# MIGRATION OF BERING SEA HERRING AND THE STATUS OF HERRING STOCKS AT NELSON AND NUNIVAK ISLANDS

Edited By:

Fritz Funk

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# PREFACE

This report is divided into two sections. The first section summarizes the currently available information on stock identification and migration patterns of herring in the Bering Sea. While most of the report condenses information from a large number of existing migration studies, some new information is presented on migratory timing of eastern Bering Sea herring stocks. The second section describes the herring stock status and commercial herring fisheries at Nelson Island and Nunivak Islands.

# SUMMARY OF BERING SEA HERRING STOCK IDENTIFICATION AND MIGRATION STUDIES

By:

Fritz Funk, Kathy Rowell, and Dana Schmidt

## EXECUTIVE SUMMARY

The Dutch Harbor food and bait fishery harvests migrating herring stocks enroute from spawning grounds to offshore wintering grounds. The following information summarizes what is known about the origin of herring caught in the Dutch Harbor food and bait fishery.

1. Several stock separation studies have indicated that the origins of the herring caught in this fishery are predominantly from the Togiak stock, averaging 78% Togiak over all studies.

2. The composition of the non-Togiak component of the harvest cannot be identified as to origin. Possible stocks contributing to the non-Togiak component include Norton Sound, Cape Romanzof, Nunivak Island, Nelson Island, Cape Avinof, Goodnews Bay, Security Cove, Port Moller, and possibly other Alaska Peninsula or other stocks. An estimate of the composition of the non-Togiak component is best made by using the relative biomass of the non-Togiak stocks.

3. In 1989, the Alaska Department of Fish and Game conducted a detailed examination of a single sample taken from one trawl haul from the groundfish fishery and of a single sample taken from one purse seine in the Dutch Harbor food and bait fishery. This study indicated that the schools from which the two samples were selected represented a segregated age-size composition, and had a larger component of non-Togiak herring than would be expected if herring from all areas were randomly mixed. However, the overall result of this study showed that Togiak stocks dominated (78%) the Dutch Harbor harvest, agreeing with earlier stock separation studies conducted by the University of Washington. The finding of segregated age-size compositions does not change the overall stock composition estimates, but increases the variability of predicted of stock composition estimates.

4. Herring from Nelson Island likely overwinter with other eastern Bering Sea herring stocks in the area north and west of the Pribilof Islands. Both a clockwise, coastal route around Bristol Bay and a counterclockwise, direct offshore route to the wintering grounds have been hypothesized for the Nelson Island stock. No convincing evidence exists to suggest that the Nelson Island herring stock follows one route or the other. If Nelson Island herring migrate via the counterclockwise, direct offshore route, they would not be taken in the Dutch Harbor food and bait fishery. If Nelson Island herring migrate via the clockwise, coastal route, the relative biomass of eastern Bering Sea herring stocks is the best available predictor of the composition of a late summer Dutch Harbor food and bait fishery.

5. Swimming speed analyses suggest that if Nelson Island herring migrate clockwise, they would not arrive at Dutch Harbor until at least early August, and perhaps as late as mid-September. Togiak herring are known to arrive at Dutch Harbor by mid-July. This suggests that a mid-July fishery at Dutch Harbor could avoid Nelson Island herring. Previous scale pattern analyses were not capable of detecting any meaningful trend in the proportion of non-Togiak stocks over time.

## INTRODUCTION

Commercial sac roe fisheries have developed around nine major herring spawning locations in the eastern Bering Sea (Figure 1). After spawning, these herring stocks begin a long migration to offshore wintering areas. During the course of this migration additional herring are taken in the Dutch Harbor food and bait fishery and as bycatch in the pollock and cod trawl fisheries.

This document summarizes the available information on the migration routes of these stocks, with an emphasis on the stock composition of herring harvests taken near Dutch Harbor during mid to late summer. Of particular concern is the magnitude of the catch of the depressed Nelson and Nunivak Island herring stocks in the Dutch Harbor food and bait fishery and trawl fisheries which occur in the Dutch Harbor area. Most of the emphasis is placed on the Nelson Island herring stock because of its former substantial abundance and the importance of subsistence herring harvests to Nelson Island residents. However, much of the material also applies to the nearby Nunivak Island herring stock.

## MIGRATION ROUTES

Soviet research vessels located the wintering grounds of eastern Bering Sea herring north and west of the Pribilof Islands (Figure 2) in the early 1960s (Rumyantsev and Darda 1970). Soviet and Japanese trawl fleets developed a massive fishery on the herring wintering grounds during the 1960's. During the early spring, Soviet and Japanese vessels tracked eastward movements of herring schools and established the western Alaskan coast as the spawning location for the herring that were wintering north and west of the Pribilof Islands. During the late 1960's, Japanese gillnet vessels were fishing just offshore of most of the locations of present sac roe herring fisheries (NPFMC 1983). For several months after spawning, the foreign fleets were not able to track herring movements, leading Rumyantsev and Darda (1970) to conclude that post-spawning herring migrations were occurring in nearshore coastal waters. In the central Bering Sea, Rumyantsev and Darda (1970) reported that adult herring reappeared in research catches southwest of Nunivak Island in early August (Figure 3). In the southern Bering Sea, herring also reappeared in Soviet and Japanese catches during August (Wespestad and Barton 1981), in the "horseshoe" area just north of Unimak Pass.

The timing of the clockwise migration of herring around Bristol Bay was further refined by Funk (1990) from records of herring bycatch in foreign and joint venture trawl fisheries in the Bering Sea. Herring bycatch is negligible during May when herring are spawning inshore (Figure 4A). During June, a large aggregation of herring appears in vicinity of Port Moller (Figure 4B). By mid-July, the aggregation has reached the Unimak Pass area (Figure 5A), with substantial offshore movement occurring by August (Figure 5B). Because the Togiak stock comprises the largest biomass of the western Alaskan spawning stocks, these data likely indicate only the movements of the Togiak stock. The movements of smaller stocks would likely be masked by the larger Togiak stock. The Togiak stock has been observed exiting the spawning grounds along the Nushugak Peninsula (Figure 3). This indicates that the Togiak stock migrates clockwise around Bristol Bay in coastal waters and does not proceed in a straight line route to the Port

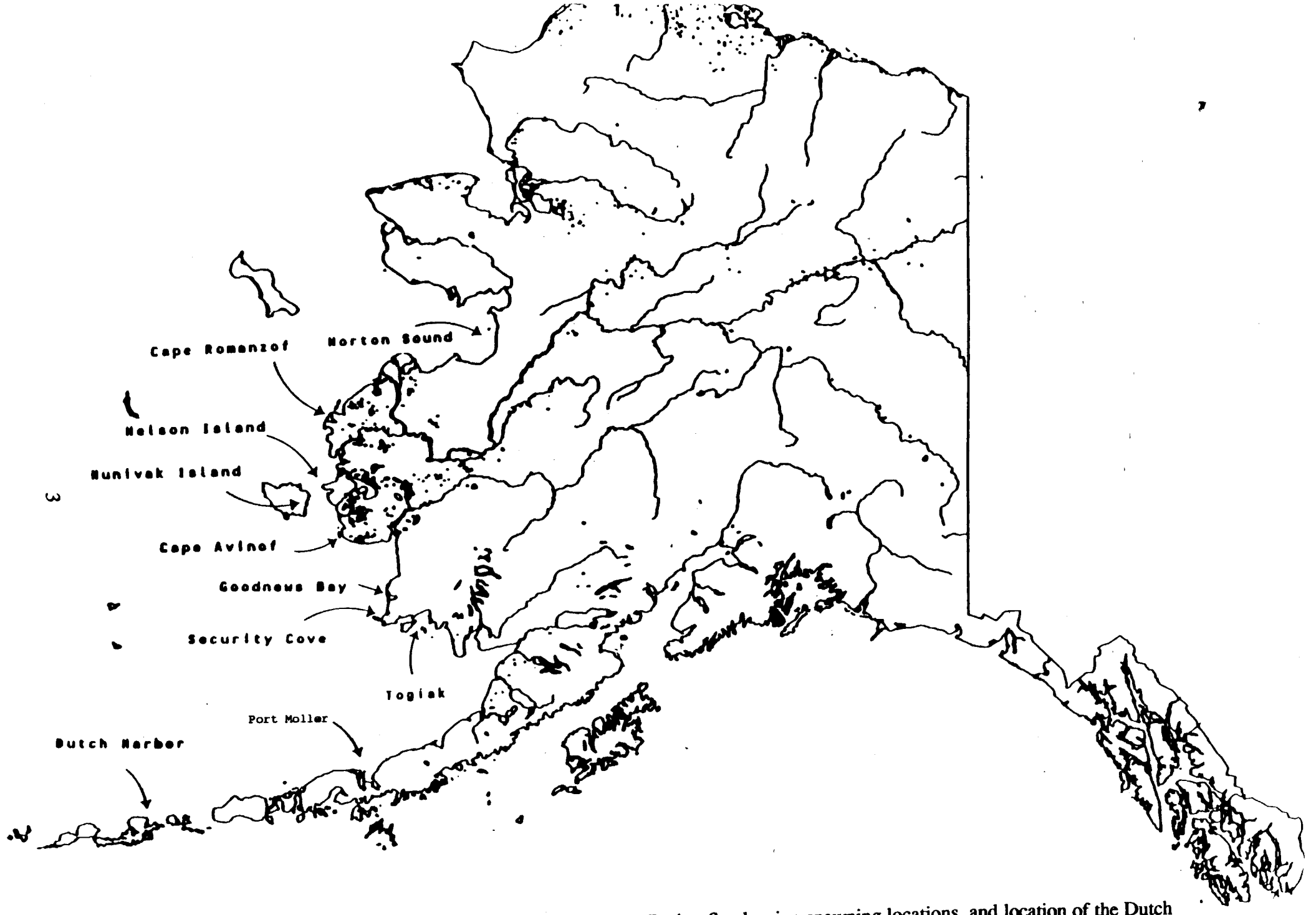


Figure 1. Location of commercial sac roe fisheries at nine eastern Bering Sea herring spawning locations, and location of the Dutch Harbor food and bait herring fishery.

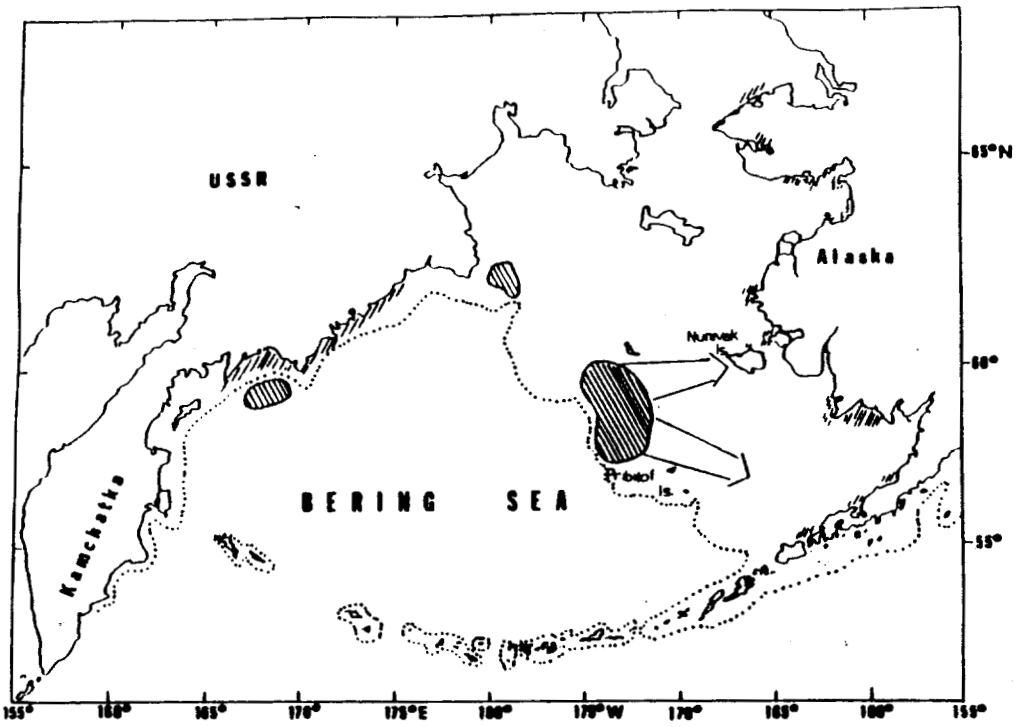


**Figure 2.** Location of spawning and winter grounds (oval areas) of main eastern and western Bering Sea herring stocks and routes of migration of eastern stocks to spawning areas (from NPFMC 1983).

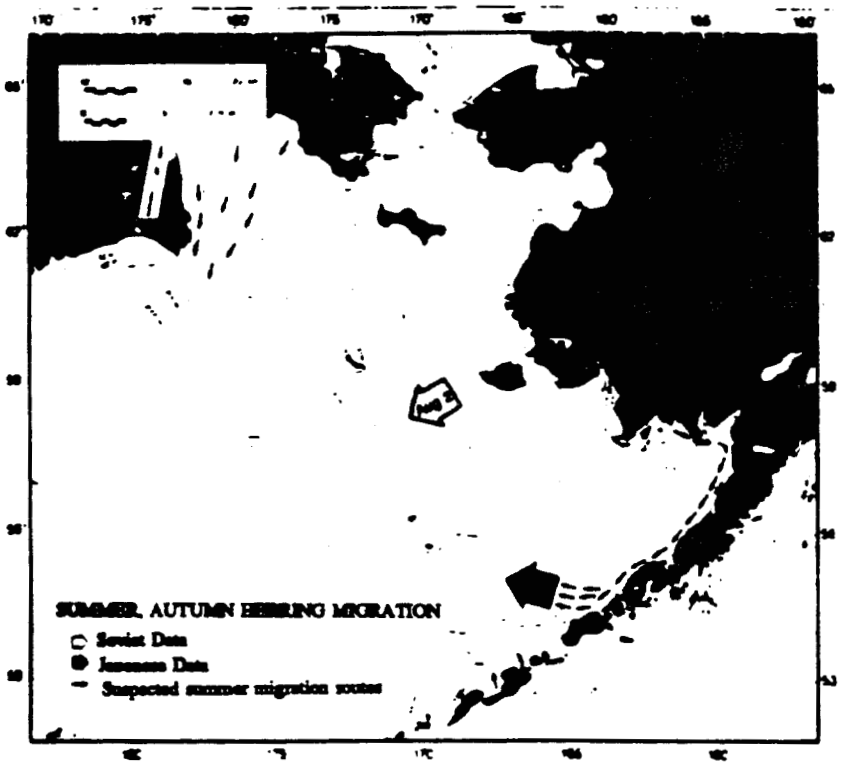


**Figure 3.** Summer and autumn migration routes to winter grounds, showing area of reappearance in Soviet and Japanese research and commercial catches (after Wespestad and Barton 1981).

Moller area. The trawl bycatch data continue to support the central Bering Sea area north and west of the Pribilofs (Figure 2) as the wintering grounds for herring that spawn in western Alaska.

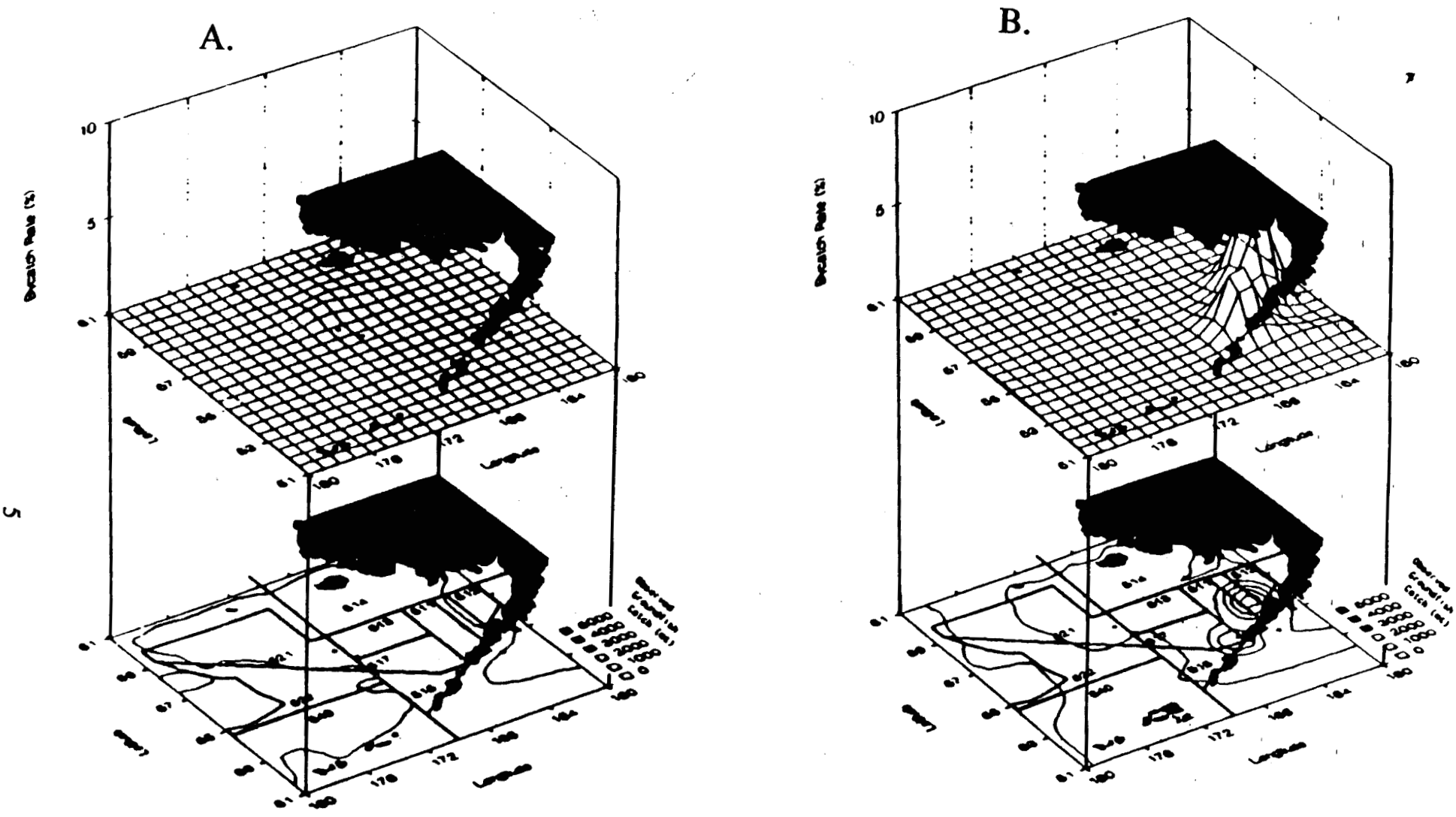


Figure 4. Distribution of herring in May (A), and June (B) reconstructed from 1983-88 foreign and joint venture bycatch data (from Funk 1990). Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

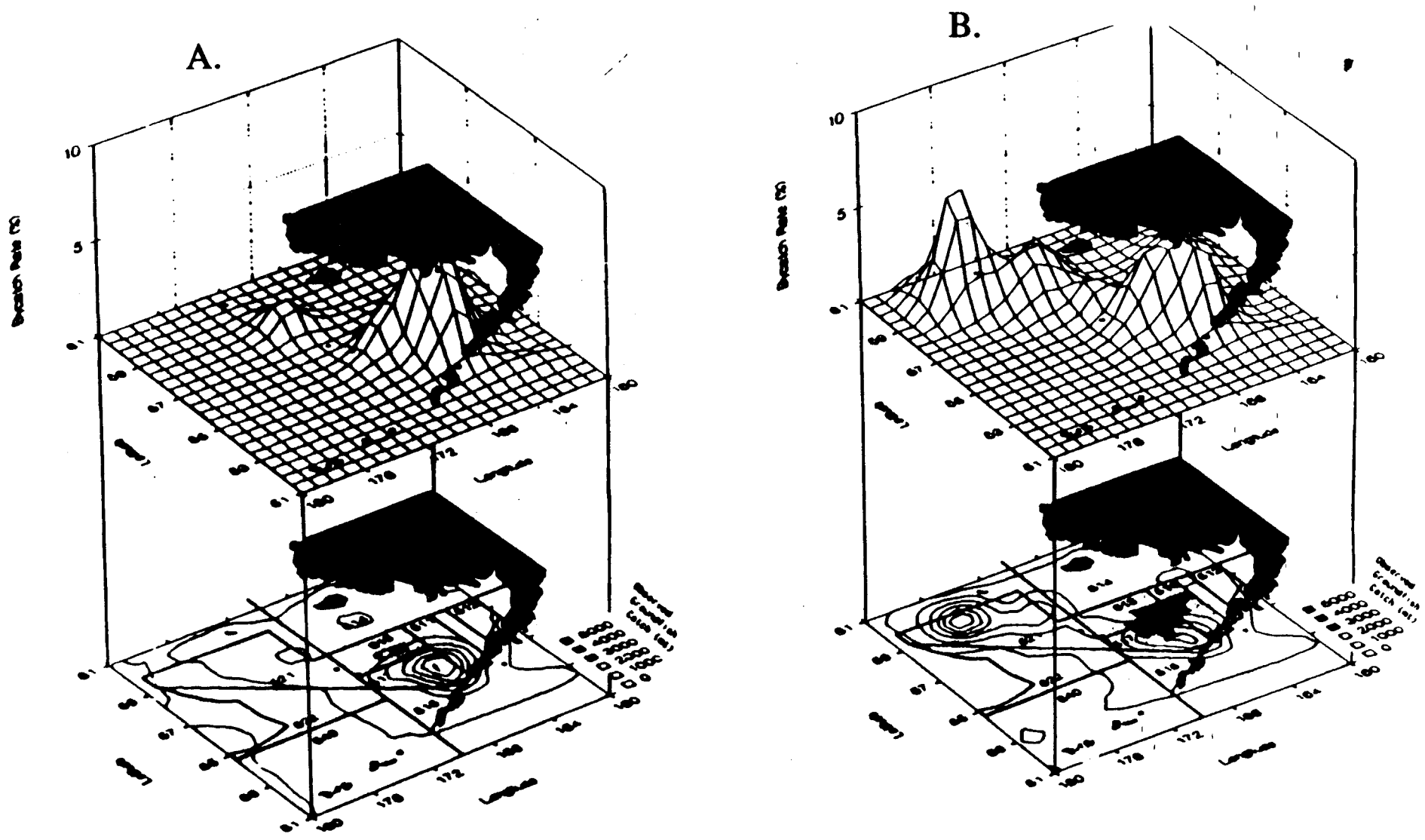


Figure 5. Distribution of herring in July (A), and August (B) reconstructed from 1983-88 foreign and joint venture bycatch data (from Funk 1990). Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 through 1988, by 1/2° latitude by 1° longitude area, smoothed by distance-weighted least squares. Lower panel: National Marine Fisheries Service regulatory reporting areas (511-540), contour lines of herring bycatch rates from the upper panel, and the distribution of observed foreign and joint venture observed catches for pollock and "other" bottom trawls from 1983-1988 (shaded areas).

The route taken by the Nelson Island herring stock after spawning was not conclusively established by any of these migration studies.

## STOCK IDENTIFICATION STUDIES

The scale pattern analysis (SPA) method of stock identification has been used in four studies of the origins of stocks taken in the Dutch Harbor food and bait herring fishery. Three of the SPA studies were conducted by the Fisheries Research Institute (FRI) of the University of Washington (Walker and Schnepf 1982, Rogers et al. 1984, and Rogers and Schnepf 1985). All of these studies suffered from the criticism that a several stocks which could be present in the Dutch Harbor fishery were not considered in the analysis. In general, the Togiak stock dominated the samples collected by these studies, averaging 78% over all three studies (Figure 6). Confidence intervals were extremely wide and in most cases the samples were indistinguishable from samples containing entirely Togiak fish.

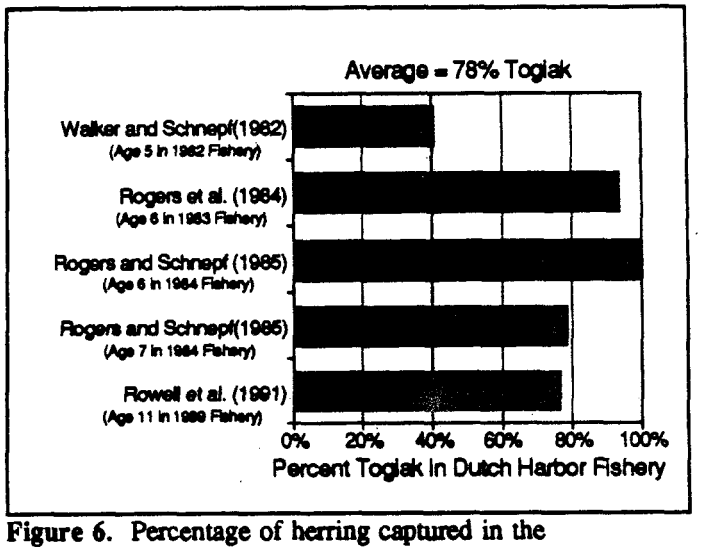


**Figure 6.** Percentage of herring captured in the Dutch Harbor food and bait fishery classified as the Togiak stock in four scale pattern analysis studies of five different age classes.

Rowell et al. (1990) included almost all possible stocks in the analysis, and similarly concluded that 78% of the Dutch Harbor harvest were Togiak fish. Rowell et al. (1990) were only able to make the SPA techniques work by pooling a number of small stocks together. In the age class examined (age 11 in the 1989 fishery), a number of the small stocks happened to have similar scale patterns, even though they were not geographically adjacent, and these patterns happened to be different from the patterns on the scales of the Togiak stock. This fortuitous circumstance allowed Rowell et al. (1990) to make more definitive statements about the composition of Togiak vs. non-Togiak stocks than was possible in earlier studies. Because pooling was required to make the SPA techniques work, Rowell et al. (1990) stress that it is impossible to conclusively identify any of the individual stocks in the pooled group of small stocks, such as the Nelson and Nunivak Island stocks. The problem of discriminating among smaller stocks afflicted the earlier FRI studies as well, as emphasized by one of the authors of the FRI studies in a recent memorandum to the North Pacific Fisheries Management Council (Appendix).

If all eastern Bering Sea herring stocks were randomly mixed during their migration, the stock composition of migrating stocks would be proportional to the relative biomass of the stocks. For 1991, the Togiak stock is projected to comprise 86% of the herring stocks spawning from Nunivak Island southward (Funk 1991). Given the fluctuations in relative biomass over the last

decade and the extremely wide confidence intervals in the SPA studies, this percentage contribution for Togiak is not significantly different from the SPA estimates. For 1991, the Nelson Island herring stock is projected to comprise 3% of the biomass of herring stocks spawning from Nunivak Island southward.

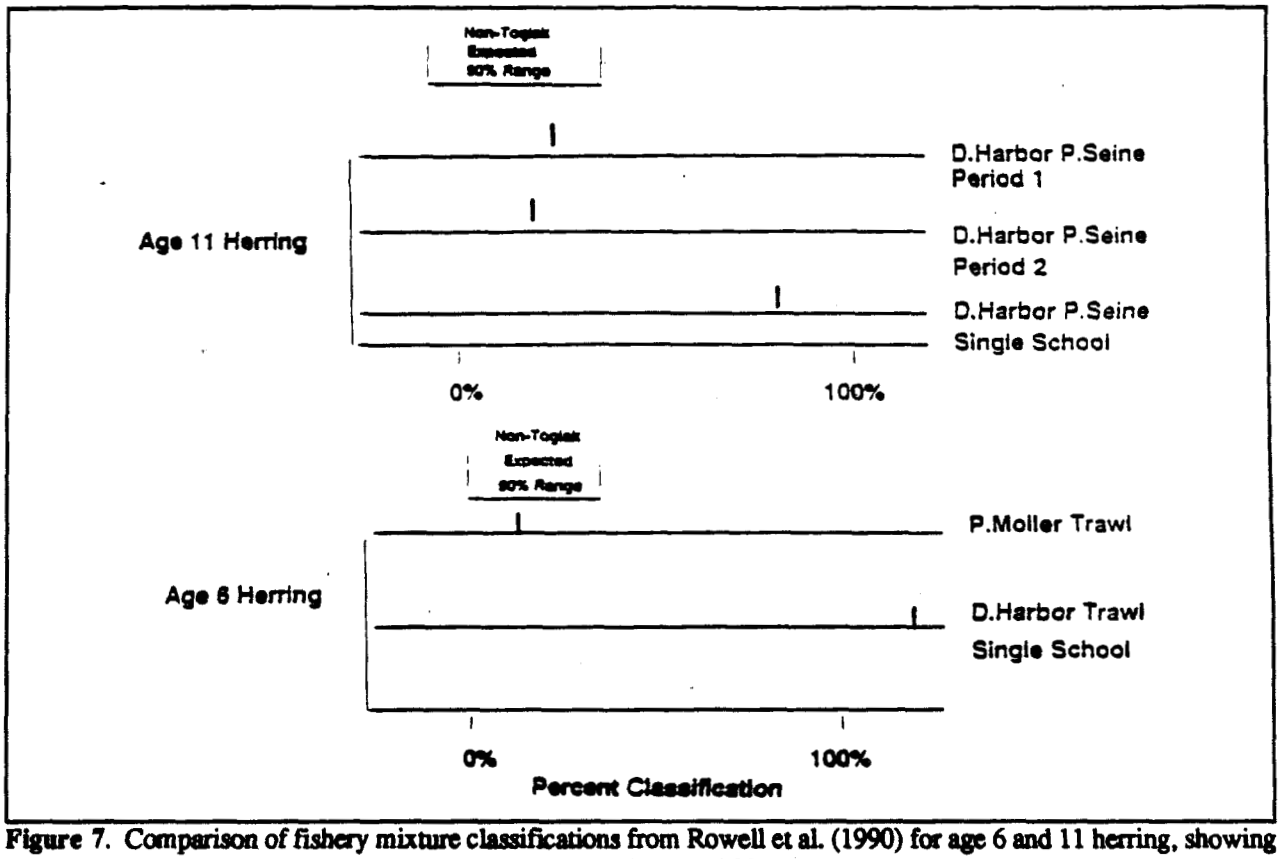


**Figure 7.** Comparison of fishery mixture classifications from Rowell et al. (1990) for age 6 and 11 herring, showing both single school and overall classifications for the 1989 Dutch Harbor food and bait and trawl fisheries.

In order to make inferences about the mixing of stocks on a school-by school basis, Rowell et al. (1990) classified the stock composition of two very large samples taken from individual fishing gear sets. One sample was from a pollock-targeted trawl haul in the Unimak Pass area, while the second was from a purse seine set during the 1989 Dutch Harbor food and bait fishery. The proportion of non-Togiak stocks greatly exceeded the proportion of the Togiak stock in both the single purse seine set and the single trawl haul (Figure 7). This is the opposite result of what would be expected from the biomass ratios if fish were randomly mixed in the Dutch Harbor area. However, the overall stock composition from all samples in both the trawl fishery and the Dutch Harbor food and bait fishery in both periods was 78% Togiak stock. This is not significantly different from the relative biomass distribution.

Therefore, in all five age classes examined in the four SPA studies, relative stock biomass has provided a reasonable approximation to the stock composition in the Dutch Harbor area. The occurrence of spatial segregation by stock of origin would not alter stock composition expected in the Dutch Harbor area in the future, but increases the variability of predicted stock composition estimates.

None of the scale pattern analysis studies conclusively established that Nelson Island herring are present in the Dutch Harbor area during the summer months. It is possible that the Nelson Island herring stock migrates directly offshore to the wintering grounds. None of the SPA studies has been able to collect samples during the late summer along the direct offshore migration route west of Nunivak Island.

## SPAWNING AND MIGRATORY TIMING

If the Nelson Island herring stock migrates clockwise around the eastern Bering Sea, the stock composition in the Dutch Harbor area would vary in time, depending on the timing of the migration of each of the Bering Sea herring stocks. Northern herring stocks spawn later and are further from the Dutch Harbor area than southern stocks and therefore should arrive at Dutch Harbor later. In the SPA studies, sample sizes were too small to detect any significant changes in the percent of the Nelson Island stock over time (Figure 8). As previously mentioned, the ability of any of the SPA studies to properly detect any of the smaller stocks has been seriously questioned. Most of the SPA studies collected samples at Dutch Harbor only during the later part of the summer and did not collect samples during mid July when only earlier-spawning stocks would more likely be present.

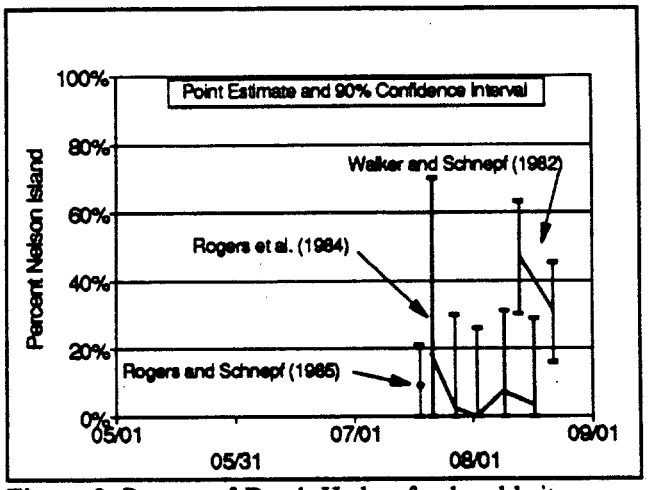


**Figure 8.** Percent of Dutch Harbor food and bait fishery samples classified to Nelson Island in FRI stock identification studies.

Based on the distance travelled by Togiak herring in Figures 4 and 5 and the mean fishery date at Togiak of May 10, Togiak herring travel approximately 7 to 8 nautical miles per day enroute to Dutch Harbor. These travel speeds agree with the observed increased bycatch of herring at Dutch Harbor in mid July, 1989, and reported abundances of herring off of Port Moller in mid June, 1989. It is not known for certain whether herring migrating from areas north of Cape Newenham would follow the coastline, as does the Togiak stock, or take a more direct route to Dutch Harbor. The earlier Soviet research attempted to follow the post-spawning migration and suspected that stocks followed a coastal route (Rumyantsev and Darda 1970). A direct route to Dutch Harbor would decrease the separation among stocks in the time of arrival at Dutch Harbor.

Assuming that all Bering Sea herring stocks travel at the speed calculated for Togiak stocks, we examined the separation in predicted arrival times of each stock at Dutch Harbor. Because we were interested only in substantial impacts on the stocks, we analyzed the timing only for the major biomass of each stock. The spawning run of the bulk of the biomass for each stock usually occurs over a short period, although lesser amounts of spawning continue for several weeks. To represent the annual variability in the date that the major biomass of each stock

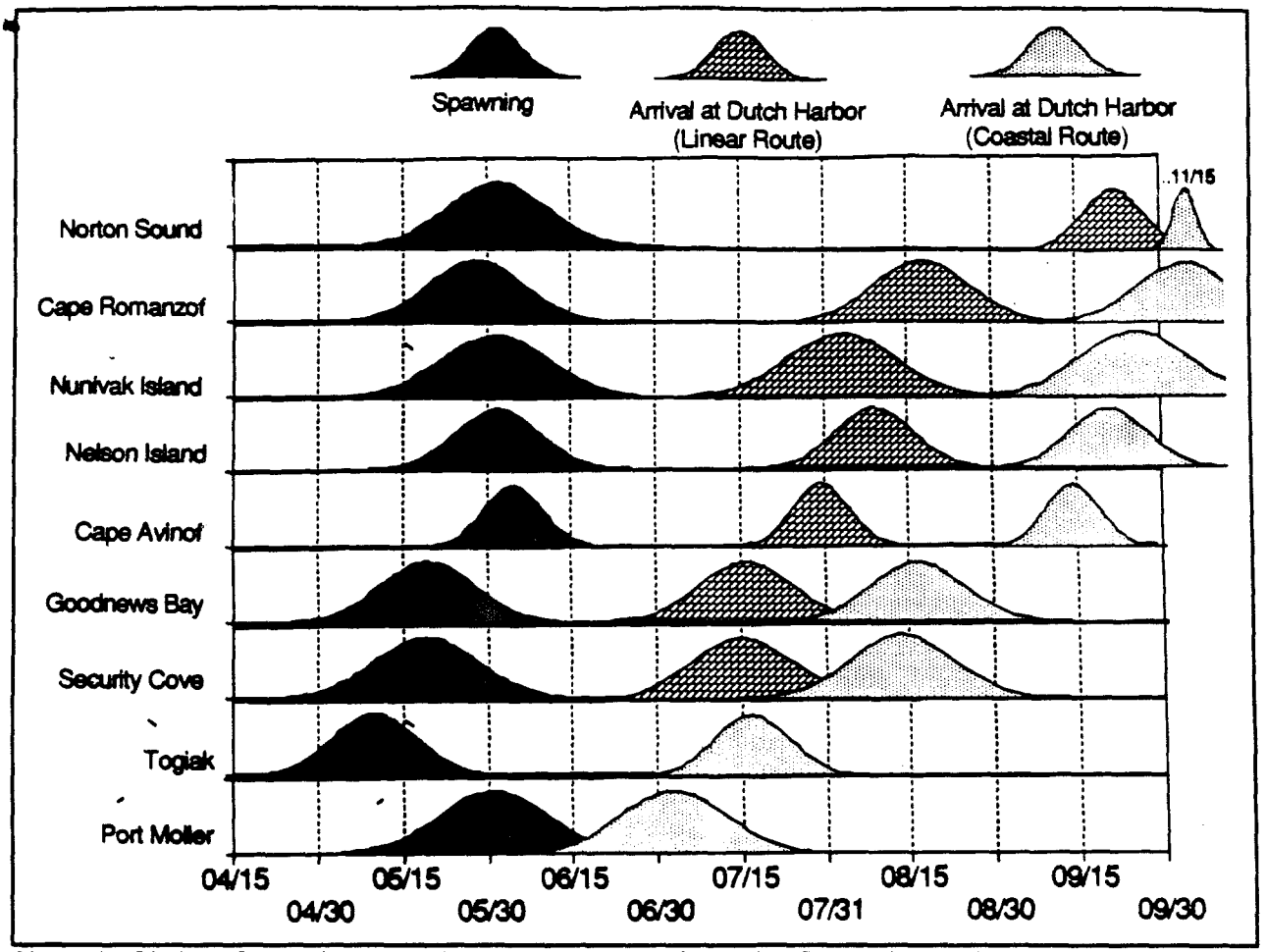


**Figure 9.** Timing of spawning and arrival at Dutch Harbor for Bering Sea herring stocks, assuming annual variability in spawn timing dates is represented by the variability in the timing of commercial sac roe fishing periods.

would be expected to depart the spawning grounds, we used the observed distribution of days that the commercial sac roe fisher was opened in each area from 1980-1990. We also assumed that departure from the spawning grounds would be expected to follow the average date of fishery openings by 3 days. We assumed that annual variability in arrival times of the major biomass of each stock at Dutch Harbor would be similar to the annual variability in fishery opening dates. Migration route distances to Dutch Harbor for stocks north of Cape Newenham was computed both as a straight line distance and following a coastal migration route. Even if stocks north of Cape Newenham follow a straight line path to Dutch Harbor, a discernable separation in the timing of arrival at Dutch Harbor is evident (Figure 9). If all stocks follow coast line routes, the arrival time of the Nelson Island stock would be clearly distinct from the arrival time of the Togiak stock.

## IMPACT OF THE DUTCH HARBOR FISHERY ON THE NELSON ISLAND STOCK

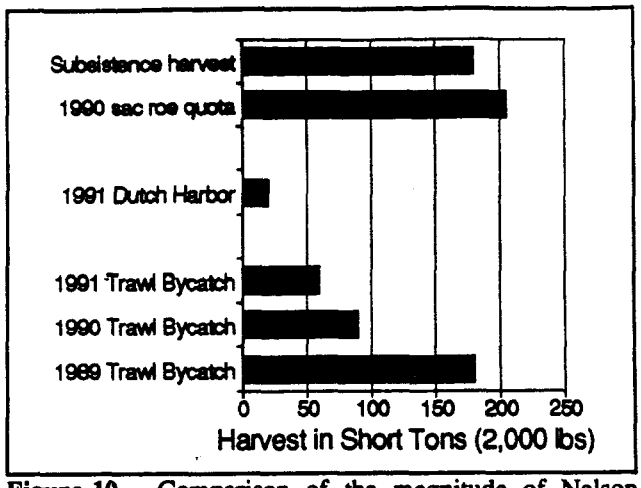


**Figure 10.** Comparison of the magnitude of Nelson Island herring harvests, assuming that the Dutch Harbor food and bait fishery and trawl fisheries take Nelson Island herring in proportion to their biomass.

Potential impacts of the Dutch Harbor food and bait fishery on the Nelson Island herring stock were computed under several scenarios. First, if the Nelson Island stock migrates directly offshore to the winter grounds, no Nelson Island fish would be caught in the Dutch Harbor fishery. If the Nelson Island stock migrates clockwise around Bristol Bay, as does the Togiak stock, then the relative biomass of the stocks provides the best estimate of stock composition at Dutch Harbor. For 1991, a harvest of 662 short tons is forecast for the Dutch Harbor fishery. In 1991, Nelson Island is projected to comprise 3% of the biomass of herring stocks spawning from Nelson Island south (Funk 1991). The expected harvest of the Nelson Island stock at Dutch Harbor is then 20 short tons. Because there is some segregation of herring schools by stock of origin in the Dutch Harbor area, the observed Nelson Island contribution is more likely to be higher or lower than 20 tons than would be the case if stocks were randomly mixed. SPA studies do not provide guidance for how much this variability would be increased. The magnitude of the expected Dutch Harbor harvest (Figure 10) is considerably smaller than the average subsistence harvest (Pete 1990). The 1991 Dutch Harbor food and bait fishery harvest is also considerably smaller than past and projected trawl bycatch impacts, using the bycatch estimates of NPFMC (1991) and assuming that based on relative biomass composition 3% of the trawl bycatch would be from the Nelson Island herring stock.

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## APPENDIX

PACIFIC SEAFOOD PROCESSORS ASSOCIATION
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## MEMORANDUM

April 26, 1990

TO: Council Members - North Pacific Fishery Management Council

FROM: Kate Meyers, Robert Walker (Fisheries Research Institute) and John Roos (PSPA)

RE: **HERRING STOCK COMPOSITION IN BERING SEA**

Herring stock separations of Eastern Bering Sea herring from scale pattern analysis was performed by FRI scientists from 1982-1985. The principal finding of the investigations was that the Togiak stock was the predominant population present in the Dutch Harbor fisheries. It was calculated that the Togiak stock comprised from about 80 to 90% of the total summer fishery catch. Other smaller stocks such as Nelson Island Norton Sound and Port Moller were classified as being present, however, the investigators do not believe that the estimates for these stocks are statistically significant because of small sample size and low biomass levels compared with Togiak herring.

FRI published four separate reports on their findings from 1982-1985 (two to NMFS, one to NPFMC and one to ADF&G). In addition, a Masters Thesis was completed in 1984 at the University of Washington which dealt exclusively with Eastern Bering Sea Herring stock separation[1].

Schnepf concluded that the 80-90% estimates for the Togiak stock seemed likely, but not for those stocks for the north. There was indication from scale analysis that Norton Sound and Nelson Island stocks were present to a small extent. However, he believed it was unlikely that Norton Sound and Nelson Island stocks migrated down to the Aleutian Islands after spawning to feed. This conclusion was further supported by most samples which indicated (at 90% confidence level) that no Nelson Island or Norton Sound stocks were present in the Dutch Harbor fishery. Also, analysis of these data indicated strong likelihood that 100% of the catch was made up of the Togiak stock during most of the summer fishery.

The information available at this time indicates that regulatory measures to protect herring stocks north of the Togiak population would have a low likelihood of success if they were implemented in the Dutch Harbor area. In addition, we are not aware of any scientific information which indicates that stock abundance of northern stocks (Nelson Island and Norton Sound) has been adversely affected by herring by-catch in the Dutch Harbor fisheries.

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1. Stock Separation of Eastern Being Sea Herring (Clupea Harengus Pallasi) with scale pattern analysis. Kenneth N. Schnepf. 1984. 147pp

# NELSON AND NUNIVAK ISLANDS 1991 HERRING FORECAST AND 1990 COMMERCIAL FISHERY OVERVIEW[1]

By:

Charles Burkey Jr.
Fishery Biologist
Bethel

## EXECUTIVE SUMMARY

No commercial openings occurred in the Nelson Island District in 1990. The district was placed on 2-hour notice on June 2 when results of the May 31 aerial survey were compiled. The 1990 allowable harvest had been set at 205 tons based on the difference between the estimated available biomass (2,705 tons) and the 2,500 ton threshold mandated in the Bering Sea Herring Fisheries Management Plan. No processors registered to buy herring in the district. The spawning biomass projected to return to the Nelson Island District during 1991 is 1,897 tons, well below the 2,500 ton threshold required to open the fishery. However, processors and fishermen are advised that management of the 1991 fishery will be based on observed biomass if conditions are satisfactory for aerial surveys. The fishery will not be opened if the threshold of 2,500 tons or significant spawning activity is not observed. The exploitation rate would be maintained at 10% unless available biomass significantly exceeds the 2,500 ton threshold level.

Because 1990 biomass estimates in the Nunivak Island District were well below the 1,500 ton threshold, no commercial herring fishery occurred in the district in 1990. The biomass of herring projected to return to the Nunivak Island District during 1991 is 235 tons. This is below the threshold of 1,500 tons needed to open the fishery. However, processors and fishermen are advised that management of the 1991 fishery will be based on observed biomass. As in 1990, the Nunivak Island District commercial herring fishery will be regulated by emergency order. The commercial harvest of herring will be up to 15% of the observed spawning biomass.

[1] This section is taken from a report by the same author which appears in: Funk, F.C. (ed.) 1991. Preliminary forecasts of catch and stock abundance for 1991 Alaska herring fisheries. Regional Information Report 5J91-03, Alaska Department of Fish and Game, Juneau.

# INTRODUCTION TO THE ARCTIC-YUKON-KUSKOKWIM REGION

The Arctic-Yukon-Kuskokwim (AYK) Region includes eight commercial herring fishing districts located in coastal areas of the northeastern Bering Sea. These are the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound and Port Clarence districts.

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

Aerial surveys are flown throughout the herring spawning season in all AYK districts to determine relative abundance, distribution, and biomass of herring. However, adverse weather conditions often limit the frequency and quality of surveys. Occurrence and extent of milt, numbers of fishing vessels, and visibility factors affecting survey quality are also recorded. Aerial surveys have been used since 1978 in the Bering Sea to estimate herring spawning biomass. Historically, it has been difficult to obtain biomass estimates from aerial surveys in the AYK Region due to poor survey conditions caused by unfavorable weather, ice conditions or turbid water.

Standard conversion factors were used to convert estimated herring school surface areas from aerial surveys to biomass within all districts. For each 538 $ft^2$ of surface area the conversion factors were 1.52 tons for water depths of 16 ft or less, 2.58 tons for water depths between 16 and 26 ft and 2.83 tons for water depths greater than 26 ft. Ground surveys were conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

## *Nelson Island Sac Roe Fishery*

The Nelson Island District consists of all waters north of Chinigyak Cape and south of the southeast tip of Kigigak Island and east of 165° 30' W. longitude (Figure 1). Since 1985, the biomass estimates of herring in the Nelson Island District have ranged from 2,705 tons in 1990 to 9,500 tons in 1985 (Figure 2). During the 1990 herring season, 15 aerial surveys were flown from May 20 to June 6. Half of these surveys were rated either poor or unacceptable. On May 31, under fair to poor aerial survey conditions, 2,705 tons of herring were observed. Large amounts of unattached eggs were observed washed up on the beach at Cape Vancouver on May 23. Only 0.25 linear miles of spawn were sighted during aerial surveys.

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

of the poor roe quality in Department test sampling and lack of processor interest.

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

Since 1980, recruitment strength, as represented by the abundance of age-5 herring, has ranged from less than one million recruits from the 1982 and 1985 year classes, which were observed in the 1987 and 1990 returns, to approximately 11 million fish from the 1977 year class, which were observed during the 1982 department test fishery (Figure 3). Age-6 herring dominated the spawning population in both numbers of fish and biomass (Table 1 and Figure 4). Recruits, ages 3, 4 and 5, comprised only 5% of the biomass but comprised 11% of the mature population in numbers of fish. Fifty-seven percent of the biomass consisted of age-9 and older herring.

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

In 1991, age-7 herring are expected to be the dominant age group (Figure 5). Herring age 9 and older are expected to comprise 54% of the biomass. The harvest level will be maintained at 10% unless available biomass significantly exceeds the 2,500 ton threshold level. As in 1990, the Nelson Island commercial fishery will be regulated by emergency order. To provide additional protection for the subsistence harvest of herring, the following guidelines will be followed:

1. The commercial fishery will be allowed to take up to 15% of the herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.

2. The commercial fishing season will be opened when a biomass of 2,500 tons or significant spawning activity is documented.

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

4. Several important subsistence use areas occur throughout the district, including the waters north of Cape Vancouver. Specific areas may be closed to commercial fishing to insure adequate subsistence harvests.

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

*Nunivak Island Sac Roe Fishery*

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

Department test fishing was conducted from May 15 to June 4 using variable mesh gill nets. Approximately 1,028 herring were sampled for biological analysis.

Since 1985 the strongest year class, as determined by the abundance of 5 year olds in the spawning population, was the 1981 year class which contributed 3.4 million recruits to the 1986 mature population (Figure 7).

Age-11 herring dominated the spawning population in both biomass and numbers of fish (Figure 8 and Table 2). Ninety-three percent of the biomass consisted of age-9 and older herring. Younger fish, age 3, 4, and 5 herring, represented only 0.2% of the mature biomass.

The biomass of herring projected to return to the Nunivak Island District during 1991 is 235 tons (Table 2). This is below the threshold of 1,500 tons needed to open the fishery. However processors and fishermen are advised that management of the 1991 fishery will be based on observed biomass. As in 1990, the Nunivak Island District commercial herring fishery will be regulated by emergency order. Commercial harvest of herring will be up to 15% of the observed spawning biomass. If the threshold of 1,500 tons of herring or significant spawning activity is not observed, the fishery will not be opened.

Ages 10 and above are expected to dominate the spawning population in both biomass and numbers of fish. Age-9 and older herring are expected to comprise 94% of the mature biomass (Figures 8 and 9).

Table 1. Nelson Island District year/age class composition of the 1990 herring escapement and total run biomass and the 1991 projected biomass by weight and number of fish.

| Year Class | Age Class | Gillnet Harvest (st) | Escapement (st) | Total Run | | | | 1991 Projection[a] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (st) | No. of Fish (* 1,000) | % by Weight | % by Number | (st) | No. of Fish (* 1,000) | % by Weight | % by Number |
| 1987 | 3 | 0 | 27 | 27 | 296 | 1.0 | 3.2 | 0 | 0 | 0.0 | 0.0 |
| 1986 | 4 | 0 | 56 | 56 | 438 | 2.1 | 4.7 | 57 | 449 | 3.0 | 7.1 |
| 1985 | 5 | 0 | 50 | 50 | 309 | 1.8 | 3.3 | 68 | 422 | 3.6 | 6.7 |
| 1984 | 6 | 0 | 464 | 464 | 2,228 | 17.2 | 23.7 | 51 | 246 | 2.7 | 3.9 |
| 1983 | 7 | 0 | 337 | 337 | 1,333 | 12.4 | 14.2 | 420 | 1,663 | 22.1 | 26.2 |
| 1982 | 8 | 0 | 228 | 228 | 792 | 8.4 | 8.4 | 278 | 969 | 14.7 | 15.3 |
| 1981 | 9 | 0 | 385 | 385 | 1,146 | 14.2 | 12.2 | 173 | 516 | 9.1 | 8.1 |
| 1980 | 10 | 0 | 301 | 301 | 779 | 11.1 | 8.3 | 257 | 663 | 13.5 | 10.5 |
| 1979 | 11 | 0 | 397 | 397 | 985 | 14.7 | 10.5 | 182 | 453 | 9.6 | 7.1 |
| 1978 | 12 | 0 | 342 | 342 | 824 | 12.7 | 8.8 | 210 | 506 | 11.1 | 8.0 |
| 1977 | 13+ | 0 | 119 | 119 | 270 | 4.4 | 2.9 | 201 | 456 | 10.6 | 7.2 |
| Total | | 0 | 2,705 | 2,705 | 9,403 | 100.0 | 100.0 | 1,897 | 6,342 | 100.0 | 100.0 |

[a] Biomass projection for older aged fish (>10) were based on natural mortality and growth rates derived from regression analysis of previous years' rates.

Table 2. Nunivak Island District year/age class composition of the 1990 herring escapement and total run biomass and the 1991 projected biomass by weight and number of fish.

| Year Class | Age Class | Gillnet Harvest (st) | Escapement (st) | Total Run | | | | 1991 Projection[a] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (st) | No. of Fish (* 1,000) | % by Weight | % by Number | (st) | No. of Fish (* 1,000) | % by Weight | % by Number |
| 1987 | 3 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| 1986 | 4 | 0 | 0 | 0 | 2 | 0.1 | 0.2 | 0 | 0 | 0.0 | 0.0 |
| 1985 | 5 | 0 | 0 | 0 | 2 | 0.1 | 0.2 | 0 | 2 | 0.2 | 0.3 |
| 1984 | 6 | 0 | 5 | 5 | 21 | 1.1 | 1.9 | 0 | 2 | 0.2 | 0.3 |
| 1983 | 7 | 0 | 12 | 12 | 43 | 2.9 | 3.9 | 4 | 16 | 1.8 | 2.6 |
| 1982 | 8 | 0 | 14 | 14 | 43 | 3.3 | 3.9 | 10 | 31 | 4.2 | 5.1 |
| 1981 | 9 | 0 | 70 | 70 | 200 | 16.5 | 17.9 | 11 | 30 | 4.5 | 5.0 |
| 1980 | 10 | 0 | 78 | 78 | 206 | 18.6 | 18.4 | 46 | 122 | 19.7 | 20.2 |
| 1979 | 11 | 0 | 116 | 116 | 291 | 27.5 | 26.0 | 47 | 119 | 20.2 | 19.7 |
| 1978 | 12 | 0 | 85 | 85 | 210 | 20.2 | 18.7 | 61 | 151 | 26.1 | 24.9 |
| 1977 | 13+ | 0 | 41 | 41 | 100 | 9.8 | 9.0 | 54 | 132 | 23.1 | 21.8 |
| Total | | 0 | 422 | 422 | 1,117 | 100.0 | 100.0 | 235 | 604 | 100.0 | 100.0 |

[a] Biomass projection for older aged fish (>10) were based on natural mortality and growth rates derived from regression analysis of previous years' rates.

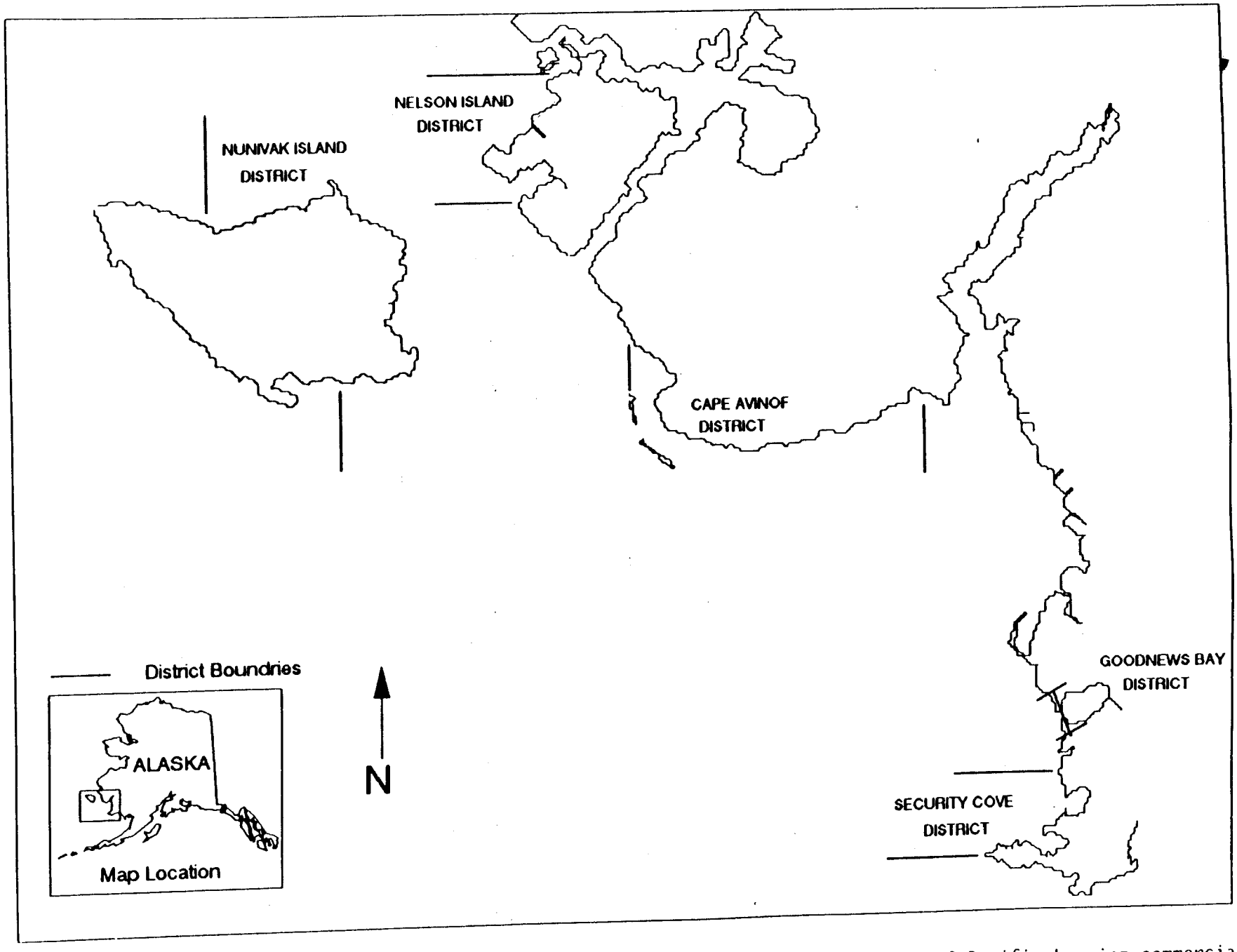


Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska.

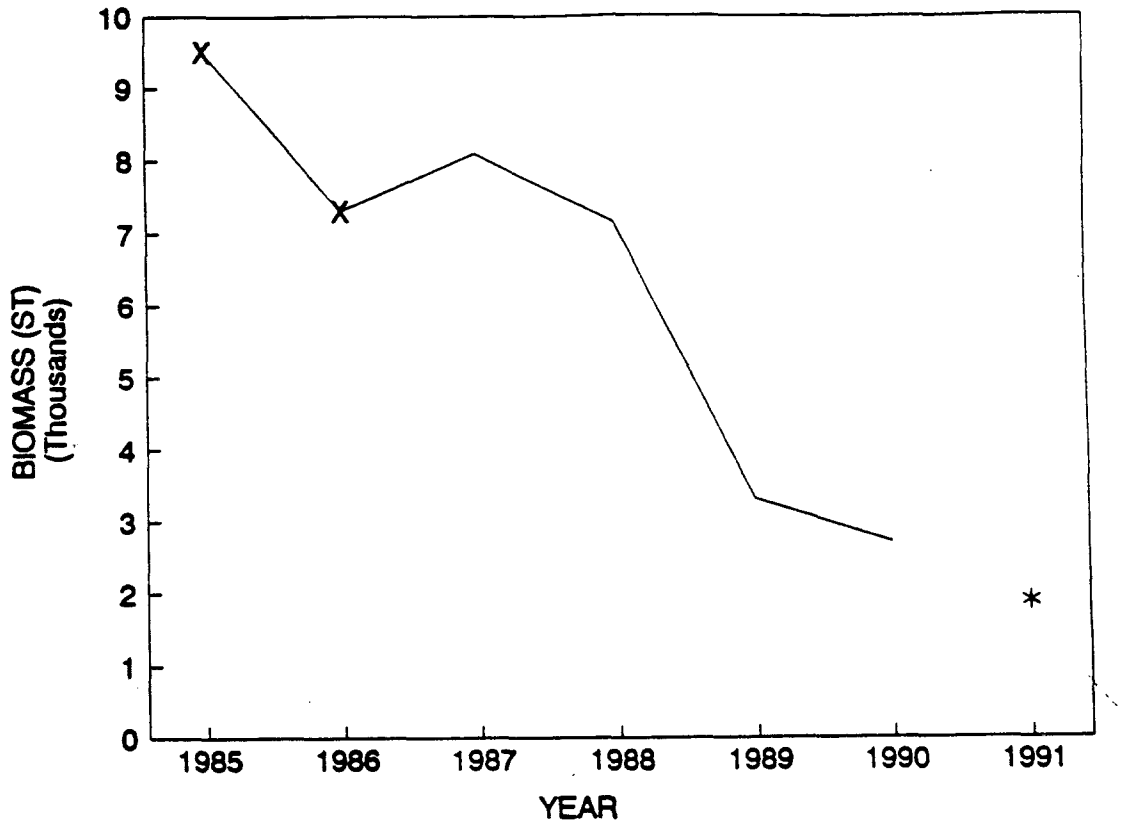


Figure 2. **Nelson Island District herring biomass, 1985-1990, with 1991 projected biomass (*). In some years (X), it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection was used instead.**

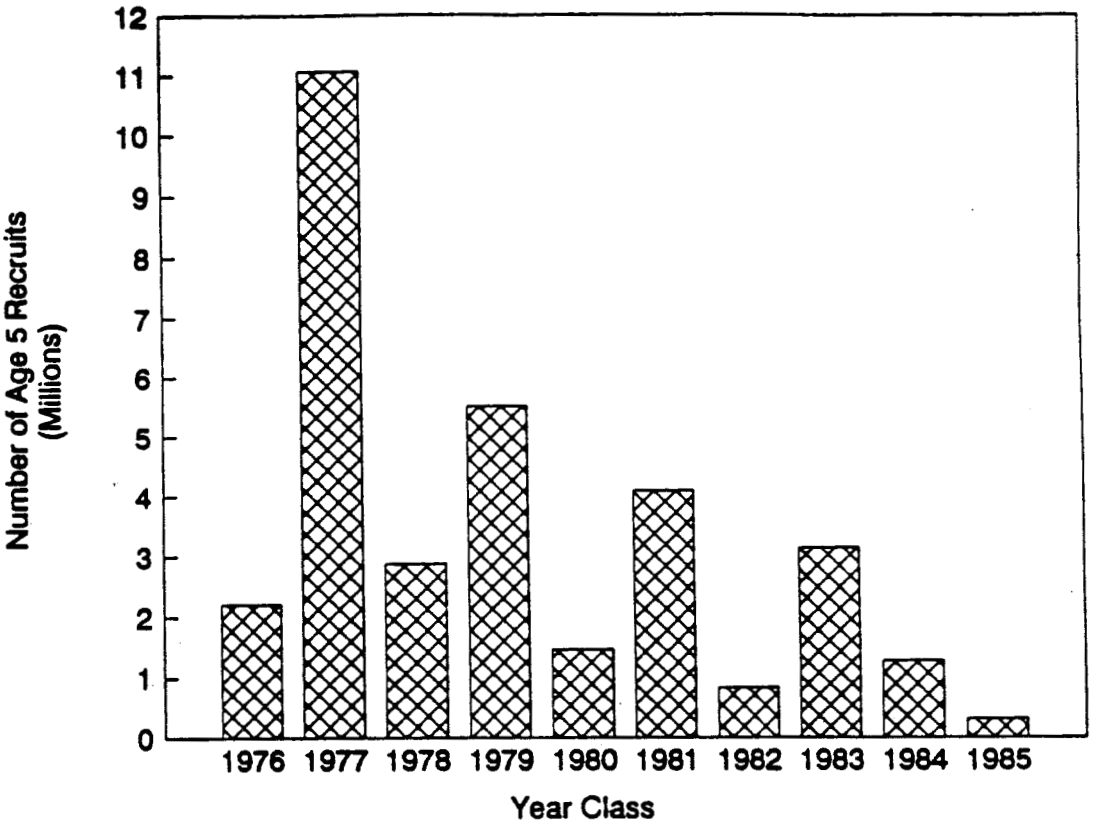


Figure 3. Historical year class strength of Nelson Island District herring in numbers of 5-year-old fish.

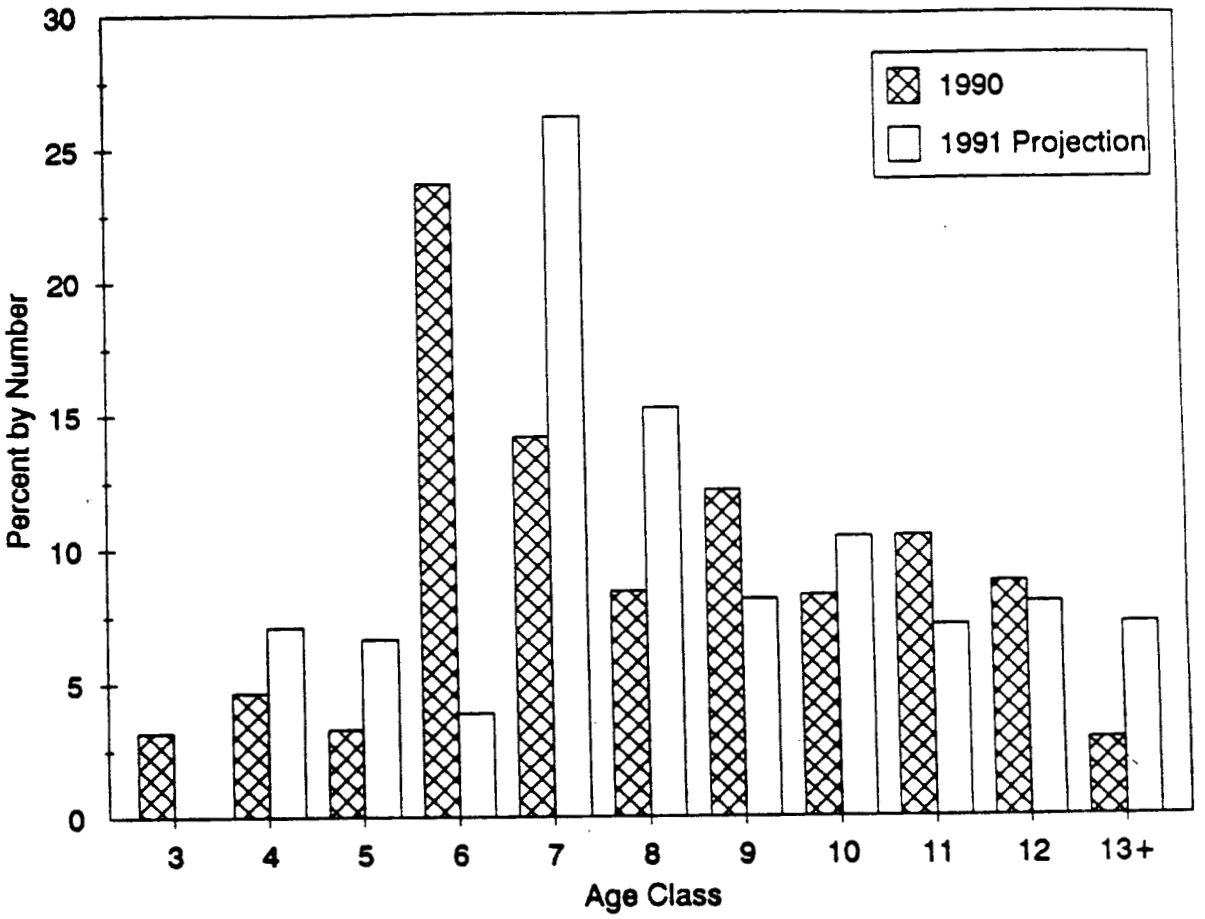


Figure 4. **Age composition of Nelson Island herring population in 1990 and projected 1991 return.**

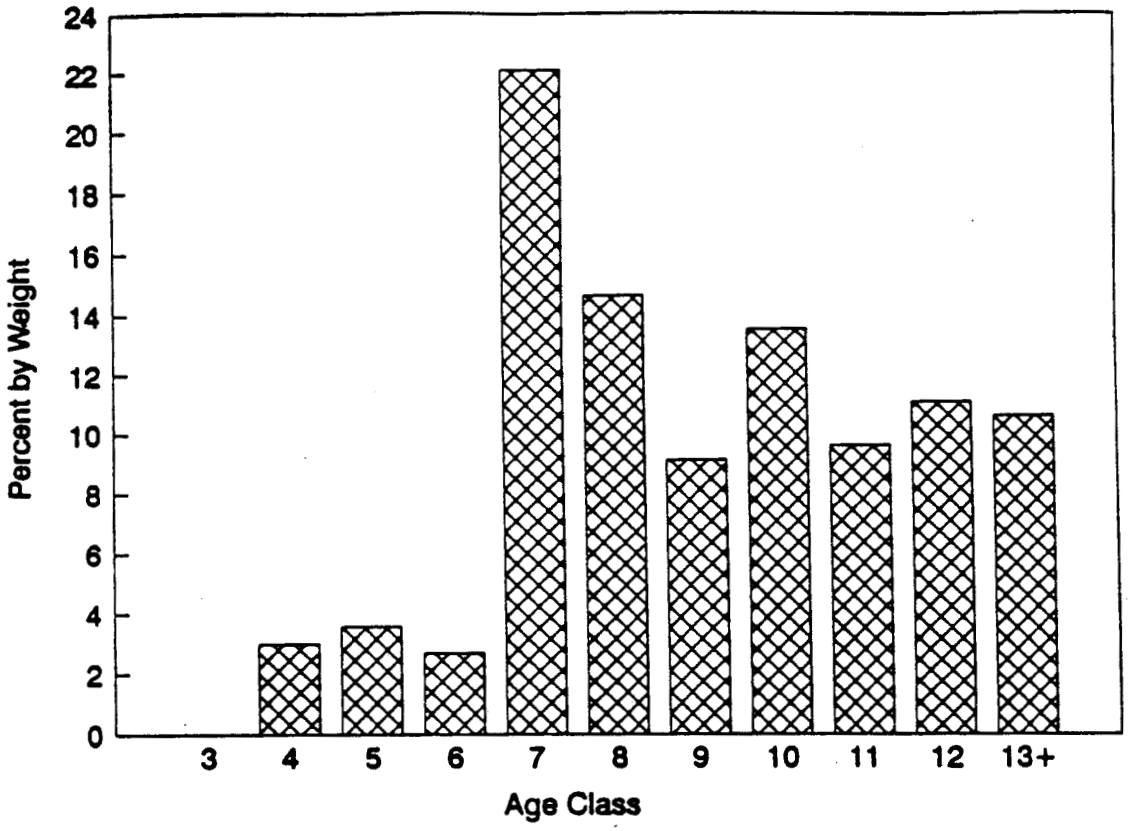


Figure 5. **Age composition by weight of the projected 1991 biomass of Nelson Island District herring.**

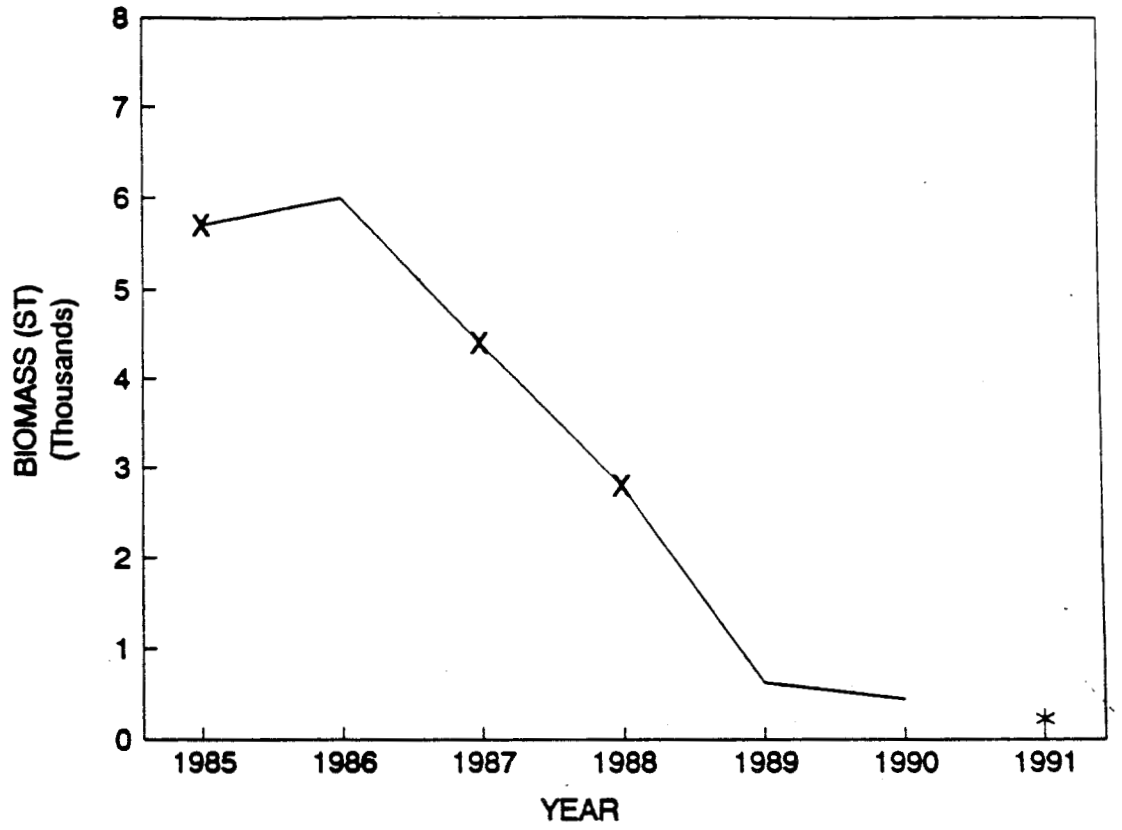


Figure 6. **Nunivak Island District herring biomass, 1985-1990, with 1991 projected biomass (*). In some years (X), it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection was used instead.**

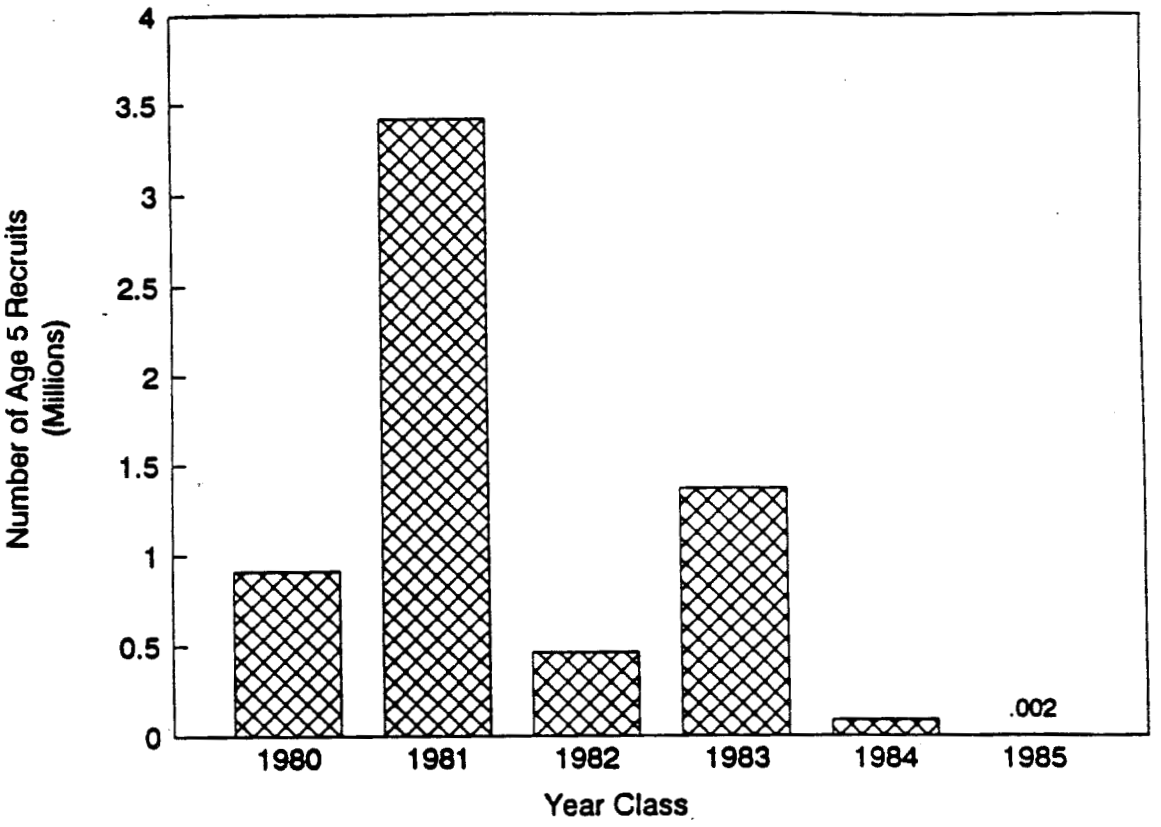


Figure 7. Historical year class strength of Nunivak Island District herring in numbers of 5-year-old fish.

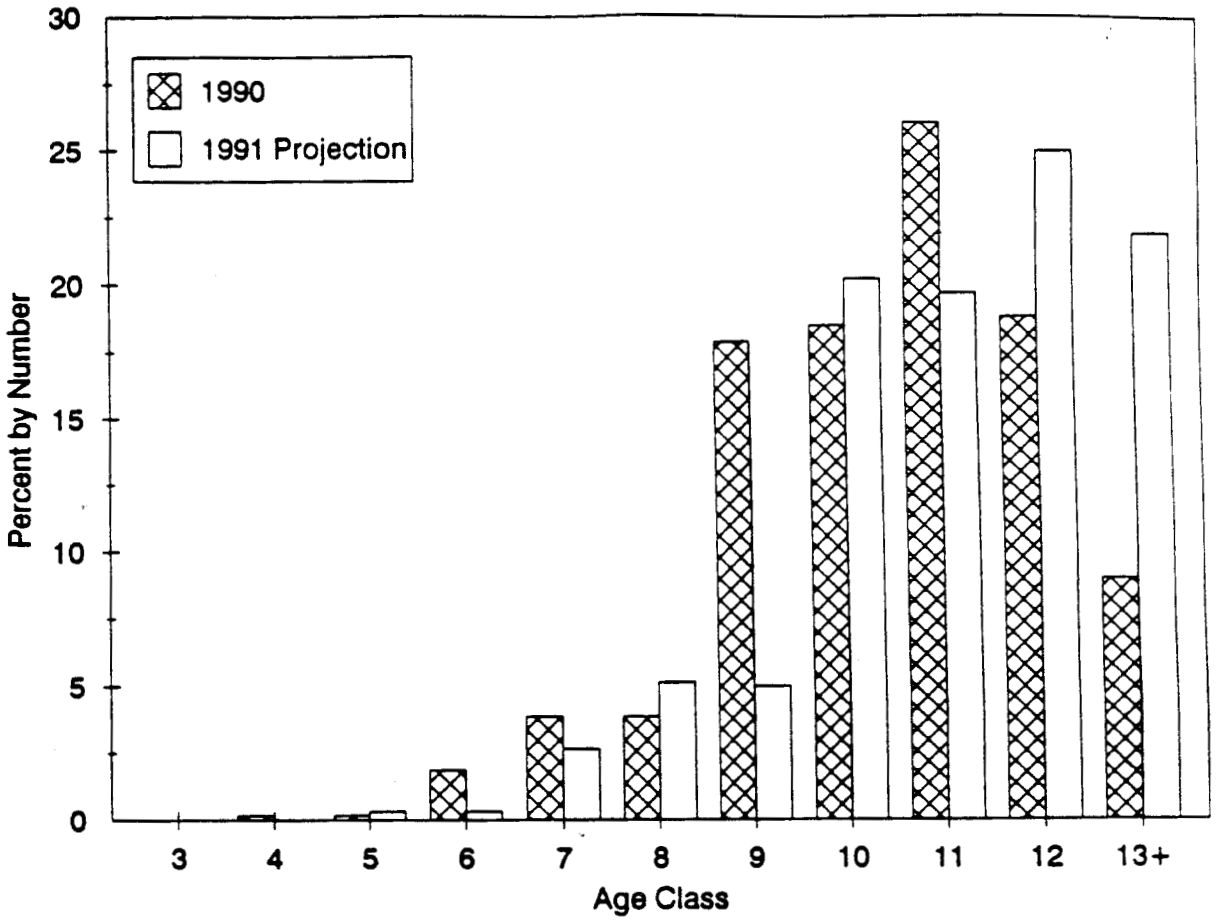


Figure 8. **Age composition of Nunivak Island herring population in 1990 and projected 1991 return.**

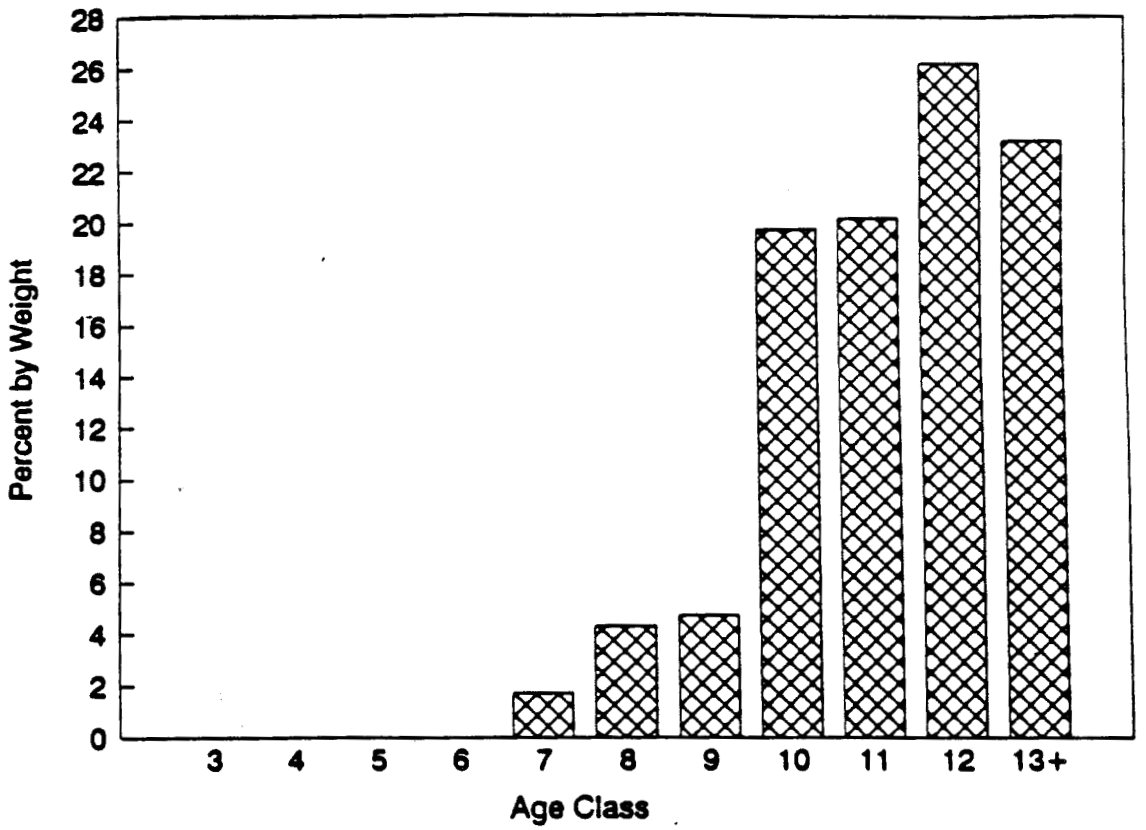


Figure 9. Age composition by weight of the projected 1991 biomass of Nunivak Island District herring .

**ATTACHMENT 2**

# EASTERN ALEUTIAN ISLANDS "DUTCH HARBOR" FOOD AND BAIT HERRING FISHERY

## REPORT TO THE BOARD OF FISHERIES

By

Alan Quimby

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Division of Commercial Fisheries
211 Mission Road
Kodiak, Alaska

December 1990

[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. The reports frequently serve diverse as hoc informational purposes or archive basic uninterrupted data. To accommodate timely reporting of recently collected information, reports in this series may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

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## ABSTRACT

The 1990 Dutch Harbor food and bait herring opening date was changed from July 16 to August 15 by the Board of Fisheries. The harvest quota was set at 903 short tons. The fishery started August 15, 1990, at 12:01 AM with seven seiners and eight tenders participating. The fishery closed after twelve hours (12:00 Noon August 15, 1990), with a harvest of 820 short tons. The entire harvest was processed as bait herring. The seven vessels participating in the fishery averaged 117 tons. Five different processing companies purchased the herring.



Key words: Aleutian Islands, herring, catch.

## INTRODUCTION

The Eastern Aleutian Islands herring food and bait fishery occurs near Unalaska and Akutan Islands, primarily in the vicinity of Unalaska and Akutan Bays (Figure 1). By regulation, the Bering Sea Management Plan applies to the Unimak, Akutan, and Unalaska Districts, and the Umnak District east of Samalga Pass. This management plan has been in effect since 1981. Historically, the Dutch Harbor Food and Bait fishery occurred from 1929 to 1938 (Table 1).

Historically, the industry was a mixture of gill net and seine gear, holding pounds, and numerous small, shore-based hand packing operations. A large portion of the catch was brined for either food or bait purposes; some product was frozen. Seine gear provided the bulk of the herring harvest. Currently, fishing gear consists of purse seine vessels, which use large seines up to 250 fathoms long and 25 to 35 fathoms deep. The entire 1981 - 1986 harvest was taken by purse seine. One gill net permit holder participated in the 1987 and 1988 season, and two gill net permit holders participated in the 1989 season. Purse seine vessels average about 50 feet in keel length and most also participate in the area M salmon fishery. Fish finding electronics (sonar) aboard these vessels are critical to the fishing operation, much as the airplane is critical to the sac-roe fishery. Generally there is a fairly free exchange of information between all the permit holders involved. Fleet efficiency is also enhanced by its ability to spread out and conduct "sonar searches" over a fairly large area when herring concentrations leave traditional fishing areas.

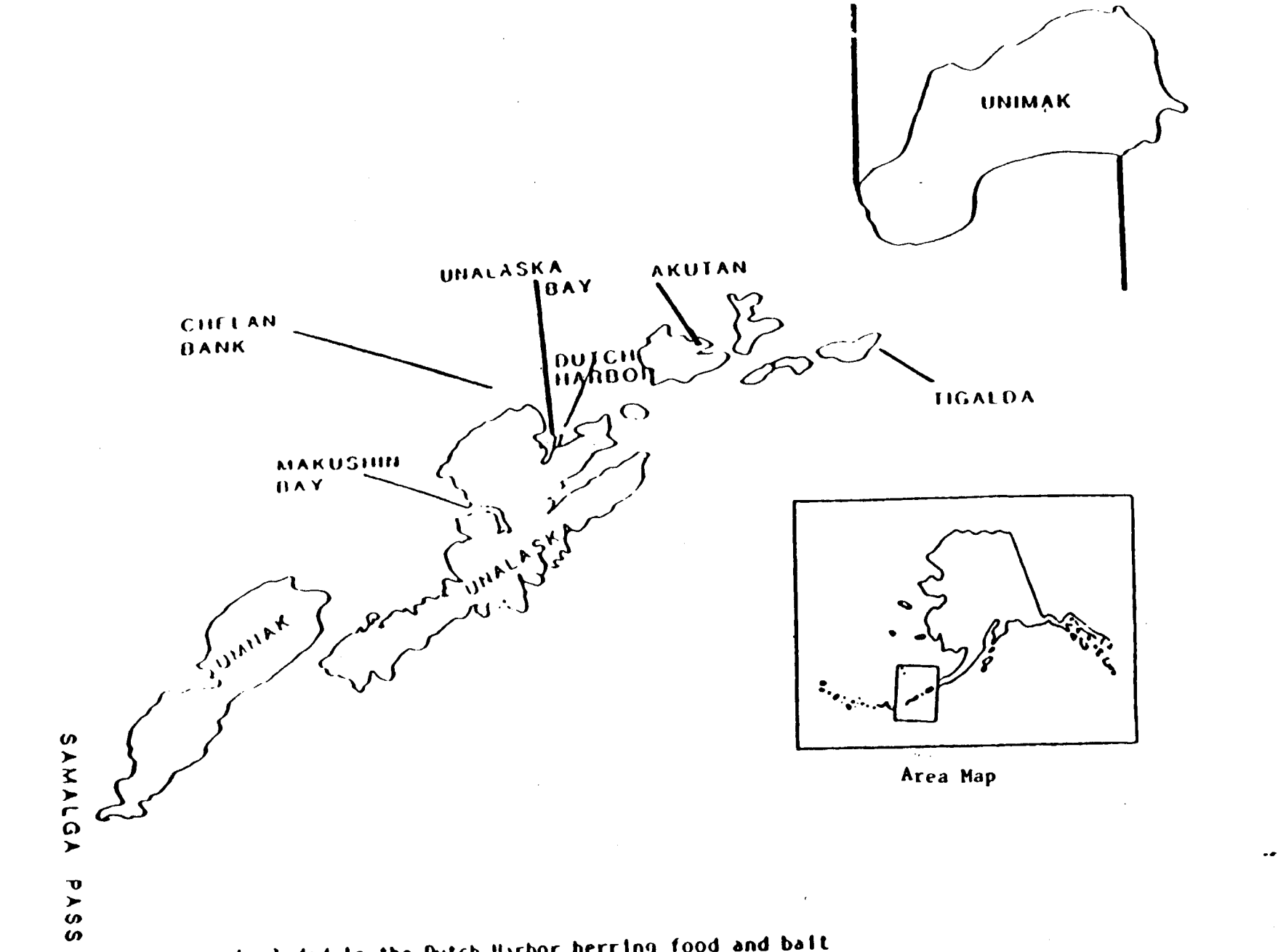


Figure 1. Waters included in the Dutch Harbor herring food and bait fisheries management plan.

Table 1. Peninsula and Aleutian Islands Management Area Eastern Aleutian Islands Herring Food/Bait Fishery Historical Industry Summary By Year, 1929-1990.

| Year | Harvest In Short Tons | No. Processors | No. Boats | No. Landings | Tons Per Boat | Tons Per Landing | $ Per Ton | $ Value (Millions) | $ Per Vessel (Millions) |
|---|---|---|---|---|---|---|---|---|---|
| 1929 | 1,259 | * | * | * | * | * | * | * | * |
| 1930 | 1,916 | * | * | * | * | * | * | * | * |
| 1931 | 1,056 | 12 | 26 | * | * | * | * | * | * |
| 1932 | 2,510 | 12 | 30 | * | * | * | * | * | * |
| 1933 | 1,585 | 12 | 38 | * | * | * | * | * | * |
| 1934 | 1,533 | 9 | * | * | * | * | * | * | * |
| 1935 | 2,412 | 10 | * | * | * | * | * | * | * |
| 1936 | 1,379 | 8 | * | * | * | * | * | * | * |
| 1937 | 579 | * | * | * | * | * | * | * | * |
| 1938 | 513 | * | * | * | * | * | * | * | * |
| 1939-44 | NO FISHERY | | | | | | | | |
| 1945 | 75 | * | * | * | * | * | * | * | * |
| 1946-80 | NO FISHERY | | | | | | | | |
| 1981 | 704 | 2 | 2 | 16 | 352 | 44 | 300 | 0.211 | 0.11 |
| 1982 | 3,565 | 6 | 7 | 95 | 509 | 38 | 300 | 1.020 | 0.15 |
| 1983 | 3,567 | 5 | 8 | 96 | 446 | 37 | 232 | 8.828 | 0.10 |
| 1984 | 3,578 | 5 | 9 | 61 | 398 | 59 | 210 | 0.751 | 0.68 |
| 1985 | 3,480 | 3 | 6 | 78 | 560 | 45 | 162 | 0.564 | 0.09 |
| 1986 | 2,394 | 4 | 7 | 53 | 342 | 45 | 254 | 0.600 | 0.09 |
| 1987 | 2,503 | 4 | 8 | 45 | 373 | 56 | 300 | 0.751 | 0.09 |
| 1988 | 2,004 | 6 | 8[a] | 59 | 251 | 34 | 252 | 0.505 | 0.06 |
| 1989 | 3,081 | 5 | 9[b] | 69 | 342 | 45 | 283 | 0.873 | 0.09 |
| 1990 | 820 | 5 | 7 | 8 | 117 | 103 | 350 | 0.287 | 0.04 |
| 1929-38 Average | 1,474 | 11 | 31 | * | * | * | * | * | * |
| 1981-90 Average | 2,570 | 5 | 7 | 58 | 369 | 51 | 264 | 1.439 | 0.15 |

* Data not available.
[a] Seven seiners and one gill netter participated.
[b] Seven seiners and two gill netters participated.

When herring concentrations leave the usual harvest locations, the industry follows the herring with floating processors and tenders. Processing efficiency and product quality may decline when this occurs. Harvest locations have extended over approximately 90 miles, from Tigalda Island to Makushin Bay (Figure 1 ). The majority of the harvest, however, has occurred within a five mile radius of shore-based processing facilities in Unalaska and Akutan Bays.

Two similarities between the current and historical fisheries are the quality problems associated with feeding herring and the availability of herring. Feed problems were overcome in the historical fishery by the use of holding pounds, where seine caught herring were held until their stomachs became empty. Gill net caught herring required special handling to prevent spoilage. In the current fishery, the use of shaved ice and super-chilled seawater in conjunction with rapid processing alleviates most of the feed related problems. When feeding conditions are severe, the processors have suspended buying. Historically, (1929-1938), the availability of herring was categorized into an early summer run (late June to late July) and a late summer run (late August to early September). This pattern does not seem to apply in the current fishery (1981-1990), as herring have been harvested from July 16 through September 15.

Shore-based processors purchase the majority of the herring harvested. Floating processors have been used each year; however, they are limited by daily handling capacities, which are considerably less than that of the shore-based plants. All of the processors associated with the herring fishery have floating processors and are diversified into bottomfish, salmon, halibut, black cod, scallops, and the Bering Sea and Peninsula crab fisheries. In 1988, some

herring were tendered to the King Cove shore plant, and in 1989 and 1990 to the Sand Point shore plant.

The values shown in Table 1 represent estimates of total ex-vessel value. Generally, the ex-vessel value for bait herring has exceeded that for food herring. Industry information indicates that foreign food markets currently have multiple sources of herring from European and Canadian stocks which have been cycling high in recent years. While Eastern Aleutian food herring are a suitable and desirable product, an ample and more reliable supply of food herring from other countries currently dominates the market. The bait product from this fishery has a more stable market which is used locally and in other fishing ports of Alaska for the longline and crab fisheries. Bait demands have been increasing in recent years and a premium price is placed on quality bait which is fresh and has high oil content. Overall, the ex-vessel value of bait herring has remained more stable than that for food.

## HARVEST STRATEGY

The harvest strategy of the Dutch Harbor food and bait herring fishery has evolved since it was re-established in 1981 (Table 2). During the 1981 and 1982 seasons, there were no harvest restrictions. From 1983 to 1985 the Board of Fisheries implemented a harvest ceiling of 3,527 tons per year due to biological concern over multiple exploitation on Eastern Bering Sea spawning stocks, specifically the Bristol Bay, Nelson Island, and Port Moller stocks. Scale pattern analysis studies identified these stocks as comprising the

Table 2. Dutch Harbor Food and Bait Herring Fishery (Short Tons), 1981-1990.

| Year | Preseason Togiak Spawning Biomass | Harvest Quota | Food and Bait Harvest | % Spawning Biomass Harvested |
|---|---|---|---|---|
| 1981 | 159,000 | NONE | 704 | .4 |
| 1982 | 98,000 | NONE | 3,565 | 3.6 |
| 1983 | 142,000 | 3,525[a] | 3,567 | 2.5 |
| 1984 | 115,000 | 3,525 | 3,578 | 3.1 |
| 1985 | 132,000 | 3,525 | 3,480 | 2.6 |
| 1986 | 96,000 | 2,453[a] | 2,394 | 2.5 |
| 1987 | 88,000 | 2,332[b] | 2,503 | 2.8 |
| 1988 | 132,000 | 3,100[c] | 2,004 | 1.6 |
| 1989 | 100,108 | 3,100[c] | 3,081 | 3.0 |
| 1990 | 72,000 | 903[c] | 820 | 1.1 |
| Average | 113,411 | 2,808 | 2,570 | 23.2 |

[a] Harvest ceiling of 3,525 established by Board of Fisheries.
[b] Harvest quota set by ADF&G. Reduced proportionate with the drop from the 1985 Togiak spawning biomass level.
[c] Harvest quota set under provisions of the Bering Sea Herring Fisheries Management Plan.

Eastern Aleutian herring biomass. The extensive sac-roe fisheries occurring on these stocks coupled with the food and bait fishery on different proportions of these same stocks creates an element of biological concern and possible exploitation above the board's 20% guideline policy. In 1986, a modification of the harvest ceiling was implemented by the Alaska Department of Fish and Game in response to the Board of Fisheries concern for the possible diminishing nature of the contributing stocks (primarily Togiak, to which the bulk of the Eastern Aleutian catch is estimated to be comprised). Concern was triggered by a possible lack of recruitment in the spawning stocks. The 1986 harvest allocation in the Eastern Aleutians was reduced by 30% (2,453 ton limit). This reduction was commensurate with the percentage reduction of the observed available Togiak spawning biomass between the springs of 1985 and 1986. The 1987 harvest allocation was 2,332 tons, which was in line with the 1985 to 1987 reduction on observed Togiak spawning biomass.

In 1988, the Alaska Board of Fisheries implemented a Bering Sea Herring Fisheries Management Plan, which established criteria for calculating the Dutch Harbor food and bait quota.

To ensure the conservation of herring stocks, the board adopted a requirement that the overall exploitation of a herring stock should not exceed 20% of the spawning biomass. In the case of the Togiak spawning stock, an allocation between the sac-roe fishery, spawn on kelp fishery, and the Dutch Harbor food an bait fishery was established so that the catch did not exceed 20% of the observed spawning biomass. The number of fishermen involved and the value of the fishery were factors considered by the Board when it made the allocations.

The Bering Sea Management Plan defines under what conditions and to what extent there will be a Dutch Harbor food and bait fishery. The elements governing the food and bait fishery are listed below:

1. The Dutch Harbor food and bait fishery quota is determined through the following calculations:

   A. The desired exploitation rate (maximum of 20%) is applied to the estimated Togiak spawning biomass. This figure represents the total combined allowable harvest to be extracted by the Togiak sac-roe fishery, spawn on kelp fishery, and the Dutch Harbor food and bait fishery.

   B. The spawn on kelp fishery is allocated 1,500 tons of herring.

   C. The Dutch Harbor fishery is allocated 7% of the remaining allowable harvest (after the 1,500 ton spawn on kelp allocation has been subtracted from the total allowable harvest).

   D. The Togiak herring sac-roe harvest allocation is the remainder of the total allowable harvest after the spawn on kelp and Dutch Harbor allocation have been subtracted.

2. If the herring sac-roe harvest in the Togiak District exceeds its allocation by more than 20%, the department shall deduct the amount of herring that exceeds the Togiak District herringsac-roe allocation from the Dutch Harbor fishery allocation for that season.

3. If the Togiak District herring sac-roe fisheries do not harvest their allocation, the unharvested amount of herring will be added to the Dutch Harbor fishery allocation. When an increase of the Dutch Harbor fishery allocation is made under this section, the total allocated harvest may not exceed 3,100 short tons.

4. When the Togiak District spawning stock is below its threshold (35,000 tons), the Dutch Harbor fishery will be closed for that season.

## 1990 FISHERY

Using the newly adopted Bering Sea Herring Management Plan and the revised Togiak spawning biomass, a preseason harvest quota of 903 short tons was calculated for the Dutch Harbor herring fishery:

```
 72,008 Estimated 1990 Togiak Spawning Biomass
x  20% Desired Exploitation

 14,400 Total Allowable Harvest
- 1,500 Spawn on Kelp Allocation

 12,900 Tons Remaining Allowable Harvest
x    7%

    903 Dutch Harbor Food and Bait Fishery
```

The fishery was opened by regulation (the Board of Fisheries changed the opening date from July 16 to August 15) to continuous fishing at 12:01 AM August 15, with seven seine vessels and eight tenders participating. Five companies were registered to buy herring.

Herring were accessible for harvest on August 15, and the entire fleet found a large school of herring at Cape Cheerful while en route to Makushin Bay. By 9:00 AM, August 15, the fleet had an estimated 940 tons seined up or on board tenders. It was decided to close the fishery at 12:00 Noon, August 15, 1990 (Table 3) in order to prevent over harvesting the allocation. After editing fish tickets, the total catch was 820 short tons, leaving 83 tons unharvested. By the time all fish tickets were received in the Dutch Harbor office, the herring fleet had departed for other fisheries and the balance of the quota (83 tons) was not attained. The entire harvest was processed as bait herring.

Fishermen were paid $350.00 per ton making the ex-vessels value of the fishery at $287,000.00.

Herring quality was good and they were a desirable size. The herring averaged about one pound and were twelve to fourteen inches in length.

## MANAGEMENT PLAN REVIEW AND 1991 HARVEST PROJECTIONS

The current management plan, adopted in 1988, generated food and bait allocations of 1,700 tons in 1988 and 1,300 tons in 1989. In both years the allocation was increased to

Table 3. Alaska Peninsula/Aleutian Islands Management Area Eastern Aleutians Herring Food/Bait Fishery Harvest Dates By Year, 1981-1990

| Year | Landing Date First | Landing Date Last | Days Fished | Seine Vessels | Total Harvest |
|---|---|---|---|---|---|
| 1981 | 8/03 | 8/23 | 21 | 2 | 704 |
| 1982 | 8/05 | 9/12 | 39 | 6 | 3,565 |
| 1983 | 7/23 | 9/06 | 46 | 5 | 3,567 |
| 1984 | 7/17 | 7/27 | 11 | 5 | 3,578 |
| 1985 | 7/17 | 8/11 | 26 | 3 | 3,480 |
| 1986 | 7/16 | 7/28 | 13 | 4 | 2,394 |
| 1987 | 7/16 | 7/23 | 4[a] | 9[b] | 2,503 |
| 1988 | 7/16 | 9/18 | 21 | 8[b] | 2,004 |
| 1989 | 7/16 | 8/05 | 19[c] | 9[d] | 3,081 |
| 1990 | 8/15 | 8/15 | 0.5 | 7 | 820 |
| Average | | | 20 | 6 | 2,570 |

[a] Closed 7/19, reopened for 14 hours on 7/23.
[b] Includes one gill netter.
[c] Closed 7/26, reopened 7/27 until August 5.
[d] Includes two gill netters.

3,100 tons because the allowable Togiak sac-roe harvest was not taken. In 1990, the allowable Togiak sac-roe harvest was attained, therefore the allocation remained at 903 tons.

Based on the projected 1991 Togiak spawning biomass of 54,772 tons the Dutch Harbor food and bait quota will be 662 tons. However, this figure could change if the biomass projection is inaccurate or if the desired 1991 sac-roe harvest is not achieved.

Attachment 3

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# SUBSISTENCE-HERRING FISHING IN THE NELSON ISLAND AND NUNIVAK ISLAND DISTRICTS, 1990

by

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## ABSTRACT

This report summarizes results of surveys conducted in summer 1990 on the participation rates and harvest levels of herring for subsistence use by communities in the Nelson Island and Nunivak Island districts. The 1990 surveys were prompted by concern over low projected returns of herring to those districts. Communities in the Nelson Island area were surveyed from 1986 through 1988 and results of those surveys are compared with the 1990 findings. This is the first complete survey (100 percent sample) administered in Mekoryuk, the single contemporary community on Nunivak Island. All fishing families were surveyed in four communities. Harvest estimates were generated for a fifth community, Nightmute, which did not give permission to conduct the surveys, primarily because of their concern about the declining herring stocks.

The 1990 survey showed that herring is a central component of the subsistence economy of the communities in the Nelson Island area, as did the previous surveys. A total of 125.7 short tons of herring was harvested and processed for subsistence use by approximately 72 percent of all Nelson Island households. Mekoryuk families, including 59 percent of all households harvested substantially less herring than the Nelson Island families: 4.5 short tons or 46 pounds of herring per capita compared to 222 pounds per capita for the Nelson Island communities combined. Drying the consistently fat herring caught along Nunivak Island involves much time and labor.

The 1990 total harvest was the second lowest for Nelson Island residents since 1986, and the lowest for Toksook Bay and Newtok. It was also the lowest per capita harvest (222 pounds) since documentation began with the 1986 fishing season. Evidence of recent declines in herring stocks have been compared to shortages in the 1960s and 1970s. Current projected declines understandably cause concern. Some families have begun to make adjustments by increasing harvests of other, less-preferred types of fish.

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## ACKNOWLEDGEMENTS

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The hospitality and generosity of Mike, Susie, and Anna Angaiak, Charles and Kathy Moses, Vincent and Theresa Waska, and Thomas Noatak during the 1990 season allowed me to concentrate on my work and I am grateful. Special recognition and gratitude is extended to all the people in the Nelson Island communities and Mekoryuk. Their concern and willingness to effect positive efforts for the herring resource was always an inspiration. The thoughtful and gentle refusal by Nightmute officials to participate in the survey was an equally compelling sign of their deep concern.

## INTRODUCTION

This report presents results of subsistence-herring harvest surveys administered in summer 1990 in three Nelson Island area communities and Mekoryuk on Nunivak Island (Fig. 1). Herring harvest estimates for a fourth Nelson Island community are also included. The 1990 findings are compared with results of surveys in the Nelson Island area communities conducted from 1986 through 1988. Surveys were conducted to document the level of subsistence use of herring by those communities, monitor the effects of the commercial herring sac-roe fishery initiated in 1985, and annually estimate the subsistence-herring harvest. Special attention was directed at local observations of the 1990 subsistence-herring fishing season, which supported management concerns about depressed herring stocks.

Herring comprise a significant part of the economy of communities along the eastern Bering Sea coast, particularly in the Nelson Island area (Fienup-Riordan 1983; Hemming, Harrison, and Braund 1978; Pete 1984; Pete and Kreher 1986; Pete, Albrecht, and Kreher 1987; Pete 1990). Herring stocks in both the Nelson and Nunivak Island districts were projected to be below thresholds to allow commercial harvest in 1990 (Hamner 1989); these projected low returns motivated the 1990 survey. Concern about subsistence productivity, even if commercial harvest was prohibited, required in-season surveys. The low projections were borne out in the Nunivak Island district. A surplus of 205 short tons was observed in the Nelson Island district in 1990 (Alaska Department of Fish and Game 1990). Commercial openings were announced in the Nelson Island district, but no herring were sold as buyers did not register for the district, anticipating the low returns.

## METHODOLOGY

The survey in Newtok, Tununak, and Toksook Bay was administered following previous methodologies (Pete and Kreher 1986; Pete, *et al.* 1987; Pete 1990). Letters were sent to the Nelson Island communities and Mekoryuk in early May asking for permission to administer surveys and

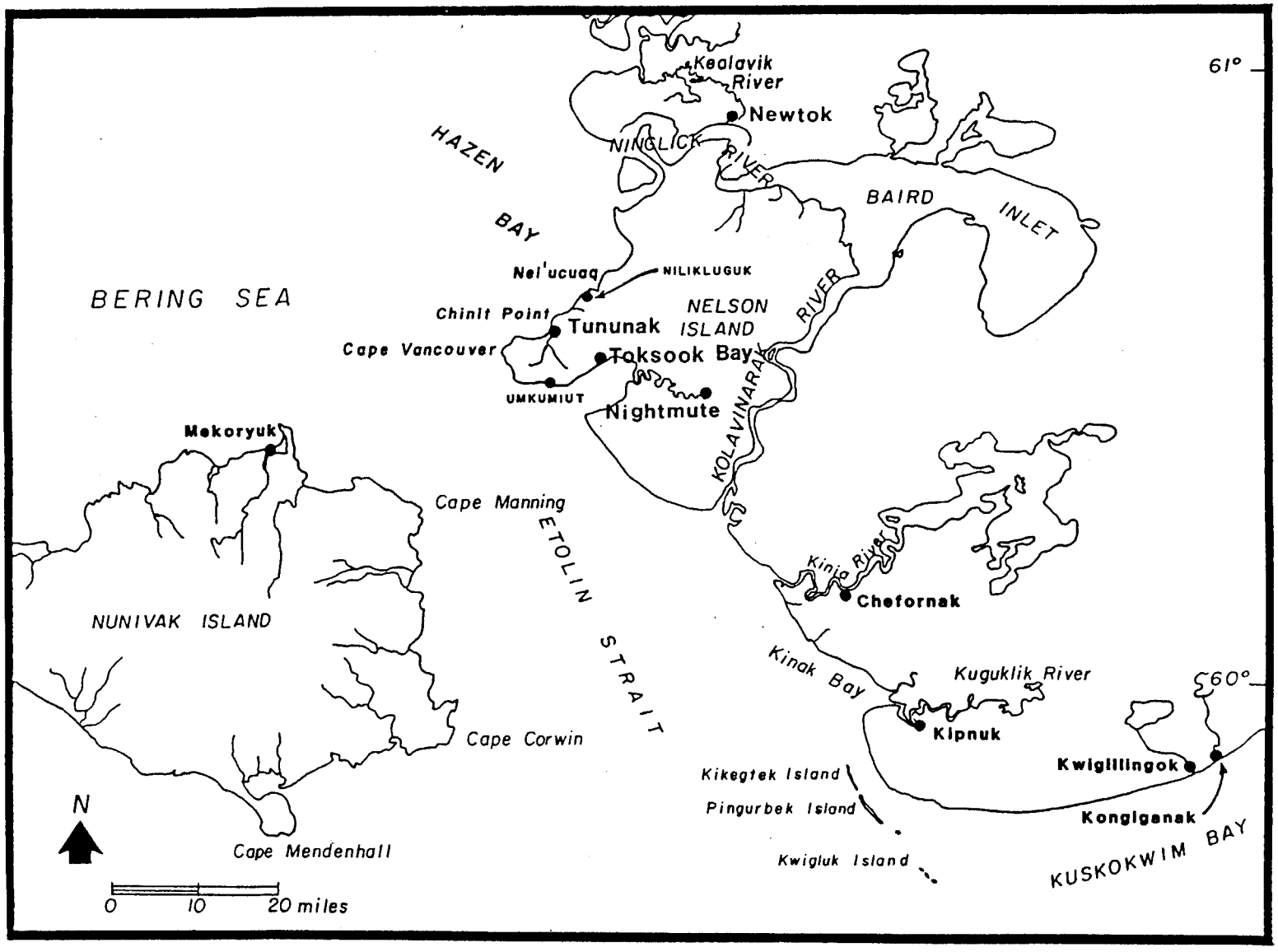


Figure 1. Location of communities on Nelson and Nunivak Islands.

recommendations for local assistants. All communities, except one, Nightmute, agreed to participate. Households censuses were updated with city officials upon arrival. Harvest information collected was similar to that recorded in previous surveys; harvest estimates were generated from direct observation of herring on drying racks. Detailed information on fishing sites, timing of harvest, specific personnel involvement, roe-on-kelp collection levels, and gear used was collected from several key respondents in each community. Participation in subsistence-herring production by every household was noted.

Nightmute officials did not grant permission to conduct the survey in their community in 1990, offering that the importance of herring to their economy has been well-documented in previous surveys. If policy developers were still not convinced about the significance of herring to protect local herring stocks, they did not think another year of information would "make them any more wise or concerned." It is a traditional Yup'ik belief that undue attention to resources in trouble hastens their downturn and eventual demise. This belief was expressed when permission for conducting a survey was denied. Human intervention in ordering of natural resources and attempting to manage them is viewed as presumptuous and arrogant. Wild resources are known to make themselves scarce to remind humans of their equal footing with them, especially when humans make inordinate commotion over wild resources. When resources face difficult times, it is considered more appropriate to deliberate and act on what human behavior and interaction should be changed to improve the situation. Nightmute officials wanted their views of the issue communicated in this report.

The harvest estimates for Nightmute were derived with a different methodology. The household census was updated as much as possible with the assistance of Nightmute residents fishing in Toksook Bay. With permission, direct observation was made of drying racks of two Nightmute families who fished from Toksook Bay. Fullness estimates of racks of seven families that fished from the fish camp at Umkumiut were made. Lastly, average harvests from previous surveys of four families that were identified as having fished from Nightmute were used to arrive at complete harvest information for all Nightmute families that fished for herring for subsistence in 1990. Because of this non-standard methodology, Nightmute population and herring-harvest figures used in this report should be interpreted more cautiously than the other community estimates.

This was the first year since 1986 that any subsistence-herring harvest information for Mekoryuk has been collected (Pete 1990). More importantly, this is the first survey in which a complete (100 percent) sample of Mekoryuk herring fishing households were contacted. Initial work included updating a household census on file with the city and determining the most common local unit of herring harvest, which were 15-gallon tubs. In addition to household participation, harvest levels, methods of herring processing, information on harvest timing, areas fished, gear used, and harvest of herring roe-on-kelp was collected. Many residents offered information on current herring productivity compared to the recent past (ca. early 1980s).

## COMMUNITY CHARACTERISTICS, 1990

### Nelson Island District

Detailed descriptions of the Nelson Island area communities were included in previous survey reports (Pete and Kreher 1986; Pete *et al.* 1987; Pete 1990). Briefly, the regional population of communities in the study represent the majority of the current *Qaluyaarmiut* Yup'ik society, one of approximately 20 traditional Yup'ik kin-based societies that generally share a land use area with unique patterns of resource use, often speak a distinctive linguistic dialect, and form a marriage universe (Fienup-Riordan 1983; Shinkwin and Pete 1984; Andrews 1989). The communities are small, most permanent residents (approximately 98 percent) are Yup'ik Eskimo, and many elderly people speak only the Yup'ik Eskimo language.

The 1990 regional population increased by 2 percent and the number of households increased by 4 percent since 1988 (Table 1) (Pete 1990). Most of the increase was due to natural growth. Average household sizes were typically large, ranging between 4.9 to 6.0 persons per household. Toksook Bay and Tununak gained residents while Newtok was reduced by two people since 1988 for an overall estimated 1990 regional population of 1,134 people (Table 1). There was some inter-village

migration due to marriage, as well as some, but less, movement for jobs to Bethel, the regional trade and transportation center.

The communities continue to rely heavily on local wild resources, with seasonal employment and commercial fishing providing the major opportunities for monetary income. The reduction in 1989, and the eventual lack of a commercial herring sac-roe fishery in 1990, was expressed as a loss of an important source of income. The commercial herring sac-roe fishery was estimated to contribute up to one-third of average annual household incomes in highly productive years (Pete 1990).

TABLE 1. NELSON ISLAND AND NUNIVAK ISLAND POPULATION AND HOUSEHOLD PARTICIPATION IN SUBSISTENCE-HERRING PRODUCTION, 1990

| Community | Population | Total number of households | Average household size | Number of participating households | | Number of fishing families |
|---|---|---|---|---|---|---|
| Nelson Island | | | | | | |
| Newtok | 205 | 39 | 5.3 | 20 | (51%) | 12 |
| Tununak | 326 | 67 | 4.9 | 54 | (81%) | 37 |
| Toksook Bay | 440 | 82 | 5.4 | 60 | (73%) | 38 |
| Nightmute[a] | 163 | 27 | 6.0 | 18 | (67%) | 13 |
| Subtotals | 1,134 | 215 | 5.3 | 152 | (71%) | 100 |
| Nunivak Island | | | | | | |
| Mekoryuk | 192 | 56 | 3.4 | 33 | (59%) | 19 |
| Totals | 1,326 | 271 | 4.9 | 185 | (68%) | 119 |

[a]Figures for Nightmute were derived from key respondents from Nightmute fishing at Toksook Bay and Umkumiut, rather than from interviews in Nightmute.

Nunivak Island District

Nunivak Island, measuring roughly 60 miles from east to west and 35 miles north to south, lies approximately 20 miles from the mainland across Etolin Strait (Fig. 1). A significant anthropological study of *Nunivaarmiut* (societal name for Nunivak Island Eskimos) conducted in 1939-40 by Lantis (1946) found 203 people in seven year-round settlements located around the entire coastline of Nunivak Island. Lantis noted seven other recently abandoned (ca. 1900) settlements, with many structures, being used as summer camps, along with numerous other camp sites. Consolidation from 14 to 7 settlements probably occurred after disease epidemics in the 1800s and early 1900s (Wolfe 1982). In the 1950s, most families with school-aged children in settlements around Nunivak Island congregated at Mekoryuk, along the northeast shore, after a new school was built there. Mekoryuk is the only current permanent community on Nunivak Island.

During the late 1930s, resources harvested for food and materials were four species of hair seal, walrus, beluga, sea lion, three species of Pacific salmon, halibut, Pacific cod, saffron cod, wolf fish, Dolly Varden, herring and herring spawn-on-kelp, stickleback ("needlefish"), smelt, several species of whitefish, "dogfish" (a species of shark), numerous types of shellfish and marine invertebrates, several species of flounder and sculpin, many species of waterfowl and sea birds and their eggs, ptarmigan, arctic and red fox, mink, weasel, reindeer (formerly caribou, until they were decimated and reindeer were introduced), and an occasional polar bear and dolphin (Lantis 1946). Many plant species and driftwood were also collected. Most of these species were still harvested and used in 1990, with the addition of introduced muskox. Mekoryuk residents still travel throughout the entire island and its coastal waters to hunt, fish, and gather wild resources.

In 1940, herring harvest and use was not large, compared to many other species taken throughout the island (Lantis 1946; Pete 1984). However, herring were more numerous on the east and south coasts of Nunivak Island (Lantis 1946:164), and specific settlements in the area not documented by Lantis may have incorporated greater use of herring for subsistence. The author spent most of the study year in communities along the north coast (Lantis 1946). Other subsistence studies

since Lantis' work have been done in Mekoryuk (Nowak 1975a, 1975b, 1977), but information on herring use was not described.

Many Nunivak Island families had moved to Bethel or other points beyond since the 1950s, to prevent families splintering when children were of high school age, because boarding schools were the only option until the mid-1970s. Some families and their descendents moved back to Mekoryuk after a local high school was built in the late 1970s, or established a pattern of returning to the island in the summer to fish for salmon, halibut, Pacific cod and herring. There is a strong and binding network of ties among former Nunivak Island families and their resident relatives expressed and strengthened by exchanges of subsistence labor and products. This dynamic adaptation is an important feature in family subsistence patterns and deserves attention in any discussion of the current Nunivak Island subsistence economy.

Mekoryuk had 192 permanent residents in 56 households in 1990 (Table 1). Most (95 percent) people were Cup'ik Eskimo (*Cup'ik* is the dialect of Yup'ik spoken by *Nunivaarmiut* society). As with other rural communities in western Alaska, the economy in Mekoryuk is based on harvest and use of local fish and wildlife combined with limited opportunities for wage employment, and commercial herring sac-roe and halibut fishing. The few available permanent jobs are generally associated with governmental services, such as with the school, local governments, and the regional health and social service agencies. Some seasonal jobs in the community are available, such as reindeer herding and butchering, and sports guiding and transporting of muskox hunters. Other wage employment opportunities include seasonal work outside of the community, such as construction or fish tendering and processing.

Cost of living is high due to the expense of importing goods and services. Barge service is the primary channel for incoming materials. Few airlines provide regular service to Mekoryuk because of the relatively small market and more stringent regulations required for flying over expanses of water such as Etolin Strait.

In the spring and summer of 1990, the Native corporation replaced a reindeer-processing plant that burned down several years ago. In July 1990, it was used to hold commercially-caught halibut for

export in cold storage, an application of the facility which increased local involvement and production in the commercial halibut fishery. Previously, Mekoryuk fishermen had to transport their catch to Toksook Bay or Tununak, the nearest ice-machines. In fall and winter, the plant will serve its designed purpose, which is a facility for reindeer butchering and storage prior to transporting meat to regional markets.

The commercial herring sac-roe fishery essentially did not occur in the Nunivak Island district in 1989 and 1990, primarily due to low returns of herring (Alaska Department of Fish and Game 1990). As with Nelson Island residents, the loss of this income opportunity has had negative effects. Fishermen feared foreclosure on many loans to purchase fishing equipment. Time spent preparing for subsequent non-existent commercial openings competed with other pursuits, such as subsistence-herring fishing and sea mammal hunting.

## SUBSISTENCE-HERRING FISHING, 1990

### Nelson Island District

Harvest and production of herring for subsistence use by Nelson Island area residents has been described in detail in previous reports (Pete and Kreher 1986; Pete *et al.* 1987; Pete 1990). The subsistence fishery was executed in essentially the same manner in 1990. Gear used and areas fished were similar to those reported earlier. Briefly, boats used were locally made wooden or purchased aluminum skiffs 14 to 28 feet in length; gill nets of between 2 to 2-3/4 inch mesh and 60 to 300 feet long were set; and areas fished were traditionally productive sites located near communities.

Production activities were organized and managed usually by a couple in charge of extended-family-based work groups. Generally, men oversee and engage in fishing and women take care of processing and storage. Extended families involving members of more than one household and many individuals with a wide age range cooperated in production activities.

In Tununak, gill nets were usually set as soon as the adjacent shoreline was ice free and herring were present in appreciable numbers in traditional fishing areas, a time span from mid May to early June. The other communities waited until rivers were clear of ice (Newtok and Nightmute) or subsequent runs of herring, noted for lower oil content, arrived (Toksook Bay). Thus, fishing generally occurred from mid May through mid June around Nelson Island.

The 1990 subsistence-herring season was unusual; subsistence fishing for herring resulted in differential success depending on timing of harvest and the area fished. Fishing families made adjustments to the prevalence of fatty herring throughout the entire season, and fewer herring congregated in schools of highly variable sizes. They fished longer and tried different meshed-sized nets to get herring for subsistence.

In 1990, Tununak families fished from late May through second week of June. Toksook Bay and Newtok families fishing activities extended from early June through late June. Reasons for the longer fishing season were related by respondents to poor returns and unusual quality of herring.

Herring were plentiful early in the 1990 season along the north shore. Tununak families did not have much difficulty obtaining as much herring as they wanted with regular gear because they customarily fish early in the season. However, in 1990, many more herring were unusually fat. Each year fishermen and processors make note of the oil content of herring as it affects spoilage. Spoilage is of particular concern in late June when weather is generally more sunny and windless, especially along the south shore of Nelson Island.

The greater proportion of strings of herring (*piirat*) processed as *ullipengayiit* in 1990 indicated the high oil content of herring caught for subsistence (Table 2). This means that more herring were subject to spoilage if suitable weather did not prevail. *Ullipengayiit* (plural; *ullipengayaq*, singular) means "those that are cut and exposed to the air." It refers to oily herring filleted and spread open for the oil to bead up to form a pellicle before braiding into strings to dry. Less fatty herring are processed into *tamalkuryat*, meaning "those that are whole (i.e. not filleted and exposed to air)," and are gutted and immediately braided into strings (Pete and Kreher 1986; Pete *et. al* 1987). In the 1990 season, 25 percent of all strings of herring were processed as *ullipengayiit* on Nelson Island, compared to regional

averages of 11.0 to 19.8 percent of all strings in 1986-88 (Table 2). In Tununak specifically, 28 percent of the 1990 catch was processed as *ullipengayiit* (Table 2).

TABLE 2. TOTAL STRINGS OF HERRING PRODUCED FOR SUBSISTENCE USE AND PERCENTAGE OF TOTAL STRINGS PROCESSED AS *ULLIPENGAYIIT* BY NELSON ISLAND RESIDENTS, 1986-88 AND 1990[a]

| | 1986 | | 1987 | | 1988 | | 1990 | |
|---|---|---|---|---|---|---|---|---|
| Community | Total No. of Strings | Percent *ullipe-ngayiit* | Total No. of Strings | Percent *ullipe-ngayiit* | Total No. of Strings | Percent *ullipe-ngayiit* | Total No. of Strings | Percent *ullipe-ngayiit* |
| Newtok | 503 | 7.0 | 463 | 8.0 | 618 | 18.0 | 351 | 16.2 |
| Tununak | 2,615 | 17.0 | 2,331 | 17.0 | 2,537 | 27.0 | 2,441 | 28.0 |
| Toksook Bay | 2,779 | 7.0 | 2,348 | 9.0 | 2,998 | 14.6 | 2,040 | 23.0 |
| Nightmute | 1,032 | 7.0 | 758 | 4.0 | 906 | 16.9 | no data | |
| Totals | 6,929 | 11.0 | 5,900 | 13.0 | 7,059 | 19.8 | 4,832 | 25.0 |

[a]Total numbers of strings vary slightly for some communities from previous reports (Pete and Kreher 1986; Pete *et al.* 1987). The numbers reported here are the final adjusted figures and percentages.

Newtok and Toksook Bay families experienced an even more difficult season in 1990 than Tununak families, which was further exacerbated by low gasoline supplies and unprecedented high prices ($5.00 per gallon). As mentioned, fishermen in both communities typically fish later than Tununak fishermen. Newtok fishermen have to wait for ice to break up in the Keyalivik River, which is their sole access to Hazen Bay. Toksook Bay (and Nightmute) families prefer to fish later in the season, when less-oily herring usually arrive in proportionately greater numbers. In 1990, herring abundance unexpectedly dropped off dramatically during mid June in the Nelson Island area, although there were slight periodic increases throughout late June along the south shore. Furthermore, the

reduced numbers of herring later in the season included a prevalence of fatty herring, rather than less oily herring which can be more reliably dried in late June.

Herring sizes were highly variable in all runs; large and small, or different age-classes, were mixed together. Generally, younger herring are smaller and less oily, so fishermen targeting these to catch set nets of smaller mesh size -- usually 2-inch stretched mesh. In 1990, even the 2-inch mesh nets caught mostly small oily herring. Nets with different mesh sizes, including mesh as small 1-1/4 inch and as long as 300 feet were strung together and set. After trying to use nets with different mesh sizes, some families suspended fishing until later in hopes of getting leaner herring. Large numbers of less oily herring never arrived.

Several families did not fish for herring at all, resulting in the lowest overall household involvement in herring production in the years of the survey. Instead, they diverted efforts to increase halibut, Pacific cod, and salmon harvests, filling drying racks and freezers with these welcome, but less-preferred, alternatives. Local residents do not consider halibut, Pacific cod adequate, or even improved, substitutes for herring, as non-local people may, but these species certainly are preferred by Nelson Island families to non-local, imported foods. Herring is the traditional winter food for Nelson Island families. Changing subsistence fishing strategies often means purchasing new gear and more gasoline, adjusting processing and drying facilities, investing more time fishing for other species, and altering subsistence production roles in the family.

Many respondents interpreted the unusual characteristics of the 1990 herring season as an indication of decreasing stocks. Some of these disturbing signs had been observed previously in herring stock reductions during the 1960s and 1970s, such as abundance of fatty herring, shorter duration of runs, and localization and concentration of spawning schools along Cape Vancouver and the north shore of Nelson Island (Pete 1990). However, there were some differences. Respondents viewed the recent trends with more alarm. Nelson Island herring stocks may have not experienced full recovery from earlier shortages before current relapses. In earlier times of shortage, herring were uniformly large one year, and then decreased in size the next year. The mixed sizes and high oil content of herring throughout the 1990 season were believed to show that herring numbers may be in a more

drastic decline in comparison to the declines in the 1960s and 1970s. Different-sized herring (age-classes) were thought by local residents to be mixing because there were too few numbers to sustain large enough schools for normal spawning saturation as discrete age-classes. Fewer herring with less competition for the abundant food have become uniformly fat. Consequently, 1990 the subsistence-herring fishery was distinctly stressful and unusual.

## Harvest Levels

The total 1990 harvest of herring for subsistence by Nelson Island communities was an estimated 125.7 short tons (Table 3), the second lowest recorded total harvest since 1986 (Pete 1990). The 1990 harvest produced the lowest per capita pounds of herring for the regional population and for Toksook Bay and Newtok (Fig. 2), the communities which fished later than Tununak. Regional per capita pounds of herring harvested ranged from 227 to 308 pounds in 1986-88; in 1990, the regional harvest produced 222 pounds of herring per person for subsistence. Nightmute figures do not show any unusual reductions. However, Nightmute estimates were not generated from direct observation, thus interpretations should be made with caution.

For the first time since 1986, the harvest by Toksook Bay residents was lower than the harvest for Tununak -- 46.3 short tons compared to 54.0 short tons, respectively. In previous years' surveys, harvest levels by Toksook Bay families usually accounted for over 40 percent of the total regional harvest while the harvest by Tununak families accounted for between 36 to 38 percent. Their contributions were reversed in 1990; Tununak harvested 43 percent of the total regional harvest while Toksook Bay obtained 37 percent of the total (Table 3) (Pete 1990). Newtok harvest levels were the lowest documented: 6.3 short tons was obtained in 1990, compared to a range of 10 to 12.6 short tons in 1986-88 (Pete 1990).

Household participation rates for Toksook Bay were likewise the lowest recorded since 1986: 73 percent of all households were involved in production of herring for subsistence use, rather than 83 percent. Although the usual percentage of Newtok and Nightmute households participated in

TABLE 3. ESTIMATED NELSON ISLAND AND NUNIVAK ISLAND SUBSISTENCE-HERRING HARVEST LEVELS (IN SHORT TONS) AND PERCENTAGE OF TOTAL HOUSEHOLDS INVOLVED IN PRODUCTION, 1986-88 AND 1990

| Community | 1986 Short tons | 1986 Percentage of households involved | 1987 Short tons | 1987 Percentage of households involved | 1988 Short tons | 1988 Percentage of households involved | 1990 Short tons | 1990 Percentage of households involved |
|---|---|---|---|---|---|---|---|---|
| Nelson Island | | | | | | | | |
| Newtok | 12.6 | 46 | 10.0 | 56 | 12.5 | 68 | 7.9 | 51 |
| Tununak | 63.3 | 86 | 48.0 | 85 | 49.3 | 86 | 54.0 | 81 |
| Toksook Bay | 69.5 | 83 | 51.0 | 83 | 58.5 | 84 | 46.3 | 73 |
| Nightmute | 21.4 | 64 | 15.0 | 65 | 16.0 | 74 | 17.5[a] | 67 |
| Subtotals | 166.8 | 75 | 124.0 | 76 | 136.3 | 80 | 125.7 | 72 |
| Nunivak Island | | | | | | | | |
| Mekoryuk[b] | no data | | no data | | no data | | 4.5 | 59 |
| Totals | | | | | | | 130.2 | 69 |

[a]Figures for Nightmute were derived from a combination of methods, rather than interviews with families in Nightmute or direct observation of all herring they processed.
[b]Herring harvest data from 1986 for Mekoryuk are incomplete and have been omitted (Pete 1990).

subsistence-herring production in 1990, a few families (cooperative multi-household units) in both communities that usually fish for herring for subsistence use did not do so in 1990. As mentioned, they chose to put their time and effort into catching and processing other types of fish for their subsistence. However, even with reduced involvement by households and fishing families, a substantial percentage

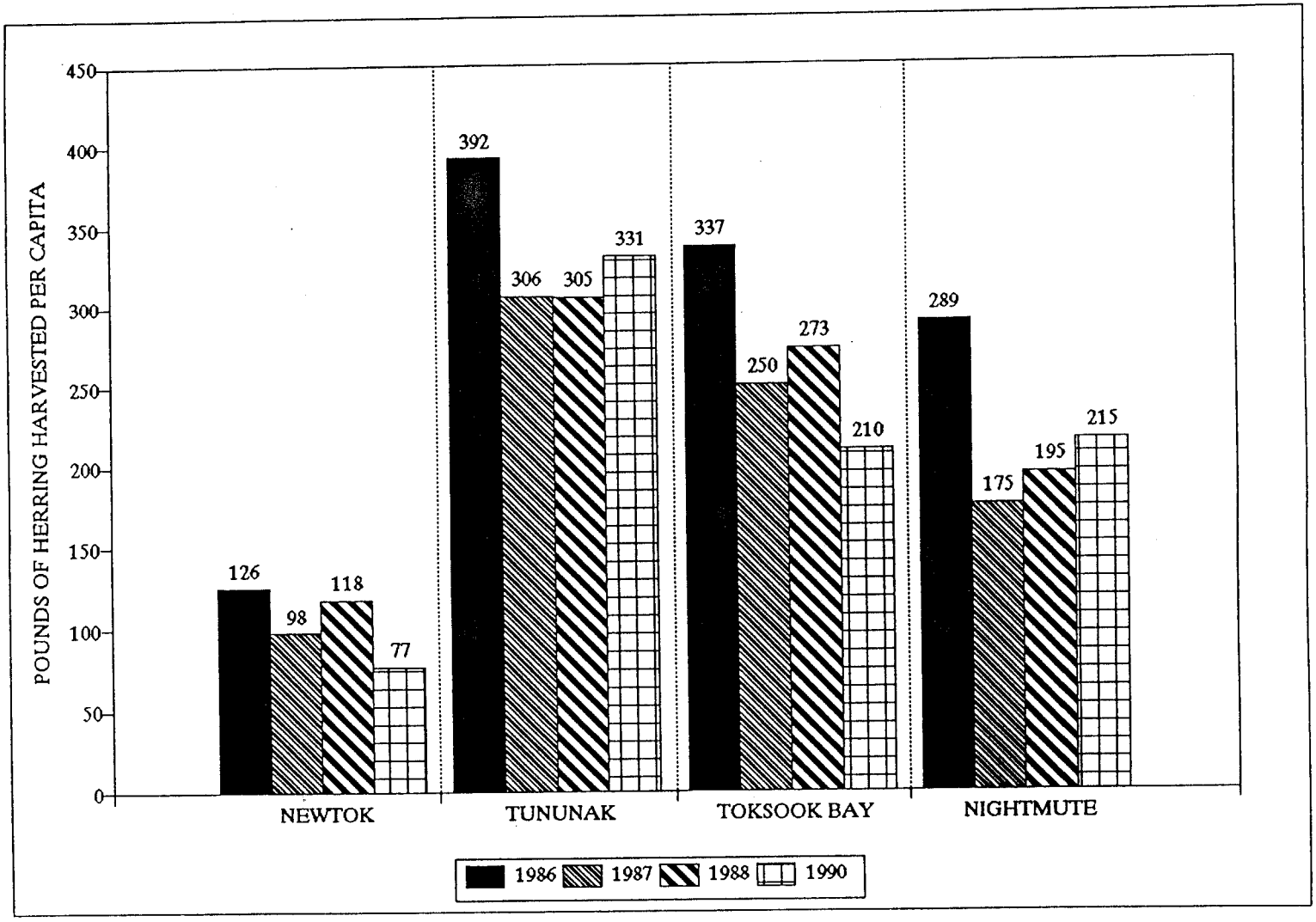


Figure 2. Pounds of herring harvested per capita for subsistence use by Nelson Island communities, 1986-88 and 1990.

(72 percent) of total households continued to be involved in subsistence-herring production (Table 3). This underscores the importance of herring as a subsistence resource to Nelson Island families.

Nunivak Island District

Timing of subsistence-herring fishing on Nunivak Island is similar to that reported for Nelson Island. Herring are harvested from mid May to mid June. Most commonly, gill nets were set or "drifted" for herring with skiffs similar in size to that described for Nelson Island. Other methods of harvest included using dipnets, picking herring by hand from tidal pools or throwing home-made "toss nets," approximately six feet in diameter, over spawning schools and pulling them closed and ashore with the "purse" full of herring.

Set and drift net fishing areas commonly used extended east and south from Mekoryuk to Cape Corwin (Fig. 1). In 1990, most nets were set off of Cape Etolin and in the Cape Manning area, between Ikathleewik Bay (*Iqalivik*, meaning "place to get many herring") and Nooravloaksmiut Island (*Nuugavluarmiut*, "inhabitants of *Nuugavluar* (big bluff)," name for a campsite derived from of the place name of the coastal headland). Herring spawn-on-kelp was collected from the same areas. One family boated across Etolin Strait to the area west of Umkumiut on Nelson Island to get herring because they missed the unusually short window of harvest opportunity around Nunivak Island.

Although herring is harvested from camps along the east shore of Nunivak Island, all herring is brought to Mekoryuk to be processed. Processing of herring was similar to methods used by Nelson Island residents (Pete and Kreher 1986; Pete *et al.* 1987), with a few significant differences. Herring caught around Nunivak Island are noted to be consistently large and fat every year, requiring more specialized processing than most herring caught around Nelson Island. Unlike the Nelson Island pattern, herring were not aged in pits. They were immediately deheaded and filleted with a knife through the back, rather than the softened ventral side. Herring were then braided through a section of backbone left near the tail, with locally collected beach grass into short strings of 15 to 40 herring each. The strings of herring were dipped in tubs of sea water to wash off slime and to add salt for taste

and good drying. These strings were hung up to dry on racks with other fish or sea mammal meat. When dry, the strings are moved into smokehouses to be smoked with green willow and driftwood, a step rarely taken by Nelson Island herring fishing families. Smoking prevents the fat from turning rancid, increasing sustained palatability and storage life. The strings of herring were stored along with other dried products in caches for the winter.

Key respondents noted the labor-intensive process as one of the reasons Nunivak Island people did not specialize in subsistence-herring production. Smoking of herring is viewed as an extra, but necessary, step in subsistence-herring processing. Precious wood has to be gathered and cut (Nunivak Island is treeless tundra). The smoke has to be tended for several days to over one week. Other fish, even salmon, are rarely smoked, because they are generally not fat (salmon are caught primarily near spawning grounds). Halibut, Pacific cod, and salmon, can be dried at fish camps without smoking. A few individuals thought that eating too much smoked products reduced endurance, a desired condition for walking throughout Nunivak Island to pursue subsistence activities.

Although harvest of herring spawn-on-kelp by Mekoryuk residents was not documented, it is believed to be considerable and may rival herring harvests in some years. Herring spawn-on-kelp not eaten immediately is frozen or dried for later use. The dried product is easily reconstituted by soaking it in salt water overnight.

As in Nelson Island, production of herring for subsistence use was a kin-based operation in Mekoryuk, with members of extended families, generally a couple and their adult children in separate households, working together. Five former Nunivak Island families now living in Bethel customarily return to the island to produce herring for subsistence, as they had in 1990. The herring products are divided among relatives that helped with production. The majority of harvesters were men, but relatively more women fished for herring than was documented in Nelson Island communities. Women generally helped their husbands or picked herring from tidal pools near Mekoryuk. Most people (90 percent) involved in subsistence-herring production were between 25 and 70 years of age; no one under 18 years of age was involved in 1990.

The commercial herring sac-roe fishery initiated in 1985 brought heightened attention to the health of local herring stocks. Mekoryuk respondents noted that herring numbers have been decreasing since the mid-1980s. As around Nelson Island, herring do not stay in area waters as long as they had in the past. Herring also are used for bait in subsistence-halibut and Pacific cod fishing; fishermen who drift for herring for bait noticed reduced schools that did not stay near shore as long as expected. Smaller numbers of herring make it more difficult to see "oiled" water surfaces which signal when vast schools have moved inshore to spawn. It has become confusing to gauge when herring fishing or spawn-on-kelp collecting activities should start or to plan for expected productivity. Depth or amount of roe deposited on kelp has become highly variable, according to local observations, affecting collecting activities as well. Similar to Nelson Island, two families that usually fish for herring for food did not do so in 1990; they concentrated on halibut and Pacific cod fishing.

## Harvest Levels

Although subsistence herring production by Mekoryuk families is not of the same magnitude as Nelson Island families, a significant proportion (59 percent) of Mekoryuk households were involved in subsistence-herring production in 1990. Three households provided only harvesters; 14 households had members who only processed herring; and 16 households had members who engaged in both harvesting and processing of herring for subsistence use. Thirty-three households cooperated in 19 fishing families to produce an estimated total of 4.5 short tons of herring for subsistence (Table 3), approximately 46 pounds per capita. Family harvests ranged from 35 to 900 pounds for an average of 470 pounds of herring per fishing family. Previous incomplete surveys documented up to .7 short tons harvested by Mekoryuk residents (Pete 1990).

Nearly 1,000 pounds of processed herring were destined for Bethel, to be taken by five families who moved to Bethel from Nunivak Island. Families estimated amounts for herring to be taken to Bethel, based on past patterns, as well as the current harvest. Bethel-based families conducted fishing and processing activities out of Mekoryuk or camps along the east shore of Nunivak Island, in some

cases, using local relatives' facilities. Thus, approximately 4.0 short tons was harvested for Mekoryuk families in 1990.

Many households involved in herring fishing reported that they also usually collected spawn-on-kelp. A few households said that they commonly only collected spawn-on-kelp; they did not fish for herring. Most respondents noted that very little good quality spawn-on-kelp was found near Mekoryuk in 1990. As mentioned, harvest levels of spawn are thought to be considerable. It is suggested that future surveys incorporate herring spawn-on-kelp harvesting activities and harvest levels.

## SUMMARY

Concern about reduced herring stocks in the Nelson and Nunivak Island districts in recent years prompted in-season subsistence harvest surveys in 1990. The commercial herring sac-roe fisheries in the Nelson and Nunivak Island districts were reduced in 1989 and did not occur in 1990.

The 1990 subsistence-herring surveys in Nelson Island area communities demonstrated the significance of herring harvest levels as in previous surveys. Approximately 126 short tons was harvested -- the second lowest recorded harvest since 1986, and the lowest for Toksook Bay and Newtok. Furthermore, the 1990 harvest reflected the lowest per capita harvest of four study years. This was the first complete herring harvest survey of Mekoryuk households. They obtained an estimated 4.5 short tons. Household participation rates in subsistence-herring production were substantial in all communities, ranging from 51 percent in Newtok to 81 percent in Tununak (Table 1).

This summer, many local observations of herring runs paralleled those made of decreasing herring stocks in the 1960s and 1970s. However, there were observable distinctions in the 1990 season which may signal more radical declines in local herring stocks. Herring schools of mixed sizes and oily herring in sustained numbers occurring throughout the entire season were the most alarming characteristics on the 1990 season.

Declining numbers of herring and proportionately greater numbers of oily herring throughout the entire season affected fishing activities, especially those of Toksook Bay and Newtok families.

Several families on both Nelson and Nunivak islands did not fish for herring this year due to a prevalence of fatty herring, perceived declines in herring numbers, and variable productivity. These families concentrated efforts for winter food on increased harvests of halibut, salmon, and Pacific cod. Augmenting harvests of other fish species was a strategy used in previous herring shortages during the 1960s and 1970s (Pete 1990).

Nightmute officials chose not to authorize the community survey in 1990, with reasons related to current herring declines. As mentioned, they believe that policymakers have enough evidence about the local significance of herring to make reasonable decisions. A traditional Yup'ik belief that inordinate attention directed at shrinking natural resources by presumptuous humans often results in further deterioration of wild resources. Deliberate hastened declines are sometimes effected by natural resources to remind humans of their place with natural resources. Rather than heightened absorption with diminishing herring numbers, they suggest that affected groups of people consider their interactions among themselves relative to the herring resource. Perhaps some of these interactive patterns need to be changed to help the Nelson Island herring resource. They wanted this message conveyed to policymakers, instead of usual survey results.

There is widespread local concern for the Nelson and Nunivak Island herring resources, especially among Nelson Island families, whose main winter food is dried herring. Herring importance in the Nelson and Nunivak Island districts was underscored with its commercialization, because opportunities for wage employment are few and cost of living is high. These recent decreases in herring stocks remind Nelson Island people of past shortages and associated difficulties, which they hope can be avoided. They want to see policies in place that ameliorate the situation soon before declines in herring abundance force subsistence closures.

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Attachment 4

# Stock Identification of Pacific Herring in the Eastern Bering Sea Trawl Bycatch and in the Dutch Harbor Directed Food and Bait Fishery

by

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Brian G. Bue

Presentation Materials to the Alaska Board of Fisheries
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Regional Information Report [1] No. 2D90-06

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Division of Commercial Fisheries
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[1] Contribution 90-6 from the Bristol Bay area. The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional resports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accomodate needs for up-to-date information, reports in this series may contain preliminary data.

SUMMARY

Stock Identification of Pacific Herring in the Eastern Bering Sea Trawl Bycatch and in the Dutch Harbor Directed Food and Bait Fishery.

Katherine A. Rowell
Harold J. Geiger
Brian G. Bue

Pacific herring *(Clupea harengus pallasi)* have been harvested for commercial and subsistence use during their spawning migration in coastal waters of the eastern Bering Sea. Nine stocks, have been defined for management purposes: Norton Sound, Cape Romanzof, Kuskokwim Bay (Nelson Island, Nunivak Island, Cape Avinof, Goodnews Bay, Security Cove), Togiak and Port Moller. Migrating herring have been caught offshore and incidentally to groundfish species by the domestic trawl fleet and directed food and bait fisheries. The impact of this additional exploitation on the coastal spawning populations has been of concern to western Alaskan fishermen. The Department of Fish and Game attempted use of scale growth to examine stock definition of these nine spawning populations. The goals of this study were to determine stock composition herring caught in the Port Moller trawl, the Dutch Harbor/Unimak trawl, and the Dutch Harbor directed herring food and bait fisheries. Single herring schools were sampled in both the Dutch Harbor food and bait fishery and in the Dutch Harbor trawl fishery to determine stock integrity of migrating schools.

During the 1989 season, spawning began the first of May for Togiak herring and occurred progressively later to the end of May for the Port Moller stock. Ages ranged from 2 to 16, herring age 8 and older dominated all spawning populations with exception of Cape Romanzof, Cape Avinof, Port Moller and Norton Sound populations. A wide distribution of ages were were present in the samples from the Port Moller trawl fishery. Age composition shifted from older herring at the beginning of the season to younger herring at the end of the season. The Dutch Harbor food and bait fishery, and single school samples and the Dutch Harbor trawl fishery were dominated by herring age 8 and older. Samples from the single school collected from the Dutch Harbor/Unimak trawl fishery was comprised primarily of age 5 and 6 fish.

Scale growth parameters were examined for two age classes, age 6 and age 11. Cluster analysis defined various groupings that changed by age. Two surrogate stocks were used to represent these stock groupings or clusters in linear discriminant analysis. For age 11 herring, these stock clusters were represented by the surrogate stocks of Togiak and Nelson Island. Classification of the offshore fishery samples showed presence both stock clusters. The first period of the Port Moller trawl fishery classified 100% to the Togiak stock cluster. In contrast, the second period of from the Port Moller trawl fishery classified 83% to the non-Togiak stock grouping. Samples from the first and second fishing periods in the Dutch Harbor food and bait fishery classified 74% and 79% to the Togiak stock cluster. Samples from the single discrete herring school collected from the Dutch Harbor food and bait fishery classified 81% to the non-Togiak stock cluster.

Analysis of the age 6 samples indicated presence of three stock clusters. These clusters were represented by the surrogate stocks of Togiak, inner Port Moller and Cape Avinof. Samples collected from the Port Moller trawl fishery classified 86% to the Togiak stock cluster. Samples collected from the single herring school in the Dutch Harbor/Unimak Trawl fishery classified 100% to the Cape Avinof stock cluster. The differences in classification rates of samples collected from the representative fisheries and from single herring schools indicate herring stocks in the eastern Bering Sea may be segregated, not mixed during their summer migration.

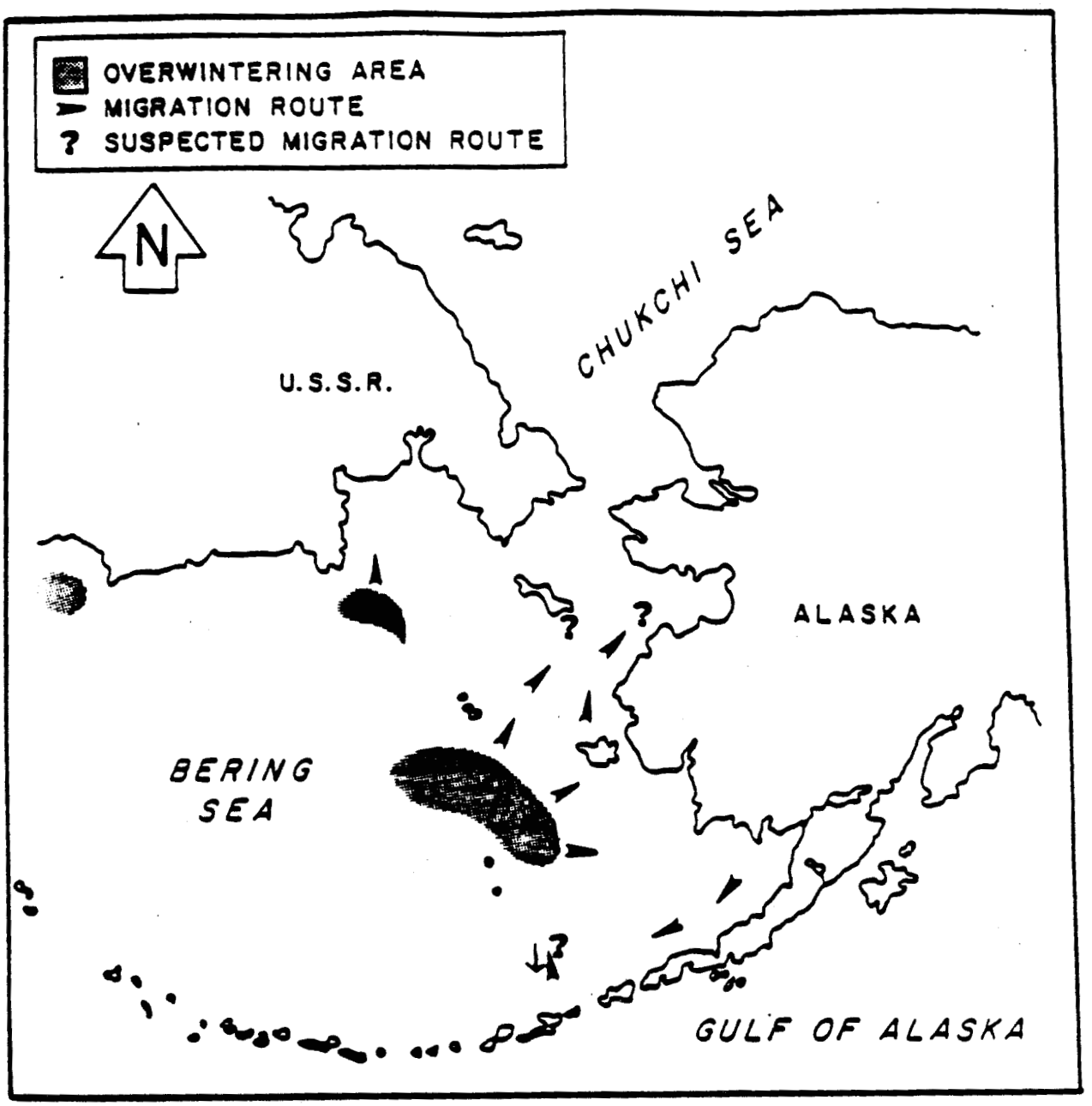


Figure 1. Herring migration routes and overwintering areas in the eastern Bering Sea.

# OBJECTIVES

1. To determine stock composition of herring caught in the domestic groundfish trawl fisheries in the Port Moller and Dutch Harbor/Unimak areas and in the Dutch Harbor directed herring food and bait fishery;

2. To examine stock homogeneity of single herring schools in non-spawning condition.

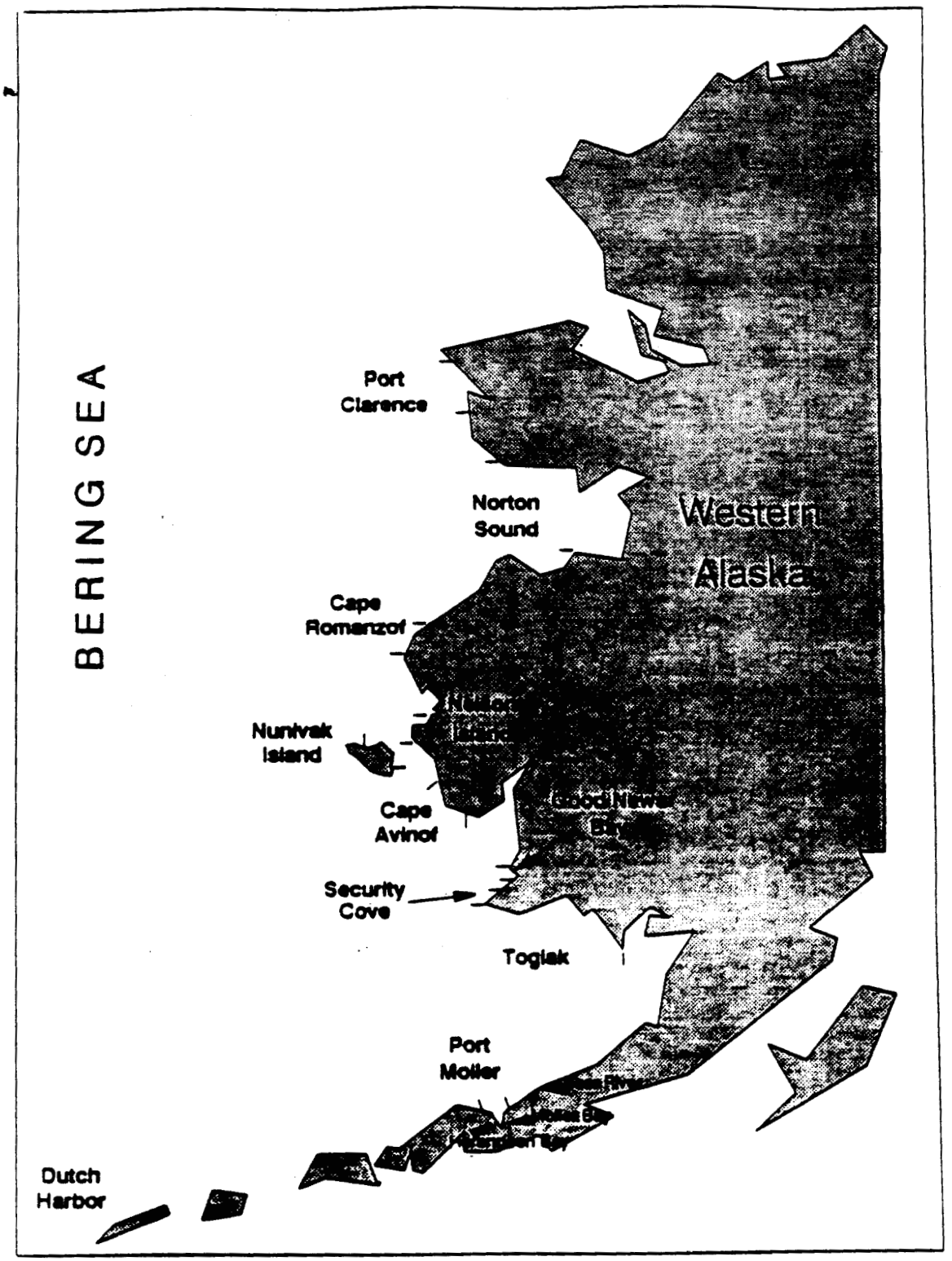


Figure 2. Eastern Bering Sea fishing districts for the sac roe harvest of Pacific Herring.

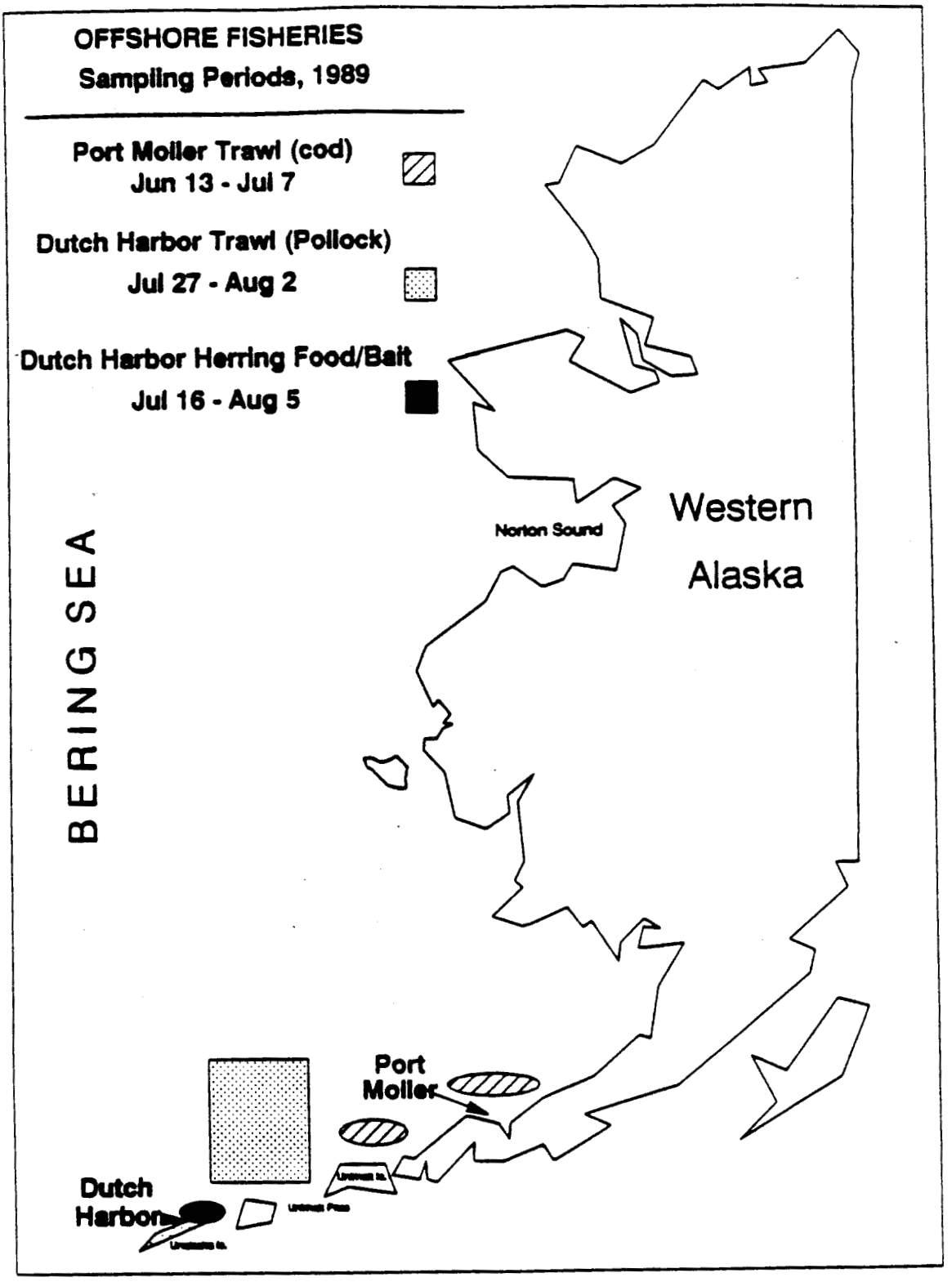


Figure 3. Timing and location of Pacific herring samples collected from the Dutch Harbor food and bait fishery and the ground fish trawl fisheries.

Table 1. Sample sizes of herring collected from spawning populations and offshore fisheries, 1989.

| SAMPLING LOCATION | GEAR | SAMPLE SIZE |
|---|---|---|
| SPAWNING POPULATIONS | | |
| Norton Sound | Variable Mesh Gill Net & Beach Seine | 2,884 |
| Cape Romanzof | Variable Mesh Gill Net | 2,003 |
| Nelson Island | Variable Mesh Gill Net | 2,140 |
| Nunivak Island | Variable Mesh Gill Net | 1,320 |
| Cape Avinof | Variable Mesh Gill Net | 2,100 |
| Goodnews Bay | Variable Mesh Gill Net | 2,190 |
| Security Cove | Variable Mesh Gill Net | 1,670 |
| Togiak | Variable Mesh Gill Net & Purse Seine | 7,800 |
| Port Moller Area | | |
| Bear River | Purse Seine | 662 |
| Port Moller (Outer) | Purse Seine | 1,253 |
| Port Moller (Inner) | Purse Seine | 297 |
| Subtotal | | 24,319 |
| OFFSHORE FISHERY MIXTURES | | |
| Dutch Harbor | | |
| Herring Food and Bait | Purse Seine | 1,100 |
| Single | Purse Seine | 539 |
| Pollock | Trawl | 473[a] |
| Single School | Trawl | 1,115 |
| Port Moller | | |
| Pacific Cod | Trawl | 2,478 |
| Subtotal | | 5,705 |
| Total All Samples | | 30,024 |

[a] Samples of poor quality, used only for age composition.

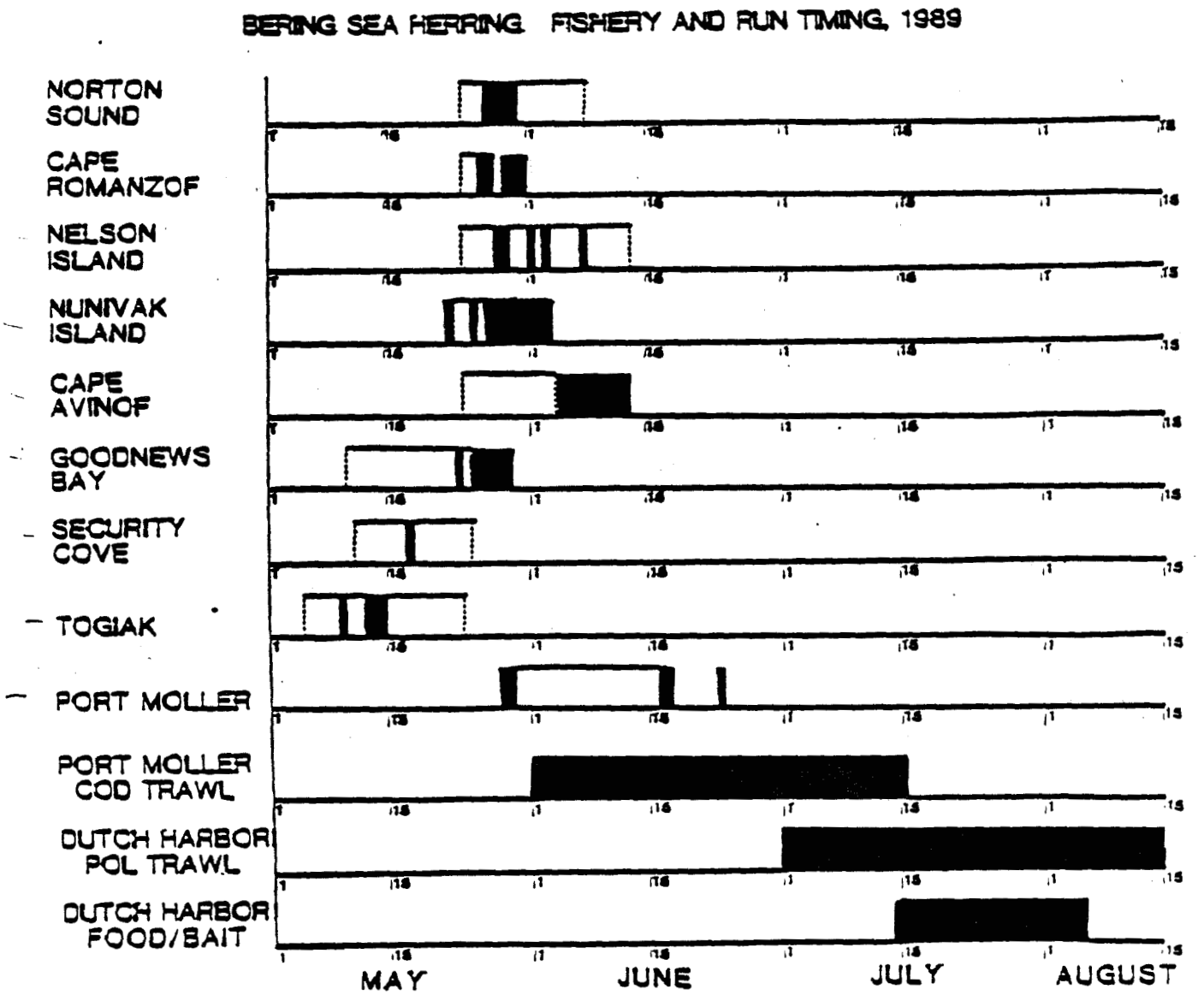


Figure 4. Run timing of Pacific herring to spawning locations and fisheries in the eastern Bering Sea, depicted by the range of dates of aerial survey observations (----) or dates of fishing periods (■) in the eastern Bering Sea.

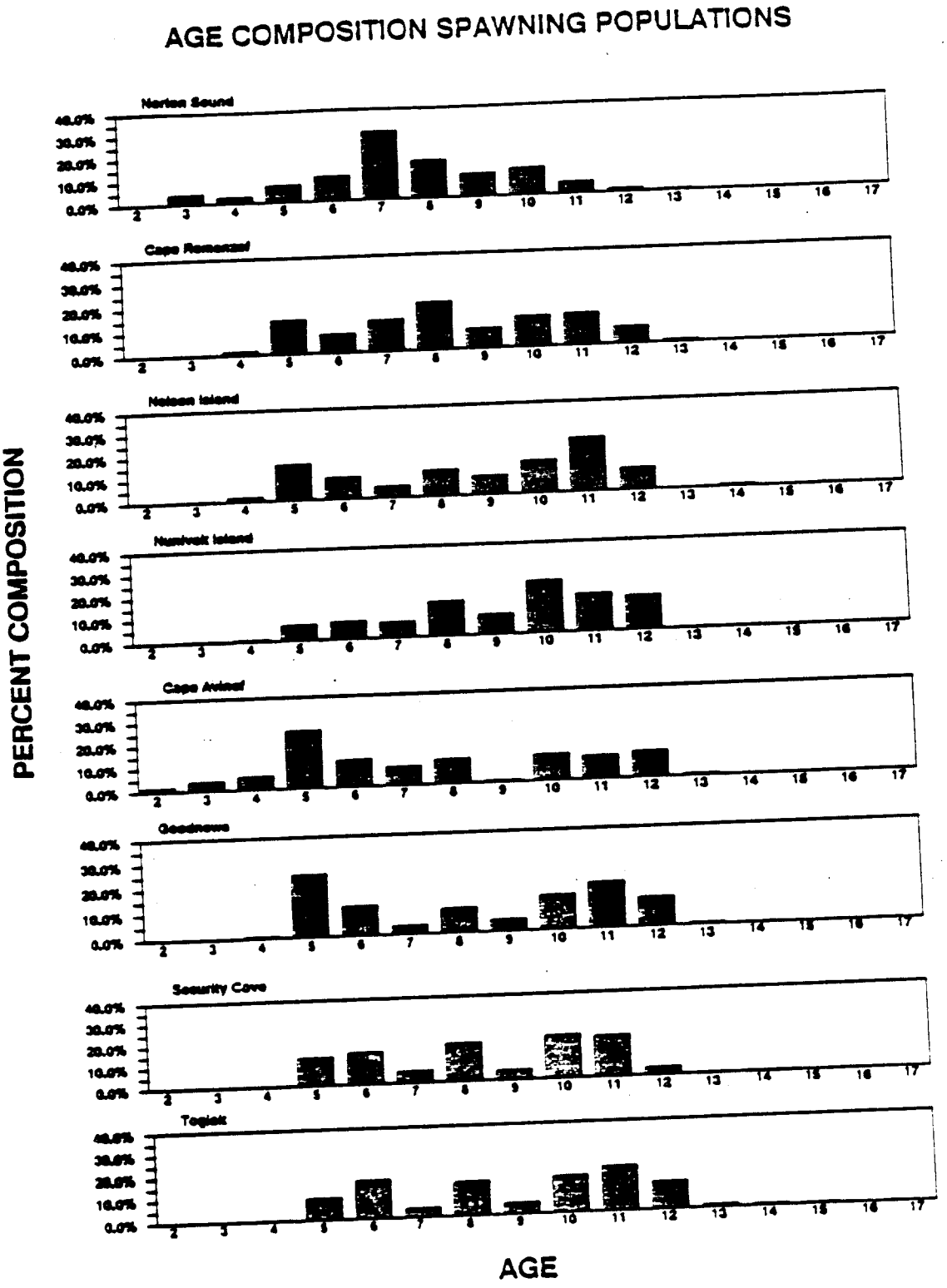


Figure 5. Age composition of Pacific herring spawning populations in the eastern Bering Sea from Norton Sound south to Togiak, 1989.

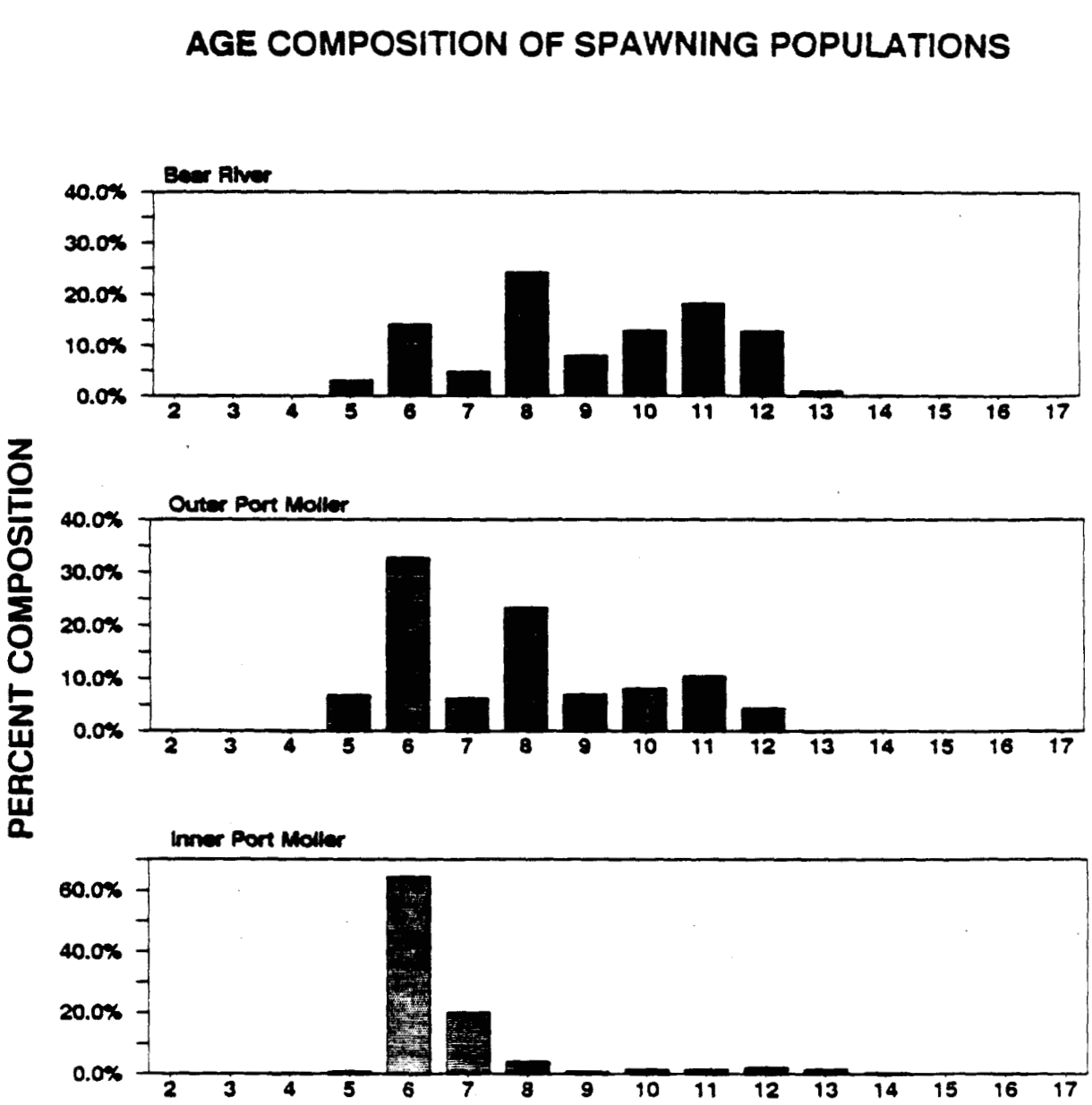


Figure 6. Age composition of Pacific herring spawning populations in the eastern Bering Sea from the Alaska Peninsula, 1989.

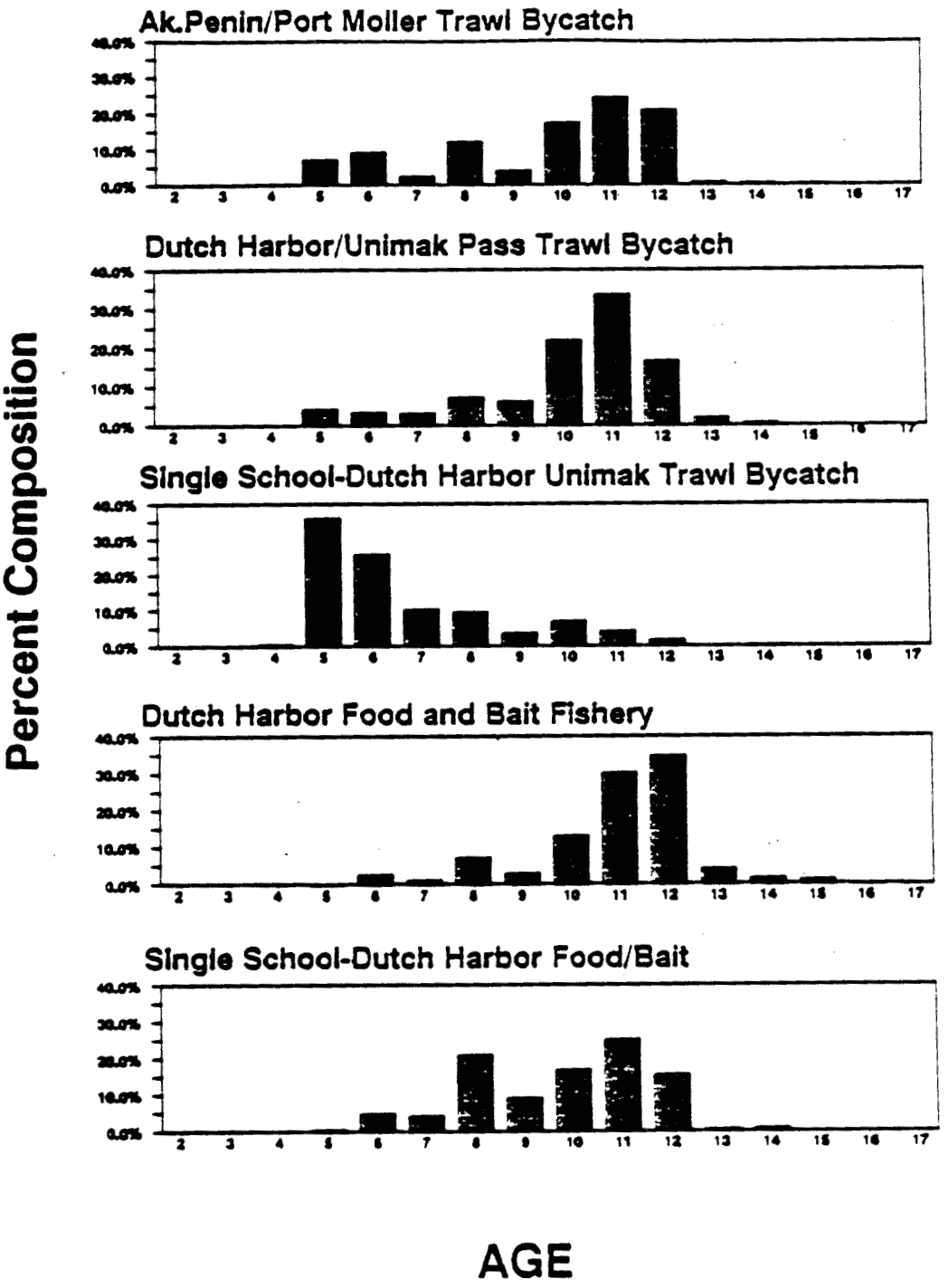


Figure 7. Age composition of Pacific herring samples collected from the Dutch Harbor food and bait, and the domestic groundfish trawl fisheries, 1989.

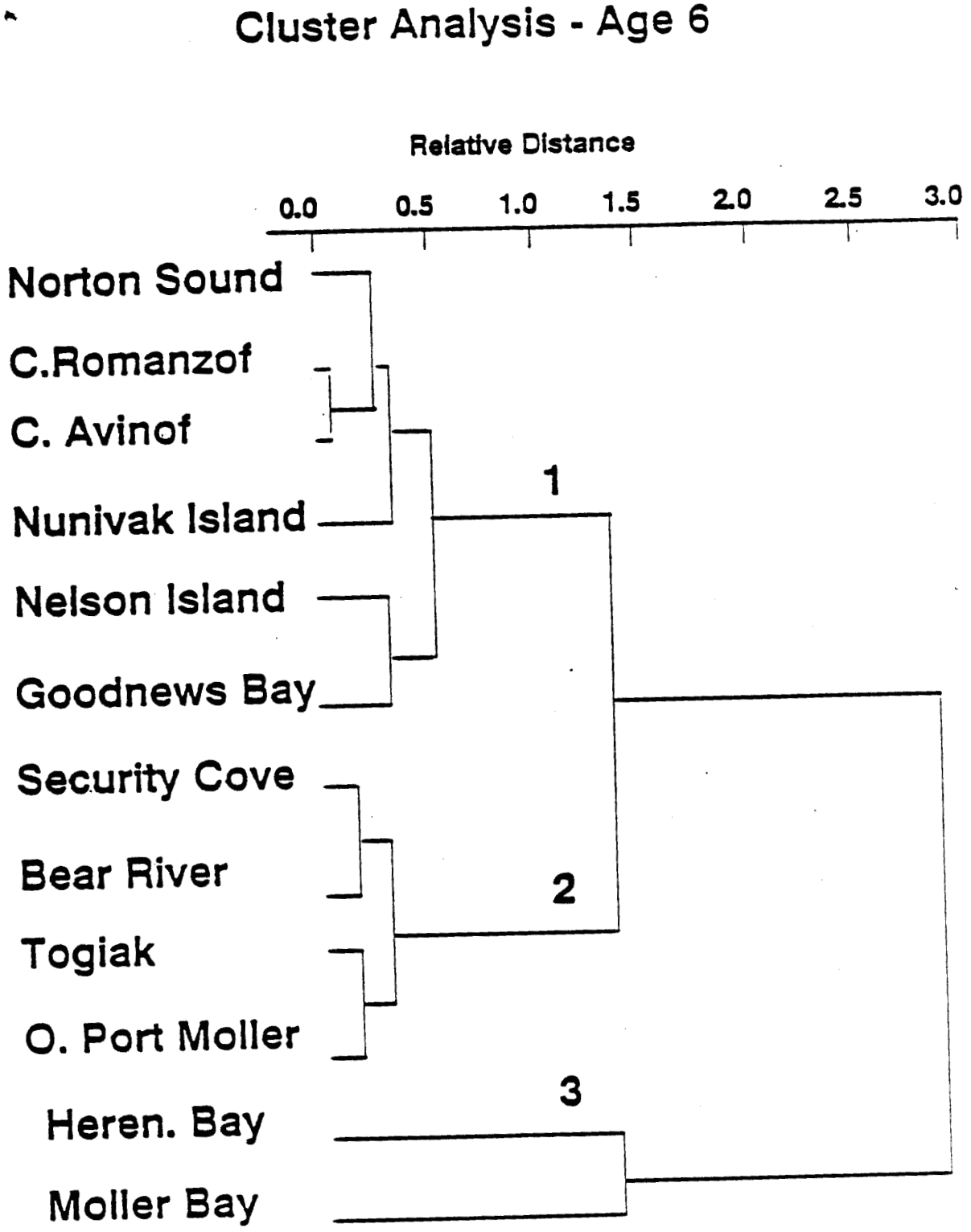


Figure 8. Results of cluster analysis for age 6 herring.

Table 2. Classification matrix from linear discriminant analysis with sample size, classification (%) to actual stock cluster and classification (%) of the unknown fishery mixtures for age 6 herring.

CLASSIFICATION MATRIX

| Stock Cluster | Sample Size | Cluster 1 | Cluster 2 Togiak) | Cluster 3 | Total |
|---|---|---|---|---|---|
| Cluster 1 | 70 | 71.4 | | | 100.0 |
| Cluster 2 Togiak) | 200 | | 72.5 | | 100.0 |
| Cluster 3 | 16 | | | 100.0 | 100.0 |
| FISHERY MIXTURE CLASSIFICATION | | | | | |
| Port Moller Trawl (6/13-7/07) | 78 | 14.6 | 86.2 | 0.0 | 100.0 |
| Dutch Harbor/ Unimak Trawl Single School (8/02) | 74 | 100.0 | 0.0 | 0.0 | 100.0 |

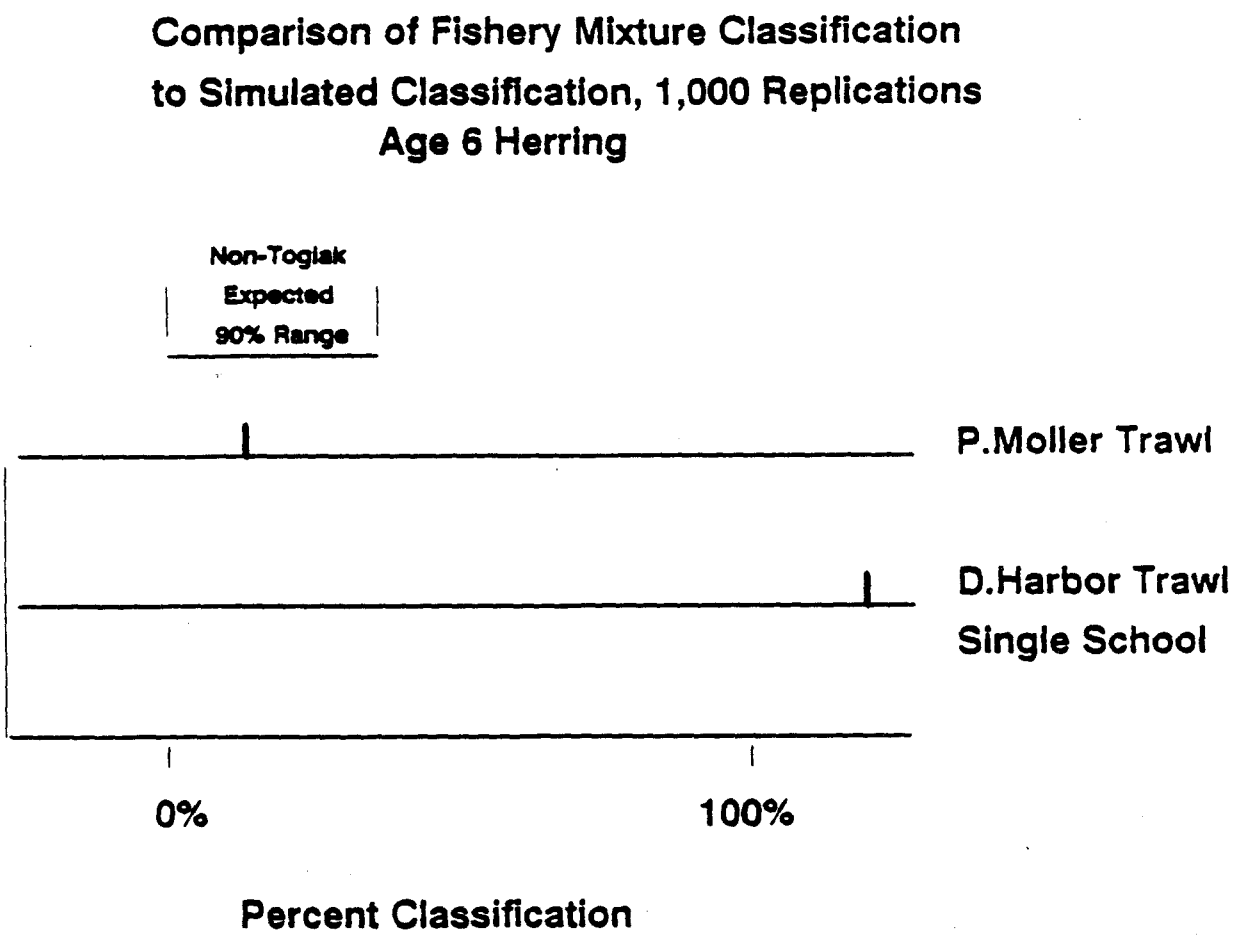


Figure 9. Classification of fishery mixtures using linear discriminant function analysis compared to the distribution of classification results from the Monte Carlo simulation for age 6 herring testing presence of herring in proportion to biomass.

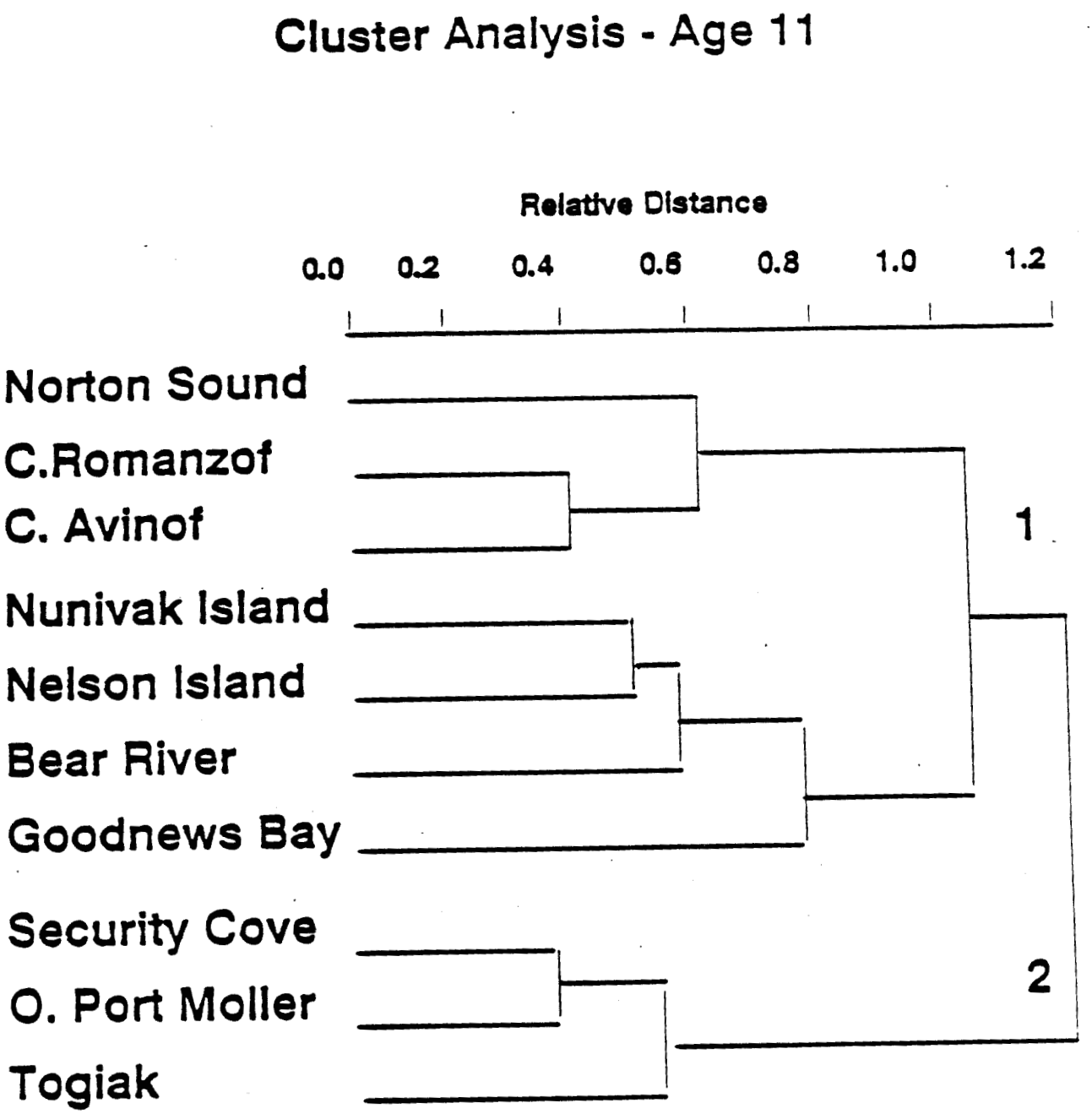


Figure 10. Results of cluster analysis for age 11 herring.

Table 3. Classification matrix from linear discriminant analysis with sample size, classification (%) to actual stock cluster and classification (%) of the unknown fishery mixtures, for age 11 herring.

CLASSIFICATION MATRIX

| Actual Stock Cluster | Sample Size | Classified Stock Cluster: Cluster 1 (Non-Togiak) | Cluster 2 (Togiak) | Total |
|---|---|---|---|---|
| Cluster 1 (Non-Togiak) | 148 | 68.2 | | 100.0 |
| Cluster 2 (Togiak) | 200 | | 71.5 | 100.0 |
| **FISHERY MIXTURE CLASSIFICATION** | | | | |
| Port Moller Trawl Period 1 (6/13-6/15) | 50 | 0 | 100.0 | 100.0 |
| Port Moller Trawl Period 2 (6/19-7/07) | 75 | 82.6 | 17.4 | 100.0 |
| Dutch Harbor Food/Bait Period 1 (7/15-7/27) | 103 | 25.9 | 74.1 | 100.0 |
| Dutch Harbor Food/Bait Period 2 (7/28-8/05) | 106 | 20.9 | 79.1 | 100.0 |
| Dutch Harbor Food/Bait Single School (8/05) | 38 | 80.6 | 19.4 | 100.0 |

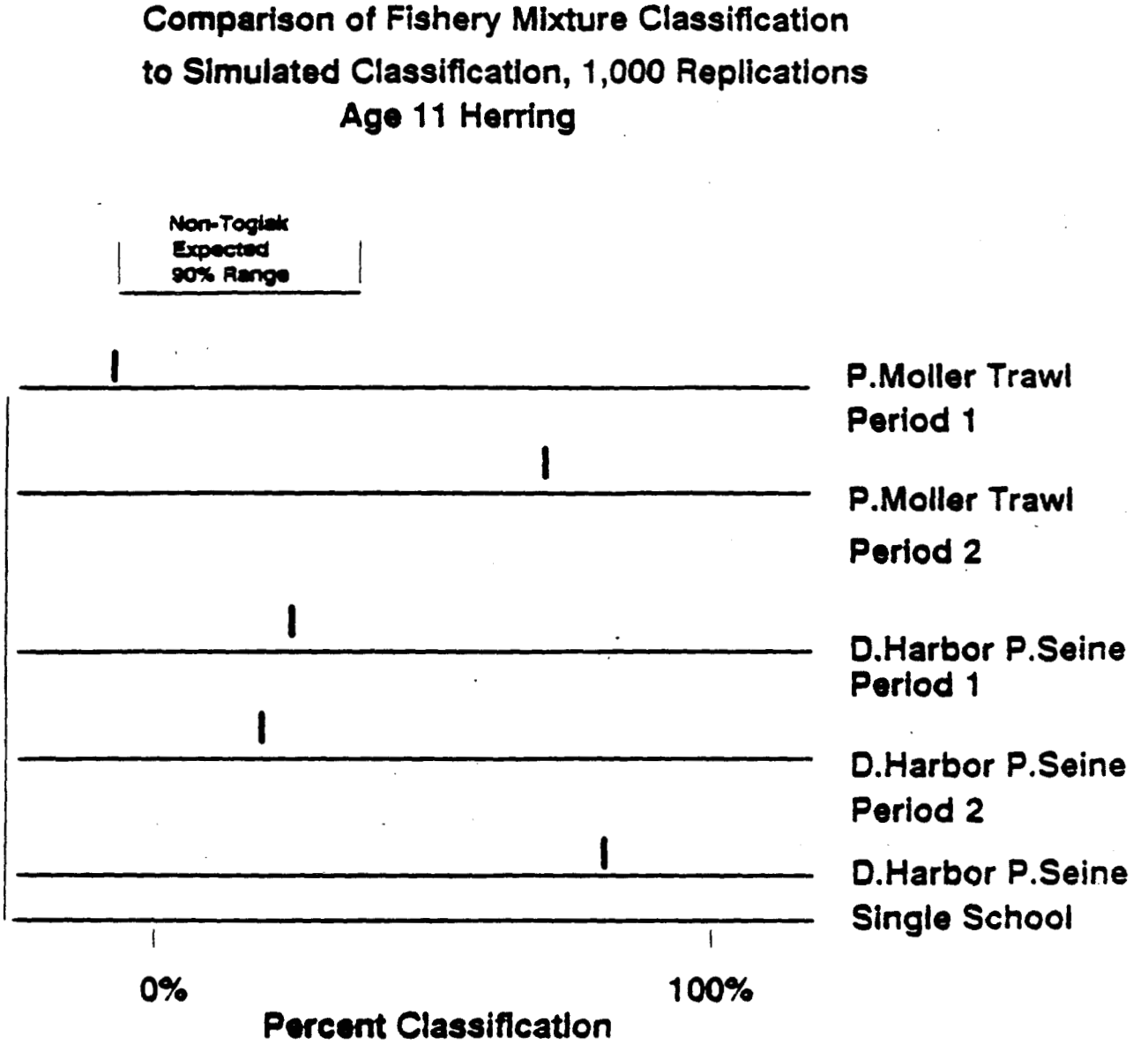


Figure 11. Classification of fishery mixtures using linear discriminant function analysis compared to the distribution of classification results from the Monte Carlo simulation for age 11 herring testing presence of herring in proportion to biomass.

# CONCLUSIONS

1. SIMILAR TO RESULTS OF PAST STUDIES, TOGIAK HERRING DOMINATED THE DUTCH HARBOR FOOD AND BAIT HERRING FISHERY SAMPLES, IN 1989.

2. THE TOGIAK STOCK CLUSTER WAS UNDER-REPRESENTED IN SAMPLES FROM SINGLE HERRING SCHOOLS FROM THE DUTCH HARBOR FOOD AND BAIT FISHERY, INDICATING THAT STOCK CLUSTERS (OR GROUPS) OF HERRING MAY NOT BE RANDOMLY MIXED IN THE FISHERIES OCCURRING IN MIGRATORY CORRIDORS.

3. THE TOGIAK CLUSTER DOMINATED THE FIRST PERIOD OF PORT MOLLER TRAWL SAMPLES, BUT NOT THOSE OF THE SECOND PERIOD.

4. STOCK MIXING RATES WITHIN A SINGLE SCHOOL MAY DIFFER FROM THOSE OF THE OVERALL FISHERY.

**ADDENDUM**

Samples collected for the stock composition estimates were not weighted by the proportion of the total harvest of each particular boatload or haul represented. During the 1989 fishery, individual deliveries ranged from 8 to 105 tons. Ideally, should the objective of a stock identification project be to determine the stock composition of the entire herring fishery, the number of samples selected for the analysis should be weighted by the volume of harvest from each boat or vessel from which it was collected.

During the 1989 fishery, purse seine deliveries sampled during the Dutch Harbor food and bait fishery ranged from 3% to 30% of the total harvest during the first fishing period and .3% to 28% of the harvest for the second fishing period. The corresponding scale samples selected for analysis that represented catches for these ranges did not reflect the same proportions but comprised 16% and 11% of the samples during the first period and 6% to 33% of the samples analyzed for the second period. The range of proportion for the second period harvest to samples collected were similar and adequately represented the harvest. Samples collected for the first period harvest were less representative and it is possible that the samples could under or over represent the presence of non-Togiak herring.

These sampling difficulties are shared by past stock identification studies for both herring and salmon. It has been assumed in past studies that collection of a large number of samples over as many vessels will account for any variability between catches to best provide an overall stock composition estimate of the fisheries.

The 1989 ADF&G herring stock identification study however was addressing the variability between catches to determine the impact of the harvest upon stocks other than Togiak. The study has provided evidence for disproportionate stock mixing of herring in the Unalaska Island area. Results of the 1989 study was similar to past studies for this area where 70-80% of the samples classified to the Togiak stock cluster and 20-30% classified to the non-Togiak stock cluster. Because it is possible that samples in the analysis did not truly reflect the stock distribution of catches, the 20-30% non-Togiak stocks could actually have represented a larger or smaller portion of the harvest.