pink or 108.6 pink per coho), and increased greatly since 1979 (i.e., 0.047 coho per pink or 21.2 pink per coho). This increase in coho salmon bycatch rate appears to reflect the greater abundance of coho in inshore areas, since 1979.

Migrating coho salmon are harvested mostly in two areas during July and August: 1. South Unimak Area, which consists of the Unimak District and the Ikatan Bay Section of the Southwestern District (Figure 11); and 2. Shumagins, which consists of the Shumagin Islands Section of the Southeastern District (Figure 11). Since 1979, an average of 93 % of the total annual harvest of coho salmon in the South Peninsula was caught during July and August. Of the July and August coho harvest, an average of 70%, 11%, and 12% were caught in the Shumagins, South Unimak, and other areas, respectively (Table 11). An average of 7% of the total harvest was caught during September and are considered local stocks.

An average of 73% of the total South Peninsula coho and 31% of the total South Peninsula pink salmon harvest came from the Shumagins area during July - August. The catches of pink salmon in the South Unimak area are a minor component, averaging 1% of the total South Peninsula pink salmon catch (Table 12).

South Unimak

The July - August catches of salmon from the South Unimak Area are dominated by chum and sockeye salmon during early July and by pink salmon during early August, (Figure 12). Catches are a mixed bag, with pink and chum salmon dominating in most years (Figure 13). During even years, the area is managed to obtain escapement of local pink salmon. However, openings are usually coincident with openings in other areas.

A small but increasing fraction of the South Peninsula July - August coho harvest occurs in the South Unimak area (Table 11). The magnitude of salmon catches in the South Unimak area depends on both abundance and level of fishing effort. There has been a noticeable increase in gill net fishing effort since 1979 (Figure 14). This increased effort has resulted from fishermen electing to move out of other traditional fishing areas primarily the Port Moller area. Increases in catches of coho salmon have accompanied this increased fishing effort (Figure 15).

Shumagin Islands

The July - August catches of salmon from the Shumagin Islands Area are dominated by pink salmon (Figure 16). Coho salmon are caught incidental to pink salmon. The fishery is managed to achieve pink salmon escapement goals and whenever pink salmon are abundant more fishing time is allocated and catches of coho salmon increase with the increasing catches of pink salmon. The magnitude of pink salmon catches in July in the Shumagin Islands area are important in-season indicators of pink salmon run strength. The fishery, during early July and in years of poor pink salmon runs is managed based on chum salmon catches.

The amount of purse seine permits fishing the Shumagin Islands area has been relatively stable, since 1979 (Figure 17). The number of gillnet permits fishing, however, has been increasing. Relatively few coho are harvested by gillnet fishermen in the Shumagin Islands area (Figure 18). Coho catches in the Shumagin Islands area have been variable. There has been no consistent trend in catches (i.e., catches are not increasing or decreasing), since 1979 (Figure 16). Variation in coho catches in the Shumagin Islands appears to be due to variable purse seine fishing intensity accompanying variable pink salmon run sizes.

On the average, the timing of coho and pink salmon in the Shumagins area is different, with coho earlier than pink salmon (Figure 19). During July, the ratio of coho to pink salmon in the Shumagin catches is generally much higher. The ratio decreases markedly during early August as pink salmon move into the area in great abundance. However, there is substantial variability between years in the relative timing of pink and coho catches in the Shumagins area (Table 13). For example, in 1982 the highest relative catches of coho salmon coincided with peak pink salmon catches.

The majority of coho salmon in the South Peninsula fisheries are harvested in cape fisheries that occur in July and early August in the South Unimak and Shumagin areas. The catches of coho

salmon were plotted against the catches of pink salmon for the South Unimak and Shumagin areas (Figure 20), and for the aggregate south Unimak and Shumagin area and other areas (Figure 21). The bycatch rate of coho salmon, expressed as ratio of pink salmon to coho salmon is very different for these areas. The bycatch rate for south Unimak, Shumagins is 3.1 and 8.8 pink salmon per coho salmon, respectively (Figure 20), and for aggregate south Unimak Shumagin and other areas is 7.8 and 107 pink salmon per coho salmon, respectively (Figure 21).

CALCULATED TIMING OF VARIOUS WESTERN AND CENTRAL ALASKA STOCKS OF COHO SALMON IN THE SOUTH PENINSULA AREA

There is no specific information on the stock composition of the coho catches in the south Peninsula and Chignik outside areas. There have been no tagging studies of coho salmon conducted in the areas of these fisheries. Because of the magnitude of the South Peninsula and Chignik July - August coho catches and the fact that the increase in these catches, beginning in 1978, is coincident with increases in catches throughout in western and central Alaska terminal harvest areas, it is thought that these catches are a mixture of western and central Alaska coho stocks.

Lacking specific stock composition, the potential for various coho stocks to be in this area was evaluated based on whether the calculated timing of various western and central Alaska coho stocks in the area of the South Peninsula and Chignik areas coincided with the timing of coho catches in these areas. The calculated run timing was made based on assumed travel times and the observed timing of catches in terminal harvest areas of these stocks.

The assumed travel times were those observed for sockeye and/or chum salmon (Table 14) in the 1987 South Peninsula tagging study (Eggers et al. 1991). The travel times were observed time elapsed from the date of release to the date capture in the respective terminal harvest area. Data were available for both the south Unimak and Shumagin release areas, which, generally, correspond to the area that coho are harvested in the July - August fishery.

Timing statistics (i.e., mean and standard deviation of run timing) were estimated for principal coho terminal fisheries from Upper Cook Inlet to Norton Sound, for the period 1979 - 1989 (Table 15). Timing statistics were also estimated for the south Unimak and Shumagin Islands (Table 16). The duration of the run was taken to be the time period of the central 90% of the time density (c.f. Mundy 1979). If run timing follows a normal distribution, then the central 90% of the run is the mean date plus or minus 1.67 standard deviations. The average time period, 1979 - 1989, that coho are in the terminal harvest area is plotted for the western and central Alaska coho stocks (Figure 23).

The calculated timing in the south Unimak and Shumagin was taken to be the timing in the terminal fishery lagged by the appropriate travel time. These were calculated for all major coho

stocks from Upper Cook Inlet to Norton Sound in south Unimak (Figure 24) and Shumagins (Figure 25).

The average timing of the early south Unimak coho catches is 7 days earlier than the Shumagin Islands early coho catches (Table 16). This pattern of timing is consistent with hypothesis that westward migrating stocks are dominant in the South Peninsula areas.

The calculated timing of various stocks in the South Peninsula areas illustrate: 1. For each of the coho interception areas there is a great overlap in the timing of western and central Alaska stocks, 2. The calculated timing is highly coincident with the timing of the coho catches in these areas. Based on these, results it is highly likely that catches in the South Peninsula areas are a complex mixture of stocks, and potential exists for all western and central Alaska coho stocks to contribute to coho catches in these areas. However, timing information cannot be used to estimate the specific magnitude of stock composition and great caution should be exercised in attributing actual interception of particular stocks to the respective degree of coincidence in calculated timing and timing of catches in the South Peninsula.

LITERATURE CITED

- Chapman, D.W. 1986. Salmon and steelhead abundance in the Columbia River in the nineteenth century. *Trans. Am. Fish. Soc.* 115:662-670.
- Eggers, D.M., K. Rowell, and B. Barrett. 1991. Stock Composition of sockeye and chum salmon catches in Southern Alaska Peninsula Fisheries in June. *Fishery Research Bulletin No. 91-01*. Alaska Department of Fish and Game, P.O. Box 3-2000, Juneau, AK. 99802. 49 p.
- Harris, C.K. 1988. Recent changes in the pattern of catch of North American salmonids by the Japanese high seas salmon fisheries. p. 41 - 65 in W.J. McNeil (ed.) *Salmon Production, Management, and Allocation: Biological, Economic, and Policy Issues*. Oregon State University Press, Corvallis, 194 p.
- Mundy, P.A. 1979. A quantitative measure of migratory timing illustrated by application to the management of commercial salmon fisheries. Ph.D. Dissertation, Univ. Wash., Seattle.
- Myers, K., R. Cook, R. Walker and C. Harris. 1981. The continent of origin of coho salmon in the Japanese landbased driftnet fishery area in 1979. (Document submitted to annual meeting of Int. N. Pac. Fish. Comm., 1981). Fisheries Research Inst., Univ. Washington, Seattle. 34 p.
- Ruggerone, G.T. 1989. Coho salmon predation on juvenile sockeye salmon in the Chignik Lakes, Alaska. Ph. D. thesis, University of Washington, Seattle.
- Shaul, A.N., J.N. McCullough, A.J. Quimby, R.S. Berceli, and M.E. Stopha. 1991. Alaska Peninsula and Aleutian Islands areas annual salmon and herring management report. Alaska Department of Fish and Game, Division of Commercial Fisheries, 211 Mission Road, Kodiak, AK 99615
- Walker, R. and C. Harris. 1982. The continent of origin of coho salmon in the Japanese landbased driftnet fishery area in 1980. (Document submitted to annual meeting of Int. N. Pac. Fish. Comm., 1982). Fisheries Research Inst., Univ. Washington, Seattle. 26 p.
- Walker, R. and N. Davis. 1983. The continent of origin of coho salmon in the Japanese landbased driftnet fishery area in 1981. (Document submitted to annual meeting of Int. N. Pac. Fish. Comm., 1983). Fisheries Research Inst., Univ. Washington, Seattle. 48 p.

Table 1. Commercial coho salmon catches (thousands of fish) in western and central Alaska, by management area, 1960-91.

YEAR	Management Area									S. Pen as % of Total
	KODIAK	CHIGNIK	S. PEN	N. PEN	B. BAY	KUSKO	YUKON	NRT. SD	TOTAL	
1960	54	7	2	43	16	5	0	0	127	1.6%
1961	28	3	10	24	20	5	3	14	107	9.4%
1962	54	1	16	39	39	13	23	9	194	8.2%
1963	57	9	16	40	41	16	6	17	202	7.9%
1964	35	2	13	36	36	29	2	0	153	8.5%
1965	26	9	34	34	8	12	0	2	125	27.2%
1966	67	15	6	37	33	23	19	6	206	2.9%
1967	10	9	2	46	53	58	11	3	192	1.0%
1968	56	2	31	64	93	154	13	7	420	7.4%
1969	48	18	10	49	81	110	15	7	338	3.0%
1970	66	15	32	26	14	62	13	4	232	13.8%
1971	22	14	16	8	12	10	12	3	97	16.5%
1972	16	19	8	9	13	24	22	1	112	7.2%
1973	3	22	6	26	57	152	37	9	312	1.9%
1974	13	12	9	24	43	180	17	2	300	3.0%
1975	23	53	0	28	46	110	3	5	268	0.0%
1976	23	35	0	26	26	112	5	7	234	0.0%
1977	27	17	2	34	107	264	39	4	494	0.4%
1978	48	20	60	63	94	247	26	7	565	10.6%
1979	140	99	356	112	294	309	17	31	1358	26.2%
1980	139	119	274	127	348	328	9	30	1374	19.9%
1981	121	78	162	155	376	279	24	32	1227	13.2%
1982	344	303	256	238	619	567	37	92	2456	10.4%
1983	157	61	127	75	128	249	13	50	860	14.8%
1984	229	110	310	200	590	830	82	68	2419	12.8%
1985	284	191	172	176	163	382	58	22	1448	11.9%
1986	167	115	227	202	170	737	47	36	1701	13.3%
1987	195	150	225	171	65	479	0	24	1309	17.2%
1988	303	370	505	234	203	624	100	37	2376	21.3%
1989	3	68	444	228	240	556	85	44	1668	26.6%
1990	293	130	307	193	100	445	46	57	1571	19.5%
1991	323	185	317	215	118	558	109	64	1889	16.8%
Avg., 1960-91	105	71	124	93	133	248	28	22	823	11.1%
Avg., 1960-78	36	15	14	35	44	83	14	6	246	6.9%
Avg., 1979-91	208	152	283	179	263	488	48	45	1666	17.2%

Table 2. Catches of coho salmon in metric tons (mt) for North Pacific region, broken into 5 regional areas:
 1. Southeast Alaska; 2. Prince William Sound and Cook Inlet; 3. W. Alaska, Alaska Peninsula,
 Chignik, and Kodiak; 4. Japanese high seas driftnet fisheries; and 5. U.S.S.R. coastal fisheries.

Year	Southeast Alaska	Cook Inlet, Prince William Sound	Western Alaska, Alaska Peninsula, Chignik, Kodiak	Japanese High Seas Driftnet	U.S.S.R. Coastal	Total
1960	2,400	1,573	358	6,000	1,690	12,022
1961	3,537	1,217	410	4,300	4,360	13,824
1962	4,347	1,955	606	8,400	4,580	19,888
1963	5,127	2,084	763	9,500	7,020	24,493
1964	5,820	3,106	577	12,500	1,140	23,143
1965	6,179	1,324	509	7,200	2,630	17,842
1966	4,898	1,697	712	4,700	3,140	15,147
1967	3,536	1,640	730	3,800	3,610	13,316
1968	5,528	2,597	1,384	5,600	3,160	18,269
1969	1,975	619	1,050	9,600	3,310	16,553
1970	2,641	1,922	834	5,400	4,510	15,306
1971	3,237	1,604	356	6,800	4,360	16,357
1972	4,800	730	381	7,500	1,910	15,320
1973	2,794	830	837	10,600	2,120	17,181
1974	4,269	755	790	9,700	3,910	19,425
1975	1,399	1,156	958	8,200	3,510	15,222
1976	2,882	1,342	837	7,600	3,470	16,131
1977	3,741	1,413	1,832	3,800	3,790	14,576
1978	5,207	1,879	1,975	5,700	2,370	17,131
1979	4,015	2,100	4,731	2,800	4,550	18,197
1980	3,652	2,053	4,482	3,700	2,260	16,147
1981	4,773	2,849	4,192	3,300	3,510	18,625
1982	7,011	5,296	8,809	5,000	3,700	29,815
1983	6,200	2,974	3,021	2,600	3,470	18,265
1984	7,366	3,878	8,930	3,900	4,660	28,734
1985	9,244	6,563	5,629	1,700	5,830	28,967
1986	9,533	3,689	5,306	1,000	4,880	24,409
1987	4,501	1,746	3,576	1,000	3,450	14,274
1988	3,487	3,570	8,151	600	---	---
1989	5,760	2,677	5,479	---	---	---

Table 3. Minimum estimates of Yukon River coho salmon escapement based upon passage estimates at the Pilot Station sonar site and upriver harvests, 1986-1991.

Year	Yukon Sonar Passage Estimate	Upriver Harvest ^a	Minimum Escapement Estimate ^b
1986	167,000	32,000	135,000
1987	228,000	74,000	154,000
1988	263,000	102,000	161,000
1989	169,000	65,000	104,000
1990	232,000	60,000	172,000
1991 ^c			

^a Upriver harvest includes commercial and estimated subsistence harvests in the Yukon River drainage upstream from the sonar site.

^b Minimum coho salmon escapement estimates are obtained by subtracting upriver harvest from the Yukon Sonar passage estimate. The sonar project is generally terminated at the tail end of the fall chum salmon run, with the coho salmon run still in progress. The resulting escapement estimates for coho salmon are therefore minimum estimates since coho salmon passage occurs after termination of the sonar project.

^c Data for 1991 are under analysis and not yet available.

Table 4. Commercial coho salmon harvest by district and year, Bristol Bay, 1960 - 1991.

Year	District					Total
	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	
1960	197	2,421	0	13,457	65	16,140
1961	426	3,533	16	16,653	5	20,633
1962	2,474	3,828	4,553	28,418	11	39,284
1963	6,823	910	2,743	29,648	1,138	41,262
1964	3,133	775	380	26,416	5,859	36,563
1965	3,053	945	713	2,851	521	8,083
1966	4,096	1,932	533	11,517	15,864	33,942
1967	1,175	1,044	1,901	31,517	18,159	53,796
1968	7,357	6,507	5,771	48,867	24,872	93,374
1969	16	13,333	8,777	35,795	27,282	85,203
1970	66	7,027	1,695	3,675	2,027	14,490
1971	87	1,879	469	7,626	2,648	12,709
1972	281	4,906	0	3,355	8,036	16,578
1973	255	2,635	2,307	28,709	23,136	57,042
1974	785	1,341	4,001	12,569	25,049	43,745
1975	43	951	4,595	7,342	33,350	46,281
1976	1,195	2,321	3,561	6,768	12,791	26,636
1977	2,878	2,685	3,884	52,567	45,201	107,215
1978	913	2,256	2,024	44,740	44,338	94,271
1979	12,356	15,148	17,886	129,606	119,403	294,399
1980	7,802	22,537	19,419	147,726	151,000	348,484
1981	1,229	32,759	30,220	220,290	29,207	313,705
1982	10,586	74,814	50,979	349,668	133,765	619,812
1983	11,396	25,954	7,816	77,224	5,711	128,101
1984	6,077	75,736	68,451	263,629	176,396	590,289
1985	10,474	32,667	60,815	20,230	38,636	162,822
1986	8,835	33,607	25,770	55,999	45,295	169,506
1987	5,274	30,793	14,785	13,263	1,292	65,407
1988	29,988	49,023	52,355	52,706	18,468	202,540
1989	22,668	49,175	33,942	77,077	56,972	239,834
1990	13,403	44,275	31,731	7,447	2,719	99,575
1991	16,517	46,487	45,048	5,399	4,262	117,713
1960-69 Avg.	2,875	3,523	2,539	24,514	9,378	42,828
1970-79 Avg.	1,886	4,115	4,042	29,696	31,598	71,337
1980-91 Avg.	12,021	43,152	36,778	107,555	55,310	254,816

Table 5. Subsistence catch of coho salmon by district, Bristol Bay, 1969-1991.

Year	District					Total
	Naknek-Kvichak	Egegik	Ugashik	Nushagak	Togiak	
1969	400	0	200	7,100	0	7,700
1970	200	0	0	900	0	1,100
1971	100	0	100	2,300	0	2,500
1972	100	100	300	1,000	0	1,500
1973	500	100	600	2,200	0	3,400
1974	200	0	500	4,700	1,800	7,200
1975	200	0	1,200	4,300	2,800	8,500
1976	600	0	300	2,100	500	3,500
1977	300	200	500	4,500	1,100	6,600
1978	300	200	900	2,500	500	4,400
1979	1,200	100	100	5,200	700	7,300
1980	800	0	200	5,100	1,200	7,300
1981	1,100	0	200	8,700	2,200	12,200
1982	1,000	0	300	8,900	1,300	11,500
1983	900	0	100	5,200	800	7,000
1984	600	300	200	8,100	3,800	13,000
1985	1,103	203	143	6,100	1,500	9,049
1986	650	319	335	9,400	500	11,204
1987	1,106	284	272	6,200	1,600	9,462
1988	813	333	330	5,223	792	7,491
1989	1,927	414	214	8,679	976	12,210
1990	726	331	280	5,919	1,111	8,367
1969-79 Avg.	373	64	427	3,345	673	4,882
1980-90 Avg.	975	199	234	7,047	1,434	9,889

Table 6. Escapement of coho salmon in the Nushagak and Togiak Districts, Bristol Bay, 1980-91.^a

Year	Nushagak District	Togiak District
	Escapement ^a	Escapement
1980	232,000	96,000 ^c
1981	180,000 ^b	61,000 ^d
1982	234,000	81,000 ^c
1983	51,000	^e
1984	171,000	104,000 ^f
1985	89,500	61,300 ^g
1986	52,800	30,200 ^c
1987	20,200	64,900 ^h
1988	131,101	86,330 ⁱ
1989	84,706	^e
1990	162,853	67,449 ⁱ
1991	41,153	
12 Year Average	120,900	72,400 ^j

- a Escapement estimates based on data collected from sonar enumeration and on aerial surveys of the spawning grounds; Sonar enumeration has not always covered the complete season; in these cases a proportional method was used to estimate escapement after the sonar operation terminated.
- b Sonar enumeration precluded by lack of funding; escapement was estimated from mean exploitation rates from 1980 and 1982-84.
- c Includes Togiak and Kulukak River drainages.
- d Includes Togiak, Kulukak, Ungalikthluk/Kukayachagak and Nunavachak drainages.
- e Aerial escapement estimate precluded by adverse weather and water conditions.
- f Togiak, Kulukak, Slug, Osviak and Matogak River drainages.
- g Togiak, Kulukak, Quigmy, Matogak and Osviak drainages.
- h Estimate of Togiak River drainage derived from sonar enumeration (USFWS) in conjunction with aerial surveys of Kulukak, Osviak, Matogak, Quigmy and Ungalikthluk drainages.
- i Togiak, Kulukak, Slug, Osviak, Matogak, Quigmy, Negukthlik and Ungalikthluk.
- j Average of 9 years

Table 7. North Alaska Peninsula coho salmon escapement, subsistence, and commercial catch, 1970-91. Values in thousands of fish.

Year	Escapement	Subsistence	Commercial Catch	Total Run	Rate of Exploitation
1970	-	1	26	-	-
1971	-	1	8	-	-
1972	-	1	10	-	-
1973	-	1	27	-	-
1974	-	1	24	-	-
1975	-	0	28	-	-
1976	-	0	26	-	-
1977	-	0	34	-	-
1978	-	0	63	-	-
1979	-	0	113	-	-
1980	-	1	128	-	-
1981	-	1	155	-	-
1982	-	2	238	-	-
1983	-	1	75	-	-
1984	-	1	199	-	-
1985	111	0	168	279	60.2%
1986	164	0	164	328	50.1%
1987	196	0	172	368	46.8%
1988	160	0	234	394	59.4%
1989	258	1	228	487	47.0%
1990	221	1	193	414	46.6%
1991	268	1	215	483	44.5%
Average	197	0.6	115	393	50.7%

Table 8. North Alaska Peninsula estimated total coho salmon escapement, in thousands of fish, 1985-91.

Location		Year							Average
		1985	1986	1987	1988	1989	1990	1991a	
Nelson Lagoon	/b	18	57	67	42	77	72	79	59
Ilnik Lagoon	/c	36	60	28	52	64	58	65	52
Meshik River	/d	40	19	69	42	65	46	55	48
Cinder River	/e	13	12	6	24	15	7	22	14
Other		4	16	25	0	38	38	47	24
Total		111	164	196	160	258	221	268	197

a/ All 1991 escapement numbers are preliminary.

b/ Nelson Lagoon includes: David's River, Caribou River, Sapsuk River, Hoodoo Lake, Petterson Creek, and Coastal Lake escapements.

c/ Ilnik Lagoon includes: Ocean River, Willie Creek, Ilnik Estuary, Ilnik Lagoon, and Unangashak River.

d/ Meshik River includes the entire drainage.

e/ Cinder River includes: Cinder River and Mud Creek.

Table 9. Chignik Bay District coho salmon escapement, catch, and run in thousands of fish, 1973-91.

Year	Escapement	Commercial Catch	Total Run	Rate of Exploitation
1973	42	21	63	33.3%
1974	35	11	46	23.9%
1975	35	52	87	59.8%
1976	41	34	75	45.3%
1977	43	17	59	28.8%
1978	47	14	61	23.0%
1979	122	43	165	26.1%
1980	68	47	115	40.9%
1981	32	63	95	66.3%
1982	108	127	235	54.0%
1983	29	30	58	51.7%
1984	64	70	134	52.2%
1985	157	156	313	49.8%
1986	107	59	167	35.3%
1987	102	77	179	43.0%
1988	148	92	240	38.3%
1989	80	68	148	45.9%
1990	44	60	104	57.7%
1991	53	56	109	51.4%
Average	71	58	129	45

Source 1973-88 data: Ruggerone (1989)

Source 1988-91 data: Method developed by Parker and Rogers (1984)

Table 10. Estimating total coho salmon escapement, catch, and run, in thousands of fish, for the Kodiak Management Area, 1984-91.

	Year			Year				
	1984	1985	1986	1987	1988	1989	1990	1991
Escapement a/ Systems With Weirs:								
Karluk	16	38	28	46	13	25	14	35
Red River	2	33	17	16	29	13	29	43
Dog Salmon	1	4	5	8	6	7	7	9
Upper Station	3	5	4	3	5	7	10	6
Akalura	a/	5	3	2	6	4	4	8
Saltery	a/	4	12	11	8	7	3	12
Buskin River	a/	9	11	11	8	10	7	10
Litnik	8	15	5	16	11	16	13	14
Pauls Bay	4	10	10	5	6	8	4	11
Index Escapement b/ Estimated Total	44	124	96	119	92	97	91	147
Escapement c/ Total Catch	145	404	312	388	301	317	218	479
Run	230	284	169	193	302	3	293	323
Harvest Rate (%)	375	689	481	581	603	320	511	802
	61	41	35	33	50	1	57	40

a/ The weir counts of coho escapement include an estimate of fish passing after weir removal. The post-weir escapement components were calculated by the rate of escapement count change for the last few weeks each weir was operated. The Akalura 1985 coho escapement was determined using the 1986-89 mean escapement distribution. Missing 1984 counts were estimated using the 1985-89 mean escapement distribution. Pauls Bay escapement for 1991 was determined from the average 1984-90 escapement distribution. Karluk and Red River escapements in 1991 are aerial survey counts.

b/ The indexed escapement number is the sum of the coho escapement counted through nine weirs.

c/ The total estimated escapement is the indexed escapement expanded by a factor of 3.26 which is based ADF&G work in 1986 (Holmes 1990).

Table 11. Coho salmon harvests (thousands of fish) by area and time for South Peninsula Management Area.

Year	July - August Harvest								Total South Peninsula Harvest
	South Unimak		Shumagin		Other Areas		September Harvest		
	Catch	%	Catch	%	Catch	%	Catch	%	
1979	0	0%	313	88%	24	7%	20	6%	357
1980	1	0%	233	85%	10	4%	30	11%	274
1981	1	1%	127	78%	15	9%	19	12%	162
1982	26	10%	206	80%	14	5%	10	4%	256
1983	12	9%	87	68%	14	11%	15	12%	128
1984	63	20%	210	68%	26	8%	11	4%	310
1985	28	16%	109	63%	21	12%	15	9%	173
1986	25	11%	200	85%	5	2%	6	3%	236
1987	33	15%	153	68%	17	8%	22	10%	225
1988	85	17%	351	70%	50	10%	19	4%	505
1989	101	23%	243	55%	87	20%	13	3%	444
1990	46	15%	181	59%	56	18%	23	7%	307
1991	11	3%	144	45%	142	45%	20	6%	317
Average	33	11%	197	70%	37	12%	17	7%	284

Table 12. Pink salmon harvests (thousands of fish) by area and time for South Peninsula Management Area.

Year	July - August Harvest						September Harvest		Total South Peninsula Harvest
	South Unimak		Shumagin		Other Areas		Catch	%	
	Catch	%	Catch	%	Catch	%			
1979	0	0%	2,050	31%	4,357	66%	164	2%	6,571
1980	63	1%	1,566	20%	4,634	58%	1,700	21%	7,962
1981	0	0%	1,372	27%	3,201	64%	463	9%	5,036
1982	51	1%	1,616	24%	3,384	50%	1,684	25%	6,735
1983	28	1%	887	31%	1,857	66%	56	2%	2,828
1984	319	3%	1,808	16%	8,506	73%	956	8%	11,589
1985	43	1%	1,645	37%	2,641	60%	105	2%	4,434
1986	75	2%	1,495	37%	2,168	54%	294	7%	4,032
1987	0	0%	547	45%	643	53%	19	2%	1,209
1988	203	3%	3,314	47%	3,246	46%	282	4%	7,045
1989	104	1%	2,027	28%	4,962	68%	199	3%	7,293
1990	63	2%	1,107	39%	730	25%	965	34%	2,865
1991	7	0%	2,160	20%	7,830	74%	620	6%	10,617
Average	73	1%	1,661	31%	3,705	58%	577	10%	6,017

Table 13. Weekly catches (thousands) of pink salmon, coho salmon, and ratio of coho salmon to pink salmon in the Shumagan Islands area fishery. Presented are values for years 1981 - 1991, in addition to the average over years 1981-91.

Date	1981			1982			1983			1984			1985			1986		
	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk												
7/6	30	2	0.07	90	1	0.02	12	3	0.26	77	5	0.07	14	1	0.04	38	9	0.24
7/13	31	16	0.53	201	18	0.09	17	12	0.70	101	28	0.28	7	3	0.45	68	53	0.78
7/20	32	15	0.48	284	32	0.11	61	25	0.40	224	43	0.19	144	90	0.63	144	53	0.37
7/27	302	29	0.09	608	95	0.16	361	33	0.09	580	86	0.15	179	28	0.16	368	45	0.12
8/3	449	36	0.08	229	40	0.18	329	7	0.02	519	41	0.08	621	41	0.07	564	31	0.05
8/10	348	9	0.03	206	19	0.09	121	7	0.06	173	5	0.03	510	13	0.03	316	9	0.03
8/17	172	19	0.11	0	0	—	0	0	—	113	2	0.02	153	3	0.02	0	0	—
Date	1987			1988			1989			1990			1991			1981-91 Average		
	Pink	Coho	Co/Pk	Pink	Coho	Co/Pk												
7/6	17	1	0.04	15	1	0.04	50	9	0.18	0	0	0.00	9	0	0.00	30	2	0.08
7/13	21	13	0.61	16	5	0.35	63	14	0.22	25	10	0.39	2	1	0.56	49	16	0.33
7/20	95	67	0.71	240	96	0.40	36	10	0.26	28	14	0.51	16	8	0.49	127	44	0.35
7/27	92	53	0.57	392	93	0.24	653	108	0.17	288	52	0.18	320	68	0.21	349	58	0.17
8/3	153	17	0.11	1039	68	0.07	790	76	0.10	536	68	0.13	785	30	0.04	522	38	0.07
8/10	0	0	—	922	46	0.05	397	24	0.06	228	22	0.09	462	8	0.02	328	14	0.04
8/17	164	2	0.01	712	37	0.05	37	3	0.07	2	0	0.13	474	30	0.06	179	9	0.05

Table 14. Travel times assumed for coho salmon migrating from South Peninsula fishing areas to various terminal harvest area. Travel times based on recoveries of tagged chum and sockeye salmon released in the South Peninsula area during the 1987 June fishery.

Area	South Unimak			Shumagin Islands			Species Used
	Mean (days)	Stand. Dev.	Sample Size	Mean (days)	Stand. Dev.	Sample Size	
Norton Sound	23.3	4.1	7	28.8	5.9	4	Chum and Sockeye
Yukon (Y1) /1	20.4	---	---	26.9	---	---	
Kuskokwim (W1)	21.7	5.8	94	24.9	6.6	45	Chum Salmon
Togiak	20.9	8.3	67	22.7	7.6	20	Chum Salmon
Nushagak	17.0	3.8	131	20.2	3.4	38	Chum Salmon
Naknek-Kvichak	15.8	3.7	378	19.4	4.7	61	Chum and Sockeye
Egegik	14.6	3.8	279	17.4	3.9	37	Chum and Sockeye
Ugashik	15.9	4.6	107	17.8	3.9	15	Chum and Sockeye
Bristol Bay Aggregated	18.0	5.8	242	21.1	6.4	80	Chum Salmon
North Peninsula (Northern)	15.6	7.8	108	20.1	6.2	28	Chum and Sockeye
Chignik	15.8	5.7	33	16.6	9.1	50	Chum and Sockeye
Kodiak Aggregated	22.8	3.2	6	23.9	10.6	15	Chum and Sockeye
Upper Cook Inlet Drift	23.3	6.9	3	30.8	7.5	15	Chum and Sockeye

1/ Due to very small sample sizes for Yukon River recoveries, travel times were taken to be the average of travel times observed for Norton Sound and Kuskokwim River.

Table 15. Timing statistics for coho salmon commercial catches in various terminal harvest areas.

Year	Norton Sound			Yukon (Y1) /1			Kuskokwim (W1)			Togiak			Nushagak		
	Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD	
1979	8/09	222	10.5	---	---	---	8/10	223	7.1	8/23	236	10.3	8/03	216	8.0
1980	8/16	229	7.6	---	---	---	8/16	229	6.7	8/30	243	8.2	8/07	220	6.9
1981	8/15	228	7.8	---	---	---	8/16	229	7.3	8/22	235	5.2	8/06	219	8.5
1982	8/14	227	9.6	---	---	---	8/14	227	8.1	8/21	234	5.8	8/03	216	8.5
1983	8/11	224	9.1	---	---	---	8/14	227	7.2	8/23	233	9.6	8/13	226	11.1
1984	8/12	225	11.5	---	---	---	8/11	224	8.3	8/21	234	9.2	7/31	213	7.9
1985	8/16	229	9.5	---	---	---	8/11	224	6.9	8/22	232	7.8	7/27	209	3.2
1986	8/14	227	9.4	8/22	235	9.3	8/12	225	7.1	8/21	231	8.0	7/30	212	4.3
1987	8/15	228	8.4	8/23	236	6.7	8/17	230	7.2	8/11	224	6.0	8/02	215	3.4
1988	8/14	227	9.9	8/24	237	4.8	8/11	224	7.6	8/22	232	10.8	8/04	217	7.2
1989	8/10	223	9.6	8/22	235	8.9	8/10	223	7.5	8/21	231	7.8	7/30	212	7.7
Average	8/13	226	9.3	8/23	236	7	8/13	226	7.4	8/20	233	8.1	8/03	216	7.0

/1 Run timing based on Yukon River sonar counts of coho salmon. Timing of salmon passage was adjusted to compensate for the 3-day migration time from Y1 to the sonar site.

Table 15 (continued). Timing statistics for coho salmon commercial catches in various terminal harvest areas.

Year	Naknek/Kvichak			Egegik			Ugashik			Bristol Bay			North Peninsula		
	Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD	
1979	7/13	195	16.1	8/05	218	18.17	8/24	237	9.3	8/12	225	15.5		---	---
1980	8/10	223	11.4	8/18	231	8.75	9/01	245	10.2	8/19	232	15.5	8/31	244	6.6
1981	8/05	218	5.9	8/12	225	6.39	8/26	239	9.4	8/10	223	10.7	8/30	243	8.4
1982	8/09	222	9.9	8/16	229	9.39	8/24	237	7.9	8/11	224	11.8	8/29	242	7.3
1983	7/17	199	14.3	8/15	228	14.98	8/24	237	6.4	8/12	225	14.9	8/26	239	7.8
1984	7/29	211	14.9	8/09	222	15.38	8/24	237	8.8	8/10	223	14.2	8/27	240	11.0
1985	8/07	220	7.8	8/14	227	10.2	8/22	235	9.2	8/16	229	12.2	8/28	241	11.1
1986	8/11	224	11.7	8/13	226	10.2	8/14	227	8.7	8/10	223	12.2	8/27	240	9.4
1987	8/19	232	8.1	8/17	230	6.79	8/24	237	7.3	8/15	228	9.8	8/29	242	7.8
1988	8/09	222	8.2	8/18	231	10.8	8/25	238	9.3	8/15	228	12.4	8/27	240	8.9
1989	8/06	219	7.9	8/14	227	10.5	8/21	234	8.1	8/11	224	12.6	8/28	241	9.5
Average	8/03	217	10.6	8/14	227	11.1	8/24	237	8.6	8/13	226	12.9	8/28	241	8.8

Table 15 (continued). Timing statistics for coho salmon commercial catches in various terminal harvest areas.

Year	Chignik Lagoon			Kodiak			Upper Cook Inlet		
	Mean (Coded)	SD		Mean (Coded)	SD		Mean (Coded)	SD	
1979	8/19	232	13.7	8/18	231	20.1	7/26	208	11.7
1980	8/26	239	10.7	8/22	235	14.8	7/28	210	10.3
1981	8/21	234	9.9	8/19	232	14.2	7/26	208	10.5
1982	9/30	243	14.8	8/25	238	13.2	7/31	213	13.4
1983	8/25	238	9.1	8/23	236	16.6	7/24	206	11.7
1984	8/28	241	9.1	8/21	234	16.1	7/26	208	13.8
1985	9/01	245	7.6	8/26	239	13.6	7/29	211	13.3
1986	8/29	242	7.7	8/17	230	17.7	7/21	203	12.6
1987	9/02	246	7.7	8/20	233	17.0	7/28	210	12.8
1988	9/02	246	10.6	8/13	226	13.9	7/28	210	13.7
1989	9/09	253	7.1	---	---	---	8/03	216	12.4
Average	8/29	242	9.8	8/20	233	15.7	7/27	209	12.4

Table 16. Timing statistics for commercial catches during July and August in the south Unimak, Shumagin Islands, and Chignik outside areas.

Year	South Unimak Island			Shumagin Islands		
	Mean	Coded Mean	SD	Mean	Coded Mean	SD
1979	---	---	---	---	---	---
1980	6/21	173	6.8	7/25	207	5.6
1981	7/07	189	5.1	7/30	212	10.9
1982	7/25	207	11.4	7/28	210	7.1
1983	7/17	199	9.5	7/22	204	8
1984	7/23	205	9.9	7/23	205	8
1985	7/27	209	7.8	7/28	210	9
1986	7/25	207	6.8	7/22	204	8.6
1987	7/24	206	6.6	7/24	206	6.4
1988	7/26	208	7.4	7/29	211	9.8
1989	7/23	205	7.8	7/28	210	8.6
Average	7/19	201	7.9	7/26	208	8.2

South Peninsula Coho Salmon Catches

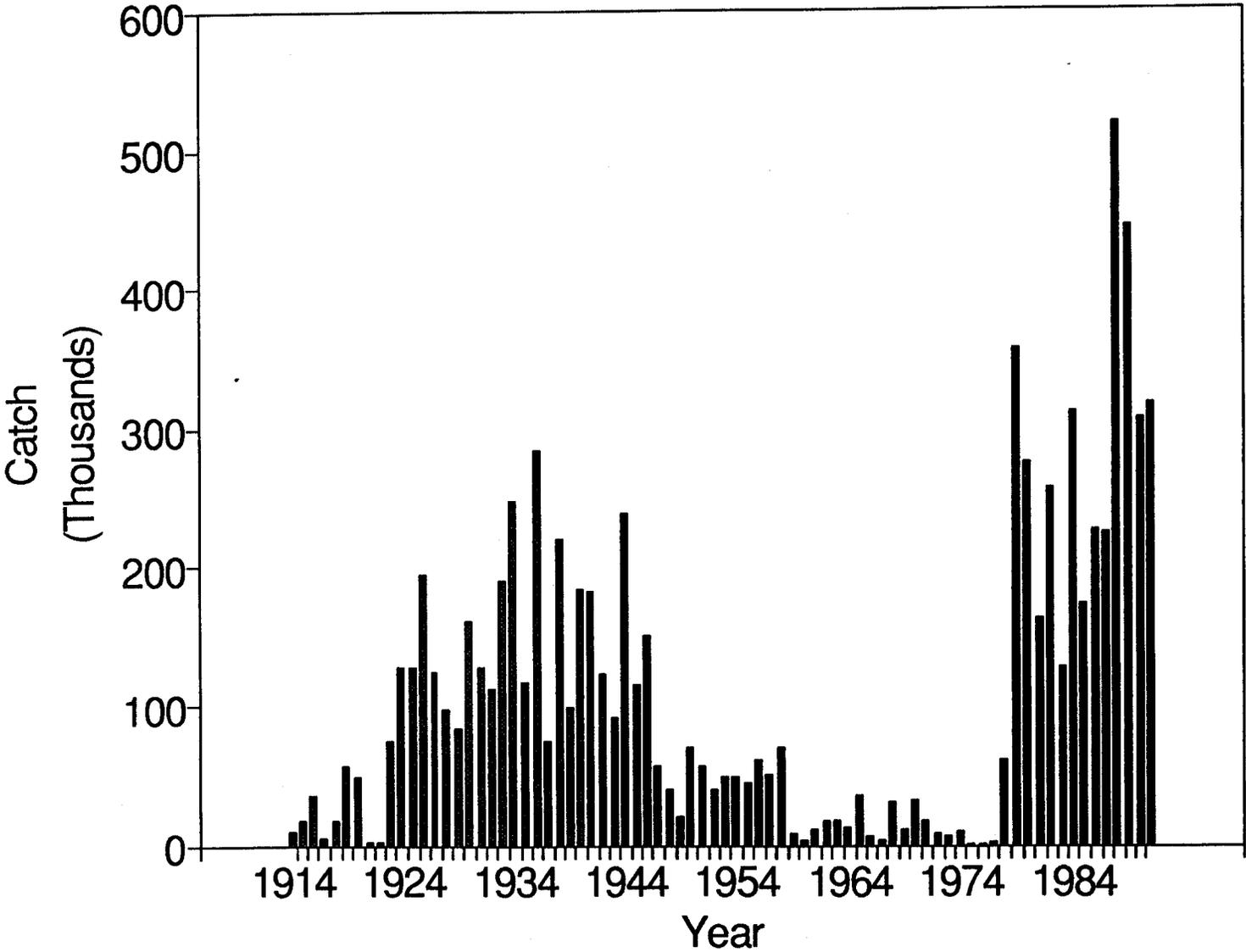


Figure 1. South Peninsula coho salmon catches (thousands of fish) for the years 1914--1991.

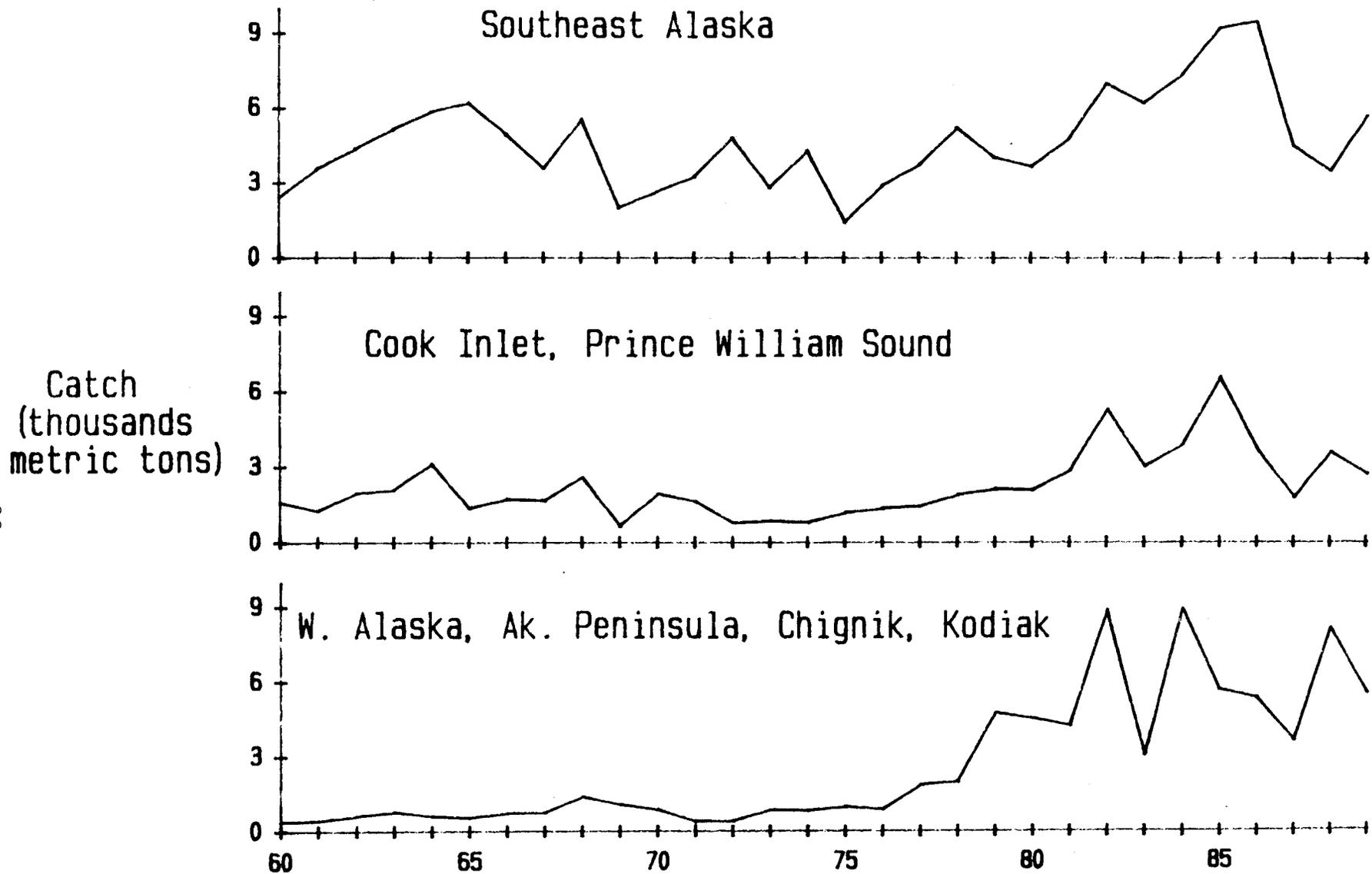


Figure 2. Coho salmon catches (metric tons) in Alaska, 1960 - 1989, for: 1. Southeast Alaska; 2. Prince William Sound and Cook Inlet, and 3. W. Alaska, Alaska Peninsula, Chignik, and Kodiak.

North Pacific Coho Salmon Catches

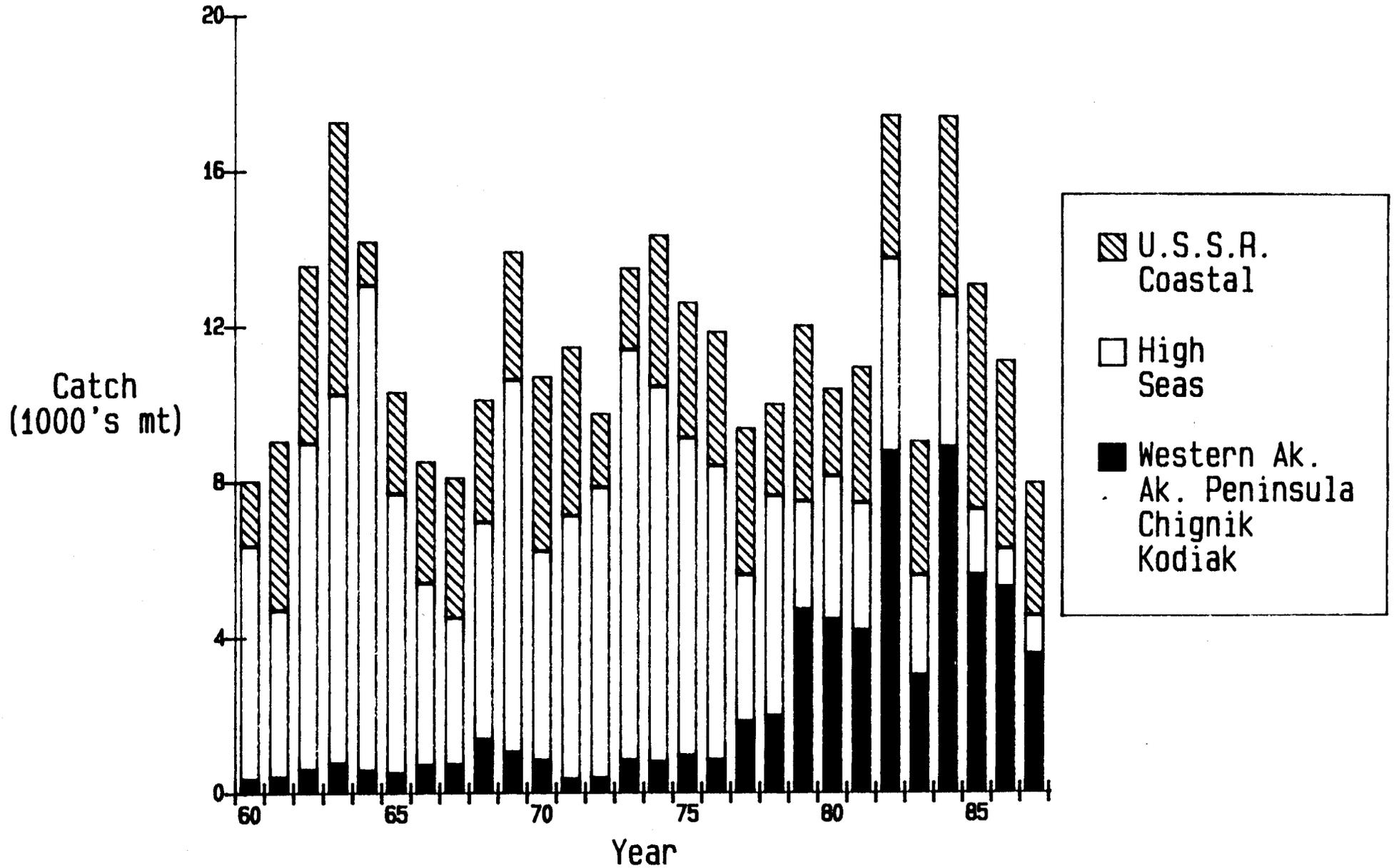
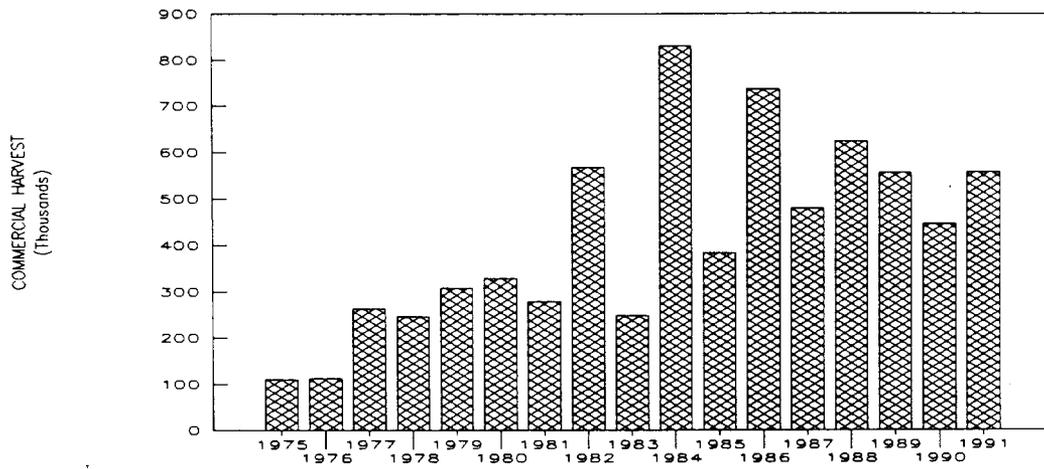
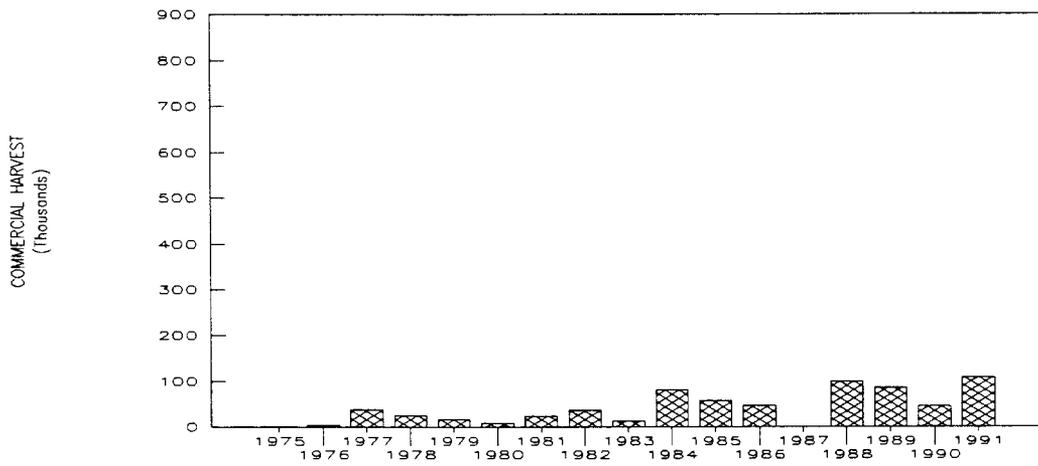


Figure 3. Coho salmon catches (metric tons), 1960 - 1989, for: 1. W. Alaska, Alaska Peninsula, Chignik, and Kodiak; 2. Japanese high seas driftnet fisheries; and 3. U.S.S.R. coastal fisheries.

KUSKOKWIM AREA COMMERCIAL COHO HARVEST



YUKON AREA COMMERCIAL COHO HARVEST



NORTON SOUND COMMERCIAL COHO HARVEST

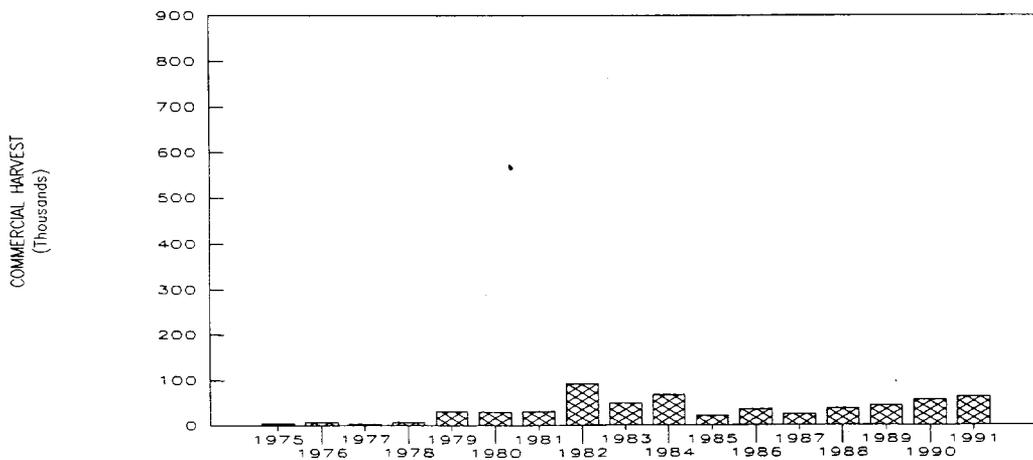


Figure 4. Coho salmon commercial harvest by area in the Arctic-Yukon-Kuskokwim region, 1975-1991.

YUKON AREA COMMERCIAL FALL CHUM & COHO

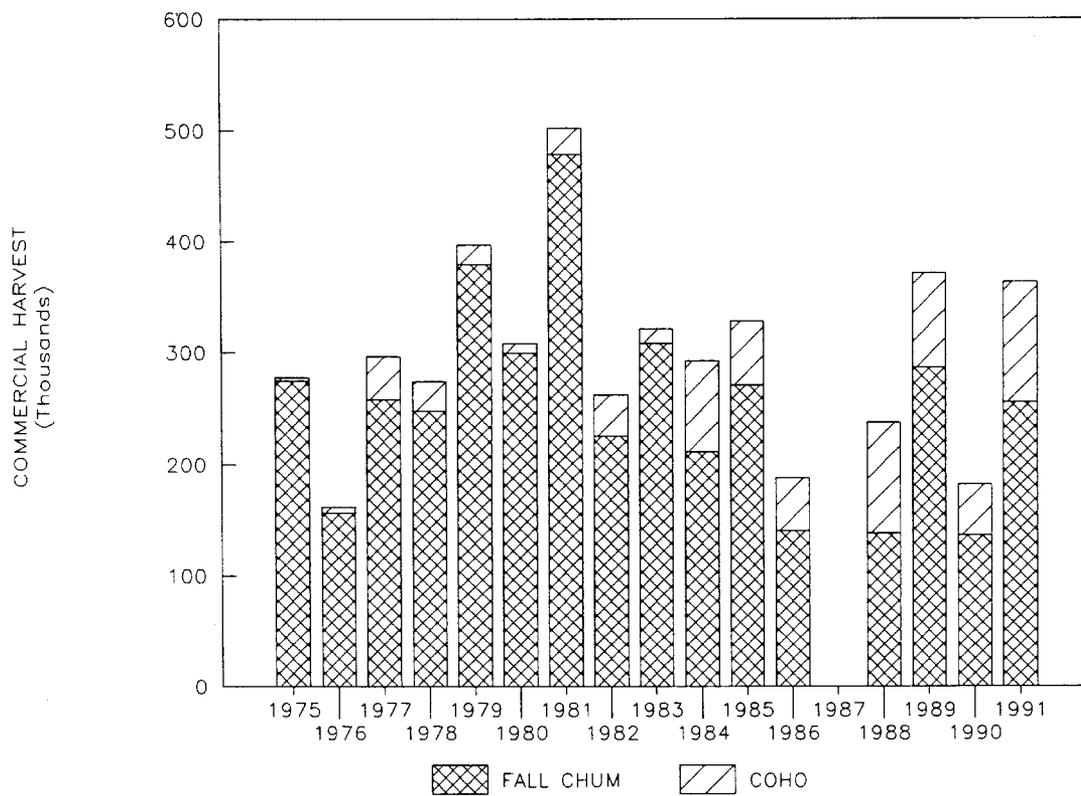
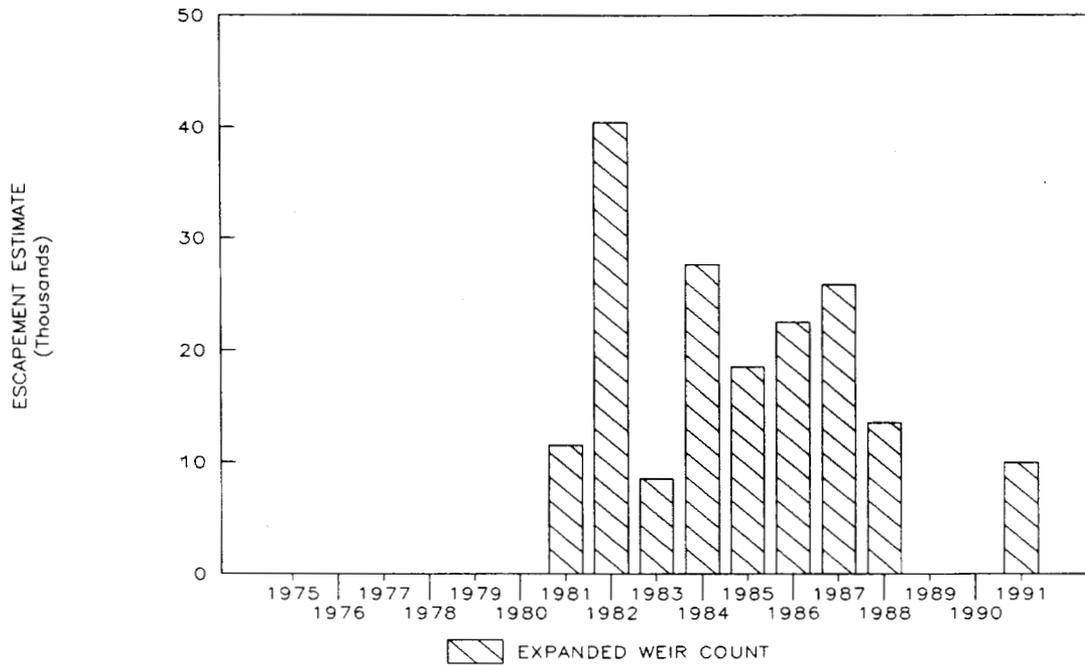


Figure 5. Commercial harvest of fall chum and coho salmon in the Yukon Area, 1975-1991.

KOGRUKLUK RIVER COHO ESCAPEMENT



DELTA CLEARWATER RIVER COHO ESCAPEMENT

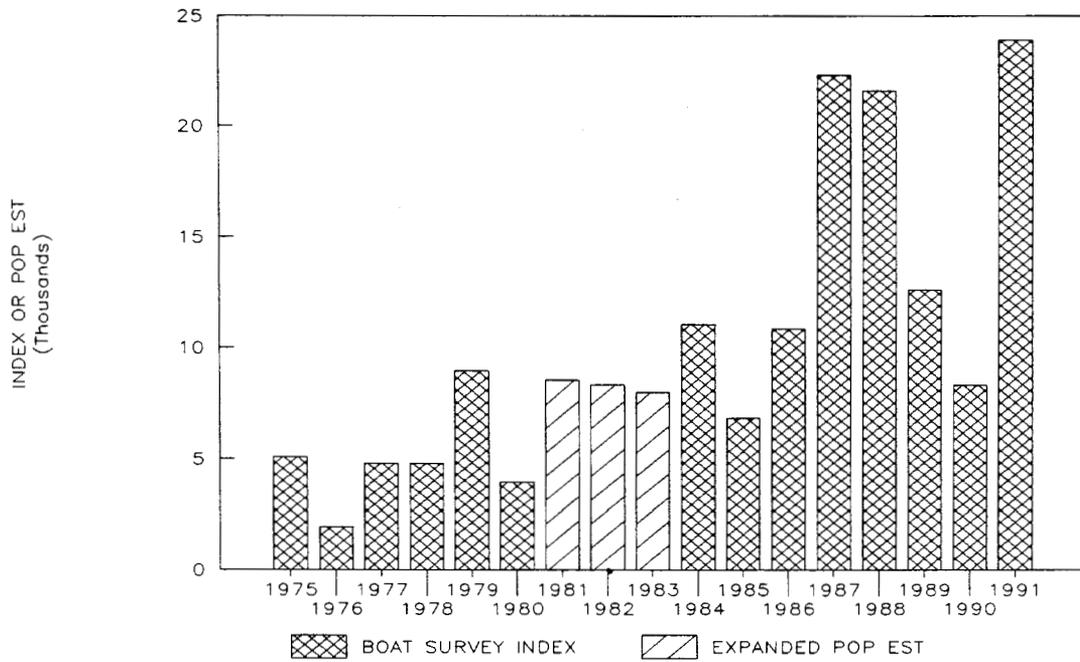


Figure 6. Coho salmon escapement to the Kogruluk River in the Kuskokwim Area, and to the Delta Clearwater River in the Yukon Area, 1975-1991.

Bristol Bay Coho Catches, 1960 - 1991

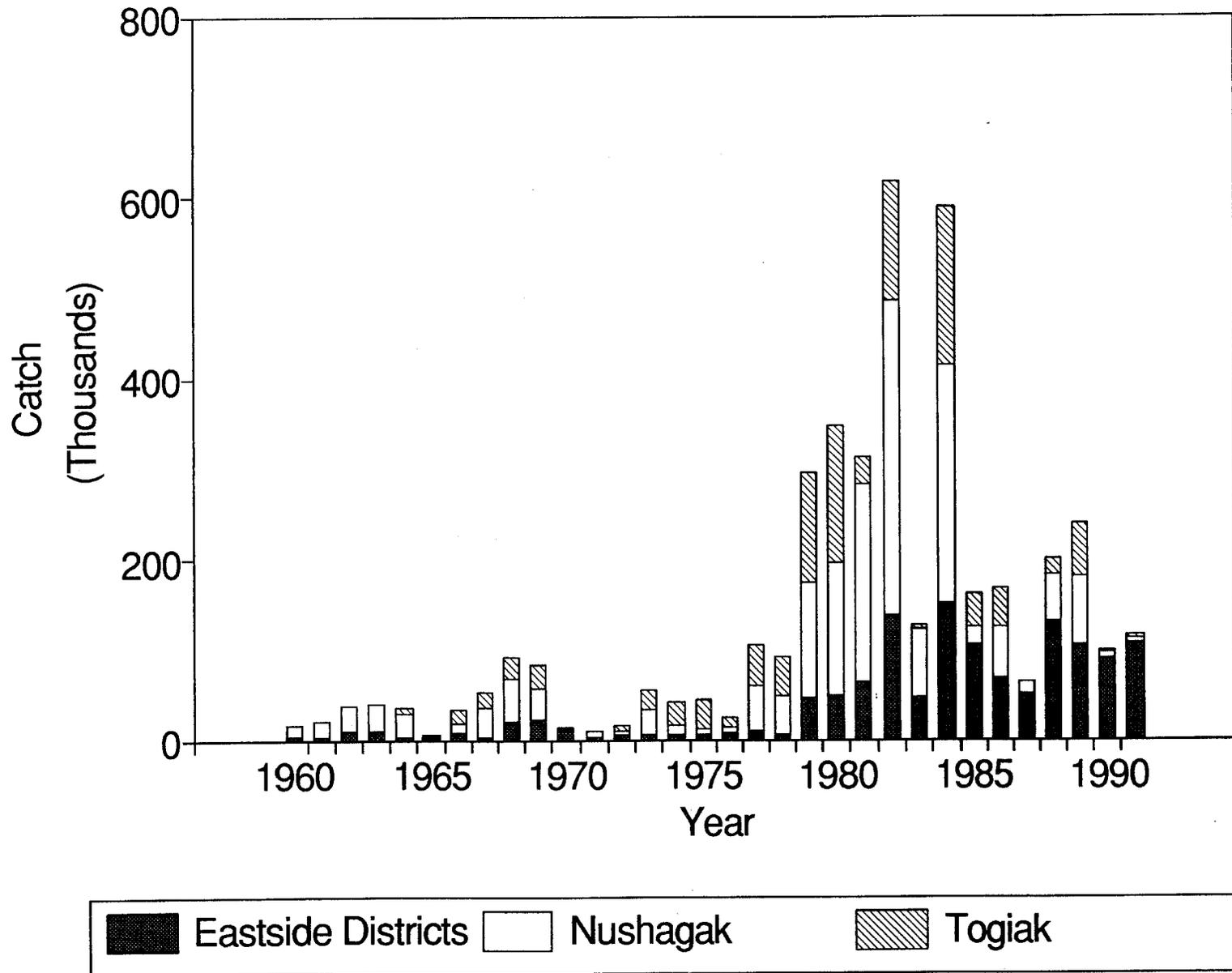


Figure 7. Coho salmon commercial catch in Bristol Bay, by district and year, 1960--1991.

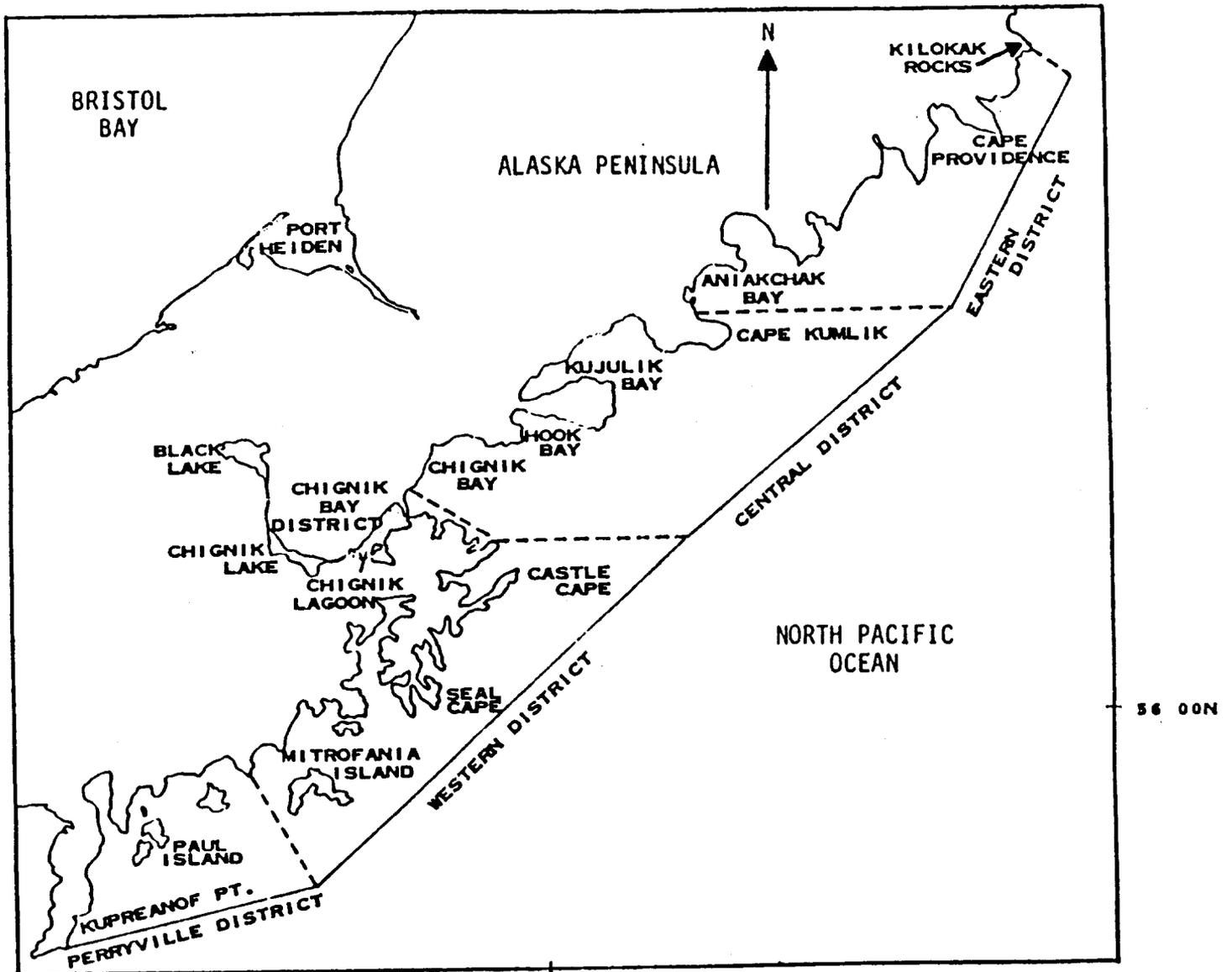


Figure 8. Map of the Chignik management area with statistical fishing districts and some prominent locations identified.

Coho Salmon Catch, 1960-1991 Kodiak Management Area

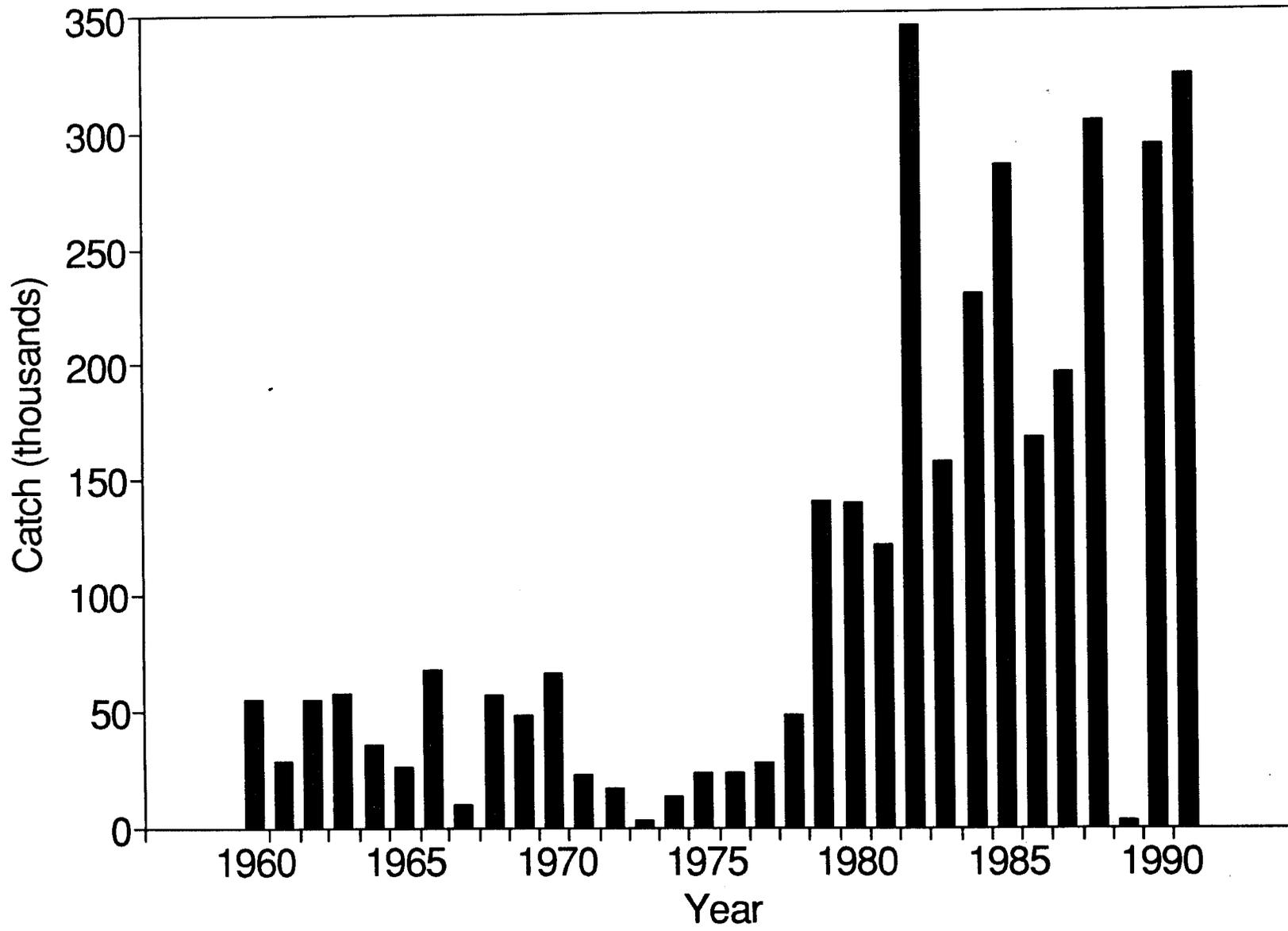


Figure 9. Coho salmon catch, 1960-1991, for the Kodiak management area

South Peninsula Salmon Fisheries

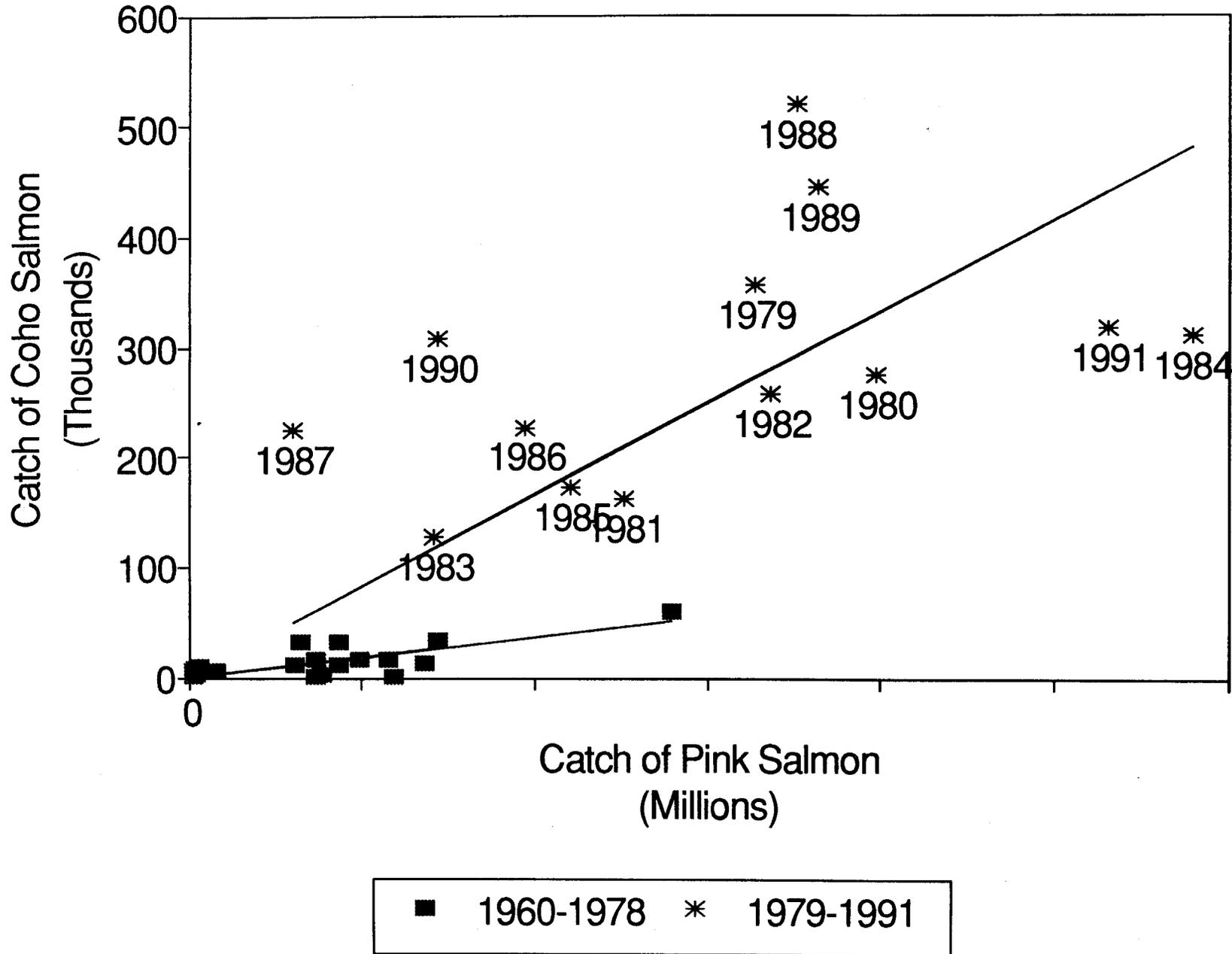


Figure 10. Relationship between total season catch of coho salmon and total season catch of pink salmon in the South Peninsula management area salmon fisheries.

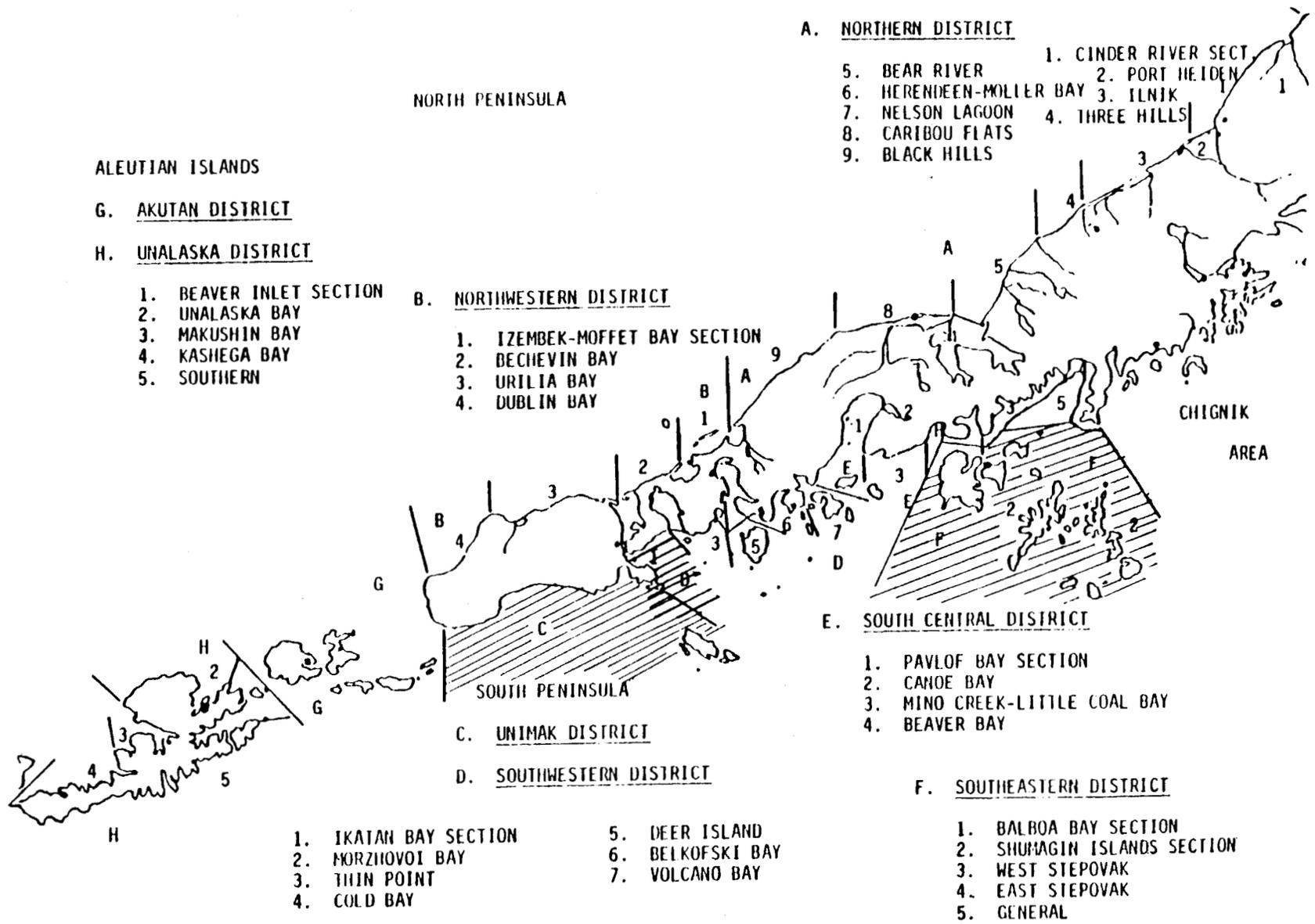
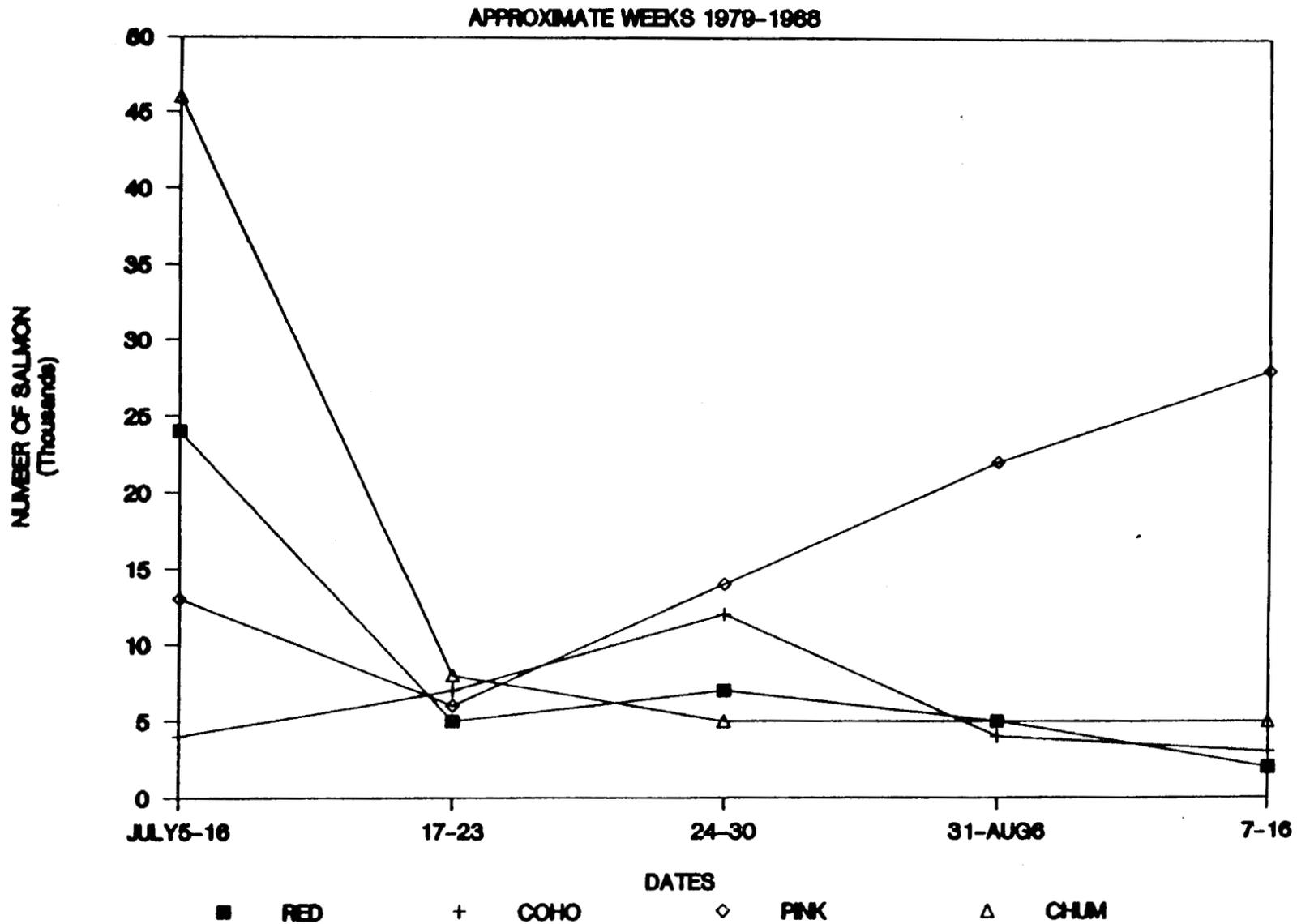


Figure 11. South Peninsula fishing districts (stippled area are the Ikutan Bay section of the Southwestern District, Unimak District, and the Shumagin Section of the Southeastern District).

S. UNIMAK AVERAGE SALMON CATCHES



43

Figure 12. Average catch, 1979-88, of salmon by statistical week and by species for the south Unimak area.

South Unimak Island Commercial Catch by Species

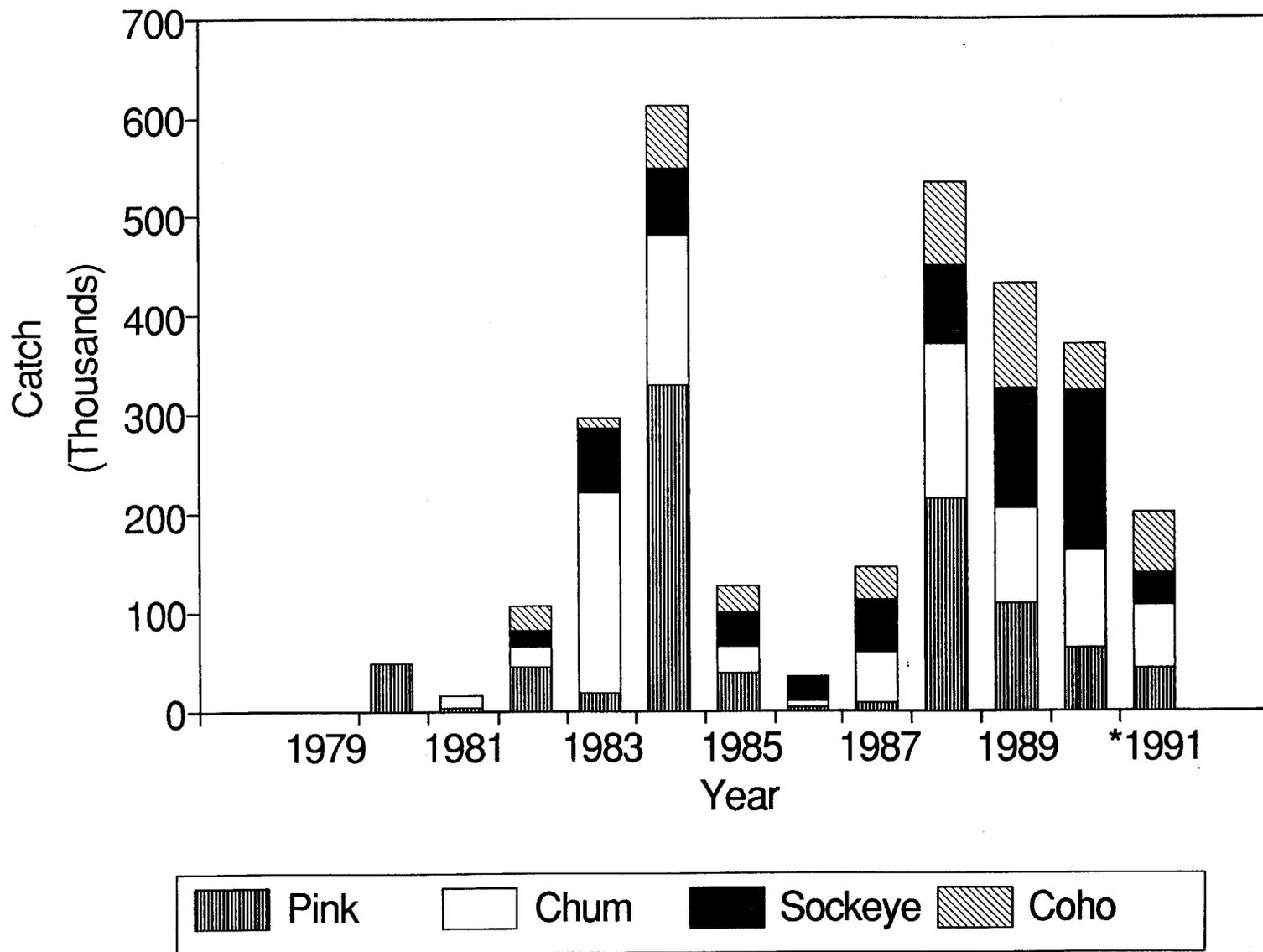


Figure 13. Commercial salmon catch during July and August (thousands of fish) by species, 1979--1991, for the south Unimak area.

Fishing Effort South Unimak July-August Fishery

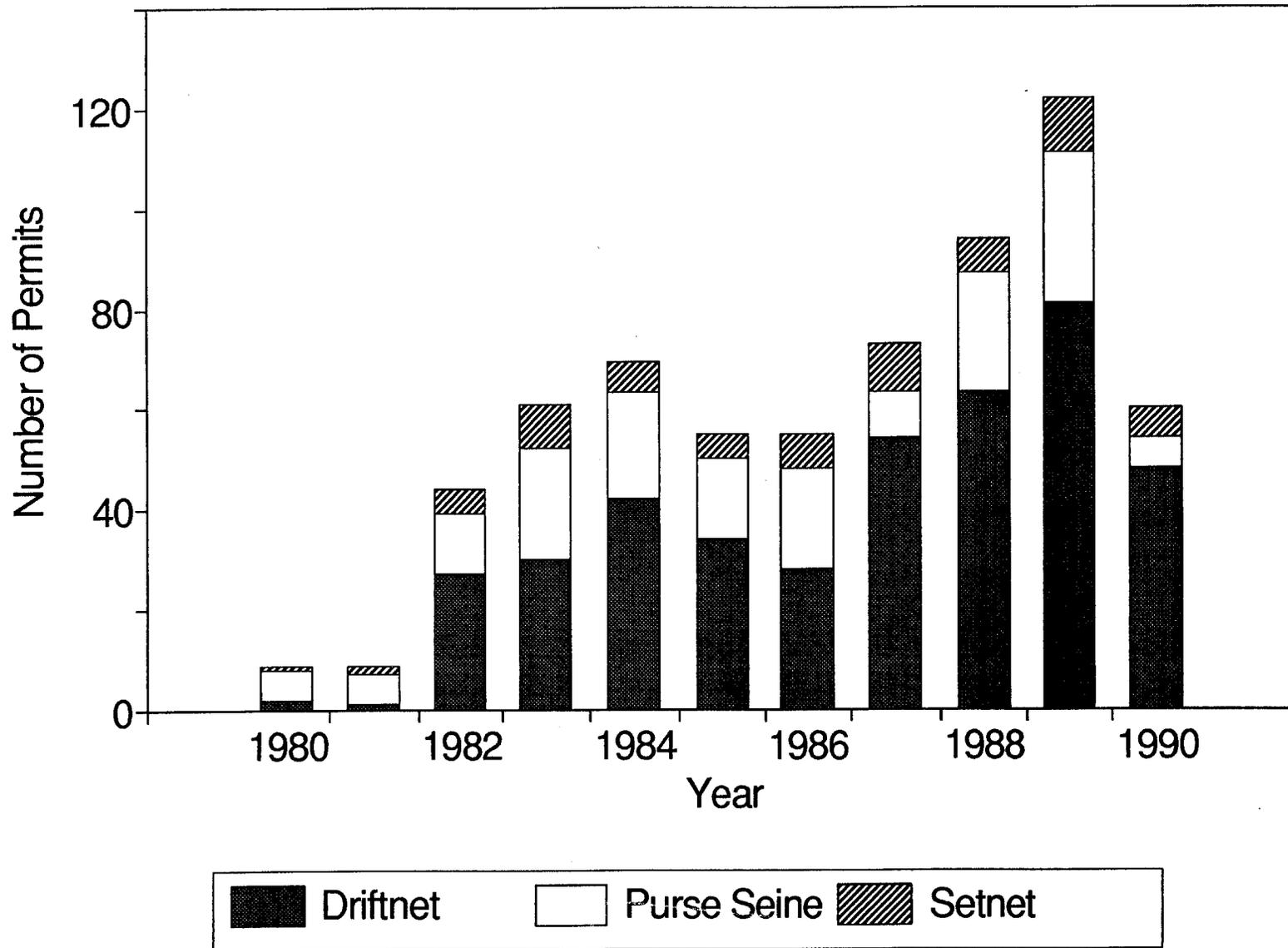


Figure 14. Fishing effort (number of vessels fishing); by setnet, purse seine, and driftnet gear; during July and August for the south Unimak area, 1980--1990.

Catch of Coho Salmon South Unimak July-August Fishery

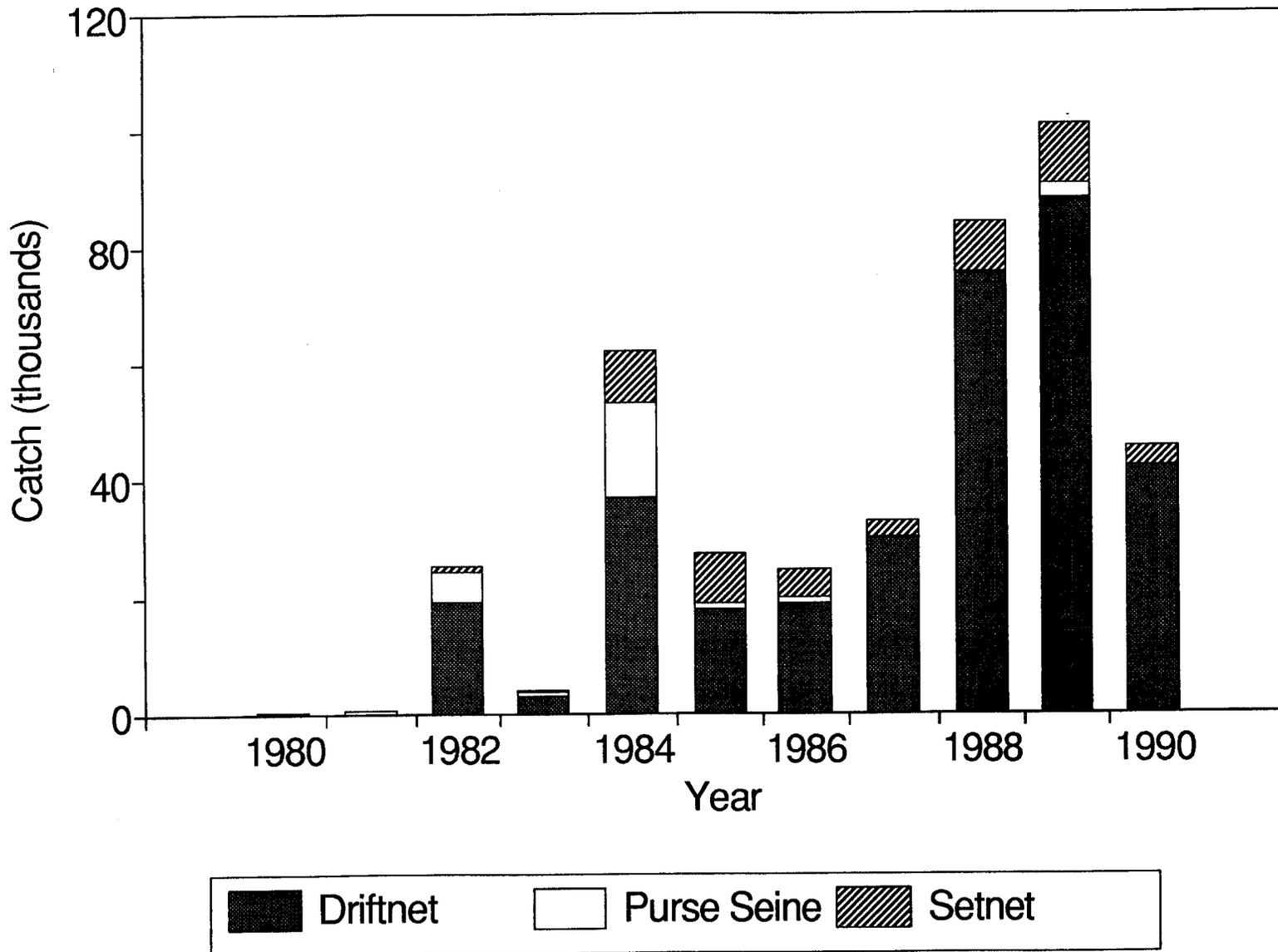


Figure 15. Catch of coho salmon (thousands of fish); by setnet, purse seine, and driftnet gear; during July and August for the south Unimak area, 1980--1990.

Shumagin Islands Commercial Catch by Species

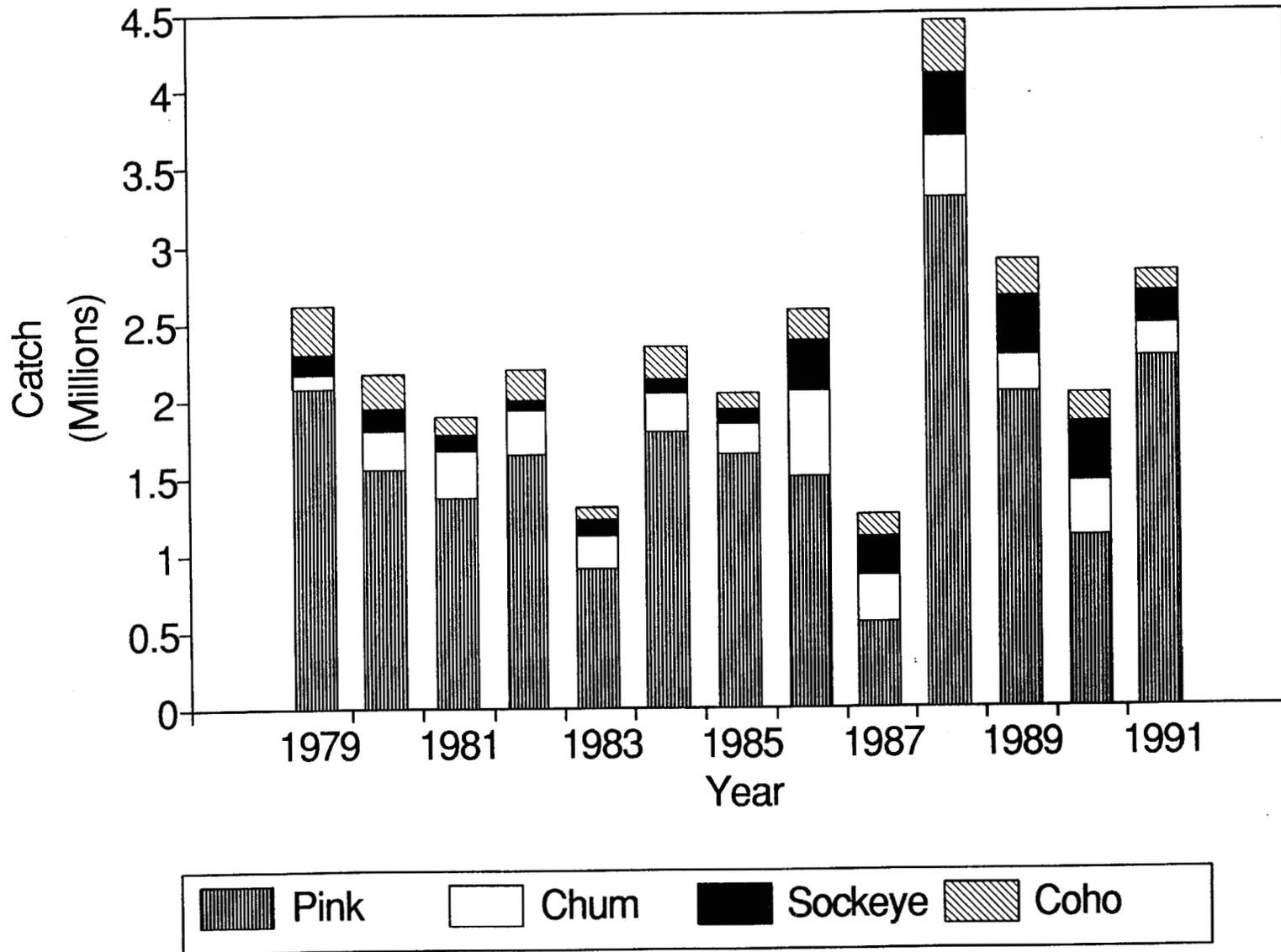


Figure 16. Commercial salmon catch during July and August (thousands of fish) by species, 1979--1991, for the Shumagin Islands area.

Fishing Effort Shumagin Islands July-August Fishery

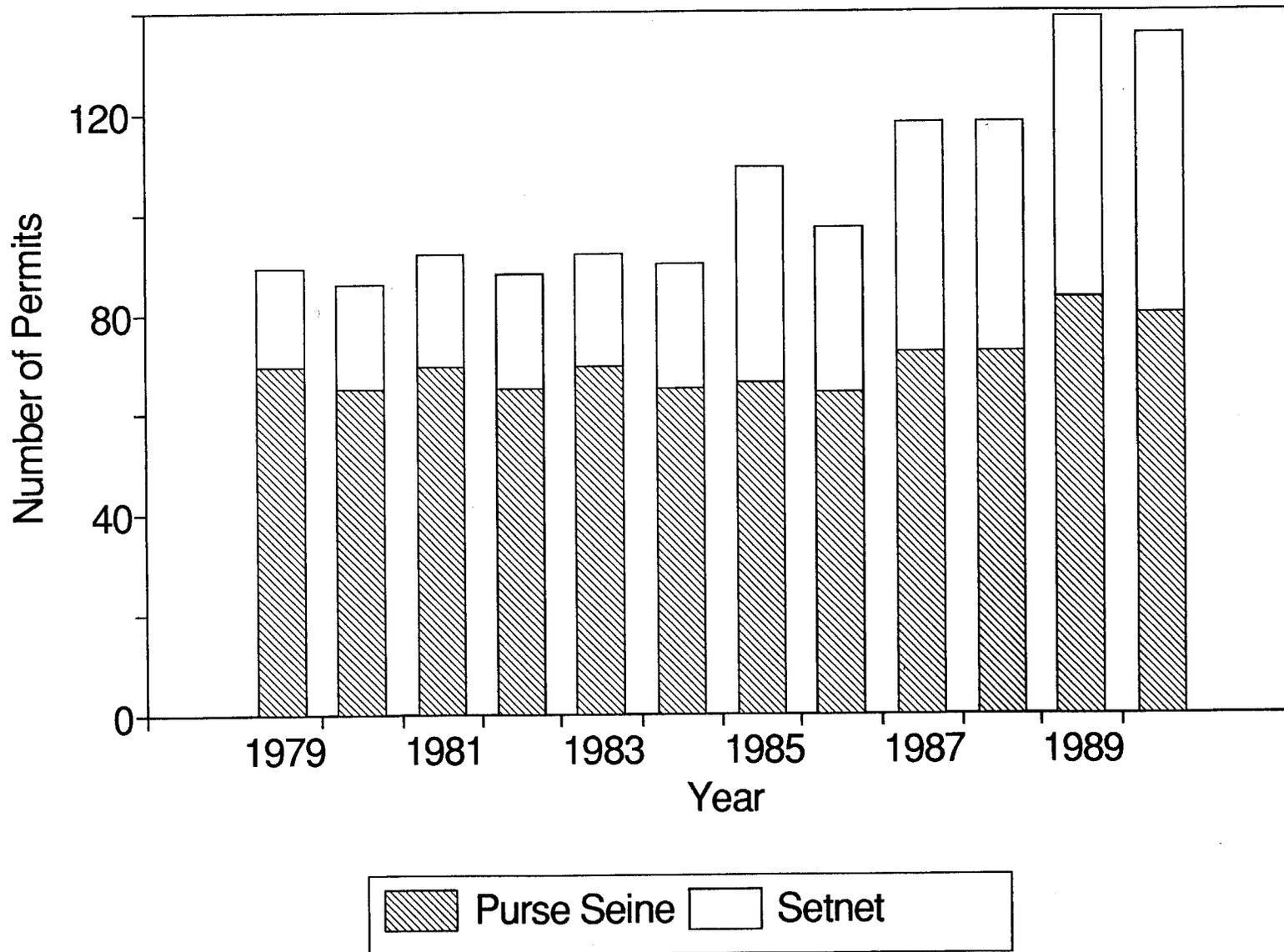


Figure 17. Purse seine and set gillnet fishing effort (number of vessels fishing) during July and August for the Shumagin Islands area, 1979--1989.

Catch of Coho Salmon Shumagin Islands July-August Fishery

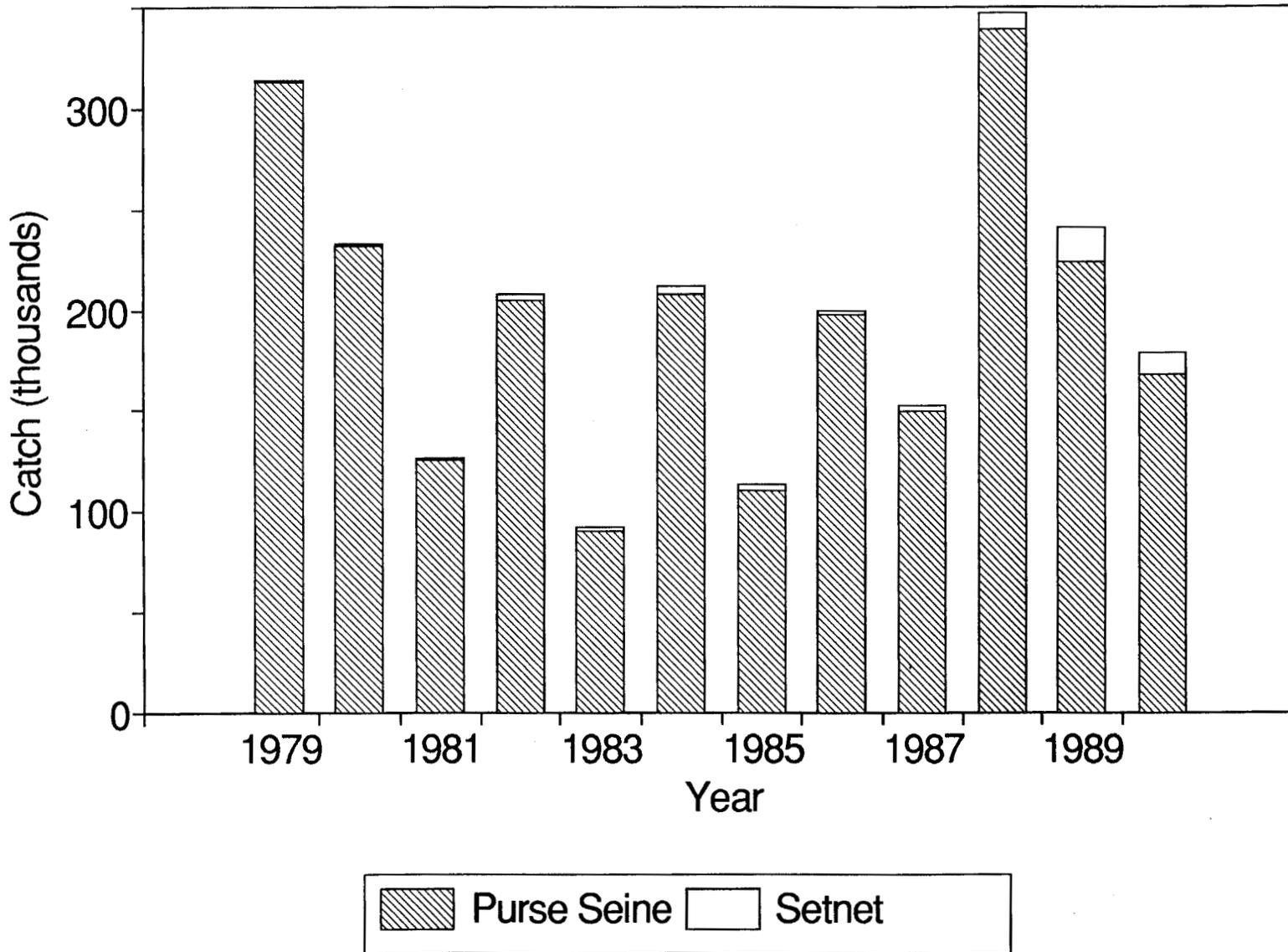


Figure 18. Purse seine and set gillnet catch of coho salmon (thousands of fish) during July and August, 1979--1989, for the Shumagin Islands area.

Shumagin Islands Fishery Average (81-91) Timing of Catches

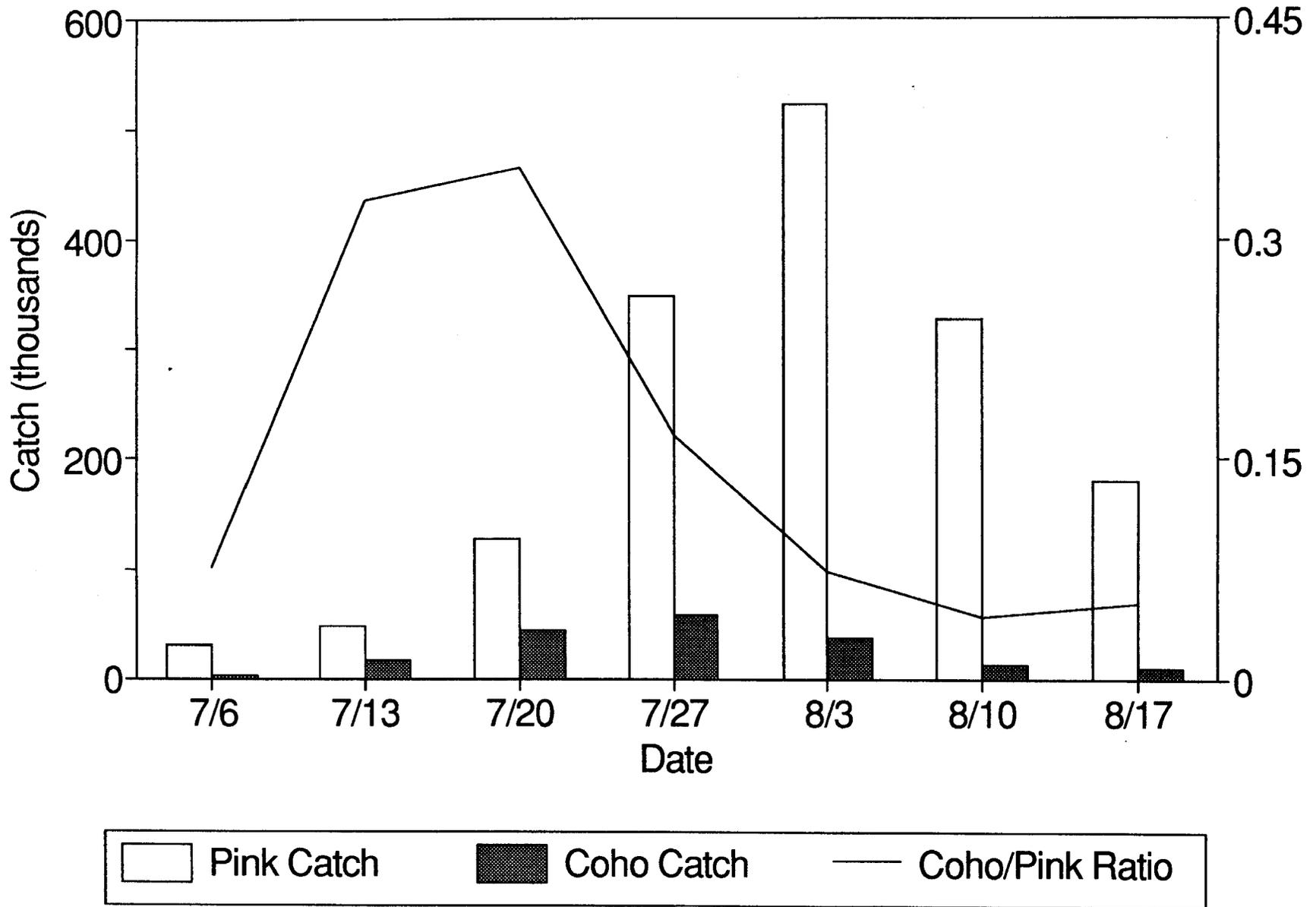


Figure 19. Average catch of coho salmon, average catch of pink salmon, and average ratio of coho to pink salmon in the catches, by statistical week, for the Shumagin Islands area. Note that averages taken over years 1981--1991.

South Peninsula July - August Fishery

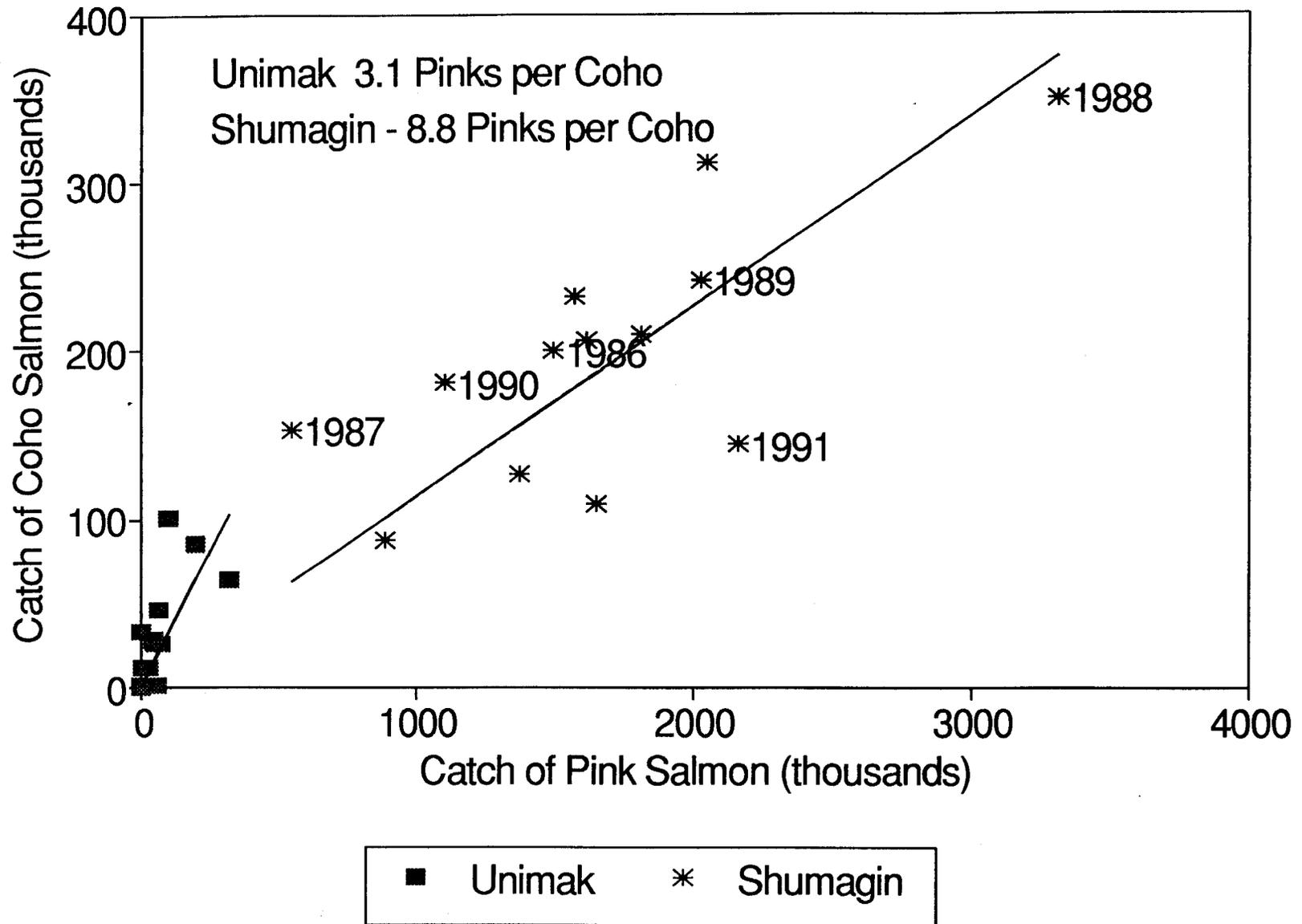


Figure 20. Relationship between catch of coho salmon and catch of pink salmon during July and August, in the south Unimak and Shumagin Islands area salmon fisheries. Shown are years 1979--1991.

South Peninsula July - August Fishery

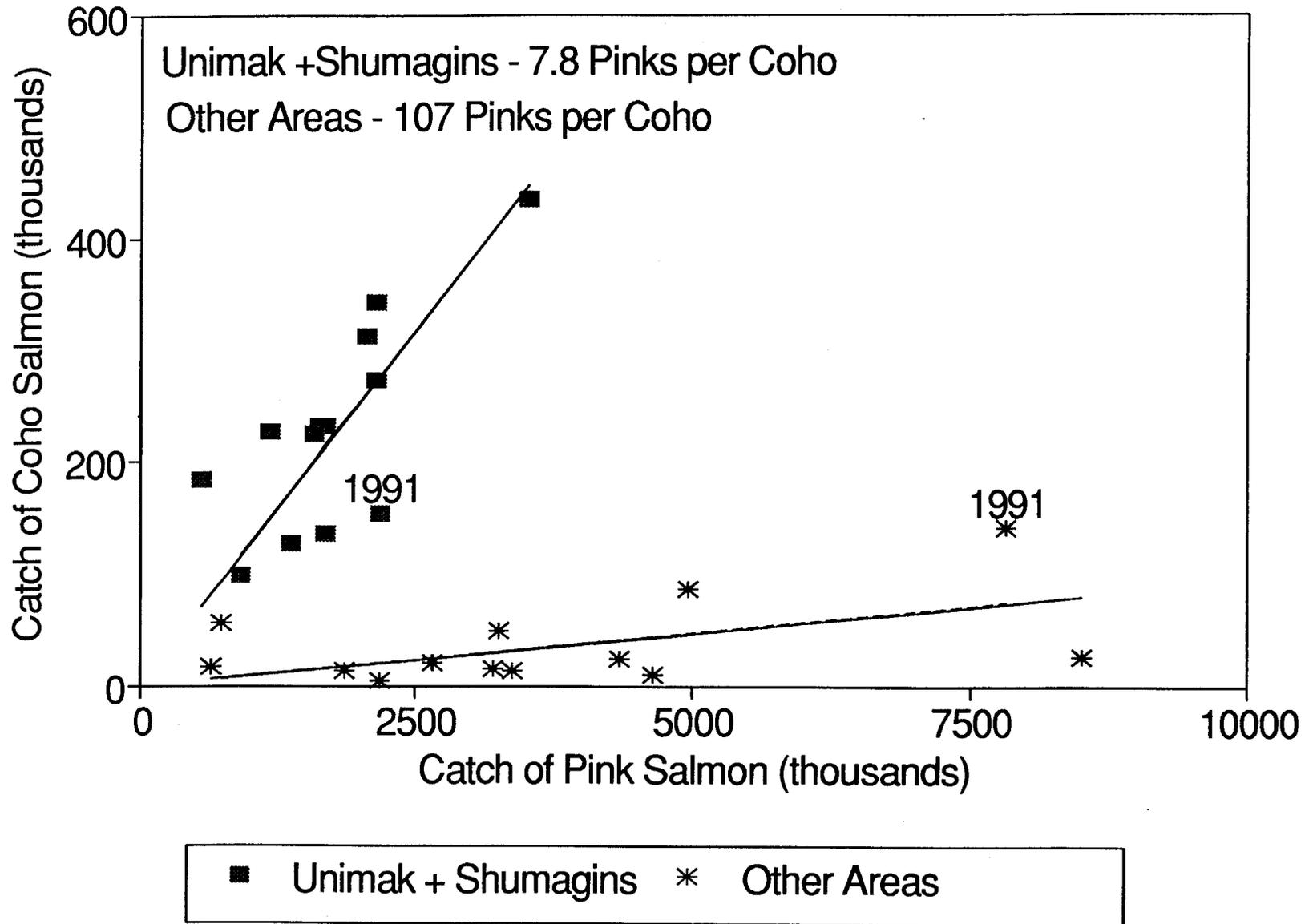
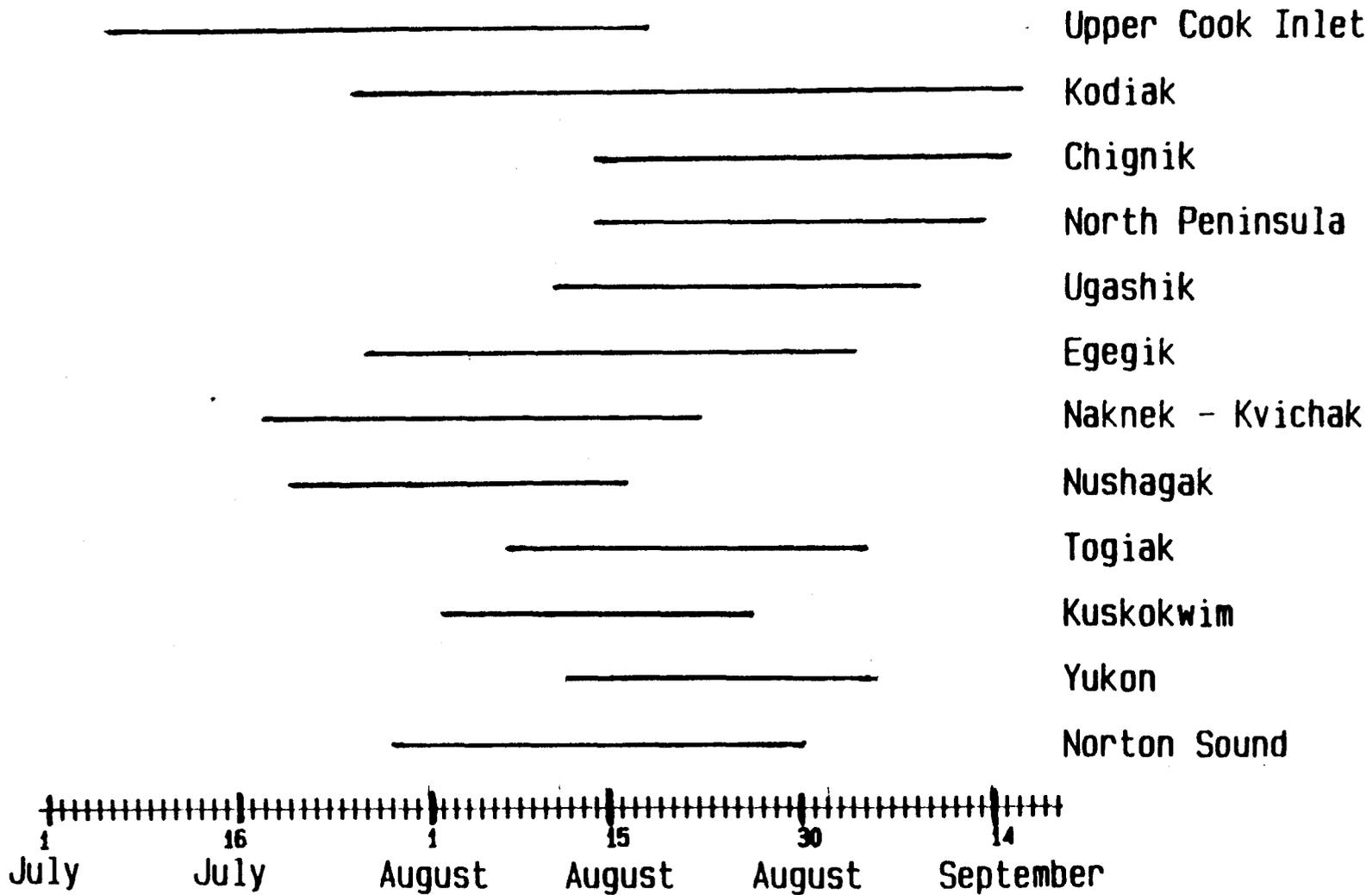


Figure 21. Relationship between catch of coho salmon and catch of pink salmon during July and August. Shown are 1. combined south Unimak and Shumagin Islands area salmon fisheries and 2. other areas (i.e., Bay areas). Data plotted are years, 1979--1991.

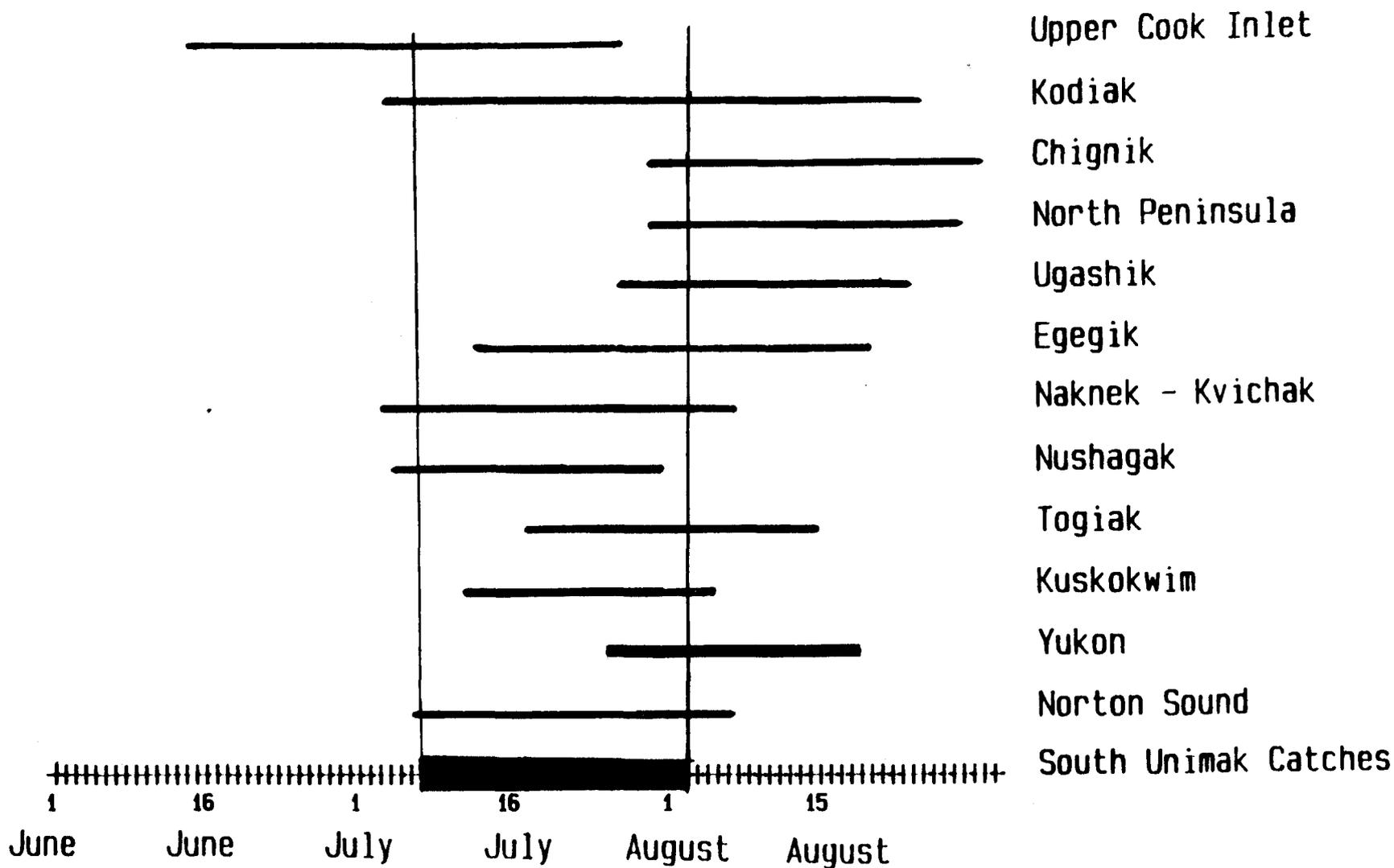
Timing of Coho Salmon Catches in Western and Central Alaska Harvest Areas



53

Figure 22. Timing of the central 90% of the commercial catch for various terminal harvest areas in western and central Alaska.

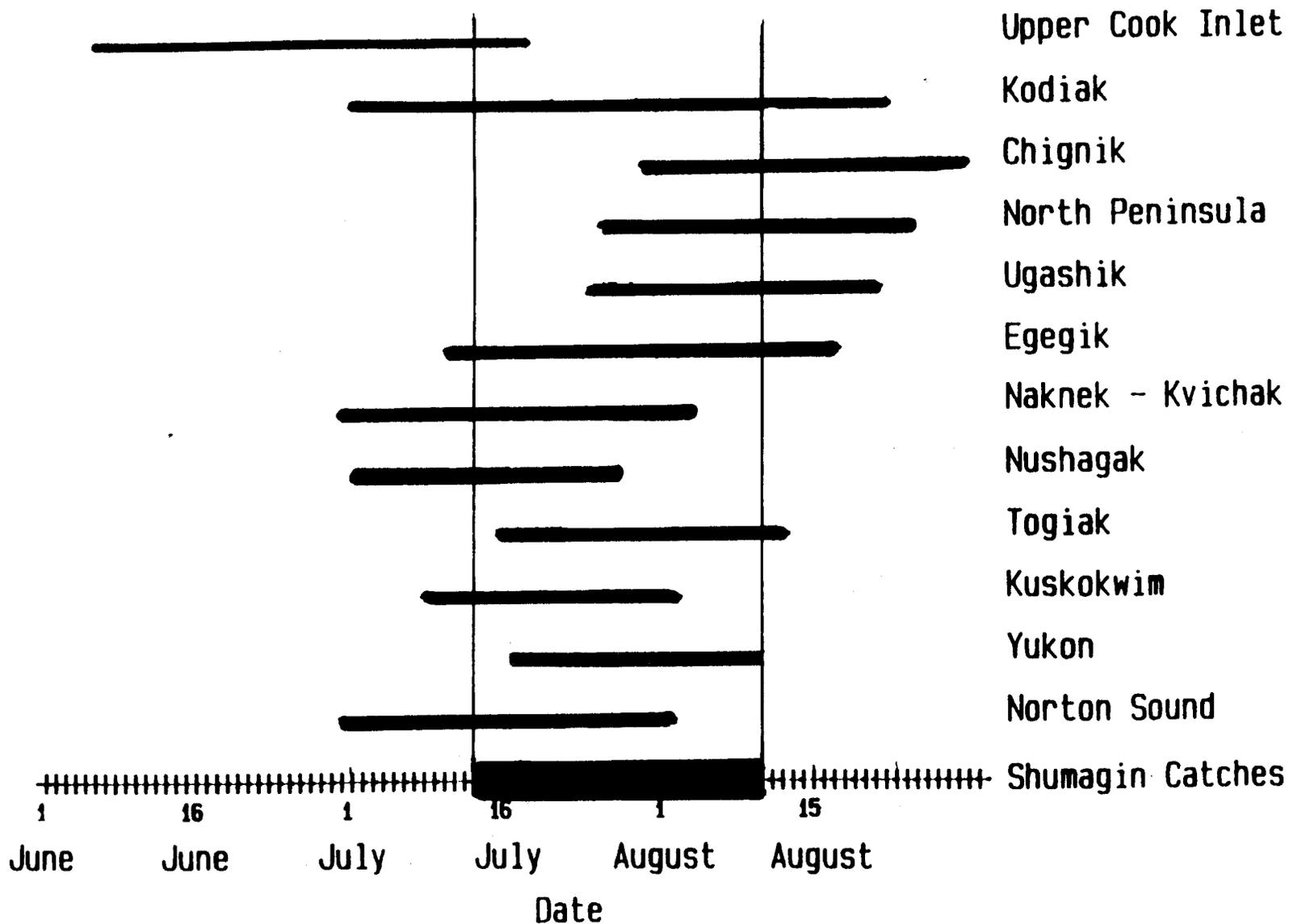
Calculated Timing of Coho Salmon in the Area of South Unimak Island



54

Figure 23. Calculated timing of the central 90% of the run in the south Unimak area for various western and central Alaska coho stocks.

Calculated Timing of Coho Salmon in the Area of the Shumagin Islands



55

Figure 24. Calculated timing of the central 90% of the run in the Shumagin Islands area for various western and central Alaska coho stocks.

The Alaska Department of Fish and Game receives federal funding. All of its public programs and activities are operated free from discrimination on the basis of race, religion, sex, color, national origin, age, or handicap. Any person who believes he or she has been discriminated against by this agency should write to: OEO, U.S. Department of the Interior, Washington, DC 20240.