OVERVIEW OF BERING SEA HERRING MIGRATION, STOCK STATUS, AND COMMERCIAL FISHERIES

Edited By:

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PREFACE

This compilation of reports was prepared as a source of information to be used by the Alaska Board of Fisheries during their October 1991 review of proposed modifications to the management of Bering Sea herring fisheries. This report is a synthesis and summary of detailed information that is available in other publications of the Alaska Department of Fish and Game and from other sources.

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. The information in this section was first presented to the Board of Fisheries during their March 1991 discussions of the management of the Dutch Harbor food and bait herring fishery. An appendix to this first section contains an updated figure which estimates the potential impact of the 1992 Dutch Harbor food and bait fishery on the Nelson Island herring stock. The second section of this report provides a current summary of Bering Sea herring stock status, commercial fisheries, and trawl bycatch impacts.

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

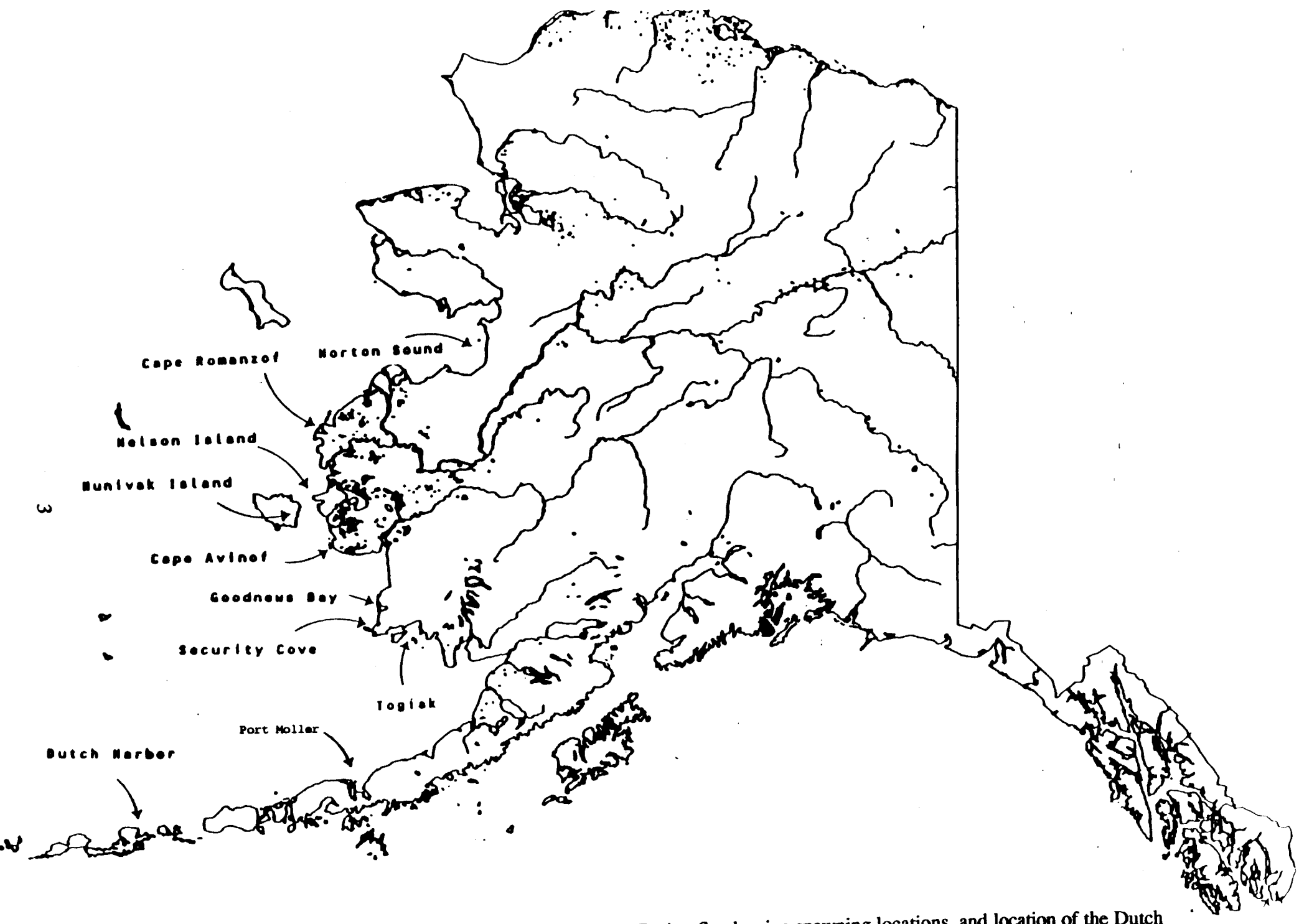

Figure 1. Location of commercial sac roe fisheries at nine eastern Bering Sea herring spawning locations, and location of the Dutch Harbor food and bait herring fishery.

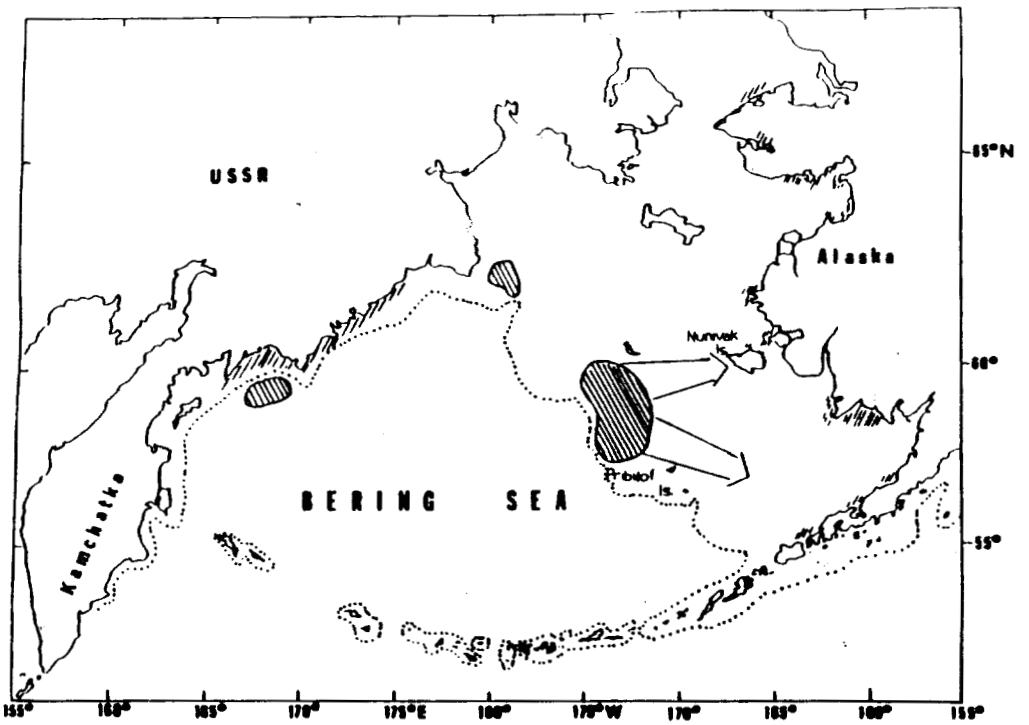

Figure 2. Location of spawning and winter grounds (oval areas) of main eastern and western Bering Sea herring stocks and routes of migration of eastern stocks to spawning areas (from NPFMC 1983).

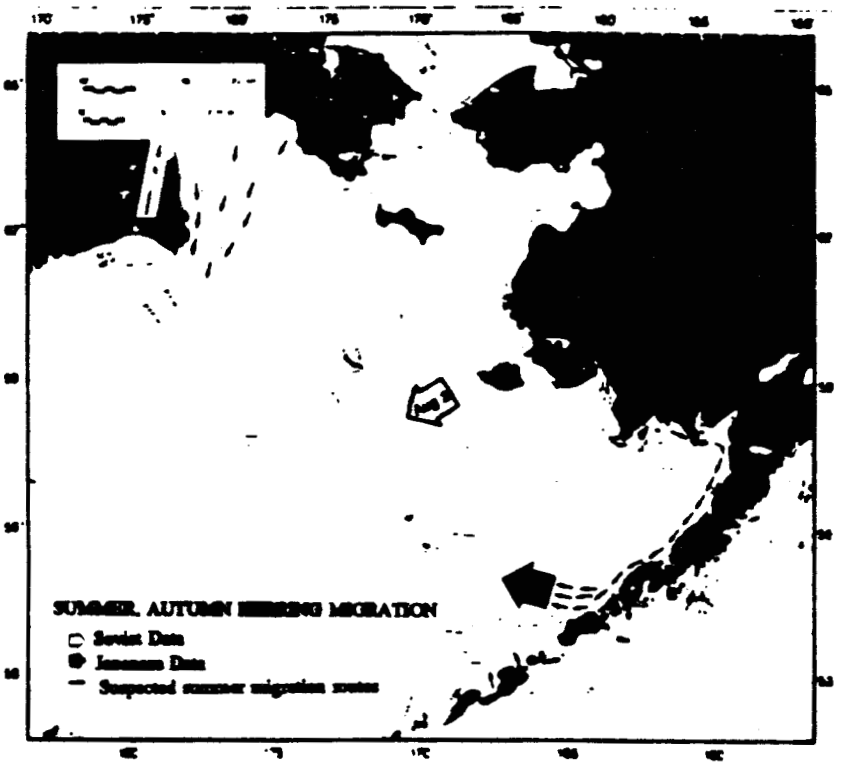

Figure 3. Summer and autumn migration routes to winter grounds, showing area of reappearance in Soviet and Japanese research and commercial catches (after Wespestad and Barton 1981).

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.

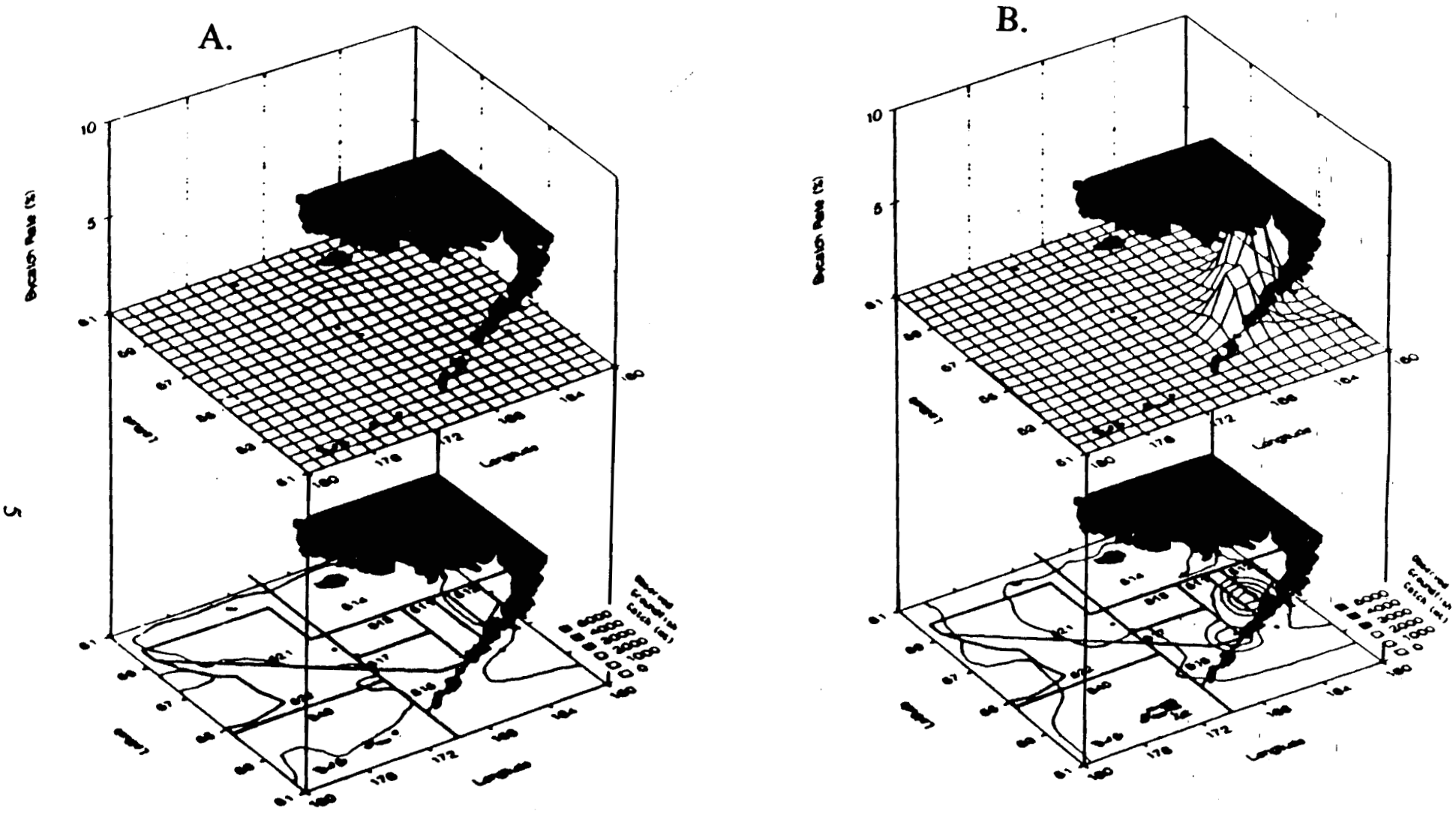

Figure 4. Distribution of herring in May (A), and June (B) reconstructed from 1983-88 foreign and joint venture bycatch data (from Funk 1990). Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 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).

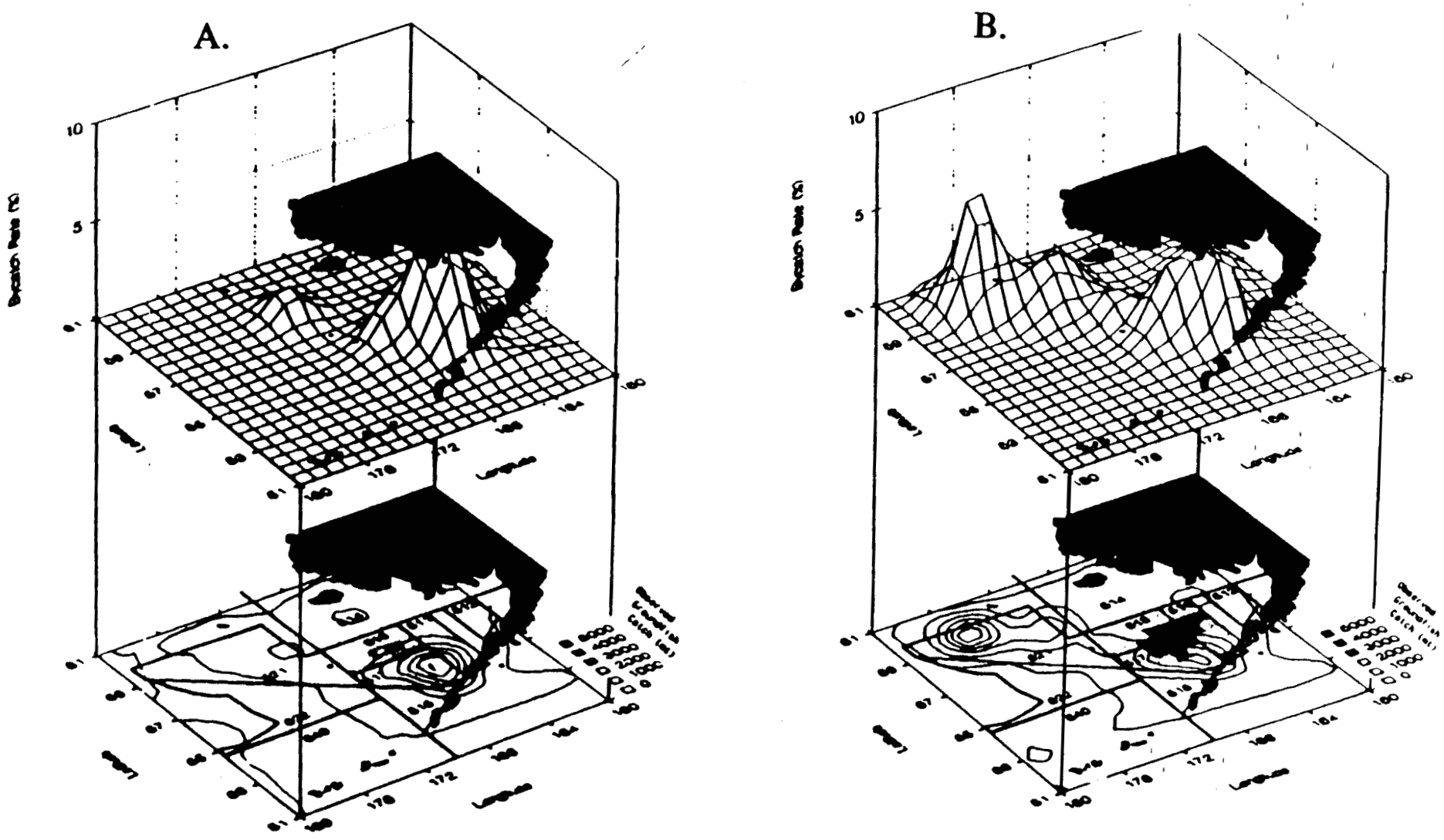

Figure 5. Distribution of herring in July (A), and August (B) reconstructed from 1983-88 foreign and joint venture bycatch data (from Funk 1990). Upper panel: herring bycatch rate by foreign and joint venture pollock bottom trawl and "other" bottom trawl (primarily Pacific cod) gears, averaged from 1983 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.

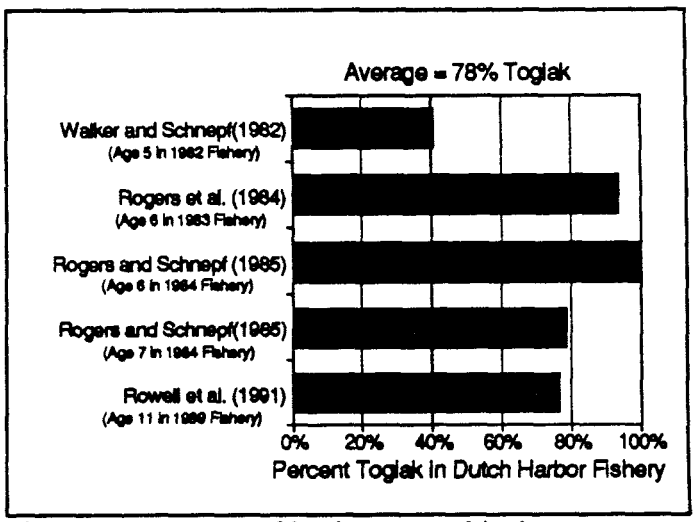

Figure 6. Percentage of herring captured in the Dutch Harbor food and bait fishery classified as the Togiak stock in four scale pattern analysis studies of five different age classes.

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 inter als in the SPA studies, this percentage contribution for Togiak is not significantly diffe nt from the SPA estimates. For 1991, the Nelson Island herring stock is projected to c nprise 3% of the biomass of herring stocks spawning from Nunivak Island southward.

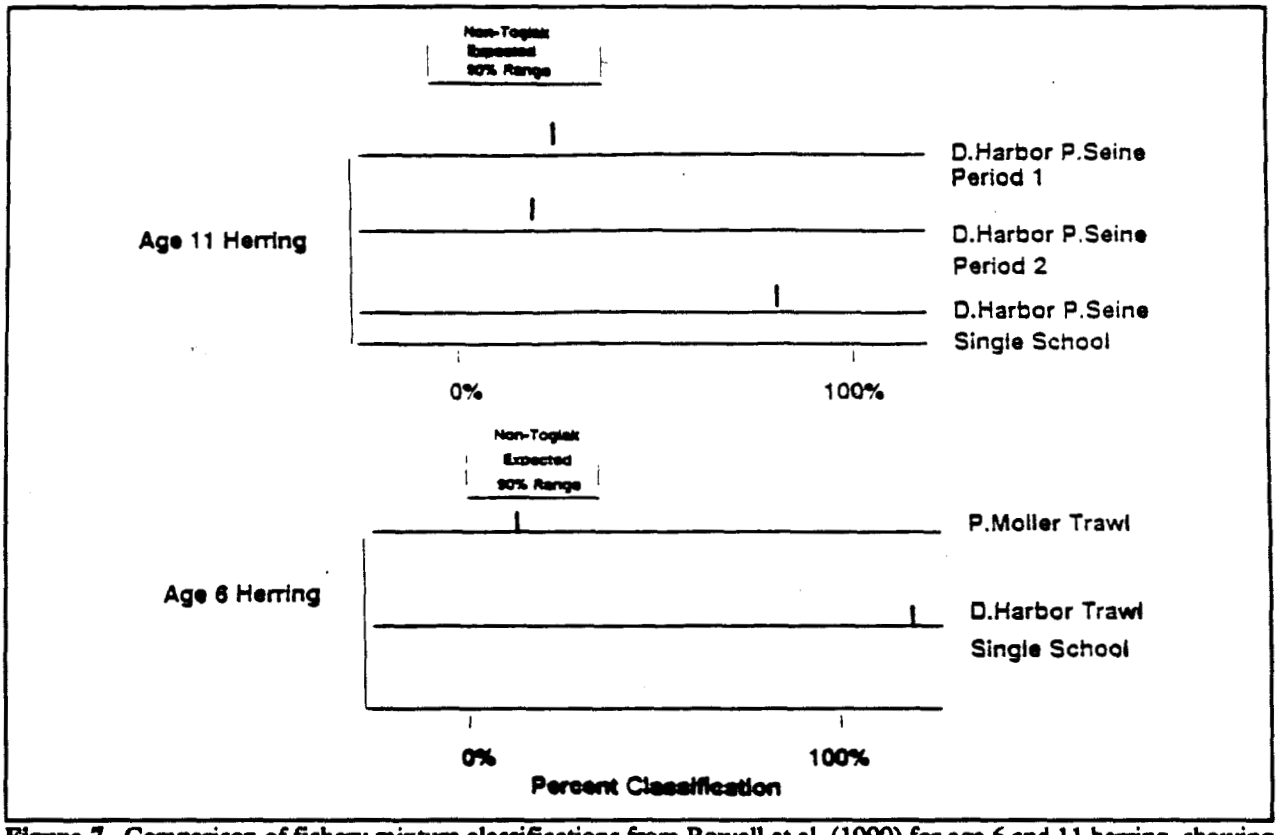

Figure 7. Comparison of fishery mixture classifications from Rowell et al. (1990) for age 6 and 11 herring, showing both single school and overall classifications for the 1989 Dutch Harbor food and bait and trawl fisheries.

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.

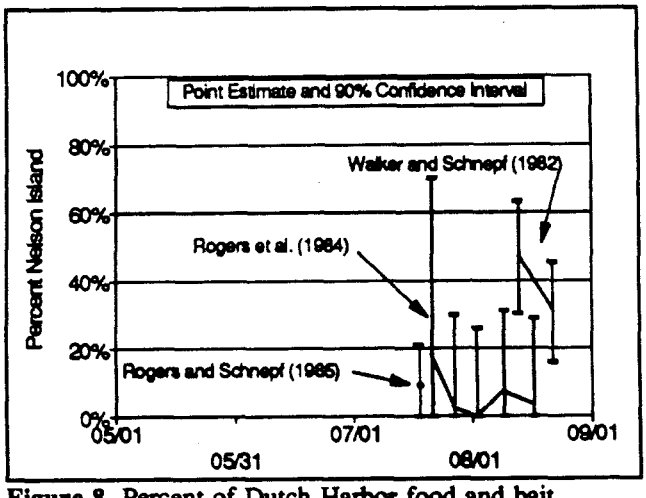

Figure 8. Percent of Dutch Harbor food and bait fishery samples classified to Nelson Island in FRI stock identification studies.

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

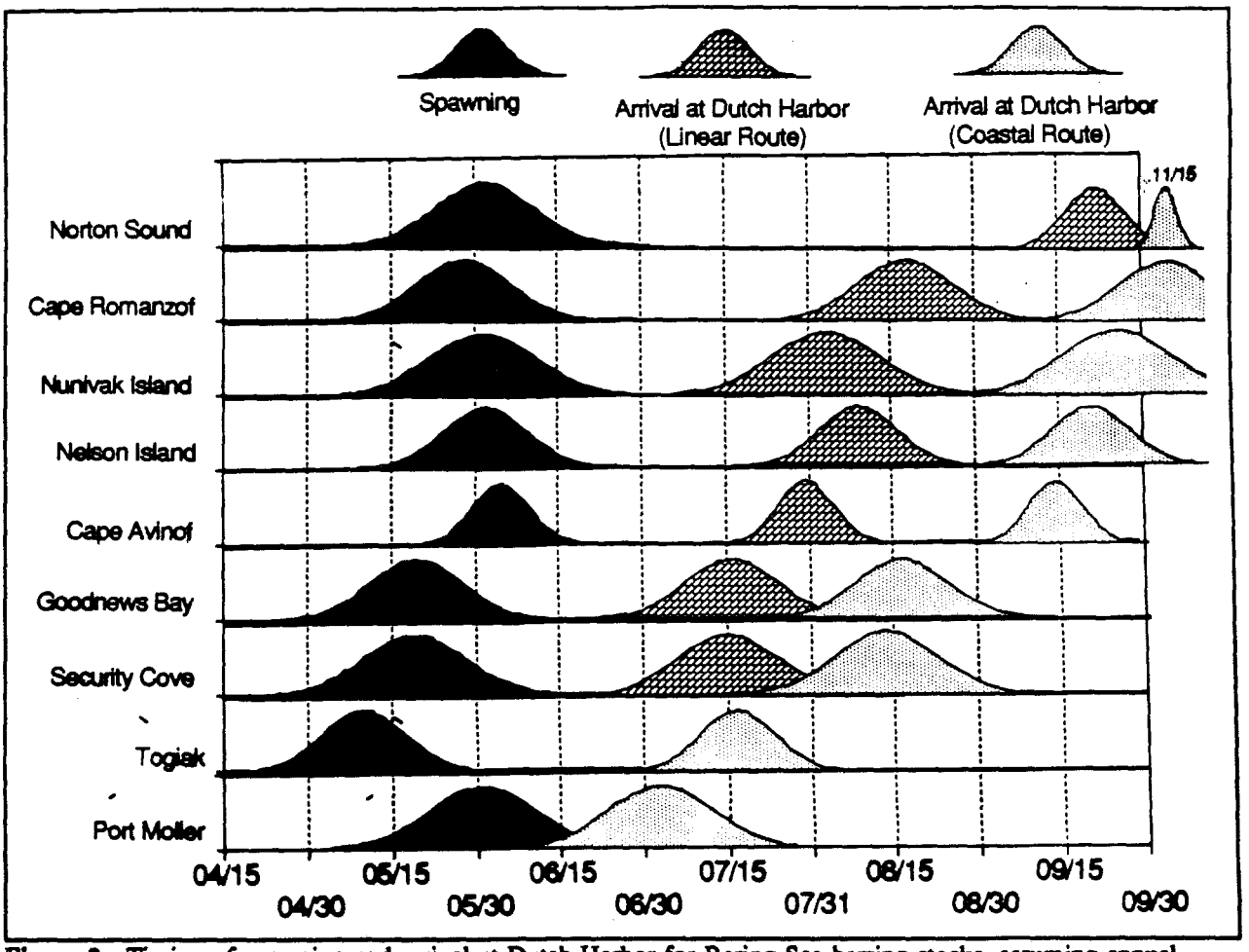

Figure 9. Timing of spawning and arrival at Dutch Harbor for Bering Sea herring stocks, assuming annual variability in spawn timing dates is represented by the variability in the timing of commercial sac roe fishing periods.

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

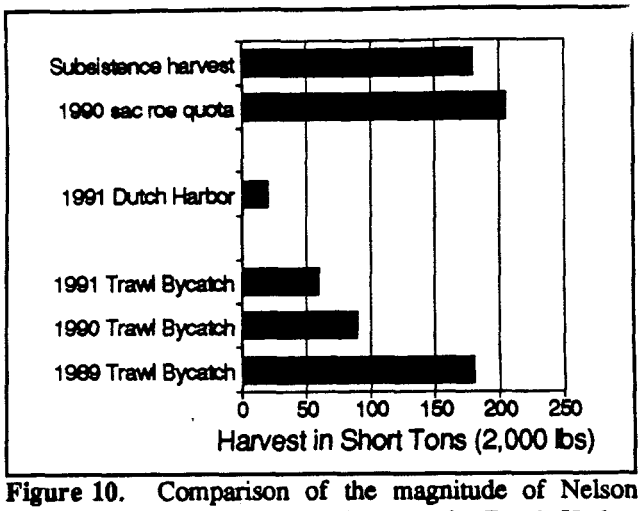

Figure 10. Comparison of the magnitude of Nelson Island herring harvests, assuming that the Dutch Harbor food and bait fishery and trawl fisheries take Nelson Island herring in proportion to their biomass.

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

IMPACT OF THE DUTCH HARBOR FISHERY ON THE NELSON ISLAND STOCK

(Revised for Fall 1991)

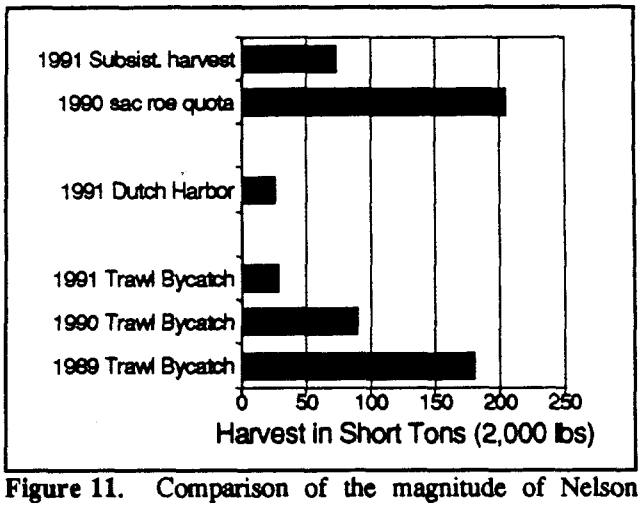

Figure 11. Comparison of the magnitude of Nelson Island herring harvests, assuming that the Dutch Harbor food and bait fishery and trawl fisheries take Nelson Island herring in proportion to their biomass.

The potential impacts of the Dutch Harbor food and bait fishery on the Nelson Island herring stock in Figure 10 were computed using the 1991 forecast projections of harvest and biomass available in March, 1991. These impacts were revised to reflect data available in the fall of 1991 (Figure 11). Actual 1991 subsistence harvests, 1991 Dutch Harbor food and bait fishery harvests, and 1991 trawl bycatches were used in revising the potential impacts. Also, in the 1991 stock assessment data, the Nelson Island stock has declined from 3% to 2% of the biomass of herring stocks spawning south of Nelson Island. The remaining assumptions used to compute Figure 10 were not changed.

SUMMARY OF 1991 HERRING STOCK STATUS AND COMMERCIAL FISHERIES

By:

Fritz Funk

This summary presents the biomass projections for each of the principle Bering Sea herring stocks and reviews trends in biomass, catch and trawl bycatch. Biomass projections in this summary in most cases are based on more detailed publications prepared by area managers and research staff for each herring management area.

Preliminary projections of biomass of Bering Sea herring stocks from Port Moller to Norton Sound indicate that biomass should increase slightly in 1992 (Figure 1). In general, herring stocks in the southern Bering Sea are declining, while the Norton Sound abundance estimates have been increasing. Bering Sea herring biomass forecasts have been substantially less than subsequent inseason biomass estimates for each of the three years for which biomass forecasts are available for all areas, perhaps because of conservative assumptions used in preparing the projections. The projected Bering Sea-wide biomass for 1992 is 95, 649 metric tons (105,456 short tons). During the 1980s, Bering Sea herring stocks were dominated by the very strong 1977 and 1978 year classes. Because the biomass trends of Figure 1 do not indicate a peak in biomass during the mid-1980s when the 1977-78 year classes were abundant, the aerial surveys used to estimate biomass in most areas likely underestimated the peak strength of these year classes. Because aerial surveys have been flown more frequently in many areas in recent years, recent biomass estimates are generally regarded as more accurate than those from earlier years. The Togiak stock is by far the largest in the Bering Sea (Figure 2), followed by Norton Sound and Port Moller. The remaining smaller stocks are each less than 5% of the Togiak biomass.

Herring reduction and bait fisheries developed in the Bering Sea as early as the 1930s, but substantial harvests did not begin until the 1960s (Figure 3). Exploratory fishing by Soviet research vessels in 1957 and 1958 resulted in the direction of large amounts of Soviet fishing effort on Bering Sea herring stocks, beginning in 1959. Japanese trawl and gillnet vessels joined the Soviet fleet in the early 1960s. Catches generally rose through the 1960s, although there are gaps in reported catch records and substantial catch under-reporting probably occurred. Catches peaked in 1968 and declined sharply in the 1970s. These declines are generally regarded to be due to overfishing. Foreign catches continued at lower levels through the 1970s until herring were given prohibited species status under the federal Bering Sea/Aleutians Groundfish Fishery Management Plan. Bering Sea-wide catches have been relatively stable since the mid-1980s at a much lower level than during the foreign herring trawl fishery.

During the offshore migration to over-wintering areas near the continental shelf, Bering Sea herring are vulnerable to incidental catch in groundfish trawls. Although retention of herring is prohibited, trawl bycatch has often amounted to thousands of tons of herring annually. There was no limit on the amount of herring that could be taken as bycatch until 1991. Foreign and joint venture (JV) fisheries took 2,500 to 4,500 tonnes of herring annually as bycatch during 1983-86 (Figure 4). These bycatches amounted to exploitation rates of 1.5% to 3% on Bering

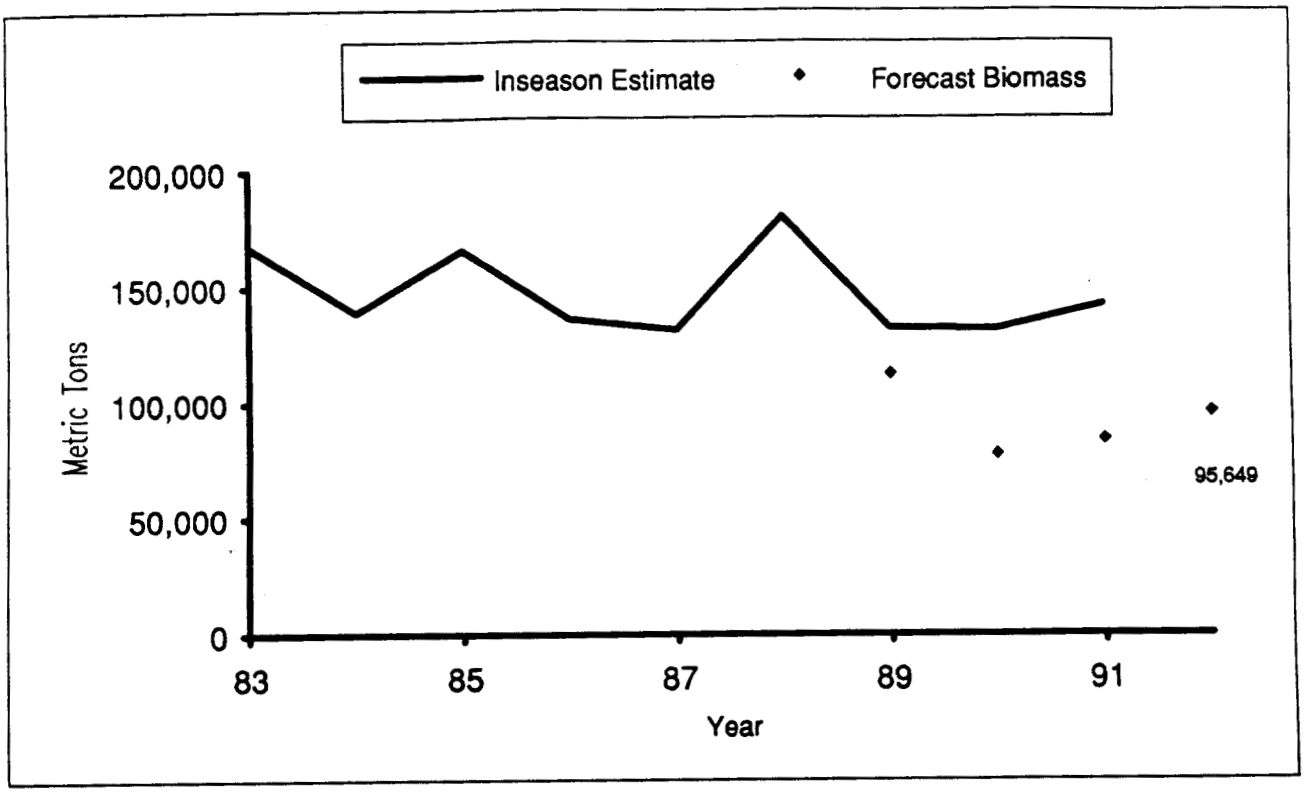

Figure 1. Estimated and forecast biomass for Eastern Bering Sea herring stocks, 1983-1991, with 1992 forecast biomass.

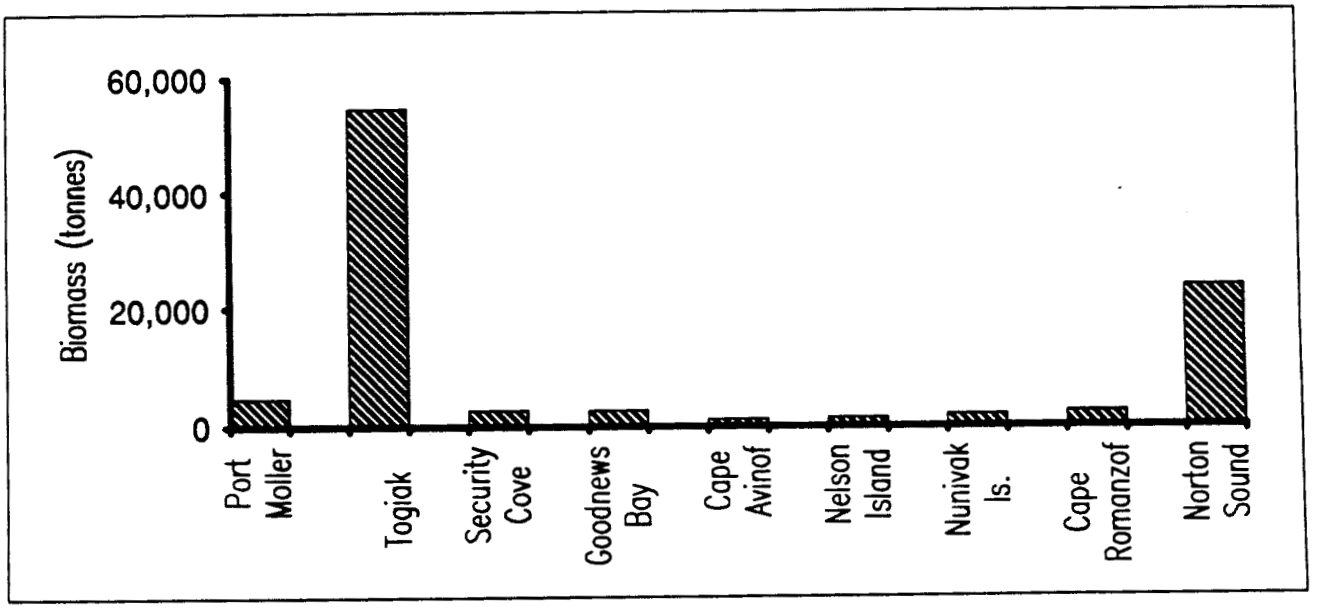

Figure 2. Projected 1992 biomass for principle Bering Sea herring stocks.

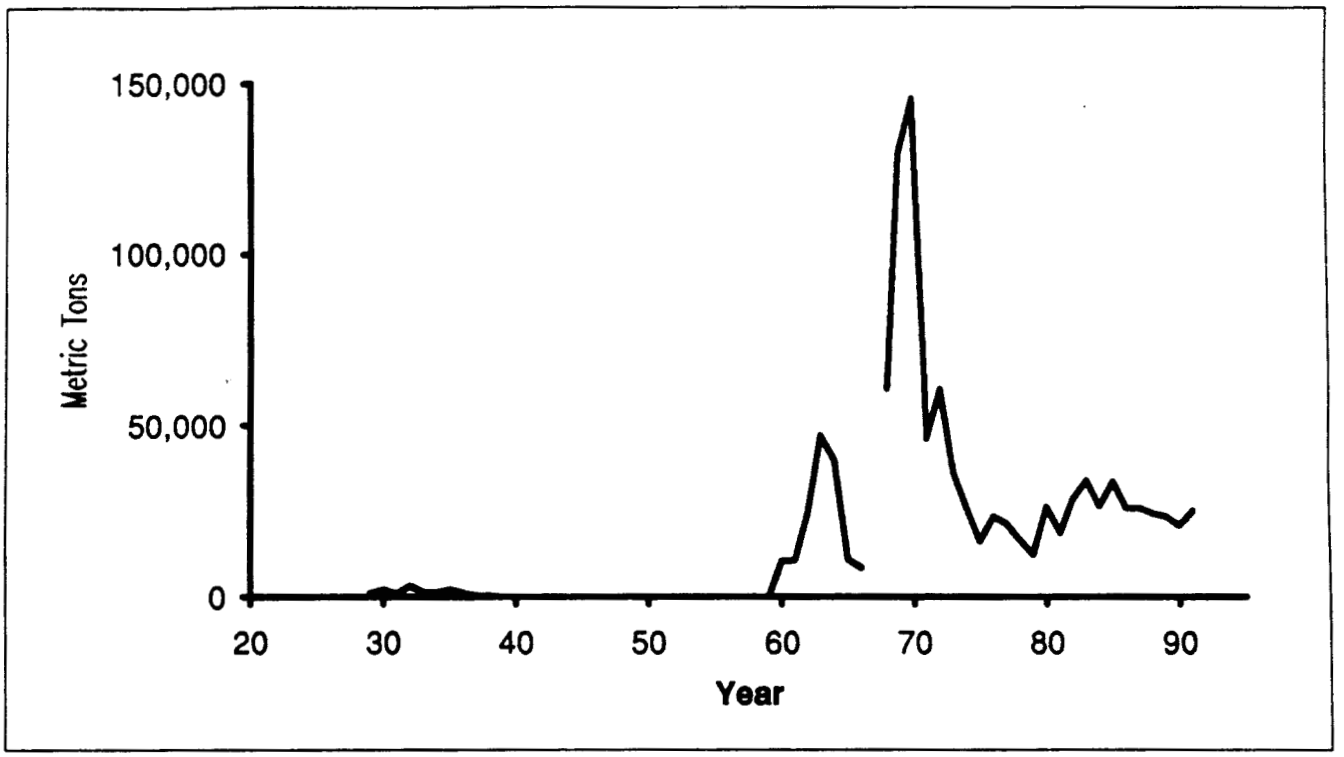

Figure 3. Total harvest of herring in the Bering Sea, 1920–1991.

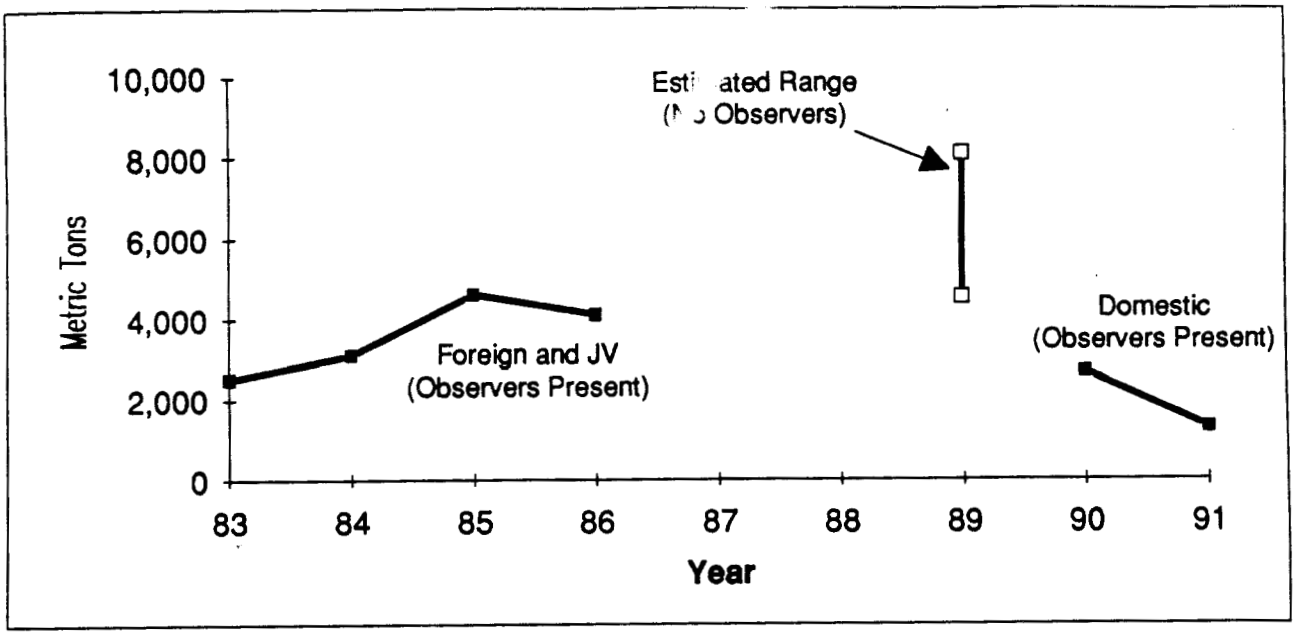

Figure 4. Bering Sea groundfish trawl bycatch of herring, 1983–1991.

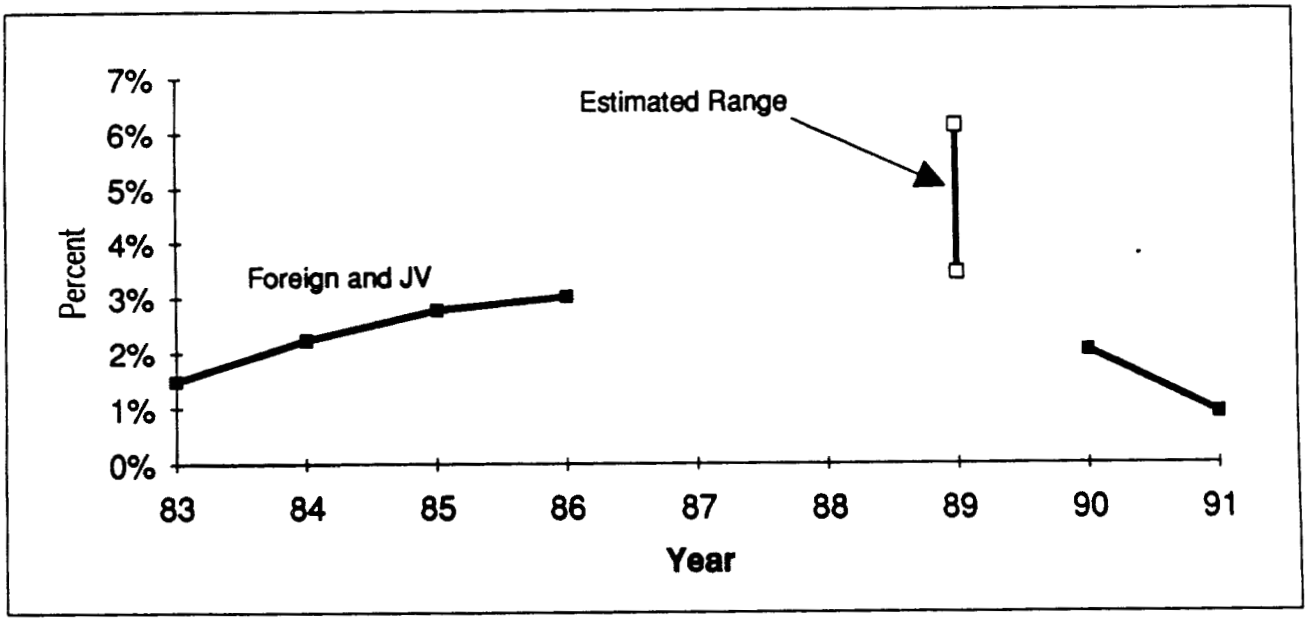

Figure 5. Bycatch exploitation rate of herring by Bering Sea groundfish trawl fisheries, 1983–1991.

Sea herring stocks (Figure 5). After 1986, domestic fisheries began to take an increasing share of the Bering Sea groundfish harvest. However, because observers were not required aboard domestic vessels until 1990, little is known about herring bycatch during this period. Based on limited observer coverage and the time periods and areas fished by domestic groundfish trawlers, trawl bycatch was estimated at a minimum of 4,500 to 8,500 tonnes in 1989. In 1990, the early closure of the pollock fishery helped to reduce herring bycatch by keeping groundfish trawl effort out of the herring wintering grounds late in the fall. The 1990 herring bycatch was estimated to be 2,661 tonnes, corresponding to a bycatch exploitation rate of 2.0%. In 1991, pollock fisheries closed early in September, eliminating the high herring bycatch has been occurring on the herring wintering grounds in late fall. In addition, in 1991 shore-based groundfish trawlers voluntarily agreed to avoid a high herring bycatch area near Unimak pass after encountering very high herring bycatch rates there during the third week of June. The result was that herring bycatch was 1,298 tonnes, corresponding to a bycatch exploitation rate of 0.9%. An estimated 715 tonnes of the 1991 herring bycatch was taken in the midwater trawl fishery, with an additional 593 tonnes taken in the flatfish fishery (Table 1).

In the fall of 1990, the North Pacific Fishery Management Council (NPFMC) voted to adopt measures to limit the bycatch of herring in groundfish trawl fisheries. The Council's actions were approved by the Secretary of Commerce and implemented as amendment 16A to the Bering Sea/Aleutians Groundfish Fishery Management Plan in June 1991. The herring bycatch control measures established three "herring savings areas" (Figure 6), and bycatch caps for each of several groundfish fishery categories. The overall prohibited species catch (PSC) limit was set at 1% of the Bering Sea herring biomass. Each groundfish fishery is allocated a portion of the PSC limit, based on its anticipated needs. When a fishery reaches its PSC limit, vessels participating in that fishery can no longer fish in the herring savings areas during the periods when herring would likely be present. In 1991 the pollock fishery achieved the pollock quota almost at the same time that the herring PSC limit for the pollock fishery was reached. Because of delays in PSC reporting, the bycatch of herring in the pollock fishery ultimately was estimated at 122% of the PSC limit. The only other groundfish fishery to take herring during 1991 was the flatfish trawl fishery, chiefly targeting on yellowfin sole. During the development of the Council's herring bycatch control measures, this fishery was ranked as a "potential" herring bycatch problem, because herring bycatch had been typically 150-400 tonnes annually. The Council designed the herring bycatch control measures to limit the bycatch of fisheries which were taking thousands of tons of herring. Herring savings areas which would specifically constrain the lower-priority flatfish fishery were not considered. In 1991, the flatfish fishery ultimately took 593 tonnes of herring, slightly more than in recent years. Although the flatfish fishery was theoretically excluded from fishing in the herring savings areas, little flatfish fishing effort would have occurred there. The NPFMC is reviewing the performance of the herring savings areas and additional bycatch control measures may be considered in the future.

Table 1. Trawl herring bycatch in 1991 Bering Sea/Aleutian Islands groundfish trawl fisheries.[1]

	TARGET FISHERY							
	FLATFISH		POLLOCK		TURBOT		'OTHER'	
	HERRING METRIC TONS		HERRING METRIC TONS		HERRING METRIC TONS		HERRING METRIC TONS	
WEEK	WK	CUM	WK	CUM	WK	CUM	WK	CUM
01/06	0	0	1	1	0	0	0	0
01/13	0	0	1	2	0	0	0	0
01/20	0	0	1	3	0	0	0	0
01/27	0	0	1	4	0	0	0	0
02/03	0	0	1	6	0	0	0	0
02/10	0	0	0	6	0	0	0	0
02/17	0	0	1	7	0	0	0	0
02/24	0	0	2	9	0	0	0	0
03/03	0	0	0	9	0	0	0	0
03/10	0	0	0	9	0	0	0	0
03/17	0	0	0	9	0	0	0	0
03/24	0	0	0	9	0	0	0	0
03/31	0	0	0	10	0	0	0	0
04/07	0	0	0	10	0	0	0	0
04/14	0	0	0	10	0	0	0	0
04/21	0	0	0	10	0	0	0	0
04/28	0	0	0	10	0	0	0	0
05/05	13	13	0	10	0	0	0	0
05/12	4	17	0	10	0	0	0	0
05/19	74	91	0	10	0	0	0	0
05/26	28	119	0	10	0	0	0	0
06/02	22	142	0	10	0	0	0	0
06/09	96	237	8	18	0	0	0	0
06/16	92	329	101	119	0	0	0	0
06/23	89	419	3	122	0	0	0	0
06/30	28	447	1	123	0	0	0	0
07/07	11	458	13	136	0	0	0	0
07/14	2	460	17	153	0	0	0	0
07/21	4	464	10	163	0	0	0	0
07/28	4	468	10	173	0	0	0	0
08/04	3	471	16	190	0	0	0	0
08/11	3	475	104	294	0	0	0	0
08/18	19	493	87	381	0	0	0	0
08/25	19	512	97	478	0	0	0	0
09/01	11	523	208	685	0	0	0	0
09/08	9	532	30	715	0	0	0	0
09/15	11	543	0	715	0	0	0	0
09/22	43	586	0	715	0	0	0	0
09/29	6	592	0	715	0	0	0	0
10/06	1	593	0	715	0	0	0	0
ALLOWANCES:								
Annual		83		584		8		158
% taken		714.69%		122.45%		0.89%		0.02%

[1] Source: National Marine Fisheries Service bulletin board system, October 11, 1991. Data are based on observer reports, extrapolated to total groundfish harvest.

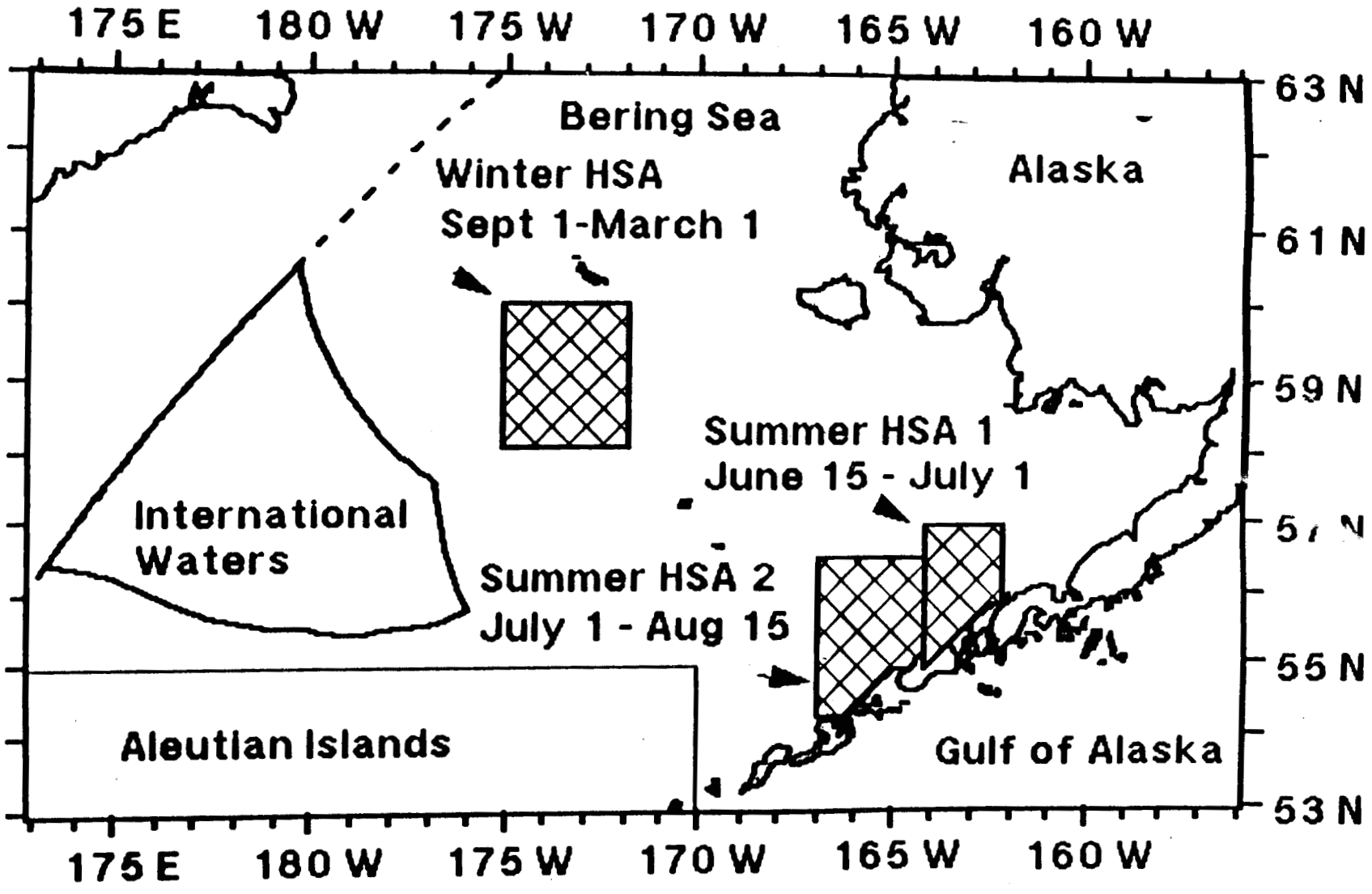

Figure 6. Herring Savings Areas (HSAs) in the Bering Sea and Aleutian Islands implemented under amendment 16A to the Bering Sea/Aleutians Groundfish Fishery Management Plan.