# YUKON RIVER SALMON SEASON REVIEW FOR 1990 AND TECHNICAL COMMITTEE REPORT

Prepared by

THE JOINT UNITED STATES/CANADA
YUKON RIVER TECHNICAL COMMITTEE

November 7-9, 1990

Anchorage, Alaska

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## ERRATA SHEET

1) Insert on page 23, third paragraph, prior to the last sentence:

It was the Canadian understanding that the U.S. rejected the previously agreed upon interim chum salmon escapement objective of 90,000 to 135,000 in part because they had not had the opportunity to review the unpublished Canadian mark-recapture data. The tagging data for 1987 and 1988 was presented to the U.S. in April 1990, during the Juneau negotiations. Canada understood that the chum salmon escapement objective would be re-evaluated by the JTC after the U.S. was satisfied with the results of the mark-recapture program.

2) Insert on page 29, a new paragraph to conclude section 10.0:

The Canadian section appreciated the U.S. review of the mark-recapture program and was pleased to note that the population estimates for chinook and chum salmon derived from the log-linear (ADF&G) and the Chapman (DFO) methods for 1987 and 1988 show fairly close agreement (Table 6). With one exception, the estimates derived with the Chapman technique fell within the 95% confidence limits of the estimates derived using the log-linear technique. The magnitude of the difference between the estimates produced by the two techniques ranged between approximately 1% and 10%. This close agreement between the estimators may remove some of the past concerns of both Canada and the U.S. regarding the validity of the DFO population estimates. Some of the suggestions included in the review of the DFO tagging program (Bromaghin 1990) for improving accuracy and precision may be incorporated into future tagging programs, but others are beyond the scope of DFO's present operational budget and implementation of them would be contingent on funding. It should be noted that consistent methodology from year to year allows the tagging program to act as both a relative indicator of run size and as an overall escapement index. Any change which would jeopardize the consistency and inter-annual comparability of the estimates would have to be carefully considered prior to implementation.

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## 1.0 INTRODUCTION

The chief negotiators for the United States and Canadian delegations to the Yukon River Salmon Negotiations directed the Joint Technical Committee (JTC) to address the subject areas described in this report. The JTC met in Anchorage on 7-9 November 1990. The meeting was attended at various times by the following persons:

Canadian Department of Fisheries and Oceans
- Mike Henderson (co-chair)
- George Cronkite
- Sandy Johnston
- Ken Wilson
- Gordie Zealand

Alaska Department of Fish and Game
- Larry Buklis (co-chair)
- Louis Barton
- Dan Bergstrom
- Jeff Bromaghin
- Rich Cannon
- John Hilsinger
- Tom Kron
- Gene Sandone
- Keith Schultz

United States Fish and Wildlife Service
- Monty Millard
- Dick Wilmot

National Marine Fisheries Service
- Aven Anderson

This report is organized into eleven sections and two attachments. Sections 2 through 6 review the 1990 fishing season on the Yukon River, the status of the spawning stocks, and results from selected projects. Sections 7 through 11 address assignments given to the JTC by the chief negotiators. Attachment I provides an update of historical Yukon River salmon catch and escapement data in graphic and tabular form. Attachment II provides a written summary of the status of marine fisheries which may intercept Yukon River origin salmon.

## 2.0 COMMERCIAL FISHERY - ALASKA

Preliminary commercial harvest estimates total 581,189 salmon and 125,796 pounds of unprocessed salmon roe for the Alaskan portion of the Yukon River drainage (Figure 1) in 1990. The harvest was composed of 96,194 chinook, 310,843 summer chum, 130,981 fall chum and 43,171 coho salmon sold in the round (Table 1). Additionally, roe sales by species totaled 1,731 pounds for chinook, 109,376 pounds for summer chum, 10,801 pounds for fall chum, and 3,888 pounds for coho salmon. With regards to fish sold in the round, the chinook salmon catch was 18% below the 1985-89 average, summer chum 59% below average, fall chum 23% below

average, and coho salmon 26% below average (Table 2). Roe sales were 54% below the 1985-89 average for summer chum salmon, and 2.6 times greater than the 1985-89 average for fall chum salmon. Note that the five year average for fall chum salmon includes 1987, when the commercial fishery was closed. Roe sales data were not previously available by species for chinook and coho salmon, therefore harvest levels for 1990 cannot be compared to historical information.

Yukon River fishermen in Alaska received an estimated $6.5 million for their catch, approximately 27% below the recent 5-year average. Ten buyer-processors operated in the Lower Yukon Area, and 13 buyer-processors operated in the Upper Yukon Area of Alaska.

Lower Yukon fishermen received an average landed price per pound of $2.84 for chinook, $0.24 for summer chum, $0.45 for fall chum, and $0.66 for coho salmon. Upper Yukon commercial fishermen received an estimated per-pound average price of $0.66 for chinook, $0.15 for summer chum, $4.42 for summer chum roe, $0.26 for fall chum, $3.64 for fall chum roe, and $0.28 for coho salmon.

## 2.1 Chinook Salmon

Chinook salmon migratory timing into the lower river appeared to be later than average. The Lower Yukon Area was generally free of ice by 28 May. The first chinook salmon was reported to have been captured 29 May in Sheldons Point by a subsistence fisherman. The first chinook salmon was caught in Department test fishing nets on 31 May. The chinook return was primarily through south and middle mouths based on commercial and test net catches. Test fishing catches of chinook salmon increased relatively slowly during the early portion of June compared to other years with early ice breakup. Approximately 50% of the 1990 chinook salmon return had entered the lower river by 18 June according to lower river test fishing data. The estimated sonar passage of chinook salmon at Pilot Station was the largest since the project was initiated, however, species apportionment was calculated differently compared to other years. Further analysis is necessary to compare the 1990 sonar counts with prior years. The chinook salmon return was unusual in regard to the large abundance of "jacks" and the early entry pattern which they exhibited. Normally, smaller chinook salmon have later run timing compared to the older, larger chinook salmon. The average weight of chinook salmon in the lower river commercial catch was 19.6 pounds, one of the lowest on record, indicating a high percentage of age 4 and 5 males. The average weight of chinook salmon harvested during unrestricted mesh size fishing periods and restricted mesh size periods was 21.1 and 13.8 pounds, respectively.

The commercial salmon fishing season was opened by emergency order after approximately seven days of increasing subsistence and test net catches in the lower Yukon River. The chinook salmon directed fishery was opened on a staggered basis: 14 June in District 1, 18 June in District 2, and 24 June in District 3. All subsequent fishing periods were established by emergency order. The first commercial fishing period in Districts 1 and 2 was 9 hours in duration because of uncertainty about chinook salmon run timing. Subsistence reports from 9 June through 12 June indicated a large buildup of chinook salmon along the coast, however, test fishing catches remained relatively low. It appeared that chinook salmon would enter the river in a large compressed pulse.

The first commercial fishing periods coincided with the first large pulse of chinook salmon to enter the river. Because of the large chinook salmon harvest taken from the first pulse and due to the anticipated large return of summer chum salmon, the second period in Districts 1 and 2 were restricted to six inch maximum mesh size. The third period in Districts 1 and 2 were unrestricted mesh size openings. The cumulative chinook salmon harvest for Districts 1 and 2 following the second District 1 unrestricted mesh size period was 60,000 fish. Since the management plan called for switching to restricted mesh size gill nets when the harvest approached 60,000 fish, fishing time was reduced to 6-hours during the second unrestricted mesh size fishing period in District 2. There was no commercial fishing from 23 June through 27 June in District 1 and from 25 June through 28 June in District 2, due to the unexpectedly low abundance of summer chum salmon. As it became apparent that the summer chum return was either very late or much weaker than anticipated, fishermen were allowed to utilize unrestricted mesh size gill nets during the last two periods in Districts 1 and 2. This strategy was used to allow fishermen to target surplus chinook salmon and lessen the harvest of summer chums.

The total District 1 and 2 chinook salmon harvest during the summer season was 84,239 fish, 6% below the mid-point of the guideline harvest range and 22% below the 1985-1989 average harvest. An additional 135 chinook salmon were captured during the fall season. A total of 66,092 chinook salmon were harvested during unrestricted mesh size fishing periods and 18,147 chinook salmon were harvested during restricted mesh size fishing periods.

In District 3, two unrestricted mesh size fishing periods (one 18-hour and one 9-hour) were allowed. The initial delay in opening District 3 allowed the first segment of the chinook salmon return to pass through the district prior to the commercial fishery. A total of 2,341 chinook salmon were harvested in District 3, which was 17% above the mid-point of the guideline harvest range, and 31% above the recent five year average.

In District 4, the chinook salmon harvest is largely incidental to the directed summer chum salmon fishery. Since chinook salmon run strength was judged to be above average in the district, the harvest goal was adjusted inseason from the midpoint to the upper end of the guideline harvest range. The harvest of 3,536 chinook was 20% above the 2,850 fish upper guideline range.

In District 5, chinook salmon is the primary species of commercial value during the early season due to the low availability of chum salmon and poor flesh quality. Commercial fishing periods were scheduled when the bulk of the run was in the district in order to reduce the impact on individual stocks. Three fishing periods (two 48-hour and one 24-hour) occurred in Subdistricts 5-A, 5-B, and 5-C for a total harvest of 2,810 chinook salmon, which was within the upper end of the guideline harvest range of 2,850 fish. Two fishing periods (one 48-hour and one 24-hour) occurred in Subdistrict 5-D for a harvest of 543 chinook salmon, which was just over the guideline of 500 fish.

In District 6, the chinook salmon harvest is largely incidental to the directed summer chum salmon fishery due to the low harvest guideline for chinook (600 to 800 fish). The commercial fishery is usually not opened until escapement levels in the Chena and Salcha Rivers indicate adequate numbers of chinook salmon will

escape. The Board of Fisheries has directed that the Tanana River should be managed as a terminal commercial fishery. The first 42-hour fishing period occurred on 13 July with a record 1,678 chinook harvested. The second period was delayed until 23 July due to escapement concerns for the Chena River stock. Total District 6 commercial harvest was 2,590 chinook salmon in five 42-hour periods.

## 2.2 Summer Chum Salmon

The first summer chum salmon was caught in Department test fishing nets on 1 June. As for chinook salmon, the majority of the summer chum salmon run entered through south and middle mouths. Comparative test net indices indicated the 1990 summer chum salmon return was below average in abundance. Approximately 50% of the summer chum salmon return had entered the lower river by 25 June according to test fishing CPUE data. The sonar project at Pilot Station estimated summer chum passage to be about 937,000 fish, which was above the poor 1987 return but well below all other years since 1986. Preliminary age composition information from District 1 and 2 indicated that the commercial catch was composed primarily of age 5 fish. This information suggests that the age 4 component of the return from the 1986 parent year was much lower than expected. The average weight of summer chum salmon in the lower river commercial catch was 7.3 pounds.

A restricted mesh size fishing period directed toward summer chum salmon was implemented in Districts 1 and 2 after the first unrestricted mesh size fishing period in each district. These fishing periods of 12 hours duration were implemented in response to early indications of a large abundance of summer chum salmon. A total of 148,768 summer chums was harvested in Districts 1 and 2 during these restricted mesh size fishing periods. After a short closure due to decreased passage of summer chum salmon, one six-hour restricted mesh size fishing period was allowed in District 2 on 29 June after test fishing data indicated an increase in summer chum salmon passage. However, this increase in abundance was short-lived and no more restricted mesh size fishing periods were allowed. A total of 99,588 summer chum salmon were harvested during unrestricted mesh size fishing periods, and 181,830 summer chum salmon were harvested in a total of three restricted mesh size fishing periods in Districts 1 and 2 combined. The total District 1 and 2 commercial summer chum salmon harvest was 281,418 fish, which was 60% below the recent 5 year average and the lowest catch since 1972.

There were no restricted mesh size fishing periods in District 3 since the chinook salmon harvest exceeded the upper end of the guideline harvest range after two unrestricted mesh size fishing periods. The summer commercial fishing season closed 28 June. The District 3 summer chum salmon harvest was 643 fish, which was well below the recent 5 year average of 5,456 summer chums.

In District 4, the season opened on 24 June with a 24-hour fishing period followed by two standard 48-hour fishing periods. After these three periods the season harvest goal was lowered to the low end of the harvest guideline range due to inseason assessment of a below average return. Subdistrict 4-A had one additional 24-hour fishing period and was then closed with a summer season harvest of 11,177 fish and 95,541 pounds of roe. Subdistricts 4-B and 4-C

continued fishing for three additional 48-hour periods for a season total of six fishing periods, and were then closed with a summer season harvest of 1,187 fish and 10,182 pounds of roe.

In District 5, summer chum salmon are caught incidentally to the chinook salmon fishery. A total of 11 summer chum salmon and 594 pounds of roe were sold.

In District 6, there were five 42-hour commercial fishing periods during the summer season. A total of 16,407 summer chum salmon and 3,059 pounds of roe were sold.

## 2.3 Fall Chum and Coho Salmon

Fall chum salmon migratory timing into the lower river initially appeared to be early, with significant numbers of fish passing prior to 24 July. However, according to test fishing and sonar data, very low passage rates occurred from 24 July through 3 August. This time period coincided with unusually warm, calm weather. It was then apparent that run timing was later than normal. After 3 August, three pulses of fall chum entered the river during 4 August, 9-10 August, and 18-19 August. Coho salmon migratory timing appeared to be later than normal as well. Consistent daily test net catches of coho salmon did not begin until 9 August, with no significant entry occurring until 17 August.

The fall season commercial salmon fishery was opened by emergency order on 23 July in District 1, 26 July in District 2, and 29 July in District 3. A fishing schedule of 12 hours duration in the coastal "Set Net Only Area" where tides affect fishing opportunity, and of six hours duration in the remainder of District 1 and in Districts 2 and 3 was established. The weather was calm during late July and early August, and catches were very low. Typically, fall chum salmon enter the river in relatively short pulses during windy weather. A total harvest of approximately 50,000 fall chums had been taken as of 8 August after five fishing periods each in Districts 1 and 2, and four periods in District 3. Historical test fishing and sonar data indicated that usually by 10 August 50% of the run has passed. In response to what appeared to be a below average fall chum salmon return, the lower river districts were closed to commercial fishing until further notice, in order to allow increased fish passage for spawning and upriver subsistence requirements.

Sonar counts at Pilot Station for 10-16 August were adjusted on 17 August to account for targets identified in mid-river transects conducted beyond the horizontal counting range. Apparently, very low water levels caused a change in migration pattern which had not been seen in prior years. With a cumulative commercial harvest to date of just 50,800 fall chum, and in light of the fact that the overall return appeared late and below average, it was decided to allow only one further commercial period in Districts 1 and 2 to allow the harvest to approach the lower end of the guideline harvest range. In addition, the coho salmon return appeared to be increasing as indicated by lower river test fishing catches.

The commercial fishing season closed by emergency order on 21 August in Districts 1, 2, and 3. A total of 68,225 fall chum and 30,707 coho salmon were harvested

in the lower river districts. This was the second consecutive year in which District 2 had a larger fall chum salmon harvest than District 1, although the harvest has been nearly equal in some other years. The preliminary cumulative sonar fish passage estimates at Pilot Station through termination of the project on 4 September were approximately 482,000 fall chum and 230,000 coho salmon.

Based on a thorough review of test net, sonar, and commercial and subsistence fishery performance, it was determined that the fall chum salmon run size was sufficient to allow upriver districts to harvest near the lower end of their guideline harvest ranges. Subdistricts 4-B and 4-C were open to commercial fishing for two 48-hour periods beginning on 22 August. Participation by fishermen and processors was at a low level due to the late opening announcement and low harvest goal of 5,000 fish. Sales totaled 4,989 fall chum salmon and 2,351 pounds of roe. No coho salmon were reported sold.

The Subdistrict 5-A, 5-B, and 5-C fall season was announced for two 24-hour periods per week beginning on 28 August. However, only one commercial period occurred since the low end of the guideline harvest range of 4,000 fish was exceeded with the sale of 5,169 fall chum salmon and 945 pounds of roe. No coho salmon were reported sold. Subdistrict 5-D was also open for only one fishing period due to the low end of the guideline harvest range being exceeded in one 48-hour period. Sales from the 7-9 September fishing period were 2,609 fall chum salmon and 113 pounds of roe. No coho salmon were reported sold.

District 6, the Tanana River, was managed under a terminal fishery management plan as directed by the Alaska Board of Fisheries for the third consecutive year. Based on sustained high catches in test fish wheels and in the subsistence fishery, performance of downriver commercial fisheries on the later run component, and the limited total exploitation on the later run component, the fall chum salmon run in the Tanana River was assessed to be above average in strength. Three fishing periods were allowed in each subdistrict in District 6. Due to Board of Fisheries concern for the Toklat River fall chum salmon stock, fishing periods in Subdistrict 6-A were 24-hours in duration, while they were 42-hours in Subdistricts 6-B and 6-C. Sales for District 6 totaled 49,989 fall chum salmon, 7,392 pounds of fall chum roe, 12,464 coho salmon, and 3,888 pounds of coho roe.

## 3.0 COMMERCIAL FISHERY - CANADA

Management plans for the Canadian chinook and chum salmon fisheries on the Yukon River in 1990 were formulated to reflect the understandings reached in the latest round of negotiations, which were held in Juneau during the week of 23 April. Accordingly, the guideline harvest ranges and border and spawning escapement goals tentatively agreed to in Juneau provided the foundation for the 1990 management plans.

The Canadian commercial fishery harvested a preliminary total of 38,498 salmon in 1990 which was composed of 11,291 chinook salmon and 27,207 chum salmon (Table 3). The chinook catch was similar to the recent chinook cycle (1984-89) average catch of 11,188 fish, whereas the chum catch was above the recent chum cycle (1986-89) average of 24,967 fish. A total of 30 commercial licenses was issued

in 1990, similar to 1989. Most of the commercial harvest was taken in gill nets set in eddies. Three fish wheels were used by three separate individuals.

## 3.1 Chinook Salmon

The elements of the chinook salmon management plan adopted for 1990 included:

a) a minimum spawning escapement goal of 18,000 chinook;

b) a total Yukon mainstem guideline harvest range for all users of 16,800 to 19,800 chinook salmon;

c) a commercial guideline harvest range of 9,400 to 12,400 chinook and a pre-season target of the midpoint (10,900 chinook); and,

d) a one day per week fishery for the initial two weeks of the season, followed by four-day per week fishing periods for the remainder of the chinook season subject to the harvest guideline. This marked a 50% reduction in fishing time during the first two weeks of the season. The change from 1 day per week openings to 4 days per week openings was to occur two weeks after the run commenced. One additional day per week would be allowed in the upper fishing district, upstream of the Sixty Mile River.

The commercial fishery opened on 1 July for one day per week after the presence of chinook had been determined by the DFO test fish wheels located just upstream of the international border. The first chinook was caught in the fish wheels on 29 June. Effort during the first opening was low (5 fishermen); however, the number of fishermen increased in succeeding weeks as chinook salmon abundance increased. The fishery remained open for one day each week for the first two weeks of July and daily catches during this period were approximately 1.5 to 2.5 times the average values. A dramatic increase in the catch occurred during the 15-16 July period with 992 chinook landed in 24 hours. This was the highest daily catch for this time period on record.

The fishing plan stipulated that fishing time would be increased two weeks after an increasing trend in abundance had been determined at the DFO fish wheels. A three-day moving average of the daily fish wheel catches assisted in identifying this trend and 4 July was chosen as the official "beginning" of the run. Therefore, an additional three days was fished during the week of 15 July, from 11:00 Thursday 19 July to 11:00 Sunday 22 July. The fishery was not opened on 18 July (which was exactly two weeks from 4 July) in lieu of the fact that there had already been a 24 hour opening on 15-16 July, and there was a desire by DFO to restrict the maximum weekly fishing effort to four days. Fishing success remained excellent during this opening and the average daily catch of 1,162 chinook per day was 106% above average (1984-89). This also constituted the peak average catch per day of the season. Usually the run peaks during the last week of July and the first week of August.

Commencing 25 July the fishery opened for four days per week for the remainder of the chinook season in the commercial fishing area located downstream of the

Sixty Mile River. An additional day of fishing was permitted each week in the upper fishing area located from the Sixty Mile River upstream to Tatchun Creek. Average daily catches remained above average only through the period of 25-29 July, and thereafter were below average.

The total commercial chinook catch was 11,291 fish with 10,459 of the catch (approximately 93%) being harvested in the lower fishing area. In spite of the excellent return, the commercial catch fell well within the commercial guideline harvest range of 9,400 to 12,400 chinook and did not come closer to the upper part of the range primarily because of the earlier than average run timing. For comparison, the recent six-year average (1984-89) commercial catch was 11,188 chinook. The lowest catch in this period occured in 1989 with a catch of 9,789 chinook, whereas a record catch of 13,217 occurred in 1988. Preliminary tag recovery information suggested a Canadian commercial harvest rate of 19.6% on chinook salmon in 1990, compared to 23.0% in 1989, and a cycle average harvest rate of 30.3% (1984-89).

Comparisons of the average commercial chinook catch per day with previous years indicated the run was above average and compressed in timing, peaking one to two weeks earlier than normal. This was corroborated by the fish wheel catches, however, the time of arrival in the fishery was about average. The fish wheel catches also indicated a strong return with a combined catch second highest on record.

The maximum number of commercial fisherman active during any one week of the chinook salmon run was 18 fishermen, the same as in 1989.

### 3.2 Fall Chum Salmon

The conservation initiatives undertaken in 1989 were continued in 1990 for Canadian Yukon mainstem chum salmon. The chum salmon management plan included the following components:

a) a spawning escapement objective of 81,600 Canadian Yukon mainstem chum salmon. This was the weighted average of the the principal brood year escapements, 1985 and 1986. In the absence of an escapement objective agreed to by both Canada and the U.S., it was Canada's intent to set an escapement objective at this level so broodstock levels could be maintained;

b) a guideline harvest range for all Canadian Yukon mainstem fisheries of 23,600 to 32,600 chum;

c) a commercial guideline harvest range of 20,900 to 29,900 chum salmon with a pre-season target of the midpoint, ie. 25,400 chum; and,

d) reduced fishing time (two days per week) for the first two weeks of the chum season, followed by four day per week openings subject to assessments of run strength and the guideline harvest ranges.

Fishing time was reduced to two days per week during the last half of August as

chinook salmon abundance declined and the chum salmon run began to build. Average daily catches of chum salmon jumped 396% above average (1986-89) by the end of August, ie. during the three day opening from 29 August to 1 September. The average catch per day during this week was a record for statistical week 35.

Commencing 5 September, the fishery was open four days per week and remained as such through the week of 16 September. Thereafter, the fishery was reduced by one day per week in each of the two following weeks in order to remain within the guideline harvest range, and to address increasing concerns regarding above average tag recovery rates. The fishery closed on 6 October, which was one of the earliest closing dates documented. With the exception of the 12-16 September and final fishing periods, average daily catches were 1.6 to 1.9 times the cycle averages. Record average daily catches occurred during the openings of 19-23 and 26-29 September.

Similar to 1989, a bimodal return was reflected in the commercial catch with a peak at the end of August (statistical week 35), followed by a second and much stronger peak during the last two weeks of September. In general, the run timing appeared to be earlier than average with a sharply defined, compressed second peak. A stronger and earlier than average return was also indicated by the DFO fish wheel catches. The combined catch of the two fish wheels was the highest on record.

The commercial chum harvest was within the guideline harvest range of 20,900 to 29,900 fish with a total catch of 27,207 chum, 99% of which was taken in the lower fishing area. The pre-season target of 25,400 chum was exceeded due to the indications of a strong return in both the commercial and test fish wheel catches. The 1990 chum catch was about 9% above the recent cycle (1986-89) average of 24,967 chum, which ranged from 17,549 in 1989 to a record of 40,591 in 1987.

Preliminary tag recovery information suggested an overall commercial harvest rate of 33.3% on chum salmon compared to 31.4% in 1989 and 43.7% in 1988. A maximum of 15 fishermen were active in any one week during the chum salmon season.

## 4.0 NON-COMMERCIAL FISHERIES

### 4.1 Alaska

#### 4.1.1 Subsistence and Personal Use Fisheries

Criteria for subsistence and personal use fisheries in Alaska were in a state of transition in 1990 due to recent court decisions. Subsistence "catch calendars" were mailed to each fishing household in all Yukon River drainage communities in Alaska in May for use during the fishing season. Direct interviews were conducted with fishermen immediately following the season. Subsistence fishermen in portions of District 5 and all of District 6 were required to obtain subsistence fishing permits and record harvest data. Fishermen not contacted by other means are now being contacted by mail. Analysis of 1990 subsistence harvest data will not be completed for several months. Data for 1989 were not available for inclusion in the March 1990 JTC report. Preliminary estimates of the 1989

subsistence harvest in the Alaska portion of the Yukon River drainage totaled 43,240 chinook, 175,729 summer chum, 181,083 fall chum, and 33,648 coho salmon. These estimates do not include commercially caught summer chum salmon retained for subsistence purposes in District 4.

Personal use harvest information is not yet available for 1990. The preliminary estimate of personal use harvest in 1989 was 2,844 chinook, 2,086 summer chum, 5,508 fall chum, and 967 coho salmon.

#### 4.1.2 Sport Fishery

Approximately 45,000 resident and non-resident fishermen annually participate in sport fisheries in the Alaskan portion of the Yukon River drainage. In total these fishermen take about 150,000 fishing trips and spend about 200,000 days fishing in these waters annually. Numbers of participating anglers and sport fishing effort has been increasing each year since these statistics have been estimated beginning in 1977. Approximately ninety percent of the effort in the Alaskan portion of the Yukon River drainage occurs in the Tanana River drainage, mostly along the road system. Only a small portion of the effort is directed toward anadromous salmon, although major sport fisheries targeting anadromous salmon take place annually in the Chena, Salcha, Chatanika, and other Interior Alaska river systems.

Fishing effort and harvests are annually monitored through a statewide sport fishery survey. Some on-site fishery monitoring also takes place at locations where more intense sport fishing occurs. Harvest information for 1990 will not be available until the fall of 1991. However, it is expected that harvests for 1990 will be similar to the last few years. In 1988 and 1989, sport fishermen harvested about 2,000 anadromous chinook salmon, 5,000 anadromous coho salmon, and 3,000 anadromous chum salmon each year. It is estimated that about half of these anadromous salmon harvests occurred within the Tanana River drainage.

### 4.2 Canada

#### 4.2.1 Indian Food Fishery

Data has not yet been compiled for the 1990 Indian food fishery catches. It is anticipated that the total upper Yukon IFF chinook salmon catch will be similar to the 1984-89 cycle average of approximately 7,000. The chum salmon catch is expected to be above average. The IFF catch of chinook salmon at Old Crow on the Porcupine River is expected to be minimal due to the evacuation of the town as a result of a forest fire during the time of the chinook salmon migration. Chum salmon catches are expected to be above average. Coho salmon catches in Canada are generally limited to the Porcupine drainage where they are taken in the Old Crow fishery. The recent average for this fishery is approximately 500 coho salmon. Catch data for 1990 are incomplete.

#### 4.2.2 Domestic Fishery

Catch data for the domestic fishery are incomplete. The total chinook salmon catch reported to date is 233 fish. Chum salmon catch records are mostly still outstanding.

#### 4.2.1 Sport Fishery

An assessment of the 1990 sport fishery is incomplete. It is assumed that approximately 300 chinook salmon were harvested by sport fishermen in Canadian sections of the Yukon River basin.

## 5.0 STATUS OF SPAWNING STOCKS

### 5.1 Chinook Salmon

#### 5.1.1 Alaska

Aerial surveys of the Anvik River and East and West Fork of the Andreafsky River, in the lower portion of the Yukon River drainage provided indices of 1,595, 2,503, and 1,545 chinook salmon, respectively, within established index areas under fair to good survey conditions. All of these estimates were above the established escapement objectives of 500, 1,600, and 1,000 chinook for each of these streams, respectively. Aerial surveys of the Chena and Salcha Rivers, in the middle portion of the Yukon River drainage, provided indices of 1,436 and 3,744 chinook salmon, respectively. The Salcha River escapement estimate was conducted under good survey conditions and met the escapement objective. The Chena River escapement objective was not met, however, the survey was conducted under fair to poor survey conditions. Since 1986, ADF&G has conducted research to estimate the proportion of chinook salmon present in a stream that are observed by aerial survey. Aerial surveys have accounted for 35% to 71% of the population as estimated by tagging in the Salcha River since 1987, and 20% to 59% in the Chena River since 1986. For 1990, the tagging population estimates were 10,728 chinook salmon for the Salcha River and 5,603 for the Chena River. It is hoped that this research effort will enable staff to expand historical aerial survey indices for these two important spawning areas into total population estimates.

#### 5.1.2 Canada

In 1990, the aerial surveys of chinook index streams in Canada were carried out only by ADF&G due to Canadian funding cuts. The ADF&G survey results are directly comparable with past Canadian survey counts.

Chinook salmon escapements in most of the major Canadian spawning index areas showed great improvement over 1989 with increases in survey counts noted in all systems except for the Tincup, Ross and Little Salmon Rivers. Index areas such as the Big Salmon, Nisutlin and Wolf Rivers showed strong returns, well above the most recent five year average. The Tatchun Creek foot survey counted 655

chinook, the highest on record for the years in which tagging has occured. The Tincup River count was down from last year and, similar to 1989, was believed to be affected by the high water levels and turbidity in the White River system which may have hindered migration. Ross and Little Salmon River escapement counts were down from the previous year but still had relatively good escapements. These three surveys were rated fair to poor which may partially account for the lower counts. Larger numbers of chinook may have been observed under more favorable conditions.

The Whitehorse Fishway count of 1,407 chinook salmon represents an increase of 200% over the most recent five year average of 469 fish. It should be noted that this return included 292 (21%) coded-wire tagged hatchery returns. Of these 292 fish, 75 were adult females, 76 were adult males and 141 were jacks or precocious males. This represents a minimum estimate of the return of hatchery chinook since not all hatchery releases of chinook are tagged.

The preliminary tagging estimate of total spawning escapement for the Canadian portion of the Yukon River drainage (excluding the Porcupine drainage) was 38,678 chinook salmon, the highest tagging estimate on record. This estimate represents an increase of approximately 118% over the most recent five year average of 17,735 and is within the interim spawning escapement objective range of 33,000 to 43,000 chinook salmon.

## 5.2 Summer Chum Salmon

Very few summer chum salmon aerial survey spawning escapement estimates were obtained due to poor weather and smoke haze caused by numerous tundra and forest fires. A preliminary sonar estimate of 395,303 summer chum salmon to the Anvik River was approximately 19% below the escapement objective of 487,000 fish, and the lowest count since 1983. Aerial surveys of the Andreafsky River system indicated a fair escapement of summer chum salmon. Surveys of other index areas in the Yukon River drainage indicated relatively low numbers of spawners, although most surveys were conducted after the peak of spawning.

## 5.3 Fall Chum Salmon

### 5.3.1 Alaska

Fall chum salmon escapement assessment was not yet completed when this report was prepared. The preliminary sonar estimate of 63,135 fall chum salmon for the Sheenjek River is similar to the escapement objective of 62,000 fish, although some fish passage occurred prior to project startup in August. The Chandalar River sonar project was operational two weeks earlier than the Sheenjek project and the preliminary season escapement estimate was 78,631 fall chum salmon. An escapement objective has not yet been established for the Chandalar River. However, the 1990 estimate was the largest since the sonar project was initiated in 1986, and exceeded the 1986-89 average of 53,600 by 47%. Escapement surveys have not yet been completed in the Tanana River drainage, but preliminary information indicates that escapement objectives were achieved for the Toklat River but not for the upper Tanana River index areas.

### 5.3.2 Canada

Chum salmon aerial surveys were conducted on the mainstem Yukon, Kluane, Koidern, Teslin and Fishing Branch Rivers by DFO in 1990. In addition, a foot survey was conducted on the Kluane River. Aerial surveys conducted on the Kluane River showed a well below average escapement but still somewhat better than 1989. The mainstem Yukon was below the most recent five year average and counts were down from 1989. The Kluane survey was rated fair to poor and the mainstem survey was rated only fair as both surveys were hampered by the ice-up conditions of various sloughs which resulted in less than ideal viewing conditions. Historically, survey counts for the Kluane stocks have been generally higher than those for the mainstem stocks. This was reversed in 1989. In 1990 a return to this trend was noted and the Kluane stock was the stronger. However, both of these two major spawning areas showed poor escapements in 1990. Only 1 chum salmon was observed in the Koidern River, again a fraction of the counts of 1984 and 1985 of over 1,100 fish. The Teslin River survey in 1990 showed the highest index count on record for the years 1982 to 1989.

The Fishing Branch River weir was not operated in 1990 due to budget cuts and therefore a total population escapement count is not available. An aerial survey was conducted, however it was believed to be approximately two weeks late when compared to average run timing. This was due to very poor weather conditions which delayed flying into the system. A further delay was caused by aircraft unavailability. Previous aerial surveys on the Fishing Branch River, on average, represented approximately 28% of the actual count through the weir at the time of the survey. However, this proportion has been quite variable, ranging from 23% to 96% of the weir count from 1985 to 1988 with most falling in the 20% to 40% range. Using an average of 28%, the aerial survey count of 7,541 chum salmon would represent a population at the time of the survey of approximately 27,000 chum salmon. An aerial count of similar magnitude (7,836) in 1986 was associated with a final weir count of 31,378. It may be of use to compare aerial counts of similar magnitude under similar viewing conditions as the errors may vary with the size of the population. Taking into account the unavoidable lateness of the survey it is likely that fish had been lost from the system and that the actual escapement would likely fall within the range of 30,000 to 40,000 chum salmon. The Fishing Branch River weir should be continued for a few more years so that a larger data base will be available for accurately determining aerial survey expansion factors to derive escapements.

The preliminary tagging estimate of the total spawning escapement in the Canadian portion of the Yukon River drainage was approximately 49,849 chum salmon, which was below the most recent five year average of 60,662 fish but up from the extremely poor escapement in 1989 of 35,750. It should be noted that the five year average has been declining for several years.

## 5.4 Coho Salmon

Coho salmon escapement assessment is very limited in the Yukon River drainage due to funding limitations and survey conditions at that time of year. Most of the information that has been collected is from the Tanana River drainage. The boat survey count of coho salmon escapement in the Delta Clearwater River for 1990 was

8,325 fish. Visibility conditions were excellent. Over the past twenty years, documented abundance of coho salmon spawners in this system have ranged from 632 fish in 1972 to 22,300 in 1987.

## 6.0 PROJECT SUMMARIES

### 6.1 Alaska

The major run assessment, harvest monitoring, and spawning escapement studies in Alaska described in prior JTC reports were continued in 1990. Operational methods for these projects remained basically the same as previously described. Results from these projects are incorporated in the fishery and stock status portions of this report, or are reported in the tables of catch and escapement data. However, several projects are specifically discussed here due to their relative importance or their status as new projects.

#### 6.1.1 Salmon Stock Identification

Analysis of chinook salmon scale patterns, age compositions, and geographic distribution of catches and escapements are used by ADF&G on an annual basis to estimate geographic region of origin of the fishery harvests. Data have not yet been analyzed for 1990. Prior year scale patterns analysis (SPA) studies provided the following estimates of region of origin for the total Yukon River drainage chinook salmon harvest (commercial and non-commercial harvests in Alaska and Canada combined):

| Year | Lower Run Origin | Middle Run Origin | Upper Run Origin |
|---|---|---|---|
| 1982 | 15% | 23% | 62% |
| 1983 | 12% | 36% | 51% |
| 1984 | 29% | 36% | 35% |
| 1985 | 31% | 19% | 50% |
| 1986 | 27% | 6% | 68% |
| 1987 | 17% | 18% | 65% |
| 1988 | 27% | 12% | 61% |
| 1989 | 25% | 18% | 57% |

Note that the lower and middle regions of origins are within Alaska, and the upper region of origin is within the Canadian portion of the drainage.

The USFWS continued research into the feasibility of using protein electrophoresis methodology to identify chinook and chum salmon stocks in the mixed stock fisheries in 1990. This work was initiated in 1987, and status reports have been provided to the delegations periodically as warranted by new

information.

### 6.1.2 Yukon River Sonar

As in previous years, hydroacoustic counters and test gill nets were operated by ADF&G on the mainstem Yukon River near Pilot Station from 5 June through 4 September 1990 to estimate salmon passage by species. Preliminary estimates of salmon passage for 1990 were approximately 129,000 chinook, 937,000 summer chum, 206,000 pink, 482,000 fall chum, and 230,000 coho salmon. Annual estimates of salmon passage for prior years are currently being reanalyzed due to recent improvements in data processing and species apportionment methodology. While the historical estimates may change as a result of the analysis currently in progress, the existing estimates are presented here for reference as follows:

| Year | Dates of Operation | Chinook | Summer Chum | Fall Chum | Coho | Pink[a] |
|---|---|---|---|---|---|---|
| 1986 | 6/09-9/12 | 86,000 | 1,926,000 | 527,000 | 200,000 | 1,056,000 |
| 1987 | 6/09-9/06 | 110,000 | 656,000 | 587,000 | 241,000 | |
| 1988 | 6/02-9/14 | 81,000 | 1,876,000 | 507,000 | 264,000 | 536,000 |
| 1989 | 6/04-9/11 | 76,000 | 1,628,000 | 683,000 | 181,000 | |
| 1990 | 6/05-9/04 | 129,000[b] | 937,000 | 482,000 | 230,000 | 206,000 |

[a] Pink salmon counts were so low in 1987 and 1989 that they were included in the non-salmonid species apportionment.

[b] Method of apportioning chinook salmon in 1990 differred from prior years and may not be directly comparable. Analysis of historical data is still in progress.

### 6.1.3 Tanana River Sonar

A new main river sonar project was operated by ADF&G in a feasibility mode on the Tanana River near Manley Hot Springs in July 1990. This project uses technology similar to that employed at the Yukon River sonar project. A field camp was established and hydroacoustic target data were collected. Drift gill nets were used to sample fish for species and size information. This project will require several more seasons before it is fully operational.

### 6.1.4 South Fork Koyukuk River Sonar

A new Bendix side-scan sonar project was operated by USFWS on the South Fork Koyukuk River from 2 August to 25 September 1990 to enumerate chum salmon escapement. Low water levels during August enabled the use of one sonar counter to cover the entire river. Higher water in September made it necessary to deploy

two sonar counters on oposite sides of the river. A season total of 20,081 chum salmon was counted. The accuracy of daily counts was verified with oscilloscope calibrations and systematic visual observations from a counting tower. The escapement estimate is conservative since counts do not include fish passing before 2 August and after 25 September. Escapement peaked on 13 August, and 50% of the run had passed the sonar site by 22 August. A helicopter survey was attempted on 26 September for comparison to the total sonar count. However, lighting was extremely poor and no salmon could be seen. Specific spawning areas were located by radio telemetry tagging of 18 chum salmon. Of the 18 fish tagged, 14 were found on spawning grounds 2 to 10 miles below the Jim River confluence.

#### 6.1.5 Chena and Salcha River Chinook Tagging

A tagging program has been conducted by ADF&G on chinook salmon escapements in the Chena River since 1986 and in the Salcha River since 1987. The objectives have been to estimate total abundance of the chinook salmon escapements into these important spawning streams along with estimating sex, age, and length compositions of these escapements. A third objective is to estimate potential egg deposition from these escapements. As discussed in the stock status section of this report, estimates of the proportion of the escapement observed by peak aerial surveys is also being investigated. Abundance estimates obtained through this tagging program since 1986 were as follows:

| Location and Year | Population Estimate | SE | Aerial Survey | | Prop. Observed During Survey |
|---|---|---|---|---|---|
| | | | Count | Condition | |
| Salcha River, 1987 | 4,771 | 504 | 1,898 | Fair | 0.398 |
| Salcha River, 1988 | 4,562 | 556 | 2,761 | Good | 0.605 |
| Salcha River, 1989 | 3,294 | 630 | 2,333 | Good | 0.708 |
| Salcha River, 1990 | 10,728 | 1,404 | 3,744 | Good | 0.349 |
| Chena River, 1986 | 9,065 | 1,080 | 2,031 | Fair | 0.224 |
| Chena River, 1987 | 6,404 | 563 | 1,312 | Fair | 0.205 |
| Chena River, 1988 | 3,346 | - | 1,966 | Fair-Poor | 0.588 |
| Chena River, 1989 | 2,666 | 249 | 1,280 | Fair-Poor | 0.480 |
| Chena River, 1990 | 5,603 | 1,164 | 1,436 | Fair-Poor | 0.256 |

### 6.2 Canada

#### 6.2.1 Yukon River Test Fishing

Run timing and relative abundance data were collected by DFO for both chinook and chum salmon from two fish wheels located near the Canada/U.S. border. Although the primary purpose of the fish wheels was to capture salmon for the tagging program, consistency in the site selection and fishing time since 1982 does

provide the opportunity for some inter-annual and in-season comparisons. In 1990, the DFO fish wheel catch data indicated chinook salmon run timing approximately one to two weeks earlier than average with a strong early component that dropped off very early and quickly. The peak of the run occurred around 20 July and the main portion of the run passed the fish wheels between 7 July and 9 August.

Throughout the 1990 chinook tagging season, water levels appeared approximately normal. It is difficult to determine the relative magnitude of the run based on fish wheel catches alone, but preliminary population estimates indicate a run size greater than that seen in 1989. The comparative weekly catches in the commercial fishery suggested a good return with a strong early component.

According to the tagging fish wheel catches, the first peak of the chum run was early and compressed, and the late peak was stronger and about average in timing. The tagging wheels showed peak catches around 1 and 15 September. Compared to previous total catches in the fish wheels at White Rock and Sheep Rock, the total fish wheel catch in 1990 was the highest on record.

Water levels during the 1990 chum run were extremely high throughout most of the chum season with levels equaling those seen in July. It may be that the unusually high water levels caused the chum to migrate closer to shore and increased their use of eddies, making them more susceptible to capture in both the test fish wheels and in the commercial fishery. This would have the effect of making the run seem stronger than it actually was.

Small numbers of chum were first caught in the tagging fish wheels and the commercial fishery in mid to late July as was noted in several other years. The chum salmon present in the Canadian portion of the drainage prior to mid to late August might not be best described as fall chum salmon.

### 6.2.2 Yukon River Tagging Program

DFO has conducted a tagging program on salmon stocks in the Canadian section of the drainage since 1982 (excluding 1984). The objectives of the study have been to estimate the total return of chinook and fall chum salmon to Canada (excluding the Porcupine drainage which is partially enumerated by the Fishing Branch weir or by aerial surveys), and to obtain estimates of total escapement, harvest rates, migration rates and run timing. Spaghetti tags are applied to salmon live-captured in the test fish wheels and subsequent recoveries are made by the different user groups fishing upstream. Population estimates are derived from those tags recovered in the commercial fishery below the Stewart River. Analysis of the 1990 data is incomplete, however the preliminary chinook salmon border population estimate is 57,502 fish (95% C.I. = 50,484 to 65,423). Of this number, approximately 38,678 chinook are estimated to have reached the various spawning grounds. Population and spawning escapement estimates for all years follow for comparison:

CANADIAN CATCHES AND ESCAPEMENTS OF YUKON RIVER CHINOOK SALMON 1982-90

| (1) YEAR | (2) COMM | (3) DOM | (4) IFF | (5) SPORT | (6) CDN TOTAL YUKON(a) | (7) OLD CROW | (8) TOTAL IFF(b) | (9) TOTAL CDN(c) | (10) BORDER ESC (d) | (11) SPAWN ESC (e) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 8,640 | 435 | 7,433 | 300 | 16,808 | 400 | 7,833 | 17,208 | 36,598 | 19,790 |
| 1983 | 13,027 | 400 | 5,025 | 300 | 18,752 | 200 | 5,225 | 18,952 | 47,741 | 28,989 |
| 1984 | 9,885 | 260 | 5,850 | 300 | 16,295 | 500 | 6,350 | 16,795 | 43,911 | 27,616 |
| 1985 | 12,573 | 478 | 5,800 | 300 | 19,151 | 150 | 5,950 | 19,301 | 29,881 | 10,730 |
| 1986 | 10,797 | 342 | 8,625 | 300 | 20,064 | 300 | 8,925 | 20,364 | 36,479 | 16,415 |
| 1987 | 10,864 | 330 | 6,119 | 300 | 17,613 | 51 | 6,170 | 17,664 | 30,823 | 13,210 |
| 1988 | 13,217 | 282 | 7,178 | 650 | 21,327 | 100 | 7,278 | 21,427 | 44,445 | 23,118 |
| 1989 | 9,789 | 400 | 6,930 | 300 | 17,419 | 525 | 7,455 | 17,944 | 42,620 | 25,201 |
| 1990* | 11,291 | 233 | 7,000 | 300 | 18,824 | 0 | 7,000 | 18,824 | 57,502 | 38,678 |

* Data for 1990 are preliminary, with some numbers approximations.

(a) = total of column (2)+(3)+(4)+(5)
(b) = total of column (4)+(7)
(c) = total of column (6)+(7)
(d) = calculated from tagging programs, except 1984 (based on escapement index)
(e) = (10)-(6)

The preliminary border population estimate of chum salmon migrating into Canada (excluding the Porcupine River drainage) in 1990 is 81,656 fish (95% C.I. = 77,280 to 86,265). Of this number, approximately 49,849 chum salmon are estimated to have reached the various spawning grounds. Population and spawning escapement estimates for all years follow for comparison:

CANADIAN CATCHES AND ESCAPEMENTS OF YUKON RIVER CHUM SALMON 1982-90

| (1) YEAR | (2) COMM | (3) DOM | (4) IFF | (5) CDN TOTAL YUKON(a) | (6) OLD CROW | (7) TOTAL IFF(b) | (8) TOTAL CDN(c) | (9) BORDER ESC (d) | (10) SPAWN ESC (e) |
|---|---|---|---|---|---|---|---|---|---|
| 1982 | 11,312 | 683 | 3,096 | 15,091 | 1,000 | 4,096 | 16,091 | 47,049 | 31,958 |
| 1983 | 25,990 | 300 | 1,200 | 27,490 | 2,000 | 3,200 | 29,490 | 118,365 | 90,875 |
| 1984 | 22,932 | 535 | 1,800 | 25,267 | 4,000 | 5,800 | 29,267 | 81,900 | 56,633 |
| I985 | 35,746 | 279 | 1,740 | 37,765 | 3,500 | 5,240 | 41,265 | 99,775 | 62,010 |
| 1986 | 11,464 | 222 | 2,150 | 13,836 | 700 | 2,850 | 14,536 | 101,826 | 87,990 |
| 1987 | 40,591 | 132 | 3,622 | 44,345 | 135 | 3,757 | 44,480 | 125,121 | 80,776 |
| 1988 | 30,263 | 349 | 1,882 | 32,494 | 1,071 | 2,953 | 33,565 | 69,280 | 36,786 |
| 1989 | 17,549 | 100 | 2,462 | 20,111 | 2,909 | 5,371 | 23,020 | 55,861 | 35,750 |
| 1990* | 27,207 | 100 | 4,500 | 31,807 | 3,000 | 7,500 | 34,807 | 81,656 | 49,849 |

* Data for 1990 are preliminary, with some numbers approximations.

(a) = total of column (2)+(3)+(4)
(b) = total of column (4)+(6)
(c) = total of column (5)+(6)
(d) = calculated from tagging programs, except 1984 (based on assumed harvest rates)
(e) = (9)-(5)

### 6.2.3 Whitehorse Hatchery Operations

A total of 1,407 chinook salmon was enumerated at the Whitehorse Fishway in 1990. This represents a 200% increase over the 1985-89 average of 469 chinook. A strong return of hatchery chinook was seen this year with a total of 292 clipped fish being counted (75 female adults, 76 male adults, and 141 male jacks). This was the second year for the return of adult chinook from hatchery releases. Hatchery chinook accounted for at least 21% of the total run through the ladder. It is likely that this percentage is actually higher due to the fact that not all hatchery raised fry were tagged.

The total fishway count consisted of 509 females and 898 males and of these, 95 females and 76 males were taken for hatchery brood stock. Therefore, the total potential naturally spawning population was 414 females and 822 males. The chinook run timing at the fishway appeared to be similar to 1989 with 50% of the run being recorded by 13 August. The first chinook appeared on 25 July which is a fairly early showing (on average the first chinook arrives on 1 August) and the peak count of 107 occurred on 13 August.

From a total fertilized egg count of 182,877 eggs in September 1989, 112,499 fry were released in June 1990 for an egg to fry survival rate of 62%. A total of 50,154 fry were released into Michie Creek and 11,969 were released into Wolf

Creek. Wolf Creek releases were not tagged but all of the fish released into Michie Creek were coded-wire tagged. The remaining 50,376 fry were coded-wire tagged with distinct tag codes and imprinted on the fishway water, after which they were released below the dam in the hopes of obtaining information in future years on differential survival of juvenile chinook released above and below the Whitehorse Dam. Differences in survival rates may give some insight into the juvenile mortality rates associated with the dam.

A total of 171 chinook salmon including 95 females and 76 males was taken for brood stock in 1990. Of this number a total of 24 females died prematurely; 10 deaths were due to ovadine poisoning due to a design flaw in the hatchery which has subsequently been corrected. Attempts were made to use the eggs from all the females that died but viability was low.

The green egg inventory was 356,848 eggs of which 273,945 have proved viable and are presently being incubated. The average fecundity was 5,792 eggs per female. The chinook taken for the hatchery were also sampled for age-size-sex data and heads were taken from adipose clipped specimens.

High water temperatures (17 degrees C) were again experienced in the fishway in 1990. To avoid holding the chinook in the relatively warm water of the fishway, the fish selected for hatchery brood stock were transported to the hatchery and held to maturity in the cool, ground water fed Capilano troughs with good success. Due to the advanced sexual state of these fish, maturation in the cooler hatchery water (6 degrees C) was not a problem although the maturity was somewhat delayed. Holding the fish in the hatchery also reduced the potential of theft of brood stock.

## 7.0 ANALYSIS OF CANADIAN ORIGIN SALMON PRODUCTIVITY

### 7.1 Chinook Salmon

A brood year table for Canadian origin chinook salmon has been constructed (Table 4) based on harvest levels and brood year escapements as presented elsewhere in this report, and harvest apportionment by stock and age as reported in the annual ADF&G Scale Pattern Analysis (SPA) reports. This analysis was limited to the 1977-83 brood years because stock identification analysis for the 1990 harvest is not yet completed and historic stock identification data are not available prior to 1982.

Chinook salmon escapements for years 1979-81 and 1984 were estimated based on the average of the annual proportional contribution of a five area spawning index count to the Canadian DFO spawning escapement estimate for 1982, 1983, and 1985-89. Specifically, the spawning indices used to estimate the spawning population were Tatchun Creek, Big Salmon River, Nisutlin River, Wolf River, and the Whitehorse Fishway less fin-clipped fish of hatchery origin (Appendix Table 9). The 1977 and 1978 spawning escapements, however, were estimated based on a four-area index. The reduction in the number of index streams used in generating these estimates was necessary because consistent aerial survey data were not available for Wolf River.

Annual spawning escapement numbers were attributed to individual brood years based on an average age-class contribution schedule previously estimated by ADF&G (Linda Brannian, ADF&G, Anchorage, personal communication). Because index escapement counts have accounted for only 8% to 27% of the total brood year return, relatively minor adjustments to the assumed age-class contribution of the escapement would only slightly affect estimates of the return per spawner ratio.

Estimated brood year escapements ranged from 7,424 in 1977 to 52,897 in 1981. Total resulting brood year returns ranged from 83,617 for the 1982 brood year to 194,140 for the 1981 brood year. Productivity, measured as return per spawner, ranged from 2.7 for the 1980 brood year to 18.1 for the 1977 brood year. However, the 1977 return per spawner estimate is probably inflated. Survey conditions were considered poor during the aerial survey of the Big Salmon River in 1977. The minimal salmon count for this area most likely resulted in an underestimate of the total spawning population and an overestimate of the productivity for the brood year. However, one of the two other spawning index counts conducted under better survey conditions, and the fishway count, were also low in 1977 (Appendix Table 9). This suggests that the overall escapement population was relatively low in 1977 and the level of productivity for the 1977 brood year was greater than it was for the other brood years. Excluding the 1977 data, return per spawner for Canadian origin chinook salmon for brood years 1978-83 averaged 4.39.

## 7.2 Fall Chum Salmon

There is no productivity information currently available specific to Canadian origin fall chum salmon in the Yukon River due to a lack of stock identification data for the Alaska harvest. Without estimates of Canadian stock contribution to Alaska fishery harvests, it is not possible to reconstruct returns for the Canadian stocks and relate the returns to parent year spawning escapements. However, data were presented in the March 1990 JTC report regarding overall Yukon River fall chum salmon escapements and returns that provides some information on overall Yukon River fall chum salmon productivity. The information was initially presented to describe how the U.S. attempts to project return sizes, but can also be of benefit in the present discussion of productivity. The approach requires some major assumptions and is only intended to provide approximate productivity information until more complete and accurate data becomes available.

Total Yukon River drainage fall chum salmon spawning escapement is not available on a historical basis. The sonar project located at Pilot Station has provided passage estimates since 1986, and spawning escapement can be estimated by subtracting documented upriver harvests. However, this does not yet provide a sufficient series of annual estimates from which to analyze productivity. The approach presented in the March 1990 JTC report was to assume that total Yukon River fall chum salmon spawning escapement could be approximated by doubling the sum of the escapement to four key spawning areas for which data are available back to 1974: the Sheenjek River, Fishing Branch River, Toklat River, and Delta River. Therefore, the estimates of return are based on the sum of documented harvests and the doubled escapement index. Returns are apportioned by age class based on annual age sampling in the lower river. Further discussion of these assumptions and their derivation can be found in the March 1990 JTC report. The

resulting estimates of overall Yukon River fall chum salmon productivity were as follows:

| Brood Year | Escapement | Return | Return per Spawner |
|---|---|---|---|
| 1974 | 344,000 | 786,000 | 2.28 |
| 1975 | 1,243,000 | 1,223,000 | 0.98 |
| 1976 | 246,000 | 810,000 | 3.29 |
| 1977 | 375,000 | 882,000 | 2.35 |
| 1978 | 243,000 | 374,000 | 1.54 |
| 1979 | 799,000 | 913,000 | 1.14 |
| 1980 | 231,000 | 475,000 | 2.06 |
| 1981 | 342,000 | 1,107,000 | 3.24 |
| 1982 | 110,000 | 495,000 | 4.50 |
| 1983 | 210,000 | 924,000 | 4.40 |
| 1984 | 142,000 | 471,000 | 3.32 |
| | | Average R/S= | 2.65 |

This analysis indicates that overall Yukon River fall chum salmon productivity may range from approximately 1.0 to 4.5 returns per spawner, averaging 2.6, and that return per spawner is inversely correlated with the number of spawners. While this is an approximation for the overall Yukon River stock grouping, due to the lack of stock identification data it is not known to what extent this may represent productivity specific to the Canadian stock.

## 8.0 YUKON MAINSTEM FALL CHUM ESCAPEMENT OBJECTIVE AND STOCK REBUILDING

### 8.1 Introduction

The JTC was requested by the chief negotiators in 1987 to develop spawning escapement objectives for Canadian chinook and chum salmon. It was recognized then, and remains true at this time, that there is a limited amount of information from which to derive these spawning escapement objectives. Determination of the spawning escapement producing the maximum sustainable yield (MSY) may be one goal of this process. However, the theoretical MSY point is not easily discoverable due to the complex stock mixture in the Yukon River and the lack of comprehensive field research programs. Therefore, objectives established for the Yukon River system are intended to be interim objectives, recognizing that returns from varying brood year spawning escapements and improvements in field programs may provide information upon which to base further revisions in the objectives. Accurate stock identification and a time series that includes a broad range of spawning escapements are necessary to more rigorously develop spawning escapement objectives.

The available data was examined in March 1987 and various calculations were made by members of the JTC. There was a tendency for point estimates of spawning escapement objectives to be relatively higher as proposed by the Canadian section than by the U.S. section. The ranges which resulted were largely due to the differing perspectives of the Canadian and U.S. sections. Consensus was reached for Yukon River mainstem chinook and fall chum salmon objectives through a compromise process in which ranges were established. However, agreement could not be reached on an objective for the Fishing Branch River fall chum salmon population at that meeting. At the next regular meeting of the JTC in October 1987 this subject was revisited and agreement was reached, once again through compromise with the establishment of a range.

As a result of their discussions in March and October 1987, the JTC recommended the following interim spawning escapement objectives in the April and October 1987 JTC reports: (1) Yukon River mainstem chinook salmon - 33,000 to 43,000; (2) Yukon River mainstem fall chum salmon - 90,000 to 135,000; and (3) Fishing Branch River fall chum salmon - 50,000 to 120,000.

At the March 1990 JTC meeting in Whitehorse, the U.S. section raised concerns regarding the technical merit for the interim spawning escapement objective of 90,000 to 135,000 for Yukon River mainstem fall chum salmon. At the March 1990 treaty negotiations in Whitehorse, the U.S. chief negotiator restated the lack of support for the interim spawning escapement objective. At the April 1990 treaty negotiations in Juneau, the chief negotiators for the U.S. and Canada jointly assigned the JTC to examine all available data, including information which has become available since 1987, at their next meeting and develop proposals for an interim spawning escapement objective for Yukon River mainstem fall chum salmon. The analysis and recommendations which follow are the result of the November 1990 JTC meeting and the work of a joint U.S. and Canadian subcommittee of the JTC subsequent to the JTC meeting.

## 8.2 Interim Spawning Escapement Objective

Spawning escapement estimates are available for the Delta, Toklat, and Sheenjek Rivers in Alaska, and the Fishing Branch River in Canada, for the period 1974-90, although some assumptions and expansions were necessary to derive the data for some years. Estimates are available for the Yukon mainstem only since 1982. Attempts were made by the JTC to generate annual Yukon mainstem estimates for the period 1974-81 based upon correlations with the other stocks, but the relationships were too variable to be of any predictive value. Spawning escapement estimates for each of the five systems during the period 1974-90, as well as notations as to method of derivation, are shown in Table 5. It should be noted that while these five systems are important fall chum salmon spawning areas, other spawning areas exist for which less information is available.

The JTC has previously stated that the Yukon mainstem fall chum salmon spawning stock was below optimal levels based on the limited data available. While this remains true in general terms, the U.S. section questions whether spawning escapements for some years might not be at the appropriate level. The current lack of stock specific harvest data for Yukon River chum salmon makes it difficult to determine the level of spawning escapement to the Yukon mainstem

that maximizes yield. However, the Canadian section believes it may be possible to determine this level of escapement through relatively large changes in spawning escapement of the Yukon mainstem stock over time accompanied by some assumptions regarding the timing of the adult return to the river and the operation of the fisheries.

The JTC reviewed an approach used by the U.S. section for reassessing interim spawning escapement objectives for the Delta, Toklat, and Sheenjek Rivers in Alaska, and a recommendation by the U.S. section to apply this approach to the Yukon mainstem and Fishing Branch Rivers in Canada. The approach for the U.S. stocks included examination of annual escapement estimates for each stock during the period 1974-90, and exclusion of selected years as outlier high escapements, or too low to be positively considered in the establishment of the objective. The remaining data were averaged, and the result was taken to be the interim spawning escapement objective minimum (Table 5). The resulting objectives were not substantially different from those currently established. Specifically, the spawning escapement objective for the Delta River would remain >11,000, the Toklat River would remain >33,000, and the Sheenjek River would change from >62,000 to >64,000.

In order to take a more conservative approach for the Yukon mainstem stock in the absence of data for the period 1974-81, no escapement estimates were excluded as outlier high during the period 1982-90, but five of the nine estimates were excluded as too low. The four estimates that were above the average were retained, and averaged to generate the escapement objective minimum. This was in recognition of the possibility that performance of this stock may have been more like the Toklat and Fishing Branch River stocks than the Delta and Sheenjek River stocks. The result is an interim spawning escapement objective of greater than (>) 80,000 fall chum salmon for the Yukon mainstem in Canada. An upper end was not established. There was discussion and analysis of data for the Fishing Branch River, but it was later decided not to revise the existing interim escapement objective for this stock.

The JTC recommends that the interim spawning escapement objectives that result from this analysis be considered for implementation by the delegations and appropriate management agencies. These interim spawning escapement objectives should be reassessed periodically as more and better data become available regarding escapements and stock specific productivity.

Although the U.S. and Canadian sections agreed on an interim spawning escapement objective of >80,000 for the Yukon mainstem chum salmon stock, there was not complete agreement on the meaning of the objective. The primary purpose of an interim escapement objective, or objective range, from the Canadian perspective is as a tool to determine the level of spawning escapement that maximizes adult returns. The Canadian section believes that spawning escapements for the Yukon mainstem stock have been less than those necessary to maximize adult production over the period 1982 to 1990. Consequently, using escapement estimates for this period to develop an objective is, in the Canadian view, inappropriate. More particularly, the Canadian section thinks an escapement objective that maximizes adult returns must be considerably greater than 80,000 and more toward the midpoint of the previously agreed to range of 90,000-135,000.

The U.S. section views spawning escapement objectives in context with historical harvest and escapement data for the aggregate stocks. For Yukon River fall chum salmon, total inriver utilization (both countries and all users combined) was below 300,000 fish per year until the mid-1970's, when the commercial fishery more fully developed (Appendix Table 2). Harvest peaked in excess of 600,000 fish in 1979 and 1981, but has been held to substantially lower levels in recent years to improve escapements. The U.S. section infers from this that MSY based solely upon wild stock management is probably somewhat below the peak levels achieved during development of the fishery. Spawning escapement objectives, in the U.S. view, are intended to provide for this sustainable yield level and are therefore greater than the low spawning levels that occurred in differing years for the various stocks as a result of excessive exploitation. The U.S. section thinks that an escapement objective of >80,000 for the Yukon mainstem stock is appropriate and consistent with this philosophy, especially when considering that spawning escapements have been as low as 32,000 and not exceeded 92,000 for this stock since assessment was initiated in 1982.

Although the U.S. and Canadian sections approach the task of establishing an interim spawning escapement objective for Canadian Yukon mainstem chum salmon with differing perspectives, we do agree that research is necessary to better evaluate the escapement level necessary to sustain maximum yield for the stock.

## 8.3 Stock Rebuilding

Various stock rebuilding scenarios for Yukon River mainstem fall chum salmon were presented to the delegations at treaty negotiations between April 1987 and April 1989. The chief negotiators agreed in concept to a three cycle (12 year) brood year rebuilding plan in April 1989 which would endeavor to rebuild strong brood years to the interim spawning escapement objective in one cycle, and weaker brood years over three cycles in equal increments. This schedule may still be appropriate, although the rebuilding goal would need to be revised if the interim spawning escapement objective recommended here by the JTC of >80,000 fall chum salmon were to be accepted by the delegations.

The model used to generate the stock rebuilding scenario graphics required a point estimate of the spawning escapement objective. Since the prior spawning escapement objective was a range, the midpoint of the range was used for illustrative purposes. With the current recommendation of an escapement objective minimum, that minimum level or some higher point could be entered into the model as the goal of stock rebuilding. The JTC can provide an updated stock rebuilding graph given further direction from the negotiators.

The JTC recommends that the minimum goal of the rebuilding plan should be to achieve the interim escapement objective minimum of 80,000 fall chum salmon. For brood years with escapements already in excess of this level, the minimum goal should be to maintain the brood year abundance. Contribution of the two major age classes (ages 4 and 5) should be considered in the assessment of brood year abundance. The result of such a three cycle rebuilding plan, if successfully completed, would be for Yukon mainstem spawning escapement in Canada to equal or exceed 80,000 fall chum salmon for all years in the cycle.

## 9.0 CANADIAN REVIEW OF USFWS ELECTROPHORESIS STUDY, 1987-89

The USFWS has been conducting a research study on Yukon River chum and chinook salmon since 1987 to determine feasibility of identifying stocks based upon electrophoresis methodology. Preliminary and partial results were provided by the U.S. section at the March 1990 JTC meeting for chum salmon (1987 and 1989), and chinook salmon (1987 and 1988). The Canadian section was asked to review this information and provide an assessment at the November 1990 JTC meeting.

The Canadian section observed that there appears to be a substantial bias in the apportionment of chum salmon among Canadian and U.S. origin stocks based on the electrophoretic stock identification method. In particular, the bias resulted in an underestimate of the Canadian contribution to the total run. This is the result, in part, of the genetic similarity between the Chandalar/Sheenjek stocks in the U.S. and a cluster of three stocks in Canada, including the Yukon mainstem stock.

In contrast to the results for chum salmon, there appears to be a good separation between Canadian and U.S. chinook salmon stocks based on the electrophoretic method. Three clusters can be identified, two of which are in the lower and middle river (U.S.), and one of which is in the upper river (Canada). However, despite the good separation, accuracy appears to be low and there is a substantial bias in favor of U.S. origin stocks.

The U.S. section appreciated the Canadian review of the preliminary results, and provided the following response. There does appear to be a problem with the current apportionment between U.S. and Canada for chum salmon using 12 genetic loci. The close genetic similarity between chum stocks near the border are the major source of error. There is reason to believe that increasing the number of loci to 23 will allow a much greater degree of accuracy in identifying these stocks. A preliminary analysis offers some grounds for optimism. If, however, the level of accuracy in the apportionment between the U.S. and Canada does not improve substantially, it may be necessary to find more genetic characters, investigate the use of DNA techniques, or accept the fact that we cannot achieve an increased level of accuracy. In this last case, it may be possible to identify the degree and direction of bias and make acceptable corrections.

In the case of chinook salmon, it was initially disappointing to see the low level of accuracy between U.S. and Canadian stocks given the high degree of genetic separation between lower, middle, and upper river stocks. Extensive simulations have been run since the preliminary results were presented, and it now appears that not all 22 of the genetic loci are usable for discriminating between U.S. and Canadian stocks. Some of the loci are confusing the GSI program because there is little or no difference between U.S. and Canadian stocks for these loci. When these loci are removed from the analysis, the level of accuracy improved dramatically.

A comprehensive summary of the research study findings for both chum and chinook salmon for the period 1987-90 will be presented at some future JTC meeting after the data have been compiled and reviewed.

## 10.0 U.S. REVIEW OF DFO TAGGING STUDY, 1987-88

The U.S. section of the JTC summarized their review of the draft documents entitled *The distribution and abundance of chinook salmon (Oncorhynchus tshawytscha) and chum salmon (Oncorhynchus keta) in the Upper Yukon River Basin as determined by a spaghetti tagging programme: 1987*, and *The distribution and abundance of chinook salmon (Oncorhynchus tshawytscha) and chum salmon (Oncorhynchus keta) in the Upper Yukon River Basin as determined by a spaghetti tagging programme: 1988*, both by R.A.C. Johnston and G.M.W. Cronkite. The original purpose of the review was to specifically respond to the contents of the draft documents. However, in light of the importance of this tagging program to the treaty negotiation process, and future implementation of a treaty, the scope of the review was expanded to include a technical evaluation of the methodology currently employed in the Yukon River tagging program conducted by DFO. The following summary of the review is condensed from a report entitled *A comprehensive review of the Yukon River salmon tagging program conducted by the Canadian Department of Fisheries and Oceans*, by J.F. Bromaghin, Alaska Department of Fish and Game, AYK Regional Information Report 3A90-24.

A substantial portion of the review consisted of a presentation and summary of two methods of analyzing capture-recapture data; the Chapman and log-linear estimation procedures. The Chapman estimation procedure is currently employed by DFO while the log-linear procedure has only been developed relatively recently. The log-linear procedure is more complex than the Chapman estimation procedure but it has a number of attractive features: (1) the procedure produces estimates of the population size and the probabilities of capture in both the fish wheels and the commercial fishery for each stratum; (2) the model assumptions of the log-linear model are more appealing in a riverine fish tagging study than are the assumptions of the Chapman model; (3) the model encourages the use of fully stratified models; and (4) the log-linear estimation procedure in general, and the hypothesis testing procedure in particular, is more flexible than the Chapman estimation procedure.

A number of important aspects of the DFO tagging program, that are relatively independent of the model under which estimates are computed, were addressed. Perhaps most importantly, it is likely that the sex and age stratification system currently employed by DFO could be improved. It is generally agreed that the gill nets used in the commercial fishery, and possibly the fish wheels used to capture and tag salmon, are size selective. If the probabilities of capture are a function of the size of individuals, as is commonly believed, it is highly desirable to stratify on a variable which is highly correlated with size or directly on size itself. In this way the advantages of stratification can be fully realized. While size and age are undoubtedly correlated, the correlation is unlikely to be large.

As examples, the 1987 and 1988 tagging data were analyzed using the log-linear estimation procedure and both a sex-age and a sex-length stratification system. The estimates of population size obtained from these analyses are contrasted with the preliminary estimates obtained by DFO in Table 6. As is apparent in these examples, age is not a good stratification variable, particularly for chinook salmon. The estimated coefficients of variation of the population size estimates, which provide the most reliable means of comparing estimates,

decreased substantially under a sex and length stratification in three of the four sets of data. The fact that the estimated coefficient of variation was larger under the sex and length stratification than under the sex and age stratification for the 1987 chum data is more likely to indicate an abnormality in those particular data than weaken the argument for using a length stratification.

Both models assume that the capture history of each individual fish is known without error. Although the stratum to which each individual captured in the fish wheels is known, the individuals captured in the commercial fishery are classified into the strata based upon a sample(s) from the commercial harvest. However, the level at which the commercial harvest is currently sampled is insufficient to perform the classification with the required accuracy. Since it is agreed that the quality of population size estimates is dependent on the use of an efficient stratification system, larger samples should be taken from the commercial harvest so that the composition of the harvest, with respect to the stratification system, can be estimated with less error.

A number of specific recommendations were made concerning the continuation of the DFO Yukon River tagging program. Note that the recommendations are derived from the complete review cited above and are not all discussed in this summary. An attempt has been made to list the recommendations in the order of their priority. It is recognized that DFO is under no obligation to adopt these recommendations and, in fact, some of the recommendations may be difficult, or impossible, to implement in the near term. However, all of the recommendations are viewed as important in maintaining the quality of the DFO tagging program:

1. Devote funding and personnel to develop methodology specific to riverine fish tagging programs.

2. Abandon the use of an age stratification in preference to a length, or size, stratification.

3. Increase monitoring of the commercial fishery and sampling of the commercial harvest.

4. Adopt the log-linear estimation procedure.

5. Investigate the statistical properties of the Chapman and log-linear estimators using simulation techniques.

6. Compute estimates of exploitation rates, and similar parameters, within strata.

7. Investigate tag loss more fully on a regular basis.

8. Examine the possibility of employing a double-tagging strategy.

9. Use exploratory analyses of existing data to investigate the relationship between length and probability of capture and search for other potentially useful measures of size.

10. If the Chapman estimator continues to be used, either estimate the within strata variances and use the estimates to construct a confidence interval for the total population size or determine how the same objective might be accomplished using the conditional distributions of the $m_i$ frequencies.

## 11.0 RESEARCH AND MANAGEMENT PROGRAM NEEDS

[Note: Description of program needs in the 25 April 1990 Draft Agreement is similar in the U.S. and Canadian proposals, with the exception that the Canadian proposal includes a statement regarding implementation of enhancement projects to benefit the fisheries of both countries. In addition, the Canadian proposal is placed in Annex IV, while the U.S. proposal is placed in the MOU. At the request of the negotiators the JTC has revised the description of program needs on a technical basis. The JTC takes no position on the location of placement within the Draft Agreement nor the inclusion of a statement regarding implementation of enhancement projects as these are understood to be points of negotiation.]

The Parties agree to endeavor to implement the fisheries research and management programs necessary to support run rebuilding and cooperative management of chinook and chum salmon stocks. The Joint Technical Committee (JTC) has determined that the existing programs, for both Parties, are presently inadequate to meet the commitments of this agreement. Therefore, the JTC recommends the upgrade of some program elements and the initiation of new projects to provide the tools necessary for treaty implementation. As an initial planning guide for the responsible agencies, the JTC has prepared the program outline which follows. This may not be all inclusive, and additional elements may be added by each Party as necessary. Major hatchery production and assessment projects are not included, since none have been jointly mandated by the Parties to date. New program elements or those requiring substantial expansion from present levels are indicated with an asterisk (*).

A. Run Forecasting
- *1. Chinook Salmon Projections (U.S. and Canada)
- *2. Chum Salmon Projections (U.S. and Canada)

B. Run Abundance Assessment
- 1. Fishery Performance Analysis (U.S. and Canada)
- 2. Lower Yukon River Test Fishery (U.S.)
- *3. Lower Yukon River Sonar (U.S.)
- 4. Middle Yukon River Test Fishery (U.S.)
- 5. Tanana River Test Fishery (U.S.)
- *6. Tanana River Sonar (U.S.)
- *7. Yukon River US/Canada Border Sonar (U.S. and Canada) - New project
- 8. Upper Yukon River Test Fishery (Canada)

C. Harvest Monitoring
- *1. Commercial Harvest Documentation (U.S. and Canada)
- *2. Subsistence/Indian Food Harvest Estimation (U.S. and Canada)
- *3. Personal Use/Domestic Harvest Estimation (U.S. and Canada)
- *4. Sport Fishery Harvest Estimation (U.S. and Canada)

D. Spawning Escapement Monitoring
- 1. Anvik River Sonar (U.S.)
- *2. Koyukuk River Sonar (U.S.)
- 3. Chandalar River Sonar (U.S.)
- 4. Sheenjek River Sonar (U.S.)
- *5. Chena and Salcha River Chinook Tagging (U.S.)
- *6. Escapement Surveys (U.S. and Canada)
- *7. Chinook and Chum Border Tag/Recapture Study (Canada)
- 8. Fishing Branch River Weir (Canada)
- 9. Whitehorse Dam Fishway Count (Canada)

E. Run Reconstruction by Stock
- *1. Sampling for Age-Sex-Size (U.S. and Canada)
- *2. U.S. Fishery Inseason Stock ID (U.S.)

F. Enhancement
- 1. Whitehorse Dam Hatchery Mitigation for Chinook (Canada)
- 2. Chum Instream Incubation (Canada)

G. Management Systems
- 1. Fishery Management Plans (U.S. and Canada)
- *2. Gear Selectivity Studies (U.S. and Canada) - New project

# FIGURES AND TABLES

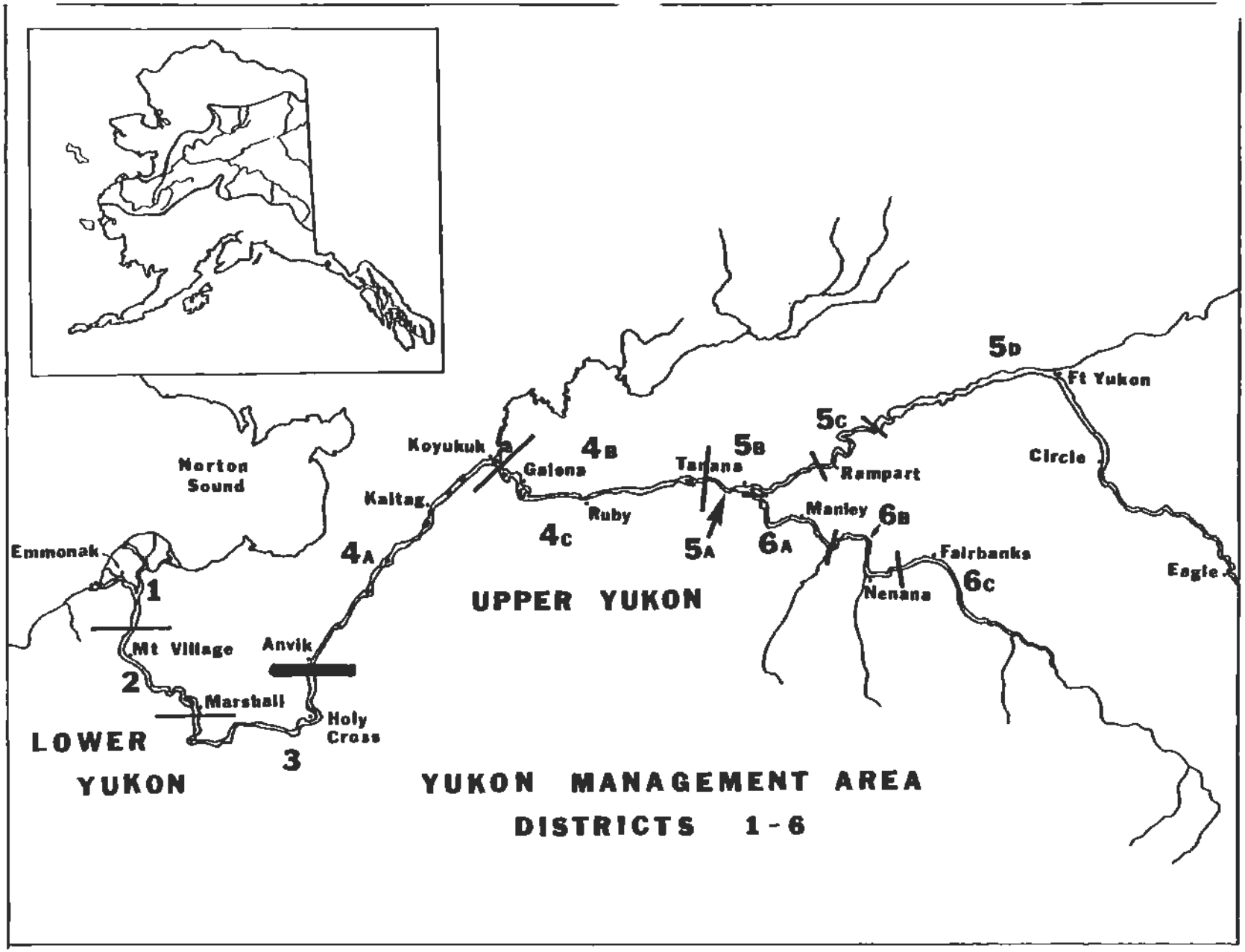


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Figure 1. Map of the Alaskan portion of the Yukon River, showing fishing district boundaries.

Table 1. Alaskan commercial sales of Yukon River salmon in 1990. a,b

| District Subdist. | No. of Fishermen c | Chinook | | Summer Chum | | Fall Chum | | Coho | | Total Salmon | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Numbers | Roe | Numbers | Roe | Numbers | Roe | Numbers | Roe | Numbers | Roe |
| 1 | 459 | 51,161 | 0 | 148,911 | 0 | 27,337 | 0 | 13,354 | 0 | 240,763 | 0 |
| 2 | 258 | 33,213 | 0 | 132,507 | 0 | 37,173 | 0 | 16,435 | 0 | 219,328 | 0 |
| Subtotal | 677 | 84,374 | 0 | 281,418 | 0 | 64,510 | 0 | 29,789 | 0 | 460,091 | 0 |
| 3 | 22 | 2,341 | 0 | 643 | 0 | 3,715 | 0 | 918 | 0 | 7,617 | 0 |
| Total Lower Yukon | 679 | 86,715 | 0 | 282,061 | 0 | 68,225 | 0 | 30,707 | 0 | 467,708 | 0 |
| 4-A | 65 | 52 | 8 | 11,177 | 95,541 | 0 | 0 | 0 | 0 | 11,229 | 95,549 |
| 4-B,C | 31 | 3,484 | 0 | 1,187 | 10,182 | 4,989 | 2,351 | 0 | 0 | 9,660 | 12,533 |
| Subtotal District 4 | 92 | 3,536 | 8 | 12,364 | 105,723 | 4,989 | 2,351 | 0 | 0 | 20,889 | 108,082 |
| 5-A,8,C | 25 | 2,810 | 47 | 5 | 575 | 5,169 | 945 | 0 | 0 | 7,984 | 1,567 |
| 5-D | 6 | 543 | 0 | 6 | 19 | 2,609 | 113 | 0 | 0 | 3,158 | 132 |
| Subtotal District 5 | 30 | 3,353 | 47 | 11 | 594 | 7,778 | 1,058 | 0 | 0 | 11,142 | 1,699 |
| District 6 | 31 | 2,590 | 1,676 | 16,407 | 3,059 | 49,989 | 7,392 | 12,464 | 3,888 | 81,450 | 16,015 |
| Total Upper Yukon | 153 | 9,479 | 1,731 | 28,782 | 109,376 | 62,756 | 10,801 | 12,464 | 3,888 | 113,481 | 125,796 |
| Total Yukon Area | 832 | 96,194 | 1,731 | 310,843 | 109,376 | 130,981 | 10,801 | 43,171 | 3,888 | 581,189 | 125,796 |

a Harvest reported in numbers of fish sold in the round and pounds of salmon roe.
b Includes ADF&G test fish sales.
c Number of unique permits fished by district, subdistrict or area. Totals by area may not add up due to transfers between districts.

Table 2. Alaskan commercial sales of Yukon River salmon, 1961-1990. a,b

| | Chinook | | Summer Chum | | Fall Chum | | Coho | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Numbers | Roe | Numbers | Roe c | Numbers | Roe d | Numbers | Roe | Numbers | Roe |
| 1961 | 119,664 | - | - | - | 42,461 | - | 2,855 | - | 164,980 | - |
| 1962 | 94,734 | - | - | - | 53,116 | - | 22,926 | - | 170,776 | - |
| 1963 | 117,048 | - | - | - | 0 | - | 5,572 | - | 122,620 | - |
| 1964 | 93,587 | - | - | - | 8,347 | - | 2,446 | - | 104,380 | - |
| 1965 | 118,098 | - | - | - | 23,317 | - | 350 | - | 141,765 | - |
| 1966 | 93,315 | - | - | - | 71,045 | - | 19,254 | - | 183,614 | - |
| 1967 | 129,656 | - | 10,935 | - | 38,274 | - | 11,047 | - | 189,912 | - |
| 1968 | 106,526 | - | 14,470 | - | 52,925 | - | 13,303 | - | 187,224 | - |
| 1969 | 91,027 | - | 61,966 | - | 131,310 | - | 15,093 | - | 299,396 | - |
| 1970 | 79,145 | - | 137,006 | - | 209,595 | - | 13,188 | - | 438,934 | - |
| 1971 | 110,507 | - | 100,090 | - | 189,594 | - | 12,203 | - | 412,394 | - |
| 1972 | 92,840 | - | 135,668 | - | 152,176 | - | 22,233 | - | 402,917 | - |
| 1973 | 75,353 | - | 285,509 | - | 232,090 | - | 36,641 | - | 629,593 | - |
| 1974 | 98,089 | - | 589,892 | - | 289,776 | - | 16,777 | - | 994,534 | - |
| 1975 | 63,838 | - | 710,295 | - | 275,009 | - | 2,546 | - | 1,051,688 | - |
| 1976 | 87,776 | - | 600,894 | - | 156,390 | - | 5,184 | - | 850,244 | - |
| 1977 | 96,757 | - | 534,875 | - | 257,986 | - | 38,863 | - | 928,481 | - |
| 1978 | 99,168 | - | 1,052,226 | 25,761 | 236,383 | 10,628 | 26,152 | - | 1,413,929 | 36,389 |
| 1979 | 127,673 | - | 779,316 | 40,217 | 359,946 | 18,466 | 17,165 | - | 1,284,100 | 58,683 |
| 1980 | 153,985 | - | 928,609 | 139,106 | 293,430 | 5,020 | 8,745 | - | 1,384,769 | 144,126 |
| 1981 | 158,018 | - | 1,006,938 | 189,068 | 466,451 | 11,285 | 23,680 | - | 1,655,087 | 200,353 |
| 1982 | 123,644 | - | 461,403 | 152,819 | 224,187 | 805 | 37,176 | - | 846,410 | 153,624 |
| 1983 | 147,910 | - | 744,879 | 149,999 | 302,598 | 5,064 | 13,320 | - | 1,208,707 | 155,063 |
| 1984 | 119,904 | - | 588,597 | 167,224 | 208,232 | 2,328 | 81,940 | - | 998,673 | 169,552 |
| 1985 | 146,188 | - | 516,997 | 248,625 | 267,744 | 2,525 | 57,672 | - | 988,601 | 251,150 |
| 1986 | 99,970 | - | 721,469 | 271,691 | 139,442 | 577 | 47,255 | - | 1,008,136 | 272,268 |
| 1987 | 134,760 | - | 442,238 | 121,968 | 0 | 0 | 0 | - | 576,998 | 121,968 |
| 1988 | 101,421 | - | 1,152,237 | 256,535 | 160,963 | 3,227 | 99,907 | - | 1,514,528 | 259,762 |
| 1989 | 102,280 | - | 966,614 | 288,549 | 286,836 | 14,749 | 85,483 | - | 1,441,213 | 303,298 |
| 1990 | 96,194 | 1,731 | 310,843 | 109,376 | 130,981 | 10,801 | 43,171 | 3,888 | 581,189 | 125,796 |
| 5 Yr Avg 1985-89 Alaska | 116,924 | - | 759,911 | 237,474 | 170,997 | 4,216 | 58,063 | - | 1,105,895 | 241,689 |
| 5 Yr Avg 1985-89 Lower Yukon | 110,195 | - | 699,031 | 0 | 111,930 | 0 | 46,319 | - | 967,475 | 0 |
| 5 Yr Avg 1985-89 Upper Yukon | 6,729 | - | 60,880 | 237,474 | 59,067 | 4,216 | 11,744 | - | 138,420 | 241,689 |

a Catches reported in numbers of fish sold in the round and pounds of unprocessed roe.

b Includes ADF&G test fish sales.

c May include small amounts of chinook salmon roe.

d May include small amounts of coho salmon roe.

le 3 . Catches of Yukon chinook and chum salmon in the Canadian commercial gillnet fishery in 1990.

| Stat. Week | Fished From | Fished To | Days Fished* | Number Fishing | Chinook Catch | Chum Catch |
|---|---|---|---|---|---|---|
| 26 | closed < | 01-Jul | | | | |
| 27 | 01-Jul | 02-Jul | 1 | 5 | 15 | 0 |
| 28 | 08-Jul | 09-Jul | 1 | 11 | 90 | 0 |
| 29 | 15-Jul | 16-Jul | 1 | 16 | 922 | 0 |
| 29 | 19-Jul | 22-Jul | 3 | 17 | 3486 | 0 |
| 30 | 25-Jul | 29-Jul | 4 | 18 | 3938 | 4 |
| 31 | 01-Aug | 05-Aug | 4 | 16 | 1516 | 24 |
| 32 | 08-Aug | 12-Aug | 4 | 6 | 381 | 4 |
| 33 | 15-Aug | 19-Aug | 4 | 2 | 88 | 18 |
| 34 | 22-Aug | 25-Aug | 3 | 3 | 5 | 459 |
| 35 | 29-Aug | 01-Sep | 3 | 13 | 11 | 2946 |
| 36 | 05-Sep | 09-Sep | 4 | 14 | 4 | 2715 |
| 37 | 12-Sep | 16-Sep | 4 | 14 | 1 | 3926 |
| 38 | 19-Sep | 23-Sep | 4 | 15 | 2 | 9610 |
| 39 | 26-Sep | 29-Sep | 3 | 12 | 0 | 6772 |
| 40 | 03-Oct | 05-Oct | 2 | 3 | 0 | 500 |
| 41 | closed > | 05-Oct | 0 | | | |
| Dawson area sub-total | | | 45 | | 10459 | 26978 |
| ɔer river sub-total | | | | | 232 | 229 |
| Total | | | | | 11291 | 27207 |

notes: * the number of days fished refers to the lower fishing area, ie. Dawson area (downstream of the Sixty-mile River). An additional day is fished in the upper commercial fishing area during each week.

Table 4. Total return from brood year escapements of Canadian origin Yukon River chinook salmon, 1977-83.

| Brood Year | Brood Year Escapement | Total Catch by Age of Return[a,b] | | | | | | Proportion | | | | | | Total Brood Year | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3 | 4 | 5 | 6 | 7 | 8 | 3 | 4 | 5 | 6 | 7 | 8 | Catch | Escape[c] | Return | Return/ Spawner |
| 1977 | 7,424[d] | | 4,252 | 12,269 | 76,874 | 11,394 | 609 | 0.00 | 0.04 | 0.12 | 0.73 | 0.11 | 0.01 | 105,398 | 28,139 | 133,537 | 18.1 |
| 1978 | 16,514[d] | | 1,559 | 11,904 | 34,905 | 17,152 | 1,007 | 0.00 | 0.02 | 0.18 | 0.52 | 0.26 | 0.02 | 66,527 | 24,966 | 91,493 | 5.5 |
| 1979 | 24,737[e] | | 2,174 | 13,369 | 72,431 | 30,534 | 614 | 0.00 | 0.02 | 0.11 | 0.61 | 0.26 | 0.01 | 119,122 | 15,873 | 134,995 | 5.5 |
| 1980 | 37,970[e] | | 3,429 | 10,216 | 47,791 | 24,376 | 2,096 | 0.00 | 0.04 | 0.12 | 0.54 | 0.28 | 0.02 | 87,908 | 15,357 | 103,265 | 2.7 |
| 1981 | 52,897[e] | 0 | 14,434 | 30,894 | 88,801 | 43,664 | 1,134 | 0.00 | 0.08 | 0.17 | 0.50 | 0.24 | 0.01 | 178,927 | 15,213 | 194,140 | 3.7 |
| 1982 | 19,790 | 0 | 2,243 | 12,434 | 27,789 | 19,248 | 789 | 0.00 | 0.04 | 0.20 | 0.44 | 0.31 | 0.01 | 62,503 | 21,114 | 83,617 | 4.2 |
| 1983 | 28,989 | 20 | 5,593 | 23,304 | 52,350 | 28,877 | 1,408 | 0.00 | 0.05 | 0.21 | 0.47 | 0.26 | 0.01 | 111,552 | 26,206 | 137,758 | 4.8 |
| 1984 | 27,616[e] | 51 | 7,184 | 18,586 | | | | | | | | | | | | | |
| 1985 | 10,730 | 40 | 3,311 | | | | | | | | | | | | | | |
| 1986 | 16,415 | 32 | | | | | | | | | | | | | | | |
| 1987 | 13,210 | | | | | | | | | | | | | | | | |
| 1988 | 23,118 | | | | | | | | | | | | | | | | |
| 1989 | 25,201 | | | | | | | | | | | | | | | | |
| 1990 | 38,678[f] | | | | | | | | | | | | | | | | |
| Mean | | | | | | | | 0.00 | 0.04 | 0.15 | 0.54 | 0.26 | 0.01 | | | | 4.39[g] |

[a]Contribution of age-4 chinook salmon of the 1977 brood year, age-8 of the 1982, and ages 7 and 8 of the 1983 brood years were estimated based on average proportional contribution to the total harvest.
[b]Alaskan subsistence harvest data for 1989 unavailable. Therefore a 5-year average was substituted.
[c]Based on the assumption that age 4, 5, 6 and 7 contribute an average 5.0, 20.0, 60.0, and 15.0 percent to the annual escapement.
[d]Estimate derived by dividing the 4-area index count (Whitehorse Fishway, Big Salmon, Nisutlin, and Tatchun) by the average proportion of the 4-area index to the estimated spawning escapements from the DFO tagging study for years 1982, 1983 and 1985-1989.
[e]Estimate derived by dividing the 5-area index count (Whitehorse Fishway, Big Salmon, Nisutlin, Wolf, and Tatchun) by the average proportion of the 5-area index to the estimated spawning escapements from the DFO tagging study for years 1982, 1983 and 1985-1989.
[f]Preliminary
[g]Does not include 1977 brood year return par spawner.

Table 5. Yukon River fall chum salmon spawning escapement population estimates for selected spawning areas, 1974-90, with existing and proposed interim spawning escapement objectives.

| Year | Escapement to Four Major Spawning Areas: Delta a | Toklat b | Sheenjek c | Fish Br d | 4-Area Total | Yukon Mainstem Spawning Escapement e | Ratio of Yukon Mainstem to 4-Area Total Esc f |
|---|---|---|---|---|---|---|---|
| 1974 | 5,915 * | 43,484 | 89,966 | 32,525 w | 171,890 | -- | -- |
| 1975 | 3,734 p,* | 90,984 * | 173,371 * | 353,282 w | 621,371 | -- | -- |
| 1976 | 6,312 p | 53,882 | 26,354 * | 36,584 | 123,132 | -- | -- |
| 1977 | 16,876 p | 36,462 | 45,544 | 88,400 | 187,282 | -- | -- |
| 1978 | 11,136 | 37,057 | 32,449 | 40,800 | 121,442 | -- | -- |
| 1979 | 8,355 | 179,627 * | 91,372 | 119,898 | 399,252 | -- | -- |
| 1980 | 5,137 * | 26,373 | 28,933 * | 55,268 | 115,711 | -- | -- |
| 1981 | 23,508 * | 15,775 * | 74,560 s | 57,386 g | 171,229 | -- | -- |
| 1982 | 4,235 * | 3,601 * | 31,421 s | 15,901 | 55,158 | 31,958 * | 0.5794 |
| 1983 | 7,705 | 20,807 | 49,392 s | 27,200 | 105,104 | 90,875 | 0.8646 |
| 1984 | 12,411 | 16,511 * | 27,130 s,* | 15,150 | 71,202 | 56,633 x,* | 0.7954 |
| 1985 | 17,276 p | 22,805 | 152,768 s,* | 56,016 w | 248,865 | 62,010 | 0.2492 |
| 1986 | 6,703 p | 18,903 * | 83,197 s | 31,378 w | 140,181 | 87,990 | 0.6277 |
| 1987 | 21,180 * | 22,141 | 140,086 s,* | 48,956 w | 232,363 | 80,776 | 0.3476 |
| 1988 | 18,024 | 13,324 * | 41,073 s | 23,597 w | 96,018 | 36,786 * | 0.3831 |
| 1989 | 21,342 p,* | 30,447 | 101,748 s,h | 43,834 w | 197,371 | 35,974 * | 0.1823 |
| 1990 preliminary | 8,000 p | 33,672 | 63,135 s | 27,000 i | 131,807 | 49,849 * | 0.3782 |
| Averages | | | | | | | |
| 1974-81 | 10,122 | 60,456 | 70,319 | 98,018 | 238,914 | -- | -- |
| 1982-90 | 12,986 | 20,246 | 76,661 | 32,115 | 142,008 | 59,206 | 0.4897 |
| 1974-90 | 11,638 | 39,168 | 73,676 | 63,128 | 187,610 | -- | -- |
| EXISTING Interim Escapement Obj. j | >11,000 | >33,000 | >62,000 | 50,000-120,000 | >156,000 | 90,000-135,000 | -- |
| PROPOSED Interim Escapement Obj. k | >11,000 | >33,000 | >64,000 | 50,000-120,000 | >158,000 | >80,000 | -- |

a Total escapement estimates made from migratory time density curve (Barton 1986) unless otherwise indicated; (p) population estimate from replicate foot surveys and stream life data.

b Total escapement estimates using Delta River migratory time density curve and percentage of live salmon present by survey date in Toklat River.

c Total escapament estimates using sonar to aerial survey expansion factor of 2.20 unless otherwise indicated; (s) sonar estimate.

d Total escapement estimates using weir to aerial survey expansion factor of 2.72 unless otherwise indicated; (w) weir estimate.

e Total spawning escapement estimated as border passage (DFO tagging studies) less harvest unless otherwise indicated; (x) estimate based upon assumed exploitation rate of 0.31 in 1984 since tagging study was not conducted in 1984.

f Relationship between Yukon mainstem escapement and the 4-area total escapement is shown for 1982-90, but proved to be too variable to be of use as a predictor of escapement for Yukon mainstem prior to 1982.

g Initial aerial survey count was doubled before applying the weir/aerial expansion factor of 2.72 since only half of the spawning area was surveyed.

h Includes an estimated 20,000 chum salmon present in river prior to sonar operations. Sonar count was 81,748 chum salmon.

i Population estimate at time of survey using average aerial to weir ratio of 28% to date of survey.

j Existing interim objectives for the Delta, Toklat, and Sheenjek Rivers are minimum escapement objectives established by ADF&G in 1986. Existing interim objectives for the Fishing Branch River and Yukon mainstem were established as ranges by the JTC in 1987.

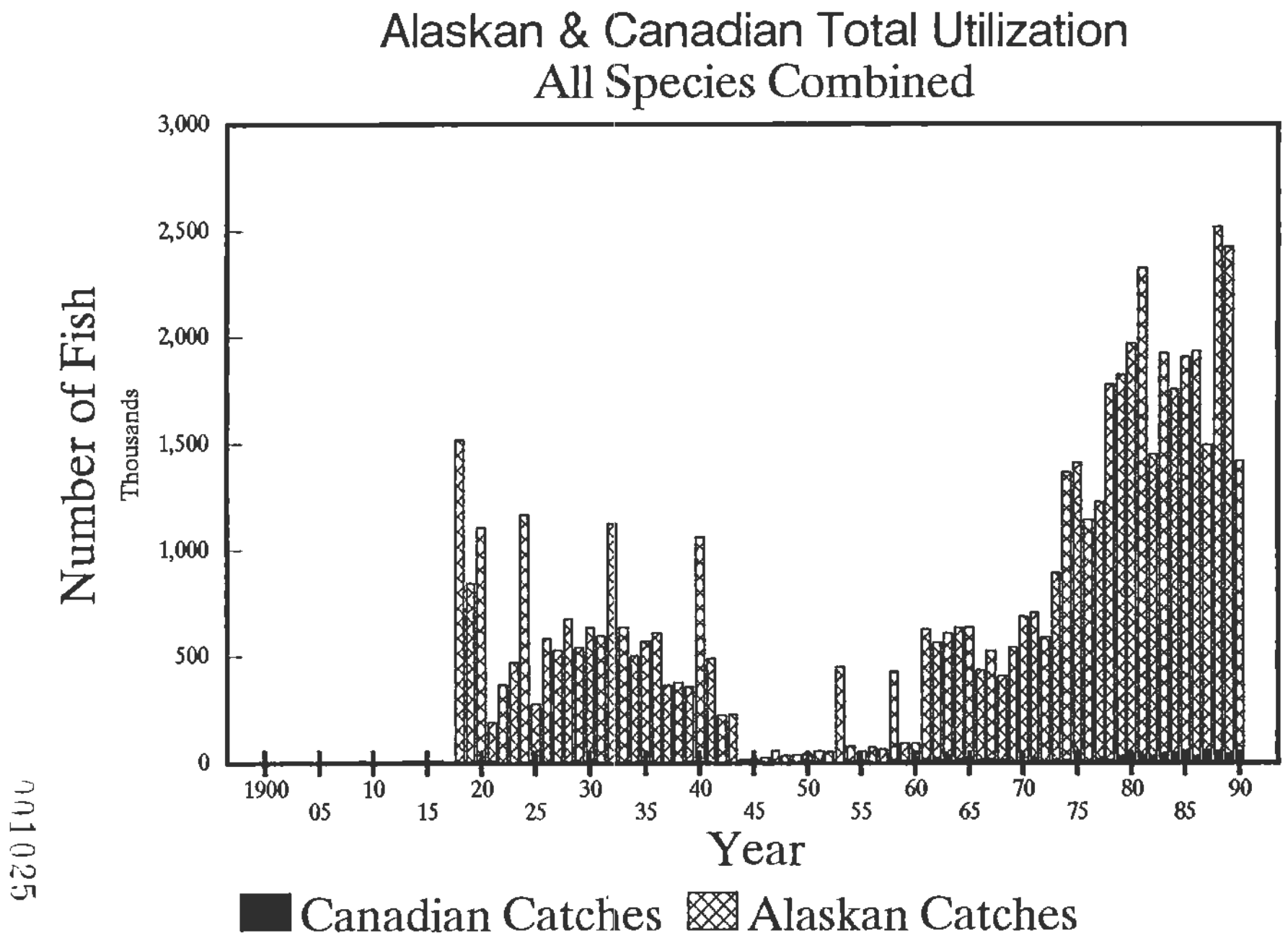
k Proposed interim objectives were determined by excluding years noted with an asterisk (*) which were either outlier high escapements or those too low to be positively considered, then data for the remaining years were averaged. These are minimum escapement objectives with no upper end specified. This method was not applied to the Fishing Branch River as it was decided not to reassess that escapement objective at this time.

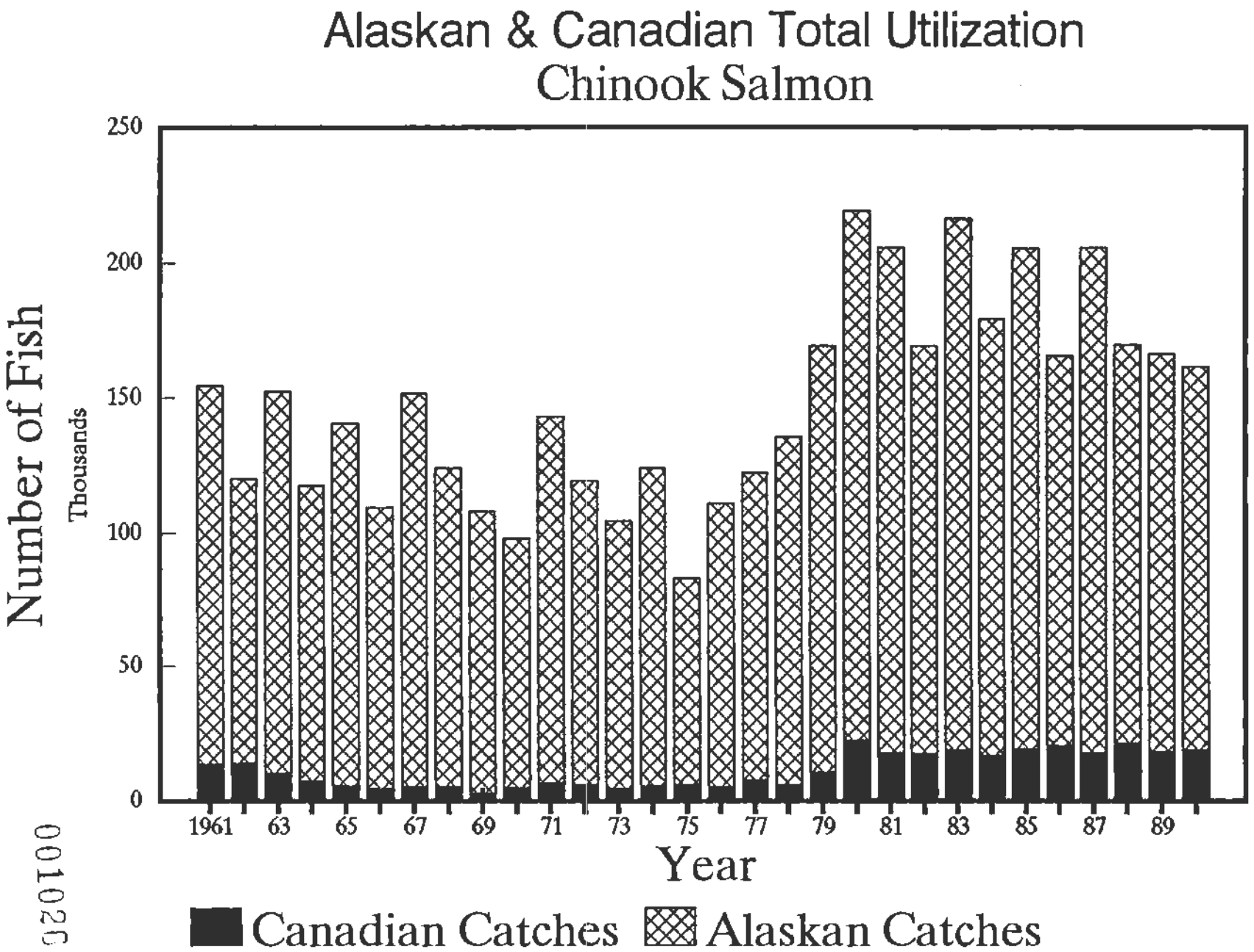
Table 6. Estimates of population size and standard errors, coefficients of variation, and upper and lower 95% confidence limits of the estimates obtained under the various models and stratification systems.

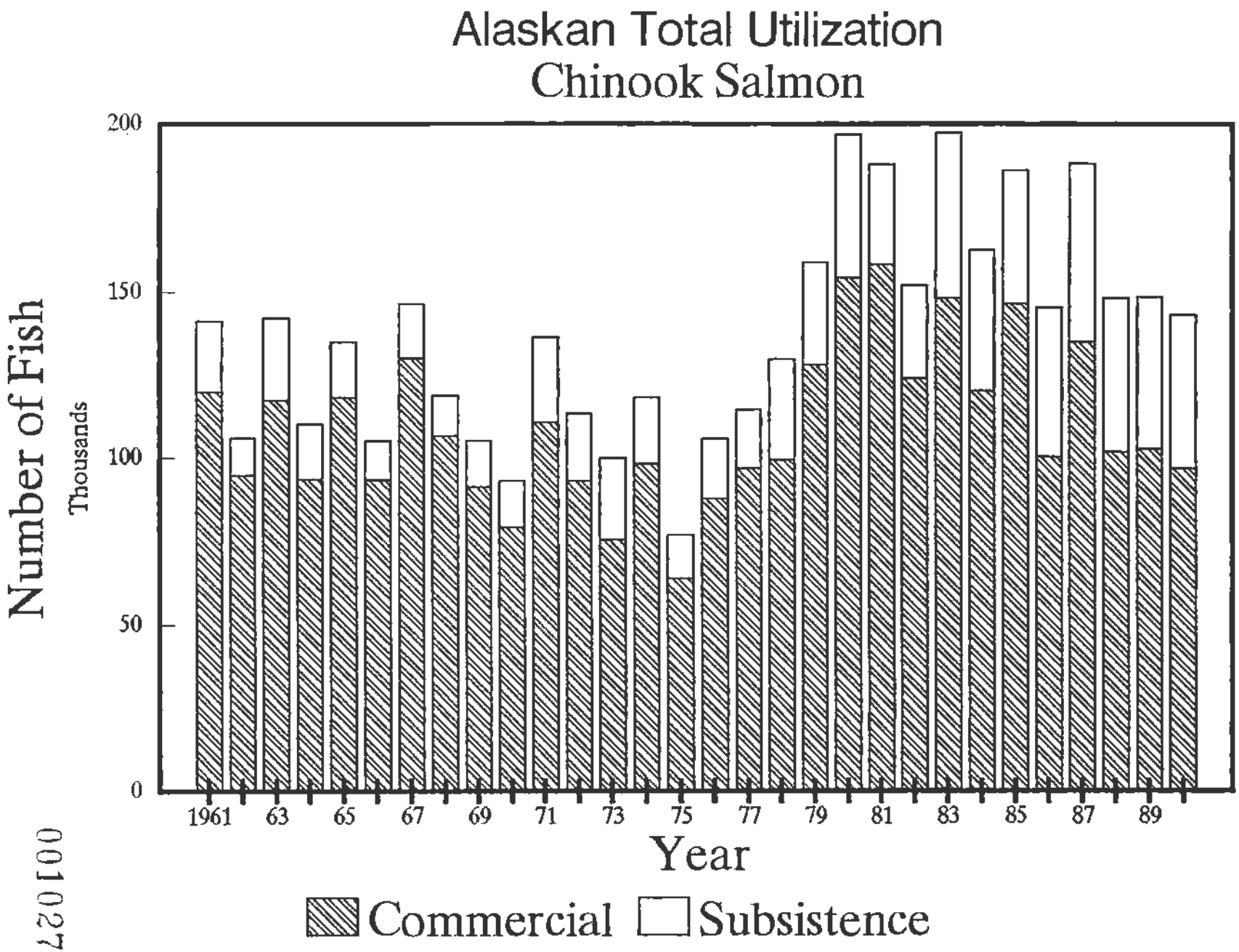
| Data | Quantity | Chapman DFO | Log-linear Sex, Age | Log-linear Sex, Length |
|---|---|---|---|---|
| 1987 Chinook | $\hat{N}$ | 30,622 | 31,439 | 28,686 |
| | se($\hat{N}$) | * | 2,862 | 1,429 |
| | cv($\hat{N}$) | * | 9.10% | 4.98% |
| | Lower Limit | 27,408 | 25,830 | 25,885 |
| | Upper Limit | 34,186 | 37,049 | 31,487 |
| 1988 Chinook | $\hat{N}$ | 44,373 | 42,226 | 39,937 |
| | se($\hat{N}$) | * | 2,605 | 2,194 |
| | cv($\hat{N}$) | * | 6.17% | 5.49% |
| | Lower Limit | * | 37,119 | 35,635 |
| | Upper Limit | * | 47,436 | 44,239 |
| 1987 Chum | $\hat{N}$ | 118,061 | 115,425 | 121,654 |
| | se($\hat{N}$) | * | 3,653 | 5,149 |
| | cv($\hat{N}$) | * | 3.16% | 4.23% |
| | Lower Limit | 130,379 | 108,264 | 111,561 |
| | Upper Limit | 106,896 | 122,731 | 131,746 |
| 1988 Chum | $\hat{N}$ | 73,419 | 73,650 | 73,981 |
| | se($\hat{N}$) | * | 3,080 | 2,887 |
| | cv($\hat{N}$) | * | 4.18% | 3.90% |
| | Lower Limit | * | 67,613 | 68,321 |
| | Upper Limit | * | 79,687 | 79,641 |

* Estimates not computed by DFO.

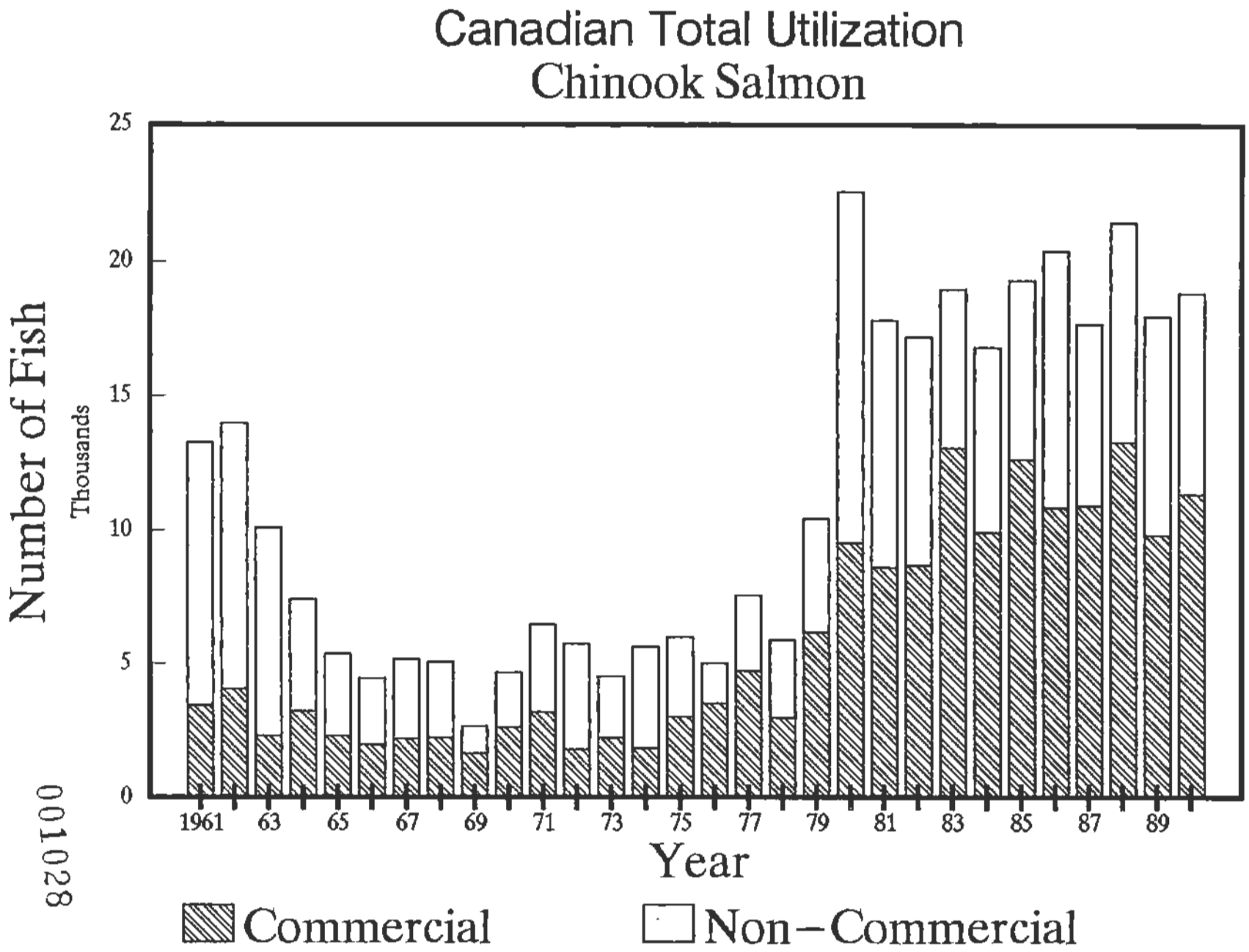
ATTACHMENT I. HISTORICAL YUKON RIVER SALMON CATCH AND ESCAPEMENT DATA


Alaskan & Canadian Total Utilization
All Species Combined
Number of Fish
Thousands
3,000
2,500
2,000
1,500
1,000
500
0
1900
05
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Year
Canadian Catches
Alaskan Catches

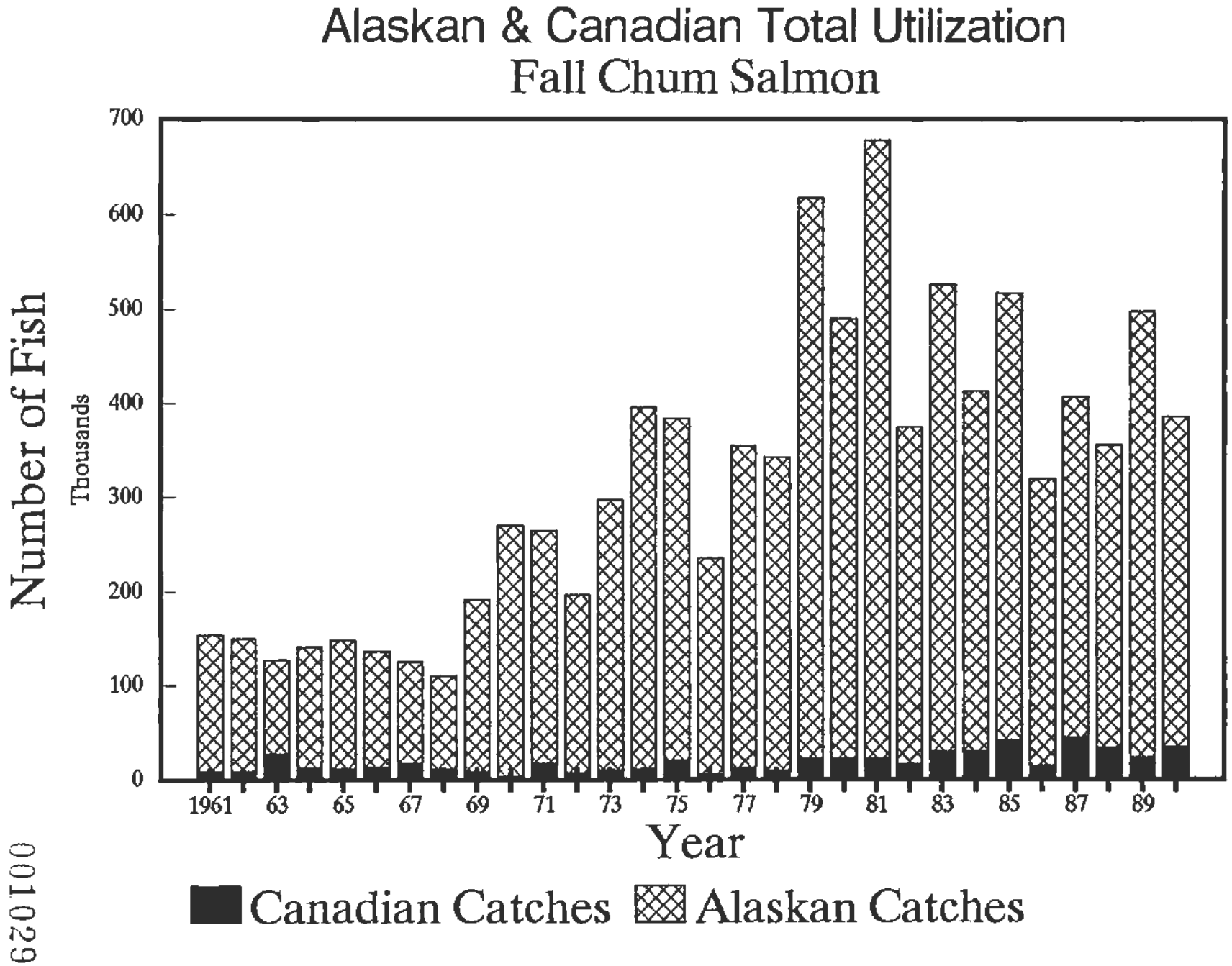

Alaskan & Canadian Total Utilization
Chinook Salmon
Number of Fish
Thousands
250
200
150
100
50
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Canadian Catches
Alaskan Catches

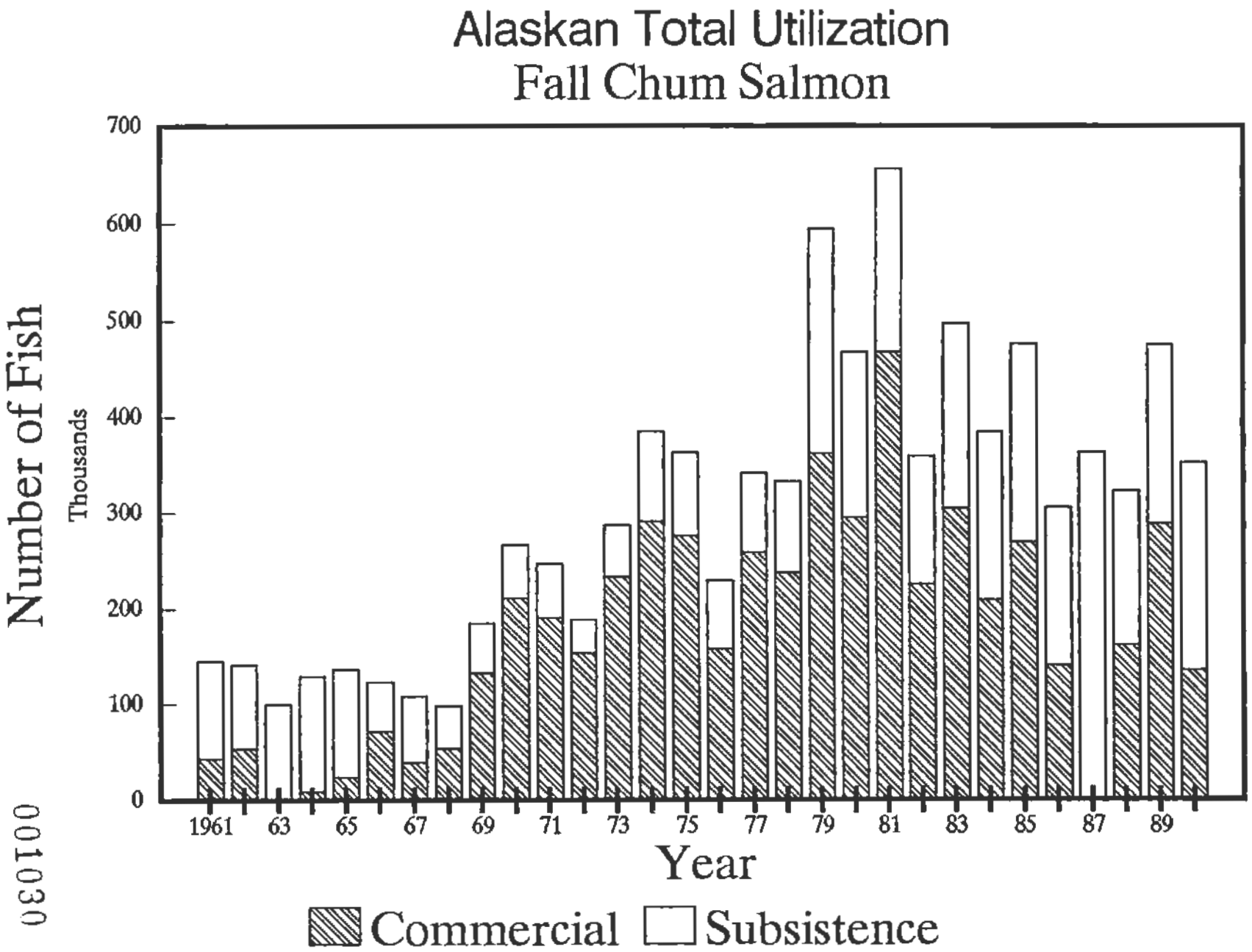

Alaskan Total Utilization
Chinook Salmon
Number of Fish
Thousands
200
150
100
50
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Subsistence

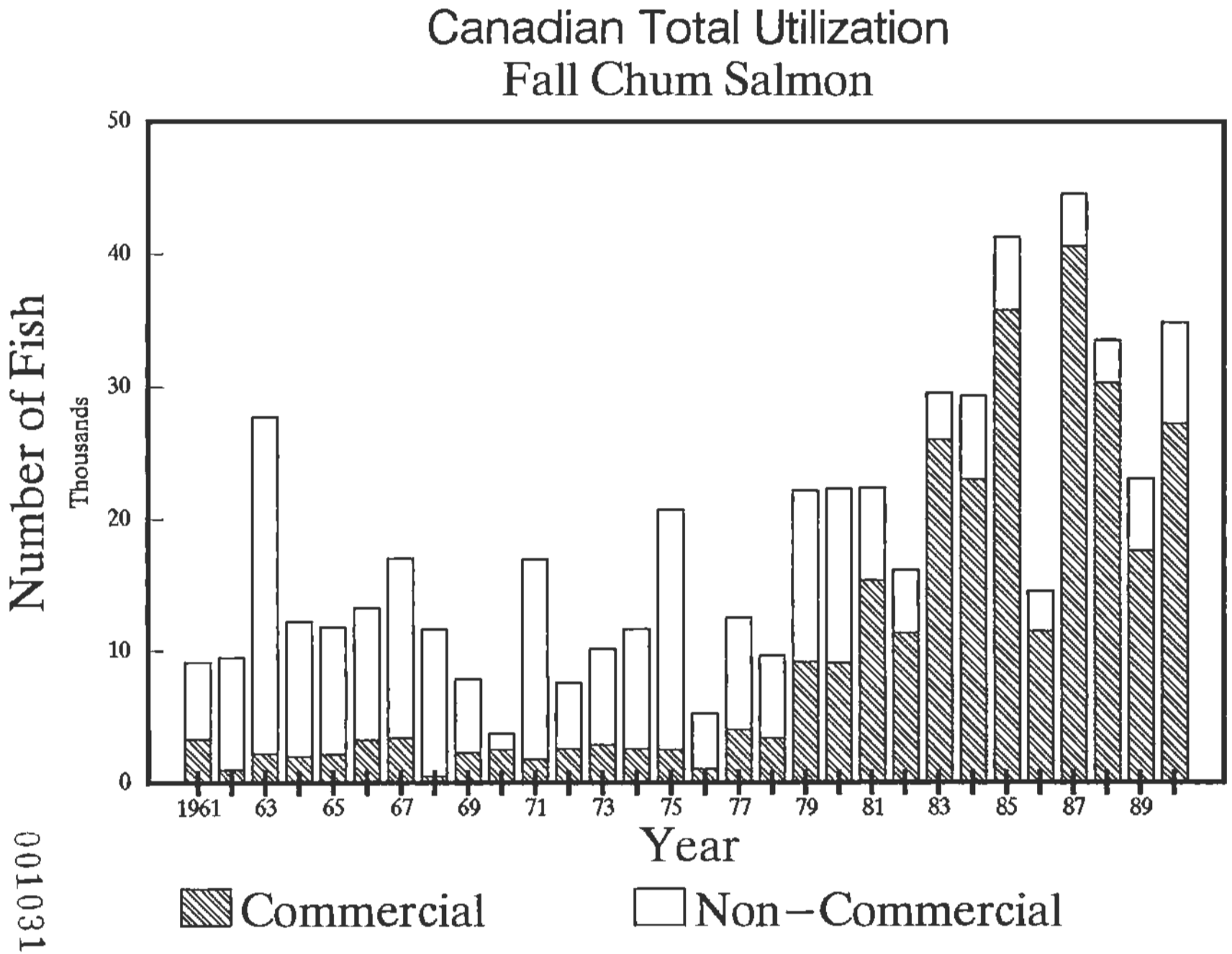
001027

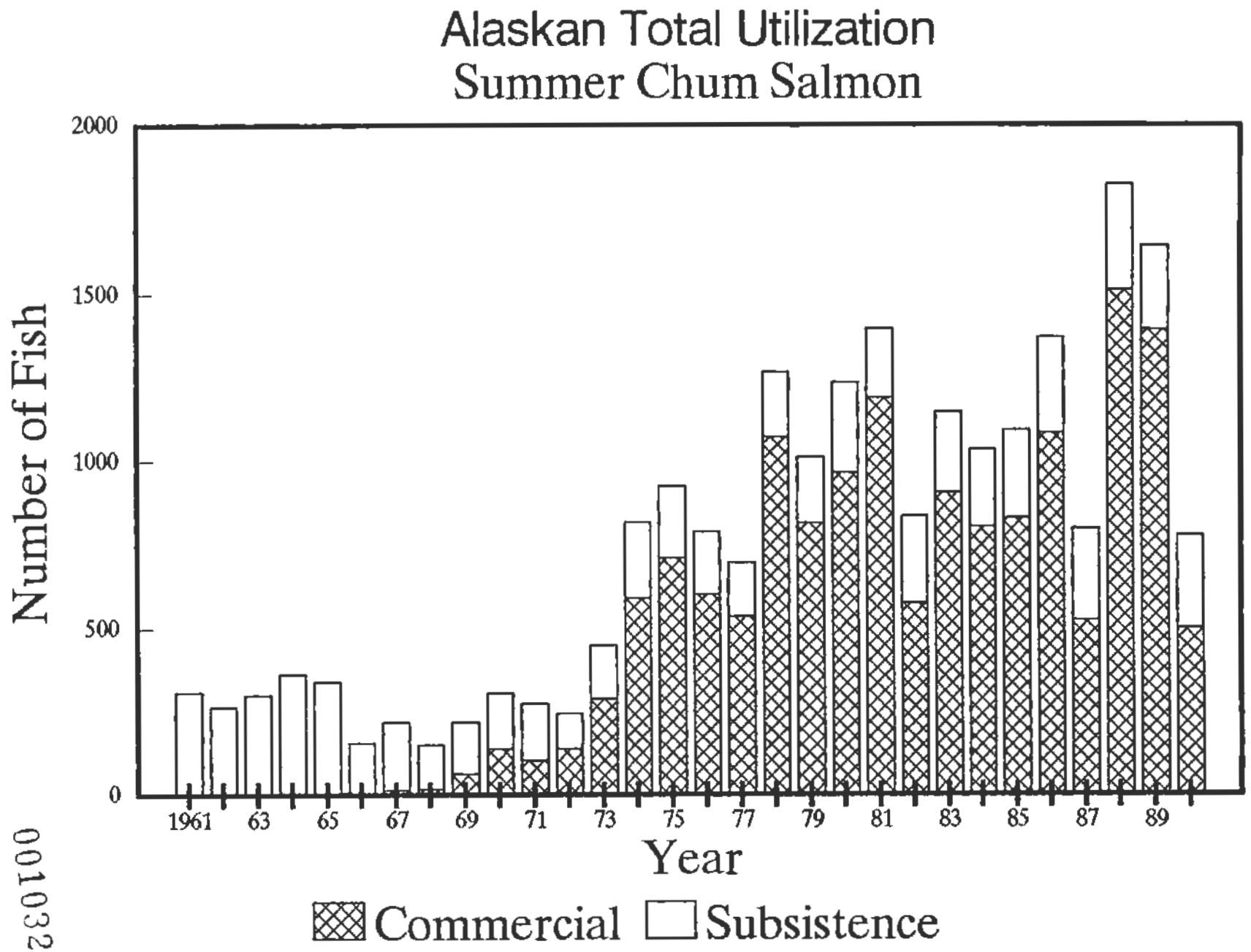

Canadian Total Utilization
Chinook Salmon
Number of Fish
Thousands
25
20
15
10
5
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Non-Commercial

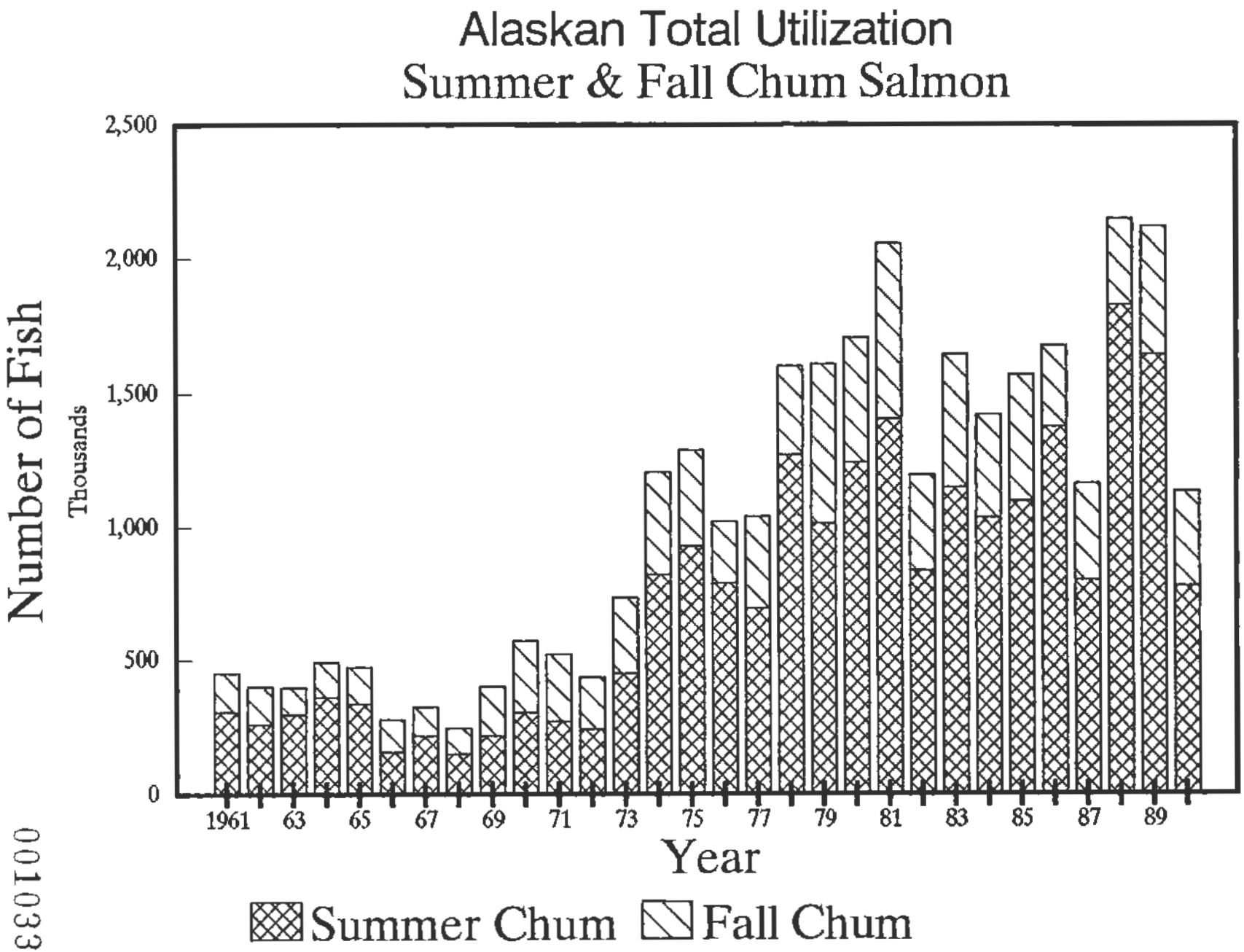
001028


Alaskan & Canadian Total Utilization
Fall Chum Salmon
Number of Fish
Thousands
700
600
500
400
300
200
100
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Canadian Catches
Alaskan Catches

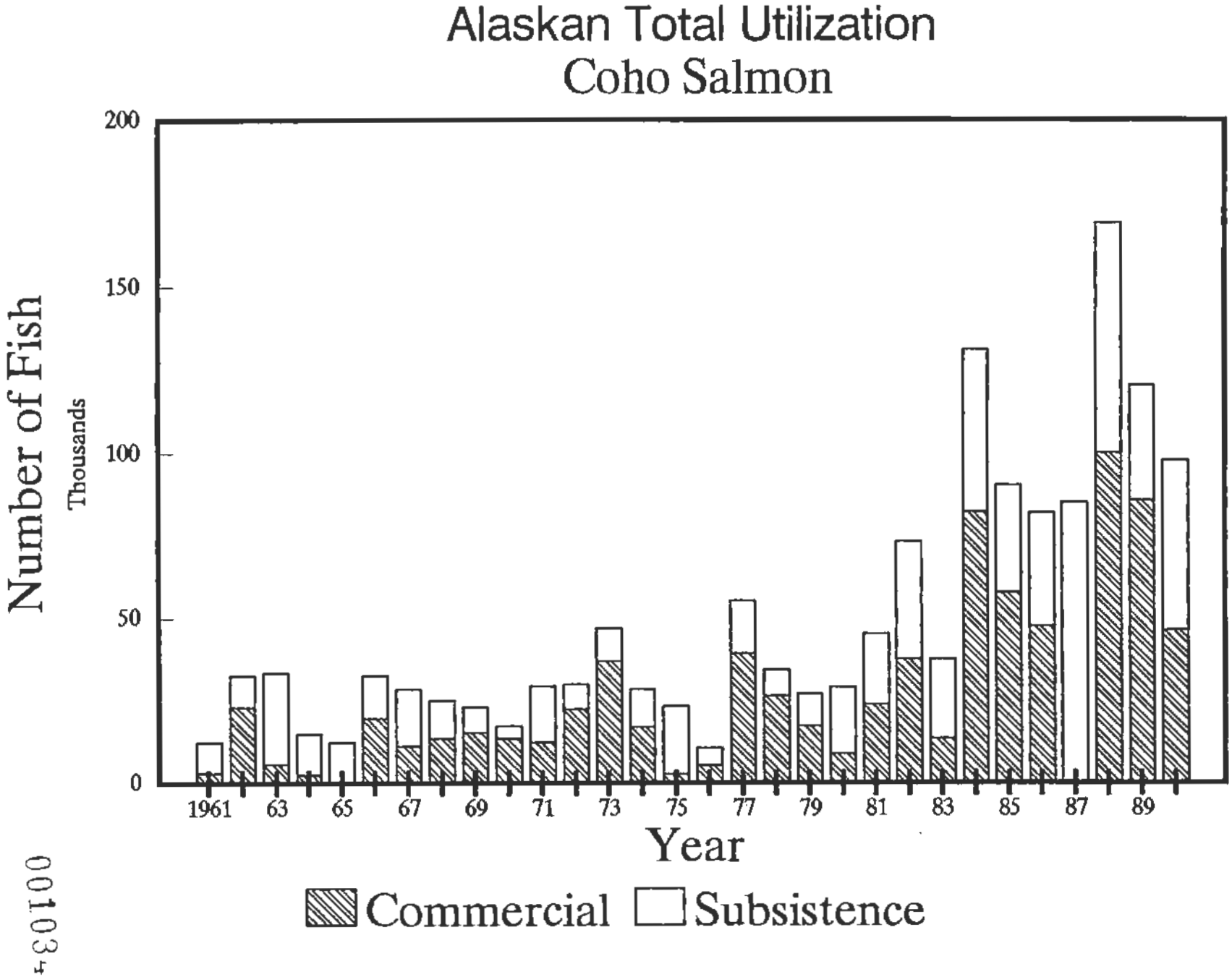

Alaskan Total Utilization
Fall Chum Salmon
Number of Fish
Thousands
700
600
500
400
300
200
100
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Subsistence


Canadian Total Utilization
Fall Chum Salmon
Number of Fish
Thousands
50
40
30
20
10
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Non−Commercial

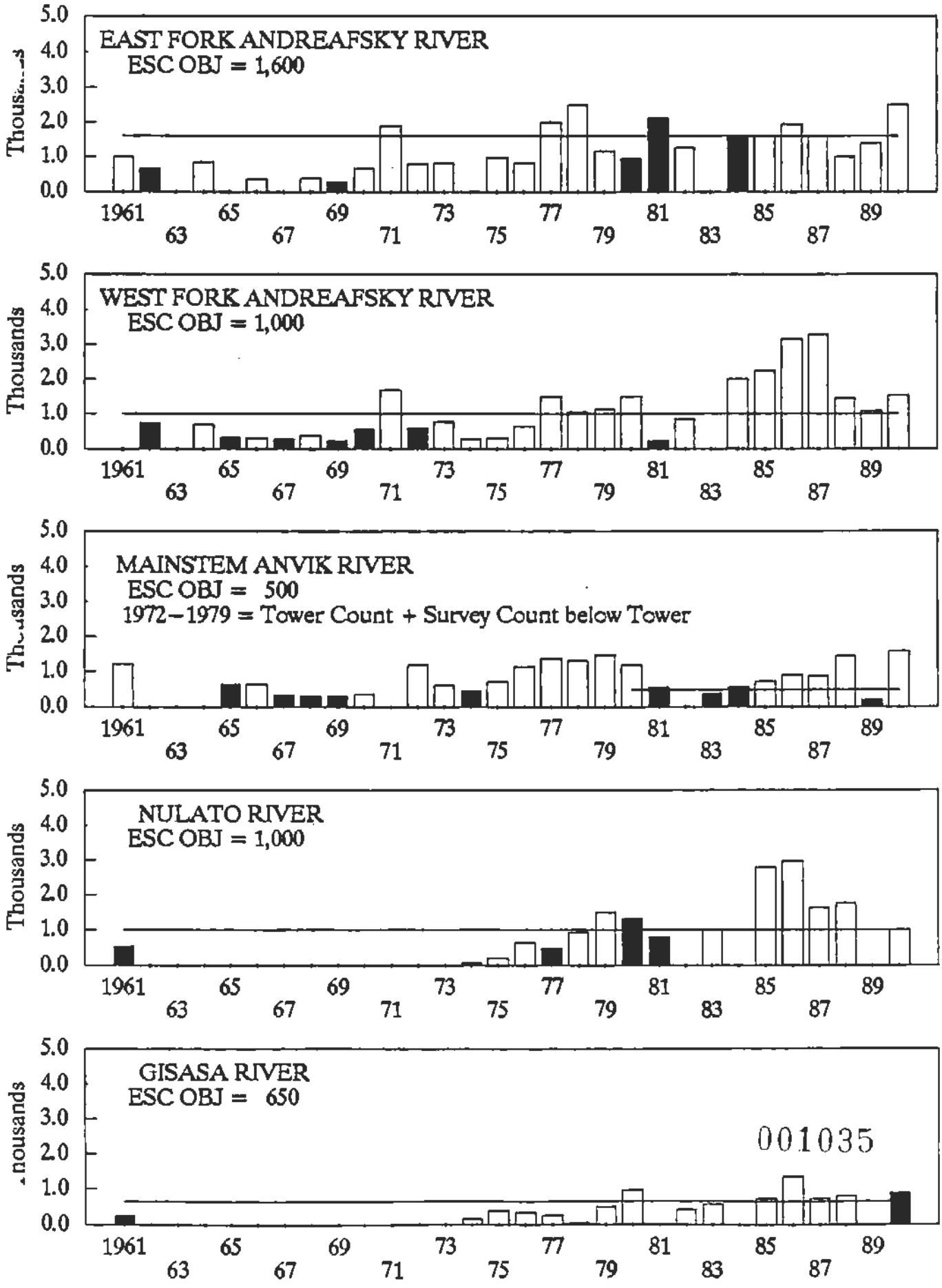

Alaskan Total Utilization
Summer Chum Salmon
Number of Fish
2000
1500
1000
500
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Subsistence


Alaskan Total Utilization
Summer & Fall Chum Salmon
Number of Fish
Thousands
2,500
2,000
1,500
1,000
500
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Summer Chum
Fall Chum

001033


Alaskan Total Utilization
Coho Salmon
Number of Fish
Thousands
200
150
100
50
0
1961
63
65
67
69
71
73
75
77
79
81
83
85
87
89
Year
Commercial
Subsistence

Lower Yukon River Chinook Salmon
Escapement Indices

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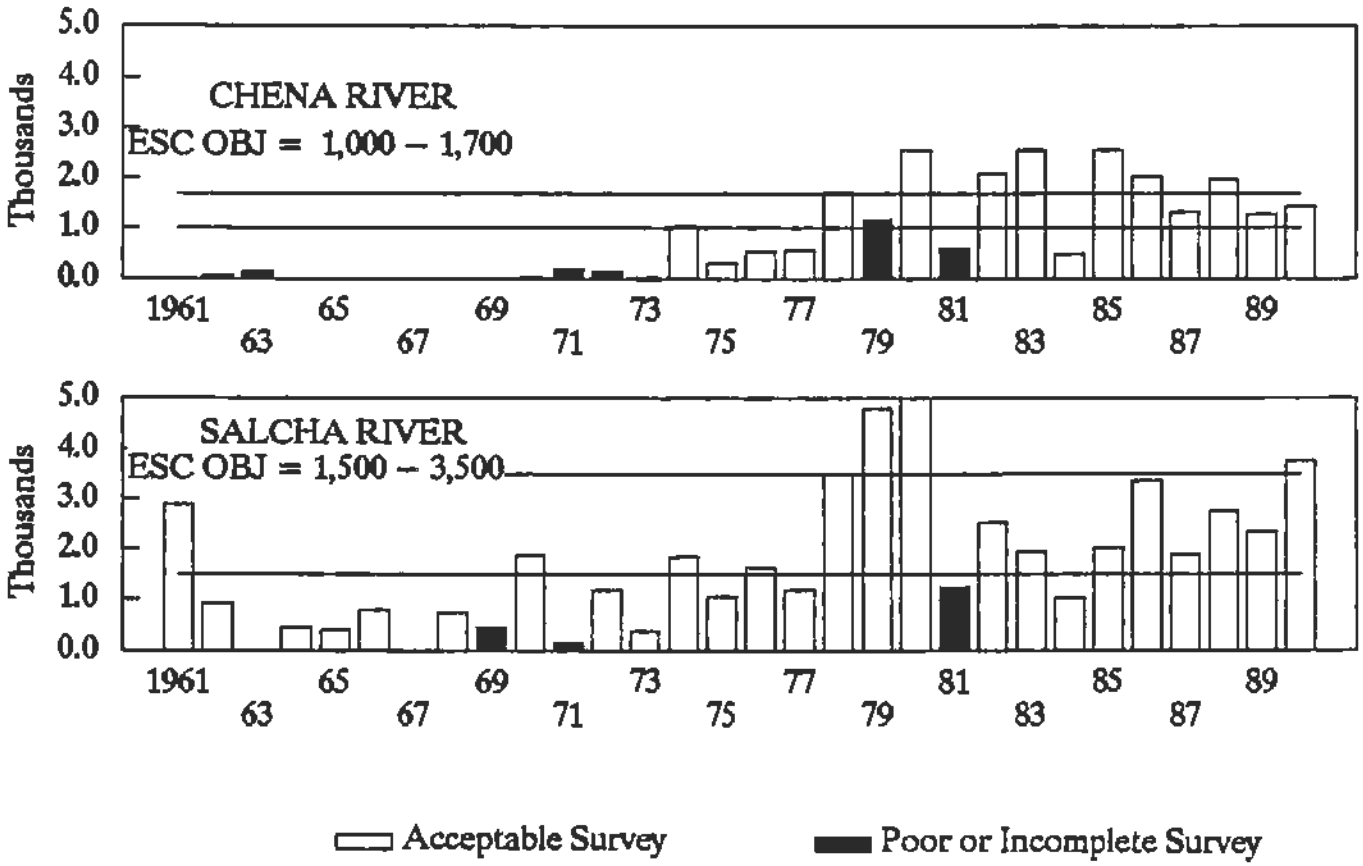
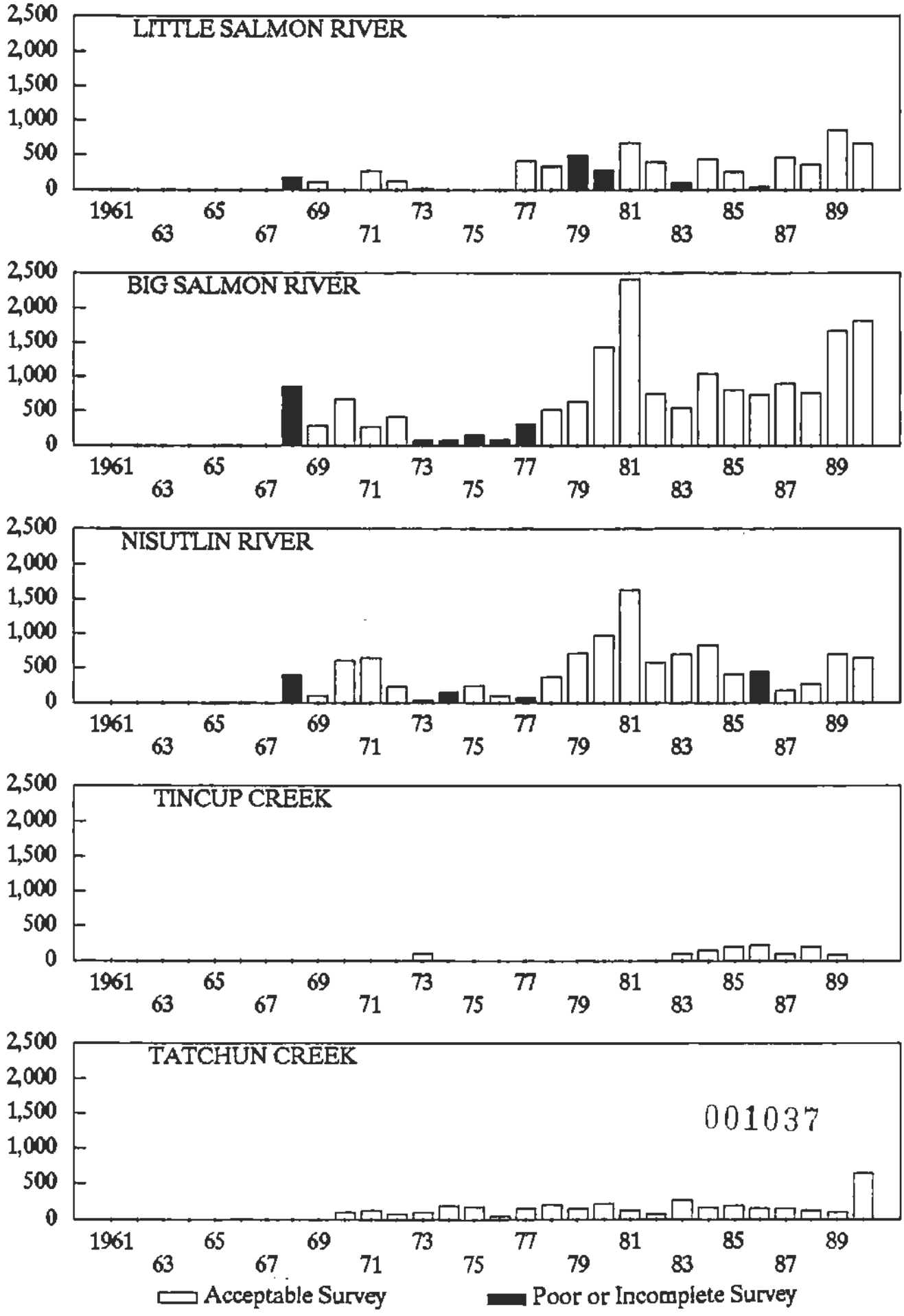
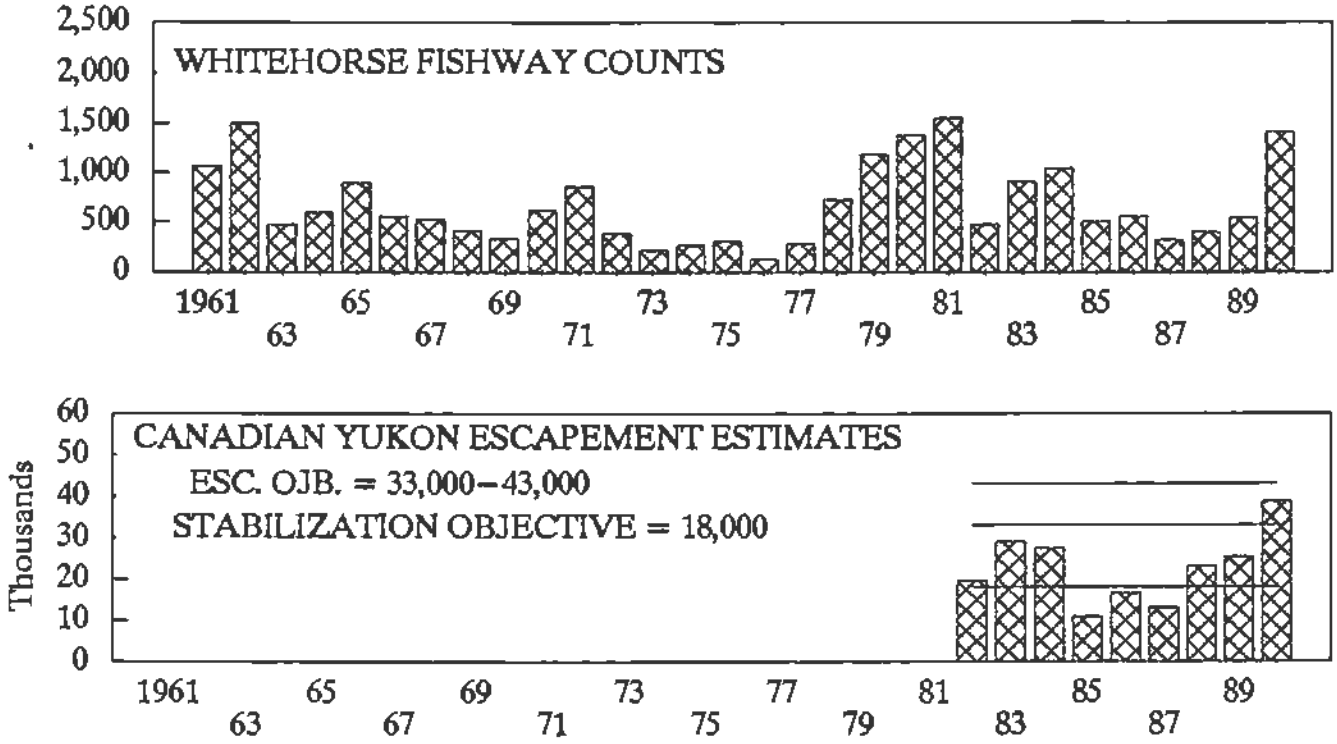
Middle Yukon River Chinook Salmon
Escapement Indices



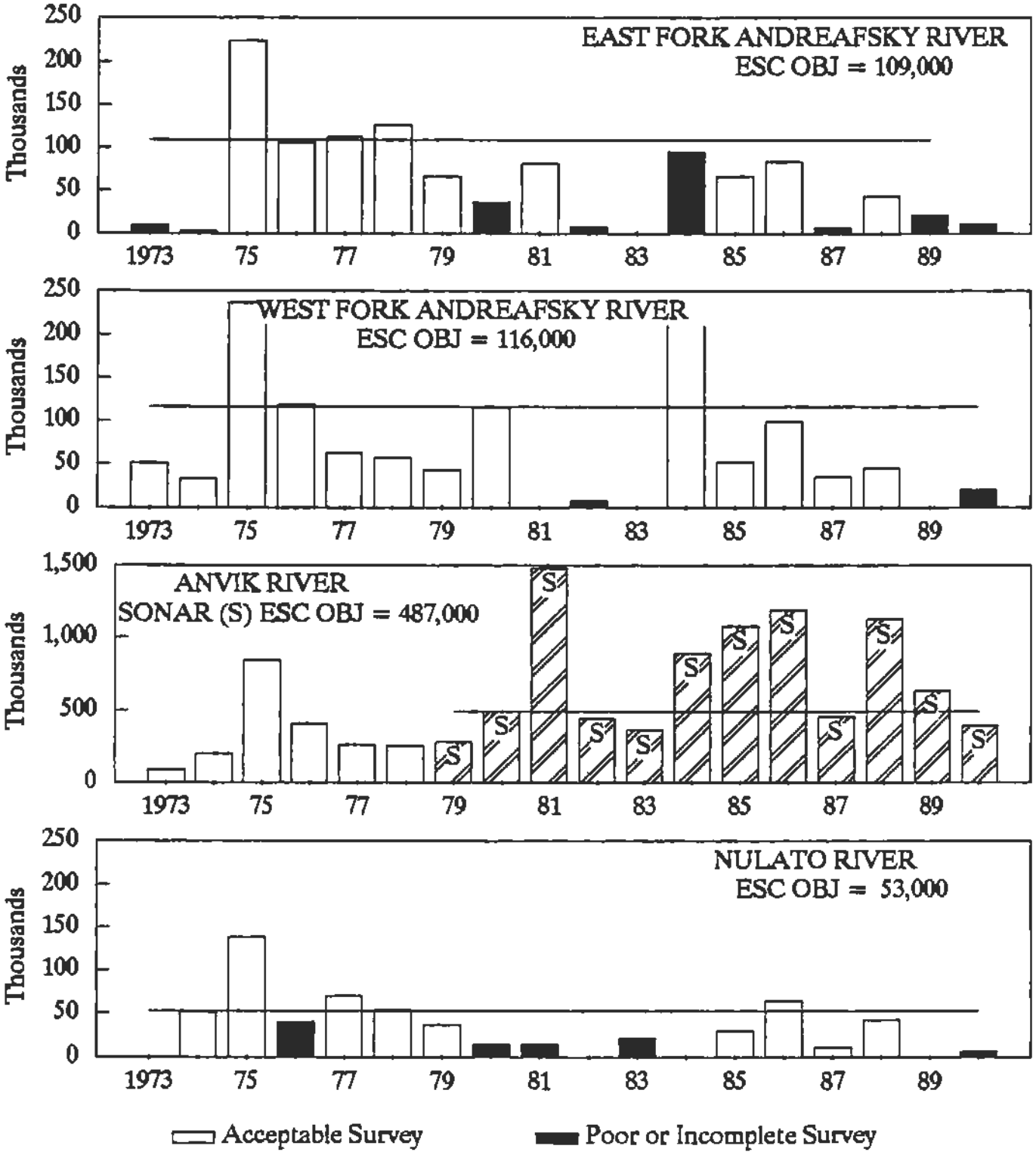
**Upper Yukon River Chinook Salmon**
**Escapement Indices**



**Upper Yukon River Chinook Salmon**
**Escapement Count and Estimate**



**Yukon River Summer Chum Salmon**
**Escapement Indices**

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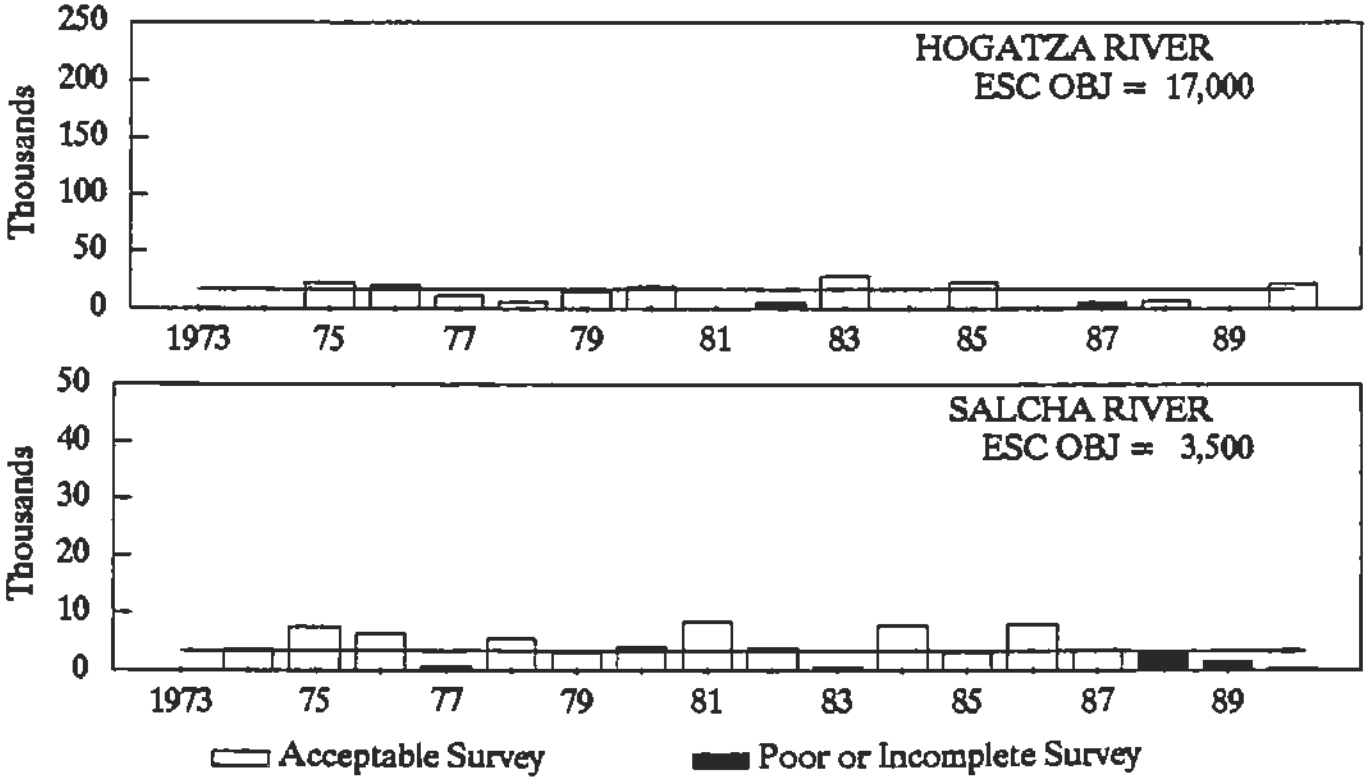
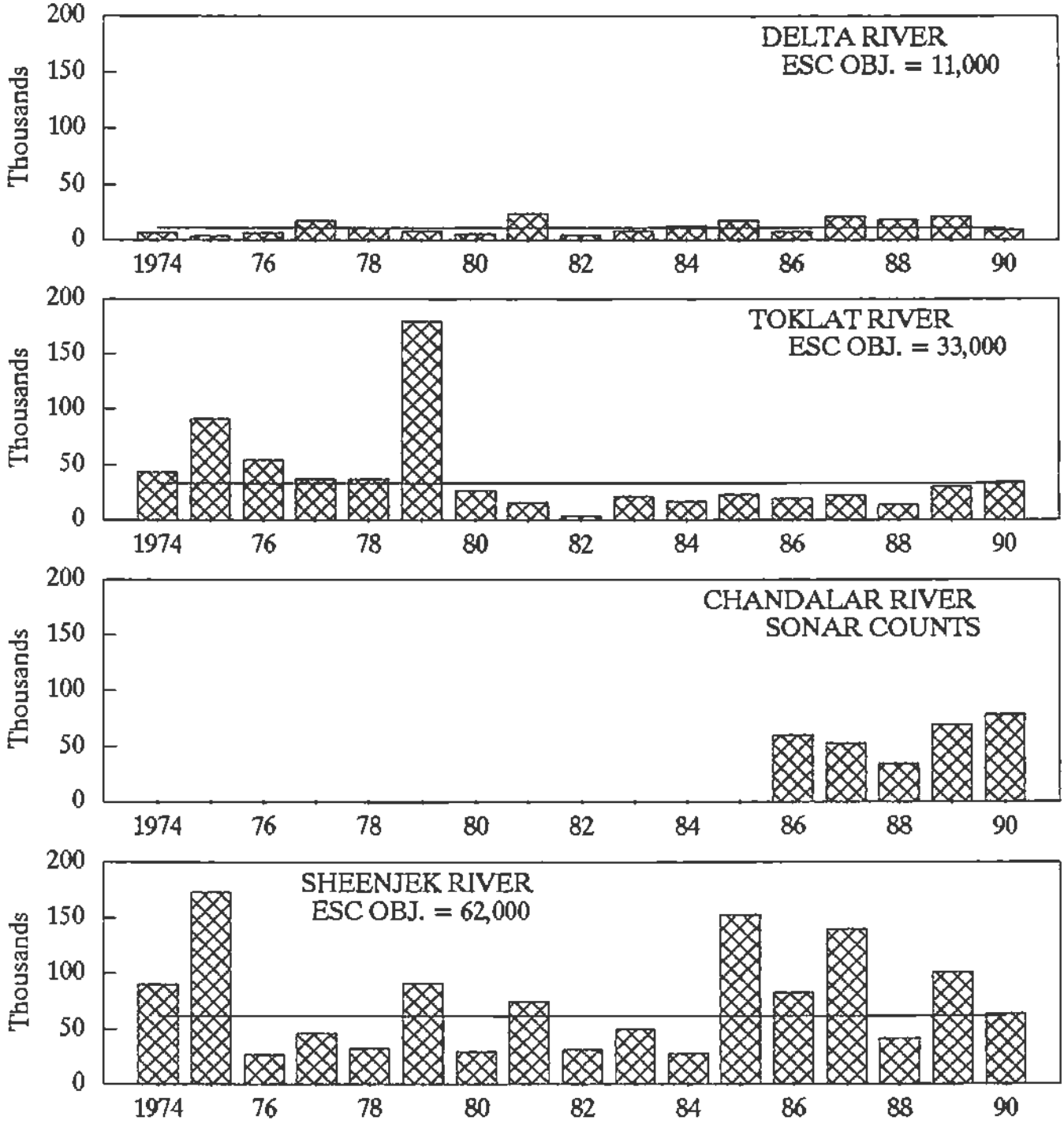
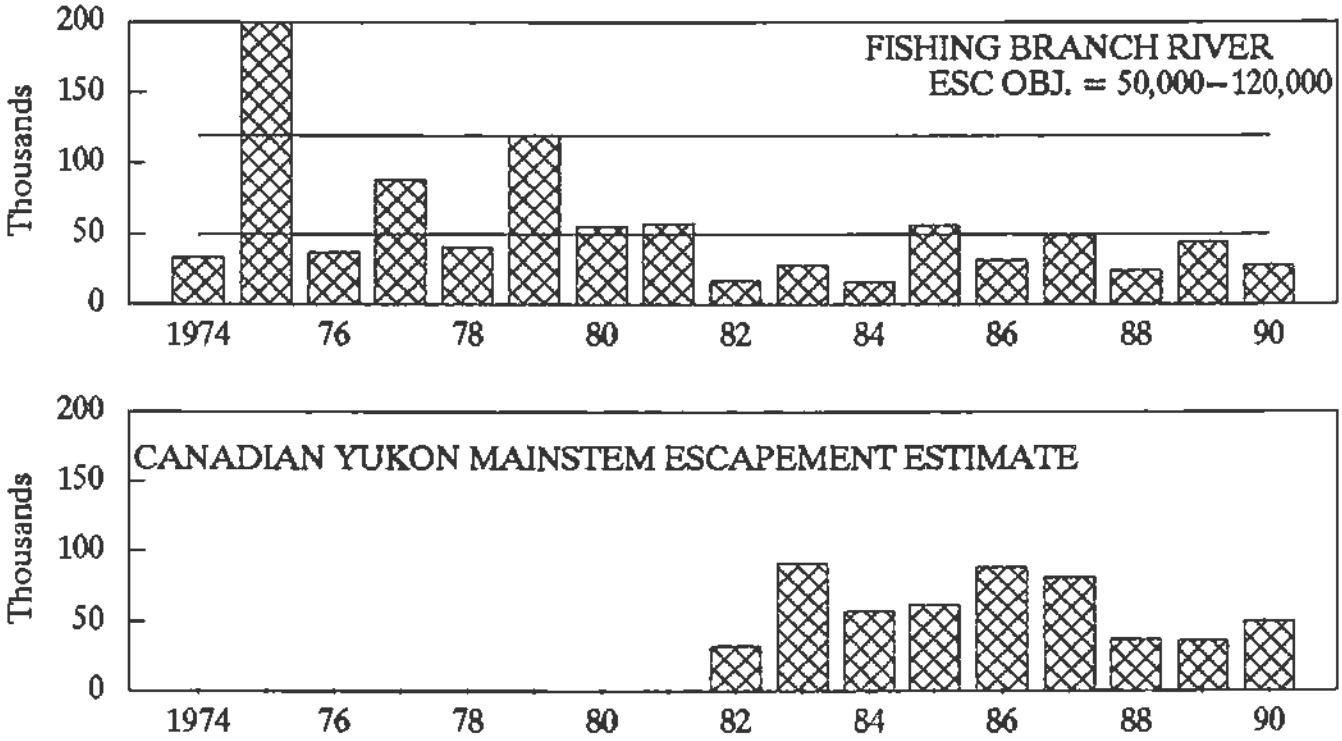
**Yukon River Summer Chum Salmon**
**Escapement Indices**



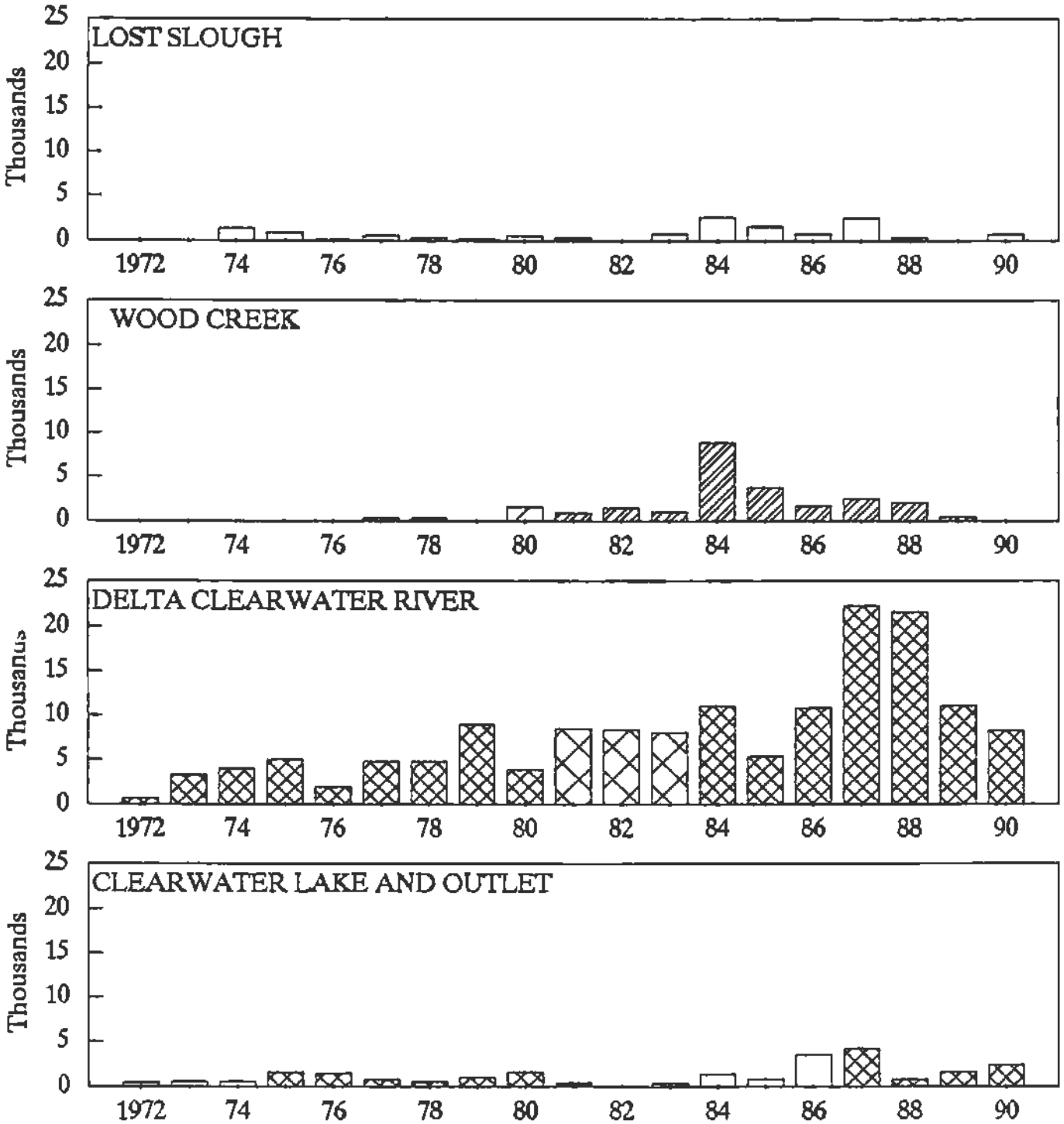
**Yukon River Fall Chum Salmon**
**Expanded Population Estimates and Sonar Counts**



**Yukon River Fall Chum Salmon**
**Expanded Population Estimates**



**Yukon River Coho Salmon**
**Escapement Indices**

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Appendix Table 1. Alaskan and Canadian total utilization of Yukon River salmon, 1903-1990.[a]

| Year | Alaska | | | Canada | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Chinook | Other Salmon | Total | Chinook | Other Salmon | Total | Chinook | Other Salmon | Total |
| 1903 | | | | 4,666 | | 4,666 | | | 4,666 |
| 1904 | | | | | | | | | |
| 1905 | | | | | | | | | |
| 1906 | | | | | | | | | |
| 1907 | | | | | | | | | |
| 1908 | | | | 7,000 | | 7,000 | | | 7,000 |
| 1909 | | | | 9,238 | | 9,238 | | | 9,238 |
| 1910 | | | | | | | | | |
| 1911 | | | | | | | | | |
| 1912 | | | | | | | | | |
| 1913 | | | | 12,133 | | 12,133 | | | 12,133 |
| 1914 | | | | 12,573 | | 12,573 | | | 12,573 |
| 1915 | | | | 10,466 | | 10,466 | | | 10,466 |
| 1916 | | | | 9,566 | | 9,566 | | | 9,566 |
| 1917 | | | | | | | | | |
| 1918 | 12,239 | 1,500,065 | 1,512,304 | 7,066 | | 7,066 | 19,305 | 1,500,065 | 1,519,370 |
| 1919 | 104,822 | 738,790 | 843,612 | 1,800 | | 1,800 | 106,622 | 738,790 | 845,412 |
| 1920 | 78,467 | 1,015,655 | 1,094,122 | 12,000 | | 12,000 | 90,467 | 1,015,655 | 1,106,122 |
| 1921 | 69,646 | 112,098 | 181,744 | 10,840 | | 10,840 | 80,486 | 112,098 | 192,584 |
| 1922 | 31,825 | 330,000 | 361,825 | 2,420 | | 2,420 | 34,245 | 330,000 | 364,245 |
| 1923 | 30,893 | 435,000 | 465,893 | 1,833 | | 1,833 | 32,726 | 435,000 | 467,726 |
| 1924 | 27,375 | 1,130,000 | 1,157,375 | 4,560 | | 4,560 | 31,935 | 1,130,000 | 1,161,935 |
| 1925 | 15,000 | 259,000 | 274,000 | 3,900 | | 3,900 | 18,900 | 259,000 | 277,900 |
| 1926 | 20,500 | 555,000 | 575,500 | 4,373 | | 4,373 | 24,873 | 555,000 | 579,873 |
| 1927 | | 520,000 | 520,000 | 5,366 | | 5,366 | | 520,000 | 525,366 |
| 1928 | | 670,000 | 670,000 | 5,733 | | 5,733 | | 670,000 | 675,733 |
| 1929 | | 537,000 | 537,000 | 5,226 | | 5,226 | | 537,000 | 542,226 |
| 1930 | | 633,000 | 633,000 | 3,660 | | 3,660 | | 633,000 | 636,660 |
| 1931 | 26,693 | 565,000 | 591,693 | 3,473 | | 3,473 | 30,166 | 565,000 | 595,166 |
| 1932 | 27,899 | 1,092,000 | 1,119,899 | 4,200 | | 4,200 | 32,099 | 1,092,000 | 1,124,099 |
| 1933 | 28,779 | 603,000 | 631,779 | 3,333 | | 3,333 | 32,112 | 603,000 | 635,112 |
| 1934 | 23,365 | 474,000 | 497,365 | 2,000 | | 2,000 | 25,365 | 474,000 | 499,365 |
| 1935 | 27,665 | 537,000 | 564,665 | 3,466 | | 3,466 | 31,131 | 537,000 | 568,131 |
| 1936 | 43,713 | 560,000 | 603,713 | 3,400 | | 3,400 | 47,113 | 560,000 | 607,113 |
| 1937 | 12,154 | 346,000 | 358,154 | 3,746 | | 3,746 | 15,900 | 346,000 | 361,900 |
| 1938 | 32,971 | 340,450 | 373,421 | 860 | | 860 | 33,831 | 340,450 | 374,281 |
| 1939 | 28,037 | 327,650 | 355,687 | 720 | | 720 | 28,757 | 327,650 | 356,407 |
| 1940 | 32,453 | 1,029,000 | 1,061,453 | 1,153 | | 1,153 | 33,606 | 1,029,000 | 1,062,606 |
| 1941 | 47,608 | 438,000 | 485,608 | 2,806 | | 2,806 | 50,414 | 438,000 | 488,414 |
| 1942 | 22,487 | 197,000 | 219,487 | 713 | | 713 | 23,200 | 197,000 | 220,200 |
| 1943 | 27,650 | 200,000 | 227,650 | 609 | | 609 | 28,259 | 200,000 | 228,259 |
| 1944 | 14,232 | | 14,232 | 986 | | 986 | 15,218 | | 15,218 |
| 1945 | 19,727 | | 19,727 | 1,333 | | 1,333 | 21,060 | | 21,060 |
| 1946 | 22,782 | | 22,782 | 353 | | 353 | 23,135 | | 23,135 |
| 1947 | 54,026 | | 54,026 | 120 | | 120 | 54,146 | | 54,146 |
| 1948 | 33,842 | | 33,842 | | | | 33,842 | | 33,842 |
| 1949 | 36,379 | | 36,379 | | | | 36,379 | | 36,379 |
| 1950 | 41,808 | | 41,808 | | | | 41,808 | | 41,808 |
| 1951 | 56,278 | | 56,278 | | | | 56,278 | | 56,278 |
| 1952 | 38,637 | 10,868 | 49,505 | | | | 38,637 | 10,868 | 49,505 |
| 1953 | 58,859 | 385,977 | 444,836 | | | | 58,859 | 385,977 | 444,836 |
| 1954 | 64,545 | 14,375 | 78,920 | | | | 64,545 | 14,375 | 78,920 |
| 1955 | 55,925 | | 55,925 | | | | 55,925 | | 55,925 |
| 1956 | 62,208 | 10,743 | 72,951 | | | | 62,208 | 10,743 | 72,951 |
| 1957 | 63,623 | | 63,623 | | | | 63,623 | | 63,623 |
| 1958 | 75,625 | 337,500 | 413,125 | 11,000 | 1,500 | 12,500 | 86,625 | 339,000 | 425,625 |
| 1959 | 78,370 | | 78,370 | 8,434 | 3,098 | 11,532 | 86,804 | 3,098 | 89,902 |
| 1960 | 67,597 | | 67,597 | 9,653 | 15,608 | 25,261 | 77,250 | 15,608 | 92,858 |

-continued-

Appendix Table 1. (p. 2 of 2)

| Year | Alaska | | | Canada | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Chinook | Other Salmon | Total | Chinook | Other Salmon | Total | Chinook | Other Salmon | Total |
| 1961 | 141,152 | 461,597 | 602,749 | 13,246 | 9,076 | 22,322 | 154,398 | 470,673 | 625,071 |
| 1962 | 105,844 | 434,663 | 540,507 | 13,937 | 9,436 | 23,373 | 119,781 | 444,099 | 563,880 |
| 1963 | 141,910 | 429,396 | 571,306 | 10,077 | 27,696 | 37,773 | 151,987 | 457,092 | 609,079 |
| 1964 | 109,818 | 504,420 | 614,238 | 7,408 | 12,187 | 19,595 | 117,226 | 516,607 | 633,833 |
| 1965 | 134,706 | 484,587 | 619,293 | 5,380 | 11,789 | 17,169 | 140,086 | 496,376 | 636,462 |
| 1966 | 104,887 | 309,502 | 414,389 | 4,452 | 13,192 | 17,644 | 109,339 | 322,694 | 432,033 |
| 1967 | 146,104 | 352,397 | 498,501 | 5,150 | 16,961 | 22,111 | 151,254 | 369,358 | 520,612 |
| 1968 | 118,632 | 270,818 | 389,450 | 5,042 | 11,633 | 16,675 | 123,674 | 282,451 | 406,125 |
| 1969 | 105,027 | 424,399 | 529,426 | 2,624 | 7,776 | 10,400 | 107,651 | 432,175 | 539,826 |
| 1970 | 93,019 | 585,760 | 678,779 | 4,663 | 3,711 | 8,374 | 97,682 | 589,471 | 687,153 |
| 1971 | 136,191 | 547,448 | 683,639 | 6,447 | 16,911 | 23,358 | 142,638 | 564,359 | 706,997 |
| 1972 | 113,098 | 461,617 | 574,715 | 5,729 | 7,532 | 13,261 | 118,827 | 469,149 | 587,976 |
| 1973 | 99,670 | 779,158 | 878,828 | 4,522 | 10,135 | 14,657 | 104,192 | 789,293 | 893,485 |
| 1974 | 118,053 | 1,229,678 | 1,347,731 | 5,631 | 11,646 | 17,277 | 123,684 | 1,241,324 | 1,365,008 |
| 1975 | 76,883 | 1,307,037 | 1,383,920 | 6,000 | 20,600 | 26,600 | 82,883 | 1,327,637 | 1,410,520 |
| 1976 | 105,582 | 1,026,908 | 1,132,490 | 5,025 | 5,200 | 10,225 | 110,607 | 1,032,108 | 1,142,715 |
| 1977 | 114,338 | 1,090,330 | 1,204,668 | 7,527 | 12,479 | 20,006 | 121,865 | 1,102,809 | 1,224,674 |
| 1978 | 129,465 | 1,631,479 | 1,760,944 | 5,881 | 9,566 | 15,447 | 135,346 | 1,641,045 | 1,776,391 |
| 1979 | 158,678 | 1,631,072 | 1,789,750 | 10,375 | 22,084 | 32,459 | 169,053 | 1,653,156 | 1,822,209 |
| 1980 | 196,709 | 1,730,410 | 1,927,119 | 22,546 | 22,218 | 44,764 | 219,255 | 1,752,628 | 1,971,883 |
| 1981 | 187,708 | 2,097,214 | 2,284,922 | 17,809 | 22,281 | 40,090 | 205,517 | 2,119,495 | 2,325,012 |
| 1982 | 151,802 | 1,264,580 | 1,416,382 | 17,208 | 16,091 | 33,299 | 169,010 | 1,280,671 | 1,449,681 |
| 1983 | 197,388 | 1,677,390 | 1,874,778 | 18,952 | 29,490 | 48,442 | 216,340 | 1,706,880 | 1,923,220 |
| 1984 | 162,332 | 1,546,685 | 1,709,017 | 16,795 | 29,267 | 46,062 | 179,127 | 1,575,952 | 1,755,079 |
| 1985 | 185,959 | 1,655,909 | 1,841,868 | 19,301 | 41,265 | 60,566 | 205,260 | 1,697,174 | 1,902,434 |
| 1986 | 145,208 | 1,756,395 | 1,901,603 | 20,364 | 14,536 | 34,900 | 165,572 | 1,770,931 | 1,936,503 |
| 1987 | 187,884 | 1,244,043 | 1,431,927 | 17,664 | 44,480 | 62,144 | 205,548 | 1,288,523 | 1,494,071 |
| 1988 | 148,011 | 2,312,894 | 2,460,905 | 21,427 | 33,565 | 54,992 | 169,438 | 2,346,459 | 2,515,897 |
| 1989[b] | 148,364 | 2,235,316 | 2,383,680 | 17,944 | 23,020 | 40,964 | 166,308 | 2,258,336 | 2,424,644 |
| 1990[c] | 142,768 | 1,224,394 | 1,367,163 | 18,824 | 34,807 | 53,631 | 161,592 | 1,256,201 | 1,420,794 |

[a]Commercial and subsistence harvest combined in numbers of fish, including "equivalent fish" converted from roe sales. See ADF&G 1985 Yukon Area Annual Management Report for data sources and methods of catch estimation used for some years.

[b]Alaskan subsistence harvest data preliminary.

[c]Alaskan subsistence harvest data unavailable. Most recent 5-year subsistence harvest average substituted. Canadian harvest data preliminary.

Appendix Table 2. Alaskan and Canadian total utilization of Yukon River chinook and fall chum salmon, 1961-1990[a]

| Year | Chinook | | | Fall Chum | | |
|---|---|---|---|---|---|---|
| | Canada[b] | Alaska[c] | Total | Canada[b] | Alaska[c] | Total |
| 1961 | 13,246 | 141,152 | 154,398 | 9,076 | 144,233 | 153,309 |
| 1962 | 13,937 | 105,844 | 119,781 | 9,436 | 140,401 | 149,837 |
| 1963 | 10,077 | 141,910 | 151,987 | 27,696 | 99,031[d] | 126,727 |
| 1964 | 7,408 | 109,818 | 117,226 | 12,187 | 128,707 | 140,894 |
| 1965 | 5,380 | 134,706 | 140,086 | 11,789 | 135,600 | 147,389 |
| 1966 | 4,452 | 104,887 | 109,339 | 13,192 | 122,548 | 135,740 |
| 1967 | 5,150 | 146,104 | 151,254 | 16,961 | 107,018 | 123,979 |
| 1968 | 5,042 | 118,632 | 123,674 | 11,633 | 97,552 | 109,185 |
| 1969 | 2,624 | 105,027 | 107,651 | 7,776 | 183,373 | 191,149 |
| 1970 | 4,663 | 93,019 | 97,682 | 3,711 | 265,096 | 268,807 |
| 1971 | 6,447 | 136,191 | 142,638 | 16,911 | 246,756 | 263,667 |
| 1972 | 5,729 | 113,098 | 118,827 | 7,532 | 188,178 | 195,710 |
| 1973 | 4,522 | 99,670 | 104,192 | 10,135 | 285,760 | 295,895 |
| 1974 | 5,631 | 118,053 | 123,684 | 11,646 | 383,552 | 395,198 |
| 1975 | 6,000 | 76,883 | 82,883 | 20,600 | 361,600 | 382,200 |
| 1976 | 5,025 | 105,582 | 110,607 | 5,200 | 228,717 | 233,917 |
| 1977 | 7,527 | 114,338 | 121,865 | 12,479 | 340,757 | 353,236 |
| 1978 | 5,881 | 129,465 | 135,346 | 9,566 | 331,250 | 340,816 |
| 1979 | 10,375 | 158,678 | 169,053 | 22,084 | 593,293 | 615,377 |
| 1980 | 22,546 | 196,709 | 219,255 | 22,218 | 466,087 | 488,305 |
| 1981 | 17,809 | 187,708 | 205,517 | 22,281 | 654,976 | 677,257 |
| 1982 | 17,208 | 151,802 | 169,010 | 16,091 | 357,084 | 373,175 |
| 1983 | 18,952 | 197,388 | 216,340 | 29,490 | 495,526 | 525,016 |
| 1984 | 16,795 | 162,332 | 179,127 | 29,267 | 383,055 | 412,322 |
| 1985 | 19,301 | 185,959 | 205,260 | 41,265 | 474,216 | 515,481 |
| 1986 | 20,364 | 145,208 | 165,572 | 14,536 | 303,485 | 318,021 |
| 1987 | 17,664 | 187,884 | 205,548 | 44,480 | 361,663[d] | 406,143 |
| 1988 | 21,427 | 148,011 | 169,438 | 33,565 | 320,666 | 354,231 |
| 1989[e] | 17,944 | 148,364 | 166,308 | 23,020 | 473,427 | 496,447 |
| 1990[f] | 18,824 | 142,768 | 161,592 | 34,807 | 349,852 | 384,659 |
| Average | | | | | | |
| 1961-79 | 6,796 | 118,582 | 125,378 | 12,611 | 230,706 | 243,317 |
| 1980-84 | 18,662 | 179,188 | 197,850 | 23,869 | 471,346 | 495,215 |
| 1985-89 | 19,340 | 163,085 | 182,425 | 31,373 | 386,691 | 418,065 |

[a]Catch in numbers of fish, including "equivalent fish" converted from roe sales.
[b]Commercial, Indian Food, and Domestic catches combined.
[c]Commercial, subsistence, and personal-use catches combined.
[d]Subsistence catch only; commercial fishery did not operate.
[e]Alaskan subsistence harvest data preliminary.
[f]Preliminary. Alaskan subsistence harvest data unavailable. Most recent 5-year subsistence harvest average substituted.

Appendix Table 3. Alaskan catch of Yukon River chinook salmon, 1961-1990.[a]

| Year | Subsistence[b] | Commercial | Total |
|---|---|---|---|
| 1961 | 21,488 | 119,664 | 141,152 |
| 1962 | 11,110 | 94,734 | 105,844 |
| 1963 | 24,862 | 117,048 | 141,910 |
| 1964 | 16,231 | 93,587 | 109,818 |
| 1965 | 16,608 | 118,098 | 134,706 |
| 1966 | 11,572 | 93,315 | 104,887 |
| 1967 | 16,448 | 129,656 | 146,104 |
| 1968 | 12,106 | 106,526 | 118,632 |
| 1969 | 14,000 | 91,027 | 105,027 |
| 1970 | 13,874 | 79,145 | 93,019 |
| 1971 | 25,684 | 110,507 | 136,191 |
| 1972 | 20,258 | 92,840 | 113,098 |
| 1973 | 24,317 | 75,353 | 99,670 |
| 1974 | 19,964 | 98,089 | 118,053 |
| 1975 | 13,045 | 63,838 | 76,883 |
| 1976 | 17,806 | 87,776 | 105,582 |
| 1977 | 17,581 | 96,757 | 114,338 |
| 1978 | 30,297 | 99,168 | 129,465 |
| 1979 | 31,005 | 127,673 | 158,678 |
| 1980 | 42,724 | 153,985 | 196,709 |
| 1981 | 29,690 | 158,018 | 187,708 |
| 1982 | 28,158 | 123,644 | 151,802 |
| 1983 | 49,478 | 147,910 | 197,388 |
| 1984 | 42,428 | 119,904 | 162,332 |
| 1985 | 39,771 | 146,188 | 185,959 |
| 1986 | 45,238 | 99,970 | 145,208 |
| 1987 | 53,124 | 134,760[c] | 187,884 |
| 1988 | 46,590 | 101,421 | 148,011 |
| 1989[d] | 46,084 | 102,280 | 148,364 |
| 1990[e] | 46,161 | 96,607[f] | 142,768 |
| Average | | | |
| 1961-79 | 18,856 | 99,726 | 118,582 |
| 1980-84 | 38,496 | 140,692 | 179,188 |
| 1985-89 | 46,161 | 116,924 | 163,085 |

[a]Catch in numbers of fish unless otherwise indicated.
[b]Includes personal-use catches.
[c]Includes 653 and 2,136 chinook salmon illegally sold in Districts 5 and 6 (Tanana River), respectively.
[d]Subsistence harvest data preliminary.
[e]Preliminary. Subsistence harvest data unavailable. Most recent 5-year subsistence harvest average substituted.
[f]Includes "equivalent fish" converted from roe sales.

Appendix Table 4. Canadian catch of Yukon River chinook salmon (including Porcupine River), 1961-1990.[a]

| Year | Commercial | Non Commercial | | | | Total |
|---|---|---|---|---|---|---|
| | | Domestic | Indian Food Fish[b] | Sport[c] | Combined | |
| 1961 | 3,446 | | 9,800 | | 9,800 | 13,246 |
| 1962 | 4,037 | | 9,900 | | 9,900 | 13,937 |
| 1963 | 2,283 | | 7,794 | | 7,794 | 10,077 |
| 1964 | 3,208 | | 4,200 | | 4,200 | 7,408 |
| 1965 | 2,265 | | 3,115 | | 3,115 | 5,380 |
| 1966 | 1,942 | | 2,510 | | 2,510 | 4,452 |
| 1967 | 2,187 | | 2,963 | | 2,963 | 5,150 |
| 1968 | 2,212 | | 2,830 | | 2,830 | 5,042 |
| 1969 | 1,640 | | 984 | | 984 | 2,624 |
| 1970 | 2,611 | | 2,052 | | 2,052 | 4,663 |
| 1971 | 3,178 | | 3,269 | | 3,269 | 6,447 |
| 1972 | 1,769 | | 3,960 | | 3,960 | 5,729 |
| 1973 | 2,199 | | 2,323 | | 2,323 | 4,522 |
| 1974 | 1,808 | 406 | 3,417 | | 3,823 | 5,631 |
| 1975 | 3,000 | 400 | 2,600 | | 3,000 | 6,000 |
| 1976 | 3,500 | 500 | 1,025 | | 1,525 | 5,025 |
| 1977 | 4,720 | 531 | 2,276 | | 2,807 | 7,527 |
| 1978 | 2,975 | 421 | 2,485 | | 2,906 | 5,881 |
| 1979 | 6,175 | 1,200 | 3,000 | | 4,200 | 10,375 |
| 1980 | 9,500 | 3,500 | 9,546 | | 13,046 | 22,546 |
| 1981 | 8,593 | 237 | 8,979 | | 9,216 | 17,809 |
| 1982 | 8,640 | 435 | 7,833 | 300 | 8,568 | 17,208 |
| 1983 | 13,027 | 400 | 5,225 | 300 | 5,925 | 18,952 |
| 1984 | 9,885 | 260 | 6,350 | 300 | 6,910 | 16,795 |
| 1985 | 12,573 | 478 | 5,950 | 300 | 6,728 | 19,301 |
| 1986 | 10,797 | 342 | 8,925 | 300 | 9,567 | 20,364 |
| 1987 | 10,864 | 330 | 6,170 | 300 | 6,800 | 17,664 |
| 1988 | 13,217 | 282 | 7,278 | 650 | 8,210 | 21,427 |
| 1989 | 9,789 | 400 | 7,455 | 300 | 8,155 | 17,944 |
| 1990[d] | 11,291 | 233 | 7,000 | 300 | 7,533 | 18,824 |
| Average | | | | | | |
| 1961-79 | 2,903 | 576 | 3,711 | | 3,893 | 6,796 |
| 1980-84 | 9,929 | 966 | 6,587 | | 8,733 | 18,662 |
| 1985-89 | 11,448 | 366 | 7,156 | 370 | 7,892 | 19,340 |

[a]Catch in numbers of fish.
[b]Includes mainstem Yukon River and Porcupine (Old Crow) Indian food fish harvest data.
[c]Sport fish harvest unknown prior to 1982.
[d]Preliminary. Does not include Old Crow Indian food fish harvest data.

Appendix Table 5. Alaska catch of Yukon River chum salmon, 1961-1990.[a,b]

| Year | Summer Chum | | | Fall Chum | | | Total Chum | | |
|---|---|---|---|---|---|---|---|---|---|
| | Subsistence[c] | Commercial | Total | Subsistence[c,d] | Commercial | Total | Subsistence[c,d] | Commercial | Total |
| 1961 | 305,317 | | 305,317 | 101,772 | 42,461 | 144,233 | 407,089 | 42,461 | 449,550 |
| 1962 | 261,856 | | 261,856 | 87,285 | 53,116 | 140,401 | 349,141 | 53,116 | 402,257 |
| 1963 | 297,094 | | 297,094 | 99,031 | 0 | 99,031 | 396,12 | 0 | 396,125 |
| 1964 | 361,080 | | 361,080 | 120,360 | 8,347 | 128,707 | 481,440 | 8,347 | 489,787 |
| 1965 | 336,848 | | 336,848 | 112,283 | 23,317 | 135,600 | 449,131 | 23,317 | 472,448 |
| 1966 | 154,508 | | 154,508 | 51,503 | 71,045 | 122,548 | 206,011 | 71,045 | 277,056 |
| 1967 | 206,233 | 10,935 | 217,168 | 68,744 | 38,274 | 107,018 | 274,977 | 9,209 | 324,186 |
| 1968 | 133,880 | 14,470 | 148,350 | 44,627 | 52,925 | 97,552 | 178,50 | 67,395 | 245,902 |
| 1969 | 156,191 | 61,966 | 218,157 | 52,063 | 131,310 | 183,373 | 208,254 | 193,276 | 401,530 |
| 1970 | 166,504 | 137,006 | 303,510 | 55,501 | 209,595 | 265,096 | 222,005 | 346,601 | 568,606 |
| 1971 | 171,487 | 100,090 | 271,577 | 57,162 | 189,594 | 246,756 | 228,649 | 289,684 | 518,333 |
| 1972 | 108,006 | 135,668 | 243,674 | 36,002 | 152,176 | 188,178 | 144,008 | 287,844 | 431,852 |
| 1973 | 161,012 | 285,509 | 446,521 | 53,670 | 232,090 | 285,760 | 214,682 | 517,599 | 732,281 |
| 1974 | 227,811 | 589,892 | 817,703 | 93,776 | 289,776 | 383,552 | 321,587 | 879,668 | 1,201,255 |
| 1975 | 211,888 | 710,295 | 922,183 | 86,591 | 275,009 | 361,600 | 298,479 | 985,304 | 1,283,783 |
| 1976 | 186,872 | 600,894 | 787,766 | 72,327 | 156,390 | 228,717 | 259,199 | 757,284 | 1,016,483 |
| 1977 | 159,502 | 534,875 | 694,377 | 82,771 | 257,986 | 340,757 | 242,273 | 792,861 | 1,035,134 |
| 1978 | 197,144 | 1,069,146 | 1,266,290 | 94,867 | 247,011 | 331,250 | 292,011 | 1,316,157 | 1,597,540 |
| 1979 | 196,187 | 814,633 | 1,010,820 | 233,347 | 378,412 | 593,293 | 429,534 | 1,193,045 | 1,604,113 |
| 1980 | 272,398 | 963,022 | 1,235,420 | 172,657 | 298,450 | 466,087 | 445,055 | 1,261,472 | 1,701,507 |
| 1981 | 208,284 | 1,189,046 | 1,397,330 | 188,525 | 477,736 | 654,976 | 396,809 | 1,666,782 | 2,052,306 |
| 1982 | 260,969 | 573,457 | 834,426 | 132,897 | 224,992 | 357,084 | 393,866 | 798,449 | 1,19' |
| 1983 | 240,386 | 904,263 | 1,144,649 | 192,928 | 307,662 | 495,526 | 433,314 | 1,211,925 | 1,64 |
| 1984 | 230,747 | 801,923 | 1,032,670 | 174,823 | 210,560 | 383,055 | 405,570 | 1,012,483 | 1,415,... |
| 1985 | 264,828 | 826,929 | 1,091,757 | 206,472 | 270,269 | 474,216 | 471,300 | 1,097,198 | 1,565,973 |
| 1986 | 290,825 | 1,080,362 | 1,371,187 | 164,043 | 140,019 | 303,485 | 454,868 | 1,220,381 | 1,674,672 |
| 1987 | 275,914 | 521,572 | 797,486 | 361,663[e] | 0 | 361,663 | 637,577 | 521,572 | 1,159,149 |
| 1988 | 311,724 | 1,511,459 | 1,823,183 | 159,703 | 164,190 | 320,666 | 471,427 | 1,676,008 | 2,143,849 |
| 1989[f,g] | 249,375 | 1,392,416 | 1,641,791 | 186,591 | 303,224 | 473,427 | 435,966 | 1,695,640 | 2,115,218 |
| 1990[h] | 278,533 | 498,629 | 777,162 | 215,694 | 142,995 | 349,852 | 494,228 | 641,624 | 1,127,015 |
| Average | | | | | | | | | |
| 1961-79 | 210,496 | 389,645 | 447,095 | 84,404 | 147,833 | 230,706 | 294,900 | 414,432 | 707,801 |
| 1980-84 | 242,557 | 886,342 | 1,128,899 | 172,366 | 303,880 | 471,346 | 414,923 | 1,190,222 | 1,600,245 |
| 1985-89 | 278,533 | 1,066,548 | 1,345,081 | 215,694 | 175,612 | 386,691 | 494,228 | 1,242,160 | 1,731,772 |

[a]Commercial catch in numbers of fish, including "equivalent fish" converted from roe sales. Total fall chum catch may not equal the sum of the commercial and subsistence harvests since fish harvested for roe were reported as subsistence.

[b]Includes ADF&G test fish sales.

[c]Catches of summer and fall chum salmon estimated for 1961-1976 since catches other than chinook salmon were not differentiated by species.

[d]Minimum estimates of fall chum salmon for 1961-1978 because surveys were conducted prior to the end of the fishing season.

[e]Includes an estimated 22,377 and 87,992 fall chum salmon illegally sold in Districts 5 and 6 (Tanana River), respectively.

[f]Subsistence harvest data preliminary.

[g]In 1988, 63.8% of the reported subsistence harvest in District 4 (excluding the Koyukuk and Innoko River catches) was reported to have been taken during commercial fishing activities. This percentage was used to preliminarily adjust the estimated commercial and subsistence harvests for 1989.

[h]Subsistence harvest data unavailable. Most recent 5-year subsistence harvest average substituted.

Appendix Table 6. Canadian catch of Yukon River fall chum salmon (including Porcupine River), 1961-1990.[a]

| Year | Commercial | Non-Commercial | | | Total |
|---|---|---|---|---|---|
| | | Domestic | Indian Food Fish[b] | Combined | |
| 1961 | 3,276 | | 5,800 | 5,800 | 9,076 |
| 1962 | 936 | | 8,500 | 8,500 | 9,436 |
| 1963 | 2,196 | | 25,500 | 25,500 | 27,696 |
| 1964 | 1,929 | | 10,258 | 10,258 | 12,187 |
| 1965 | 2,071 | | 9,718 | 9,718 | 11,789 |
| 1966 | 3,157 | | 10,035 | 10,035 | 13,192 |
| 1967 | 3,343 | | 13,618 | 13,618 | 16,961 |
| 1968 | 453 | | 11,180 | 11,180 | 11,633 |
| 1969 | 2,279 | | 5,497 | 5,497 | 7,776 |
| 1970 | 2,479 | | 1,232 | 1,232 | 3,711 |
| 1971 | 1,761 | | 15,150 | 15,150 | 16,911 |
| 1972 | 2,532 | | 5,000 | 5,000 | 7,532 |
| 1973 | 2,806 | | 7,329 | 7,329 | 10,135 |
| 1974 | 2,544 | 466 | 8,636 | 9,102 | 11,646 |
| 1975 | 2,500 | 4,600 | 13,500 | 18,100 | 20,600 |
| 1976 | 1,000 | 1,000 | 3,200 | 4,200 | 5,200 |
| 1977 | 3,990 | 1,499 | 6,990 | 8,489 | 12,479 |
| 1978 | 3,356 | 728 | 5,482 | 6,210 | 9,566 |
| 1979 | 9,084 | 2,000 | 11,000 | 13,000 | 22,084 |
| 1980 | 9,000 | 4,000 | 9,218 | 13,218 | 22,218 |
| 1981 | 15,260 | 1,611 | 5,410 | 7,021 | 22,281 |
| 1982 | 11,312 | 683 | 4,096 | 4,779 | 16,091 |
| 1983 | 25,990 | 300 | 3,200 | 3,500 | 29,490 |
| 1984 | 22,932 | 535 | 5,800 | 6,335 | 29,267 |
| 1985 | 35,746 | 279 | 5,240 | 5,519 | 41,265 |
| 1986 | 11,464 | 222 | 2,850 | 3,072 | 14,536 |
| 1987 | 40,591 | 132 | 3,757 | 3,889 | 44,480 |
| 1988 | 30,263 | 349 | 2,953 | 3,302 | 33,565 |
| 1989 | 17,549 | 100 | 5,371 | 5,471 | 23,020 |
| 1990[c] | 27,207 | 100 | 7,500 | 7,600 | 34,807 |
| Average | | | | | |
| 1961-79 | 2,721 | 1,716 | 9,349 | 9,890 | 12,611 |
| 1980-84 | 16,899 | 1,426 | 5,545 | 6,971 | 23,869 |
| 1985-89 | 27,123 | 216 | 3,408 | 3,624 | 30,747 |

[a]Catch in numbers of fish.
[b]Includes mainstem Yukon River and Porcupine (Old Crow) Indian food fish harvest data.
[c]Preliminary.

Appendix Table 7. Alaskan catch of Yukon River coho salmon, 1961-1990.[a]

| Year | Subsistence[b] | Commercial | Total |
|---|---|---|---|
| 1961 | 9,192 | 2,855 | 12,047 |
| 1962 | 9,480 | 22,926 | 32,406 |
| 1963 | 27,699 | 5,572 | 33,271 |
| 1964 | 12,187 | 2,446 | 14,633 |
| 1965 | 11,789 | 350 | 12,139 |
| 1966 | 13,192 | 19,254 | 32,446 |
| 1967 | 17,164 | 11,047 | 28,211 |
| 1968 | 11,613 | 13,303 | 24,916 |
| 1969 | 7,776 | 15,093 | 22,869 |
| 1970 | 3,966 | 13,188 | 17,154 |
| 1971 | 16,912 | 12,203 | 29,115 |
| 1972 | 7,532 | 22,233 | 29,765 |
| 1973 | 10,236 | 36,641 | 46,877 |
| 1974 | 11,646 | 16,777 | 28,423 |
| 1975 | 20,708 | 2,546 | 23,254 |
| 1976 | 5,241 | 5,184 | 10,425 |
| 1977 | 16,333 | 38,863 | 55,196 |
| 1978 | 7,787 | 26,152 | 33,939 |
| 1979 | 9,794 | 17,165 | 26,959 |
| 1980 | 20,158 | 8,745 | 28,903 |
| 1981 | 21,228 | 23,680 | 44,908 |
| 1982 | 35,894 | 37,176 | 73,070 |
| 1983 | 23,895 | 13,320 | 37,215 |
| 1984 | 49,020 | 81,940 | 130,960 |
| 1985 | 32,264 | 57,672 | 89,936 |
| 1986 | 34,468 | 47,255 | 81,723 |
| 1987 | 84,894[c] | 0 | 84,894 |
| 1988 | 69,138 | 99,907 | 169,045 |
| 1989[d] | 34,615 | 85,483 | 120,098 |
| 1990[e] | 51,076 | 46,304[f] | 97,380 |
| Average | | | |
| 1961-79 | 12,118 | 14,937 | 27,055 |
| 1980-84 | 30,039 | 32,972 | 63,011 |
| 1985-89 | 51,076 | 58,063 | 109,139 |

[a]Catch in numbers of fish. Includes ADF&G test fish catches.
[b]Catches estimated for 1961-1976 since catches other than chinook salmon were not differentiated by species. Catches for 1961-1978 represent minimum numbers since surveys were conducted prior to the end of the fishing season.
[c]Includes an estimated 4,996 and 31,276 coho salmon illegally sold in Districts 5 and 6 (Tanana River), respectively.
[d]Subsistence harvest data preliminary.
[e]Preliminary. Subsistence harvest data unavailable. Most recent 5-year subsistence harvest average substituted.
[f]Includes "equivalent fish" converted from roe sales.

Appendix Table 8. Chinook salmon escapement counts for selected U.S. spawning stocks in the Yukon River drainage, 1961-1990[a]

| Year | Andreafsky River | | Anvik River[b] | | Nulato River | Gisasa River | Chena River | Salcha River |
|---|---|---|---|---|---|---|---|---|
| | East Fork | West Fork | Aerial | Tower | | | | |
| 1961 | 1,003 | - | 1,226 | - | 543[c] | 266[c] | - | 2,878 |
| 1962 | 675[c] | 762[c] | - | - | - | - | 61[c,d] | 937 |
| 1963 | - | - | - | - | - | - | 137[c] | - |
| 1964 | 867 | 705 | - | - | - | - | - | 450 |
| 1965 | - | 344[c] | 650[c] | - | - | - | - | 408 |
| 1966 | 361 | 303 | 638 | - | - | - | - | 800 |
| 1967 | - | 276[c] | 336[c] | - | - | - | - | - |
| 1968 | 380 | 383 | 310[c] | - | - | - | - | 739 |
| 1969 | 274[c] | 231[c] | 296[c] | - | - | - | - | 461[c] |
| 1970 | 665 | 574[c] | 368 | - | - | - | 6[c] | 1,882 |
| 1971 | 1,904 | 1,682 | - | - | - | - | 193[c,d] | 158[c] |
| 1972 | 798 | 582[c] | - | 1,198 | - | - | 138[c,d] | 1,193 |
| 1973 | 825 | 788 | - | 613 | - | - | 21[c] | 391 |
| 1974 | - | 285 | - | 471[c] | 78[c] | 161 | 1,035[d] | 1,857 |
| 1975 | 993 | 301 | - | 730 | 204 | 385 | 316[d] | 1,055 |
| 1976 | 818 | 643 | - | 1,153 | 648 | 332 | 531 | 1,641 |
| 1977 | 2,008 | 1,499 | - | 1,371 | 487[c] | 255 | 563 | 1,202 |
| 1978 | 2,487 | 1,062 | - | 1,324 | 920 | 45[c] | 1,726 | 3,499 |
| 1979 | 1,180 | 1,134 | - | 1,484 | 1,507 | 484 | 1,159[c] | 4,789 |
| 1980 | 958[c] | 1,500 | 1,192 | - | 1,323[c] | 951 | 2,541 | 6,757 |
| 1981 | 2,146[c] | 231[c] | 577[c] | - | 791[c] | - | 600[c] | 1,237[c] |
| 1982 | 1,274 | 851 | - | - | - | 421 | 2,073 | 2,534 |
| 1983 | - | - | 376[c] | - | 1,006 | 572 | 2,553 | 1,961 |
| 1984 | 1,573[c] | 1,993 | 574[c] | - | - | - | 501 | 1,031 |
| 1985 | 1,617 | 2,248 | 720 | - | 2,780 | 735 | 2,553 | 2,035 |
| 1986 | 1,954 | 3,158 | 918 | - | 2,974 | 1,346 | 2,031 | 3,368 |
| 1987 | 1,608 | 3,281 | 879 | - | 1,638 | 731 | 1,312 | 1,898 |
| 1988 | 1,020 | 1,448 | 1,449 | - | 1,775 | 797 | 1,966 | 2,761 |
| 1989 | 1,399 | 1,089 | 212[c] | - | - | - | 1,280 | 2,333 |
| 1990 | 2,503 | 1,545 | 1,595 | - | 998 | 884[c] | 1,436 | 3,744 |
| E.O.[e] | 1,600 | 1,000 | 500[f] | - | 1,000 | 650 | 1,000-1,700 | 1,500-3,500 |

[a]Data obtained by aerial survey unless otherwise noted. Only peak counts are listed.
[b]From 1961-1970, aerial survey count data are from various segments of the mainstem Anvik River. From 1972-1979, total mainstem aerial survey counts below the tower site were added to the tower counts. From 1980-present, aerial survey counts are from the mainstem Anvik River between the Yellow River and McDonald Creek.
[c]Incomplete and/or poor survey conditions resulting in minimal or inaccurate counts.
[d]Boat Survey.
[e]Interim escapement objective.
[f]Interim escapement objective for the mainstem Anvik River between the Yellow River and McDonald Creek.

Appendix Table 9. Chinook salmon escapement counts for selected Canadian spawning stocks in the Yukon River drainage, 1961-1990.[a]

| Year | Tincup Creek | Tatchun River[b] | Little Salmon River | Big Salmon River[d] | Nisutlin River[e] | Wolf River[f] | Whitehorse Fishway[g] | Canada Mainstem Tagging[h] |
|---|---|---|---|---|---|---|---|---|
| 1961 | - | - | - | - | - | - | 1,068 | - |
| 1962 | - | - | - | - | - | - | 1,500 | - |
| 1963 | - | - | - | - | - | - | 483 | - |
| 1964 | - | - | - | - | - | - | 595 | - |
| 1965 | - | - | - | - | - | - | 903 | - |
| 1966 | - | 7[c] | - | - | - | - | 563 | - |
| 1967 | - | - | - | - | - | - | 533 | - |
| 1968 | - | - | 173[c] | 857[c] | 407[c] | - | 414 | - |
| 1969 | - | - | 120 | 286 | 105 | - | 334 | - |
| 1970 | - | 100 | - | 670 | 615 | 71[c] | 625 | - |
| 1971 | - | 130 | 275 | 275 | 650 | 750 | 856 | - |
| 1972 | - | 80 | 126 | 415 | 237 | 13 | 391 | - |
| 1973 | 100 | 99 | 27[c] | 75[c] | 36[c] | - | 224 | - |
| 1974 | - | 192 | - | 70[c] | 48[c] | - | 273 | - |
| 1975 | - | 175 | - | 153[c] | 249 | 40[c] | 313 | - |
| 1976 | - | 52 | - | 86[c] | 102 | - | 121 | - |
| 1977 | - | 150 | 408 | 316[c] | 77 | - | 277 | - |
| 1978 | - | 200 | 330 | 524 | 375 | - | 725 | - |
| 1979 | - | 150 | 489[c] | 632 | 713 | 183[c] | 1,184 | - |
| 1980 | - | 222 | 286[c] | 1,436 | 975 | 377 | 1,383 | - |
| 1981 | - | 133 | 670 | 2,411 | 1,626 | 395 | 1,555 | - |
| 1982 | - | 71 | 403 | 758 | 578 | 104 | 473 | 19,790 |
| 1983 | 100 | 264 | 101[c] | 540 | 701 | 95 | 905 | 28,989 |
| 1984 | 150 | 153 | 434 | 1,044 | 832 | 124 | 1,042 | 27,616[i] |
| 1985 | 210 | 190 | 255 | 801 | 409 | 110 | 508 | 10,730 |
| 1986 | 228 | 155 | 54[c] | 745 | 459[c] | 109 | 557 | 16,415 |
| 1987 | 100 | 159 | 468 | 891 | 183 | 35 | 327 | 13,210 |
| 1988 | 204 | 152 | 368 | 765 | 267 | 66 | 405 | 23,118 |
| 1989 | 88 | 100 | 862 | 1,662 | 695 | 146 | 549 | 25,201 |
| 1990 | - | 655 | 665 | 1,806 | 652 | 188 | 1,407 | 38,678[j] |
| E.O.[k] | | | | | | | | 33,000-43,000 |

[a]Data obtained by aerial survey unless otherwise noted. Only peak counts are listed.
[b]All foot surveys except 1978 (boat survey) and 1986 (aerial survey).
[c]Incomplete and/or poor survey conditions resulting in minimal or inaccurate counts.
[d]For 1968, 1970, and 1971 counts are from mainstem Big Salmon River. For all other years counts are from the mainstem Big Salmon River between Big Salmon Lake and the vicinity of South Creek.
[e]One Hundred Mile Creek to Sidney Creek
[f]Wolf Lake to Red River.
[g]Includes 50, 90, and 292 fin-clipped hatchery-origin salmon in 1988, 1989, and 1990, respectively.
[h]Estimated total spawning escapement excluding Porcupine River (estimated border escapement minus the Canadian catch).
[i]Estimate derived by dividing the 1984 5-area index count (Whitehorse Fishway minus fin-clipped salmon, Big Salmon, Nisutlin, Wolf, Tatchun) by the average proportion of the 5-area index count to the estimated spawning escapements from the DFO tagging study for years 1982, 1983 and 1985-1989.
[j]Preliminary.
[k]Interim escapement objective.

Appendix Table 10. Summer chum salmon escapement counts for selected spawning areas in the Yukon River drainage, 1974-1990.[a]

| | Andreafsky River | | | Anvik River | | | | |
|---|---|---|---|---|---|---|---|---|
| | E. Fork | | W. Fork | | | | | |
| Year | Aerial | Sonar or Tower | | Tower & Aerial | Sonar | Nulato | Hogatza[e] | Salcha |
| 1973 | 10,149[b] | - | 51,835 | 86,665[b] | - | - | - | |
| 1974 | 3,215[b] | - | 33,578 | 201,277 | - | 51,160 | - | 3,510 |
| 1975 | 223,485 | - | 235,954 | 845,485 | - | 138,495 | 22,355 | 7,573 |
| 1976 | 105,347 | - | 118,420 | 406,166 | - | 40,001[b] | 20,744 | 6,474 |
| 1977 | 112,722 | - | 63,120 | 262,854 | - | 69,660 | 10,734 | 677[b] |
| 1978 | 127,050 | - | 57,321 | 251,339 | - | 54,480 | 5,102 | 5,405 |
| 1979 | 66,471 | - | 43,391 | - | 280,537 | 37,104 | 14,221 | 3,060 |
| 1980 | 36,823[b] | - | 115,457 | - | 492,676 | 14,946[b] | 19,786 | 4,140 |
| 1981 | 81,555 | 147,312[c] | - | - | 1,479,582 | 14,348[b] | - | 8,500 |
| 1982 | 7,501[b] | 181,352[c] | 7,267[b] | - | 444,581 | - | 4,984[b] | 3,756 |
| 1983 | - | 110,608[c] | - | - | 362,912 | 21,012[b] | 28,141 | 716[b] |
| 1984 | 95,200[b] | 70,125[c] | 238,565 | - | 891,028 | - | - | 9,810 |
| 1985 | 66,146 | - | 52,750 | - | 1,080,243 | 29,838 | 22,566 | 3,178 |
| 1986 | 83,931 | 167,614[d] | 99,373 | - | 1,189,602 | 64,265 | - | 8,028 |
| 1987 | 6,687[b] | 45,221[d] | 35,535 | - | 455,876 | 11,257 | 5,669[b] | 3,657 |
| 1988 | 43,056 | 68,937[d] | 45,432 | - | 1,125,449 | 42,083 | 6,890 | 2,889[b] |
| 1989 | 21,460[b] | - | - | - | 636,906 | - | - | 1,574[b] |
| 1990 | 11,519[b] | - | 20,426[b] | - | 395,303[g] | 6,590[b] | 21,077 | 450 |
| E.O.[f] | 109,000 | _ | 116,000 | _ | 487,000 | _ | 17,000 | 3,500 |

[a]Data obtained by aerial survey unless otherwise noted. Only peak counts are listed.
[b]Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.
[c]Sonar count.
[d]Tower count.
[e]Caribou and Clear Creeks.
[f]Interim escapement objectives.
[g]Preliminary

Appendix Table 11. Fall chum salmon expanded population escapement estimates for selected spawning areas in the Yukon River drainage, 1974-1990.

| Year | Delta River[a] | Upper Toklat River[b] | Chandalar River[c] | Sheenjek River[d] | Fishing Branch River[e] | Canada Mainstem Tagging Estimate[f] |
|---|---|---|---|---|---|---|
| 1974 | 5,915 | 43,484 | - | 89,966 | 32,525[g] | - |
| 1975 | 3,734[h] | 90,984 | - | 173,371 | 353,282[g] | - |
| 1976 | 6,312[h] | 53,882 | - | 26,354 | 36,584 | - |
| 1977 | 16,876[h] | 36,462 | - | 45,544 | 88,400 | - |
| 1978 | 11,136 | 37,057 | - | 32,449 | 40,800 | - |
| 1979 | 8,355 | 179,627 | - | 91,372 | 119,898 | - |
| 1980 | 5,137 | 26,373 | - | 28,933 | 55,268 | - |
| 1981 | 23,508 | 15,775 | - | 74,560 | 57,386[i] | - |
| 1982 | 4,235 | 3,601 | - | 31,421[c] | 15,901 | 31,958 |
| 1983 | 7,705 | 20,807 | - | 49,392[c] | 27,200 | 90,875 |
| 1984 | 12,411 | 16,511 | - | 27,130[c] | 15,150 | 56,633[j] |
| 1985 | 17,276[h] | 22,805 | - | 152,768[c] | 56,016[g] | 62,010 |
| 1986 | 6,703[h] | 18,903 | 59,313 | 83,197[c] | 31,378[g] | 87,990 |
| 1987 | 21,180 | 22,141 | 52,416 | 140,086[c] | 48,956[g] | 80,776 |
| 1988 | 18,024 | 13,324 | 33,619 | 41,073[c] | 23,597[g] | 36,786 |
| 1989 | 21,342[h] | 30,447 | 69,161 | 101,748[c] | 43,834[g] | 35,750 |
| 1990[k] | 8,000[h] | 33,672 | 78,631 | 63,135[c] | 27,000[m] | 49,849 |
| E.O.[n] | 11,000 | 33,000 | - | 62,000 | 50,000-120,000 | - |

[a]Total escapement estimates made from migratory time density curve (Barton 1986) unless otherwise indicated.
[b]Total escapement estimates using Delta River migratory time density curve and percentage of live salmon present by survey date in the upper Toklat River area.
[c]Sonar estimate
[d]Total escapement estimates using sonar to aerial survey expansion factor of 2.22 unless otherwise indicated.
[e]Total escapement estimates using weir to aerial survey expansion factor of 2.72 unless otherwise indicated.
[f]Estimated total spawning estimates excluding Porcupine-Fishing Branch Rivers (estimated border escapement minus Canadian removal).
[g]Weir estimate.
[h]Population estimate from replicate foot surveys and stream life data.
[i]Initial aerial survey count was doubled before applying the weir to aerial survey expansion factor of 2.72 since only half of the spawning area was surveyed.
[j]Escapement estimate based on mark-recapture program unavailable. Estimate based on assumed average exploitation rate.
[k]Preliminary.
[m]Weir was not operated. Total escapement estimate using weir to aerial survey expansion factor of 3.57. Survey was conducted approximately 2 weeks late. Therefore, a more reasonable escapement estimate would be between 30,000 and 40,000 salmon.
[n]Interim escapement objective.

Appendix Table 12. Coho Salmon escapement counts for selected spawning areas in the Yukon River drainage, 1972-1989.[a]

| Year | Nenana River Drainage | | | | Delta Clearwater River[e,d] | Clearwater Lake and Outlet | Richardson Clearwater River |
|---|---|---|---|---|---|---|---|
| | Lost Slough | Clear Creek | Wood Creek[b] | 17 Mile Slough | | | |
| 1972 | - | - | - | - | 632 | 417 | 454[g] |
| 1973 | - | - | - | - | 3,322 | 551[d] | 375[d] |
| 1974 | 1,388 | - | - | 27 | 3,954 | 560 | 652[d] |
| 1975 | 943 | - | - | 956 | 5,100 | 1,575[d,e] | 48[g] |
| 1976 | 118 | 13 | - | 281 | 1,920 | 1,500[d,e] | 80[g] |
| 1977 | 524 | - | 310[c] | 1,167 | 4,793 | 730[d,e] | 327 |
| 1978 | 350 | - | 300[c] | 466 | 4,798 | 570[d,e] | - |
| 1979 | 227 | - | - | 1,987 | 8,970 | 1,015[d,e] | 372 |
| 1980 | 499 | - | 1,603[c] | 592 | 3,946 | 1,545[d,e] | 611 |
| 1981 | 274 | - | 849[h] | 1,005 | 8,563[f] | 459[g] | 550 |
| 1982 | - | - | 1,436[h] | - | 8,365[f] | - | - |
| 1983 | 766 | - | 1,044[h] | 103 | 8,019[f] | 253 | 88 |
| 1984 | 2,677 | 2,600[b,e] | 8,805[h] | - | 11,061 | 1,368 | 428 |
| 1985 | 1,584 | - | 3,775[h] | 2,081 | 5,358 | 750 | - |
| 1986 | 794 | 605[b,e] | 1,664[h] | 218[b,e] | 10,857 | 3,577 | 146[g] |
| 1987 | 2,511 | - | 2,450[h] | 3,802 | 22,300 | 4,225[d,e] | - |
| 1988 | 348 | - | 2,046[h] | - | 21,600 | 825[d,e] | - |
| 1989 | - | - | 412[h] | 824[g] | 11,000 | 1,600[d,e] | 483 |
| 1990[i] | 688 | - | - | 15[g] | 8,325 | 2,375[d,e] | - |

[a]Only peak counts presented. Survey rating is fair-good unless indicated otherwise.
[b]Surveyed by F.R.E.D.
[c]Foot survey.
[d]Survey by Sport Fish Division.
[e]Boat survey.
[f]Population estimate.
[g]Poor survey
[h]Weir count.
[i]Preliminary

# ATTACHMENT II. STATUS OF MARINE FISHERIES WHICH MAY INTERCEPT YUKON RIVER ORIGIN SALMON

## ATTACHMENT II. STATUS OF MARINE FISHERIES WHICH MAY INTERCEPT YUKON RIVER ORIGIN SALMON

A. Introduction.

Salmon originating in the Yukon River system migrate as juveniles out of the river and into the Bering Sea. The distribution of Yukon River salmon in the ocean is only partly understood, but evidence from tagging studies and the analysis of scale patterns show that these salmon spread throughout the Bering Sea and some move considerably south of the Aleutian Island chain into the Gulf of Alaska and North Pacific Ocean.

Four commercial fisheries operate in areas where Yukon River salmon occur and do catch some of those salmon: (1) the high-seas salmon gillnet fisheries in the North Pacific Ocean and the Bering Sea by Japan; (2) the high-seas squid gillnet fisheries in the North Pacific Ocean by Japan, the Republic of Korea, and the Republic of China (Taiwan); (3) the groundfish trawl fisheries of the Gulf of Alaska and Bering Sea by foreign nations (now restricted to international waters in the Bering Sea), joint-venture fisheries between U.S. harvesting vessels and foreign processor ships (now restricted to the Bering Sea), and the U.S. fisheries of the Gulf of Alaska and Bering Sea; and (4) the U.S. purse seine and gill net salmon fisheries in the Unimak and Shumagin Islands area (known as the "False Pass" fisheries).

Three other commercial fisheries operate in marine waters where Yukon River salmon occur, but they catch few if any salmon and make no significant harvest of Yukon River salmon: (1) the U.S. longline fisheries for Pacific halibut, Pacific cod, and other groundfish, (2) the U.S. pot fisheries for Dungeness, king, and Tanner crab, and (3) the U.S. purse seine and gillnet fisheries for Pacific herring.

Only two of these fisheries may legally retain the salmon they catch: (1) the Japanese high-seas salmon gillnet fisheries and (2) the U.S. False Pass seine and gill net fisheries. Under U.S. law and fishing regulations, U.S. fishermen are prohibited from fishing for salmon with nets seaward of a line 3 nautical miles from the coastline, and if they catch any salmon in their net fisheries for other species they must return the salmon immediately to the sea. The same restrictions applied to foreign groundfish fishermen operating in the U.S. EEZ. Also, Japan, the Republic of Korea, and Taiwan have now imposed those restrictions on their high-seas squid fisheries. Some of these fishermen, however, have illegally caught retained, and sold salmon, some of which probably came from the Yukon River.

Of the two fisheries that may legally retain salmon, both are under restrictions to keep small their harvest of Yukon River salmon. the Japanese high-seas gillnet salmon fisheries are under restrictions that limit the amount of fishing effort, and the times and areas where they may fish; the fishing times and areas are designed to minimize their catch of salmon originating in North America. The U.S. False Pass fisheries are under restrictions on the amount and type of fishing gear, fishing times and areas, and the harvests of chum salmon.

In summary, although several fisheries operate in marine waters where Yukon River salmon occur, only two may legally catch salmon and their harvests are controlled by regulations on the amount and types of fishing gear, fishing times, fishing areas, and, for the False Pass fishery, a limit on its harvest of sockeye and chum salmon. The following sections describe each fishery in detail and provide records of their harvests.

B. Japanese High-Seas Salmon Gillnet Fisheries.

Following World War II, but particularly from 1952 until 1990, the Japanese operated two high-seas gillnet fisheries for salmon: (a) the mothership fishery in the North Pacific Ocean and the Bering Sea and (b) the land-based gillnet fishery in the North Pacific Ocean. The International North Pacific Fisheries Commission (INPFC) was established in 1953 to regulate these fisheries and to ensure the protection of North American salmon stocks. INPFC was established under the International Convention for the High Seas Fisheries of the North Pacific Ocean (an agreement between the United States, Canada, and Japan). In addition, a bilateral agreement between Japan and the Soviet Union controls the harvest by these fisheries of salmon originating in the Soviet Union. Each fishery operated within specific areas (Figure 1).

Until 1988, the Japanese mothership salmon fishery operated in parts of the United States' Exclusive Economic Zone (EEZ, waters from 3 to 200 miles off the coast of the United States). In 1988, a United States Superior Court order (Kokechik Fisherman's Assoc. v. Secretary of Commerce, 839 F.2d 795) prohibited the United States Department of Commerce from issuing to Japan a permit that would allow the incidental taking of marine mammals. This action kept the Japanese mothership fishery out of the U.S. EEZ. The Japanese operated the mothership fishery seaward of the U.S. EEZ during 1988 and 1989. Table 1 provides the catch by species for the Japanese Mothership fishery from 1978 through 1989, and Table 2 provides the same information for the Japanese land-based fishery.

For chinook salmon, the analysis of scale patterns provides scientists a method for estimating the contribution of Western Alaska chinook salmon to these harvests. Table 3 shows the total catch of chinook salmon and the estimated number of Western Alaska chinook salmon (including those originating in the Yukon River) harvested by the mothership and traditional land-based salmon fisheries for 1964 through 1989.

Because the Japanese mothership fishery had been excluded from the U.S. EEZ in 1988 and 1989, the International North Pacific Fisheries Commission let the Japanese, for 1990 only, convert its mothership fishery to another landbased fishery (the "nontraditional landbased fishery"). Only Japanese fishing vessels previously licensed in the traditional high-seas mothership salmon fishery were allowed in this new fishery and fishing was restricted to two areas: Area 4-North in international waters of the Bering Sea and Area 2a in the North Pacific Ocean south of the Aleutian Islands (Figure 2). The fishing vessels had to operate as organized fleets under the command of a fleet commanders, and no harvests could be transferred at sea. At least two Japanese patrol vessels monitored the fishery. Each fishing vessel had to report to a Japanese patrol vessel when it would arrive and depart from the fishing grounds as well as report its position at a fixed time every day while the vessel was in a fishing area. Also, all vessels were required to use naval navigational satellite system devices with recording tapes. Finally, 10 percent of the vessels had to carry automatic, real-time satellite position fixing devices (transmitters).

At the time of this report (December 1990) only the salmon harvests by the nontraditional land-based fishery have been reported. This fishery harvested a total of 1,006,128 salmon, of which 22,670 were chinook salmon; 501,185, chum; 200,050, sockeye; 264,317, pink; and 17,908, coho. Although most (almost 80%) of the salmon were caught in the North Pacific Ocean (Area 2a), 34% of the chinook and 50% of the chum came from the Bering Sea (Area 4-North), as shown in the following table:

| Area | Chinook | Chum | Coho | Pink | Sockeye | Total |
|---|---|---|---|---|---|---|
| N. Pacific (Area 2-a) | 7,595 | 248,522 | 17,906 | 164,066 | 161,577 | 800,648 |
| Bering Sea (Area 4-N) | 15,073 | 251,663 | 0 | 100,251 | 38,493 | 405,480 |
| Total | 22,670 | 501,185 | 17,906 | 264,317 | 200,050 | 1,006,1286 |

C. High-Seas Squid Fisheries of Japan, Korea, and Taiwan.

The Japanese began the high-seas driftnet fishery for neon flying squid, *Ommastrephes bartrami*, in 1978, coincident with reductions in its other distant-water fisheries, particularly the reduction in its salmon mothership fishery. In 1981, Japan regulated the times and areas for squid fishing to minimize the interceptions of salmon. The regulations were designed to restrict the squid fishery to areas of warm waters (15°C (59°F) or warmer) where salmon are rarely found. Thus, the northern boundary of the squid-fishing area moves north during the year as the ocean warms and then retreats south as the ocean cools (Figure 3). In addition, the regulations prohibited squid fishing vessels from retaining any salmon they caught incidently in the squid fishery.

In 1987, Japan had 478 vessels in the North Pacific squid fleet, with each vessel using up to 45 kilometers (28 miles) of gillnet each night for 4 to 7 months each year; that number has stayed about the same over the past three years.

The Republic of Korea first began harvesting flying squid with driftnets in 1979. Its fishing grounds originally were located in the western North Pacific, but the fishery soon extended eastward to 165°W. In 1989, the Republic of Korea had about 150 vessels fishing in its driftnet squid fleet. The Republic of Korea has implemented regulations prohibiting the retention of salmonids and has established time and area restrictions (similar to those of Japan) for its fishery (Figure 4).

The Republic of China (Taiwan) squid driftnet fishery began in 1980 and grew quickly to 150 vessels by 1984. In 1989, Taiwan had about 240 fishing vessels and 11 support/transport vessels. In 1985, Taiwan adopted regulations (similar to Japan's) for its squid fishery (Figure 5).

Squid fishermen abiding by these regulations are unlikely to catch any salmon destined for the Yukon River because the fisheries are supposed to take place in waters generally too warm for salmon and, further, because they take place where few Yukon River salmon are likely to be. Nevertheless, because the high-seas squid fisheries have been accused frequently of catching large numbers of salmon, and much evidence has shown that some squid fishermen and some Japanese salmon fishermen have violated the regulations, the United States entered into negotiations with Japan, Republic of Korea, and Taiwan to ensure stricter compliance with and enforcement of the regulations. Recently, the Republic of Korea and Taiwan agreed to expand observer coverage of the fleets, beef up enforcement, and place position indicators on board the squid boats. Japan agreed to increased enforcement and observers but did not agree to place position indicators on their vessels.

In 1990, the United Nations General Assembly passed Resolution 44/225. This resolution bans large-scale pelagic driftnets in the South Pacific Ocean by July 1, 1991, and bans their use in the worldwide by June 30, 1992. One section of the resolution, however, states that a ban will not be imposed in a region or an existing one will be removed if the fishery can show it is taking effective conservation and management measures to avoid the wasteful catch of unwanted marine mammals, fish, sea turtles, and birds. Japan, a member of the United Nations, endorsed the resolution. The Republic of Korea and the Republic of China are not members of the United Nations and are not bound by the resolution.

D. Foreign Groundfish Fisheries.

In recent years, foreign groundfish fisheries operated in two areas where they were likely to catch some salmon originating in the Yukon River system. The first area is the U.S. Exclusive Economic Zone (EEZ) in the Gulf of Alaska and Bering Sea. The second is an area of international waters in the Bering Sea known as the "Doughnut Hole" (see Figure 1).

When the foreign groundfish vessels operated in the U.S. EEZ, they needed to obtain a permit from the United States government, their catches were regulated, observed, and reported, and they had to return to sea immediately any salmon they caught. In the international waters of the Doughnut Hole, the groundfish harvests are unregulated and (generally) not monitored by scientific observers, and catches of salmon by fishermen other than U.S., Canadian, or Japanese are not strictly prohibited.

The Foreign Groundfish Fisheries in the U.S. EEZ.

The directed foreign groundfish fishery in the EEZ off the coast of Alaska ended in 1985 in the Gulf of Alaska and in 1987 in the Bering Sea as the United States "Americanized" the groundfish fisheries there. Tables 4 and 5 show the catches of salmon in these areas from 1977 until the time the fisheries ended.

The Foreign Groundfish Fisheries in the Doughnut Hole.

A large foreign groundfish fleet continues to operate in international waters of the Bering Sea, an area known as the "Doughnut Hole," (See Figure 1). The 1989 total groundfish harvest by all fisheries in this area probably exceeded 1,000,000 metric tons; in 1988, the harvest amounted to about 1,470,000 metric tons, most of which were walleye pollock.

Chinook salmon are known to occur in the doughnut hole area, but because there is no international fisheries agreement for this area that requires reports of salmon caught, the numbers are unknown. The United States has had a few observers on a few of the foreign pollock trawlers since 1982, but the number of trips and boats were small. For example, in 1989, one U.S. fishery observer on one polish trawler observed 7 salmon. Because of the few observers and few trips as well as the time period when the observations were made, no conclusions should be drawn from these data.

Discussions are underway between the U.S., Canada, the U.S.S.R., Japan, and other countries to develop some controls for the groundfish fishery in the Doughnut Hole and prohibit the catches of salmon there.

The Joint-Venture Groundfish Fishery.

The joint-venture fishery (U.S. vessels harvesting groundfish and delivering at sea to foreign processors) has been eliminated from the Gulf of Alaska and almost eliminated from the Bering Sea and along the outer Aleutian Islands. Accordingly, the number of salmon accidentally caught by these fisheries has declined tremendously from years (Tables 4 and 5). In 1990, the joint-venture harvest of groundfish in the Bering Sea and Aleutian Islands area amounted to only 133,320 mt. As of December 1990, there was little likelihood that the joint-venture fishery would operate at all in the EEZ off Alaska during 1991.

E. The U.S. Groundfish Fishery of the Bering Sea and Gulf of Alaska.

The U.S. groundfish fishery expanded rapidly in the EEZ off the coast of Alaska. In 1977 (the year after the U.S. claimed jurisdiction over the fisheries within 200 miles of the U.S. coast), the U.S. groundfish harvest off Alaska amounted to only 2,300 metric tons (mt), or a meager 0.2% of the total groundfish catch by all nations in this area. Since then, the U.S. harvests have doubled nearly every year to a record of 243,417 mt being reported from the Gulf of Alaska in 1990 and over 1,695,127 mt from the Bering Sea and Aleutian Island areas.

In 1988, Federal permits for the groundfish fisheries off Alaska totaled 312 for trawlers, 1609 for longliners, 255 for pot gear, and 85 for other gear, giving a total of 1891 permits.

Salmon may not be retained by the U.S. groundfish fishery and must be returned to the sea. Until 1990, however, there has been little information on the accidental catch of salmon by the U.S. groundfish fishery. Beginning in 1990, there will be scientific

observers on most groundfish harvesting vessels, on all large at-sea groundfish processors, and at all shoreside groundfish processors. In addition, all groundfish harvesters and processors must maintain and submit logbooks on their groundfish harvests and their catch of the prohibited species, including crabs, halibut, herring, and salmon. Also, the North Pacific Fishery Management Council, which governs the groundfish fishery in the U.S. EEZ off Alaska, has been considering limits on the accidental catches of salmon, just as it has for crabs and halibut.

F. The U.S. Alaska Peninsula Salmon Fishery

Most of the salmon harvested during June in the Unimak and Shumagin Island area, located on the south side of the Alaska Peninsula, are bound for terminal fisheries in the northern Gulf of Alaska and the Bering Sea, including the Yukon River. The stocks contributing to this fishery have been described by several tagging studies, including the 1987 study summarized in the November 1988 JTC report. Sockeye salmon is the target species in the June fishery, but relatively large incidental catches of chum salmon are also made. The sockeye salmon harvest is regulated by a quota that is annually adjusted according to the Bristol Bay sockeye salmon forecast.

The Alaska Board of Fisheries adopted new regulations for the 1990 season which delayed the season opening until 13 June, increased the chum salmon quota to 600,000 fish, and established depth limitations for both gill net and purse seine gear. The purpose of these regulation changes was to allow full utilization of sockeye salmon while minimizing the impact on chum salmon.

Harvest for the 1990 June fishery was 1,359,000 sockeye salmon and 503,000 chum salmon. The chum salmon harvest in 1990 was 13% greater than the 1985-1989 average of 447,000 chum salmon.

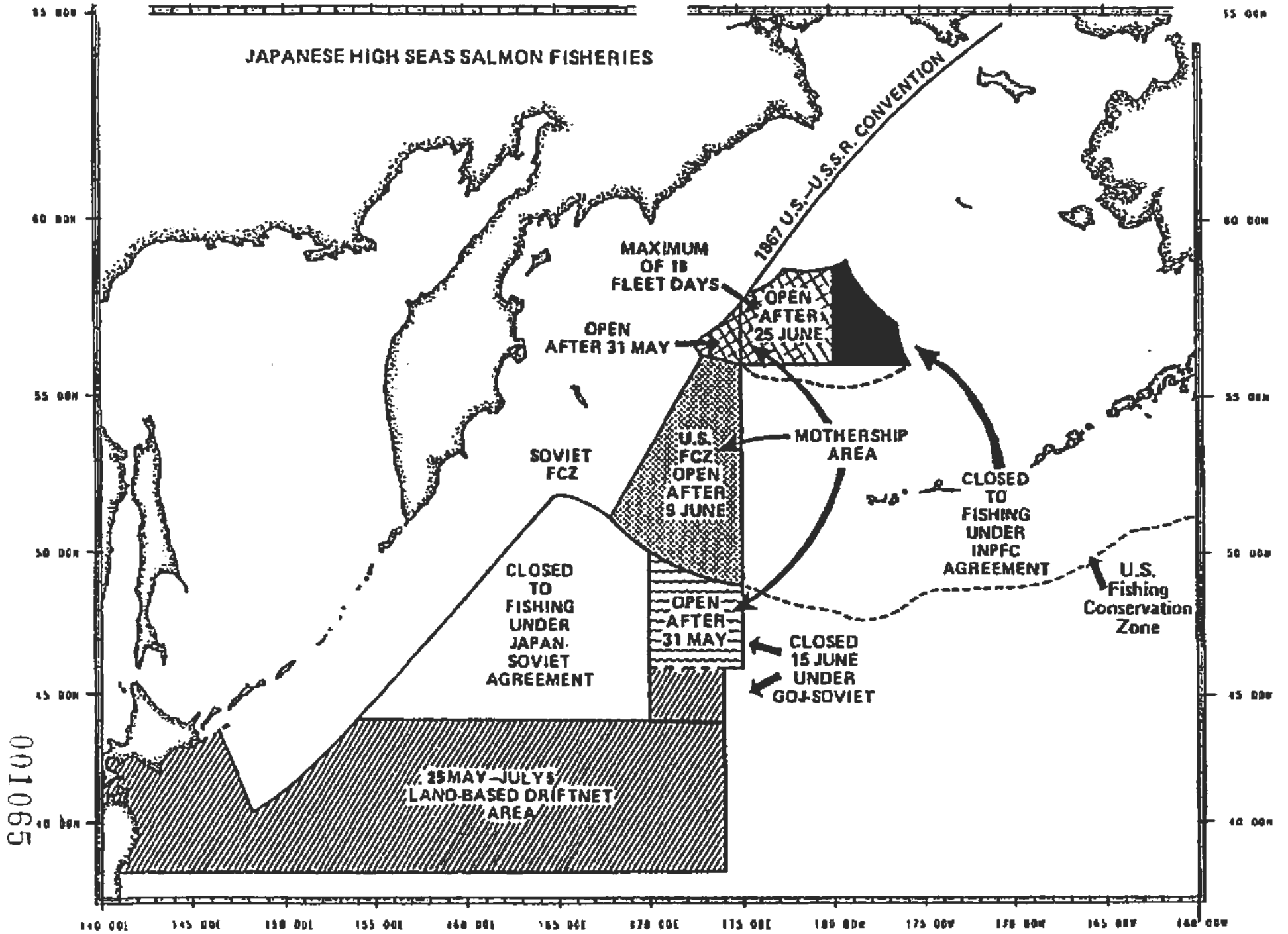
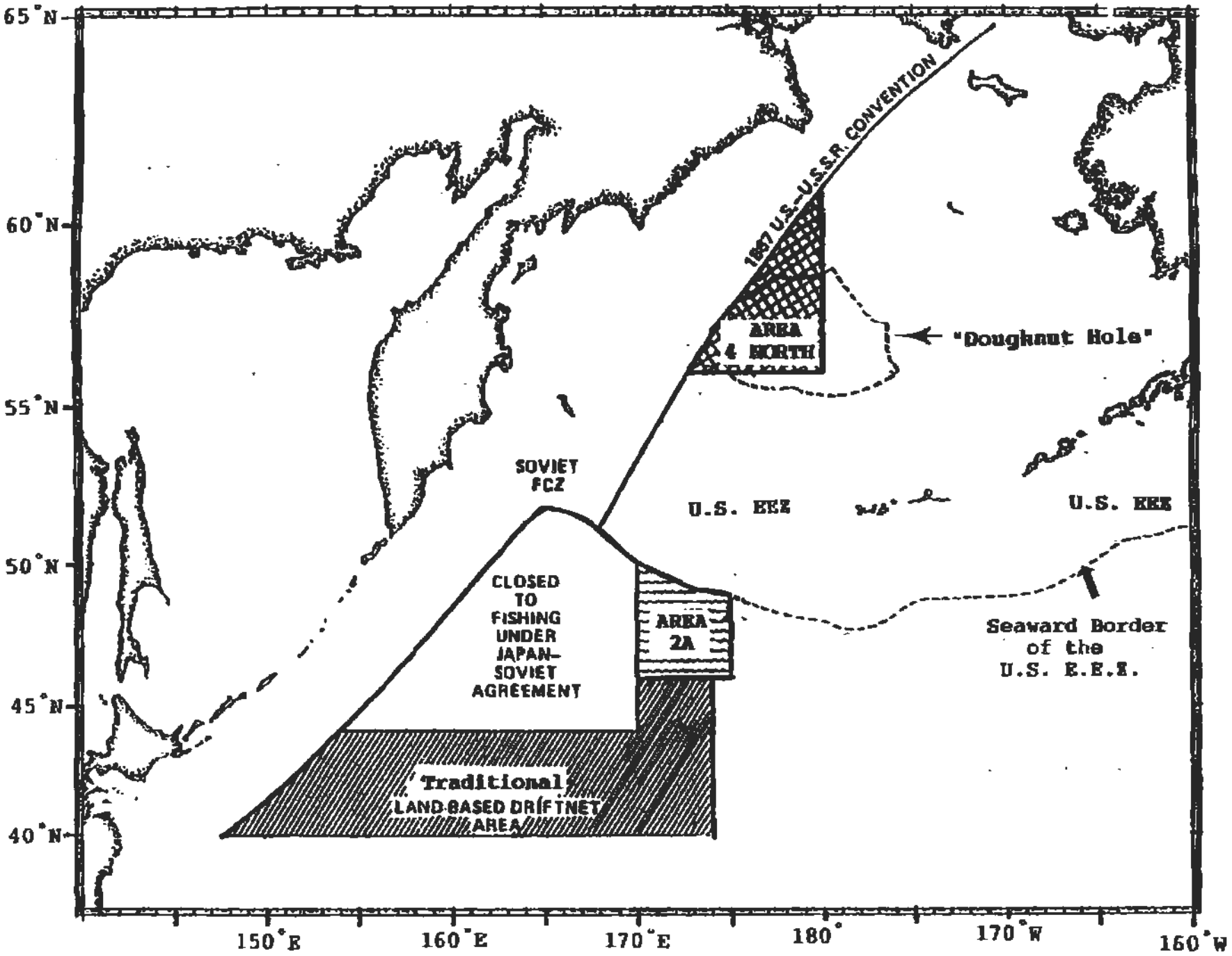





Figure 1. Time and area restrictions for the high-seas salmon fisheries of Japan as regulated by the INPFC treaty and the Japan-Soviet agreement of 1989.




F e 2. Location of fishing grounds for the "Nontraditional" (Areas 2A and 4-North) and "Traditional" Japanese land-based mon gillnet fisheries during 1990. Loca n of the area in international wate nown as "The Doughnut Hole" is also sh

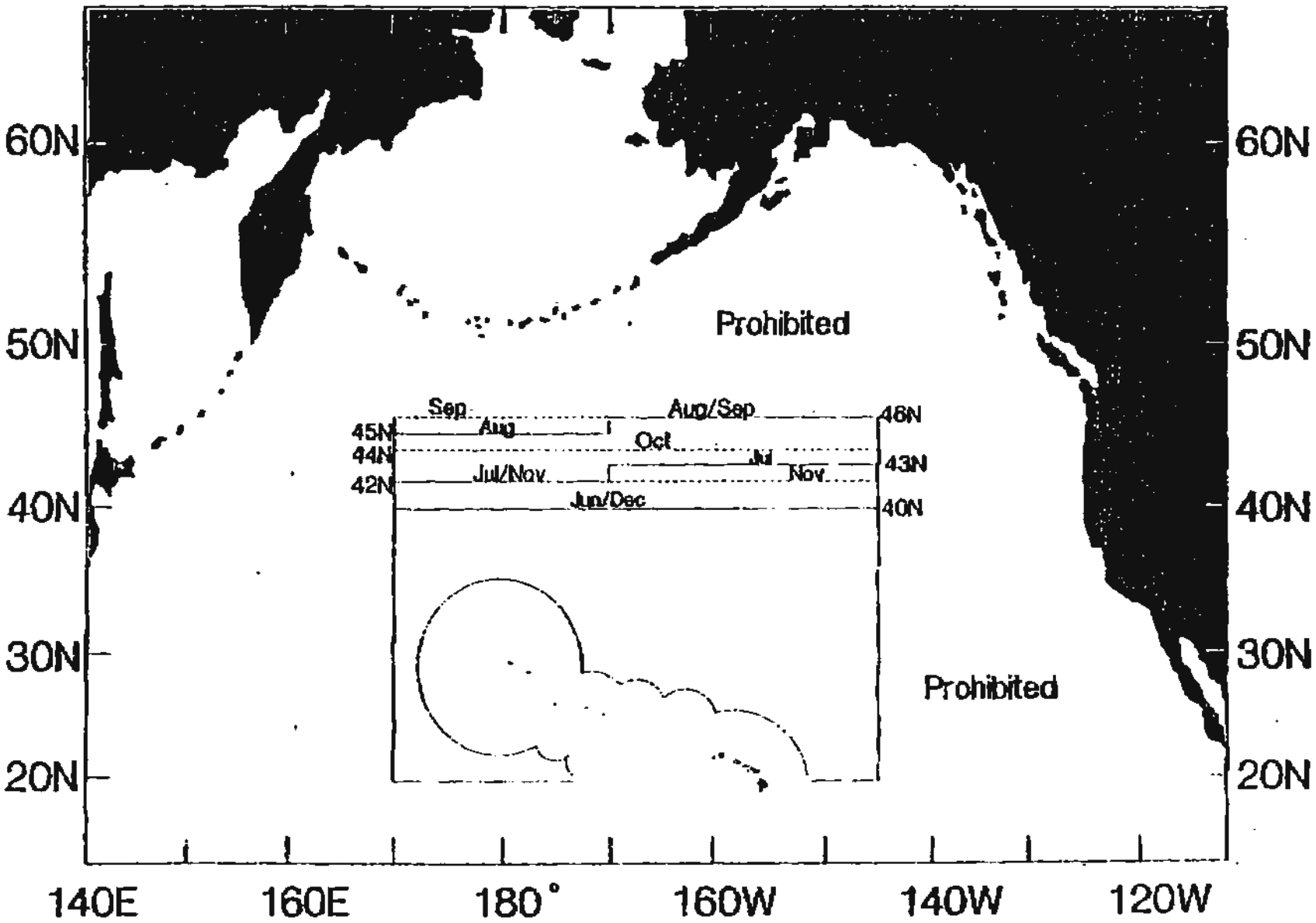



Figure 3. 1990 Japanese high seas squid driftnet fishing area.

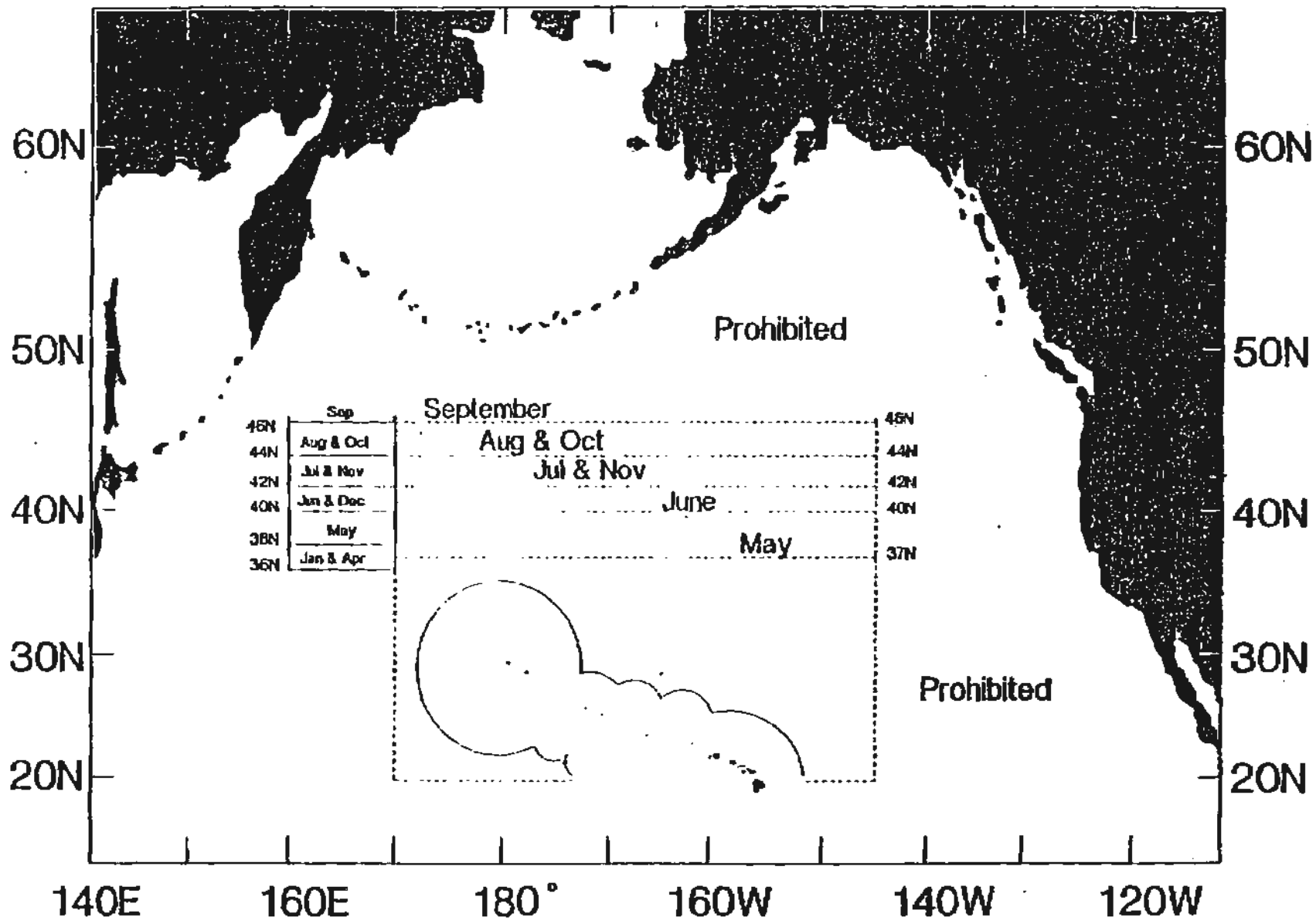





Figure 4. 1990 Republic of Korea high seas driftnet fishing area.

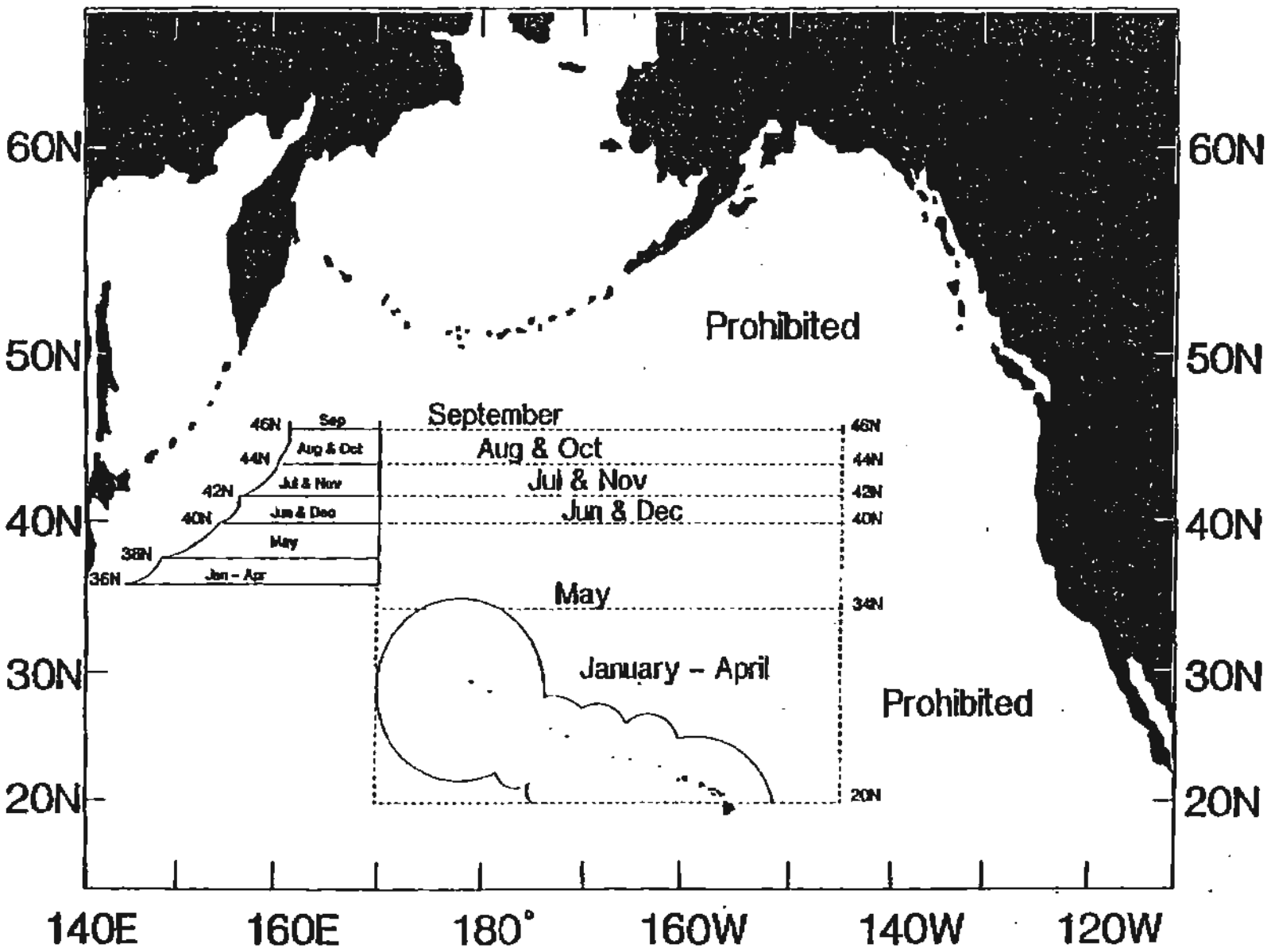



Figure 5. 1990 Republic of China high seas driftnet fishing area.

Table 1. Salmon harvested by the Japanese mothership fishery from 1978 through 1989, by species (in thousands of salmon).

| Year | Sockeye | Chum | Pink | Coho | Chinook | Total |
|---|---|---|---|---|---|---|
| 1978 | 1882 | 3802 | 1853 | 609 | 105 | 8251 |
| 1979 | 2186 | 3277 | 3405 | 281 | 126 | 9275 |
| 1980 | 2412 | 3098 | 561 | 656 | 704 | 7431 |
| 1981 | 2224 | 2539 | 4094 | 615 | 88 | 9560 |
| 1982 | 1738 | 3217 | 1654 | 1167 | 107 | 7883 |
| 1983 | 1655 | 3081 | 4324 | 294 | 87 | 9441 |
| 1984 | 1597 | 3276 | 1430 | 786 | 82 | 7170 |
| 1985 | 1138 | 2836 | 2717 | 128 | 66 | 6885 |
| 1986 | 729 | 1925 | 390 | 65 | 60 | 3170 |
| 1987 | 667 | 1822 | 966 | 35 | 39 | 3530 |
| 1988 | 225 | 892 | 56 | 177 | 26 | 1199 |
| 1989 | 244 | 607 | 339 | 2 | 16 | 1029 |

Source: Mike Dahlberg, Auke Bay Fisheries Laboratory, National Marine Fisheries Service, Juneau, AK.

Table 2. Salmon harvested by the Japanese landbased gillnet fishery, 1978 through 1989, by species (in thousands of salmon).

| Year | Sockeye | Chum | Pink | Coho | Chinook | Total |
|---|---|---|---|---|---|---|
| 1978 | 1293 | 7846 | 3488 | 2512 | 210 | 15349 |
| 1979 | 756 | 2661 | 11189 | 1198 | 162 | 15968 |
| 1980 | 787 | 2697 | 11611 | 1205 | 160 | 16461 |
| 1981 | 859 | 2509 | 11292 | 1209 | 190 | 16059 |
| 1982 | 723 | 2930 | 11035 | 1201 | 165 | 16054 |
| 1983 | 828 | 2395 | 11308 | 1122 | 178 | 15831 |
| 1984 | 305 | 2214 | 9727 | 894 | 92 | 13233 |
| 1985 | 155 | 1432 | 9973 | 766 | 100 | 12427 |
| 1986 | 148 | 959 | 4513 | 483 | 76 | 6179 |
| 1987 | 140 | 936 | 6068 | 459 | 74 | 7677 |
| 1988 | 116 | 751 | 5083 | 293 | 47 | 6289 |
| 1989 | 102 | 746 | 5339 | 208 | 51 | 6448 |

Source: Mike Dahlberg, Auke Bay Fisheries Laboratory, National Marine Fisheries Service, Juneau, AK.

Table 3. Total catch and estimated catch of Western Alaska (including Canadian Yukon) chinook salmon (in thousands of fish) in Japanese high seas salmon gillnet fisheries, 1964-1989[a,b]

| | Mothership | | Landbased | | Combined | |
|---|---|---|---|---|---|---|
| Year | Total Catch | W.AK Catch | Total Catch | W.AK Catch | Total Catch | W.AK Catch |
| 1964 | 410 | 179 | 208 | 40 | 618 | 219 |
| 1965 | 185 | 106 | 102 | 20 | 287 | 126 |
| 1966 | 208 | 108 | 118 | 22 | 326 | 130 |
| 1967 | 128 | 71 | 115 | 22 | 243 | 93 |
| 1968 | 362 | 244 | 97 | 18 | 459 | 262 |
| 1969 | 554 | 367 | 88 | 17 | 642 | 384 |
| 1970 | 437 | 312 | 148 | 28 | 585 | 340 |
| 1971 | 206 | 132 | 139 | 27 | 345 | 159 |
| 1972 | 261 | 189 | 107 | 20 | 368 | 209 |
| 1973 | 119 | 56 | 165 | 31 | 284 | 87 |
| 1974 | 361 | 208 | 188 | 36 | 549 | 244 |
| 1975 | 162 | 108 | 137 | 20 | 299 | 407 |
| 1976 | 285 | 117 | 201 | 42 | 486 | 159 |
| 1977 | 93 | 55 | 146 | 31 | 239 | 86 |
| 1978 | 105 | 36 | 210 | 63 | 315 | 99 |
| 1979 | 126 | 69 | 162 | 45 | 286 | 114 |
| 1980 | 704 | 416 | 160 | 22 | 864 | 438 |
| 1981 | 88 | 30 | 190 | 55 | 278 | 85 |
| 1982 | 107 | 45 | 165 | 41 | 272 | 86 |
| 1983 | 87 | 31 | 178 | 44 | 265 | 75 |
| 1984 | 82 | 36 | 92 | 21 | 174 | 57 |
| 1985 | 66 | 25 | 100 | 22 | 167 | 47 |
| 1986 | 60 | 24 | 76 | 20[c] | 137 | 44[c] |
| 1987 | 39 | 20 | 74 | NA[d] | 116 | NA[d] |
| 1988 | 26 | 23 | 47 | NA[d] | 73 | NA[d] |
| 1989 | 16 | NA[d] | 51 | NA[d] | 67 | NA[d] |

[a]Sources: 1964-83: Rogers, Donald et al., 1984. Origins of chinook salmon in the area of Japanese Mothership Fisheries. Fisheries Research Institute, University of Washington. 215 pgs. 1984-1987 Western Alaska catch estimate for mothership fishery: Mike Dahlburg, National Marine Fisheries Service, Juneau, AK. 1988-1989 data from Mike Dahlberg.

[b]Western Alaska catches represent fish from Bristol Bay, Kuskokwim, Yukon River and Norton Sound areas.

[c]From Rogers, Donald. April 1987. Interceptions of Yukon Salmon by High Seas Fisheries, Fishery Research Institute, University of Washington, 34 pp. Dahlburg, Michael T. (NMFS) reported 9/27/86 an estimate of 24,000 west AK chinook salmon intercepted by mothership fleet. The difference between these two estimates results in the estimate of 20,000 western AK chinooks intercepted in the landbased fishery for 1986.

[d]Data not available.

Table 4. Estimated incidental catches (numbers and metric tons) of Pacific salmon (*Oncorhynchus spp.*) in the foreign and joint-venture groundfish fisheries in Gulf of Alaska, 1977-1989[a].

| | Foreign | | Joint Venture | | Total | |
|---|---|---|---|---|---|---|
| Year | Numbers | Tons | Numbers | Tons | Numbers | Tons |
| 1977 | 5,272 | 19 | NF[b] | NF[b] | 5,272 | 19 |
| 1978 | 45,603 | 131 | -[c] | -[c] | 45,603 | 131 |
| 1979 | 20,410 | 69 | 1,050 | 2 | 21,460 | 71 |
| 1980 | 35,901 | 107 | 168 | 1 | 36,069 | 108 |
| 1981 | 30,860 | 96 | 0 | 0 | 30,860 | 96 |
| 1982 | 5,556 | 19 | 1,411 | 3 | 6,967 | 22 |
| 1983 | 9,621 | 32 | 4,253 | 12 | 13,874 | 44 |
| 1984 | 12,001 | 36 | 63,845 | 169 | 75,846 | 205 |
| 1985 | 365 | 2 | 13,737 | 39 | 14,102 | 41 |
| 1986 | NF | NF | 20,820 | 54 | 20,820 | 54 |
| 1987 | NF | NF | 1,221 | 4 | 1,221 | 4 |
| 1988 | NF | NF | 137 | N/A[d] | 137 | N/A |
| 1989 | NF | NF | NF | NF | NF | NF |

[a]Estimates for years 1977-1988 are from Berger and Weikart, 1988, NOAA Tech. Memo. NMFS F/NWC-148. Estimates for 1989 are from the National Marine Fisheries Service, Alaska Region, Juneau, Alaska.

[b]No estimates of incidental catch were made of the limited joint-venture fishery in 1978.

[c]NF = No fishing.

[d]N/A = Data not available.

Table 5. Estimated incidental catches (numbers and metric tons) of salmon (*Oncorhynchus spp.*) in the foreign and joint venture groundfish fisheries in the Bering Sea and Aleutian Islands region, 1977-1989[a].

| | Foreign | | Joint Venture | | Total | |
|---|---|---|---|---|---|---|
| Year | Numbers | Tons | Numbers | Tons | Numbers | Tons |
| 1977 | 47,840 | 198 | NF[b] | NF | 47,840 | 198 |
| 1978 | 44,548 | 137 | NF | NF | 44,548 | 137 |
| 1979 | 107,706 | 340 | NF | NF | 107,706 | 340 |
| 1980 | 120,104 | 381 | 1,898 | 7 | 122,002 | 388 |
| 1981 | 42,337 | 137 | 854 | 3 | 43,191 | 140 |
| 1982 | 21,241 | 85 | 2,382 | 8 | 23,623 | 92 |
| 1983 | 18,173 | 66 | 24,493 | 54 | 42,666 | 120 |
| 1984 | 16,516 | 51 | 67,622 | 160 | 84,138 | 211 |
| 1985 | 10,003 | 33 | 10,420 | 30 | 20,423 | 63 |
| 1986 | 1,643 | 5 | 19,340 | 66 | 20,983 | 71 |
| 1987 | 3,386 | 13 | 10,848 | 41 | 13,234 | 54 |
| 1988 | NF | NF | 9,213 | N/A[c] | 9,213 | N/A |
| 1989 | NF | NF | 14,538 | N/A | 14,538 | N/A |

[a]Estimated catches for years 1977-1987 from Berger and Weikart, 1988, NOAA Tech. Memo. NMFS F/NWC-148. Data for 1988 from National Marine Fisheries Service, Alaska Region, Juneau, Alaska.

[b]NF = No fishing.

[c]N/A = Data not available.