

**SUBSISTENCE HERRING FISHING IN THE EASTERN
BERING SEA REGION: NELSON ISLAND,
NUNIVAK ISLAND, AND KUSKOKWIM BAY**

by

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ABSTRACT

This report summarizes information on the subsistence use of herring in the Nelson Island and Etolin Strait region of Alaska. Data were gathered in annual surveys from 1986 through 1988. All fishing families were surveyed each season to arrive at total harvests. Qualitative information on community experiences with depletions of herring stocks in the late 1960s and early 1970s is included. A brief description of subsistence-herring use by five other communities in the Nunivak Island and Kuskokwim Bay areas supplements the more detailed information presented for Nelson Island communities.

Herring is a central component of the subsistence economy of the communities in the Nelson Island area. It comprises the highest proportion of all species harvested of the total subsistence outputs -- 40 percent by weight in Tununak in 1986. Participation, both by individuals and households, in subsistence-herring production is high.

Subsistence harvest estimates for Nelson Island communities in recent years (1986 through 1988) have shown substantially higher annual harvests than those recorded in previous years. The recent estimates indicate that herring harvest effort and use was considerable. Over 200 short tons of herring were harvested annually for subsistence use by communities in the Nelson and Nunivak Island districts and the Kuskokwim Bay area combined. This is considerably greater than earlier estimates from the late 1970s which projected that the combined harvest by communities in the eastern Bering Sea region was approximately 110 short tons of herring taken annually for subsistence use. Smaller sample sizes and reduced numbers of fish probably account for much of the difference.

Declines in herring stocks within the past two decades have been attributed to offshore foreign fishing in the 1960s and 1970s. Depletion of herring returning to the Nelson Island area has created hardship for local residents. They have had to make adjustments. Current projected declines understandably cause concern.

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INTRODUCTION

This report primarily summarizes information from a three-year research project, conducted from 1986 through 1988, in the Nelson Island area communities. The multi-year study was conducted to document the level of subsistence use of herring by the residents of these communities, to monitor the effects of the commercial herring sac-roë fishery initiated in 1985, and to develop a cost-effective means of annually estimating the subsistence-herring harvest. Findings from this project were described in two reports -- one completed in 1986 (Pete and Kreher 1986) and another in 1987 (Pete, Albrecht, and Kreher 1987). The present report also briefly describes effects to subsistence use of declines in Nelson Island area herring numbers in the late 1960s and early 1970s. Finally, the scant information on subsistence-herring utilization by other communities in the Nunivak Island and Kuskokwim Bay area is summarized.

The importance of the subsistence use of herring to residents of Nelson Island and vicinity has been reported in many sources (Lantis 1946; Barton 1978; Hemming, Harrison, and Braund 1978; Lenz 1980; Skrade 1980; Fienup-Riordan 1983; Pete 1984; Pete and Kreher 1986; Pete *et al.* 1987), including the North Pacific Fishery Management Council's Bering-Chukchi Sea Herring Fishery Management Plan (1981). Between the early 1970s and 1984, proposals to open Nelson Island herring stocks to commercial fishing were met with intense opposition by Nelson Island area residents, primarily because of their experience with effects of previous offshore commercial harvests by foreign fisheries (Hemming *et al.* 1978; Pete 1984).

In 1984, with an understanding that commercialization was inevitable given state and federal mandates to authorize use of harvestable surpluses of fish, the people of the Nelson Island area submitted proposals to open the Nelson Island herring stocks to commercial harvest. The regulations they requested and obtained for the commercial herring fishery were designed to favor participation by local fishermen and to protect the important subsistence fishery. Equipment was small-scale, like that used in the subsistence fishery, and area closures to commercial fishing were established to protect subsistence fishing and herring spawning sites. Local residents requested documentation of their

subsistence use of herring in order that minimal disruption occur due to commercial activity, hence this three-year research project was developed.

The research substantiated the importance of herring in the subsistence economy of Nelson Island area residents. The scope and timing of surveys for this project was notable for several reasons. A complete census of fishing families in all communities was surveyed during the subsistence fishing season each year. At the time of the studies herring stocks were plentiful, thus effort and participation in the subsistence fishery was reported to be similar to earlier years (those prior to the mid-1960s) when herring were typically abundant. Harvest surveys that were conducted previously, during the late 1970s and early 1980s, were limited by an inability to contact many fishermen, and those surveys also took place during years that stock abundance was considered to be improving from low levels.

Projected returns of herring for the 1990 season are below the thresholds at which commercial harvests are allowed to occur in Nelson Island and Nunivak Island districts (Hamner 1989). Nelson Island residents have expressed concern about loss of opportunity and reduced productivity of subsistence-herring fishing in the near future. Furthermore, the commercial herring fishery became an important option for generating income as well as providing a significant, if fluctuating, financial contribution to the local economy (Pete 1985).

METHODOLOGY

A detailed description of the methods of data collection can be found in Appendix 1. Briefly, information on harvest times, personnel involved, gear used, areas fished, and harvest levels were recorded using a survey questionnaire administered in person (Appendix 2). In all years of the project, a census (100 percent) sample of fishing families was surveyed to arrive at total community harvests of herring for subsistence use.

Information on results of declines in the late 1960s and early 1970s in Nelson Island herring stocks was derived predominantly from interviews with members of approximately 50 percent of Tununak fishing families during the 1986 survey and between one to five elders in each of the other

three communities. Furthermore, Tununak was the subject of a comprehensive subsistence harvest study and elderly residents were systematically asked about herring production during the time of declining stocks. The survey team specifically asked knowledgeable elders in the other communities about what happened when herring were not plentiful. The topic was discussed informally with many other individuals at other occasions subsequent to the 1986 survey season. Although the information regarding responses to declining herring stocks was qualitative compared to in-season harvest data, it was highly consistent among individuals and communities.

COMMUNITIES USING HERRING FOR SUBSISTENCE USE

Nelson Island District

There were four communities that utilized Nelson Island district herring stocks for subsistence use that participated in the three-year project. From north to south, these communities were Newtok, Tununak, Toksook Bay, and Nightmute (Fig. 1). These communities and Chefnak, approximately 20 miles south of Nelson Island, constituted a discrete regional and societal group, called *Qaluyaarmiut* (Fienup-Riordan 1983; Shinkwin and Pete 1984). They traditionally were united by a network of kinship ties, formed a marriage universe, and cooperated in important social, religious, and political ceremonies. This intercommunity relationship has persisted to current times; the communities still were intertwined through kinship and in the late 1970s, they formed a regional political organization through which they interact with outside agencies.

Newtok, the only community not situated on Nelson Island proper, is along the Keyalik River, just north of the island (Fig. 1). Tununak, Toksook Bay, and Nightmute are all on Nelson Island. Newtok and Nightmute are riverine communities; their residents relocated to coastal camps to produce herring and other subsistence foods. Newtok residents used to go to Niliklugak until the late 1970s, when cumulative erosion and deposition made their settlement there unsuitable. They camped at Tununak to fish for herring until the early 1980s. With faster outboard motors and longer nets, they

often harvested their herring in one tide and returned to the village to process their catch. Umkumiut, a sizable seasonal camp is still used by residents of Nightmute and Toksook Bay. Families used to move to Umkumiut prior to ice breakup for spring seal hunting and stay until August for marine fishing and drying. Throughout the study period, its occupation by families was generally limited to the herring season, although hunters used the camp throughout the year.

The present locations of Tununak and Toksook Bay have been noted as influential in their current levels of herring use. Located along the coast near herring spawning areas, they were most advantageously situated to harvest and process herring. Furthermore, their locations made trips to traditional winter harvesting areas for fresh water fish prohibitive because of costs in fuel, time, and equipment, thereby contributing to an increased dependence on herring (Hemming *et al.* 1978).

Prehistoric evidence and historical records (Okada, Okada, Yajima, Miyaoka, and Oka 1982; Fienup-Riordan 1983) demonstrate that Tununak was a spring and summer camp for harvesting sea mammals, herring, salmon, and other marine resources. In winter, Tununak residents moved eastward on Nelson Island, nearer to Chakchak, or to small, extended-family based settlements along northern Nelson Island or east of Newtok. From these settlements, they harvested pike, burbot, whitefish, blackfish, and other resources throughout the winter. The establishment of Tununak as a permanent settlement occurred to facilitate use of the school, church, and stores.

Toksook Bay, previously another customarily used summer camp, was established as a permanent settlement in 1964 when some of the residents of Nightmute whose homes had been threatened by erosion settled there, because there was little area for expansion in Nightmute (Hemming *et al.* 1978; Fienup-Riordan 1983). Winter resource use areas of Toksook Bay residents were still focused in the vicinity of Nightmute and areas south and east of Nelson Island.

Community populations and numbers of households remained relatively stable over the three study years, 1986 through 1988, with only a three-percent increase in the regional population. According to our censuses, in June 1988, the four villages had a combined, permanent-resident population of 1,110 persons in 207 households (Table 1), an overall average household size of 5.4 persons, with a range of 1 to 11 persons per household. More than one-half (58 percent) of the

households ranged in size of 5 to 11 persons. Toksook Bay, the largest village in terms of population, also had the largest average household size. Close to 99 percent of the permanent residents were Alaska Native, primarily Yup'ik Eskimo, and most, including children, spoke Central Yup'ik as their first language. Many elders did not understand English.

TABLE 1. NELSON ISLAND POPULATION AND PARTICIPATION IN SUBSISTENCE-HERRING PRODUCTION, 1988

Community	Population	Total number of households	Number of participating <u>households</u>	Number of fishing families
Newtok	207	40	27 (68%)	16
Tununak	318	63	54 (86%)	37
Toksook Bay	422	77	65 (84%)	37
Nightmute	163	27	20 (74%)	14
Totals	1,110	207	166 (80%)	104

The local economy of these communities is characterized as "a mixed, subsistence-based economy" referring to their use of local, wild resources obtained by hunting, trapping, fishing, and gathering, with some income secured by primarily seasonal, though intermittent, wage employment, commercial sale of halibut, salmon, herring, and furs, and cottage industries (Wolfe and Walker 1987). None of these communities were linked by road. Air and water transportation were the primary means of access. Cost of living was typically high because of the expense of importing goods and services. In economies such as these, the subsistence sector is generally the most stable, therefore, the most reliable. Adjustments are made in subsistence production based on fluctuations in abundance,

availability of resources, and personal circumstances. However, drastic and unexpected reductions in abundance of critical species, such as herring in the Nelson Island area, have caused difficulties. With commercialization, the contribution herring has made to the local economy becomes amplified. Extrapolation of income data from a socio-economic survey conducted in Tununak indicates that, in highly productive seasons, remuneration from the commercial herring fishery has contributed as much as one-third of average annual household incomes.

Nunivak Island and Kuskokwim Bay

Other communities situated on Nunivak Island and along Kuskokwim Bay use herring for subsistence purposes. These include Mekoryuk, located on the north shore of Nunivak Island, and Chefornek, Kipnuk, Kwigillingok, and Kongiganak along Etolin Strait and Kuskokwim Bay (Fig. 1). Although an historical account indicates relatively limited harvest and use of herring for subsistence by residents of Nunivak Island (Lantis 1946), historical information on subsistence-herring use for these communities is scant (Hemming *et al.* 1978).

Kipnuk participated in subsistence herring harvest surveys in 1985 and 1987. Surveys in both years were administered to 100 percent of the subsistence-herring fishing families (Pete *et al.* 1987). Recent information on subsistence-herring use by residents of the other four communities was based on existing literature and reports (Hemming *et al.* 1978; Stickney 1984; Pete 1984; Anderson 1985; Bue 1986; Alaska Department of Fish and Game 1987).

These communities experienced recent commercial development of local herring stocks, parallel with Nelson Island communities. Commercialization of Nunivak Island herring stocks occurred the same year (1985) as Nelson Island stocks. Proposals submitted in 1987 initiated a commercial herring fishery in the Cape Avinof (Kuskokwim Bay) district in the 1988 season.

Current demographic and socio-economic characteristics of these communities appear similar to those described for Nelson Island communities. Population and household data are presented in Table 2. Community size ranged between 180 and 500 persons, most of whom were Yup'ik Eskimo.

TABLE 2. POPULATION FOR NUNIVAK ISLAND AND KUSKOKWIM BAY AREA
COMMUNITIES, 1986 and 1980

Community	1986 ^a Population	1980 ^b		
		Population	Number of households	Percentage Alaska Native
Mekoryuk	173	160	44	95.6
Chefornak	310	230	38	96.1
Kipnuk	498 ^c	371	81	96.5
Kwigillingok	257	205 ^d	35 ^d	96.9
Kongiganak	295	239	48	96.7
Totals	1,533	1,205	246	-

^a Alaska Department of Labor 1989.

^b U.S. Department of Commerce 1983.

^c This is 1987 data (Pete *et al.* 1987).

^d This is 1981 data (Stickney 1984).

SUBSISTENCE-HERRING FISHING

Nelson Island District

Previous reports (Pete and Kreher 1986; Pete *et al.* 1987) include detailed descriptions of harvest times, gear used, fishing areas, personnel involved, and methods of processing and storing of herring for winter food. Most aspects of the fishery remained very similar throughout the three years of the project. The following is a brief summary of information in the two earlier reports.

Kin-based, subsistence-herring production units, or fishing families, organized the complex of activities necessary to harvest, process, and store herring for the winter. Most fishing was done by men and most processing was done by women. Fishing families were often composed of members from

more than one household. Commonly, adult children cooperated with their parents who lived in separate households to produce herring for subsistence use. Participation in subsistence-herring production by households throughout the three years was typically high. There was an annual average involvement by 80 percent of all households which included over 40 percent of the regional population and approximately 85 percent of the people between the ages of 15 to 70 years. Children as young as six years of age were involved in some aspect of subsistence-herring production.

Each community used traditional fishing areas which were located in proximity to the settlements (Fig. 2). Set gill nets with mesh sizes of 2 to 2-3/4 inches were the most common gear, although drift gill nets were also occasionally used. Nets were typically between 60 and 150 feet long with some as long as 300 feet. Locally made, wooden, and industrially manufactured, aluminum boats between 14 to 28 feet long were used for subsistence-herring fishing. Most boats were between 18 and 22 feet in length.

Herring season from preparations for fishing, through aging, cleaning, braiding, drying, and storing of the herring began as soon as the adjacent ocean became ice free, generally in late May, and lasted for about two and one-half months. It was a very busy time of year with many other subsistence activities occurring around those involving subsistence-herring production. Herring sac-roes from processed herring was aged and spread out to dry, and herring spawn-on-kelp (*elquat*) was also collected. Other fish species sought throughout this time included halibut, Pacific cod, wolf fish, five species of salmon, capelin, smelt, and many species of shellfish and marine invertebrates. Many of these fish were also processed for drying on separate drying facilities. June through August was the most common time to get seasonal wage employment, often outside of the communities. Most subsistence fishing occurred after the local commercial herring season was over, except for Tununak; they fished as soon as herring arrived in the area. The other communities preferred the smaller sized, "less-fatty" herring which arrived later (early to mid June). In spring and fall (May, June, and September), beach grass, called *tapermat* was gathered to use in braiding herring into strings (*piirrat*) to dry. Throughout the season, assuring adequate numbers of well-tended herring were on the drying racks was always a priority task. It was their main food for the winter.

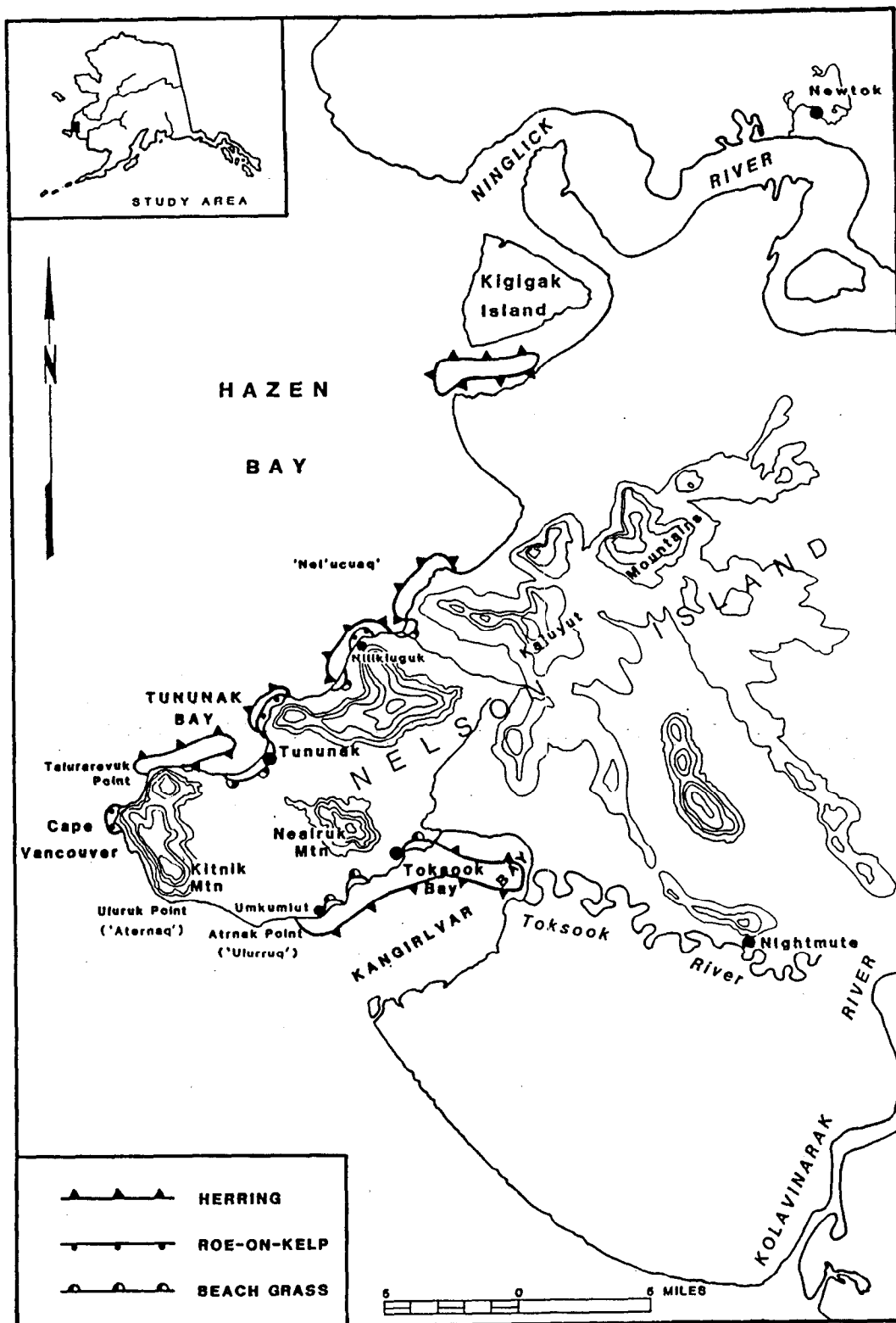


Figure 2. Areas used by Nelson Island residents for subsistence herring fishing and roe-on-kelp, beach grass, and *kelugkaq* collecting in 1987.

Harvest Levels

Throughout the three years of the surveys, subsistence-herring harvest levels for the four Nelson Island communities ranged from 124 to 166.8 short tons (Table 3). The numbers of fishing families involved in producing herring for subsistence use has remained relatively constant -- over two-thirds of all households have fished in most years (Tables 1 and 3). Average family (multi-household) harvests ranged from three-quarters of a ton to two tons, depending on the community and year (Pete and Kreher 1986; Pete *et al.* 1987). The harvest levels and degree of involvement described by this study were significant. Prior to these findings, most managers and policymakers involved with herring fisheries assumed that all communities along the eastern Bering Sea coast, from Pilot Point in Ugashik Bay to Golovin in Norton Sound, only utilized up to 110 short tons of herring for subsistence. The four Nelson Island area communities exceeded that estimate themselves.

**TABLE 3. ESTIMATED NELSON ISLAND SUBSISTENCE HERRING HARVEST LEVELS
(IN SHORT TONS) AND HOUSEHOLD PARTICIPATION, 1986-88**

Community	1986		1987		1988	
	Short tons	Number of participating households	Short tons	Number of participating households	Short tons	Number of participating households
Newtok	12.6	18	10.0	22	12.5	27
Tununak	63.3	56	48.0	56	49.3	54
Toksook Bay	69.5	64	51.0	63	58.5	65
Nightmute	21.4	18	15.0	19	16.0	20
Totals	166.8	156	124.0	160	136.3	166

By all criteria, herring are a crucial part of the economy of Nelson Island area residents. Total subsistence harvests demonstrate its importance in the subsistence sector. Based on a household harvest and income survey of 52 percent of all Tununak households in 1986, the total per capita subsistence production was 1,091 pounds, placing it within the top 10 percent of communities statewide in terms of per capita subsistence output (Wolfe and Walker 1987). As many as 90 species of fish, shellfish, marine invertebrates, marine mammals, large and small game, birds, berries, and plants were listed as commonly harvested for subsistence uses by Tununak residents. Still, herring accounted for 40 percent by weight of the subsistence output in Tununak that year. Per capita pounds of herring harvested in all four communities from 1986 through 1988 was considerable (Fig. 3). For example, 392 per capita pounds of herring was produced by Tununak fishing families in 1986. Lastly, as mentioned above, expansions from the same survey data infer that considerable, but fluctuating proportions of overall average household incomes are attributable to the commercial herring fishery.

Nunivak Island and Kuskokwim Bay

Gear used for subsistence-herring fishing by Kipnuk fishermen was similar to that used by Nelson Island fishermen (Pete *et al.* 1987). In Kipnuk, outboard powered boats ranged in length from 12 to 24 feet. Locally constructed, wooden, and aluminum skiffs were utilized. Drift or set gill nets ranged from 12 to 450 feet in length with stretched mesh sizes from 1 to 2-3/4 inches (Anderson 1985; Pete *et al.* 1987). Drift gill nets were used more frequently than set gill nets because much of the fishing area was heavily influenced by the tide. Mud flats and eel grass were exposed at low tide, inviting sea gulls to pick at entangled herring.

In Kipnuk, herring caught for subsistence use were processed in a manner essentially similar to that described for Nelson Island. Although herring were not aged in pits, they were gutted, cleaned, and braided into strings to dry for winter food. Just as it did in Nelson Island communities, subsistence-herring production in Kipnuk coincided with many other subsistence and income-generating activities. Subsistence fishing and processing of salmon, smelt, cisco, and whitefish,

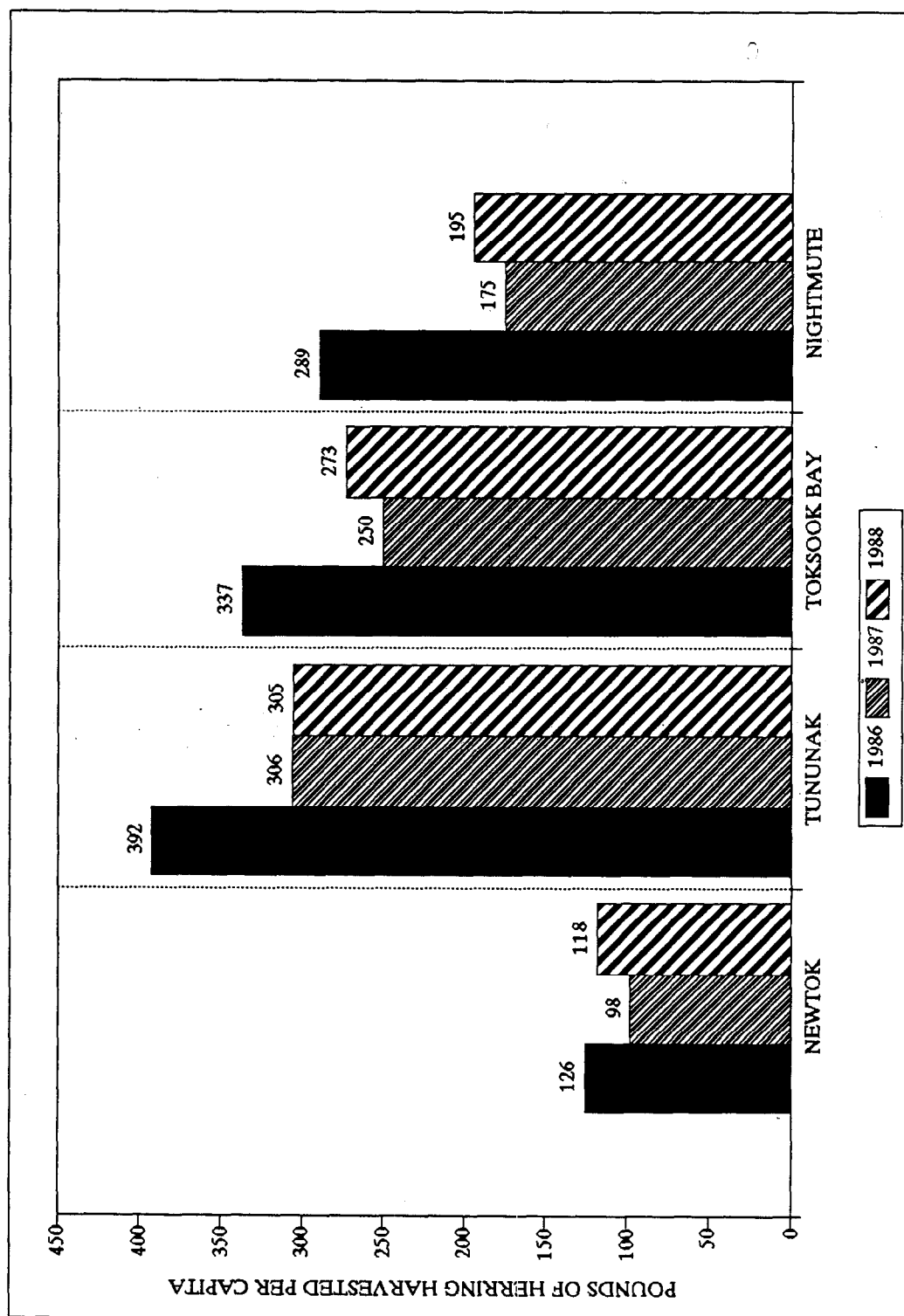


Figure 3. Pounds of herring harvested per capita for subsistence use by Nelson Island communities, 1986-88.

gathering of several species of edible plants, and processing of sea mammal hides harvested earlier in the spring occurred throughout this time (Stickney 1984). Many people temporarily left the community for commercial salmon and herring fishing and wage employment opportunities. It is likely that harvesting and processing of herring, as well as associated activities were similar in the other communities, although no recent studies have been conducted.

Most subsistence-herring fishing areas of each community were in nearby waters, with the exception of Mekoryuk where people were reported to fish for herring along the entire eastern coast of Nunivak Island (Fig. 1; Pete 1984) or within the Nunivak Island fishing district. The communities from Chefnak, south and east to Kongiganak, fished in the Cape Avinof district. A few people from Chefnak joined relatives in Toksook Bay and at Umkumiut, to fish for, and process herring for subsistence in 1986 through 1988 (Pete and Kreher 1986; Pete *et al.* 1987). In contrast to past years, Kongiganak residents fished near their community in 1985, rather than the area used by Kwigillingok fishermen (Anderson 1985; Stickney 1984)). There are no data on Kongiganak or Chefnak herring fishing areas for 1986 and 1987.

Harvest Levels

Herring harvest data from Nunivak Island and Kuskokwim Bay communities have been collected, intermittently, between 1976 and 1987 by various entities using differing methodologies (Alaska Department of Fish and Game 1986; Hemming *et al.* 1978; Pete *et al.* 1987; Stickney 1982). Table 4 shows subsistence-herring harvest data from these reports. Only in 1985 were harvest data collected from all five communities; the total estimated harvest was 31.1 short tons. The 1985 harvest was the largest recorded to date for Mekoryuk and Kongiganak. Larger harvests have been documented for Chefnak, Kipnuk, and Kwigillingok prior to and since 1985 (Table 4). More detailed information on subsistence-herring harvest levels and effort is available for Kipnuk. Nearly 60 percent of all Kipnuk households cooperated in at least 32 production units to harvest approximately 40 and 59 per capita pounds of herring for subsistence use in 1985 and 1987, respectively (Pete *et al.* 1987).

TABLE 4. ESTIMATED SUBSISTENCE-HERRING HARVEST LEVELS (IN SHORT TONS)
FOR NUNIVAK ISLAND AND KUSKOKWIM BAY COMMUNITIES, 1976-87^a

Community	'76	'77	'78 ^b	'79	'80	'81 ^c	'82	'83 ^c	'84 ^c	'85	'86	'87 ^d
Mekoryuk		.6 ^b	.6				.3 ^e			.7	.2	
Chefornak			3.1							13.0		14.0
Kipnuk			6.1							9.4 ^f		14.4 ^f
Kwigillingok	11	1.0		7.9	13.2		13.2			4.6		
Kongiganak		.3								3.4	2.0	
Harvest Totals (short tons)	11	1.9	9.8	7.9	13.2		13.5			31.1	2.2	28.4
Communities Represented	1	3	3	1	1	0	2	0	0	5	2	2

^aUnless otherwise noted, harvest levels up to 1986 are from Alaska Department of Fish and Game 1987.

^bHemming *et al.* 1978.

^cNo surveys conducted; blank spaces reflect lack of data rather than no harvest for individual communities throughout this period.

^dK. Schultz, pers. comm. 1987.

^eStickney 1982.

^fPete *et al.* 1987.

Total Subsistence Herring Harvests

Subsistence-herring harvest information from 1976 to 1988 from all nine communities discussed in this report is compiled in Table 5. The figures do not reflect complete harvests for all fishing families for Mekoryuk or Kuskokwim Bay communities. However, the total upper-range harvest estimate for all these communities was 212.5 short tons. This is twice the previously assumed typical subsistence harvest for all communities along the eastern Bering Sea coast (Hemming *et al.* 1978). Furthermore, the harvest estimates for the years depicted in Table 5 were reported by local

TABLE 5. TOTAL SUBSISTENCE-HERRING HARVESTS (IN SHORT TONS), NELSON ISLAND AND NUNIVAK ISLAND DISTRICTS AND KUSKOKWIM BAY

Community	Average harvest	Range of harvest	Years with data
<u>Nelson Island District</u>			
Newtok	11.7	10.0 - 12.6	86, 87, 88
Tununak	53.5	48 - 63.3	86, 87, 88
Toksook Bay	59.7	51 - 69.5	86, 87, 88
Nightmute	17.5	15 - 21.4	86, 87, 88
Subtotals	142.4	124 - 166.8	
<u>Nunivak Island and Kuskokwim Bay</u>			
Mekoryuk ^a	0.5	0.2 - 0.7	77, 78, 82, 85, 86
Chefornak ^a	10.0	3.1 - 14.0	78, 85, 87
Kwigillingok ^a	8.5	1.0 - 13.2	76, 77, 79, 80, 82, 85
Kongiganak ^a	1.9	0.3 - 3.4	77, 85, 86
Kipnuk	10.2	6.7 - 14.4	78, 85, 87
Subtotals	9.1	? - 45.7	
Totals	151.5	? - 212.5	

^aData represent minimal harvest estimates; not all fishing households were contacted.

residents to approach normal subsistence production from healthy herring stocks. Not until 1984 were herring returns considered "recovered" by elderly residents of the Nelson Island region. Herring were considered "good-sized" and abundant in areas traditionally fished with customary gear, and necessary harvest levels were attainable in reasonable timespans. Thus, harvest estimates for years prior to the late 1970s portrayed less productive times, and possibly, reduced effort.

On an average, Nelson Island communities accounted for approximately 70 percent of the total subsistence-herring harvests for the nine communities. Kuskokwim Bay communities have harvested the remaining 30 percent of the total harvest. Mekoryuk harvests were the lowest, averaging one-half ton (Table 5). However, information on Mekoryuk subsistence herring harvests was the most incomplete of all communities, because fishing families that camp on the south side of the island have never been contacted. Although historical sources report less dependence on herring than the Nelson Island communities (Lantis 1946), no complete or current data exist to confirm the level of use for Mekoryuk or Nunivak Island.

Effects of Reduced Herring Stocks on Subsistence Fishing, ca. 1960-80

Beginning in the early 1960s, changes in the herring runs returning to Nelson Island were observed. Numbers fluctuated from year to year, herring sizes decreased, and productivity changed in usually consistent fishing areas. During this time, Nelson Island residents reported finding more glass floats and pieces of monofilament herring gill net webbing on beaches around Nelson Island. In 1968 and 1969, local residents saw large, foreign fishing boats north of Nunivak Island, and in Etolin Strait, while seal hunting in spring (early May). In 1973, one person found an extremely long section of gill net webbing, over several thousand feet long. At that time, locally made nets, ranging from 20 to 60 feet in length, with multifilament cotton or nylon twine, were the predominant gear for subsistence-herring fishing.

From the late 1960s through the mid-1970s, subsistence-herring fishing was generally unpredictable and often not productive for many fishermen. Herring were small; they passed through

set gill nets previously used. Fishermen began using smelt and capelin dipnets or pieced together webbing with mesh sizes of 1 to 1-1/2 inch. They often drifted for herring with these short nets. Nets were set for weeks rather than days. A few fishermen salvaged and hung the monofilament webbing they found on beaches. Although herring were more likely to get caught in those nets, because of the smaller mesh size, the nylon mesh dug into the flesh of the herring, complicating processing and sometimes making them unusable for food.

Consistently productive fishing areas, such as waters off Chinit Point and Cape Vancouver became erratic, and were heavily fished by residents of all communities when herring occurred in appreciable numbers. Because spawn-on-kelp was sparse, local residents felt that whatever spawn was deposited should be allowed to produce herring, and spawn-on-kelp collecting ceased. Subsistence-herring harvests declined; several families noted for catching up to two tons of herring estimated that they got no more than 100 to 200 pounds -- "a pilot-cracker-box full."

Because of the unpredictable nature of herring fishing and unreliability of success, many families ceased subsistence-herring fishing and concentrated on other species. This was especially true for the residents of Newtok and Nightmute. These two communities, located near productive fresh water fishing areas, reportedly increased production of pike, whitefish, burbot, and blackfish for food to sustain them through the winter. Tununak and Toksook Bay residents also targeted other species as well. Halibut, sculpin, "needlefish" (stickleback), flounder, saffron cod, Dolly Varden, all species of salmon, smelt, and capelin harvests increased. Late-summer and fall berry picking trips made by residents of all four communities to the east side of Nelson Island and the adjacent mainland were prolonged in order to set nets for pike, whitefish, and burbot. These substitutes increased gasoline and time expenditures during both harvesting and processing.

By 1972, local residents began appealing for help from agencies and organizations, such as Nunam Kitlutsisti in Bethel. A few elders remember emergency food drops (government cheese, macaroni, dried milk) (Lenz 1980). Either the Division of Emergency Services or Alaska Air National Guard of the Alaska Department of Military and Veterans Affairs were credited with the food drops.

However, a few younger people have attributed the food drops to other circumstances which may have coincided with the reduced number of herring.

It is not difficult to understand the local view that offshore foreign fishing in the 1960s and 1970s was directly responsible for herring depletions in the Nelson Island area. After their experience, area residents became vocal about their opposition to any commercialization (Hemming *et al.* 1978) and have played an active role in the regulatory process pertaining to all herring fishing affecting subsistence uses.

SUMMARY

The subsistence-herring fishery in Nelson Island was a significant aspect of the economy of the communities in the area, demonstrated by rates of effort and participation, total harvests, per capita and family harvests, and with available data, by the proportionate contribution of herring to total wild resource outputs. The proposal to establish a commercial herring sac-roë fishery in the Nelson Island district and its subsequent authorization have underscored the importance of herring in the subsistence economy.

Subsistence-herring use occurred in five other communities in the Nunivak Island and Kuskokwim Bay areas. Although not of the same magnitude of use as that in Nelson Island villages, the total contribution of subsistence herring use to the economy is unknown because data have not been collected for the Kuskokwim Bay communities.

Of the communities outside the Nelson Island region, Kipnuk was the only community for which harvests by all fishing families were documented in 1985 and 1987. Participation in the subsistence fishery was considerable; up to 60 percent of all households were involved in subsistence herring production in 1987 (Pete *et al.* 1987).

Table 5 summarized available subsistence-herring harvest information for all the communities in the Nelson Island, Nunivak Island, and Kuskokwim Bay area. The community for which there exists the least amount of subsistence herring harvest information is Mekoryuk where households fish for

herring in the Nunivak Island district. The 1990 projected returns of herring for the Nunivak Island district are one-fifth of the total biomass necessary to allow a commercial harvest; 320 short tons are expected to return and the minimum biomass estimate to allow commercial harvest is 1,500 short tons.

Depleted herring stocks within the past several decades resulted in hardships for fishing families in the Nelson Island area. Procuring herring became unpredictable, very time-consuming, and expensive. Other resources were harvested to substitute for the decrease in stores of herring. In 1984, when local representatives of the Alaska Department of Fish and Game, Division of Commercial Fisheries, explained the inevitability of commercial utilization of herring surpluses, local residents reluctantly supported commercialization of Nelson Island herring stocks. The commercial fishery, designed to favor local participation, has provided important local options for securing monetary income. With declines in projected herring returns, local residents have expressed the most concern over the opportunity for continued and sustained levels of subsistence use.

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APPENDIX 1. SURVEY METHODOLOGY

Throughout the three years of the project, this research employed several data gathering methods consisting of systematic survey, selective mapping sessions, topically-focused interviews, formal (*i.e.*, meeting-setting) and informal discussions, participant observation, and literature reviews. Each year fieldwork was conducted by up to four researchers occurred through all phases of the subsistence fishery, from harvesting, through processing and drying, to the early stages of storing of dried herring, during a time span of over one month.

Each year, a letter introducing and asking permission to conduct the research was sent to village officials in Newtok, Tununak, Toksook Bay, and Nightmute in early spring (April). Follow-up telephone calls to village officials to invite questions and input or to schedule informational village meetings, if necessary, were made in late April and early May. Additionally, Tununak was the subject of a study of wider scope in which the herring fishery research was a component. The community was already informed about this phase of the project and approved it. After approval to administer the surveys was obtained, telephone contact with community officials was maintained to provide current information on ice conditions and movements and the commercial and subsistence herring fishing activities. This contact helped to contribute to logistical planning for the research team.

The senior researcher throughout the three study years was bilingual in Yup'ik and English. In 1986, an additional member of the research team was bilingual, also. In other years, local, bilingual assistants were employed as needed to assist the non-Yup'ik speaking researchers.

During the first year, the initial task in each community was the compilation of a current household census. Existing community lists or tribal rolls in the city or tribal council offices or health clinics were updated with residents of each community. The household censuses were reviewed and made current each year.

The survey was administered to members of every household that was designated as a "rack manager" of the subsistence herring production units in each community resulting in a complete (100 percent) census of subsistence herring fishing families. A survey instrument was used to record herring

harvest levels, times, gear, role in production of dried herring, facilities, effort in harvest of roe-on-kelp, and areas used (Appendix 2). For racks with logs laid horizontally on vertical posts, subsistence herring harvest estimates were calculated by selecting the longest, shortest, and most medium length strings of drying herring on every rack. The number of herring were counted and the total of the three averaged, to arrive at an average estimate of the number of herring per string. The number of strings per rack were counted and multiplied by the average number of herring per string to estimate total number of herring per rack. For "teepee-style" racks, each herring was counted because the strings of herring on this type of rack were tied together in a spiral around the teepee rack, making it difficult to account for the length of strings of herring.

In 1986, the first year of the project, sections of U.S. Geological Survey maps (1:63,360 scale) depicting the surrounding areas of each community were attached to survey forms. The maps were used to accurately record herring fishing, roe-on-kelp, and beach grass collecting areas during each survey interview session. Current aerial photographs by the Alaska Department of Community and Regional Affairs were obtained from the city offices and were utilized as base maps on which herring drying racks and processing facilities were delineated and assigned to their respective owners. The Tununak photograph did not include critical areas of the beach on which the drying racks were constructed. The map of its herring facilities was drafted relative to structures in the photograph. As there was no photograph of Umkumiut, all structures in that camp were sketched from ground observations. The length and height of log post-and-beam racks and the height and breadth of the base of "teepee-style" racks was measured. Changes or additions to rack maps were made each year.

All researchers directly observed and, for limited time periods, participated in herring fishing and processing. Discussions at these times provided important information to the understanding of the subsistence herring fishery. For example, researchers learned the method of distinguishing between "fatty" and "non-fatty" herring while helping with processing.

At the end of each field season, survey data were compiled and entered into the computer using Lotus 1-2-3 software for data analysis. Reports were completed in 1986 and 1987. Information in the 1988 season was summarized in tabular form.

APPENDIX 2

Subsistence Herring Fishery Survey Division of Subsistence, Spring 1988

Village: _____ H.H.#: _____

Fishing time: (Calendar days)
No. of days _____ (_____) TOTAL DAYS: _____

Set net site: _____ Drift area: _____
Gear type: Net length _____ Mesh size _____ Boat type _____ Length _____

Harvesting and processing:

Who fished? _____ Relationship to H.H. Head _____

Who processed? _____

<u>Harvest levels:</u>	1	2	3	4	5	6	7
Rack length(s):	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /
Rack height(s):	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /
Percent full:	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /
No. of strings:	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /
No. of herring:	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /	_____ /

No. of strings *ullipengayit*: _____ TOTAL NO. STRINGS: _____

TOTAL NO. HERRING: _____

Elquat (herring spawn-on-kelp) collected: Yes _____ No _____

Where collected: _____ Quantity collected: _____

Tapermat (beach grass) collection area or source: _____

General information: (Use back of page if necessary)

