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Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Bering Sea, Alaska, 1997

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 1997 Pacific herring stock assessment programs of the Arctic-Yukon-Kuskokwim (AYK) Region, review 1997 harvests and management strategies of all AYK commercial and subsistence herring fisheries, and present general management strategies planned for the AYK herring fishing season in 1998. 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 commercial harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060, ADF&G 1996), 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. All AYK herring districts open and close by Emergency Order authority to provide for an orderly fishery and allow periodic assessment of herring biomass. The Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries have been limited entry since 1987. A moratorium to new entry will be placed on the Goodnews Bay herring fishery beginning in the 1998 season. In addition, all AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

A total biomass of 78,484 tons of herring was estimated to have been present in the surveyed portion of the AYK Region herring districts in 1997 (Tables 2 and 5). The 1997 return is 5.9% above the 5-year average (1992-1996) of 74,092 tons. Young (ages 4 and 5), middle-aged (ages 6-8) and older (ages 9 and older) herring each comprised approximately one-third of the biomass in the Kuskokwim herring districts (Security Cove, Goodnews Bay, Cape Avinof, Nelson Island and Nunivak Island). Ages 4 and 9 were the dominant age groups in these districts. Age nine dominated the herring biomass in the Cape Romanzof and Norton Sound Districts.

The 1997 herring harvest for the AYK Region was approximately 8,017 tons with an estimated ex-vessel value of $1,602,000 (Tables 1 and 2). This represents a decrease in both harvest and value compared to 1996 record levels of 11,986 tons and $8,730,000. The 1997 harvest is 8% above the 5-year average (1992-1996) of 7,422 tons and the value is 39% of the 5-year average of $4,085,000 (Table 2). This decrease in value is primarily due to record low prices paid to fishermen in 1997.

The price paid to fishermen in AYK fishing districts for herring with 10% roe content was approximately $200 per ton in the Kuskokwim Area, $208 per ton in the Cape Romanzof District, and $154 per ton in the Norton Sound District, plus or minus $20 a percentage point, and $50 per ton for bait-quality herring. Prices paid to fishermen in 1997 were the lowest paid per ton in the history of the Bering Sea commercial herring fishery and were one-fourth to one-third of prices paid in 1996 for sac roe-quality herring. Food and bait sales during the sac roe fishery totaled 266 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 calculations of exploitation rates. In 1997, 10 tons of herring were discarded (Table 2).

A total of 908 permit holders participated in AYK sac roe herring fisheries during the 1997 season (Table 3). This is a decline from the record number of permit holders in 1996, but is the second highest effort on record. An increased participation in the Security Cove District, exceeding the number of gillnet fishermen in the Norton Sound District, in both 1996 and 1997 is the primary reason for these record levels of effort. There has not been a commercial sac roe fishery in the Port Clarence District since 1988 due to a lack of buyers. In most years, there is a small bait fishery in the Port Clarence District.

Surveyed subsistence fishermen from selected Yukon River coastal villages harvested approximately 3 tons of herring (Table 4). No surveys were conducted in the Nelson Island and Nunivak Island villages in 1997 because of budget cuts. These villages have historically harvested approximately 110 tons of herring annually.

Roe recoveries in the sac roe harvest ranged from 9.9% in the Norton Sound to 14.2% in the Goodnews Bay District, with a combined regional roe recovery of 11.1%. An awareness among processors, managers and fishermen of poor market conditions and the need for a high-quality product has helped produce high roe percentages in recent years. Managers have attempted to limit period harvests to an amount that could be processed within three days. The 1997 total exploitation rate for the AYK Region was 10.2%. Exploitation rates, not including 0% in the Nunivak Island District, ranged from 8.3% in the Norton Sound District to 19.2% in the Security Cove District (Table 2).

Biomass projections for each district using postseason escapement estimates, historical mean rates of survival, current mean weights for each age class and estimates of recruitment for each age class (Wespestad 1982), suggest that the 1998 spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be 67,737 tons with an allowable commercial harvest of 13,141 tons (Table 7). This is a decline from the 1997 biomass of 78,484 tons. Districts with projected declines are either those with poor aerial survey conditions in 1997 or those in which a slight decline is expected as the predominant year class ages. These projections do not include age classes, generally age 3, not yet seen in the fishery.

Variability in survival rates and in 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 may be adjusted inseason 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 timing of the spawning migration 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 soon 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, 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 1997, 62 aerial surveys totaling 59.9 hours of flight time were flown in the AYK Region: 7 (3.4 hours) in Security Cove, 8 (5.8 hours) in Goodnews Bay, 4 (2.4 hours) in Cape Avinof, 9 (3.7 hours) in Nelson Island, 4 (4.0 hours) in Nunivak Island, 6 (1.5 hours) in Jacksmith Bay, 5 (2.4 hours) in Cape Romanzof, and 19 (36.7 hours) in Norton Sound and Port Clarence combined. During only one fourth of these surveys were survey conditions rated as fair or better.

Gillnets are the only legal gear in the AYK Region, with the exception of Norton Sound where a portion of the harvest is taken by beach seine. An attempt was made to sample at least 420 herring from each commercial gear type, district or subdistrict per week. 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. Sample sizes in the Nunivak Island District were insufficient for age composition summaries. A total of 14,733 herring from commercial, subsistence and test catches were sampled during the 1997 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 helped to increase roe recoveries.

Spawning Populations

Security Cove District

Since 1981, biomass estimates in the Security Cove District have ranged from 2,300 tons in 1987 to 8,267 tons in 1981 (Table 5). The herring biomass projected to return to this district in 1997 was 4,640 tons. Between May 1 and May 24, 1997, seven aerial surveys were flown in the district to estimate herring biomass and spawning activity. Two of these surveys were flown under acceptable conditions. The highest amount of biomass, 4,064 tons, was observed on May 8 under unacceptable conditions. The projected biomass estimate was used as the biomass estimate for 1997. A total of 6.5 miles of spawn was observed in the district with the highest amount, 2.5 miles, observed on May 8.

The Security Cove test fish crew sampled 979 fish caught with variable-mesh gillnets from May 5 to May 22 for biological data. Age 4 dominated both the biomass (23.7%; Figure 5) and the return in numbers of fish (36.6%). Age 9 and older herring comprised 36.6% of the biomass. Recruit herring represented 46.5% of the returning population (Figure 7).

Goodnews Bay District

Since 1981, biomass estimates in the Goodnews Bay District have ranged from 2,000 tons in 1987 to 6,315 tons in 1996 (Table 5). The herring biomass projected to return to this district in 1997 was 4,752 tons. During the 1997 season, eight aerial surveys were flown in the district between May 1 and May 25 to estimate herring biomass and spawning activity. Only one of these surveys was flown under acceptable conditions. The highest amount of biomass, 2,848 tons, was observed on May 5 under unacceptable conditions. The projected biomass estimate was used as the 1997 biomass estimate. The only amount of spawn observed was a total of one mile on May 5.

Department personnel used variable-mesh gillnets to catch herring for biological sampling. The Department's test fish crew sampled 1,449 herring caught with variable-mesh gillnets from May 4 to May 29 for biological data. As in Security Cove, age 4 dominated both the return in biomass (19.6%) and in numbers of fish (31.1%). Age 9 and older herring comprised 39.1% of the biomass (Figure 5). Recruit herring represented 40.9% of the returning population (Figure 7).

Cape Avinof District

Since 1985, biomass estimates in the Cape Avinof District have ranged from 1,225 tons in 1987 to 4,600 tons in 1997 (Table 5). The herring biomass projected to return to this district in 1997 was 3,737 tons. During the 1997 season, four aerial surveys were flown in the district between May 23 and May 28 to estimate herring biomass and spawning activity. Only one of these surveys was flown under acceptable conditions and neither herring nor spawn were observed during any of the surveys. Aerial survey estimates of herring biomass in the Cape Avinof District have only been obtained in three of the past ten years. The area consists of shallow mud flats. Water turbulence

caused by wind and wave action obscures visibility of the bottom through the water column. The last year in which the herring biomass was estimated by survey was in 1992, when 3,446 tons were observed. In other years, the preseason projection or commercial catch rates have been used for estimating herring biomass. Due to poor aerial survey conditions in 1997, the total biomass present in the district was assessed to be 4,600 tons primarily based on a qualitative comparison of commercial catch rates in 1996 and 1997. Other indicators of herring abundance such as spawn deposition, the preseason projected biomass, test fish catch rates, comments from local residents, age composition, and the limited information from aerial surveys were also used in assessing the size of the herring population in Cape Avinof.

The Cape Avinof test fish crew sampled 1,247 herring caught with variable-mesh gillnets from May 21 to June 5 for biological data. As in other Kuskokwim Districts, age 4 dominated both the biomass (24.5%) and the return in numbers of fish (40.0%; Figure 5). Age 9 and older herring comprised 36.3% of the biomass. Recruit herring represented 44.8% of the returning population (Figure 7).

Nelson Island District

Since 1985, biomass estimates in the Nelson Island District have ranged from 2,385 tons in 1991 to 9,500 tons in 1985 (Table 5). The herring biomass projected to return to this district in 1997 was 5,094 tons. During the 1997 season, nine aerial surveys were flown between May 11 and May 28 to estimate herring biomass and spawning activity. None of these surveys was flown under acceptable conditions. The highest amount of biomass, 839 tons, was observed on May 28. A total of 5.4 miles of spawn was observed in the district with the highest amount, 4.0 miles, observed on May 21. Because there were no acceptable surveys, the total biomass present in the district was assessed to be 7,900 tons primarily based on a qualitative comparison of the commercial fishery CPUE in 1996 and 1997. Other indicators of herring abundance such as spawn deposition, the preseason projected biomass, test fish and subsistence catch rates, comments from local residents, age composition, and the limited information from aerial surveys were also used in assessing the size of the herring population.

Test fishing with variable-mesh gillnets occurred from May 14 through June 12. The crew sampled 1,790 herring caught in variable-mesh gillnets for biological data. Ages 4 and 9 dominated the return in biomass (17.8% and 22.0%, respectively) and in numbers of fish (31.4% and 16.4%, respectively). Age 9 and older herring comprised 47.0% of the biomass. Recruit herring represented 35.0% of the spawning population (Figure 7).

Nunivak Island District

Since 1985, biomass estimates in the Nunivak Island District have ranged from 422 tons in 1990 to 6,000 tons in 1986 (Table 5). The herring biomass projected to return to this district in 1997 was 3,801 tons. During the 1997 season, four aerial surveys were flown between May 22 and May 26 to estimate herring biomass and spawning activity. Two of these surveys were flown under acceptable

conditions. The highest amount of biomass, 31 tons, was observed on May 22 under unacceptable conditions. The preseason biomass projection was used as the biomass estimate for 1997. A total of 0.8 miles of spawn was observed in the district with the highest amount, 0.5 miles, observed on May 25.

Test fishing with variable-mesh gillnets occurred on May 23. The Department's test fish crew sampled 56 herring caught in variable-mesh gillnets for biological data. Due to insufficient sample sizes, age compositions are estimated for the Nunivak Island District using data from the Nelson Island District. Ages 4 and 9 dominated the herring biomass (20.6% and 21.5%, respectively, Figure 6). Age 4 dominated the return in numbers of fish (33.8%). Age 9 and older herring comprised 41.9% of the biomass. Recruit herring represented 37.7% of the spawning population.

Central Kuskokwim Bay

The Central Kuskokwim Bay area extends from Jacksmith Bay, south of Quinhagak, to the Ishkowik River. No commercial herring fishing districts are located in this area. Six aerial surveys were flown in this area from May 1 to May 25. All but two of these surveys were flown under unsatisfactory conditions. During a survey on May 5, 804 tons of herring were observed.

Cape Romanzof District

Due to excessive water turbidity in the Cape Romanzof area, it is generally not possible to estimate herring biomass using aerial survey techniques. Based on information from limited aerial surveys, test and commercial catches, and spawn deposition, the estimated herring biomass in the Cape Romanzof District has ranged from approximately 5,000 to 7,500 tons since 1981 (Table 5). Five aerial surveys were flown during the 1997 season from May 12 through June 2. A total of 2.4 hours were spent surveying the district. None of these surveys were flown under acceptable survey conditions. The largest quantity of herring observed during an aerial survey was 144 tons on May 25. Based on spawn deposition study results, commercial and test fishery catch rates, herring age composition and the preseason projection, the 1997 biomass of herring in the Cape Romanzof District was assessed to be between 4,500 and 5,500 tons.

Spawn deposition surveys began on May 12. The first observations were recorded on May 13 in Kokechik Bay. This initial spawn deposition was light. A quantitative spawn deposition project, using platforms covered with an artificial spawning substrate was continued in 1997. Artificial substrates were located in the same general spawning locations as in 1992 through 1996. Forty platforms were placed just north of the Department's field camp on May 14. However, high winds prevented staff from checking the platforms for the next five days. This delay in adjusting placement of platforms within the intertidal zone resulted in the project not being successful this season. Very little spawn was recorded on the platforms, although spawn deposition within the study area appeared to be similar to that in 1996. The project has indicated a trend of increasing spawn deposition within the study from 1992 through 1996. However, it is uncertain whether the study area results are indicative of the total spawning biomass within the entire district.

The Department's test fish crew at Cape Romanzof caught 2,373 herring from May 15 through June 7 with variable-mesh gillnets of which 1,367 were sampled. Age 9 herring dominated the return in both biomass (35.8%) and numbers of fish (30.4%). Age 9 and older herring comprised 67.7% of the biomass (Figure 6). Recruit herring represented 20.3% of the spawning population (Figure 7).

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 ranged from 5,291 tons in 1978 to 57,974 tons in 1992 (Table 5). During 1997, 17 surveys were flown between May 13 and June 2. Survey conditions were generally good. Herring were first sighted during an aerial survey on May 17 and spawn was first observed on May 19. The peak aerial survey count was made on May 27 when 43,815 tons was sighted. This is the most herring ever observed in one day in Norton Sound. The 1997 herring biomass for Norton Sound of 47,791 tons was estimated by combining the aerial survey estimate of 43,815 tons with the commercial harvest of 3,971 tons and 5 tons of estimated wastage. The preseason biomass estimate was 19,657 tons.

Two Department test fish projects were operational during the 1997 season. One crew operated in the northern portion of Norton Sound at Cape Denbigh and the second crew was stationed in the southern end of the district at Klikitarik. Test fishing was conducted in the Unalakleet area as time allowed. Test fish crews sampled 2,679 herring caught with variable-mesh gillnets from May 18 through June 10 for biological data. Age 9 herring dominated the return in both biomass (40.4%) and in numbers of fish (33.0%). The biomass consisted of 60.3% age 9 and older herring (Figure 6). Recruit herring, ages 2-5, represented 21.0% of the return in numbers of fish (Figure 7). However, herring in Norton Sound may not be fully recruited to the fishery until age 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. Two aerial surveys were flown during the 1997 season on June 4 and June 13. A total of 1.7 hours were spent surveying the district. The largest quantity of herring observed during an aerial survey was 3 tons on June 13.

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.

Extensive subsistence surveys have been conducted in most years since 1990 by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area (Pete 1990, 1991, 1992, 1993). However, no herring subsistence surveys were conducted in those districts in 1997 (Table 4). Nelson Island villages harvest approximately 110 tons of herring annually.

A total of 480 herring were sampled from the subsistence catches from Nelson and Nunivak Islands for biological data. Ages 6 and 7 herring dominated the subsistence harvest (24.9% and 24.4%, respectively). The catch consisted of 27.1% age 9 and older herring and 18.7% recruit-aged herring.

During 1997, a subsistence harvest of 3.2 tons was estimated to have been taken by 34 fishing families from the Yukon Delta villages of Hooper Bay, Chevak, and Scammon Bay (Table 4). In addition, 555 pounds of spawn-on-kelp (*fucus*) were harvested for subsistence use by 20 families. A combination of mail-out questionnaires and personal interviews were used to collect subsistence harvest information. A total of 74 fishing households were contacted out of a total of 216 identified households. The subsistence catch figures represent only the harvest which was reported. Therefore, the reported harvest is a minimum estimate since not all families were contacted and not all families who received questionnaires returned them.

COMMERCIAL FISHERY

Security Cove District

The total harvest of 892 tons was composed of 884 tons of sac roe herring with an average roe content of 12.5%, 3 tons of bait, and 5 tons of waste (Tables 1 and 2). Fourteen processors bought herring from 222 permit holders who made 528 deliveries in three periods with 10.5 hours total fishing time (Tables 3 and 6). The estimated ex-vessel value was $221,000. The exploitation rate was 19.2% based on the preseason biomass projection of 4,640 tons.

On May 7, the first period opened for 3.5 hours starting at 7:00 PM. One hundred sixty-seven permit holders delivered 322 tons of sac roe quality herring with an average roe content of 12.4% and 3 tons of bait herring. Approximately 5 tons of herring were wasted due to low roe content. The second opening occurred on May 8 for 3 hours starting at 7:30 AM. One hundred seventy-one permit holders delivered 196 tons of herring with a 12.3% average roe content. The final period was for 4 hours on May 8 starting at 7:30 PM. One hundred ninety permit holders delivered 367

tons of herring with a 12.7% average roe content. Due to a high number of participating permit holders all periods were open to only 50 fathoms of gillnet per boat.

A sample of 420 herring was taken from the commercial catch. Age 9 herring comprised the largest age group (36.4%) in the harvest biomass. Age 9 and older herring made up 73.8% of the catch by weight (Figure 5). There were no recruit-age herring in the commercial sample.

Goodnews Bay District

The total harvest was 805 tons of sac roe herring with an average roe content of 14.2% (Tables 1 and 2). Three processors bought herring from 139 permit holders who made 933 deliveries in 12 periods with 65 hours total fishing time (Tables 3 and 6). The estimated ex-vessel value was $228,000. The exploitation rate was 16.9% based on the preseason biomass projection of 4,752 tons. Various factors including early run timing and adverse weather contributed to the inability of fishermen to reach the 950-ton guideline harvest limit.

On May 16, the first period opened for 4 hours at 2:00 PM. Fifty-eight permit holders delivered 33 tons of sac roe herring with a 13.8% average roe content. The second period opened for 5 hours at 2:00 PM on May 17. Forty-nine permit holders delivered 14 tons of herring with an average roe content of 14.7%. A severe storm with 60-knot winds prevented a fishing period on May 18. Between May 19 and May 25, the district was opened 10 times for a total of 56 hours. Catches ranged from less than 1 ton on May 25 to 219 tons on May 21.

A sample of 440 herring was taken from the commercial catch. The largest age class in the harvest was age 9 (38.2%). Age 9 and older herring made up 80.5% of the catch (Figure 5). Recruit herring comprised less than 1% of the harvest.

Cape Avinof District

The total harvest was 687 tons of sac roe herring with an average roe content of 11.5% (Tables 1 and 2). Two processors bought herring from 145 permit holders who made 560 deliveries in five periods with a total fishing time of 26 hours (Tables 3 and 6). The estimated ex-vessel value was $157,000. The exploitation rate was 14.9% based on a postseason biomass estimate of 4,600 tons.

On May 21 the first period opened for 4 hours starting at 8:00 PM. Seventy-four permit holders delivered 106 tons of herring with an 11.3% average roe content. Between May 22 and 24 the district was opened four times for a total of 16 hours. Catches ranged from 129 tons on May 22 to 173 tons on May 23.

A total of 560 herring were sampled from the commercial catch. Age 9 herring dominated the harvest (35.1%). Age 9 and older herring made up 75.5% of the catch (Figure 5). Recruit herring comprised less than 1% of the harvest.

Nelson Island District

The total harvest was 778 tons of sac roe herring with an average roe content of 12.7% (Tables 1 and 2). Three processors bought herring from 105 permit holders who made 348 deliveries in three periods with a total fishing time of 10 hours (Tables 3 and 6). The estimated ex-vessel value was $198,000. The exploitation rate was 9.8% based on a postseason biomass estimate of 7,900 tons.

On May 20, the first period opened for 4 hours starting at 9:00 PM. Ninety-six permit holders delivered 304 tons of sac roe quality herring with a 12.6% average roe content. The second period was for 4 hours beginning 9:00 AM on May 21. Ninety-nine permit holders harvested 404 tons of sac roe herring with an average roe content of 12.8%. The last period was for two hours starting at 11:00 AM on May 22. Catch from this period was 71 tons of herring with 13.0% average roe content. The final period was open to only 50 fathoms of gillnet per boat.

A total of 422 herring were sampled from the commercial catch. Age 9 herring was the largest age class comprising 26.6% of the harvest by weight. Age 9 and older herring made up 91.0% of the catch (Figure 5). There were no recruit-age herring in the commercial sample.

Nunivak Island District

The district was open to herring fishing for 6 hours on May 21 (Table 6). Although twelve permit holders fished, no herring were sold because there was no buyer (Table 3). Approximately 200 pounds of herring caught during this period were utilized for subsistence. On May 24, a buyer arrived and the district was opened continuously from 4:00 PM until 10:00 AM on May 27. Fishermen were unable to locate marketable quantities of herring and no deliveries were made.

A total of 29 herring were sampled from the commercial catch. Age 9 herring dominated (29.2%) the catch sample. Herring aged 9 and older comprised 79.2% of the catch sample. There were no recruit-age herring in the commercial sample.

An additional 115 herring were sampled from the test commercial gillnet catch. Age 9 herring dominated (41.1%) the test catch sample. Herring aged 9 and older comprised 80% of the test catch sample. There was less than 1% recruit-age herring in the test commercial sample.

Cape Romanzof District

A total of 879 tons of herring were harvested by 65 fishermen in 1997 (Tables 1, 2 and 3). The commercial harvest was 66% above the recent five-year-average (1992-1996) of 530 tons. All of the herring harvest was sold as sac roe, with an average roe recovery of 10.2%. The commercial harvest was allowed to approach the preseason harvest projection of 900 tons. The commercial fishery consisted of nine fishing periods between May 21 and May 25 (Table 6). Fishing periods ranged from 1 hour to 5 hours in duration for a total fishing time of 29.5 hours. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season.

Estimated value of the harvest to fishermen was $186,000. Three companies purchased herring. These companies were represented by one processing vessel and ten tenders during the fishery (Table 3).

Fishing effort was similar to the 1996 fishing season. Local Alaskan residents (defined as residents of Chevak, Hooper Bay, and Scammon Bay) accounted for 95% (62 permits) of the effort and 95% (839 tons) of the harvest. Fishermen harvested an estimated 17.6% of the available biomass (Table2).

A total of 560 herring were sampled from the commercial harvest. Age 9 herring dominated the harvest (40.5%). Age 9 and older herring made up 88.5 % of the catch (Figure 6). Recruit herring comprised less than 1% of the harvest.

Norton Sound District

The 1997 Norton Sound herring fishery opened by emergency order on May 20. During the sac roe season, there were four gillnet openings for a total fishing time of 20.0 hours and two beach seine openings for a total of 6.0 hours of fishing (Table 6). Approximately two tons of herring were harvested on May 25 by the school district using an educational permit. The total harvest during the sac roe fishery was approximately 3,972 tons of herring. The catch consisted of 3,709 tons of sac roe herring, 263 tons of bait-quality herring and 5 tons of wasted herring. Since 1981, catches, including waste, have averaged 4,625 tons.

A total of 220 fishermen made at least one delivery during the season (Table 3). During the 1997 season, 214 fishermen used gillnets to harvest a total of 3,459 tons (Tables 3 and 6). The gillnet harvest consisted of 3,196 tons of sac roe-quality herring with an average recovery of 10.0% and 263 tons of bait. Six fishermen participated in the beach seine fishery landing 513 tons of herring. The average sac roe recovery for beach seine-caught herring was 9.2%. Table 8 compares historical beach seine and gillnet commercial catches in the Norton Sound District. The average sac roe recovery for all gear types was 9.9% (Table 2.) Fishermen harvested an estimated 8.3% of the available biomass.

In recent years, the fishery managers have taken a more aggressive attitude in allowing commercial openings. During 1997, low prices caused fewer fishermen to participate in the fishery and the reduced harvest guideline caused less buyers and tenders to participate. Storms also delayed the arrival of many boats to Norton Sound. The older herring arrived fairly early and with mature roe. Because the participation was judged to be low, management staff opened earlier than normal to extend the time in which the fishery could occur. This strategy worked well with a minimal impact to roe quality. It did require an assumption that more herring would arrive later so that the high exploitation rates on the early arriving herring would be offset to levels mandated by regulation. Staff believe the preseason guideline harvest was conservative due to the poor survey data from 1996. As it was, more herring arrived than were anticipated.

The first confirmed sighting of herring was made during a May 17 aerial survey. The gillnet fishery opened May 20. Although the harvest was small due to a low level of participation, the quality was good. A second gillnet opening was called the following day, and the quality of the harvest remained high and participation was low. On May 22, the level of participation increased with the arrival of more of the fleet and the roe quality remained high. The last gillnet and the first beach seine opening occurred May 23. The abundance of high roe quality herring began to decline on May 23, and there was a significant decline in abundance by May 24. The decline in abundance did not have much affect on the harvest during the last beach seine opening, which produced over twice the first period's harvest. Beach seine fishermen were able to fish in an area where herring were still preparing to spawn.

Nine companies were present on the grounds during the season to purchase herring. Two of these companies combined to report as one buyer during the fishery. These nine companies registered nine processors and 46 tenders to operate in Norton Sound (Table 3). The total value of the herring harvest to Norton Sound fishermen was approximately $612,000.

A total of 1,226 herring were sampled from the commercial harvest. Age 9 herring dominated the harvest comprising 53.8% of the gillnet catch and 51.1% of the beach seine harvest. Age 9 and older herring represented 89.0% of the gillnet sample and 72.5% of the beach seine catch. Recruit herring comprised less than 1% of the gillnet sample and recruits comprised 6.8% of the beach seine sample.

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. A small bait fishery with a harvest less than 10 tons occurs in most years. However, there was not a bait fishery in Port Clarence in 1997.

ENFORCEMENT

The Division of Fish and Wildlife Protection (FWP) was present in Goodnews Bay, Security Cove, and Norton Sound Districts this year. A special project targeted violators of superexclusive regulations during the 1997 herring fisheries. FWP officers collected as much information as possible on permit holders, crew and vessels participating in the various herring districts. However, because of the timing of the Norton Sound fishery, officers were not present in the Cape Avinof, Nelson Island, Nunivak Island and Cape Romanzof Districts. At least ten officers from FWP using the P/V Walstad, two supercub aircraft, a Cessna 185, a R-22 helicopter and two FWP skiffs were involved with the Security Cove and Goodnews Bay fisheries. Specific information about citations issued in the Kuskokwim area was not available for this report.

Protection efforts in Norton Sound consisted of five single engine aircraft (three supercubs on wheels, one supercub on floats, and a R-22 helicopter) and two small boats. Personnel consisted of seven permanent full-time FWP officers, 2 seasonal assistants and a US Fish and Wildlife agent. Fish and Wildlife protection boarded 879 vessels statewide during the 1997 Norton Sound herring fishery to collect information about permit holders, crew and vessel registration. A total of 22 citations were issued during the Norton Sound fishery. Seven of these were for violation of superexclusive regulations by vessels or permit holders. Five boats were seized. Other citations in the Norton Sound fishery were issued for violations including fishing an extra shackle of gear, and buying from a fisherman without a permit. Fish and Wildlife Protection officers patrolled the fishery during each opening and closure. Eleven citations were issued for fishing during a closed period and one was issued for not having vessel numbers visible. Approximately 14 tons of herring were seized by the State of Alaska in Norton Sound during the 1997 season.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1998

Projections from postseason escapement estimates, using historic mean rates of survival, current mean weights for each age class, and estimates of recruitment for each age class (Wespestad 1982), suggest that the 1998 spawning biomass for northeastern Bering Sea herring stocks (Security Cove to Norton Sound) will be 67,737 tons, with an anticipated allowable harvest of 13,141 tons (Table 7). If the return is as expected, a small to moderate reduction in biomass will be observed in all districts.

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. In all districts, the Department will work together with fishermen and buyers during the 1998 season to optimize roe recovery.

Security Cove District

The 1998 projected return to the Security Cove District is 4,017 tons. A 20% exploitation rate would result in a harvest of 803 tons (Table 7). A larger catch may occur if the 1998 biomass is assessed to be greater than projected. 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 5 and 7 are expected to comprise over one-half of the biomass (36.5% and 18.2%, respectively). Age 9 and older herring are expected to comprise one-fourth of the biomass.

Goodnews Bay District

The management strategy for this district will be similar to that planned 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 1998 projected return of herring to the Goodnews Bay District is 4,064 tons. A 20% exploitation rate would result in a harvest of 813 tons (Table 7). A larger catch may occur if the 1998 biomass is assessed to be greater than projected.

Similar to Security Cove, ages 5 and 7 are expected to comprised over one half of the returning biomass (31.5% and 19.6%, respectively). Age 9 and older herring are expected to comprise over one-fourth 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 1998 biomass for the Cape Avinof District is 4,287 tons (Table 7). The exploitation rate will be no greater than 15% because of the limited database for this area and the priority of subsistence fishing. Assuming a 15% commercial exploitation rate, the projected harvest will be 643 tons of herring.

Ages 5 and 8 herring are expected to dominate the returning population (38.9% and 17.0%, respectively). Age 9 and older herring are expected to comprise over one-fourth of the biomass.

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 for 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 1998 is 7,136 tons (Table 7). At an exploitation rate of 15%, the harvest will be 1,070 tons of herring. A larger catch may occur if the 1998 biomass is assessed to be greater than projected.

Age 5 herring are expected to comprise almost one-third of the return. Age 9 and older herring are expected to comprise over one-third of the biomass in 1998.
To provide additional protection for the subsistence harvest of herring, the following guidelines will be observed:

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 districts.

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

3. Several important subsistence use areas occur throughout the district, including the waters around 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 acting on input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Nunivak Island District

The biomass of herring projected to return to the Nunivak Island District in 1998 is 3,778 tons. A 20% exploitation rate would result in a 756 ton harvest (Table 7). A larger catch may occur if the 1998 biomass is assessed is to be greater than projected. The commercial season will open when the biomass reaches 1,500 tons, or when significant spawning is observed.

Due to insufficient data having been collected from the Nunivak Island District in 1997, the estimated 1998 herring age composition was calculated using data from Nelson Island District. Age 5 herring are expected to comprise almost one-third of the returning biomass. Age 9 and older herring are expected to comprise over one-third of the return.

Cape Romanzof District

The projected return for 1998, based on limited data, is expected to be between 3,300 and 4,200 tons based on an assessed biomass of between 4,500 and 5,500 tons in 1997. The midpoint of this range for 1997 was 5,000 tons, which resulted in a projection of 3,767 tons. At a 20% exploitation rate, the harvest based on this projection would be 753 tons (Table 7). The allowable harvest is expected to range from approximately 650 to 850 tons and will be based on inseason indicators of abundance. It is likely that fishing gear will be restricted to no more than 50 fathoms and one gillnet per vessel by emergency order. Since water turbidity in the Cape Romanzof area generally prevents aerial observations of herring, spawn deposition and test and commercial catch rates will be used to determine the timing and duration of commercial fishing periods. If stock abundance is judged to be lower or higher than projected, the projected harvest of 753 tons will be modified accordingly.

Ages 10, 5 and 8 herring are expected to dominate the biomass, contributing 31.9%, 17.6% and 15.1%, respectively. Age 9 and older herring are expected to comprise over one-half of the return.

Norton Sound District

The biomass projected to return to Norton Sound in 1998 is 40,688 tons. A 20% exploitation rate would result in a harvest of 8,138 tons (Table 7). As in Cape Romanzof, ages 10, 5 and 9 herring are expected to dominate the returning biomass (36.5%, 14.9% and 12.1%, respectively). Age 9 and older herring are expected to comprise 62.7% 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 814 tons.

The 1998 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 1998. 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, 1909-1997.

	Herring (st) [a]									Spawn on Kelp (st)
Year	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound [b]	Port Clarence	Total Harvest	Norton Sound
1909-1916	-	-	-	-	-	-	-	-	-	-
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	-
1995	1,292	1,054	485	1,113	41	541	6,763	-	11,289	-
1996	1,859	1,204	820	1,030	101	752	6,220	-	11,986	-
1997	892	805	687	778	0	879	3,976	-	8,017	-

a Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage is 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, 1990-1997.

Year	District	Estimated Biomass(st)	Harvest (st) Sac roe	Bait	Waste	Total	Roe %	Estimated Value ($ x 1,000)	Exploitation Rate (%)
1997	Security Cove	4,640 [b]	884	3	5	892	12.5	221	19.2
	Goodnews Bay	4,752 [b]	805	0	0	805	14.2	228	16.9
	Cape Avinof	4,600 [b]	687	0	0	687	11.5	157	14.9
	Nelson Island	7,900 [b]	778	0	0	778	12.7	198	9.8
	Nunivak Island	3,801 [b]	0	0	0	0	-	-	0
	Cape Romanzof	5,000 [b]	879	0	0	879	10.2	186	17.6
	Norton Sound	47,791	3,709	263	5	3,976	9.9	612	8.3
Total		78,484	7,742	266	10	8,017	11.1	1,602	10.2
1996	Security Cove	6,867	1,795	59	5	1,859	11.6	1,251	27.1
	Goodnews Bay	6,315	1,191	13	0	1,204	12.5	895	19.1
	Cape Avinof	4,500 [b]	820	0	0	820	13.4	659	18.2
	Nelson Island	6,638 [b]	986	44	0	1,030	11.4	679	15.5
	Nunivak Island	4,195 [b]	61	40	0	101	9.9	39	2.4
	Cape Romanzof	6,000 [b]	750	1	0	752	10.6	638	12.5
	Norton Sound	27,307 [b]	6,061	109	50	6,220	10.6	4,569	22.8
Total		61,822	11,664	266	55	11,986	11.2	8,730	19.4
1995	Security Cove	6,702 [b]	1,292	0	0	1,292	12.3	956	19.3
	Goodnews Bay	4,219 [b]	1,051	0	3	1,054	13.5	848	25.0
	Cape Avinof	3,627 [b]	485	0	0	485	12.5	363	13.4
	Nelson Island	7,754	1,113	0	0	1,113	10.6	710	14.3
	Nunivak Island	4,579 [b]	33	7	0	41	11.0	22	0.9
	Cape Romanzof	5,000 [b]	541	0	0	541	10.1	328	10.8
	Norton Sound	37,779	6,647	116	10	6,773	10.4	4,206	17.9
Total		69,660	11,162	123	13	11,299	11.0	7,433	16.2
1994	Security Cove [c]	7,638 [b]	-	-	-	-	-	-	-
	Goodnews Bay	5,679 [b]	1,061	0	1	1,062	12.3	391	18.7
	Cape Avinof	2,827 [b]	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 [b]	456	0	0	456	9.2	124	9.1
	Norton Sound	37,829	958	2	0	960	10.3	271	2.5
Total		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 [b]	206	9	0	215	12.0	75	7.6
	Nelson Island	4,944	613	52	74	739	10.6	198	14.9
	Nunivak Island [c]	5,176	-	-	-	-	-	-	-
	Cape Romanzof	4,000 [b]	371	0	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 [b]	516	14	0	530	8.0	159	11.8
	Norton Sound [c]	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 [b]	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 Island [c]	2,705	-	-	-	-	-	-	-
	Nunivak Island [c]	422	-	-	-	-	-	-	-
	Cape Romanzof	4,500 [b]	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

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 or some other method of estimating biomass was used.
c No commercial fishery.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1990-1997.

Year	District	Number of Buyers	Number of Fishermen		
			Gillnet	Beach Seine [a]	Totals
1997	Security Cove	14	222	-	-
	Goodnews Bay	3	139	-	-
	Cape Avinof	2	145	-	-
	Nelson Island	3	105	-	-
	Nunivak Island	1	12	-	-
	Cape Romanzof	3	65	-	-
	Norton Sound	9	214	6	220
1996	Security Cove	14	326	-	-
	Goodnews Bay	5	182	-	-
	Cape Avinof	2	161	-	-
	Nelson Island	3	109	-	-
	Nunivak Island	2	24	-	-
	Cape Romanzof	3	63	-	-
	Norton Sound	10	281	6	287
1995	Security Cove	12	106	-	-
	Goodnews Bay	4	127	-	-
	Cape Avinof	2	93	-	-
	Nelson Island	4	100	-	-
	Nunivak Island	2	13	-	-
	Cape Romanzof	2	49	-	-
	Norton Sound	6	209	6	215
1994	Security Cove	0	0	-	-
	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	215
1993	Security Cove	1	9	-	-
	Goodnews Bay	3	63	-	-
	Cape Avinof	1	97	-	-
	Nelson Island	1	73	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	2	41	-	-
	Norton Sound	6	256	7	263
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	0	-	-
1991	Security Cove	6	52	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	137	-	-
	Nelson Island	0	0	-	-
	Nunivak Island	2	17	-	-
	Cape Romanzof	2	80	-	-
	Norton Sound	8	272	7	279
1990	Security Cove	9	52	-	-
	Goodnews Bay	3	126	-	-
	Cape Avinof	1	101	-	-
	Nelson Island	0	0	-	-
	Nunivak Island	0	0	-	-
	Cape Romanzof	4	95	-	-
	Norton Sound	8	357	8	365

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, 1978-1997.[a]

Village	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
								Nelson Island												
Tununak	38	34	65	40	48	94	-	43	63	48	49	47	54	21	32	45	42	30	25.8	-
Umkumiut	11	8	3	10	0	-	-	-	-	[c]	[c]	[c]	[c]	[c]	[c]	-	-	-	-	-
Toksook Bay	37	51	29	14	35	-	-	46	70	51	58	52	46	40	43	23	53	46	41.5	-
Nightmute	-	-	-	-	-	-	-	3[b]	21	15	16	15	18	8	10	9	13	13	16.2	-
Newtok	-	-	-	-	-	-	-	7[b]	13	10	12	10	8	1	7	6	9	9	11.5	-
Total	86	93	97	64	83	94	-	99	167	124	136	124	126	70	92	82	117	98	95	-
No. Fishing Families	83	54	70	93	65	43	-	65[b]	72[b]	96	104	[b]	100	85	97	89	-	91	96	-
								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	-	8	13	-	13	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	8	13	-	13	-	-	30	2	28	-	-	-	-	-	-	-	-	-	-
No. Fishing Families	-	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	1	1	1
Chevak	-	2	4	2	2	1	3	2	1	1	2	<1	1	<1	<1	<1	2	1	<1	<1
Hooper Bay	4	3	4	4	5	5	4	4	4	1	4	2	6	2	2	2	3	4	2	2
Total	5	11	11	14	11	9	11	8	6	3	7	3	8	3	4	5	6	6	3	3
No. Fishing Families	30	84	61	45	43	37	47	44	40	23	32	24	32	18	30	42	48	42	29	34

[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, 1978-1997.

	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
1993	6,995	6,211	2,837 [b]	4,944	5,176	4,000	46,549	822	77,534
1994	7,638 [b]	5,679 [b]	2,827 [b]	5,564	4,921	5,000	37,829	92	69,550
1995	6,702 [b]	4,219 [b]	3,627 [b]	7,754	4,579 [b]	5,000	37,779	-	69,660
1996	6,867	6,315	4,500 [b]	6,638 [b]	4,195 [b]	6,000	27,307 [b]	-	61,822
1997	4,640 [b]	4,752 [b]	4,600 [b]	7,900 [b]	3,801 [b]	5,000 [c]	47,791	-	78,484

a Biomass estimate based on limited aerial survey information, spawn deposition, age composition, and CPUE from commercial and test fisheries.

b Unacceptable aerial survey conditions for estimating herring biomass, therefore projected biomass or some other method of estimating biomass was used.

c Biomass listed for Cape Romanzof is midpoint for estimated range of 4,500 to 5,500 tons.

Table 6. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1997.

District	Subdistrict Sec/Area	Gear	Period	Date	Time	Total Hours	Harvest (st)
Security Cove		Gillnet	1	5/07	1900-2230	3.5	324.6
			2	5/08	0730-1030	3.0	195.8
			3	5/08	1930-2330	4.0	366.8
					Total	10.5	887.2
Goodnews Bay		Gillnet	1	5/16	1400-1800	4.0	33.3
			2	5/17	1400-1900	5.0	14.4
			3	5/19	1530-2030	5.0	53.1
			4	5/20	0330-0930	6.0	191.9
			5	5/20	1600-2100	5.0	94.3
			6	5/21	0400-1000	6.0	219.1
			7	5/21	1600-2200	6.0	53.2
			8	5/22	0500-1100	6.0	83.7
			9	5/23	0600-1200	6.0	48.6
			10	5/24	0600-1100	5.0	10.0
			11	5/24	1900-2400	5.0	2.7
			12	5/25	0700-1300	6.0	0.8
					Total	65.0	805.2
Cape Avinof		Gillnet	1	5/21	2000-2400	4.0	105.7
			2	5/22	0800-1400	6.0	128.9
			3	5/22-23	2000-0200	6.0	172.5
			4	5/23	0900-1500	6.0	148.7
			5	5/23-24	2200-0200	4.0	131.3
					Total	26.0	687.0
Nelson Island		Gillnet	1	5/20-21	2100-0100	4.0	304.0
			2	5/21	0900-1300	4.0	403.5
			3	5/22	1100-1300	2.0	70.7
					Total	10.0	778.2
Nunivak Island		Gillnet	1	5/21	1700-2300	6.0	0.0
			2	5/24-27	1800-1000	64.0	0.0
					Total	70.0	0.0
Cape Romanzof		Gillnet	1	5/21	0030-0300	2.5	18.1
			2	5/21	1200-1500	3.0	30.1
			3	5/22	0000-0430	4.5	260.0
			4	5/23	0000-0430	4.5	57.1
			5	5/23	1430-1630	2.0	35.4
			6	5/24	0030-0530	5.0	125.2
			7	5/24	1430-1730	3.0	132.1
			8	5/25	0300-0700	4.0	207.0
			9	5/25	1600-1700	1.0	14.2
					Total	29.5	879.2
Norton Sound	1,2,3	Gillnet	1	5/20	1400-1700	3.0	389.6
	1,2,3		2	5/21	0600-1200	6.0	885.8
	1,2,3		3	5/22	0800-1500	7.0	1,483.0
	1,2,3		4	5/23	1000-1400	4.0	698.3
	School District Permit			5/24			2.1
					Total	20.0	3,458.8
	1,2,3	Beach	1	5/23	0600-0900	3.0	144.5
	1,2,3	Seine	2	5/24	0800-1100	3.0	368.2
					Total	6.0	512.7

Table 7. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1998.

		1998 Projection [a]		
			Exploitation	
District	Threshold	Biomass (st)	Rate (%)	Harvest (st)
Security Cove	1,200	4,017	20	803
Goodnews Bay	1,200	4,064	20	813
Cape Avinof	500	4,287	15	643
Nelson Island	3,000	7,136	15	1,070
Nunivak Island	1,500	3,778	20	756
Cape Romanzof	1,500	3,767 [b]	20	753 [b]
Norton Sound	7,000	40,688	20	8,138
Port Clarence	-	-	-	165 [c]
Totals		67,737		13,141

a Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.

b Projection from midpoint of 1997 biomass estimate of 4,500 to 5,500 tons which was based on spawn deposition, age composition, and CPUE from commercial and test fisheries. Allowable harvest will range from 650 to 850 tons based on inseason indicators of abundance

c Harvest guideline of 165 st (150 mt).

Table 8. Herring harvest by gear type and subdistrict, Norton Sound District, 1982-1997.

	NORTON SOUND HERRING CATCHES															
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
GILLNET HARVEST (tons)																
St. Michael	2,062	434	-	1,538	2,560	2,214	3,215	2,927	4,491	-	-	2,288	249	2,359	3,074	1,575
Unalakleet	946	1,264	-	95	-	-	42	10	618	731	-	120	12	374	-	20
Cape Denbigh	925	2,692	3,244	1,599	2,420	1,545	1,211	1,414	923	4,419	-	1,659	619	1,467	2,507	1,864
Elim	-	65	-	147	-	-	6	-	-	-	-	225	41	1,774	-	-
Golovin	-	85	-	-	-	-	-	-	-	-	-	-	-	191	-	-
Total [a]	3,933	4,540	3,244	3,379	4,980	3,759	4,474	4,351	6,032	5,150	[b]	4,291	921	6,166	5,581	3,459
SEINE HARVEST (tons)																
St. Michael (beach)	-	-	-	-	-	4	45	329	6	-	-	-	1	-	-	472
Unalakleet (beach)	-	-	-	93	-	-	58	50	332	149	-	467	24	230	111	41
Cape Denbigh (beach)	-	41	327	76	30	293	96	11	9	373	-	222	15	57	325	-
Elim (beach)	-	-	-	-	185	-	-	-	-	-	-	54	-	334	153	-
Cape Denbigh (purse)	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-
Total [a]	0	41	327	169	215	323	198	390	347	522	[b]	743	40	621	589	513
TOTAL HARVEST (tons) [a]	3,933	4,581	3,571	3,548	5,195	4,082	4,672	4,741	6,380	5,672	0	5,034	961	6,787	6,170	3,972
Percent of total harvest																
Gillnet Harvest	100	99.1	90.8	95.2	95.9	92.1	95.8	91.8	94.6	90.8		85.2	95.9	90.9	90.5	87.1
Seine Harvest	0	0.9	9.2	4.8	4.1	7.9	4.2	8.2	5.4	9.2		14.8	4.1	9.1	9.5	12.9

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

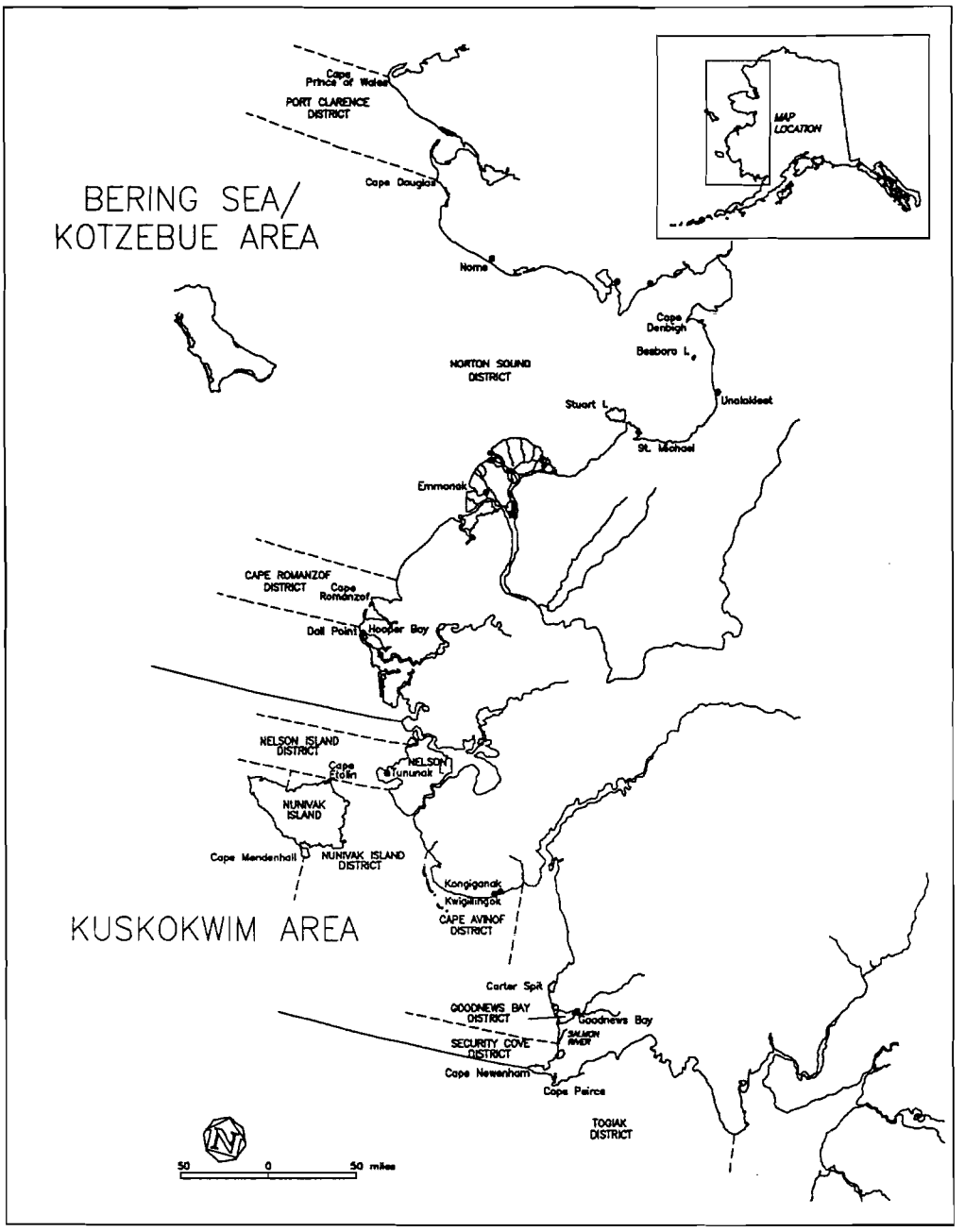

Figure 1. Commercial herring fishing districts within the Arctic-Yukon -Kuskokwim Region, Alaska, 1996.

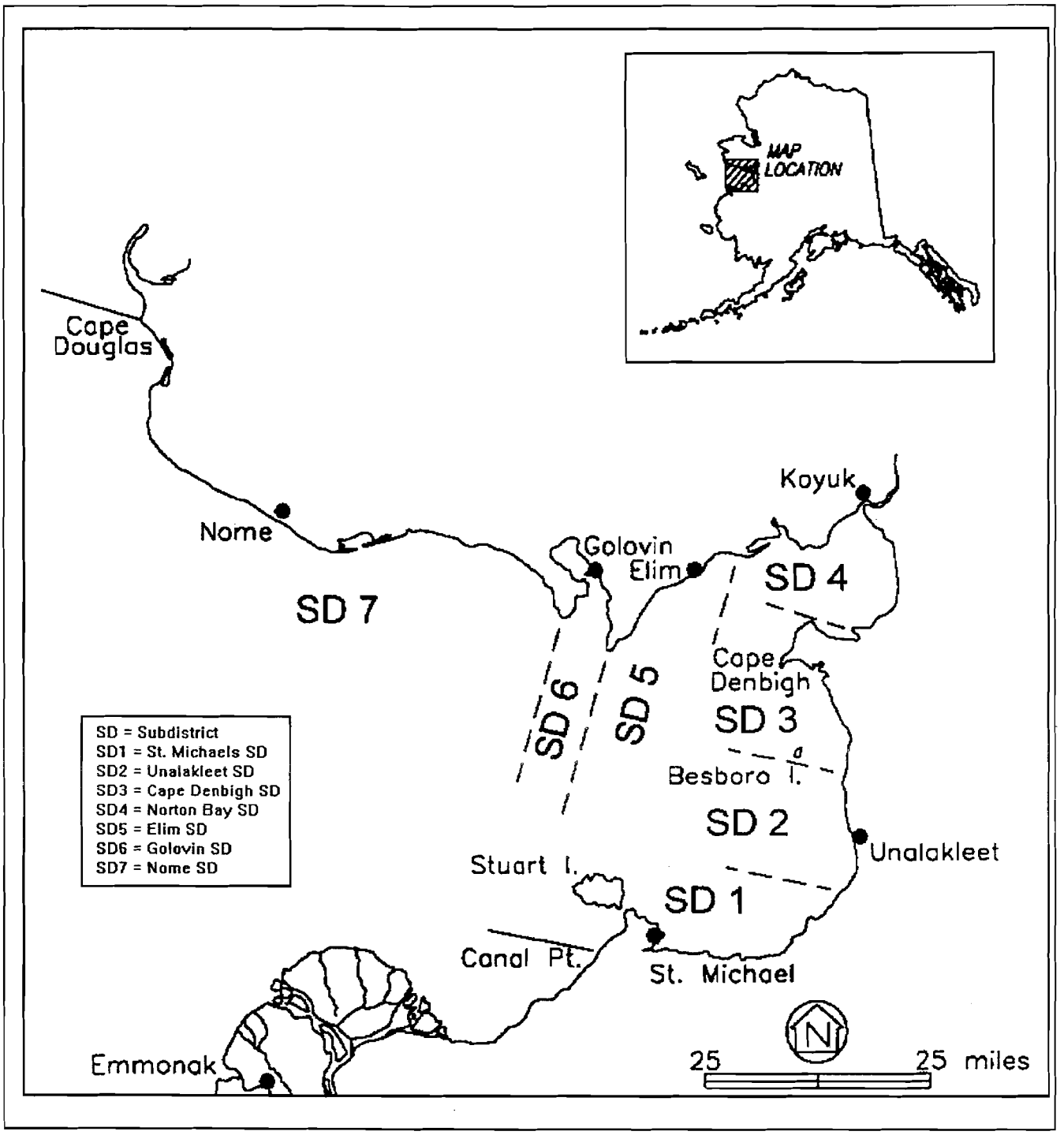

Figure 2. Norton Sound commercial herring subdistricts.

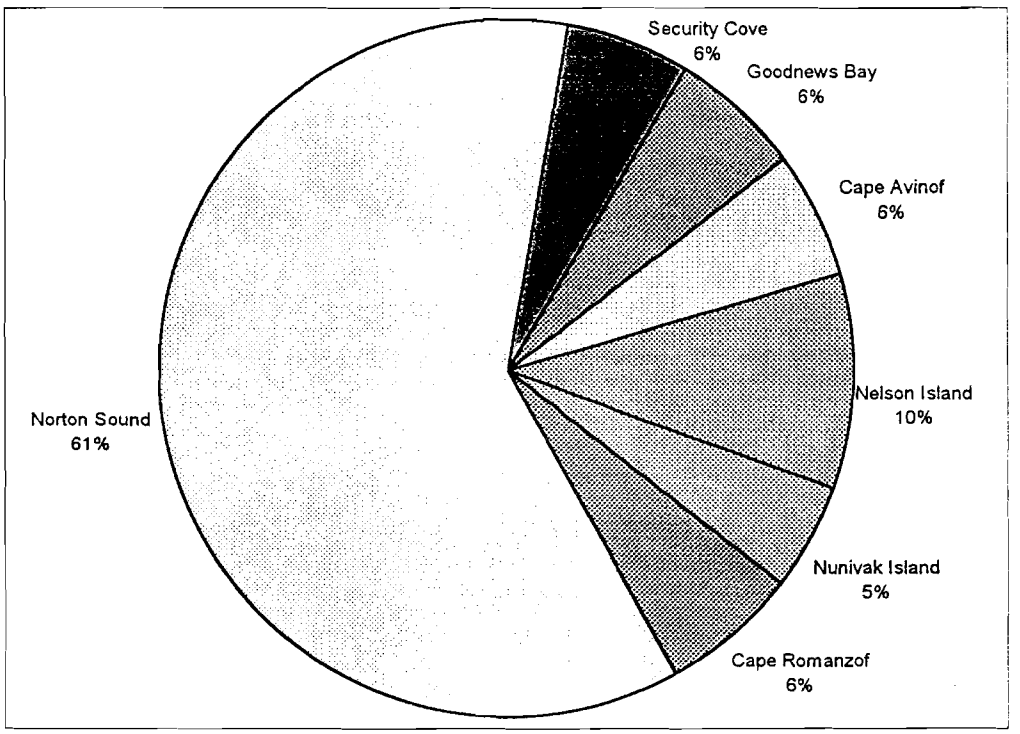

Figure 3. Pacific herring run biomass distribution by fishing district Arctic-Yukon-Kuskokwim Region, Alaska, 1997.

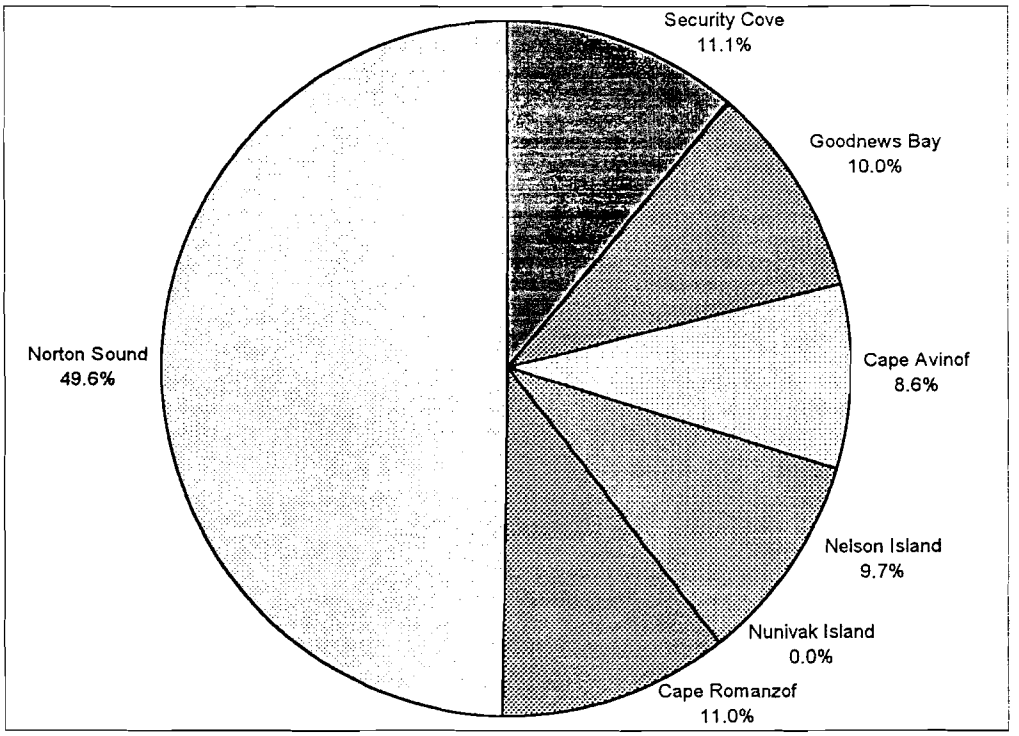

Figure 4. Pacific herring commercial harvest distribution by fishing district Arctic-Yukon-Kuskokwim Region, Alaska, 1997.

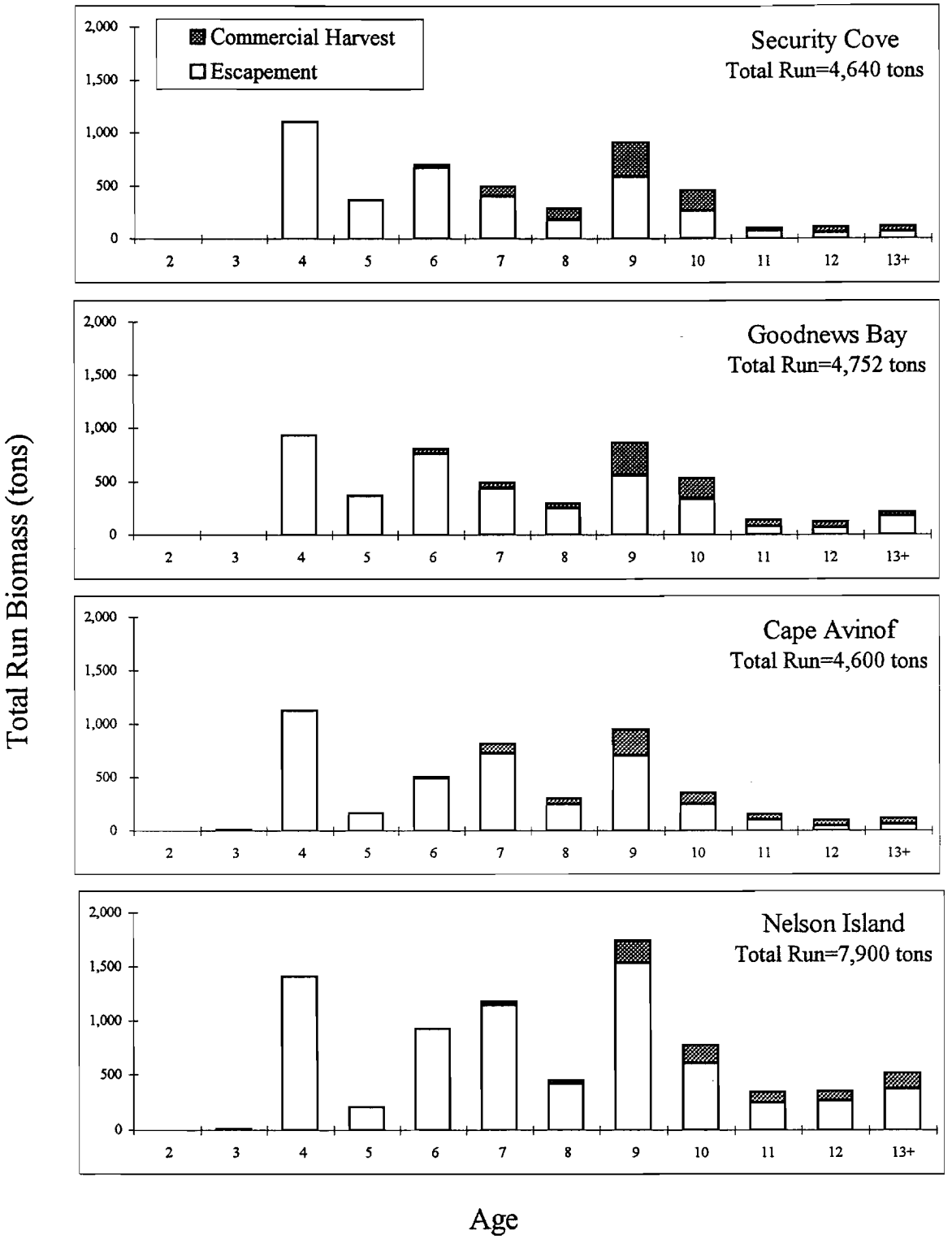

Figure 5. Age composition of Pacific herring for the total run, escapement and harvest biomass for the Security Cove, Goodnews Bay, Cape Avinof, and Nelson Island Districts within the Arctic-Yukon-Kuskokwim Region, Alaska, 1997.

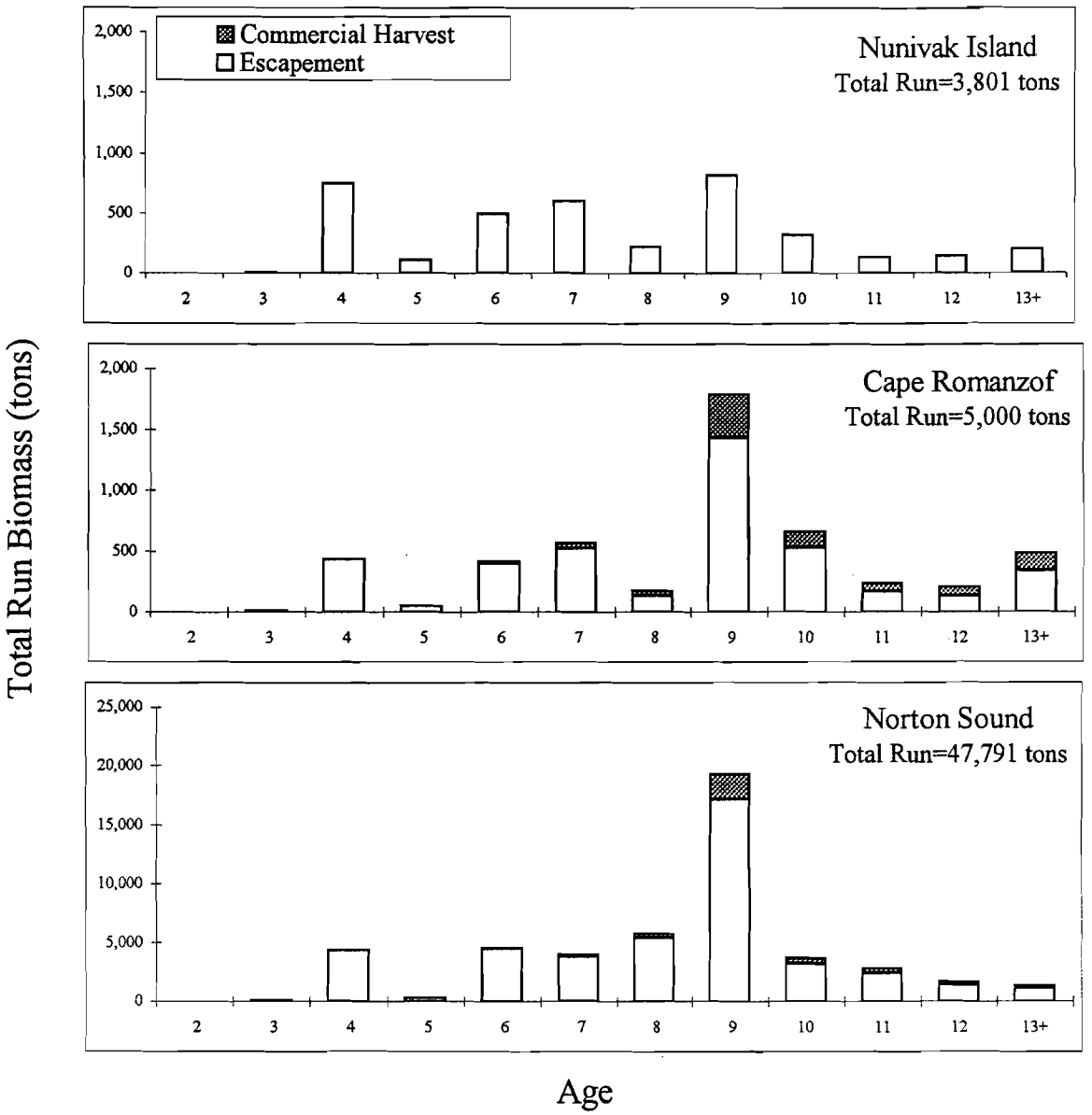

Figure 6. Age composition of Pacific herring for the total run escapement and harvest bimass for the Nunivak Island, Cape Romanzof, and Norton Sound Districts, within the Arctic-Yukon-Kuskokwim Region, Alaska, 1997. Cape Romanzof biomass estimated to be between 4,500 and 5,500 tons.

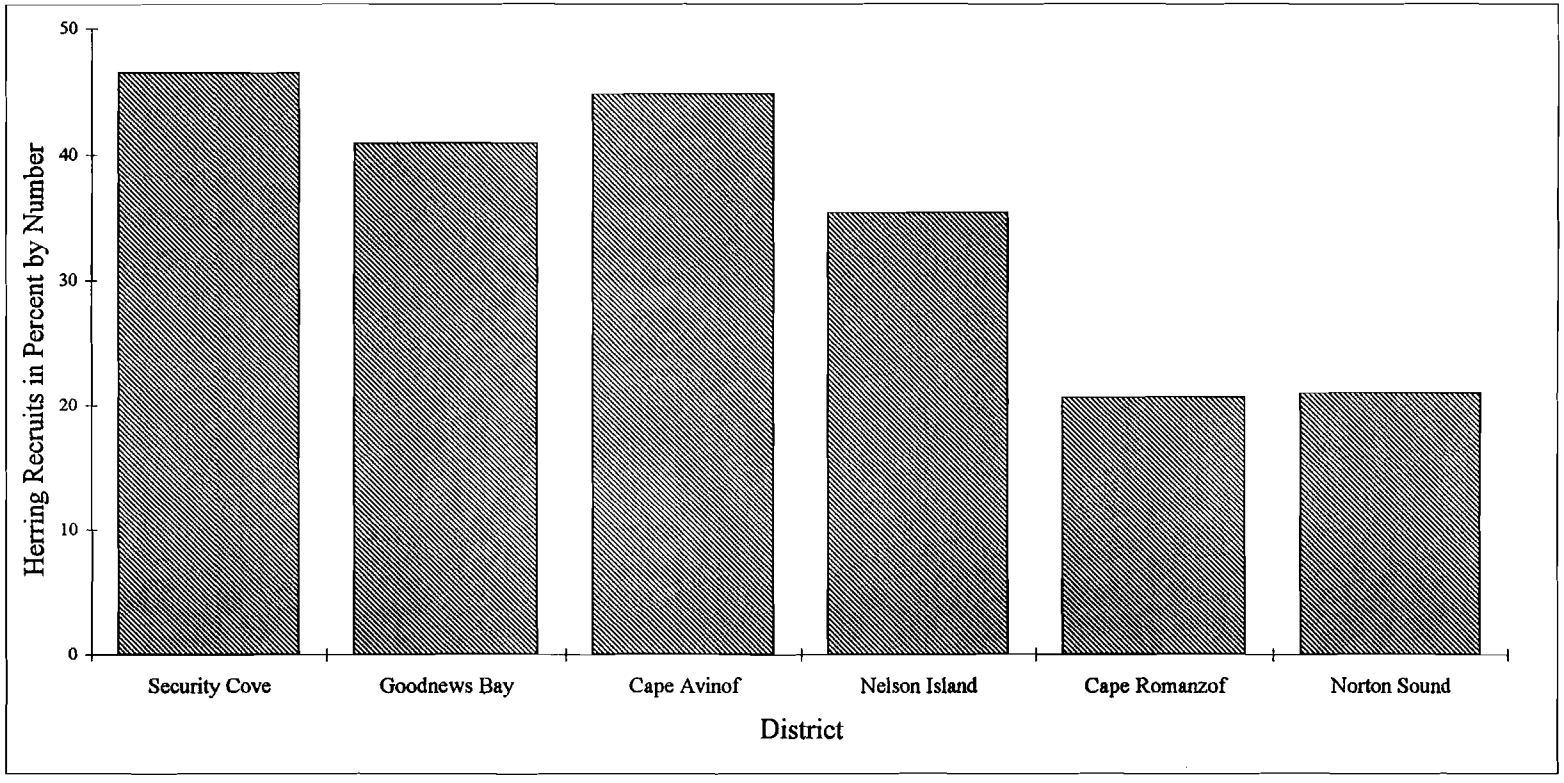

Figure 7. Pacific herring recruits (ages 2 through 5) for commercial fishing districts within the Arctic-Yukon Kuskokwim Region, Alaska, 1997.

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