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Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Northeastern Bering Sea, Alaska, 1990

A Report to the Alaska Board of Fisheries
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By

Helen H. Hamner

and

Carol M. Kerkvliet

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Alaska Department of Fish and Game
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Kim Francisco, Area Manager; Charles Burkey and Cindy Anderson, Asst. Area Managers; Doug Molyneaux, Research Project Leader. Commercial Fisheries Division, P.O. Box 90, Bethel, Alaska. 99559-9990. 543-2931.

Cape Romanzof District
Dan Bergstrom, Area Manager; Sue Merkouris, Asst. Area Manager; Gene Sandone, Research Project Leader. Commercial Fisheries Division, 333 Raspberry Rd., Anchorage, Alaska. 99518-1599. 344-0541.

Norton Sound and Port Clarence Districts
Charles Lean, Area Manager and Fred Bue, Asst. Area Manager. Commercial Fisheries Division, P.O. Box 1148, Nome, Alaska. 99762-1148. 443-5167.

AYK Region
Rich Cannon, Regional Management Coordinator, Commercial Fisheries Division, 333 Raspberry Rd., Anchorage, Alaska. 99518-1599. 344-0541.

Resource Assessment for AYK Herring
Helen Hamner, Biometrician, Commercial Fisheries Division, 333 Raspberry Rd., Anchorage, Alaska. 99518-1599. 344-0541.

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INTRODUCTION

The objectives of this report are to: (1) summarize the results of the 1990 herring stock assessment programs for the Arctic, Yukon, and Kuskokwim (AYK) Region, (2) review and evaluate 1990 harvests and management strategies for all AYK commercial herring fishing districts and the Yukon-Kuskokwim River Delta subsistence fishery, and (3) present management strategies for the AYK herring fishing season in 1991. 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 1990 herring harvest for the AYK Region was approximately 7,507 tons with a total estimated ex-vessel value of $4,204,000 (Tables 1 and 2). Harvest identified as food and bait primarily occurs during the sac roe fishery when fish are sold with a roe content that is below buyer's acceptable minimums. Food and bait sales during the sac roe fishery totaled 1,135 tons, with the remaining harvest sold for sac roe product. A total of 739 fishermen participated in AYK sac roe herring fisheries during the 1990 season (Table 3). Fishing effort decreased from 1989 to 1990 by 335 fishermen.

Commercial fisheries did not occur in three AYK districts in 1990. The Nelson Island District was put on two hour notice for a commercial opening; however, due to poor roe quality of the Department's test samples and lack of processor interest, no commercial fishing occurred. The estimated biomass of herring in the Nunivak Island District never reached the 1,500 ton threshold mandated by the Bering Sea Herring Fishery Management Plan and therefore no commercial fishery occurred. The Port Clarence District remained closed since no buyers were present in the district.

Average roe recovery of the sac roe harvest ranged from 8.4% in Cape Romanzof District to 12.2% in the Goodnews Bay District with a regional average of 9.0%. The percentage of the estimated biomass harvested ranged from no harvest in the Nelson Island, Nunivak Island and Port Clarence Districts to 17.7% in the Goodnews Bay District (Table 2).

Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 140 tons of herring (Table 4).

The total estimated herring biomass of 54,258 tons for the surveyed portion of the AYK herring districts was approximately 20% higher than the 1989 estimate of 43,970 tons (Table 2). Norton Sound herring accounted for nearly 75% of the total AYK herring biomass and was dominated by age 8 herring. Ages 6, 7, 11 and 9 were the dominant age groups for other AYK stocks. Recruits (ages 3, 4, and 5) accounted for nearly 10% of the Norton Sound biomass compared with 6% for non-Norton Sound stocks.

A moratorium on entry into the herring fisheries in the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound Districts was implemented in 1988. The Commercial Fisheries Limited Entry Commission is currently in the process of issuing limited entry permits for these fisheries. The Goodnews Bay, Security Cove, Cape Avinof, and Port Clarence Districts remain open to entry. All AYK

Region commercial herring districts except Security Cove and Port Clarence, are designated as superexclusive use areas.

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, timing, 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. Historically, it has been difficult to obtain biomass estimates from aerial surveys in this region due to poor survey conditions caused by unfavorable weather, ice conditions or turbid water.

During 1990, a total of 78 aerial surveys were conducted in the AYK region; 6 in Security Cove, 10 in Goodnews Bay, 7 in Cape Avinof, 15 in Nelson Island, 7 in Nunivak Island, 5 in Cape Romanzof, 23 in Norton Sound, and 5 in the central Kuskokwim Bay area. Approximately one-half of these surveys were flown under poor to unacceptable survey conditions.

Standard conversion factors of 1.52 tons (water depths of 16 ft or less), 2.58 tons (water depths between 16 and 26 ft) and 2.83 tons (water depths greater than 26 ft) per 538 ft^2 of surface area were used to convert estimated herring school surface areas from aerial surveys to biomass within all districts.

Herring from test fish and commercial catches were sampled in all but the Port Clarence District to estimate age, size, and sexual maturity of herring and to note the occurrence of other schooling fishes. Nearly 12,000 herring from commercial and test catches were sampled from seven of the eight AYK herring districts during the 1990 fishing season.

In most districts, fishermen, in cooperation with the Department, provided catch samples for roe quality evaluation by industry representatives. Participation by 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

Since 1981, the estimated biomass of herring in the Security Cove District has ranged from 2,300 tons in 1987 to 8,300 tons in 1981. During 1990, six aerial surveys were flown in the district from May 9 to May 31 to estimate herring biomass and spawning activity. Half of these surveys were flown under poor or unacceptable survey conditions. Herring were first seen in the Security Cove District on May 9. The season's largest biomass of 1,561 tons was observed during an aerial survey flown under excellent conditions on May 10. A second peak of 1,089 tons was sighted during a May 31 survey. The total biomass of herring in the district was estimated to be 2,650 tons by combining these surveys. On May 19, 4.0 miles of spawn was observed which marked the peak in spawning activity for the district.

Department test fishing was conducted from May 9 to May 17 using variable mesh gill nets. Approximately 447 herring from test nets were sampled for biological analysis. A sample of 308 herring was taken from the commercial harvest.

In 1990, nearly 75% of the sampled biomass consisted of age 9 and older herring (Figure 4). Recruits, ages 4 and 5 herring, represented only 0.5% of the run by weight. However, no samples were taken from the second biomass peak and the latter portion of the herring migration generally tends to consist of younger aged fish.

Goodnews Bay District

Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 4,479 tons in 1988. In 1990, ten aerial surveys were flown from May 9 to May 31 in the Goodnews Bay District. Half of these surveys were flown under poor to unacceptable conditions. During a survey flown on May 16, 1,184 tons of herring were estimated to be present in the district. An additional 1,393 tons of herring were observed during an aerial survey flown on May 31. The total biomass estimate of 2,577 tons for Goodnews Bay was calculated by combining the biomass estimates from these two surveys. Only 0.5 linear miles of milt was sighted during the season.

The Department test fish crew first documented spawning activity on May 9. A total of 1,143 herring were sampled from variable mesh gill nets from May 8 to May 26. A total of 581 herring were sampled from the commercial harvest.

In 1990, ages 7 and 6 comprised 17% and 18% of the biomass, respectively (Figure 3). Nearly 54% of the total run by weight was age 9 and older herring. Recruits, ages 3, 4, and 5 herring, represented only 2.6% of the biomass.

Cape Avinof District

Aerial surveys have been conducted systematically in the Cape Avinof area since

1985. An estimated herring biomass of 2,000 tons, 1,225 tons, and 4,110 tons were observed in 1985, 1987, and 1988, respectively. Weather conditions in 1986 and ice conditions in 1989 precluded biomass estimates by aerial survey. In 1990, only two of the seven aerial surveys of the Cape Avinof District were flown under acceptable conditions. No spawn was observed during these surveys. During an aerial survey on May 22, Department biologists counted 152 tons of herring. Since unsatisfactory aerial survey conditions prevailed during the 1990 season, the projected biomass of 2,020 tons was assumed to be the biomass available in the district.

Spawning activity was first documented by the test fish crew on May 31. A total of 1,185 herring were sampled from variable mesh gill nets for age, sex, length, and weight data. A total of 144 herring were sampled from commercial and subsistence harvests.

Age 6 herring represented 26% of the run by weight (Figure 3). Age 9 and older herring comprised 24% of the biomass. Younger herring, ages 3, 4 and 5, represented approximately 16% of the return.

Nelson Island District

Since 1985, the biomass estimates of herring in the Nelson Island District have ranged from 2,705 tons in 1990 to 9,500 tons in 1985. During the 1990 herring season, fifteen aerial surveys were flown from May 20 to June 6. Half of these surveys were rated either poor or unacceptable. On May 31, under fair to poor aerial survey conditions, 2,705 tons of herring were observed. Prior to this survey, on May 23 at Cape Vancouver, large amounts of unattached eggs were observed washed up on the beach. Only 0.25 linear miles of spawn were sighted during aerial surveys.

A Department test fish crew sampled 1,519 herring in variable mesh gill nets from May 19 to June 7 for biological analysis. An additional 338 herring were sampled from commercial gear and 230 herring were sampled from subsistence catches.

Age 6 herring represented 17% of the 1990 biomass (Figure 3). Recruits, ages 3, 4 and 5, comprised only 5% of the run by weight. Fifty-seven percent of the biomass consisted of age 9 and older herring.

Nunivak Island District

Since 1985, the estimated biomass in the Nunivak Island District has ranged from 422 tons in 1990 to 6,000 tons in 1986. During 1990, seven aerial surveys were flown between May 21 and June 1. Five of these surveys were flown in fair to excellent survey conditions. Spawning activity was first documented in the district on May 22 when approximately 4 linear miles of milt was observed during an aerial survey. The total biomass estimate for the district was calculated to be 422 tons based on an aerial survey flown on May 28. Since this biomass estimate was below the 1,500 tons threshold mandated in the Bering Sea Herring Fisheries Management Plan, no commercial herring fishery occurred in the district in 1990.

Age 11 herring comprised 28% of the return (Figure 4). Ninety-three percent of the biomass consisted of age 9 and older herring. Younger fish, age 3, 4, and 5 herring, represented only 0.2% of the biomass.

Department test fishing was conducted from May 15 to June 4 using variable mesh gill nets. Approximately 690 herring from test nets were sampled for biological analysis.

Cape Romanzof District

Since 1975, the estimated biomass of herring in the Cape Romanzof District has ranged from 2,400 tons in 1990 to 7,500 tons in 1986. Due to excessive water turbidity in the Cape Romanzof area, it has not been possible to estimate herring biomass from aerial surveys. Biomass has been estimated using a combination of information from test and commercial catches, spawn deposition, and age composition. In 1990, five aerial surveys were flown from mid-May to early June. All surveys flown during May were unacceptable due to poor weather and/or turbid water conditions. No herring was observed on the June 1 survey which was flown under poor conditions.

Department test fishing was conducted from May 17 to June 6 using variable mesh gill nets. A total of 2,220 herring were caught, of which 1,112 herring were sampled for biological data. A total of 308 herring were sampled from the commercial harvest.

Daily spawn deposition surveys in the Kokechik Bay area of the Cape Romanzof District began on May 15. On May 19, the first observations of spawn were recorded. This initial spawn deposition was considered to be quite extensive and dense for a first spawn and averaged two egg layers over areas where spawning occurred on *Fucus* substrate. After May 19, the average egg layer dropped due to wave action which caused considerable egg loss. Predictably, a gradual increase in spawn deposition followed both in layers of eggs and distribution. Spawn deposition peaked on May 29, with an average of 3.9 layers estimated on *Fucus* substrate on May 30. A steady decline of spawn deposition occurred subsequently. The last survey was conducted on June 6.

Since the Department was not able to estimate the biomass for the District, the projected biomass of 2,410 tons was used to manage the fishery. Twenty-one percent of the biomass was composed of age 9 herring (Figure 4). However, age 6 herring comprised 23% of the run in numbers of fish. Recruits, age 3, 4, and 5 herring, represented only 4% of the biomass.

Norton Sound District

The primary spawning areas within Norton Sound have been from Stuart Island to Tolstoi Point. Additional spawning areas have been documented along Cape Denbigh, and several bedrock outcroppings along the northern shore of Norton Sound between Bald Head and Topkok especially in years when sea ice has remained in the near-shore areas into June.

Herring biomass in the Norton Sound District has fluctuated from a low of 5,300 tons in 1978 to nearly 39,400 tons in 1990. During 1990, twenty-three surveys were flown on eighteen different days, from May 15 to June 12, for a total of 47.6 hours of aerial survey time. Five of these surveys were rated poor or unacceptable and four were flown while ice was still in the district. Two biomass peaks were observed during aerial surveys and under acceptable aerial survey conditions. The first peak of 35,522 tons was observed May 27 and the second peak of 24,029 tons on June 7. The majority of herring sighted on June 7 were judged to have already spawned and thus it is likely that these fish were already counted on the May 27 survey. Approximately, one-fourth of the fish in the second peak were young fish, primarily age 4, that had not be observed previously. Therefore, the post-season biomass estimate of 39,384 tons was derived by combining older herring from the May 27 survey with young fish from the June 7 survey. A total of 90 linear miles of spawn was sighted during aerial surveys.

Two Department test fishing projects operated during the 1990 season. One project was located at Cape Denbigh in northern Norton Sound. A second crew was stationed at Klikitarik, in southern Norton Sound. Test fish crews sampled 1,831 herring caught with variable mesh gill nets for age, sex, length and weight data. A sample of 1,217 herring was taken from the commercial catch.

Twenty-nine percent of the 1990 biomass consisted of age 8 herring; age 9 comprised 19% of the run by weight (Figure 4). Recruits, ages 3, 4 and 5 represented approximately 11% of the biomass.

Port Clarence District

This district is characteristically not surveyable due to ice, water stain, or poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species in the area. In 1990, there were no commercial or test fisheries in the Port Clarence District. Two aerial surveys were flown over the district however no fish were sighted.

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. The annual subsistence harvest of Pacific herring has averaged 110 tons since 1975 (Table 4). The total catch reported from surveys or mailed questionnaires should be considered minimum levels of effort and harvest since not all fishing families are contacted nor return completed questionnaires.

Extensive subsistence surveys were conducted by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area in 1990 (Pete 1990). This effort was prompted by concern over expected low returns of herring to these districts. A total of 126 tons of herring were harvested for subsistence by

approximately 72% (100 fishing families) of all Nelson Island households. Subsistence fishermen in the village of Mekoryuk on Nunivak Island harvested 4.5 tons. Subsistence fishermen surveyed in the Nelson Island and Nunivak Island Districts expressed concern over declining herring stocks.

During 1990, a total of 208 subsistence herring survey questionnaires were mailed to known fishing families in the Yukon Delta villages of Hooper Bay, Chevak and Scammon Bay. Forty-two of these were returned. Approximately 8.9 tons of herring was reported as having been harvested by 31 fishing families. The subsistence questionnaires also asked villagers how the amount of herring returning to their area this year compared with last year. The majority of people who responded to this question replied that there was more herring in 1990 than in 1989.

COMMERCIAL FISHERY

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 reassessment of herring biomass. The total 1990 harvest of 234 tons of herring was taken during two openings. During the first opening on May 12, fishermen harvested 125 tons of sac roe herring with an average roe percentage of 8.8% and 39 tons of bait-quality herring. During the second 3 hour opening on May 13, 48 tons of sac roe herring with a average roe content of 8.4% and 21 tons of bait-quality herring were harvested. The large amount of bait-quality herring in the catch was due to the presence of spawnouts. The harvest was 8.8% of the season total biomass. Nine processors and 52 fishermen were involved in this fishery. Fishermen received approximately $500 per ton for 10% sac roe herring. The total ex-vessel value of the harvest was approximately $94,000.

Goodnews Bay District

The 1990 herring harvest in the Goodnews Bay District totaled 455 tons. Meetings with fishermen and processors were held daily from May 13 to May 21. Commercial fishermen brought catch samples to these meetings for evaluation by industry roe technicians. On May 18 the roe content of commercial test fish samples averaged 9.5% and the district was opened to commercial fishing. Six fishing periods were scheduled from May 18 to May 23 for a total of 32 hours of fishing time. The harvest included 427 tons of sac roe herring with an average roe content of 12.2% and 28 tons of bait-quality herring. The harvest was 17.7% of the estimated spawning biomass. There were 126 fishermen who made 530 deliveries to three processors. Fishermen received approximately $550 per ton for 10% sac roe herring. The total ex-vessel value of the harvest was approximately $314,000.

Cape Avinof District

In November of 1989, the Alaska Board of Fisheries extended the eastern boundary of the Cape Avinof District to the Ishkowik River (162° 44′ W.long). At the request of the Kwigillingok IRA Council, the eastern boundary of the Cape Avinof District was extended to three miles east of the village of Kwigillingok by emergency order on May 1, 1989.

In 1990, two commercial openings were scheduled in the Cape Avinof District. Fishermen harvested 10.1 tons during a one hour opening on May 29. Because of this low harvest, the district was reopened for two hours. The harvest from both openings was 49.1 tons of sac roe herring with an average roe content of 12.1% and 0.6 tons of bait-quality herring.

Only one tender was present in the district on May 29. Commercial test fishing on June 4 failed to find herring with acceptable roe quality due to the presence of young and spent fish. The district was closed to commercial fishing on June 12 since Department test fish samples showed poor row quality and no processors were available.

The harvest was 2.4% of the projected biomass. One hundred-one fishermen made deliveries to one processor. Fishermen received approximately $500 per ton for 10% sac roe herring. The value of the catch to fishermen was about $35,000.

Nelson Island District

No commercial openings occurred in the district in 1990. The district was placed on 2 hour notice on June 2 when results of the May 31 aerial survey were known. The allowable harvest was set at 205 tons based on the difference in the estimated available biomass (2,705 tons) and the 2,500 ton threshold mandated in the Bering Sea Herring Fisheries Management Plan. No processors registered to buy herring in the district. The district was closed on June 12 due to the poor roe quality of the Department's test samples and lack of processor interest.

Nunivak Island District

Since the inseason biomass estimate of 422 tons was below the 1,500 tons threshold mandated by the Bering Sea Herring Fishery Management Plan, no commercial fishery occurred in the district in 1990.

Cape Romanzof District

The 1990 commercial herring season in the Cape Romanzof District consisted of a three hour opening on May 23-24. The harvest totaled 329 tons of herring. The harvest consisted of 318 tons of sac roe with an average roe recovery of 8.4% and 11 tons of bait-quality herring. There was a relatively high percentage of males in the catch. A total of 95 fishermen participated in the fishery. This is the lowest effort since 1985 and is 17% below the 1989 effort. Four buyers in the Cape Romanzof District paid fishermen $566 tons for 10% sac roe herring. The

total ex-vessel value of the harvest was approximately $154,940.

In coordination with the Department, commercial fishermen provided catch samples for evaluation by industry representatives prior to the opening. Since it was not possible to obtain an inseason estimate of herring biomass based on aerial surveys, the preseason projected biomass of 2,410 tons was used to manage the fishery. The harvest was 13.7% of this estimate but only 7.3% of the post-season adjusted estimate of 4,500 tons.

Norton Sound District

The 1990 Norton Sound herring fishery opened by emergency order on May 28. The commercial fishery was managed using the peak aerial estimate of 35,522 tons which was observed on the May 27 aerial survey. The preseason guideline harvest was 3,305 tons with 2,975 tons allocated to the gill net fishery and 330 tons allocated to the beach seine fishery. A total of four gill net openings for 19 hours of fishing and three beach seine openings for 8 hours of fishing occurred this season. The district closed on May 31. The harvest of 6,380 tons of herring was approximately 16% of the estimated biomass. The harvest included 5,353 tons of sac roe herring with an average roe recovery of 8.8% and 1,026 tons of bait-quality herring. Twelve abandon gill nets were observed each containing approximately 5 tons of herring for an estimated total of 60 tons of wasted herring. There were 365 fishermen, consisting of 357 gillnetters and 8 beach seiners, who made at least one delivery during the season. This is the second highest effort on record. The harvest by gill nets was 6,032 tons with 8.7% average roe recovery. Beach seiners landed 347 tons of herring with 9.5% roe. The timing of the beach seine fishery coincided with the gill net fishery at times; however, for the most part, the two fisheries were held at separately to prevent gear conflict. One educational gill net permit was issued by CFEC, and was fished by the Bering Straits School District Commercial Fisheries Vocational class immediately following the closure of the commercial gill net and beach seine fisheries. A total of 8.5 tons was landed on this permit and is included in the gill net total harvest.

Eight companies registered 7 processing vessels and 58 tenders to operate in Norton Sound for the 1990 season. Fishermen received approximately $686 per ton of 10% sac roe herring. The total value of the herring harvest to fishermen was approximately $3,605,597.

Because shore-fast ice covered southern Norton Sound, test fish data was heavily relied upon to determine when to open the fishery. In concert with an aerial survey, a beach party was organized on May 27. The record biomass of 35,522 tons was observed on this aerial survey, while the beach party samples showed mixed ripeness with slightly more "green" fish than spawned fish. May 28 marked the peak spawning period, as well as the first beach seine and gill net openings in Subdistricts 1, 2, and 3. Eighty percent of the catch from the Cape Denbigh gill net opening was sold as bait. Consequently that portion of Subdistrict 3, west of the Shaktoolik River, was closed for the next two gill net periods in an attempt to target more valuable sac roe quality herring.

The gill net period was timed to open on a flood tide and end at high tide to

maximize roe quality. To prevent gear conflicts, the beach seine opening was held later. During the May 29 and May 30 periods, gill net and beach seine openings occurred simultaneously.

Several seiners petitioned the Board of Fisheries to strike the regulation portion, that limits the seine harvest to not more than 10% of the preseason harvest projection. They preferred the regulation to read no more than 10% of the allowable harvest. The Board took up the petition in a teleconference and rejected the petition. That action closed the fishery.

Port Clarence District

There was no commercial fishery in the Port Clarence District in 1990.

ENFORCEMENT

In 1990, the Division of Fish and Wildlife Protection (FWP) was present in all AYK districts with the exception of Cape Avinof. At least 10 FWP officers were involved in Kuskokwim Bay herring fisheries. The (Protection Vessel) P\V WOLSTAD, various fixed-winged aircraft and a helicopter were used in the Security Cove, Goodnews Bay, and Nelson Island Districts during the season. Citations for violating fishing regulations were issued in two Kuskokwim districts.

Seven FWP officers were present in the Cape Romanzof District during the 1990 herring season. These officers were supported by the P\V WOLSTAD, two skiffs, two fixed-wing aircraft and one helicopter. A total of five commercial fishing citations were issued. All commercial fishing citations were issued for fishing during a closed period. Two deliveries, totaling 4,466 pounds (2.2 st) of herring, were confiscated.

Fish and Wildlife Protection effort in Norton Sound consisted of three fixed-winged aircraft, a helicopter, several small boats, and the P\V WOLSTAD. There were 8 permanent, full-time FWP officers and three civilian public safety employees present. FWP officers patrolled the grounds during each opening and closure. This represents the best enforcement effort ever mounted in the Norton Sound fishery. Over 20 citations were issued for the following violations: fishing during a closed period, fishing with more than two shackles of gill net, and fishing without proper identification. In addition, investigations are pending on abandoned gill net gear and superexclusive use violations. A total of 23.6 tons of herring was confiscated by the State of Alaska during the 1990 season.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1991

Based upon apparent weak recruitment of younger age classes (ages 3-5) 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 all AYK herring districts, particularly the five Kuskokwim districts is expected for 1991. The return to Norton Sound is expected to be less than 1990 but should remain stable. Levels of recruitment and biomass indicate that the Norton Sound fishery is stable unlike most other AYK herring districts which are believed to be in a state of decline. Since methods of reliably forecasting actual returns are still being developed, and reliable estimates of recruitment are not available, harvest levels may 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.

Projections from post-season escapement estimates, using mean rates of natural mortality and growth for each age class, indicate that the 1991 spawning biomass for the northeastern Bering Sea Pacific herring stocks (Security Cove to Norton Sound) will be a minimum of 35,156 tons (Table 6). The projections indicate that a decrease in herring biomass compared to 1991 levels is expected for all AYK districts. Increased recruitment of ages 3 through 5-year-old Pacific herring could increase the 1991 observed biomass over the projected biomass estimates. However in accordance with AYK region harvest policy, newly recruited age classes (age 3, 4, and 5 year old herring) will not be targeted by the commercial fishery.

Security Cove District

The 1991 projected return is 1,490 tons which at a 15% exploitation rate would result in a harvest of about 224 tons (Table 6). Age 9 and older herring are expected to comprise 72% of the biomass.

Emergency order authority will be used to adjust the occurrence and length of fishing periods commensurate with stock strength, fishing effort, and spawning activity. Commercial fishing will not be allowed until total biomass reaches 1,200 tons or significant spawning activity is documented. The harvest level will be maintained at 15% or less, unless available biomass significantly exceeds the 1991 projection. If this occurs, an exploitation rate of up to 20% may be allowed.

Goodnews Bay District

The 1991 projected return is approximately 1,470 tons which at a 15% exploitation rate would result in a harvest of about 221 tons (Table 6). Ages 7 and 8 herring are expected to dominate the return. Age 9 and older herring are expected to comprise approximately 50% of the biomass.

The management strategy for this district will be similar to that used for Security Cove. The season will be opened by emergency order. Commercial fishing will not be allowed until the total biomass reaches 1,200 tons or significant spawning is observed. The harvest level will be 15% or less, unless the available biomass exceeds the 1991 projection at which time a higher exploitation rate may be allowed.

Cape Avinof District

Since the peak aerial survey estimate of biomass was observed under unacceptable survey conditions, the 1990 preseason projection of 2,020 tons was used to estimate the 1991 return. The return to the Cape Avinof District in 1991 is expected to be 1,708 tons, which at an exploitation rate of 15% would result in a 256 ton harvest (Table 6). Age 7 herring are expected to be the largest age group in the return. Age 9 and older herring are expected to comprise 28% of the return.

The 1991 Cape Avinof District commercial herring fishery will be regulated by emergency order. No commercial fishery will be allowed until the total biomass reaches 500 tons or significant spawning is observed. Commercial harvest of Pacific herring will be up to 15% of the total spawning biomass.

Nelson Island District

The spawning biomass projected to return to the Nelson Island District during 1991 is 1,897 tons (Table 6). This is below the 2,500 ton threshold required to open the fishery. If the threshold of 2,500 tons of herring or significant spawning activity is not observed, the fishery will not be opened. However, processors and fishermen are advised that management of the 1991 fishery will be based on observed biomass.

Age 7 herring are expected to be the dominant age group. Herring of age 9 and older are expected to comprise 54% of the biomass in 1991. The harvest level will be maintained at 10% unless available biomass significantly exceeds the 2,500 ton threshold level.

As in 1990, the Nelson Island commercial fishery will be regulated by emergency order. 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 tons or significant spawning activity is documented.

3. Periodic closures of the commercial fishery will be scheduled, during which time only subsistence fishing will be allowed.

4. Several important subsistence use areas occur throughout the district, including the waters north of Cape Vancouver. 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.

Nunivak Island District

The biomass of herring projected to return to the Nunivak Island District during 1991 is 235 tons (Table 6). This is well below the threshold of 1,500 tons needed to open the fishery. As in 1990, the Nunivak Island District commercial herring fishery will be regulated by emergency order. Commercial harvest of Pacific herring will be up to 15% of the observed spawning biomass. If the threshold of 1,500 tons of herring or significant spawning activity is not observed, the fishery will not be opened. However processors and fishermen are advised that management of the 1991 fishery will be based on observed biomass.

Age 9 and older herring are expected to comprise 94% of the return.

Cape Romanzof District

The projected return for 1991, based upon limited data, is 2,983 tons which at a 15% exploitation rate would result in a 447 ton harvest (Table 6). Age 7 herring are expected to comprise the largest age group in biomass.

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, spawn deposition observations and test and commercial catch rates will be used to determine timing and duration of commercial fishing periods and relative stock abundance.

Norton Sound District

The preliminary projected return to Norton Sound in 1991 is a minimum of 25,371 tons which at a 20% exploitation rate would result in a harvest of 5,074 tons (Table 6). This projection may be revised after a reassessment of Norton Sound herring mortality rates. The 1991 spawning population is expected to be dominated primarily by 9 year olds.

In-season assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery except where weather prevents obtaining an in-season estimate. The beach seine fishery is already set by regulation at 10% of the projected harvest.

The 1991 herring fishery will be opened by emergency order. 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. If the projection is not adjusted the beach seine guideline harvest will be set at 507 tons.

Port Clarence District

The Department does not generally project an outlook for the Port Clarence fishery due to the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons as set by the Board of Fisheries in 1981 will determine the allowable harvest in 1991. This harvest guideline is based on two years research by the Department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time. In 1990, ages 7 and 8 were expected to dominate the return. Therefore, 8 and 9 year old herring are expected to be the dominant age classes in 1991.

Table 1. Pacific herring harvests by domestic commercial fishermen in the northeastern Bering Sea, Alaska, 1909-1990.

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	-	7,639
1986	751	557	-	886	511	1,865	5,194	-	9,764	-	9,764
1987	313	321	-	923	414	1,342	4,082	146	7,541	-	7,541
1988	324	483	348	775	-	1,119	4,672	80	7,801	-	7,801
1989	554	616	129	233	116	926	4,771	-	7,345	-	7,345
1990	234	455	50	-	-	329	6,439	-	7,507	-	7,507

[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, 1984-1990.

Year	District	Estimated Biomass (st)	Harvest (st)			% Harvest by Gear				Estimated Value ($ x1,000)	Exploitation Rate (%)
			Catch	Waste	Total	Gill Net	Purse Seine	Beach Seine	Roe %		
1990	Security Cove	2,650	234	0	234	100	0	0	8.7	94	8.8
	Goodnews Bay	2,577	455	0	455	100	0	0	12.2	314	17.7
	Cape Avinof	2,020[a]	50	0	50	100	0	0	12.0	35	2.5
	Nelson Is.	2,705	-	-	-	100	0	0	-	-	-
	Nunivak Is.	422	-	-	-	100	0	0	-	-	-
	Cape Romanzof	4,500	329	0	329	100	0	0	8.4	155	7.3
	Norton Sound	39,384	6,379	60	6,439	95	0	5	8.8	3,606	16.0
	Total	54,258	7,447	60	7,507	95	0	5	9.0	4,204	13.8
1989	Security Cove	2,830	554	0	554	100	0	0	9.4	265	19.6
	Goodnews Bay	4,040	616	0	616	100	0	0	8.4	335	15.2
	Cape Avinof	2,780[a]	129	0	129	100	0	0	8.0	54	18.7
	Nelson Is.	3,320	222	11	233	100	0	0	8.5	57	7.0
	Nunivak Is.	620	116	0	116	100	0	0	9.4	42	18.8
	Cape Romanzof	4,400	926	0	926	100	0	0	9.3	486	21.0
	Norton Sound	25,980	4,741	30	4,771	91	0	8	9.2	2,322	18.3
	Total	43,970	7,304	41	7,345	95	0	5	9.0	3,561	16.7
1988	Security Cove	4,910	324	0	324	100	0	0	9.3	362	6.6
	Goodnews Bay	4,480	483	0	483	100	0	0	8.0	463	10.7
	Cape Avinof	4,110	348	0	348	100	0	0	8.6	264	8.5
	Nelson Is.	7,150	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	33,920	4,672	0	4,672	96	0	4	9.0	3,864	13.8
	Port Clarence	790	80	0	80	30	70	0	8.2	43	10.2
	Total	64,760	7,801	0	7,801	97	<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[a]	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[a]	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	900	146	<1	146	<1	100	0	6.6	77	15.6
	Total	57,300	7,541	<1	7,541	94	2	4	8.6	4,957	13.1
1986	Security Cove	3,700[a]	751	0	751	100	0	0	11.2	535	20.3
	Goodnews Bay	3,000[a]	557	0	557	100	0	0	10.4	325	18.1
	Nelson Is.	7,300[a]	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	28,100	5,194	0	5,194	96	0	4	9.6	2,900	18.5
	Total	55,600	9,764	0	9,764	98	0	2	9.7	5,543	17.6
1985	Security Cove	4,900[a]	703	30	733	100	0	0	10.1	355	15.0
	Goodnews Bay	4,300[a]	724	0	724	100	0	0	8.7	309	16.8
	Nelson Is.	9,500[a]	977	0	977	100	0	0	10.6	527	10.3
	Nunivak Is.	5,700[a]	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	20,000	3,548	0	3,548	95	0	5	9.9	1,438	17.7
	Total	51,400	7,609	30	7,639	98	0	2	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	23,100	3,572	90	3,662	91	0	9	10.3	888	15.9
	Total	38,400	5,749	150	5,899	95	0	5	10.0	1,472	15.4

[a] Inseason biomass estimate from poor aerial survey, therefore projected biomass used.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1985-1990.

Year	District	Number of Buyers	Number of Fishermen		
			Gill Net	Seine[a]	
				Purse	Beach
1990	Security Cove	9	52	-	-
	Goodnews Bay	3	126	-	-
	Cape Avinof	1	101	-	-
	Nelson Island	-	-	-	-
	Nunivak Island	-	-	-	-
	Cape Romanzof	4	95	-	-
	Norton Sound	8	357	-	8
1989	Security Cove	8	110	-	-
	Goodnews Bay	6	138	-	-
	Cape Avinof	3	147	-	-
	Nelson Island	4	162	-	-
	Nunivak Island	3	45	-	-
	Cape Romanzof	6	115	-	-
	Norton Sound	9	351	-	6
1988	Security Cove	4	31	-	-
	Goodnews Bay	6	60	-	-
	Cape Avinof	1	98	-	-
	Nelson Island	7	174	-	-
	Nunivak Island	-	-	-	-
	Cape Romanzof	6	113	-	-
	Norton Sound	11	343	-	6
	Port Clarence	1	6	1	-
1987	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	-
1986	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
1985	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

[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, 1977-1990.[a]

Village	Year													
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Nelson Island														
Tununak	57	38	34	65	40	48	94	-	43	63	48	49	47	54
Umkumiut	3	11	8	3	10	0	-	-	-	-	-[c]	-	-	-
Toksook Bay	21	37	51	29	14	35	-	-	46	70	51	58	52	46
Nightmute	-	-	-	-	-	-	-	-	3[a]	21	15	16	15	18
Newtok	-	-	-	-	-	-	-	-	7[a]	13	10	12	10	8
Total	81	86	93	97	64	83	94	-	99	167	124	136	124	126
Number of Fishing Families	90	83	54	70	93	65	43	-	65[b]	72[b]	96	104	-[b]	100
Nunivak Island														
Mekoryuk	-	-	-	-	-	-	-	-	<1	<1	-	-	-	5
Number of Fishing Families	-	-	-	-	-	-	-	-	11	6[b]	-	-	-	19
Other Kuskokwim Delta														
Chefornak	-	-	-	-	-	-	-	-	13[b]	-	14	-	-	-
Kipnuk	-	-	-	-	-	-	-	-	9	-	14	-	-	-
Kongiganak	-	-	-	-	-	-	-	-	3	2[b]	-	-	-	-
Kwigillingok	1	-	8	13	-	13	-	-	5	-	-	-	-	-
Total	1	-	8	13	-	13	-	-	30	2	28	-	-	-
Number of Fishing Families	9	-	22	19	-	21	-	-	55[b]	12[b]	49	-	-	-
Yukon Delta														
Scammon Bay	-	1	6	3	8	4	3	4	2	2	1	2	1	<2
Chevak	<1	-	2	4	2	2	1	3	2	1	1	2	<1	<1
Hooper Bay	2	4	3	4	4	5	5	4	4	4	1	3	1	6
Total	<3	5	11	11	14	11	9	11	8	7	3	7	2	9
Number of Fishing Families	30	29	84	61	46	43	37	47	44	41	39	30	19	31

[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, 1990.

District	Subdistrict Section/Area	Gear	Period	Date	Time	Total hours	Harvest (st)
Security Cove	Entire	GN	1	5/12	1900-2300	4.0	164.8
			2	5/13	1000-1300	3.0	68.8
					Total	7.0	233.6
Goodnews Bay	Entire	GN	1	5/18	1430-1630	2.0	5.9
			2	5/19	1100-1900	8.0	79.4
			3	5/20	1200-2000	8.0	43.6
			4	5/22	0600-1000	4.0	60.7
			5	5/22	1500-2000	5.0	120.5
			6	5/23	0600-1100	5.0	144.5
					Total	32.0	454.6
Cape Avinof	Entire	GN	1	5/22	1400-1500	1.0	10.1
			2	5/22	1600-1800	2.0	39.6
						3.0	49.7
Nelson Island	No Commercial Opening						
Nunivak Island	No Commercial Opening						
Cape Romanzof	Entire	GN	1	5/23-5/24	2230-0130	3.0	329.0
					Total	3.0	329.0
Norton Sound	SD 1, 2, 3	GN	1	5/28	0900-1300	4.0	1,878.1
	SD 1, 2, 3		2	5/29	0800-1700	9.0	2,104.6
	SD 1, 2, 3		3	5/30	0900-1300	4.0	1,113.7
	SD 1, 2, 3		4	5/31	1200-1400	2.0	935.8
					Total	19.0	6,032.2[a]
Norton Sound	SD 1, 2, 3	BS	1	5/28	1600-1900	3.0	73.7
	SD 2		2	5/29	1500-1800	3.0	94.5
	SD 1, 2		3	5/30	1000-1200	2.0	179.1
					Total	8.0	347.2
Port Clarence	No Commercial Opening						

[a] Harvest of 8.5 st taken with educational permit.

Table 6. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1991.

District	1991 Projection[a]			
	Biomass(st)	Threshold	Harvest(st)	Exploitation Rate (%)
Security Cove	1,490	1,200	224	15
Goodnews Bay	1,472	1,200	221	15
Cape Avinof	1,708	500	256	15
Nelson Island	1,897	2,500	-[b]	10
Nunivak Island	235	1,500	-[b]	15
Cape Romanzof	2,983	1,500	447	15
Norton Sound	25,371[c]	7,000	5,074[c]	20
Port Clarence[d]	-	-	165[e]	-
Total	35,156		6,387	

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.
[b] Projected biomass is below minimum for commercial harvest; fishery will not be opened unless threshold biomass is observed.
[c] Minimum estimates; projected biomass and harvest may be adjusted after re-evaluating Norton Sound herring mortality rates.
[d] No biomass estimate for 1990.
[e] Harvest guideline of 165 st (150 mt).

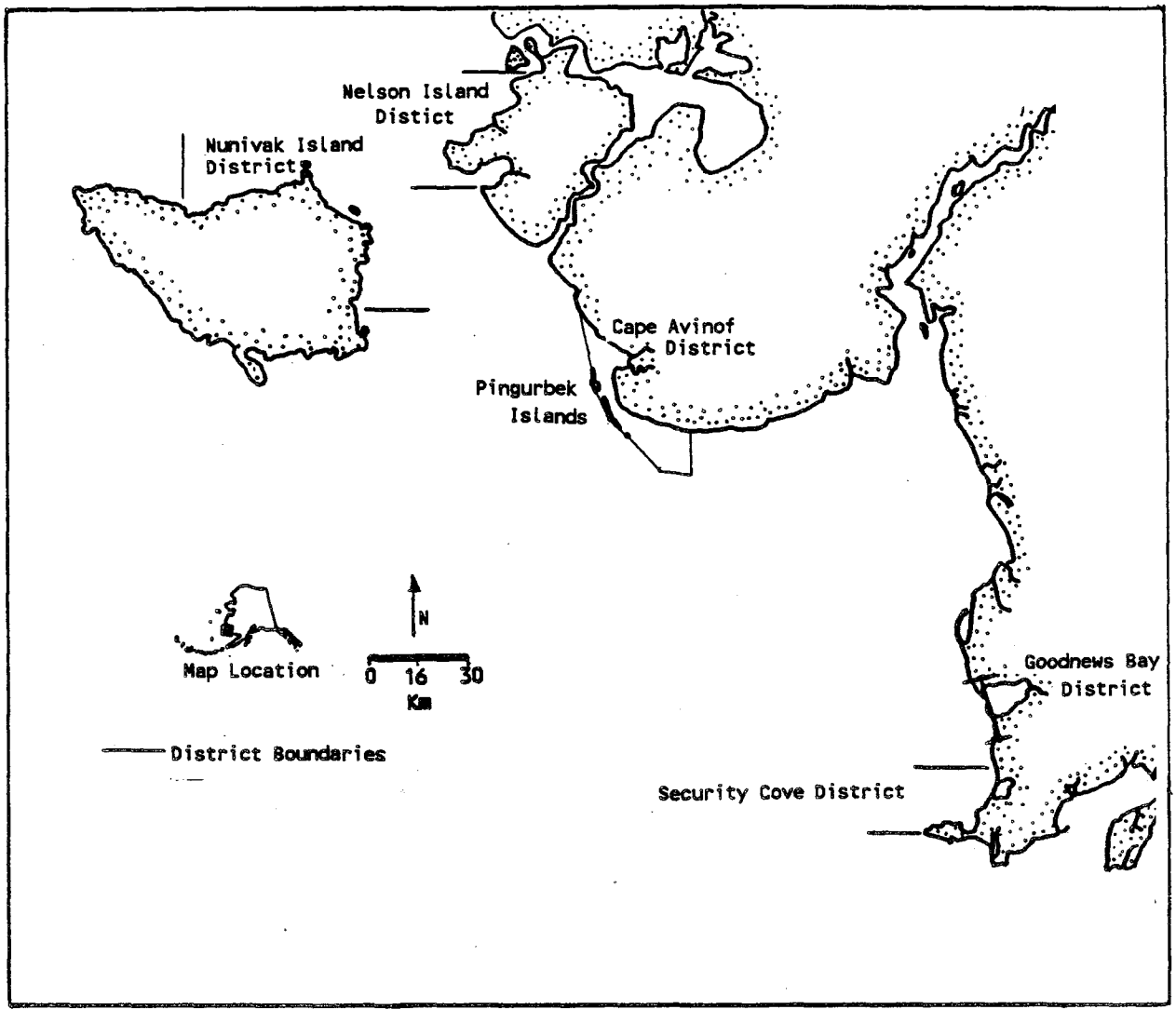

Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

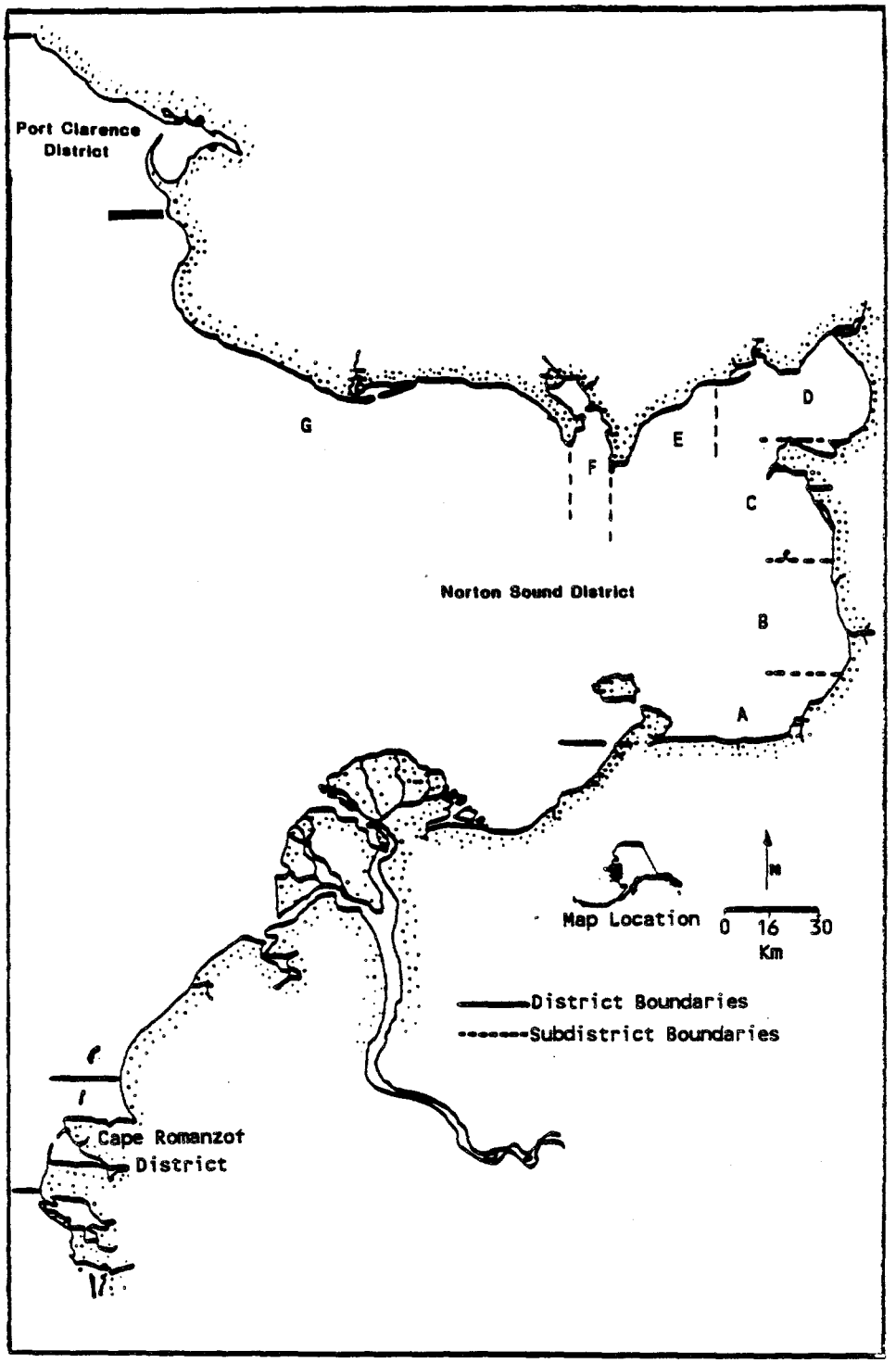

Figure 2. Cape Romanzof, Norton Sound, and Port Clarence Pacific herring commercial fishing districts, in the northeastern Bering Sea, Alaska

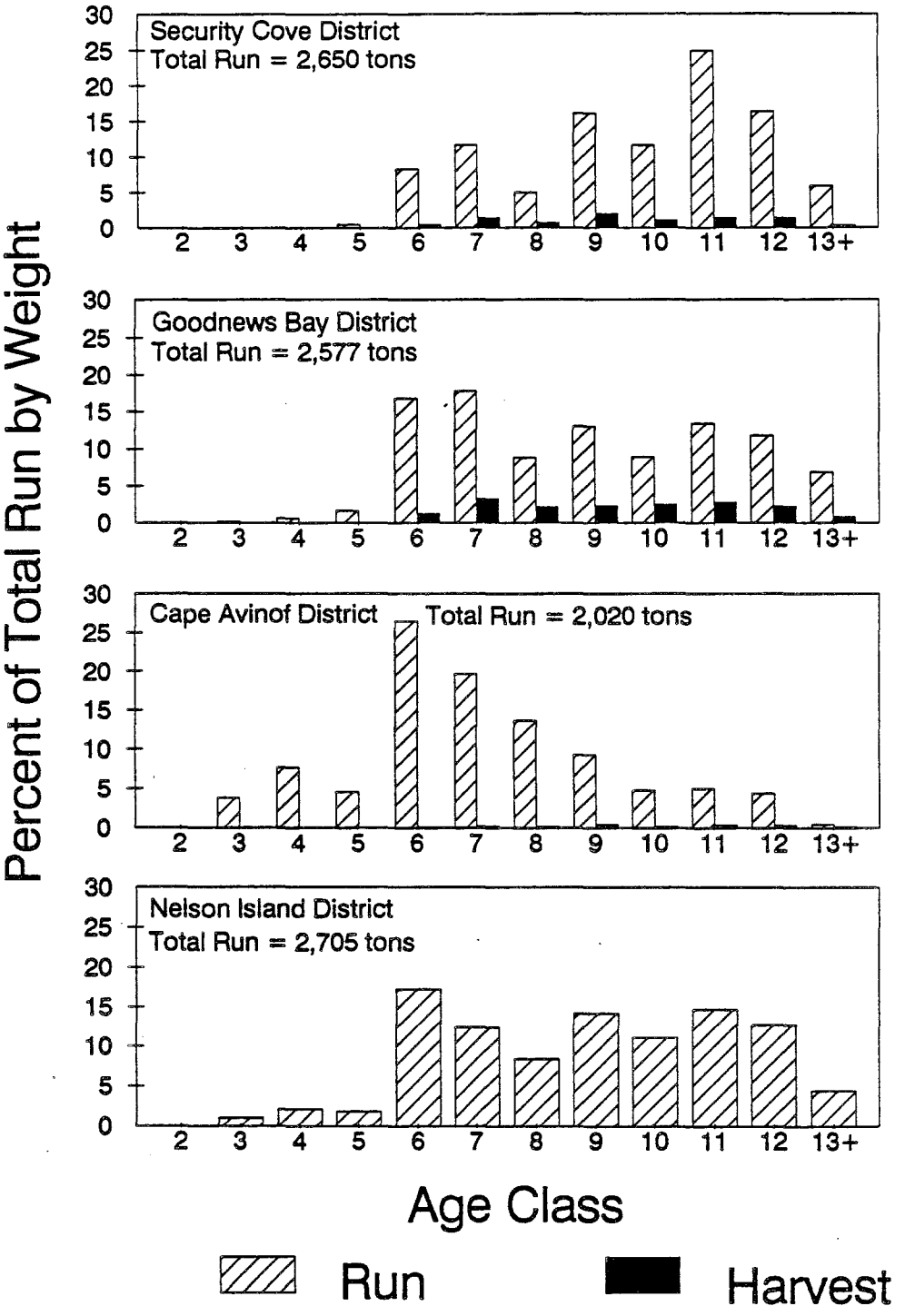

Figure 3. Age composition of Pacific herring in spawning populations and commercial harvests in Security Cove, Goodnews Bay, Cape Avinof and Nelson Island commercial herring fishing districts in the northeastern Bering Sea, Alaska, 1990.

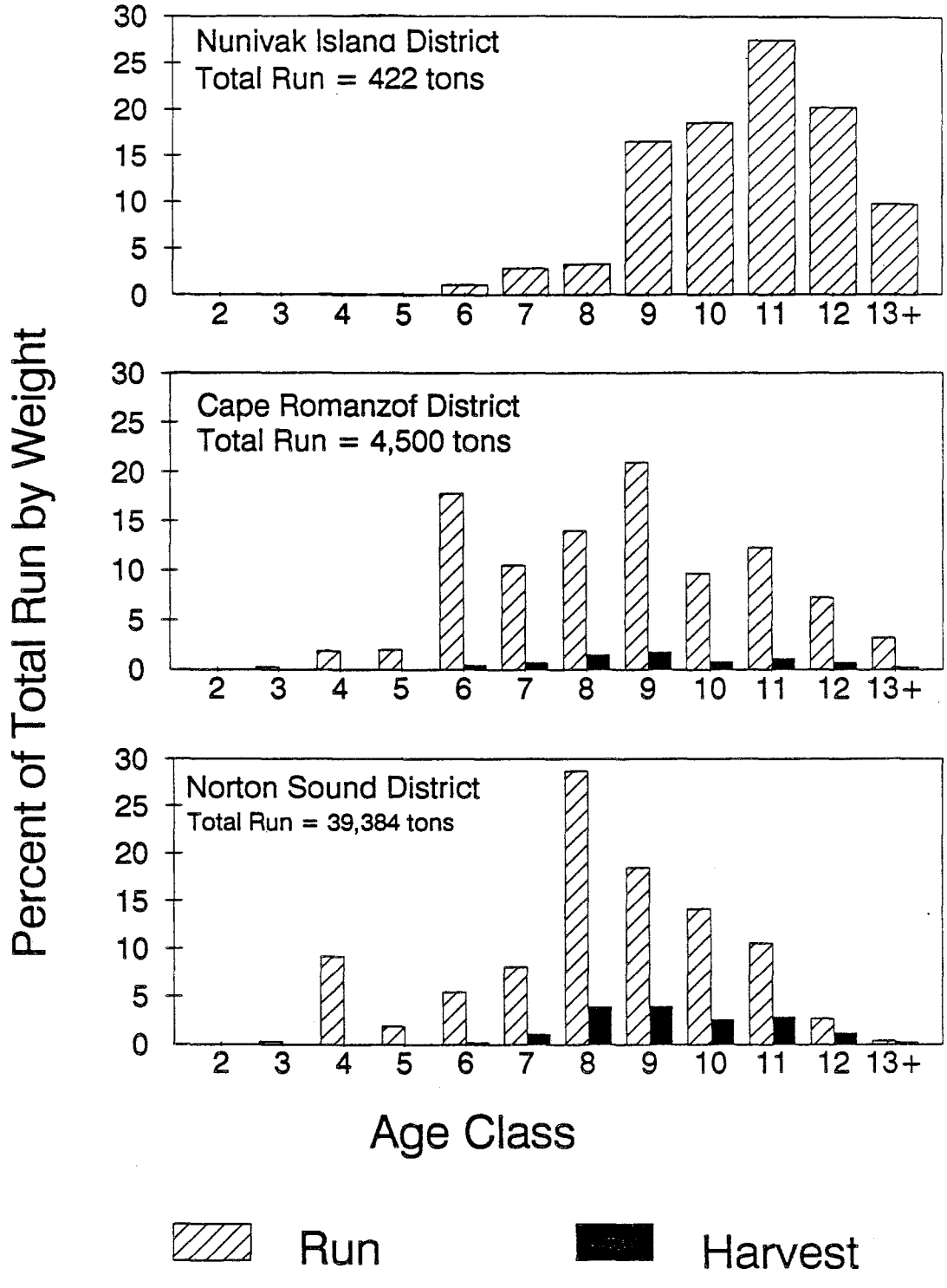

Figure 4. Age composition of Pacific herring in spawning populations and commercial harvests in Nunivak Island, Cape Romanzof, and Norton Sound commercial herring fishing districts in the northeastern Bering Sea, Alaska, 1990.