Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Bering Sea, Alaska, 1992

A Report to the Alaska Board of Fisheries

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INTRODUCTION

The objectives of this report are to summarize the results of the 1992 herring stock assessment programs of the Arctic-Yukon-Kuskokwim (AYK) Region, review and evaluate 1992 harvests and management strategies of all AYK commercial herring fishing districts and the Yukon-Kuskokwim River Delta subsistence fishery, and present general management strategies planned for the AYK herring fishing season in 1993. Commercial fishing districts included in this report consist of the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figures 1 and 2).

The 1992 herring season in the AYK Region was unusual in several ways. Because of ice conditions and low temperatures, herring arrived in coastal spawning areas from 1 to 3 weeks later than average. In many districts, for the first time in many years, the herring biomass consisted largely of recruit herring. A historic record biomass of herring was observed in Norton Sound. However, because ice prevented processors from reaching Norton Sound until late in the season, the Norton Sound fishery did not open. Since Norton Sound is the major herring fishery in AYK, the total harvest and ex-vessel value of herring for the region were both near record lows.

The 1992 herring harvest for the AYK Region was approximately 2,828 tons with an estimated ex-vessel value of $990,000 (Tables 1 and 2). The harvest is 38% of the 1991 harvest and is the lowest harvest since 1979. The low harvest was due to no commercial fishery in Norton Sound which generally comprises about two-thirds of the total AYK herring harvest. Food and bait sales during the sac roe fishery totaled 251 tons, with the remaining harvest sold as sac roe product. Harvest identified as food and bait primarily occurs during the sac roe fisheries when fish are sold with a roe content that is below buyer's acceptable minimums. A total of 429 fishermen participated in AYK sac roe herring fisheries during the 1992 season (Table 3). This is only 65% of the fishermen who participated in the 1991 fishery and is 36% of the record 1987 effort. Again this reduction was primarily due to the lack of a fishery in Norton Sound. However, fishing effort has been declining since a historic high of 1,195 fishermen was reached in 1987, when a moratorium was placed on entry into the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries. The Commercial Fisheries Entry Commission is currently in the process of issuing limited entry permits for these fisheries. All AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

There was no herring fishery in the Port Clarence District since no buyers were present in the district. There has not been a commercial fishery in the Port Clarence District since 1988 for this reason.

Average roe recovery of the sac roe harvest ranged from 8.0% in the Cape Romanzof District to 9.9% in the Cape Avinof District with a regional average of 9.1%. Exploitation rates (the percentage of the biomass harvested) were low in all AYK

herring districts in 1992. The total exploitation rate for the AYK Region was only 3.1% due to the large biomass observed in Norton Sound and the lack of a commercial fishery in that district. Exploitation rates range from 0.5% in the Nunivak Island District to 13.3% in the Goodnews Bay District (Table 2). The overall exploitation rate for districts with commercial herring fisheries in 1992 is 8.8%.

Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 100 tons of herring (Table 4).

The estimated herring biomass of 90,243 tons for the surveyed portion of the AYK herring districts sets a historic record and is 140% of the previous record biomass of 64,757 tons set in 1988 (Tables 2 and 5). This dramatic increase in herring biomass is primarily due to a record biomass of herring observed in the Norton Sound District. Norton Sound herring comprised 64.2% (Figure 3) of the regional total in 1992. However significant increases in herring biomass were also observed in the Security Cove, Goodnews Bay, Nelson Island and Nunivak Districts primarily due to good numbers of age 4 and 5 herring recruiting to the spawning population. The increased biomass in the Nunivak Island District is probably a result of improved aerial survey conditions.

With the exception of Security Cove, age 8 and older herring dominated the biomass in AYK districts (Figures 4 and 5). Recruits (ages 3, 4, and 5) comprised at least 15% of the biomass and at least 31% of the population (numbers of fish) in all districts with the exception of Cape Romanzof (Figure 6).

STOCK STATUS

Assessment Methods

Aerial surveys were flown throughout the spawning season in all commercial fishing districts to determine the relative abundance, timing, distribution, and biomass of herring. The 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 area due to poor survey conditions caused by unfavorable weather, presence of ice and turbid water.

During 1992, 88 aerial surveys totalling 102.9 hours of flight time were flown in the AYK region: 12 (6.0 hours) in Security Cove, 11 (5.7 hours) in Goodnews Bay, 5 (1.2 hours) in Jacksmith Bay, 10 (6.6 hours) in Cape Avinof, 14 (7.6 hours) in Nelson Island, 10 (12.9 hours) in Nunivak Island, 7 (2.9 hours) in Cape Romanzof, 17 (60 hours) in Norton Sound, and 2 in Port Clarence.

In general, 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 herring school surface areas observed during aerial surveys to biomass within all districts (Lebida and Whitmore 1985).

Herring from test and commercial fishery harvests were sampled in all but the Nunivak and Port Clarence Districts to estimate age, sex, size, and gonad maturity of herring and to note the occurrence of other schooling fishes. Approximately 8,630 herring from commercial and test catches were sampled from six of the eight AYK herring districts during the 1992 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 8,267 tons in 1981 (Table 5). During the 1992 season, a total of 12 aerial surveys were flown on 12 days from 14 May to 9 June. Five of these were flown under acceptable survey conditions. Herring schools were first observed in the district on 21 May (1,300 tons). The peak biomass of 6,939 tons was sighted on 31 May. This does not include the 834 tons of herring harvested prior to the survey. The total biomass of 7,773 tons was calculated by combining the commercial catch with the 31 May aerial survey estimate. This is the largest biomass observed in the Security Cove District since 1981. A total of 17.5 linear miles of milt was documented during aerial surveys with peak spawning occurring on 31 May when 5.5 miles of milt were seen.

The Security Cove test fish crew fished from 18 May to 29 May with variable mesh gillnets. From this catch, 1,006 herring were sampled for biological data. Ages 4 and 5 dominated the return in both biomass and numbers of fish (Figures 4 and 6). Age 9 and older herring comprised 33.7% of the biomass. Recruit herring, ages 3, 4, and 5, represented 70% of the return in numbers of fish.

A sample of 412 herring was taken from the commercial catch. Age 9 and older herring represented 74.2% of the catch by weight (Figure 4). Young fish, 3, 4, and 5 year olds, comprised only 1% of the catch.

Goodnews Bay District

Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 5,572 tons in 1992 (Table 5). During the 1992 season, eleven aerial surveys were flown on 11 days from 14 May to 9 June. Only four of these surveys were flown under satisfactory conditions. A survey on 24 May documented 3,633 tons while 1,939 tons were sighted during a survey on 9 June. The total biomass estimate of 5,572 tons was calculated by combining the

two surveys. A total of 5.2 linear miles of milt was observed during aerial surveys with a peak of 2.2 miles observed 22 May.

Department test fishing was conducted from 18 May to 29 May. A total of 909 herring were sampled for biological data. Age 8 herring dominated (19.3%) the biomass whereas age 4 dominated (20.9%) the return in numbers of fish (Figures 4 and 6). Age 9 and older herring represented 52.3% of the biomass. Young herring, ages 3, 4, and 5 were 40.1% of the spawning population (Figure 6).

A sample of 424 herring was taken from the commercial catch. Age 9 and older herring represented 64.3% of the harvest (Figure 4). Young herring, ages 3, 4, and 5, were only 3.6% of the catch.

Cape Avinof District

Aerial surveys have been conducted by the department in the Cape Avinof area since 1985. Herring biomass observations of 2,000 tons, 1,225 tons, 4,108 tons and 2,083 tons were made in 1985, 1987, 1988 and 1991 (Table 5). Weather conditions in 1986 and 1990 and ice conditions in 1989 precluded biomass estimates by aerial survey. During 1992, 10 aerial surveys were flown in the Cape Avinof District between 29 May and 12 June. Only two of these surveys were flown under satisfactory conditions. An aerial survey on 9 June documented 3,095 tons of herring. Prior to this survey, 351 tons of herring had been harvested in the Cape Avinof commercial fishery. The total biomass (3,446 tons) was calculated by combining the 9 June aerial survey estimate with the commercial catch to that date. No spawn was observed in the Cape Avinof District in 1992.

The department's test fishery near Kipnuk captured 810 herring between 7 June and 11 June to sample for age-sex-size data. Age 8 herring dominated the biomass whereas age 4 herring dominated the return in numbers (Figures 4 and 6). Age 9 and older herring comprised 46.3% of the biomass. Recruit herring represented 32.7% of the return in numbers of fish.

A sample of 528 herring was taken from the commercial catch. Age 9 and older herring made up 62.1% of the catch by weight (Figure 4). Young herring (ages 3, 4, and 5) comprised only 0.3% of the harvest.

Nelson Island District

Since 1985, biomass observations of herring in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). Fourteen aerial surveys were flown on 12 days from 29 May to 12 June during the 1992 season. Nine of these surveys were made under acceptable conditions. An aerial survey on 9 June documented 5,275 tons of herring in the district. A total of 10.8 linear miles of milt was observed during aerial surveys with a peak spawning of 3.8 linear miles occurring on 6 June.

Test fishing with variable mesh gillnets occurred from 26 May to 18 June. From this catch, 1,300 herring were sampled for biological data. Age 4 fish dominated (19.8%) the return in numbers of fish whereas ages 10 and 11 dominated the

biomass (15.7% and 16.0%, respectively) (Figures 4 and 6). Age 9 and older herring comprised 62.8% of the biomass. Recruit herring, ages 3, 4, and 5, represented 31.2% of the spawning population in numbers. Herring from Nelson Island subsistence fishermen were also collected.

A total of 528 herring was sampled from the commercial catch. Age 9 and older herring were 79.1% of the catch (Figure 4). Only 0.2% of the harvest was recruit-aged 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 (Table 5). Aerial surveys were flown on 10 days between 26 May and 8 June during the 1992 season. Five surveys were made under either excellent or fair conditions. An aerial survey on 1 June documented 5,703 tons of herring. A total of 19.4 linear miles of milt was sighted with a peak spawn of 6.5 miles occurring on 5 June.

Ice conditions prevented the department's test fish crew from reaching the east side of the island. Test fishing was hampered by floating ice around Mekoryuk and no herring were captured.

No herring were sampled from the commercial catch but based on size the majority appeared to be older aged fish. The average weight of fish from test fish samples was over 300 grams.

Cape Romanzof District

Since 1980, the estimated biomass of herring in the Cape Romanzof District has ranged from 2,976 tons in 1980 to 7,500 tons in 1986 (Table 5). Due to excessive water turbidity in the Cape Romanzof area, it is generally not possible to estimate herring biomass using aerial survey techniques. Biomass has been estimated using information from test and commercial catches, spawn deposition, and age composition. Seven aerial surveys were flown during the 1992 season from 5 June through 18 June. A total of 2.9 hours were spent surveying the district. A majority of the surveys were unacceptable due to poor weather and/or turbid water conditions. A survey flown on 11 June under poor conditions documented a herring biomass of 1,292 tons. The peak biomass of 3,898 tons was sighted on 16 June. A very large school was observed during this survey in Kokechik Bay, however, the school was not very dense as water depth was estimated to be less than 2 meters. A conversion factor of only 0.1 tons per 538 ft of surface area was used to estimate the biomass of this school. Observations made during a hike along the mountains near the cape earlier in the season on 6 June revealed that large thin schools were present in Kokechik Bay, however these schools would be difficult to see except during calm winds and under direct sunlight.

Daily spawn deposition surveys in the Kokechik Bay area of the Cape Romanzof District began on 1 June. The first observations were recorded on 5 June in Kokechik Bay. This initial spawn deposition was light, averaging 0.4 to 0.9 egg layers over the area where spawning occurred. A gradual increase in spawn

deposition followed, both in layers of eggs and distribution. Spawn deposition peaked approximately 12 June, with egg layers generally ranging from 2 to 4.7 egg layers on *Fucus* substrate and from 1 to 4.3 egg layers on rock substrate, depending on location. The last survey was conducted on 17 June.

Given the difficulty of observing herring during aerial surveys, the department conducted further studies to develop a spawn deposition index this year. The major difficulty estimating biomass from spawn deposition data in this area is the loss of spawn due to storms and desiccation. To address this problem, artificial substrates were located in intertidal spawning areas in 1992. The artificial substrate consisted of small steel platforms with 6 inch by 12 inch rectangular pieces of astroturf attached to a steel plate on each platform. Spawn deposited on the astroturf was removed and weighed daily at low tide. Daily removal of spawn allowed measurements of new spawn deposition and decreased the problem of spawn loss due to wave action and desiccation observed in previous studies. A total of 50 platforms were placed just north of the department's field camp between 5 and 9 June. The results indicated that the largest spawn deposition occurred on 6, 9, and 14 June within the study area. Hopefully, the spawn deposition index obtained this year can be used for comparative purposes in the future.

Because of potential annual variation in spawn deposition between areas, it will be important to obtain an additional index in another location. A study area located approximately two miles farther inside the bay would assist in solving this potential problem and provide timing information as well. Over the years, it has been observed that spawning occurs later farther inside the bay than in the present study area.

Since it was not possible to estimate the biomass inseason, the projected biomass of 3,000 tons was used to manage the fishery. The herring spawning biomass based on aerial surveys was 4,428 tons. This estimate was adjusted to 4,500 tons after evaluating commercial and test fish catch rates and spawn deposition data.

Test fishing with variable mesh gillnets was conducted by the department from 4 June to 17 June. A total of 1,696 herring were caught, of which 1,062 were sampled for biological data. Herring comprised approximately 98% of the total catch of schooling species. Other fish captured during test fishing, primarily during the later portion of the project, were yellowfin sole, flounder, saffron cod, sculpin, and whitefish.

Age 10 herring comprised 21.7% of the biomass followed by age 8 herring (18.8%) (Figure 5). Age 9 and older herring comprised 71.7% of the biomass. Recruits, ages 3, 4, and 5, represented 4.8% of the biomass and 9.8% of the population in numbers of fish (Figure 6). Due to the late arrival of herring, younger aged fish may have arrived after termination of the department's test fishing project. Ages 8 and older herring comprised 98.0% of commercial catch samples.

Norton Sound District

Historically, 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 nearshore areas into June.

Since 1978, herring biomass estimates in the Norton Sound District have fluctuated from 5,291 tons in 1978 to 57,974 tons in 1992 (Table 5). During 1992, 17 surveys were flown on seventeen different days between 27 May and 29 June, for a total of 60 hours of aerial survey time. Six of these surveys were flown under acceptable survey conditions. Ice floes hampered aerial surveys until 15 June and covered much of the preferred spawning area until 19 June when ice began to retreat from west to east.

The first spawn was observed 15 June at Stuart Island and gradually increased over several days to include the south shore of Norton Sound to Tolstoi Point. Fish spawned as soon as substrate became available as ice moved away from the beach. Fifty-nine linear miles of milt was observed during surveys with peak spawning occurring 19 June.

Beach surveys conducted within a few days of the peak spawn found 3 to 4 egg layers on *Fucus* substrate in the St Michaels area and 2 to 3 egg layers in the Black Point and Klikitarik areas.

The Cape Denbigh test fishing project was the only test fish project funded in Norton Sound during the 1992 season. The crew operated out of Unalakleet from 6 June until 12 June because of the extensive ice cover in the Cape Denbigh area. The field crew moved to Cape Denbigh and started fishing on 12 June. The test fishing project ended on 27 June. A roving crew consisting of office and regional staff operated out of Unalakleet until 25 June.

Test fish crews sampled 1,217 herring caught with variable mesh gillnets for biological data. Age 10 herring comprised 27.5% of the 1992 biomass (Figure 5). The biomass consisted of 51.2% age 9 and older herring. Recruits, ages 3, 4 and 5 represented 20.8% of the biomass and 34.8% of the return in numbers of fish (Figures 5 and 6).

Port Clarence District

Generally, it is not possible to survey this district due to ice, water stain, and poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. Two aerial surveys were flown in 1992. Eight tons of herring were observed near Point Spencer during a survey on 17 June, when most of the district was still covered with shore-fast ice. A record biomass for this district of 1,652 tons was sighted during an aerial survey on 29 June.

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 total catch reported from surveys or mailed questionnaires should be considered minimum levels of effort and harvest since not all fishing families are contacted and not all families contacted by mail return completed questionnaires.

Extensive subsistence surveys were conducted by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area in 1990, 1991, and 1992 (Pete 1990, 1991, 1992). This effort was prompted by concern over expected low returns of herring to these districts. A total of 92 tons of herring was harvested for subsistence by 97 Nelson Island fishing families in 1992. Twenty fishing families in the village of Mekoryuk on Nunivak Island harvested 4 tons of herring. A more detailed description of the 1992 subsistence fishing season for Nelson and Nunivak Islands is available in a separate report by Subsistence Division (Pete 1992).

During 1992, 208 subsistence herring survey questionnaires were mailed to subsistence fishing families in the Yukon Delta villages of Hooper Bay, Chevak and Scammon Bay. Seventy (34%) of these questionnaires were returned. Approximately 4 tons of herring were reported as having been harvested by 30 fishing families (Table 4). In addition, an unknown quantity of herring spawn on *Fucus* was harvested for subsistence use.

COMMERCIAL FISHERY

Security Cove District

The commercial herring fishery in the Security Cove District has opened and closed by emergency order since 1981 to provide for an orderly fishery and periodic assessment of herring biomass. A total of 834 tons of herring was harvested during five openings in the Security Cove District in 1992.

The harvest quota was raised to 789 tons from the preseason forecast of 608 tons on 22 May after 3,944 tons were observed during an aerial survey of the district. The quota was increased to 860 tons on 24 May after an aerial survey documented 4,300 tons. An aerial survey on 31 May documented a biomass of 6,939 tons. However, the harvest quota was not increased since fishermen and processors were no longer present in the area.

The district was opened to commercial harvest for 4 hours starting at noon on 25 May (Table 6). Six processors purchased 157.0 tons of sac roe herring with an average roe percentage of 8.6% and 35.2 tons of bait. Forty-two deliveries were made by 42 fishermen. The second opening was for 9 hours starting at 10:30 am on 27 May. The catch totaled 384.9 tons of sac roe herring with an average roe content of 9.2%, 82.0 tons of bait and 10.0 tons of waste. Fifty-one fishermen made 88 deliveries. Two openings occurred on 28 May, the first for 2 hours from 4:00 am to 6:00 am and the second for 4 hours from 11:30 am to 3:30 pm. Twenty fishermen made 36 deliveries for a total catch of 73.7 tons of sac roe herring with an average roe content of 9.7% and 8.1 tons of bait. The last period was for 15 hours from 4:00 am until 7:00 pm on 29 May. Four fishermen made 12

deliveries for 81.2 tons of sac roe herring with an average roe content of 9.7% and 1.9 tons of bait.

Overall, the sac roe quality herring had an average roe recovery of 9.2%. Six processors purchased herring in Security Cove. A total of 58 fishermen made 178 deliveries (Table 3). The average price was $450 per ton for 10% roe recovery, with an increase or decrease of $45 per ton for each percentage point above or below 10%. Value of the harvest to fishermen was about $285,000 (Table 2).

The commercial exploitation rate was 10.7% of the estimated available biomass (Table 1). Ages 9 and older herring comprised 70% of the total harvest. No herring under age 5 were observed in the commercial catch sample.

Goodnews Bay District

Since 1981, commercial herring fishing in Goodnews Bay has opened and closed by emergency order to provide for an orderly fishery and periodic reassessments of herring biomass. A total of 740 tons were taken during 29 hours of fishing over seven periods.

The harvest quota was raised from the preseason projection of 596 tons to 727 tons after a 24 May aerial survey observed 3,633 tons of herring in the district. Beach meetings with fishermen occurred to monitor the quality of the herring in Goodnews Bay. Samples were brought in by volunteer fishermen and analyzed by industry roe technicians. On 29 May roe content of commercial test fish samples averaged 10.0%.

The first commercial opening on 29 May from 3:00 pm to 9:00 pm produced a harvest of 225.2 tons of sac roe herring with 9.7% roe content and 8.7 tons bait. Sixty-seven fishermen made 114 landings (Table 6). Two openings occurred on 30 May, the first for 4 hours from 4:00 am to 8:00 am and another for 6 hours starting at 4:00 pm. Seventy-one fishermen made 161 landings on 30 May for 309.3 tons of sac roe herring with an average roe content of 9.5% and 5.1 tons of bait. Two more openings were called for 31 May, a 4 hour period from 4:00 am until 8:00 am and a 3 hour period from 5:00 pm to 8:00 pm. On 31 May, 58 fishermen made 85 deliveries amounting to 129.3 tons of sac roe herring with 9.6% roe and 15.1 tons of bait. The last two openings occurred on 1 June, the first for 2 hours starting at 5:00 am and another of 4 hours from 6:00 pm to 10:00 pm. Fifteen fishermen made 15 deliveries on 1 June for 47.3 tons of sac roe herring with 8.2% roe content.

Three processors bought herring from 78 fishermen with an estimated ex-vessel value of $286,000 (Tables 2 and 3). The exploitation rate of herring was 13.3% of estimated available biomass. Ages 9 and older herring comprised 64% of the total harvest. No age-4 or younger herring occurred in the harvest sample.

Cape Avinof District

This was the fifth year that a commercial herring fishery occurred in the Cape Avinof District. As in all other Kuskokwim Bay districts, commercial herring

fishing is regulated by emergency order. In November 1989, the Alaska Board of Fisheries moved the eastern boundary of the Cape Avinof District from Tsintulik Slough to the Ishkowik River. This area was previously closed to commercial fishing at the request of local residents to prevent interference with the subsistence harvest. A total of 451 tons of herring were harvested during 12 hours of fishing time (Table 6).

The district was first opened to commercial fishing for 5 hours starting at 11:00 pm on 4 June. The harvest was 206.1 tons of sac roe herring with an average roe content of 9.9% and 8.0 tons of bait. One hundred and four fishermen made 150 deliveries. The district was reopened on 6 June with a 4 hour opening starting at midnight. Ninety-seven fishermen harvested 136.7 tons of sac roe herring with a roe content of 9.9% and 0.2 tons of bait. The harvest quota was raised to 464 tons on 9 June based on an aerial survey biomass estimate of 3,095 tons. The final period was for 3 hours on 11 June starting at 6:00 pm. Fifty-four fishermen made 70 deliveries for 99.6 tons of sac roe quality herring with 10.0% roe content and 0.9 tons of bait.

A tender was available near Kwigillingok for the second year in the Cape Avinof District fishery. A total of 64 tons of sac roe herring with an 11.2% roe content were delivered by 40 permit holders in the Kwigillingok area (Table 2).

In the Cape Avinof District, 121 fishermen made 335 deliveries worth approximately $178,000 to two processors (Tables 2 and 3). The exploitation rate of herring was 13.1% of the estimated available biomass. Age 8 herring were the most abundant and comprised 29% of the harvest biomass; ages 9 and older herring comprised 62% of harvest biomass. No age-5 or younger herring occurred in the harvest sample.

Nelson Island District

The commercial harvest of herring began in the Nelson Island District in 1985. To provide for an adequate subsistence harvest, an orderly commercial fishery, and to allow for periodic assessment of the herring biomass, the commercial fishery has opened and closed by emergency order.

The Nelson Island District did not open to commercial fishing in 1990 or 1991 because the herring biomass was below the level necessary to allow a fishery. In 1992, an aerial survey on 9 June observed 5,275 tons of herring in the district. Based on this survey, the harvest quota for the commercial fishery was set at 495 tons. A total of 246 tons of herring was taken in three periods.

The first opening was for 3 hours starting at 6:00 pm on 10 June. Fifty-three fishermen made 68 landings with 66.3 tons of sac roe herring with an average roe content of 8.4% and 7.8 tons of bait. There were two commercial periods on 11 June, the first for 4 hours from 8:00 am until noon and a second for 3 hours starting at 6:00 pm. Total catch from both periods was 121.7 tons of sac roe herring with a roe content of 8.3%, 43.8 tons of bait and 6.0 tons of waste. Eighty-three permit holders made 154 deliveries on 11 June. Nearly 50% of the catch from the first period on 11 June was bait herring. The district was not reopened because commercial test fishermen were unable to locate marketable

herring.

Three processors paid approximately $78,000 to 85 fishermen who made 222 deliveries. The exploitation rate was 4.7% of the available biomass. Age 9 and older herring comprised 79% of the harvest.

Nunivak Island District

Commercial fishing for herring in the Nunivak Island District began in 1985. To provide for an orderly fishery and to allow for periodic assessment of herring biomass, the fishery has opened and closed by emergency order.

The harvest quota was raised from the preseason forecast of 337 tons to 400 tons on 30 May based on an aerial survey biomass estimate of 2,667 tons. After a biomass of 5,730 tons was sighted during a 1 June aerial survey, the harvest quota was increased to 855 tons. A total of 27 tons were harvested in six hours of fishing (Table 6).

For the second consecutive year ice conditions restricted fishing to the southeast corner of Nunivak Island between Cape Corwin and Cape Mendenhall. Very intensive test fishing by commercial fishermen had limited success in finding marketable herring. Most samples contained a high male count and a mixture of immature, mature and spawned out females.

The first period, on 4 June, started at 3:00 pm. Six fishermen landed 0.1 tons of sac roe herring with a roe content of 11.6% and 8.2 tons of bait. The second opening started at 8:00 pm on 6 June with 4.0 tons of sac roe herring with a roe content of 8.5% and 12.0 tons of bait herring being landed by nine fishermen. The first two periods occurred on an outgoing tide which may have contributed to the high percentage of bait-quality herring caught. The third period began at 3:00 pm on 8 June. Eight fishermen landed 3.1 tons of sac roe herring with a roe content of 8.5% and 0.1 tons of bait.

Fourteen fishermen made deliveries to one processor. The value of the catch to fishermen was about $4,000. Nunivak area fishermen accounted for all of the harvest.

The exploitation rate of herring was 0.5% of the estimated available biomass. Since ice conditions prevented the department's test fish crew from reaching the east side of the island, no herring were sampled from the commercial catch.

Cape Romanzof District

The 1992 commercial herring season in the Cape Romanzof District consisted of a 2-hour period on 11 June and a 4-hour period on 12 June for a total fishing time of 6 hours. The commercial harvest was managed to achieve the preseason harvest projection of 405 tons, since no inseason biomass estimate was obtained. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season. A total of 529.7 tons of herring was harvested by 73 fishermen utilizing 73 fishing vessels. The harvest consisted of 515.8 tons of

sac roe with an average roe recovery of 8.0% and 13.9 tons of bait-quality herring.

Two buyers in the Cape Romanzof District paid fishermen an average of $383 per ton for 10% sac roe herring plus or minus $38 a percentage point. The average price paid for bait-quality herring (less than 7% roe) was $50 per ton. The total ex-vessel value of the harvest was approximately $159,000. The two buyers were represented by one processing vessel and five tenders during the fishery. Fishing effort in 1992 was the lowest since 1985 and was 9% below the 1991 effort. Local Alaskan residents (defined as residents of Chevak, Hooper Bay, and Scammon Bay) accounted for 97% (71 permits) of the effort and 96% (508.9 tons) of the harvest.

In coordination with the department, commercial fishermen provided catch samples for evaluation by industry representatives prior to each opening. Samples were collected relatively early on the incoming tide to provide time for scheduling beach meetings and announcing periods. As in recent years, the fishery was put on a one hour advance notice prior to opening the commercial fishery. Industry evaluation of department test fish catches in the morning of 9 June indicated a high percentage of males and low roe recovery. Samples obtained in advance of the first opening in the evening on 9 June showed a relatively high roe recovery and a higher percentage of females than samples collected in the morning, particularly in 3 1/8 inch mesh size catches. Samples collected prior to the second opening showed an increase in percentage of ripe herring and a higher roe recovery.

The roe recovery from both commercial periods was disappointing. Only 7.1% roe recovery was reported for the first period and 8.4% for the second period. A high percentage of males (64%) was observed during the first period as indicated by commercial catch samples. Commercial test samples evaluated by industry technicians suggested that larger mesh sizes usually resulted in higher percentages of females and better roe recovery, while smaller mesh size catches generally had higher percentages of males. In addition, roe recovery appeared to be higher from catches inshore than offshore.

Norton Sound District

There was no commercial herring fishery in Norton Sound during 1992. The pack ice covered over 80% of Norton Sound on 10 June. Large vessel traffic was impossible from the Yukon River north. During 13-15 June, the three largest buyers considered their other commitments, the risk of moving their buying fleet through dense pack ice, and the ramifications of buying herring with less processing capacity than the probable harvest. By 15 June, the five companies which initially expressed an interest in the fishery decided not to participate.

The projected Norton Sound harvest was a record 5,200 tons. The peak aerial survey flown 20 June during heavy spawning sighted 57,974 tons which would have allowed a 11,600 ton harvest. As buyers backed out of the fishery, fishermen approached the department about conducting a spawn-on-kelp fishery in order to recoup some of the lost sac roe fishery. Sac roe permit holders were to participate since they had suffered the loss. There was some local concern that

nothing was being done to help the crewmembers and it was pointed out that during the early 1980s crewmembers had been allowed to participate. This became a mute point when it was apparent that the *Fucus* kelp in southern Norton Sound was suffering from the late spring and was generally not suitable for harvest. On 24 June, it was announced that there would be no spawn-on-kelp fishery. The ex-vessel value of the projected harvest (from the biomass observed inseason) of the sac roe was estimated to be worth nearly 3.5 million dollars (estimated at $300 per ton) to approximately 320 permit holders.

Port Clarence District

There has not been a commercial fishery in the Port Clarence District since 1988 because buyers have not been present in the district.

ENFORCEMENT

In 1992, the Division of Fish and Wildlife Protection (FWP) was present in the Security Cove, Goodnews Bay, and Cape Romanzof Districts. The Norton Sound fishery was closed.

In the Security Cove District, a Fish and Wildlife Protection helicopter, C-185 aircraft and the FWP vessel P/V Wolstad were used during the fishery. Several minor fishing violations were reported.

In Goodnews Bay, the P/V Wolstad patrolled the district during the season. Several fishing violations were reported.

One FWP officer was present in the Cape Romanzof District during the 1992 herring season. The test fishing boat and a boat operator were provided by the department, so the officer could patrol the fishery. A total of three commercial fishing citations were issued. Two citations were issued for fishing without a crew member license and one was issued for not having photo identification. No herring were confiscated.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1993

Projections from post-season escapement estimates, using mean rates of natural mortality and growth for each age class (Wespestad 1982; S. Fried, Alaska Department of Fish and Game, Anchorage, personal communication), indicate that the 1993 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be approximately 67,335 tons (Table 7). Since newly recruited fish are not included in these projections, an increase in recruitment of ages 3 through 5-year-old herring would result in a larger observed biomass than what is projected. However in accordance with the AYK Region harvest policy, newly recruited age classes (age 3, 4, and 5 year-old-herring) will not be targeted by the commercial fishery.

Since methods to forecast herring 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 the forecasted biomass, test and commercial catches and spawn deposition observations.

Security Cove District

The 1993 projected return to the Security Cove District is 6,282 tons. A 20% exploitation rate would result in a harvest of about 1,256 tons (Table 7). The increased recruitment of younger age fish into the population allows a 20% exploitation rate for the Security Cove herring stock in 1993. A larger catch may occur if the 1993 biomass assessment is greater than the projection. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons or significant spawning activity is observed. The occurrence and length of fishing periods will depend on stock strength, fishing effort, and spawning activity.

Age 5 and 6 herring are expected to dominate the return. Age 9 and older herring are expected to comprise approximately 28% of the biomass.

Goodnews Bay District

Management strategy for this district will be similar to that used for Security Cove. The season will open and close by emergency order when a biomass of 1,200 tons is observed or spawning activity occurs. The 1993 projected return of herring to the Goodnews Bay District is 3,600 tons. A 20% exploitation rate would result in a harvest of 720 tons (Table 7). A larger catch may occur if the 1993 biomass assessment is greater than the projection.

Ages 8 and 5 herring are expected to be the dominant year classes in the return. Age 9 and older herring are expected to comprise approximately 50% of the biomass.

Cape Avinof District

Either significant spawning activity or a biomass of 500 tons must be observed before the commercial herring season can be opened. The season will open and close by emergency order. The projected 1993 biomass for the Cape Avinof area stock is 2,358 tons (Table 7). The exploitation rate will be set at 15% because of the limited data base for this area and the priority of subsistence fishing. Assuming a 15% commercial exploitation rate, the projected harvest would be 354 tons of herring.

Age 5 herring are expected to be the largest year class in the returning population. Age 9 and older herring are expected to comprise approximately 49% of the returning population.

Nelson Island District

In the Bering Sea Herring Fishery Management Plan the Alaska Board of Fisheries set a minimum biomass threshold of 3,000 tons necessary for a commercial herring fishery in the Nelson Island District. The inseason estimate of herring biomass must exceed the threshold level before a commercial fishery can be allowed.

The spawning biomass projected to return to the Nelson Island District in 1993 is 3,514 tons (Table 7). Since the projected biomass is less than 1.5 times the threshold, the exploitation rate will be reduced from the 15% maximum allowable rate to 10%. At the 10% exploitation rate, the harvest will be 351 tons of herring. The harvest level will not exceed 10% unless the available biomass exceeds 4,500 tons.

To provide additional protection for the subsistence harvest of herring, the following guidelines will be followed:

1. The commercial fishery will not be allowed to take more than 15% of the herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.

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

3. 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.

4. The department will by all available means, including input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Age 5 herring are expected to be the dominant age group. Herring of age 9 and older are expected to comprise approximately 64% of the biomass in 1993.

Nunivak Island District

The commercial season will open when the biomass reaches 1,500 tons or when significant spawning is observed. The projected biomass of herring returning to the Nunivak Island District in 1993 is 3,942 tons. A 15% exploitation rate would result in a 591 ton harvest (Table 7). A larger catch may occur if the 1993 biomass assessment is greater than the projection.

Age 9 and older herring are expected to comprise 65% of the return.

Cape Romanzof District

The projected return for 1993, based upon limited data, is 2,369 tons which would result in a 355 ton harvest at a 15% exploitation rate (Table 7). Ages 9 and 11

herring are expected to comprise 22.6% and 22.1% of the biomass, respectively.

Emergency order authority will be used to regulate the occurrence and length of fishing periods. Aerial biomass assessment cannot be used to determine the opening of commercial fishing due to typically poor survey conditions caused by turbid water. Therefore, spawn deposition observations and test and commercial catch rates will be used to determine timing and duration of commercial fishing periods. If stock abundance is judged to be lower or higher than the projection, the projected harvest of 355 tons will be modified accordingly.

Norton Sound District

The Norton Sound projected return is 45,270 tons. A 20% exploitation rate would result in a harvest of 9,054 tons (Table 7). The 1993 biomass is expected to be dominated by 5 (23.0%), 7 (21.0%), and 11 (20.9%) year old herring.

Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery except where weather prevents obtaining an inseason estimate. The beach seine harvest is, by regulation, 10% of the projected harvest, or 900 tons.

The 1993 herring fishery will be opened by emergency order. The fishery will close by emergency order when up to 20% of the available 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.

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 established by the Board of Fisheries in 1981 will determine the allowable harvest in 1993. 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.

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Table 1. Pacific herring harvests by domestic commercial fishermen in the northeastern Bering Sea, Alaska, 1909-1992.

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
1909-1916	-	-	-	-	-	-	-[b]	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-
1929	-	-	-	-	-	-	166	-	166	-
1930	-	-	-	-	-	-	441	-	441	-
1931	-	-	-	-	-	-	86	-	86	-
1932	-	-	-	-	-	-	529	-	529	-
1933	-	-	-	-	-	-	31	-	31	-
1934	-	-	-	-	-	-	4	-	4	-
1935	-	-	-	-	-	-	15	-	15	-
1936	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-
1938	-	-	-	-	-	-	10	-	10	-
1939	-	-	-	-	-	-	6	-	6	-
1940	-	-	-	-	-	-	14	-	14	-
1941	-	-	-	-	-	-	3	-	3	-
1942-1944	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-
1965	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-
1967	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-
1970	-	-	-	-	-	-	8	-	8	-
971	-	-	-	-	-	-	20	-	20	-
1972	-	-	-	-	-	-	17	-	17	-
1973	-	-	-	-	-	-	35	-	35	-
1974	-	-	-	-	-	-	2	-	2	-
1975	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-
1977	-	-	-	-	-	-	11	-	11	<1
1978	286	-	-	-	-	-	15	-	301	4
1979	424	90	-	-	-	-	1,292	-	1,806	13
1980	697	448	-	-	-	611	2,452	-	4,208	24
1981	1,173	657	-	-	-	720	4,371	-	6,921	47
1982	813	486	-	-	-	657	3,933	-	5,889	38
1983	1,073	435	-	-	-	816	4,582	-	6,906	29
1984	335	717	-	-	-	1,185	3,662	-	5,899	19[c]
1985	733	724	-	977	358	1,299	3,548	-	7,639	-
1986	751	557	-	886	511	1,865	5,194	-	9,764	-
1987	313	321	-	923	414	1,342	4,082	146	7,541	-
1988	324	483	348	775	-	1,119	4,672	80	7,801	-
1989	554	616	129	233	116	926	4,771	-	7,345	-
1990	234	455	50	-	-	329	6,439	-	7,507	-
1991	570	263	267	-	59	526	5,672	-	7,357	-
1992	834	740	451	246	27	530	-	-	2,828	-

[a] Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage included.

[b] 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, 1988-1992.

Year	District	Estimated Biomass (st)	Harvest (st) Sac-roe	Bait	Waste	Total	Roe %	Estimated Value ($ x1,000)	Exploitation Rate (%)
1992	Security Cove	7,773	697	127	10	834	9.2	285	10.7
	Goodnews Bay	5,572	711	29	0	740	9.5	286	13.3
	Cape Avinof	3,446	442	9	0	451	9.9	178	13.1
	Nelson Is.	5,275	188	52	6	246	8.3	78	4.7
	Nunivak Is.	5,703	7	20	0	27	8.5	4	0.5
	Cape Romanzof	4,500	516	14	0	530	8.0	159	11.8
	Norton Sound	57,974	-	-	-	-	-	-	-
	Total	90,243	2,561	251	16	2,828	9.1	990	3.1[a]
1991	Security Cove	4,434	561	9	0	570	9.3	208	12.9
	Goodnews Bay	4,387	259	4	0	263	8.9	93	6.0
	Cape Avinof	2,083	240	27	0	267	9.5	94	12.8
	Nelson Is.	2,385	-	-	-	-	-	-	-
	Nunivak Is.	3,903	17	42	0	59	7.4	9	1.5
	Cape Romanzof	4,500	451	75	0	526	8.8	210	11.7
	Norton Sound	42,854	5,465	207	125	5,797	9.3	2,414	13.5
	Total	64,546	6,993	364	125	7,482	9.2	3,028	11.4
1990	Security Cove	2,650	174	60	0	234	8.7	94	8.8
	Goodnews Bay	2,577	427	28	0	455	12.2	314	17.7
	Cape Avinof	2,020[b]	49	1	0	50	12.0	35	2.5
	Nelson Is.	2,705	-	-	-	-	-	-	-
	Nunivak Is.	422	-	-	-	-	-	-	-
	Cape Romanzof	4,500	318	11	0	329	8.4	155	7.3
	Norton Sound	39,384	5,353	1,026	60	6,439	8.8	3,606	16.0
	Total	54,258	6,321	1,126	60	7,507	9.0	4,204	13.8
1989	Security Cove	2,830	544	10	0	554	9.4	265	19.6
	Goodnews Bay	4,040	453	162	0	616	8.4	335	15.2
	Cape Avinof	2,780[b]	90	39	0	129	8.0	54	18.7
	Nelson Is.	3,320	122	100	11	233	8.5	57	7.0
	Nunivak Is.	620	79	37	0	116	9.4	42	18.8
	Cape Romanzof	4,400	925	1	0	926	9.3	486	21.0
	Norton Sound	25,980	4,494	247	30	4,771	9.2	2,322	18.3
	Total	43,970	6,708	596	41	7,345	9.0	3,561	16.7
1988	Security Cove	4,906	324	0	0	324	9.3	362	6.6
	Goodnews Bay	4,479	473	10	0	483	8.0	463	10.7
	Cape Avinof	4,108	348	0	0	348	8.6	264	8.5
	Nelson Is.	7,152	760	15	0	775	9.2	713	10.8
	Nunivak Is.	2,800[b]	-	-	-	-	-	-	-
	Cape Romanzof	6,600	1,108	11	0	1,119	9.1	1,018	17.0
	Norton Sound	33,924	4,256	416	0	4,672	9.0	3,864	13.8
	Port Clarence	788	80	0	0	80	8.2	43	10.2
	Total	64,757	7,349	452	0	7,801	9.0	6,727	12.0

[a] Total exploitation rate for fishing districts which had a commercial fishery in 1992 is 8.8%.
[b] 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, 1987-1992.

Year	District	Number of Buyers	Number of Fishermen		
			Gill Net	Seine[a]	
				Purse	Beach
1992	Security Cove	6	58	-	-
	Goodnews Bay	3	78	-	-
	Cape Avinof	2	121	-	-
	Nelson Island	3	85	-	-
	Nunivak Island	1	14	-	-
	Cape Romanzof	2	73	-	-
	Norton Sound	0	-	-	-
1991	Security Cove	6	52	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	137	-	-
	Nelson Island	-	-	-	-
	Nunivak Island	2	17	-	-
	Cape Romanzof	2	80	-	-
	Norton Sound	8	272	-	7
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	-

[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, 1977-1992.[a]

Village	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Nelson Island																
Tununak	57	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32
Umkumiut	3	11	8	3	10	0	-	-	-	-	-[c]	-[c]	-[c]	-[c]	-[c]	-[c]
Toksook Bay	21	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43
Nightmute	-	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10
Newtok	-	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7
Total	81	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92
Number of Fishing Families	90	83	54	70	93	65	43	-	65[b]	72[b]	96	104	-[b]	100	85	97
Nunivak Island																
Mekoryuk	-	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4
Number of Fishing Families	-	-	-	-	-	-	-	-	11	6[b]	-	-	-	19	20	17
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	1	1
Chevak	<1	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1
Hooper Bay	2	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2
Total	<3	5	11	11	14	11	9	11	8	7	3	7	3	8	3	4
Number of Fishing Families	30	29	84	61	46	43	37	47	44	41	39	32	24	32	18	30

[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. Pacific herring estimated biomass in the northeastern Bering Sea, Alaska, 1978-1992.

Year	Herring (st)								
	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof[a]	Norton Sound	Port Clarence	Total Biomass
1978	1,323	441	-	5,952	805	2,976	5,291	-	16,788
1979	21,495	7,385	-	5,952	-	2,976	7,716	-	45,524
1980	1,213	1,213	-	5,952	-	2,976	8,377	-	19,731
1981	8,267	4,299	-	3,968	19	4,850	22,928	-	44,331
1982	5,071	2,646	-	3,968	-	4,850	17,416	-	33,951
1983	6,393	3,197	-	7,275	7,606	5,512	28,109	-	58,092
1984	5,071	4,079	-	11,023	6,695	6,063	23,148	-	56,079
1985	4,900	4,300	2,000	9,500[b]	5,700[b]	7,000	20,000	-	51,400
1986	3,700[b]	3,000[b]	-	7,300[b]	6,000	7,500	28,100	-	55,600
1987	2,300[b]	2,000[b]	1,225	8,100	4,400[b]	7,200	32,400	932	57,332
1988	4,906	4,479	4,108	7,152	2,800[b]	6,600	33,924	788	64,757
1989	2,830	4,040	2,780[b]	3,320	620	4,400	25,980	-	43,970
1990	2,650	2,577	2,020[b]	2,705	422	4,500	39,384	-	54,258
1991	4,434	4,387	2,083	2,385	3,903	4,500	42,854	-	64,546
1992	7,773	5,572	3,446	5,275	5,703	4,500	57,974	1,652	91,895[c]

[a] Biomass estimate based on aerial surveys, spawn deposition, age composition, and the CPUE from commercial and test fisheries.

[b] Inseason biomass estimated from poor aerial survey, therefore projected biomass was used.

[c] Biomass is 90,243 tons if Port Clarence excluded from total.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1992.

District	Subdistrict Section/Area	Gear	Period	Date	Time	Total hours	Harvest (st)
Security Cove	Entire	GN	1	5/25	1200-1600	4.0	192.2
			2	5/27	1030-1730	7.0	476.9
			3	5/28	0400-0600	2.0	24.2
			4	5/28	1130-1530	4.0	57.6
			5	5/29	0400-1900	15.0	83.1
					Total	32.0	834.0[a]
Goodnews Bay	Entire	GN	1	5/29	1500-2100	6.0	233.9
			2	5/30	0400-0800	4.0	67.6
			3	5/30	1600-2200	6.0	246.8
			4	5/31	0400-0800	4.0	99.5
			5	5/31	1700-2000	3.0	44.9
			6	6/01	0500-0700	2.0	1.0
			7	6/01	1800-2200	4.0	46.3
					Total	29.0	739.8
Cape Avinof	Entire	GN	1	6/4-5	2300-0400	5.0	214.1
			2	6/06	0000-0400	4.0	136.9
			3	6/11	1800-2100	3.0	100.5
					Total	12.0	451.5
Nelson Island	Entire	GN	1	6/10	1800-2100	3.0	74.1
			2	6/11	0800-1200	4.0	118.6
			3	6/18	1800-2100	3.0	52.9
					Total	10.0	245.6[b]
Nunivak Island	Entire	GN	1	6/04	1500-1730	2.0	8.3
			2	6/06	2000-2200	2.0	16.0
			3	6/08	1500-1700	2.0	3.2
					Total	6.0	27.5
Cape Romanzof	Entire	GN	1	6/09	2200-2400	2.0	146.1
			2	6/11-12	2200-0200	4.0	383.6
					Total	6.0	529.7
Norton Sound	No Commercial Opening						
Port Clarence	No Commercial Opening						

[a] Includes 10 tons of waste.
[b] Includes 6 tons of waste.

Table 7. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1993.

District	1993 Projection[a]			
	Biomass(st)	Threshold	Harvest(st)	Exploitation Rate (%)
Security Cove	6,282	1,200	1,256	20
Goodnews Bay	3,600	1,200	720	20
Cape Avinof	2,358	500	354	15
Nelson Island	3,514	3,000	351	10
Nunivak Island	3,942	1,500	591	15
Cape Romanzof	2,369[b]	1,500	355	15
Norton Sound	45,270	7,000	9,054	20
Port Clarence	-	-	165[c]	-

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.
[b] Projection from estimated 1992 relative biomass which was based on 1992 aerial surveys, spawn deposition, age composition, and the CPUE from commercial and test fisheries.
[c] Harvest guideline of 165 st (150 mt).

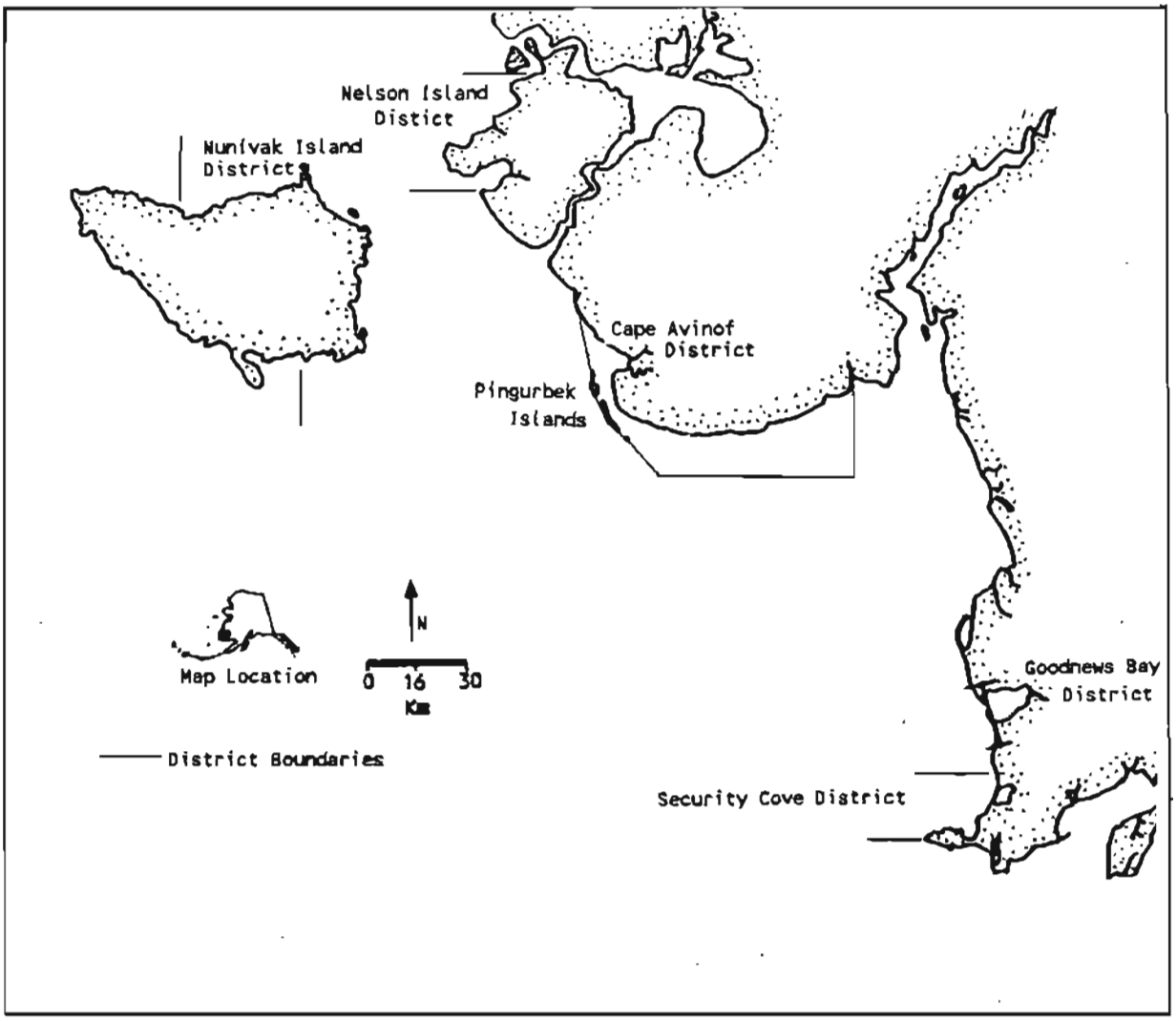

Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

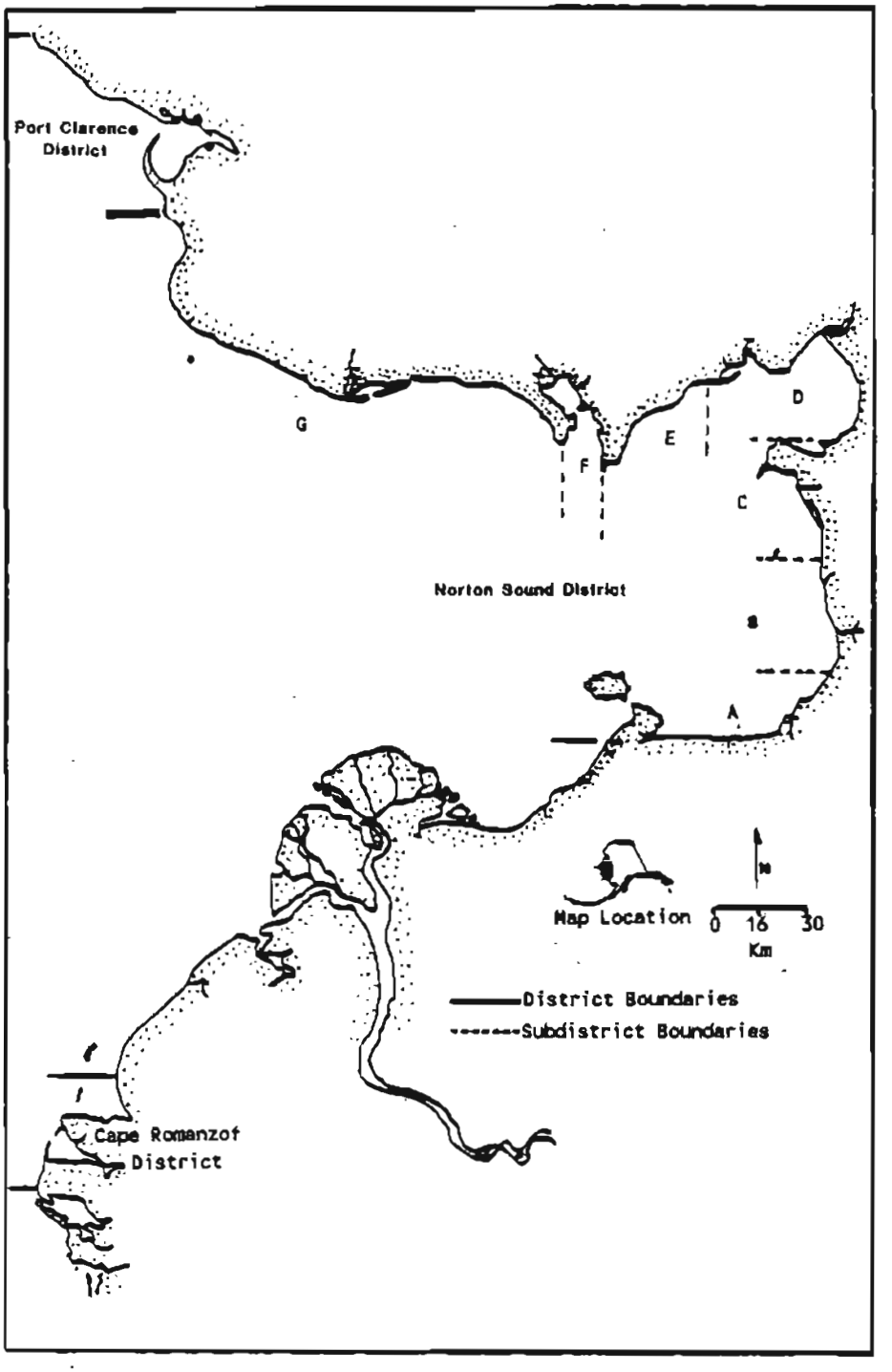

Figure 2. Cape Romanzof, Norton Sound, and Port Clarence Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

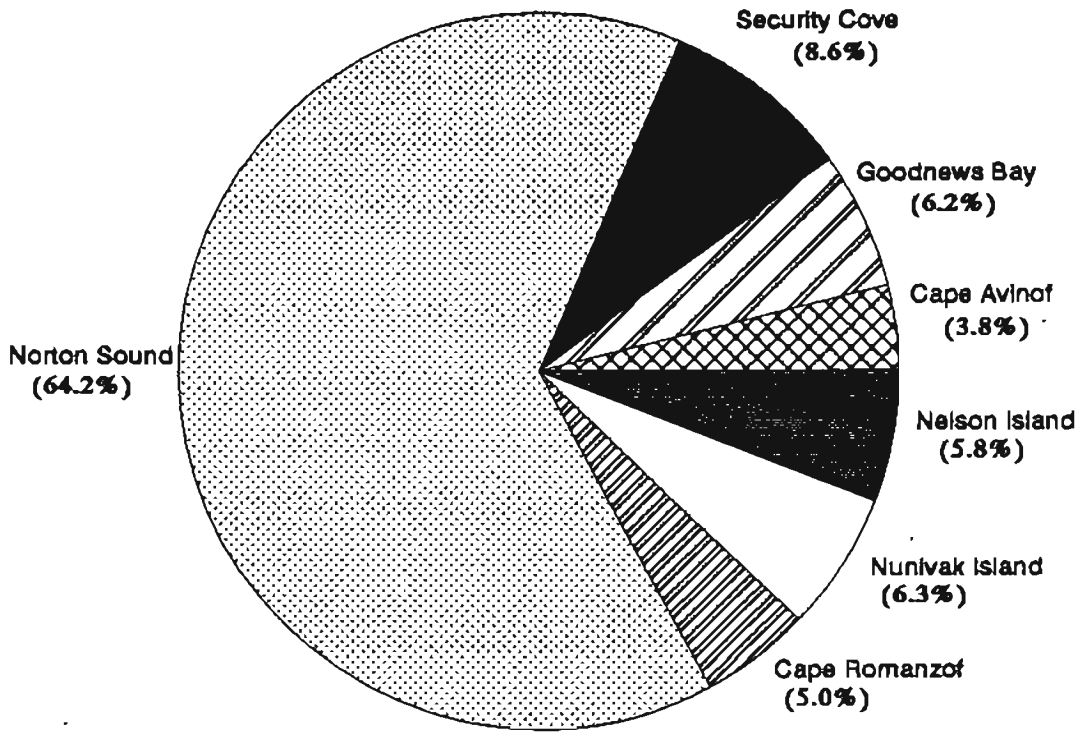

Figure 3. Pacific herring spawning biomass distribution by commercial fishing district, Arctic–Yukon–Kuskokwim Region, Alaska, 1992.

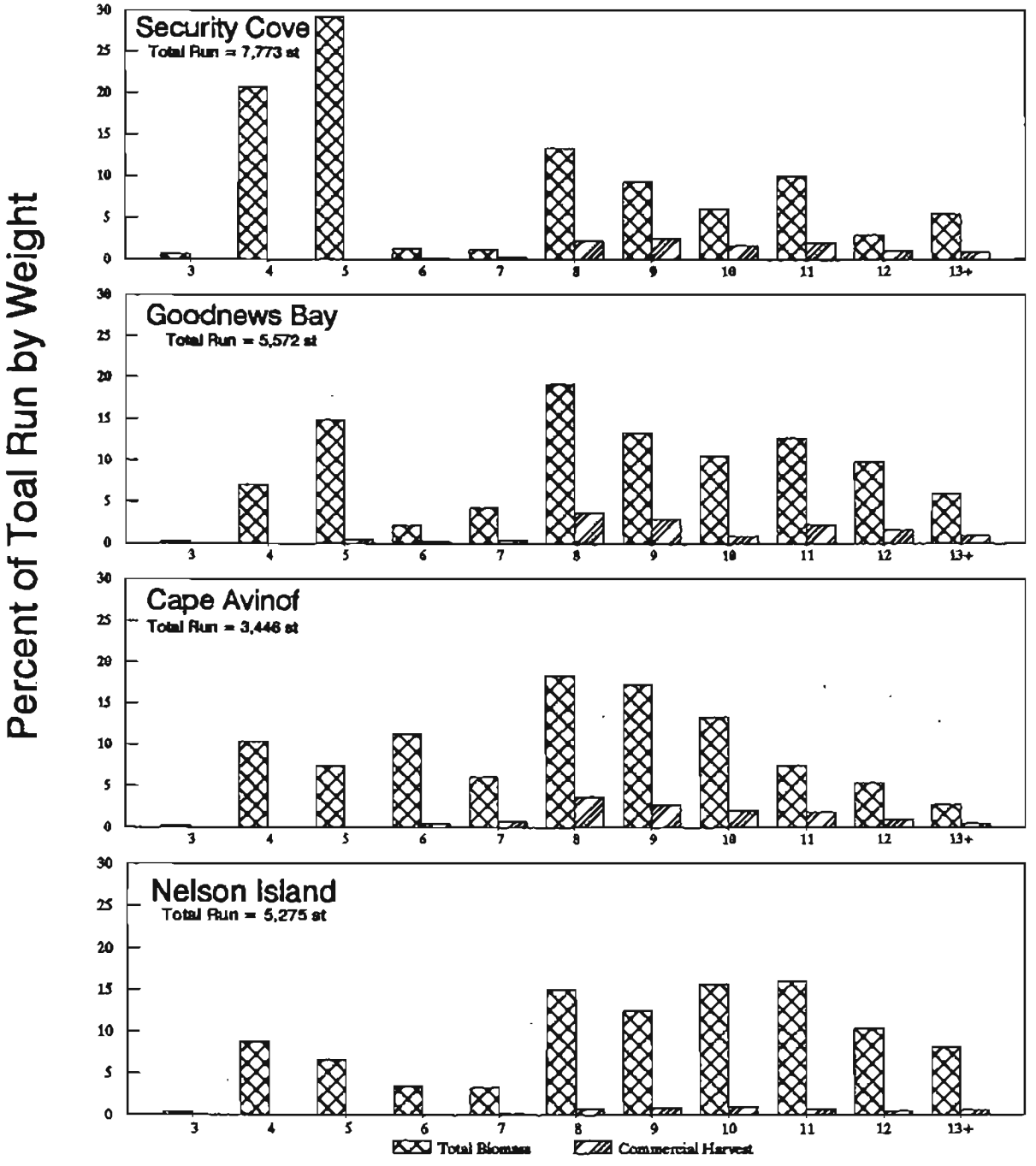

Figure 4. Age composition of Pacific herring by total biomass and commercial harvest for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island commercial fishing districts within the Arctic–Yukon–Kuskokwim Region, Alaska, 1992.

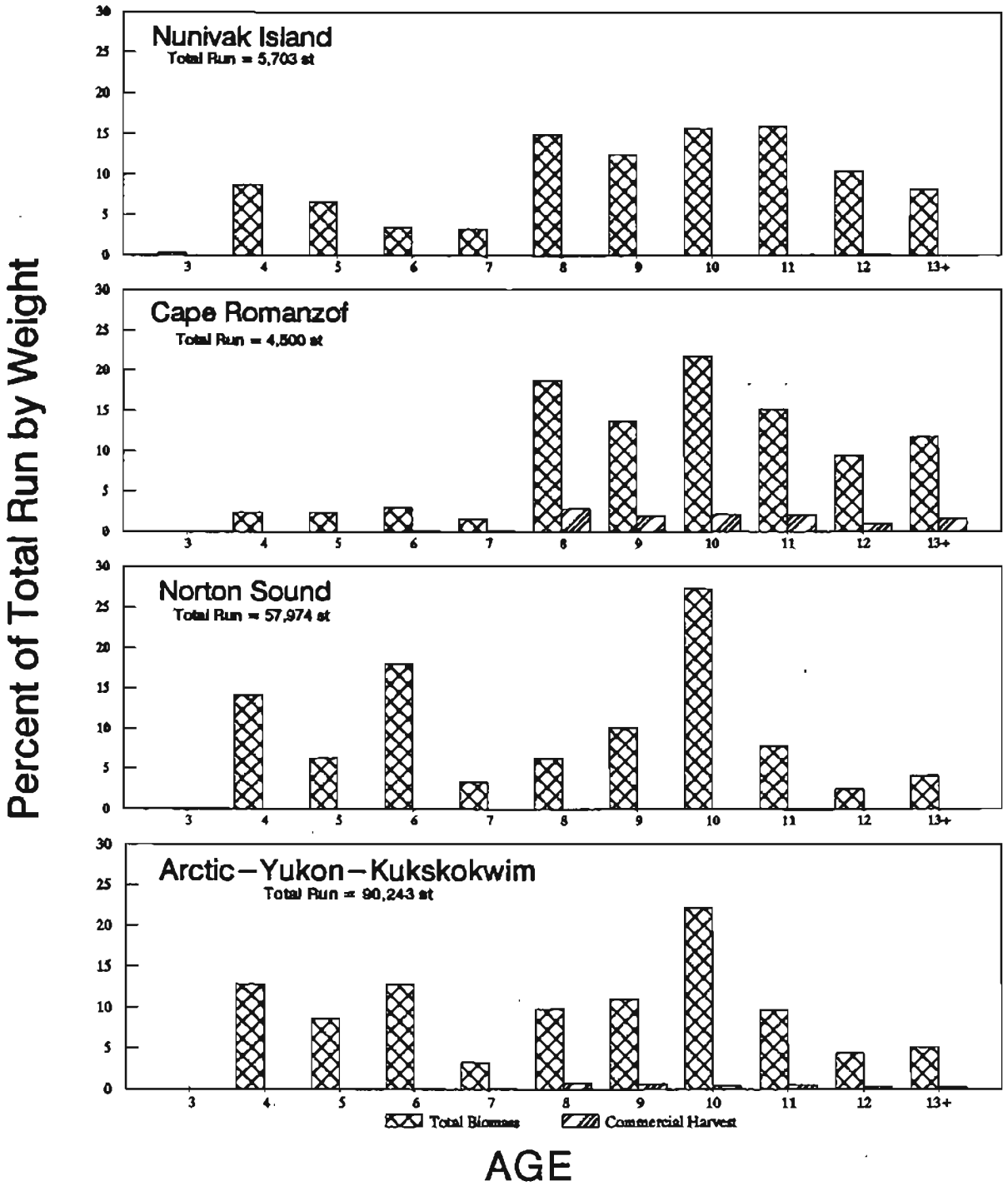

Figure 5. Age composition of Pacific herring by total biomass and commercial harvest for the Nunivak Island, Cape Romanzof, Norton Sound commercial fishing districts, and the Arctic–Yukon–Kuskokwim Region, Alaska, 1992.

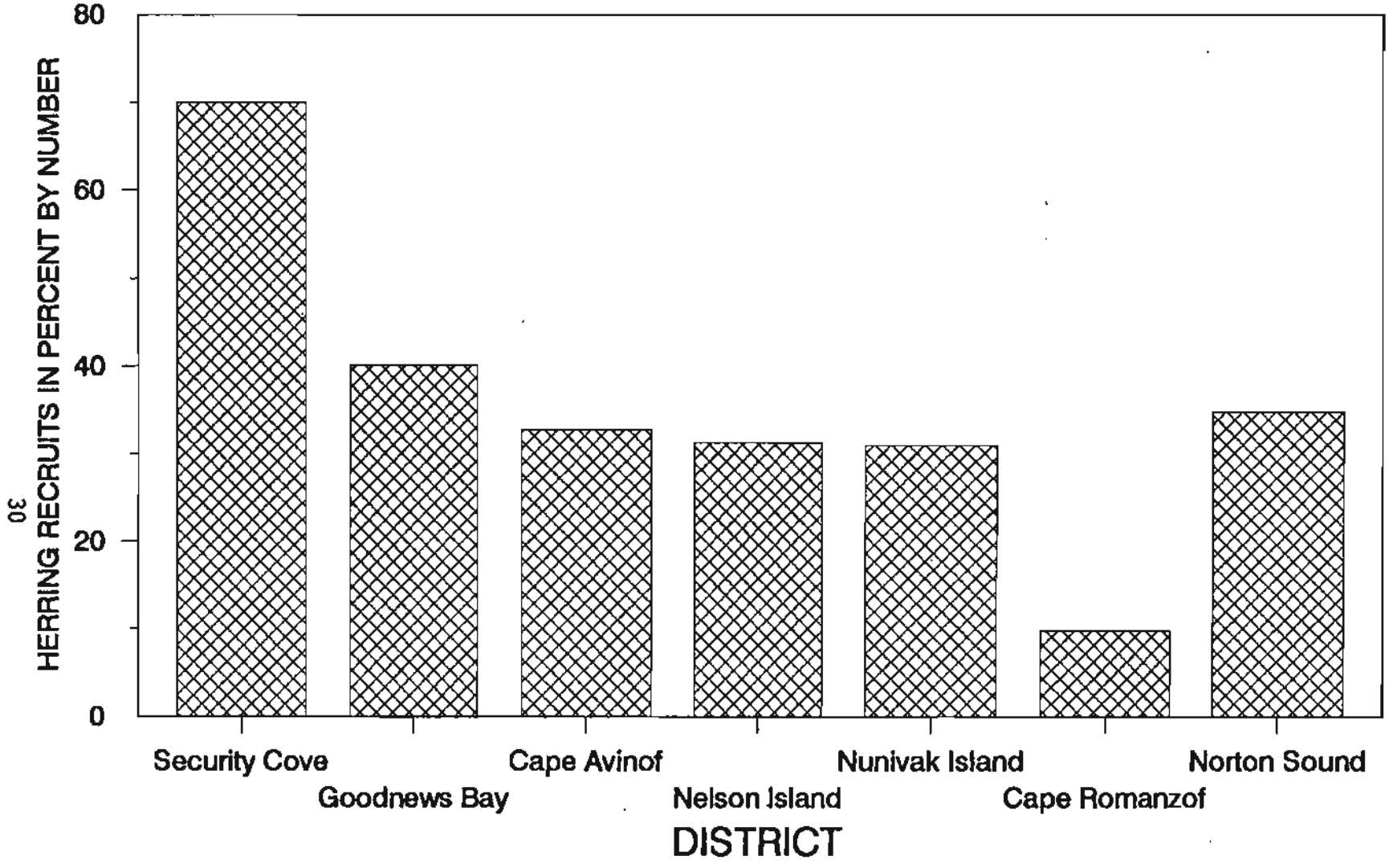

Figure 6. Pacific herring recruits (ages 3, 4, and 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska 1992.