

Pacific Herring Stocks and Fisheries in the
Arctic-Yukon-Kuskokwim Region of the
Northeastern Bering Sea,
Alaska, 1988

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By

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Resource Assessment for A-Y-K Herring

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INTRODUCTION

The objectives of this report are to: (1) summarize the results of the Pacific herring stock assessment programs for 1988, (2) review and evaluate 1988 harvests and management strategies for all Arctic, Yukon, and Kuskokwim (A-Y-K) commercial fishing districts in the northeastern Bering Sea and the Yukon-Kuskokwim River delta subsistence fishery, and (3) present management strategies for the A-Y-K Pacific herring fishing season in 1989. Commercial fishing districts included in this report are: Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence (Figures 1 and 2).

The total Pacific herring harvest for the A-Y-K Region in 1988 was approximately 7,800 tons (st) (Table 1). The estimated value to fishermen of this harvest was approximately \$6,727,000 of which \$40,000 was for food/bait and \$6,687,000 was for sac roe (Table 2). The majority of the food/bait fishery in this region occurs during the sac roe fishery when roe content is below buyer's acceptable minimums. A very small portion of the harvest is sold in this manner. The food/bait sales totaled 443 st, while the sac roe harvest was 7,358 st.

A total of 832 permittees participated in A-Y-K herring fisheries during the 1988 season (Table 3). This is a 30% decrease in fisherman participation from the record level of effort in the 1987 season. This reduction in effort was due in part to a limited entry moratorium which prohibited fishermen who had not participated in the fishery prior to the 1987 season from fishing in the Nelson Island, Cape Romanzof, and Norton Sound Districts.

Average roe recovery from harvested Pacific herring ranged from 8.0% in Goodnews Bay District to 9.3% in Security Cove District with a regional average of 9.0%. Harvests of estimated herring biomass ranged from no harvest in Nunivak Island District to 17.0% in Cape Romanzof District (Table 2).

Subsistence fishermen representing at least 134 families from 7 Yukon-Kuskokwim River delta villages harvested an estimated 168 st of Pacific herring (Table 4).

The total estimated herring spawning biomass of 64,757 st for the surveyed portion of the A-Y-K herring districts was slightly higher than the 1987 estimate of 57,300 st (Table 2). Ages 9 and 10 Pacific herring (1979 and 1978 year classes, respectively) comprised 45% of the biomass. Older fish (10+) comprised a greater percentage of the run in 1988 than in 1987. Younger age fish (ages 3, 4, and 5) accounted for only 6% of the total biomass, a 7% decrease from 1987. Recruits (ages 3, 4, and 5) represented only 2% of the biomass in the Norton Sound District.

The Board of Fisheries adopted several new regulations for the 1988 season which affected herring fisheries in the AYK Region. Board actions included establishing regulations which restricted vessel and gear specifications and operations. In addition, the Board established the Cape Avinof District, a new superexclusive registration area herring fishery located along the middle Kuskokwim River delta.

SEASON SUMMARY

Stock status

Assessment Methods

Aerial surveys were flown throughout the Pacific herring spawning season in all commercial fishing districts to determine relative abundance, distribution, and biomass of Pacific herring. Occurrence and extent of milt, numbers of fishing vessels, and visibility factors affecting survey quality were also recorded. Data collection methods were similar to those used since 1978. In total, 88 aerial surveys were conducted in the A-Y-K region; 13 in Security Cove, 14 in Goodnews Bay, 7 in the central Kuskokwim Bay area, 17 in Nelson Island, 14 in Nunivak Island, 2 in Cape Romanzof, 15 in Norton Sound, and 6 in Port Clarence. Weather and sea conditions were generally fair to good in Security Cove, Goodnews Bay, Central Kuskokwim (Cape Avinof and Jacksmith Bay), and Norton Sound. Unfavorable weather and turbid water conditions during aerial surveys of the Nelson-Nunivak Islands area and Port Clarence resulted in poor survey ratings for these districts. Aerial surveys were unacceptable in Cape Romanzof due to turbid water. Therefore, the 1988 biomass estimate for Cape Romanzof was derived from a combination of spawn deposition and test fishing data.

Standard conversion factors of 1.52 st (water depths of 16 ft or less), 2.58 st (water depths between 16 and 26 ft) and 2.83 st (water depths greater than 26 ft) per 538 ft² of surface area were used to convert estimated herring school surface areas from aerial surveys to biomass within all districts.

Test fishing with variable mesh gill nets and sampling of commercial landings were conducted in most fishing districts to estimate age, size, and sexual maturity of Pacific herring and to note occurrence of other schooling fishes. Over 7,000 herring from commercial and test catches were sampled during the 1988 fishing season. No commercial samples were taken in the Nunivak Island District since there was no fishery in 1988. In addition, no test fishing projects were conducted in the Nunivak Island and Cape Avinof Districts in 1988. In most districts, fishermen, in coordination with the Department, provided catch samples for evaluation by industry representatives. Participation of fishermen in collecting samples, processor evaluation of samples, and the flexibility of fishermen to fish on short notice aided in obtaining optimum roe recoveries.

Ground surveys were conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

Spawning Populations

Security Cove District

Thirteen aerial surveys were flown on eleven different days, from 4 April to 23

May, in the Security Cove District during the 1988 herring season. Ten of these surveys were flown under good to excellent conditions. Herring schools were first observed in the district on 16 May (536 st). The largest biomass (4,906 st) was observed on 22 May under good conditions. A total of 11.5 linear miles of milt was observed in 13 spawn sightings during aerial surveys with the peak spawn observed on 18 May. Fifty percent of the biomass consisted of age 9 and 10 herring from the 1979 and 1978 year classes, respectively (Figure 3). Recruits, age 4 and 5 herring, comprised approximately 10% of the biomass.

Test fishing was conducted from 5 May to 23 May using variable mesh gill nets by the Department of Fish and Game. Nearly half of the 1,005 herring caught were sampled for age, sex, length, and weight data.

A total of 429 herring were sampled from the Security Cove commercial catch.

Goodnews Bay District

Fourteen aerial surveys were flown on eleven different days in the Goodnews Bay District. Most of these surveys were flown under fair to excellent conditions. The peak inseason biomass estimate of 4,479 st was observed on 21 May. A total of five linear miles of milt was observed in three spawn sightings during aerial surveys with the peak spawn observed on 17 May. Age 9 herring from the 1979 year class represented 25% of the biomass; ages 8 and 10 each comprised 16% of the run (Figure 3). Approximately 15% of the total run was age 4 and 5 herring from the 1984 and 1983 year classes.

A Department test fish crew caught 1,884 herring in variable mesh gill nets from 3 May to 30 May. Approximately 700 herring were sampled.

A total of 617 herring were sampled from the Goodnews Bay commercial catch.

Central Kuskokwim Districts (Cape Avinof District and Jacksmith Bay Area)

Six aerial surveys were flown on seven different days in the Central Kuskokwim District. Four of these were flown under fair to good conditions. A peak inseason biomass estimate of 434 st was observed on 23 May in the Jacksmith Bay Area and 4,108 st was observed on 28 May in the Cape Avinof District. No spawn sightings were made in the Central Kuskokwim Districts. Fifty percent of the biomass consisted of age 9 and 10 herring (Figure 3). Recruits, ages 3, 4 and 5 herring, comprised approximately 12% of the run.

Since no test fishery was conducted in Cape Avinof in 1988, samples collected from Nelson Island test catches were combined with Cape Avinof commercial catch samples to apportion the biomass to age class.

Approximately 600 herring samples were collected from the Cape Avinof commercial catch.

Nelson Island District

Seventeen aerial surveys were flown on sixteen different days in the Nelson Island District during the 1988 herring season. Eleven surveys were flown under poor to unsatisfactory conditions since turbid water conditions persisted for most of the season. The peak inseason biomass estimate of 7,152 st was observed on 25 May under poor to unsatisfactory conditions. A total of 17.8 linear miles of milt was observed in 29 spawn sightings during aerial surveys with the peak spawn observed on 11 June. Similar to the rest of the Kuskokwim area, 50% of the biomass consisted of age 9 and 10 herring; recruits comprised 11% of the run (Figure 3).

A Department test fish crew caught approximately 1,000 herring in variable mesh gill nets from 19 May to 13 June. Most of these were sampled for age, sex, length and weight composition.

A total of 393 herring were sampled from the commercial catch.

Nunivak Island District

Fourteen aerial surveys were flown on fourteen different days in the Nunivak Island District during the herring season. Ten of these surveys were flown under unsatisfactory conditions. The peak inseason biomass estimate of 1,038 st for the Nunivak Island District and 1,316 for all of Nunivak Island was observed on 21 May. Due to the poor survey conditions which prevailed during most of the season, this biomass estimate is thought to underestimate the actual biomass. Therefore, the projected biomass for 1988, rather than the observed, was used to calculate the 1989 projected biomass. A total of 15.6 linear miles of milt was observed in the district in 48 spawn sightings during aerial surveys with the peak spawn observed on 21 May. Again, almost half of the biomass consisted of age 9 and 10 herring. Age 3, 4, and 5 fish comprised 13% of the run (Figure 4).

Since no test fishery was conducted in the Nunivak Island District in 1988, variable mesh gill net catches from the Nelson Island test fish project were used to apportion biomass to age class.

No commercial catch samples were taken since a commercial fishery did not occur in the Nunivak Island District in 1988.

Cape Romanzof District

Aerial surveys were flown on 23 and 25 May; however, turbid water within Kokechik and Scammon Bays resulted in unsatisfactory survey conditions. A helicopter was used for the 25 May survey when approximately 500 st of Pacific herring were observed under unacceptable survey conditions.

Since weather conditions prevented obtaining an accurate biomass estimate based on aerial survey, evaluation of spawn deposition, test fishing and age composition data from test and commercial catches were used to estimate biomass.

This resulted in a herring biomass of 6,600 st. Approximately 23% of the total biomass was composed of age 9 herring (Figure 4). Ages 7 and 10 totalled 18% and 19% of the biomass, respectively. Fewer recruits (age 3, 4, and 5) were observed in Cape Romanzof compared to the Kuskokwim fisheries. These younger fish comprised approximately 6% of the biomass.

Approximately 600 herring were captured in test nets during 20 May to 5 June. Pacific herring comprised approximately 98% of the total catch of schooling species. A total of 418 herring were sampled from the commercial catch on 24-25 May.

Ground surveys indicated that spawn deposition occurred from 19 May through the termination of the project on 5 June, with the majority of spawn deposited from 21 May to 28 May. A series of hold-over tides during 24 May to 28 May made spawn deposition evaluation difficult. Spawn deposition occurred over an extended period of time and generally exceeded an average of 2 egg layers in primary spawning areas.

Norton Sound District

Fifteen surveys were flown on eleven different days in Norton Sound. Ten of these surveys were flown under poor to unsatisfactory conditions. The peak inseason biomass of 33,924 st occurred on 25 May under good to excellent survey conditions. This is the largest biomass ever observed in the Norton Sound District. A total of 50.2 linear miles of milt was seen in 108 sightings during aerial surveys with the peak spawn occurring on 26 May. Twenty-eight percent of the biomass consisted of age 9 herring; age 7 comprised 18% of the run (Figure 4). Recruits, ages 3, 4 and 5 represented only 2% of the biomass.

Two Department field crews were deployed during the 1988 season. One crew operated from Cape Denbigh. A second crew operated initially from Unalakleet, and later from the Portage area, west of Elim. A test fish camp was not established at the traditional Klikitarik site because of the presence of loose ice.

Department crews began test fishing at Cape Denbigh and Unalakleet on 21 May. The first test fish catches occurred at Cape Denbigh on 22 May. Also on 22 May, local fishermen from Elim reported spawning activity near the village. On 23 May, a subsistence catch sample obtained from Elim had a high percentage of male herring and all female herring were ripe or near ripe. Increasing test fish catches at Cape Denbigh on 23 May also had a high percentage of males, but females were predominantly ripe. Samples consisted of primarily large, old age class herring.

Port Clarence District

Six aerial surveys were flown on six different days, from 31 May to 13 June, in the Port Clarence District. The majority of these were flown under poor survey conditions. This district is characteristically unsurveyable due to ice, water coloring, or poor weather. In addition, it is difficult to identify herring due

to the large numbers of tomcod and whitefish in the area. The peak biomass of 788 st was observed on 12 June. Age composition of Port Clarence herring in 1988 was different from any other A-Y-K district. Half of the biomass was comprised of herring age 6 or younger (Figure 4). Sixteen and 12% of the run were ages 7 and 9, respectively.

A test fish project was not conducted in Port Clarence in 1988; a single biologist worked in conjunction with commercial fishermen to sample herring for age, sex, length, and weight data. Samples contained large numbers of whitefish and tomcod.

SUBSISTENCE FISHERY

Pacific herring are an important component of the diet of residents of many Yukon-Kuskokwim delta villages. Surveys of subsistence harvests have been conducted annually in Yukon delta villages and sporadically in Kuskokwim delta villages since 1975. Annual harvests of Pacific herring have averaged 110 st since 1975 (Table 4). During 1988, an estimated 140 st of subsistence herring were harvested by 134 fishing families. This represents the catch of only those fishermen and villages surveyed, since not all subsistence families are contacted.

In the Kuskokwim area, residents of Tununak, Tooksook Bay, Nightmute, and Newtok were surveyed by Subsistence Division in 1988. A total of 133 st was taken by 104 families in these villages.

In the Cape Romanzof District, a preliminary subsistence harvest estimate of 6.9 st of Pacific herring was reported for 35 fishing families from Hooper Bay, Chevak, and Scammon Bay. The subsistence harvest survey was conducted through the mail by catch questionnaire. About 16% of the questionnaires were returned. Approximately 54% of the fishermen who returned questionnaires reported more herring were present during 1988 than during other recent years. Only 6% of the fishermen reported less herring than during previous years, while the remainder of the fishermen made no report regarding herring abundance. The catch figures represent only the harvest which was reported. Therefore, the reported catch is a minimum estimate since not all families were mailed questionnaires and not all families which received questionnaires returned them.

COMMERCIAL FISHERY

The average price paid for sac roe herring in the A-Y-K Region during 1988 was \$1,000 per ton at 10% roe recovery plus or minus \$100 for each percentage point. The majority of bait quality herring was purchased according to the sac roe price schedule in Cape Romanzof. In Norton Sound, fishermen received an average of \$93 per ton of bait herring; in Nelson Island fishermen were paid \$63 per ton, and in Goodnews Bay fishermen earned \$51 per ton. Bait herring was not

purchased in other districts.

Security Cove District

The commercial herring fishery in the Security Cove District has been regulated by emergency order since 1981 to provide for an orderly fishery and periodic reassessments of herring biomass. Two fishing periods were allowed for a total fishing time of 23.5 hours in 1988 (Table 5). In total, 324.2 st of herring with an average roe recovery of 9.3% were harvested. Thirty-one permit holders participated in the fishery making 51 deliveries. The exploitation rate of herring in Security Cove was estimated to be 6.6% of the available biomass.

The initial harvest guideline of 150 st was increased to 200 st on 17 May and then to 240 st on 19 May as observed biomass during aerial surveys increased. The district was opened to the commercial harvest of herring on 19 May for 8.5 hours. Since the harvest was estimated to be only 90 st, a 8 hour extension of fishing time was announced near the end of the day on 19 May. After the closure of the first period, verbal estimates from three buyers indicated 129 st of herring with an average roe recovery of 10.2% had been taken by approximately 10 fishermen. The district was reopened for 7 additional hours on 20 May. At the close of the second commercial period, verbal estimates from four buyers indicated 198.5 st of herring with an average roe recovery of 9.7% had been taken. The value of the herring harvest to fishermen was \$361,800. Out-of-state fishermen harvested 74% of the catch compared with 26% taken by non-local Alaskans. No local fishermen participated in the Security Cove fishery.

The Division of Fish and Wildlife Protection (FWP) implemented a special enforcement program in 1988 involving personnel from other detachments. A team of seven FWP troopers was dedicated to the Herring Enforcement Program in Security Cove. They used the 121 foot P/V Woldstad and crew, a helicopter, and Grumman Goose aircraft. No violations were reported in Security Cove District.

Due to the extremely large area and the logistics of moving personnel and equipment to cover the short and widespread fishing periods, approximately 700 hours of overtime was required with 32 hours of helicopter, 20 hours of Grumman flight time, and 15 vessel sea days for the Woldstad in the Kuskokwim Area.

Goodnews Bay District

In the Goodnews Bay District, seven companies registered and six companies actually purchased herring during the 1988 herring season. A total of 482.7 st of herring with an average roe recovery of 8.0% was harvested. Sixty permit holders participated in the fishery making 309 deliveries. The initial harvest guideline of 130 st was increased to 240 st on 19 May and then to 450 st on 21 May as observed biomass during aerial surveys increased. The district was opened to the commercial harvest of herring for 8 hours on 24 May. An estimated 152.1 st was taken with a percent roe of 7.7%. A second opening was allowed for 8 hours on 24 May and resulted in a harvest of 71.1 st with a roe recovery of 8.6%. A third opening was allowed for 8 hours on 25 May. An estimated 16 tons was landed with an estimated roe recovery of 9.7%. A fourth opening was allowed

for an additional 8 hours later on 25 May. The harvest during this period was 121.9 st with a roe recovery of 7.5%. A fifth and final opening was allowed on 26 May for 8 hours. The catch for this period was 9.4 st with a roe recovery of 8.9%. The exploitation rate for the 1988 season in Goodnews Bay was 10.7% of the available biomass. The value of the harvest to fishermen was \$463,400. Local fishermen harvested 77% of the catch compared to 15% taken by out-of-state fishermen and 8% caught by non-local Alaskans.

The same Division of Fish and Wildlife Protection team that operated in Security Cove was also present in the Goodnews Bay fishery. Two fishermen violated the superexclusive regulation.

Cape Avinof District

In the Cape Avinof District, three companies registered and one company actually purchased herring during the 1988 season. A total of 347.7 st of herring with an average roe recovery of 8.6% was harvested. Ninety eight permit holders participated in the fishery making 485 deliveries. The initial harvest guideline of 80 st was increased to 115 st on 23 May; increased again to 235 st on 27 May, and then to 410 st on 29 May as observed biomass during aerial surveys increased. The newly established district was opened to the commercial harvest of herring for 3 hours on 29 May. Later in the day, the commercial period was extended for 3 more hours which ended 30 May. Since only 16 st of herring were landed, the district was opened until further notice. The Cape Avinof District closed on 3 June, when roe percentages began dropping and the purchasing company left due to prior commitments. The total harvest fell 85 st short of the harvest guideline. The exploitation rate for the 1988 herring season in Cape Avinof was 8.5% of the available biomass. The value of the catch to fishermen was \$264,300. Local fishermen harvested 97% of the catch compared to 1% and 2% harvested by non-local Alaskans and out-of-state fishermen, respectively.

Due to the lateness of the Cape Avinof District opening and the shallow fishing grounds, FWP presence was minimal in this district. Two fishermen violated the superexclusive regulation.

Nelson Island District

In the Nelson Island District, eight companies registered and seven companies actually purchased herring during the 1988 season. A total of 774.7 st of herring with an average roe recovery of 9.2% was harvested. One hundred seventy four permit holders participated in the fishery making 547 deliveries. The initial harvest guideline of 500 st was increased to 715 st on 25 May as observed biomass during aerial surveys increased. The district was opened to the commercial harvest of herring on 26 May for 4 hours. Fishermen landed an estimated 447 st of herring during this first opening. A second opening was allowed on 26 May for 3.5 hours, during which approximately 353 st of herring were taken. The exploitation rate for the season was 10.8% of the available biomass. The exvessel value of the catch was \$712,700. Local fishermen harvested 88% of the catch compared to 7% taken by out-of-state fishermen and 5% caught by non-local Alaskans.

The same Division of Fish and Wildlife Protection team that operated in Security Cove and Goodnews Bay was also present in the Nelson Island District. A total of 17 violations were reported. Six nets (50 fathoms each) and 13,280 pounds of herring were seized.

Nunivak Island District

Seven companies registered to purchase herring in the Nunivak Island District in 1988. Commercial test fishing in the Nunivak Island District failed to find any quantity of herring with marketable roe, therefore, there was no commercial herring fishery.

Cape Romanzof District

Commercial herring fishing periods were established by emergency order during 24-26 May for a total fishing time of 11 hours. A total harvest of 1,119 st was made by 113 fishermen. The entire harvest was taken from Kokechik Bay. The overall exploitation rate of Pacific herring was estimated to be approximately 17% of the available biomass.

Over 99% of the harvest was taken as sac roe with an average roe recovery of 9.1%. Wastage of herring was not a problem. Roe recovery information indicated that over 96% of the Pacific herring sampled were mature and roe recovery of fish captured in gill nets with 3 inch mesh was in excess of 10% while roe recovery from fish captured in gill nets with 2 3/4 inch mesh was 5.2% to 10%. Low recovery samples were the result of catches with high male ratios obtained primarily in offshore sets. Following evaluation of roe quality, the fleet was given 2 hours notice prior to the beginning of the second and final commercial fishing period. Participation of fishermen in collecting samples, processor evaluation of samples, and flexibility of fishermen to fish on short notice resulted in obtaining an optimum roe recovery.

Estimated value of the total harvest to fishermen was \$1.02 million. Six processors purchased herring in the Cape Romanzof District, three less than during 1987. A total of 113 fishermen participated in the fishery, the second highest on record but 28% below the 1987 effort level. Local fishermen harvested 60% of the catch compared to 35% and 4% taken by non-local Alaskans and out-of-state fishermen, respectively. One percent of the catch was confiscated by Fish and Wildlife Protection.

Seven FWP officers were present on the Cape Romanzof fishing grounds during the commercial fishing season for herring in 1988. These officers were supported by the Protection Vessel (P/V) WOLDSTAD, 2 skiffs, a helicopter, and fixed-wing aircraft including a Grumman Goose and a Cessna 185. A total of 20 commercial fishing citations were issued. The citations were issued for fishing during closed periods (9), limit on gear (4), license violations (3), lack of photo identification (2), and lack of vessel registration (2). Additionally, FWP seized 14.7 st of herring, six units of gear, and one vessel.

Implementation of two new regulations by the Board of Fisheries in December 1987, in conjunction with the moratorium towards limited entry, and participation by FWP provided for an orderly fishery. In effect for the first time during the 1988 season was a regulation which prohibited the use of mechanical shakers. The second regulation, which was made effective by emergency order, restricted gill net gear to a maximum of 50 fathoms per vessel.

Norton Sound District

The Norton Sound herring fishery opened by emergency order on 27 May. A total of five gill net openings for 44 hours of fishing and six beach seine openings for 25 hours of fishing occurred in 1988. The entire district closed by emergency order on 31 May. The total harvest was 4,672.1 st of herring. Since 1980, catches have averaged 3,978 st.

There were approximately 348 fishermen (one fisherman fished both gear types) who made at least one delivery during the season. This is the second highest effort on record since a large scale domestic fishery began in 1980. Fishing effort during the 1980 to 1986 period averaged 276 fishermen. Effort levels in 1987 escalated to a record high of 564 fishermen. The total number of fishing vessels which participated in 1988 was impossible to estimate because of changing effort distribution as the season progressed. A survey flown during the 28 May gill net opening counted approximately 200 fishing vessels. The fishing effort during 1988 was lower than in 1987 due to: (1) a moratorium on new entry this season, which allowed only fishermen who had participated prior to January 1, 1987 to participate in 1988; and (2) the bulk of the tendering and non-local fleet being present on the grounds when the fishery opened.

During the 1988 season, 343 fishermen used gill nets, landing a total of 4,473.7 st; 6 fishermen participated in the beach seine fishery landing 198.4 st of herring. The beach seine openings were conducted during separate times from the gill net openings to prevent gear conflicts.

There were 11 companies present on the grounds during the season to purchase herring. These 11 companies registered 12 processors and 53 tenders to operate in Norton Sound; a total of 12 processors and 49 tenders were reported by company representatives to have arrived on the grounds prior to the fishery closure on 31 May.

The average sac roe recovery was 9.0%. Of the 4,672.1 st harvested, 416.2 st were purchased as bait herring (roe percent less than 6.0%). The total value of the herring harvest to the fishermen was approximately \$3.86 million. This is the highest dollar value in the history of the fishery. The average fisherman earned \$11,072. Local fishermen harvested 35% of the catch compared to 37% and 29% taken by nonlocal Alaskans and out-of-state fishermen, respectively. Fish and Wildlife Protection confiscated less than 1% of the harvest.

An exploitation rate of 20% could have allowed a commercial harvest of 6,785 st (6,311 st by gill net, 474 st by beach seine). However, due to the timing of the arrival of the peak biomass and the lack of processing and tendering capacity present on the grounds, it was not possible to fully harvest the available surplus. The commercial harvest of 4,672.1 st represented an exploitation rate

of 13.8% of the available biomass.

Fish and Wildlife Protection in Norton Sound consisted of two single engine aircraft, a helicopter, and two Boston Whalers manned by five Fish and Wildlife Protection officers and one seasonal aide.

FWP patrolled the fishing grounds during each opening and closure. A total of 36 citations were issued for fishing closed periods; 2 citations were issued for incorrect or lack of ADF&G numbers; 1 citation for fishing without a license; and 1 citation for no ADF&G number plate. In addition, one fishing vessel was seized for fishing excess gear. Three cases were made for violation of the superexclusive use area designation, with more likely to follow pending investigation of postseason fish ticket information. A total of 11.1 st of herring was confiscated during the 1988 season. Additional forfeitures are likely to follow pending upcoming court case decisions.

Port Clarence District

The Port Clarence District was opened to commercial herring fishing in 1982. The season opens by regulation on 15 April and closes by regulation on 15 November, providing the harvest guideline of 165 st (150 mt) has not been met earlier. A tender, processor, and a Japanese tramper traveled to Port Clarence on 6 June. One purse seine vessel was observed inside Port Clarence during an aerial survey on 6 June. The purse seiner had traveled through the ice to Teller, followed by the other vessels on 7 June. In addition to the seiner, six gill net vessels composed the fishing fleet.

The bulk of the gill net catch was caught on the incoming tide on 11 June (approximately 18 st). Catches soon dropped to almost nothing, and all gill nets were out of the water by 12 June. The total gill net harvest was estimated to be 23.6 tons with an average roe percent of 8.2.

A total of 56.4 tons of herring with an average roe percent of 7.6 was harvested in a purse seine set made on 11 June on the outside of the Port Clarence spit. Four unsuccessful attempts to seine herring were made 12-13 June.

The exploitation rate based on an estimated peak biomass of 788 st was 10.2% of the available biomass. The exvessel value of the harvest was nearly \$43,000.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1989

Based upon apparent weak recruitment of younger age classes (ages 3-5), especially in the Norton Sound District, and reduced returns of the abundant 1977 and 1978 year classes due to high natural mortality of older aged herring, a decline in the total harvestable surplus of Pacific herring in the A-Y-K region is expected for 1989. However, since methods to reliably forecast actual returns are still being developed, and reliable estimates of recruitment are not

available, harvest levels will be adjusted during the season according to observed herring spawning biomass. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from test and commercial catches and spawn deposition observations.

Projections from post-season escapement estimates, using mean rates of natural mortality and growth for each age class, indicate that the 1989 minimal spawning biomass for the northeastern Bering Sea Pacific herring stocks (Security Cove to Norton Sound) should be approximately 41,773 st (Table 6). This is larger than the projected 1988 biomass but is less than the observed 1988 biomass. A decrease in herring biomass compared to 1988 levels is expected for all fishing districts. Due to improved recruitment of younger age fish in the Goodnews and Security Cove Districts, an increase in herring harvest is anticipated for these districts. The 1989 projected biomass for Security Cove and Goodnews Bay is significantly larger than the 1988 projected biomass but is less than the observed biomass. In all districts, increased recruitment of ages 3 through 5-year-old Pacific herring could increase the 1989 observed biomass over the projected biomass estimates. (NOTE - use all projection estimates with extreme caution as the projection method is in the developmental stage and the database is not extensive.)

Security Cove District

Emergency order authority will be used to adjust the occurrence and length of fishing periods to stock strength, fishing effort, and spawning activity. No fishing will be allowed until total biomass reaches 1,200 st. The Security Cove Pacific herring stock will be harvested at a 15% or less exploitation rate in response to an increase in recruitment of younger age fish into the population. If in-season surveys indicate a biomass well in excess of the 1989 projection, up to a 20% exploitation rate may be used. The 1988 projected return is 3,312 st which at a 15% exploitation rate would result in a harvest of about 497 st.

Goodnews Bay District

Management strategy for this district will be similar to that used for Security Cove. The season will be opened by emergency order. A minimum biomass of 1,200 st will be required on the grounds prior to the first opening. The harvest level will be maintained at 15% or less, unless available biomass is in excess of the 1989 projection and then a higher exploitation rate may be used. The 1989 projected return is 3,077 st which, at a 15% exploitation rate, would result in a harvest of 462 st.

Cape Avinof District

As in 1988, the Cape Avinof District commercial herring fishery will be regulated by emergency order authority. No commercial fishery will be allowed until the total biomass reaches 500 st or spawning is observed. Commercial harvest of Pacific herring will be up to 15% of the total spawning biomass. The biomass projected to return to the Cape Avinof District during 1989 is 2,777 st which

at a 15% exploitation rate would result in a 310 st harvest.

Nelson Island District

As in 1988, the Nelson Island commercial fishery will be regulated through the use of emergency order authority. To provide additional protection for the subsistence harvest of Pacific herring, the following guidelines will be followed:

1. The commercial fishery will be allowed to take up to 15% of the herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.
2. The commercial fishing season will be opened when a biomass of 2,500 st or spawning activity is documented.
3. Periodic closures of the commercial fishery will be scheduled, during which time subsistence fishing will be the only activity allowed.
4. Several important subsistence use areas occur throughout the district, including the waters north of Cape Vancouver, and specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.
5. The Department will by all available means, including input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

The spawning biomass projected to return to the Nelson Island District during 1989 is 4,709 st which, at a 10% exploitation rate, would result in a harvest of 471 st. The harvest level will be maintained at 10% unless available biomass is in excess of the 1989 projection.

Nunivak Island District

As in 1988, the Nunivak Island District commercial herring fishery will be regulated by emergency order authority. No commercial fishery will be allowed until the total biomass reaches 1,500 st or spawning is observed. Commercial harvest of Pacific herring will be up to 15% of the total spawning biomass. The biomass projected to return to the Nunivak Island District during 1989 is 2,068 st which at a 15% exploitation rate would result in a 310 st harvest. While this district is also showing a decline in biomass, similar to the Nelson Island District, a higher exploitation rate can be used due to the insignificant subsistence harvest.

Cape Romanzof District

Emergency order authority will be used to adjust the occurrence and length of fishing periods. A minimum level of biomass cannot be used to determine the

timing and duration of commercial fishing periods since turbid water conditions usually preclude aerial biomass assessments. Therefore, test and commercial catch rates and spawn deposition observations will be used to determine timing and duration of commercial fishing periods. Average harvest for the period 1980-1987 was 1,069 st. Projected return for 1989, based upon limited data, is 3,990 st which at a 20% exploitation rate would result in a 798 st harvest.

Norton Sound District

The Norton Sound herring fishery will be opened by emergency order in 1989. The fishery will close by emergency order when up to 20% of the available Pacific herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions. The projected return is 21,250 st which at a 20% exploitation rate would result in a 4,250 st harvest. Therefore, the beach seine guideline harvest level as established by Board of Fisheries directive will be 425 st. As in other districts, the projected biomass will be superceded by the observed biomass during the season. In order for the Department to adequately evaluate harvest data, all processors, buyers, and tenders will be required to report herring landings at least twice daily.

Port Clarence District

Previously, the Department has not projected an outlook for the Port Clarence fishery due to a lack of data and the very limited scope of the fishery. A projected biomass of 590 st for 1989 was calculated based on a peak biomass estimate derived from an aerial survey conducted under poor survey conditions. The actual guideline harvest of 150 mt (165 st) as set by the Board of Fisheries in 1981 will determine the allowable harvest. This harvest guideline is based on 2 years research by the department in both the Pt. Clarence and Kotzebue Districts. Even though those guidelines have not appeared in the regulation books since 1984, they still represent the best estimate of harvestable biomass at this time.

Table 1. Pacific herring harvests by domestic commercial fishermen in the northeastern Bering Sea, Alaska, 1909-1988.

Year	Herring (st) ^a								Spawn on Kelp (st)		
	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound	Port Clarence	Total Harvest	Norton Sound	Total Harvest
1909-1916	-	-	-	-	-	-	- ^b	-	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-	1,881
1929	-	-	-	-	-	-	166	-	166	-	166
1930	-	-	-	-	-	-	441	-	441	-	441
1931	-	-	-	-	-	-	86	-	86	-	86
1932	-	-	-	-	-	-	529	-	529	-	529
1933	-	-	-	-	-	-	31	-	31	-	31
1934	-	-	-	-	-	-	4	-	4	-	4
1935	-	-	-	-	-	-	15	-	15	-	15
1936	-	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-	6
1938	-	-	-	-	-	-	10	-	10	-	10
1939	-	-	-	-	-	-	6	-	6	-	6
1940	-	-	-	-	-	-	14	-	14	-	14
1941	-	-	-	-	-	-	3	-	3	-	3
1942-1944	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-	20
1965	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-	12
1967	-	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-	2
1970	-	-	-	-	-	-	8	-	8	-	8
1971	-	-	-	-	-	-	20	-	20	-	20
1972	-	-	-	-	-	-	17	-	17	-	17
1973	-	-	-	-	-	-	35	-	35	-	35
1974	-	-	-	-	-	-	2	-	2	-	2
1975	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-	9
1977	-	-	-	-	-	-	11	-	11	<1	11
1978	286	-	-	-	-	-	15	-	301	4	305
1979	424	90	-	-	-	-	1,292	-	1,806	13	1,819
1980	697	448	-	-	-	611	2,452	-	4,208	24	4,232
1981	1,173	657	-	-	-	720	4,371	-	6,921	47	6,968
1982	813	486	-	-	-	657	3,933	-	5,889	38	5,927
1983	1,073	435	-	-	-	816	4,582	-	6,906	29	6,935
1984	335	717	-	-	-	1,185	3,662	-	5,899	19 ^c	5,918
1985	733	724	-	977	358	1,299	3,548	-	7,639	0	7,639
1986	751	557	-	886	511	1,865	5,194	-	9,764	0	9,764
1987	313	321	-	923	414	1,342	4,082	146	7,541	0	7,541
1988	324	483	348	775	-	1,119	4,672	80	7,801	0	7,801

^a Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe.

^b Wastage included.

^c Fishery occurred some years but harvest data unavailable.

^c Additional 3 st harvested from imported kelp (*Macrocystis* sp) not included.

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1982-1988.

Year	District	Estimated Biomass (st)	Harvest (st)			% Harvest by Gear			Roe %	Estimated Value (\$ x1,000)	Exploitation Rate (%)	
			Catch	Waste	Total	Gill Net	Purse Seine	Beach Seine				
1988	Security Cove	4,906	324	0	324	100	0	0	9.3	362	6.6	
	Goodnews Bay	4,479	483	0	483	100	0	0	8.0	463	10.7	
	Cape Avinof	4,108	348	0	348	100	0	0	8.6	264	8.5	
	Nelson Is.	7,152	775	0	775	100	0	0	9.2	713	10.8	
	Nunivak Is.	2,800 ^a	-	-	-	-	-	-	-	-	-	
	Cape Romanzof	6,600	1,119	0	1,119	100	0	0	9.1	1,018	17.0	
	Norton Sound	33,924	4,672	0	4,672	96	0	4	9.0	3,864	13.8	
	Port Clarence	<u>788</u>	<u>80</u>	<u>0</u>	<u>80</u>	<u>30</u>	<u>70</u>	<u>0</u>	<u>8.2</u>	<u>43</u>	<u>10.2</u>	
Total	64,757	7,801	0	7,801	94	<1	2	9.0	6,727	12.0		
1987	Security Cove	2,300	313	0	313	100	0	0	9.7	242	13.4	
	Goodnews Bay	2,000	321	0	321	100	0	0	7.3	133	16.0	
	Nelson Is.	8,100	923	0	923	100	0	0	9.2	661	11.4	
	Nunivak Is.	4,400	414	0	414	100	0	0	7.8	231	9.2	
	Cape Romanzof	7,200	1,342	0	1,342	100	0	0	8.9	1,000	18.6	
	Norton Sound	32,400	4,082	0	4,082	92	0	8	8.6	2,613	12.6	
	Port Clarence	<u>900</u>	<u>146</u>	<u>>1</u>	<u>146</u>	<u>>1</u>	<u>100</u>	<u>0</u>	<u>6.6</u>	<u>77</u>	<u>15.6</u>	
	Total	57,300	7,541	>1	7,541	94	2	4	8.6	4,957	13.1	
1986	Security Cove	3,700	751	0	751	100	0	0	11.2	535	20.3	
	Goodnews Bay	3,000	557	0	557	100	0	0	10.4	325	18.1	
	Nelson Is.	7,300	886	0	886	100	0	0	10.3	428	12.1	
	Nunivak Is.	6,000	511	0	511	100	0	0	10.1	213	8.5	
	Cape Romanzof	7,500	1,865	0	1,865	100	0	0	9.2	1,142	24.9	
	Norton Sound	<u>28,100</u>	<u>5,194</u>	<u>0</u>	<u>5,194</u>	<u>96</u>	<u>0</u>	<u>4</u>	<u>9.6</u>	<u>2,900</u>	<u>18.5</u>	
	Total	55,600	9,764	0	9,764	98	0	2	9.7	5,543	17.6	
	1985	Security Cove	4,900	703	30	733	100	0	0	10.1	355	15.0
Goodnews Bay		4,300	724	0	724	100	0	0	8.7	309	16.8	
Nelson Is.		9,500	977	0	977	100	0	0	10.6	527	10.3	
Nunivak Is.		5,700	358	0	358	100	0	0	8.9	146	6.3	
Cape Romanzof		7,000	1,299	0	1,299	100	0	0	8.3	550	18.6	
Norton Sound		<u>20,000</u>	<u>3,548</u>	<u>0</u>	<u>3,548</u>	<u>95</u>	<u>0</u>	<u>5</u>	<u>9.9</u>	<u>1,438</u>	<u>17.7</u>	
Total		51,400	7,609	30	7,639	98	2	13	9.6	3,325	14.8	
1984		Security Cove	5,100	325	10	335	100	0	0	11.8	110	6.6
	Goodnews Bay	4,100	667	50	717	100	0	0	10.1	168	17.5	
	Cape Romanzof	6,100	1,185	0	1,185	100	0	0	8.6	306	19.4	
	Norton Sound	<u>23,100</u>	<u>3,572</u>	<u>90</u>	<u>3,662</u>	<u>91</u>	<u>0</u>	<u>9</u>	<u>10.3</u>	<u>888</u>	<u>15.9</u>	
	Total	38,400	5,749	150	5,899	95	0	5	10.0	1,472	15.4	
	1983	Security Cove	6,400	1,073	0	1,073	100	0	0	9.4	443	16.8
		Goodnews Bay	3,200	435	0	435	100	0	0	9.4	185	13.6
		Cape Romanzof	5,500	816	0	816	100	0	0	9.0	367	14.8
Norton Sound		<u>28,100</u>	<u>4,582</u>	<u>0</u>	<u>4,582</u>	<u>100</u>	<u>0</u>	<u><1</u>	<u>8.6</u>	<u>1,519</u>	<u>16.3</u>	
Total		43,200	6,906	0	6,906	100	0	<1	8.8	2,514	16.0	
1982		Security Cove	5,100	813	0	813	100	0	0	9.3	271	15.9
		Goodnews Bay	2,600	486	0	486	100	0	0	9.5	188	18.7
		Cape Romanzof	4,900	657	0	657	100	0	0	9.3	222	13.4
	Norton Sound	<u>17,400</u>	<u>3,933</u>	<u>0</u>	<u>3,933</u>	<u>100</u>	<u>0</u>	<u>0</u>	<u>8.8</u>	<u>1,046</u>	<u>22.6</u>	
	Total	30,000	5,889	0	5,889	100	0	0	9.0	1,727	19.6	

^a Inseason biomass estimate from poor aerial survey, therefore 1988 projected biomass used.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1982-1988

Year	District	Number of Buyers	Number of Fishermen		
			Gill Net	Seine ^a	
				Purse	Beach
<u>1988</u>	Security Cove	4	31	-	-
	Goodnews Bay	6	60	-	-
	Cape Avinof	1	98	-	-
	Nelson Island	7	174	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	6	113	-	-
	Norton Sound	11	343	-	6
	Port Clarence	1	6	1	-
<u>1987</u>	Security Cove	8	65	-	-
	Goodnews Bay	4	117	-	-
	Nelson Island	9	235	-	-
	Nunivak Island	4	61	-	-
	Cape Romanzof	9	157	-	-
	Norton Sound	12	559	-	22
	Port Clarence	2	1	3	-
<u>1986</u>	Security Cove	11	88	-	-
	Goodnews Bay	5	104	-	-
	Nelson Island	4	163	-	-
	Nunivak Island	5	36	-	-
	Cape Romanzof	5	97	-	-
	Norton Sound	10	319	-	4
<u>1985</u>	Security Cove	6	107	-	-
	Goodnews Bay	5	83	-	-
	Nelson Island	6	143	-	-
	Nunivak Island	5	37	-	-
	Cape Romanzof	2	73	-	-
	Norton Sound	11	274	-	4
<u>1984</u>	Security Cove	4	38	-	-
	Goodnews Bay	4	130	-	-
	Cape Romanzof	3	66	-	-
	Norton Sound	8	189	-	10
<u>1983</u>	Security Cove	6	94	-	-
	Goodnews Bay	4	84	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	9	271	-	1
<u>1982</u>	Security Cove	3	107	-	-
	Goodnews Bay	3	84	-	-
	Cape Romanzof	2	75	-	-
	Norton Sound	7	237	-	0

^a Gear prohibited in all districts except Norton Sound and Port Clarence.

Table 4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1975-1988.^a

Village	Year												
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
<u>Nelson Island</u>													
Tununak	15	57	38	34	65	40	48	94	-	43	63	48	48
Umkumiut	9	3	11	8	3	10	0	-	-	-	-	- ^c	-
Toksook Bay	35	21	37	51	29	14	35	-	-	46	70	51	57
Nightmute	-	-	-	-	-	-	-	-	-	3 ^a	21	15	16
Newtok	-	-	-	-	-	-	-	-	-	7 ^a	13	10	12
Total	59	81	86	93	97	64	83	94	-	99	167	124	133
Number of Fishing Families	42	90	83	54	70	93	65	43	-	65 ^b	72 ^b	96	104
<u>Nunivak Island</u>													
Mekoryuk	-	-	-	-	-	-	-	-	-	<1	<1	-	-
Number of Fishing Families	-	-	-	-	-	-	-	-	-	11	6 ^b	-	-
<u>Other Kuskokwim Delta</u>													
Chefornak	-	-	-	-	-	-	-	-	-	13 ^b	-	14	-
Kipnuk	-	-	-	-	-	-	-	-	-	9	-	14	-
Kongiganak	-	-	-	-	-	-	-	-	-	3	2 ^b	-	-
Kwigillingok	11	1	-	8	13	-	13	-	-	5	-	-	-
Total	11	1	-	8	13	-	13	-	-	30	2	28	-
Number of Fishing Families	8	9	-	22	19	-	21	-	-	55 ^b	12 ^b	49	-
<u>Yukon Delta</u>													
Scammon Bay	1	-	1	6	3	8	4	3	4	2	2	1	2
Chevak	1	<1	-	2	4	2	2	1	3	2	1	1	2
Hooper Bay	3	2	4	3	4	4	5	5	4	4	4	1	3
Total	5	<3	5	11	11	14	11	9	11	8	7	3	7
Number of Fishing Families	41	30	29	84	61	46	43	37	47	44	41	39	30
<u>Areas Combined</u>													
Total Catch	75	85	91	112	121	78	107	103	11	138	177	155	140
Number of Fishing Families	91	129	112	160	150	139	89	80	47	175	131	184	134

^a Subsistence survey results are believed to accurately reflect harvest trends, however, reported catches reflect minimum figures since all fishermen cannot be contacted.

^b Fishing families were not interviewed or only a portion of fishing families were interviewed as catch was enumerated while on drying racks.

^c Umkumiut effort included with Tununak.

Table 5. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1988.

District	Subdistrict Section/Area	Gear	Period	Date	Time	Total hours	Harvest (st)		
Security Cove	Entire	GN	1	5/19	1530-2400	8.5			
				5/20	0000-0800 ^a	8.0			
			2	5/20	1000-1700	7.0	324.2		
				Total	23.5	324.2			
Goodnews Bay	Entire	GN	1	5/24	0000-0800	8.0			
			2	5/24	1130-1930	8.0	244.1		
			3	5/25	0000-0800	8.0			
			4	5/25	1200-2000	8.0	146.8		
			5	5/26	0100-0900	8.0	91.8		
Total	40.0	482.7							
Cape Avinof	Entire	GN	1	5/29	1900-2200	3.0			
				5/29	2200-0100 ^a	3.0			
			5/30-6/3	0100-1130 ^a	82.5	347.7			
				Total	88.5	347.7			
Nelson Island	Entire	GN	1	5/26	0600-1000	4.0			
			2	5/26	1930-2400	3.5	774.7		
			Total	7.5	774.7				
Nunivak Island	No Commercial Opening								
Cape Romanzof	Entire	GN	1	5/24	2100-2400	3.0			
				5/25	0000-0300	3.0	492.5		
			2	5/26	0000-0500	5.0	627.0		
				Total	11.0	1,119.4			
Norton Sound	SD 1, 2, 3	GN	1	5/27	0800-1000	2.0			
			2	5/27-5/28	1800-1200	18.0	2,707.6		
			3	5/29	0600-1200	6.0	466.0		
			4	5/30	0000-1200	12.0	828.2		
			5	5/31	0000-0600	6.0	460.8		
			Total	44.0	4,462.6				
Norton Sound	SD 1, 2, 3	BS	1	5/27	1400-1700	3.0	74.2		
			2	5/28	1000-1300	3.0			
			3	5/28	1900-2200	3.0	24.3		
			4	5/29	1400-1700	3.0	59.9		
			5	5/30	1400-1700	5.0	13.3		
			6	5/31	1000-1800	8.0	37.8		
			Total	25.0	209.5				
Port Clarence	Entire	GN	1	4/15-8/15			23.6		
				2	8/16-11/15 ^b			0	
			Total			23.6			
			Entire	PS	1	4/15-6/6			0
					2	6/10-8/15			56.4
					3	8/16-11/15 ^b			0
	Total		56.4						
	Entire	BS	1	4/15-6/6			0		
			2	6/10-8/15			0		
			3	8/16-11/15 ^b			0		
	Total		0						

^a Extension of commercial opening.

^b Fishery was opened to gillnet by regulation on 4/15 and closed by regulation on 11/15.

Table 6. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1989.

District	1989 Projection ^a		
	Biomass (st)	Harvest (st)	Exploitation Rate (%)
Security Cove	3,312	497	15
Goodnews Bay	3,077	462	15
Cape Avinof	2,777	417	15
Nelson Island	4,709	471	10
Nunivak Island	2,068	310	15
Cape Romanzof	3,990	798	20
Norton Sound	21,250	4,250	20
Port Clarence	<u>590^b</u>	<u>165^c</u>	<u>28</u>
Total	41,773	7,370	

^a Preseason projection. Projection may be adjusted based on inseason biomass estimates.

^b Based on 1988 inseason biomass estimated from poor aerial survey.

^c Harvest guideline of 165 st (150 mt).

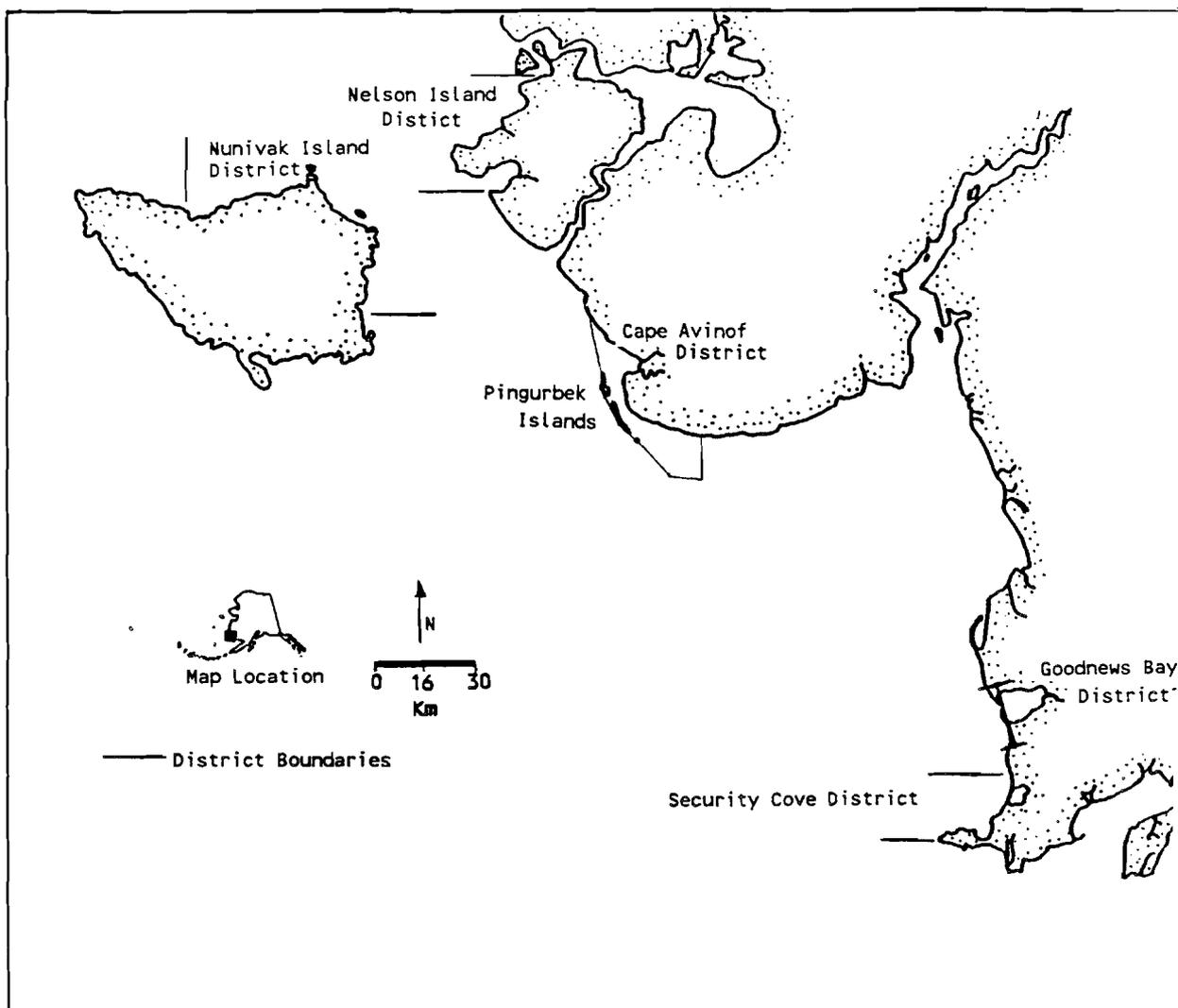


Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

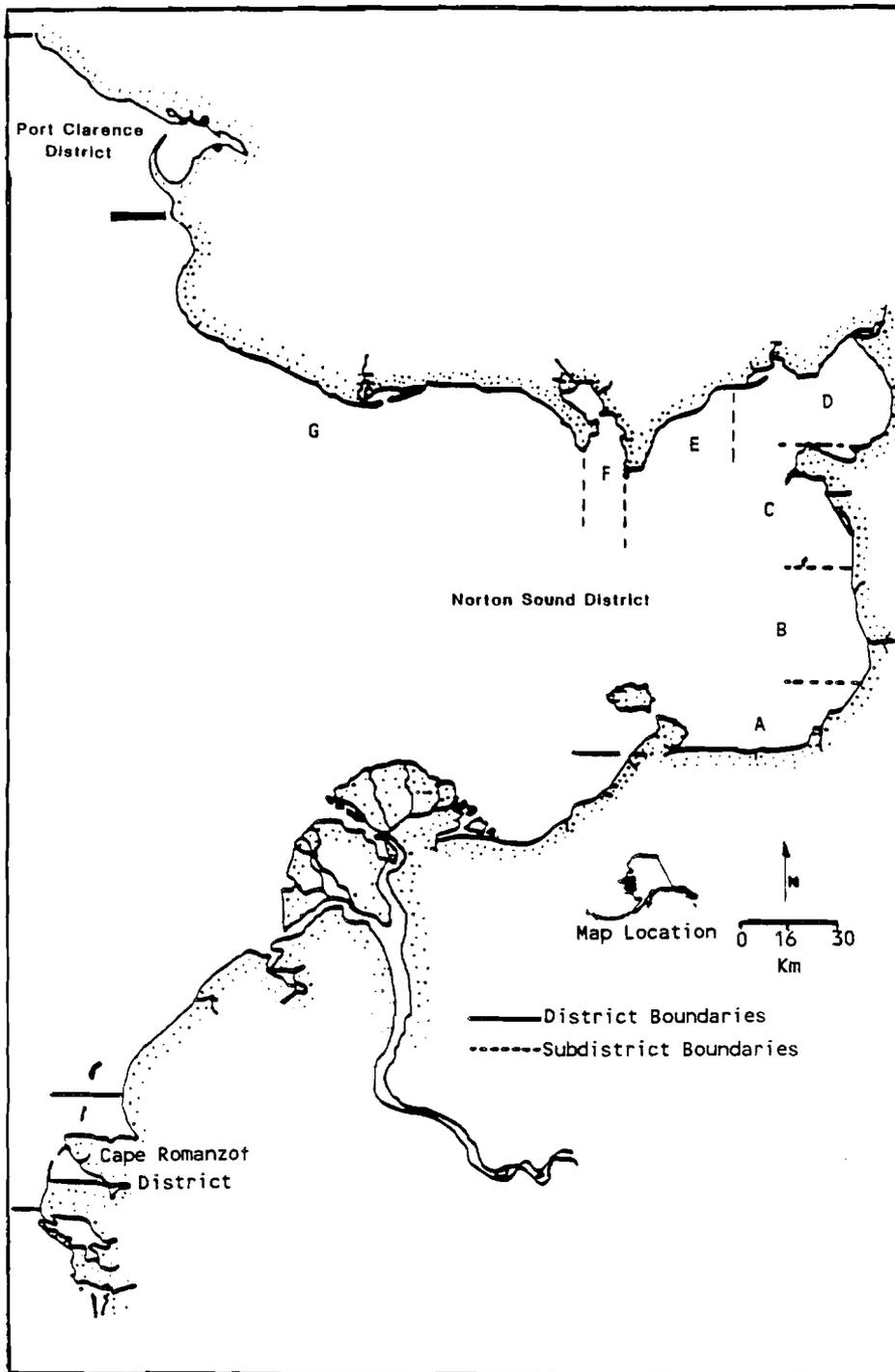


Figure 2. Cape Romanzof, Norton Sound, and Port Clarence Pacific herring commercial fishing districts, in the northeastern Bering Sea, Alaska

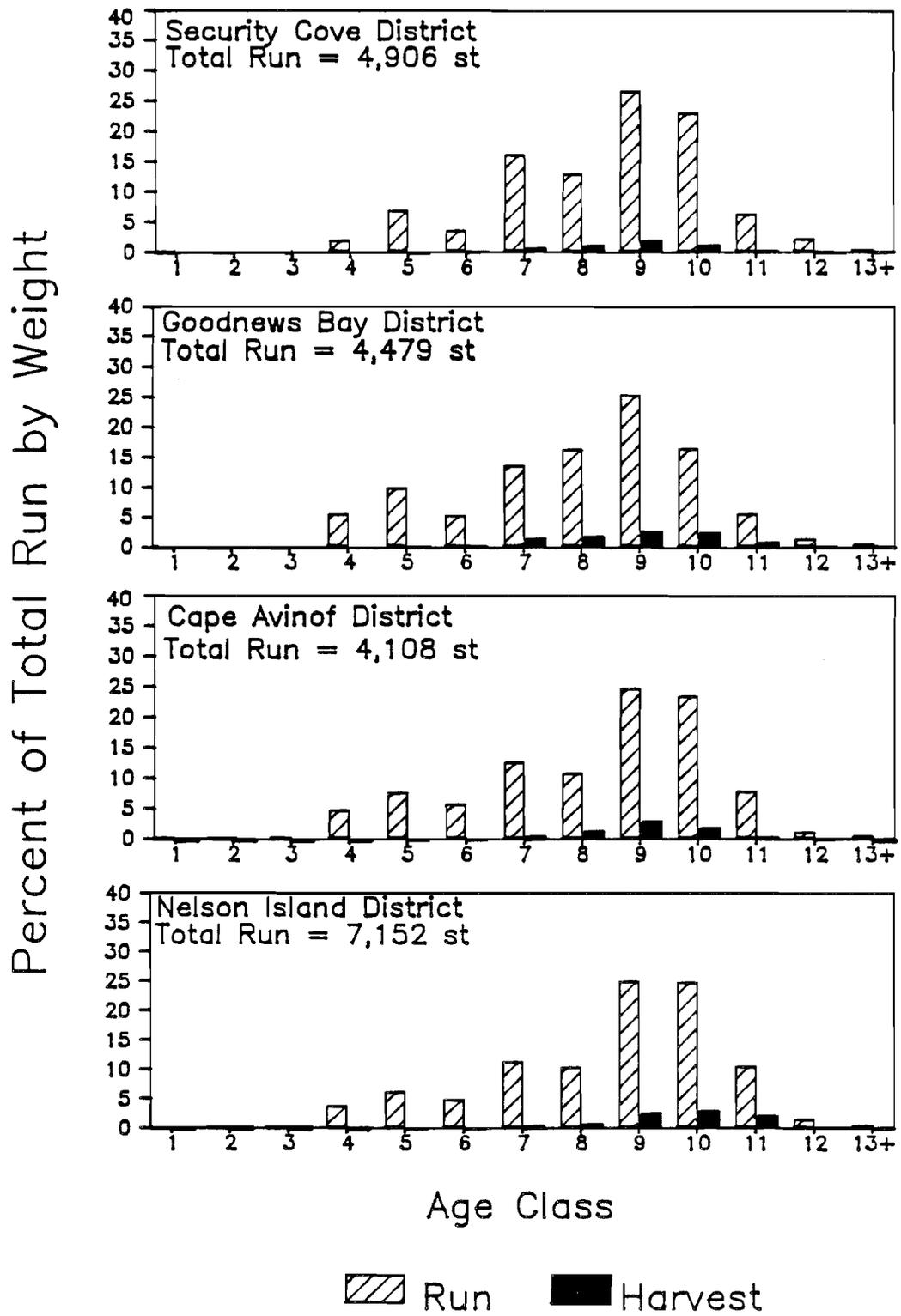


Figure 3. Age composition of Pacific herring in spawning populations and commercial harvests in Security Cove, Goodnews Bay, Cape Avinof and Nelson Island commercial herring fishing districts in the northeastern Bering Sea, Alaska, 1988.

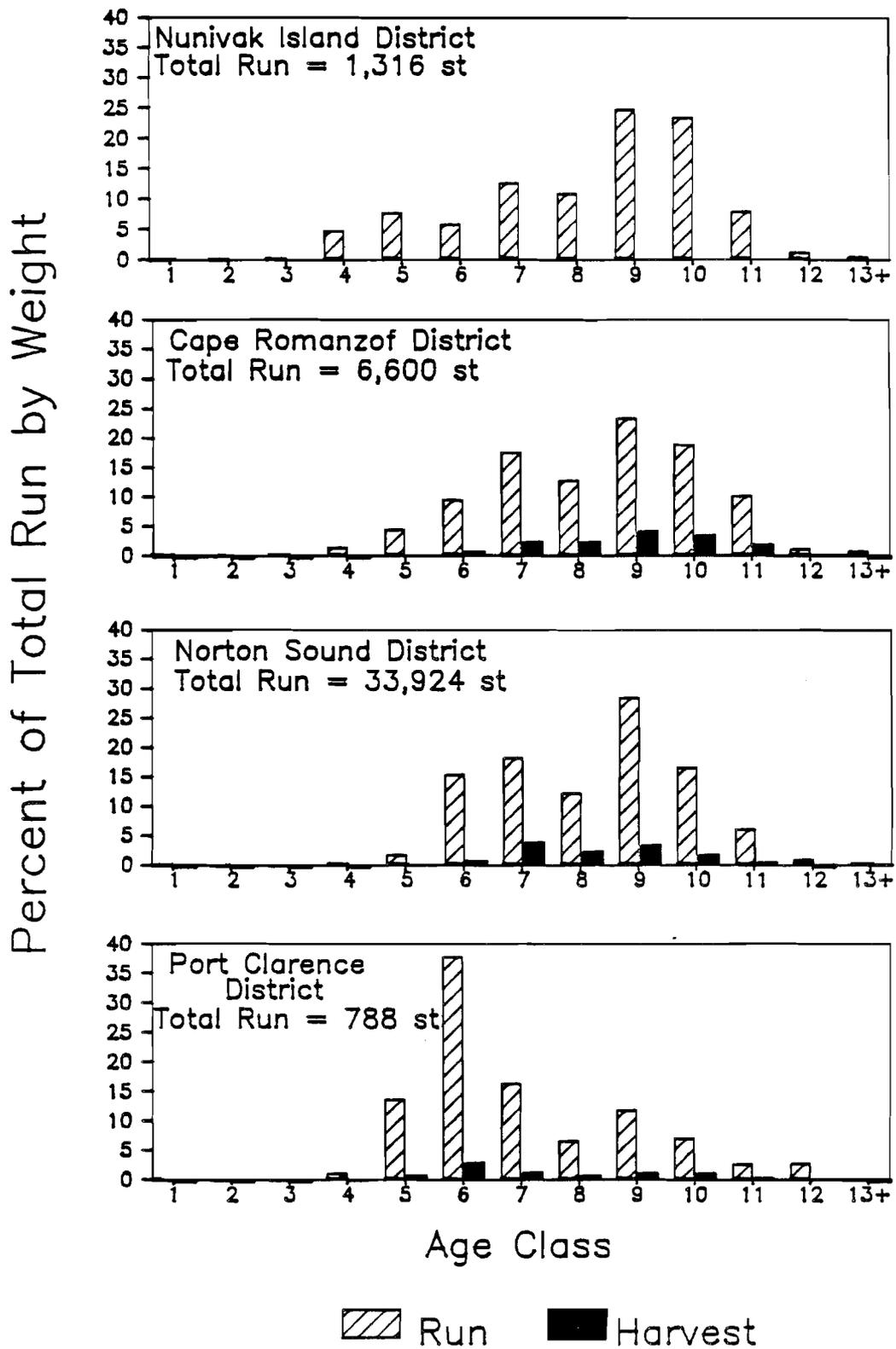


Figure 4. Age composition of Pacific herring in spawning populations and commercial harvests in Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence commercial herring fishing districts in the northeastern Bering Sea, Alaska, 1988

