Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Bering Sea, Alaska, 1994

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 1994 herring stock assessment programs of the Arctic-Yukon-Kuskokwim (AYK) Region, review 1994 harvests and management strategies of all AYK commercial herring fisheries and the Yukon-Kuskokwim River Delta subsistence fishery, and present general management strategies planned for the AYK herring fishing season in 1995. 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 Alaska Board of Fisheries established threshold biomass levels, below which harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060), for all districts with the exception of the Port Clarence District. Exploitation rates are limited to a maximum of 20% in all areas. In some areas the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests. A moratorium was placed on entry into the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries in 1987. All AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

A total biomass of 69,458 tons of herring was estimated to have been present in the surveyed portion of the AYK Region herring districts in 1994. This estimate is less than the 76,712 tons observed in 1993 and the record biomass of 90,243 tons observed in 1992 (Tables 2 and 5). However, it is greater than the 5-year average (1989-1993) of 65,946 tons and the 10-year average (1984-1993) of 61,318 tons. Ages 6 and 7 comprised approximately one-half of the biomass and ages 9 and older comprised one-third of the biomass for the entire region. Ages 6, 7 and 10 dominated the herring biomass in most districts south of Norton Sound. Ages 6 and 8 dominated the Norton Sound biomass. The number of recruits, ages 2 through 5, declined in most districts and comprised from 10% to 15% of the run with the exception of the Cape Avinof District (35.2%), Nelson Island District (24%) and in the Cape Romanzof District where recruits totalled only 5.6% of the run.

The 1994 herring harvest for the AYK Region was approximately 3,636 tons with an estimated exvessel value of $1,181,000 (Tables 1 and 2). This is approximately one-half of the tonnage and value of the 1993 harvest. The harvest is approximately 55% of the 5-year average of 6,505 tons. The low harvest is primarily due to no harvest in the Security Cove District and an exceptionally small harvest in the Norton Sound District. The price paid to fishermen in AYK fishing districts was approximately $300 per ton for herring with 10% roe content plus or minus $30 a percentage point and $50 per ton for bait-quality herring. The price paid is similar to 1993 but is much lower than other years, such as in 1987 when fishermen received $800 per ton or in 1992 when fishermen received $450 per ton. Food and bait sales during the sac roe fishery

totaled only 6.5 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. In some years, wastage occurs when fishermen abandon gillnets or cannot sell their catch. This amount is added to the total harvest and is included in the exploitation rate calculation. In 1994, only 1 ton of herring was discarded (Table 2).

A total of 574 fishermen participated in AYK sac roe herring fisheries during the 1994 season (Table 3). Effort was low again this year in all districts as fishermen were discouraged by both low prices and fewer buyers than in previous years. In addition, an extended fishery in the Togiak District kept the fleet from fishing in the Security Cove District. Security Cove fishermen generally fish the Togiak District prior to the Security Cove District. Typically about 60 fishermen (1988-1992 average) participate in the Security Cove fishery. There was no herring fishery in the Port Clarence District during the sac roe season in 1994. There has not been a commercial sac roe fishery in the Port Clarence District since 1988 due to a lack of buyers.

Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 123 tons of herring (Table 4).

Average roe recovery of the sac roe harvest ranged from 8.6% in the Nunivak Island District to 12.3% in the Goodnews Bay District, with an regional average of 11.1%. An awareness among processors, managers and fishermen of the poor market conditions and the need for a high-quality product helped produce high roe percentages. Managers strived to limit period harvests to an amount that could be processed within three days. This resulted in an extended commercial season for most districts and contributed to a record roe recovery for the region. Exploitation rates were generally low in AYK Region herring districts. The 1994 total exploitation rate for the AYK Region was only 5.2%. Exploitation rates ranged from 0.3% in the Nunivak Island District to 18.7% in the Goodnews Bay District (Table 2).

Biomass projections for each district using postseason escapement estimates, historic mean rates of survival and current mean weights for each age class (Bromaghin and Hamner 1994, Alaska Department of Fish and Game, Anchorage, personal communication), and estimates of recruitment for each age class (Wespedstad 1982), indicate that the 1995 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be approximately 56,283 tons (Table 7). These projections do not include age classes not yet seen in the fishery.

Variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Harvest levels will be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest policy, newly recruited age classes will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations.

STOCK STATUS

Assessment Methods

The arrival of herring in the northeastern Bering Sea is greatly influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear immediately after ice breakup which generally occurs between late-April and mid-June. Spawning usually begins in the Security Cove District and generally progresses in a northerly direction. In some areas spawning may continue as late as July.

Aerial survey techniques have been used since 1978 in Bering Sea herring fisheries to estimate herring spawning biomass (Lebida and Whitmore 1985). However, it is often difficult to obtain biomass estimates from aerial surveys in the AYK Region because of poor survey conditions caused by unfavorable weather, ice conditions or turbid water. Herring school surface areas are recorded in 538 ft^2 relative abundance index (RAI) units. In the AYK Region, RAI units are converted to biomass based on water depth. Because purse seine gear is needed to estimate the conversion factors, and purse seine gear is not fished in the AYK Region, these conversion factors were estimated from sampling performed in the Togiak District. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 1994, 84 aerial surveys totalling 118.2 hours of flight time were flown in the AYK Region: 9 (5.4 hours) in Security Cove, 9 (5.1 hours) in Goodnews Bay, 3 (0.7 hours) in Jacksmith Bay, 5 (4.4 hours) in Cape Avinof, 11 (6.8 hours) in Nelson Island, 8 (8.9 hours) in Nunivak Island, 5 (2.7 hours) in Cape Romanzof, and 34 (84.2 hours) in Norton Sound and Port Clarence combined.

Gillnets are the only legal gear in the AYK Region with the exception of Norton Sound, where a small portion of the harvest is taken by beach seine. An attempt was made to sample at least 420 herring from each commercial gear type and district or subdistrict. The sampling goal for test fish catches was to sample a minimum of 60 herring per day or 420 per week from each district or subdistrict. Herring from test fish and commercial catches were sampled in all but the Port Clarence District to estimate age, sex, size, and sexual maturity of herring and to note the occurrence of other schooling fishes. Approximately 13,552 herring from commercial and test catches were sampled from seven of the eight AYK herring districts during the 1994 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.

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 1994 season, nine aerial surveys were flown in the district between May 6 and May 27 to estimate herring biomass and observe spawning activity. Only four of these surveys were flown under acceptable conditions. On May 14, 4,563 tons of herring were observed during an aerial survey. The herring biomass expected to return to the Security Cove District in 1994 was 7,638 tons based on preseason projections. Since no acceptable surveys occurred outside the May 11-14 period, the preseason forecasted biomass of 7,638 tons was used as the total biomass estimate for 1994. A total of 11.5 miles of spawn was observed in the district with peak spawning activity (6.0 miles) on May 14.

The Security Cove test fish crew fished sampled 1,142 fish caught with variable mesh gillnets from May 11 to May 26 . Ages 6 and 7 dominated the return in both biomass (22.7% and 26.4% respectively) and numbers of fish (27.8% and 27.3% respectively). Age 9 and older comprised 39.4% of the biomass. Recruit herring represented 11.4% of the return in numbers of fish (Figure 6).

Goodnews Bay District

Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 6,211 tons in 1994 (Table 5). During the 1994 season, nine aerial surveys were flown in the district between May 6 and May 28. Only two surveys (May 12 and May 14) were flown under acceptable conditions. The Department's test fish crew documented spawning activity on May 12. On May 14, 4,189 tons were observed during an aerial survey. The herring biomass expected to return to the Goodnews Bay District in 1994 was 5,679 tons based on preseason projections. Since no acceptable surveys occurred outside the May 12-14 period, the preseason forecasted biomass of 5,679 tons was used as the total biomass estimate for 1994. Three miles of spawn was observed during aerial surveys of the district with a peak of 2.0 miles seen on May 12.

The Department's test fish crew sampled 1,359 herring caught with variable mesh gillnets from May 8 to May 27. Ages 6 and 7 dominated the return in both biomass (23.8% and 21.4%, respectively) and numbers of fish (30.5% and 23.1%, respectively). Age 9 and older comprised 42.3% of the biomass. Recruit herring represented 10.1% of the return in numbers of fish (Figure 6).

Cape Avinof District

Aerial surveys have been conducted by the department in the Cape Avinof area since 1985 and biomass estimates have ranged from 1,225 tons in 1987 to 4,108 tons in 1988 (Table 5). Weather and ice conditions in 1986, 1989, 1990 and 1994 precluded biomass estimates by aerial survey. During 1994, five surveys were flown in the Cape Avinof District from May 27 to June 6. Only one of these was flown under acceptable aerial survey conditions. On June 2, 2,269 tons of herring was observed in the district. Due to poor aerial survey conditions the total biomass present in the district was estimated to be 2,827 tons based on the projected return. One mile of spawn was observed (June 6) during aerial surveys.

The Cape Avinof test fish crew sampled 1,072 fish caught from May 25 to June 8 with variable mesh gillnets. Age 6 dominated the return in both biomass and numbers of fish (35.5% and 35.7%). Age 9 and older comprised 20.2% of the biomass. Recruit herring represented 35.2% of the return in numbers of fish and were dominated by age 4 herring (22.4%, Figure 6).

Nelson Island District

Since 1985, biomass estimates of herring in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). In 1994, eleven aerial surveys were flown in the Nelson Island area between May 18 and June 6. Only three of these surveys were made under acceptable conditions. During a May 24 survey, 4,134 tons of herring were observed in the district. On a second survey, flown June 2, 4,321 tons of herring were seen. Changes in age composition of test catches before and after May 29 indicate that some new fish had entered the district after May 28. The total biomass estimate of 5,564 tons was calculated by adding fish seen on the June 3 survey that were not present on May 24 and the commercial harvest occurring before May 24, to the May 24 biomass. A total of 25.5 miles of spawn was observed during aerial surveys of the district. Peak spawning was observed on May 20 and June 3 when 6.0 miles of spawn were sighted on both days.

Test fishing with variable mesh gillnets occurred from May 18 through June 15. Of the fish caught, 1,907 herring were sampled for biological data. Age 6 dominated the return in both biomass and numbers of fish (17.4% and 21.4%, Figure 5). Age 9 and older herring comprised 50.8% of the biomass. Recruit herring represented 24.3% of the spawning population in numbers (Figure 6).

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 1985 (Table 5). In 1994, eight aerial surveys were flown in the Nunivak Island District between May 20 and June 6. During an aerial survey on May 28, 4,921 tons of herring were observed. About 11.3 miles of spawn were observed during aerial surveys with

peak spawning (3.8 miles) occurring on May 23.

Test fishing with variable mesh gillnets occurred from May 21 through June 7. From this catch, 1,234 herring were sampled for biological data. Age 6 dominated the return in both biomass and numbers of fish (32.0% and 37.5%, Figure 5). Age 9 and older herring comprised 37.0% of the biomass. Recruit herring represented 16.6% of the spawning population in numbers (Figure 6).

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. Five aerial surveys were flown during the 1994 season from May 20 through June 7. A total of 2.7 hours was spent surveying the district. Survey conditions were much improved over previous years, primarily due to calm winds early in the season. The largest quantity of herring observed during an aerial survey was 2,316 tons on May 21. The projected biomass of 2,758 tons was used to manage the fishery.

Daily qualitative spawn deposition surveys were conducted from May 17 until June 7. The first observations were recorded on May 19 in Kokechik Bay. This initial spawn deposition was heavy. Spawn deposition peaked approximately May 27, with an average of 5.8 layers on *Fucus* substrate and an average of 2.4 egg layers on rock substrate.

Artificial substrates of astroturf were located in the same general spawning locations as in 1993. Spawn deposited on the astroturf was removed and weighted daily at low tide. Fifty platforms were placed just north of the Department's field camp on May 17 and 18. The results indicated that the largest spawn deposition within the study area occurred on May 19, 21 and 31. The spawn deposition index of 4,068g obtained this year was larger than the 2,403g and 3,746g obtained in 1992 and 1993, respectively.

Aerial survey biomass estimates and spawn deposition observations indicated a larger biomass than projected. Based on spawn survey results, spawn deposition in 1994 was greater than in 1992 and 1993. The 1994 biomass was subjectively estimated to be approximated 5,000 tons. Biomass estimates were 4,500 and 4,000 tons for 1992 and 1993, respectively.

The Department's test fish crew at Cape Romanzof sampled 1,362 herring which were caught from May 17 through June 7 with variable mesh gillnets. Age 9 and older herring comprised 65.1% of the run by weight (Figure 5). Age 10 herring dominated the biomass (20.2%) whereas age 6 dominated the return in numbers of fish (22.2%). Herrring, ages 5 and younger, represented only 5.6% of the spawning population in numbers (Figure 6).

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. During 1994, 29 surveys were flown between May 17 and June 20. Fifteen of these surveys were flown under acceptable survey conditions. The peak aerial survey of 36,869 tons was observed on June 11. The estimated biomass for the district of 37,829 (Tables 2 and 5) was calculated by adding the 960 ton harvest to the peak survey.

Aerial survey conditions were generally rated from fair to poor during the 1994 herring season. Sea ice cleared from Norton Sound early in the season. Very few ice flows existed from Wood Point to Point Dexter by May 25. Only Norton Bay and Golovin Bay held much ice along the northern shore of Norton Sound at that time. Herring were first spotted during an aerial survey on May 25. However the first herring was caught in test nets on May 23.

The biomass gradually increased, with the first spawn reported on May 31. Although more spawn was observed, the estimated biomass remained less than 1,000 tons of predominantly male herring though June 3. The peak biomass was observed June 11, when nearly 37,000 tons of herring were observed primarily along the northern shores of Norton Sound. The last survey of eastern Norton Sound was flown June 14. Fifty miles of spawn were observed during surveys with a peak spawn of 6.9 miles seen on June 7.

Two Department field crews were operational during the 1994 season. One crew operated from Cape Denbigh and the second crew operated from Klikitarik. Test fishing was conducted in the Unalakleet area as time allowed. Test fish crews sampled 2,321 herring caught with variable mesh gillnets from May 16 through June 15 for biological data. Age 6 herring comprised 43.7% of the biomass and 44.6% of the return in numbers of fish. The biomass consisted of 20.1% age 9 and older herring (Figure 5). Recruit herring represented 11.1% of the return in numbers of fish (Figure 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. A record biomass for this district of 1,652 tons was sighted during an aerial survey in 1992. Five aerial surveys were flown in 1994 from June 11 through June 20. Only two of these surveys were rated as fair. Small quantities of herring, 27.4 tons and 91.5 tons, were observed on June 16 and June 20, respectively. No herring spawn was 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 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 have been conducted in most years by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area since 1990 (Pete 1990, 1991, 1992, 1993). A total of 117 tons of herring was harvested for subsistence by Nelson Island fishing families in 1994 (Table 4). No herring subsistence surveys were conducted on Nunivak Island in 1994.

During 1994, a subsistence harvest of 6 tons was estimated to have been taken by 48 fishing families from the Yukon Delta villages of Hooper Bay, Chevak, and Scammon Bay (Table 4). In addition, 656 pounds of spawn-on-kelp (*fucus*) were harvested for subsistence use by 23 families. A total of 222 herring survey questionnaires were mailed to subsistence fishing families. Additionally, personal interviews were conducted in Hooper Bay and Scammon Bay in September to contact fishermen who did not return questionnaires. Approximately 42% of the 222 identified households were contacted. The subsistence catch figures represent only the harvest which was reported. Therefore, the reported catch is a minimum estimate since not all families were contacted and not all families who received questionnaires returned them. A majority of the fishermen who responded to questionnaires reported herring abundance appeared to be the same or greater than in 1993.

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. The Security Cove District had no commercial herring periods in 1994. For the second consecutive year, the long duration of the Togiak District herring fishery caused processors and fishermen to delay their arrival at Security Cove until past the time when herring are available in commercial quantities.

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. In 1994 1,062 tons were harvested in 8 commercial periods for a total fishing time of 38 hours (Tables 1, 2 and 6).

A meeting with fishermen and processors was held on May 20. Commercial fishermen brought catch samples to the meeting for evaluation by industry roe technicians. Roe content of commercial test fish samples averaged 13.1%. Fishermen refused to commercial fish because the only available processor was offering $200 per ton for herring with 10% roe content. Commercial test fish samples on May 21 produced an average roe content of 12.3%. The arrival of a second processor in the bay raised the price of herring to $300 per ton for 10% roe content.

The fishery first opened on May 22 for 6 hours with 74 fishermen delivering 177.7 tons of sac roe herring with an average roe content of 12.6%. Total catch in 1994 was 1,060 tons of sac roe quality herring with an average roe content of 12.3% and 1.0 tons of waste. Catches ranged from 42.7 tons on May 26 to 211.8 tons on May 23. During the fishery, roe contents ranged from 11.3% to 13.3%. Two buyers bought herring from 103 permit holders who made 683 deliveries with an estimated exvessel value of $391,000 (Tables 2 and 3). The exploitation rate was 18.7% of the available biomass.

A sample of 416 herring was taken from the commercial catch. Age 9 and older herring made up 76.1% of the catch by weight (Figure 4). Recruit herring comprised less than 1% of the harvest.

Cape Avinof District

This was the seventh year of commercial herring fishing 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. In 1994, 427.2 tons of herring were harvested during nine commercial openings for a total fishing time of 62 hours (Tables 1, 2, and 6).

The district was first opened to commercial fishing for 4 hours starting at 11:00 am on May 28. The harvest was 18.6 tons of sac-roe herring with an average roe content of 11.2%. Forty-five fishermen made deliveries. Between May 28 and June 1 the district was reopened eight times for 58 hours of fishing time. Catches ranged from 8.8 tons on May 28 to 87.4 tons on May 31. Roe contents ranged from 11.2% to 13.1%. A total of 427.2 tons of sac roe-quality herring with an average roe content of 12.2% were caught. Samples brought to Kipnuk by commercial fishermen on May 28 had an average roe content of 13.4%. In the Cape Avinof District, 85

fishermen made 502 deliveries with an exvessel value of $156,000 to one processor (Tables 2 and 3). The exploitation rate was 15.1% of the available biomass.

Three hundred seventy one herring were sampled from the commercial catch. Age 9 and older herring made up 67.4% of the catch by weight (Figure 4). Recruit herring comprised less than 1% of the harvest.

Nelson Island District

Commercial fishing for herring occurred for the third time since 1989 in the Nelson Island District. During the 1994 season, there were five commercial openings in which 717.1 tons of herring were harvested by 104 permit holders.

The first opening was for 4 hours starting at 6:00 am on May 23. Effort was very low and the estimated harvest of 0.2 tons was taken by 4 fishermen for subsistence purposes. The second opening was for 6 hours beginning 5:00 pm on May 23. Seventy-five fishermen made landings with 184.6 tons of sac roe herring with an average roe content of 10.2%. The next commercial period was on May 24 for 6 hours starting at 6:00 pm. Catch from this period was 260.2 tons of sac roe herring with a roe content of 10.7% and 4.3 tons of bait. Ninety permit holders made 134 deliveries. The May 25 period saw a total catch of 152.9 tons of sac roe quality herring at 12.7% average roe content. The final period ran 4 hours starting at 9:00 pm on May 26. Eighty-six fishermen delivered 115.1 tons with an average roe content of 10.6%

The total catch of 717.1 tons consisted of 712.8 tons of sac-roe-quality herring with an average roe content of 11.0% and 4.3 tons of bait. Three processors paid approximately $235,000 to 104 fishermen (Tables 2 and 3). The exploitation rate was 12.9% of the available biomass.

A total of 391 herring were sampled from the commercial catch. Age 9 and older herring made up 81.5% of the catch by weight (Figure 4). Recruit herring comprised less than 1% 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 Nunivak Island District had one commercial herring period in 1994. On June 3, 12 fishermen harvested 13.9 tons of herring with an average roe content of 8.6% in a 6 hour period.

Only 41 herring were sampled from a commercial test set. There were no recruit herring in this sample. Herring, aged 9 and older, comprised 83.3% of the catch sample by weight (Figure 4).

Cape Romanzof District

A total of 456 tons of herring was harvested by 55 fishermen utilizing 54 fishing vessels in 1994 (Tables 1, 2 and 3). All 456 tons were purchased as sac roe. The average sac roe recovery was 9.2%. The commercial fishery consisted of 3 periods between May 23 and May 26. Fishing periods ranged from 1 hour to 3 hours duration for a total fishing time of 7 hours. Fishing was restricted to one 50-fathom gillnet per vessel throughout the commercial season.

The commercial harvest was allowed to exceed the preseason harvest projection of 414 tons. Buyers reported roe recovery and sex ratio information early during each fishing period to determine if periods could be extended. This information was used during the second period to extend that fishing period for one hour.

Fishing effort in 1994 was the second lowest on record, and was 34% above the 1993 effort level. Local Alaskan residents (defined as residents of Chevak, Hooper Bay, and Scammon Bay) accounted for 95% (52 permits) of the effort and 92% (421 tons) of the harvest. The estimated value of the total harvest to fishermen was $123,874 (Tables 2). Two companies purchased herring. These companies were represented by two processing vessels and five tenders during the fishery (Table 3).

A total of 452 herring were sampled from the commercial harvest. Age 9 and older herring made up 88.4% of the catch by weight (Figure 5). There were no herring recruits in the commercial sample.

Norton Sound District

The 1994 Norton Sound herring fishery opened by emergency order on June 5. During the sac roe season, there were four gillnet openings for a total fishing time of 24 hours and one cooperative beach seine opening of 54 hours (Table 6). No educational openings were allowed in 1994. Subdistricts 1 through 5 were closed on June 9. The total harvest during the sac roe fishery was approximately 960 tons of herring. Since 1981, catches have averaged 4,074 tons. Table 8 compares historic beach seine and gillnet commercial catches in the Norton Sound District.

There were 215 fishermen who made at least one delivery during the season (Table 3). This is the lowest effort since 1984, excluding 1992 when there was no fishery. Fishing effort has been declining since limited entry was put into effect. This season's low effort was in part due to the poor price projected prior to the season, the lack of a commercial herring fishery in 1993, and a drawn out commercial season in 1994.

During the 1994 season, 212 fishermen used gillnets, landing a total of 918 tons (Tables 3 and 6). The average sac roe recovery for the gillnet fishery was 10.3%. Five fishermen participated in the beach seine fishery, but only three made deliveries, landing 39.7 tons of herring. The

average sac roe recovery for the beach seine fishery herring was 9.4%.

The average sac roe recovery for all gear types was 10.3% (Table 2). The average price advanced to the fishermen for a short ton of herring with 10% roe recovery was approximately $295. Only 2.5 tons were purchased as bait-herring (with roe content less than 7.0%) for $50 per ton. The total value of the herring harvest to Norton Sound fishermen was approximately $270,804. Seven companies registered 11 processors and 46 tenders to operate in Norton Sound (Table 3).

The commercial fishery was managed using the preseason biomass projection. The preseason guideline harvest was 7,812 tons, with 7,031 tons allocated to the gillnet fishery and 781 tons allocated to the beach seine fishery. During the fishery, it was assumed the projected biomass was present and that the preseason guideline harvest could be harvested.

Since over half of the biomass was observed in Subdistrict 5 (Elim), that area was opened to commercial herring fishing on June 6. Few herring were harvested since the herring present were immature and therefore were of poor roe quality. With the biomass and roe quality increasing, Subdistricts 1, 2, 3 and 5 were opened June 7. The biomass in Subdistrict 1 (St Michaels) had tripled from two days earlier. However fishing was slow in all locations, with high roe quality reported in the three southern subdistricts. Over the next three days, biomass estimates remained relatively constant, while age composition changed from predominantly older age classes to young herring. The fishery was closed June 9 as both the Department and industry were concerned with the impact of the gillnet fishery on these young fish.

The 1994 Norton Sound herring fishery was one of the least successful seasons in the history of the fishery. The 1994 herring migration seemed destined to be early, with an early break-up of sea ice. Although the waters of Norton Sound were quite warm, ice conditions in the central Bering Sea kept water temperatures low and formed a thermal barrier to migrating herring. Only a narrow corridor of greater than zero degree Celsius water connected the warm waters of Norton Sound to the warmer waters south of Nunivak Island during late May and early June. This unusual temperature barrier caused the herring to trickle into Norton Sound with immature roe. When the herring encountered the warm waters of Norton Sound, they quickly ripened and began to spawn. Since the timing of large older herring was spread from May 31 to June 8, only small amounts of herring of commercial quality were available at any given time.

A total of 1,310 herring were sampled from the commercial harvest. Age 9 and older dominated (93.8%) the gillnet harvest. Ages 6, 5 and 11 herring comprised 30.9%, 12.6%, and 11.4% of beach seine catches, respectively.

Port Clarence District

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

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in all but the Security Cove and Nunivak Island Districts this year. At least 4 people from FWP using two supercub aircraft, a helicopter and a skiff were involved with the Kuskokwim area fisheries. Two FWP officers using a helicopter and the Department's skiff were present at Cape Romanzof during the last commercial period. No citations were issued in that fishery. Enforcement in Norton Sound consisted of five single engine aircraft (three supercubs on wheels, a helicopter and a C-185 on wheels) and a small boat. Personnel consisted of 5 permanent, full-time and one seasonal FWP officers. FWP officers patrolled the fishery during each opening and closure. One citation was issued for no photo ID. No herring were confiscated by the State of Alaska during the 1994 season.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1994

Projections from post-season escapement estimates, using historic mean rates of survival and current mean weights for each age class (Bromaghin and Hamner 1994, Alaska Department of Fish and Game, Anchorage, personal communication), and estimates of recruitment for each age class (Wespedstad 1982), indicate that the 1995 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be approximately 56,283 tons (Table 7). If the return is as expected, a moderate reduction in biomass will be observed in all district except Cape Romanzof. However, variability in the quality of aerial survey assessments of biomass and deviations from the assumed survival or recruitment rates may result in the observed biomass being either above or below these projections. Therefore, harvest levels will be adjusted during the season according to observed herring spawning biomass. In addition, in accordance with the AYK Region harvest policy, newly recruited age classes (age 2 through 5 year-old-herring) will not be targeted by the commercial fishery. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from the projected biomass, test and commercial catches and spawn deposition observations.

Security Cove District

The 1995 projected return to the Security Cove District is 6,702 tons. A 20% exploitation rate would result in a harvest of about 1,340 tons (Table 7). A larger catch may occur if the 1995 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.

Ages 7 and 8 herring are expected to dominate the return. Age 9 and older herring are expected to comprise approximately one-third 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 1995 projected return of herring to the Goodnews Bay District is 4,224 tons. A 20% exploitation rate would result in a harvest of 845 tons (Table 7). A larger catch may occur if the 1995 biomass assessment is greater than the projection.

Ages 7 and 8 herring are expected to comprise over one-half of the biomass. Age 9 and older herring are expected to comprise approximately one-third 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 1995 biomass for the Cape Avinof District is 2,644 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 397 tons of herring.

Age 5 and 7 herring are expected to dominate the returning population. Age 9 and older herring are expected to comprise only 12% 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 1995 is 4,460 tons (Table 7). At an exploitation rate of 15%, the harvest will be 669 tons of herring. A larger catch may occur if the 1995 biomass assessment is greater than the projection.

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 7 herring are expected to be the dominant age group. Herring age 9 and older are expected to comprise approximately 38.6% of the biomass in 1994.

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 1995 is 4,579 tons. A 15% exploitation rate would result in a 687 ton harvest (Table 7). A larger catch may occur if the 1995 biomass assessment is greater than the projection.

Age 7 herring are expected to be the dominant age group. Age 9 and older herring are expected to comprise one-third of the return.

Cape Romanzof District

The projected return for 1995, based upon limited data, is 3,417 tons which would result in a 513 ton harvest at a 15% exploitation rate (Table 7). Ages 7 and 11 herring are expected to dominate the biomass. Age 9 and older herring are expected to comprise 53.8% of the biomass.

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 513 tons will be modified accordingly.

Norton Sound District

The Norton Sound projected return is 30,257 tons. A 20% exploitation rate would result in a

harvest of 6,051 tons (Table 7). Age 7 herring are expected to comprise half of the returning biomass. Age 9 and older herring are expected to comprise 32.4% of the biomass.

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 605 tons.

The 1995 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 1995. 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 during the sac-roe fisheries in the northeastern Bering Sea, Alaska, 1909-1994.

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	-	-	-	-	-	-	1-[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	-
1971	-	-	-	-	-	-	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	-
1993	5	954	215	739	-	371	5,079	-	7,363	-
1994	-	1,062	427	717	14	456	960	-	3,636	-

[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, 1989-1994.

Year	District	Estimated Biomass (st)	Harvest (st)				Roe %	Estimated Value ($ x 1,000)	Exploitation Rate (%)
			Sac-roe	Bait	Waste	Total			
1994	Security Cove	7,638	-	-	-	-	-	-	-
	Goodnews Bay	5,679	1,061	0	1	1,062	12.3	391	18.7
	Cape Avinof	2,827	427	0	0	427	12.2	156	15.1
	Nelson Island	5,564	713	4	0	717	11.0	235	12.9
	Nunivak Island	4,921	14	0	0	14	8.6	4	0.3
	Cape Romanzof	5,000	456	0	0	456	9.2	124	9.1
	Norton Sound	37,829	958	2	0	960	10.3	271	2.5
		69,458	3,629	6	1	3,636	11.1	1,181	5.2
1993	Security Cove	6,995	5	0	0	5	12.8	2	0.1
	Goodnews Bay	6,211	945	9	0	954	10.3	293	15.4
	Cape Avinof	2,837	206	9	0	215	12.0	75	7.6
	Nelson Island	4,944	613	52	74	739	10.6	198	14.9
	Nunivak Island	5,176	-	-	-	-	-	-	-
	Cape Romanzof	4,000	371	0	-	372	9.6	110	9.3
	Norton Sound	46,549	4,713	321	45	5,079	9.9	1,411	10.9
Total		76,712	6,853	391	119	7,363	10.1	2,089	9.6
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 Island	5,275	188	52	6	246	8.3	78	4.7
	Nunivak Island	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 Island	2,385	-	-	-	-	-	-	-
	Nunivak Island	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	49	1	0	50	12.0	35	2.5
	Nelson Island	2,705	-	-	-	-	-	-	-
	Nunivak Island	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	90	39	0	129	8.0	54	18.7
	Nelson Island	3,320	122	100	11	233	8.5	57	7.0
	Nunivak Island	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

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

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1989-1994.

Year	District	Number of Buyers	Number of Fishermen		
				Seine[a]	
			Gill Net	Purse	Beach
1994	Security Cove	-	-	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	85	-	-
	Nelson Island	3	104	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	2	55	-	-
	Norton Sound	7	212	-	3
1993	Security Cove	1	9	-	-
	Goodnews Bay	3	63	-	-
	Cape Avinof	1	97	-	-
	Nelson Island	1	73	-	-
	Nunivak Island	-	-	-	-
	Cape Romanzof	2	41	-	-
	Norton Sound	6	256	-	7
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

[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, 1977-1994.[a]

Village	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Nelson Island																		
Tununak	57	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32	45	42
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	23	53
Nightmute	-	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10	9	13
Newtok	-	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7	6	9
Total	81	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117
No. Fishing Families	90	83	54	70	93	65	43	-	65[b]	72[b]	96	104	-[b]	100	85	97	89	-
Nunivak Island																		
Mekoryuk	-	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4	4	2	-
No. Fishing Families	-	-	-	-	-	-	-	-	11	6[b]	-	-	-	19	20	17	16	-
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	-	-	-	-	-	-	-
No. 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	3	1
Chevak	<1	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2
Hooper Bay	2	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3
Total	<3	5	11	11	14	11	9	11	8	7	3	7	3	8	3	4	5	6
No. Fishing Families	30	29	84	61	46	43	37	47	44	41	39	32	24	32	18	30	42	48

[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, 1978-1994.

	Herring (st)								
Year	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	22,360	-	44,331
1982	5,071	2,646	-	3,968	-	4,850	19,403	-	33,951
1983	6,393	3,197	-	7,275	7,606	5,512	6,841	-	58,092
1984	5,071	4,079	-	11,023	6,695	6,063	21,475	-	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	32,370	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	25,981	-	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]
1993	6,995	6,211	2,837[b]	4,944	5,176	4,000	46,549	822	77,534[d]
1994	7,638[b]	5,679[b]	2,827[b]	5,564	4,921	5,000	37,829	92	69,550

[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 is excluded from total.

[d] Biomass is 76,712 tons if Port Clarence is excluded from total.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1994.

District	Subdistrict Section\Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Security Cove	No Commercial	Fishery					
Goodnews Bay	Entire	GN	1	5/22	1400-2000	6.0	177.7
			2	5/23	1500-2200	7.0	211.8
			3	5/24	0300-0800	5.0	130.0
			4	5/24	2000-2200	2.0	79.7
			5	5/26	0530-1130	6.0	42.7
			6	5/26-27	1900-0100	6.0	201.4
			7	5/27	1030-1230	2.0	65.9
			8	5/27	2000-2400	4.0	151.6
					Total	38.0	1060.9
Cape Avinof	Entire	GN	1	5/28	1100-1500	4.0	18.6
			2	5/28-29	2100-0400	7.0	8.8
			3	5/29	0900-1600	7.0	15.3
			4	5/29-30	2100-0500	8.0	43.0
			5	5/30	0900-1800	9.0	81.0
			6	5/30-31	2300-0700	8.0	67.9
			7	5/31	1100-1900	8.0	87.4
			8	6/01	0200-0800	6.0	38.0
			9	6/01	1500-2000	5.0	67.3
					Total	62.0	427.2
Nelson Island	Entire	GN	1	5/23	0600-1000	4.0	0.2
			2	5/23	1700-2300	6.0	184.6
			3	5/24	1800-2400	6.0	264.5
			4	5/25	1830-0030	6.0	152.9
			5	5/26-27	2100-0100	4.0	115.1
					Total	26.0	717.1
Nunivak Island	Entire	GN	1	6/03	0300-0900	6.0	13.9
					Total	6.0	13.9
Cape Romanzof	Entire	GN	1	5/23	2315-0015	1.0	56.0
			2	5/24-25	2330-0230	3.0	276.5
			3	5/25-26	2200-0100	3.0	123.5
					Total	7.0	456.0
Norton Sound	S.D. 1,2,3,5	GN	1	6/05	0800-1300	5.0	248.9
	S.D. 1,2,3,5		2	6/07	0600-1100	5.0	12.3
	S.D, 1,2,3,5		3	6/08	1000-1500	5.0	616.6
			4	6/09	0400-1300	9.0	40.5
					Total	24.0	918.3
	S.D. 1,2	BS[1]	1	6/07-09	1200-1800	54.0	39.7
					Total	54.0	39.7

[1] Co-oped opening.

Table 7. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1995.

			1995 Projection[a]	
District	Biomass(st)	Threshold	Harvest(st)	Exploitation Rate (%)
Security Cove	6,702	1,200	1,340	20
Goodnews Bay	4,224	1,200	845	20
Cape Avinof	2,644	500	397	15
Nelson Island	4,460	3,000	669	15
Nunivak Island	4,579	1,500	687	15
Cape Romanzof	3,417[b]	1,500	513	15
Norton Sound	30,257	7,000	6,051	20
Port Clarence		-	165[c]	-

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.
[b] Projection from estimated 1994 relative biomass which was based on 1994 aerial surveys, spawn deposition, age composition, and the CPUE from commercial and test fisheries.
[c] Harvest guideline of 165st (150mt).

Table 8. Herring harvest by gear type and subdistrict, Norton Sound District, 1981-1994.

NORTON SOUND HERRING CATCHES

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
GILLNET HARVEST (tons)															
St. Michael		3,067	2,062	434	—	1,538	2,560	2,214	3,215	2,927	4,491	—	—	2,288	249
Unalakleet		831	946	1,264	—	95	—	—	42	10	618	731	—	120	12
Cape Denbigh		472	925	2,692	3,244	1,599	2,420	1,545	1,211	1,414	923	4,419	—	1,659	619
Elim		—	—	65	—	147	—	—	6	—	—	—	—	225	41
Golovin		—	—	85	—	—	—	—	—	—	—	—	—	—	—
total	a/	4,370	3,933	4,540	3,244	3,379	4,980	3,759	4,474	4,351	6,032	5,150	b/	4,291	921
SEINE HARVEST (tons)															
St. Michael (beach)		—	—	—	—	—	—	4	45	329	6	—	—	—	1
Unalakleet (beach)		—	—	—	—	93	—	—	58	50	332	149	—	467	24
Cape Denbigh (beach)		—	—	41	327	76	30	293	96	11	9	373	—	222	15
Elim (beach)		—	—	—	—	—	185	—	—	—	—	—	—	54	—
Cape Denbigh (purse)		—	—	—	—	—	—	26	—	—	—	—	—	—	—
total	a/	0	0	41	327	169	215	323	198	390	347	522	b/	743	40
TOTAL HARVEST (tons)	a/	4,370	3,933	4,581	3,571	3,548	5,195	4,082	4,672	4,741	6,380	5,672	0	5,034	961
Percent of total harvest															
Gillnet Harvest		100.0	100.0	99.1	90.8	95.2	95.9	92.1	95.8	91.8	94.6	90.8		85.2	95.9
Seine Harvest		0.0	0.0	0.9	9.2	4.8	4.1	7.9	4.2	8.2	5.4	9.2		14.8	4.1

a/ Totals do not include waste.
b/ No commercial fishery.

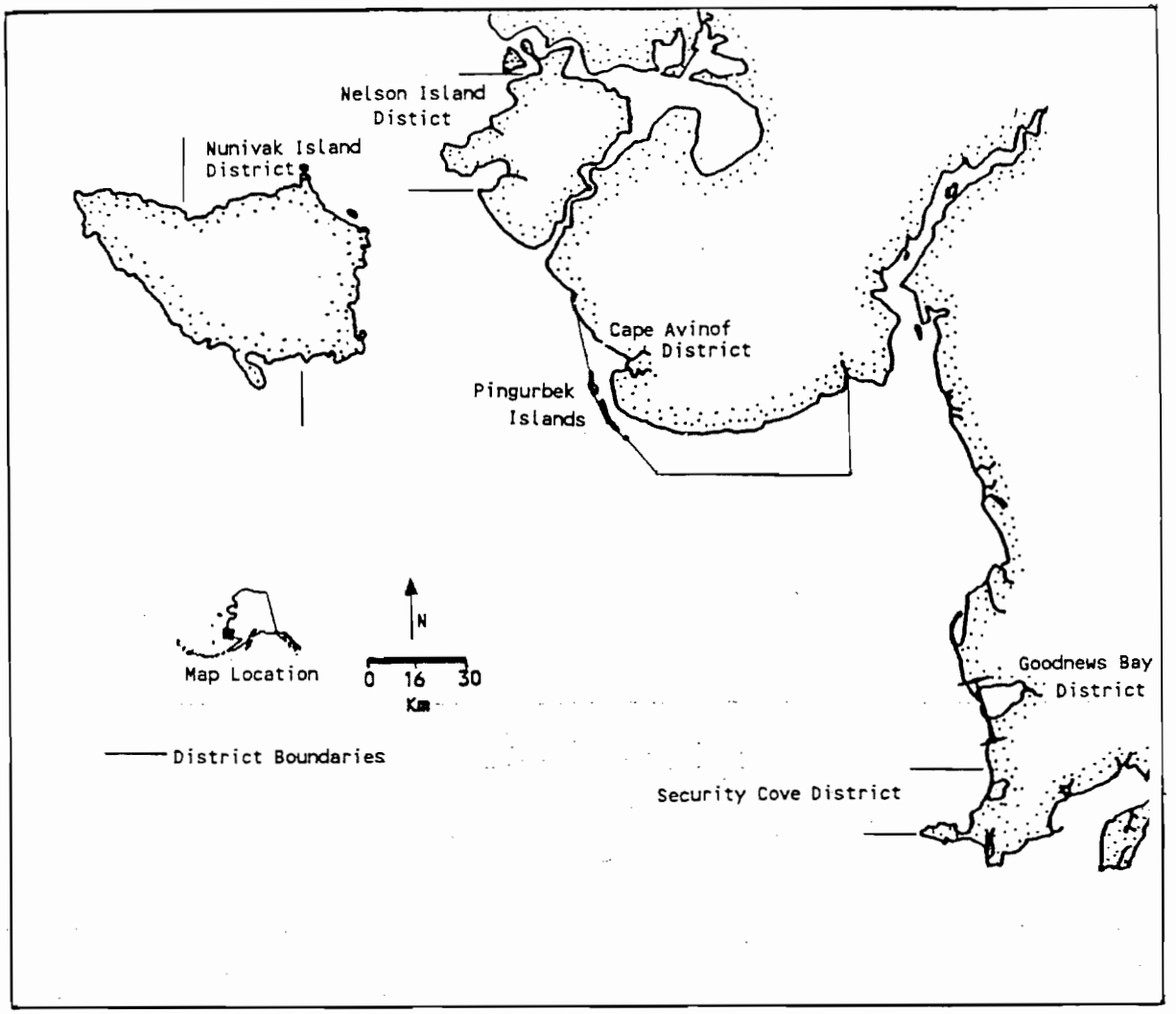

Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

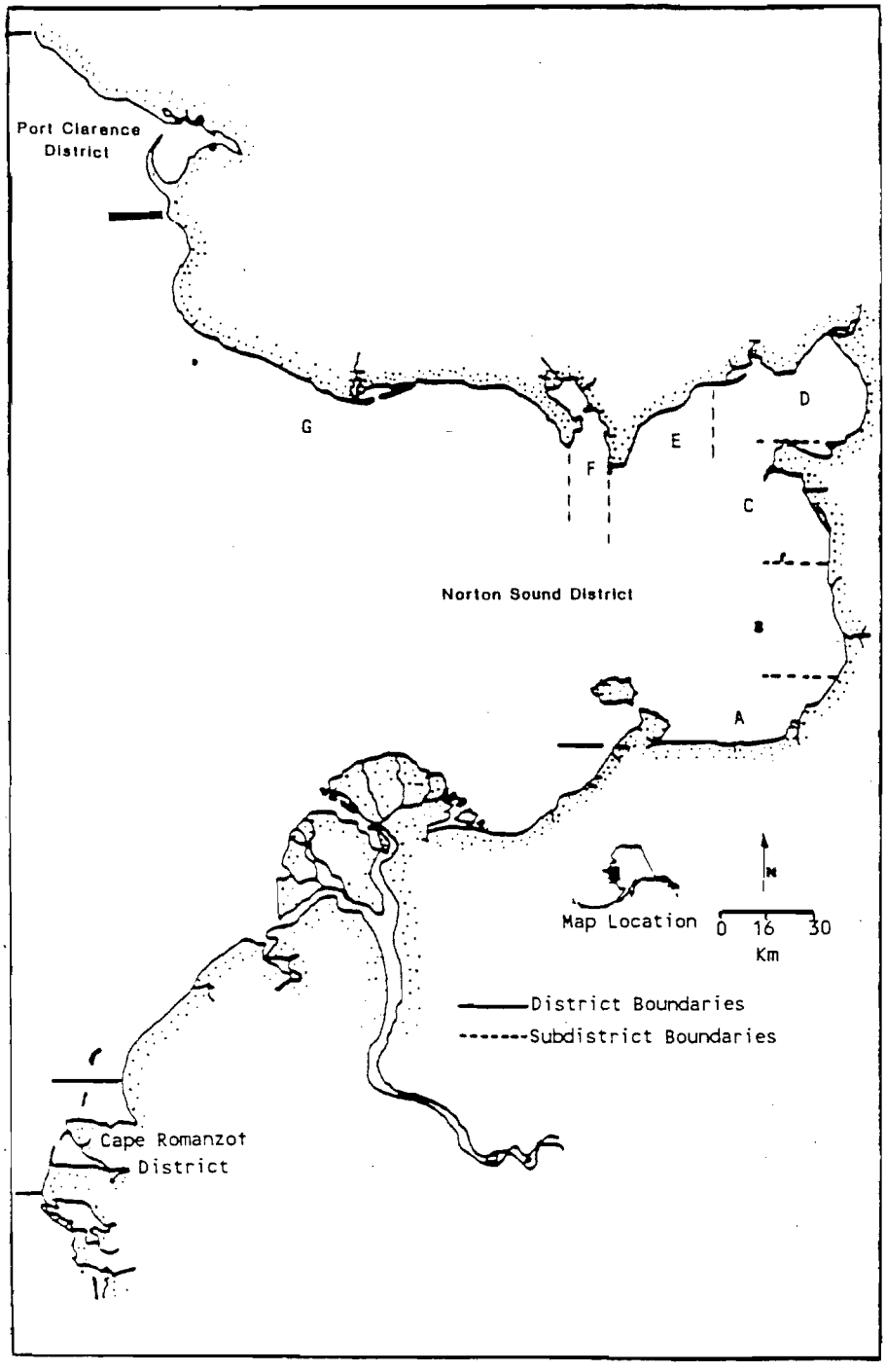

Figure 2. Cape Romanzof, Norton Sound, and Port Clarence Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

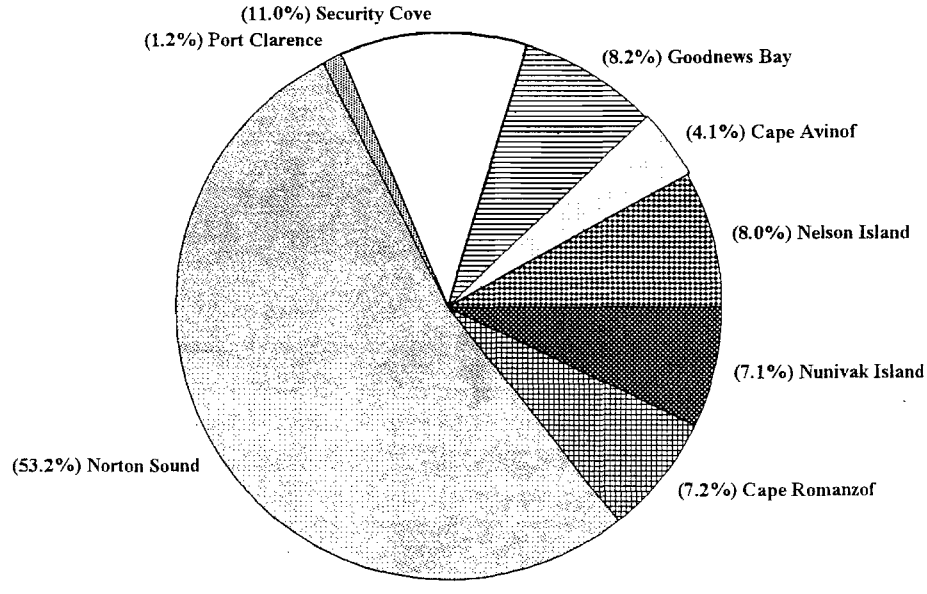

Figure 3. Pacific herring run biomass distribution by commercial fishing district, Arctic-Yukon-Kuskokwim Region, Alaska, 1994.

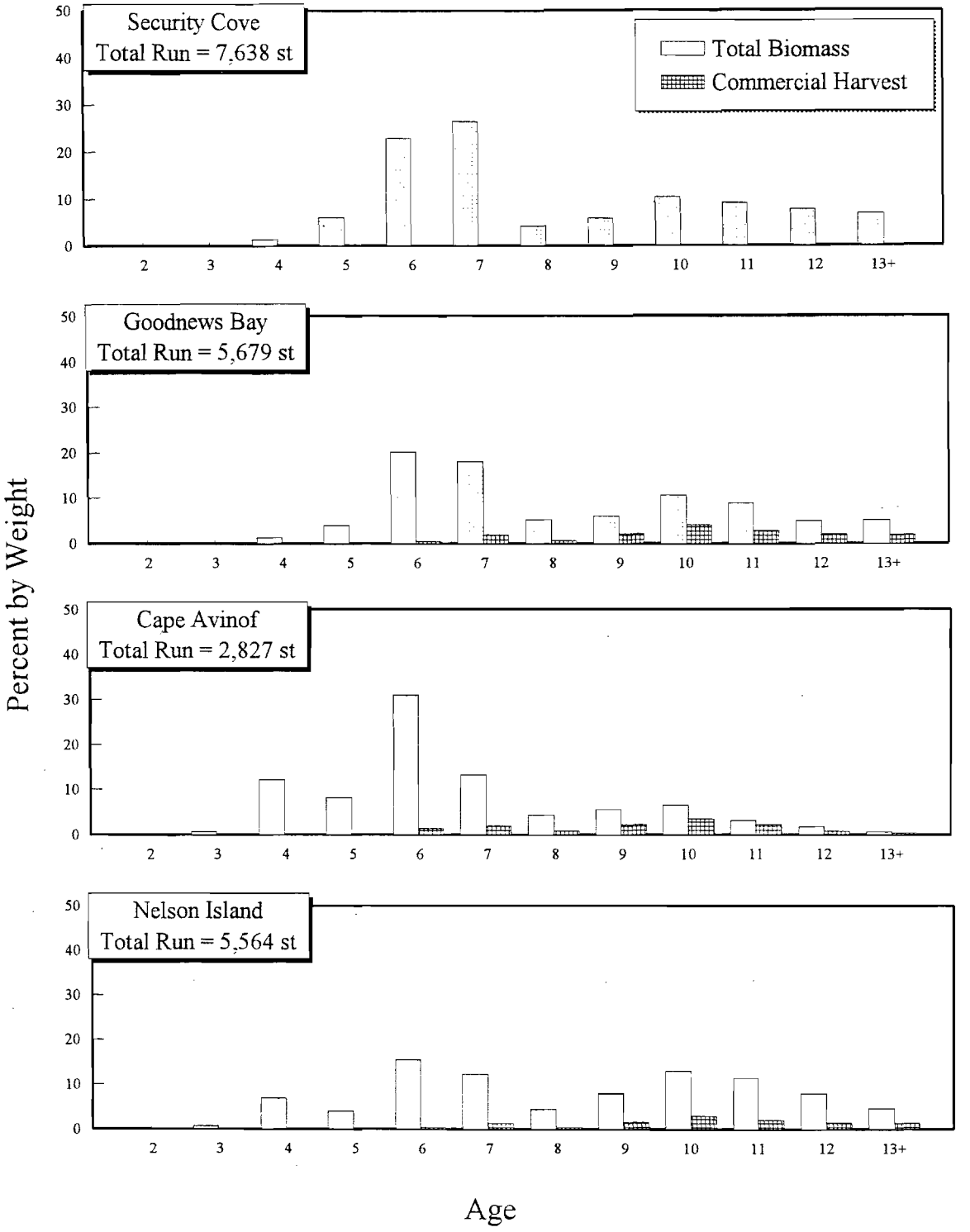

Figure 4. Age composition of Pacific herring for the run and harvest for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1994.

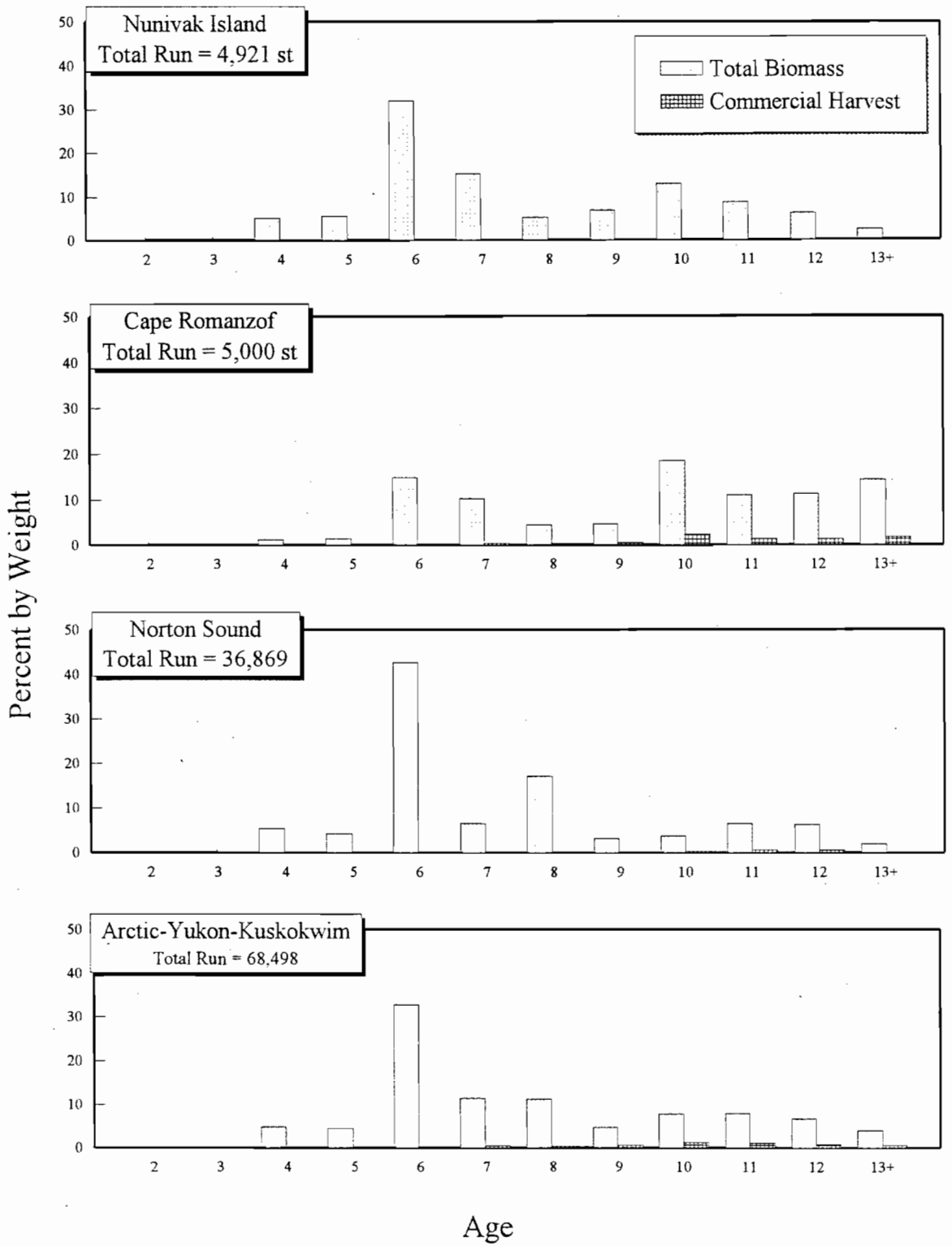

Figure 5. Age composition of Pacific herring for the run and harvest for the Nunivak Island, Cape Romanzof, Norton Sound Districts, and the combined Arctic-Yukon-Kuskokwim Region, Alaska, 1994.

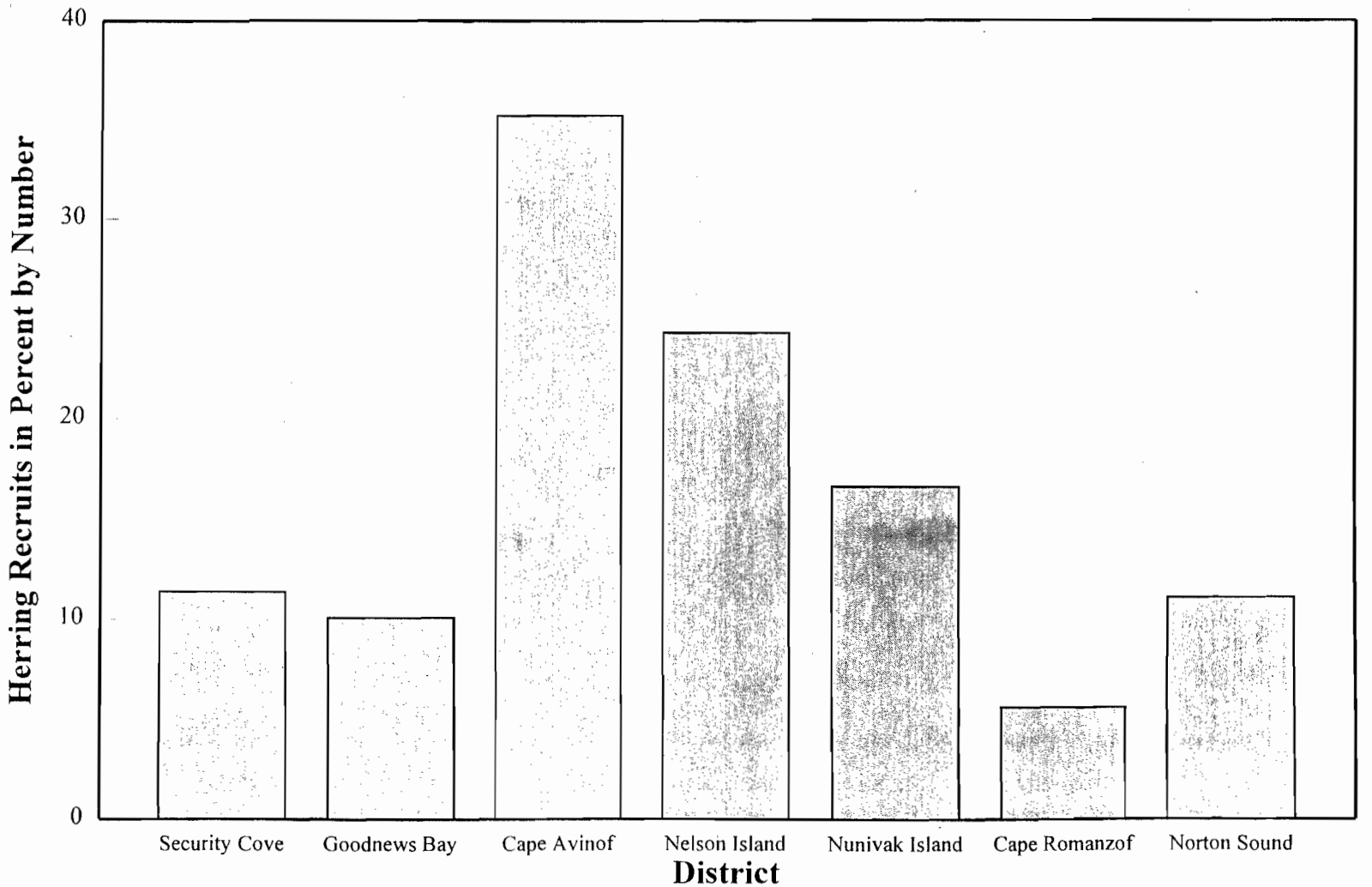

Figure 6. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1994.