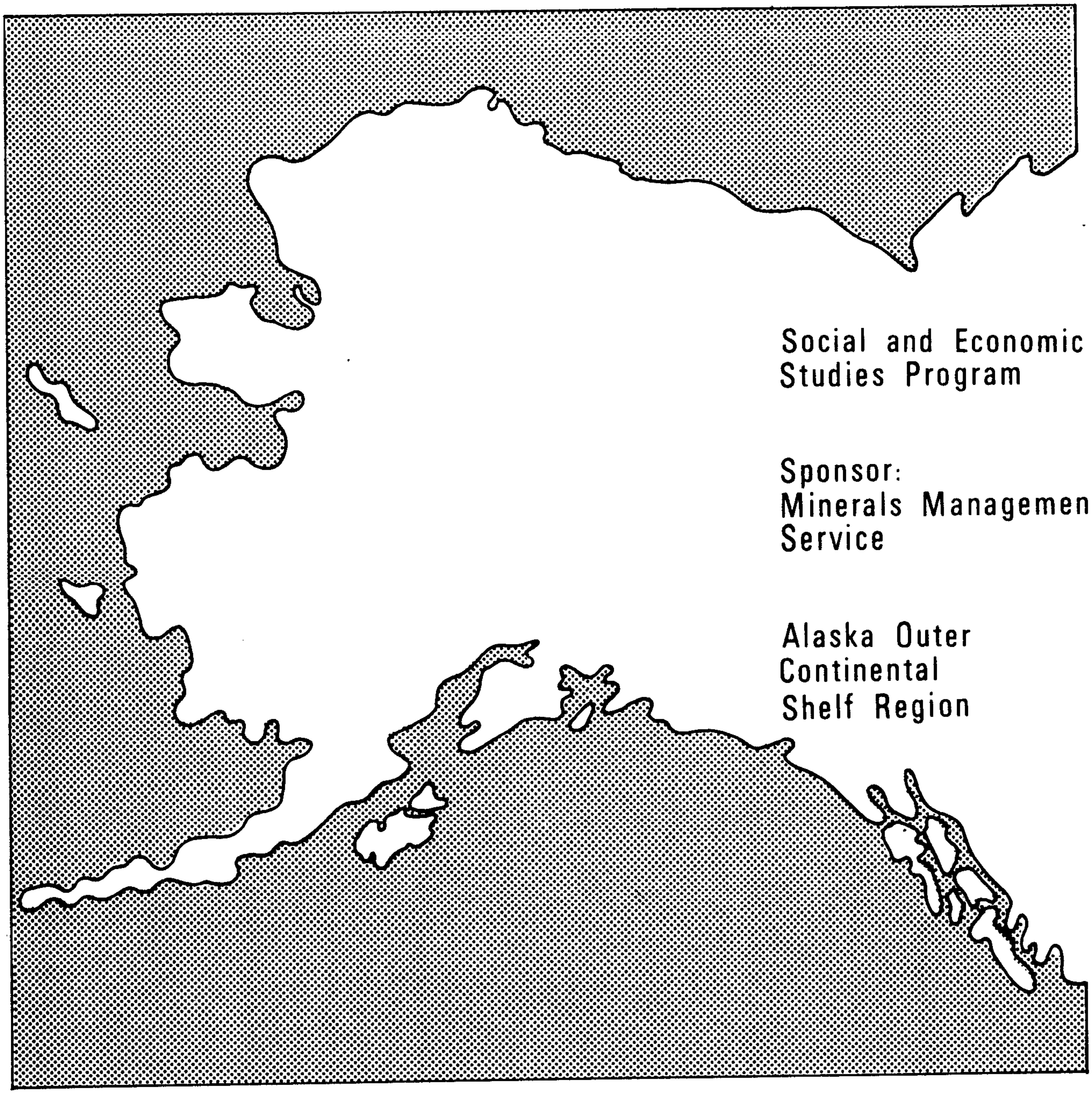
Technical Report
Number 97



Social and Economic
Studies Program

Sponsor:
Minerals Management
Service

Alaska Outer
Continental
Shelf Region

Bering Sea Commercial Fishing Industry Impact Analysis

Contract No.
AA851-CT2-46/14-12-0001-29072

BERING SEA COMMERCIAL FISHING INDUSTRY IMPACT ANALYSIS

TECHNICAL REPORT NO. 97

PREPARED FOR

MINERALS MANAGEMENT SERVICE
ALASKA OUTER CONTINENTAL SHELF OFFICE

SOCIAL AND ECONOMIC
STUDIES PROGRAM

APRIL, 1984

BY

CENTAUR ASSOCIATES, INC.
Bradley S. Ingram
Bruce B. Weyhrauch
Garry L. Brown

AND

DAMES & MOORE
Mark I. Hutton
Stephen T. Grabacki

AND

LZH ASSOCIATES
Lynne Z. Hale

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region in the interest of information exchange. The United States Government assumes no liability for its content or use thereof.

Alaska OCS Social and Economic Studies Program
Bering Sea Commercial Fishing Industry Impact Analysis.

This report was prepared under the helpful guidance of Karen Gibson, Minerals Management Service. Principal contributors to this report included Bradley Ingram, Bruce Weyhrauch, and Garry Brown of Centaur Associates, Mark Hutton and Steve Grabacki of Dames and Moore, and Lynne Hale of LZH Associates.

ABSTRACT

Conditions in the Bering Sea fishing industry without the planned OCS lease sales are forecast through the year 2007. Included are descriptions of the current fisheries and biological potential and projections of the domestic harvest, number of vessels and employment, and port and infrastructure characteristics. Based on the OCS development scenarios for the Bering Sea, impacts associated with loss of catch, labor interactions, gear loss, vessel collisions and potential port interactions were projected. The OCS development scenario includes exploration and/or development in the Navarin, Norton, St. George and North Aleutian Basins.

Domestic commercial fishing activity is expected to increase significantly in the next 30 years in the Bering Sea. Fisheries with the greatest future exploitation potentials are pollock, pacific cod, flounders, rockfish, tanner crab, and herring; pollock is the dominant species. U.S. vessels will gradually replace foreign vessels in the area. Catcher/processor vessels are expected to process the great majority of the Bering Sea catch at sea. Gears used to harvest fish will be trawls, pots, and longlines. The maximum number of vessels expected to harvest all fisheries excluding crab boats by 2007 is 217 catcher vessels, all larger than 100 feet long and 53 processing vessels averaging about 300 feet.

The mean OCS development scenario describes exploration in all four basins but development only in the Navarin and North Aleutian Shelf. Activity in the Bering Sea is projected from 1984 through 2007.

Activities are expected to fluctuate seasonally with more activity in the summer. The expected number of OCS supply boats and total amount of dock space and onshore storage space is also projected.

The amount of fishing space and catch lost in the four lease area are estimated using a Markov random movement model based on fish movement and catch rates. The estimated catch loss in 2007 (peak year) is 0.27 metric tons with a value of $31.7 in 1982 dollars for surface structures and 40 metric tons with a value of $23,552.7 in 1982 dollars for subsurface structures.

Competition between the OCS and fishing industries for labor will be minimal due to mobility of the labor pool, the large area from which both industries draw labor, higher pay for domestic fishermen, and relatively small demand for labor by OCS industries.

Theoretical shellfish pot loss due to OCS vessel traffic was calculated based on the area "swept" by the vessels. This is calculated to be 1,205 pots lost during 1997, the peak year of OCS vessel traffic. Actual pot loss may be somewhat less due to mitigating measures. Theoretical longline gear losses (i.e., lost bouy poles) in 1997 are projected to be 2 in the halibut fishery and 599 in the Pacific cod fishery. Trawl gear losses are estimated to number 25 in 2007 (the peak years) averaging $45,000 per year in gear damage and $25,000 per year for lost fishing time for domestic trawl fishermen based on data from the North Sea. Collisions between fishing and OCS vessels while vessels are in the vicinity of port, traveling to and from the four offshore basins and while in the four basins are estimated. Without the lease sales collisions are estimated to be about one every 67 years in 1997. Additional collisions associated with the lease sales are estimated to be one additional every 79 years in 1997, the peak impact year.

The port of Dutch Harbor/Unalaska will likely be the major staging area for OCS development in the Bering Sea with the possibility of some activity out of Chernofski, St. George, Nome, and St. Paul. Congestion is common in Dutch Harbor, particularly during crab seasons. Dedicated OCS dock facilities are planned in Captains Bay south of the major concentrations of fishing industry port activity. This should minimize interference with fishing industry activities. Demand for skilled machinists, mechanics, and welders by the OCS industry would benefit the fishing due to the creation of a larger base for these skills.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

1.0 INTRODUCTION

This final report was produced under Minerals Management Service contract No. AA851-CT2-46/14-12-0001-29072 and presents findings for the study: "A Commercial Fishing Industry Impact Analysis for the Cumulative Bering Sea Impacts". Information presented here projects activity associated with the fishing industry in the Bering Sea and projects impacts on the fishing industry from OCS activities in the Bering Sea.

Section 2.0 describes the commercial fisheries of the Bering Sea/ Aleutian Islands. Catch, commercial operations, species of commercial importance, markets, trends, and factors of change associated with these fisheries of major importance are presented.

Section 3.0 gives projections of activity associated with Bering Sea fisheries including harvest and processing technologies, the size of the anticipated commercial fleet, and externalities important to the domestic fishing industry. These externalities include limited entry, aquaculture activities, and political and economic decisions and policies.

Section 4.0 references the mean development scenario for the Bering Sea on which the impacts are based. Certain projections regarding the number of subsea completions, amount of gathering pipeline, and the number of OCS-related vessels, are made upon which the subsequent impact analysis is based. The four lease sales in the Bering Sea which comprise the cumulative case are the St. George, Norton Sound, North Aleutian and Navarin Basins. OCS exploration is assumed in all four basins with development only in the North Aleutian and Navarin Basins.

Section 5.0 examines gear loss and vessel collision impacts in the Bering Sea. Gears which are associated with Bering Sea fisheries are longlines, pots and trawls. Moderate impacts on gear loss are projected due to OCS vessel traffic and because of debris on the ocean floor associated with OCS development.

Section 6.0 examines the ports along the Bering Sea and outlines the possibility of fisheries or OCS development in these ports. Nome is expected to construct a new dock facility which fishing and OCS vessels could operate from. However, most of the emphasis in Section 6.0 is on Dutch Harbor which is expected to the major port in the region in terms of future Bering Sea activity. Some activity is also allocated to the ports of St. George, St. Paul, Akutan and Chernofski. Also included in Section 6.0 is a description of possible future infrastructure impacts from OCS development and mitigations to these impacts.

Section 7.0 assesses the loss of offshore fishing space from surface structures (production platforms and exploration rigs) and subsurface structures (pipelines and subsea completions). The effect of OCS structures on catch loss in terms of volume and value is projected to 2007. The greatest impact was found in the St. George Basin and the smallest impact in the Norton Basin. However, all impacts are relatively minor.

Section 8.0 makes an assessment of potential labor competition between the OCS and fishing industries. It was found that the impacts from labor competition are not significant because it is expected that the two industries will draw from a labor market much larger than the local focal points of shore-side activity of the two industries in the Aleutian Islands.

Section 9.0 presents literature cited.

Appendix A contains historical yearly catch, total projected domestic catch and the projected number of domestic fishing boat days for 1987, 1992, 2002 and 2007. This information is broken out by one degree by one half degree reporting grids. These historical and projected data are presented for the lease sale areas of the North Aleutian Basin, St. George Basin, Norton Basin and the Navarin Basin.

Appendix B presents "Technical Memorandum B-1: Standards, Methods and Assumptions, Bering Sea/Aleutian Islands Commercial Fishing Industry Impact Analysis." This memorandum presents assumptions upon which fishery projections are based and forecast methods used in Sections 2.0 and 3.0. Areas of uncertainty, data sources and a bibliography pertaining to the Bering Sea impact analysis are also presented.

Appendix C presents the catch loss methodology which is used in Section 7.0 to project the volume and value of fisheries lost due to OCS structures.

CHAPTER 2

A DESCRIPTION OF THE ORGANIZATIONS, MARKETS, TRENDS, AND FACTORS OF CHANGE

2.1 INTRODUCTION

The most important element in this analysis of the fishing industry in the Bering Sea and Aleutian Islands (BSAI) is the projection of domestic fishing activity. Table 2-1 lists the commercially utilized fish and shellfish in the BSAI region and Table 2-2 presents a summary of the major Bering Sea fisheries and the existing domestic and foreign participation. There are two major categories of domestic fisheries -- the traditional and the developing fisheries. For the fisheries that are already fully utilized by domestic fishermen, i.e. salmon, crab, halibut and herring, changes in fishing activity will probably be small and will largely result from fluctuations in the resource base and changes in the economics of the fishery (e.g. markets, fuel prices, etc.). For developing domestic fisheries, especially the Bering Sea whitefish fishery, the pace of development and resource utilization is difficult to predict, will vary by lease sale area, and is tied to a wide variety of factors. For both types of fisheries, projections must be based on an understanding of the components that influence changes and their linkages.

It is illogical to firmly assume any level of domestic fishing activity at any given point in the future. Therefore, the concept of a "living" time line is used in this analysis to provide the best possible estimate of future domestic fishing industry activity in the BSAI. Biological, technological, economic, and political factors influence the time line and each affects the development of the domestic industry differently. Together, these factors will become causative forces influencing, to a measurable degree, the level of domestic fisheries in the BSAI. Biological factors include the historical and present status and trends of the resource, and fisheries oceanography peculiar to each species or species group. Technological factors, such as improvements in harvest technologies and in automated processing, cover the fishing and processing industries. Economic factors include financing,

TABLE 2-1

COMMERCIALLY UTILIZED FISH AND SHELLFISH IN THE EASTERN BERING SEA AND ALEUTIAN ISLAND REGION

	Common Name	Scientific Name
TARGET SPECIES:	Walleye pollock	*Theragra chalcogramma*
	Pacific Ocean perch	*Sebastes alutus*
	Atka mackerel	*Pleurogrammus monopterygius*
	Sablefish	*Anoplopoma fimbria*
	Yellowfin sole	*Limanda aspera*
	Greenland turbot	*Reinhardtius hippoglossoides*
	Pacific halibut	*Hippoglossus stenolepis*
	Sockeye salmon	*Oncorhynchus nerka*
	Pink salmon	*O. gorbuscha*
	Chum salmon	*O. keta*
	Chinook salmon	*O. tshawytscha*
	Coho salmon	*O. kisutch*
	Pacific herring	*Clupea harengus pallasii*
	Pacific cod	*Gadus macrocephalus*
	Red king crab	*Paralithodes camtschatica*
	Blue king crab	*P. platypus*
	Brown king crab	*Lithodes aequispina*
	Tanner crab (bairdi)	*Chionoecetes bairdi*
	Tanner crab (opilio)	*C. opilio*
	Korean hair crab	*Erimacrus isenbeckii*
	Pink shrimp	*Pandalus borealis*
	Humpy shrimp	*P. gonivrus*
	Snails	*Neptunea spp* *Buccinum spp*
	Squid	*Berrytheuthis magister* *Onychoteuthis banskii*
OCCASIONAL TARGET SPECIES:	Rock sole	*Lepidopsetta bilineata*
	Flathead sole	*Hippoglossoides elassodon*
	Arrowtooth flounder	*Atheresthes stomias*
	Rattails	*Corphaenoides* spp.
MINOR COMMERCIAL SPECIES[1]:	Rougheye rockfish	*Sebastes aleutianus*
	Dusky rockfish	*Sebastes ciliatus*
	Northern rockfish	*Sebastes alascanus*
	Shortspine thornyhead	*Sebastolobus alascanus*
	Shortraker rockfish	*Sebastes borealis*
	Dark botcher rockfish	*Sebastes crameri*
	Yelloweye rockfish	*Sebastes ruberrimus*
	Blue rockfish	*Sebastes mystinus*
	Alaska plaice	*Pleuronectes quadrituberculatus*
	Rex sole	*Glytocephalus zachirus*
	Butter sole	*Isopsetta isolepis*
	Longhead dab	*Limanda proboscidea*
	Dover sole	*Microstomus pacificus*
	Starry flounder	*Platichthys stellatus*
	Skates	Rajidae

---

[1] Includes species that may be marketable, but have low abundance.

Sources: Science Applications 1981, Hammeedi 1982.

TABLE 2-2

MAJOR EXISTING COMMERCIAL FISHERIES IN THE BERING SEA

Species	Gear	OCS PLANNING AREAS Norton Basin	 Navarin Basin	 St. George Basin	 North Aleutian Basin
Whitefish					
Walleye pollock	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pacific cod	Longline/Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Flounders (Other)	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Yellowfin sole	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Turbot	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pacific halibut[1]	Longline	No Fishery	No Fishery	Domestic	Domestic
Pacific Ocean perch	Trawl	No Fishery	Foreign	Foreign	Foreign
Rockfish (Other)	Trawl	No Fishery	Foreign	Foreign	Foreign
Sablefish	Longline/Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Atka mackerel	Trawl	No Fishery	Foreign	Foreign/Domestic	No Fishery
Other whitefish species	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pelagic Fish					
Salmon[1]	Gillnet/Seine	Domestic	Foreign	Domestic	Domestic
Herring[1]	Seine/Gillnet/Trawl	Domestic	No Fishery	Domestic	Domestic
Shellfish					
Tanner crab[1]	Pot	No Fishery		Domestic	Domestic
C. opilio			Domestic		
C. bairdi			No Fishery		
King crab[1]	Pot				
Red king crab		Domestic	No Fishery	Domestic	Domestic
Blue king crab		Domestic	No Fishery	Domestic	Domestic
Golden king crab		No Fishery	No Fishery	Domestic	No Fishery
Korean hair crab	Pot	No Fishery	No Fishery	Domestic	Domestic
Snails	Pot	No Fishery	Foreign	Foreign	Foreign
Shrimp	Trawl	No Fishery	No Fishery	No Fishery	No Fishery
Pink shrimp					
Humpy shrimp					
Squid	Gillnet/Longline	No Fishery	Foreign	Foreign	No Fishery
Octopus	Trawl/Pot	No Fishery	No Fishery	Domestic	Domestic

---

[1] Incidental foreign catch (by foreign fleets targeting on other species) of these species in 1979 was 3,238 metric tons of halibut, 1,162,949 king crabs (mostly brown) 18,269,582 Tanner crabs, 110,473 salmon and 6,547 metric tons of herring.

efficiency, marketing, and costs (operational and capital). Political factors will center around fishing regulations, incentive programs and key legislation, both state and federal.

Factors that will influence the degree and rate of development of the domestic industry are both positive and negative. Positive factors include improving stock conditions, advances in gear and processing technology, strengthening markets and marketing, financing packages, and favorable legislation. Negative factors can include declining stocks, import/export trade restrictions, foreign competition, labor and trade barriers, and a depressed economy.

Two types of sources were used to evaluate the resource potentials for the BSAI and the projected growth of the domestic fishing industry in the four OCS planning areas. The first includes most of the written reports; the second, knowledge gleaned from several years experience in the fishing industry and many conversations with fishermen, processors and managers in the Bering Sea. Some of the written works are of dubious value. Few provide any insights into the industry's activities.

In the following sections, we have attempted to blend our knowledge of the fishing industry with relevant published data to form our best professional judgement.

2.2 HISTORY OF FOREIGN AND DOMESTIC FISHERIES

The following discussion of the history of foreign and domestic fisheries in the Bering Sea, when combined with the discussion of biology (Section 2.3), is the foundation for the projections of resource potentials and the domestic fisheries in the BSAI.

The first commercial venture in the Bering Sea occurred when a single schooner fished for Pacific cod in 1864 (Cobb 1927). The domestic cod fishery did not begin on a regular basis until 1882. It continued until 1950 when demand for cod declined and economic conditions caused the fishery to be discontinued (Alverson et al. 1964). While the early cod fishermen also reported incidental catches of halibut, this fishery did not begin to develop until 1928 (Thompson and Freeman 1930). Small and infrequent landings of halibut were made by U.S. and Canadian vessels between 1928 and 1950, but catches were not landed every year until 1952 (Dunlop et al. 1964). Salmon fishing in the BSAI began in Bristol Bay nearly a century ago, in 1884, and, until the early 1950s, the Bay's large salmon runs were harvested by sail boats. Salmon fishing in the other BSAI districts began in the early 1900s. A nearshore, domestic herring fishery took place in the BSAI during the early 1900s, and was centered in Norton Sound and Unalaska. Salt-cured food herring were produced through World War II, after which operations ceased. Domestic herring fishing again started in 1964, but catches were small and sporadic until 1979 when they expanded rapidly.

Foreign fishing in the Bering Sea began in the 1930s, when Japan began mothership operations for king crab and whitefish (pollock and yellowfin sole). King crab were taken from 1932 to 1939 and the total catch during this period was estimated to be 7.6 million crab. Pollock were harvested for meal from 1933 to 1937 with catches ranging up to 43,000 metric tons. While 1930 catch rates for yellowfin sole are unavailable, catches in 1940-1941 were less than 10,000 metric tons.

Following World War II, Japanese vessels returned to the Bering Sea to re-establish fisheries for whitefish and crab. Much of the early effort and catches were small and concentrated on yellowfin sole and king crab. In the late 1950s, mothership fisheries expanded and so did the catch. At the same time, Soviet vessels entered the eastern Bering Sea fishery with effort concentrated on Pacific Ocean perch, yellowfin sole, herring and king crab. In the mid-1960s, Korean vessels entered the fishery, but catches remained relatively small scale in relation to Japanese and Soviet fisheries. Through the 1960s and and early 1970s, foreign catches increased rapidly and then declined as shrimp, Pacific Ocean perch and yellowfin sole were commercially depleted. More recently, foreign fishing activity has concentrated on the outer continental shelf and continental slope, south of St. Matthew Island, and in the vicinity of the Aleutian Islands. No foreign whitefish fishing activity has occurred in the Norton Basin area. Through various bilateral agreements with the U.S., king crab became a prohibited species for all foreign fishermen.

2.2.1 Whitefish (1)

The Bering Sea whitefish complex can be grouped into three categories based on depth: (1) small flounders of the shelf (yellowfin sole, Alaska plaice, rock sole); (2) demersal and semi-demersal species of the outer shelf and upper continental slope (pollock, cod, rockfish); and (3) large flounders of the lower continental slope (arrowtooth flounder, halibut, Greenland turbot) and sablefish. The three groupings also constitute distinct fisheries. The major group is the demersal and semi-demersal species of the outer shelf and upper slope; pollock is the dominant species.

While foreign fishermen still dominate the harvest of Bering Sea whitefish, domestic fishermen have made impressive gains in utilizing this resource over the last 5 years. In 1976 there were no domestic landings of whitefish from the BASI area; in 1982 over 108 thousand metric tons were harvested. Domestic whitefish operations are currently limited to the southern, relatively nearshore areas of the eastern Bering Sea (in the North Aleutian Shelf and St. George Basin planning areas). In September of 1982, the North Pacific Fishery Management Council (NPFMC) passed a resolution that would prohibit foreign trawlers from operating within a 5,300 square mile area north and west of Unimak Pass (including parts of the North Aleutian Shelf and St. George Basin planning areas). As the domestic industry expands, domestic effort will extend to the more remote areas, such as the Navarin Basin. No significant whitefish harvests are expected in the Norton Basin area.

---

(1) Throughout this report the term whitefish is used synonymously with bottomfish or groundfish. These include flatfish and roundfish species. Roundfish included in the Bering Sea whitefish grouping include walleye pollock, Pacific cod, rockfish (including Pacific Ocean perch), sablefish, Atka mackerel and minor roundfish species such as greenling and saffron cod. Flatfish species include yellowfin sole, Alaska plaice, rock sole, arrowtooth flounder, Pacific halibut, Greenland turbot and other turbots, flathead sole and other minor species such as rex sole, dover sole, starry flounder, longhead dab and butter sole. In this report the category "flounder" is used synonymously with flatfish following commonly used conventions for statistical categories.

Historical catch data included in this section is taken from Bakkala et al. (1981), NPFMC (1979), and data supplied by National Marine Fisheries Service (V. Wespestad, NMFS, personal communication).

2.2.1.1 Walleye Pollock

Pollock in the eastern Bering Sea support the largest single-species fishery in the North Pacific. Pollock became a highly targeted species in the 1960s when mechanized processing of pollock into minced meat was successfully implemented on Japanese motherships and large factory stern trawlers.

Japan is by far the largest user of pollock, accounting for over 80 percent of total catches since 1970. Until 1978, most of the remaining catch was taken by the U.S.S.R. The Republic of Korea catches exceeded those of the U.S.S.R. in 1979 and 1980, reaching 114,000 metric tons in 1980. New fisheries for pollock have developed in recent years -- by Poland and by West Germany. In 1980, there were two joint ventures (where U.S. fishing vessels delivered their catches to the foreign vessels for processing) for pollock -- U.S./Republic of Korea and U.S./U.S.S.R.; in 1982, there were ten. In addition, limited quantities of pollock have been harvested by American catcher-processors operating in the BSAI area.

2.2.1.2 Pacific Cod

The annual catch of Pacific cod by all foreign nations in the eastern Bering Sea and Aleutians increased from 13,400 metric tons in 1964, to about 70,000 metric tons in 1970; since then, catches have varied between 36,000 and 62,000 metric tons. Japan has accounted for 66 to 99 percent of the catch since 1971.

During the early 1960s, when a fairly large Japanese longline fishery operated on the continental slope, cod were harvested for the frozen fish market. Beginning in 1964, the Japanese North Pacific trawl fishery for pollock expanded, and cod became an important incidental catch in the pollock fishery. At present, cod are believed to be an occasional target species when high concentrations are detected during pollock fishery operations.

Domestic fishermen and processors are making significant progress towards full utilization of the BSAI Pacific cod resource. An expanding salt cod fishery is centered in the Aleutians from Unimak Island to Seaguam Island (North Aleutian Shelf and St. George Basin planning areas) with a major shore based processing plant at Akutan. This fishery landed 11,800 metric tons of Pacific cod in 1982, up from 7,000 metric tons in 1981. In addition, joint ventures landed 13.6 metric tons of Pacific cod in 1982 with additional landings by American catcher-processors.

2.2.1.3 Pacific Ocean Perch and Other Rockfish Species

Pacific Ocean perch has been an important resource for foreign trawl fisheries operating in the eastern Bering Sea and Aleutian region since the late 1950s and early 1960s. Japan and the U.S.S.R. have historically accounted for the major portion of the harvest; combined catches of both nations peaked at about 47,000 metric tons in the eastern Bering Sea in 1961 and at about 109,000 metric tons in the Aleutian area in 1965. Catches declined precipitously following these peak removals and, in 1980, totaled less than 1,000 metric tons in the eastern Bering Sea slope region and 3,300 metric tons in the Aleutian region. The low catches are attributed primarily to a decline in stock abundance although fishery restrictions beginning in 1976 have played a minor role.

Other rockfish species are also taken but until 1977 they were identified as Pacific Ocean perch in catch reports. From 1977 to 1980, U.S. fisheries observers identified 15 species of rockfish in whitefish catches landed by foreign vessels and U.S. vessels fishing in joint venture operations.

Domestic landings of Pacific Ocean perch have been limited to small joint venture catches (26 metric tons in 1982).

2.2.1.4 Turbot Complex

Arrowtooth flounder, Greenland turbot and other turbots are generally discussed together as part of the turbot complex. These large flatfishes have similar bathymetric distributions along the outer continental shelf and slope, with arrowtooth flounder generally limited to the southern portion of the BSAI.

The target fishery on the turbot complex by the Japanese landbased trawl fleet is distinct from other target fisheries since turbot stocks of commercial abundance are generally segregated by distribution and biology from other target flatfish species. However, the Japanese mothership-North Pacific trawl fishery has often accounted for more than half of the catch of turbot, presumably as an incidental part of the target fishery for pollock and other species. A large part of these incidental catches of turbot are assumed to come from waters on the continental shelf and consist primarily of juvenile fish. The overall fishery, therefore, takes both juvenile and adult turbot.

Domestic landings are limited to small joint venture catches (87 metric tons in 1982).

2.2.1.5 Sablefish

The sablefish populations of the eastern Bering Sea and Aleutian Islands are small when compared with those of the Gulf of Alaska, the center of sablefish abundance.

The eastern Bering Sea sablefish fishery was initiated by Japanese longliners in 1958. This small fishery grew rapidly during the early 1960s. A Japanese record catch of 28,520 metric tons was landed in 1962. After 1966, when longliners began to be displaced by the expanding trawl fishery, new sablefish longlining areas were established in the Aleutian region. The peak Aleutian catch of 3,580 metric tons was taken in 1972. Since then, catches have continued to decline and recent catches have been at low levels; e.g. the total all-nation catch in 1980 was 1,847 metric tons in the Bering Sea and 267 metric tons catch in the Aleutian region. In 1982 the optimum yield for sablefish was 3,500 metric tons for the Bering Sea area and 1,500 metric tons for the Aleutians region. While foreign fishermen still take most of the catch (4,570 metric tons for both regions in 1982), domestic fishermen have started to participate in the BSAI sablefish fishery (776 metric tons harvested in 1982).

2.2.1.6 Halibut

Halibut fisheries are restricted to domestic fishermen who fish in the Bering Sea primarily in the spring and summer months. However, significant numbers of halibut are taken incidentally in the foreign trawl fishery, primarily during the winter months when halibut are concentrated along the edge of the continental shelf. There are extensive halibut savings areas in the southeastern Bering Sea to protect nursery grounds. In addition, time-area closures are imposed on the foreign trawl fleet to limit their incidental halibut catch.

A few U.S. vessels conducted a small fishery in the southeastern Bering Sea between 1930 and 1934. In those years the Bering Sea was open to fishing at the same time as the Gulf of Alaska. No further fishing occurred in the area until 1952, when U.S. vessels began taking about 100 metric tons annually from fishing grounds east of 175°W longitude. To encourage fishing in the Bering Sea, the fishing season was opened one month earlier than in the Gulf of Alaska beginning in 1958. The catch began to increase, reaching nearly 4,400 metric tons in 1962 (Myhre et al. 1977), about equally divided between U.S.. and Canadian vessels. The International North Pacific Fishery Convention determined that halibut in the Bering Sea no longer qualified for abstention and Japan was allowed to enter the fishery in 1963. A three-nation catch limit of 5,000 metric tons was established by the International North Pacific Fishery Commission for that portion of the Bering Sea along the edge of the shelf between Unimak Island and the Pribilof Islands. The 1963 catch from the quota area reached 4,974 metric tons and the total catch for the area east of 175°W was 7,254 metric tons. In 1964, a catch limit of 2,900 metric tons was set for the area between Unimak Island and the Pribilof Islands, but only 972 metric tons were taken from the depleted stocks. Japan discontinued longlining for halibut after the 1964 season. Catches declined after that time, and since 1970 have averaged about 250 metric tons,largely caught by U.S. vessels. In the Bering Sea, despite a large halibut savings area in Bristol Bay, the foreign incidental catch of halibut remains more than half the total directed catch of the setline fishery, which averaged about 600 metric tons annually between 1977 and 1982.

The 1983 BSAI halibut quota has been raised to 2.4 million pounds (1,091 metric tons). A special 400,000-pound quota was set aside for the small boat, native halibut fishery that is just beginning to develop in the nearshore waters off the Pribilof Islands, Nelson Island and Nunivak Island.

2.2.1.7 Yellowfin Sole

The yellowfin sole resource of the eastern Bering Sea was substantially overfished by the Japanese and the Soviets in the early 1960s. Analysis indicated that continued overfishing through the 1960s reduced the exploitable biomass (6-year old fish and older) to an historic low of about 600,000 metric tons in 1969. In the last decade, the resource has recovered slightly.

Catches from 1972 to 1977 were relatively low (average annual catch of 58,000 metric tons) due primarily to the absence of a directed fishery for yellowfin sole by the U.S.S.R. The U.S.S.R. re-entered the yellowfin sole fishery in 1978-1979, and catches nearly doubled over the average annual levels of 1972 to 1977. The U.S.S.R. was not allowed to fish in the U.S. 200-mile conservation zone in 1980 although they were allowed to process catches take by U.S. fishermen in joint venture operations. As a result of the absence of the U.S.S.R. fishery, overall catches of yellowfin sole declined to 87,000 metric tons in 1980. Two new developments in the 1980 fishery were the increase in catches from 1,900 metric tons in 1979 to 16,000 metric tons in 1980 by vessels from Republic of Korea and the catch of 9,600 metric tons by the U.S./U.S.S.R joint venture operation. In 1982, U.S. fishermen harvested 17,000 metric tons of yellowfin sole in joint venture fisheries, mostly from Bristol Bay (North Aleutian Shelf planning area).

2.2.1.8 Atka Mackerel

In the early 1970s, the Soviet trawl fishery intensified its effort towards Atka mackerel and other relatively unexploited species when its principal target species, Pacific ocean perch, declined in commercial abundance. The Soviet harvest of Atka mackerel in the BSAI region increased from 949 metric tons in 1970 to peak at 22,622 metric tons in 1978. In 1980, the U.S.S.R. catch declined sharply to 937 metric tons due to the termination of Soviet fisheries in U.S. waters; however, overall catches remained near recent levels as the Republic of Korea increased their harvest to 17,483 metric tons.

Japanese harvests of Atka mackerel have been increasing annually since 1977, although they are still at relatively low levels with 1,719 metric tons taken in 1980. Much of the Japanese catch was taken by vessels of the landbased dragnet fishery. The all-nation catch of Atka mackerel has remained relatively stable from 1977 to 1980, averaging about 22,000 metric tons annually.

Approximately 77 percent of the 1980 all-nation catch came from the Aleutian Islands region. Only a small amount is taken along the edge of the continental shelf between the Pribilof Islands and Unimak Pass. Within the past year, however, representatives of the Marine Resources Company and Northwest and Alaska Fisheries Center research surveys have reported concentrations of this species previously not noted. This could be due to an expanding population as abundance appears to have increased in the Aleutian region. In 1982, domestic fishermen took close to 13,000 metric tons of Atka mackerel as part of a U.S./U.S.S.R. joint venture. Unfortunately, very little is known about Atka mackerel to clearly define its abundance or distribution in the eastern Bering Sea.

2.2.1.9 Other Flatfish

This species complex is made up of the following small flatfish, which are mainly restricted to waters of the continental shelf: flathead sole, rock sole, Alaska plaice, and small amounts of rex sole, dover sole, starry flounder, longhead dab, and butter sole. Catches of these species are almost entirely from the eastern Bering Sea, with only small amounts taken in the Aleutians. All-nation catches of these species in the eastern Bering Sea and Aleutians were relatively stable in the 1960s, ranging around 30,000 metric tons, but increased to about 92,000 metric tons in 1971. At least part of this increase is due to better species identification and reporting of catches in the 1970s. After 1971, catches declined to about 22,000 metric tons in 1977, increased to 43,000 metric tons in 1978, and were 35,600 metric tons in 1979 and 34,400 metric tons in 1980. Because these species are incidental to target fisheries, fluctuations in catches are thought to be mainly a function of changes in fishing effort for target species, particularly yellowfin sole. The absence of a U.S.S.R. target fishery for yellowfin sole from 1973 to 1977 may be the primary cause of the relatively low catches of other flatfish in this period. Winter closure of areas in the southeastern Bering Sea for the protection of Pacific halibut may have also restricted catches of flatfish.

2.2.2 Pelagic Finfish

Exploitable pelagic finfish in the eastern Bering Sea include herring, salmon and capelin. The principal species in this group is herring.

2.2.2.1 Herring

Pacific herring have been commercially exploited on a continuous basis since 1960 when the Soviet Union began a fishery on the herring wintering grounds northwest of the Pribilof Islands. Japan entered the fishery in 1967 with a winter trawl fishery and a spring gillnet fishery for herring roe near the western Alaska coast. Catches generally increased through the early years of the fishery, except in 1965 and 1966 when the Soviet fleet reportedly failed to find herring concentrations. In 1970, the fishery peaked with an all-nation harvest of 146,000 metric tons. In the following years, catches declined sharply due to a series of apparently weak year-classes.[1] In 1976, catches began to rise slightly as herring abundance began to increase, but in 1977 the U.S. established a quota of 21,000 metric tons in response to uncertainty about the status of the resource (Barton and Wespestad 1981).

In 1977, the first large-scale U.S. herring fishery since the 1940s began operation in the nearshore waters of northern Bristol Bay. The U.S. fishery primarily harvests herring for roe along with small amounts of roe on kelp. Since 1977, the fishery has expanded from Bristol Bay to nearly all coastal spawning areas including Security Cove, Goodnews Bay, Kokechik Bay and Norton Sound. Domestic herring for roe catches in the BSAI increased from just over 2,000 metric tons in 1977 to 7,305 metric tons in 1978, 11,750 metric tons in 1979, 18,092 metric tons in 1981, and approximately 28,000 metric tons in 1982. Roe on kelp harvests have ranged between 100 and 200 metric tons over those same years. Food and bait harvests are largely limited to the water around Unalaska Island (Fried et al 1982).

Since U.S. extended jurisdiction, several management measures have been enacted that altered the foreign fishery and limited catches. Foreign catch quotas were established in 1977 (19,400 metric tons) and 1978-1979 (8,600 metric tons each year). In 1980 and 1981, foreign fishing for herring was totally prohibited and offshore domestic fishing for herring was prohibited north of 58°N latitude. In December 1982, the Alaska Board of Fisheries changed existing regulations to allow a 10,000 metric ton offshore domestic trawl fishery for herring in the Bering Sea _if_ the inshore sac roe fishermen fail to take the allowable harvest.

---

1) Available data (Wespestad & Barton 1980) indicate that eastern Bering Sea herring stocks declined in abundance in the early 1970s. Age frequency and length frequency data indicate that recruitment to the fishery was very low in the late 1960s and early 1970s. Soviet relative abundance data on herring year-class strength from 1947 to 1976 show that most of the year-classes from the 1960s were of below average strength. This data reinforces the suggestion that high levels of catch on weak stocks were the cause of the decline in catch.

2.2.2.2 Salmon

The BSAI region domestic salmon fishery is a nearshore fishery with fishing grounds that extend from Unalaska Island in the Aleutians to Norton Sound. Major coastal fishing grounds are found around Unalaska, Cold Bay, Port Moller, in Bristol Bay, around the mouth of the Kuskokwim and Yukon Rivers and in Norton Sound (see also Technical Memorandum BC-1). Salmon harvests have been above historical averages for the last several years in most districts. Biologists believe this is a result of both conservation practices (including the reduction of foreign fishing) and favorable environmental conditions. Historical information on salmon fisheries is taken from Alaska Department of Fish and Game (ADFG) annual management reports for each area (ADFG 1982a).

Bristol Bay, with its large run of sockeye (red) salmon, produces by far the largest proportion of salmon caught in the BSAI. The salmon season starts with king (chinook) runs in early June in Bristol Bay and lasts until September when fall runs of chum salmon are harvested in the Yukon and Kuskokwim Rivers.

The Bristol Bay salmon fishery is the state's largest and over the years has ranged from 400 fish in 1884 to a record catch of 28 million fish, mostly reds, in 1980. The 1963 to 1972 average was 9.8 million fish, and the 1973 to 1982 average was 13.8 million, illustrating the come back of the area's salmon resource. The usual breakdown is 80 percent reds, with the remaining 20 percent pink, coho, chum, and king salmon.

The northern Alaska Peninsula/Aleutian region's total salmon harvest averaged just over 1.8 million fish during 1973 to 1982. On the northern Alaska Peninsula, red and chum salmon are the major species harvested. Pink salmon make up the majority of the Aleutian Island catch. The fishery is carried out by drift gill nets, purse seines, and set gill nets.

The first commercial catches in the Kuskokwim district were reported in 1913; however, the fishery did not expand much until 1939. The 1963 to 1972 annual average harvest was 136,000 fish and the 1973 to 1982 average was

677,000, primarily reflecting increased fishing effort. Approximately 48 percent of the Kuskokwim district catch is usually chum salmon, 36 percent coho, and the remaining 16 percent pinks, reds, and king salmon.

The lower Yukon River commercial salmon fishery started in 1918, but closed between 1925 and 1931 to protect subsistence users. Since then, commercial salmon fishing has been continuous and has expanded rapidly since statehood in 1959. The 1963 to 1972 annual average for the Yukon River salmon harvest was 241,000 fish, and the 1973 to 1982 average was about 1.2 million. The Yukon River commercial salmon catch is usually made up of approximately 89 percent chum salmon with the remainder mostly king salmon.

Commercial salmon fishing began in Norton Sound in 1961 and first concentrated on king and coho salmon. Since then operations have expanded to include all five salmon species. In Norton Sound, the 1963 to 1972 annual average salmon catch was 147,000 fish, and the 1973 to 1982 average was 311,000, reflecting recently increased effort. The Norton Sound salmon catch is usually made up of about 48 percent pink salmon, 45 percent chum salmon, and 7 percent coho and king salmon.

There is also limited "high seas" salmon fishing well offshore in the BSAI (Navarin Basin planning area). This fishery, which started in 1952 is dominated by Japanese mothership operations. From 1971 to 1975, the Japanese took 6.8 million salmon from Bering Sea subareas 8 and 10, which overlap the Navarin Basin.

2.2.2.3 Capelin

To date there has been no commercial capelin fishery in the BSAI regin. Little is known about this small, smelt-like fish in Alaska but commercial quantities are thought to exist in Bristol Bay and Norton Sound. There has been some interest in establishing a Bering Sea capelin fishery to supplement existing herring fisheries; and a state-supported demonstration fishery is planned for Norton Sound in June 1983 (D. Nashoolik, President, Arctic Sea, Inc.). If a Bering Sea capelin fishery develops, it will probably target on female capelin with roe for the Japanese market. It is not expected that such a fishery would exceed 10,000 metric tons per year, primarily due to limited markets (Hale 1983).

2.2.3 Shellfish

2.2.3.1 Squid

There is little information available on distribution, abundance, and biology of squid stocks in the eastern Bering Sea and Aleutian Island regions. Squid are generally taken incidentally or are temporarily targeted when large concentrations are encountered. *Gonatus magister* and *Onchoteuthis borealijaponicus* are the major components of squid catches. *G. magister* predominates in catches made in the eastern Bering Sea whereas *O. borealijaponicus* is the principal species encountered in the Aleutian Islands region.

Reported catch data are somewhat limited, dating back only to the late 1970s. Overall catches declined after 1978 (9,411 metric tons) with a total all-nation catch of 6,343 metric tons in 1980. Approximately 63 percent of the total squid catch in 1980 came from the eastern Bering Sea region. In 1982, U.S. fishermen in joint ventures harvested 5 metric tons from the BSAI region.

2.2.3.2 Crab

The world catch of crab increased from 404,800 metric tons in 1976 to 448,800 metric tons in 1977 (Food and Agricultural Organization 1978). Of the 44,000 metric tons increase, 10,300 metric tons (23 percent) came from increased yield in the eastern Bering Sea. Taken together, all-nation landings of king and Tanner crabs made up 31 percent (127,000 metric tons) of the world crab catch in 1976 and 28 percent (127,500 metric tons) in 1977. Landings of king and Tanner crabs in the eastern Bering Sea were 11 percent (44,100 metric tons) and 12 percent (54,400 metric tons) of the world crab catch in 1976 and 1977, respectively.

King and Tanner crab provided 59 percent of the domestic crab catch in 1981 (NMFS 1982). Tanner crab have become more important in recent years and current landings have exceeded those of king crab. In terms of landed value, king crab is the most important crab fishery, although the relative value of Tanner crab has been increasing. Only limited quantities of Dungeness crab are taken in the BSAI region. During the last 2 years, domestic fishermen have started harvesting golden king crab and Korean hair crab. Bering Sea king and, to a lesser extent, Tanner crab catches have declined precipitously in the last 2 years. King crab harvests peaked in the 1980-1981 season at just under 170 million pounds. The 1982 season totals were very low at 26.5 million pounds, leaving many crab fishermen in a desperate situation. Tanner crab catches have experienced similar, though less drastic, declines.

Japan and the U.S.S.R. were the only foreign nations that engaged in directed fisheries for king crab. Except for 1960 and 1961, Japan took most of the annual landings every year until 1971. Japan's catch peaked in 1964 with 5.9 million crabs weighing 18,600 metric tons. A steady decline in Japanese landings followed, and by 1970 the Japanese catch had declined to 28 percent of the 1964 peak catch. Starting in 1965, blue king crab from the Pribilof population made up 3 to 48 percent of the Japanese king crab catch annually. Japanese catches continued to decline from 1970 until Japan stopped fishing in 1974.

The U.S.S.R. entered the fishery in 1959 with a catch of 620,000 crab weighing about 1,000 metric tons. The Soviet fishery expanded rapidly and peaked in 1961 with a catch of 10,200 metric tons. In 1960 and 1961, the Soviet catch actually exceeded that of the Japanese by a small number, although the weight of the Soviet catch was somewhat less. The Soviets landed more than 6,100 metric tons in each succeeding year until 1966. The Soviet catch was 3,800 metric tons in 1967 and only 800 metric tons by 1970. The Soviets did not continue their fishery after 1971.

U.S. fishermen began harvesting king crab in the Bering Sea with trawl gear in 1947. There were small catches that peaked in 1953 at 900 metric tons. A gradual decline in effort followed until 1959, when no U.S. king crab catch in the Bering Sea was reported. Available markets were filled by the rapidly growing fisheries in less remote areas. A period of fluctuating, low catches (less than 450 metric tons) followed from 1960 through 1966. In 1967, the U.S. crab fishery in the Bering Sea began to expand, primarily as a result of declining catches in other areas. Historical information on domestic crab fisheries is from the ADFG Westward Region Annual Shellfish Report (ADFG 1982b).

King Crab: Since the mid-1970s Alaska king crab harvests have been dominated by landings from the BSAI. While red king crab accounts for the greatest proportion of the harvests, an important blue king crab fishery is centered around the Pribilof Islands and a brown king crab fishery is just getting started (total landings of 415,000 pounds during the 1981-1982 season). Red king crab landings increased steadily from the fishery's beginning in Bristol Bay in 1953 until 1980, when close to 190 million pounds were harvested. In the 1981-1982 season, catches plummeted to about 85 million pounds and catches during the 1982-1983 season further declined to crisis levels. Blue king crab landings were first made in 1973, and have generally increased with just over 11 million pounds harvested during the 1980-1981 season. Brown king crab catches are beginning to increase as landings of red king crab drop off.

The Bering Sea king crab season has changed dramatically since the early 1970s when it lasted most of the year. Now because of vastly increased fishing effort and reduced stocks, the season begins in earnest in September and is mostly over by late November. The relatively small Norton Sound king crab fishery, which began in 1977, and the Bristol Bay 6-1/2 inch shell crab fishery both occur during the summer. There is also a small, local shorebased through-the-ice fishery for king crab around Nome that occurs from February through April.

In 1977, exploratory blue king crab fishing in the St. Matthew Island area yielded 500 metric tons. The St. Matthew area fishery continued in 1978, with a catch of 900 metric tons by 22 vessels, and in 1979, when some blue king crab were taken as far north as St. Lawrence Island. Interest in the 1979 fishery was low, however, and only 96 metric tons were landed by 17 vessels. Typically, blue king crabs in the northern district are smaller (average 1.8 kilograms) than those taken in the Pribilof Islands (3.5 kilograms).

The time series of catch-per-unit-of-effort (CPUE) statistics indicates that southeastern Bering Sea red king crab were at moderate levels of abundance in 1953, increasing through the 1950s; catch rates peaked in 1959. Both Japanese and Soviet fisheries enjoyed high catch rates in 1959 and 1960. CPUE peaked before the record foreign catches of the early 1960s. The average size of crab taken in the Japanese fishery was stable from 1956 to 1962; it ranged from 158.0 to 158.9 millimeters carapace length (or approximately 3.3 kilograms). Both CPUE and average size generally decreased from 1964 to 1967 despite relatively stable levels of effort. In 1967 the average size reached 153 millimeters carapace length (approximately 2.9 kilograms).

Catch rates in the U.S. fishery declined precipitously from 1966 to 1970, and by 1970 the catch rates of all three nations (U.S., Japan, U.S.S.R.) reached all-time lows. U.S. fishery efforts were increasing during this period while those of foreign fisheries were declining. The average size of red king crab taken by both U.S. and Japanese fisheries declined significantly from 1967 to 1970. Those taken by the U.S. fell from 3.5 kilograms in 1967 to 2.3 kilograms in 1970.

Data for the pre-1973 Pribilof Islands blue king crab fishery are sparse. The Japanese catch in 1973 was taken incidentally to Tanner crab fishing. Domestic effort was minimal (6,800 pot lifts) in 1973, the catch was small (580 metric tons), and U.S. CPUE was 25.6 crabs per pot lift. U.S. effort increased to 45,500 pot lifts in 1974 and decreased to 16,300 in 1975. There is a similar fluctuation in the catch. CPUE in 1974 (19.9 crabs per pot) and 1975 (19.3 crabs per pot) was stable. Starting in 1976, U.S. effort in the Pribilof Islands increased substantially, reaching 64,400 pot lifts in 1976, 78,300 in 1977, and 101,200 in 1978. Catches were, however, stable during this period and averaged 2,900 metric tons. CPUE fell from 19.3 crabs per pot in 1975 to 12.1 in 1976, 10 in 1977, and a low of 8 in 1978.

Tanner (Snow) Crab

Two species of Tanner (snow) crab (Chionoecetes bairdi and C. opilio) are harvested in the BSAI.

The distribution of C. bairdi is strongly associated with the coast of the Alaska Peninsula, continental slope areas, and the Pribilof Islands. Surveys have mapped two centers of abundance in most years. Most of the population has generally been found in the area north of the Alaska Peninsula (North Aleutian Shelf planning area); another area of concentration has centered on the Pribilof Islands (St. George Basin planning area). The two centers of abundance are connected by a region where C. bairdi is lower in abundance. C. opilio appears to dominate in abundance north of 58°N; however, distribution appears to vary between years.

Before 1965, Tanner crabs were taken incidentally to king crab fishing. Some directed fishing by Japan did, however, take place as early as 1954, according to reports in International North Pacific Fisheries Commission (INPFC) statistical yearbooks. Effort was small and few catch data were given. Directed Tanner crab fishing started after 1964, when bilateral negotiations led to progressively smaller Japanese and Soviet king crab quotas. The U.S. entered the fishery in 1968, but fishing was incidental to king crabbing until 1974. The U.S.S.R. discontinued its fishery after 1971, but Japan's Tanner crab fishery continued through 1980. Until 1978 the U.S. fishery was almost entirely for C. bairdi. Since that time, both species have been taken, although C. bairdi still accounts for most of the U.S. catch.

Domestic Tanner crab landings in the eastern Bering Sea were less than 460 metric tons annually from 1968 to 1973. Some 482,000 crab were taken in the peak year of this period. After a directed fishery was begun, C. bairdi catches grew rapidly from 2,300 metric tons in 1974 to 10,100 metric tons in 1976 and peaked at 30,020 metric tons in 1978. The 1979 catch was much reduced and only 19,280 metric tons were taken. The domestic C. opilio fishery, which only occurs in the Bering Sea, began in 1978 with a catch of only 780 metric tons but grew rapidly to 14,600 metric tons in 1979 (ADFG 1979). Interest in C. opilio in 1979 was triggered by low production of C. bairdi. In aggregate, U.S. landings of Tanner crab in the eastern Bering Sea peaked in 1979 with landings of 33,900 metric tons. Catches since then have declined, but increasing ex-vessel values of Tanner crab caused the value of the 1982 catch to increase.

Korean Hair Crab

Another crab fishery is developing in the eastern Bering Sea. Landings of Korean hair crab (Erimacrus isenbeckii, also known as horse crab) were 4.5 metric tons in 1979, 27.3 metric tons in 1980 and 90.9 metric tons in 1981. Survey estimates in 1979 indicated that about 5,700 metric tons could be harvested if hair crab were exploited at the same rate as other eastern Bering Sea crabs and ADFG expects this fishery to continue to grow. About half of the available resource is in the Pribilof district (St. George Basin planning area).

2.2.3.3 Snails

Japan has commercially harvested snails in the eastern Bering Sea since 1971 (MacIntosh 1980). The fishery occurs east of 175°W longitude on the continental shelf northwest of the Pribilof Islands. Statistics available since 1972 indicate that about 3,000 metric tons of edible snail meats (11,000 metric tons live weight) were harvested each year from 1972 through 1975. Total weight and recovered meat weight data from the 1974 harvest indicate an edible meat recovery of 27 percent. This value is similar to values of edible meat recoveries of 26.8 to 30.6 percent obtained by MacIntosh and Paul (1977) for four species of eastern Bering Sea snails.

The most common gastropod in Japanese catches made northwest of the Pribilof Islands in 1973 was Neptunea pribiloffensis, about 70 percent of the catch by weight. Buccinum angulosum and B. scalariforme accounted for an additional 23 percent of the catch.

In 1977, Japan began to supply the United States with statistics on the number of vessels and amount of effort expended in the eastern Bering Sea snail fishery. Vessels licensed for this fishery range from 96 to 490 gross metric tons and from 25 to 50 meters in length. Between June and October 1977, three vessels caught 404 metric tons of edible meat, approximately 15 percent of Japan's 3,000 metric tons quota. The vessels had an average catch of 2.7 metric tons of meat per day. In 1978, a maximum of nine vessels caught 2,200 metric tons of edible meat between May and November. The average catch rate during the 1978 fishery was 2.9 metric tons per day. In 1979, three vessels caught only 537 metric tons of edible meat in a fishing season that began in July and ended in October. The average daily catch was 2.8 metric tons on the remainder.

We know little about Japanese fishing techniques, but in 1973, one vessel fished about 6,000 pots on 12 groundlines (500 pots per groundline) and took three days to pick and rebait the entire set of gear. An average catch rate of 4 kg/pot/3-day soak was reported by that same vessel. In the 1977 fishery, the average catch rate was reported as 0.9 kg/pot/33-hour soak (MacIntosh 1980).

All processing of the snail catch now occurs on board the catcher vessel. This consists of crushing the shells, briefly cooking the meats, and removing any soft parts and shell fragments. The meats are graded by size and quality and quick-frozen in trays. Small snails in the catch may be frozen whole.

The only available figures on the value of the snail fishery are derived from estimates of the ex-vessel price of snail meats. These figures are used by the U.S. as a base for calculating fee schedules for foreign vessels fishing within the extended jurisdiction zone. Estimated ex-vessel prices for the years 1976 to 1978 are $600, $600, and $1,657 per metric ton for snails in the eastern Bering Sea. The total allowable catch has been allocated to Japan, the only nation now involved in the fishery. Japan's 1977 to 1979 quotas were set at 3,000 metric tons of edible meat, the same level as the average catch for the years 1972 to 1975.

Domestic fishermen and processors have expressed interest in the Alaska snail resource, but their future involvement is less certain than the future involvement of Japan. Although crab vessels would be well suited to snail pot fishing, most crab fishermen consider fishing for Gulf of Alaska and eastern Bering Sea bottomfish as an alternate or supplemental activity.

Attempts to initiate a domestic snail fishery in the Gulf of Alaska have not been productive. They have been exploratory in nature but show promise as potential off-season operations in the next few years. Innovative processing and marketing techniques as well as a continued increase in the value of the traditional frozen meat product will be necessary conditions for the initiation of a domestic snail fishery.

2.2.3.4 Clams

A geographically isolated, discrete stock of Alaska surf clam (*Spisula polynyma*) has been described with a conservatively estimated exploitable biomass of 329,170 metric tons (± 52,000 metric tons) and potential annual yield equal to 17,775 metric tons (maximum sustainable yield) of whole clams. The species is long-lived (maximum observed age 25), slow growing, fully recruited to the spawning population at 8 years of age, and attains maximum biomass at 9.4 to 13 years of age. Mortality increases rapidly with increasing age beyond 14. At present, the stock appears to be in a state of equilibrium, probably because it is not fished. Age-composition data suggest that 11-year old clams are the youngest age-group fully recruited to harvest gear equipped with collecting bags with rings 7.6 centimeters in diameter. The use of rings 5 centimeters in diameter in the collecting bags lowers the age of full recruitment to the gear to 10 years.

In view of the sizable potential yield of the stock and production catch rates, which averaged 736 kilograms of clams per hour with a harvester 1.8 meters wide, a clam fishery off the north coast of the Alaska Peninsula has development potential.

2.2.3.5 Shrimp

A Japanese mothership fishery with about 25 catcher boats began harvesting pink shrimp (Pandalus borealis) and sidestripe shrimp (P. goniurus) near the Pribilof Islands in 1960. The fishery in this area peaked rapidly at nearly 30,000 metric tons in 1963, then declined dramatically and has been inconsequential since 1967. The shrimp fishery in the eastern Bering Sea was first managed in 1977, when prohibitions were placed on retention of shrimp by any nation other than the U.S. in jurisdictional waters in the Bering Sea.

A small domestic shrimp fishery started in the Bering Sea in 1975 in the waters surrounding Unalaska Island (Unalaska Bay, Makushin Bay, Usof Bay, Beaver Inlet) in the St. George Basin planning area. Catches peaked in 1978 at just over 6.6 million pounds. Reduced harvests have been required in recent years because of depressed stocks, and Unalaska Bay has been closed to shrimping since the 1980-1981 season. Total catch for the 1981-1982 season totaled just under 2.2 million pounds. During its peak years, the shrimp fishery occurred throughout the year, but activity during the last several years has been confined to the months from November through June.

2.2.3.6 Octopus

Octopus are found in many locations in the BSAI. In 1982, over 26,900 pounds were landed as an incidental catch in the Tanner crab fishery. There is little information on the size of the resource, but if additional markets develop for octopus, a small fishery may arise.

2.2.3.7 Sea Urchins

Sea urchins are abundant around the Aleutian Islands. They are marketed for their roe, which is considered a delicacy. If a sea urchin fishery develops, it is expected that it will be relatively small and of local importance only.

2.3 BIOLOGY

The demersal assemblage of the southeastern Bering Sea shelf (including the St. George Basin, North Aleutian Shelf, and Navarin Basin areas) is dominated by fishes; to the north (including Norton Basin), invertebrates, primarily echinoderms, predominate. The reasons for the relative scarcity of demersal fish in the Norton Basin area, which has 15 percent of the eastern Bering Sea's continental shelf, but less than 3 percent of its demersal fish resource, are not well understood but low water temperatures are thought to play a role (Zimmerman 1983).

As shown in Figure 2-1, walleye pollock and to a much lesser extent, Pacific cod dominate the southeastern Bering Sea's demersal assemblage. The next most important component is the flounders. Yellowfin sole dominate this group and the overall assemblage of the inner shelf (National Marine Fisheries Service [NMFS] areas 1 and 4; North Aleutian Shelf area), and the Greenland turbot, flathead sole, and Alaska plaice gain prominance in the central Bering Sea (NMFS areas 2 and 3; St. George Basin and Navarin Basin areas; Figure 2-2).

Halibut are relatively abundant in the St. George and Aleutian Shelf planning areas and probably reach the northern limit of their range in the central Bering (Navarin Basin area). Crab is most abundant in the southern sections of the Bering Sea although commercially important populations are found in Norton Sound. This group is primarily represented by the commercially important king and Tanner crabs. The other most common invertebrates are starfish, snails, sea squirts (ascidians), and sponges.

Pelagic fish have not been as systematically sampled in the Bering Sea as have demersal assemblages, but vast populations of salmon, important populations of herring, and potentially significant capelin populations are present. As with demersal resources, populations are greatest in the southeastern Bering Sea and decrease in the northern areas.

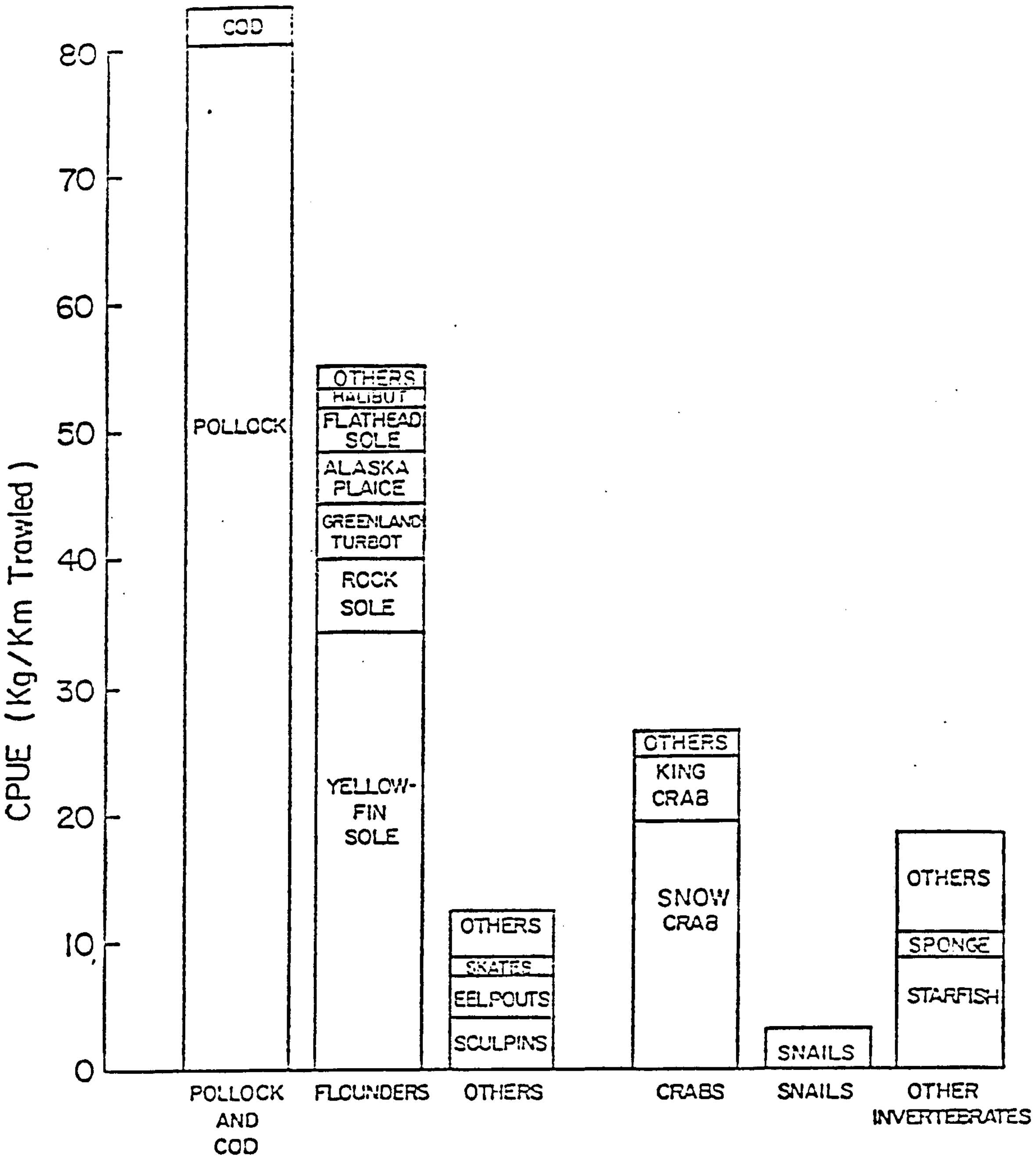


FIGURE 2 - 1. RELATIVE IMPORTANCE OF MAJOR GROUPS OF FISH AND INVERTEBRATES AND OF SPECIES OR SPECIES GROUPS WITHIN THESE MAJOR CATEGORIES AS SHOWN BY AVERAGE CPUE VALUES IN THE BERING SEA SURVEY AREA.

SOURCE: NMFS data as shown in Morris 1981

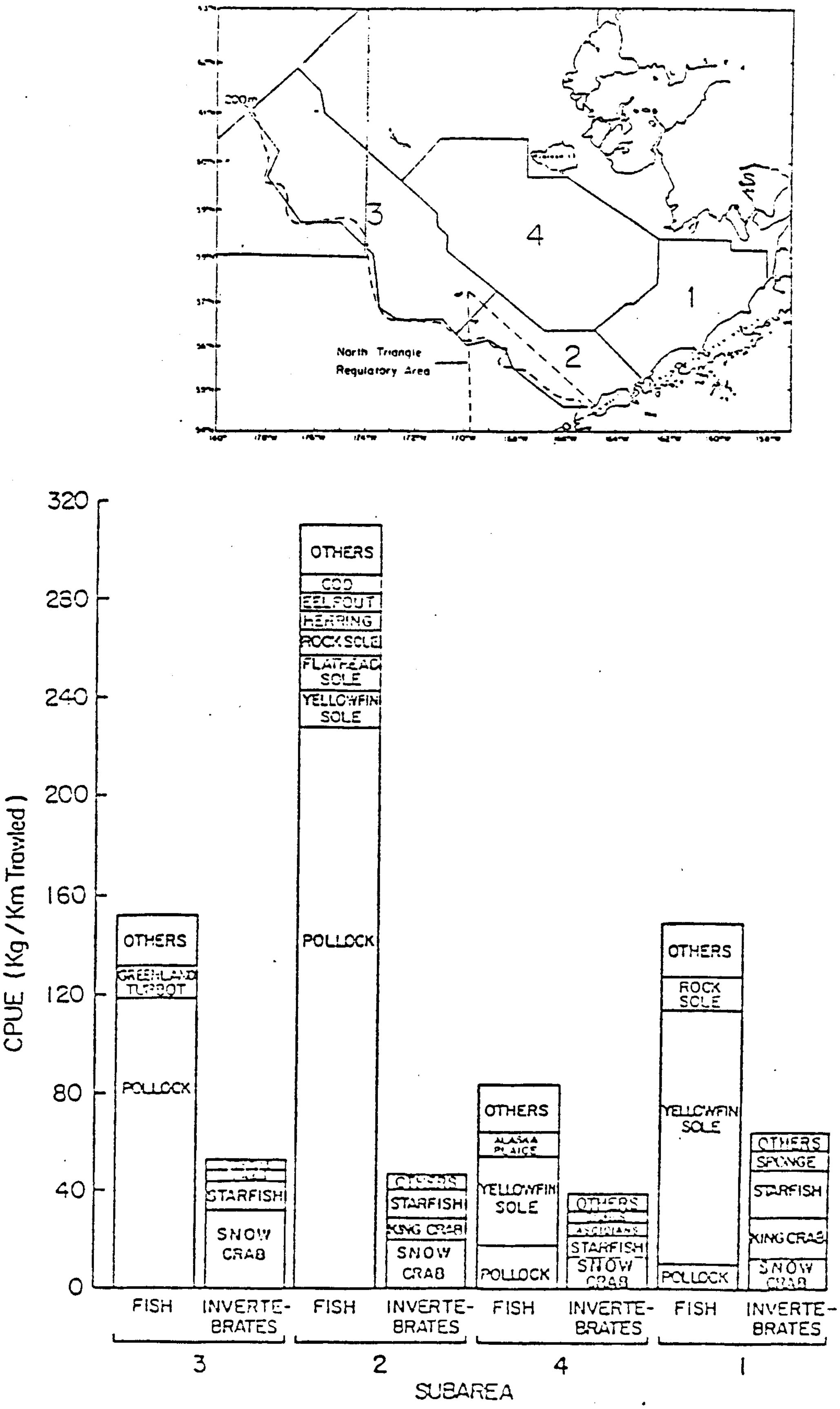


FIGURE 2 - 2. RELATIVE IMPORTANCE OF FISH AND INVERTEBRATES AND SPECIES OR SPECIES GROUPS WITHIN THESE CATEGORIES BY SURVEY SUBAREAS IN THE BERING SEA AS SHOWN BY AVERAGE CPUE VALUES.

SOURCE: NMFS data as shown in Morris 1981

In addition to the general distribution and abundance patterns briefly described above, it must be noted that all species show a patchy distribution and have specific areas of concentration or particularly high abundance.

This section briefly summarizes some relevant biological characteristics of the commercially important fish and shellfish species in the BSAI area. Much of the discussion is based on Morris (1981), Dames & Moore (1982), Hutton (1981), Higgins (1978), Thorsteinson and Thorsteinson (1982), and Zimmerman (1983).

2.3.1 Whitefish

The most frequently encountered (and most abundant) species of whitefish during NMFS surveys in the BSAI area were generally those also most important in the catches of the foreign fishing fleets -- walleye pollock, Greenland turbot, Pacific cod, flathead sole, rock sole, and yellowfin sole.

A summary of the life history characteristics of these principal whitefish species is shown in Table 2-3. The following subsections provide brief discussions of the pertinent biological factors believed to affect resource abundance and the commercial fisheries over this study's 25-year planning horizon.

2.3.1.1 Walleye Pollock

Walleye pollock (Theragra chalcogramma) are the most abundant demersal species in the BSAI. They are widely distributed over the continental shelf, but are most abundant along the shelf edge. Pollock grow quite rapidly and attain an average weight of 1 pound and a length 16 inches at about 4 years. The fishery harvests primarily 2 to 6 year olds although pollock live to be 14 and 15 years old.

Spawning occurs between late February and June, usually peaking in May, along the outer continental shelf in waters 40 to 1,000 feet deep. While

TABLE 2-3

LIFE HISTORY CHARACTERISTICS OF PRINCIPAL WHITEFISH SPECIES IN THE EASTERN BERING SEA (NORTH PACIFIC FISHERY MANAGEMENT COUNCIL 1979)[a]

Life history characteristics	Pollock	Pacific cod	Sablefish	Pacific ocean perch	Pacific halibut	Arrowtooth flounder	Greenland turbot	Flathead sole	Rock sole	Yellowfin sole	Alaska plaice	Atka mackerel
Bottom depths of common occurrence (m)	55-365	20-275	90-825	90-460	20-460	55-550	90-640	55-365	20-185	20-550	35-165	coastal & open sea
Depths of high availability by season (m)	180-365 (winter) 90-275 (summer)	90-275 (winter) less than 185 (summer)	365-730 (winter) 180-825 (summer)	275-460 (winter) 145-275 (summer)	90-410 (winter) 20-185 (summer)	275-550 (winter) 145-365 (summer)	550-915 (winter) 145-730 (summer)	185-365 (winter) 90-275 (summer)	35-185 (winter) 35-90 (summer)	90-275 (winter) 35-90 (summer)	90-130 (winter) 35-90 (summer)	offshore (winter) inshore (summer)
Spawning period	March to July	Jan. to May	Dec. to April	March to June	Nov. to March	Dec. to Feb.	Oct. to Dec.	March to June	March to June	June to August	May to June	June to Sept.
Maximum age	17 years	12 years	20 years	30 years	42 years	22 years	25 years	21 years	16 years	21 years	19 years	?
Average age at maturity (female)	3 years	4 years	7 years	7 years	12 years	9-11 years	13-14 years	6 years	4-5 years	9 years	8 years	3-4 years
Average size at maturity (female)	30 cm	73 cm	71 cm	27 cm	125 cm	55 cm	70 cm	29 cm	22 cm	26 cm	30 cm	33-35 cm
Instantaneous natural mortality rate, M	0.43	0.30-0.45	0.22	0.27	0.17	0.2	?	0.2	0.26	0.25	0.2	?
Growth completion rate, K (female)	0.28	0.30	0.14[b]	0.11	0.10	0.10	0.10	0.11	0.15	0.11-0.18	0.1	?
Fecundity at average size at maturity	100,000	1,000,000 to 2,000,000	400,000	10,000	700,000	?	25,000	50,000	200,000	800,000	100,000	9,000

[a] Values and time periods given in this table are approximations.

[b] Sexes combined.

Source: Bakkala et al. 1981

pollock eggs and larvae are found throughout the southeastern Bering Sea, spawning activities are concentrated between the Pribilofs and Unimak Island in the North Aleutian Shelf and St. George Basin planning areas. The eggs develop in the surface layers. Pollock eggs hatch in 2 or 3 weeks, depending on the temperature, and the larvae float near the surface for an unknown period of time. Juvenile pollock become demersal at lengths of 1 to 2 inches and reach 3 to 4 inches during their first year, suggesting that larvae may drift pelagically for several months (Morris 1981).

Pollock feed near the seafloor on zooplankton (especially euphausiids), but older (20 inches) pollock are cannibalistic on young (12 inches) pollock. Pollock in turn serve as an important food resource for a wide variety of other fish species, marine mammals and marine birds.

The distribution of pollock appears to be strongly influenced by temperature, which may account for annual shifts in population location. Pollock also undertake extensive seasonal migrations associated with feeding and reproduction (see Table 2-3).

Although pollock have a relatively large biomass, the exploitable population is composed mostly of young fish of ages 3 and younger. Reproductive potential is lower now than in the past when the population had a greater number of older, more fecund fish. Although pollock range to about 3 feet in length, the average size of harvested fish is 12 inches. Since maturity for most pollock is not reached until ages 3 or 4, the failure of one or two successive year-classes in such a young population could have disastrous consequences on stock productivity that would severely affect the large trawl fisheries based upon this resource.

A recent report by Bakkala et al. (1981) indicates that pollock abundance has been on a declining trend since 1973 with the sharpest decline occurring between 1973 and 1975 (from 14.3 to 11.4 million metric tons) and then a slower, gradual decline between 1975 and 1980 (from 11.4 to 9.4 million metric tons). They also projected pollock biomass through 1985 and found that abundance is not likely to undergo any major decline in the immediate future.

According to Alverson (quoted in AFDF 1982), yields of the pollock fishery could be increased through rather intensive fishing effort. Alternatively, the fishery could be managed to increase the size of individual fish by decreasing the catch.

2.3.1.2 Pacific Cod

Pacific cod (Gadus macrocephalus), like pollock, are widely distributed over the Bering Sea continental shelf, although cod is a somewhat more shallow water species. Major concentrations occur in the eastern and central regions at depths that range from 260 to 2,000 feet.

Pacific cod are fast growing and are reported to grow to 40 inches and 25 pounds. They are exploited at ages 3 to 12 when they average 8 to 12 pounds. Cod are mostly benthic and are caught in waters between 260 and 1,640 feet deep. They mature at age 4 to 5 and can live to be 14 to 15 years old (Ketchen 1964).

The spawning period and area have not been delineated for cod in the central or eastern Bering Sea (Morris 1981) but spawning probably occurs from January to May (Thorsteinson and Thorsteinson 1983). In general, however, Pacific cod appear to spawn below the mixed layer at temperatures of 32° to 41°F. Females are highly fecund and produce from 1 to 2 million eggs per individual. Fertilized eggs are demersal and, initially, slightly adhesive. The incubation period for cod eggs is about 10 to 20 days.

Cod feed primarily on benthic organisms and planktonic organisms and are a major predator on the juveniles of commercially important crab species in the Bering Sea.

The migratory habits of Pacific cod are unclear. However, some researchers (e.g. Low 1974) have reported east-west movements as the fish migrate back and forth between the continental slope and shelf. Migrations extending into inner shelf waters apparently involve large numbers of cod only in relatively warm years.

The abundance of Pacific cod has increased substantially since the mid-1970s. The relative abundance of cod increased six-fold between 1976 and 1979 based on Northwest and Alaska Fisheries Center research survey data. Their surveys also suggest that the large biomass increase resulted from the recruitment of a strong 1977 year-class and may have peaked in 1980.

2.3.1.3 Yellowfin Sole

Yellowfin sole (Limanda aspera) are widely distributed over the eastern Bering Sea shelf at depths less than 380 feet and form a major component of the eastern Bering Sea's ichthyofauna. The center of abundance for this species is the central region of Bristol Bay (North Aleutian Shelf area) with a secondary concentration around the Pribilof Islands (St. George planning area), with deeper water areas such as the Navarin Basin containing only a small proportion of the total population. The bathymetric distribution of yellowfin sole varies seasonally. During winter, they inhabit the outer shelf and upper slope, but with the onset of spring migrate to shallower waters for spawning.

Yellowfin sole appear to spawn from early July through September in water from 50 to 250 feet deep. Their pelagic eggs have been observed over most of the Bering Sea with the greatest densities southeast and northwest of Nunivak Island (extending into the North Aleutian Shelf area). Yellowfin sole can live 14 or 15 years and usually enter the fishery between ages 5 or 6. They are a slow growing species and were fished to near depletion in the late 1950s and early 1960s. The population has since recovered and recent NMFS analyses of catch data show the abundance of this population remaining high through the mid-1980s.

2.3.1.4 Pacific Halibut

The Pacific halibut (Hippoglossus stenolepis) is widespread in the Bering Sea, occupying the shelf edge and upper zones of the continental slope from Cape Navarin to Bristol Bay. The population is particularly abundant in the central Bering Shelf area between 175° - 180° W. The northern limit of halibut's normal range is placed in Norton Sound at about 64° N latitude. Currently most fishing for halibut takes place along the Aleutian Islands as far west as Adak.

Halibut occupy a wide range of depths, performing seasonal migrations to the shallows (100 to 460 feet) in the spring for foraging and to deeper slope waters (800 to 1,800 feet) for spawning in the fall and for overwintering. They are usually found in waters of 36° to 46°F.

The species is prolific and can produce up to 2 million eggs per female. Spawning occurs over a protracted period of time in the winter, from about December to February. Eggs are bathypelagic and larvae are free floating, but after about 4 to 5 months and at about 4 inches length, the juveniles settle to the bottom. Halibut mature slowly; a mature female will be about 13 years old and over a foot in length. Halibut are known to live to at least 42 years of age.

Halibut are opportunistic bottom feeders, and will consume whatever prey is readily available. Juveniles feed primarily on small crustaceans.

The commercially fishable stock of Pacific halibut in the Bering Sea remains in an unsatisfactory state although 1983 marks a year of significant improvement with over 100 percent increases in catch quotas. The incidental catch of small halibut by the foreign trawl fleets during the 1960s and early 1970s has reduced the potential for recruitment and rebuilding of the adult halibut stocks. Although time and area closures on the foreign trawl fleets have reduced the incidental catch of halibut in recent years, the stock probably will never return to a size that will permit catches as large as those of 1962 and 1963, which were made from a virtually unfished stock.

2.3.1.5 Greenland Turbot and Arrowtooth Flounder

The turbots are larger than most other flounders. They are widely distributed over the continental shelf and slope with juveniles found mainly on the shelf and adults mainly in the deeper waters (>650 feet) along the continental slope. Greenland turbots (Reinhardtius hippoglossoides), the most abundant turbot, may reach 36 inches in length and weigh 22 pounds (Shuntov 1970). Seasonally they migrate from deep to shallow water and return, concentrating at depths of 2000 to 3000 feet in the winter, 1300 to 2300 feet in spring, and 700 to 2300 feet in the summer (Shuntov 1970). Spawning occurs from October to December. The eggs are bathypelagic, but the larvae rise to shallow depths of 100 to 400 feet. Recruitment to the fishery occurs at ages 4 to 7 (Shuntov 1970).

The arrowtooth flounder (Atheresthes stomias) occurs in the central Bering Sea along the continental slopes at depths of 650 to 1,640 feet during their first year, whereas older (larger than 12 inches) fish live on the slope at depths of 650 to 1,970 feet. In winter, most of the young flounder migrate to the deepest parts of the shelf and upper slope.

Spawning of the arrowtooth flounder probably occurs from December to February. The eggs are bathypelagic, but the larvae are found in shallow waters on the shelf. Metamorphosis occurs after several months and the juveniles settle to the bottom.

2.3.1.6 Other Flounders

Other important flatfish that occur in abundance and are widely distributed along the Bering Sea shelf include the flathead sole (Hippoglossoides elassodon), Alaska plaice (Pleuronectes quadrituberculata), and to a lesser extent the rock sole (Lepidopsetta bilineata).

Flathead sole: Flathead sole are found mainly on the eastern Bering Sea shelf, but on somewhat deeper grounds than those occupied by yellowfin sole and rock sole. They are caught mainly as an incidental species in the yellowfin sole and pollock fisheries.

During the winter flathead sole are usually found in deeper waters (230 to 1,300 feet) than yellowfin sole, rock sole, or Alaska plaice.

In the spring, these wintering groups migrate eastward to the shallower waters (65 to 590 feet) of the shelf. During the summer, flathead sole are widely dispersed over the outer shelf area from Unimak Island northwest into the central Bering Sea. Some flathead sole remain on the slope during the summer, but these fish are dispersed.

Flathead sole reproduce in the deeper shelf waters during the winter and spring (February - May) at depths of 330 to 650 feet. Each female produces up to several hundred thousand free-floating eggs. Eggs may be transported from the spawning grounds to shallower (100 feet or less) or deeper (to 1,640 feet) waters. The pelagic larvae float near the surface until they metamorphose to adult form and descend to the sea bed.

Rock sole: Rock sole are found mainly on the eastern Bering Sea shelf in shallower waters where yellowfin sole predominate. They are often found in association with Greenland turbot, flathead sole, walleye pollock, Pacific cod, and Tanner crab.

In the eastern Bering Sea and Bristol Bay, rock sole spawn during the spring (March-June at depths of 230 to 460 feet and temperatures of 33° to 38°F).

Alaska plaice: In contrast to rock sole and flathead sole, Alaska plaice are always dispersed and do not form separate commercial concentrations.

In the eastern Bering Sea, Alaska plaice are usually found in continental shelf waters together with yellowfin sole. They apparently live throughout the year on the Bering Sea shelf. During the winter, Alaska plaice occur at depths of 300 to 400 feet or deeper where bottom temperatures are 34° to 41°F. In summer, they apparently migrate to shallower water (100 to 300 feet), where they show a preference for water colder than 37°F.

2.3.1.7 Pacific Ocean Perch

The Pacific Ocean perch (Sebastes alutus) is the most abundant and valuable of the Bering Sea rockfishes. They are small in size, rarely exceeding 3 pounds in weight.

Pacific Ocean perch are widespread along the shelf edge and upper slope at depths ranging from 490 to 1,640 feet. They are most abundant near the 590-foot contour, about 70 feet off bottom in gullies, canyons, and depressions of the upper slope.

From January to May in the Bering Sea the densest concentrations of Pacific Ocean perch are in spawning areas to the south and west of the Pribilof Islands at depths of 1,000 to 1,400 feet. Except for distinct daily vertical migrations attributed to feeding, the schools are relatively immobile. From May to September the fish make an intensive foraging migration to the central Bering Sea; from September to January they return to their southeastern spawning areas. During this migration, the schools are in shallower water but are spread out at a greater range of depths (460 to 1,200 feet).

Growth of the species is slow, a 14-year old fish rarely exceeds 16 inches. Sexual maturity is attained at age 6 to 8. Pacific Ocean perch are caught in the fishery at 5 to 12 years.

Rockfish give birth to live young. Females may produce an average about 10,000 larvae. The larvae are usually born in the spring and in that stage, and as juveniles, they are one of the chief food supplies of larger fish, including their own kin.

2.3.1.8 Sablefish

The sablefish or black cod (Anoplopoma fimbria) lives mainly on the continental slope. Although schools of sablefish are geographically widely distributed, the exploitable biomass is largely confined to the depths of 490 to 4,000 feet and to the central portion of its range in the Gulf of Alaska. About 13 percent of the estimated exploitable biomass is located in the Bering Sea region.

Sablefish can live to be 20 years old, but are commonly caught in the commercial fishery between 3 and 8 years (Low et al. 1980). Some grow to 100 pounds and 40 inches. Juvenile sablefish are usually found inshore and to water depths of 500 feet; adults live in 500 to 4,000 feet of water.

Spawning generally occurs between December and April at depths between 820 and 2,300 feet on the continental slope west of St. George Basin (Thorsteinson and Thorsteinson 1983). There are migrational tendencies in sablefish populations with some migrations of 2,100 to 2,700 miles in 6 years recorded (Low et al. 1980).

2.3.1.9 Atka Mackerel

The Atka mackerel (Pleurogrammus monopterygius) occurs in the Bering Sea from the Aleutian Islands to Cape Navarin. It is a demersal marine fish, but is frequently encountered in upper water layers.

Little is known of the life history of Atka mackerel. They can grow to 18 to 19 inches and live in 13 to 400 feet of water (Miller and Lea 1972). Atka mackerel tend to migrate to shallower water for spawning during the summer and back to deeper water in the fall.

In the Bering Sea, Atka mackerel spawn from June to September in coastal areas with stony or rocky bottoms. The eggs are benthic and are deposited in large masses on stones or in cracks among rocks. The hatched larvae are found at depths of 6 to 100 feet and move to the surface at night. The larvae are widely dispersed for distances of up to 200-500 miles from shore.

2.3.2 Pelagic Fish

2.3.2.1 Herring

The Pacific herring (Clupea harengus pallasi) is a widely distributed species that exhibits strong schooling and migratory instincts. Herring spend about 8 months each year in the open sea far from coasts. Spawning runs commence in March to May, arriving at the Bering Sea coastal spawning area in late April to July depending on water temperatures. Adult herring remain in inshore waters and bays through the summer, then form large schools that migrate offshore to overwinter near the bottom in waters deeper than 330 feet northwest of the Pribilof Islands in the St. George and Navarin Basin areas and along the southern margin of the seasonal pack ice. The exact location of winter herring concentrations varies from year to year, depending on sea ice and water temperature conditions.

Larval herring hatch from adhesive eggs deposited on eelgrass and seaweeds in the coastal zone. The major spawning grounds are found in Bristol Bay (North Aleutian Shelf area) with smaller spawning populations in Security Cove, Goodnews Bay, Nelson Island, Kohchik Bay, Norton Sound (Norton Basin planning area). After drifting pelagically for 6 to 8 weeks, they metamorphose to juveniles. The juveniles form small schools and gradually move seaward toward the mouths of bays and inlets in which they were hatched. By early fall, individuals about 4 inches long form schools of perhaps 1 million or more fish. Most of the schools move into deeper or offshore waters by late fall. They stay at sea for about 2-1/2 years, then return to shallows to spawn for the first time.

Herring may reach reach a maximum age of about 15 years. They enter the commercial fishing at ages 3 or 4. Herring populations appear to be highly sensitive to environmental conditions and wide fluctuations in abundance are possible.

2.3.2.2 Capelin

Capelin (*Mallotus villosis*) are small (5 to 8 inches long), smelt-like fish with a circumpolar distribution. Little is known about Alaska's capelin resource but relatively large spawning populations are thought to exist in Bristol Bay (North Aleutian Shelf area) and Norton Sound (Norton Basin area). Capelin may vary greatly in their annual numbers and spawning habits. Intertidal beach spawning has been reported from April to May. Males are larger than females. Both males and females reach sexual maturity at ages 2 to 3. Nothing is known about capelin migration patterns in the Bering Sea (Pahlke 1981).

2.3.2.3 Pacific Salmon

Five species of Pacific salmon (*Oncorhynchus* spp.) are produced in the river systems tributary to the Bering Sea shelf. The sockeye salmon (*O. nerka*) is the most abundant species. Next is chum salmon (*O. keta*) and then, in order, pink salmon (*O. gorbuscha*), chinook salmon (*O. tshawytscha*), and coho salmon (*O. kisutch*). Generally, salmon are transitory in the Bering Sea while travelling as adults from the north Pacific to spawning areas in the rivers of Alaska and Siberia or as juveniles moving from streams to feeding grounds in the north Pacific. However, some chinook salmon may spend some or all of their sea life within the Bering Sea since this species is frequently taken in groundfish trawls along the continental slope.

All species of Pacific salmon have similar life histories but they differ in fecundity, food habits, growth rate, migration patterns, freshwater and ocean age, age and size at maturity, and time and location of spawning (Table 2-4). From early summer to early fall, salmon return from the sea to spawn in the rivers and streams from which they originated. When they enter fresh water, they cease feeding and derive their nourishment from body stores. All Pacific salmon die after spawning.

The fry of some species of salmon proceed immediately to sea; fry of other species reside in fresh water for a few weeks or for one or more

TABLE 2-4

LIFE HISTORY OF THE FIVE SPECIES OF PACIFIC SALMON IN ALASKA - EXCEPTIONS ARE FREQUENT

Species of Salmon	Freshwater habitat	Time spent in fresh water after emergence from gravel	Estimated average juvenile weight at time of seaward migration[g]	Time spent at sea (yr)	Age at spawning (yr)	Average adult weight[f] (kg)	Average number eggs per female (thousands)
Sockeye	short streams and lakes	12-36 months	8.7[a]	1-4	3-6	2.27	3.5
Chum	short streams and lakes	1 month	0.37[b]	2-4	3-5	2.96	3.0
Pink	short streams	1 day, usually	0.26[c]	1	2	2.00[g]	2.0
Chinook	large rivers	3-12+ months	4.3[d]	1-6	3-6	7.26	4.0
Coho	short streams and lakes	12-14 months	29.0[e]	1-3	3-4	3.04	3.5

[a] Average for age 1.0 and 2.0 Bristol Bay sockeye salmon (National Marine Fisheries Service Auke Bay Laboratory 1979, unpublished data).

[b] Hooknose Creek, British Columbia (from Table 5 of Bams 1970).

[c] Southeastern Alaska pink salmon (Bailey and Pella 1976).

[d] Yukon River (Salcha River) chinook salmon (Trasky 1974).

[e] Karluk Lake (Kodiak Island) coho salmon (Drucker 1972).

[f] Mean weight for Alaska Peninsula (north side), Bristol Bay, and Yukon River stocks combined. Source: INPFC Statistical Yearbook (1961).

[g] Mean for Alaska Peninsula (north side) and Bristol Bay only.

Sources: Adapted in part from Bailey 1969, Merrell 1970, and Hartman 1971.

years. They migrate seaward across the shelf to the open ocean regions of the central and western Bering Sea and north Pacific Ocean, where they spend most of their marine life. Depending upon the species, salmon usually spend from a few months to several years at sea (see Table 2-4).

When salmon are distributed throughout the vast area of the Bering Sea and north Pacific Ocean (French et al. 1976), they undergo rapid growth and attain sexual maturity. This period of ocean life may last from a few months to several years depending on the species of salmon and ocean growing conditions. More than one generation of sockeye, chum, chinook, and coho salmon are present on the shelf during ocean life. Immature and maturing salmon of different races and ocean ages and from different continents or geographic areas may, depending on the season, become segregated from or intermix with one another (Royce et al. 1968). Immature chinook salmon apparently are abundant in the central Bering Sea near the edge of the continental shelf in June and July (Major et al. 1978). Immature chum salmon have been captured in research gillnets in July in the western Bering Sea shelf and in the slope area near Cape Navarin and the Gulf of Anadyr (Nishiyama et al. 1968). A few immature chum and sockeye salmon have also been taken during research fishing on the Bering Sea shelf as far north as 62°N in late July (Yonemori 1967).

The distribution and direction of migration and relative abundance of all five species of Pacific salmon on the Bering Sea shelf are depicted in Figures 2-3 to 2-7. All five species pass in large numbers through the St. George Basin and North Aleutian Shelf areas on their way to Bristol Bay. The Navarin Basin is somewhat less used. All salmon entering Norton Sound pass through the Norton Basin area. These figures were prepared by the NMFS in Auke Bay by plotting the locations of capture of each species on a chart of the Bering Sea shelf for all years for which data are available. For sockeye, chum, and pink salmon, certain areas of the shelf consistently yielded larger catches or larger CPUE values than other areas. For chinook and coho salmon, similar data were available only for Bristol Bay, where these species have been captured most frequently. Direction of migration of each species was derived from the published results of tagging experiments

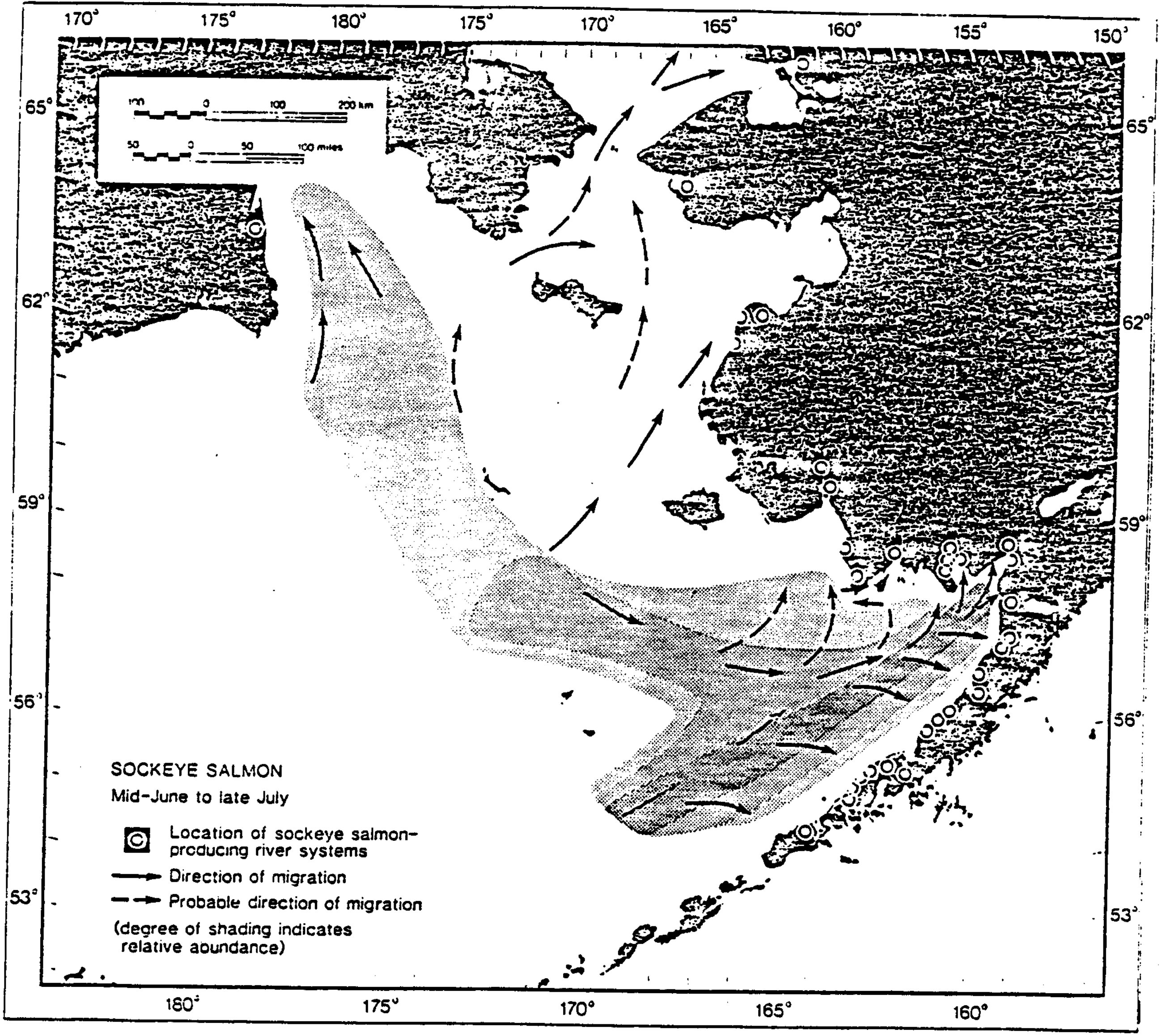


Figure 2 - 3

DISTRIBUTION OF SOCKEYE SALMON
DURING SPAWNING MIGRATION, MID-JUNE TO LATE JULY

Source: NMFS, 1982

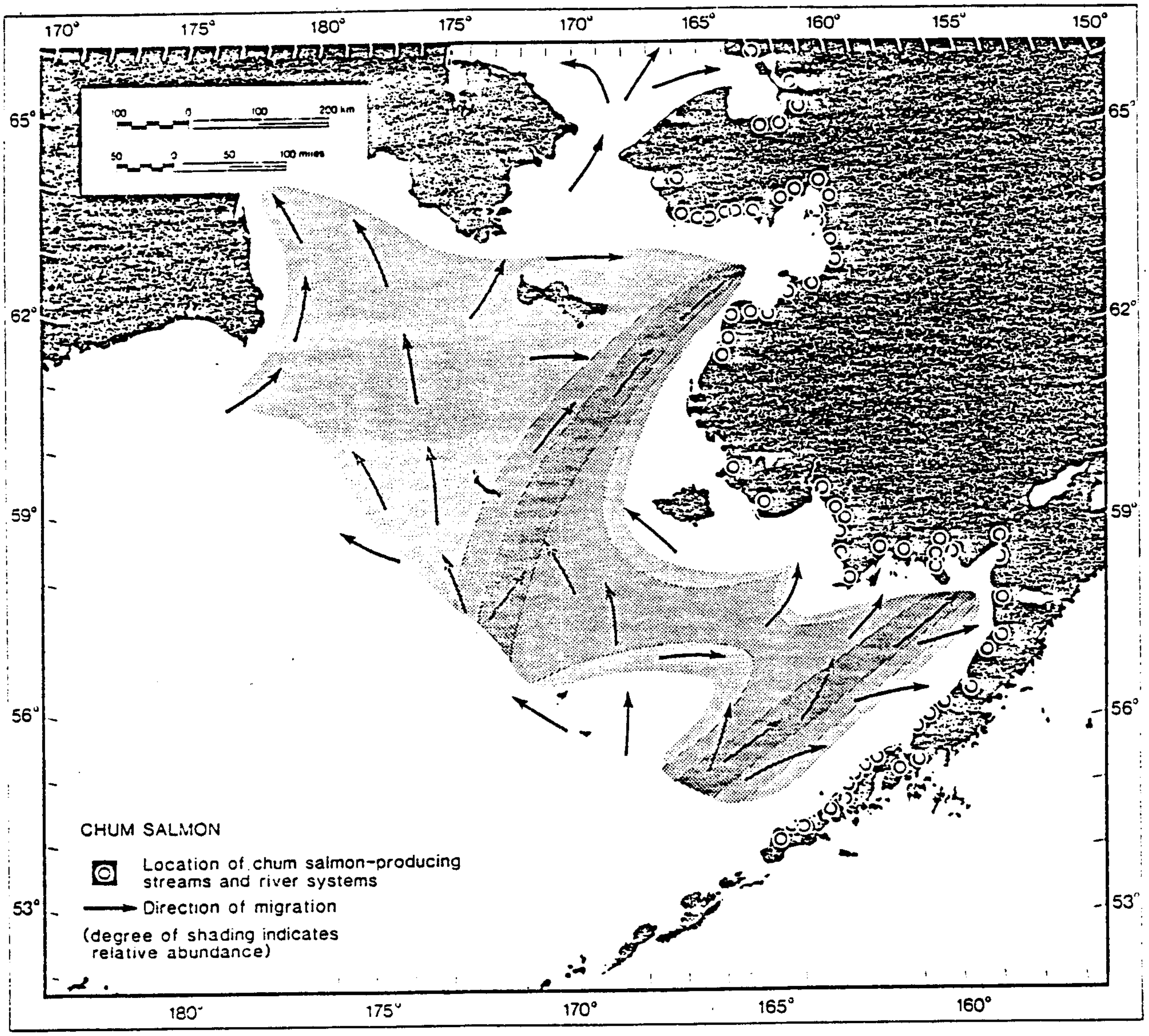


Figure 2 - 4

DISTRIBUTION OF CHUM SALMON
DURING SPAWNING MIGRATION, MID-JUNE TO EARLY AUGUST

Source: NMFS, 1982

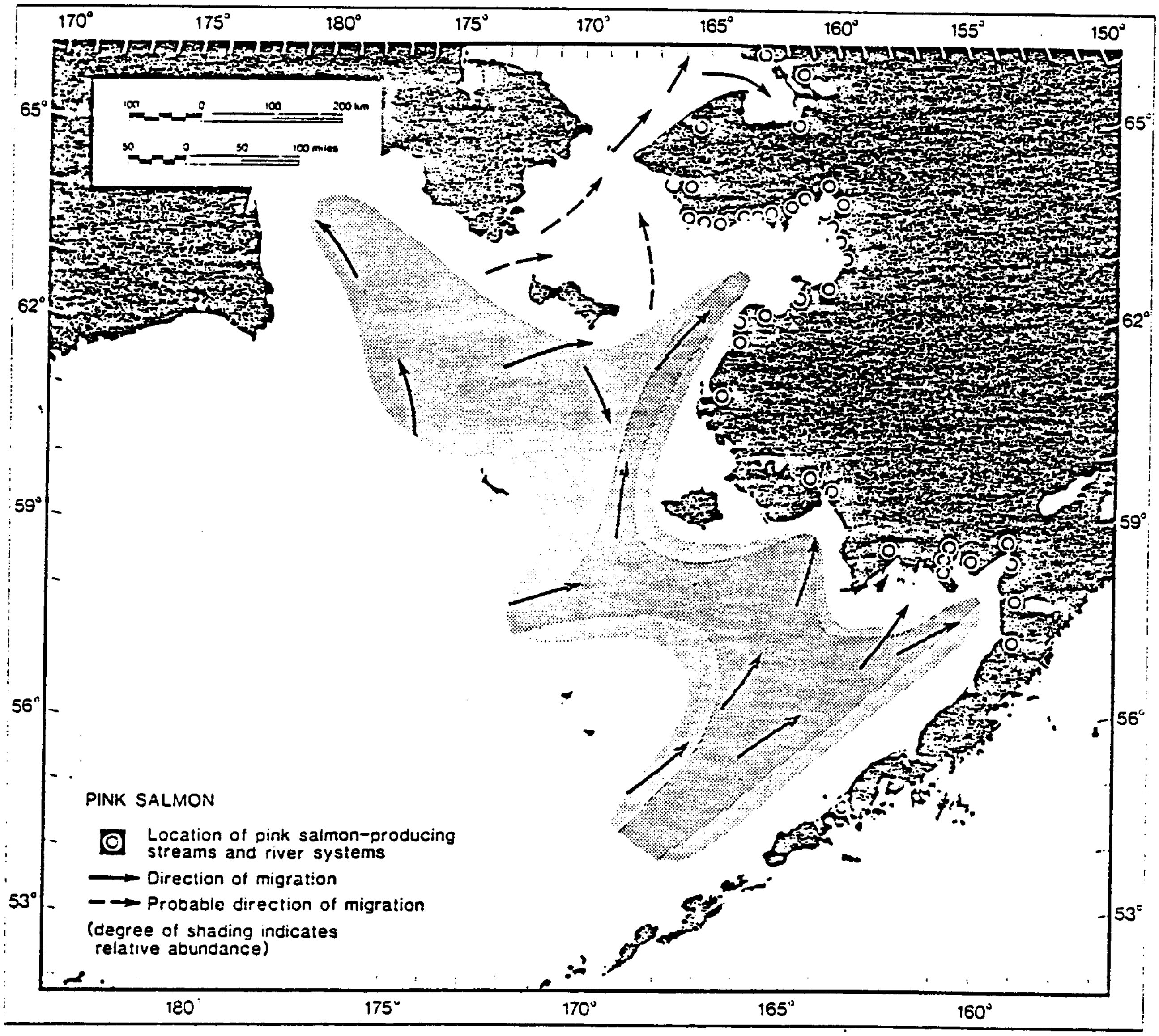


Figure 2 - 5

DISTRIBUTION OF PINK SALMON
DURING SPAWNING MIGRATION, MID-JUNE TO MID-AUGUST

Source: NMFS, 1982

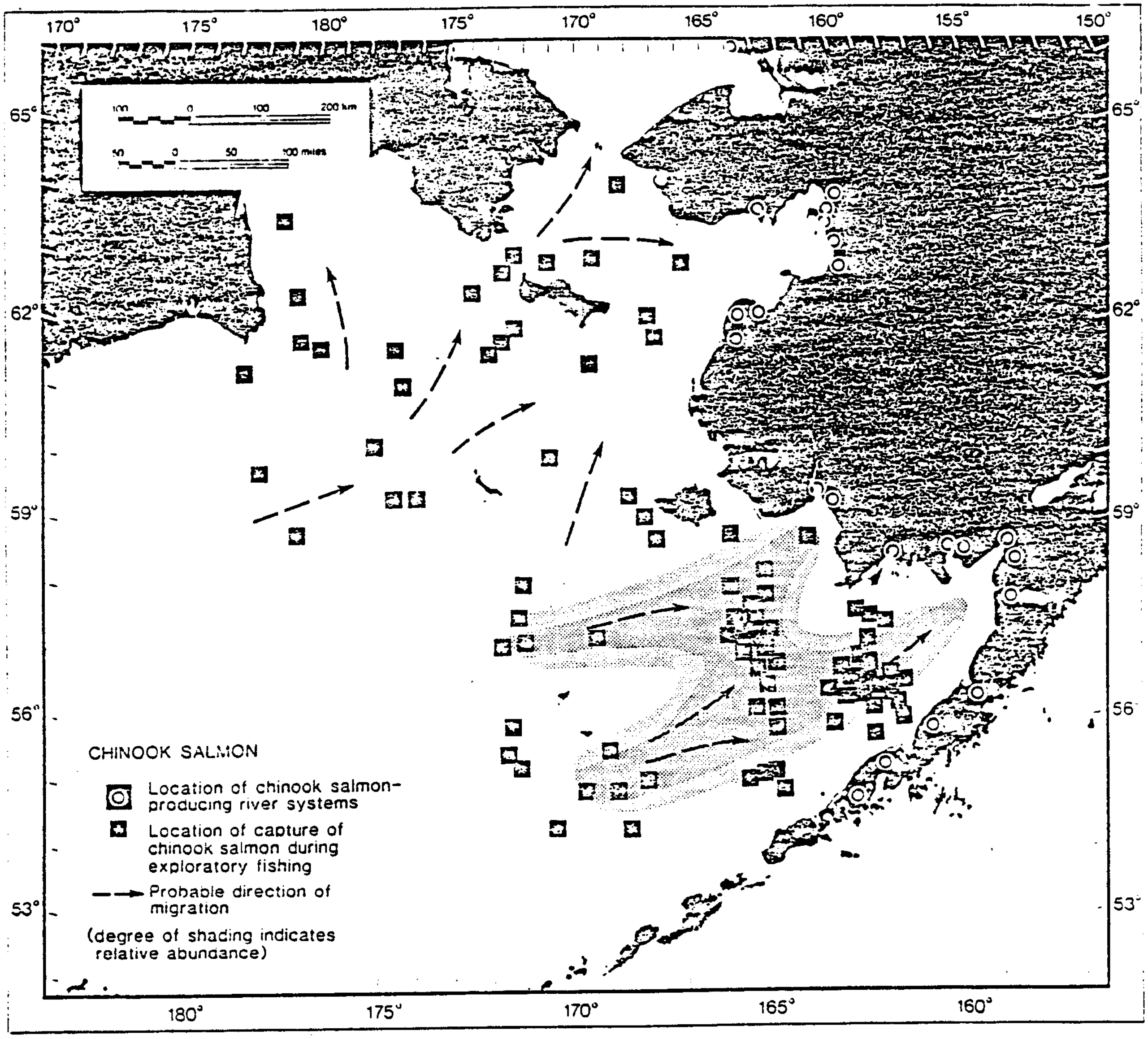


Figure 2 - 6

DISTRIBUTION OF CHINOOK SALMON
DURING SPAWNING MIGRATION, EARLY JUNE TO MID-JULY

Source: NMFS, 1982

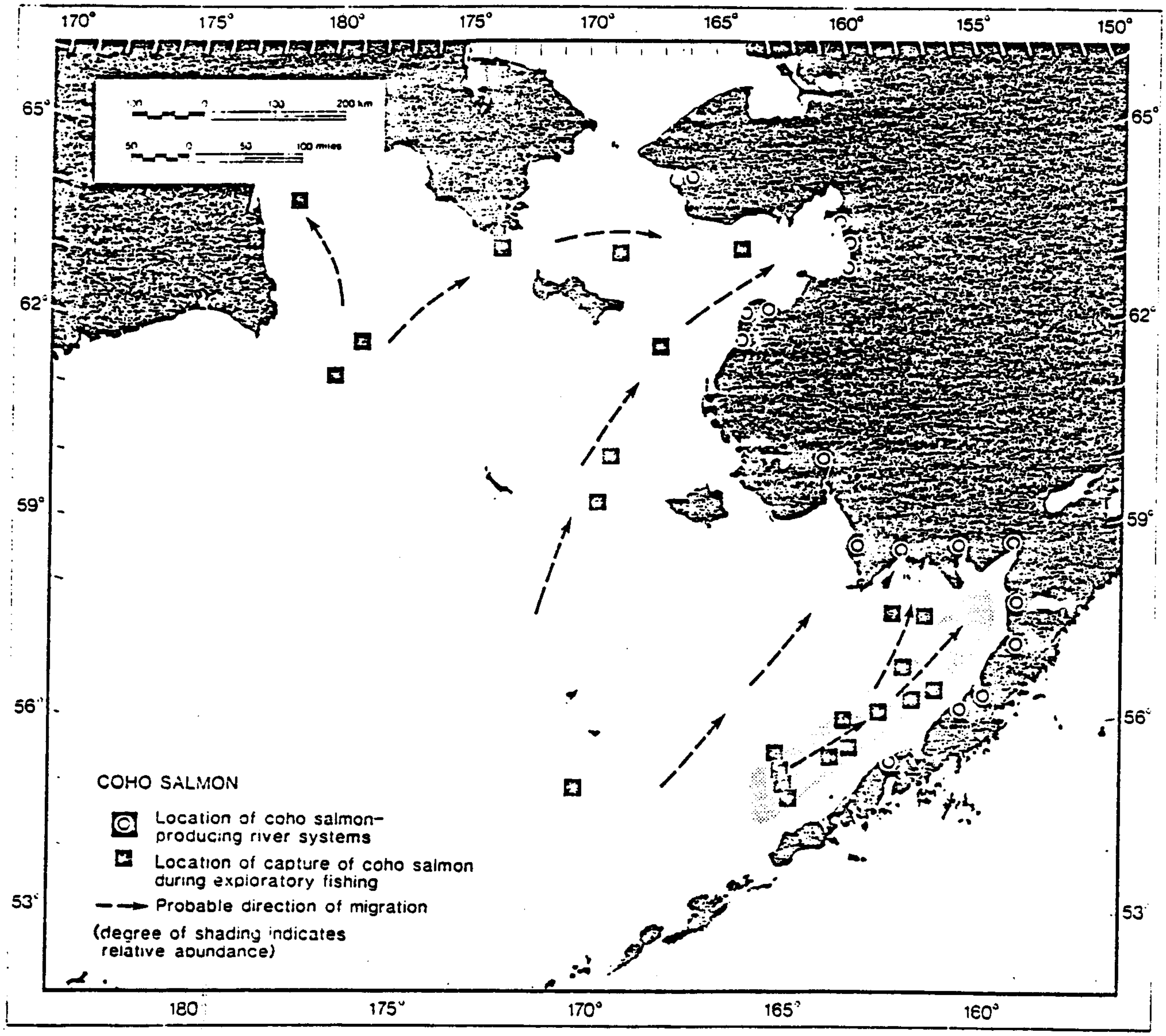


Figure 2 - 7

DISTRIBUTION OF COHO SALMON
DURING SPAWNING MIGRATION, EARLY JULY TO EARLY SEPTEMBER

Source: NMFS, 1982

and direction-of-movement studies. The probable direction of migration was based on the geographic location or proximity of the home river system of the species and the verified direction of movement of other salmon species captured in the same area. For example, maturing sockeye and chum salmon appear to migrate eastward north, and maturing chum and pink salmon south, of St. Lawrence Island (Yonemori 1967) (see Figures 2-4 and 2-5). Major spawning streams of chum and pink salmon are northwest of St. Lawrence Island in Kotzebue Sound and east of St. Lawrence Island in Norton Sound. Spawning streams of chinook and coho salmon are also to the east and northwest of St. Lawrence Island.

The timing of the seaward migration of juvenile Pacific salmon across the shelf is similar to that of the adult spawning migration (i.e., juvenile salmon are most abundant on the shelf between early to mid-May and late September). Although both juvenile and adult salmon are present on the shelf at the same time, their distributions and migration routes are quite different. Adult salmon appear to remain in the offshore waters of the shelf until they are near the coastal area of the estuary of their home river or stream. Juvenile sockeye, chum, pink, and coho salmon, however, appear to move along the coast during the initial 2 months or so of seaward migration (Figure 2-8).

2.3.3 Shellfish

2.3.3.1 King Crab

There are three commercially important species of king crab in Alaska waters. The species commonly referred to as king crab is red crab (*Paralithodes camschatica*). The other two commercial species are the blue king crab (*P. platypus*) and the brown or golden king crab (*Lithodes aequispina*).

King crabs are not true crabs, but are more closely related to hermit crabs. Members of the genera *Paralithodes* and *Lithodes* are noted for their large size at maturity, spinate bodies, and only three pairs of walking legs.

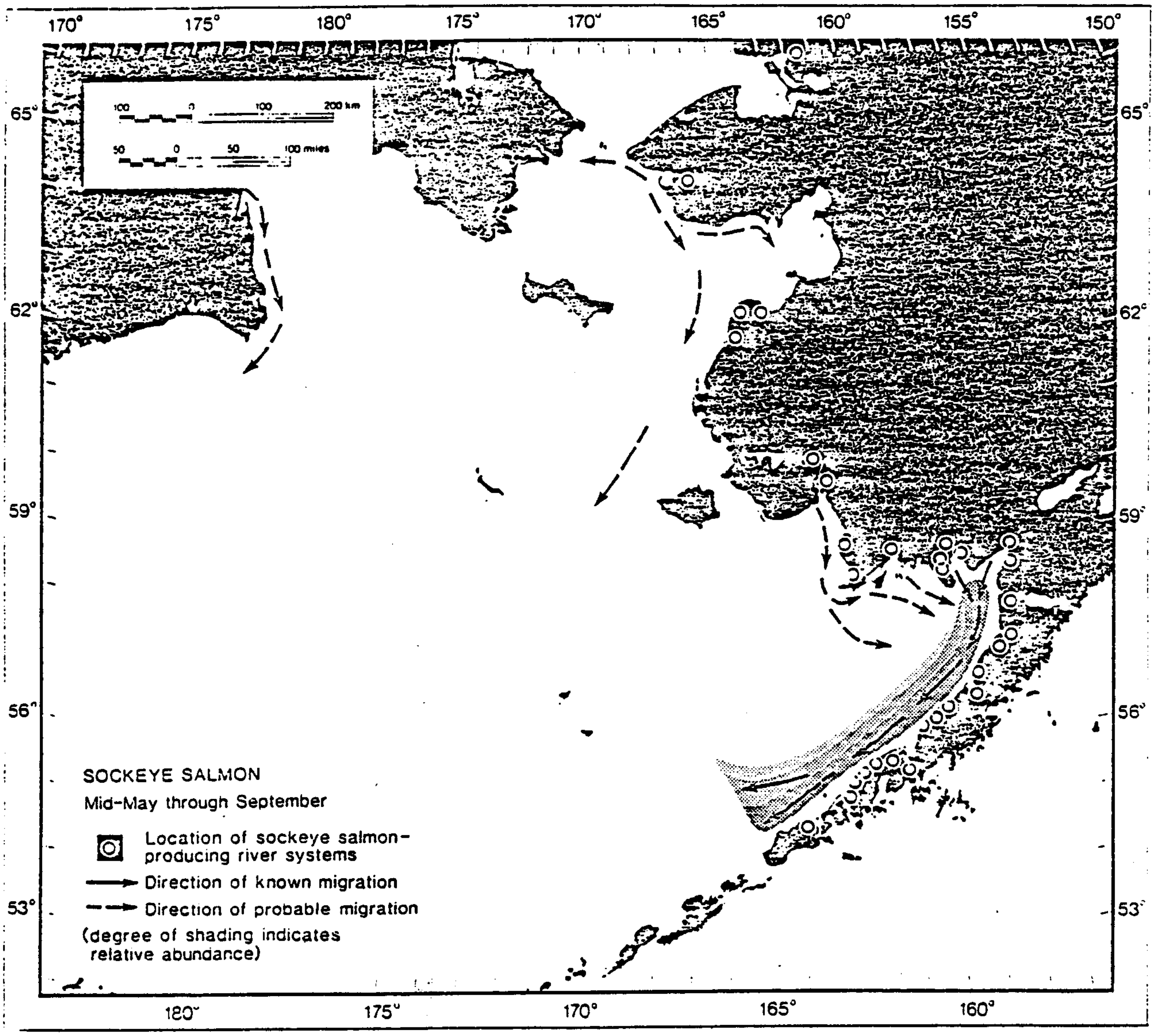


Figure 2 - 8

DISTRIBUTION OF SOCKEY SALMON
DURING SEAWARD MIGRATION, MID-MAY THROUGH SEPTEMBER

Source: NMFS, 1982

Sexual dimorphism in adult king crab of the same age is extreme with males being much larger than females. Only the large male crabs are currently of economic importance.

King crab like all crustaceans have rigid exoskeletons and must molt to increase in size. Growth in length occurs immediately after molting and before the new exoskeleton hardens.

The king crab is relatively long-lived, and individuals of age 15 and as large as 24 pounds have been taken in the fishery. Most commercially caught males in the southeastern Bering Sea are 8 or 9 years old and average about 7 pounds. King crab in Norton Sound are about 30 percent smaller. Juvenile king crabs are heavily preyed upon by fish and large invertebrates.

Red king crab are the most abundant species and inhabit the continental shelf areas. In the southern Bering Sea, the area of maximum abundance extends up to 100 miles offshore between Unimak Pass and Port Heiden in the North Aleutian Shelf area. In Norton Sound they are concentrated between 163°W and 167°W (Wolotira et al. 1977). The blue king crab is second in abundance with major centers of abundance near the Pribilof Islands (St. George Basin), St. Matthew Island, and St. Lawrence Island (Norton Basin). The golden king crab is found in the deeper slope waters (to 3,000 feet) of the Bering Sea.

The annual life cycle of the red king crab is characterized by a spring mating and spawning migration to shallow water and a summer and fall feeding migration to deep water. King crabs reach sexual maturity at 4 to 6 years of age. Females molt on the breeding grounds near the Amak Island-Black Hills-Port Moeller area (North Aleutian Shelf area) between February and May, and mate shortly after molting. Peak larval hatching and abundance occur from early May through mid July. Shallow coastal areas are primary settling areas for juvenile crabs (Curl and Manen 1982).

Litle is known about the biology of the blue king crab but is assumed to be similar to that of the red king crab. However, recent data show there may be significant differences (Curl and Manen 1982).

Even less is known about brown king crab biology. Males are thought to reach a maximum carapace length of 10 inches. Females reach sexual maturity at about 5 to 6 inches and are thought to spawn between July and October (McBride et al. 1982).

2.3.3.2 Tanner Crab

The Tanner, or snow crab, is found mainly in water less than 1,500 feet from southeast Alaska to the Aleutians, into the Bering Sea and north past the Bering Straits. Two species of Tanner crab (Chionoecetes bairdi and C. opilio) and a hybrid of these species are widely distributed and abundant along the central and outer continental shelf of the Bering Sea. Although the two species occur together over most of their geographic ranges, a separation is found between each species' areas of highest abundance. C. bairdi are found in deeper, warmer water than C. opilio. Hence, C. bairdi are most numerous in the southern Bering Sea (St. George Basin and North Aleutian Shelf) and C. opilio are more numerous in the north (Navarin and Norton Basins). The highest average abundance of adult Tanner crabs is to the south and north of the Pribilofs with main concentations found in waters of 160 to 560 feet. Populations in Norton Sound are mainly composed of juveniles (Wolotira et al., 1977).

Tanner crab range in carapace widths to 7 inches for C. bairdi and to 6 inches for C. opilio. They live to an estimated maximum age of 14 years. Males of commercial size usually range from 7 to 11 years old and from 2 to 4 pounds in weight. Sexual maturity is reached at age 5 or 6.

Migration patterns are not well understood. The sexes are separate during much of the year until they move to their breeding grounds. Eggs number from 85,000 to over 400,000, and are brooded for nearly a year. Hatching occurs late the following winter and spring. The hatched larvae are planktonic for 2 to 3 months, depending on water temperatures, during which time they undergo numerous molts. Juveniles settle to the bottom to feed and grow. Tanner crabs feed on dead and decaying molluscs, crustaceans, and other organisms accumulating on the ocean floor.

2.3.3.3 Korean Hair Crab

The Korean hair crab (Erimacrus isenbeckii) is found throughout the Aleutian Islands and as far north as St. Matthew Island; the largest concentrations are found in the shallow waters along the northern shore of the Alaska Peninsula and around the Pribilof Islands (North Aleutian Shelf and St. George Basin areas).

Little is known about their biology although females are thought to reach sexual maturity at age 2 and males at age 4. Males may reach 4 to 6 inches in length, females may reach 4 inches (Curl and Maven, 1982).

2.3.3.4 Squid

There is little information available on distribution, abundance, and biology of squid stocks in the eastern Bering Sea. Several species of squid inhabit the Bering Sea waters. The exact nature and size of this resuorce is ill-defined, but it is generally agreed to be large. Illex vulgaris, a common Bering Sea squid, is a typical catch species, ranging in mantle size from 9 to 14 inches in length.

2.3.3.5 Shrimp

Three principal species of pandalid shrimp are found in the Bering Sea, the sidestripe shrimp (Pandalopsis dispar), the pink shrimp (Pandalus borealis), and the humpy shrimp (Pandalus goniurus). These species are of greatest abundance along the central outer shelf and slopes of the central Bering Sea area. The species of primary commercial interest in the Bering Sea is the pink shrimp.

These species are bottom dwellers, preferring relatively smooth sand and mud bottoms. Pink shrimp are small (average body length of from 3 to 5 inches) and are the so-called cocktail shrimp.

According to NMFS surveys, pink shrimp are found to the northwest of the Pribilofs, around Unalaska Island, and in Bristol Bay. Their distributional patterns appear to reflect their temperature requirements.

Shrimp populations are now at low levels. The stocks were overfished in the early 1960s. Despite the lack of fishing pressure since that time, the stocks have not recovered. It is possible that heavy predation by walleye pollock and Pacific cod may contribute to this continued depression.

2.3.3.6 Snails

Large marine snails, some reaching 6 inches in shell length, are abundant in the waters of the central Bering Sea. The most common large snails are members of the genera Neptunea and Buccinum, but others such as Fusitriton, Volutopsius, Beringius, and Plicifusus are also well represented. NMFS surveys conducted in the summer and fall of 1975 assessed the snail resource of the Bering Sea shelf. Fifteen species of large marine snails were found to inhabit the continental shelf and shelf edge of the Bering Sea. All can be found in the Navarin Basin area (MacIntosh 1980).

Each snail species inhabits specific depth and temperature regions. Of the more abundant Neptunea, N. pribiloffensis and N. layrata inhabit the warmer, deeper waters near the shelf edge, while N. heros and N. ventricosa inhabit shallower, seasonally cooler waters nearer the coast.

Among the large Neptunea, sexual maturity occurs at a shell length of 3.5 to 3.9 inches, or possibly at about age 10. Egg clusters are laid on both living and dead shells of other large snails as available, and without regard to species. Crawling young hatch directly from egg capsules, lacking a pelagic stage.

The most common marine snail in Japanese catches made northwest of the Pribilofs in 1973 was N. pribiloffensis, which composed 70 percent of the catch by weight. Buccinum angulossum and B. scalariforme accounted for an additional 23 percent.

Very little is known about the feeding habits of these gastopods. All are carnivorous, and most are thought to be facultative predators and scavengers feeding on other benthic invertebrates.

2.4 REGULATORY REGIME

The fishing industry is controlled by myriad regulations, laws and treaties that govern fisheries conservation and management, food processing, trade and commerce, waste discharge, and safety and health.

Since statehood (1959), the State of Alaska, through the Board of Fisheries, had managed all of the domestic commercial fisheries onshore and offshore, while the federal government had been responsible for all foreign fishing. Passage of the (Magnuson) Fishery Conservation and Management Act of 1976 (MFCMA, i.e. the 200-mile legislation) had several milestone effects on the fisheries of Alaska. Most important in terms of the regulatory process was the requirement that all domestic fisheries outside 3 miles be federally managed by a fishery management plan. The State of Alaska continues to manage all fisheries within state waters.

The fisheries of the BSAI outside the U.S. Fishery Conservation Zone (beyond the 200-mile limit) but east of the U.S.-Russia Convention Line of 1867 are managed internationally.

Table 2-5 summarizes the regulatory regime for commercial fisheries in the BSAI region.

2.4.1 State of Alaska

The State of Alaska has jurisdiction over, and regulates and mandates all fisheries resources within 3 miles of shore. The State carries out its responsibilities through a regulatory board, the Alaska Board of Fisheries. The Alaska Division of Commercial Fisheries within the Department of Fish and Game is the management agency that develops the information base for management decisions and carries out the State's day-to-day management activities.

TABLE 2-5

FISHERIES REGULATORY REGIME IN THE BERING SEA/ALEUTIAN ISLANDS

SPECIES	WITHIN STATE WATERS	WITHIN FCZ(1)	OUTSIDE FCZ(6)
Groundfish			
Walleye pollock	ADF&G	USA(2)	(No Fishery)
Pacific cod	ADF&G	USA(2)	(No Fishery)
Flounders (other)	ADF&G	USA(2)	(No Fishery)
Yellowfin sole	ADF&G	USA(2)	(No Fishery)
Turbot	ADF&G	USA(2)	(No Fishery)
Pacific halibut	ADF&G	IPHC(3)	(No Fishery)
Pacific Ocean perch	ADF&G	USA(2)	(No Fishery)
Rockfish (other)			
Sablefish	ADF&G	USA(2)	(No Fishery)
Atka mackerel	ADF&G	USA(2)	(No Fishery)
Other groundfish species	ADF&G	USA(2)	(No Fishery)
Pelagic Fish			
Salmon	ADF&G	USA(2)	INPFC(4)
Herring	ADF&G	USA (pending)(5)	(No Fishery)
Shellfish			
Tanner crab	ADF&G	USA(2)	(No Fishery)
King crab	ADF&G	USA (pending)(5)	(No Fishery)
Squid	No Fishery	USA(2)	(No Fishery)
Snails	No Fishery	USA(2)	(No Fishery)
Shrimp	ADF&G	USA(2)	(No Fishery)

---

(1) FCZ = U.S. Fishery Conservation Zone, 3-200 miles offshore.
(2) Regulated by the USA under a fishery management plan of the North Pacific Fisheries Management Council.
(3) IPHC = International Pacific Halibut Council.
(4) INPFC = International North Pacific Fisheries Commission.
(5) Regulated by the USA under a preliminary management plan of the Secretary of Commerce.
(6) Most species (benthic and demersal) do not exist in fishable concentrations in this area because of unsuitable depths and conditions. Only salmon are fished in this area now, by the Japanese mothership fishery.

The Board of Fisheries acts upon proposed regulations submitted to it either by ADFG or members of the general public after hearing testimony from all interested parties.

2.4.2 Fisheries Conservation Zone

Domestic regulations outside the territorial waters of the State are controlled by Public Law 94-165 (as amended) (The [Magnuson] Fishery Conservation and Management Act of 1976), Federal Executive Order 12291, and Office of Management and Budget review.

The law (P.L. 94-165) requires all fisheries (foreign and domestic) from 3 to 200 miles offshore to be managed by a federal fishery management plan. It further mandates "consistency" between any domestic management plan for fisheries from 0 to 3 miles offshore and for the same stocks and fisheries 3 to 200 miles offshore.

The area between 3 and 200 miles offshore is called the Fishery Conservation Zone. In this zone the U.S. has the responsibility to regulate all fishing (foreign and domestic) for conservation, economics and social reasons.

Development of a fishery management plan begins with a team of State and federal biologists who prepare a draft management plan for a particular fishery, fish stock or group of fisheries for a particular area. The North Pacific Fishery Management Council reviews the draft plan and adopts it. A Draft Environmental Impact Statement (DEIS) is prepared and the DEIS and the draft plan are submitted to the Secretary of Commerce for a 45-day review. If the DEIS is approved, the draft fishery managment plan is submitted for a 60-day review by the Secretary of Commerce for consistency with the national standards.

A Final Environmental Impact Statement is published and, after public comments on the draft plan have been received, proposed regulations are drafted and submitted first to the Office of Management and Budget (OMB) for approval (60 days) and then published in the Federal Register for 45 days. If there are no serious objections to the proposed regulations (which implement the fishery management plan), they are resubmitted to OMB for another 30-day review period and are subsequently published as final regulations after another 30-day publication review.

Amendments to the plan are handled annually. A significant amendment can require almost all of the review processes that encumber the development plan.

The federal government has a responsibility to develop, implement, monitor and enforce the provisions of the fishery management plans in the Fishery Conservation Zone off Alaska.

2.4.3 International

2.4.3.1 Halibut

Halibut fisheries, both within and outside the Fishery Conservation Zone (FCZ), are regulated by the International Pacific Halibut Commission (IPHC). The activities of the IPHC in the non-FCZ portion of the BSAI are limited because of the scarcity of halibut in this area. The United States and Canada signed the Pacific Halibut Fishery Convention on 9 May 1930. The IPHC (originally the International Fisheries Commission) has been and is the implementing agency of this convention between the U.S. and Canada. The goal of IPHC, defined in articles of the Convention, is the preservation of the halibut fishery of the northern Pacific Ocean and Bering Sea. Each country (U.S. and Canada) provides one-half of the IPHC appropriation.

2.4.3.2 Other Species

Salmon is the only species now fished in the deepwater, non-FCZ portion of the BSAI. Salmon are caught by the Japanese mothership fleet. All fisheries in this region are managed by the International North Pacific Fisheries Commission (INPFC).

The Commission was established in 1953 by the International Convention for the High Seas Fisheries of the North Pacific Ocean consisting of Japan, Canada, and USA. Its original purpose was to ensure that the fishery resources of the Convention area were maintained at the level of maximum sustainable productivity. This was expanded in 1978 to direct INPFC to:

"(a) provide for scientific studies and for coordinating the collection, exchange and analysis of scientific data regarding anadromous species, including data regarding the continent of origin of these species, and provide a forum for cooperation among the Contracting Parties with respect to these species; and

(b) pending the establishment of an international organization with broader membership dealing with species other than anadromous species, provide a forum for cooperation among the Contracting Parties with respect to the study, analysis and exchange of scientific information and views relating to the stocks of non-anadromous species of the Convention area, including information and views relating to all relevant factors affecting these stocks, and promotion of scientific research designed to fill gaps in knowledge and the compilation and dissemination of statistics and records." (INPFC 1979).

2.5 MARKET CONDITIONS

This section presents summary information on the principal markets for fish and shellfish currently harvested or projected to be harvested by U.S. fishermen in the BSAI. A summary of the principal product forms produced by primary processors in Alaska, the major distribution centers and the most important final markets is presented in Table 2-6.

2.5.1 U.S. Fish Consumption

U.S. per capita consumption of fish products increased 17.7 percent over the 20-year period from 1961 to 1981, with per capita consumption remaining

TABLE 2-6

PROJECTED PRINCIPAL PRODUCT FORMS, PRIMARY PROCESSING LOCATIONS, AND MAJOR MARKETS FOR FINFISH AND SHELLFISH SPECIES PROJECTED TO BE HARVESTED BY DOMESTIC FISHERMEN IN THE BERING SEA AND ALEUTIAN ISLANDS AREA BY 2007

SPECIES	PRINCIPAL PRODUCT FORMS	PRIMARY PROCESSING LOCATIONS/ARRANGEMENTS	MAJOR MARKETS
Salmon	FRESH FROZEN CANNED CURED ROE	ONSHORE Floaters	UNITED STATES JAPAN Europe
Pollock	BLOCKS & SURIMI(1) Frozen H&G(2) Fillets	AT SEA (Joint Ventures)	UNITED STATES Japan Europe
Pacific Cod	BLOCKS Fillets & steaks Salted	AT SEA (Domestic) Aleutian/Pribilof Ports(3)	UNITED STATES Europe
Yellowfin Sole	BLOCKS	AT SEA (Joint Ventures)	SOVIET UNION United States
Pacific Halibut	FILLETS & STEAKS	ALEUTIAN/PRIBILOF PORTS	UNITED STATES
Other Flounders	FILLETS Blocks	AT SEA (Domestic & Joint Venture) Aleutian/Pribilof Ports	UNITED STATES
Pacific Ocean Perch/ Other Rockfish	FROZEN H&G Frozen Round	AT SEA (Domestic & Joint Venture) Aleutian/Pribilof Ports	UNITED STATES Japan
Sablefish	FILLETS & STEAKS Cured	AT SEA (Domestic) Aleutian/Pribilof Ports	UNITED STATES Japan
Atka Mackerel	FROZEN ROUND	AT SEA Aleutian/Pribilof Ports	SOVIET UNION
Herring	FROZEN H&G Fillets Cured	AT SEA (Domestic) Aleutian/Pribilof Ports	UNITED STATES Japan Europe
Capelin	FROZEN FEMALES Industrial Fish	AT SEA (Domestic) Onshore	JAPAN
Squid	BLOCKS	AT SEA	JAPAN
Blue King Crab	FROZEN SECTIONS	AT SEA Aleutian/Pribilof Ports	UNITED STATES Japan
Red King Crab	FROZEN SECTIONS	AT SEA ALEUTIAN/PRIBILOF PORTS	UNITED STATES
Brown King Crab	FROZEN SECTIONS & MEAT	AT SEA Aleutian/Pribilof Ports	UNITED STATES
Tanner Crab	FROZEN SECTIONS	AT SEA Aleutian/Pribilof Ports	UNITED STATES Japan
Snails	MEAT	AT SEA	JAPAN
Shrimp	MEAT	ONSHORE	UNITED STATES

---

[1] Capital letters indicate major category

[2] Frozen H&G = frozen headed and gutted

[3] The Aleutian/Pribilof ports projected as receiving Navarin Basin fish include Dutch Harbor, Akutan, Chernofski, St. Paul and St. George

near level during the last 4 years (Table 2-7). The increases have primarily been caused by increases in fresh and frozen fish consumption. Total consumption has increased 34.5 percent over that same period. The reduced rate of per capita consumption may be linked to reduced real per capita income. Future growth in the domestic consumption of fish products will, in part, be dependent upon the general health of the U.S. economy (Combs 1981).

2.5.2 Markets

Detailed discussions of whitefish markets are found in recent reports by Natural Resource Consultants (1981) and Earl R. Combs, Inc. (1978). Only a brief summary, largely based on the above mentioned reports, is presented here.

The market for frozen whitefish is a worldwide, international market with nearly half the world catch entering international trade. The centers of the world whitefish trade, from a marketing perspective, are the United States, western Europe, and Japan. Production is centered in the northeast and northwest Atlantic, the northeast and northwest Pacific, and to a much lesser extent, the central east Atlantic and southwest Atlantic. The extension of 200-mile fishing zones worldwide significantly changed the world marketing pattern for whitefish and the potential for change is greater yet. At present the U.S. produces only a minor fraction of the total world catch of whitefish, and is by far the largest importer of whitefish.

Prices for whitefish are determined in a world market and are largely independent of actions taken by the American fishing industry. The growth of U.S. harvesting and processing of whitefish depends largely on expansion of markets in three possible areas:

1) the U.S. market (through import substitution and/or the capture of a major part of future growth);

2) increased exports to Japan and other Asian countries; and

TABLE 2-7

U.S. PER CAPITA AND TOTAL CONSUMPTION OF COMMERCIAL FISH AND SHELLFISH, 1961 TO 1981

Year	Per Capita Consumption (Pounds)	Total U.S. Consumption (million pounds)
1961	10.7	1,937.8
1962	10.6	1,947.2
1963	10.7	1,995.6
1964	10.5	1,985.6
1965	10.8	2,069.3
1966	10.9	2,108.1
1967	10.6	2,070.1
1968	11.0	2,168.1
1969	11.2	2,229.9
1970	11.8	2,382.4
1971	11.5	2,356.4
1972	12.5	2,593.8
1973	12.8	2,682.9
1974	12.1	2,560.4
1975	12.2	2,608.4
1976	12.9	2,785.1
1977	12.7	2,769.9
1978	13.4	2,954.7
1979	13.0	2,899.0
1980	12.8	2,887.7
1981	13.0	2,960.1

Source: NMFS 1982.

3) increased exports to the European Economic Community.

Until such markets are expanded, U.S. participation in the Bering Sea whitefish industry can be expected to continue as U.S. harvester/foreign processor joint ventures. For a detailed discussion of whitefish joint ventures, see Natural Resource Consultants (1982).

In contrast to the worldwide market for Bering Sea whitefish, the markets for salmon and shellfish are relatively more domestically oriented. Salmon, shrimp, crab, herring and halibut are the traditional Alaska species sold in the domestic U.S. market. Nevertheless, there is an increasingly strong international component in the traditional market structure, influenced, in part, by exports of Alaska seafood to Europe and Asia, and imports of foreign seafood (e.g., aquacultured Norwegian salmon).

2.5.2.1 The U.S. Market

The species groups traditionally sold on the domestic market are: salmon, crab, shrimp, halibut and herring. Unlike whitefish (discussed later in this section) these traditional species are marketed in a variety of forms throughout the U.S.: fresh, frozen (whole, steak, fillet), and canned. Furthermore, these domestic processing and marketing industries are relatively firmly established, as compared to the developing BSAI whitefish industry. Most of the product is transshipped through Seattle.

Five species groups -- cod, flatfish, haddock, perch and pollock -- account for the majority of U.S. whitefish sales. The U.S. supply of whitefish has increased steadily over the last decade. Over half the whitefish supply is comprised of imported blocks (which are further processed into fish sticks and portions). The per capita consumption of these products has grown dramatically over the last 20 years (Table 2-8), with fast food chains being the largest growing user group. The growth of this market has leveled off during the last few years. The marketing channels for these products are shown in Figure 2-9. Foreign governments, foreign processing firms and seafood brokers supply most of the blocks to U.S. firms. Four large processing firms, all located on the east coast,

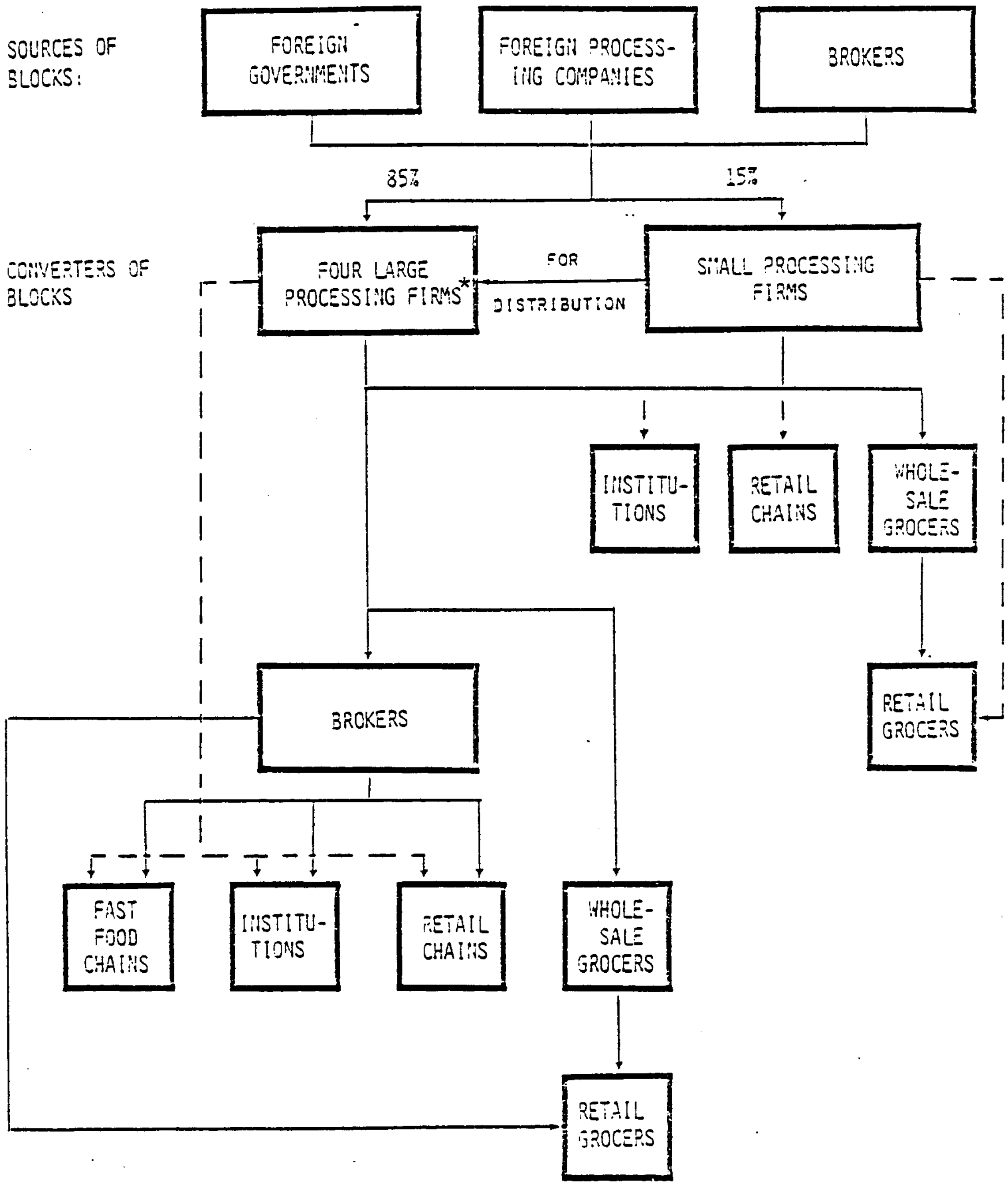
TABLE 2-8

U.S. APPARENT CONSUMPTION OF FISH STICKS AND PORTIONS, 1960-1980.

	APPARENT CONSUMPTION*	
	Total Product Weight (Millions of Pounds)	Per Capita (Pounds)
1960	112.5	0.625
1961	128.7	0.703
1962	150.1	0.807
1963	172.1	0.912
1964	185.6	0.969
1965	211.1	1.091
1966	230.1	1.176
1967	241.1	1.222
1968	265.4	1.328
1969	330.0	1.637
1970	354.8	1.746
1971	337.5	1.637
1972	373.9	1.784
1973	420.2	2.002
1974	389.0	1.840
1975	385.1	1.808
1976	438.4	2.042
1977	443.8	2.051
1978	478.8	2.194
1979	489.9	2.226
1980	460.7	2.072

* Production plus imports less change in inventories.

Source: Natural Resource Consultants 1982.



——— DENOTES DISTRIBUTION THROUGH BROKER AND/OR WHOLESALER.

— — — — DENOTES DIRECT DISTRIBUTION BY PROCESSOR TO END-USER.

*These firms are all located on the east coast.

FIGURE 2 - 9. DOMESTIC MARKETING CHANNELS FOR BREADED AND BATTER-COATED FROZEN POLLOCK STICKS AND PORTIONS.

SOURCE: Combs 1978

dominate the market for pollock and other whitefish blocks. They convert the blocks to breaded and batter-coated frozen fish sticks and portions. Almost all of the frozen blocks and fillets flowing through these channels are imported. Atlantic species predominate in the imports. If and when really large deliveries of U.S.-processed whitefish develop, they will have to be marketed through these converter channels, or new competitive operations will have to be developed. New operations will require major investment, not only in physical facilities, but in developing the network of sales contacts, market information, and purchase arrangements to carry a full line of products that characterize these existing large integrated firms. It is also possible that some of the established converters might choose to establish west coast operations.

Because they command higher prices than blocks, Natural Resource Consultants (1981) concludes that the fresh and frozen fillet market and salted and dried fish market offer more immediate opportunities than frozen blocks for Alaska whitefish sales. Continued growth of whitefish markets in the U.S. will be most closely determined by long-term factors such as population increase, real per capita income, fish prices, and prices of inexpensive meat and poultry that compete with whitefish.

2.5.2.2 Export Markets

Direct entry of U.S. processed seafood to both the Japanese and European markets is and probably will continue to be impeded by quotas, tariffs and less formal restrictions. Sales in Japan will be further limited by the U.S. inability to produce high quality surimi, a fish paste product that is used as raw material to make a wide variety of processed fish products. (See Natural Resource Consultants [1981] for a detailed discussion of surimi. Some gains will be made, however, as market channels become more established, and as quality control of long-distance shipments improves.

2.5.2.3 Joint Ventures

A third market for Bering Sea whitefish is through joint ventures, where U.S. fishermen deliver their catches to foreign processing vessels, at sea.

After processing and delivery to the processing vessel's home port, some of the product may be exported back to the U.S. While this type of operation accounts for only a small fraction of the BSAI harvest, it is increasing and represents a significant entry of domestic fishermen into the "export" market.

2.5.3 Species Accounts

Walleye pollock: Pollock has a soft flesh requiring rapid and specialized handling and processing. Most pollock harvested in the Bering Sea is processed by large Japanese factory ships into surimi. The rest of the pollock catch is frozen. The larger fish (greater than 17 inches) are filleted, the smaller fish are headed or headed and gutted. Pollock offal is made into fish meal.

Alaska pollock is imported back into the U.S. from Korea and Japan in frozen fillets or mince blocks for reprocessing into sticks and portions. A very small amount of Alaska pollock also enters the U.S. market as individual quick frozen (IQF) fillets. The growth of a pollock IQF market is questionable because of the fish's small size and high parasite infestation rate. Because of high production costs, it will also be difficult for U.S. processors to break into the highly competitive frozen block market for pollock. While much of the demand for pollock is for surimi, the U.S. industry has just broken the technology barrier to produce surimi using selected species. It is anticipated that U.S. caught pollock in the BSAI will be sold at sea to foreign processing vessels in a joint-venture arrangement.

Pacific Cod: Pacific cod are processed in three ways:

1) fillets;
2) headed, gutted and frozen; and
3) salted.

The outlook for marketing Alaska cod appears bright. Natural Resource Consultants (1981) predicted that within 5 years U.S. producers and processors would fully utilize the Bering Sea cod resource with much of the product entering the U.S. market. In addition, a significant export market is now being developed for Alaska produced salted cod. Most of the current product (wet or green-salted cod) is being shipped to Norway for further drying, packaging and sale, primarily in European markets. As U.S. expertise develops, more final processing may take place in Alaska (Natural Resource Consultants 1982). The current success of the Alaska Pacific cod fishery is due in part to the depressed Atlantic cod stocks worldwide. Its long-term future is thus somewhat dependent on events outside the industry's control.

Yellowfin Sole: Yellowfin sole is a small flounder which cannot be economically filleted. Its primary market is the Soviet Union. Yellowfin sole in the Bering Sea are caught by U.S. harvesters and delivered to Soviet processors where they are headed, gutted and trimmed by a mechanical device resembling a cookie cutter. They are then frozen into blocks for sale and reprocessing in the Soviet Union.

Pacific Halibut: Unlike other whitefish species, halibut is a traditional U.S. species that enjoys high ex-vessel prices. Halibut catches from the BSAI are not expected to be significant, as compared to the catches off southcentral and southeast Alaska; however, what is caught will probably be distributed through well-established domestic market channels as frozen product from Seattle.

Other Flounders: The larger flounders (including Greenland turbot) caught in the BSAI are most often filleted (usually by hand) and frozen. Flounders are a key product in the fresh and frozen markets; however, because of stiff competition from imported fish, domestic flatfish producers have recently shifted more toward the fresh fish market. It is more likely, however, that flounder from the BSAI will continue to be frozen.

Pacific Ocean Perch and Other Rockfish: Approximately 40 species of rockfish are caught in the commercial fishery off Alaska. Pacific Ocean perch, whose stocks are now depressed (but improving) in the Bering Sea, is the only species for which there is a direct fishery. Pacific Ocean perch are commonly either headed, gutted and frozen or frozen in the round.

Sablefish: Sablefish is a highly prized fish for smoking and for the fresh and salted markets. Sablefish receive primary processing in Alaska where they are most often headed, gutted and frozen. Domestic market channels for smoked sablefish steaks are shown in Figure 2-10. Significant quantities of sablefish are also exported to Japan.

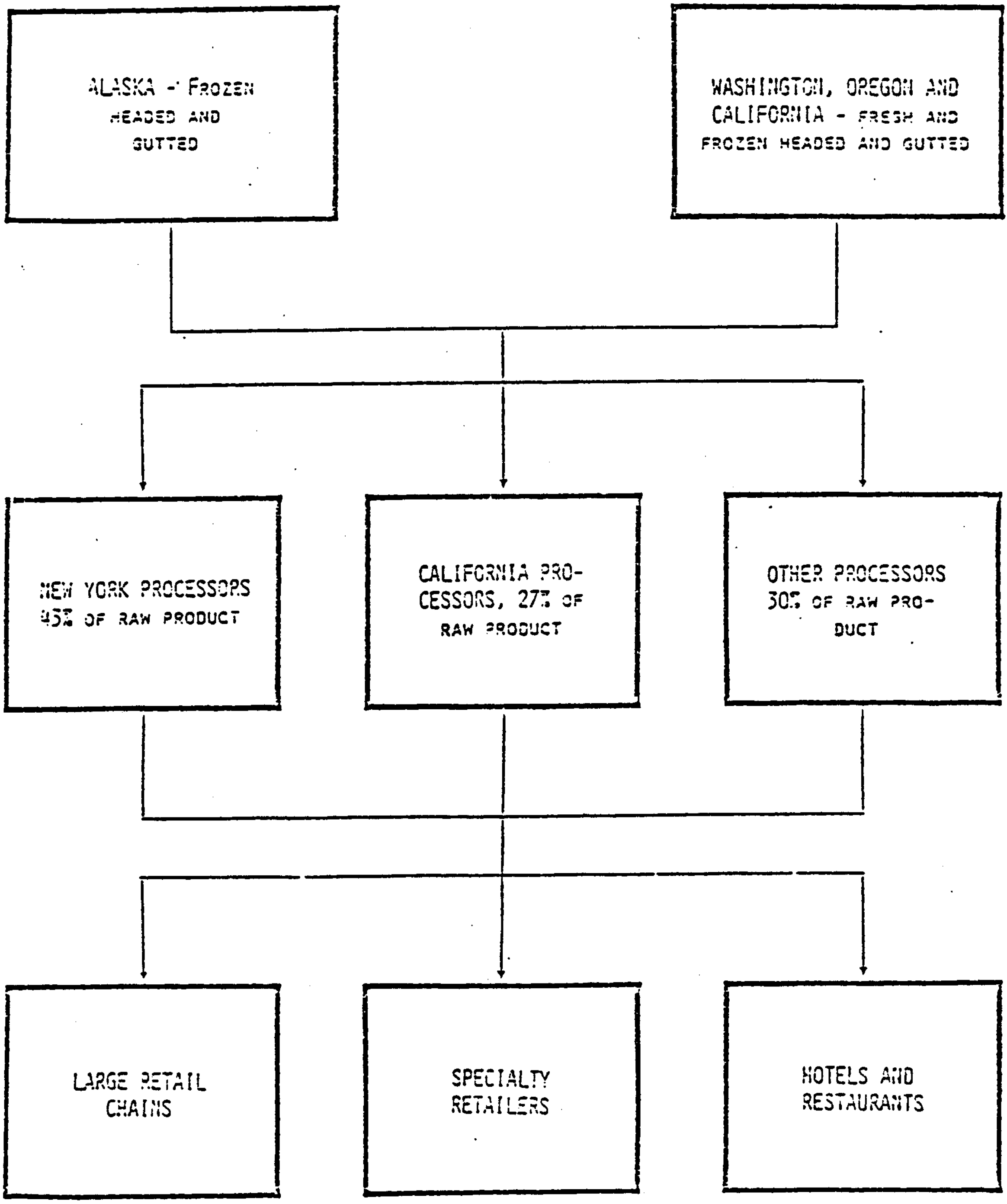
Atka Mackerel: Atka mackerel, which is largely an unknown species, is a close relative to the highly prized ling cod. At present the only market for Atka mackerel is an isolated Soviet market for frozen round fish. However, small amounts of this firm-fleshed fish have been successfully canned and smoked in research laboratories with favorable results (Natural Resource Consultants 1982). The preferred market for these processed products is the U.S.

Herring: The predominant herring fisheries in the BSAI are the inshore fisheries for roe-herring and for herring roe-on-kelp. Both products are exported, primarily to Japan. Herring caught offshore in the BSAI would be non-spawning, high oil-content, food quality herring that could be marketed in the U.S., European and Japanese markets. However, as long as the inshore, domestic herring roe fishery continues to fully utilize the Bering Sea herring resource, an offshore, lower food value, herring fishery will probably not be permitted.

The food herring market has exacting size and quality standards that U.S. processors would have to meet. Demand for Bering Sea food herring will be based in large part on the status of other herring stocks closer to the consumption centers. See Alaska Native Foundation (1981) for a detailed review of potential markets for Bering Sea herring.

Capelin: The future of a capelin fishery in the BSAI is speculative. If one develops it would most likely be marketed to Japan for the female capelin with roe market (Hale 1983).

Squid: There are underutilized squid stocks in most of the world oceans. Markets for squid in the U.S. are limited primarily because of



BROKERS OR WHOLESALER/DISTRIBUTORS ARE OCCASIONALLY UTILIZED BY PROCESSORS, BUT PRODUCT IS GENERALLY DISTRIBUTED DIRECTLY BY THE PROCESSOR'S SALES FORCE.

FIGURE 2 — 10. MARKETING CHANNELS FOR SMOKED SABLEFISH STEAKS

SOURCE: Combs 1978

consumer resistance to the product (Combs 1980). If squid is harvested in the BSAI, it would probably be sold to countries in Asia, most probably Japan.

Crab: As the highest priced line of fisheries products, shellfish are most sensitive to economic pressures. Domestic consumption is primarily through restaurants, whose growth generally mirrors the overall economy. King crab consumption has not, however, suffered from the generally slow shellfish market. Demand has been steady, and with supplies sharply decreasing, price is expected to stay high. Tanner crab enjoys some of the substitute king crab market in addition to having a steady market demand itself. For both king and Tanner crab, the domestic food service market and Japanese market predominate. Figures 2-11 and 2-12 show major domestic distribution routes and market channels. Product for export is shipped from the processing plant to the importing company either directly or via Seattle. See Orth et al. (1979) for a detailed discussion of the processing and marketing structures for Alaska produced crab.

The predominant king crab product form produced in Alaska is sections (four legs and one claw). Most product is then routed through the Seattle area and either shipped from there as bulk sections or reprocessed into meat.

Brown king crab is processed into meat rather than sections as their shells are very hard and spiny. Tanner crab is also almost always processed into sections in Alaska. Because of its size and the associated labor requirements, only small amounts are later reprocessed into meat.

Shrimp: The small pink shrimp harvested in the BSAI are destined primarily for the "cocktail" shrimp meat markets rather than as competition with the larger shrimp from the Gulf of Mexico. Low abundance and high price are limiting the growth of this market.

Snails: The only market for Bering Sea snails is Japan where snail meats served with rice wine are considered a delicacy. All processing of the

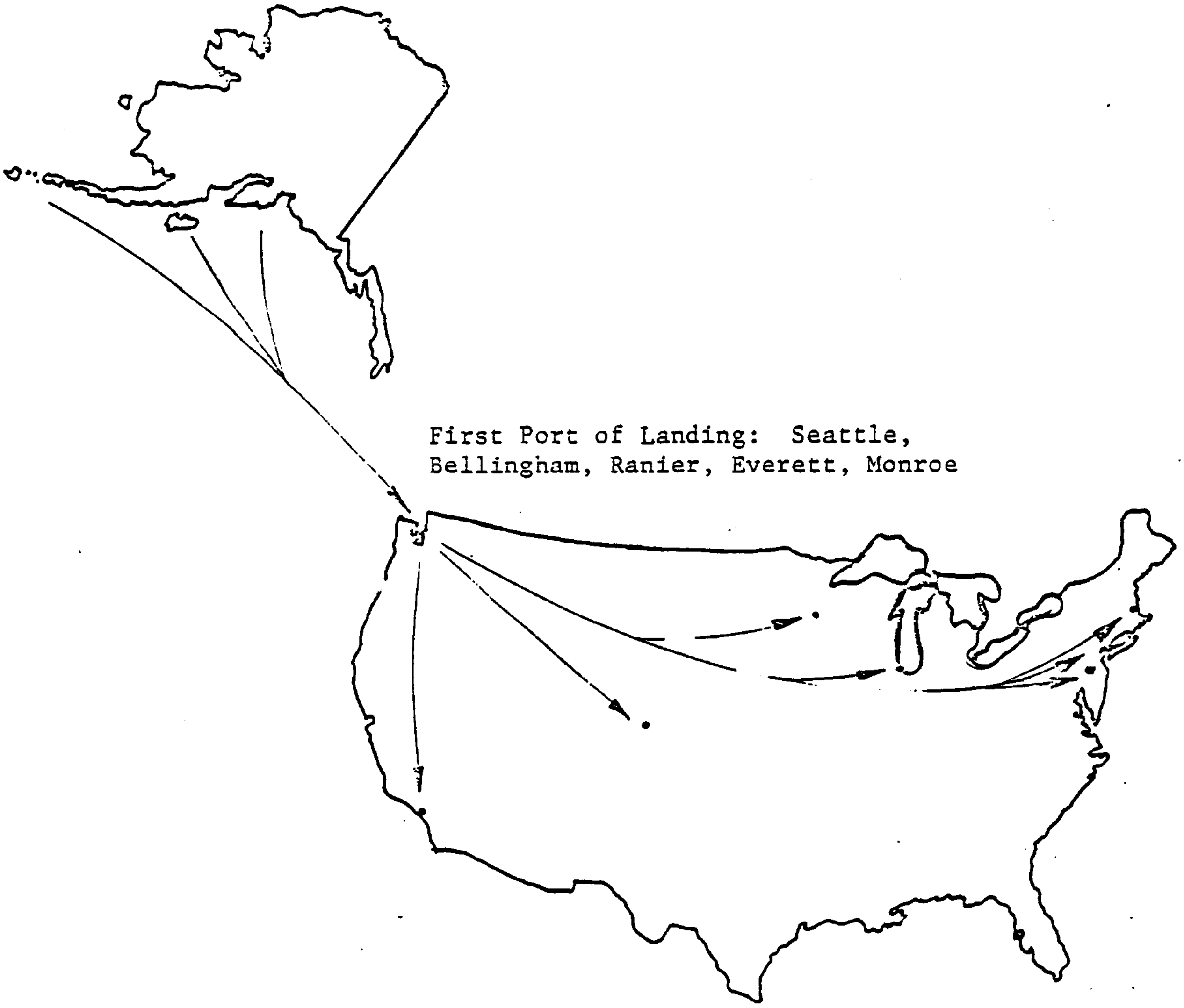


FIGURE 2 - 11. DISTRIBUTION OF ALASKAN SHELLFISH PRODUCTS BY MAJOR DOMESTIC CENTERS OF DISTRIBUTION

SOURCE: Orth et al. 1979

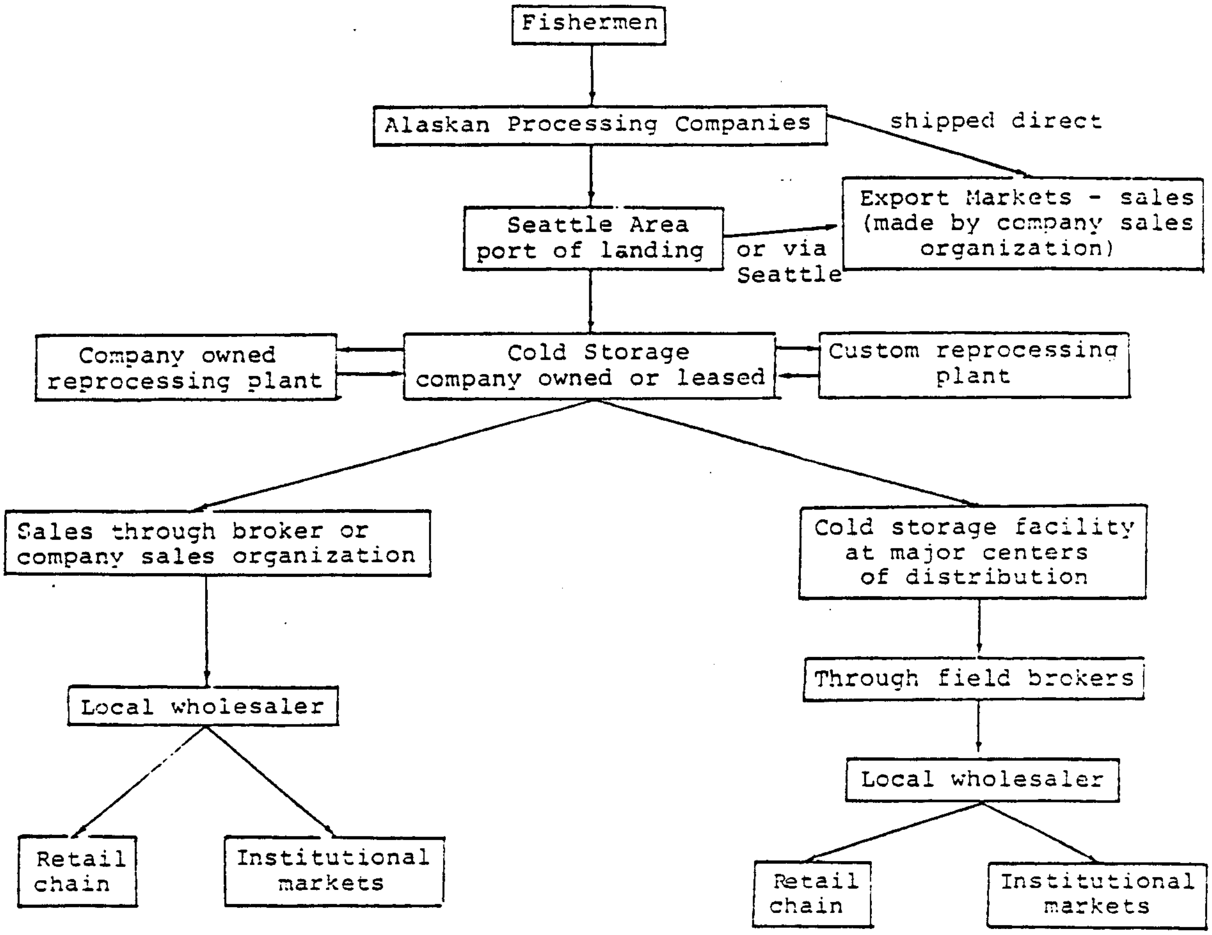


FIGURE 2 - 12. MARKET CHANNELS FOR FROZEN KING AND TANNER CRAB PRODUCTS

SOURCE: Orth et al. 1979

snail catch now occurs on board Japanese catcher vessels. This consists of crushing the shells, briefly cooking the meats, and removing any soft parts and shell fragments. The meats are graded by size and quality and quick-frozen in trays. Small snails in the catch may be frozen whole (Morris 1981).

Salmon: An increasing majority of salmon (56 percent in 1981) is processed into fresh, frozen and cured forms, while the remainder (44 percent) is canned. The product mix has changed substantially in recent years: in 1977, 62 percent of Alaska salmon was canned.

Pink salmon are primarily canned; red and chum salmon are canned and are processed for the fresh, frozen and cured markets; silver and king salmon are predominantly fresh, frozen or cured.

Salmon roe and cured salmon are sold almost exclusively in Japan. Fresh and frozen salmon are traditional in the U.S. and are sold in Canada and Japan (Japan dominates the fresh, frozen and cured market). Canned salmon is sold widely throughout the U.S., and is exported to the United Kingdom, Canada, Australia, and France. Development Planning & Research Associates, Inc. (1982) provide a detailed analysis of the markets for Alaska salmon.

2.5.4 Forthcoming Changes in Marketing Strategy

Factors of change that will accelerate, influence and evolve with the domestic fisheries in the BSAI are the changing strategy of domestic seafood marketing and the penetration of foreign markets. These changes will be consumer- and product-oriented, relating to changes in markets, products and product form, consumer preference, etc. Examples of these potential changes are:

- Lifting of foreign import restrictions.
- Individual quick-frozen (IQF) pollock fillets replacing surimi.
- Surimi replacing fish meal.

- IQF pollock fillets replacing whole block frozen pollock.
- General growth of the IQF form.
- Potential use of Alaska whitefish by some major U.S. fast seafood firms.

Furthermore, the domestic (and Alaska) seafood industry, as it builds in volume and economic visibility, is beginning to overcome obstacles to the growth of all markets, and the fresh seafood market in particular. These obstacles include unreliable airline service, poor handling in transit and unattractive retail display. It is not clear how these changes will affect the fishing industry in the BSAI and an exhaustive, quantitative analysis of these changes is outside the scope of this study. Nevertheless, the projections task of this analysis (Chapter 3) will account for this development.

2.6 POLITICAL AND ECONOMIC FACTORS

A wide variety of programs and events will influence the pace of U.S. development of the BSAI commercial fishery resources. The principal political, economic, and regulatory incentives and deterrents to U.S. participation are briefly summarized below.

2.6.1 Incentives

Magnuson Fisheries Conservation and Management Act (MFCMA): The passage of the MFCMA in 1976 was the first incentive to the U.S. fishing industry to take over the extensive offshore fisheries in the Bering Sea. Recent amendments to the act and the institution of a "fish and chips" policy for foreign allocations are providing further incentives for full U.S. utilization of Bering Sea fisheries resources. "Fish and chips" means that foreign nations receive fishing allocations within our 200-mile limit only in return for such concessions as joint ventures, increased purchases of U.S. caught product, and technology transfer projects. An excellent example of how "fish and chips" is working is the recent announcement that Japan will buy 120,000 tons of pollock during June 1982 - May 1983 and 200,000 tons during June 1983 - May 1984 from American harvesters participating in U.S./Japanese joint ventures. Additional federal legislation has been proposed to link U.S. fisheries in the Fishery Conservation Zone to an economic zone; the net effect modifies the mandates for allocating surplus resources to foreign fisheries.

Saltonstall-Kennedy Funds: The Saltonstall-Kennedy (S-K) Program is the United States' major fishery development program. Thirty percent of the tariffs on imported fish and fish products are channeled to the S-K fund in the U.S. Department of Commerce (National Marine Fisheries Service [NMFS]) with the remainder going to the U.S. Department of Agriculture. Fifty percent of the NMFS S-K funds must be spent on fishing industry projects. In Alaska, most of the S-K funds are channeled through the Alaska Fisheries Development Foundation (AFDF) and are used for a variety of industry demonstration projects. Many of these projects have proved extremely helpful to members of the industry considering entrance to the whitefish fishery. Projects funded by AFDF in the near future will be directed at pollock and cod processing technology.

State of Alaska Agencies: The Alaska Office of Commercial Fisheries Development (OCFD) is the primary State agency concerned with fishery development. While Alaska no longer has a discrete whitefish program, OCFD is continuing certain efforts to expand Alaska participation in the developing Bering Sea fisheries. OCFD sees their primary responsibility in whitefish development as promoting and facilitating private investment in the industry. In addition, OCFD sponsors a number of fisheries development programs including: (1) the development of a market information system (accessed by computer) that will include information on whitefish prices and markets (on line in 1984); (2) product development research; and (3) the development of computer production cost models (Stan Hajenga, OCFD, personal communication).

Limited Entry: Limited entry programs are in place for all salmon fisheries that occur in the BSAI region. Numbers of permits and their values are shown in Table 2-9. No limited entry programs are in effect for herring; effort increased rapidly from 1978 to 1980 but has since leveled off. Exclusive registration areas were established for Goodnews Bay, Security

TABLE 2-9

COMMERCIAL SALMON FISHING PERMITS

Area	Number of Permits[1]	Value[2]
Alaska Peninsula		
Set Gillnet	115	N.A.[3]
Drift Gillnet	147	$60,625
Purse Seine	115	N.A.
Bristol Bay		
Drift Gillnet	1,670	$64,588
Set Gillnet	754	$18,184
Kuskokwim District		
Gillnet	771	$ 6,420
Lower Yukon River		
Gillnet	621	$ 5,834
Norton Sound		
Gillnet	153	$ 6,833

---

[1] 1980 data from the Alaska Department of Fish and Game.

[2] 1979 data from Commercial Fisheries Entry Commission.

[3] Not available.

Cove, Cape Romanzof and Norton Sound for the 1983 herring season. Exclusive registration is another management technique to limit fishing effort. The NPFMC is in the process of holding public hearings on a proposed moratorium on new entries to the halibut fishery off Alaska for 1983. This is the first step toward establishing a limited entry program. Estimates for when the halibut limited entry system will be in place range from 1984 to never. There are no limited entry programs for king crab, Tanner crab or hair crab, although both statistical area T (Bristol Bay) and O (Unalaska) are exclusive registration areas for king crab. Effort in these fisheries has continued to increase, despite decreasing stocks. No limited entry programs are planned for whitefish.

For fisheries with limited entry, fishing effort (number of vessels) will remain at a relatively constant level unless a major economic dislocation occurs. Effort in fisheries without limited entry can be much more variable. The institution of commercial fishery limited entry programs is a highly political and unpredictable topic.

Alaska Seafood Marketing Institutes (ASMI): ASMI is a joint industry-government organization that promotes Alaska seafood by providing generic marketing for Alaska's fishery. While most of its funds are spent on Alaska's traditional species (i.e. salmon, halibut, king and Tanner crab), some funds are spent on whitefish market promotion. As the domestic whitefish harvests increase, more generic advertising funds will be available for such efforts.

Capital Construction Fund: The Capital Construction Fund (CCF) is a government program that helps fishermen and other commercial vessel owners accumulate cash to purchase new vessels. Taxes are deferred on funds deposited in a CCF account. Funds must come from fish sales or from the sale of a vessel. This capital accumulation program was critical in the development of the U.S. king crab fleet and could play a key role in helping finance whitefish fishing vessels. Furthermore, it has recently been proposed that shore-based processors also have access to the CCF.

Fishing Vessel Obligation Guarantee (FVOG): FVOG is a federal program that guarantees fishing industry loans for vessels, processing facilities, cold storages, and other port facilities related to commercial fishing.

Alaska Commercial Fishing and Agriculture Bank (CFAB): CFAB is a lending cooperative operating along the lines of a production credit association. Because of their interest in Alaska's fisheries and their very competitive interest rates, CFAB can be expected to play a key role in financing the development of the Bering Sea fisheries.

Alaska Resources Corporation: In 1982, the Alaska Renewable Resources Corporation (ARRC) was reauthorized as the Alaska Resources Corporation (ARC). ARC is a profit-making, venture-capital corporation created by the legislature to invest in basic industries (including the fishing industry) in Alaska. ARRC invested in whitefish development in the past and the new ARC expects to continue to participate in the development of Alaska's fisheries. Their investments are limited, however, to a maximum of $500,000 per project (combined equity and debt) and they must receive a return on their investments at least equal to money market yields. The extent of their participation in the developing fisheries in the Bering Sea will depend in large part on the attractiveness of the investments offered to them.

Tax Incentives: The State of Alaska fish tax for developing species (e.g. whitefish) is less (3 percent) than for developed species (5 percent).

High Debt Service of New Bering Sea Crab Boats: The large (>100 feet) classes of crab vessels that have entered the Bering Sea crab fishery during the last several years require annual gross incomes of close to $1.5 million. With crab populations in traditional fishing areas rapidly declining, fishermen will be forced to new grounds (i.e., further offshore along the shelf break) and to year-round fishing for alternative species.

U.S. Fishery Development Zone: The North Pacific Fisheries Management Council has proposed an area north of Unimak Pass an an exclusive domestic fishing ground. This U.S. fishery development zone is intended to give

American harvesters exclusive access to an extremely productive and accessible trawling area. At present there are no plans for additional Fishery Development Zones but such techniques can speed U.S. participation in the developing Bering Sea fisheries.

2.6.2 Deterrents

Trade Policies: The U.S. fishing industry is faced with extremely unfavorable trade policies in trying to enter the whitefish fishery. U.S. trade policies impose low duties on frozen fish blocks and fillets entering the U.S. and at the same time certain laws (Jones Act) and other policies require that Americans fishing in the U.S. Fishery Conservaton Zone build their vessels in the U.S. and pay high duty on imported net webbing, electronics, and processing equipment. The result of these laws and policies is that the costs of vessel construction and gear acquisition is maximized and foreigners are allowed relatively easy access to the very large U.S. groundfish markets. Compounding the U.S. industry's problems is the fact that American access to European and Asian markets is severely restricted by relatively high import duties, quotas and other operational barriers (Natural Resource Consultants 1982). Because fish are a small part of the overall U.S. trade policy agenda, concessions to these policies are not always as high a priority as for other products.

Jones Act: The Jones Act of 1920 requires that American-built vessels be used for fishing off of the coast of the U.S. A foreign processing ship under 5,000 gross tons can, however, be leased by an American company and, if documented, process fish caught by American fishermen if 1) the ship does not engage in coastwide trade and 2) does not fish.

New vessel construction is expensive, especially in light of current interest rates, and it is doubtful that new factory trawler vessels could be built in the U.S. and operate profitably. Alaska Fisheries Development Foundation (1981) concluded that a new U.S. factory vessel similar to the German vessel "Fredrich Busse" (301 feet) would need to increase its gross by $10 million/year to break even (a highly unlikely prospect). Even more frustrating to the U.S. fishing industry is the fact that there is a worldwide surplus of large factory vessels that would undoubtedly be cheaper to acquire for the Bering Sea whitefish fishery as catcher/processors. Nevertheless, at least one new catcher/processor, destined for the Bering Sea, is now under construction in Seattle.

Fuel Costs: Fuel costs have risen rapidly over the last several years, significantly increasing the operating costs of all fishing operations. Fuel costs are a limiting factor in the projections for the BSAI as there are no ports near most of the fishing areas. This factor contributes significantly to the progression from foreign joint ventures, through domestic catcher/processors to domestic mothership operations.

2.7 AQUACULTURE AND ENHANCEMENT ACTIVITIES

Three aquaculture facilities release salmon fry into river systems that drain into the BSAI area. There is a small research facility on Clear Air Force Base (Yukon River), a small (2 million egg capacity) experimental hatchery on the Noatak River (Kotzebue Sound), and a 20 million egg capacity hatchery on Russel Creek in Cold Bay. There are two nonprofit aquaculture associations in the region -- Imarkpik (Bristol Bay) and the Yukon - facilities, nor are any planned. There are small educational hatcheries in Unalaska, Sand Point, and Bethel. The State of Alaska operated a sockeye salmon hatchery on East Creek in Bristol Bay, but the facility was closed due to budget constraints and there are no plans to reopen it. It is conceivable that another group could acquire and operate the facility. The Russel Creek hatchery is scheduled to close in 1983 for budgetary reasons, although ADFG is also issuing a contract to redesign the facility to increase its capacity to 100 million eggs. If the Russel Creek hatchery is redesigned and successfully reopened, it could eventually produce more than a million adult chum salmon each year. Except perhaps in the Cold Bay area, it is unlikely that salmon aquaculture or enhancement activities will significantly impact commercial fisheries in the Bering Sea-Aleutian Island area.

2.8 TECHNOLOGY FACTORS

The development of new fisheries in new areas is usually accompanied by the evolution of harvesting technology. While it is impossible to prophesy the veritable plethora of creative thinking, this section attempts to detail some of the recent advances in harvesting and processing technologies. Primary sources of information for this discussion were personal communications with knowledgeable industry representatives, AFDC (1979), Fisher (1980), and AFDF (1981).

2.8.1 Harvest Technology

Harvest technology is not a major limiting factor in the development of the BSAI fisheries. No significant changes are expected, except for those intended to reduce incidental catches of prohibited species, and to reduce conflicts with subsea obstacles (natural and man-made).

Changes in harvesting techniques for whitefish may significantly reduce the incidental catch of prohibited species in the BSAI area and would have a positive effect on the traditional domestic fisheries. A significant bycatch of traditionally "prohibited" species (salmon, halibut, crab, herring) is currently taken by the foreign trawl whitefish fisheries in the Bering Sea. This incidental catch reduces the yield available to both foreign and domestic target fisheries. When a certain level of prohibited species is caught in a foreign trawl fishery, that fishery is closed.

Research is underway on possible gear changes to reduce the catch of prohibited species. Wespestad et al. (1982) report that the incidental catch of prohibited species is generally less with longlines or off-bottom trawls than with the on-bottom trawl gear now most commonly used. Most available whitefish could probably be harvested with longlines and off-bottom trawls with a substantial reduction (over 80 percent) in the incidental catch of prohibited species.

Current conflicts between on-bottom trawls and petroleum related structures are expected to be mitigated by the use of off-bottom trawls.

Very few changes in salmon, herring, and crab harvest technology are expected. Salmon and herring are fished close inshore, away from most areas of potential petroleum exploration and development. Moreover, the gear types and fishing techniques for all three of these species groups are fairly standardized.

Other potential conflicts between petroleum and fishing activities (e.g., seismic exploration cables vs pot and longline buoys), and between fisheries (e.g., trawls vs crab pots) are expected to be mitigated more by changes in techniques and timing, rather than by technology changes.

2.8.2 Processing Technology

The evolution of processing technology will greatly influence the development of fisheries in the BSAI; especially those fisheries that occur great distances from onshore processing plants, such as in the northwest portions of the St. George Basin or in the Navarin Basin. Processing technology for traditional species (e.g., salmon, crab) is well developed, although there does appear to be a trend from canning to freezing. Processing technology for whitefish is developing, and this development will accelerate as the University of Alaska's new Fisheries Industrial Technology Institute and the Alaska Fisheries Development Foundation's vertically-integrated minced pollock processing project get underway.

It appears that a trend may be toward mechanized processing. A clear example of this trend is the new Trident Seafoods plant in Akutan, which uses a mechanized line for the processing of Pacific cod, yellowfin sole, and walleye pollock.

In most instances, large finfish require mostly manual processing technology. Shellfish are also generally processed by hand, except for the meat extractors for shell-less crab products.

Foreign processors handling BSAI small finfish, especially pollock and cod, use a mostly mechanized operation (Fisher 1980, AFDC 1981). Manual steps in the predominantly machine process are the sorting of species and the candling (visual inspection of translucent meat) for parasites. One recent evolution is a machine to remove pollock belly flaps, where the parasites are concentrated, resulting in a reduced product weight, but also in reduced processing time.

The Alaska Department of Commerce and Economic Development, Office of Commercial Fisheries Development (OCFD) is one of the primary funding sources for research on fisheries development and support. While not specific to the BSAI fisheries, two projects potentially funded by OCFD are:

- Ozone Ice: OCFD has shown that icing of fresh salmon with ozone-impregnated ice can kill bacteria and triple the shelf life of the fresh product. OCFD hopes to fund further research on ozone-icing of shellfish and bottomfish, thereby increasing the life of fresh product in a vessel's hold and on the shelf.

- Waste Utilization: Recognizing that a large amount of meat is wasted with the filleted skeleton of a whitefish, OCFD hopes to fund a $100,000 study on alternate methods of removal of the meat and its alternate product forms.

The North Aleutian Shelf will be the last Bering Sea lease sale area to be explored. By the time it is impacted by OCS activities, processing technology will be advanced much further than at present. This analysis will assume that domestic processing technology will not be limiting within the 20-year planning period of this study.

2.8.3 Harvest and Production Capacities

Almost every conceivable type and size of fishing boat and processing operation can be found in the cumulative Bering Sea/Aleutian Island fisheries.

Fishing boat categories to be evaluated include:

Drift gill net boats (≤ 32 feet)
Small seine boats (≤ 48 feet)
Longline boats (48-116 feet)
Crab boats (85-150 feet)
Trawlers, small (65-150 feet)
Trawlers, large (150-400 feet)

Catcher/processor boats categories to be evaluated include:

Domestic (150-400 feet)

Large offshore processor categories to be evaluated include:

Barges (100-400 feet)
Factory processors (100-600 feet)

The majority of all onshore domestic processing is for salmon and crab; a few isolated processors receive and process halibut, shrimp, cod and pollock. Few, if any, new crab or salmon processing plants are envisioned for the next 25 years. Most new construction will probably focus on pollock and cod. The fishery development scenario will include a survey of existing onshore processing plants, to the extent their operations could be impacted by an oil development activity. The primary focus will be for onshore processing operations that may conflict (temporally and spatially) with onshore oil development activities and then onshore plants that may be impacted directly by loss of product.

2.9 SUMMARY

The species traditionally harvested in the BSAI (salmon, halibut,shrimp, herring, crab) are now fully utilized and are expected to remain so over the planning horizon. The development of the marketing of these species is well in place, and, except for changes such as biological fluctuations and new product development, will continue to be important in the overall BSAI fishing industry.

Development of the domestic whitefish fishery in the Bering Sea and Aleutian Island area over the next 25 years will be guided primarily by economics. At present, it appears paradoxical to speak of the potential growth (and wealth) of the domestic fishery in that region when the domestic seafood industry is hard pressed by industry-specific problems and the U.S. economic climate. However, all evidence points to the almost automatic realization that in 25 years the domestic fishing industry will be harvesting the whitefish resources of the BSAI and will be processing most of it.

CHAPTER 3

DOMESTIC FISHING INDUSTRY PROJECTIONS

3.1 INTRODUCTION

Domestic fishing activity in the Bering Sea and Aleutian Island (BSAI) region should change rather dramatically over the next two decades. The projections in this chapter qualify and quantify this change based on biological, technological, economic and political factors. While these factors will independently and collectively affect the rate and magnitude of change, two conclusions are readily apparent: 1) all commercial fishing activity in this region within this time frame will be by U.S. fishermen; and 2) a significant portion of the BSAI catch will be processed by domestic processors.

Separate fishery projections are presented in this chapter for the North Aleutian Shelf (Section 3.4), St. George Basin (Section 3.5), Norton Basin (Section 3.6) and Navarin Basin (Section 3.7) areas. A cumulative projection (Section 3.8) summarizes the interrelationships of all four areas.

3.2 METHODS AND ASSUMPTIONS

3.2.1 Basin-Specific Cases

The following methods were used to project resource abundance through the year 2007:

- Historic foreign catch data (1971 - 1982) for each lease sale area were evaluated, seasonally and by 1/2° latitude x 1° longitude subareas.

- Based on Wespestad (1983), low, high and most likely resource estimates were made by species and by species group through the year 2007 for each basin. This estimate approximates maximum sustainable yield (MSY) and appears reasonable in light of historic catch information.

The following methods were used to project the domestic catches in each of the four lease sale areas:

- The maximum catch was assumed to be equal to the long-term MSY estimates (except where noted).
- The catches apportioned to each lease sale area were based on the historic foreign catches in these areas compared to the historic foreign catches in the entire BSAI; i.e., proportional catch percentages.
- The catches proportioned to each 1/2° x 1° subarea within each lease sale area are similarly based on the historic foreign catches within each 1/2° x 1° subarea; i.e., proportional catch percentage by 1/2° x 1°.
- The projected domestic catch for each 5-year increment for each lease sale area and for each 1/2° x 1° subarea is based on an estimated rate of development of the domestic fishing industry for each basin. The rate of development is described for each lease sale area as a percentage of the total caught by domestic fishermen estimated for each 5-year increment beginning 1987.
- Projected domestic catches by 1/2° x 1° in each of the four lease sale areas are based on historic catch trends and assumed to remain constant in terms of where, when and how many fish are caught.
- Five-year projections were made through 2007 to reflect our estimates of decreasing foreign and increasing domestic fishing activities in the BSAI.

- Data from the 1981 and 1982 joint ventures were evaluated to determine catch rates, vessel sizes, processing capacities, crew requirements, and the number of boats needed to harvest and process fish.

The following formula was used to project domestic harvests, by species or species group:

$$PDC_y = MLCE \times PDGR \times PCLSA \times PC_{(1/2x1)}$$

where:

PDC = Projected domestic catch, in any 1/2° x 1° subarea, expressed in metric tons

y = The year for which the projection is made

MLCE = Most likely catch estimate (usually MSY) of a species or species group, for the entire BSAI, expressed in metric tons

PDGR = Projected domestic growth rate, expressed as the fraction of MLCE taken by domestic fishermen in year y

PCLSA = Proportional catch in a lease sale area, expressed as a fraction of MLCE

$PC_{(1/2x1)}$ = Proportional catch in a 1/2° x 1° subarea, expressed as a fraction of PCLSA

Several assumptions were used in the growth projections of the domestic fishing industry that reflect the dramatic differences between the four basins in terms of species present (Table 3-1), the types of fisheries, and distance from shore.

Norton Basin is the least important of the four basins in terms of total pounds caught. The area's crab and whitefish fisheries are very minor compared to those in the other areas of the Bering Sea. Because the resource potentials in Norton Basin represent less than 1 percent of the total catch for the Bering Sea, we have assumed that commercial fishing activity in Norton Basin will be entirely domestic by 1987.

TABLE 3-1

PROJECTED COMMERCIAL FISHERY RESOURCES IN THE BERING SEA AND ALEUTIAN ISLANDS AREA FOR 1982-2007(1)

Species	Bering Sea and Aleutian Islands(2)	North Aleutian Shelf	St. George Basin	Navarin Basin	Norton Basin
Pollock	700,000-2,000,000 (1,200,000)	39,130-111,800 (67,080)	391,300-1,118,000 (670,800)	268,100-766,000 (459,600)	700-2,000 (1,200)
Pacific Cod	50,000-300,000 (180,000)	6,340-19,020 (12,680)	63,400-190,200 (126,800)	17,100-51,300 (34,200)	Nil
Flatfish	100,000-300,000 (200,000)	3,000-18,000 (6,000)	30,000-180,000 (60,000)	13,350-80,100 (26,700)	Nil
Rockfish	10,000-50,000 (20,000)	(3)	(3)	(3)	(3)
Sablefish	3,000-15,000 (5,000)	(3)	(3)	(3)	(3)
Atka Mackerel	20,000-60,000 (25,000)	(3)	(3)	(3)	(3)
Other Roundfish(3)	17,000-175,000 (60,000)	566-5,827 (1,998)	5,661-58,275 (19,980)	3,111-32,025 (10,980)	170-1,750 (600)
Halibut	400-2,000 (1,000)	Nil	300-3,000 (850)	200-2,000 (150)	Nil
Herring	2,000-50,000 (10,000)	Nil	2,000-30,000 (7,000)	2,000-20,000 (3,000)	Nil
Tanner Crab	5,000-20,000 (9,900)	450-1,800 (900)	4,500-18,000 (9,000)	Nil	Nil
King Crab	5,500-42,000 (23,000)	110-840 (460)	1,100-8,400 (4,600)	6-42 (23)	110-840 (460)
Hair Crab	5,000-6,000 (5,500)	Nil	5,000-6,000 (5,500)	Nil	Nil

---

1) Estimates in low-high and (most likely) in metric tons.

2) Totals include areas outside the four basins.

3) Other roundfish includes rockfish, sablefish, Atka mackerel, and all other roundfish not discretely listed.

The dominant assumptions used to predict domestic growth in the North Aleutian Shelf, St. George Basin, and Navarin Basin areas are:

- The U.S. domestic fishery will develop in the North Aleutian Shelf and St. George Basin areas before expanding into the Navarin Basin.
- The Navarin Basin domestic fishery will be primarily whitefish rather than crab.
- The domestic fishery in the St. George Basin and the North Aleutian Shelf will be supported predominantly by offshore processors. Some of the processing vessels will be foreign owned.
- The domestic fishing industry in the Navarin Basin will be supported 100 percent by offshore processing. Some of the processing vessels will be foreign owned.
- The ratio of onshore to offshore processing activities will be determined by evaluating those resources within a 200-mile radius of St. Paul and the ports and harbors at Akutan, Unalaska and Chernofski. This potential catch represents an upper limit that might be processed onshore, but by no means represents the exact numbers. A significant portion of the fish caught in the outer two-thirds of the 200-mile radius will be processed either by catcher/processors or by floating processors.
- No salmon fishing by domestic fishermen occurs in the North Aleutian Shelf OCS planning area (outside the 3-mile limit of State of Alaska waters). In order to predict potential impacts from offshore oil and gas activities in the North Aleutian Shelf area, we have evaluated fishing vessel traffic to and from the fishing grounds of Bristol Bay.

3.2.2 Cumulative Case

The cumulative growth of the domestic fishing industry in all four lease sale areas is presented later in this chapter. It is used in a side-by-side comparison with the cumulative potential growth of the petroleum industry in these same areas. A qualitative evaluation of both industries' growth curves is then used to predict when and where one industry may have an impact on the other.

Several assumptions were critical to the methods used in our determination of the cumulative growth and subsequent character of the domestic industry:

- The whitefish fisheries in Norton Basin and the North Aleutian Shelf are relatively unimportant.
- The dominant cumulative processing characteristic is offshore processing; some by foreign processors.
- The onshore processing centers should be St. Paul Harbor, Unalaska, Akutan and perhaps Chernofski, all located in St. George Basin.
- The proposed "sovereign rights" amendment to the (Magnuson) Fishery Conservation and Management Act (MFCMA) is independent of our projections.
- Some relief from the Jones Act is assumed in the predictions of domestic growth.
- We assume boats will fish in more than one lease sale area and in non-lease sale areas during a 12-month period, but that they will be directed fisheries.
- The accelerated portion of the domestic growth curve is assumed to be the time when the industry is most susceptible to adverse impacts from petroleum development activities.

- The majority of the potential domestic commercial fisheries are within the four lease areas; the other areas of the Bering Sea and along the Aleutian Islands are not considered in the cumulative scenarios.

- There is a direct interrelationship between the domestic fishermen in the St. George, North Aleutian and Navarin areas.

3.3 VALUE AND LABOR

3.3.1 Unit Value of the Catch

The purpose of these projections is to present estimates of the unit value of future catches at the ex-vessel and first-wholesale levels. However, it is recognized that any economic projection is subject to revision in light of changing events. The values are displayed as a range (low, average and high) in dollars per pound for every 5 years over the 25-year planning horizon.

The current values were obtained from "Alaska 1980 Catch and Production Commercial Fisheries Statistics" (ADFG 1982), Preliminary 1981 Average Ex-vessel Prices (a computer file of the Alaska Commercial Fisheries Entry Commission), and Pacific Fishing Magazine's 1983 Yearbook (for 1982 prices). These data sources are compared in Table 3-2 (ex-vessel prices) and Table 3-3 (first-wholesale prices). The most recent data were used, unless a given price was judged to be spurious, in the context of this study's 25-year horizon. When existing data was questionable, the project team used its best estimate of a "recent average price" as the basis of the price projections. The base prices used in the projections (Tables 3-4 and 3-5) are identified in the comparisons (Tables 3-2 and 3-3). Some other data handling procedures were followed:

- The unit values of herring were calculated only on the basis of sac-roe herring (the dominant type in the offshore fishery); roe-on-kelp, skeins, food herring and bait herring were excluded.

TABLE 3-2

EX-VESSEL UNIT PRICES (DOLLARS PER POUND) - COMPARISON OF SOURCES
(The Prices Used For Value Projections Are Underlined)

	ADFG 1980 C&P(1)	ADFG 1981 (CFEC)(2)							1982 PF(3)
		Dutch Harbor	Bering Sea	Adak	W. Aleutian	Bristol	Goodnews	Norton	
Pollock	0.06	--	--	--	--	--	--	--	0.035
Cod	0.10	0.20	0.30	--	--	--	--	--	0.24
Flounders (including Yellowfin Sole & Turbot)	0.18	--	--	--	--	--	--	--	0.33
Rockfish (including Pacific Ocean Perch)	0.23	0.18	0.18	--	--	--	--	--	0.19
Sablefish	0.39	--	--	--	--	--	--	--	0.50 small 0.85 large
Other (General Whitefish)	0.19	--	--	--	--	0.50	--	--	?
Halibut	--	0.90	0.16	--	--	--	--	--	1.06
Herring - Food	0.03	0.11	--	--	--	0.18	--	--	--
- Sac Roe	0.15	--	0.15	--	--	0.17	0.15	0.16	0.13-0.41
- ROK	0.80	--	--	--	--	0.65	--	0.58	--
- Bait	0.03	--	0.12	--	--	0.12	0.025	0.025	--
Tanner - Bairdi	0.58	0.58	0.61	0.66	--	--	--	--	--
- Opilio	0.26	0.26	0.26	0.26	--	0.26	--	--	--
- All	0.64	--	--	--	--	--	--	--	1.14
King - Red	0.98	1.02	1.29	1.06	0.97	--	--	--	--
- Blue	0.94	--	0.91	--	--	--	--	--	--
- Golden	0.74	--	--	0.90	--	--	--	--	>3.00
- All	1.37	1.45	1.34	1.51	--	0.89	--	0.83	2.65-3.45
Shrimp - Pot	--	2.00	--	--	--	--	--	--	--
- General	--	0.22-0.25	--	--	--	--	--	--	--
- Trawl	0.23	--	--	--	--	--	--	--	0.27

---

(1) Alaska Department of Fish & Game 1982 "Alaska 1980 Catch and Production Commercial Fisheries Statistics," Western Alaska or State average data.

(2) Alaska Commercial Fisheries Entry Commission 1982 computer files (1981 prices, by region).

(3) "Pacific Fishing" 1983 Yearbook (1982 prices).

TABLE 3-3

FIRST WHOLESALE UNIT PRICES (DOLLARS PER POUND) - COMPARISON OF SOURCES
(The Prices Used For Value Projections Are Underlined)

	1980 ADFG(1)	1982 PF(2)	1982 SBR(3)
Pollock	0.35	--	0.72
Cod	1.35	--	1.11
Flounders (including Yellowfin Sole and Turbot)	0.31	3.45-3.85 (Petrale) 1.65 (Dover)	1.51
Rockfish (including Pacific Ocean Perch)	0.81	0.95-1.20	1.07
Sablefish	0.51	0.55	--
Other (General Whitefish)	0.35	--	--
Halibut	2.33	0.60-1.85	--
Herring - Food	0.25	--	--
- Sac Roe	0.53	11.46-12.11	--
- ROK	1.30	--	--
- Bait	0.29	--	--
Tanner - Bairdi	1.70	3.25-3.30	--
- Opilio	1.26	1.60-2.00 (2.20)	--
- All	1.32	--	3.50
King - Red	--	--	--
- Blue	--	--	--
- Golden	--	--	--
- All	2.93	7.90-9.00	7.46
Shrimp	3.69	3.50-3.85	--

---

(1) Alaska Department of Fish & Game 1982 "Alaska 1980 Catch & Production Commercial Fisheries Statistics," Western Alaska or State average data.

(2) "Pacific Fishing," 1983 Yearbook (1982 prices).

(3) "Seafood Business Report," Winter (1982 prices).

TABLE 3-4

PROJECTED EX-VESSEL UNIT VALUE OF IMPORTANT BSAI SPECIES, IN DOLLARS PER POUND, BASED ON ASSUMED LOW, AVERAGE AND HIGH RATES OF INFLATION

Species(1)	"Current"(2)	1987(3)			1992			1997			2002			2007		
		Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi
Walleye Pollock	0.06	0.08	0.08	0.09	0.10	0.12	0.14	0.13	0.16	0.21	0.17	0.22	0.32	0.21	0.30	0.49
Pacific Cod	0.24	0.31	0.33	0.37	0.40	0.45	0.56	0.51	0.63	0.85	0.66	0.86	1.30	0.85	1.19	1.98
Flounders, including Yellowfin Sole & Turbot	0.33	0.43	0.45	0.50	0.55	0.63	0.77	0.71	0.86	1.17	0.91	1.18	1.78	1.17	1.63	2.72
Rockfish, including Pacific Ocean Perch	0.19	0.24	0.26	0.29	0.32	0.36	0.44	0.41	0.50	0.67	0.52	0.68	1.03	0.67	0.94	1.56
Sablefish	0.39	0.50	0.54	0.59	0.65	0.74	0.91	0.83	1.02	1.38	1.07	1.40	2.11	1.39	1.93	3.21
Other (as "General Whitefish")	0.19	0.24	0.26	0.29	0.32	0.36	0.44	0.41	0.50	0.67	0.52	0.68	1.03	0.67	0.94	1.56
Halibut	1.06	1.37	1.46	1.62	1.76	2.01	2.46	2.27	2.76	3.76	2.92	3.81	5.73	3.76	5.24	8.73
Sac Roe Herring	0.16	0.21	0.22	0.24	0.27	0.30	0.37	0.34	0.42	0.57	0.44	0.57	0.86	0.57	0.79	1.32
Tanner Crab	1.14	1.47	1.57	1.74	1.89	2.16	2.65	2.44	2.97	4.04	3.14	4.09	6.16	4.05	5.63	9.39
King Crab	3.45	4.45	4.75	5.26	5.73	6.54	8.02	7.38	9.00	12.23	9.51	12.39	18.64	12.25	17.05	28.41
Shrimp	0.27	0.35	0.37	0.41	0.45	0.51	0.63	0.58	0.70	0.96	0.74	0.97	1.46	0.96	1.33	2.22

---

(1) Species and species groups are aggregated to match the reported data. No data were available for species not caught, processed or marketed by domestic participants: Atka mackerel, squid and snails.

(2) See Table 3-2.

(3) Lo = Low rate of increase, 5.2% annually.
Avg = Average rate of increase, 6.6% annually.
Hi = High rate of increase, 8.8% annually.
- See text for rationale.

TABLE 3-5

PROJECTED FIRST WHOLESALE UNIT VALUE OF IMPORTANT BSAI SPECIES,
IN DOLLARS PER POUND, BASED ON ASSUMED LOW, AVERAGE AND HIGH RATES OF INFLATION

Species[1]	"Current"[2]	1987[3]			1992			1997			2002			2007		
		Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi	Lo	Avg	Hi
Walleye Pollock	0.72	0.93	0.99	1.10	1.20	1.36	1.67	1.54	1.88	2.55	1.98	2.59	3.89	2.56	3.56	5.93
Pacific Cod	1.11	1.43	1.53	1.69	1.84	2.10	2.58	2.37	2.90	3.93	3.06	3.99	6.00	3.94	5.49	9.14
Flounders, including Yellowfin Sole & Turbot	1.51	1.95	2.08	2.30	2.51	2.86	3.51	3.23	3.94	5.35	4.16	5.42	8.16	5.36	7.46	12.44
Rockfish, including Pacific Ocean Perch	1.07	1.38	1.47	1.63	1.78	2.03	2.49	2.29	2.79	3.79	2.95	3.84	5.78	3.80	5.29	8.81
Sablefish	0.51	0.66	0.70	0.78	0.85	0.97	1.19	1.09	1.33	1.81	1.41	1.83	2.76	1.81	2.52	4.20
Other (as "General Whitefish")	0.35	0.45	0.48	0.53	0.58	0.66	0.81	0.75	0.91	1.24	0.97	1.26	1.89	1.24	1.73	2.88
Halibut	1.85	2.38	2.54	2.82	3.07	3.51	4.30	3.96	4.83	6.56	5.10	6.64	9.99	6.57	9.14	15.24
Sac Roe Herring	11.46	14.77	15.78	17.47	19.03	21.71	26.64	24.51	29.89	40.61	31.59	41.15	61.91	40.70	56.64	94.39
Tanner Crab	3.50	4.51	4.82	5.34	5.81	6.63	8.13	7.49	9.13	12.40	9.65	12.57	18.91	12.43	17.30	28.83
King Crab	7.46	9.61	10.27	11.37	12.39	14.14	17.34	15.96	19.46	26.43	20.56	26.78	40.30	26.49	36.87	61.44
Shrimp	3.50	4.51	4.82	5.34	5.81	6.63	8.13	7.49	9.13	12.40	9.65	12.57	18.91	12.43	17.30	28.83

---

(1) Species and species groups are aggregated to match the reported data. No data were available for species not caught, processed or marketed by domestic participants: Atka mackerel, squid and snails.

(2) See Table 3-3.

(3) Lo = Low rate of increase, 5.2% annually.
Avg = Average rate of increase, 6.6% annually.
Hi = High rate of increase, 8.8% annually.
- See text for rationale.

- "Other Finfish Species" (this report) was assumed to be equivalent to "General Groundfish" (ADFG 1982).

- No ex-vessel or first-wholesale data were available for Atka mackerel, squid or snails.

- Some species, discrete elsewhere in this report, were aggregated in the tables for consistency with the data sources; e.g., ex-vessel data for king crab are discrete by species, first-wholesale king crab data are reported as "General King Crab."

The forecasting methodology is very simplistic and is intended to be "ballpark" only. A rigorous and thorough econometric forecasting study would be required, but is outside the scope of this report. The projection of any set of prices is a very complex process. Fish and seafood prices are particularly volatile, being affected by changes in market conditions, landings, imports/exports, and inventories, making predictions especially difficult. This analysis assumes that fish and seafood prices will increase, in some fashion, in both real and current dollars. However, changes in market consumption and competition among species and product forms are not forecast. The data for a given year were assumed to be "current" for that year. The forecasts begin at 5 years from present (i.e. 1987), and continue, for every 5 years, over the planning horizon to 2007 (25 years).

A range of three inflation rates was assumed: low (5.2 percent annually), average (6.6 percent annually), and high (8.8 percent annually) (Data Resources Inc. 1982). These rates of increase were applied to the "current" prices in compound interest fashion.

As explained later in this chapter, walleye pollock will be the dominant species (by weight landed) in each of the four lease sale areas. Table 3-4 indicates that the 2007 ex-vessel price of pollock will range between $0.21/lb and $0.49/lb, while its first wholesale price will be $2.56/lb to $5.93/lb (Table 3-5).

3.3.2 Labor Projections

From 1970 to 1976, numbers of fish harvesting employees throughout Alaska fluctuated between 4,000 and 5,000. However,

> "the number of people employed in commercial fishing in Alaska has never been accurately determined nor is there a standardized procedure for estimating fishing employment. The majority of fishermen do not participate in the state's unemployment insurance programs and therefore are not required to submit employment and earnings data to the Alaska Department of Labor. Catch statistics, vessel licenses, landing statistics, and other figures are available from various governmental agencies, however, none of these directly addresses the question of fisheries employment" (Alaska Department of Labor 1980).

For the purposes of this study, fishermen employment in the BSAI fisheries was projected by multiplying the number of catcher vessels (projected in this chapter) by the estimated number of fishermen per vessel. The projections of fishermen employment are presented in the basin-specific and cumulative case sections later in this chapter. As discussed above, fishermen's earnings data are not collected by Alaska Department of Labor. This inadequate (non-existent) data base makes reasonable projections of earnings impossible. Estimates of gross income per fishing vessel are presented in the basin-specific and cumulative case discussions.

Total statewide employment in seafood processing rose from 3,976 in 1975 to 6,784 in 1979, while the respective earnings rose from $9,862 to $15,440 (Alaska Department of Labor 1980). However, the character of the BSAI processing industry is changing: a variety of factors (discussed in Chapter 2 and in Technical Memorandum BC-1, Appendix B) is forcing a trend from traditional onshore processing to offshore processing on floating processors and catcher/processors. Employment on these vessels was estimated by calculating the number of workers necessary to process the projected catches, based on a current understanding of processing technology. Earning were not projected because of the inadequate data base with its associated time lags and variances in reporting. Furthermore, no data are presented to differentiate the processors by the species they handle. "Alaska Economic Trends" (Alaska Department of Labor monthly) reports average hourly earnings, hours per week, and weekly earnings for workers in the food and kindred products category. In Alaska, this category is overwhelmingly composed of seafood processing workers. The wages reported in the most recent 11 months of this bulletin (April 1982 - February 1983) indicate that workers in this category earned an average of $14,786 per year in 1982.

3.3.3 Labor Mobility

Labor mobility implies that factors (income, job satisfaction, property ownership, travel and stability) will positively or negatively influence a worker's decision to remain at his or her job or take another job elsewhere. Not all of these factors are measurable (job satisfaction and stability) and those that are measurable (income, travel) require generalized or averaged data that are relatively meaningless for a quantitative estimate of the impact one industry has on another for job competition.

The development of the domestic fishery projected for the BSAI does not lend itself to a quantitative analysis for labor mobility for the following reasons:

- Many boats fish several species, each with its own separate economic projection.

- Crew shares vary greatly between differing percents of the gross or net earnings. Crew earnings are also affected by expenses they may or may not be required to pay. These arrangements differ between boats and captains. Any generic average is not valid for extrapolating earnings.

- Few crew members in the Bering Sea commercial fishery reside in Dutch Harbor or the other Aleutian or western Alaska villages. Most are from Seattle or major population centers in Alaska.
- There is not much danger of negatively impacting fishery effort by hiring commercial fishing boats for charter. Any financial assistance to the fleet would help the beleaguered crab fleet, where there is already a surplus of effort. It would mitigate the debt service of the fleet.

Combs (1981) calculated labor transfer from the fishing sector to the oil sector using: 1) the results from a study conducted by the Organisation for Economic Co-Operation and Development (OECD 1965), which relates salary differential to probability of transfer; and 2) occupational mobility data in the U.S. (U.S. Department of Labor 1979), which relates age to mobility rate. Combs analyzed generic characteristic gross earnings for different vessels and processing operations to conclude "...the effects of competition for labor will not be as great as would otherwise be expected." The estimates were for the St. George Basin and the North Aleutian Shelf lease sale areas.

The detailed domestic fishing projections contained in this report were not designed to allow a quantitative estimate of each basin by itself. We attempted economic forecasts isolating crew members in each basin using:

- average crew shares
- average crew size
- total pounds per boat
- average ex-vessel prices for each species
- average projected catches
- average number of boats

These projections were unusable because they resulted in unaccountably unrealistic (too high and too low) estimates of fisherman earnings.

3.4 NORTH ALEUTIAN SHELF

Whitefish catches in the North Aleutian Shelf area of the Bering Sea total only 10 percent of the total Bering Sea catch. The domestic fishery in the North Aleutian Shelf can be characterized as a fully developed king and Tanner crab fishery. While a dominant world-class sockeye salmon fishery occurs in Bristol Bay, it does not take place within the proposed lease sale area boundary.

3.4.1 Resource Projections by Species

The projected commercial fishery resources in the North Aleutian Shelf area through 2007 (Table 3-1) are equal to the maximum sustainable yield as calculated by historic catches in the area. The king and Tanner crab resource projections through 2007 presuppose that crab stocks will rebuild, but not to former levels of abundance. While pollock stock estimates are 50 times greater than those for crab, the ex-vessel value of crab is almost two-thirds of the value of pollock[1].

Changes in resource abundance over the next two decades will not significantly affect the impact analysis, which relies on total numbers of boats and crews and the nature of the processing industry. In fact, changes in resource levels would have to be catastrophic to affect the impact projections.

3.4.2 Projected Foreign and Domestic Harvest

Several factors will influence the rate of growth of the domestic fishery in the North Aleutian Shelf area. One important factor is the relaxation of import restrictions by Japan of U.S. exported pollock, surimi and other whitefish products. If the proposed extension of soverign rights in the fishery conservation zone is approved, the growth rate of the U.S.

---

[1] If ex-vessel prices are $0.06/lb for pollock, $1.00/lb for Tanner crab, and $3.00/lb for king crab.

fishery would accelerate. The projections, beginning about 1997, assume there are some temporary exceptions made to the Jones Act that would allow processors and fishermen to purchase large foreign-built catcher/processors.

While the potential whitefish fishery in the North Aleutian Shelf is small when compared to that of the total Bering Sea, the shelf's close proximity to the major onshore processing plants in Bristol Bay, Unalaska, Akutan and, possibly, Chernofski should spur rapid development of a domestic whitefish fishery in the area. As shown on Table 3-6, 25 percent of the pollock catch, 60 percent of the Pacific cod catch, 20 percent of the flatfish catch and 15 percent of all other roundfish species will be caught by the domestic industry in 1987. In 1992, the domestic catch of Pacific cod should increase to 80 percent of the MSY and the accompanying incidental catch of roundfish should double or increase to 30 percent. The total Pacific cod MSY should be harvested by domestic fisherman by 1997; the incidential catch of pollock and roundfish will further increase. The flounder fishery will develop more slowly; by 1997, more than half of the estimated MSY will be caught by domestic fishermen. By 2007, 100 percent of the MSY for all whitefish species should be caught by the domestic fishing industry. The king and Tanner crab fishery will remain a domestic fishery, including domestic at-sea and onshore processing.

The nature and character of the crab processing industry in the North Aleutian Shelf area will remain unchanged. The offshore groundfish fisheries will probably be divided between onshore (40,000 to 50,000 metric tons) and offshore (30,000 metric tons) processors. The offshore processing component will probably be shared between joint ventures and some domestic catcher/processors. The exact nationality of the offshore processors is difficult to determine but it is reasonable to expect one or more foreign/U.S. joint ventures in the North Aleutian Shelf through the year 2007.

Table 3-7 presents the projected domestic catches and estimates of numbers of fishing boats and processors in 5-year increments through 2007. Figures 3-1 and 3-2 present the total projected domestic catch and maximum

TABLE 3-6

PROJECTED DOMESTIC HARVEST OF COMMERCIAL FISHERIES RESOURCES IN THE NORTH ALEUTIAN SHELF, 1987-2007.

	1987		1992		1997		2002		2007	
	Catch (mt)	% of MSY	Catch (mt)	% of MSY	Catch (mt)	% of MSY	Catch (mt)	% of MSY	Catch (mt)	% of MSY
Walleye Pollock	16,770	25	33,540	50	53,664	80	67,080	100	67,080	100
Pacific Cod	7,608	60	10,144	80	12,680	100	12,680	100	12,680	100
All Flounders(1)	1,200	20	1,800	30	3,600	60	4,200	70	6,000	100
Other Roundfish(1)	299	15	599	30	999	50	1,198	60	1,998	100
Herring										
Tanner Crab	900	100	900	100	900	100	900	100	900	100
King Crab	460	100	460	100	460	100	460	100	460	100

Note: It is projected that the domestic industry will be fully harvesting MSY by the year 2007. The catches projected for years previous to 2007 are the domestic fraction of MSY, e.g., North Aleutian Shelf pollock MSY = 67,080 mt; in 1997, the domestic industry will take 80% of this (=53,664 mt).

(1) For terminology, see footnote on page 9.

TABLE 3-7

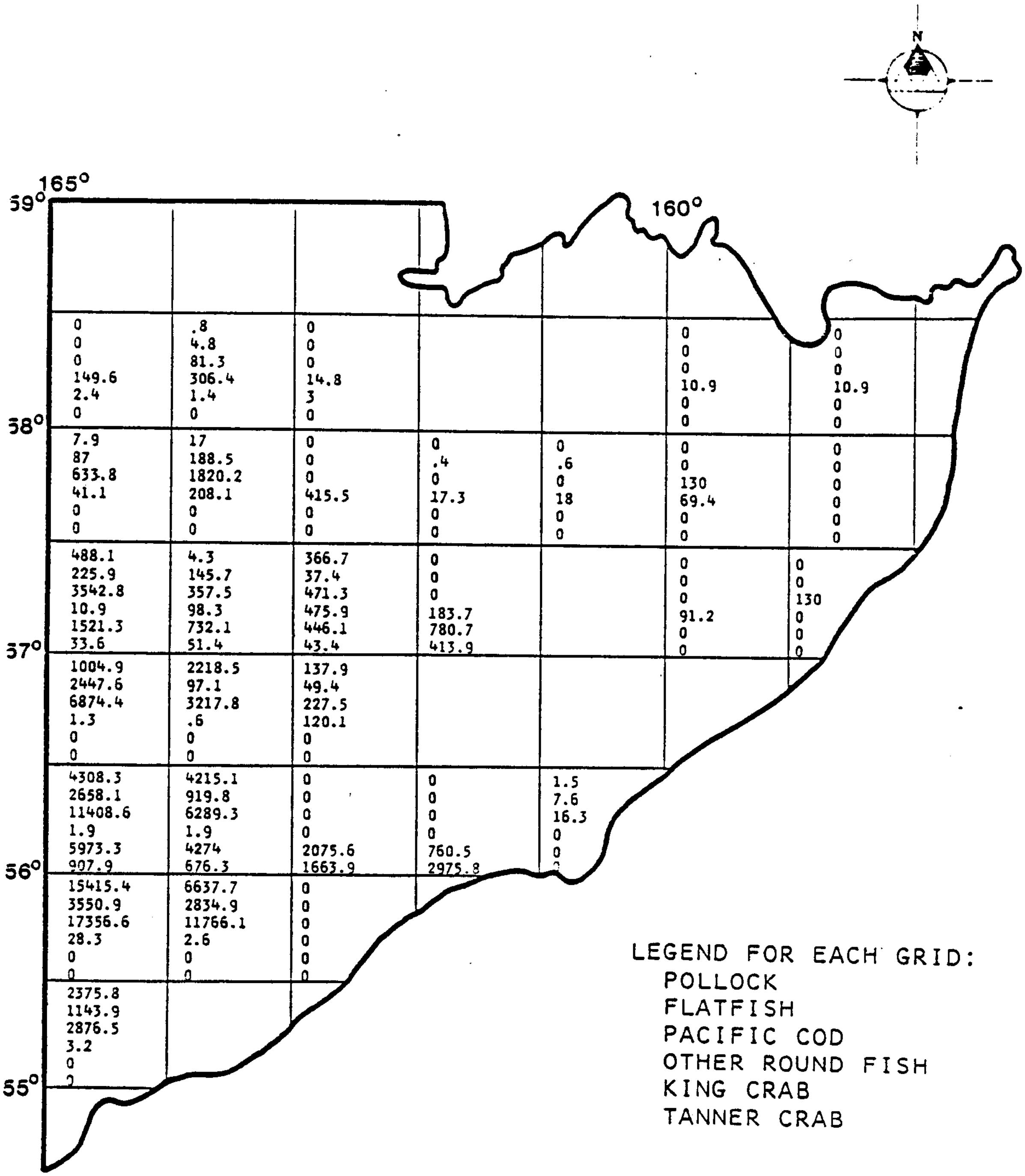
PROJECTED DOMESTIC CATCHES AND NUMBERS OF FISHING BOATS AND PROCESSORS IN THE NORTH ALEUTIAN SHELF AREA IN 5-YEAR INCREMENTS THROUGH 2007

	1987	1992	1997	2002	2007
Pollock					
Metric tons	16,700	33,540	53,664	67,080	67,080
Fishing boats[1]	2	4	7	8	8
Offshore processors[2]	1	1	2	3	3
Onshore processors	0	0	0	0	0
Pacific Cod					
Metric tons	7,608	10,144	12,680	12,680	12,680
Fishing boats[3]	3	4	4	4	4
Offshore processors[4]	1	1	1	1	1
Onshore processors	0	0	0	0	0
All Flatfish					
Metric tons	1,200	1,800	3,600	4,200	6,000
Fishing boats[5]	0	0	1	1	1
Offshore processors[6]	0	0	1	1	1
Onshore processors	0	0	0	0	0
All Other Roundfish					
Metric tons	299	599	999	1,198	1,998
Fishing boats[7]	0	0	0	0	0
Offshore processors	0	0	0	0	0
Onshore processors	0	0	0	0	0
Tanner Crab					
Metric tons[8]	900	900	900	900	900
Fishing boats	5-20	5-20	5-20	5-20	5-20
Offshore processors	0	0	0	0	0
Onshore processors[9]	1-4	1-4	1-4	1-4	1-4
King Crab					
Metric tons	460	460	460	460	460
Fishing boats[8]	5-20	5-20	5-20	5-20	5-20
Offshore processors	0	0	0	0	0
Onshore processors[9]	1-4	1-4	1-4	1-4	1-4
TOTALS					
Metric tons	27,167	47,443	72,303	86,518	89,118
Fishing boats	15-45	18-48	22-52	23-53	23-53
Offshore processors	2	2	4	5	5
Onshore processors	2-8	2-8	2-8	2-8	2-8

---

1) Estimated 80 mt/day, 100 fishing days/year.
2) Estimated 225 mt/day, 100 processing days/year (weight calculated after heading-and-gutting).
3) Estimated 30 mt/day, 100 fishing days/year.
4) Estimated 225 mt/day, 100 processing days/year (weight calculated after heading-and-gutting).
5) Estimated 60 mt/day, 100 fishing days/year.
6) Estimated 225 mt/day, 100 processing days/year.
7) Other roundfish will be caught incidental to other directed fisheries with no boats or processors estimated.
8) Estimates of catch per boat are not valid because the number of fishing boats exceed supply of crab.
9) Estimates of processors reflect crab processed from other adjacent area.

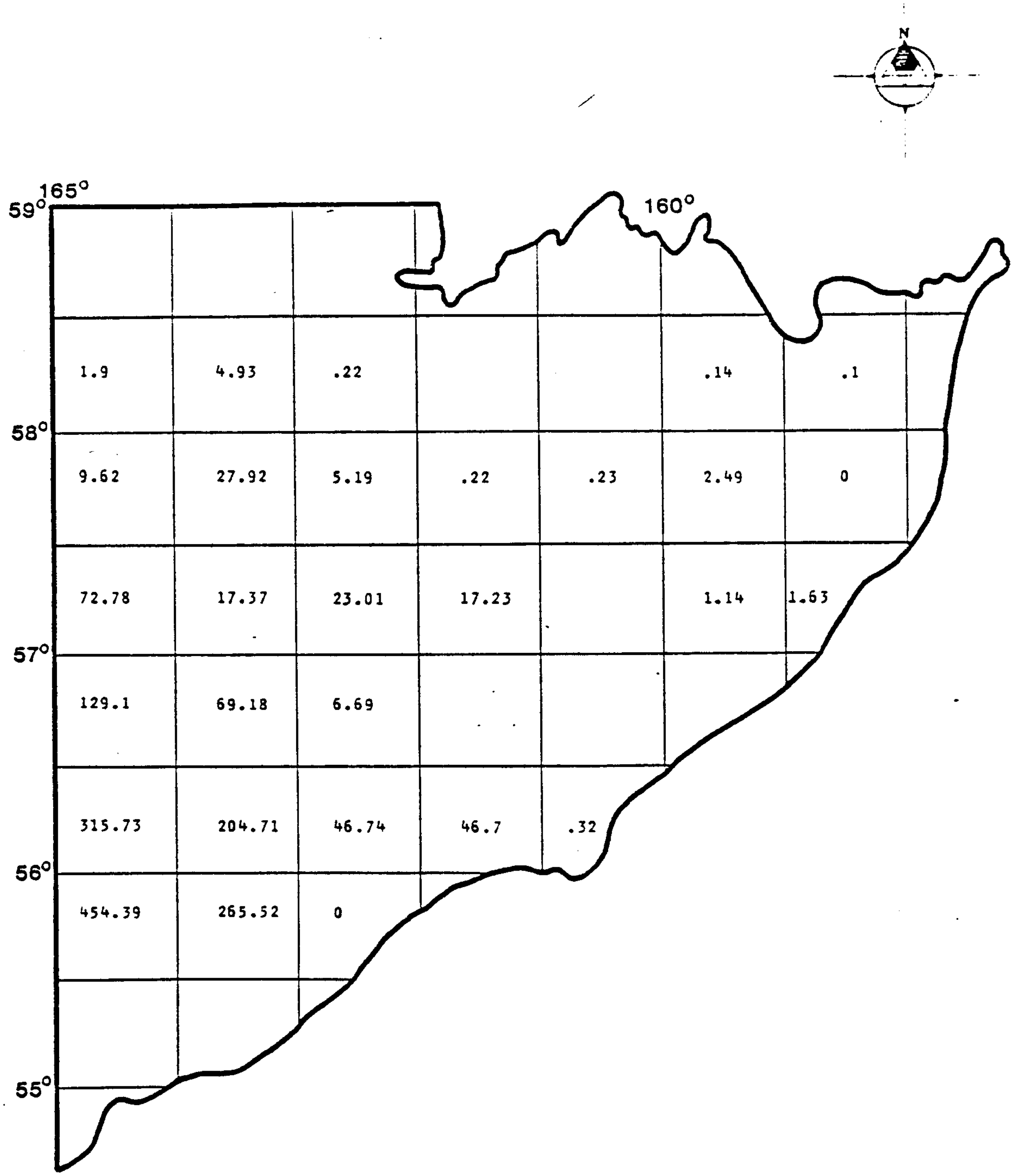
Note: Fishing boats and onshore processors are all domestic. Offshore processors may be foreign or domestic; predominantly domestic.



NORTH ALEUTIAN SHELF LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS
(FULL DOMESTIC USE OF MSY IN 2007 AND THEREAFTER)

Figure 3-1



NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY
(AT FULL DOMESTIC USE OF MSY)

Figure 3-2

number of boat days and illustrate that the southwest sector of the North Aleutian Shelf lease sale area is the most important in terms of the whitefish fishery.

3.4.3 Labor Projections

Tables 3-8 and 3-9 present the estimated employment generated in the harvesting and processing sectors by the projected catches in the North Aleutian Shelf. In the year 2007, the projected catches of walleye pollock will employ 48 harvesting workers and 670 processing workers.

3.5 ST. GEORGE BASIN

3.5.1 Resource Projections by Species

The St. George Basin is the most important of the four lease sale areas in the Bering Sea in terms of volume and value of the catch. For the last 10 years, over 50 percent of the total Bering Sea whitefish catch and most of the king and Tanner crab catch has come from this area. Almost 85 percent of the yellowfin sole, 60 percent of the flatfish, and 56 percent of the pollock catch in the Bering Sea has come from the St. George Basin. The total average annual catch has been around 720,000 metric tons.

The wide range between the lowest and highest potential resource projections of the St. George Basin (Table 3-1) is due in part to fluctuating strengths of different year classes, management stategies, and strong ecosystem food chain relationships. For pollock, the range is between 391,000 and 1,118,000 metric tons. The most likely estimate and the one used for this projection is 670,800 metric tons, which is approximately equal to an apportioned MSY for the St. George Basin area.

Significant quanities of Pacific cod are found along the continental slope. The estimated low and high resource estimates range from 63,000 metric tons to 190,000 metric tons; the most likely estimate has been set at

TABLE 3-8

PROJECTED DOMESTIC FISH HARVESTING EMPLOYMENT BY MAJOR SPECIES GROUPS, NORTH ALEUTIAN SHELF

Species Group	Employees per Vessel(1)	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock	6	12	24	42	48	48
Pacific Cod	6	18	24	24	24	24
All Flatfish, except Halibut	6	0	0	6	6	6
Shellfish	6	240	240	240	240	240
Halibut	6	minor	minor	minor	minor	minor
All Others(2)	6	minor	minor	minor	minor	minor

---

(1) Assumed average.

(2) These are only by-catches and will not appear as discrete target species.

TABLE 3-9

PROJECTED FISH PROCESSING EMPLOYMENT BY MAJOR SPECIES GROUPS, NORTH ALEUTIAN SHELF

Species Group	Employees per Metric Ton	Total Employment (1) 1987	1992	1997	2002	2007
Walleye Pollock	.01	167	335	536	670	670
Pacific Cod	.01	76	100	126	126	126
All Flatfish, except Halibut	.01	0	0	60	60	60
Other Major Species	(2)	(2)	(2)	(2)	(2)	(2)
Shellfish(3)						
King and Tanner Crab	.024	31	31	31	31	31

---

(1) All estimated offshore, except shellfish.

(2) Sablefish, all rockfish, Atka mackerel area counted in pollock, cod and flatfish estimates because they are too insignificant to be measured.

(3) Estimated all onshore.

126,800 metric tons. Estimates for all flatfish are 30,000 to 180,000 metric tons; the most likely estimate is 60,000 metric tons.

Projected crab catches are 4,600 metric tons for king crab and 9,000 metric for Tanner crab. While the Tanner crab resource in the eastern Bering Sea has declined in the last decade, there is some evidence it has stabilized and will rebuild in the next decade (Wespestad 1983). The king crab resource has collapsed but an apportioned MSY estimate is also based on a long-term resource analysis. While the projected domestic pollock catch in 2007 is fifty times greater than the expected crab catch, the ex-vessel value of the crab catch is almost two-thirds of the value of the pollock.

If the winter herring fishery in the northwest corner of the basin is developed by the domestic industry, the projected resources available for harvest could be 6,000 to 7,000 metric tons. The North Pacific Fishery Management Council is continually reviewing the possibility of an offshore winter herring fishery and will in all likelihood recommend one in the near future.

3.5.2 Projected Foreign and Domestic Harvest

The development of the domestic fishery in the St. George Basin will proceed almost simultaneously with the development of the domestic fishery in the North Aleutian Shelf area. The pollock fishery will be larger in St. George Basin than it will be in the North Aleutian Shelf and will proceed at approximately at the same rate of development. Twenty-five percent of the pollock catch in 1987 will be domestic and will expand to 50 percent in 1992, 80 percent in 1997 and 100 percent by the year 2002 (Table 3-10). The Pacific cod fishery will be larger in St. George Basin than in the North Aleutian Shelf but the rate of development will be slower. Possibly by 1987, 50 percent of the 126,800 metric tons of cod will be caught by domestic fishermen. This amount should increase to 80 percent in 1992 and 100 percent in 1997. The rate of development of the flatfish domestic fishery will be similar that in the North Aleutian Shelf, although the quantities will be much larger. The domestic flatfish fishery will not intensify until 1992/

TABLE 3-10

PROJECTED DOMESTIC HARVEST OF COMMERCIAL FISHERIES RESOURCES IN THE ST. GEORGE BASIN, 1987-2007

	1987		1992		1997		2002		2007	
	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY
Walleye Pollock	167,770	25	335,400	50	536,640	80	670,800	100	670,800	100
Pacific Cod	63,400	50	101,440	80	126,800	100	126,800	100	126,800	100
All Flounders(1)	12,000	20	18,000	30	36,000	60	42,000	70	60,000	100
Other Roundfish(1)	2,997	15	5,994	30	9,990	50	11,988	60	19,980	100
Herring	7,000	100	7,000	100	7,000	100	7,000	100	7,000	100
Tanner Crab	9,000	100	9,000	100	9,000	100	9,000	100	9,000	100
King Crab	4,600	100	4,600	100	4,600	100	4,600	100	4,600	100
Halibut	850	100	850	100	850	100	850	100	850	100

Note: It is projected that the domestic industry will be fully harvesting MSY by the year 2007. The catches projected for years previous to 2007 are the domestic fraction of MSY, e.g., St. George Basin pollock MSY = 670,800 mt; in 1997, the domestic industry will take 80% of this (=536,640 mt).

(1) For terminology, see footnote on page 9.

1997 and is not expected to reach 100 percent of the projected catch totals until the year 2007. The rate of development for all other roundfish, except herring, is expected to proceed simultaneously with the pollock and cod fisheries as most other roundfish are caught incidental to those two fisheries. The catch for all other roundfish is projected to be 3,000 metric tons in 1987 and almost 20,000 tons in 2007.

If an offshore winter herring fishery is authorized, it would be an instantaneous domestic fishery taking approximately 7,000 metric tons in 1987. The historic catch for herring has ranged between 2,000 and 50,000 metric tons for the Navarin and St. George Basins. The projected catch is approximately 10,000 metric tons, of which one-third will be caught in the Navarin Basin and two-thirds caught in the St. George Basin.

The king and Tanner crab fisheries will be totally domestic with the annual average catch projected to be approximately 9,000 metric tons for Tanner crab and 4,600 metric tons for king crab.

Because the St. George Basin is the largest basin in the BSAI region, the processing segment of the industry is expected to be diverse. Onshore processing is expected at St. Paul, Unalaska, Akutan and perhaps Chernofski. Offshore processing will involve joint ventures and American floating processors and catcher/processors. With only three to five major onshore processors projected, a significant burden will be placed on offshore processors to handle the projected catch in the St. George Basin.

By the year 2007, the expected domestic catch could be 877,580 metric tons for all whitefish species (Table 3-11). Assuming two whitefish processing plants on St. Paul, two similar plants in Unalaska, and one at Akutan, each processing 200 metric tons per day and operating 150 days per year, the total whitefish processing volume onshore would be 150,000 metric tons. If the plants operate 300 days per year or with double shifts, the expected processing volume would be 300,000 metric tons, leaving almost 420,000 metric tons to be processed offshore. Given that volume, 20 offshore

TABLE 3-11

PROJECTED DOMESTIC CATCHES AND NUMBERS OF FISHING BOATS AND PROCESSORS IN THE ST. GEORGE BASIN IN 5-YEAR INCREMENTS THROUGH 2007

	1987	1992	1997	2002	2007
Pollock					
Metric tons	167,700	335,400	536,640	670,800	670,800
Fishing boats[1]	14	28	45	56	56
Offshore processors[2]	4	8	13	16	15
Onshore processors	1[3]	2[3]	3[4]	4[5]	5[6]
Pacific Cod					
Metric tons	63,400	101,440	126,800	126,800	126,800
Fishing boats[7]	22	35	45	45	45
Offshore processors[8]	2	3	3	2	2
Onshore processors[9]	2	3	4	5	5
Flatfish					
Metric tons	12,000	18,000	36,000	42,000	60,000
Fishing boats[10]	2	3	6	7	10
Offshore processors[11]	1	1	2	2	2
Onshore processors[12]	0	0	0	0	0
All Other Roundfish					
Metric tons	2,997	5,994	9,990	11,988	19,980
Fishing boats[13]	0.2	0.4	0.8	1	2
Offshore processors	[14]	[14]	[14]	[14]	[14]
Onshore processors	[14]	[14]	[14]	[14]	[14]
Herring					
Metric tons	7,000	7,000	7,000	7,000	7,000
Fishing boats[15]	5	5	5	5	5
Offshore processors[16]	1	1	1	1	1
Onshore processors	0	0	0	0	0
Tanner Crab					
Metric tons	9,000	9,000	9,000	9,000	9,000
Fishing boats[17]	10-12	10-12	10-12	10-12	10-12
Offshore processors[18]	1	1	2	2	2
Onshore processors	1	1	0	0	0
King Crab					
Metric tons	4,600	4,600	4,600	4,600	4,600
Fishing boats[19]	10-20	10-20	10-20	10-20	10-20
Offshore processors	0	0	1	1	1
Onshore processors[20]	2	2	1	1	1

TABLE 3-11
(Continued)

	1987	1992	1997	2002	2007
Halibut					
Metric tons	850	850	850	850	850
Fishing boats[21]	8	8	8	8	8
Offshore processors	0	0	0	0	0
Onshore processors[22]	1	1	1	1	1
TOTALS					
Metric tons	267,547	482,284	730,880	873,038	899,030
Fishing boats	71.2-83.2	99.4-111.4	129.8-141.8	142-154	146-158
Offshore processors	9	14	22	24	23
Onshore processors	7	9	9	11	12

---

1) Estimated 80 mt/day fishing 150 days/year.
2) Estimated 225 mt/day processing 150 days/year.
3) Estimated 125 mt/day processing 200 days/year/plant.
4) Estimated one onshore plant processing 250 mt/day, 200 days per year and two onshore plants processing 125/mt day, 200 days/year each.
5) Estimated one onshore plant processing 250 mt/day, 200 days/year and three onshore plants processing 125 mt/day, 200 days per year each.
6) Estimated two onshore plants processing 250 mt/day, 200 days/year each and three onshore plants processing 125 mt/day, 200 days/year each.
7) Estimated 30% of catch by longline boats and 70% by trawlers at 10 mt/day, 150 days/year each for longline boats and 30 mt/day, 150 days/year each for trawlers.
8) Estimated 150 mt/day, 150 days/year each offshore processor.
9) Estimated 75 mt/day, 200 days/year each onshore processor.
10) Estimated 60 mt/day, 100 days/year fishing.
11) Estimated 160 mt/day, 100 days processing each.
12) Estimated no onshore processing for flatfish, except halibut to be processed in insignificant quantities in Pribilofs.
13) Estimated 80 mt/day, fishing 150 days/year.
14) Quantities taken will be incidential to other directed fisheries and will be processed in existing plants, offshore and onshore.
15) Estimated 30 mt/day, 50 fishing days/year.
16) Estimated 150 mt/day, 50 processing days/year.
17) Estimated 5-10 mt/day, 100 fishing days/year.
18) Estimated 50 mt/day, processing 100 days/year.
19) Estimated 20 mt/day, 25 fishing days/year.
20) Estimated 100 mt/day, 25 processing days/year.
21) Estimated 2.5 mt/day catch for 45 days/year fishing.
22) Estimated Pribilofs shore-based processing for 50 percent of catch; the remainder landed outside BSAI area.

Note: Fishing boats and onshore processors are all domestic. Offshore processors may be foreign or domestic; predominantly domestic.

processors harvesting 180 metric tons per day and processing for 116 days per year could process the quota. It is unlikely that more than 50 percent of those processors would be domestic processors by the year 2007.

Figures 3-3 and 3-4 present the total projected domestic catch and maximum number of boat days.

3.5.3 Labor Projections

Tables 3-12 and 3-13 present the estimated employment generated in the harvesting and processing sectors by the projected catches in the St. George Basin. In the year 2007, the projected catches of walleye pollock will employ 336 harvesting workers and 6,708 processing workers.

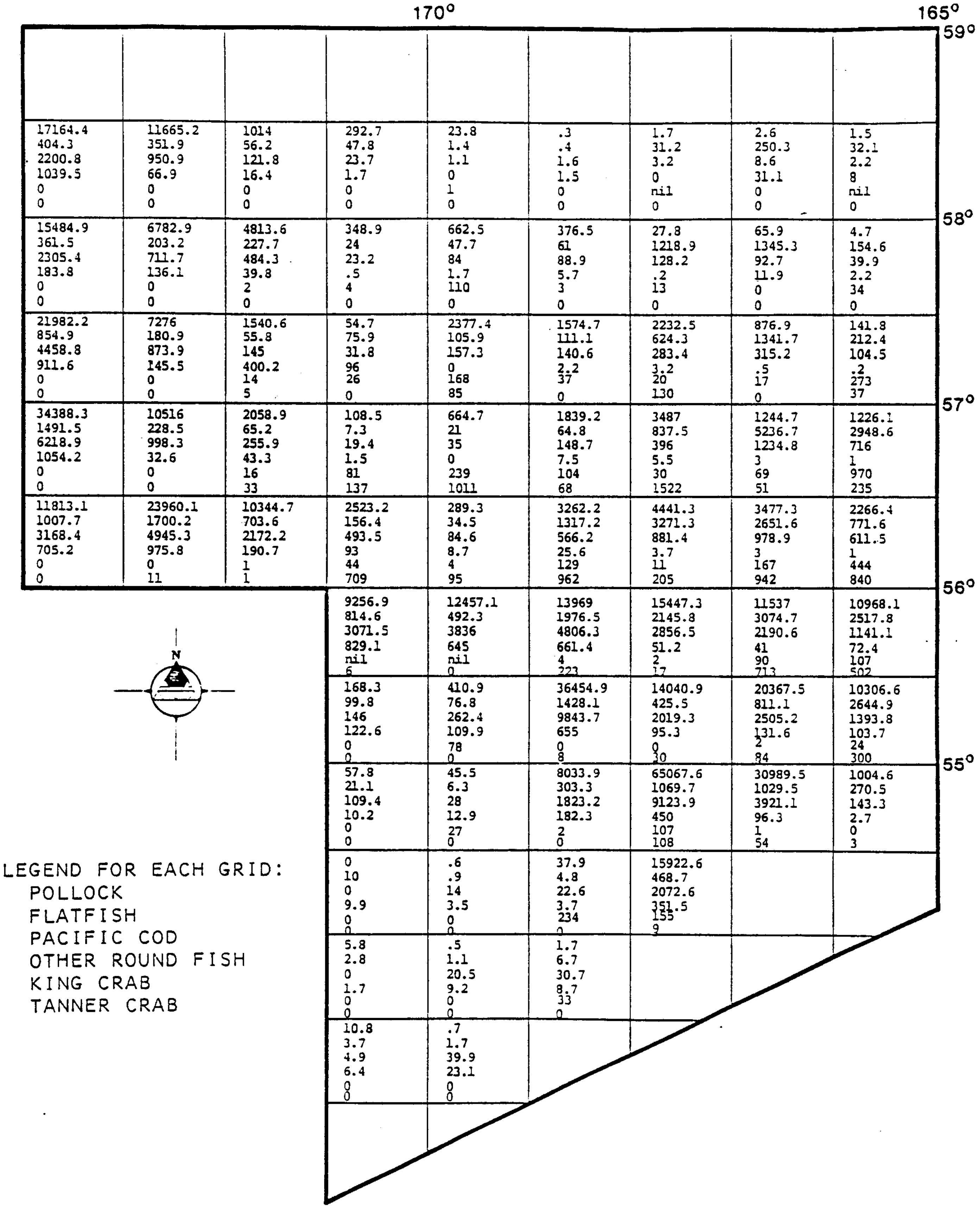
3.6 NORTON BASIN

3.6.1 Resource Projections by Species

The projected commercial fisheries resources in Norton Basin are insignificant when compared to the resources of the other three basins or the Bering Sea as a whole (Table 3-1). Less than one percent of the total whitefish catch comes from Norton Basin; the annual historic average based on 10 years of foreign catches is only 1,558 metric tons. Minor amounts of pollock, flounder, Pacific cod, and herring are caught in Norton Basin. Blue king crab are taken in a small domestic fishery. The estimates of the projected commercial fisheries resources through the year 2007 are 1,200 metric tons of pollock and 600 metric tons of other whitefish. Approximately 460 metric tons of king crab could be taken in the Norton Basin annually. The relatively high value of the king crab resource makes it the dominant fishery in Norton Basin.

3.6.2 Projected Foreign and Domestic Harvest

Domestic utilization of Norton Basin resources is projected at 100 percent. In actual fact, the projection is insignificant when compared to



17164.4 404.3 2200.8 1039.5 0 0	11665.2 351.9 950.9 66.9 0 0	1014 56.2 121.8 16.4 0 0	292.7 47.8 23.7 1.7 0 0	23.8 1.4 1.1 0 1 0	.3 .4 1.6 1.5 0 0	1.7 31.2 3.2 0 nil 0	2.6 250.3 8.6 31.1 0 0	1.5 32.1 2.2 8 nil 0
15484.9 361.5 2305.4 183.8 0 0	6782.9 203.2 711.7 136.1 0 0	4813.6 227.7 484.3 39.8 2 0	348.9 24 23.2 .5 4 0	662.5 47.7 84 1.7 110 0	376.5 61 88.9 5.7 3 0	27.8 1218.9 128.2 .2 13 0	65.9 1345.3 92.7 11.9 0 0	4.7 154.6 39.9 2.2 34 0
21982.2 854.9 4458.8 911.6 0 0	7276 180.9 873.9 145.5 0 0	1540.6 55.8 145 400.2 14 5	54.7 75.9 31.8 96 26 0	2377.4 105.9 157.3 0 168 85	1574.7 111.1 140.6 2.2 37 0	2232.5 624.3 283.4 3.2 20 130	876.9 1341.7 315.2 .5 17 0	141.8 212.4 104.5 .2 273 37
34388.3 1491.5 6218.9 1054.2 0 0	10516 228.5 998.3 32.6 0 0	2058.9 65.2 255.9 43.3 16 33	108.5 7.3 19.4 1.5 81 137	664.7 21 35 0 239 1011	1839.2 64.8 148.7 7.5 104 68	3487 837.5 396 5.5 30 1522	1244.7 5236.7 1234.8 3 69 51	1226.1 2948.6 716 1 970 235
11813.1 1007.7 3168.4 705.2 0 0	23960.1 1700.2 4945.3 975.8 0 11	10344.7 703.6 2172.2 190.7 1 1	2523.2 156.4 493.5 93 44 709	289.3 34.5 84.6 8.7 4 95	3262.2 1317.2 566.2 25.6 129 962	4441.3 3271.3 881.4 3.7 11 205	3477.3 2651.6 978.9 3 167 942	2266.4 771.6 611.5 1 444 840
			9256.9 814.6 3071.5 829.1 nil 6	12457.1 492.3 3836 645 nil 0	13969 1976.5 4806.3 661.4 4 223	15447.3 2145.8 2856.5 51.2 2 17	11537 3074.7 2190.6 41 90 713	10968.1 2517.8 1141.1 72.4 107 502
			168.3 99.8 146 122.6 0 0	410.9 76.8 262.4 109.9 78 0	36454.9 1428.1 9843.7 655 0 8	14040.9 425.5 2019.3 95.3 0 30	20367.5 811.1 2505.2 131.6 2 84	10306.6 2644.9 1393.8 103.7 24 300
			57.8 21.1 109.4 10.2 0 0	45.5 6.3 28 12.9 27 0	8033.9 303.3 1823.2 182.3 2 0	65067.6 1069.7 9123.9 450 107 108	30989.5 1029.5 3921.1 96.3 1 54	1004.6 270.5 143.3 2.7 0 3
			0 10 0 9.9 0 0	.6 .9 14 3.5 0 0	37.9 4.8 22.6 3.7 234 0	15922.6 468.7 2072.6 351.5 155 9		
			5.8 2.8 0 1.7 0 0	.5 1.1 20.5 9.2 0 0	1.7 6.7 30.7 8.7 33 0			
			10.8 3.7 4.9 6.4 0 0	.7 1.7 39.9 23.1 0 0				

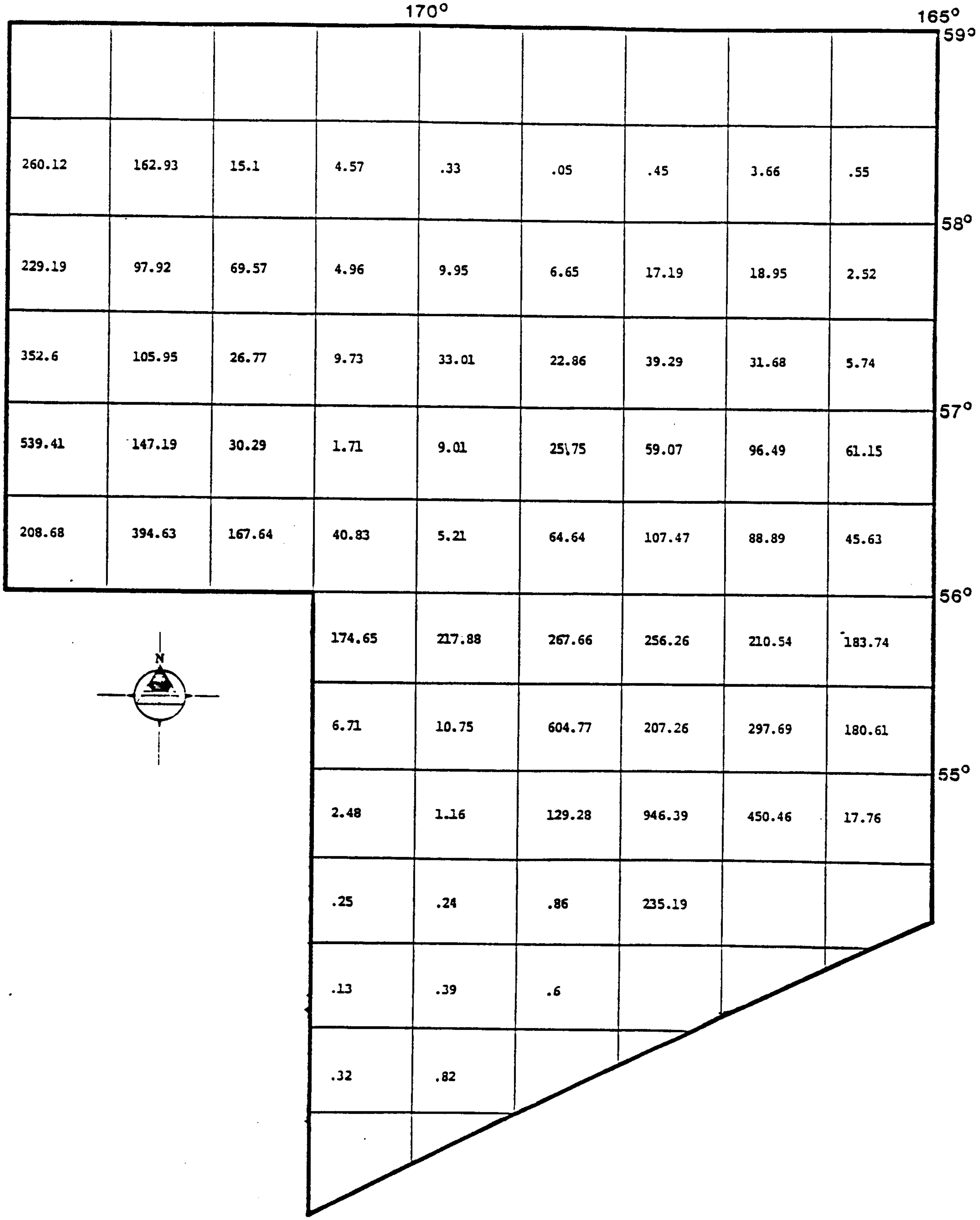
LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS

(FULL DOMESTIC USE OF MSY IN 2007 AND THEREAFTER)

Figure 3-3



260.12	162.93	15.1	4.57	.33	.05	.45	3.66	.55
229.19	97.92	69.57	4.96	9.95	6.65	17.19	18.95	2.52
352.6	105.95	26.77	9.73	33.01	22.86	39.29	31.68	5.74
539.41	147.19	30.29	1.71	9.01	25.75	59.07	96.49	61.15
208.68	394.63	167.64	40.83	5.21	64.64	107.47	88.89	45.63
			174.65	217.88	267.66	256.26	210.54	183.74
			6.71	10.75	604.77	207.26	297.69	180.61
			2.48	1.16	129.28	946.39	450.46	17.76
			.25	.24	.86	235.19		
			.13	.39	.6			
			.32	.82				

ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY
(AT FULL DOMESTIC USE OF MSY)

Figure 3-4

TABLE 3-12

PROJECTED DOMESTIC FISH HARVESTING EMPLOYMENT BY MAJOR SPECIES GROUPS, ST. GEORGE BASIN

Species Group	Employees per Vessel(2)	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock	6	84	168	270	336	336
Pacific Cod	6	132	210	270	270	270
All Flatfish, except Halibut	6	12	18	36	42	60
Herring	6	30	30	30	30	30
Other Major Species(1)	6	Nil	Nil	Nil	6	6
Shellfish	6	240	240	240	240	240
Halibut	6	48	48	48	48	48

---

(1) Sablefish, all rockfish, Atka mackerel.

(2) Assumed average.

TABLE 3-13

PROJECTED FISH PROCESSING EMPLOYMENT BY MAJOR SPECIES GROUPS, ST. GEORGE BASIN

Species Group	Employees per Metric Ton	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock						
Onshore	.01	335	670	1006	1341	1677
Offshore	.01	1341	2683	4360	5366	5031
Pacific Cod						
Onshore	.01	184	340	593	818	818
Offshore	.01	450	675	675	450	450
All Flatfish, except Halibut						
Onshore	.01	0	0	0	0	0
Offshore	.01	180	180	360	420	600
Herring						
Offshore Only	.008	60	60	60	60	60
Other Major Species(1)						
Onshore	.01	(2)	(2)	(2)	(2)	(2)
Offshore	.01	(2)	(2)	(2)	(2)	(2)
Shellfish						
Onshore	.024	210	210	210	210	210
Offshore	.024	104	104	104	104	104

---

(1) Sablefish, all rockfish, Atka mackerel.

(2) Too insignificant to calculate.

the projections for the other three basins. One large trawler could take the entire projected Norton Basin whitefish quota in 22 days and all the fish could be processed by one processor in less than 10 days (Table 3-14).

The maximum projected catch by species by 1/2° x 1° subarea for 2007 is shown on Figure 3-5. The maximum estimates of boat days is depicted on Figure 3-6.

3.6.3 Labor Projections

Tables 3-15 and 3-16 present the estimated employment generated in the harvesting and processing sectors by the projected catches in the Norton Basin. In the year 2007, the projected catches of shellfish will employ 60 harvesting workers and 10 processing workers.

3.7 NAVARIN BASIN

3.7.1 Resource Projections by Species

The resources of the Navarin Basin are second only to those of the St. George Basin. Almost 40 percent of the BSAI pollock quota has historically been taken in the Navarin Basin and nearly one-third of the Pacific cod have been caught there.

The estimated potential pollock catch is 459,600 metric tons (Table 3-1). By comparison, all other species combined account for less than 20 percent of the expected catch from the Navarin area. New survey information (NMFS 1983) suggests the Pacific cod resources will surpass the flatfish estimates, making cod the next most abundant species (contrary to Technical Report 82, which was based 1982 information [Wespestad 1983]). The estimated annual average yields for cod and all flatfish are 34,200 metric tons and 26,700 metric tons, respectively.

All other roundfish except herring will be caught incidental to the directed fisheries for pollock, cod and flatfish. The herring resource is

TABLE 3-14

PROJECTED DOMESTIC CATCHES AND NUMBERS OF FISHING BOATS AND PROCESSORS IN THE NORTON BASIN IN 5-YEAR INCREMENTS THROUGH 2007

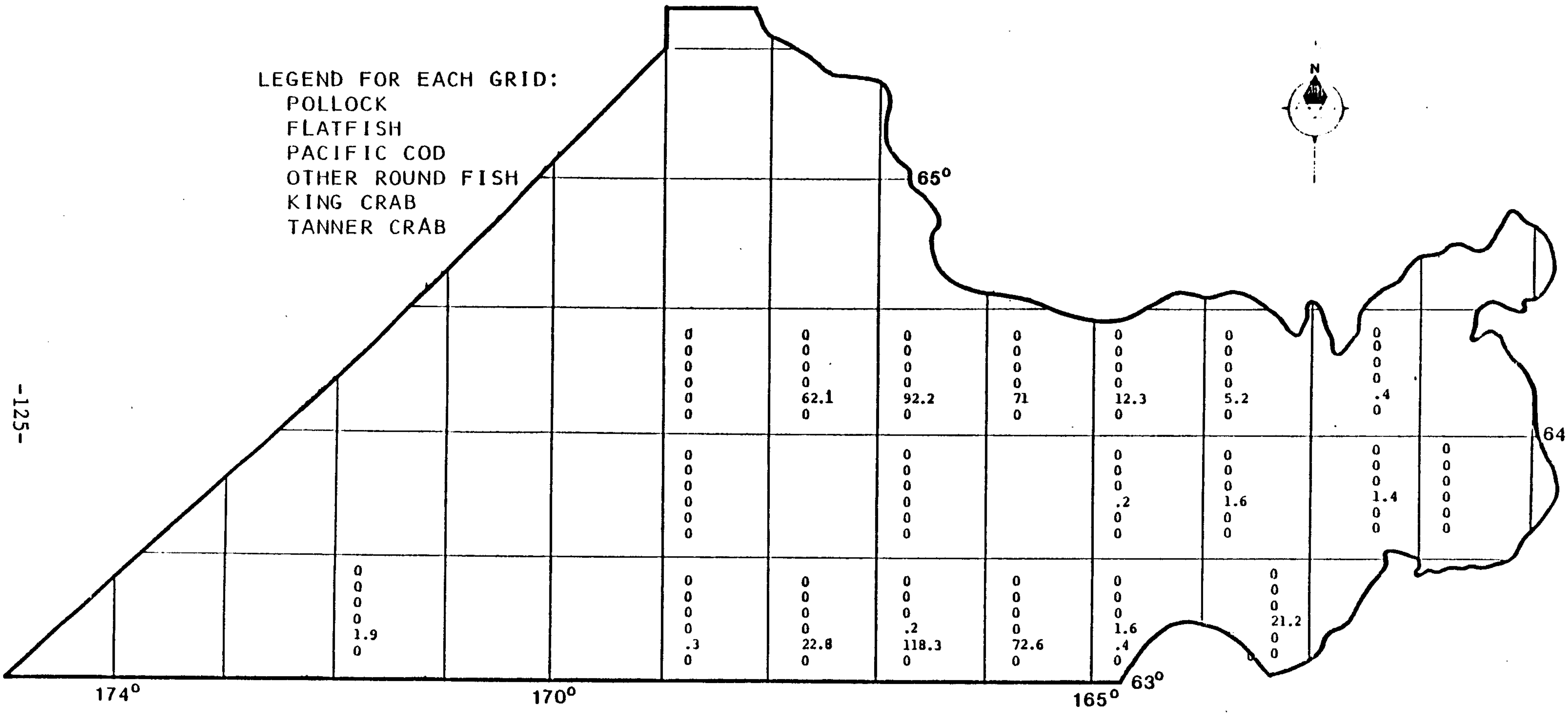
	1987	1992	1997	2002	2007
Pollock					
Metric tons	1,200	1,200	1,200	1,200	1,200
Fishing boats1)	0.15	0.15	0.15	0.15	0.15
Offshore processors	0	0	0	0	0
Onshore processors	0	0	0	0	0
Pacific Cod					
Metric tons	minor	minor	minor	minor	minor
Fishing boats	2)				
Offshore processors	2)				
Onshore processors	2)				
Flatfish					
Metric tons	minor	minor	minor	minor	minor
Fishing boats	2)				
Offshore processors	2)				
Onshore processors	2)				
All Other Roundfish					
Metric tons	600	600	600	600	600
Fishing boats	nil	nil	nil	nil	nil
Offshore processors	2)				
Onshore processors	2)				
Tanner Crab					
Metric tons	minor	minor	minor	minor	minor
Fishing boats	2)				
Offshore processors	2)				
Onshore processors	2)				
King Crab					
Metric tons	460	460	460	460	460
Fishing boats	4-10	4-10	4-10	4-10	4-10
Offshore processors	1	1	1	1	1
Onshore processors	0	0	0	0	0
TOTALS					
Metric tons	2,260	2,260	2,260	2,260	2,260
Fishing boats	4-10	4-10	4-10	4-10	4-10
Offshore processors	1	1	1	1	1
Onshore processors	0	0	0	0	0

---

1) Estimated 80 mt/day, fishing 100 days per year.

2) The estimates are so low it is not practical to estimate boats or processors.

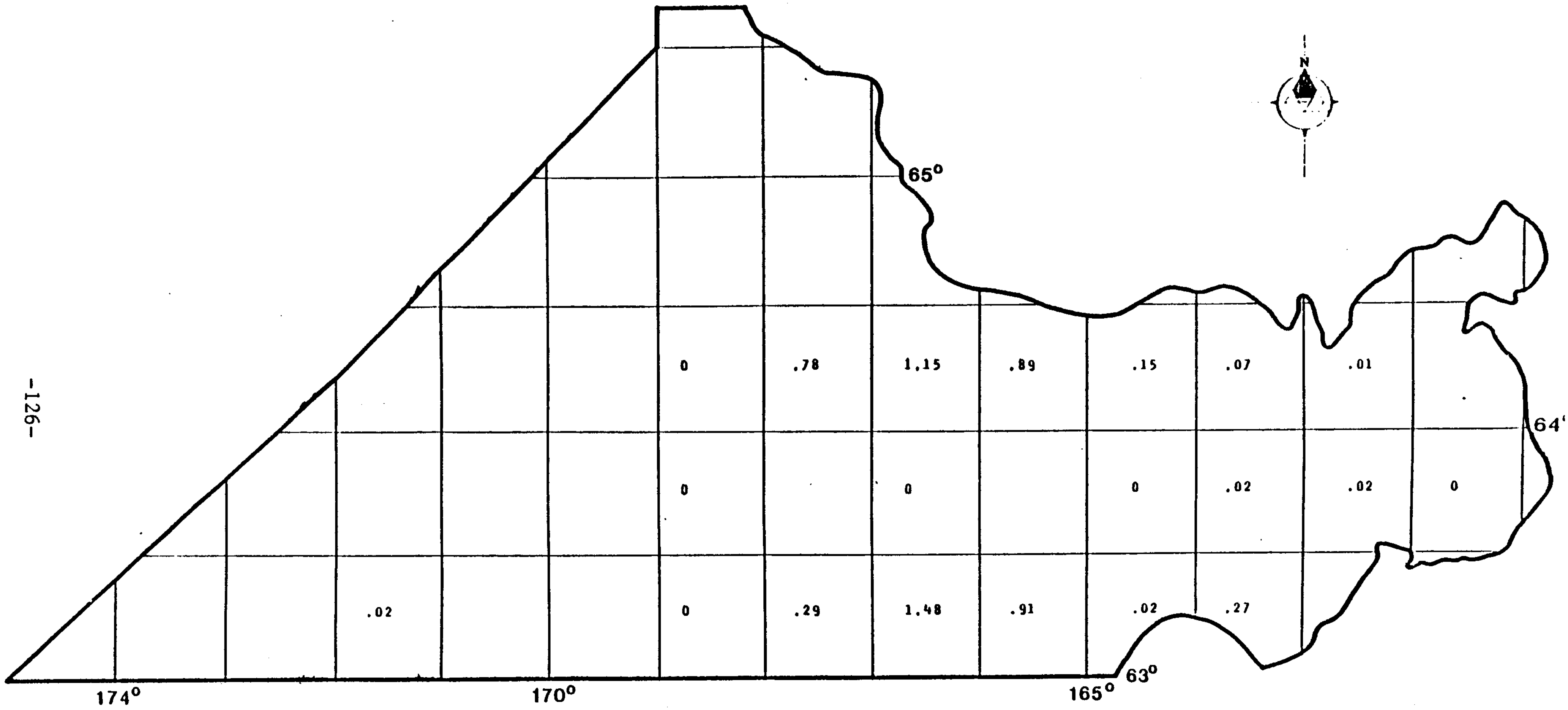
Note: Fishing boats and onshore processors are all domestic. Offshore processors may be foreign or domestic; predominantly domestic.



NORTON BASIN LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS
(FULL DOMESTIC USE OF MSY IN 2007 AND THEREAFTER)

Figure 3-5



NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY
(AT FULL DOMESTIC USE OF MSY)

Figure 3-6

TABLE 3-15

PROJECTED DOMESTIC FISH HARVESTING EMPLOYMENT BY MAJOR SPECIES GROUPS, NORTON BASIN

Species Group	Employees per Vessel(2)	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock	6	(1)	(1)	(1)	(1)	(1)
Pacific Cod	6	(1)	(1)	(1)	(1)	(1)
All Flatfish, except Halibut	6	(1)	(1)	(1)	(1)	(1)
Herring	6	(1)	(1)	(1)	(1)	(1)
Other Major Species	6	(1)	(1)	(1)	(1)	(1)
Shellfish	6	60	60	60	60	60
Halibut	6	(1)	(1)	(1)	(1)	(1)
All Others	6	(1)	(1)	(1)	(1)	(1)

---

(1) One trawler fishing 22 days can catch the projected quota for Norton Sound. Therefore, no employment figures are possible for whitefish.

(2) Assumed average.

TABLE 3-16

PROJECTED FISH PROCESSING EMPLOYMENT BY MAJOR SPECIES GROUPS, NORTON BASIN

Species Group	Employees per Metric Ton	Total Employment(1) 1987	1992	1997	2002	2007
Walleye Pollock	.01	12	12	12	12	12
Pacific Cod	0	0	0	0	0	0
All Flatfish, except Halibut	0	0	0	0	0	0
Other Major Species(2)	.01	6	6	6	6	6
Shellfish	.023	10	10	10	10	10

---

(1) Estimated offshore.

(2) Sablefish, all rockfish, Atka mackerel.

seasonal and is generally found in the Navarin Basin during the winter. The average annual harvest is projected to be 3,000 metric tons (Wespestad 1983).

Tanner crab are present in the Navarin Basin, but a fishery that could harvest the MSY may never materalize because of weather and the relative sparse distribution of Tanner crab in this area.

3.7.2 Projected Foreign and Domestic Harvests

The pollock fishery in the Navarin Basin is currently 100 percent foreign. All available evidence supports the projection that the fishery will be 100 percent domestic by the year 2007 (Table 3-17), although Navarin Basin will be the last of the four basins to be fully developed because it is farthest from existing ports and will require larger boats and a fleet of floating processors.

The first efforts at establishing a domestic pollock fishery in the Navarin Basin will occur after the domestic industry has entered the St. George area and has established a dominant offshore processing capability. This will probably occur in 10 to 15 years if: 1) major input restrictions by Japan are lifted; 2) large processors can be purchased or leased cheaply; 3) crab stocks remain depressed or below historic levels; and 4) Japan/U.S. joint ventures producing surimi are encouraged. The projections will be off by 5 to 10 years if any of these factors do not materialize.

Catches could increase in 10 to 20 years if management strategies emphasize the harvest of large pollock to decrease predation on invertebrates. The catch projected for 1997 assumes only 17 trawlers catching 80 metric tons per day each for 100 fishing days a year (Table 3-18). By 2007, assuming conservative catch rates and 100 fishing days per year per boat, 57 boats could harvest the entire pollock resource historically caught in the Navarin Basin. There are now more than 30 trawlers fishing whitefish off Alaska and 10 times that many could be converted.

TABLE 3-17

PROJECTED DOMESTIC HARVEST OF COMMERCIAL FISHERIES RESOURCES IN THE NAVARIN BASIN, 1987-2007

	1987		1992		1997		2002		2007	
	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY	Total (mt)	% of MSY
Walleye Pollock	22,980	5	45,960	10	137,880	30	321,720	70	459,600	100
Pacific Cod	342	1	10,260	30	23,940	70	27,360	80	34,200	100
All Flounders(1)	267	1	1,335	5	8,010	30	18,690	70	26,700	100
Other Roundfish(1)	109	1	549	5	3,294	30	7,686	70	10,980	100
Herring	3,000	100	3,000	100	3,000	100	3,000	100	3,000	100
King Crab	23	100	23	100	23	100	23	100	23	100
Halibut	150	100	150	100	150	100	150	100	150	100

Note: It is projected that the domestic industry will be fully harvesting MSY by the year 2007. The catches projected for years previous to 2007 are the domestic fraction of MSY, e.g., Navarin Basin pollock MSY = 459,600 mt; in 1997, the domestic industry will take 80% of this (=137,880 mt).

(1) For terminology, see footnote on page 9.

TABLE 3-18

PROJECTED DOMESTIC CATCHES AND NUMBERS OF BOATS AND PROCESSORS IN THE NAVARIN BASIN IN 5-YEAR INCREMENTS THROUGH 2007

	1987	1992	1997	2002	2007
Pollock					
Metric tons	22,980	45,960	137,880	321,720	459,600
Fishing boats[1)]	3	6	17	40	57
Offshore processors[2)]	1	2	6	14	20
Onshore processors[3)]	0	0	0	0	0
Pacific Cod					
Metric tons	342	10,260	23,940	27,360	34,200
Fishing boats[4)]	1	3	8	9	11
Offshore processors[5)]	0	1	1	2	2
Onshore processors[3)]	0	0	0	0	0
Flatfish					
Metric tons	267	1,335	8,010	18,690	26,700
Fishing boats[6)]	0	0	1	3	5
Offshore processors[7)]	0	0	0	1	1
Onshore processors[3)]	0	0	0	0	0
All Other Roundfish					
Metric tons	109	549	3,294	7,686	10,980
Fishing boats	0	0	1	1	1
Offshore processors	0	0	0	0	0
Onshore processors	0	0	0	0	0
Herring					
Metric tons	3,000	3,000	3,000	3,000	3,000
Fishing boats[8)]	2	2	2	2	2
Offshore processors	1	1	1	1	1
Onshore processors	0	0	0	0	0
Shellfish[9)]					
Metric tons	Nil	Nil	Nil	Nil	Nil
Fishing boats					
Offshore processors					
Onshore processors					
Halibut					
Metric tons	150	150	150	150	150
Fishing boats[10)]	2	2	2	2	2
Offshore processors	0	0	0	0	0
Onshore processors	0	0	0	0	0

TABLE 3-18
(Continued)

	1987	1992	1997	2002	2007
TOTALS					
Metric tons	26,848	51,254	176,274	378,606	534,630
Fishing boats	8	13	31	57	78
Offshore processors	2	4	8	18	24
Onshore processors	0	0	0	0	0

---

1) Estimated 80 mt/day catch, fishing 100 days/year.

2) Estimated processing capacity 500,000 lbs/day, 100 days/year (weight calculated after heading-and-gutting).

3) No onshore processing estimated for the Navarin Basin.

4) Estimated 30 mt/day catch trawling, fishing 100 days/year.

5) Estimated processing capacity 225 mt/day, 100 days year (weight calculated after heading-and-gutting).

6) Estimated 60 mt/day catch, fishing 100 days/year.

7) Estimated 225 mt/day, 100 days/year processing.

8) Estimated 30 mt/day, 50 days/year catch.

9) Negligible shellfish catches.

10) Estimated 2.5 mt/day, fishing 45 days/year..

Note: Fishing boats and onshore processors are all domestic. Offshore processors may be foreign or domestic; predominantly domestic.

A Pacific cod fishery could develop quite rapidly in the Navarin area assuming: 1) full utilization of the cod quotas in all other areas, primarily Unimak Pass and the southern Bering Sea shelf area; 2) continued strong market for salt cod and headed and gutted blocks; 3) a healthy cod population; 4) financing support for directed cod operations; 5) favorable management, perhaps providing some U.S. sanctuaries; and 6) the development of the pollock fishery.

Figure 3-7 represents the maximum projected domestic catch in the Navarin by species, by 1/2° x 1° cell for 2007. Figure 3-8 represents the maximum estimated boat days to be expected in the Navarin by 1/2° x 1° cell in 2007.

3.7.3 Labor Projections

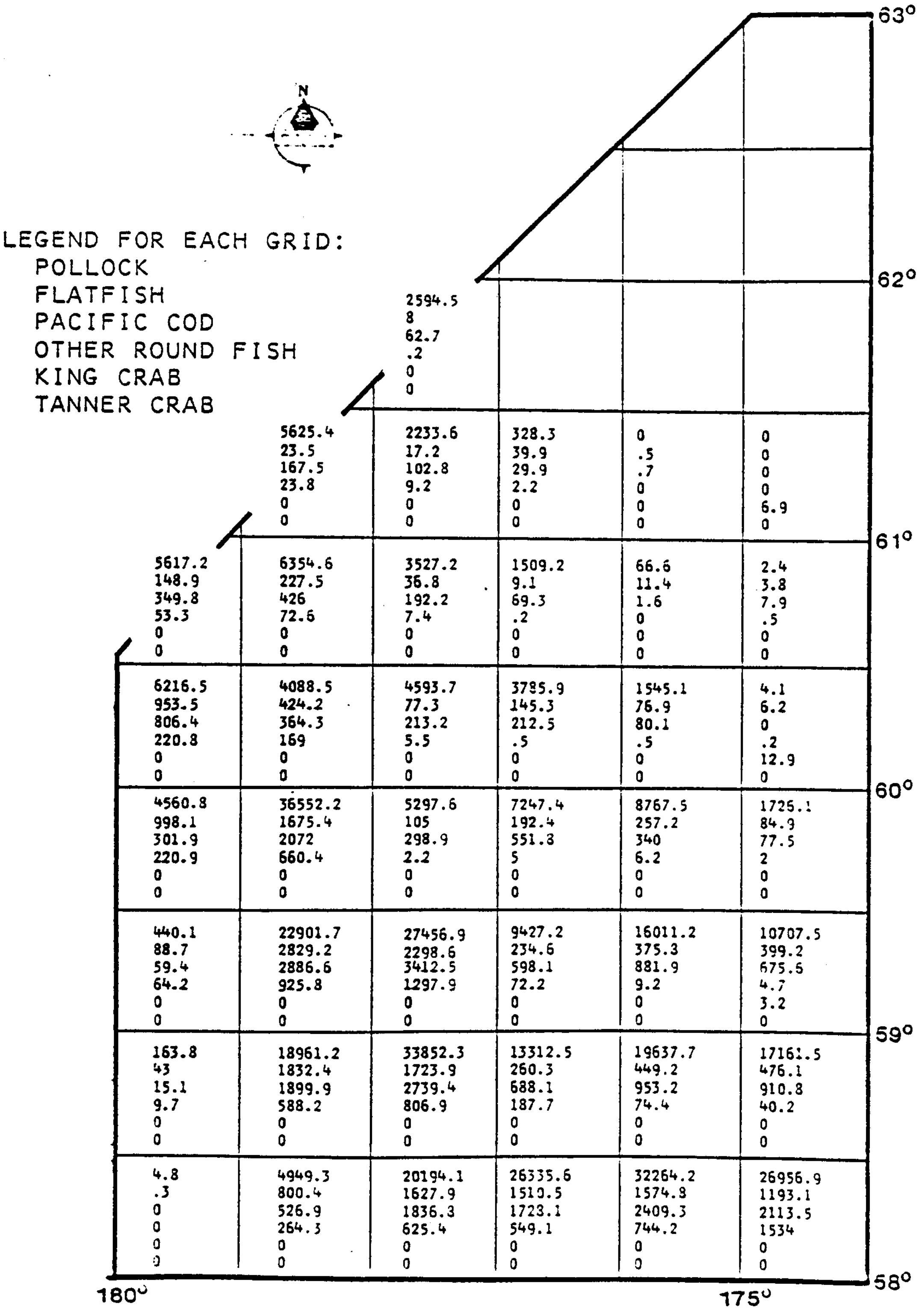
Tables 3-19 and 3-20 present the estimated employment generated in the harvesting and processing sectors by the projected catches in the Navarin Basin. In the year 2007, the projected catches of walleye pollock will employ 342 harvesting workers and 4,596 processing workers.

3.8 CUMULATIVE CASE

3.8.1 Resource Projections by Species

Clearly, the geographic area included in the four lease sale areas takes in most of the fishery resources of the BSAI. Pollock constitute the most significant biomass. The other dominant species are Pacific cod and the flatfish group, each constituting about 20 percent of the pollock biomass.

While it is acceptable to consider the four lease sale areas separately for petroleum interests, it is not practicable for fisheries. The resources, fisheries, fishermen and processors are not necessarily divided geographically. Therefore, this section discusses the cumulative development of the fishing industry in all four areas and, perhaps, is an accurate reflection of the cumulative scenario for the entire BSAI.

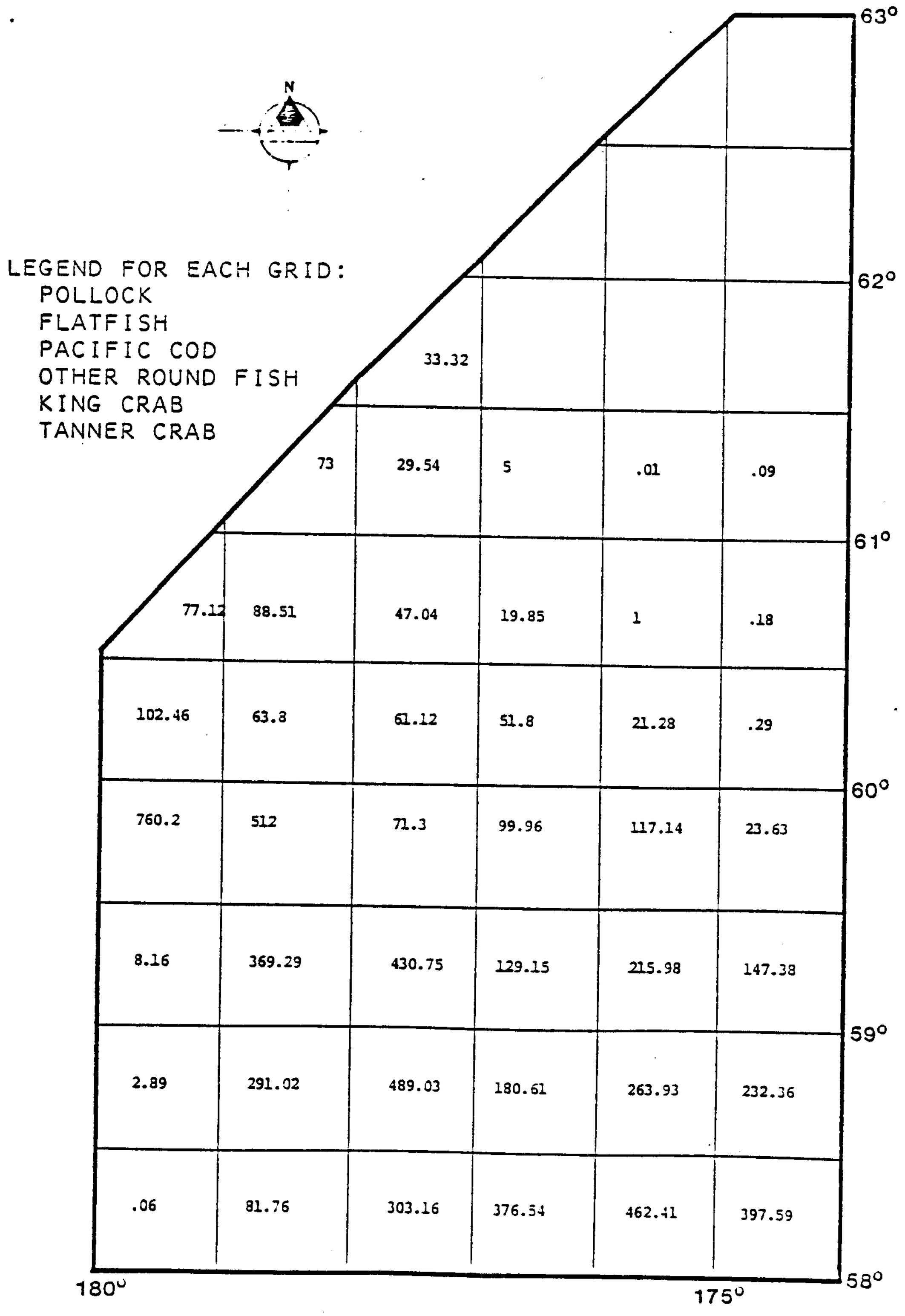


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		2594.5 8 62.7 .2 0 0			
	5625.4 23.5 167.5 23.8 0 0	2233.6 17.2 102.8 9.2 0 0	328.3 39.9 29.9 2.2 0 0	0 .5 .7 0 0 0	0 0 0 0 6.9 0
5617.2 148.9 349.8 53.3 0 0	6354.6 227.5 426 72.6 0 0	3527.2 36.8 192.2 7.4 0 0	1509.2 9.1 69.3 .2 0 0	66.6 11.4 1.6 0 0 0	2.4 3.8 7.9 .5 0 0
6216.5 953.5 806.4 220.8 0 0	4088.5 424.2 364.3 169 0 0	4593.7 77.3 213.2 5.5 0 0	3785.9 145.3 212.5 .5 0 0	1545.1 76.9 80.1 .5 0 0	4.1 6.2 0 .2 12.9 0
4560.8 998.1 301.9 220.9 0 0	36552.2 1675.4 2072 660.4 0 0	5297.6 105 298.9 2.2 0 0	7247.4 192.4 551.8 5 0 0	8767.5 257.2 340 6.2 0 0	1725.1 84.9 77.5 2 0 0
440.1 88.7 59.4 64.2 0 0	22901.7 2829.2 2886.6 925.8 0 0	27456.9 2298.6 3412.5 1297.9 0 0	9427.2 234.6 598.1 72.2 0 0	16011.2 375.3 881.9 9.2 0 0	10707.5 399.2 675.5 4.7 3.2 0
163.8 43 15.1 9.7 0 0	18961.2 1832.4 1899.9 588.2 0 0	33852.3 1723.9 2739.4 806.9 0 0	13312.5 260.3 688.1 187.7 0 0	19637.7 449.2 953.2 74.4 0 0	17161.5 476.1 910.8 40.2 0 0
4.8 .3 0 0 0 0	4949.3 800.4 526.9 264.3 0 0	20194.1 1627.9 1836.3 625.4 0 0	26335.6 1510.5 1723.1 549.1 0 0	32264.2 1574.8 2409.3 744.2 0 0	26956.9 1193.1 2113.5 1534 0 0

NAVARIN BASIN LEASE SALE AREA
TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS
(FULL DOMESTIC USE OF MSY IN 2007 AND THEREAFTER)

Figure 3-7



NAVARIN BASIN LEASE SALE AREA

TOTAL NUMBER OF DOMESTIC FISHING BOAT-DAYS:
CATCH RATE = 80 METRIC TONS/DAY

(AT FULL DOMESTIC USE OF MSY)

Figure 3-8

TABLE 3-19

PROJECTED DOMESTIC FISH HARVESTING EMPLOYMENT BY MAJOR SPECIES GROUPS, NAVARIN BASIN

Species Group	Employees per Vessel(2)	Total Employment				
		1987	1992	1997	2002	2007
Walleye Pollock	6	18	36	102	204	342
Pacific Cod	6	6	18	48	54	66
All Flatfish, except Halibut	6	Nil	Nil	6	18	30
Herring	6	12	12	12	12	12
Other Major Species(1)	6	Nil	Nil	6	6	6
Shellfish	6	Nil	Nil	Nil	Nil	Nil
Halibut	6	12	12	12	12	12

---

(1) Sablefish, all rockfish, Atka mackerel.

(2) Assumed average.

TABLE 3-20

PROJECTED FISH PROCESSING EMPLOYMENT BY MAJOR SPECIES GROUPS, NAVARIN BASIN

Species Group	Employees per Metric Ton	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock						
Onshore	.01	0	0	0	0	0
Offshore	.01	230	460	1378	3217	4596
Pacific Cod						
Onshore	.01	0	0	0	0	0
Offshore	.01	0	102	240	273	342
All Flatfish, except Halibut						
Onshore	.01	0	0	0	0	0
Offshore	.01	0	0	0	186	276
Herring						
Offshore Only	.008	24	24	24	24	24
Other Major Species(1)						
Onshore	.01	0	0	0	0	0
Offshore	.01	0	0	0	0	0
Shellfish						
Onshore	.023	0	0	0	0	0
Offshore	.01	Nil	Nil	Nil	Nil	Nil

---

(1) Sablefish, all rockfish, Atka mackerel. Estimates counted in pollock, cod and flatfish estimates.

The combined fishery resource potentials of the North Aleutian Shelf, St. George Basin, Navarin Basin and the Norton Basin are:

Species	Metric Tons
Pollock	1,198,680
Pacific Cod	173,680
All Flatfish	92,700
All Other Roundfish	33,558
Halibut	1,000
Herring	10,000
Crab (King, Tanner & Hair Crab)	20,943
TOTAL	1,529,361

If the high estimates of resources available (Table 3-1) materialize, the cumulative resource estimates would soar to 2,740,219 metric tons, almost 1.2 million metric tons more than the estimates given as most likely.

Only a casual glance is needed to confirm the importance of the pollock resource. Its importance should also be noted in terms of major ecosystem relationships because minor changes in the pollock stocks affect other resources such as cod and crab. Major increases in pollock stocks could adversely affect the cod and crab populations in terms of competition for food and in predator/prey relationships.

3.8.2 Projected Foreign and Domestic Harvest

Two significant factors reflect the character of the BSAI domestic fishing industry over the next 20 to 25 years: 1) the number of fishing boats needed and the rate they will enter new fisheries; and 2) the imbalance between the estimated number of offshore and onshore processors (Table 3-21).

While the growth rate of the domestic industry is different for each lease sale area and does not present linear acceleration, the cumulative pattern represents fairly uniform growth at least through 2002. From 1987 to 1992, domestic fishing efforts will center on the St. George Basin. As the basin's resources are exploited, the domestic fishery will expand north to the Navarin Basin where significant growth will occur in 1997, 2002 and 2007.

TABLE 3-21

PROJECTED DOMESTIC CATCHES AND NUMBERS OF FISHING BOATS AND PROCESSORS IN ALL FOUR BERING SEA LEASE SALE AREAS IN 5-YEAR INCREMENTS THROUGH 2007

	1987	1992	1997	2002	2007
Pollock					
Metric tons	208,580	416,100	729,384	1,060,800	1,198,680
Fishing boats	19	38	69	104	121
Offshore processors	6	11	21	33	38
Onshore processors	1	2	3	4	5
Pacific Cod					
Metric tons	71,350	121,844	163,420	166,840	173,680
Fishing boats	26	42	57	58	60
Offshore processors	3	5	5	5	5
Onshore processors	2	3	4	5	5
Flatfish					
Metric tons	13,467	21,135	47,610	64,890	92,700
Fishing boats	2	3	8	11	16
Offshore processors	1	1	3	4	4
Onshore processors	0	0	0	0	0
All Other Roundfish					
Metric tons	4,005	7,742	14,883	21,472	33,558
Fishing boats	0	0	2	2	3
Offshore processors	0	0	0	0	0
Onshore processors	0	0	0	0	0
Herring					
Metric tons	10,000	10,000	10,000	10,000	10,000
Fishing boats	7	7	7	7	7
Offshore processors	2	2	2	2	2
Onshore processors	0	0	0	0	0
Tanner Crab					
Metric tons	9,900	9,900	9,900	9,900	9,900
Fishing boats	15-22	15-22	15-22	15-22	15-22
Offshore processors	1	1	2	2	2
Onshore processors	2-5	2-5	1-4	1-4	1-4
King Crab					
Metric tons	5,520	5,520	5,520	5,520	5,520
Fishing boats	19-50	19-50	19-50	19-50	19-50
Offshore processors	1	1	2	2	2
Onshore processors	3-6	3-6	2-5	2-5	2-5

TABLE 3-21
(Continued)

	1987	1992	1997	2002	2007
Halibut					
Metric tons	1,000	1,000	1,000	1,000	1,000
Fishing boats	10	10	10	10	10
Offshore processors	0	0	0	0	0
Onshore processors	1	1	1	1	1
TOTALS					
Metric tons	323,822	593,241	981,717	1,320,422	1,525,038
Fishing boats	98-146	134-182	187-235	226-274	251-299
Offshore processors	14	21	35	48	53
Onshore processors	9-15	11-17	11-17	13-19	14-20

Note: Fishing boats and onshore processors are all domestic. Offshore processors may be foreign or domestic; predominantly domestic.

The number of fishing boats needed at each 5-year interval for all four basins combined are:

Year	Number of Boats(1)
1987	64
1992	100
1997	153
2002	192
2007	217

Unlike previous projections of other researchers whose estimates of offshore versus onshore processing range from 100 percent onshore to 50 percent offshore and 50 percent onshore, we believe that most of the whitefish catch from the BSAI region will be processed at sea. Onshore processing will be limited to existing centers at Unalaska and Akutan and, if planned facilities are constructed, St. Paul and Chernofski. Perhaps in 50 years the emphasis will change but, given 1) the existing deep water ports which can be used, 2) the availability and suitability of land, 3) current plans for new plants and expansions, and 4) quality issues and economics, most of the processing will be at sea.

3.8.3 Labor Projections

Tables 3-22 and 3-23 present the estimated employment generated in the harvesting and processing sectors by the projected catches in the BSAI cumulative case. In the year 2007, the projected catches of walleye pollock will employ 726 harvesting workers and 11,986 processing workers.

3.8.4 Labor Mobility

Our qualitative assessment of the BSAI agrees with the Combs conclusion as well as with the conclusions of Terry et al. (1980) and Centaur Associates (1980). Generally, the competition for unskilled and skilled labor between

---

(1) Excluding crab boats.

TABLE 3-22

PROJECTED DOMESTIC FISH HARVESTING EMPLOYMENT BY MAJOR SPECIES GROUPS, CUMULATIVE CASE

Species Group	Employees per Vessel[2]	Total Employment 1987	1992	1997	2002	2007
Walleye Pollock	6	114	228	414	624	726
Pacific Cod	6	156	252	342	348	360
All Flatfish, except Halibut	6	12	18	48	66	96
Herring	6	42	42	42	42	42
Other Major Species[1]	6	Nil	Nil	12	12	18
Shellfish	6	600	600	600	600	600
Halibut	6	60	60	60	60	60

---

[1] Sablefish, all rockfish, Atka mackerel.

[2] Assumed average.

TABLE 3-23

PROJECTED FISH PROCESSING EMPLOYMENT BY MAJOR SPECIES GROUPS, CUMULATIVE CASE

	Total Employment				
Species Group	1987	1992	1997	2002	2007
Walleye Pollock					
Onshore	335	670	1006	1341	1677
Offshore	1749	3490	6286	9265	10309
Pacific Cod					
Onshore	184	340	593	818	818
Offshore	526	877	1041	849	918
All Flatfish, except Halibut					
Onshore	Minor	Minor	Minor	Minor	Minor
Offshore	180	180	180	180	180
Other Major Species(1)					
Onshore	Minor	Minor	Minor	Minor	Minor
Offshore	6	6	6	6	6
Herring(2)	84	84	84	84	84
Shellfish					
Onshore	241	241	241	241	241
Offshore	114	114	114	114	114

---

(1) Sablefish, all rockfish, Atka mackerel.
(2) All offshore.

the fisheries and oil industries will be small. It will be dictated by the relatively small number of jobs available within the oil industry regardless of the supply of labor.

Therefore, we qualitatively believe the competition for fishing boat laborers will be minimal. Most competition will be at the service industry level, especially for the offshore operations. If the whitefish fishery were over-exploited and highly inter-industry competitive, or if the crab earnings were more severely depressed than they are, then the economic climate might be volatile enough to witness a labor movement out of the Bering Sea fisheries.

3.8.5 Value of the Fisheries

Table 3-24 presents the projected value of the BSAI fisheries at the ex-vessel level. The values are expressed in millions of 1982 dollars. The projections were made by multiplying the current unit value of the catch (Table 3-4) by the projected quantities (all species) harvested. Table 3-24 shows, for example, that the 2007 cumulative BSAI harvest will be worth $406.9 million at the ex-vessel level.

3.8.6 Resource Timelines

Figure 3-9 shows the petroleum production in each lease sale area and in the cumulative case (summation). The petroleum data and projections used here are from the USDOI Technical Report 80 (Dames & Moore and Gordon S. Harrison 1982); the reader is cautioned to review carefully the assumptions upon which the petroleum projections were based. Figure 3-9 also shows, for comparison, the total (all species) fisheries production from these areas, over the life of the petroleum field. For example, Technical Report 80 projected that the St. George Basin would produce 1,111 million barrels of oil and 2,187 billion cubic feet of gas, from 1993 to 2015. Over that same time, we project that the St. George Basin fisheries will produce 18.8 million metric tons.

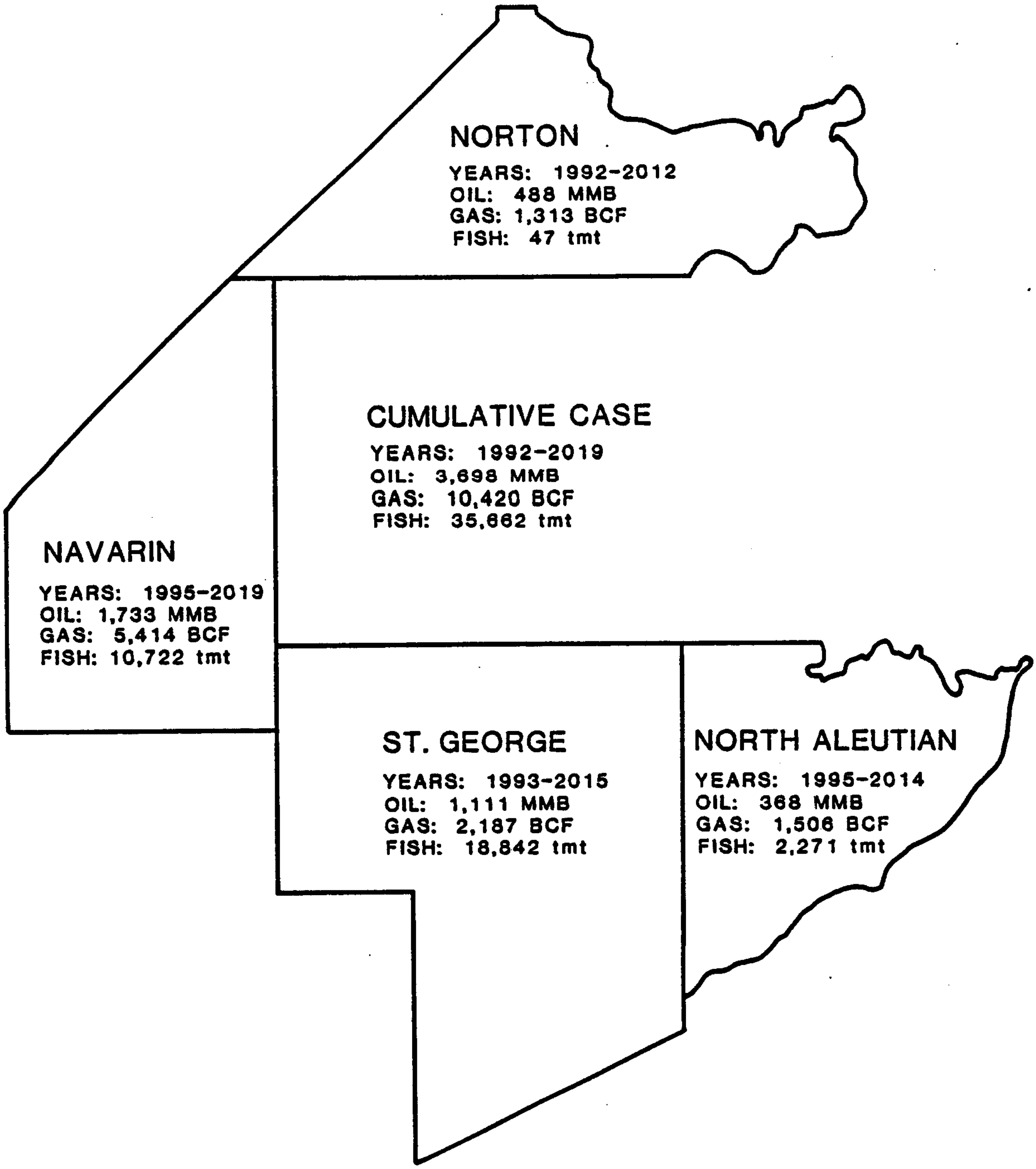
TABLE 3-24

PROJECTED EX-VESSEL VALUE OF THE TOTAL FISHERIES HARVEST

Lease Sale Area	Value of the Harvest in the Respective Year(1) 1987	1992	1997	2002	2007
North Aleutian	13.0	17.2	22.7	25.0	26.8
St. George	126.0	174.3	229.6	252.8	270.4
Navarin	4.6	13.8	39.6	76.0	105.5
Norton	4.0	4.0	4.0	4.0	4.0
Cumulative (Total)	147.6	209.3	295.9	357.8	406.7

---

(1) In millions of 1982 dollars.



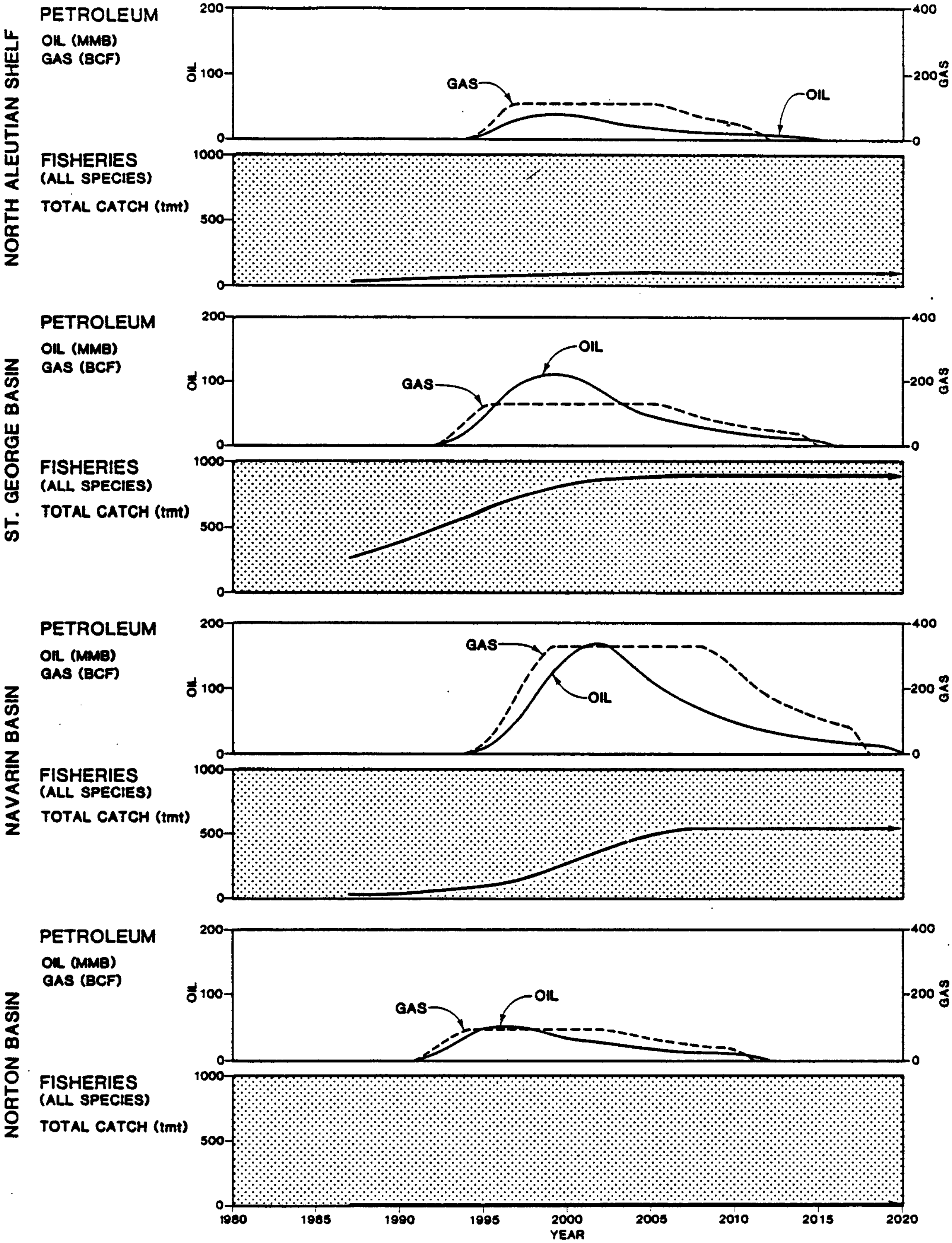
UNITS: OIL IN MILLION BARRELS (MMB)
GAS IN BILLION CUBIC FEET (BCF)
FISHERIES IN THOUSAND METRIC TONS (tmt)

PROJECTED PETROLEUM & FISHERIES PRODUCTION IN THE FOUR BERING SEA LEASE SALE AREAS, INDIVIDUALLY & CUMULATIVELY

Figure 3-9

The basin-specific petroleum and fisheries timelines of development are presented in Figure 3-10, showing the projected years of ascending, high, and, in the case of petroleum, decreasing production. Significant petroleum production was projected for all four lease sale areas, especially St. George and Navarin Basins. These two basins are also expected to produce the greatest fisheries harvests.

The significant feature of Figures 3-10 (Individual Timelines) and 3-11 (Cumulative Timeline) is that the petroleum resources are projected to be well developed, and, in fact, already declining, before the slower developing fisheries production has approached its maximum. We qualitatively estimate that the BSAI commercial fisheries industry could be at a somewhat greater risk during its developmental phase than it would be if it occurred before, or in the absence of, petroleum development.



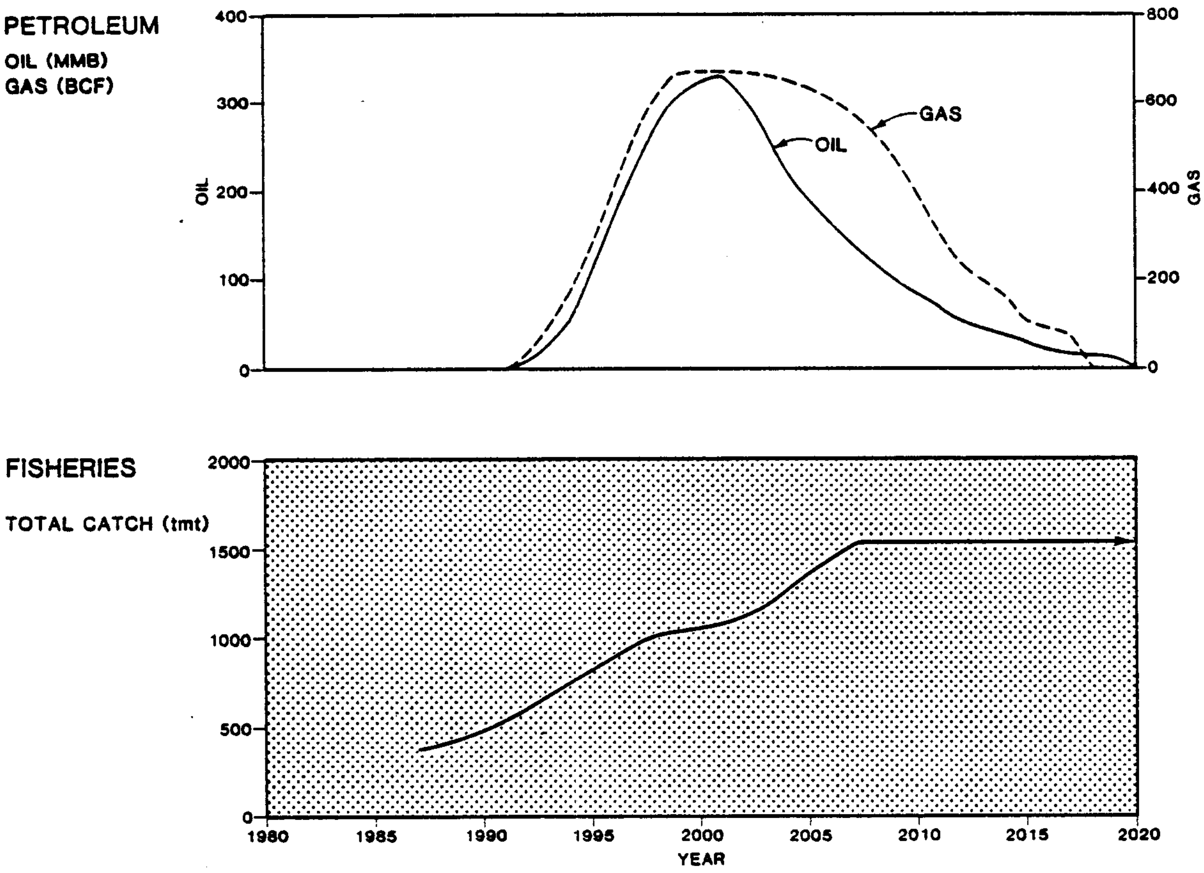
UNITS: OIL IN MILLION BARRELS (MMB)
GAS IN BILLION CUBIC FEET (BCF)
FISHERIES IN THOUSAND METRIC TONS (tmt)

DATA SOURCES: FISHERIES - DAMES & MOORE CALCULATIONS, THIS REPORT.

PETROLEUM - DAMES & MOORE AND GORDON S. HARRISON 1982 "AN ECONOMIC ANALYSIS OF CONCURRENT DEVELOPMENT OF OUTER CONTINENTAL SHELF OIL & GAS LEASES IN THE BERING SEA" TECHNICAL REPORT 80.
(NOTE: THE READER IS CAUTIONED TO REVIEW THE ASSUMPTIONS IN T.R. 80, e.g. - OPTIMISTIC SCHEDULING OF LEASE SALES, BEFORE DRAWING FIRM CONCLUSIONS).

PROJECTED PETROLEUM & FISHERIES PRODUCTION
IN THE FOUR BERING SEA LEASE SALE AREAS
COMPRISING THE CUMULATIVE CASE - INDIVIDUAL TIMELINES OF DEVELOPMENT

Figure 3-10



UNITS: OIL IN MILLION BARRELS (MMB)
GAS IN BILLION CUBIC FEET (BCF)
FISHERIES IN THOUSAND METRIC TONS (tmt)

DATA SOURCES: SUMMATION OF THE DATA IN THE BASIN-SPECIFIC TIMELINES.

NOTE: IN ADDITION TO THE ASSUMPTIONS MADE BY THE FISHERIES PROJECTIONS (THIS REPORT) & BY THE PETROLEUM PREDICTIONS (DAMES & MOORE AND GORDON S. HARRISON 1982), THIS SUMMATION ASSUMES SIMULTANEITY OF ALL FOUR PETROLEUM DEVELOPMENT SCENARIOS & ALL FOUR FISHERIES DEVELOPMENT SCENARIOS.

PROJECTED PETROLEUM & FISHERIES PRODUCTION
IN THE FOUR BERING SEA LEASE SALE AREAS
COMPRISING THE CUMULATIVE CASE - CUMULATIVE TIMELINE OF DEVELOPMENT

Figure 3-11

4.0 BERING SEA OCS DEVELOPMENT SCENARIO

The assessment of the fishing industry impacts for the Bering Sea cumulative case is based on mean oil and gas scenarios obtained from the following sources: Dames and Moore and Gordon Harrison (1982) from which development and scheduling assumptions were derived; Centaur Associates, Inc., et. al. (1983) from which information on OCS resources in the Navarin Basin were obtained; BLM (1982) from which information on Norton Sound OCS resources were obtained and BLM (1981) from which information on St. George OCS resources were obtained. The Norton Basin sale was proposed for November, 1982. The St. George sale was proposed for February, 1983. The Navarin sale was proposed for March 1984, and the North Aleutian Sale is proposed for April, 1985.

For purposes of this analysis, it is assumed that exploration will occur in all four lease sale areas but that development will occur only in the Navarin Basin and the North Aleutian lease sale areas.

Resource estimates and the anticipated number of facilities used to develop the OCS resources in the Bering Sea are given in Exhibit 4-1. Not all information shown in Exhibit 4-1 was available from the sources above and in a few instances, inferences were made based on what information was available. Also, because development of OCS resources in the St. George and Norton Basins is not assumed, production wells, service well platforms and subsea completions are not given. Time periods for exploration in the St. George and Norton Basins were pushed back to 1986.

Exhibit 4-2 shows the expected time sequence of OCS oil and gas development in the Bering Sea. In the four lease sale areas in the exploration and delineation phase, it is expected that from one to five exploratory rigs will be operating at any one time in each of the lease areas between 1986 and 1992. It is assumed that the exploration rigs working in the Bering Sea will operate only about six months (mid-May to mid-November). This is due to harsh environmental conditions such as

Exhibit 4-1

Mean Development Scenarios:
Key Parameters For Bering Sea Lease Sales

Resource	North Aleutian Shelf	Navarin Basin	St. George Basin	Norton Sound	Bering Sea Cumulative
Oil (billion barrels)	0.37	1.20	1.12	0.48	3.17
Total, Gas (trillion cubic feet)	2.40	7.68	2.93	2.00	15.01
Associated Gas (trillion cubic feet)	0.60	0.60	0.73	0.50	2.43
Non-associated Gas (trillion cubic feet)	1.80	7.08	2.20	1.50	12.58
Facilities					
Number of Exploration Wells	9	26	27	29	91
Number of Delineation Wells	7	13	28	16	64
Number of Production and Service Wells	52	227	0	0	279
Number of Platforms	2	13	0	0	15
Number of Subsea Completions	4	23	0	0	27
Site of Pipeline Landfall	Morzhovoi Bay	St. Matthew Island	None	None	-
Site of OCS Support Base - Primary	Dutch Harbor	Dutch Harbor	Dutch Harbor	Nome	
- Possible	St. Paul	St. Paul	Chernofski	Dutch Harbor	

Sources: Centaur Associates, Inc. et. al., 1983; Dames & Moore, et. al., 1982; BLM, 1981; BLM, 1982.

Exhibit 4-2

Estimated Schedule of Development and Production for Mean Development Scenario for Bering Sea Oil and Gas Development

Year	North Aleutian Basin Exploratory Wells	North Aleutian Basin Delineation Wells	Navarin Basin Exploratory Wells	Navarin Basin Delineation Wells	St. George Basin Exploratory Wells	St. George Basin Delineation Wells	Norton Basin Exploratory Wells	Norton Basin Delineation Wells
1984	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-
1986	-	-	3	-	4	4	3	3
1987	-	-	8	-	7	6	7	4
1988	-	-	7	2	7	8	10	3
1989	3	1	5	4	6	7	7	4
1990	4	3	2	4	3	3	2	2
1991	2	2	1	2	-	-	-	-
1992	-	1	-	1	-	-	-	-
1993	-	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-	-
1995	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-
2005	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	-
2009	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-
Total	9	7	26	13	27	28	29	16

Exhibit 4-2 (Cont.)

Estimated Schedule of Development and Production for
Mean Development Scenario for Bering Sea
Oil and Gas Development

	North Aleutian Basin		Navarin Basin		St. George Basin		Norton Basin	
Year	Exploration Rigs	Production Platforms	Exploration Rigs	Production Platforms	Exploration Rigs	Production Platforms	Exploration Rigs	Production Platforms
1984	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-
1986	-	-	1	-	3	-	2	-
1987	-	-	3	-	5	-	4	-
1988	-	-	3	-	5	-	5	-
1989	1	-	3	-	5	-	4	-
1990	1	-	2	-	2	-	2	-
1991	1	1	1	2	-	-	-	-
1992	-	1	1	3	-	-	-	-
1993	-	-	-	4	-	-	-	-
1994	-	-	-	3	-	-	-	-
1995	-	-	-	1	-	-	-	-
1996	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-
2005	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	-
2009	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-
Total	NA	2	NA	13	NA	0	NA	0

Exhibit 4-2 (Cont.)

Estimated Schedule of Development and Production for Mean Development Scenario for Bering Sea Oil and Gas Development

	North Aleutian			Navarin Basin			St. George Basin			Norton Basin		
		Production Schedule			Production Schedule			Production Schedule			Production Schedule	
Year	Development Wells	Oil (MMB)	Gas (BCF)	Development Wells	Oil (MMB)	Gas (BCF)	Development Wells	Oil (MMB)	Gas (BCF)	Development Wells	Oil (MMB)	Gas (BCF)
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-	-
1991	-	-	-	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	-	-	-	-	-	-
1993	4	-	-	18	-	-	-	-	-	-	-	-
1994	8	-	-	36	7	3	-	-	-	-	-	-
1995	15	7.0	31.5	65	22	11	-	-	-	-	-	-
1996	7	21.0	84.1	42	40	20	-	-	-	-	-	-
1997	6	29.4	110.4	29	55	67	-	-	-	-	-	-
1998	5	36.4	110.4	20	68	112	-	-	-	-	-	-
1999	5	36.4	110.4	10	96	282	-	-	-	-	-	-
2000	2	36.4	110.4	7	96	498	-	-	-	-	-	-
2001	-	33.6	110.4	-	96	614	-	-	-	-	-	-
2002	-	28.6	110.4	-	96	614	-	-	-	-	-	-
2003	-	24.3	110.4	-	96	614	-	-	-	-	-	-
2004	-	20.6	110.4	-	96	614	-	-	-	-	-	-
2005	-	17.5	110.4	-	96	614	-	-	-	-	-	-
2006	-	14.9	110.4	-	83	608	-	-	-	-	-	-
2007	-	12.7	110.4	-	67	599	-	-	-	-	-	-
2008	-	10.8	101.2	-	53	593	-	-	-	-	-	-
2009	-	9.1	85.1	-	42	587	-	-	-	-	-	-
2010	-	7.8	71.6	-	33	441	-	-	-	-	-	-
2011	-	6.6	60.2	-	27	312	-	-	-	-	-	-
2012	-	5.6	60.2	-	21	231	-	-	-	-	-	-
2013	-	4.8	42.6	-	10	152	-	-	-	-	-	-
2014	-	4.1	35.9	-	-	60	-	-	-	-	-	-
2015	-	-	-	-	-	34	-	-	-	-	-	-
Total	52	367.6	1,786.8	227	1,200	7,680	0	0	0	0	0	0

Source: BLM, 1981; Centaur Associates, Inc. et.al. 1983; Dames and Moore, et. al., 1982; BLM, 1982.

sea ice and rough weather (Dames and Moore, 1982a.) It is projected that thirteen platforms will be in place in the Navarin Basin by 1996. Two production platforms are projected to be in place by 1992 in the North Aleutian Shelf. These platforms should remain in place through the end of the impact projection time horizon, 2015.

The St. George and Norton areas are assumed to undergo exploration but not development in the mean scenario, and exploration rigs will operate in these areas from 1986 through 1990. These operations will require exploratory and delineation wells as shown in Exhibit 4-2, but no production platforms, development wells or pipelines are anticipated.

It is assumed that pipelines will be used in the Navarin Basin for both oil and gas and that there will be pipeline landfall at St. Matthew Island (Centaur Associates, Inc. et. al., 1983). It is assumed that there will be two trunk pipelines of 175 miles each and one booster platform associated with the pipeline. No offshore processing, storage or loading is projected for the Navarin Basin. It is assumed that there will be a gas and an oil pipeline about 80 miles long each from the North Aleutian OCS production sites to a landfall at Mozhovoi Bay, which is just north of Cold Bay (Dames and Moore and Gordon Harrison, 1982.)

Pipelaying activity in both lease areas is projected to take place during 1992 and 1993. Centaur Associates, Inc. et. al. (1983) projects twelve, 15 mile oil and gas gathering pipelines which will connect 12 of the 13 production platforms to the main oil and gas pipelines in the Navarin Basin. It is anticipated that there will be one gathering line in the North Aleutian Shelf which will connect both platforms to the main trunk pipeline.

The main support base for both exploration and development in the Bering Sea is anticipated to be Dutch Harbor. Nome should be the support base of OCS exploration in the Norton Sound. The possibility of having OCS activities operate out of St. Paul, St. George, Akutan and Chernofski will also be assumed for purposes of projecting impacts on the fishing industry.

Estimates of the number of supply boats operating in the Bering Sea is based on Centaur Associates, Inc., et. al., (1983), Dames and Moore (1982a), and the New England River Basins Commission (NERBC) (1976). The number of supply boats estimated to be used in the exploration and development of OCS resources in the Bering Sea is given in Exhibit 4-3. A breakdown between the number of supply boats expected to be in the Bering Sea lease sale areas in winter (December through May) and summer (June through November) is shown. This is because exploration and development in the Bering Sea is expected to be highly seasonal until the early 1990's. Two figures for supply boats for cumulative Bering Sea OCS exploration and development are given in Exhibit 4-3. One is an initial estimate based on the number of exploration rigs, pipelaying barges, and production platforms expected to be in a specific lease sale area. The other is a final adjusted estimate of the number of supply boats based on an economy of scale factor from NERBC (1976) presented in Exhibit 4-4.

Because most of the support activities are projected to occur out of Dutch Harbor, this economy of scale for supply vessel operations becomes valid. If support bases were scattered around the Bering Sea, the economies of scale would be less applicable. However, because of the lack of good ports in the Bering Sea, decentralized OCS support bases should be the exception rather than the rule.

Exhibit 4-3

Number of OCS Supply Vessels for Bering Sea Mean Development Scenarios

Year	North Aleutian Initial Estimate		Navarin Basin Initial Estimate		St. George Basin Initial Estimate		Norton Basin Initial Estimate		Total Initial Estimate		Final Adjusted Estimate[1]	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	2	-	6	-	4	-	12	-	10
1987	-	-	-	6	-	10	-	8	-	24	-	19
1988	-	-	-	6	-	10	-	10	-	26	-	20
1989	-	2	-	6	-	10	-	8	-	26	-	20
1990	-	2	-	4	-	4	-	4	-	14	-	11
1991	2	5	4	8	-	-	-	-	6	13	5	10
1992	4	5	10	21	-	-	-	-	14	26	11	20
1993	4	8	18	31	-	-	-	-	22	39	18	30
1994	2	2	24	36	-	-	-	-	26	38	20	30
1995	2	2	26	39	-	-	-	-	28	41	21	31
1996	2	2	26	39	-	-	-	-	28	41	22	31
1997	2	2	26	39	-	-	-	-	28	41	21	31
1998	2	2	17	17	-	-	-	-	19	19	14	15
1999	2	2	12	20	-	-	-	-	14	22	11	17
2000	2	2	10	10	-	-	-	-	12	12	10	10
2001	2	2	6	6	-	-	-	-	8	8	6	6
2002	2	2	6	6	-	-	-	-	8	8	6	6
2003	2	2	6	6	-	-	-	-	8	8	6	6
2004	2	2	6	6	-	-	-	-	8	8	6	6
2005	2	2	6	6	-	-	-	-	8	8	6	6

---

[1] Because most of the support activities are projected to occur out of Dutch Harbor, economies of scale are projected for supply boat operations. Exhibit 4-4 presents the number of vessels eliminated because of economies of scale.

Source: Estimates based on the number of exploration rigs and the cumulative number of platforms are from Exhibit 4-2. Two supply vessels are estimated per exploration rig and operations are assumed to take place in summer. Two supply vessels are needed per platform year-round plus one additional in summer when there is increased activity. Four supply boats are required to support pipelaying activity in 1992 and 1993 in the Navarin Basin. Only two additional supply boats are required to support pipelaying activity in 1992 and 1993 in the North Aleutian Basin.

After 1997 when development tapers off in the Navarin Basin, the number of supply vessels reduces to two for every five platforms. After 1993 when development tapers off in the North Aleutian Shelf, the number of supply vessels is reduced to two for both platforms in place.

Exhibit 4-4

Effect of Economies of Scale on Supply Vessel Operations

Initial Range of of Supply Vessel Estimates	Number Subtracted to Obtain Final Estimate
1-5	0-1
6-9	1-2
10-14	2-3
15-18	3-4
19-22	4-5
23-25	5-6
26-28	6-7
29-30	7-8
31-32	8-9
33-34	9-10
35-36	10-11
37-38	11-12
39-40	12-13
41-42	13-14

Source: Based on NERBC, 1976.

CHAPTER 5

VESSEL COLLISIONS AND GEAR LOSS IMPACTS

This chapter presents estimates of two impacts associated with offshore oil and gas development in the Bering Sea: the first is vessel collisions and the second is fishing gear loss. The projections on the number of potential vessel collisions and gear loss are given first for the case of fishing development only, with no OCS development. These are based on the projections of the number of anticipated fishing vessels from Chapter 3. These baseline data estimates are then compared to the scenarios given in Chapter 4 when OCS development in the Bering Sea occurs.

Gear loss is then estimated in a similar manner: projecting the amount of gear lost without and then with OCS development. Gear loss is associated with shellfish pots, otter trawl gear, and long lines. At the end of this section is a discussion of how gear losses can be mitigated. This information is based on conversations with knowledgeable industry personnel and draws from examples on the Washington, Oregon, and California coasts where gear loss associated with vessel traffic was successfully mitigated. Information on some of the benefits associated with OCS development is also presented. These benefits include at-sea search and rescue and instances where the OCS industry has come to the aid of members of the fishing industry.

5.1 Vessel Collision Impacts

Section 5.1.1 presents estimates of vessel collisions in each of the four lease sales and cumulative totals for the Bering Sea. Forecasts of vessel collisions for the case of no OCS development are presented and are done for three segments of vessel traffic which could be potentially affected by OCS vessel traffic: 1) open water fishing in each lease sale, 2) open water travelling to and from each lease sale, and 3) in the relatively constricted waters near port. In Section 5.1.2, the models are run again and used to predict vessel collisions for the case of OCS development as described in Chapter 4.

5.1.1 Vessel Collisions Without OCS Development

Vessel collisions in the Bering Sea were estimated for fishing vessels through the use of two collision prediction models as presented by Combs (1981). These models are the "free gas" analogy for open water vessel maneuvering and the parallel path model for vessel passage through constricted areas.

The "free gas" model was used to estimate collisions for vessels fishing in the Navarin Basin, the Norton Basin, St. George Basin, and the North Aleutian Shelf (the four lease sale areas in the Bering Sea). The "free gas" model was also used to estimate collisions for vessels traveling in open waters between port and the four lease sales areas.

The "free gas" model can be summarized as:

$$C = P(C/C_0)L(N/A)w$$

where C = expected number of collisions per year

$P(C/C_0)$ = conditional probability of a collision given a collision situation

L = total number of vessel miles logged in an area by all vessels (fishing and OCS) in a given year

N/A = vessel density in an area

w = a parameter termed the average collision cross section

Based on Combs (1981), $P(C/C_0)$ is estimated to be 1.78×10^{-5} and w is estimated to be 2/3 times the average vessel length (130 feet) expressed in nautical miles. The parameter "w" was thus equal to 0.0143 for this analysis. This model was applied for vessels engaged in open water operation. Vessel miles and density were calculated based on total number of vessels and expected trip patterns. The results of the model were then summed to estimate total collision impacts.

Exhibit 5-1 presents the basic assumptions for the collision prediction models. Exhibit 5-2 then shows the factors for calculating vessel miles logged and vessel density for use in the "free gas" model. The major aspects of vessel traffic in the Bering Sea other than domestic fishing vessels and potential OCS vessels are foreign fishing vessels. However, under our fishing development projections, all fisheries will be harvested by U.S. vessels and foreign fishing vessels will be replaced. Other vessel traffic in the lease areas is comprised of tugs, barges, tankers, and other non-fishing vessel traffic. These vessels are seasonally present from about May through September when the absence of sea ice allows vessel navigation. These vessels typically follow traffic lanes which have been established over time and which are known to vessel operators.

Two separate computations were performed. First, the actual fishing time in the four lease sale areas was determined based on the estimated number of trips and time spent fishing in each lease sale area from Exhibit 5-1. The number of processor and catcher vessels projected was taken from Chapter 3. The "free gas" model was then used to estimate the number of open water collisions in each lease sale. The expected number of open water collisions while fishing in the North Aleutian Shelf, the St. George Basin, the Navarin Basin and the Norton Basin are given in Exhibits 5-3 through 5-6 and the total number of open water collisions estimated in the four Bering Sea lease sale areas estimated in Exhibit 5-7.

Exhibit 5-1

Bering Sea
Typical Vessel Trip Characteristics

	Navarin Basin	Norton Basin	St. George Basin	No. Alutian Shelf
Catcher Vessel				
Trawling Speed	5 Knots	5 Knots	5 Knots	5 Knots
Speed in Transit	10 Knots	10 Knots	10 Knots	10 Knots
Trip Length	14 days	14 days	14 days	14 days
Transit Time	4 days	1/2 day	1 day	1 day
Number of Trips per Year	10	6	10	6
Time in Lease Area per Trip	10 days	13 days	13 days	13 days
Processor Vessel				
Speed on Location	5 Knots	5 Knots	5 Knots	5 Knots
Speed in Transit	10 Knots	10 Knots	10 Knots	10 Knots
Trip Length	30 days	30 days	30 days	30 days

Exhibit 5-1 (Cont.)

Bering Sea
Typical Vessel Trip Characteristics

Processor Vessel	Navarin Basin	Norton Basin	St. George Basin	No. Alutian Shelf
Transit Time	4 days	1/2 day	1 day	1 day
Number of Trips per Year	6	3	6	3
Time in Lease Area per Trip	26 days	29 days	29 days	29 days

---

[1] Assumes typical trip of 600 miles each way between the Navarin Basin and Dutch Harbor or other port in the Aleutians; 215 miles each way between the St. George Basin and Dutch Harbor; 210 miles each way between the North Alutian Shelf and Dutch Harbor and 100 miles each way between the port of Nome and the Norton Basin.

Source: Centaur Associates, 1983; Centaur assumptions for vessel traffic and collision assessment.

Exhibit 5-2

Bering Sea
Vessel Trip Patterns

	In Navarin Basin		Transit to and from Navarin Basin		In Norton Basin		Transit to and from Norton Basin	
	Catcher	Processor	Catcher	Processor	Catcher	Processor	Catcher	Processor
Miles logged per vessel per year	12,000[1]	18,720[2]	12,000[3]	7,200[4]	9,360[1]	10,440[2]	1,200[3]	600[4]
Size of area	14,700 square miles[5]		30,000 square miles[6]		12,600 square miles[7]		6,500 square miles[8]	
Number of port arrivals and departures per vessel per year[13]	-	-	20	12	-	-	12	6

---

[1] 5 knots times 24 hours per day times number of trips per year times time in lease area per trip.

[2] 5 knots times 24 hours per day times number of trips per year times time in lease area per trip.

[3] Number of trips per year times miles per trip (one way) times 2.

[4] Number of trips per year times miles per trip (one way) times 2.

[5] Assumes fishing activity will be roughly concentrated in 14 one degree by one half degree grids as determined by inspection of tables in Appendix A. Each grid is approximately 30 miles (one half degree latitude) by 35 miles (one degree longitude at that latitude) or about 1,050 square miles.

[6] Assumes transit will be in an area roughly approximated by a triangle with base equal to 100 miles (a line running northeast defining the width of destination points in the major Navarin Basin fishing areas from Dutch Harbor) and altitude equal to 600 miles (distance from Navarin Basin to Dutch Harbor).

Exhibit 5-2 (Cont.)

Bering Sea
Vessel Trip Patterns

	In St. George Basin		Transit to and from St. George Basin		In No. Alutian Shelf		Transit to and from No. Alutian Shelf	
	Catcher	Processor	Catcher	Processor	Catcher	Processor	Catcher	Processor
Miles logged per vessel per year	15,600[1]	20,880[2]	4,300[3]	2,580[4]	9,360[1]	10,440[2]	5,460[3]	1,260[4]
Size of area	27,300 square miles[9]		24,188 square miles[10]		5,250 square miles[11]		6,300 square miles[12]	
Number of port arrivals and departures per vessel per year[13]	-	-	20	12	-	-	12	6

---

[7] Assumes fishing activity will be concentrated in 12 grids as described in Footnote 5 above.

[8] Assumes transit in a triangular area of base 130 miles and altitude 100 miles (distance from Norton Basin to the Port of Nome) as described Footnote 6 above.

[9] Assumes fishing activity will be concentrated in 26 grids as described in Footnote 5.

[10] Assumes transit in a triangular area of base 225 miles and altitude 215 miles (distance from St. George Basin to Dutch Harbor) as described in Footnote 6.

[11] Assumes fishing activity will be concentrated in 5 grids as described in Footnote 5.

[12] Assumes transit in a triangular area of base 60 miles and altitude 210 miles (distance from North Alutian Shelf to Dutch Harbor) as described in Footnote 6.

[13] Two times the number of trips per year as shown in Exhibit 5-1.

Exhibit 5-3

Open Water Collision Estimates While Fishing In the Northern Aleutian Shelf[1]

Year	Number of Vessels Catcher	Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
1987	15 - 45	2	161.3 - 442.1	$3.24 - 8.95 \times 10^{-3}$	$1.33 \times 10^{-4} - 1.01 \times 10^{-3}$
1992	18 - 48	2	189.4 - 470.2	$3.81 - 9.52 \times 10^{-3}$	$1.84 \times 10^{-4} - 1.14 \times 10^{-3}$
1997	22 - 52	4	247.7 - 528.5	$4.95 \times 10^{-3} - 0.0107$	$3.12 \times 10^{-4} - 1.44 \times 10^{-3}$
2002	23 - 53	5	267.5 - 548.3	$5.33 \times 10^{-3} - 0.0110$	$3.63 \times 10^{-4} - 1.54 \times 10^{-3}$
2007	23 - 53	5	267.5 - 548.3	$5.33 \times 10^{-3} - 0.0010$	$3.63 \times 10^{-4} - 1.54 \times 10^{-3}$

---

[1] Includes time while on station in the North Aluetian Shelf, but does not include transit time to or from the area. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-7. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-4

Open Water Collision Estimates While Fishing In the St. George Basin[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)[2]	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
1987	71.2 - 83.2	9	1,298.6 - 1,485.8	2.94 - 3.38x10^{-3}	9.72x10^{-4} - 1.28x10^{-3}
1992	99.4 - 111.4	14	1,842.9 - 2,030.2	4.15 - 4.60x10^{-3}	1.91 - 2.34x10^{-3}
1997	129.8 - 141.8	22	2,484.2 - 2,671.4	5.56 - 6.00x10^{-3}	3.46 - 4.01x10^{-3}
2002	142 - 154	24	2,716.3 - 2,903.5	6.08 - 6.52x10^{-3}	4.13 - 4.43x10^{-3}
2007	146 - 158	23	2,757.8 - 2,945.0	6.19 - 6.63x10^{-3}	4.27 - 4.89x10^{-3}

---

[1] Includes time while on station in the St. George Basin, but does not include transit time to or from the Basin. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-11. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-5

Open Water Collision Estimates While Fishing In the Navarin Basin[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	8	2	133.4	6.80×10^{-4}	2.31×10^{-5}
1992	13	4	230.9	1.16×10^{-3}	6.82×10^{-5}
1997	31	8	521.8	2.65×10^{-3}	3.52×10^{-4}
2002	57	18	1,133.3	5.10×10^{-3}	1.47×10^{-3}
2007	78	24	1,385.3	6.94×10^{-3}	2.48×10^{-3}

---

[1] Includes time while on station in the Navarin Basin, but does not include transit time to or from the Navarin Basin. Based on "free gas" model.

Source: Number of vessels from Table 3-18. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-6

Open Water Collision Estimates While Fishing In the Norton Basin[1]

Year	Number of Vessels Catcher	 Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
1987	4 - 10	1	47.88 - 104.04	$3.97 - 8.73 \times 10^{-4}$	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$
1992	4 - 10	1	47.88 - 104.04	$3.97 - 8.73 \times 10^{-4}$	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$
1997	4 - 10	1	47.88 - 104.04	$3.97 - 8.73 \times 10^{-4}$	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$
2002	4 - 10	1	47.88 - 104.04	$3.97 - 8.73 \times 10^{-4}$	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$
2007	4 - 10	1	47.88 - 104.04	$3.97 - 8.73 \times 10^{-4}$	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$

---

[1] Includes time while on station in the Norton Basin, but does not include transit time to or from the Norton Basin. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-14. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-7

Open Water Collision Estimates While Fishing In the Bering Sea[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.[2]	Expected Number of Collisions per Year[2]
1987	98 - 146	14	1,641.2 - 2,165.4	$7.26\text{x}10^{-3}$ - $1.39\text{x}10^{-2}$	1.14 - $2.34\text{x}10^{-3}$
1992	134 - 182	21	23,110.8 - 23,352.4	$9.52\text{x}10^{-3}$ - $1.61\text{x}10^{-2}$	2.17 - $3.57\text{x}10^{-3}$
1997	187 - 235	35	33,015.6 - 38,257.2	1.35 - $2.02\text{x}10^{-2}$	4.12 - $5.82\text{x}10^{-3}$
2002	226 - 274	48	41,649.6 - 45,019.2	1.69 - $2.35\text{x}10^{-2}$	5.97 - $7.46\text{x}10^{-3}$
2007	251 - 299	53	41,584.8 - 49,826.4	1.88 - $2.55\text{x}10^{-2}$	7.12 - $8.93\text{x}10^{-3}$

---

[1] Includes time while on station in the Bering Sea, but does not include transit time to or from the Bering Sea. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Sum of Exhibits 5-3, 5-4, 5-5, and 5-6.

The second computation using the "free gas" model was for open water travel to and from the same four lease sales (not including going in and out of port). These results are presented in Exhibit 5-8 for vessels travelling to and from the North Aleutian shelf, Exhibit 5-9 presents open water collision estimates for vessels travelling to and from the St. George lease sale area. Exhibit 5-10 presents collision estimates for vessels travelling to and from the Navarin lease sale area. Exhibit 5-11 presents collision estimates for vessels travelling to and from the Norton lease sale area and Exhibit 5-12 presents the total number of collisions in the Bering Sea while vessels travel between port and the four lease sales areas. For the Navarin, St. George and North Aleutian lease sales, the port of Dutch Harbor was used to calculate distances to a point about in the center of each area. For Norton Sound, the port of Nome was used to calculate distance travelled to the lease sale area.

The parallel path model was used to estimate collision impacts while vessels enter and leave port. For this assessment the characteristics of Dutch Harbor were assumed since the great majority of fishing vessels fishing in the Navarin Basin, the St. George Basin, and the North Aleutian Shelf, will make primary use of this port. For the Norton Basin, the characteristics of Nome were used since it is assumed that port development at Nome will take place and that both OCS and fishing vessels will use that port (see Section 6.1.1).

The parallel path model is summarized as follows:

$$C = P(C/C_o)Eb / W$$

$$E = N^2L / (2KV)$$

where C = expected number of collisions per year

$P(C/C_o)$ = conditional probability of a collision given a collision situation

Exhibit 5-8

Open Water Collision Estimates While Traveling To and From North Aleutian Basin[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
1987	15 - 45	2	84.4 - 248.2	$2.70 - 7.46\text{x}10^{-3}$	$5.80\text{x}10^{-5} - 4.71\text{x}10^{-4}$
1992	18 - 48	2	111.7 - 264.6	$3.17 - 7.94\text{x}10^{-3}$	$9.01\text{x}10^{-5} - 5.35\text{x}10^{-4}$
1997	22 - 52	4	125.2 - 288.9	$4.13 - 8.89\text{x}10^{-3}$	$1.32 - 6.54\text{x}10^{-4}$
2002	23 - 53	5	131.8 - 295.7	$4.44 - 9.21\text{x}10^{-3}$	$1.49 - 6.93\text{x}10^{-4}$
2007	23 - 53	5	131.9 - 295.7	$4.44 - 9.21\text{x}10^{-3}$	$1.49 - 6.93\text{x}10^{-4}$

---

[1] Includes time while in transit to or from the No. Aleutian Basin but does not include transit time in immediate vicinity of port. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-7. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-9

Open Water Collision Estimates While Traveling To and From St. George Basin[1]

Year	Number of Vessels		Total Miles Logged (1000 miles)[2]	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
	Catcher	Processor			
1987	71.2 - 83.2	9	329.4 - 380.9	3.32 - 3.81×10^{-3}	2.78 - 3.69×10^{-4}
1992	99.4 - 111.4	14	463.5 - 515.1	4.69 - 5.18×10^{-3}	5.53 - 6.79×10^{-4}
1997	129.8 - 141.8	22	614.9 - 666.5	6.28 - 6.77×10^{-3}	9.83×10^{-4} - 1.15×10^{-3}
2002	142 - 154	24	672.5 - 724.1	6.86 - 7.36×10^{-3}	1.17 - 1.36×10^{-3}
2007	146 - 158	23	687.1 - 738.7	6.99 - 9.48×10^{-3}	1.22 - 1.41×10^{-3}

---

[1] Includes time while in transit to or from the St. George Basin but does not include transit time in immediate vicinity of port. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-11. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-10

Open Water Collision Estimates While Traveling To and From Navarin Basin[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	8	2	110.4	3.33×10^{-4}	9.36×10^{-6}
1992	13	4	184.8	5.67×10^{-4}	2.67×10^{-5}
1997	31	8	429.6	1.30×10^{-3}	1.42×10^{-4}
2002	57	18	813.6	2.50×10^{-3}	5.18×10^{-4}
2007	78	24	1,108.8	3.40×10^{-3}	9.60×10^{-4}

---

[1] Includes time while in transit to or from the Navarin Basin but does not include transit time in immediate vicinity of port. Based on "free gas" model.

Source: Number of vessels from Table 3-18. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-11

Open Water Collision Estimates While Traveling To and From Norton Sound[1]

Year	Number of Vessels Catcher	Number of Vessels Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)[2]	Expected Number of Collisions per Year[2]
1987	4 - 10	1	5,400 - 12,600	7.94×10^{-4} - 1.75×10^{-3}	1.09 - 5.61×10^{-6}
1992	4 - 10	1	5,400 - 12,600	7.94×10^{-4} - 1.75×10^{-3}	1.09 - 5.61×10^{-6}
1997	4 - 10	1	5,400 - 12,600	7.94×10^{-4} - 1.75×10^{-3}	1.09 - 5.61×10^{-6}
2002	4 - 10	1	5,400 - 12,600	7.94×10^{-4} - 1.75×10^{-3}	1.09 - 5.61×10^{-6}
2007	4 - 10	1	5,400 - 12,600	7.94×10^{-4} - 1.75×10^{-3}	1.09 - 5.61×10^{-6}

---

[1] Includes time while in transit to or from the Norton Sound but does not include transit time in immediate vicinity of port. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Number of vessels from Table 3-14. Miles logged and vessel density from figures in Exhibit 5-2. Expected number of collisions calculated from formulation for "free gas" model described in text.

Exhibit 5-12

Open Water Collision Estimates
While Traveling To and From Bering Sea Lease Areas[1]

Year	Number of Vessels Catcher	Processor	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year[2]
1987	98 - 146	14	529.6 - 752.2	7.15×10^{-3} - 1.34×10^{-2}	3.45 - 8.55×10^{-4}
1992	134 - 182	21	765.5 - 977.1	9.23×10^{-3} - 1.55×10^{-2}	6.71×10^{-4} - 1.24×10^{-3}
1997	187 - 255	35	1,175.1 - 1,385.1	1.25 - 1.87×10^{-2}	1.25 - 1.95×10^{-3}
2002	226 - 274	48	1,618.0 - 1,121.9	1.46 - 2.09×10^{-2}	1.84 - 2.57×10^{-3}
2007	251 - 299	53	1,933.2 - 2,155.8	1.59 - 2.19×10^{-2}	2.33 - 3.07×10^{-3}

---

[1] Includes time while in transit to or from the four lease areas, but does not include transit time in immediate vicinity of port. Based on "free gas" model.

[2] These are ranges of the minimum and maximum number. In cases where each number in the range is raised to the same power, the power specified applies to both numbers in the range.

Source: Sum of Exhibits 5-8, 5-9, 5-10 and 5-11.

E = number of encounters per year

b = average width or clearance of vessels

W = width of the body of water

N = number of vessel trips associated with the waterway

L = length of specific body of waterway traversed by vessels

K = a constant equal to the number of hours in a year

V = average velocity of vessels

This model was used to estimate collisions in the vicinity of Dutch Harbor as vessels enter and leave the harbor on their way to offshore waters in the Navarin Basin, the St. George Basin and the North Aleutian Shelf. Note that even though vessels are projected to use more ports than Dutch Harbor (e.g., Akutan, Chernofski, St. Paul, St. George, or "Other" ports as described in Chapter 6, the characteristics of all these ports are similar to Dutch Harbor. Therefore, collision estimates presented here would remain valid and should be considered to be a maximum as vessel traffic is projected to be dispersed unevenly amongst ports in the Bering Sea.

For the purposes of applying the model, four waterway segments were defined starting from just inside Dutch Harbor and going north. These have the following length and width:

Segment	L	W
I	1 Mile	1 Mile
II	3 Miles	4 Miles

III	3 Miles	5 Miles
IV	23 Miles	15 Miles

These waterway segments would apply for vessels operating in the Navarin, St. George, and North Aleutian lease sale areas. For the Norton Basin, Nome is anticipated to be the major staging port. Since the harbor is to be built along a causeway extending into Norton Sound, the initial waterway segments would be similar to those given above but would be less confined further away from port. For the port of Nome and going south, the model's four waterway segments have the following length and width:

Segment	L	W
I	1 Mile	1 Mile
II	3 Miles	4 Miles
III	5 Miles	8 Miles
IV	38 Miles	25 Miles

$P\ (C/C_0)$ is estimated to be 1.49×10^{-4} using calibration data from the Strait of Dover (Combs, 1981). The other parameters used data on vessel numbers and characteristics appropriate to typical fishing vessels (130 foot class) projected to be fishing in the four lease sale areas.

The parameter "b" was set equal to 0.0143 miles as in the other model. Vessel trips going in and out of Nome and Dutch Harbor were estimated based on the number of fishing vessels (Chapter 3.0) and trip characteristics as shown in Exhibit 5-1. The model also requires estimates of other vessel traffic in addition to that associated with the four lease sales. These were taken from Peat, Marwick, Mitchell & Company, et al., (1981) for Dutch Harbor vessel traffic and from Peat, Marwick, Mitchell & Company, et al., (1980) for Nome vessel traffic. The total number of collision situations is equal to:

C divided by $P(C/C_0)$

in the above formulation and can be thought of roughly as the number of times vessels pass close enough for a collision if no evasive action is taken.

Exhibit 5-13 presents estimates of the expected number of collisions in the vicinity of port for vessels projected to be fishing in the North Aleutian Shelf. Exhibit 5-14 presents estimates of the expected number of collisions in the vicinity of port for vessels projected to be fishing in the St. George Basin. Exhibit 5-15 presents estimates of the expected number of collisions in the vicinity of port for vessels expected to be fishing in the Navarin Basin. Exhibit 5-16 presents estimates of the expected number of collisions in the vicinity of port for vessels projected to be fishing in the Norton Basin. Exhibit 5-17 presents a summary of vessel collisions in the vicinity of port for the Bering Sea.

The results of the three separate collision calculations were then summed to estimate total baseline collisions associated with vessels fishing in the Bering Sea. These are presented in Exhibit 5-18 for the

Exhibit 5-13

Vessel Collisions in the Vicinity of Port for the North Aleutian Shelf[1]

Year	Number of Trips by No. Aleutian Fishing Vessels	Number of Trips by Other Vessels	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions[2]
1987	192 - 552	459	651 - 1,011	0.1343 - 0.3240	2.0 - 4.83x10^{-5}
1992	228 - 600	800	1,028 - 1,400	0.3350 - 0.6212	5.0 - 9.26x10^{-5}
1997	288 - 648	1,077	1,365 - 1,725	0.5906 - 0.9432	8.80x10-5 - 1.41x10^{-4}
2002	306 - 666	1,276	1,582 - 1,942	0.7933 - 1.195	1.18 - 1.78x10^{-4}
2007	306 - 666	1,484	1,582 - 1,942	0.7933 - 1.195	1.18 - 1.78x10^{-4}

---

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in text.

[2] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: The number of trips by North Aleutian fishing vessels is based on 12 port arrivals or departures per year for catcher vessels and 6 for processor vessels. This is two times the respective number of trips per year shown in Exhibit 5-1. Total number of trips calculated by taking these figures times the number of vessels (catcher and processor) from Table 3-7. The number of trips by other vessels is from Peat, Marwick, Mitchell & Co. et. al., (1981).

Exhibit 5-14

Vessel Collisions in The Vicinity of Port[1]

Year	Number of Trips by St. George Fishing Vessels	Number of Trips by Other Vessels	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions[2]
1987	1,532 - 1,772	459	1,991 - 2,231	1.26 - 1.58	$1.88 - 2.35\times10^{-4}$
1992	2,156 - 2,396	800	2,956 - 3,196	2.77 - 3.24	$4.13 - 4.83\times10^{-4}$
1997	2,860 - 3,100	1,077	3,937 - 4,177	4.91 - 5.53	$7.32 - 8.24\times10^{-4}$
2002	3,128 - 3,368	1,276	4,404 - 4,644	6.15 - 6.84	$9.16\times10^{4}-1.02\times10^{-3}$
2007	3,196 - 3,436	1,484	4,680 - 4,920	6.97 - 7.67	$1.04 - 1.14\times10^{-3}$

---

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in text.

[2] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: The number of trips by St. George fishing vessels is based on 20 port arrivals or departures per year for catcher vessels and 12 for processor vessels. This is two times the respective number of trips per year shown in Exhibit 5-1. Total number of trips calculated by taking these figures times the number of vessels (catcher and processor) from Table 3-11. The number of trips by other vessels is from Peat, Marwick, Mitchell & Co. et. al., (1981).

Exhibit 5-15

Vessel Collisions in The Vicinity of Port in the Navarin Basin[1]

Year	Number of Trips by Navarin Fishing Vessels	Number of Trips by Other Vessels	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	184	459	643	0.1310	1.95×10^{-5}
1992	308	800	1,108	0.3891	5.80×10^{-5}
1997	716	1,077	1,793	1.019	1.52×10^{-4}
2002	1,356	1,276	2,632	2.196	3.27×10^{-4}
2007	1,848	1,484	3,332	3.519	5.24×10^{-4}

---

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in text.

Source: The number of trips by Navarom fishing vessels is based on 20 port arrivals or departures per year for catcher vessels and 12 for processor vessels. This is two times the respective number of trips per year shown in Exhibit 5-1. Total number of trips calculated by taking these figures times the number of vessels (catcher and processor) from Table 3-18. The number of trips by other vessels is from Peat, Marwick, Mitchell & Co. et. al., (1981).

Exhibit 5-16

Vessel Collisions in The Vicinity of Port in Norton Sound[1]

Year	Number of Trips by Norton Fishing Vessels	Number of Trips by Other Vessels	Total Number of Vessel Trips	Total Number of Collision Situations[2]	Expected Number of Collisions[2]
1987	54 - 126	372	426 - 498	$5.70 - 7.80 \times 10^{-2}$	$8.5 \times 10^{-6} - 1.16 \times 10^{-5}$
1992	54 - 126	396	450 - 522	$6.36 - 8.56 \times 10^{-2}$	$9.5 \times 10^{-6} - 1.28 \times 10^{-5}$
1997	54 - 126	428	482 - 554	$7.30 - 9.64 \times 10^{-2}$	$1.09 - 1.44 \times 10^{-5}$
2002	54 - 126	456	510 - 582	$8.17 \times 10^{-2} - 0.1064$	$1.22 - 1.50 \times 10^{-5}$
2007	54 - 126	484	538 - 610	$9.10 \times 10^{-2} - 0.1170$	$1.36 - 1.74 \times 10^{-5}$

---

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of port of Nome which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in text.

[2] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: The number of trips by North Alutian fishing vessels is based on 12 port arrivals or departures per year for catcher vessels and 6 for processor vessels. This is two times the respective number of trips per year shown in Exhibit 5-1. Total number of trips calculated by taking these figures times the number of vessels (catcher and processor) from Table 3-7. The number of trips by other vessels is from Peat, Marwick, Mitchell & Co. et. al., (1980).

Exhibit 5-17

Vessel Collisions in The Vicinity of Port[1]

Year	Number of Trips by Bering Sea Fishing Vessels	Number of Trips by Other Vessels	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions[2]
1987	1,962 - 2,634	831	2,793 - 3,465	1.58 - 2.11	$2.36 - 3.14x10^{-4}$
1992	2,745 - 3,430	1,196	3,942 - 4,626	3.56 - 4.33	$4.72 - 6.46x10^{-4}$
1997	3,918 - 4,590	1,505	5,423 - 6,095	6.59 - 7.59	$9.78x10^{-4} - 1.13x10^{-3}$
2002	4,844 - 5,516	1,732	6,576 - 7,248	9.23 - 10.34	$1.38 - 1.54x10^{-3}$
2007	5,404 - 6,148	1,968	7,372 - 8,116	11.37 - 12.50	$1.70 - 1.86x10^{-3}$

---

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor and Nome which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in text.

[2] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: Sum of Exhibits 5-13, 5-14, 5-15 and 5-16.

Exhibit 5-18

Collision Impact Summary for the North Aleutian Shelf
(expected number of collisions per year)

Year	Collisions Fishing in The No. Aleutian Basin[1]	Collisions to and from the No. Aleutian Basin[1]	Collisions in the Vicinity of Port[1]	Total Expected Number of Collisions[1]
1987	1.33×10^{-4} - 1.01×10^{-3}	5.80×10^{-5} - 4.71×10^{-4}	2.0 - 4.83×10^{-5}	2.11×10^{-4} - 6.30×10^{-3}
1992	1.84×10^{-4} - 1.14×10^{-3}	9.01×10^{-5} - 5.35×10^{-4}	5.0 - 9.26×10^{-5}	3.24×10^{-4} - 1.77×10^{-3}
1997	3.12×10^{-4} - 1.44×10^{-3}	1.32 - 6.54×10^{-4}	8.8×10^{-5} - 1.41×10^{-4}	5.32×10^{-4} - 2.24×10^{-3}
2002	3.63×10^{-4} - 1.54×10^{-3}	1.49 - 6.93×10^{-4}	1.18 - 1.78×10^{-4}	6.30×10^{-4} - 2.41×10^{-3}
2007	3.63×10^{-4} - 1.54×10^{-3}	1.49 - 6.93×10^{-4}	1.18 - 1.78×10^{-4}	6.30×10^{-4} - 2.41×10^{-3}

---

[1] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: Summary of Exhibits 5-3, 5-8, and 5-13.

North Aleutian Shelf, Exhibit 5-19 for the St. George Basin, Exhibit 5-20 for the Navarin Basin, Exhibit 5-21 for the Norton Basin and Exhibit 5-22 for the entire Bering Sea.

The expected number of collisions in the Bering Sea as a result of projected fishery development and without OCS development in 1987 ranges from 0.00827 to 0.00172 per year or about one collision every 120 to 580 years. In 1997, the chances of a collision increase to 0.0149 to 0.00637 per year or about one collision every 67 to 157 years. Finally in 2007, it is estimated that the chances of collision in the Bering Sea in the absence of OCS development range between 0.0138 to 0.0111 or about one collision every 72 to 90 years.

5.1.2 Vessel Collisions with OCS Development

For each of the lease sales, the "free gas" model is run to estimate the probability of collisions between fishing vessels and OCS vessels given OCS development occurs using scenarios given in Chapter 4. Exhibit 5-23 presents estimates of open water collisions with the addition of OCS vessels in the North Aleutian Shelf. Exhibit 5-24 presents estimates of open water collisions with the addition of OCS vessels in the St. George Basin. Exhibit 5-25 presents estimates of open water collisions with the addition of OCS vessels in the Navarin Basin. Exhibit 5-26 presents estimates of open water collisions with the addition of OCS vessels in the Norton Basin and Exhibit 5-27 presents cumulative totals of open water collisions in the Bering Sea with the addition of OCS vessels.

Open water collisions were also estimated using the "free gas" model while vessels travel to and from each lease sale and port with the 5ddition of OCS vessels. The results for each lease sale are given in

Exhibit 5-19

Collision Impact Summary for the St. George Basin
(expected number of collisions per year)

Year	Collisions Fishing in The St. George Basin[1]	Collisions to and from the St. George Basin[1]	Collisions in the Vicinity of Port[1]	Total Expected Number of Collisions
1987	9.24×10^{-4} - 1.28×10^{-3}	2.78 - 3.69×10^{-4}	1.88 - 2.35×10^{-4}	1.44 - 1.88×10^{-3}
1992	1.91 - 2.34×10^{-3}	5.53 - 6.79×10^{-4}	4.13 - 4.83×10^{-4}	2.88 - 3.50×10^{-3}
1997	3.46 - 4.01×10^{-3}	9.83×10^{-4} - 1.15×10^{-3}	7.32 - 8.24×10^{-4}	5.18 - 5.98×10^{-3}
2002	4.13 - 4.43×10^{-3}	1.17 - 1.36×10^{-3}	9.16×10^{-4} - 1.02×10^{-3}	6.22 - 6.81×10^{-3}
2007	4.27 - 4.89×10^{-3}	1.22 - 1.41×10^{-3}	1.04 - 1.14×10^{-3}	6.53 - 7.44×10^{-3}

---

[1] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: Summary of Exhibits 5-4, 5-9, and 5-14.

Exhibit 5-20

Collision Impact Summary for the Navarin Basin
(expected number of collisions per year)

Year	Collisions Fishing in The Navarin Basin[1]	Collisions to and from the Navarin Basin[1]	Collisions in the Vicinity of Port[1]	Total Expected Number of Collisions[1]
1987	$2.31x10^{-5}$	$9.36x10^{-6}$	1.95x10-5	$5.20x10^{-5}$
1992	$6.82x10^{-5}$	$2.67x10^{-5}$	5.80x10-5	$1.53-10^{-4}$
1997	$3.52x10^{-4}$	$1.42x10^{-4}$	1.42x10-4	$6.44x10^{-4}$
2002	$1.47x10^{-3}$	$5.18x10^{-4}$	3.27x10-4	$2.32x10^{-3}$
2007	$2.48x10^{-3}$	$9.60x10^{-4}$	5.24x10-4	$3.97x10^{-3}$

Source: Summary of Exhibits 5-5, 5-10. and 5-15.

Exhibit 5-21

Collision Impact Summary in the Norton Basin
(expected number of collisions per year)

Year	Collisions Fishing in The Norton Basin	Collisions to and from The Norton Basin	Collisions in the Vicinity of Port	Total Expected Number of Collisions
1987	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$	$1.09 - 5.61 \times 10^{-6}$	$8.5 \times 10^{-6} - 1.16 \times 10^{-5}$	$1.44 - 4.03 \times 10^{-5}$
1992	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$	$1.09 - 5.61 \times 10^{-6}$	$9.5 \times 10^{-6} - 1.28 \times 10^{-5}$	$1.54 - 4.15 \times 10^{-5}$
1997	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$	$1.09 - 5.61 \times 10^{-6}$	$1.09 - 1.44 \times 10^{-5}$	$1.68 - 4.31 \times 10^{-5}$
2002	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$	$1.09 - 5.61 \times 10^{-6}$	$1.22 - 1.50 \times 10^{-5}$	$1.81 - 4.37 \times 10^{-5}$
2007	$4.84 \times 10^{-6} - 2.31 \times 10^{-5}$	$1.09 - 5.61 \times 10^{-6}$	$1.36 - 1.74 \times 10^{-5}$	$1.95 - 4.61 \times 10^{-5}$

---

[1] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: Summary of Exhibits 5-6, 5-11, and 5-16.

Exhibit 5-22

Cumulative Collision Impact Summary for the Bering Sea
(expected number of collisions per year)

Year	Collisions Fishing in The Bering Sea[1]	Collisions to and from the Bering Sea[1]	Collisions in the Vicinity of Port[1]	Total Expected Number of Collisions[1]
1987	$5.58 - 2.34\times10^{-3}$	$3.46 - 8.55\times10^{-4}$	$2.36 - 3.14\times10^{-4}$	$1.72 - 8.27\times10^{-3}$
1992	$2.17 - 3.57\times10^{-3}$	$6.71\times10^{-4} - 1.24\times10^{-3}$	$5.30 - 6.46\times10^{-4}$	$3.38 - 5.47\times10^{-3}$
1997	$4.12 - 5.82\times10^{-3}$	$1.25 - 1.95\times10^{-3}$	$9.78\times10^{-4} - 1.13\times10^{-3}$	$6.37\times10^{-3} - 1.49\times10^{-2}$
2002	$5.97 - 7.46\times10^{-3}$	$1.83 - 2.57\times10^{-3}$	$1.38 - 1.54\times10^{-3}$	$9.19\times10^{-3} - 1.16\times10^{-2}$
2007	$7.12 - 8.93\times10^{-3}$	$2.33 - 3.07\times10^{-3}$	$1.70 - 1.86\times10^{-3}$	$1.11 - 1.38\times10^{-2}$

---

[1] These are ranges of the minimum and maximum number of expected collisions. In cases where each number in the range is raised to the same power, the power applies to both numbers in the range for the first number.

Source: Summary of Exhibits 5-18, 5-19, 5-20 and 5-21.

Exhibit 5-23

Open Water Collision Estimates While Fishing In North Aleutian Shelf[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	442.1	0	442.1	8.95×10^{-3}	0
1992	470.2	25.2	495.4	1.01×10^{-2}	1.27×10^{-3}
1997	528.5	10.1	538.6	1.03×10^{-2}	1.41×10^{-3}
2002	548.3	10.1	558.4	1.05×10^{-2}	1.49×10^{-3}
2007	548.3	10.1	558.4	1.05×10^{-2}	1.49×10^{-3}

---

[1] Includes time while in the North Aleutian Shelf, but does not include transit time to or from the North Aleutian Shelf. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-3. Annual miles logged by OCS vessels from Exhibit 5-57 where 1/5 of mileage is within the fishing area of the North Aleutian Shelf. Vessel density from Exhibit 5-2 and 5-3, and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Rather than the range of numbers given in Exhibit 5-3, the maximum figures are given here, therefore, these estimates should be considered an upper bound.

Exhibit 5-24

Open Water Collision Estimates While Fishing In St. George Basin[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	1,485.8	68.8	1,554.6	3.67×10^{-3}	1.45×10^{-3}
1992	2,030.2	0	2,030.2	4.60×10^{-3}	0
1997	2,671.4	0	2,671.4	6.00×10^{-3}	0
2002	2,903.5	0	2,903.5	6.52×10^{-3}	0
2007	2,945.0	0	2,945.0	6.63×10^{-3}	0

---

[1] Includes time while in the St. George Basin, but does not include transit time to or from the St. George Shelf. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-4. Annual miles logged by OCS vessels from Exhibit 5-58 where 1/3 of mileage is within the fishing area of the St. George Basin. Vessel density from Exhibit 5-2 and 5-3, and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Rather than presenting the range of numbers for fishing vessels in Exhibit 5-4, the maximum figures are given here, therefore, these estimates should be considered an upper bound.

Exhibit 5-25

Open Water Collision Estimates While Fishing In Navarin Basin[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	133.4	72	205.4	1.09×10^{-3}	5.70×10^{-5}
1992	230.9	360	590.9	2.31×10^{-3}	3.47×10^{-4}
1997	521.8	720	1,241.8	4.70×10^{-3}	1.48×10^{-3}
2002	1,133.3	144	1,277.3	5.44×10^{-3}	1.77×10^{-3}
2007	1,385.3	144	1,529.3	7.28×10^{-3}	2.83×10^{-3}

---

[1] Includes time while in the Navarin Basin, but does not include transit time to or from the Navarin Basin. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-5. Annual miles logged by OCS vessels from Exhibit 5-59 where 1/3 of mileage is within the fishing area of the Navarin Basin. Vessel density from Exhibit 5-2 and 5-3 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Exhibit 5-26

Open Water Collision Estimates While Fishing In Norton Sound[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	104.0	33.6	137.6	1.43×10^{-3}	5.00×10^{4}
1992	104.0	0	104.0	8.73×10^{-4}	0
1997	104.0	0	104.0	8.73×10^{-4}	0
2002	104.0	0	104.0	8.73×10^{-4}	0
2007	104.0	0	104.0	8.73×10^{-4}	0

---

[1] Includes time while in the Norton Sound, but does not include transit time to or from the Norton Sound. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-6. Annual miles logged by OCS vessels from Exhibit 5-60 where 1/3 of mileage is within the fishing area of the Norton Sound. Vessel density from Exhibit 5-2 and 5-3 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Rather than presenting the range of numbers for fishing vessels given in Exhibit 5-6, the maximum figures are given here, therefore, these estimates should be considered an upper bound.

Exhibit 5-27

Open Water Collision Estimates While Fishing In The Bering Sea

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	2,165.3	174.4	2,339.7	1.51×10^{-2}	2.01×10^{-4}
1992	2,835.3	385.2	3,220.5	1.79×10^{-2}	1.62×10^{-3}
1997	3,825.7	730.1	4,555.8	2.19×10^{-2}	2.89×10^{-3}
2002	4,689.1	154.1	4,843.2	2.33×10^{-2}	3.26×10^{-3}
2007	4,982.6	154.1	5,136.7	2.08×10^{-2}	4.32×10^{-3}

Source: Sum of Exhibits 5-23, 5-24, 5-25 and 5-26.

the following exhibits: Exhibit 5-28, the North Aleutian Shelf; Exhibit 5-29, the St. George Basin; Exhibit 5-30 the Navarin Basin; Exhibit 5-31, Norton Sound; and Exhibit 5-32, the cumulative Bering Sea totals.

The "parallel path" model was run again to estimate collisions between fishing vessels and other vessels including OCS vessels in the vicinity of port. The results for each lease sale are given in the following exhibits: Exhibit 5-33 for North Aleutian Shelf; Exhibit 5-34, St. George Basin; Exhibit 5-35, Navarin Basin; Exhibit 5-36, Norton Sound; and Exhibit 5-37 presents cumulative totals for the Bering Sea. The port of Dutch Harbor is used for vessels operating in the North Aleutian Shelf, Navarin Basin and St. George Basin. Nome is the port used for vessels operating in Norton Sound. The incremental number of collisions associated with Bering Sea OCS development is shown for the North Aleutian Shelf in Exhibit 5-38, St. George in Exhibit 5-39, Navarin Basin in Exhibit 5-40, Norton Sound in Exhibit 5-41 and cumulative Bering Sea totals in Exhibit 5-42.

5.2 Trawl Gear Loss

OCS-caused loss of trawl gear occurs primarily because of debris on the seafloor deposited during construction of OCS structures. The best data base currently available on such loss is that from the United Kingdom Offshore Operators Association (UKOOA). This is an association of the OCS oil industry which has established a fund to compensate fishermen for gear damage claims. Both the nature of fishing operations and OCS development would be analogous to that which is expected to occur in the Bering Sea.

These data will be used to project trawl gear loss with an adjustment made for differences in magnitude of both fishing effort and OCS development between the two areas in Section 5.2.2. However, as a

Exhibit 5-28

Open Water Collision Estimates While Traveling To and From the North Aleutian Shelf[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Milles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	248.2	0	248.2	7.46×10^{-3}	0
1992	264.6	100.8	365.4	8.73×10^{-3}	8.12×10^{-4}
1997	288.9	40.3	329.2	9.21×10^{-3}	7.72×10^{-4}
2002	295.7	40.3	336.0	9.52×10^{-3}	8.14×10^{-4}
2007	295.7	40.3	336.0	9.52×10^{-3}	8.14×10^{-4}

---

[1] Includes time while in transit to or from the North Aleutian Shelf but does not include transit time in immediate vicinity of port. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-8. Annual miles logged by OCS vessels from Exhibit 5-57 where 4/5 of mileage is traveling to and from the North Aleutian Shelf. Vessel density from Exhibit 5-2 and 5-8 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Maximum figures were used for fishing vessels. These collision estimates should be considered an upper bound.

Exhibit 5-29

Open Water Collision Estimates While Traveling To and From St. George Basin[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Milles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	380.9	137.6	518.5	4.14×10^{-3}	5.47×10^{-4}
1992	515.1	0	515.1	5.18×10^{-3}	0
1997	666.5	0	666.5	6.77×10^{-3}	0
2002	724.1	0	724.1	7.36×10^{-3}	0
2007	738.7	0	738.7	9.48×10^{-3}	0

---

[1] Includes time while in transit to or from the St. George Basin but does not include transit time in immediate vicinity of port. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-91. Annual miles logged by OCS vessels from Exhibit 5-58 where 2/3 of mileage is traveling to and from the St. George Basin. Vessel density from Exhibit 5-2 and 5-9 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Maximum numbers were used for the number of fishing vessels present, therefore, these estimates should be considered an upper bound.

Exhibit 5-30

Open Water Collision Estimates While Traveling To and From Navarin Basin[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Milles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	110.4	144	254.4	5.04×10^{-4}	3.26×10^{-5}
1992	184.8	720	904.8	1.13×10^{-3}	2.60×10^{-4}
1997	429.6	1,440	1,869.6	2.30×10^{-3}	1.09×10^{-3}
2002	813.6	288	1,101.6	2.67×10^{-3}	7.49×10^{-4}
2007	1,108.8	288	1,396.8	3.57×10^{-3}	1.27×10^{-3}

---

[1] Includes time while in transit to or from the St. George Basin but does not include transit time in immediate vicinity of port. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-10. Annual miles logged by OCS vessels from Exhibit 5-59 where 2/3 of mileage is traveling to and from the St. George Basin. Vessel density from Exhibit 5-2 and 5-10 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Exhibit 5-31

Open Water Collision Estimates While Traveling To and From Norton Sound[1]

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	12.6	67.2	79.8	2.86×10^{-3}	5.80×10^{-5}
1992	12.6	0	12.6	1.75×10^{-3}	0
1997	12.6	0	12.6	1.75×10^{-3}	0
2002	12.6	0	12.6	1.75×10^{-3}	0
2007	12.6	0	12.6	1.75×10^{-3}	0

---

[1] Includes time while in transit to or from the Norton Sound but does not include transit time in immediate vicinity of port. Based on "free gas" model.

Source: Annual miles logged by fishing vessels from Exhibit 5-11. Annual miles logged by OCS vessels from Exhibit 5-60 where 2/3 of mileage is traveling to and from the Norton Sound. Vessel density from Exhibit 5-2 and 5-11 and Exhibit 4-3. Collisions calculated from model presented in Section 5.1.1.

Note: Maximum numbers were used for fishing vessels from Exhibit 5-11. These collision estimates should be considered a maximum.

Exhibit 5-32

Open Water Collision Estimates While Traveling To and From Bering Sea Lease Sales

Year	Annual Miles Logged By Fishing Vessels (1000 miles)	Annual Miles Logged By OCS Vessels (1000 miles)	Total Miles Logged (1000 miles)	Vessel Density (No. per sq. mi.)	Expected Number of Collisions per Year
1987	752.2	348.8	1,101.0	1.22×10^{-2}	6.38×10^{-4}
1992	977.1	820.8	1,797.9	1.68×10^{-2}	1.07×10^{-3}
1997	1,385.1	1,480.3	2,865.4	2.00×10^{-2}	1.86×10^{-3}
2002	1,121.9	328.3	1,450.2	2.13×10^{-2}	1.56×10^{-3}
2007	2,155.8	328.3	2,484.1	2.43×10^{-2}	2.08×10^{-3}

Source: Sum of Exhibit 5-28, 5-29, 5-30 and 5-31.

Exhibit 5-33

Vessel Collisions In The Vicinity of Port[1] North Aleutian Shelf

Year	Number[2] of Trips by Fishing Vessels	Number of[2] Trips by Other Vessels	Number of[3] Trips by OCS Vessel	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	552	459	0	1,011	0.3240	0
1992	600	800	1,500	2,900	2.6656	3.97×10^{-4}
1997	648	1,077	240	1,965	1.2238	1.82×10^{-4}
2002	666	1,276	240	2,182	1.5091	2.25×10^{-4}
2007	666	1,484	240	2,390	1.8105	2.70×10^{-4}

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in Section 5.1.1.

Source:

[2] Exhibit 5-13.

[3] Exhibit 5-57. Each arrival or departure counts as a trip.

Note: Only maximum numbers from Exhibit 5-13 are given here.

Exhibit 5-34

Vessel Collisions In The Vicinity of Port[1]
St. George Basin

Year	Number[2] of Trips by Fishing Vessels	Number of[2] Trips by Other Vessels	Number of[3] Trips by OCS Vessel	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	1,772	459	3,840	6,071	11.68	1.74×10^{-3}
1992	2,396	800	0	3,196	3.24	0
1997	3,100	1,077	0	4,177	5.53	0
2002	3,368	1,276	0	4,644	6.84	0
2007	3,436	1,484	0	4,920	7.67	0

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in Section 5.1.1.

Source:

[2] Exhibit 5-14.

[3] Exhibit 5-58. Each arrival or departure counts as a trip.

Note: Only maximum figures from Exhibit 5-14 are given here.

Exhibit 5-35

Vessel Collisions In The Vicinity of Port[1] Navarin Basin

Year	Number[2] of Trips by Fishing Vessels	Number of[2] Trips by Other Vessels	Number of[3] Trips by OCS Vessel	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	184	459	360	1,003	0.32	4.77×10^{-5}
1992	308	800	1,800	2,908	2.68	4.00×10^{-5}
1997	716	1,077	3,600	5,393	9.22	1.37×10^{-3}
2002	1,356	1,276	720	3,352	3.56	5.30×10^{-4}
2007	1,848	1,484	720	4,052	5.20	7.75×10^{-4}

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Dutch Harbor which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in Section 5.1.1.

Source:

[2] Exhibit 5-15.

[3] Exhibit 5-59. Each arrival or departure counts as a trip.

Exhibit 5-36

Vessel Collisions In The Vicinity of Port[1] Norton Sound

Year	Number[2] of Trips by Fishing Vessels	Number of[2] Trips by Other Vessels	Number of[3] Trips by OCS Vessel	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	126	372	3,528	4,026	5.15	7.67×10^{-4}
1992	126	396	0	522	8.66×10^{-2}	0
1997	126	428	0	554	9.64×10^{-2}	0
2002	126	456	0	582	0.11	0
2007	126	484	0	610	0.12	0

[1] Includes collisions in the constricted waters in and around the vicinity of port. Calculations based on the characteristics of Nome which is where the great majority of port arrivals and departures will take place. Based on "parallel path" model described in Section 5.1.1.

[2] Exhibit 5-16.

[3] Exhibit 5-60. Each arrival or departure counts as a trip.

Note: Only maximum numbers from Exhibit 5-16 are given here.

Exhibit 5-37

Vessel Collisions In The Vicinity of Port Cumulative Bering Sea

Year	Number of Trips by Fishing Vessels	Number of Trips by Other Vessels	Number of Trips by OCS Vessel	Total Number of Vessel Trips	Total Number of Collision Situations	Expected Number of Collisions
1987	2,634	831	7,728	11,193	17.47	2.60×10^{-3}
1992	3,430	1,196	3,300	7,926	8.67	4.37×10^{-4}
1997	4,590	1,505	3,840	9,935	16.07	1.55×10^{-3}
2002	5,516	1,732	960	8,208	12.02	7.55×10^{-4}
2007	6,076	1,968	960	9,004	14.80	1.05×10^{-3}

Source: Sum of Exhibits 5-33, 5-34, 5-35, and 5-36.

Exhibit 5-38

Collision Impact Summary in the North Aleutian Shelf
(expected maximum number of collisions per year)

		Collisions With OCS Development				
Year	Total Expected Number of Collisions Without OCS Activity	Collisions Fishing in the Lease Sale Area	Collisions to and from the Lease Sale Area	Collisions in the Vicinity of Port	Total Expected Number of Collisions	Incremental Number of Collisions Due To OCS Activity
1987	1.3×10^{-3}	0	0	0	0	0
1992	1.8×10^{-3}	1.3×10^{-3}	8.1×10^{-4}	4.0×10^{-4}	2.5×10^{-3}	7.0×10^{-4}
1997	2.2×10^{-3}	1.4×10^{-3}	7.7×10^{-4}	1.8×10^{-4}	2.4×10^{-3}	5.5×10^{-4}
2002	2.4×10^{-3}	1.5×10^{-3}	8.1×10^{-4}	2.3×10^{-4}	2.5×10^{-3}	1.4×10^{-4}
2007	2.4×10^{-3}	1.5×10^{-3}	8.1×10^{-4}	2.7×10^{-4}	2.6×10^{-3}	1.8×10^{-4}

Source: Summary of Exhibit 5-18, and Exhibits 5-23, 5-28, and 5-33.

Exhibit 5-39

Collision Impact Summary in the St. George Basin
(expected number of collisions per year)

Year	Total Expected Number of Collisions Without OCS Activity	Collisions With OCS Development: Collisions Fishing in the Lease Sale Area	Collisions With OCS Development: Collisions to and from the Lease Sale Area	Collisions With OCS Development: Collisions in the Vicinity of Port	Collisions With OCS Development: Total Expected Number of Collisions	Incremental Number of Collisions Due To OCS Activity
1987	1.9×10^{-3}	1.5×10^{-3}	5.5×10^{-4}	1.7×10^{-3}	3.8×10^{-3}	1.9×10^{-3}
1992	3.5×10^{-3}	0	0	0	0	0
1997	5.9×10^{-3}	0	0	0	0	0
2002	6.8×10^{-3}	0	0	0	0	0
2007	7.4×10^{-3}	0	0	0	0	0

Source: Summary of Exhibit 5-19, and Exhibits 5-24, 5-29, and 5-34.

Exhibit 5-40

Collision Impact Summary
in the Navarin Basin
(expected number of collisions per year)

Year	Total Expected Number of Collisions Without OCS Activity	Collisions With OCS Development				Incremental Number of Collisions Due To OCS Activity
		Collisions Fishing in the Lease Sale Area	Collisions to and from the Lease Sale Area	Collisions in the Vicinity of Port	Total Expected Number of Collisions	
1987	5.2×10^{-5}	5.7×10^{-5}	3.3×10^{-5}	4.8×10^{-5}	1.4×10^{-4}	8.8×10^{-5}
1992	1.5×10^{-4}	3.5×10^{-4}	2.6×10^{-4}	4.0×10^{-5}	6.5×10^{-4}	5.0×10^{-4}
1997	6.4×10^{-4}	1.5×10^{-3}	1.1×10^{-3}	1.4×10^{-3}	4.0×10^{-3}	3.4×10^{-3}
2002	6.3×10^{-3}	1.8×10^{-3}	7.5×10^{-4}	5.3×10^{-4}	3.1×10^{-3}	3.2×10^{-3}
2007	4.0×10^{-3}	2.8×10^{-3}	1.3×10^{-3}	7.8×10^{-4}	4.9×10^{-3}	8.8×10^{-4}

Source: Summary of Exhibit 5-20 and Exhibits 5-24, 5-29, and 5-34.

Exhibit 5-41

Collision Impact Summary
in the Norton Sound
(expected number of collisions per year)

Year	Total Expected Number of Collisions Without OCS Activity	Collisions With OCS Development: Collisions Fishing in the Lease Sale Area	Collisions With OCS Development: Collisions to and from the Lease Sale Area	Collisions With OCS Development: Collisions in the Vicinity of Port	Collisions With OCS Development: Total Expected Number of Collisions	Incremental Number of Collisions Due To OCS Activity
1987	4.0×10^{-5}	5.0×10^{-4}	5.8×10^{-5}	7.7×10^{-4}	1.3×10^{-3}	1.3×10^{-3}
1992	4.2×10^{-5}	0	0	0	0	0
1997	4.3×10^{-5}	0	0	0	0	0
2002	4.4×10^{-5}	0	0	0	0	0
2007	4.6×10^{-5}	0	0	0	0	0

Source: Summary of Exhibit 5-21 and Exhibits 5-25, 5-30, and 5-35.

Exhibit 5-42

Collision Impact Summary for the Bering Sea

(expected number of collisions per year)

Year	Total Expected Number of Collisions Without OCS Activity	Collisions With OCS Development				Incremental Number of Collisions Due To OCS Activity
		Collisions Fishing in the Bering Sea	Collisions to and from the Bering Sea	Collisions in the Vicinity of Port	Total Expected Number of Collisions	
1987	8.3×10^{-3}	2.1×10^{-3}	6.4×10^{-4}	2.5×10^{-3}	5.2×10^{-3}	3.1×10^{-3}
1992	5.5×10^{-3}	1.7×10^{-3}	1.1×10^{-3}	4.4×10^{-4}	3.2×10^{-3}	2.3×10^{-3}
1997	8.9×10^{-3}	2.9×10^{-3}	1.9×10^{-3}	1.6×10^{-3}	6.4×10^{-3}	2.5×10^{-3}
2002	1.2×10^{-2}	3.3×10^{-3}	1.6×10^{-3}	7.6×10^{-4}	5.7×10^{-3}	6.3×10^{-3}
2007	1.4×10^{-2}	4.3×10^{-3}	2.1×10^{-3}	1.1×10^{-3}	7.5×10^{-3}	6.5×10^{-3}

Source: Summary of Exhibit 5-38, 5-39, 5-40, and 5-41.

baseline with which to compare these estimates, the estimated gear loss without OCS development was estimated and is presented in Section 5.2.1.

5.2.1 Trawl Gear Loss Without OCS Development

Since no precise recorded data are available on trawl gear loss, these estimates are based on estimates by knowledgeable individuals of the incidence rate for loss of trawl gear. The incidence rate was then applied to the projected number of fishing vessels from Chapter 3 by five year increment.

The estimated baseline trawl gear loss for the North Aleutian Shelf is given in Exhibit 5-43. Baseline trawl gear loss for the St. George Basin is given in Exhibit 5-44. Estimated trawl gear loss for the Navarin Basin is given in Exhibit 5-45. Estimated trawl gear loss for the Norton Basin is given in Exhibit 5-46. Estimated cumulative total of trawl gear lost for the Bering Sea is given in Exhibit 5-47.

5.2.2 Trawl Gear Loss With OCS Development

Loss or damage of otter trawls has in the past proved to be a significant problem in areas where major OCS activity has coincided with large trawl fisheries. This has been true in the North Sea and the Gulf of Mexico. It appears that the major problem is debris lost overboard (or in some cases intentionally dumped) during the construction of offshore structures and development and maintenance of oil and gas fields. Economic loss to fishermen can involve both the loss of the gear itself as well as lost value of their fishing time due to lost or damaged gear.

The best source of data currently available for projecting trawl gear loss in the Bering Sea is for the North Sea from the United Kingdom Offshore Operators Association (UKOOA). Both the type of trawling as

Exhibit 5-43

Baseline Trawl
Gear Loss in the North Aleutian Shelf
(1982 dollars)

Year	Number of Trawl Vessels[1]	Total Value of Towed Gear[2] ($1000)	Estimated Annual Value of Trawl Gear Lost[3] ($1000)
1987	2	50	2.5
1992	4	100	5.0
1997	8	200	10.0
2002	9	225	11.3
2007	9	225	11.3

---

[1] From Table 3-7. Does not include numbers of vessels for Pacific cod or shellfish.

[2] Based on an estimate of $25,000 for net and rigging per vessel.

[3] Based on an estimate of five percent of value of gear lost per year (Centaur Associates, et. al. 1983).

Exhibit 5-44

Baseline Trawl Gear Loss in the St. George Basin (1982 dollars)

Year	Number of Trawl Vessels[1]	Total Value of Towed Gear[2] ($1000)	Estimated Annual Value of Trawl Gear Lost[3] ($1000)
1987	16.2	405	20.3
1992	31.4	785	39.3
1997	51.8	1,295	64.8
2002	64	1,600	80.0
2007	68	1,700	85.0

---

[1] From Table 3-11. Does not include numbers of vessels for Pacific cod, shellfish, herring, or halibut.

[2] Based on an estimate of $25,000 for net and rigging per vessel.

[3] Based on an estimate of five percent of value of gear lost per year (Centaur Associates, et. al. 1983).

Exhibit 5-45

Baseline Trawl
Gear Loss in the Navarin Basin
(1982 dollars)

Year	Number of Trawl Vessels[1]	Total Value of Towed Gear[2] ($1000)	Estimated Annual Value of Trawl Gear Lost[3] ($1000)
1987	3	75	3.8
1992	6	150	7.5
1997	19	475	23.8
2002	44	1,100	55.0
2007	63	1,575	78.75

---

[1] From Table 3-18. Does not include numbers of vessels for Pacific cod, shellfish, herring, or halibut.

[2] Based on an estimate of $25,000 for net and rigging per vessel.

[3] Based on an estimate of five percent of value of gear lost per year (Centaur Associates, et. al. 1983).

Exhibit 5-46

Baseline Trawl Gear Loss in the Norton Basin (1982 dollars)

Year	Number of Trawl Vessels[1]	Total Value of Towed Gear[2] ($1000)	Estimated Annual Value of Trawl Gear Lost[3] ($1000)
1987	0.15	3.8	0.2
1992	0.15	3.8	0.2
1997	0.15	3.8	0.2
2002	0.15	3.8	0.2
2007	0.15	3.8	0.2

---

[1] From Table 3-14. Does not include numbers of vessels for Pacific cod, shellfish, herring, or halibut. .

[2] Based on an estimate of $25,000 for net and rigging per vessel.

[3] Based on an estimate of five percent of value of gear lost per year (Centaur Associates, et. al. 1983).

Exhibit 5-47

Baseline Trawl Gear Loss in the Bering Sea[1]

(1982 dollars)

Year	Number of Trawl Vessels	Total Value of Towed Gear ($1000)	Estimated Annual Value of Trawl Gear Lost ($1000)
1987	21.4	533.8	26.7
1992	41.6	1,038.8	52.0
1997	79.0	1,973.8	98.7
2002	117.2	2,928.8	146.0
2007	140.2	3,503.8	175.2

---

[1] Sum of Exhibits 5-43, 5-44, 5-45 and 5-46.

well as the general type of OCS development activity are analogous to what is expected to occur in the Bering Sea.

Major offshore oil and gas activity began in the North Sea in the early 1970's. It soon became apparent that gear loss was a significant problem to fishermen. In 1974 a fund was set up to attempt to compensate fishermen for gear loss. The fund is operated under the auspices of the UKOOA which is an association of firms involved in the offshore oil industry. Payment is made at the discretion of the management committee of the fund under a set of criteria and based upon the merits of each individual claim.

The payment criteria have varied over time. Originally, compensation was generally available only for damage to actual gear and not for vessel damage or economic loss due to lost fishing time. Beginning in 1976 compensation began to be paid for lost fishing time.

Exhibit 5-48 presents a summary of information on claims made against the UKOOA fund. In recent years the number of claims settled has ranged from about 80 to 90 percent of the number of claims submitted. However, the fund does not necessarily pay the full value of even a well substantiated claim. The payment for an accepted claim ranges between about 1/4 and 2/3 of the value of the claim. There is a much greater reluctance to accept a claim for hardship (lost fishing time) loss. Over recent years, the actual payments for settlements of claims have been about 38 percent of the value of claims submitted. Settlements for actual gear loss have been approximately 50 percent of the value of such claims submitted, and payments for lost fishing time have been about 17 percent of the value of such claims submitted (Centaur Associates Inc., 1981).

Exhibit 5-49 presents data on the type of debris causing damage in claims to the UKOOA fund. These are from a sample of claim files examined by Mackay and Moir (1980). Note that in about a third of the

Exhibit 5-48

Claims Made to UKOOA Compensation Fund

		Amount Claimed			Amount of Claims Paids[1]		
					Settlements		
Year of Incident	Total Number of Claims Received	Gear Loss (Thousands of Pounds Sterling)	Hardship Loss (Thousands of Pounds Sterling)	Number of Claims Settled	Gear Loss (Thousands of Pounds Sterling)	Hardship Loss (Thousands of Pounds Sterling)	Number of Claims Rejected
1974	20	8	-	13	3	-	7
1975	89	43	10	70	26	2	19
1976	104	55	30	90	37	.25	14
1977	116	72	46	108	42	7	8
1978	106	79	58	89	38	15	17
1979	67	67	37	55	14	4	12
6 year total	502	322	181	425	160	29.25	77

---

[1] May not add due to rounding.

Source: Department of Agriculture and Fisheries for Scotland.

Exhibit 5-49

UKOOA Claims and Type of Debris Involved

Type of Debris	Number of Cases	Percent[1]
Unidentified Debris	85	34
Wire	53	21
Anchors	25	10
Oil Drums	12	5
Weight	14	6
Steel Plates, Girders, etc.	11	4
Chains	12	5
Buoys	7	3
Pipe	4	2
Others	28	11
Total	251	100

---

[1] May not add due to rounding.

Source: MacKay and Moir, 1980

claims, the nature of the debris or obstruction causing the damage is unknown. These occur when a net is brought up damaged and there is presumably some circumstantial evidence to relate it to OCS activity. In claims against the U.S. Fishermen's Contingency Fund from the Gulf of Mexico commercial fisheries, approximately 52 percent of the claims were attributable to unidentified debris (Centaur Associates, Inc., 1981).

In order to project potential gear loss in the Bering Sea, an estimating relationship was applied to the data from the North Sea UKOOA fund. This estimating relationship considered differences in the magnitude of OCS development as well as fishing effort between the two areas. Exhibit 5-50 shows indicators of OCS activity in the North Sea over the period 1976 through 1980. Data for these years was taken in order to allow operation of the claims procedure to stabilize somewhat from the initial start-up.

The data in Exhibit 5-50 refers to OCS activity in the middle and upper North Sea of the U.K. sector north of 55 degree north latitude. This is where the U.K. offshore oil and gas activity coincides with heavy fishing activity. Included is OCS development in the Argyll, Auk, Beryl, Brent, Claymore, Dunlin, Forties, Heather, Montrose, Ninian, Piper and Thistle fields.

Consideration was given to determining an appropriate measure for scaling the level of OCS activity. Since the major cause of gear damage is debris, it seems reasonable to assume that gear loss would be proportional to the total volume of material transported to the offshore production platform and exploration drilling rigs. On an annual basis somewhat more material will be transported to a production platform than an exploration rig because of the greater volume of activity per installation. However, it seems likely that the debris problem might be

Exhibit 5-50

North Sea Oil and Gas Activity

Year	Number of Production Platforms in Place	Number of Mobile Exploration Rigs Operating	Number of[1] Oil and Gas Installations	Miles of[2] Pipeline in Place
1976	14	18	32	445
1977	17	20	37	683
1978	21	15	38	1202
1979	26	17	43	1235
1980	28	20	48	1516

---

[1] Includes production platforms and exploration rigs.

[2] Based on year pipeline was commissioned.

Source: U.K. Department of Energy, 1981.

greater for an exploration rig because of the greater amount of anchor handling, rig movement, and set-up and take-down activity. It is impossible to say with precision, what actual activities cause the debris problem. Thus, in lieu of such data the amount of OCS activity for scaling potential gear loss was taken to be the sum of annual operation of production platforms and mobile exploration rigs. The sum of these is termed the number of oil and gas installations.

Consideration was given to adjusting the data to account for pipeline installation, since this involves a considerable amount of material delivered offshore and construction activity on the seafloor. However, it has been estimated that of the UKOOA claims, approximately eight percent occured within two kilometers of a pipeline (Centaur Associates, Inc., 1981). Thus, scaling for the amount of pipeline construction would not significantly affect the results.

In the early stages of oil and gas exploration in the North Sea, gear hang-ups on suspended or abandoned wellheads proved to be a problem. However, in recent years this has become much less of a problem due to the fact that the locations of such structures have been well publicized to fishermen and they are able to effectively avoid them. Also this problem can be effectively mitigated through shrouds or flush cut-offs.

Exhibit 5-51 relates claims made against the UKOOA compensation fund to the relative amount of fishing and OCS activity. Shown are the number of UKOOA claims by year and the catch and effort for demersal species in the 14 International Convention for the Exploration of the SEA (ICES) statistical areas in which the North Sea oil fields are located. The fishing effort per square mile was calculated. This was defined as the fishing effort expressed in number of hours divided by 12,600 square miles which is the estimated area of the 14 ICES statistical areas. (Each one degree by one-half degree statistical area is approximately 30

Exhibit 5-51

North Sea Gear Damage Related to Fishing and OCS Effort

	Claims Made to UKOOA Fund	Catch (metric tons)	Fishing Effort (hours)	Fishing Effort Per Square Mile[1] (hours/Sq. Mile)	Gear Damage Factor[2]
1976	104	6,685	14,791	1.17	2.78
1977	116	12,559	22,628	1.80	1.74
1978	106	23,941	36,759	2.92	0.96
1979	67	26,272	38,132	3.03	0.51
1980	74	23,501	42,167	3.35	0.46

---

[1] Fishing effort divided by 12,600 square miles which is the area of the 14 one degree one-half degree ICES statistical areas (each area is approximately 30 by 30 miles) in which the offshore oil and gas installations are located).

[2] Number of claims divided by fishing effort per square mile divided by number of oil and gas installations.

Source: Department of Agriculture and Fisheries for Scotland.

by 30 square miles.) Fishing effort per square mile is used to normalize fishing effort under the assumption that the incidence of gear damage is proportional to the percentage of area swept by trawls in an area subject to OCS debris. This is equivalent to saying that the chance of any given trawl encountering a specific piece of debris on the bottom is equal to the probability that the piece of debris is in that portion of the area swept by the trawl during a season.

The relationship for normalizing gear damage is then given by the relationship:

D = G times O times E / A

where:

D = the number of instances of gear damage

G = a parameter termed the gear damage factor which relates gear damage to the other variables

O = the number of oil and gas installions which is used as a relative measure of OCS activity

E = fishing effort expressed in terms of hours trawled per year

A = the area of the statistical reporting area to which the fishing effort data relate.

Using this relationship the gear damage factor, "G" was calculated for each year and is given in Exhibit 5-51. As can be seen the gear damage factor decreases from 1976 to 1980. This would indicate that the gear damage problem decreased somewhat over the late 1970's. There could be a number of explanations for this. The most likely is that both the fishing and the OCS industry became more sensitive to the problem and took measures to mitigate it. For instance, the OCS industry could have begun to exercise more care to prevent accidental or intentional dumping or the fishing industry could have become more aware of specific locations likely to cause damage.

Based on the above, trawl gear damage projections for the Bering Sea were calculated using a gear damage factor of 0.50. This is roughly the level at which the gear damage factor in the North Sea stabilized in the years 1979 through 1980.

Estimates of trawl gear damage for each lease and the cumulative totals for the Bering Sea are given in Exhibits 5-52 through 5-56. The estimates of trawl gear damage are projected using the 0.50 gear damage factor and the estimating relationships for gear damage just described.

The anticipated numbers of OCS supply vessel trips are given in Exhibit 5-57 for the North Aleutian Shelf, Exhibit 5-58 for the St. George Basin, Exhibit 5-59 for the Navarin Basin, Exhibit 5-60 for the Norton Basin and Exhibit 5-61 for the cumulative Bering Sea case.

Based on a survey of a sample of gear damage claims submitted to the UKOOA fund, 57 percent of the cases of gear damage incurred by North Sea Fishermen, either the net or the gear had to be repaired. In 38 percent of the cases either the net or the gear had to be replaced, and in only six percent of cases was replacement of the whole net and gear necessary.

In interpreting the average value of individual claims and the associated settlements it must be remembered that the fund had varying payment limits for the hardship loss. Also, even for what are considered to be valid claims the fund does not pay the full value of the claim.

Exhibit 5-52

Estimated North Aleutian Shelf Trawl Gear Loss[1]

Year	Number of Oil and Gas Installations[2]	Number of Domestic Trawl Vessels[3]	Fishing Effort (1000 hours)[4]	Fishing Effort Per Square Mile (hours/sq. mile)[5]	Projected Annual Number of Damage Claims[6]
1987	0	2	0.042	0.007	0.0
1992	2	4	0.084	0.014	0.01
1997	2	8	0.168	0.028	0.03
2002	2	9	0.189	0.032	0.03
2007	2	9	0.189	0.032	0.03

---

[1] Domestic fishing vessels only.

[2] Includes number of exploration rigs plus cumulative number of production platforms.

[3] From Exhibit 5-43.

[4] Vessels fish 100 days per year and actually drag gear an average of 15 hours per day and assumes that 1.4 percent (based on NMFS historical foreign catch data) of trawling in North Aleutian Shelf will be done in area of geologic potential.

[5] Area of geological potential was estimated to contain 5,940 square miles based on Dames and Moore, et. al., 1982.

[6] Fishing effort per square mile times number of oil and gas installations times 0.50 (estimated gear damage factor).

Exhibit 5-53

Estimated St. George Basin Trawl Gear Loss[1]

Year	Number of Oil and Gas Installations[2]	Number of Domestic Trawl Vessels[3]	Fishing Effort (1000 hours)[4]	Fishing Effort Per Square Mile (hours/sq. mile)[5]	Projected Annual Number of Damage Claims[6]
1987	5	16	4.0	0.8	1.9
1992	0	31	7.9	1.5	0
1997	0	52	13.3	2.5	0
2002	0	64	16.3	3.1	0
2007	0	68	17.3	3.3	0

---

[1] Domestic fishing vessels only.

[2] Includes number of exploration rigs.

[3] From Exhibit 5-44.

[4] Vessels fish 100 days per year and actually drag gear an average of 15 hours per day and assumes that 17.0 percent (based on NMFS historical foreign catch data) of trawling in St. George Basin will be done in area of geologic potential.

[5] Area of geological potential was estimated to contain 5,310 square miles based on BLM, 1981.

[6] Fishing effort per square mile times number of oil and gas installations times 0.50 (estimated gear damage factor).

Exhibit 5-54

Estimated Navarin Basin Trawl Gear Loss[1]

Year	Number of Oil and Gas Installations[2]	Number of Domestic Trawl Vessels[3]	Fishing Effort (1000 hours) [4]	Fishing Effort Per Square Mile (hours/sq. mile)[5]	Projected Annual Number of Damage Claims[6]
1987	3	3	2.9	0.2	0.3
1992	6	6	5.9	0.3	0.9
1997	13	19	18.6	1.1	7.2
2002	13	44	43.0	2.5	16.3
2007	13	63	61.6	3.6	23.4

---

[1] Domestic fishing vessels only.

[2] Includes number of exploration rigs plus cumulative number of production platforms.

[3] From Exhibit 5-45.

[4] Vessels fish 100 days per year and actually trawl gear an average of 15 hours per day and assumes that 65.2 percent (based on NMFS historical foreign catch data) of trawling in Navarin Basin will be done in area of geologic potential.

[5] Area of geological potential was estimated to contain 17,100 square miles based on Centaur Associates, et. al., 1983.

[6] Fishing effort per square mile times number of oil and gas installations times 0.50 (estimated gear damage factor).

Exhibit 5-55

Estimated Norton Sound Trawl Gear Loss[1]

Year	Number of Oil and Gas Installations[2]	Number of Domestic Trawl Vessels[3]	Fishing Effort (1000 hours)[4]	Fishing Effort Per Square Mile (hours/sq. mile)[5]	Projected Annual Number of Damage Claims[6]
1987	4	.15	0.015	0.005	0.01
1992	0	.15	0.015	0.005	0
1997	0	.15	0.015	0.005	0
2002	0	.15	0.015	0.005	0
2007	0	.15	0.015	0.005	0

---

[1] Domestic fishing vessels only.

[2] Includes number of exploration rigs.

[3] From Exhibit 5-46.

[4] Vessels fish 100 days per year and actually drag gear an average of 15 hours per day and assumes that 6.6 percent (based on NMFS historical foreign catch data) of trawling in Norton Sound will be done in area of geologic potential.

[5] Area of geological potential was estimated to contain 2,898 square miles based on BLM, 1982.

[6] Fishing effort per square mile times number of oil and gas installations times 0.50 (estimated gear damage factor).

Exhibit 5-56

Estimated Bering Sea Trawl Gear Loss

Year	Number of Oil and Gas Installations	Number of Domestic Trawl Vessels	Fishing Effort (1000 hours)	Projected Annual Number of Damage Claims
1987	12	21.15	7.0	2.1
1992	8	41.15	13.9	0.9
1997	15	79.15	32.1	7.2
2002	15	117.15	59.5	16.3
2007	15	140.15	79.1	23.4

Source: Sum of Exhibits 5-52, 5-53, 5-54, 5-55.

Exhibit 5-57

OCS Supply Vessel Trip Activity in the North Aleutian Shelf (round trips)

Year	Number of Trips per Month		Miles Logged per Month	
	Winter	Summer	Winter	Summer
1984	-	-	-	-
1985	-	-	-	-
1986	-	-	-	-
1987	-	-	-	-
1988	-	-	-	-
1989	-	20	-	8,400
1990	-	20	-	8,400
1991	20	50	8,400	21,000
1992	40	50	16,800	21,000
1993	40	70	16,800	29,420
1994	20	20	8,400	8,400
1995	20	20	8,400	8,400
1996	20	20	8,400	8,400
1997	20	20	8,400	8,400
1998	20	20	8,400	8,400
1999	20	20	8,400	8,400
2000	20	20	8,400	8,400

Source: Based on adjusted vessel estimates from Exhibit 4-3 for each season with 10 trips per month with a round trip distance of 420 miles between a supply base at Dutch Harbor and the North Aleutian shelf. Winter includes December to May; Summer is from June to November.

Exhibit 5-58

OCS Supply Vessel Trip Activity in the St. George Basin (round trips)

Year	Number of Trips per Month		Miles Logged per Month	
	Winter	Summer	Winter	Summer
1984	-	-	-	-
1985	-	-	-	-
1986	-	50	-	21,500
1987	-	80	-	34,400
1988	-	100	-	43,000
1989	-	100	-	43,000
1990	-	100	-	43,000
1991	-	40	-	17,200
1992	-	-	-	-
1993	-	-	-	-
1994	-	-	-	-
1995	-	-	-	-
1996	-	-	-	-
1997	-	-	-	-
1998	-	-	-	-
1999	-	-	-	-
2000	-	-	-	-

Source: Based on adjusted vessel estimates from Exhibit 4-3 for each season with 10 trips per month with a round trip distance of 420 miles between a supply base at Dutch Harbor and the North Aleutian shelf. Winter includes December to May; Summer is from June to November.

Exhibit 5-59

OCS Supply Vessel Trip Activity in the Navarin Basin (round trips)

Year	Number of Trips per Month		Miles Logged per Month	
	Winter	Summer	Winter	Summer
1984	-	-	-	-
1985	-	-	-	-
1986	-	12	-	14,400
1987	-	30	-	36,000
1988	-	30	-	36,000
1989	-	30	-	36,000
1990	-	24	-	28,800
1991	24	42	28,800	50,400
1992	48	102	57,600	122,400
1993	90	138	108,000	165,600
1994	114	162	136,800	194,400
1995	120	180	144,000	216,000
1996	120	180	144,000	216,000
1997	120	180	144,000	216,000
1998	84	84	100,800	100,800
1999	60	60	72,000	72,000
2000	48	48	57,600	57,600
2001	30	30	36,000	36,000
2002	30	30	36,000	36,000

Source: Based on adjusted vessel estimates from Exhibit 4-3 for each season with an estimated 6 trips per month with a round trip distance of 420 miles between Navarin Basin and Dutch Harbor of 1,200 miles. Winter includes December to May; Summer is from June to November.

Exhibit 5-60

OCS Supply Vessel Trip Activity in the St. George Basin (round trips)

Year	Number of Trips per Month		Miles Logged per Month	
	Winter	Summer	Winter	Summer
1984	-	-	-	-
1985	-	-	-	-
1986	-	48	-	9,600
1987	-	84	-	16,800
1988	-	96	-	19,200
1989	-	84	-	16,800
1990	-	48	-	9,600
1991	-	-	-	-
1992	-	-	-	-
1993	-	-	-	-
1994	-	-	-	-
1995	-	-	-	-
1996	-	-	-	-
1997	-	-	-	-
1998	-	-	-	-
1999	-	-	-	-
2000	-	-	-	-

Source: Based on adjusted vessel estimates from Exhibit 4-3 for each season with an estimated 12 trips per month with a round trip distance between Nome and Norton Sound. Winter includes December to May; Summer is from June to November.

Exhibit 5-61

OCS Supply Vessel Trip Activity in the Bering Sea Cumulative Case (round trips)

Year	Number of Trips per Month		Miles Logged per Month	
	Winter	Summer	Winter	Summer
1984	-	-	-	-
1985	-	-	-	-
1986	-	110	-	45,500
1987	-	194	-	54,800
1988	-	226	-	98,200
1989	-	234	-	179,800
1990	-	192	-	89,800
1991	44	132	37,200	88,600
1992	88	152	74,400	143,400
1993	130	208	124,800	186,600
1994	134	182	145,200	202,800
1995	140	200	152,400	224,400
1996	140	200	152,400	224,400
1997	140	200	152,400	224,400
1998	124	104	109,200	109,200
1999	80	80	80,400	80,400
2000	68	68	66,000	66,000
2001	50	50	44,400	44,400
2002	50	50	44,400	44,400

Source: Sum of Exhibits 5-57, 5-58, 5-59 and 5-60.

Based on these data, it is not likely that the typical incidence of damage will cause the total loss of a trawl net and the associated gear. The net and gear may cost around $25,000 for the type of vessel expected to be fishing in the Bering Sea. Assuming the average value of a claim from the UKOOA fund for 1979 (1000 pounds sterling for gear loss and 550 pounds for lost fishing time when the pound was worth about $1.80), the average value of gear loss per incident would be about $1800 for loss or damage of gear and approximately $1000 for opportunity loss or lost fishing time.

Using an upper bound of about 25 instances gear damage per year, the loss to domestic fishermen would be about $45,000 per year for gear damage or loss alone with another $25,000 per year for opportunity loss or lost fishing time. This compares to an estimated $175,200 in annual gear loss for the baseline case (Exhibit 5-47).

Again, it is likely that the OCS-related gear loss estimates on which these are based may be on the high side. An additional factor is the fact that at least some of the North Sea claims undoubtedly were caused by natural or other non-oil and gas related debris. The North Sea is an area of very heavy ship traffic and past naval battles.

There are a number of mitigating measures that can reduce the magnitude of the trawl gear damage problem. Potential mitigating measures include:

- Strict regulations and enforcement to prohibit dumping of debris,
- Marking and/or containerization of items transported to the offshore drilling sites such that identification of the responsible operator is possible,

- Required reporting of major-sized objects that are lost so that their location can be charted,
- Establishing sea lanes for OCS vessels to offshore work sites which would minimize areas of debris accumulation, and
- Seafloor inspection and/or clean up.

With regard to the latter there have been several such efforts in the Norwegian sector of the North Sea. A study conducted by Norway indicated that the majority of debris can be found within 50 to 70 meters of a drilling site MacKay and Moir (1980). This has prompted regulations in the North Sea requiring inspection and/or clean up of a specific distance around drilling sites. Norway has embarked upon an very extensive program to go back and clean up significant areas of concentrated debris.

5.3 Crab Gear Loss

Crab pots in the Bering Sea which are used for king and tanner crab may measure six or seven feet square by three feet high and may weigh 300 to 800 pounds empty. Depths at which the pots are placed may run from about 30 to 150 fathoms. The pot is connected by a line to a bouy on the surface to mark its location. The bouy may typically be of inflatable plastic approximately five feet in circumference. A crab pot bouy may also have at least one, sometimes two, trailer bouys behind the main bouy. One may be rubber and one may be rigid foam. The foam bouy is called a sea lion bouy and it is used because sea lions cannot puncture it. The multiple bouy system is used to enable the fishermen to find the gear in case one of the bouys is popped or lost. Also, having one or more trailer bouys gives the fishermen more line to hook when the vessel picks up the gear. This makes gear pick-up easier. In addition, the trailer bouy system is used in case the main bouy is pulled under by the tide, in which case the other bouys would stay up above the water thus remaining visible and helping to prevent loss. The pots are set in strings that may run from several dozen pots to more than 100. Pots are usually spaced a couple of hundred yards apart, but at times may be spaced closer than this (Browning, 1980).

A substantial number of vessels participate interchangeably in both the Tanner and king crab fisheries. Typically, the same pot is used for both species of crab, although different entrance panels will be used. Beginning in the early 1970's the number of vessels and pots being fished in the Bering Sea has increased rather dramatically.

The crab pot and associated gear including rigging and bouys may cost up to approximately $1000. In 1976 the average tanner crab pot in Alaska was estimated to have a value of $400 (North Pacific Fishery Management Council, 1978b) which would be about $600 in 1983 dollars. In view of the fact that pots to be fished in the outer Bering Sea will likely be heavier with a greater amount of rigging to fish the deeper waters, a figure of $900 per pot is used here for estimating potential economic loss.

Loss of pots has long been a perplexing problem for crab fishermen. Between 1965 and 1976, 671 crab pots were reported to the National Marine Fisheries Service to have been lost due to foreign trawlers (North Pacific Fishery Management Council, 1977b). Of these, 363 were located in the Gulf of Alaska and 308 were in the Bering Sea and Aleutian Islands. This was during a period when the number of pots in use in those areas was considerably below what it is today. In another instance more than 50 pots were lost to foreign trawlers by ten boats in a two-week period off Kodiak Island in 1979 (Terry, et. al., 1980). This suggests that the data reported to NMFS is only a small portion of actual pot loss due to trawling activity.

Estimates by fishermen of the number of pots currently lost per season ranged from about 3 to 15 percent of the number of pots in use (Centaur Associates, et. al., 1983). Pot loss will vary somewhat depending on ice conditions and weather.

Besides the foreign otter trawl gear conflict factors which contribute to crab pot loss include:

- Bottom depth changes along path where vessel lays pots such that depth is greater than buoy length,
- Sea lions puncturing buoy,
- Wear in buoy line,
- Inability to re-locate buoy,
- Theft,
- Tides pulling buoys under,
- Sea ice severing bouy lines or carrying away the pots,
- Vessel traffic, and
- Seismic exploration activity.

It appears, however, that the foreign otter trawl activity is currently one of the major causes of crab pot loss. As the foreign otter trawl fleet is gradually displaced by domestic fishermen, it is expected that the domestic trawl activity will continue to be a major cause of the loss of crab and other shellfish pots.

This section analyzes potential impacts associated with pot gear in the areas of Bering Sea OCS development. Estimates of the number and value of crab pots lost in the Bering Sea without OCS development are given in Section 5.3.1. Estimates of the amount of crab pots which may be lost due to OCS development in the Bering Sea are given in Section 5.3.2.

5.3.1 Crab Pot Losses Without OCS Development

Because of the lack of good historical data upon which to base projections of crab pot loss, estimates of future loss are based upon three to 15 percent of the number of pots in use. The cost of replacing a pot including gear (bouy and line) is assumed to be 900 dollars. Each crab vessel is assumed to fish an average of 300 pots.

Because both king and Tanner crabs are being harvested at their maximum levels the number of vessels will remain constant or decline. Vessel numbers are from Chapter 3 tables. Using these parameters, projected estimates of annual crab pot gear loss are given as follows:

Lease Sale	No. of Boats	Projected Amount of Gear Loss[1]
North Aleutian	5 - 20	$40,500 - $810,000
St. George	10 - 12	$81,000 - $486,000
Navarin	Nil	Nil
Norton	4 - 10	$32,400 - $81,000
Bering Sea Cumulative Case	19 - 42	$153,900 - $1,377,000

5.3.2 Crab Gear Loss With OCS Development

It is reasonable to assume that increased vessel traffic associated with OCS development will contribute to increased pot loss. Because of the lack of an adequate historical data base upon which to project pot loss associated with OCS vessel traffic, pot loss potentially associated with OCS development was estimated as follows. The area "swept" by OCS vessels was calculated. This considered the number of vessels, typical vessel beam, average speed, and typical trip patterns through crab pot areas where conflicts were likely. Next, the average pot density in these areas of potential conflict was estimated. The "swept" area times the number of pots expected in that area then gives an estimate of the maximum theoretical pot loss.

This assumes, of course, that no pots would be seen and successfully avoided. While this may not be a reasonable assumption, the figure derived from this method would serve as an upper bound, or at least as an indication of the magnitude of the problem. There are reasons for

---

[1] This equals the number of boats times 300 pots times 3 to 15 percent times $900. The number of boats remains constant from the present through 2007.

suspecting that actual pot loss would be close to this figure, however, assuming that no mitigating measures are taken. These reasons include the fact that approximately one half of the vessel travel will be conducted at night when pot buoys would be extremely difficult to see and avoid. The buoys are extremely difficult to pick up with radar. The frequent bad weather conditions in the Bering Sea would further contribute to the difficulty of observing buoys. Also, vessels are typically operated on automatic pilot in open water with infrequent scanning of the horizon when not in the vicinity of other vessels. Where crab fisheries are located in areas of heavy vessel traffic, observation and avoidance are not always particularly effective methods.

The theoretical pot loss was calculated according to the following procedure:

Let:

A = the area of a particular section of ocean where pots are located

S = the area "swept" by OCS vessels in a given time period. This is equal to the number of miles traveled by OCS vessels through the area defined by A in the given time period times the cross section of the vessels that would be expected to damage crab pots.

N = the estimated number of crab pots in the area defined by A

Then, the expected number of pots expected to be lost (L) in the given time period is given by:

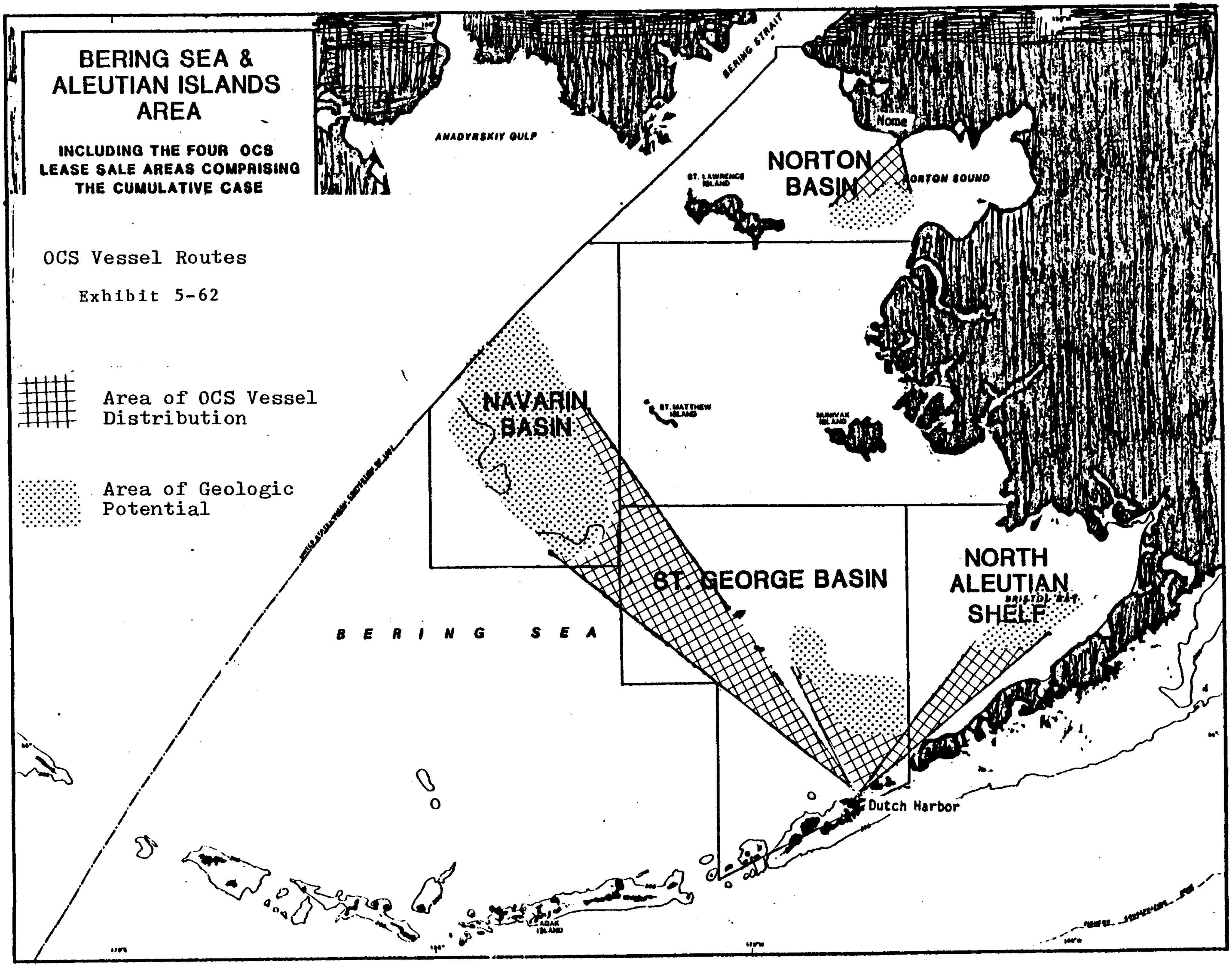
L = N times S / A.

This can be seen as follows. Assume that there were N crab pots in a given area. S / A defines the percentage of the total area "swept" by the OCS vessels in a given time. If this is 0.25, there is a 0.25 chance that any given pot would be in the area swept by the OCS vessels assuming that the pot was equally likely to be located throughout the area. If each pot has a 0.25 chance of being hit, the expected number of pots that would be hit in a given time would be 0.25 times N.

Based on the development scenario in Chapter 4, Exhibits 5-57 through 5-61 give the expected level of OCS supply vessel activity in the North Aleutian, St. George, Navarin, and Norton Basins and the cumulative Bering Sea case. While there is some additional vessel activity generated by OCS development, supply vessel trips constitute the great majority of trips through potential crab pot areas. Note that there is somewhat greater activity in the "summer" months of June through November because activity in the Bering Sea is expected to be somewhat seasonal.

Exhibit 5-62 shows the expected range of the corridors through which the OCS vessels will operate on their way between the supply base at Nome and Unalaska/Dutch Harbor and the various lease sale areas. The equally probable locations of the offshore drilling activity in the four basins are indicated by the area of geologic potential.

Supply vessels would be expected to travel along a distribution of courses that would range between port and the areas of geologic potential. Except for Norton Basin supply vessel traffic, these supply vessel corridors will coincide with areas of high shellfish pot fishing activity as shown in Exhibits 5-63 and 5-64.



BERING SEA & ALEUTIAN ISLANDS AREA

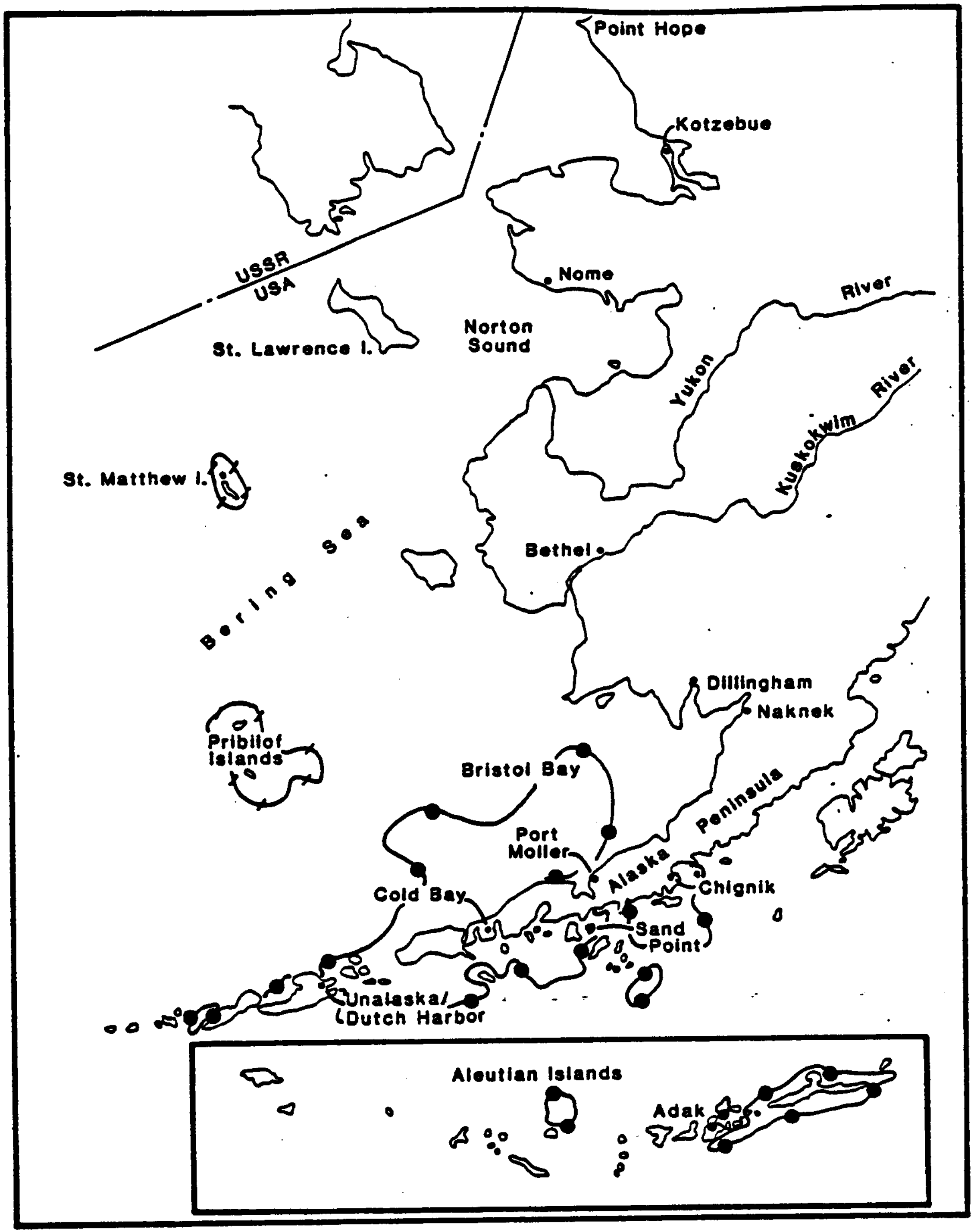
INCLUDING THE FOUR OCS LEASE SALE AREAS COMPRISING THE CUMULATIVE CASE

OCS Vessel Routes

Exhibit 5-62

▦ Area of OCS Vessel Distribution

░ Area of Geologic Potential



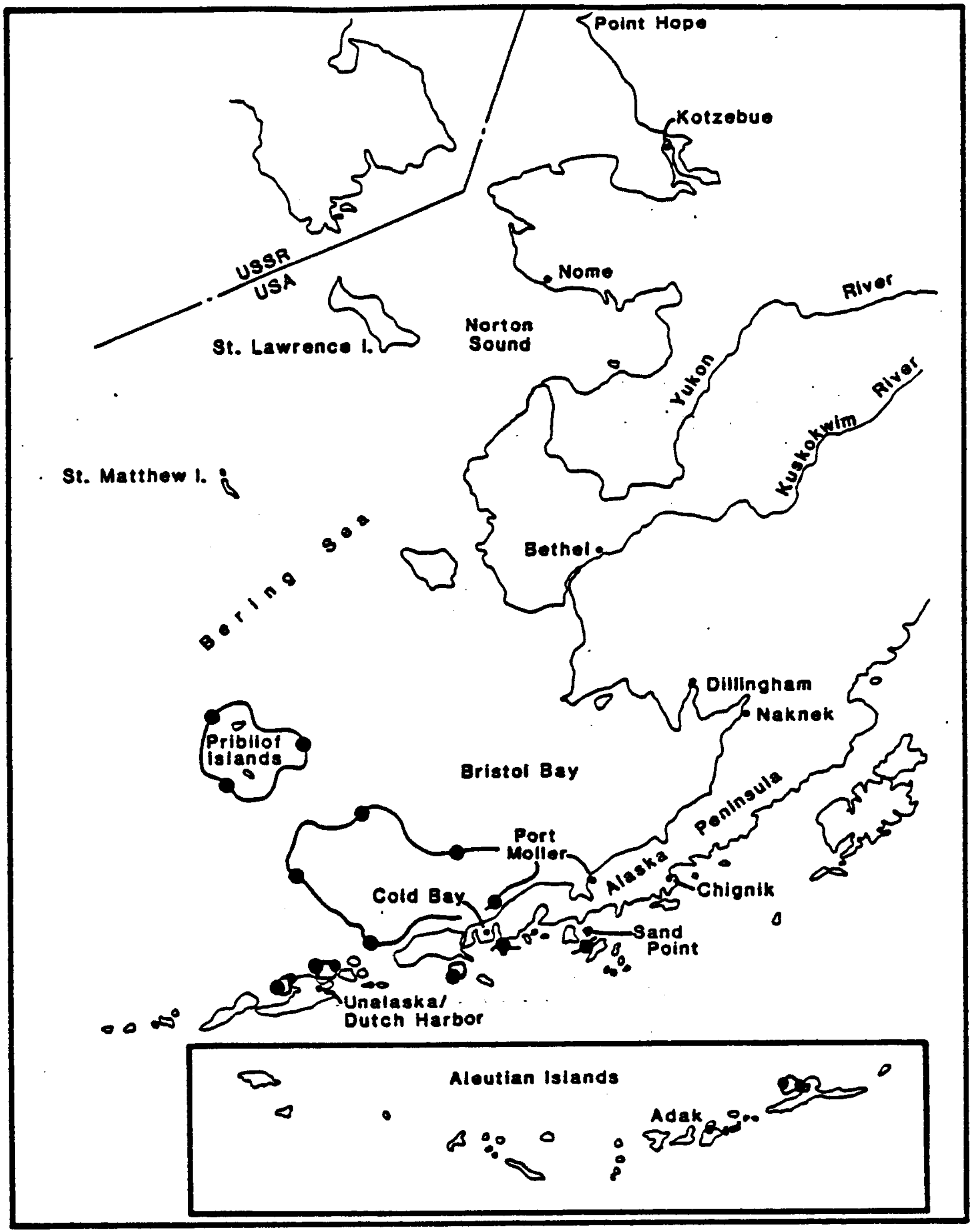
Sources:
Alaska Department of Fish and Game: Alaska's Fisheries Atlas 1978,
University of Alaska 1980.

—●——●——●——●— Major Blue King Crab Fishing Areas

—/—/—/—/—/—/— Major Red King Crab Fishing Areas

Exhibit 5-63

MAJOR KING CRAB FISHING AREAS,
WESTERN ALASKA



Source:
Alaska Department of Fish and Game,
Alaska's Fisheries Atlas 1978,
University of Alaska 1980.

●——●——● **Major Tanner Crab Fishing Areas**

Exhibit 5-64

MAJOR TANNER CRAB FISHING AREAS

Theoretical pot loss was calculated for OCS supply vessel activity for each of the respective lease sale areas and the major crab fisheries that would be affected. North Aleutian shelf OCS activity would affect the Bristol Bay king crab and Southeastern Bering Sea Tanner crab fisheries. Exhibits 5-65 and 5-66 show the calculation of theoretical pot loss per 100 OCS vessel trips for these fisheries. The future number of pots in each fishery was projected and distributed to each Alaska Department of Fish and Game statistical area through which OCS vessels could be expected to pass. This distribution was done based on the reported pot lifts for the 1981/1982 season by statistical area. Also shown is the number of miles traveled and the estimated "swept area" by OCS vessels by ADFG block for every 100 trips made through the crab areas. (Here a trip is defined as a one way trip either coming or going.) These were calculated by plotting 100 equally likely courses for OCS vessels using the expected range of trip patterns as shown in Exhibit 5-62. That is, 100 courses from Unalaska/Dutch Harbor were plotted with destinations spaced evenly between the eastern and western range of the area of geologic potential in the North Aleutian shelf. The total mileage traversed through each ADFG statistical area was then measured for these 100 trips. The "swept area" through each ADFG block was then calculated based on an estimated sweep cross section of 25 feet. This is based on a typical expected beam for OCS vessels of about 50 feet and where it is assumed that a pot buoy falling within the inner half of the vessel beam would be lost such that the line was swept into the vessel propeller or that the inflatable bouy were punctured. A buoy outside this inner area was assumed to be pushed away such that the buoy line was not cut. This figure of 25 feet (0.00411 nautical mile) was then used to calculate the "swept area" (.00411 miles is taken times the number of miles traveled) which is also presented.

The theoretical pot loss for each 100 one-way vessel trips was then calculated using the expression presented earlier. Theoretical pot

Exhibit 5-65

Theoretical Pot Loss Per 100 OCS Vessel Trips[1]

North Aleutian Basin OCS Activity Bristol Bay King Crab Pot Loss

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
350-05	5,102	1.07	401	582	2.40	0.92
350-06	2,101	0.44	165	1129	4.65	0.73
350-07	-	-	-	688	2.83	-
350-14	13,914	2.93	1095	353	1.45	1.51
350-15	26,851	5.65	2113	1553	6.39	12.86
350-16	3,800	0.80	299	1500	6.17	1.76
350-17	-	-	-	247	1.02	-
350-23	24,530	5.16	1930	211	0.87	1.60
350-24	30,787	6.47	2422	1729	7.12	16.42
350-25	29,277	6.16	2303	1659	6.83	14.97
350-26	2,485	0.52	195	441	1.82	0.38
350-33	19,073	4.01	1501	1571	6.46	9.24
350-34	21,092	4.44	1660	1976	8.13	12.85
350-35	950	0.20	75	424	1.74	0.12
350-42	3,305	0.70	260	953	3.92	0.97
350-43	2,321	0.49	183	2471	10.17	1.77
350-44	1,635	0.34	129	476	1.96	0.24
350-52	-	-	-	3000	12.34	-
Total						76.30

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 542,250 pot lifts for the 1981/1982 season for the Bristol Bay red king crab fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 37,878 pots estimated to be in use in the Bristol Bay king crab fishery in 1987 through 2007. It was estimated by the Alaska Department of Fish and Game that in the 1981/1982 season 75,756 pots were used in this fishery. It is projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-66

Theoretical Pot Loss Per 100 OCS Vessel Trips[1]

North Aleutian Basin OCS Activity Southeastern Bering Sea Tanner Crab

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
350-05	-	-	-	582	2.40	-
350-06	-	-	-	1129	4.65	-
350-07	-	-	-	688	2.83	-
350-14	5,778	1.00	179	353	1.45	0.25
350-15	8,308	1.43	257	1553	6.39	1.57
350-16	3,925	0.68	122	1500	6.17	0.72
350-17	-	-	-	247	1.02	-
350-23	3,676	0.63	114	211	0.87	0.10
350-24	19,763	3.41	612	1729	7.12	4.15
350-25	44,086	7.60	1366	1659	6.83	8.88
350-26	1,425	0.25	44	441	1.82	0.08
350-33	32,222	5.56	998	1571	6.46	6.14
350-34	24,940	4.30	773	1976	8.13	5.99
350-35	4,758	0.82	147	424	1.74	0.25
350-42	58,646	10.11	1817	953	3.92	6.79
350-43	56,565	9.76	1753	2471	10.17	16.97
350-44	4,450	0.77	138	476	1.96	0.26
350-52	37,640	6.49	1166	3000	12.34	13.71
Total						65.82

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 579,827 pot lifts for the 1981/1982 season for the Southeastern Bering Sea Tanner crab (bairdi and opilio) fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 17,965 pots estimated to be in use in the Southeastern Bering Sea Tanner crab fishery in 1987 through 2007. It was estimated that in the 1981/1982 season 35,930 pots were used based on reported figures for pot lifts, vessel landings, and number of vessels and the assumption that 20 percent of pot lifts represent pots that were pulled twice on each vessel trip (i.e. number of pots equals pot lifts divided by vessel landings times number of vessels times 0.80). It is further projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

losses in each block were then totaled to arrive at a theoretical estimate that approximately 76.30 Bristol Bay king crab pots and 65.82 Southeastern Bering Sea Tanner crab pots would be lost for every 100 OCS vessel trips to or from the North Aleutian shelf (a trip either to or from the North Aleutian shelf is counted as one trip).

Similar calculations are shown in Exhibits 5-67 and 5-68 for OCS activity in the St. George Basin which affects the Pribilof District king and Tanner crab fisheries. Exhibits 5-69 and 5-70 shows theoretical pot loss per 100 OCS vessel trips for the Navarin Basin which also affects the Pribilof District king and Tanner crab fisheries. Exhibit 5-71 shows results for Norton sound OCS activity which affects the small Norton Sound king crab fishery.

Exhibit 5-72 then summarizes the theoretical pot loss for the Bering Sea cumulative case. Here theoretical pot loss per 100 OCS vessel trips from Exhibits 5-65 through 5-71 were taken times the expected annual number (in hundreds) of OCS vessel trips from Exhibits 5-57 through 5-60 for the months in which the fisheries are expected to be in operation. In the maximum year 1997 approximately 1,205 pots would heoretically be lost if no avoidance action were taken. It is impossible to state accurately what portion of this theoretical loss would actually occur. However, if a pot could be successfully avoided in all but one out of ten instances, the actual post loss would be about 120 pots lost. This would amount to a dollar loss of approximately $110,000 annually.

This pot loss can be significantly reduced if effective mitigating measures are taken. The most effective mitigating measure would consist of specially-designated OCS vessel corridors that would be routed around areas of high pot concentration of the crab fishery. Another method of mitigation of high losses of crab pots to OCS traffic is to keep OCS vessel operators informed of high concentrations of crabbing operations

Exhibit 5-67

Theoretical Pot Loss Per 100 OCS Vessel Trips[1]

St. George Basin OCS Activity Pribilof District King Crab Pot Loss

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
351-23	16,230	9.21	2060	776	3.19	6.27
351-32	-	-	-	1112	4.57	-
351-33	650	0.37	83	1835	7.55	0.59
350-41	-	-	-	2082	8.57	-
351-41	-	-	-	2080	8.57	-
351-42	-	-	-	2576	10.60	-
351-43	-	-	-	1024	4.21	-
350-51	-	-	-	3882	15.97	-
351-51	-	-	-	4024	16.56	-
351-52	-	-	-	2647	10.89	-
Total						6.86

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 176,168 pot lifts for the 1981/1982 season for the Pribilof blue king crab fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 22,360 pots estimated to be in use in the Bristol Bay king crab fishery in 1987 through 2007. It was estimated that in the 1981/1982 season 44,720 pots were used based on reported figures of 176,168 pot lifts, 312 vessel landings, and 99 vessels and the assumption that 20 percent of pot lifts represent pots that were pulled twice on each vessel trip (i.e. number of pots equals pot lifts divided by vessel landings times number of vessels times 0.80). It is further projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-68

Theoretical Pot Loss Per 100 OCS Vessel Trips[1]

St. George Basin OCS Activity Pribilof District Tanner Crab Pot Loss

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
351-23	115,530	30.45	3587	776	3.19	10.91
351-32	-	-	-	1112	4.57	-
351-33	22,462	5.92	697	1835	7.55	5.02
350-41	31,997	8.43	993	2082	8.57	8.11
351-41	6,655	1.75	207	2080	8.57	1.69
351-42	4,068	1.07	126	2576	10.60	1.28
351-43	765	0.20	24	1024	4.21	0.10
350-51	31,068	8.19	965	3882	15.97	14.67
351-51	12,842	3.39	399	4024	16.56	6.29
351-52	7,506	1.98	233	2647	10.89	2.42
Total						50.47

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 379,363 pot lifts for the 1981/1982 season for the Pribilof Tanner crab (bairdi and opilio) fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 11,778 pots estimated to be in use in the Tanner king crab fishery in 1987 through 2007. It was estimated that in the 1981/1982 season 23,556 pots were used based on reported figures for pot lifts, vessel landings, and number of vessels and the assumption that 20 percent of pot lifts represent pots that were pulled twice on each vessel trip (i.e. number of pots equals pot lifts divided by vessel landings times number of vessels times 0.80). It is further projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-69

Theoretical Pot Loss
Per 100 OCS Vessel Trips[1]

Navarin Basin OCS Activity
Pribilof District King Crab Pot Loss

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
349-85	1,733	9.84	220	517	2.13	0.45
349-86	1,000	5.68	127	1067	4.39	0.53
349-87	-	-	-	1028	4.23	-
349-88	-	-	-	925	3.81	-
351-04	35,767	20.30	4540	67	0.28	1.19
351-05	9,725	5.52	1234	760	3.13	3.68
351-06	5,539	3.14	703	1117	4.60	3.08
351-07	-	-	-	1101	4.53	-
351-14	40,207	22.82	5103	610	2.51	12.20
351-15	10,212	5.80	1296	1327	5.46	6.74
351-16	6,492	3.69	824	1243	5.11	4.01
351-17	-	-	-	380	1.56	-
351-23	16,230	9.21	2060	50	0.21	0.40
351-24	7,435	4.22	944	1383	5.69	5.11
351-25	5,128	2.91	651	1443	5.94	3.68
351-26	1,075	0.61	136	716	2.95	0.38
351-33	650	0.37	83	683	2.81	0.22
351-34	1,200	0.68	152	1850	7.61	1.10
351-43	-	-	-	2218	9.13	-
351-52	-	-	-	1127	4.64	-
Total						42.78

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 176,168 pot lifts for the 1981/1982 season for the Pribilof blue king crab fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 22,360 pots estimated to be in use in the Pribilof king crab fishery in 1987 through 2007. It was estimated that in the 1981/1982 season 44,720 pots were used based on reported figures of 176,168 pot lifts, 312 vessel landings, and 99 vessels and the assumption that 20 percent of pot lifts represent pots that were pulled twice on each vessel trip (i.e. number of pots equals pot lifts divided by vessel landings times number of vessels times 0.80). It is further projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-70

Theoretical Pot Loss
Per 100 OCS Vessel Trips[1]

Navarin Basin OCS Activity
Pribilof District Tanner Crab Pot Loss

Statistical[2] Area	Reported Pot Lifts 1981/1982 Season	Percent of[3] Pot Lifts	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
349-85	-	-	-	517	2.13	-
349-86	5,330	1.41	165	1067	4.39	0.69
349-87	4,015	1.06	125	1028	4.23	0.50
349-88	5,500	1.45	171	925	3.81	0.62
351-04	550	0.15	17	67	0.28	0.01
351-05	2,355	0.62	73	760	3.13	0.22
351-06	27,178	7.16	844	1117	4.60	3.69
351-07	6,350	1.67	197	1101	4.53	0.85
351-14	17,768	4.68	552	610	2.51	1.32
351-15	26,632	7.02	827	1327	5.46	4.34
351-16	32,840	8.66	1020	1243	5.11	4.97
351-17	450	0.12	14	380	1.56	0.02
351-23	115,530	30.45	3587	50	0.21	0.70
351-24	62,159	16.39	1930	1383	5.69	10.46
351-25	25,358	6.68	787	1443	5.94	4.45
351-26	1,587	0.42	49	716	2.95	0.14
351-33	22,462	5.92	697	683	2.81	1.87
351-34	3,174	0.84	99	1850	7.61	0.71
351-43	765	0.20	24	2218	9.13	0.21
351-52	7,506	1.98	233	1127	4.64	1.03
Total						36.75

---

[1] One way trips.

[2] Alaska Department of Fish and Game statistical reporting areas.

[3] This is the percent that pot lifts in each statistical area represent of the total of 379,363 pot lifts for the 1981/1982 season for the Pribilof Tanner crab (bairdi and opilio) fishery. Not all of these statistical reporting areas are shown, but only those relevant to the calculation of OCS-related pot loss.

[4] The percent of pot lifts in each statistical area times a projected 11,778 pots estimated to be in use in the Pribilof Tanner crab fishery in 1987 through 2007. It was estimated that in the 1981/1982 season 23,556 pots were used based on reported figures for pot lifts, vessel landings, and number of vessels and the assumption that 20 percent of pot lifts represent pots that were pulled twice on each vessel trip (i.e. number of pots equals pot lifts divided by vessel landings times number of vessels times 0.80). It is further projected that number of pots in use will decline by one-half by 1987 because of the current excess of vessels and gear in the crab fishery.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Crab pot data from Alaska Department of Fish and Game. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-71

Theoretical Pot Loss Per 100 OCS Vessel Trips[1]

Norton Sound OCS Activity
Norton Sound King Crab Pot Loss

Statistical[2] Area	Projected Catch (metric tons)	Percent of Projected[3] Catch	Estimated[4] Future Number of Pots	Miles Traveled Per 100 OCS Vessel Trips[1]	Swept Area[5] Per 100 OCS Vessel Trips (sq. mi.)	Theoretical[6] Pot Loss Per 100 OCS Vessel Trips
167°W 64°N	62.1	13.52	473	-	-	-
166°W 64°N	92.2	20.07	702	169	0.70	0.47
165°W 64°N	71.0	15.45	541	2280	9.38	4.83
164°W 64°N	12.3	2.68	94	1200	4.94	0.44
163°W 64°N	5.2	1.13	40	388	1.60	0.06
162°W 64°N	0.4	0.09	3	-	-	-
166°W 63° 30'N	-	-	-	699	2.88	-
165°W 63° 30'N	-	-	-	635	2.61	-
164°W 63° 30'N	-	-	-	607	2.50	-
163°W 63° 30'N	-	-	-	642	2.64	-
171°W 63°N	1.9	0.41	14	-	-	-
168°W 63°N	0.3	0.07	2	-	-	-
167°W 63°N	22.8	4.96	174	-	-	-
166°W 63°N	118.3	25.75	901	-	-	-
165°W 63°N	72.6	15.80	553	-	-	-
164°W 63°N	0.4	0.09	3	-	-	-
Total						5.80

---

[1] One way trips.

[2] One degree latitude by one-half degree longitude areas identified by the longitude and latitude respectively of the southeast corner.

[3] Catch in each statistical area divided by projected total for Norton Sound of 460 metric tons.

[4] It is assumed that there will be seven vessels each having 500 pots for a total of 3500 pots in the Norton Sound area.

[5] Equal to number of miles traveled times an estimated sweep cross section of 0.00411 nautical miles (25 feet).

[6] Equal to number of pots times swept area divided by 1050 square miles per statistical reporting area.

Source: Projected catch and pot projections from Figure 3-5. Miles traveled by OCS vessels through each statistical area based on analysis of the likely distribution of OCS vessel routes to production and/or exploration areas.

Exhibit 5-72

Cummulative Bering Sea Theoretical Shellfish Pot Loss

	North Aleutian Shelf		St. George Basin		Navarin Basin		Norton Sound	
	Bristol Bay King Crab	Southeastern Bering Sea Tanner Crab	Pribilof King Crab	Pribilof Tanner Crab	Pribilof King Crab	Pribilof Tanner Crab	Norton Sound King Crab	Total Theoretical Pot Loss
Projected Number of Pots In Place	37,878	17,965	22,360	11,778	22,360	11,778	3,500	
1987								
Annual OCS Vessel Trips[1]	-	-	320	320	120	120	336	
Theoretical Pot Loss[2]	-	-	22	162	51	44	19	298
Percent Loss of Pots in Place[3]	-	-	0.10	1.37	0.23	0.37	0.56	
1992								
Annual OCS Vessel Trips[1]	400	520	-	-	408	792	-	
Theoretical Pot Loss[2]	305	342	-	-	175	291	-	1,113
Percent Loss of Pots in Place[3]	0.81	1.91	-	-	0.78	2.47	-	
1997								
Annual OCS Vessel Trips[1]	160	240	-	-	720	1,680	-	
Theoretical Pot Loss[2]	122	158	-	-	308	617	-	1,205
Percent Loss of Pots in Place[3]	0.32	0.88	-	-	1.38	5.24	-	
2002								
Annual OCS Vessel Trips[1]	160	240	-	-	120	360	-	
Theoretical Pot Loss[2]	122	158	-	-	51	132	-	463
Percent Loss of Pots in Place[3]	0.32	0.88	-	-	0.23	1.12	-	
2007								
Annual OCS Vessel Trips[1]	160	240	-	-	120	360	-	
Theoretical Pot Loss[2]	122	158	-	-	51	132	-	463
Percent Loss of Pots in Place[3]	0.32	0.88	-	-	0.23	1.12	-	

---

[1] One way trips equal to the sum of monthly trips from Exhibits 5-57, 5-58, 5-59, and 5-60 times two to convert to one-way trips for the following months: Bristol Bay king crab-July through October; southeastern Bering Sea Tanner crab-February through July; Pribilof king crab- September through October; Pribilof Tanner crab-February through July; Norton Sound king crab-July through August. Gives annual number of OCS vessel trips through pot areas during crab season.

[2] Total theoretical pot loss per 100 OCS vessel trips from Exhibits 5-65, 5-66, 5-67, 5-68, 5-69, 5-70 and 5-71 respectively times annual number of OCS vessel trips (in hundreds) during crab season.

[3] Annual theoretical pot loss divided by projected number of pots in place expressed as a percent.

Source: Exhibits 5-57 through 5-60 and 5-65 through 5-71.

so that they can be skirted entirely. It must be noted that most OCS vessel activity will occur during the summer when daylight occurs almost all day. Visual sightings of gear will be assisted which should also mitigate gear loss.

5.4 Longline Gear Loss

5.4.1 Longline Gear Loss Without OCS Development

Longline gear is potentially affected by vessel traffic running over and dislodging the bouys and poles marking the location of the longlines. Longlines used in the Bering Sea are of the bottom tending variety and typically consist of a 1/4 inch nylon line anchored at its ends and lying along the bottom to which short lengths of line called gangions with hooks are attached at intervals. Each length of longline gear is called a skate and the usual skate is 300 fathoms (1800 feet) long. A typical string may stretch for 10 skates (about three nautical miles). Three or four or more of these strings may be fished side by side. Hook spacing is about 21 feet for halibut and about three feet for Pacific cod. Each end of each skate is attached to a line running to the surface that is suspended from a bouy (which is similar to the inflatable bouys used to mark king or Tanner crab pots). Closely attached to the bouy is a marker pole about 17 feet long which may be made of bamboo or aluminum. The pole floats upright on a float. The pole has a flag attached and sometimes a light or radar reflector to facilitate spotting (Browning, 1980).

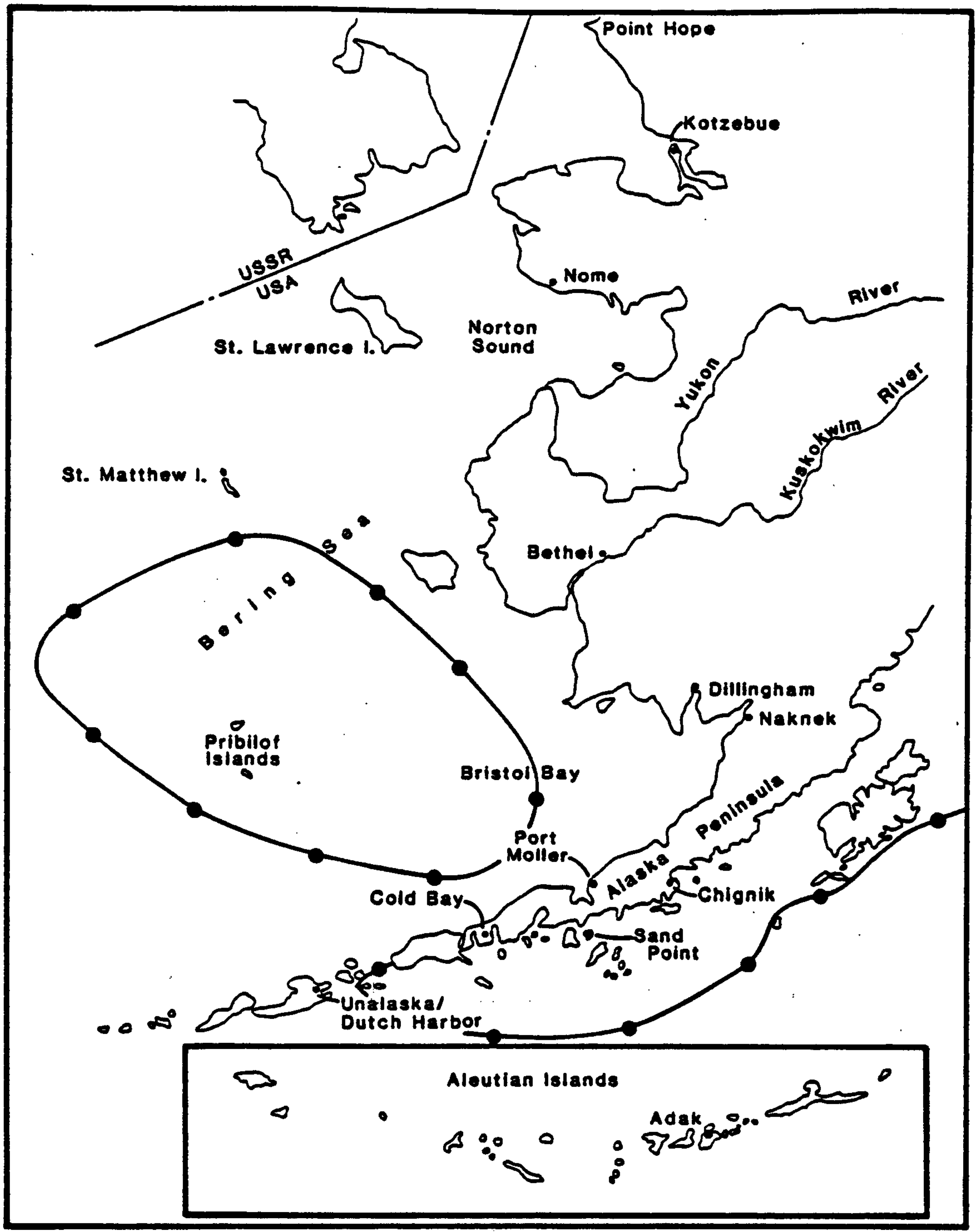
Longline gear may be lost due to many of the same reasons crab gear is lost (see Section 5.3). However, recovery of longline line gear has a great advantage over crab gear in that longlines have two ends with bouys whereas crab lines have only one end with a bouy. If one end of the longline is severed, the gear can still be picked up on the other end.

It is difficult to say with precision how much longline gear is lost each year. Generally, fishermen using longline gear can expect to loose about ten skates per year. This loss may be due to actual destruction of the gear or through natural wear and tear such that the gear is taken out of service. The value of longline gear varies. Generally, gear costs will be greater if the gear is used in deep water far offshore where the required gear must be heavier and more expensive. The following are average values for gear based on conversations with the Alaska Longline Fishermen's Association (Baker, pers. com.).

Item	Number Used Per Longline	Value
Skate	5 to 10, 300 fathoms long	$200 each
Gangions	about 300	$ 30
Pole	2	$ 25 each
Bouy	2	$ 20 each
Anchor	2	$ 30 each
Total	$2,180 for each 10 skate longline.	

5.4.2 Longline Gear Loss With OCS Development

The most significantly affected fisheries using longline gear are the traditional Bering Sea halibut fishery and the projected domestic Pacific cod fishery. Exhibit 5-73 shows the expected major halibut fishing areas in the Bering Sea. Concentrations of Pacific cod have been harvested in the Navarin, North Aleutian and St. George lease sales (as shown in Appendix A). Based upon the expected amount of cod and halibut projected to be harvested and the level of OCS development, theoretical longline gear loss is presented in Exhibit 5-74.



Sources:
International Pacific Halibut Commission, Technical Report No. 6;
Alaska Department of Fish and Game;
University of Alaska 1980.

●——●——● **Major Halibut Fishing Areas**

Exhibit 5-73

MAJOR HALIBUT FISHING AREAS

Exhibit 5-74

Bering Sea Theoretical Longline Gear Loss

	1987		1992		1997		2002		2007	
	Halibut	Cod	Halibut	Cod	Halibut	Cod	Halibut	Cod	Halibut	Cod
Projected Number of Vessels in Bering Sea[1]	10	26	10	42	10	57	10	58	10	60
Approximate Number of Bouy Poles in Bering Sea[2]	800	2,080	800	3,360	800	4,560	800	4,640	800	4,800
Number of Buoy Poles used in OCS Vessel Area[3]										
No. Aleutian	-	98	-	158	-	214	-	218	-	226
St. George	36	196	36	316	36	429	36	436	36	451
Navarin	128	853	128	1,378	128	1,870	128	1,902	128	1,968
Norton Sound	-	-	-	-	-	-	-	-	-	-
Area of Fishery Traversed by OCS Vessels (sq. mi.)[4]										
No. Aleutian	-	3,000	-	3,000	-	3,000	-	3,000	-	3,000
St. George	10,000	6,000	10,000	6,000	10,000	6,000	10,000	6,000	10,000	6,000
Navarin	36,000	35,000	36,000	35,000	36,000	35,000	36,000	35,000	36,000	35,000
Norton Sound	-	-	-	-	-	-	-	-	-	-

Exhibit 5-74 (Cont.)

Bering Sea Theoretical Longline Gear Loss

	1987		1992		1997		2002		2007	
	Halibut	Cod	Halibut	Cod	Halibut	Cod	Halibut	Cod	Halibut	Cod
Miles Traversed Through Fishery Per 100 OCS Vessel Trips[5]										
No. Aleutian	-	8,000	-	8,000	-	8,000	-	8,000	-	8,000
St. George	7,500	10,000	7,500	10,000	7,500	10,000	7,500	10,000	7,500	10,000
Navarin	40,000	26,000	40,000	26,000	40,000	26,000	40,000	26,000	40,000	26,000
Norton Sound	-	-	-	-	-	-	-	-	-	-
OCS Vessel "Swept" Area[6]										
No. Aleutian	-	-	-	355	-	158	-	158	-	158
St. George	99	395	-	-	-	-	-	-	-	-
Navarin	197	385	671	1,923	1,184	3,847	197	769	197	769
Norton Sound	-	-	-	-	-	-	-	-	-	-
Theoretical Bouy Pole Loss[7]										
No. Aleutian	-	-	-	19	-	11	-	11	-	11
St. George	1	13	-	-	-	-	-	-	-	-
Navarin	1	9	2	76	4	205	1	42	1	43
Norton Sound	-	-	-	-	-	-	-	-	-	-
Total Cumulative Case	2	22	2	95	4	216	1	53	1	54

Exhibit 5-74 (Cont.)

---

[1] All Pacific cod and halibut are assumed to be harvested with longlines. The number of halibut and Pacific cod vessels are taken from Table 3-21 in Section 3.0.

[2] Assumes 40 skates per vessel times 2 poles per skate.

[3] Refers to area where OCS vessels associated with the respective lease sale areas operate within the major areas of each fishery. Total Bering Sea bouy poles apportioned to these areas based on the following percentages. North Aleutian OCS vessels traverse none of the major halibut fishing grounds and 4.7 percent of the major Pacific cod fishing grounds. St George OCS vessels traverse 4.5 percent of major halibut fishing grounds and 9.4 percent of major Pacific cod fishing grounds. Navarin OCS vessels traverse 16 percent of major halibut fishing grounds and 41 percent of major Pacific cod fishing grounds. Norton sound OCS vessels do not traverse either halibut or Pacific cod fishing grounds.

[4] Refers to OCS vessel areas (areas in which OCS vessels operate within the areas of the respective fisheries) assocciated with the respective lease sale (e.g., for the Navarin Basin OCS vessels traverse an area that is actually within the St. George lease sale area).

[5] Refers to the miles traveled through each fishery by OCS vessels associated with the respective lease sale areas.

[6] Based on a vessel "sweep" cross section of 25 feet (0.00411 nautical miles' and OCS vessel trips from Exhibits 5-57, 5-58 and 5-59 times two to convert to one-way trips. Trips are computed for two months for halibut and 12 months for Pacific cod (i.e. "swept" area equals miles traversed by OCS vessels times annual number of OCS vessel trips times 0.00411.)

[7] Equals number of bouy poles in area times OCS vessel "swept" area divided by the area of fishery traversed by OCS vessels associated with each respective lease sale area.

The calculations were made using the "swept" area methodology described for the estimation of crab pot loss. Theoretical pole loss is based on the total average number of poles used in the halibut and cod fisheries which may be subjected to severing by OCS vessels. The total number of poles is based upon the fishery development scenario in the Bering Sea from Section 3.0. This activity is then overlaid with expected OCS vessel activity to arrive at theoretical OCS vessel/fishing gear interaction. The theoretical loss assumes that the OCS vessel operator can't see the pole, and/or takes no evasive action, and, that no mitigation measures are implemented, such as vessel corridors.

The total number of poles were first estimated based on the estimated number of vessels for each fishery in the total Bering Sea. For each fishery and lease sale area an area was then defined which consisted of the area of overlap between the OCS vessel corridors and the fishery. The percentage of each fishery traversed by OCS vessels was then estimated by overlaying projected OCS vessel routes on the areas in which the fisheries are conducted. This percentage was then used to allocate gear to the area of overlap. The area of overlap of each fishery traversed by OCS vessels was then calculated. The miles traveled by OCS vessels through this area was also calculated by plotting equally likely courses and this was used to calculate "swept" area. The model described in Section 5.3 was then applied where theoretical pole loss equals OCS vessel "swept" area divided by the area of fishery traversed by OCS vessels times number of poles in this area.

The results indicate that the theoretical pole loss would be about one to four poles annually in the traditional halibut fishery which is much less than one percent of the estimated number of bouy poles in the fishery. For the projected Pacific cod fishery, the theoretical pole loss was estimated to be up to 216 poles in the maximum year of 1997 which is about five percent of the number of such poles projected to be used. It is believed that the actual pole loss will be much less than the theoretical loss presented here. The poles are easier to see than crab pot bouys, particularly where lights and radar reflectors are employed. Also, unlike the case of crab pots the loss of a bouy (which costs less than $50) does not usually mean the loss of the longline gear. The gear can be retrieved using the other bouy unless both were lost.

Browning (1980) describes a method which is apparently effective for retrieving lost gear. This consists of a 20 foot long piece of chain with hooks attached to very third link. This is attached to a line and dragged in a zigzag pattern across the bottom in the area where the gear was set. This position can be determined fairly accurately using LORAN. When the chain and hook snag the longline, the gear can be hauled aboard. Browning (1980) reports that this method was used to successfully recover a string of loss sablefish pots from 420 fathoms.

It must be noted, however, that recovery of longline gear using the above method at that depth is rare. Baker (pers. com.) reports that at 100 fathoms and less, gear is more likely to be recovered (and fishermen will be more likely to attempt to recover gear). Another method of retrieving lost longlines in water less than 100 fathoms is to lay another longline across the location of the lost gear using the LORAN coordinates. By doing this the fisherman has a chance of hooking the lost gear.

5.5 Other Impacts of Offshore Development

This section discusses the impacts of OCS development on the fishing industry in the following terms:

- The beneficial impact of the presence of OCS vessels and aircraft on search and rescue,
- The positive impact of offshore OCS-related structures on vessel navigation and safety,

- Examples of how OCS and fishing conflicts can be mitigated based on precedent on the western U.S. coast,
- Mitigation measures which can be implemented to reduce OCS-fishing industry conflicts.

The presence of OCS supply boats has certain effects that help vessel safety in the fishing industry. The increased number of OCS vessels inthe Bering Sea will increase the availability of vessels able to respond to fishing vessels which are in distress and will be able to assist fishing vessel crew during a medical emergency.

In the Gulf of Mexico, where offshore oil and gas development is very prolific, there have been many instances where oil and gas vessels have come to the aid of fishing vessels. The U.S. Coast Guard keeps records on vessels which have been distressed and been assisted by other "non-Coast Guard vessels." However, the Coast Guard data are filed such that determing whether a fishing vessel in distress was assisted by an OCS vessel can only be done on a case-by-case analysis. There are thousands of cases each year in which vessels in distress have been assisted by other vessels. Centaur Associates (1981) reviewed the record of fishing vessel-OCS interactions in the Gulf of Mexico and found that of 18 instances where fishing vessels had collided with platforms or oil-related barges, 72 percent were the fault of the fishing vessel.

The presence of offshore platforms provides both visual and navigational aids to ocean-going vessels and can provide assistance to vessels which are in distress. Gilbreath (pers. com.) provides an example of such assistance when in the late 1970's a 32 foot fishing vessel broached and was flooded in rough seas in Cook Inlet near Shell Platform "C". Because of the high elevation of the platform above the rough seas, the fishing vessel was sighted and a standby supply vessel tending the platform was sent to tow the fishing vessel to safety.

Other examples of assistance provided to the fishing industry by the OCS industry include the rescue of a stranded fishermen in a small dory, delivery of fuel to a stranded fishing boat, recovery of a skiff that had gone adrift, and multiple instances of using oil service helicopters to rescue personnel from sinking fishing boats (Gilbreath, pers. com.). In May, 1976 a fire at the Native Corporation Cannery in Yakatat was extinguished by the crew of the work boat Ocean Marlin which was under contract to Shell Oil Company. The crew of the boat moved the vessel to the cannery dock and used the boat pumps to pump water on the fire.

The Nikiski, Alaska Fire Department on the Kenai Peninsula has received many calls for medical and rescue assistance. The Fire Department and emergency medical personnel have responded to these calls with the assistance of helicopters from the AMOCO Shell heliport. These helicopters are in the region for the purpose of supporting offshore oil and gas development in Cook Inlet. A sample of instances provided by Gilbreth (pers. com.) include:

- Transporting a young fisherman unconscious from carbon monoxide poisoning from the fishing boat to Central Peninsula General Hospital (July 11, 1982).

- Transporting an unconscious cannery worker from Columbia Ward Cannery on Chisik Island where he had fallen two stories onto a concrete floor, to Providence Hospital (June 21, 1982).

- Transporting medical personnel to assist man with abdominal pains (July 7, 1982).

- Transported medical personnel to the scene of a swamped fishing vessel to aid fishermen (July 21, 1982).

- Transport medical team to the site of a tractor turn-over accident and their transported victim to Kenai Medical Center (July 26, 1982).

Helicopters also help in searching for downed aircraft and for vessels which are overdue. Having OCS operations in area increases the number of vessels and aircraft, and with these increases comes an extra means of assisting fishermen in emergencies.

There have been problems with vessel traffic conflicting with fishing gear which can be expected to increase if mitigation measures are not implemented. There is not a detailed, quantitative historical data based on such gear loss in the Bering Sea. However, almost all fishermen can give accounts of losing gear to debris, natural causes, trawlers or other vessels. Losing gear is considered part of the fishing operation. Only two cases could be found where fishermen had such an acute gear loss problem, that documentation of the problem was kept.

Hutton (pers. com.) provided historical documentation of crab gear/tug and barge conflicts. Basically, the problem was that tug boats entering and leaving Price William Sound in the Gulf of Alaska repeatedly ran over crab gear, dragging the pots, severing the bouy lines, and tangling several different sets of gear. It was estimated by Cordova, Alaska crab fishermen that during the 1975-76 crab, 300 pots were destroyed by the tug and barge traffic (Hutton, pers. com.). This increased barge traffic was a result of the Trans-Alaska pipeline construction in Valdez.

Of 17 crab boats contacted during the 1975-76 season, 14 of the vessels had lost gear. The number of pots reportedly lost by these vessels ranged from four to 54 with an average loss of 22 pots per vessel. These losses were documented by pot number in the ship's log. The skippers of these crab boats estimated that 10 percent of the losses were due to reasons other than tug and barge traffic. They also estimated that 50 percent more pots which were not lost, had cable marks and cable chaff marks on the crab pot and bouy lines.

The problem occurred because crab pots were fished in the waters of Prince William Sound in the tug navigation lanes. Instead of maneuvering around the crab pot bouys, tug and barges would run them over. It is not practical for tugs to continually turn to avoid gear. Bouys usually are pushed aside by the tug's bow wash but the tow bridle, which is a cable between the tug and barge, hangs down into the water and can easily pick up the bouy line, dragging the pot along the bottom or cutting the bouy cable. The problem of crab gear loss in the Hichenbrook area of Prince William Sound was so acute that local fishermen threatened violence and lawsuits (Hutton, per. com.). Fishermen argued that they were being forced out of their fishing grounds by the barges and that tug captains would not respond to radio calls when it appeared that the tug was threatening to run over crab gear. Tug and barge companies responded that their tugs did not deliberately run over gear but that the tugs and barges are not easily maneuverable and the captains could not 1) risk the safety of their cargos and crews to avoid the gear, and 2) make costly detours around crab pot concentrations.

The problem was partially solved by communication between the two primary parties in cooperation with the Coast Guard and other government officials. The Alaska Marine Advisory Program Officials facilitated this communication by serving as a meditator between all impacted parties. The problem of crab gear loss was mitigated by the establishment of traffic lanes and fishing areas. The end result was the Prince William Sound Vessel Traffic Service System (Hutton, pers. com.). This is a set of tug and barge approaches, lanes of navigation for Valdez tankers, anchorages, and heavy fishing areas. The Traffic Service System illustrates specific areas on navigational charts and the vessel captains operating in the area are provided with these charts (through Sea Grant, fish marketing associations, and tug and barge associations). Gear-vessel conflicts can then be avoided. The established lanes of navigation are not binding on either the tug and barge captains or the fishermen. Rather, the lanes serve as a guide and as notice to vessel operators. As a guide, they provide suggested lanes for tug captains to minimize conflicts with pot fishermen. As a notice, the lanes notify fishermen that if they place pots within the lanes, the chances are greater of the pots becoming lost or damaged due to vessel traffic.

This same type of problem occurred off the Washington, Oregon and California coasts between crab fishermen and tug and barge companies (Carter, pers. com.). Tug boat associations and fishermen worked with the University of Oregon's Marine Extension Service to arrive at a solution to the gear loss problem fishermen were having. Charts of the whole West Coast were displayed in various lacations. Fishermen marked their gear locations and areas which were heavily fished on the charts with . Towboat operators looked at these charts to construct their lanes of travel and worked with the fishermen if there were use conflicts (Hutton, pers. com.). The charts were then marked with the normal-weather tug lanes, reduced in size, and place aboard all coastwise tugs, crab, and black cod boats.

These charts are not legally binding, but rather serve as an informal agreement between fishermen and towboat operators. According to Carter (pers. com.), fishermen know where the lanes are and fish their gear accordingly. If the fishermen lose gear because it was within these lanes, the loss is considered a result of which the fisherman had prior notice. Each year, fishermen and towboat operators meet to work out new charts or point out problem areas. Any changes in the navigation lanes are then disseminated through the regular channels. This mitigation to pot gear loss is a "gentlemen's agreement" arrangement (i.e. not legally mandated) which facilitates communication between the towboat companies and fishing industry and the system appears to work well.

Conflicts between pot fishermen in the Bering Sea and vessel traffic can be expected to increase unless appropriate measures, such as those just mentioned, are implemented. Two examples of conflicts already occurring in the Bering Sea are between crab pots and siesmic exploration vessels and crab pots and foreign trawling operations. There is evidence that foreign trawlers and siesmic boats have been involved with gear conflicts (Freed, pers. com.).

Accurate data on the types of OCS-fishing industry conflicts is sparse. Basically fishermen organizations feel they should have some input to the permit process for allowing OCS exploration to prevent the OCS vessels from working in areas of heavy pot storage, fishing concentrations and during busy seasons.

Chapter 6

PORT INFRASTRUCTURE DESCRIPTIONS AND IMPACTS

This section describes the major ports along the Bering Sea which are expected to play a role in fisheries development in the region. The ports in Western Alaska along the Aleutian Chain, Bristol Bay and Norton Sound are somewhat limited either: 1) by their distance from the fishing grounds (and in terms of OCS development, their distance from the lease sales), 2) because their harbors are too shallow and would restrict the large vessels operating in the Bering Sea, or 3) their infrastructure is limited and cannot support a harbor facility. While most of the ports on the perimeter of the Bering Sea cannot support large fisheries or OCS development they will be briefly discussed in this section.

Emphasis is placed on the port of Nome which is expected to develop its harbor, and the ports of Dutch Harbor/Unalaska, Akutan, Chernofski, and St. Paul. There are a number of other important smaller ports which support nearshore fisheries such as herring and salmon but few of these ports would be significantly impacted by petroleum or fisheries development activity for the reasons listed above.

Ports distant from the Bering Sea fisheries and OCS development, such as Kodiak, Sand Point, Cold Bay, and King Cove, will be briefly discussed as they can be expected to play a role in the area's development. However, Dutch Harbor/Unalaska is expected to be the major port in the region in terms of use by the fishing industry.

Information in this section comes primarily from the State of Alaska's Department of Commmunity and Regional Affairs, local planning documents, the Alaska Department of Transportation's port planning documents and previous work done for the BLM. A map with the four OCS lease sale areas is shown in Exhibit 6-1. Ports discussed in this section and their locations are shown in Exhibit 6-2.

Based on each port's infrastructure, potential development opportunity and various assumptions regarding port construction to support fisheries and/or OCS development in the Bering Sea, projections are made in terms of future vessel use of the major Bering Sea ports.

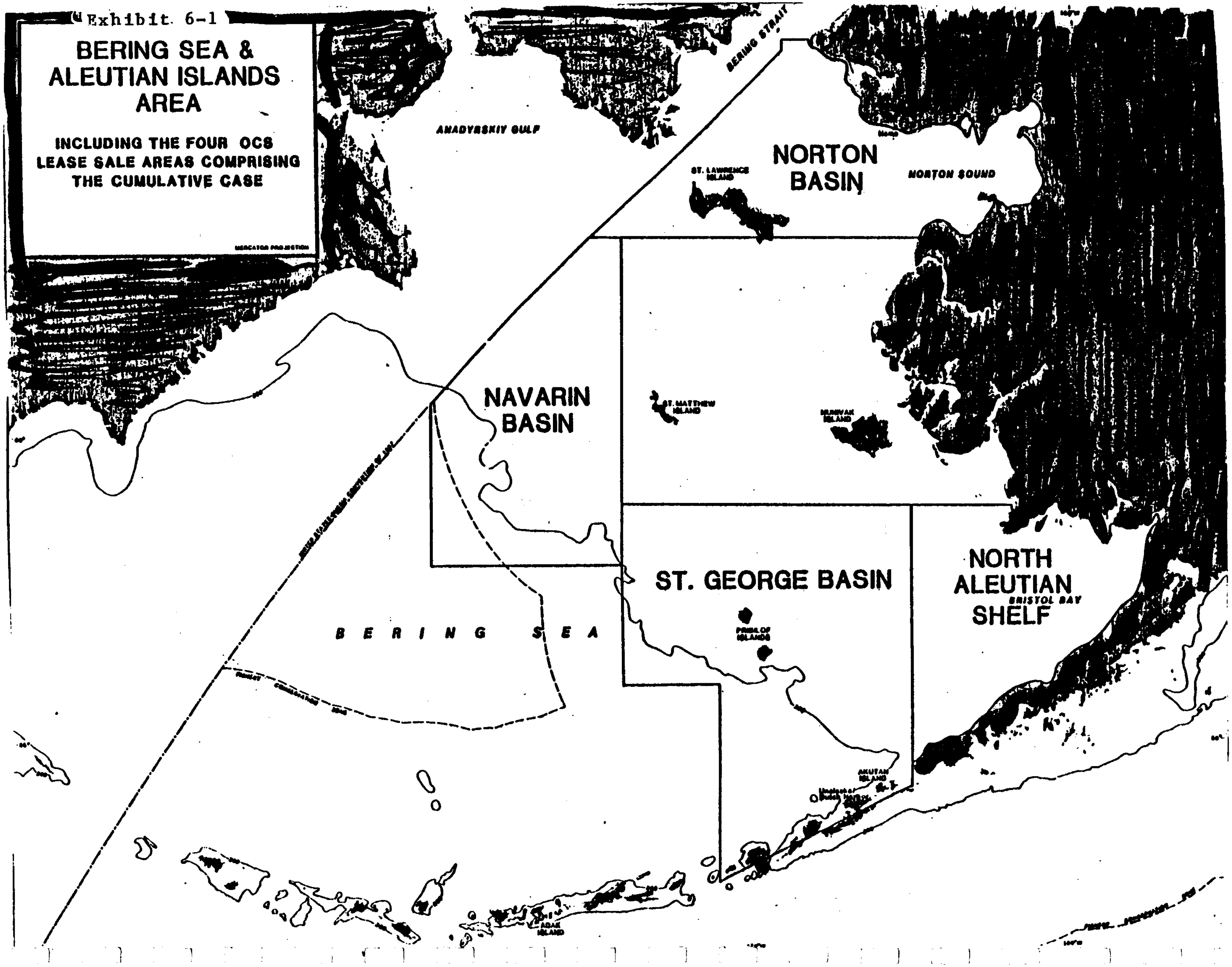
This section also addresses infrastructure impacts in of Unalaska, St. Paul, St. George, Nome, Chernofski and Akutan as these are expected to be the ports of major importance to the OCS and fishing industries.

The focus is on determining which facilities and components of each community's infrastructure would be impacted by OCS onshore development and relating these impacts to the fishing industry. Because of the lack of accurate historical data on the use of municipal services such as water consumption or because data such as fuel consumption could not be divulged because of privacy disclosures, much of the discussion of impacts is qualitative rather than quantitative.

The majority of future OCS operations are assumed to be based in Dutch Harbor/Unalaska. Therefore most of the discussion is on the City of Unalaska's municipal facilities, the fishing industry's use of those facilities, and a projection of impacts on the fishing industry and the municipal infrastructure given that OCS support bases locate there.

Information on impacts in this section comes primarily from personal communications with local government officials and planners, consultants to the municipalities, state agencies, and the few secondary sources that exist. Because of the lack of a good, documented data base on the

Exhibit 6-1



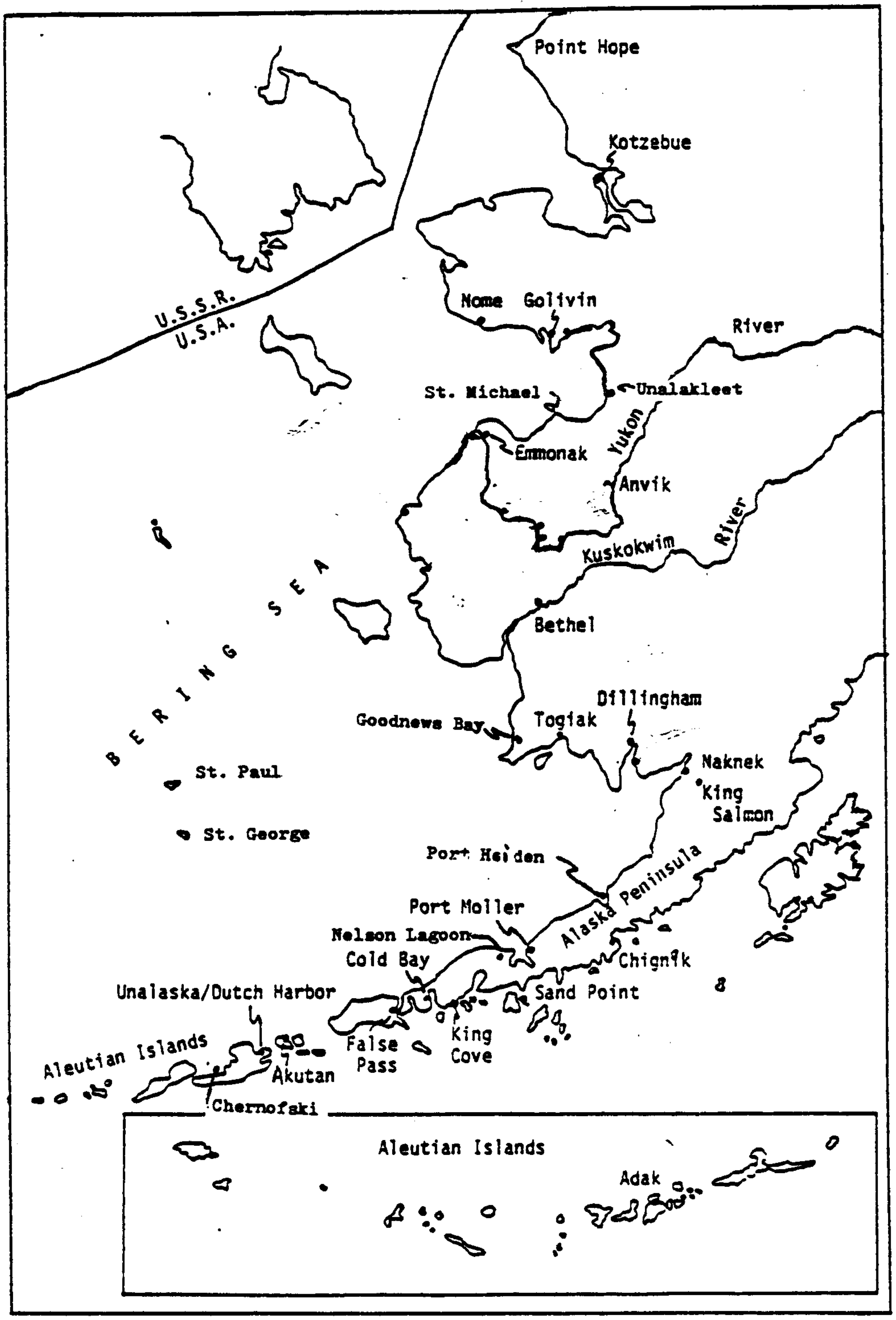
BERING SEA & ALEUTIAN ISLANDS AREA

INCLUDING THE FOUR OCS LEASE SALE AREAS COMPRISING THE CUMULATIVE CASE

MERCATOR PROJECTION

Exhibit 6-2

Ports in the Study Area



communities, much of the information presented here is based on judgments and opinions of those most closely affiliated with the communities.

Both positive and negative impacts on the municipalities and the fishing industry are noted and when appropriate a range of alternative mitigation measures to negative impacts are given.

6.1 PORT DESCRIPTIONS

6.1.1 Nome

6.1.1.1 Harbor Description

The port of Nome is located on the Seward Peninsula along the northern side of Norton Sound, at the mouth of the Snake River. The harbor in Nome is reached through the opening of the River between two concrete and steel jetties. The entrance channel is 75 feet wide and turns to the West towards the harbor's turning basin which measures 250 feet wide by 600 feet long. Nome Harbor and the City are shown in Exhibit 6-3. The U.S. Army Corp of Engineers is responsible for maintaining an authorized depth of eight feet in the entrance channel. The entrance to the harbor is subject to littoral drift and both the harbor and the entrance channel receive silt deposits from the Snake River such that actual depths may range from five to eight feet. Steel revetments extend along the turning basin and the entrance channel. The north revetment in the turning basin serves as the only dock in Nome. The port accomodates lighterage vessels or barges with three to five foot drafts. The sharp turn from the entrance channel into the turning basin limits the length of vessels entering the port of Nome to 200 feet or less. About 600 feet of berthing space is available. There is space for three dry cargo berths along the channel and one combination

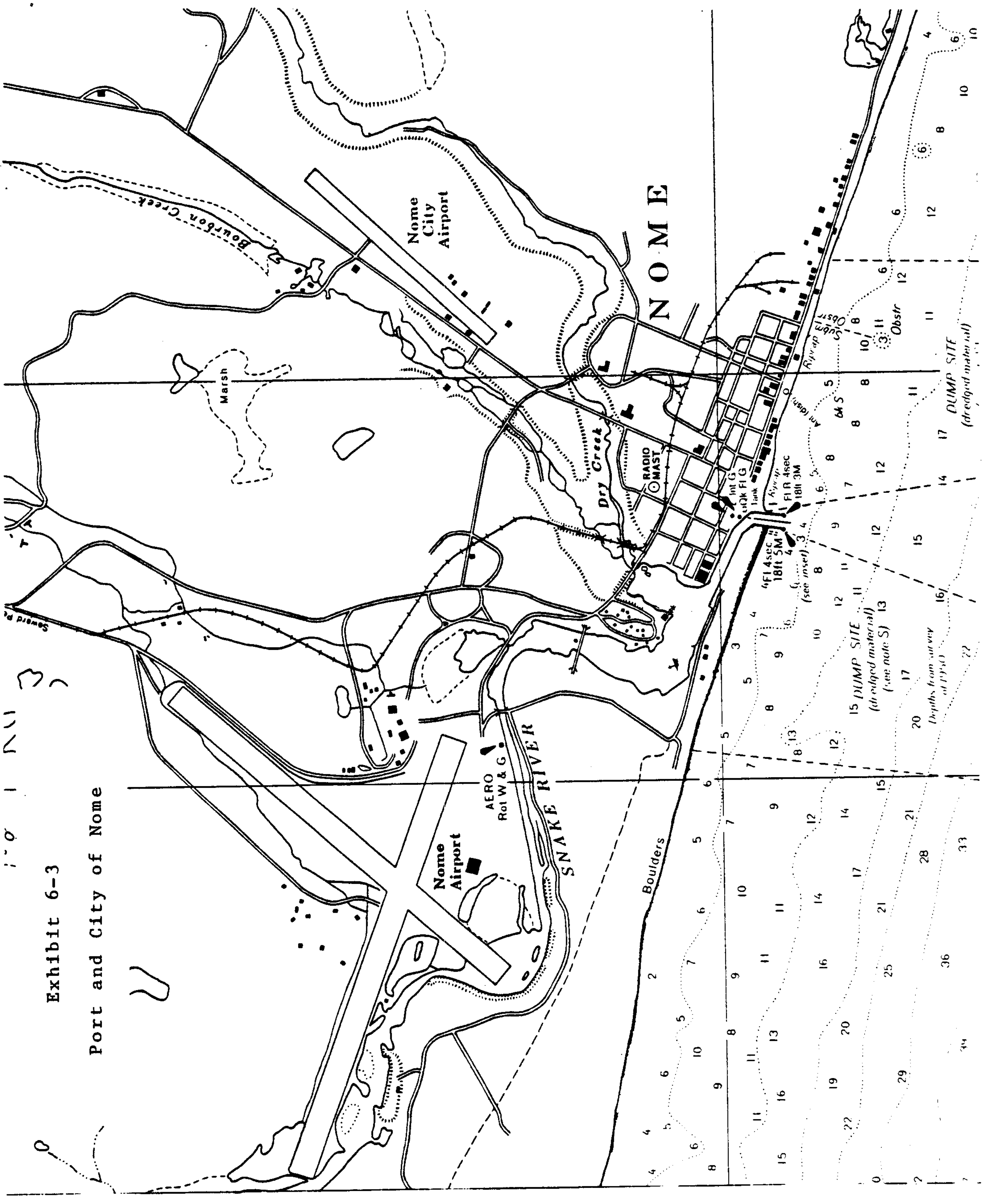


Exhibit 6-3

Port and City of Nome

petroleum/dry bulk cargo berth in the turning basin. The freight terminal is owned by the Arctic Lighterage Company and there is a petroleum terminal, used by Chevron, adjacent to this dock.

Freight coming into Nome is either in containorized seavans or on pallats. There are cranes, fork lifts and other assorted cargo handling equipment onshore to move the freight. Two warehouses of about 22,000 square feet each are used to store freight until it is picked up by the owners. There is limited open storage adjacent to the warehouses. However, a large area for open storage of materials is available within three miles of the harbor. Chevron Oil Company uses the harbor to lighter its tankers and has an onshore fuel storage capacity of 6.5 million gallons.

Shallow water and a small harbor limit the size and amount of vessel traffic in Nome. Deep draft cargo vessels and barges are forced to anchor one mile offshore to unload their freight onto smaller lighterage craft due to the shallow water conditions. During periods of strong northerly winds, vessels anchor as far as three miles offshore at better anchorage sites. The diurnal tide range is 1.6 feet which adds to the problem of shallow water. The shallow water is influenced by wind much more than tide conditions, however, and during periods of extended northerly winds, water depth at Nome is reduced to a point where the port must be closed. The 120 day shipping season which runs from mid-May to mid-September has about 20 days when the port is unsuitable for lightering (Peat, Marwick, Mitchell & Co., et al., 1980). From September through May sea ice is present up to a maximum of 40 to 52 inches which prohibits almost all vessel traffic. Winter travel is further hindered by almost continuous storms. During the late spring and summer, fog and rain are present. All these factors combined make Nome a marginal port.

Nome is used as a major transshipment point for goods moving to other coastal communities. Freight or fuel are offloaded at Nome and stored until a full barge load can be delivered to the village of final destination. Dry cargo linehaul vessels, cargo ships, and linehaul tanker barges stop at Nome. Lighterage service is available locally and barges haul both liquid bulk and dry cargo. Annual commercial vessel activity in Nome Harbor for the years 1972-79 is given in Exhibit 6-4. Annual throughout tonnage for 1970 through 1977 is given in Exhibit 6-5. Commodity tonnage by origin and destination is given in Exhibit 6-6.

Commercial vessel activity figures reflect both linehaul and transhipment lightering activities. The great majority of throughput tonnage is petroleum products. All other products (food, commodities, lumber and wood products, and building products), account for less than 25 percent of total throughout. Almost all commodity tonnage going into Nome originates in the Seattle area. The exception is petroleum products coming from Iliuliuk Harbor (Dutch Harbor/Unalaska) and construction materials from elsewhere in Alaska. Of the inbound commodities, 84 percent of the shipments originate in the Seattle/Lake Washington Canal area, seven percent from Iliuluik, two percent from Anchorage, and four percent from Bethel. In terms of outbound destinations, five percent are foreign, 22 percent go to Bering Sea villages, seven percent to the Pribilofs, five percent to Anchorage, two percent to Kodiak and two percent to the village of St. Michael.

6.1.1.2 Fishing Industry Activity

The port at Nome supports two major commercial fisheries: Pacific herring and salmon. Typical boats in these fisheries are 24 to 35 feet in length with a crew of one or two. Nome is neither a processing or harvesting center although it is the largest community on Norton Sound. The fishing season runs from June to September. Since there are no

Exhibit 6-4

Annual Commercial Vessel Activity
Nome Harbor
1972 - 1979

Year	Inbound			Outbound		
	Dry Cargo	Tanker	Tow or Tug	Dry Cargo	Tanker	Tow or Tug
1972	29	248	271	30	248	269
1973	8	171	215	7	172	217
1974	14	4	19	18	4	19
1975	13	172	214	13	174	215
1976	18	29	16	18	31	15
1977	210	7	318	205	6	316
1978	34	139	198	35	149	187
1979	23	7	21	21	4	21

Source: Corps of Engineers, Waterborne Commerce Statistics, Part 4: Various Years.

Exhibit 6-5

Port of Nome
Annual Throughput Tonnage For Period 1970 to 1977

	COMMODITY GROUPS						
Year	Petroleum Products[1]	Food Products[2]	Commodities[3]	Lumber and Wood Furniture Products[4]	Building Products[5]	All Other[6] Commodity Groups	Annual Total
1970	13,244	2,095	1,473	2,015	1,753	371	20,951
1971	15,809	1,684	899	1,329	1,853	357	21,931
1972	35,523	2,875	697	1,296	2,268	490	43,149
1973	23,302	1,319	1,086	1,195	1,194	686	28,782
1974	22,581	2,335	1,289	1,853	2,921	1,335	32,314
1975	25,720	1,414	933	939	2,043	307	31,356
1976	23,022	1,859	1,660	1,476	1,185	422	29,624
1977	43,260	1,871	5,817	2,195	1,768	1,507	56,418
Percent of Annual Total	77%	3%	10%	4%	3%	3%	100%

---

[1] Petroleum Products include gasoline; jet fuel; distillate fuel oil; kerosene; lubricating oils and greases; asphalt and tar; liquefied gases; naptha; and petroleum solvents.

[2] Food Products include fresh fruits and tree nuts; fresh and frozen vegetables; meat; dairy products; prepared fish and shellfish; prepared fruit and vegetable juice; grain mill products; alcoholic beverages; groceries; and miscellaneous food products.

[3] Commodities include a broad variety of times such as stereos, pots and pans, etc.

[4] Lumber and Wood Furniture Products include lumber; plywood; furniture and fixtures; pulp and paper products; timber posts; piling; and worked wood.

[5] Building Products include asphalt building materials; rubber and miscellaneous plastic products; building cement; structural clay products; iron and steel shapes; fabricated metal products; and electrical and nonelectrical machinery.

[6] The "Other" group includes transportation equipment, such as motor vehicles, ships, boats; iron and steel scrap; chemical products, such as paints and basic chemicals; fertilizer; sand and gravel; textiles; salt; fresh fish other than shellfish; coal; nonferrous ores; and other miscellaneous manufactured products.

Source: Corps of Engineers, Waterborne Commerce Statistics, Part 4: Various Years.

Exhibit 6-6

Port of Nome
1977 Commodity Tonnage By Origin and Destination

Group	Commodity Classification Code	Title	Inbound Commodities Origin	Inbound Commodities Tonnage	Throughout Tonnage[1]	Outbound Tonnage	Commodity Destination
	0911	Fresh Fish, Except Shellfish	--	--	508	508	Foreign
	1442	Sand, Gravel, Crushed Rock	--	--	250	250	Bering Sea
Food	2031	Fish and Shellfish, Prepared	Seattle	70	381	381	Foreign
Products	2081	Alcoholic Beverages	LWC[2]	325	395	--	--
			Seattle	696			
	2094	Groceries	LWC	772	1,476	8	Bering Sea
Lumber	2414	Timber, Posts, Poles, Piling	Seattle	34	34	--	--
and	2421	Lumber and	Seattle	792			
Wood	2431	Veneer, Plywood, Worked Wood	LWC	838	1,650	20	Bering Sea
Furniture	2491	Wood Manufactures, Nec.	Seattle	338			
Products			LWC	130	469	1	Bering Sea
	2511	Furniture and Fixtures	Seattle	14			
			LWC	28	42	--	--
Chemical	2819	Basic Chemicals and Products					
Products		Nec.	Seattle	25	25	--	--
	2851	Paints	Seattle	14	14	--	--
	2891	Miscellaneous Chemical Products	Seattle	4	4	--	--
	2911	Gasoline	LWC	10,532[3]			
			Iliuliuk	585	17,310	5,788	Local
						263	Pribilofs
						142	Bering Sea
Petroleum	2912	Jet Fuel	Iliuliuk	568	569	--	--
Products	2914	Distillate Fuel Oil	Iliuliuk	3,223	25,323	21,817	Local
						81	Pribilofs
						202	Bering Sea

Exhibit 6-6 (Cont.)

Port of Nome
1977 Commodity Tonnage By Origin and Destination

	Commodity Classification		Inbound Commodities		Throughout	Outbound	Commodity
Group	Code	Title	Origin	Tonnage	Tonnage[1]	Tonnage	Destination
Petroleum Products	2916	Lubricating Oils and Greases	Seattle	3	3	--	--
	2921	Liquefied Gases	Seattle	56	56	--	--
	2951	Asphalt Building Materials	Seattle	6	6	--	--
	2991	Petroleum and Coal Products Nec.	Seattle	420			
			LWC	23	443	--	--
	3011	Rubber and Misc. Plastic Products	Seattle	7	7	--	--
	3241	Building Cement	Seattle	62	62	--	--
Building Products	3251	Structural Clay Products	Seattle	1	1	--	--
	3291	Misc. Nonmetallic Mineral Products	Seattle	324	324	--	--
	3315	Iron, Steel Shapes, Except Sheet	LWC	15	15	--	--
	3411	Fabricated Metal Products	Seattle	394	420	19	Seattle
						7	Bethel
	3511	Machinery, Except Electrical	Seattle	153			
			LWC	64			
			Bethel	14			
			Bering Sea North	210	476	35	Bering Sea
	3611	Electrical Machinery and Equipment	Seattle	5			
			LWC	9	14	--	--
	3711	Motor Vehicles, Parts, and Equipment	Seattle	145			
			LWC	135			
Transportation Equipment			Bethel	2	304	4	Anchorage
						18	Bering Sea
	3731	Ships and Boats	Seattle	4	4	--	--
	3791	Misc. Transportation Equip.	Seattle	17	17		
	4112	Commodities, Nec.	Seattle	879			
			LWC	232			

Exhibit 6-6 (Cont.)

Port of Nome
1977 Commodity Tonnage By Origin and Destination

	Commodity Classification		Inbound Commodities		Throughput	Outbound	Commodity
Group	Code	Title	Origin	Tonnage	Tonnage[1]	Tonnage	Destination
Transpor-tation Equipment			Anchorage	2	5,817	4,361	Local
						1	Anchorage
						2	Kodiak
						83	Pribilofs
						68	St. Michael
						189	Bering Sea
TOTALS				22,170	56,418	34,248	

---

[1] Throughput tonnage is the sum of inbound and outbound commodities.

[2] "LWC" represents the Lake Washington Canal.

[3] To convert barrels of petroleum products to tonnage, the Corps of Engineers uses a factor of 1 ton = 7.15 bbl. This factor average the varying weights among different petroleum products.

Source: Corps of Engineers, Waterborn Commerce Statistics, Part 4.

small boat docking facilities in Nome, fishing boats are taken up the Snake River and beached or pulled out when the season is over. Boats may also be beached or pulled out of water along the Norton Sound Beach. The major gears used are set nets although drift gill nets are also used. Some herring are harvested with gillnets although purse seines harvest the majority of herring. Along with other villages in the area, Nome serves as a fish buying location. Several floating fish buyers and/or processors in the area buy fish from fishermen. These fish are frozen, processed, or chilled until they can be transported to the processor. Local onshore processing is limited due to extensive use of processing vessels and tenders (Terry et. al., 1980). Floating processors do not presently use the port due to the shallow water conditions.

According to TAMS (1982) there are about 200 small fishing boats that either fish out of Nome or use Nome at one time or another during the summer fishing season. There are also four to 10 floating processors and buyers which are in the Nome area during the fishing season. During the herring season about 332 boats, about half non-local, are in the Nome area (TAMS, 1982). It should be noted, however, that the local fishing boats are used predominantly for travel, hunting, fishing and subsistence, and that Nome plays a minor role in the Norton Sound fisheries. Of a total of 177 commercial salmon entry permit holders in the Norton Sound fishery, only 16 had a Nome home address (Environmental Services Ltd., 1981).

6.1.1.3 Harbor and Community Infrastructure

Nome's population, as determined by the 1980 census, was 2,301 (Environmental Services Limited, 1981). Electricity in Nome is generated by diesel powered units with a capacity of 8,350 KW (BLM, 1982). Peak load usually occurs in the winter. The generating equipment is apparently in good condition. Potable water is provided to the City of Nome through a central water supply system operated by the City. However, only about 60 percent of the city's residents are connected to the central water and sewer. Nome has a 1.5 day water storage capacity and has an 80 gallon per day per capita water consumption rate which stays fairly constant year-round (BLM, 1982; Terry, et. al., 1980).

Water is also trucked to about 200 residents of the community. The water flow is considered inadequate for large fire fighting emergencies and any large user of water in Nome would need to develop their own water supply. This would be the case in the event onshore OCS or fisheries development took place in Nome.

Sewage disposal is accomplished in a variety of ways. Material collected in honey buckets is deposited at the city dump. The Nome sewer system is primarily gravity flow. The sewage goes to the primary treatment facility which was designed to handle 173,000 gallons per day. The plant apparently is inadequate and does not work well. Most effluent is discharged into the mouth of the Snake River (Environmental Services Limited, 1981). New fish or oil-related facilities would have to dispose of their own wastes which would have to be done using a septic system or by ocean outfall.

Nome is served by two airports: Nome Field and Nome City Airport. Nome Field is the larger of the two and has two asphalt runways: 6,000 by 150 feet and 5,570 by 150 feet. There is a weather service station and the field has a complete instrument landing system including markers, VOR, lights, and rotating beacon. There are five hangers, two terminals and minor engine and frame repair facilities available. Nome Field has daily jet service to Anchorage and Kotzebue with several local charter operators which service outlying communities. Nome City Airport has a 3,200 foot gravel airstrip which is used primarily by private aircraft. Under OCS development scenarios Nome City Airport has been suggested as a base for helicopter operations and because Nome field is operating at less than capacity, the Airport should be adequate for long term future needs (Environmental Services Limited, 1981; Peat, Marwick, Mitchell & Co., et. al., 1980).

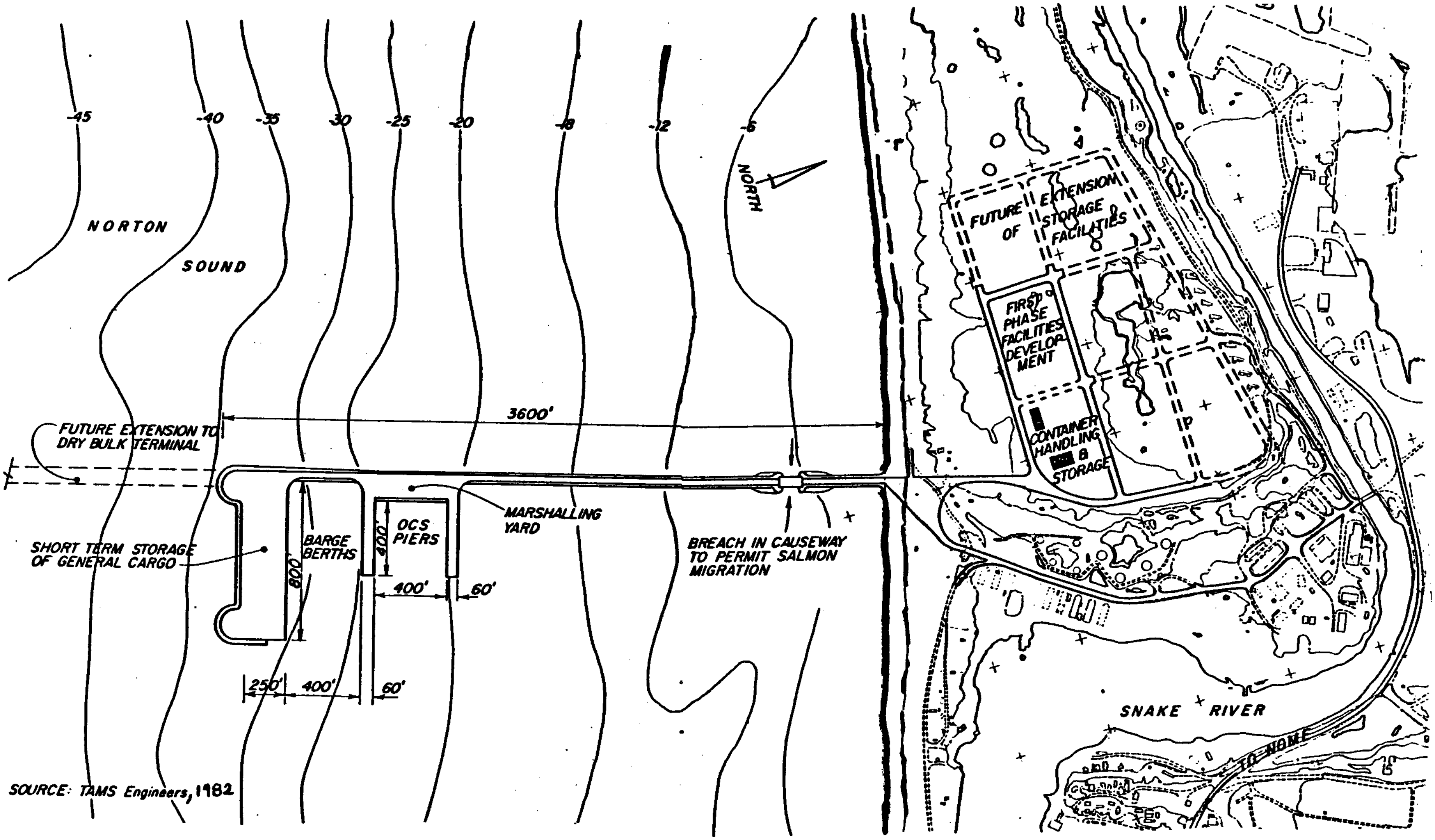
The marine-related boat and engine repair facilities in Nome are limited. Arctic Lighterage Company has personnel available who do minor work on tugs and barges. Small engine repair facilities are available locally through the snow machine and three-wheeler dealer. Mining companies in the area obtain mechanics to do work on their equipment. Major boat and engine repair work would have to be done in Kodiak, Dutch Harbor, Anchorage or Seattle. Marine electronic repairmen are not available locally although parts and equipment are routinely flown in.

6.1.1.4 Future Port Requirements and Facilities

If port development at Nome does not occur, it is likely that fishing industry activity will remain minimal. And, if OCS support facilities are developed at Cape Nome, as suggested by the BLM (1982), with no harbor improvements at the port of Nome, fishing industry activities at Nome would remain low. There have, however, been many plans for the development of a port facility at Nome, the most recent by TAMS (1982). In the TAMS report it is assumed that OCS development, area mining activity, population growth, and commercial fishing growth will create a demand for larger port facilities in Nome. Preliminary designs for an expanded port at Nome consists of a 3,600 foot causeway extending from shore slightly west of the mouth of the Snake River. The causeway would have berthing and loading facilities and container and general cargo storage space onshore complete with warehouse facilities. Depth alongside would be 30 feet, suitable for vessels and barges drawing up to 27 feet. A second phase of the port development would add facilities for OCS vessels. A proposed layout for the harbor is shown in Exhibit 6-7.

Exhibit 6-7

Port of Nome Expansion Plan



SOURCE: TAMS Engineers, 1982

A critical aspect of any port development is ensuring that there is adequate water depth alongside to facilitate deep draft vessels and barges which now must be lightered into Nome. Given that the port is developed, OCS activity would be expected to use the port for a storage and support base. The port would also be used to export coal and minerals which show development potential inland. As far as fisheries are concerned, floating processors and catcher vessels would be expected to take on fuel and supplies at the port. Processing vessels would also use the port to buy and process locally caught herring and salmon. Vessels would unload catch for transshipment elsewhere or to be flown out in the case of the higher value fishery products.

6.1.2 Golovin

Golovin is a small settlement on Golovin Bay about 75 miles east of Nome. The community is located on a spit of land jutting into the Bay and had a 1980 population of 118. Water depths near Golovin are shallow but the Bay provides good, deep anchorages for larger vessels (National Ocean Survey, 1983). There is a small fish cooperative in Golovin for processing and cold storage of salmon and herring roe which is then sold to processing ships (Environmental Services Limited, 1980b). About 12 limited entry salmon permits are held by villagers and 20 to 30 residents work at the cold storage plant which is open in the summer. There are 30 to 40 small fishing boats which are used locally for personal subsistence and for inshore salmon and herring gillnet fishing.

Because of the shallow water near the village, cargo and fuel is lightered to the beach from about one-half mile offshore. OCS vessels have used the Bay in the past as a harbor of refuge as it is fairly well sheltered by Cape Darby, 12 miles south of the village of Golovin (BLM, 1982). All water traffic is hindered in the winter by sea ice which covers the Bay from November to May.

There is a 2,500 foot gravel runway and air service to Nome. The processor and village are served by creek water in the summer and residents must melt snow or store their own water in the winter. Only private diesel generators are in town and there are tanks which store 8,000 gallons of fuel. Sewage is disposed of in honey buckets or by direct discharge. Public buildings have septic tanks.

Golovin does not have docking facilities; only beach areas where boats and lightering craft are pulled onshore. It is unlikely that the community will develop the infrastructure necessary to exploit offshore development.

6.1.3 Unalakleet

The village of Unalakleet lies on Norton Sound at the mouth of the Unalakeet River, 148 miles southeast of Nome and 400 air miles from Anchorage. The village had a 1980 population of 632. The major components of the economy are commercial and subsistence fishing. From May to August, a small herring processing plant employs about 50 people. Also, during the summer fishing season salmon fish buyers operate near Unalakleet. The salmon are usually chilled in ice and may undergo various stages of cleaning before being flown to processing plants elsewhere (Terry et. al., 1980).

Supplies are brought into Unalakleet by barge companies from Nome, Saint Michael, and Seattle. The BIA cargo ship North Star III also supplies the village. Cargo is lightered off vessels one-half mile from shore due to shallow water conditions. One barge company does have their own dock/unloading area on the Kouwegoh Slough, adjacent to Unalakleet. Along the banks of the Slough, many of the villagers beach their fishing boats. There are two snowmachine businesses which can service and sell the outboard motors.

There is a 6,200 foot gravel runway and a 2,300 foot cross runway in Unalakleet with jet service to Anchorage and Nome. Charter air services are available to outlying communities. The village has a 300 KW, a 450 KW, and a 600 KW diesel generator. Standby generators are located at public facilities. Fuel is brought in from Saint Michael and there is storage for 250,000 gallons of petroleum products (Environmental Services Limited, 1980a). Fuel and all other supplies, are brought in during the summer as Norton Sound is ice free only from May through September.

The village's water is provided by a filtration system with a one million gallon storage tank. Residential wastes are collected and treated in a two acre lagoon. Fish wastes are dumped into the Unalakleet River.

Unalakleet is located far enough away from the majority of Bering Sea fisheries and OCS activities such that major consideration is not being given to it as a possible port for development. Its lack of a developed infrastructure and waterfront also preclude it from OCS or any major fisheries development.

6.1.4 Saint Michael

The village of Saint Michael is located on the east coast of Saint Michael Island in Norton Sound 48 miles southwest of Unalakleet and 125 miles southeast of Nome. In 1980 Saint Michael had a population of 283 (Environmental Services Limited, 1980). Saint Michael's basic economy is one of subsistence. Some of the villagers fish commercially for herring in Norton Sound. Saint Michael has a good natural harbor but it is fairly shallow and is exposed to northeast storms. The village serves as a transfer point where cargo from Dutch Harbor, Nome, and

Seattle is transferred to river barges and shipped to other villages along the coast or up the various rivers emptying into Norton Sound. The harbor is ice free from June to November.

Saint Michael does have a marine railway operated by the Northern Commercial Company capable of hauling vessels up to 100 tons and nine feet in draft and there are limited machine shop facilities available (National Ocean Survey, 1983). Vessels needing major repairs must go to Dutch Harbor or Kodiak. Saint Michael's airport consists of a dirt runway 2,000 feet long. There are scheduled flights between Unalakleet and Nome with charter services available to other smaller communities. The community of Saint Michael has two 175 KW diesel generators and one 125 KW diesel generator. Chevron delivers fuel to the town. There is 1.47 million gallons of fuel storage. The village's water supply is obtained from wells and piped to a 120,000 gallon wooden tank. Individual users then haul the water. Sewage is disposed of by honey buckets.

The infrastructure in Saint Michael is primative, but because it has the only natural harbor in Norton Sound, it does have a chance of some OCS or fisheries development. However, it is assumed that these activities will not take place because of the lack of infrastructure and support population.

6.1.5 Emmonak

Emmonak is a river port located near the mouth of the Yukon River. It has become a center for commercial salmon fishing on the Yukon River and for goods moving upriver. The village had a 1979 population of 545. Emmonak has a seasonal economy that peaks in the summer during fishing season. From November through May the river is frozen which limits activity. There are about 100 gillnet permits belonging to Emmonak residents and a native owned cannery which employs about 300 persons each summer (Darbyshire and Associates, 1979). The native cannery is on a barge and is self contained. A smaller salmon cleaning facility owned by Whitney-Fidalgo is also in the village. There are boat docks at these two processors for unloading and a fuel dock. Boats in the area are beached when not in use.

Emmonak relys solely on air and water transportation and has a 2,200 foot dirt airstrip which accomodates small aircraft only. Processors and public buildings have their own electrical generators. There is a central power source for villagers which consists of four diesel generators totaling 950 KW. Fuel barges come each summer and there is local storage capacity of 614,000 gallons. Water is piped to large users and collected at a central watering point by local residents. Sewage is discharged directly into the river.

The majority of fishing activity near Emmonak is limited to salmon. It is also far enough away from the offshore fishery and OCS resources such that it is not under consideration for port development in this analysis.

6.1.6 Bethel

Bethel is located on the Kuskokwim River about 65 miles upriver from Bristol Bay. Bethel is the major transshipment center for supplies and cargo bound for smaller villages upriver and in the surrounding area. A significant amount of fishing takes place on the river but the fish are usually either bought by local fish buyers and flown out, or they are used locally.

Supplies are brought in on barge and either unloaded or shipped further upriver. While Bethel is a major community in Western Alaska, it is far enough upriver and away from ocean resources such that major offshore fishing or OCS activities would not be likely to locate there.

6.1.7 Goodnews Bay

Goodnews Bay is a small village located at the head of Goodnews Bay between Bristol Bay and Kuskokwim Bay. Water depths range from one to twelve fathoms but the Bay is used only by smaller vessels because of the meandering channel and changing shoal conditions (National Ocean Survey, 1983).

The area's economy consists primarily of subsistence hunting and fishing. There is also a mining company, Platinum, which is located at the inner end of the spit on the southside of the Bay's entrance. Fuel, water and general supplies are available locally. However, because of the limited infrastructure and shallow conditions of the harbor, few large vessels call here and large port developments are not expected.

6.1.8 Togiak

Togiak is located at the head of Togiak Bay north of Bristol Bay two miles west of the Togiak River. Togiak had a 1981 population of about 500 which remains fairly stable year-round (DOWL Engineers, 1982a). The economy of the village is based on commercial and subsistence fishing. Fishery resources are located close to the village. About 400 residents of Togiak are commercial fishermen. In 1980 there were 50 set net and about 100 to 150 drift net permits owned by the towns residents. Fishing takes place for salmon, herring and kelp. Activity is primarily near shore and near the village. In 1980, 84 percent of the herring was harvested by non-resident purse seine vessels (DOWL Engineers, 1982a).

There are three processing facilities onshore near Togiak: Togiak Fisheries, Kachemak Seafoods Cannery, and Togiak Eskimo Seafoods. In recent herring seasons, five processors and 27 buyers have operated offshore from Togiak. Local processing efforts consist primarily of canning, freezing, and flying out fresh salmon and salting or freezing herring before the herring is shipped to the Orient or Kodiak for further processing (Terry, et al., 1980).

There are no harbor or port facilities. Boats are beached or docked elsewhere. Lightering barges carrying freight, cargo, and fuel are beached and then unloaded or pumped out. Goods can only be brought in by water during the summer months as ocean ice prevents travel from late November through April. The Togiak area's marine transportation and dock building capabilities are further hampered by widely fluctuating tides, storms, strong winds, serious shoreline erosion, and flooding (DOWL Engineers, 1982a).

Togiak has a 2,600 by 100 feet gravel airstrip with a 990 by 80 foot cross-strip. There is regular air service to Dillingham. The Alaska Village Electrical Cooperative operates a 300 KW and a 160 KW diesel generator with buried cable transmission. The Public Health Service and School operate standby generators; the fish processing facilities are self sufficient. There are 14 fuel storage tanks in the village with a capacity of 114,470 gallons. The sewage system is a combination of treatment lagoon and septic systems. Fish processors discharge into the bay. The water system is inadequate in the summer to meet the needs of both the fish processing plants and the residents. Villagers often go without water for periods of time. There is a 60,000 gallon water storage tank and a 43 foot well. Water is distributed through two and four inch water lines.

Any additional fish processors wanting to locate in Togiak would have to develop their own water, sewage, and electrical systems. Also, because of poor waterfront and docking facilities it seems highly unlikely that OCS activities would use Togiak as a support base.

6.1.9 Dillingham

Dillingham is located at the extreme north end of Nushagak Bay at an embayment formed by the Nushagak and Wood Rivers as they enter Bristol Bay. Dillingham is the largest town in the Bristol Bay area and had a 1981 population of 1,656. During the spring and summer fishing season, Dillingham's population swells to three times this number as fishery workers come to Bristol Bay (DOWL Engineers, 1982b).

Fishing and fish processing are the primary components of the economy. Locally, there are about 400 fishermen working three months of the year and about 300 fishing boats owned by residents. Almost all of these boats fish for salmon in Bristol Bay and a few travel to Togiak to fish for herring. Five processors operate onshore in Dillingham but several other floating processors operate in the Nushagak Bay vicinity. Also, as many as 20 fish buyers may buy fish at the Dillingham city dock and those buyers not working for a local processor fly the product out for processing.

Dillingham's docks can be reached by large vessels and barges only during high tide when water depths are adequate. The port experiences a 24 foot tidal range and low tide water line is about 15 feet from the docks (Terry, et al. 1980). Unloading is coordinated with the tides. Barges could be moved to the dock for unloading and then beached but they are moved in and out with the tide rather than letting barges be grounded. This is a time consuming process but prevents hull damage to the barges. The shipping season is from May through September. The area is characterized by summer fog and high winds in winter.

Seattle based barge companies serve Dillingham. Processed fish, fish processing equipment, and construction materials account for most of the tonnage moving over the dock. Goods are unloaded across the Dillingham Municipal Dock which is the only public dock in town. Because of its small size the dock can be tied up for a long time by a single barge. Plans have been made to expand and improve the dock facility but construction has not yet begun.

Dillingham also has a small boat harbor for commercial fishing boats which are less than 32 feet long and which draw less than five feet. The harbor has about 950 feet of float space and will accomodate 150 to 200 vessels. Up to 250 boats use the harbor during the busy salmon season often rafting 18 across (Terry, et. al, 1980). Other boats are beached or anchored upriver. Onshore storage of boats is provided at canneries. The small boat harbor requires annual dredging because of river deposits (National Ocean Survey, 1983).

Dillingham has a 6,400 by 150 foot gravel airstrip with daily flights to Anchorage. However, King Salmon is considered to be the major airport for the region. King Salmon and Dillingham are connected by gravel road.

Electricity in Dillingham is generated using five diesel generators with a total output of 3,850 KW with a firm capacity of 2,600 KW (DOWL Engineers, 1982b). There are fuel storage tanks for these generators with a capacity of 26,000 gallons. The seafood processors and local cold storage facility all operate their own standby electrical generators. Chevron delivers fuel to the bulk storage tanks in Dillingham after spring break-up. Petroleum products are stored in eleven tanks with 2.5 million gallons of capacity.

The City of Dillingham provides water to less than half of the households in the community. Those not connected to the city's water supply obtain their water from private wells. Seafood processors also obtain their own water. Sewage treatment ranges from septic systems to direct discharge into the Nushagak River.

There are some boat and minor engine repair facilities at Dillingham. One of the canneries has a marine railway which can haul vessels up to 100 tons at high tide, (National Ocean Survey, 1983).

It seems unlikely that Dillingham will develop into a port capable of serving the OCS or Bering Sea groundfish industries. This is primarily due to the large tide fluctuations which would not allow the deep draft vessels necessary for the two industries into the port.

6.1.10 Naknek

Naknek is located at the mouth of the Naknek River at the upper eastern end of Bristol Bay. Naknek is a major salmon processing center in the Bristol Bay region. Most of the Bristol Bay salmon harvest is canned or frozen in Naknek or Dillingham. The Bristol Bay Borough, which contains Naknek, South Naknek and King Salmon had a 1981 population of 1,250 residents which included 371 military personnel. In June and July, during the sockeye run, the local population swells to around 4,000 (Environmental Services Limited, 1982b).

In the Naknek area there are 12 onshore processors with approximately 30 buyers active during the salmon season. These buyers fly fish to other areas for processing. Many of the buyers are floating processors as well. As a whole, there is extensive use of floating processors, tenders and cargo aircraft which can change the processing capacity of the Bristol Bay area rapidly (Terry, et. al., 1980). Seafood processors in Naknek include: Peter Pan Seafoods, Whitney-Fidalgo Seafoods, Nelbro

Packing Co., Dragnet Fisheries, Ocean Beauty, Alaska Far East Corp., Queen Fisheries, and Red Salmon Co.

The canneries are self contained and draw all but a few employees from outside the village (Environmental Services Limited, 1982). There are docks at each cannery but no small boat harbor. Most of the boats are stored onshore during the offseason. Canneries maintain their own marine ways and they can haul vessels up to 70 tons, 120 feet long with 10 foot drafts. Limited machine work and marine repairs are available in Naknek.

Most the boats in the area are 32 feet or less and use drift or set net gear. The Bristol Bay Borough operates a dock facility which is used by fishermen. Several wharves are in the area for unloading salmon and general cargo. Oil companies operate their own fuel docks (Environmental Services Limited, 1982a).

The Chevron tank farm has storage tanks for 500 thousand gallons of fuel oil and 400 thousand gallons of gas. Naknek Electric Association has 10 generators with a name plate capacity of 6,170 KW. Individual and community water wells are used. Most waste is discharged into receiving waters and a few septic tanks are used. Canneries are self-contained and provide their own water, power, waste discharge, and employee housing.

Naknek will probably not be developed into a port capable of servicing offshore fisheries and OCS development for many of the same reasons given for Dillingham. These include wide tidal fluctuations, limited infrastructure, distance from the offshore resource areas, and shallow water. Naknek should remain as a major salmon processing center.

6.1.11 King Salmon

The village of King Salmon is located on the north bank of the Naknek River about 15 miles upriver from Naknek. According to latest census information, there was a 1981 population of 374 in the community of King Salmon and 371 on the Air Force base near King Salmon (DCRA, 1982). King Salmon has a large airport and serves as an air transportation hub for the thousands of workers in the fishing industry processing plants on the Alaska Peninsula and on Bristol Bay (DCRA, 1982).

There is daily jet service to Anchorage and other charter air services available to villages throughout the area. King Salmon has a 8,500 foot paved runway with a 5,000 foot cross runway, and serves as an important link in the region's fishing economy because of its airport facilities. It is connected by road to Naknek and several buyers operate seasonally in King Salmon, chilling and flying catch out (Terry, et. al., 1980). Because of extreme tidal fluctuations of about 19 feet in the Naknek river, vessels with drafts greater than four feet do not usually navigate the river. Also, the river is usually only ice free from May to October. Supplies are shipped to Naknek on barge, offloaded, and then trucked to King Salmon. King Salmon does have a few residents that participate in Bristol Bay commercial fisheries but there is not a small boat harbor.

Because of King Salmon's distance from Bristol Bay, poor navigational characteristics of the Naknek River, and limited fishing-related infrastructure, King Salmon is not expected to be developed as a harbor for either the fishing or OCS industries. It will remain an important regional airport to fly labor, products and equipment in and out of the region.

6.1.12 Port Heiden

Port Heiden is on the north side of the Alaska Peninsula on the south side of Bristol Bay. There is a small cannery there with fuel and supplies available and a small airstrip. Port Heiden offers a good, large harbor, however, unloading of cargo at the wharf needs to be done at high tide because of the tidal flats which uncover at low water. Tidal range is about 12 feet (National Ocean Survey, 1983). Sea ice usually restricts vessels from entering the port from January through April. Because of sea ice and the wide tidal range future harbor development is expected to be limited.

6.1.13 Port Moller

Port Moller is located on the Alaska Peninsula southwest of Port Heiden. The major settlement in Port Moller lies along the eastern side of the bay. Extensive shoals just inside Port Moller are subject to frequent change. The cannery pier inside Entrance Point is 350 feet long with depths alongside of 6 feet. Port Moller also has a small airstrip.

Use of the port is generally limited to vessels seeking shelter and to fishing vessels. A limited amount of fuel is available for cannery boats. A marine railway is also maintained for small cannery boats (National Ocean Survey, 1983). Much of the fish which is harvested in the Port Moller area is also transported to floating processors anchored in the Bay or near Nelson Lagoon.

6.1.14 Nelson Lagoon

The community of Nelson Lagoon is located on a narrow sand spit separating the Alaska Peninsula from the Bering sea, about 20 miles west of Port Moller. There are about 54 persons living there (University of Alaska, 1978). The economy is based on commercial and subsistence salmon fishing. Catch is delivered to cold storage in Port Moller or to a chilled brine fish storage barge anchored locally. Both set nets from shore and drift gillnets are used. There are no docks. Boats are tied to the anchored brine scow or beached. There are primative airstrips near Nelson Lagoon and float planes also use the area. Cargo and fuel is brought in once a year which has to be lightered to shore by skiff due to the shallow water conditions. Two 60 KW generators supply power to the 20 buildings in town. Water is hauled, obtained from wells, or melted. Sewage is dumped into the lagoon.

Because of the lack of deep water and harbor infrastructure, no offshore OCS or fisheries development facilities are anticipated in Nelson Lagoon.

6.1.15 King Cove

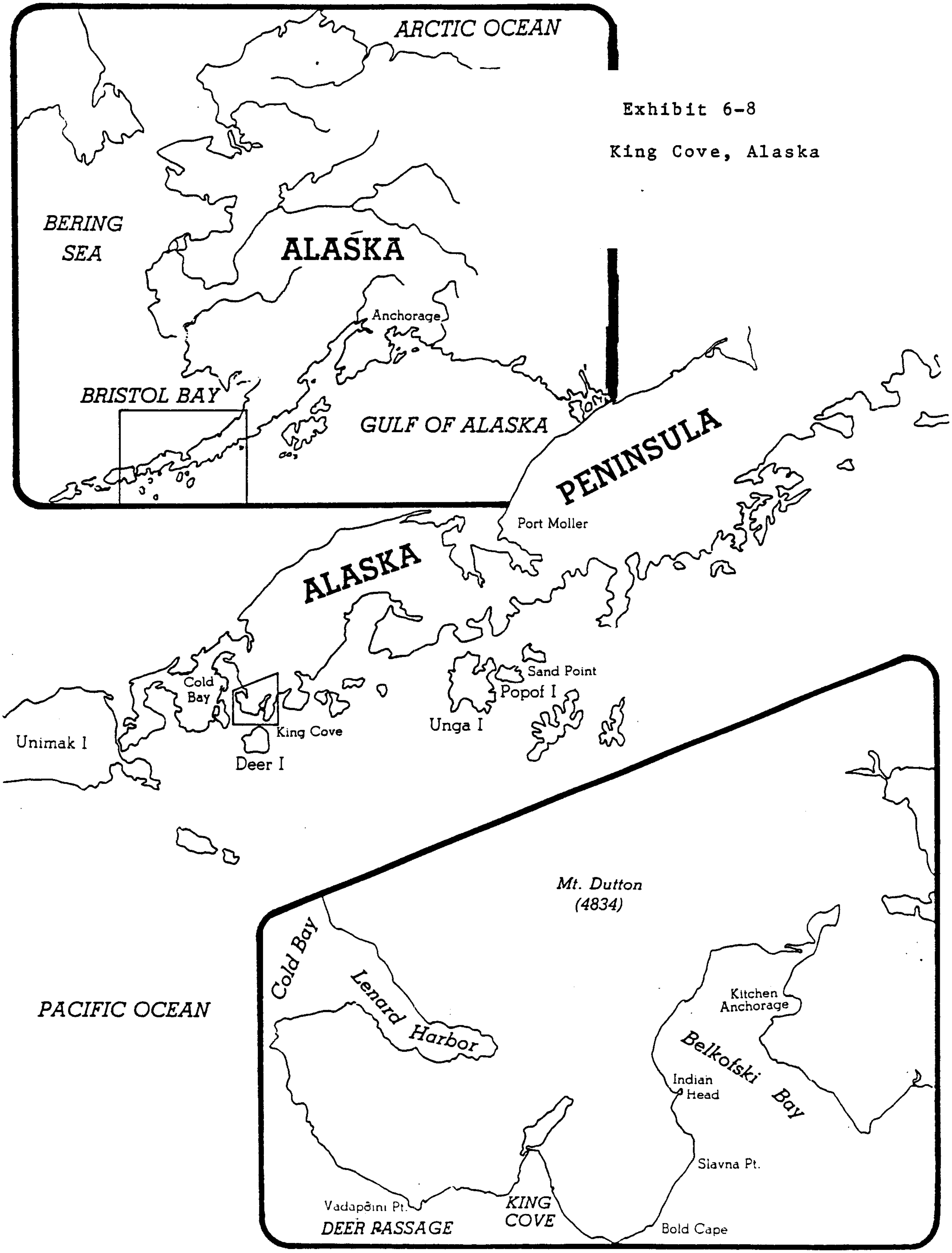
King Cove is located on the Alaska Peninsula about 200 miles east of Dutch Harbor, directly between Sand Point and Dutch Harbor. A map of the area is shown in Exhibit 6-8. King Cove has an excellent holding ground for anchored vessels and the bay is deep and free from dangers except those close to shore (National Ocean Survey, 1983). King Cove has a wharf and salmon cannery owned by Peter Pan Seafoods. The wharf has a 300 foot berth for the transfer of general cargo and off-loading of petroleum products. Adjacent to this dock is a small 60 foot oil dock used to refuel fishing vessels. The community of King Cove has a newly built, small boat harbor with 320 feet of dockspace which can dock up to 85 vessels. The harbor has a depth of eleven feet in the channel with nine to fifteen feet in the basin. Small boats can operate year-round and even though the harbor may freeze over occasionally, the cove does not.

The cannery maintains a slipway for hauling out their boats and is available for emergency repairs of other vessels. This facility can haul vessels up to 100 feet. There are also machine shops and engine repair services available. At the small boat harbor, a 80,000 square foot marine service wharf was recently constructed.

The local population numbers about 800 and is completely dependant upon the seafood industry (University of Alaska, 1978b). Peter Pan Seafoods processes salmon, crab and bottomfish. This plant is heavily dependant on the local boats as well as a large number of transient vessels which sell their catch there.

Exhibit 6-8

King Cove, Alaska



King Cove obtains its water from a creek and maintains supply far above consumption (DCRA, 1981). Sewage is treated when facilities are operational but most sewage is deposited into septic tanks or is directly discharged. Power is generated by three diesel generators. The seafood processor is self-sufficient. Local fuel storage facilities hold about 30,000 gallons.

King Cove should continue to serve as an important port for the region and for transient vessels seeking a safe harbor. However, because of its location relative to the Bering Sea and lack of large vessel-accomodating infrastructure (limited fuel and supplies), it is not considered to be a major port for future BSAI fisheries or OCS development and may only be used as a port en route to the Bering Sea.

6.1.16 Cold Bay

Cold Bay is located on the Alaska Peninsula, 630 miles from Anchorage and 180 miles East of Dutch Harbor. The community of 226 (1980 population) developed around the airport which was a major stop off point during World War II and the Korean and Viet Nam Wars. Cold Bay has the third largest airstrip in Alaska: 10,400 feet with a cross runway of 5,200 feet.

The Bay itself is 25 miles long by eight miles wide and has a 60 foot deep entrance channel (DOWL Engineers, 1982). The harbor is used by floating processors and portions of the waterfront land have been purchased by fish processing interests. Cold Bay is served by tanker, freight barges, and the State Ferry two times a year. Fish is the primary outbound cargo and shipping is possible year-round. However, in winter shorefast ice is common and the Bay may be subject to ice packs and vessels may become ice bound.

The State operates a new commodity dock with a wharf area of 40 by 100 feet, a dock face of 400 feet and a depth alongside of 30 feet MLW. The dock is 1,824 feet long and 12 feet wide and used for general purpose loading and unloading.

In the settlement of Cold Bay, there are four diesel generators with a total capacity of 1,700 KW. Chevron operates fuel storage tanks in Cold Bay with the following capacities: 3.3 million gallons of jet fuel, 300 thousand gallons of aviation fuel, 75 thousand gallons of gasoline, and 475 thousand gallons of number two diesel heating fuel.

Local sewer and water systems are operating at capacity and present an impediment to future development (DOWL Engineers, 1982). There are five water wells and two storage tanks in the system and daily consumption is 20 to 30 thousand gallons. Sewage treatment consists of aerated sludge and chlorinated outfall with a capacity of 22 to 30 thousand gallons per day.

Cold Bay offers an excellent harbor for both the fishing and OCS industries. Use of the harbor and airport facilities are presently far under capacity and would serve as excellent areas for development should either industry decide to locate there. Infrastructure is presently limiting and would have to be developed to meet either industry's needs. Cold Bay could also develop as a major port en route to the Bering Sea.

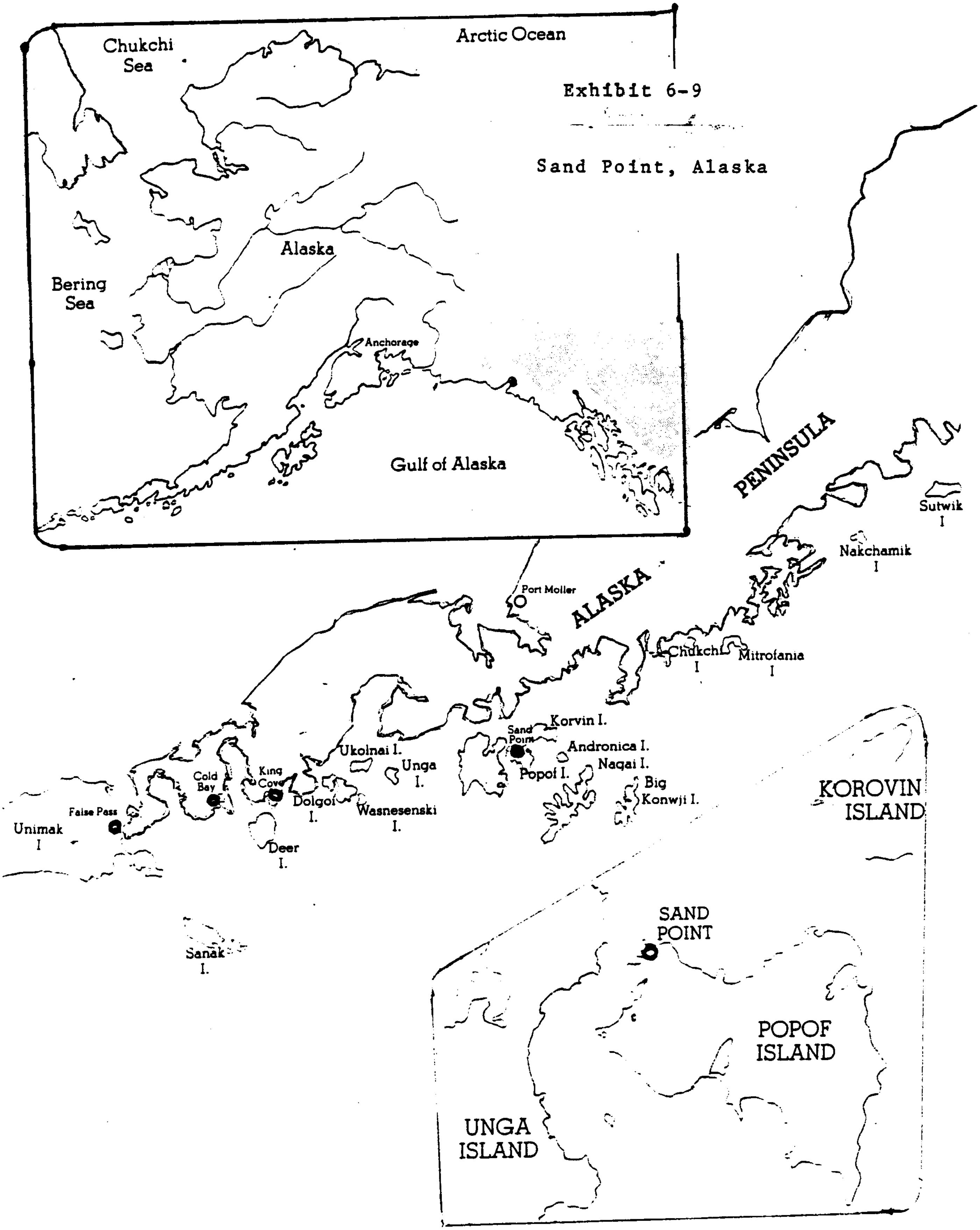
6.1.17 Sand Point

The village of Sand Point is located about 275 miles east of Cold Bay on a small island south of the Alaska Peninsula. A map of the area is shown in Exhibit 6-9. Sand Point is the major fishing port in the region. In 1978 a small boat harbor was constructed that accomodates up to 170 vessels. There is a city dock which is capable of docking a 300 foot vessel. All three of the local processors have docks. Also, there is a smaller 60 foot dock which is used to unload fuel tankers and refuel fishing vessels.

The three processors in town are Aleutian Cold Storage, Ocean Beauty and Peter Pan Seafood. The major processed products are crab, shrimp, salmon and bottomfish. While 80 percent of the boats in the harbor are

Exhibit 6-9

Sand Point, Alaska



considered local boats, the processing facilities are heavily dependant on transient vessels for their product (DCRA, 1981a). Of the vessels in port, the average vessel length is 150 feet with a 12 foot average draft. Sand Point also serves as a stopover point for vessels travelling between the Bering Sea and points south.

Sand Point has a 150 ton marine lift available and minor engine and repair and facilities. The port is served by the State Ferry twice a year and shipping companies and fuel tankers make regular calls at the port.

The Aleutian Cold Storage provides fuel and electricity to the community from its generating facilities. Both the other local canneries are self-sufficient. The Cold Storage plant operates eight diesel generating units with a combined generating capacity of 3,200 KW. Local fuel storage is about 220,000 gallons. Sewage is discharged by processors into receiving waters and community sewage is treated by aeration and sludge. The sewage plant is limited in its growth capacity. Water is obtained from a local creek and supply is several times larger than local consumption. Local canneries are self-sufficient (DCRA, 1981a). Sand Point Airport has a gravel surfaced 3,800 foot runway and receives regular flights between Anchorage and other Aleutian communities.

Because of its central location between Dutch Harbor and Kodiak, Sand Point should play a role in developing Bering Sea fisheries. It has a good harbor, fuel facilities and offers docking and some marine repair.

6.1.18 False Pass

The community of False Pass is located on the eastern side of Unimak Island next to the end of the Alaska Peninsula. False Pass is so named because Isanotski Strait offers passage to the Bering Sea from the south but not for large vessels. Peter Pan has established a cannery there. The major processed products are salmon and crab with some shrimp and groundfish.

There was a 1977 population of 55 persons. About 120 seasonal workers are housed by the cannery when it is working (University of Alaska, 1978a). There are only a few large boats in port year-round. Most of the vessels are used seasonally. Many of the local villagers operate smaller skiffs.

Freight barges come into port occasionally. Freight is sometimes brought by fuel barge or fishing boat and there is a small airstrip. Community infrastructure is relatively primative and homes have their own power generators as does the cannery. The cannery generates 710 KW of power with seven generators. Sewage is discharged into the Bay. Water is collected from a small stream.

Because there is no access to the Bering Sea from False Pass, support for future BSAI fisheries from False Pass should be limited.

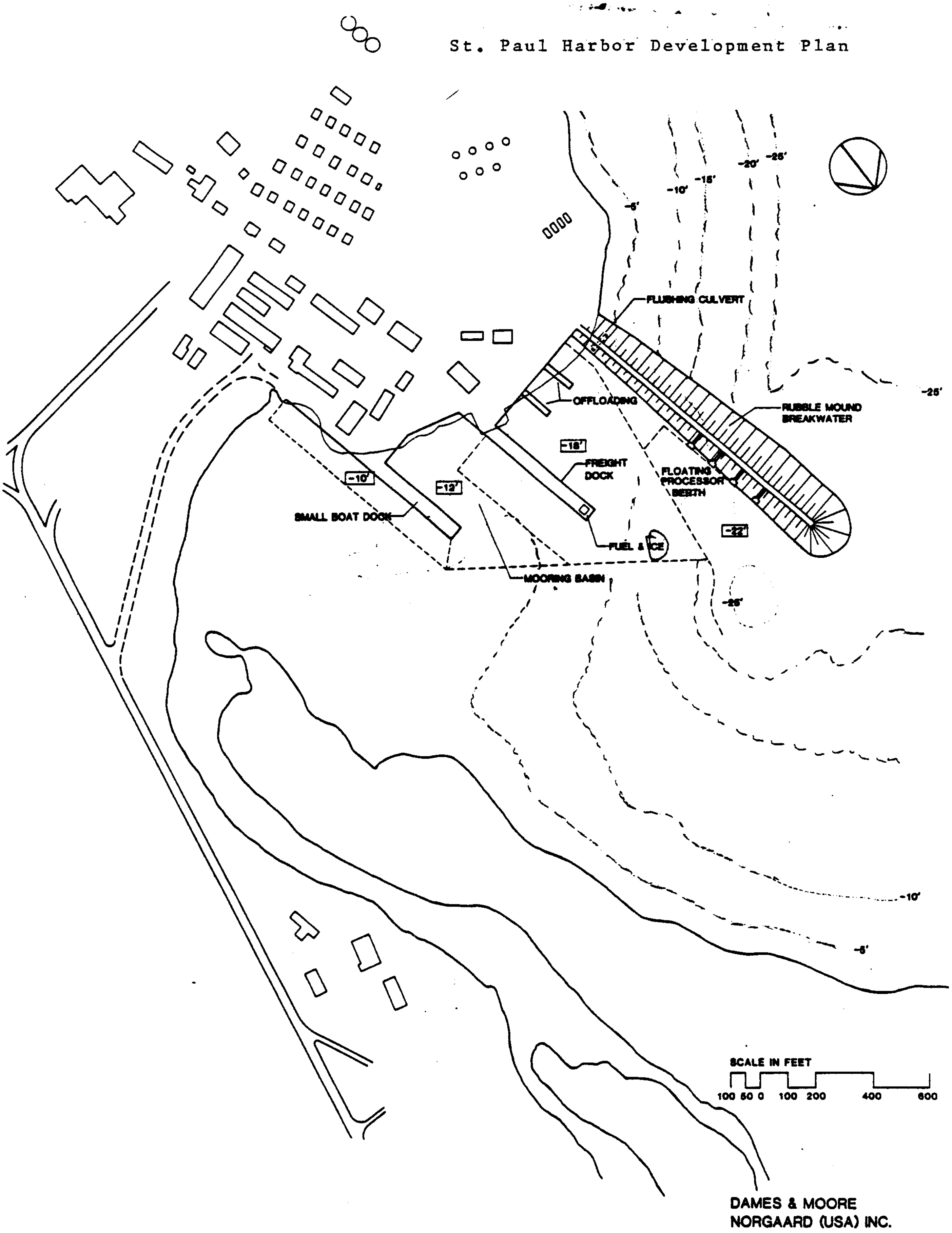
6.1.19 St. Paul

St. Paul is one of the Pribilof Islands about 200 miles northwest of Dutch Harbor/Unalaska. There is no port located in St. Paul and only minor docks and infrastructure are currently in place to support the village of St. Paul. A conceptual plan to develop a harbor for St. Paul Island has been completed (Dames & Moore, 1982) and is shown in Exhibit 6-10.

The St. Paul development plan calls for the construction of a 1,100 foot breakwater, one berth for two 200 foot floating processors, docking for 120 foot vessels for offloading seafood, a cargo dock for 200 foot barges and berthing totaling 500 to 750 linear feet. There is room to expand docking facilities in the area known as Village Cove. It was concluded in the development plan that any harbor facility built at St. Paul would be filled in a short time due to the immense fishery resource in the Bering Sea. The baseline harbor development would be geared towards the fishing industry and have dock space for 10 to 20 fishing vessels and one or two floating processors.

Exhibit 6-10

St. Paul Harbor Development Plan



There are areas on the island available for onshore storage but in the harbor plan, none are adjacent to the harbor. Therefore, it would be necessary for OCS representatives, the St. Paul community, and the State to plan together how much land should be made available for a support base and where such a base should be located. In the present plan, fuel and docking would probably be the best uses. However, water depth is somewhat shallow for the very large supply boats and the two most logical places for docking are the breakwater and freight dock. Use of these docks would directly interfere with their planned use for the fishing industry. There are no repair facilities planned for the harbor. Presently, fuel is the only service available at St. Paul and without harbor protection (i.e., a breakwater) moorage is often impossible due to adverse weather conditions.

If facilities were developed as described in the Dames and Moore report, all infrastructure would have to be installed. If more facilities were desired after the initial plan were constructed, this could be accomplished by extending the breakwater further. Onshore areas are somewhat limited due to steep terrain and portions of the hills would have to graded and removed for fill and to provide onshore harbor access.

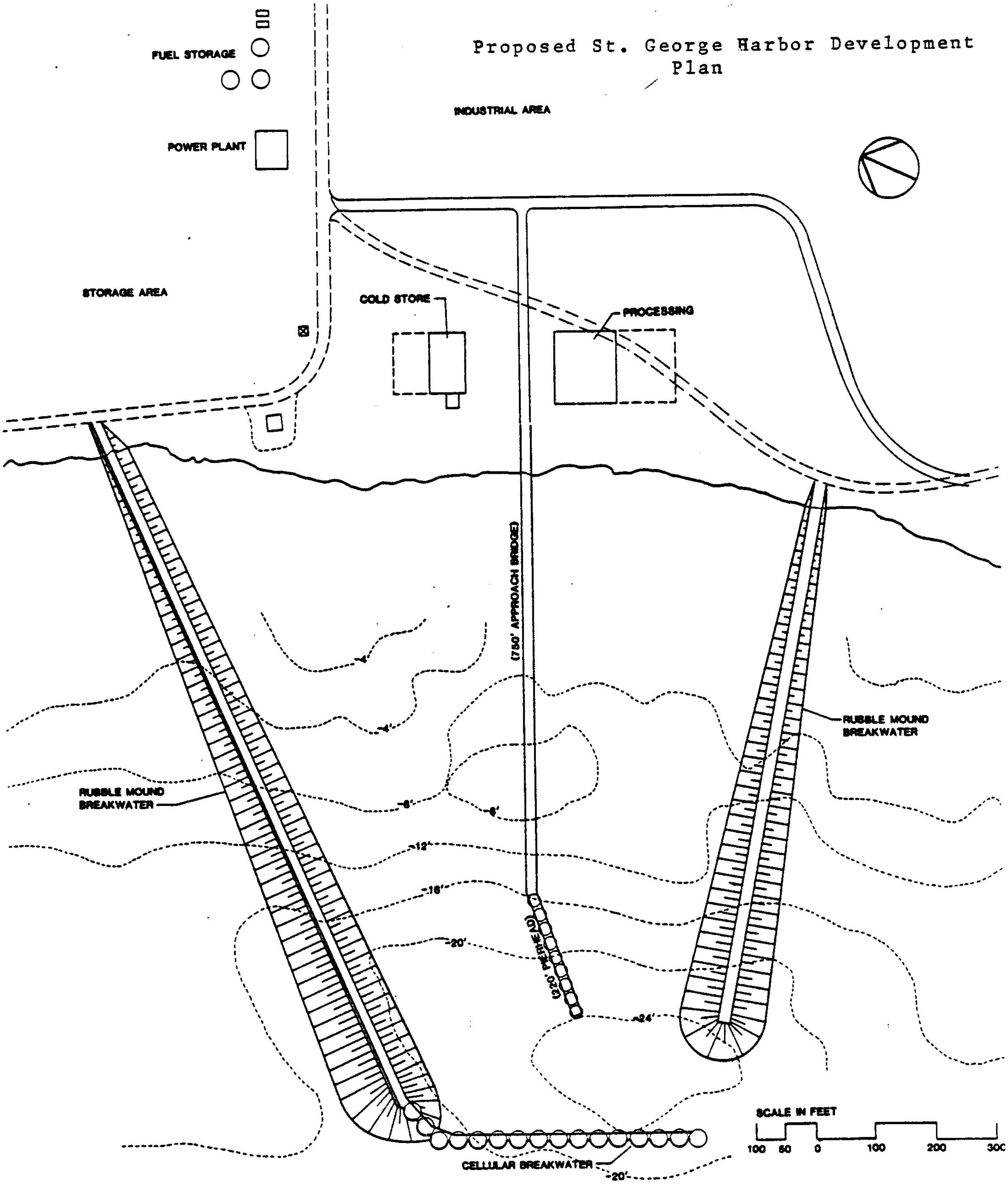
6.1.20 St. George

St. George Island, located to the south of St. Paul, also has a harbor plan which proposes future fishing industry activities. The development would accomodate two to four 120 foot fishing vessels and up to ten boats 24 to 50 feet long. There is no existing infrastructure at the St. George Zapadni Bay harbor site and new facilities would be required to supply water, power, and fuel. A harbor development plan is shown in Exhibit 6-11.

This harbor development is relatively small-scale because of the adverse physical conditions of St. George. The proposed harbor would consist of a 14 acre boat basin, a pier and two large breakwaters. All infra-

Exhibit 6-11

Proposed St. George Harbor Development Plan



DAMES & MOORE
NORGAARD (USA) INC.

structure would be constructed and dock facilities installed for ten to 15 boats and one processor.

6.1.21 Akutan

The village of Akutan is on Akutan Island, about 60 miles east of Dutch Harbor and 800 miles southwest of Anchorage. Akutan is accessible only by boat or amphibious aircraft. The village is on a large deep bay about four miles long and from one half to 1.8 miles wide. The harbor is well sheltered with deep anchorages and has a large area for many of the floating processors which seasonally work there.

Basically, the village has two distinct population groups: the local native population and transient fish processing workers. The 1982 village population was 89 with 100 personnel listed as working at a Sea West seafood processing vessel (DCRA, 1982a). Other processors operating temporarily in the harbor add about 800 to 1,000 persons to the area's seasonal population. These workers travel between Akutan and Dutch Harbor via floatplane. About 30 residents are employed on the processors. During the fall through spring shellfish seasons, the number of floating processors using Akutan ranges between 11 and 13.

Sea West and Trident, the two permanently moored processors, have docks along their facilities of 150 and 200 feet, respectively. Otherwise, Akutan has no docking or moorage facilities and no home fleet except for a few skiffs. A dock for about 15, 60 to 90 foot vessels has been proposed by the Corp of Engineers but this is not anticipated for several years. There are no local marine or electronic repairs available. Local village electricity is generated by a 36 inch Pelton wheel hydroelectric system. Fish processors generate their own power and obtain fresh water and discharge sewage into the Bay.

Akutan will continue to serve as a harbor for floating processors operating in the Bering Sea/Aleutian Island fisheries. Because of its close proximity to the fishery resource and Dutch Harbor, Akutan should continue to receive spill-over fishery activity from Dutch Harbor and play a major role in future fishery developments in the Bering Sea, Aleutian Island area.

6.1.22 Chernofski

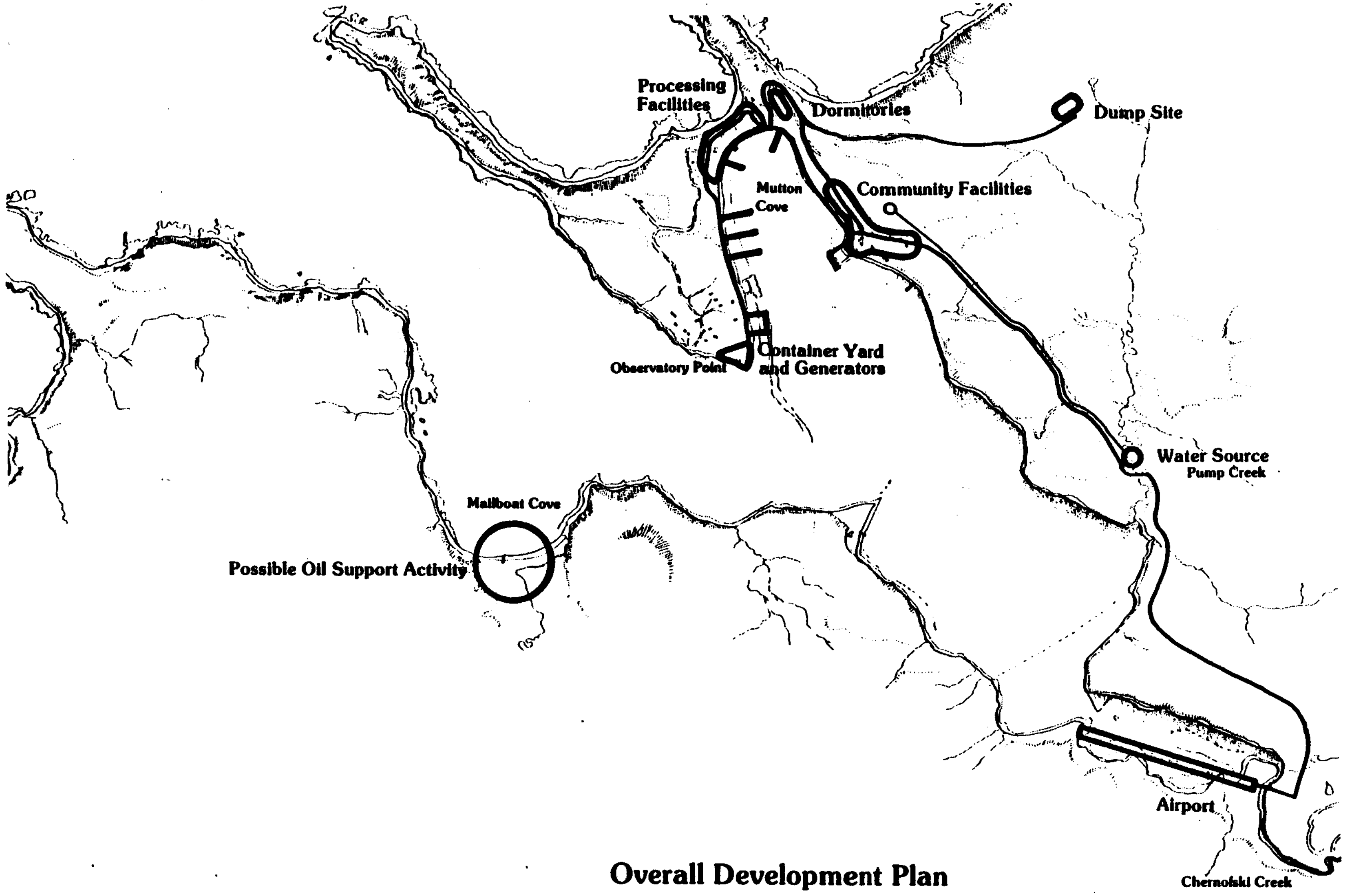
Chernofski is located about 70 miles southwest of Dutch Harbor. This is a small deepwater harbor that affords good protection with fairly good, deep anchorages. No community exists at Chernofski but land around the harbor has been conveyed to the St. Paul Native Corporation and development of a harbor and fishing village has been proposed. A possible future layout of the harbor is given in Exhibit 6-12. This plan includes areas for both fishing and OCS activities. If the harbor should develop, it would serve both the fishing and OCS industries because of its location relative to Bering Sea resources. This port could also be similar to Akutan in receiving spillover processing ships from Dutch Harbor.

6.1.23 Dutch Harbor/Unalaska

The port of Dutch Harbor/Unalaska is the major port in the Bering Sea/Aleutian Island area. It has all the aspects of becoming the premier port for both fishing industry activities and OCS onshore development. This is because of the following characteristics:

- Dutch Harbor is a large deepwater port.
- It is the major port on the Aleutian Chain and vessels on their way between the Gulf of Alaska and the Bering Sea pass by Dutch Harbor and often stop off there for supply transfer or rest before continuing on.
- It has large shore-based and permanently moored seafood processors.
- Dutch Harbor has boat harbors, docks, cargo handling equipment and deepwater.

Exhibit 6-12



Overall Development Plan

0 3000 feet

Dames & Moore
CCC+
ABKJ, Inc.
Norgaard (USA) Inc.

Chernofski Harbor Development Plan

Unalaska Island, Alaska

DOT/PF

- A large marine ways, a sizable fuel facility, and a number of local electronic and engine repair facilities are available.

- Processors provide their own electricity but have access to municipal water. The support infrastructure is already in place.

For these major reasons, Dutch Harbor is expected to attract the great majority of the future development associated with the fishing and OCS industries.

In terms of anticipated growth in the harvesting and processing sectors it is assumed that the majority of the future fisheries activity will use Dutch Harbor/Unalaska. The major uses there by these vessels would be to refuel, take on supplies, crew R and R, transfer of product, and minor vessel or engine maintenance.

The port of Dutch Harbor/Unalaska is strategically located such that any cargo vessel or fishing vessel traveling between the Bering Sea and points to the east or south will pass nearby and find it a convenient place to stop. Dutch Harbor is also an ideal port from the standpoint of vessel use because:

1) it is a deep water port, eliminating the need for a major dredging program;

2) the natural harbors are ice free year-round which is a major consideration for smaller fishing vessels; and

3) it is large enough to handle several port users and fairly well protected from violent storms such that weather-related damage to vessels is relatively minor.

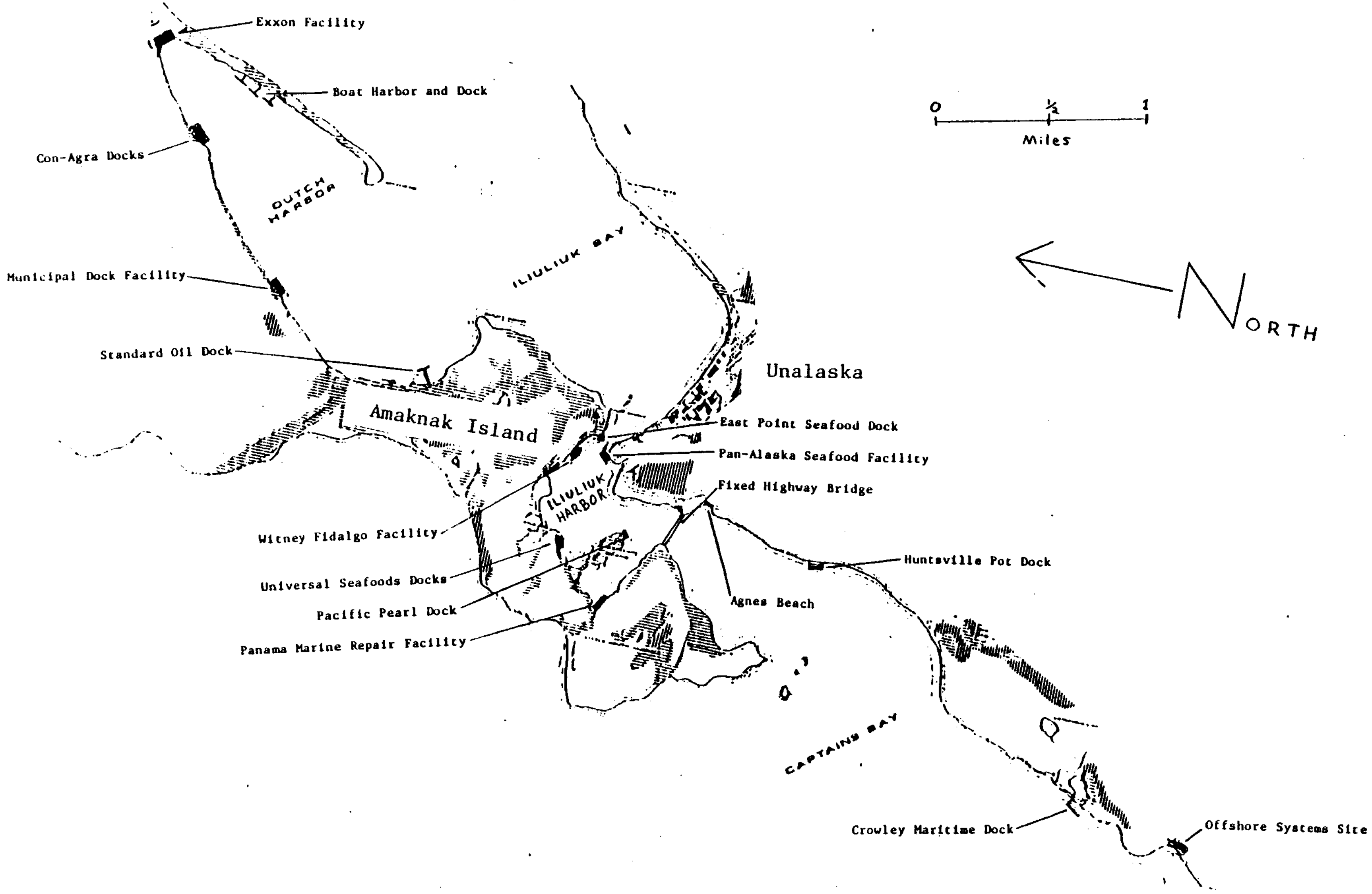
Dutch Harbor is subject to the violent storms which are frequent in the Bering Sea/Aleutian Island region. However, weather-related damage to vessels in the port because of these occasional storms has been characterized by the Dutch Harbor Harbormaster as "negligible" (Riordan, pers. com.). The Dutch Harbor Harbormaster reported that southwesterly winds have produced waves up to four feet in the harbor. This was verified by Coast Guard personnel in Kodiak, Alaska (Coast Guard Cutter Storis personnel, Kodiak, Alaska, pers. com.). Winds can reach 40 to 80 miles per hour and gust to 100 miles per hour.

The combination of winds and waves in Dutch Harbor can make vessel maneuvering difficult, particularly if a vessel is attempting to take on fuel at the fuel pier which is exposed to the southwest. In instances reported by the Coast Guard and Harbormaster, the Coast Guard Cutter Storis required tug assistance to get away from the fuel dock. In other instances, vessels have dragged anchor in Iliuliuk Harbor because of the soft bottom and strong winds. The port of Dutch Harbor maintains a tug on call to assist vessels having maneuvering problems because of the weather.

The Community of Unalaska is at the head of Unalaska Bay which consists of smaller bays separated by islands and fairly steep hills. The three major moorage areas in the port of Unalska/Dutch Harbor are Dutch Harbor, Iliuliuk Harbor, and Captains Bay (See Exhibit 6-13). These areas serve the petroleum industry, cargo industry and fishing industry. Unalaska is located on a portion of Unalska Island and includes all of Amaknak Island. A spit of land on northern Amaknak Island projects to the south separating a good anchorage known as Dutch Harbor from Iliuliuk Bay. Dutch Harbor contains most of the non-fishing industry facilities including the boat harbor, the Exxon dock, the municipal general cargo dock, the Con-Agra fish processing plant and docks, and the Standard Oil dock and tank farm.

Exhibit 6-13

Key Facilities in Dutch Harbor/Unalaska



The land bordering Iliuliuk Bay to the west is quite steep and has no uplands suitable for development. Also the waterfront is exposed to northerly storms which renders the area unsuitable for either dock construction or onshore developments. The only present activity there is for a city landfill site.

In Dutch Harbor, there are several areas which could be developed for OCS uses but which are not ideal due to limited upland areas and potential interactions with the fishing industry. An area adjacent to the public boat dock consists of about 2,400 feet of waterfront land on the spit, could be used to expand the dock facilities. The dock is currently used by permanent and transient fishing vessels. The uplands (land adjacent to the harbor) is limited and very narrow and is not suitable for OCS storage or development.

Also in Dutch Harbor is an area of waterfront land which is presently under lease to Exxon and is expected to be used for OCS support activities. This site consists of 4.5 acres of flat land with another four acres available if a small lake were filled in. Two small docks are on the water but dock space could conceivably be expanded to about 500 feet if these were replaced by a quay and backfill.

The Unalaska municipal dock facility on Dutch Harbor extends about 60 feet from shore and has a 250 foot face. This dock is used to load and unload general cargo and as part of the municipality's continuing dock facilities expansion, a 5,000 square foot transit storage shed and a 600 square foot cold storage locker for incoming grocery shipments are planned for consturction in 1983. Depth alongside the city dock averages 45 feet.

The Standard Oil dock extends 400 feet from shore and has a T-shaped face measuring about 330 by 50 feet. Depths alongside this dock average 35 feet. Standard operates this facility which serves as a major refueling base for the Aleutian - Pribilof region and all western and northwestern Alaskan coastal communities. Adjacent to this dock is a tank farm with a total storage capacity of about 13 million gallons.

On Iliuliuk Bay, the American President Line dock measures about 350 by 150 feet. This wharf dock is roughly a "U" shape with access at both ends. Depth alongside ranges from 35 to 45 feet. The dock is capable of handling ships up to 670 feet. Cargo handling equipment includes a gantry crane capable of moving 30 containers per hour, a smaller container crane, one 20 foot and one 30 foot spreader bar handler for bulk cargo, and smaller handling equipment. The Ounalkashka Corporation which owns the land and APL facility, also owns a fishing pier at the northwest end of the APL dock. Fishing vessels up to 200 feet may moor there. There are about four acres of onshore storage area next to the APL dock with two storage buildings measuring 60 to 200 feet and 40 by 200 feet with container storage capacity ranging from 300 to 400 containers.

Located in Iliuliuk Harbor are the majority of seafood processors. There are four onshore processors and 13 other processing vessels which are permanently moored in Dutch Harbor. Permanently moored means that they are anchored or moved in nearshore with landfill placed around the vessels so that they have become, in effect, onshore processing plants. These processors have their own power generating facilities, docks and unloading facilities and fishing vessels will tie up or raft alongside these processors while waiting for season opening, taking on supplies, or on a general layover. The tank farm operated by Standard Oil Company provides fuel to the Dutch Harbor/Unalaska seafood processors which operate their own power generating facilities. Processing vessels take on fuel at the Standard dock. Underground fuel lines connect the storage tanks with Pan Alaska, Pacific Pearl, Universal Seafoods, Whitney-Fidalgo and East Point Seafood Processors.

South from Iliuliuk Harbor via South Channel is Captains Bay which is the site of private fish docks at Agnes Beach (in South Channel at the north end of Captains Bay), Crowley Maritime dock and tank farm, a pot dock owned by Pan Alaska used for crab pots, and the site of the Offshore Systems dock.

A fixed highway bridge with a vertical clearance of 20 feet (U.S. Department of Commerce, 1981: U.S. Coast Pilot) which connects Amaknak Island (Iliuliuk and Dutch Harbors) and the community of Unalaska and the bridge presents a barrier to any OCS vessel or large fishing vessel passing between Iliuliuk Harbor and Captains Bay.

The Agnes Beach docks accommodate floating processors and mid-size crab boats. This privately owned facility is dedicated to fisheries activities.

The Huntsville pot dock is operated by Pan-Alaska and used to offload and store crab pots. Onshore land available for pot storage is about 15 to 20 acres. This area is dedicated for fishery use and any OCS activity here would probably be limited.

Southwest of the Huntsville dock is the Crowley Maritime dock which is owned and operated by Crowley. The dock is about two miles from Unalaska and is used primarily for cargo shipments in and out of Unalaska. The pier extends 500 feet offshore and has a "T"-shaped face measuring 350 feet. There are three large sheds onshore with two storage bays in each shed measuring 60 by 30 feet (totaling about 10,800 square feet of storage area). Storage space can be leased to companies on an individual basis. The Crowley dock and the American Presidents Line (APL) dock exhibit the best potentials for offloading and marshalling OCS materials and supplies. This is because: 1) the docks are large and heavy, suitable for moving heavy OCS pipe and equipment over them, 2) there is onshore storage space for materials in transit, 3) there is adequate for deep draft vessels. Of these two docks the best dock in terms of OCS use in the Crowley dock because it is further enhanced by being located away from the majority of the fishing industry congestion and because it is located closest to the site under development by Offshore Systems.

The Offshore Systems site will eventually have a 400 foot dock and an onshore storage area of about 40 acres. Because the uplands are rugged, it will be necessary to quarry and grade areas to obtain fill for the docking facility. This project is to be phased in over time and both the dock and uplands area will be dedicated for OCS development as a support base.

Marine repair facilities (Panama Marine) have been constructed at an old naval submarine station. The ways is capable of handling vessels up to 150 feet and 300 tons. Onshore there is space for only one vessel at a time due to a lack of sidings off the marine railway. The repair facilities offered by Panama Marine include a complete machine shop and welding. Diesel repair is offered by two to six free-lance diesel technicians in town or by contracting with firms in Anchorage. It is quite common to have both parts and labor flown to Unalaska from Anchorage or even Seattle when vessels are broken down. At least four firms offer the sale and service of electronic equipment. And, once again, electronic needs may be met by using parts and labor flown in from Anchorage or Seattle via Anchorage. If a vessel does need major repairs or maintenance, this is usually done at well-equipped shipyards in Seward, Anchorage, Kodiak or Seattle.

Presently, all processors generate their own electricity individually, on-site. Fuel for generation is obtained by each processor from Standard Oil. The City of Unalaska generates its own municipal power. The City of Unalaska is preparing construction documents for the installation of a 35 KV distribution system on Unalaska Island via City Dock, Unalaska Airport, the APL Dock, and US 310 Bridge. This will be energized by a generation capacity of 1500 KW. It appears that this system can be in operation by the end of 1983. The utility plans to displace most private generation by residential and small commercial users and to offer seasonal power and/or peak power to industrial users who will continue to be self-supplied. Following a period of initial operation under this scheme, the city will consider adding capacity in approximately 2500 KW increments as industrial demand warrants. By 1990 it is expected that prime power will probably be provided by either a geothermal plant at the Makushin Field or a heavy fuel low-speed diesel plant in Unalaska.

Waste water treatment in the area is handled either by septic systems for small waste dischargers, or by ocean outfall in the case of seafood processors. Waste treatment consists of diluting wastes with water and grinding particulates to a size specified by the Alaska Department of Environmental Conservation and the U.S. Environmental Protection Agency. Each processor is responsible for their own waste discharge facilities.

The major municipal service used by all industries in the Dutch Harbor/Unalaska area is water. Water distribution lines are in need of major repairs and continual maintenance. Unalaska's water utility has recently replaced more than 1,000 feet of 16 inch wood stave water transmission pipe with 24 inch ductile iron pipe. The wood pipe system is deteriorating as it was originally installed in the early 1940's. There are approximately another 40,000 linear feet of wood stave line to be replaced, together with improved treatment, intake modifications, elevated storage and other work which represents a required investment of approximately $30 million over the next three to five years. Due to the rapidly deteriorating condition of the existing system and the decline in industrial water consumption with depressed shellfish catches, the water utility is operating at an annual deficit estimated at $200,000. The physical and financial conditions of the utility make it doubtful that it will be possible to undertake the needed improvements, even with restoration of the Alaska Department of Environmental Conservation's 50 percent grant program. Other major problems with the water system are leakage through the pipe, inadequate treatment facilities, and the possibility that extended periods of freezing weather could lower supply. Presently, processors use both municipal and surface (salt) water for processing. Many have storage tanks for emergency situations. They also use potable water to replenish fishing vessels and to make ice.

6.2 SUMMARY OF PORT FACILITIES

The Corp of Engineers collects data on six other ports in the study area in terms of inbound and outbound vessel activity. Data for these selected ports is given in Exhibit 6-14. Dutch Harbor is the busiest port in terms of vessel activity followed by Kodiak and Bethel.

Port facilities for all ports discussed in Section 6.1 are summarized in Exhibit 6-15. Besides noting port infrastructure, port use, and municipal infrastructure associated with the port, two other factors are noted. These two factors are: 1) Aspects for Port Growth, and 2) Major Port Constraints. These are the major positive and negative attributes the port has for port growth and development. They are an intrepretation of the port's physical setting (such as water depth, harbor access, how subject the port is to ice, onshore site suitabilities, tidal fluctuation and range, etc.) and infrastructure (docks, water supply, availability and source of power and fuel, onshore storage space, etc.), with an eye towards future development. In other words, given a port's physical setting and infrastructure what are the major aspects the port has for growth and what are the major port constraints for growth. This summarizes the possible future use of the port by the fishing industry which is expected to develop the Bering Sea/Aleutian Island fisheries. The Port Growth and Port Constraint summary can also be considered as an indication of whether or not future port development can be expected, the expense of development, and what the best use of the port is. It also gives an idea of how to allocate future use of the port to the fishing industry, and later to the OCS industry.

6.3 RELATIONSHIP BETWEEN INFRASTRUCTURE AND FISHING VESSEL OPERATIONS

Based on the previous two subsections, various relationships between a port's infrastructure and fishing vessels which are expected to take

Exhibit 6-14

Annual Commercial Vessel Activity For Selected Ports on the Bering Sea, 1978 (Excludes Domestic Fishing Craft)

Port	Inbound			Outbound		
	Dry Cargo[1]	Tanker[2]	Tow or Tug[3]	Dry Cargo[1]	Tanker[2]	Tow or Tug[3]
Bethel	67	113	99	69	94	99
Dillingham	26	4	36	29	4	37
King Cove	88	12	19	97	12	19
Naknek River	47	17	44	50	11	47
Dutch Harbor/ Unalaska	249	61	100	332	98	96
Kodiak	261	40	75	222	37	74

---

[1] Includes Passenger Vessels. Both self-propelled and non-self propelled vessels included.

[2] Both self propelled and non-self propelled vessels included.

[3] Self propelled vessels only.

[4] Given as Iliuliuk Harbor in the data.

Source: Corp of Engineers, Waterborne Commerce of the U.S. Part 4.

Exhibit 6-15

Bering Sea Port's Infrastructure Summary

Port	Harbor Description	Dock Facilities	Major Port Users	Warehouse Storage
Nome	Located at mouth of Snake River. 75 foot wide entrance channel between two jetties. 250 by 600 foot turning basin. Channel and basin five to eight feet deep; both subject to littoral drifting. Ice conditions in Norton Sound at Nome occur from November through May.	North revetment of turning basin functions as only dock. 600 feet of space used primarily to unload lighterage vessels. 3 dry cargo berth spaces available and one petroleum/dry cargo berth. No small boat harbor is in Nome. Boats are beached when not in use.	Commercial lightering activities associated with the movement of dry cargo and bulk petroleum into Nome and other coastal communities. All cargo must be lightered.	Freight terminal adjacent to dock and owned by Arctic Lighterage Co. Both palletized and sea van cargo handled. Two large warehouses measuring 22,000 square feet. Some limited open storage available adjacent to the terminal. Open storage also available within 3 miles of the terminal but no security.
Golovin	Golovin Bay is a large deep Bay with protected anchorages. Water adjacent to village is shallow, from 5 to 10 feet. Bay not well protected from southerly storms.	None.	The Bay is used by vessels for shelter. OCS seismic boats have used in the past; freight barges brought in. Small fishing boats in Bay during summer.	None.
Unalakleet	Very shallow water. Dock facility for unloading barges along slough water depths less than one fathom.	One lightering dock area.	Local villagers and barge lightering companies.	minor storage for goods brought in on barges.
Naknek	Port lies along Naknek River which has a tide range of 25 feet at the mouth. Port iced over in the winter.	Each fish processor has their own dock. One municipal dock which is used by cargo barges and fishermen.	By far the commercial salmon industry followed by support services for this industry: barge and fuel companies.	Space for general cargo on city dock. Each processor has separate storage space.
King Salmon	Located along Naknek River upriver from Naknek: no harbor.	Many small sport skiff docks and floatplane docks.	Sport fishermen and float planes.	Warehouse space available near airport for flying salmon out.
Port Heiden	About 9 miles in width and length. Shallow at low tide and usually restricted to smaller boats.	Local cannery has a dock.	Commercial salmon fishing boats.	Minor storage at cannery.
Port Moller	Protected bay about 4 by 8 miles in size with shallow water and changing shoals.	Cannery pier 350 feet long with depth alongside of 6 feet.	Salmon cannery, small boats and and support barges.	Minor amount.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Harbor Description	Dock Facilities	Major Port Users	Warehouse Storage
St. Michael	Fairly deep, natural harbor used as a terminus for ocean vessels which transfer cargo to river vessels.	Shipyard and barge company has one dock: oil barge lightering dock.	Local villagers, Chevron oil company, barge companies from Dutch Harbor and Seattle.	Very minor amount.
Goodnews Bay	Primarily a shoal except for 1 to 12 Fathom channel.	Minor.	Local fishing boats and smaller freight and supply boats.	None for expansion.
Bethel	Located on Kushkokwim River 65 miles from Ocean Bay. Major transshipment point for river traffic.	Cargo docks and small boat docks.	Cargo and fuel barges. Small river fishing boats.	Space available for dry storage.
Togiak	Beachfront adjacent to large shallow bay.	Very minor docks at fish processor.	Cargo lightered onto beach. Local subsistence boats and small commercial boats.	Fish-related warehouses and storage areas.
Dillingham	Located on wide protected bay which is very shallow at low tide. Harbor is unusuable for all but the smallest boats at low tide.	Public small boat harbor with 950 feet of float space. Many fish buyers and fish processing docks. One municipal dock for cargo unloading.	The salmon commercial fishing industry. Freight and Fuel companies also use during the summer.	Available at fish processing plants and some available for cargo on a short term basis.
Cold Bay	8 miles wide, 25 miles long. 60 foot entrance channel. Heavy ice in winter. Strong winds and fog are usual.	Fuel pier, 1,800 feet long with T-Face of 40 by 100 feet.	Aviation industry, floating processors and tankers and barges.	Minor space available.
False Pass	Long, narrow, fairly deep water: located on Isanotski Strait.	Cannery docks and fuel barge dock.	Peter Pan salmon cannery.	Limited to seafood processors use.
Sand Point	Good anchorage water depths 18 to 30 feet; protected from weather.	Small boat harbor for about 200 boats. 60 foot oil dock and 300 foot cannery dock.	Seafood processors and fishing boats.	Processors have storage space.
Nelson Lagoon	Very shallow water near village. Harbor protected from Bering Sea by spit of land.	None-all boats are beached.	Small fishing boats.	None.
Emmonak	Mouth of the Yukon River. Ice free during summer. Deep water.	Fuel dock, cannery dock and fish processor dock.	Floating cannery barges, small fishing boats, river traffic.	Limited to existing canneries and stores.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Harbor Description	Dock Facilities	Major Port Users	Warehouse Storage
King Cove	Boat basin is about 20 feet deep. Outer bay about 60 feet deep with good anchorage.	300 foot Peter Pan Cannery dock, dry dock, and 60 foot fuel dock. Small boat harbor for about 140 boats.	Medium sized salmon boats. Crab and bottomfish boats.	Cannery has some space.
Chernofski	Natural harbor, deep water (30 feet) close to shore. Level land.	None. Abandoned docks exist.	None at present.	None.
Akutan	Large, deep, protected harbor with year round boating possible.	3 small private docks the largest (300 feet) owned by Sea West processors.	Floating processors and other fishing vessels.	Canneries have space.
St. Paul	Shallow, unprotected harbor.	2 docks -- one 100 feet long for freight unloading another dock on north side of island used during southerly storms.	Federal Government, Freight barges and fuel barge.	Space at seal skin plant.
St. George	No harbors but several anchorages.	None.	Local villagers.	None.
Dutch Harbor	Large, deep harbor; sheltered with good anchorages and docks.	Freight docks, fuel docks processor docks, boat harbor, municipal dock.	Fishing industry, freight companies oil company, tugs and barges.	Freight companies, Chevron and processors have space.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Fishing Vessel Use	Fish Processing Facilities	Marine Repair Services	Airport Facilities
Nome	Smaller fishing vessels use Nome in the summer to sell salmon and herring to fish buyers and floating processors. From 200 to 300 boats are in the area but only about 10 to 20 percent use as home port.	Some local fish buyers, one minor herring roe processor located onshore. All other processing is done offshore on processing ships. Some salmon are frozen in the round and air-freighted out of Nome.	Gas and diesel engine repair services available. Marine engine dealer, electronic dealer and repairmen also available. No extensive vessel haul-out or service center available.	Nome field has two paved runways, 6,000 by 150 feet and 5,570 by 150 feet. Instrument landing system. National Weather Service and FAA operate at airport. Facilities include 5 hangers, 2 terminals and aircraft engine and and frame repair. Wien and Alaska Airlines operate non-stop jet service to Anchorage and Kotzebue. Major aviation hub in the area. Charter services also available. A smaller Nome City Airport with gravel runways is located one mile north of the city.
Golovin	Small inshore herring and salmon boats which double as personal use boats. More boats in area during the summer from other villages.	Floating processors use the bay in the summer. One small salmon processing coop.	None.	One 2,400 foot gravel airstrip.
Unalakleet	15 to 25 local fishing boats used for herring and salmon commercial fishing and personnal subsistence use.	Several fishbuyers in the area durin the summer and one small herring processor.	None.	Two gravel runways with jet and charter flights available.
Naknek	Up to 400 salmon boats about 30 feet long use during the salmon season using gillnets.	12 onshore processors which process primarily salmon. Up to 30 floating processors and buyers during salmon season.	Haulouts available at canneries for smaller boats. Some machine shop facilities and minor engine repair available.	Two 2,000 foot runways.
King Salmon	Very minor. Some storage during the winter.	None. fish brought to King Salmon are usually flown out.	Very Minor.	8,500 foot paqed runway. Daily jet service and a large air force facility.
Port Heiden	During the summer, small, 32 foot salmon gillnetters.	One cannery. some floating processors may operate here occasionally.	None.	One small airstrip.
Port Moller	Less than 100 small fishing boats use during the summer.	One cannery.	Marine railway for small boats.	Charter float plane service available and small airstrip.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Fishing Vessel Use	Fish Processing Facilities	Marine Repair Services	Airport Facilities
St. Michael	Small skiffs only which are beached when not in use.	None.	Minor machine ship and one, 100 ton marine ways.	2,000 foot dirt runway.
Goodnews Bay	Small skiffs used for inshore salmon and subsistence fishing.	None.	None.	Airplane landing strip.
Bethel	150 to 160 river boats fishing for salmon and subsistence.	2 onshore, one floating processor which all process salmon several other buyers.	Engine and boat sales and service some machine shop facilities also available.	Large airport with paved.
Togiak	100 - 125 small local boats using gillnets non-local boats fish in the area.	Seasonally there are 3 onshore processors of herring and salmon and 5 floating processors and up to 27 buyers.	None.	Gravel, 2,600 foot with cross-strip and regular air service.
Dillingham	About 300 local boats less than 32 feet. As many as 400 may be in port during the summer. Major gear: gillnet.	5 onshore processors. Up to 20 offshore processors and buyers. Canning, freezing and fresh fish are all products of the processors.	Marine railway at cannery can haul vessels up to 100 tons at high tide. Minor engine repair.	6,400 gravel airstrip used heavily to fly out salmon in the summer.
Cold Bay	Large fishing vessels use on a transient basis when floating processors are in port.	Floating Processors currently use to process shellfish Movement onshore may occur over time.	None.	Large airport facility with 10,400 foot paved runway.
False Pass	Small skiffs owned by villagers. Transient crab and salmon boats.	One large canner/processor primarily salmon but also halibut, crab and bottomfish.	Minor repairs and boat haul out available at cannery.	Small gravel airstrip.
Sand Point	Vessels up to 300 feet can dock in harbor with drafts 12 to 20 feet.	One onshore facility (Alutian Cold Storage) and 2 Floating processors: Processing crab, shrimp, salmon, bottomfish.	150 ton marine travel lift with other minor engine repair facilities at the cannery.	Municipal airport terminal and 3,800 foot gravel strip.
Nelson Lagoon	Local salmon gillnet boats: about 6 to 12.	Floating processors may anchor near the Lagoon during the summer.	None.	Small airstrip and float planes.
Emmonak	50 to 100 small fishing skiffs.	One fish cleaning plant and one cannery barge.	Minor engine repair.	2,200 foot gravel airstrip for small aircraft.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Fishing Vessel Use	Fish Processing Facilities	Marine Repair Services	Airport Facilities
King Cove	Local fleet of abut 80 vessels. Transient vessels number 30 - 50 yearly.	Peter Pan onshore processing plant for crab, shrimp, salmon and bottom fish.	80,000 square foot marine service wharf; 150 ton marine lift; engine and electronic service available.	3,800 foot gravel runway.
Chernofski	Occasional use as shelter.	Seasonal use by processors.	None.	None.
Akutan	Many crab vessels use during season only small skiffs are in port year-round.	2 permanently based floating processors. 13 other transient processors during crab season.	None.	None. Floatplanes only.
St. Paul	Local skiffs only.	None.	None.	One mile gravel airstrip.
St. George	Local skiffs.	None.	None.	3,000 foot gravel airstrip.
Dutch Harbor	Both large transient and local boats from 30 to 150 boats depending on the season.	4 onshore processors and 13 other floating processors.	Diesel, electronic and hull repair available marine ways for vessels up to 300 tons.	4,000 foot gravel runway concrete apron and several buildings.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Municipal Water	Electricity	Sewage	Petroleum Storage
Nome	Piped and trucked water delivery comprise Nome's water system. Ground water sources provide 300 to 380 GPM. Adequate storage capacity for normal use but some hinderances for firefighting.	Eight diesel generators are city owned that generate a total of 7,150 KW. A major gold company operates its own facilities but otherwise the city services all electrical users.	Nome's sewage is disposed of using a combination of honey buckets, septic tanks, and sewage treatment facilities. Waterfront industries use collection system. The city's waste treatment facility is presently overloaded.	Petroleum terminal owned by Chevron with storage capacity of 6.5 million gallons.
Golovin	Obtained from 300,000 gallon storage tank.	Diesel generators privately owned.	No treatment; direct discharge.	8,000 gallons; brought in on barge.
Unalakleet	One million gallon storage tank with filtration system.	Diesel generators with 1,300 KW available to the villagers.	Treated in a 2 acre lagoon and ocean discharged.	250,000 gallons; brought in on barge.
Naknek	Waterwells for residents, canneries obtain their own water supply.	10 diesel generators with 6,170 KW. Canneries operate their own generators.	Some septic tanks but most wastes are discharged into river.	About 1 million gallons of gas and diesel storage.
King Salmon	Individual and community water wells.	10 diesel generators with 4,890 KW. Some windmill generators in area.	Individual homes and facilities operate septic tanks.	Large fuel storage facility for aviation fuel.
Port Heiden	Individual wells.	Diesel generated at cannery.	Direct discharge into bay.	Minor amounts.
Port Moller	Surface and well water.	Diesel generated at cannery.	Direct discharge into bay.	Minor.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Municipal Water	Electricity	Sewage	Petroleum Storage
St. Michael	Collected in a wooden storage tank. Hauled by individuals.	475 KW of power generated by diesel generators.	Ad hoc disposal by honey bucket.	1.47 million gallons of storage: Chevron Barges deliver.
Goodnews Bay	Fresh water wells.	Diesel generated.	Ocean discharge.	Several tanks.
Bethel	Water wells and taken from the river.	Diesel generated.	Septic systems and direct river.	Many storage tanks.
Togiak	Well water with 60,000 gallons of storage. Shortages of water when processing fish.	460 KW of diesel generation.	Bay discharge, septic systems, and treatment lagoon.	114,000 gallons of fuel storage lightered from fuel barges.
Dillingham	Private wells and city-supplied water. Processors obtain their own water supply.	5 diesel generators totaling 3,850 KW.	A few septic tanks and direct discharge into river and bay.	11 tanks storing 2.5 million gallons.
Cold Bay	Water wells with system operating at capacity.	Diesel generators with 1,700 KW capacity.	Collection, sludge and clorination treatment.	4.15 million gallons of storage: primarily jet fuel.
False Pass	Local surface water and wells.	Diesel generated by individual users.	direct discharge.	Chevron operates storage tanks.
Sand Point	Water piped from creek and distributed by cannery.	8 diesel generators with 3,200 KW operated by processor and village.	Central collection and direct ocean discharge.	220,000 gallons.
Nelson Lagoon	None: water obtained from lakes and rain.	2 60 kw diesel generators.	No treatment: direct discharge.	8 small tanks.
Emmonak	Central watering point -- individually obtained with buckets.	4 diesel generators totaling 95 KW. Other standby generators.	Direct discharge on land or water.	About 650,000 gallons.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Municipal Water	Electricity	Sewage	Petroleum Storage
King Cove	Distributed to users by city; good condition but limited supply.	3,200 KW diesel generators Seafood processor self sufficient.	Cannery has direct discharge. Others have septic tanks.	30,000 gallons of fuels storage.
Chernofski	None - but developable in good supply.	None.	None.	None.
Akutan	Obtained from small creek, large local supply.	Hydroelectric for residential diesel generated for processors.	Direct discharge into ocean.	Very minor.
St. Paul	Well water pumped to storage.	750 KW -- diesel generated.	Septic tanks and ocean dumping.	900,000 gallons of fuel storage.
St. George	Well water which is very salty.	Four diesel generators with 750 KW of capacity.	Direct discharge of wastes. Some septic tanks.	Very minor.
Dutch Harbor	Supplied by city; distribution system in need of repair.	Diesel generators -- 1000 KW. Processors operate separate generators.	Direct discharge and septic tanks.	Major fuel facility, about 13 million gallons of storage.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Aspects for Port Growth	Major Port Constraints
Nome	Harbor development plans completed. Construction of a 3,600 foot causeway with storage and docking space 25 to 30 feet alongside. Major users expected to be OCS and freight companies.	Ocean ice in the winter. Shallowness of water constrains size of vessels using Nome. Port subject to violent weather. High cost of any construction project limits size.
Golovin	Land available on large deep bay so that expansion capacity appears good. However, area around village not suitable due to shallow water.	Need breakwater for vessels; cost would be high. Lack of any infrastructure. Ocean ice shortens season available for boating.
Unalakleet	Good along river and slough. Flat areas. Major airport facility may attact development.	Shallow water. Lack of developed shoreside infrastructure. Winter ocean ice limits vessel movement from fall to spring.
Naknek	The harbor is well protected and has excellent access to salmon resources.	Wide tide fluctuations and limited dock space along deep water limits growth. Activity concentrated in in summer due to sea ice and fishing season.
King Salmon	Major use will be as an important airport facility not as a port.	Located on a river. Unnavigable at low tide, frozen in the winter.
Port Heiden	Good harbor for smaller boats.	Shallow water, limited infrastructure and services.
Port Moller	Safe refuge harbor and good access to Southern Bristol Bay.	Shallow water, very limited insfrastructure and few services available.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Aspects for Port Growth	Major Port Constraints
St. Michael	Natural deepwater harbor for the Norton Sound area.	Very limited infrastructure and dock facilities. Ice free only from June to November.
Goodnews Bay	Harbor has good anchorage.	Wide tidal fluctuations; sea ice; limited infrastructure.
Bethel	Major inland port between ocean and inland villages.	Located far upriver. River ice from November through May.
Togiak	Large flat areas along beach which could be developed. Major herring and salmon fishing area.	Shore ice, shallow area along beach, no developed docks or infrastructure.
Dillingham	Tremendous fishing activity in the summer; offshore processing and many boats dictate need for improved docking facilities.	Wide tidal fluctuations cause boats to dry up. Difficulty building long piers to compensate. Winter sea ice. Silting in of harbor requires annual dredging.
Cold Bay	Excellent harbor -- well protected and deep. Good access to developing fisheries. Major air field.	Limited infrastructure and dock facilities, poor weather and navigation characteristics.
False Pass	Alternative pass to Bering Sea if channel dredged and maintained. Presently restricted to vessels with draft less than 14 feet.	Cost of maintenance dredging; navigational problems including shallow water, ice, strong tides. Limited docks and infrastructure.
Sand Point	Good location for stopovers between Kodiak and Dutch Harbor. Fairly well developed docks and port infrastructure; deep harbor.	Lack of shoreside infrastructure.
Nelson Lagoon	Protected Bay in summer offers fairly deep water for floating processors.	No local infrastructure. Poor winter weathr conditions. Lack of developable land.
Emmonak	Good location for harvesting salmon on lower Yukon, and for floating processors.	Limited infrastructure, poor winter navigation conditions. Poor access to bottomfish resource.

Exhibit 6-15 (Cont.)

Bering Sea Port's Infrastructure Summary

Port	Aspects for Port Growth	Major Port Constraints
King Cove	Good port for transient vessels between Kodiak and Dutch Harbor. Good shelter, deep water, boat harbor, and dock for transient boats.	Limited water, sewage and fuel infrastructure.
Chernofski	Sheltered natural deep water harbor with excellent development potential for industry use.	No settlement or infrastructure. High cost to develop.
Akutan	Large deep, harbor; heavy use by floating processors. Excellent access to fishery resources.	High cost to develop. Very limited infrastructure.
St. Paul	Good access to fishery and OCS resources. Port development plans complete.	High cost of development limited infrastructure poor harbor environment.
St. George	Access to fish and OCS resources. Port development plan complete.	High cost, no harbor, no infrastructure, poor navigation.
Dutch Harbor	Excellent harbor, historic use patterns, developed infrastructure. Large fuel facility.	Lack of developable waterfront land and dock space.

Source: Infrastructure summary based on port descriptions in text.

part in the BS/AI fisheries can be determined. Part of the decision to use a port as a base of operations for BS/AI fisheries is future construction projects which may be implemented. Even though the port might be presently limited as a harbor site, future development could render the port a probable site for fishing vessel use.

An example of this is Chernofski which has no port at all and which is presently a harbor of refuge for vessels. However, major port planning documents have been completed. Therefore, one could expect Chernofski to support BS/AI fisheries. Dutch Harbor and Akutan are expected to play major roles in future Bering Sea fisheries development. Kodiak, Sand Point, and Cold Bay, are expected to play major roles as ports en route between Seattle and the fishery resource. St. Paul and St. George both have harbor development plans and could play minor roles in future fisheries development. Nome is expected to develop a port facility and would play a role in developing fisheries within the Norton Basin. Relationships between ports in the study area and vessels expected to operate in future BS/AI fisheries are given in Exhibit 6-16.

6.4 PRESENT AND PROJECTED SEASONAL FISHING DEMAND BY PORT

Given that nine ports are expected to play a role in developing BS/AI fisheries, future vessel activity must then be allocated to these ports. Anticipated future demand for port facilities by fishing vessel is given in Exhibit 6-17.

These future demand figures are based on the future level of catcher and processing vessels expected to operate in the Bering Sea that were given in Chapter 3.

The number of vessels given in Exhibit 6-17 should be considered as the range of projected vessel demand. Kodiak, Cold Bay, and Sand Point are considered ports en route to the Bering Sea fisheries and as such, vessels projected to use these ports are not considered part of the universe from which vessels are allocated. Vessel figures are taken

Exhibit 6-16

Present Relationship Between Port Infrastructure and Vessels Expected to Operate in Bering Sea Fisheries

Port	Adequate Harbor Water Depth	Fresh Water Supply	Availability of Fuel	Marine Repair Facilities	Docking Facilities	Access to Resource	Development Plans	Expected to Support BSAI Fisheries
Dutch Harbor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nome	No	Yes	Yes	No	No	Yes	Yes	Yes
Akutan	Yes	Yes	No	No	No	Yes	Yes	Yes
St. Paul	No	No	No	No	No	Yes	Yes	Yes
St. George	No	No	No	No	No	Yes	Yes	Yes
Chernofski	Yes	Yes	No	No	No	Yes	No	No
St. Michael	Yes	No	Yes	No	No	Yes	No	Yes
Kodiak	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Cold Bay	Yes	No	Yes	No	No	No	Yes	Yes
Sand Point	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Golovin	No	No	No	No	No	No	No	No
False Pass	No	Yes	No	No	No	No	No	No
Togiak	No	No	No	No	No	Yes	No	No
Dillingham	No	Yes	Yes	Yes	No	No	Yes	No
Port Moller	Yes	No	No	No	No	Yes	No	No
Port Heiden	Yes	No	No	No	No	Yes	No	No
King Cove	Yes	No	No	No	No	No	No	No

Exhibit 6-16 (Cont.)

Present Relationship Between Port Infrastructure and Vessels Expected to Operate in Bering Sea Fisheries

Port	Adequate Harbor Water Depth	Fresh Water Supply	Availability of Fuel	Marine Repair Facilities	Docking Facilities	Access to Resource	Development Plans	Expected to Support BSAI Fisheries
Nelson Lagoon	Yes	No	No	No	No	Yes	No	No
King Salmon	No	No	Yes	No	No	No	No	No
Naknek	No	Yes	Yes	Yes	No	No	Yes	No
Emmonak	No	No	No	No	No	No	No	No
Unalakleet	No	No	No	No	No	No	No	No
Bethel	Yes	Yes	Yes	Yes	No	No	No	No

Source: Condensed from text.

Exhibit 6-17

Future Anticipated Fishing Vessel (Catchers) and Floating Processor (Floaters) Demand by Port

	1987		1992		1997		2002		2007	
Port	Catchers	Floaters	Catchers	Floaters	Catchers	Floaters	Catchers	Floaters	Catchers	Floaters
Dutch Harbor	78-84	10	76-99	13	87-113	24	97-131	36	94-123	40
St. Paul	0	0	5-10	1	10-15	1	15-20	1	30	1
St. George	0	0	0	0	5-10	1	10-15	1	20	1
Akutan	15-40	2	13-52	3	18-68	4	22-79	5	25-87	6
Chernofsky	5-22	2	13-34	3	37-45	4	44-53	4	49-58	4
Nome	0	0	4-10	1	4-10	1	4-10	1	4-10	1
Sand Point	70	2	81	3	90	6	110	10	190	18
Cold Bay	40	2	65	4	92	8	114	12	180	20
Total	98-146	14	134-182	21	187-235	35	226-274	48	251-299	53

Source: Vessel numbers from Table 3-21; allocated according to text.

Note: Cold Bay and Sand Point are not included in total.

from Table 3-21. Fishing vessels expected to operate in the BS/AI fisheries are distributed among the ports of Dutch Harbor, St. Paul, St. George, Akutan, and Chernofski with the majority of vessels allocated to Dutch Harbor. Nome will also support fishing vessels and floating processors (floaters) operating in the Norton Sound lease area but not until 1987 when the Nome port development is expected to be completed. In 1992, Nome is expected to be the port for all vessels operating in Norton Sound: four to ten catcher vessels and one floater.

The St. Paul harbor development is expected to be completed by 1992 and should accommodate five to ten fishing vessels and one floater. This increases to ten to 15 catchers in 1997, 15 to 20 in 2002, and 30 catchers in 2007. Only one floater is projected to be in St. Paul at any one time. These projections are based on the size of the harbor described by Dames and Moore, et al., (1982). Because the number of catchers in St. Paul is greater than the amount of dock space expected to be constructed there, catcher vessels can be expected to raft alongside other vessels and to use the dock on a transitory basis.

The harbor at St. George is not projected to be completed until sometime in the late 1990's. Fishing vessel use should start out low in 1997 when from five to ten catchers and one floating processor use the port. The number of catchers increases to 20 by 2007.

Because of the close proximity of St. Paul and St. George Island to the large fishery resources in the St. George Basin (and likewise, because of their proximity to OCS resources) a great deal of pressure may be exerted on any future ports there by fishing and OCS vessels. Physical constraints to harbor size will place a firm cap on major harbor developments and concomitant vessel use.

Akutan and Chernofski are projected to receive increasingly more vessels. This is due to their close proximity to Dutch Harbor. They should receive "spill-over" fishing activity from that port. Also, Chernofski could be developed into a major fisheries port as described earlier.

Exhibit 6-18 shows present and projected seasonal fishing demand by port. The exhibit is divided into three major seasons and each port will be affected differently because of these seasons. For example, Nome would not be expected to have any fishing activity from September through May because of sea ice. Nome would, however, be used by herring and salmon boats in the summer and by other vessels expected to operate in Norton Sound as projected in Chapter 3.

Dutch Harbor presently receives more activity in the September through May seasons because of the crab fisheries. Use of Dutch Harbor can be expected to be constant with the development of offshore fisheries. St. Paul, St. George, Akutan, and Chernofski can all expect a fairly constant seasonal demand when fisheries begin to develop in the Bering Sea.

The use of Sand Point, Cold Bay, and any other ports en route to the Bering Sea can be expected to fluctuate based on several factors which include:

- How attractive these ports make themselves to vessels through the offering of docks, entertainment for crews of fishing vessels, and marine repair facilities.
- Future development of fish processing facilities in these ports which could attract vessels to fish in nearby areas and sell their catch to these processors.
- The weather which could force fishing vessels into the ports for refuge.

Exhibit 6-18

Present and Projected Seasonal Fishing Vessel Demand by Port[1]

Port	January - May[2]		May - September[3]		September - January[4]	
	Present	Projected	Present	Projected	Present	Projected
Dutch Harbor	60 to 100 catchers 100 to 150 feet long. 3 to 5 floaters 120 to 400 feet long.	70 to 130 catchers 100 to 250 feet long. 10 to 40 floaters 200 to 500 feet long.	5 to 12 vessels 90 to 12 feet long. 2 to 3 floaters 120 to 400 feet long.	70 to 131 catchers 100 to 250 feet long. 10 to 40 floaters. 200 to 500 feet long.	100 to 150 catchers 100 to 150 feet long. 4 to 8 floaters 120 to 400 feet long.	76 to 131 catchers 100 to 200 feet long. 10 to 40 floaters 200 to 400 feet long.
St. Paul	None.	One 300 foot floater. Up to 30 catcher vessels.	None.	One 300 foot floater. Up to 30 catcher vessels.	None.	One 300 foot floater. Up to 30 catcher vessels.
St. George	None.	One 300 foot floater. Up to 20 catcher vessels.	None.	One 300 foot floater. Up to 30 catcher vessels.	None.	One 300 foot floater. Up to 30 catcher vessels.
Akutan	10 to 20 catchers. 4 to 10 floaters.	10 to 87 catchers. 2 to 6 floaters	3 to 10 catchers. 2 to 3 floaters.	10 to 87 catchers. 2 to 6 floaters.	30 to 45 catchers. 4 to 12 floaters	10 to 87 catchers. 2 to 6 floaters.
Chernofsky	None.	5 to 58 catchers. 2 to 4 floaters.	None.	5 to 58 catchers. 2 to 4 floaters.	None.	5 to 58 catchers. 2 to 4 floaters.
Nome	None.	None.	50 to 150 smaller herring and salmon boats. 2 to 8 floaters.	4 to 10 catchers 100 to 150 feet long and one floater 200 to 400 feet long.	None.	None.
Sand Point	10 to 25 catchers 90 to 120 feet long.	Up to 70 catchers on a transient basis. Up to 18 floaters on a transient basis.	120 to 160 catchers 45 to 60 feet long.	Up to 190 catchers and 18 floaters on a transient basis.	10 to 25 vessels 100 to 120 feet long.	Up to 190 catchers and 18 floaters on a transient basis.
Cold Bay	One floater and up to 10 catcher vessels.	Up to 180 catchers and 20 floaters on a transient basis.	One to 2 floaters up to 15 catchers.	Up to 180 catchers and 20 floaters.	One floater and up to 10 catcher vessels.	Up to 180 catchers and 20 floaters.

Source: Centaur Associates, Inc., et. al., 1983, text, and Exhibit 6-17.

[1] Present fishing vessel demand figures represent the number of vessels which can be found in a port above the existing dock capacity. Projected fishing vessel demand figures are derived from Exhibit 6-17 and are allocated by port depending on each locations relative carrying capacity.

[2] The January to May fishing season is primarily for Tanner crab. Species which will also be harvested during this period include halibut and other groundfish.

[3] The May to September fishing season is primarily for herring, salmon, shrimp, and groundfish. Species which will also be harvested during this period include pollock, cod, flatfish, and roundfish.

[4] The September to January fishing season is primarily for king crab. Species which will also be harvested during this period included pollock, cod and other groundfish.

6.5 PROJECTED OCS DOCK SPACE REQUIREMENTS

Supply vessels range in size from 200 to 300 feet. In order to project dock demands for supply vessels, 250 feet is used per supply vessel. Based on the final adjusted estimate for supply vessels projected to operate in the Bering Sea given in Section 4.0, Exhibit 4-3, the total dock space demand estimated for vessels operating in the Bering Sea, by year, is given in Exhibit 6-19. This exhibit shows the demand for dock space in the winter (December through May) and summer (June through November). OCS activities should be greater in the summer than in the winter because of more favorable ice and weather conditions. The number of supply vessels initially estimated is derived by a straight forward multiplication of the number of supply vessels in Exhibit 4-3 by 250 feet of dock space. The final adjusted dock space demand is derived by multiplying the total initial demand in Exhibit 6-19 by two-thirds to reflect the fact that all supply boats will not be in port at once; some of the boats will be at the offshore platforms at the lease site, some will be tending exploration rigs or pipelaying barges, and some will be travelling between port and the work site. Also, it is quite common for vessels to raft alongside one another and the two-thirds factor takes this into account.

Dock space demand begins in 1986 at 2,000 feet and increases to a maximum of 6,800 feet in 1995. This demand begins to decline in 1998 until 2001 when total winter and summer demand is 1,300 feet. Summer dock demand is about 46 to 48 percent higher than winter dock demand from 1991 until 1997. From 1997 on, winter and summer dock demand figures converge to be similarly equal to 1,300 feet.

Exhibit 6-20 takes the total amount of dock space demand projected in Exhibit 6-19 and allocates the demand by port. In Exhibit 6-20, Dutch Harbor is shown as the primary support base for OCS exploration and development in the Bering Sea. Other ports which are projected to be used by the offshore industry for OCS operations in the Bering Sea are St.

Exhibit 6-19

Projected Estimated Dock Space Demand for
Bering Sea OCS Exploration and Development

	No. Aleutian Initial Dock Demands		Navarin Initial Dock Demands		St. George Initial Dock Demands		Norton Initial Dock Demands		Total Initial Demand		Final Adjusted Demand	
Year	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	500	-	1,500	-	1,000	-	3,000	-	2,000
1987	-	-	-	1,500	-	2,500	-	2,000	-	6,000	-	4,000
1988	-	-	-	1,500	-	2,500	-	2,500	-	6,500	-	4,300
1989	-	500	-	1,500	-	2,500	-	2,000	-	7,500	-	5,000
1990	-	500	-	1,000	-	1,000	-	1,000	-	3,500	-	2,300
1991	500	1,250	1,000	2,000	-	-	-	-	1,500	3,250	1,000	2,170
1992	1,000	1,250	2,500	5,250	-	-	-	-	3,500	6,500	2,300	4,300
1993	1,000	2,000	4,500	7,750	-	-	-	-	5,500	9,750	3,670	6,500
1994	500	500	6,000	9,000	-	-	-	-	6,500	9,500	4,300	6,300
1995	500	500	6,500	9,750	-	-	-	-	7,000	10,250	4,600	6,800
1996	500	500	6,500	9,750	-	-	-	-	7,000	10,250	4,600	6,800
1997	500	500	6,500	9,750	-	-	-	-	7,000	10,250	4,600	6,800
1998	500	500	4,250	4,250	-	-	-	-	4,750	4,750	3,200	3,200
1999	500	500	3,000	5,000	-	-	-	-	3,500	5,500	2,300	3,600
2000	500	500	2,500	2,500	-	-	-	-	3,000	3,000	2,000	2,000
2001	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2002	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2003	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300

Exhibit 6-19 (Cont.)

Projected Estimated Dock Space Demand for
Bering Sea OCS Exploration and Development

Year	No. Aleutian Initial Dock Demands		Navarin Initial Dock Demands		St. George Initial Dock Demands		Norton Initial Dock Demands		Total Initial Demand		Final Adjusted Demand	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
2004	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2005	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2006	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2007	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2008	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2009	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2010	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2011	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2012	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2013	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2014	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300
2015	500	500	1,500	1,500	-	-	-	-	2,000	2,000	1,300	1,300

Source: Based on Exhibit 4-3, Final adjusted estimates for the number of OCS supply vessels.

Note: All figures are in feet. Total initial demand is derived by adding each lease sale's dock demand. Initial dock demand is figured by multiplying the number of supply vessels in Exhibit 4-3 by 250 feet. Final adjusted demand is derived by multiplying total initial demand by two-thirds.

Exhibit 6-20

Projected OCS Supply Vessel Dock Space Demand by Port By Season

Year	Dutch Harbor		St. Paul		St. George		Akutan		Chernofsky		Nome	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	1,200	-	-	-	-	-	-	-	140	-	660
1987	-	2,400	-	-	-	-	-	-	-	270	-	1,330
1988	-	2,380	-	-	-	-	-	90	-	170	-	1,660
1989	-	3,300	-	-	-	-	-	130	-	240	-	1,330
1990	-	1,480	-	-	-	-	-	-	-	160	-	660
1991	1,000	2,170	-	-	-	-	-	-	-	-	-	-
1992	2,300	3,660	-	160	-	-	-	160	-	160	-	-
1993	3,190	5,440	160	250	-	160	-	160	160	160	-	-
1994	3,790	5,160	160	330	-	160	-	160	160	330	-	-
1995	3,790	5,820	160	330	160	160	-	-	160	330	-	-
1996	3,790	5,820	160	330	160	160	-	-	160	330	-	-
1997	3,950	5,820	160	330	-	160	-	-	160	330	-	-
1998	2,550	2,390	160	330	-	160	-	-	160	160	-	-
1999	1,980	2,790	-	330	-	160	-	-	160	160	-	-
2000	1,680	1,830	-	330	-	160	-	-	160	160	-	-
2001	980	660	-	160	-	160	-	-	160	160	-	-
2002	980	660	-	160	-	160	-	-	160	160	-	-
2003	980	660	-	160	-	160	-	-	160	160	-	-
2004	980	660	-	160	-	160	-	-	160	160	-	-
2005	980	660	-	160	-	160	-	-	160	160	-	-
2006	980	660	-	160	-	160	-	-	160	160	-	-
2007	980	660	-	160	-	160	-	-	160	160	-	-
2008	980	660	-	160	-	160	-	-	160	160	-	-
2009	980	660	-	160	-	160	-	-	160	160	-	-
2010	980	660	-	160	-	160	-	-	160	160	-	-
2011	980	660	-	160	-	160	-	-	160	160	-	-
2012	980	660	-	160	-	160	-	-	160	160	-	-
2013	980	660	-	160	-	160	-	-	160	160	-	-
2014	980	660	-	160	-	160	-	-	160	160	-	-
2015	980	660	-	160	-	160	-	-	160	160	-	-

Exhibit 6-20 (Cont.)

Projected OCS Supply Vessel Dock Space Demand by Port By Season

Year	Sand Point		Cold Bay		Other		Total Demand	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
1984	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-
1986	-	400	-	100	-	-	-	2,000
1987	-	800	-	200	-	-	-	4,000
1988	-	960	-	215	-	-	-	4,300
1989	-	1,000	-	250	-	-	-	5,000
1990	-	460	-	115	-	-	-	2,300
1991	200	430	100	217	-	-	1,000	2,170
1992	460	860	230	430	-	160	2,300	4,300
1993	734	1,300	367	650	160	330	3,670	6,500
1994	860	1,260	430	630	160	160	4,300	6,300
1995	920	1,360	460	680	330	160	4,600	6,800
1996	690	1,020	920	1,360	330	160	4,600	6,800
1997	690	1,020	920	1,360	330	160	4,600	6,800
1998	480	480	640	640	330	160	3,200	3,200
1999	345	540	460	720	160	160	2,300	3,600
2000	300	300	400	400	160	160	2,000	2,000
2001	195	195	260	260	160	160	1,300	1,300
2002	195	195	260	260	160	160	1,300	1,300
2003	195	195	260	260	160	160	1,300	1,300
2004	195	195	260	260	160	160	1,300	1,300
2005	195	195	260	260	160	160	1,300	1,300
2006	195	195	260	260	160	160	1,300	1,300
2007	195	195	260	260	160	160	1,300	1,300
2008	195	195	260	260	160	160	1,300	1,300
2009	195	195	260	260	160	160	1,300	1,300
2010	195	195	260	260	160	160	1,300	1,300
2011	195	195	260	260	160	160	1,300	1,300
2012	195	195	260	260	160	160	1,300	1,300

Exhibit 6-20 (Cont.)

Projected OCS Supply Vessel Dock Space Demand by Port By Season

Year	Sand Point		Cold Bay		Other		Total Demand	
	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer
2013	195	195	260	260	160	160	1,300	1,300
2014	195	195	260	260	160	160	1,300	1,300
2015	195	195	260	260	160	160	1,300	1,300

Source: Based on final adjusted dock demand from Exhibit 6-19.

Note: All figures are in feet. Sand Point and Cold Bay are considered ports en route to the Bering Sea and dock demand there is not included in Total Demand. All Norton Sound dock demand is allocated to the Port of Nome. Also, some figures given for dock demand may be less than the length of supply vessels (which are expected to range between 200 and 300 feet long). In these instances, dock demand should be considered as a percentage of total Bering Sea dock demand which is allocated to the port as described in the text. Figures may not add exactly to the total due to rounding.

"Other" ports is given to represent harbors of refuge along the Bering Sea which OCS vessels may use if they were developed by OCS companies or in the case of vessels needing a harbor to sit out a storm. These may include Port Moller, Port Heiden, False Pass, Golovin Bay or King Cove.

Paul, St. George, Akutan, Chernofsky, and Nome. Sand Point and Cold Bay are projected to be used by OCS vessels en route to the Bering Sea, not as support bases. This is why they have been included in Exhibit 6-20. "Other" ports which may be used by support vessels include False Pass, Port Moller, King Cove, Port Heiden, or Golovin Bay. These ports may be used as a support base or as ports of refuge during storms. Note that during the peak development years, 1995 through 1998, the winter demand in these other ports outweighs summer dock demand by 170 feet.

During exploration in the Norton Basin all of the OCS supply vessel activity is projected to be out of Nome (this assumes a completed harbor facility there as described in Section 6.1.4). Demand in Nome for dock space begins in 1986 at 660 feet increases to 1660 feet in 1988 and declines to 660 feet in 1990. No demand is anticipated after 1990 as development of resources is not expected in the Norton Basin. OCS supply vessel demand is expected in St. Paul beginning in the summer of 1992, when 160 feet of dock space will be used. This increases to 250 feet in 1993, 330 feet from 1994 through 2000 and declines to 160 feet in 2001. No more than 160 feet is needed in any year during the winter. It should be noted that while the size of OCS supply vessels anticipated in the Bering Sea ranges between 200 and 300 feet, the figures given for St. Paul and the other Bering Sea ports for vessel dock demand are often less than 250 feet. This is because the dock demand figures represent relative demand when looking at all ports in the region. The figure 160 feet should be taken as the space necessary, at minimum, to dock a supply vessel ranging between 200 and 300 feet. Refering back to Exhibit 6-19, this is an average size supply boat measuring 250 feet times two-thirds which equals about 160 feet.) At no time prior to the decline in OCS activity in 2000 does St. Paul receive more than five percent of total Bering Sea dock demand.

St. George is projected to receive about 160 feet of supply vessel demand beginning in the summer of 1993. This demand would be realized only if the port development discussed previously were completed.

Akutan should also receive an occasional supply vessel. However, because any future docking facility in Akutan is expected to be dedicated exclusively to the fishing industry, the demand for space should be considered anchoring space rather than actual docking space.

Chernofski may be developed for the fishing industry, the offshore oil and gas industry, or both. It is assumed that there will be some sort of harbor development at Chernofski and that OCS supply vessels will use the port beginning in 1986 with dock demand peaking at 330 feet in 1994.

6.6 PROJECTED ONSHORE OCS SPACE NEEDS

The offshore oil and gas industry needs land onshore for storage of equipment used to develop OCS resources. Ideally, the land should be located adjacent to dock sites to aid in the marshalling of equipment onto supply vessels for transport to the offshore work sites. The land onshore is needed primarily to store pipe, drilling mud, welding materials, tools, supplies, machinery, equipment, field offices and warehouses. This analysis and projection of onshore OCS space needs takes into account only the needs associated with support bases, not processing facilities, pipeline landfalls, tanker terminals and other land needs associated with OCS development. Information used here to derive onshore space requirements comes from the New England River Basins Commission (1976) and Centaur Associates, Inc., et. al. (1983). For planning purposes, the following criterion will be used for projecting onshore space needs:

OCS Structure	Onshore Space Requirements
o Each exploratory rig	four acres
o Each pipelaying barge	six acres
o Each development platform	six acres
o Each production platform	three acres

No economy of scale will be used in this analysis and therefore, figures presented for onshore storage needs should be considered a maximum.

Onshore space projected to be needed by Bering Sea OCS development is given in Exhibit 6-21. Information for the number of rigs, barges and platforms comes from Section 4.0, Exhibit 4-2. Note that a one year lag is shown for the placement of production platforms in Exhibit 4-2 (1991) and production platforms in Exhibit 6-21 (1992). This is to allow pipeline barges to complete pipelines so that the development platforms can start producing. Figures given for exploration rigs, development platforms, and production platforms are cumulative totals. Also, because the same platforms that are developing are also producing, they would not require additional acreage. Therefore, to prevent onshore space double count, from 1993 through 2000, the development platforms should not require additional acreage for space and therefore not until 2001 when the platforms only produce will acreage be dedicated to producing platforms.

The demand for onshore space is projected to begin in 1986 when 24 acres are needed for exploration activity. This increases to 58 acres in 1992 when exploration activity, pipelaying activity, development and production activities take place. The peak years are 1995 through 2000 when 90 acres of land are needed to support OCS development and production. In 2001, demand for land is reduced to 45 acres while only production takes place. This figure of 45 acres is maintained throughout the projection horizon to 2015.

Exhibit 6-22 allocates the total acres of land required to support OCS activities in the Bering Sea by port. Only the ports of Dutch Harbor, Nome, Chernofski, and "Other" are expected to be developed by onshore companies for onshore storage. All ports along the Bering Sea

Exhibit 6-21

Projected Onshore Land Requirements for
Development of Bering Sea OCS Resources

Year	Exploratory Rigs	Acres of Land Required	Pipe-laying Barges	Acres of Land Required	Development Platforms	Acres of Land Required	Production Platforms	Acres of Land Required	Total Acres of Land Required
1984	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-
1986	6	24	-	-	-	-	-	-	24
1987	12	48	-	-	-	-	-	-	48
1988	13	52	-	-	-	-	-	-	52
1989	13	52	-	-	-	-	-	-	52
1990	7	28	-	-	-	-	-	-	28
1991	2	8	-	-	3	18	-	-	26
1992	1	4	2	12	7	42	7	-	58
1993	-	-	2	12	11	66	11	-	78
1994	-	-	-	-	14	84	14	-	84
1995	-	-	-	-	15	90	15	-	90
1996	-	-	-	-	15	90	15	-	90
1997	-	-	-	-	15	90	15	-	90
1998	-	-	-	-	15	90	15	-	90
1999	-	-	-	-	15	90	15	-	90
2000	-	-	-	-	15	90	15	-	90
2001	-	-	-	-	-	-	15	45	45
2002	-	-	-	-	-	-	15	45	45
2003	-	-	-	-	-	-	15	45	45
2004	-	-	-	-	-	-	15	45	45
2005	-	-	-	-	-	-	15	45	45
2006	-	-	-	-	-	-	15	45	45
2007	-	-	-	-	-	-	15	45	45
2008	-	-	-	-	-	-	15	45	45
2009	-	-	-	-	-	-	15	45	45
2010	-	-	-	-	-	-	15	45	45
2011	-	-	-	-	-	-	15	45	45

Exhibit 6-21 (Cont.)

Projected Onshore Land Requirements for Development of Bering Sea OCS Resources

Year	Exploratory Rigs	Acres of Land Required	Pipe-laying Barges	Acres of Land Required	Development Platforms	Acres of Land Required	Production Platforms	Acres of Land Required	Total Acres of Land Required
2012	-	-	-	-	-	-	15	45	45
2013	-	-	-	-	-	-	15	45	45
2014	-	-	-	-	-	-	15	45	45
2015	-	-	-	-	-	-	15	45	45

Source: Exhibit 4-2 for the number of exploratory rigs, pipelaying barges, development platforms and production platforms. New England River Basin Commission, (1976) for acres of land required per unit of OCS development phase.

Note: All figures are in acres. Figures for exploratory rigs, development platforms and production platforms are cumulative totals.

Exhibit 6-22

Projected OCS Onshore Acreage Needed for Bering Sea Development Allocated by Port

Year	Dutch Harbor	Chernofsky	Nome	Other	Total
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	16	-	8	-	24
1987	32	-	16	-	48
1988	32	-	20	-	52
1989	36	1	16	-	52
1990	18	2	8	-	28
1991	23	3	-	-	26
1992	51	4	-	3	58
1993	70	4	-	4	78
1994	70	8	-	6	84
1995	72	9	-	9	90
1996	70	10	-	10	90
1997	68	10	-	12	90
1998	68	10	-	12	90
1999	68	10	-	12	90
2000	68	10	-	12	90
2001	23	10	-	12	45
2002	23	10	-	12	45
2003	23	10	-	12	45
2004	23	10	-	12	45
2005	23	10	-	12	45
2006	23	10	-	12	45
2007	23	10	-	12	45
2008	23	10	-	12	45
2009	23	10	-	12	45
2010	23	10	-	12	45
2011	23	10	-	12	45
2012	23	10	-	12	45
2013	23	10	-	12	45
2014	23	10	-	12	45
2015	23	10	-	12	45

Source: Based on acreage totals from Exhibit 6-21. All figures are in acres.

perimeter including those just named face an acute lack of developable land due to: 1) poor port access to land through a harbor because the harbor is shallow or exposed to heavy seas (unprotected); 2) the onshore topography is steep, or uneven, such that construction of a support base would be difficult and very expensive. "Other" ports is meant to convey a sense of unknown regarding future OCS basing decisions. "Other" ports could be developed from an existing port somewhere in the region such as Port Moller, Port Heiden, King Cove, Cold Bay, Sand Point, or False Pass. However, the majority of OCS onshore activity should be based at Dutch Harbor, Nome and Chernofski because of their proximities to the Bering Sea and because they display the best potential to be developed as staging areas.

In Exhibit 6-22, between 50 and 90 percent of the onshore land needs are allocated to Dutch Harbor, Nome is allocated from eight to 20 acres in 1986 through 1990. This land would be used for the exploration in the Norton Sound only. Chernofsky is projected to develop up to ten acres of storage land beginning in 1989. "Other" ports should develop up to 12 acres of storage space onshore beginning in 1992.

6.7 DOCKING AND ONSHORE STORAGE AREAS IN THE BERING SEA

The docking and storage areas in the Bering Sea are presently very limited. The majority of dock space is in Dutch Harbor as shown in Exhibit 6-23. Most of the dock space there is dedicated to the fishing industry. Other docks in Dutch Harbor are for general cargo loading and unloading and for fuel storage and dispensing. Roughly 7,700 to 8,700 feet of dock space is available in Dutch Harbor/Unalaska at seafood processing facilities, public docks, and private seafood docks. The two docks in Dutch Harbor which currently have the capacity to service OCS vessels are the Exxon dock in Dutch Harbor and the Offshore Systems dock in Captains Bay. These two dock facilities have a docking capacity of approximately 1,550 feet.

Exhibit 6-23

Bering Sea Dock Facilities

Port	Existing Dock Facility Description	Approximate Dock Size	Amount Available to Fishing Industry	Amount Available to the OCS Industry
Dutch Harbor	Dutch Harbor spit boat docks.	2,400 feet of dock space.	2,400 feet.	0 to 250 feet.
	Exxon dock area.	500 feet of dock space possible.	None.	500 feet.
	Seafood processor docks: con-Agra, East Point, Whitney-Fidalgo, Universal, Pacific Pearl, Pan Alaska, "Agnes Beach dock."	From 5,100 to 6,100 feet of dock space available.	100% of space along-side processors is reserved for fishing vessels.	None.
	Municipal dock.	60 feet by 250 feet.	Used by fishing industry for offloading -- not docking.	None for docking -- can be be used for offloading.
	Standard oil (Chevron Dock).	330 by 50 foot dock face.	None for docking -- only for refueling.	None for docking -- only for refueling.
	American President Line Dock).	350 by 150 feet of dock space.	Temporary docking available.	Temporary docking available.
	Ounalashka Corp.	200 feet.	200 feet.	None at present.
	Panama Marine Shipyard.	250 feet.	None for docking unless for repairs.	None for docking unless for repairs.
	Crowley Maritime Dock.	Dock face is 350 feet.	Space available for off-loading cargo.	Space available for off-loading cargo.
	Captains Bay OCS dock.	400 feet of dock space.	None.	400 feet.

Exhibit 6-23 (Cont.)

Bering Sea Dock Facilities

Port	Existing Dock Facility Description	Approximate Dock Size	Amount Available to Fishing Industry	Amount Available to the OCS Industry
St. Paul	Municipal dock.	Extends from shore 1,000 feet.	None due to shallow water.	None due to shallow water.
St. George	None.	-	None.	None.
Akutan	Sea West dock.	Dock extends 140 feet with 30 foot face.	Dedicated to floating processor.	None.
	Trident dock.	350 feet.	100 percent.	None.
Chernofsky	None of any use.	-	None.	None.
Nome	Turning Basins North Revetment is municipal and fuel dock.	600 feet of berthing space.	None due to shallow water.	None due to shallow water.

Exhibit 6-23 (Cont.)

Bering Sea Dock Facilities

Port	Total Existing Dock Space available for the OCS Industry	Total Existing Dock Space available for the Fishing Industry
Dutch Harbor	Up to 1,150 feet.	From 7,700 to 8,700 feet.
St. Paul	None.	None.
St. George	None.	None.
Akutan	None.	400 Feet.
Chernofsky	None.	None.
Nome	None.	None.
Total	1,150 Feet.	7,700 to 9,100 Feet.

Sources: Centaur Associates, et. al. (1983); Section 6.0 port descriptions.

Akutan has a small amount of dock space but this is solely for the existing floating processors. Chernofski, St. Paul and St. George do not have dock facilities which could be used by any large vessels. This is also true of Nome which presently lacks harbor facilities capable of docking large offshore vessels with drafts greater than ten feet.

In terms of onshore storage areas in the Bering Sea, existing areas are also limited. There are, however, areas which could be developed into storage areas in all ports. The major limiting factors for land development at this time seem to be: ownership conflicts, expensive development, rugged topography, and inaccessable areas. St. Paul and St. George, in their harbor development plans are not projected to have onshore storage space of any size to accomodate either onshore fisheries development, or onshore OCS storage area. Akutan is now, and will continue to, play host for many floating processors and transient fishing vessels. Onshore developments, such as expanding docks and processing facilities for the fishing industry are contemplated but the OCS industry is not projected to build major storage areas there.

Chernofski has areas of land which could be developed by the OCS industry (Dames and Moore, et. al., 1981). Based upon preliminary port development plans for Chernofski, it appears that about 2500 feet of dock space could be constructed at an area in Chernofski harbor known as Mailboat Cove with about ten acres of storage space. Nome's harbor development, as discussed previously, will have an onshore storage capaciity of ten acres with provisions for future port expansion of a further 50 acres as needed. Presently, dockside warehouse and open-air storage is available in Nome in privately and publicly-owned facilities but there are limited storage areas nearby the dock and harbor area. However, there are large open areas of about 20 acres located away from the harbor and City of Nome, towards the municipal airport which could be pressed into service by the OCS companies for Norton Sound exploration. Therefore, it is assumed that Nome has an adequate supply of land to meet any OCS need for onshore storage for Norton Sound exploration.

Dutch Harbor has several areas which could be used for onshore OCS storage. At the Exxon dock facility, the waterfront land is capable of being used as an onshore storage site. Presently there are four acres which could be used immediately and four more acres which could be added by filling in a small pond on the property. The Offshore Systems dock in Captains Bay will have about ten acres of land in the near term and up to 40 acres of potential storage space in the long term (Centaur Associates, et. al., 1983). Also, there is an area near Unalaska Lake, west of the Community of Unalaska, which could be used for storage. This area is moderately hilly and in a flood plain but if needed it has the capacity to supply up to 150 acres of storage area.

In Exhibit 6-24 a summary of current and projected storage space and dock space facilities is given to arrive at anticipated levels of surplus or deficit storage and dock space. The fact that there are surplus amounts of land available for OCS storage relies heavily upon the assumptions that the Exxon Dock facility in Dutch Harbor, the Offshore Systems dock in Captains Bay near Dutch Harbor, the proposed dock at Nome, and the development in Chernofski all take place. Given the level of anticipated OCS development, the pressure to develop OCS bases exists. However, sites to develop OCS bases are fairly limited.

Unlike storage space, dock space available for OCS supply vessels is less than the anticipated demand. Future supply is not only based upon future port developments as mentioned above, but upon some dock space being used by OCS vessels in St. Paul and St. George in the Pribilof Islands. Since it is projected that there will be greater demand for dock space than supply, dock development will have to occur either in greater amounts or at "other" ports. It cannot be foreseen at this time where dock developments could occur. Additional port development in Dutch Harbor can be speculated but these developments should occur for the OCS industry to prevent interactions with fishing vessel dock facilities.

Exhibit 6-24

Comparison of Existing Dock and Storage Space in the Bering Sea with Projected OCS Demands

Year	Current and Projected Port Storage Space For OCS Activities[1]	Projected Storage Space Needs for OCS Development[2]	Projected Onshore Space Surplus or (Deficit)[3]	Current and Projected Dock Space for OCS Vessels[4]	Projected Dock Needs For OCS Development[5]	Projected Dock Space Surplus or (Deficit)[6]
1983	24[7]	-	24	950[13]	-	950
1984	24	-	24	950	-	950
1985	24	-	24	1,350[14]	-	1,350
1986	44[8]	24	20	1,750[15]	2,000	(250)
1987	44	48	(4)	2,150[16]	4,000	(1,850)
1988	78[9]	52	26	2,350[17]	4,300	(1,950)
1989	78	52	26	2,850[18]	5,000	(2,150)
1990	88[10]	28	60	3,350[19]	2,300	1,050
1991	118[11]	26	62	3,850[20]	2,170	1,680
1992	118	58	60	4,510[21]	4,300	210
1993	118	78	40	5,170[22]	6,500	(1,330)
1994	118[12]	84	34	5,170	6,300	(1,330)
1995	118	90	34	5,170	6,800	(1,330)
1996	118	90	34	5,170	6,800	(1,330)
1997	118	90	34	5,170	6,800	(1,330)
1998	118	90	34	5,170	3,200	1,970
1999	118	90	34	5,170	3,600	1,570
2000	118	90	34	5,170	2,000	3,170
2001	118	45	73	5,170	1,300	3,870
2002	118	45	73	5,170	1,300	3,870
2003	118	45	73	5,170	1,300	3,870
2004	118	45	73	5,170	1,300	3,870
2005	118	45	73	5,170	1,300	3,870
2006	118	45	73	5,170	1,300	3,870
2007	118	45	73	5,170	1,300	3,870
2008	118	45	73	5,170	1,300	3,870
2009	118	45	73	5,170	1,300	3,870
2010	118	45	73	5,170	1,300	3,870
2011	118	45	73	5,170	1,300	3,870
2012	118	45	73	5,170	1,300	3,870
2013	118	45	73	5,170	1,300	3,870
2014	118	45	73	5,170	1,300	3,870
2015	118	45	73	5,170	1,300	3,870

Exhibit 6-24 (Cont.)

Comparison of Existing Dock and Storage
Space in the Bering Sea with Projected OCS Demands

Footnotes:

---

[1] This column is based upon existing onshore storage areas major Bering Sea ports.

[2] Based upon Exhibit 6-21.

[3] Column 1 minus column 2.

[4] This column is based upon existing dock facilities in major Bering Sea ports.

[5] Based upon Exhibit 6-19.

[6] Column 4 minus column 5.

[7] Includes four acres at Exxon Dock and 10 acres at the Captains Bay dock in Dutch Harbor and 10 acres in Nome.

[8] Adds 20 more acres at the port of Nome.

[9] Adds 4 acres at the Exxon dock site in Dutch Harbor, 20 acres at the Offshore Systems dock in Captains Bay and 10 acres at the port of Nome.

[10] Adds 10 acres at Chenofsky.

[11] Adds 10 acres at the Offshore Systems dock and 20 acres at Nome.

[12] From this point on an additional 150 acres could be added as needed at the port of Dutch Harbor.

[13] This figure includes 250 feet of dock space at the Dutch Harbor public boat harbor, 500 feet at the Exxon dock and 200 feet at the Offshore Systems Dock in Dutch Harbor.

Exhibit 6-24 (Cont.)

Comparison of Existing Dock and Storage Space in the Bering Sea with Projected OCS Demands

Footnotes (Cont.):

---

[14] This adds 400 feet of dock space at Nome (assuming a port development there).

[15] This adds 400 feet at Nome.

[16] This adds 400 feet at Nome.

[17] This adds 200 feet at the offshore systems dock in Dutch Harbor.

[18] This adds 500 feet of dock space at Chernofsky (assuming a port is developed there).

[19] This adds 500 feet at Chernofsky.

[20] This adds 500 feet at Chernofsky.

[21] This adds 500 feet at Chernofsky and 160 of dock space at St. Paul (assuming a port develops there).

[22] This adds 500 feet at Chernofsky and 160 feet of dock at St. George (assuming a port develops there).

6.8 Dutch Harbor/Unalaska Infrastructure Impacts

This section addresses infrastructure impacts in Dutch Harbor/Unalaska which could result if OCS development occurs there. The focus of determining impacts is on determining which facilities and components of the community's infrastructure would be impacted by OCS onshore development and relating these impacts to the fishing industry.

6.8.1 Municipal Water

All users of fresh water in Dutch Harbor/Unalaska are dependant upon the City of Unalaska's municipal water system to meet their needs. The fresh water used in Unalaska's existing system is primarily supplied by surface water from Unalaska Creek and Pyramid Creek. This supply can drop during extended cold periods even though these sources are augmented with several water wells located in the Unalaska Creek drainage. The water distribution system is comprised of wood stave pipe which has decayed to the point where an estimated one-third of the water supply is lost through leakage. Also lacking in the water system are adequate water storage tanks and treatment facilities (Beyer Engineering, 1981).

Because of a lack of metering and the malfunctioning of existing in-line meters, accurate information on water consumption is not available. However, water consumption at seafood processing facilities is not all freshwater, in fact, most of the water used to process fishery products is saltwater. Water consumption is highest for processing shrimp, next highest for crab, then fish and finally salt cod. As an indication of water use in the seafood processing industry, the City of Unalaska's Water Plan cited Kodiak processors as having a 500,000 gallon per day (gpd) consumption rate for fish and crab processing facilities and a 1,000,000 gpd consumption rate for shrimp processing facilities.

It is assumed that this is fresh water. Even specific consumption rates for products such as crab processing will vary depending on whether the end product is meat only or sections. Also, water consumption will vary depending on the level of technology in a plant, the price of the water, if there are freshwater recovery systems in processing plants, and the available water supply.

In Dutch Harbor/Unalaska, an approximation of water consumption is shown in Exhibit 6-25. The exhibit gives water demands for the processors in Dutch Harbor in terms of their permitted discharge. The figures given should be considered an upper bound for the amount of water discharged. Note that the majority of seafood produced is crab and that freshwater to saltwater consumption ratios range from 5 to 1, to 78 to 1. For those processors showing both freshwater and saltwater discharge, the total ratio is 21 to 1 for saltwater to freshwater use. These data are several years old and may be different today. Also, in terms of the fishing industry's use of freshwater, Exhibit 6-25 does not show freshwater which is used onboard catcher and processing vessels for personal use or in the form of ice.

Information on the present consumption of water in Unalaska/Dutch Harbor and anticipated water needs was taken from the City of Unalaska's Water Plan, completed in 1981. It is estimated that with a system leakage of one-third, the water system has a peak flow of 18,000 gallons per minute (gpm) and a peak consumption of 12,000 gpm.

With the size of the Unalaska's population expected to increase dramatically over the next 20 years as the OCS and fishing industries grow in Dutch Harbor/Unalaska, the demand on the city's water is also expected to grow considerably. Based on the water plan's economic and population growth figures, future average demand for non-industrial water consumers is projected at 1,000 gpm and peak demand estimated at 1,400 gpm. For industrial water users, future peak water demands are estimated to be 28,500 gpm and future average water demands are estimated at 20,000 gpm. Current and future water estimates are given in Exhibit 6-26. These estimates assume that all existing wood stave pipe will be replaced and that leakage will be reduced to almost zero.

Exhibit 6-25

Fishery Processors' Water Discharge in Dutch Harbor/Unalaska

Processor	Fresh Water (gpd)	Surface Water (gpd)	Type of Seafood Processed
Dutch Harbor Seafoods			
On-Shore Unit	27,000	1,300,000	crab
Floating Processor	65	700,000	crab
Universal			
Barge Vita	200,000	1,000,000	crab
Barge Uni-Sea	50,000	-	crab, salmon
Pacific Pearl	2,000,000	-	crab
Whitney Fidalgo	48,000	1,400,000	crab, shrimp, salmon
Sea Alaska			
Floating Processor	205,000[1]	-	crab
Sea Producer			
Floating Processor	132,000[1]	-	crab
East Point Seafoods	20,000	1,005,000	crab
Pan-Alaska	27,600	2,150,000	crab, herring bottomfish, salmon, shellfish
Totals	2,659,715	7,555,000	

---

[1] Data is for total discharge only and was not broken down by fresh water/surface water.

Source: EPA discharge permits office, Seattle, Washington Personal Communication, 1979 data.

Exhibit 6-26

Current and Projected Water Flow and Consumption in Dutch Harbor/Unalaska[1]

	Peak		Average	
	gpm	mgpd	gpm	mgpd
Present Flow	18,000	25.9	12,000	17.3
Present Leakage[2]	6,000	8.6	4,000	5.8
Present Consumption	12,000	17.3	8,000	11.5
Present Non-Industrial Consumption[3]	350	0.50	230	0.33
Present Industrial Consumption[4]	11,700	16.8	7,800	11.17
Projected Non-Industrial Demand[5]	1,400	2.0	1,000	1.5
Projected Industrial Demand[6]	28,500	41.0	20,000	28.5
Projected Total Demand	29,900	43.0	21,000	30.0

---

[1] Water meters were installed for each user of City water but they have been rendered inoperable, therefore, these data are estimates. In some cases, only gallons per minute (gpm) or million gallons per day (mgpd) were given. In these cases, that figure not given was computed. Some columns may not add due to rounding.

[2] Leakage estimated at 33 percent of total flow.

[3] Current peak non-industrial consumption is estimated during periods of maximum employment by the seafood processing industry. Average non-industrial consumption was calculated by multiplying peak consumption rates by two-thirds.

[4] Present industrial consumption was calculated by subtracting non-industrial consumption from present consumption.

[5] This estimate assumes existing water pipe is replaced and a minimal leakage loss. Total population was expected to be upwards to 20,000 persons in Unalaska by 2010.

[6] This estimate assumes a tripling of activity in the seafood processing industry within the next 30 years. This figure also takes into account: conservation, metered readings, repaired pipe, and minimal leakage loss.

Source: Beyer Engineering, Water System Master Plan, City of Unalaska, 1981, pp 24-27.

Also, estimated future demand projection figures should be considered a minimum goal given reasonable, assumed population and industrial growth projections.

From the two exhibits, it can be seen that there is enough water to meet existing demand. In conversations with Dutch Harbor's seafood processors, water supply has not been a problem in the past two years. However, some problem with adequate supplies of freshwater during extended winter cold spells (two weeks or more of below freezing temperatures) occured before this time.

In terms of future industry water use in Dutch Harbor, only two industries were considered in projected growth scenarios: the seafood industry and the oil and gas industry. Of these two industries, by far the greater user of water is the seafood industry. As was stated earlier, water use by different components of the fishing industry will vary. Shore-based processors will use more freshwater than floating processors by the very fact that the shore-based processors have greater access to freshwater. Floating processors will generate their own freshwater and use seawater for processing, generally only using freshwater to rinse the final product (fillets, for example) before freezing.

Based on conversations with engineers at Dutch Harbor processors, commercial fishermen, marine architects and other sources (Dames and Moore, and Norgard USA., 1982), an indication of freshwater use by the fishing industry can be determined. Some vessels fishing for salt cod and other fish and shellfish will use ice for their catch in amounts of about one pound of ice for each pound of fish. These vessels are typically not larger than 100 feet and usually fish no more than 40 weeks of the year. Other freshwater needs are for the crew's cooking and cleaning and this water demand is about 700 to 800 gallons per trip.

Large crab vessels will use 2,000 to 3,000 gallons of freshwater per trip only for the crew's use. Some of these vessels have desalination plants which generate freshwater and may not take on water during their stay in port. In the future, larger catcher processor vessels up to 200 feet will have freshwater storage capacity of about 8,000 gallons -- all of which is generated onboard. Vessel captains may elect not to use a port's water particularly if it is of questionable quality. Many remote Alaskan ports have had problems with water quality such as high sodium levels, inadequate clorination and poor taste. Newer catcher-processors and processing vessels will process all seafood products with chlorinated seawater. The chlorine is also generated on-board by chemically breaking down seawater.

Onshore processing plants can be expected to use about 90,000 gallons of freshwater per day on average. This consumption will also depend on the quality and quantity of freshwater available, the cost of water, the product being processed and whether or not seawater can replace the use of freshwater. Estimated water demands by vessel are summarized in Exhibit 6-27.

While the demands by the fishing industry for water are great and are expected to increase, if the city's system is improved, there should be few problems meeting demand. Future fish processing activity in the Bering Sea is expected to be done exclusively by floating processors and processor/catchers, therefore, the incremental increase in fishing vessels exploiting BS/AI fisheries should not impact freshwater demand in Unalaska to any significant extent. Vessels generate freshwater on-board using desalination equipment.

The offshore oil and gas industry also has needs for freshwater. These needs include cooking, cleaning, employees's personal use, and for use in mixing drilling mud and cement. While the need for freshwater for these uses is just as important as the fishing industry's for the same reasons, some distinction can be made in terms of freshwater and potable water demands by the OCS industries. Potable water is not necessarily needed for drilling mud and cement and therefore other sources of water could be tapped to obtain freshwater aside from Unalaska's municipal water system. Each supply boat will need to transport about 30,000 to 50,000 gallons of fresh water per week offshore to drilling sites (figure based on conversations with industry sources). This translates

Exhibit 6-27

Seafood Industry Fresh Water Demand

	Target Species		
Vessel Type	King and Tanner Crab	Groundfish	Salt Cod and Other fish
Catcher Vessel: No Processing	200-300 gpd for crew needs[1]	167-190 gpd for crew needs[2]	167-190 gpd for crew needs and 700 to 900 gpd for ice[3]
Catcher-Processing vessel	6,000 to 8,000 gpd generated daily onboard for crew needs. Minimal processing needs[4]	6,000 to 8,000 gpd for crew needs	6,000 to 8,000 gpd for crew needs[5]
Floating Barge Processor	Up to 90,000 gpd	40,000 to 50,000 gpd for processing	30,000 to 50,000 gpd for processing
Onshore Processor	Up to 100,000 gpd for processing	40,000 to 90,000 gpd for processing	30,000 to 50,000 gpd for processing

---

[1] Assuming vessel needs 2-3,000 gallons of fresh water per filling and is filled 3 times every 30 days.

[2] Assumes 700 to 800 gallons used per trip with replenishment needed for 40 weeks per year. (700 x 40 trips divided by 7 crew members times 24 days = 167 gpd.)

[3] Assumes 12 to 15 tons of ice per trip. Ice can be made out of salt water too however. (Water equals 8 pounds per gallon and was used to calculate ice demand). Also assumes 40 trips per year as in Footnote 2.

[4] Assumes 30 to 60 day trips, fresh water generated on board vessels, generated daily with no need for water obtained in port.

[5] Salt cod will not be processed offshore. "Other fish" may include halibut, salmon, etc.

Source: Personal Communications with fishing industry personnel.

to about 4,000 to 7,000 gallons per day. Drilling rigs, pipe-laying barges, development platforms and exploratory rigs are all expected to have their own desalination plants for generating fresh water.

Ideally, OCS companies would like water distribution lines to run to their property and docks for convenience reasons. However, running lines to planned OCS bases in Captains Bay near Dutch Harbor would require an updating of the water plan, installing pipe, and tying into existing distribution lines on the Crowley property. The cost of doing all this to get such a small amount of water does not seem to justify the benefits. Rather, in the short term, to forego costly outlays for obtaining fresh water to Captains Bay, the best alternative seems to have all the fresh water transferred by tank truck operated by the OCS companies. This could be easily accomodated by the city. Future onshore OCS development scenarios should include servicing the offshore industry directly with city water lines, and in the event a large OCS service base is constructed in Captains Bay or elsewhere, alternative sources of water should be considered for that development. These alternative developments would include water wells, ground water and surface runoff collection, or the development of the Shaishnikof River which outlets at the head of Captains Bay.

In conclusion, use of the city's water by OCS companies is expected to be minimal, therefore impacts on the fishing industry from this use should be very minimal. An extreme amount of improvement on the city's existing system needs to be undertaken.

6.8.2 Sewer and Wastewater Treatment

Sewage is handled in a variety of ways in Dutch Harbor/Unalaska. According to the State of Alaska's Department of Environmental Conservation, all seafood processor wastes are discharged by pipe on the northwest side of Amaknak Island. The city's wastes are discharged directly into Iliuliuk Bay. New construction developments in the area are either discharging directly into the adjacent ocean waters or into septic tanks. Construction of OCS support bases would not impact the fishing industry unless wastes were discharged directly into Iliuliuk

Harbor where the processors obtain their seawater for processing. Some processors screen and treat their wastes with chlorine but for the most part wastes are piped directly offshore.

Offshore support bases in Captains Bay are far enough removed from fishing activity in Iliuliuk Harbor (about four miles), such that any discharge into the Bay would not interact with the fishing industry. The operator of the Offshore Systems dock has indicated that a septic tank and leach field will be built to handle the wastes generated on shore by the OCS work force. Bilge wastes from offshore supply vessels will have to be appropriately discharged in accordance with EPA, U.S. Coast Guard and State DEC regulations.

Unless wastes are discharged into the seafood processors saltwater intake systems, wastes generated by the OCS industry in Unalaska should not impact the fishing industry.

In the community of Unalaska, homes discharge water effluent in a variety of ways. Some homes have cesspools, some homes are using wood stave pipe which was installed in the 1940's and some homes and housing projects are using septic tanks and leech fields. Presently all leech fields and waste discharges are subject to State DEC laws and regulations.

Continued monitoring of all intake waters should occur and OCS wastes appropriately treated before allowing them into receiving waters to prevent pollution.

6.8.3 Electricity Generation

At present, electricity is generated by the City of Unalaska for its municipal and residential customers, not for industrial users of electricity. All power used by the seafood procesors is generated on an individual basis by each processor at their own processing facility. OCS companies will likewise generate their own power with their own generators.

The City of Unalaska is planning on constructing a 35KV distribution system to connect the boat harbor on the Dutch Harbor Spit. Also, the city's utility plans to eventually displace all power generation by residential and small commercial power users and to offer seasonal and/or occasional power to industrial users, such as seafood processors. However, industrial power users will continue to be self-supplied. Over time, alternative power generation may be supplied by local hydro development, a heavy fuel low-speed diesel plant, or a geothermal plant at Makushin Field on Unalaska.

Ostensibly, "industrial users," as mentioned above would also include OCS support bases. OCS companies planning on operating out of Dutch Harbor/Unalaska will generate their own power on-site until power is distributed to their docks via a reliable central system.

Because each large power user generates their own power, the existence of OCS operations in port would not affect the fishing industry's electricity generation. Additional power demand by OCS companies from a central power source would reduce power available for other users thereby increasing their need to generate power during peak loads and thereby increasing costs to the fishing industry. To mitigate this, OCS companies should use their standby power generators to decrease their demand on the central power system.

6.8.4 Fuel

All fuel is sold and distributed by the Chevron Oil Company's (Standard) retail outlet in Dutch Harbor. The major demands on the Chevron facility in the Dutch Harbor/Unalaska area are for fuel to power the city's diesel generators, the processor's generators, fishing vessels, and other ocean-going vessels. This fuel facility is wholly owned by Chevron and is not a municipal facility.

Fuel is stored on-shore in tanks with a combined storage capacity of 13 to 16 million gallons. The storage tanks are replenished by tankers from refineries in California. The frequency of tanker deliveries into

Dutch Harbor depends upon the season and local demand with about seven tankers in the summer and two to three in the winter (from October to May). Hours for the facility are 8 a.m. to 5 p.m. or until all customers waiting to be refueled are finished. Major users in the summer besides fishing vessels are tugs and barges which use the fuel outlet on their way northward to Nome and the North Slope.

According to Chevron management in Kenai and at the Dutch Harbor facility, there is a steady, heavy demand upon the fuel. This is to be expected as not only is all electric power generated by decentralized diesel generators with each processor and the municipality operating separate generators, but the Standard dock is the major fueling station in the Aleutian area. Some decrease in fuel usage would be expected if a central power distribution system were installed. Long term power generation plans include either a geothermal plant at the Makushin Field near Unalaska or by a heavy fuel low-speed diesel plant in Unalaska as discussed in the previous sub-section.

In any event, seafood processors will operate their own generators and the City will probably only be able to augment these sources. The processors feel it is important to have their own sources of back-up power generation during emergencies even if there were a central power source. Because of this, long-term dependance of all electricity users on fuel and energy supplied by Chevron's fuel facility is expected to continue.

Offshore development will impact this fuel outlet in several ways. Additional vessels requiring fuel will probably lengthen the time needed to refuel. However, this demand will not preclude fishing vessels or other vessels from obtaining fuel as the fuel docks stay open while demand warrants. Additional vessels waiting for fuel could create some congestion near the fuel dock but Dutch Harbor is large enough such that actual vessel interaction should be minimal.

It is customary for any large user of fuel to let the Chevron management know in advance that they will be needing a large amount of fuel so that

Chevron can plan ahead, order additional fuel barges, and meet the incremental demand. There has never been an instance in the past at this facility of a shortage of fuel or a break in the delivery schedule, even during the 1973-74 oil shortage. This is because fishing is classified as an agriculture activity and received priority over other users for fuel supplies, and because the major users of fuel in Dutch Harbor/Unalaska are the fishing industry, all fuel needs were met.

The operators of the Offshore Systems dock in Captains Bay are installing a 10,000 gallon fuel storage tank which will be used as a fuel tank for their diesel generation plant to generate power at the dock. Fueling this facility and the initial number of supply vessels has been arranged between the operator and the Chevron dealer, and, as is standard operating procedure, when and if very large amounts of fuel are needed, this would also be pre-arranged with Chevron. A breakdown of Chevron's total throughput in 1981 and the first 11 months of 1982 is provided in Exhibit 6-28.

This exhibit shows that the majority of fuel moving through Dutch Harbor is used in other communities in Northwest Alaska (59 percent in 1981). Dutch Harbor is used as a storage depot for these other coastal communities. Of the total throughput amount, 33,873,472 gallons of fuel (41 percent) were delivered locally. Of total local distribution the largest amount of fuel went to marine vessels (82 percent). The second largest demand (15 percent) went for diesel fuel sales for trucks, heating oil and the area's electrical generating plants. Larger prop-jet aircraft fuel demands accounted for two percent of the demand on local fuel usage and smaller aircraft used less than one-half of one percent of total local fuel use. Gasoline sales accounted for one percent of all local demand.

Exhibit 6-29 shows the total throughout by major tonnage group in Dutch Harbor for 1972 through 1978. Petroleum products, as a percent of total tonnage, accounts for the majority of tonnage coming into Dutch Harbor.

Exhibit 6-28

Volume of Fuel Sales in Dutch Harbor/Unalaska and Other Northwest
Alaska Communities for 1981 and 1982

Year	Local Gas Sales[1]	Marine Vessels[2]	Diesel Fuel[3]	Aviation Gas[4]	Jet Fuel[5]	Transhipped[6] through Dutch Harbor	Total[7]
1981	405,500	27,812,000	5,018,500	104,400	532,790	49,242,528	83,116,000
1982 (first 11 months)	386,036	27,276,500	4,410,400	63,720	494,746	58,091,000	90,722,000

---

[1] Primarily for cars and trucks.

[2] Marine vessel category includes all fishing vessels and research vessels.

[3] Diesel fuel represents all number 2 diesel fuel sales for trucks, heating fuel, and for generators owned by the City of Unalaska and the port's seafood processors.

[4] Aviation gas is for smaller airplanes, float planes, etc.

[5] Jet fuel is for prop-jets using the city's airport.

[6] Transhipped out through Dutch Harbor to the following communities: Kotzebue, Nome, Bethel, St. Paul, and St. Michael. This figure represents the total of all categories (gas, diesel, aviation gas and jet fuel). Dutch Harbor serves as a storage depot for these communities and deliveries are made as needed.

[7] Figures may not add due to rounding.

Source: Personal Communication with Chevron management in Dutch Harbor/Unalaska.

Exhibit 6-29

Total Throughput Tonnage by Major Commodity Group
Iliuliuk Harbor[1]

1972-1978

Year	Petroleum[2] Products	Percent	Food[3] Products	Percent	Fish[4] Shellfish	Percent	All Other[5] Commodity Groups	Percent	Annual Total	Percent
1972	173,460	91	36	0.02	14,508	8	2,105	1	190,109	100
1973	144,555	88	3,224[6]	0	13,086	8	2,721	2	163,586	100
1974	88,790	56	5,598	2	61,429	39	4,021	3	157,477	100
1975	272,222	90	9,241	2	20,563	7	2,570	1	300,953	100
1976	321,290	92	10,813	2	15,638	4	3,591	1	349,760	100
1977	318,298	93	10,813	3	6,226	2	6,987	2	342,324	100
1978	333,240	88	6,053	2	23,329	7	10,879[7]	3	378,501	100

---

[1] The term "Iliuliuk Harbor" is used by the Corps of Engineers to refer to all bays and harbors in the Unalaska/Dutch Harbor area.

[2] Includes gasoline, jet fuel, fuel oil and miscellaneous petroleum and coal products.

[3] Includes salt, prepared fish, alcoholic beverages, groceries and miscellaneous food products.

[4] Includes fresh fish and fresh shellfish.

[5] Includes all other commodities.

[6] Large increase between 1972 and 1973 due to large change in prepared fish.

[7] Excludes local dock-to-dock transfer - 396 tons shipped and 396 tons received.

Source: Corps of Engineers, Waterborne Commerce Statistics, Part 4, for the period 1968-1978.

Supply vessels using Dutch Harbor will increase demand for diesel fuel and offshore-related dock facilities will also increase demand on diesel fuel because of the need to operate electric generators.

A breakdown of fuel use by vessel type is given in Exhibit 6-30. These figures are estimated based on conversations with industry personnel and various articles in the National Fisherman Magazine. Because of the large amounts of fuel taken on by vessels and because of a higher price charged for diesel in Dutch Harbor than in Seattle, some of the larger processing vessels and catcher-processing vessels can be expected to return to Seattle for fuel. This is not only due to the price of fuel but other economic reasons. Fishing trips by larger fishing vessels will last 40 to 90 days and after this time of catching and processing fish it would be necessary for crew R&R, refueling, equipment maintenance and repair, and to unload the finished fish product. To do all of this in Unalaska would involve major costs including higher fuel costs, flying the crew south, and paying extra freight costs for the finished fish products. Therefore, vessels may elect to go to Seattle directly and take care of all of these things which would reduce the impact on Dutch Harbor's fuel facility.

While impacts on the supply of fuel for users of the Chevron fuel facility can be expected to be minimal, some impact at the docking facility between offshore oil vessels and fishing vessels will probably occur. To mitigate congestion at the fuel facility between the fishing and offshore industries, dedicated docking facilities built by offshore exploration and development companies should be encouraged to have their own fuel tanks to fill their vessels. Dedicated fuel facilities at a dedicated dock (such as the Offshore Systems and Exxon dock) should be encouraged in the planning process for these facilities. Individual dock owners which have fuel tanks for their vessels and power plants should continue to cooperate with the Chevron fuel dealer to place orders and prevent supply bottlenecks.

6.8.5 Police, Fire, and Health Services

Over the years, Unalaska has had to adjust to the fact that economic activity and its affect on the local population would rise and fall with

Exhibit 6-30

Fuel Use by Vessel Type

Vessel Type	Fuel Use	Fuel Storage Onboard
OCS Supply Boat	1,800 - 2,000 gpd	40,000 - 60,000 gallons
Floating Processor	1,800 - 2,200 gpd	170,000 - 200,000 gallons
Crab Vessels and Groundfish Vessels	800 - 2,000 gpd	40,000 - 60,000 gallons
Catcher/ Processing Vessels (Groundfish)	1,200 - 2,100 gpd	130,000 - 150,000 gallons

Source: Fishing and offshore personnel, marine architects, National Fisherman Magazine, January, 1983.

the yearly fishing seasons. Therefore, the community has had to strike a balance between the high and low population levels in terms of the City's police, fire and health services. And, rather than training City personnel to be fire fighters, or policemen, or emergency health technicians, City personal are trained in public safety and fire fighting and receive Emergency Medical Technician (EMT) training. This gives the Director of Public Safety a "pool" of personel to draw from.

The City's fire department, which is manned by police as needed, has one full time Commander. Also, both Amaknak Island (the Dutch Harbor side) and Unalaska Island (the Unalaska side) have their own volunteer fire fighters and fire fighting equipment. The police department has 17 to 18 full time personnel which do dispatch and clerical duties, serve as watch commanders, public safety officers, and correction officers. Each part of the community has an officer on patrol with police operating 24 hours a day, year-round.

Health services consist of a clinic and an osteopath. Typically, any case which cannot be dealt with locally is flown to Anchorage on a scheduled airline flight. Extreme emergencies can be handled by air charter out of Unalaska.

OCS activities will increase the local population and put an additional strain on fire, police and health services. This increase in local population would not be cyclical, as is the fishing industry, but steady and an increase the City could plan on in terms of their service needs. To mitigate the impact on these services, the OCS employees should be familiarized with volunteer fire fighting practices and fire safety precautions should be a part of any Dutch Harbor OCS onshore facility such as seawater pumps for firefighting. OCS companies should also provide for their own site security by providing fences, lights and their own security guards to relieve patrol burdens on local police. Increasing the number of local workers in the hazardous offshore industry will also tax the local health services. In this case, the possible improvement of the airstrip by offshore companies and the addition of helicopters and airplanes could help the community in emergency rescue evacuation, and transportation, of the injured.

The presence of the OCS industry in town would affect all these services to some extent. The fishing industry would be impacted by an increase in local taxes to support additional government services. The City should work with all local businesses to insure an equitable tax load. The fishing industry could also be impacted if police or fire services were directed towards an OCS site and the fishing processor or vessel were left without the availability of these services in case of fire, theft or vandalism.

6.8.6 Airport Facilities

Dutch Harbor/Unalaska's airport consists of a 3,900 foot gravel runway on Amaknak Island just north of Iliuliuk Harbor, adjacent to Dutch Harbor. The runway, which runs NW-SE across the island has a usable width of about 100 feet (Dames and Moore, 1980, and City of Unalaska, 1982). Near the southeast end of the island, is a concrete apron measuring about 1000 by 400 feet. On this apron are several former military buildings including a terminal used by Reeve Aleutian Airlines. This runway is suitable only for smaller propeller airplanes and is relatively dangerous because of its gravel surface, short length, and exposure to weather. The northwest end of the runway is unprotected and fronts Unalaska Bay and is often flooded by waves during storms.

A construction project proposed to the Department of Transportation would lengthen and surface the Unalaska airstrip to accommodate larger jet aircraft. A rockfill extension, wave protection structures, cutting away part of a hill adjacent to the runway, and major quarry work to obtain fill are all part of the plan. However, according to the State's Department of Transportation and Public Facilities (DOT/PF), most recent cost estimates place the project cost well above $50 million. Also, it was felt that the most practical site for a runway had not been final. Additional studies are needed, according to DOT/PF, to evaluate regional considerations of a runway at Unalaska. These include looking at Cold Bay, possible future developments at Chernofsky and the need there for air transportation facilities, and using existing airstrips at Fort Glen, which is about 70 miles from Unalaska, as a major jet landing strip and offering shuttle service to Unalaska in smaller propeller planes.

Basing offshore development support facilities in Dutch Harbor/Unalaska would have an impact on air service to the area and an impact on the fishing industry. Air service is presently provided by Reeve's YS-11 or AirPac's Metro II small propeller aircraft; flying time is about 5 hours one way from Anchorage via Cold Bay because transfer from larger planes at Cold Bay is necessary (which adds about one hour ground time).

Air travel is essential to maintaining high productivity in the fishing industry in Dutch Harbor. Both fishing vessels and processors may be idled while waiting for parts or labor to be flown in from Anchorage. Airplanes are used to transport workers to and from Anchorage. Emergency medical cases must be flown by airplane to Cold Bay to catch a jet to Anchorage.

Long term demand for air service is expected to grow dramatically with an increase in both bottomfish development and offshore development. Potential growth scenarios have been throughly discussed by the City of Unalaska (1982) with respect to offshore petroleum discoveries and growth in the bottom fish industry. It is apparent that future growth in both industries will cause competition for available passenger space and cargo space. It was stated in the City's report that the present airport is only able to handle a peak schedule of ten YS-11 aircraft daily -- well below mean growth estimates for bottomfish and offshore development which would require 28 flight operations daily. It was stated in the report that expanding the airport to accomodate 737 jet traffic would save money for the air traveler and for cargo shipping, cut delays, and lower the cost of transferring the Unalaska workforce between Unalaska and Anchorage or Seattle.

However, due to increased cost estimates for the runway expansion and a need for DOT/PF to look at alternatives to the Unalaska airport, for the purposes of this report it is assumed that airport expansion is not eminent. Therefore, some impact on the fishing industry's use of the airport will occur from the use of the same facility by the offshore industry. If Dutch Harbor/Unalaska were developed into a sizeable staging area for offshore development, some accomodation would have to be made to handle the necessary increase in fixed wing and helicopter traffic. Possible alternatives to the airport expansion at Unalaska include using the three airstrips at Fort Glen which is 70 miles from Unalaska and either picking materials up there or having them shuttled to Unalaska. The drawback to this alternative is that there are only small airport facilities at Fort Glen. The airstrips at Fort Glen are 8,500 feet long and two are 7,500 feet long.

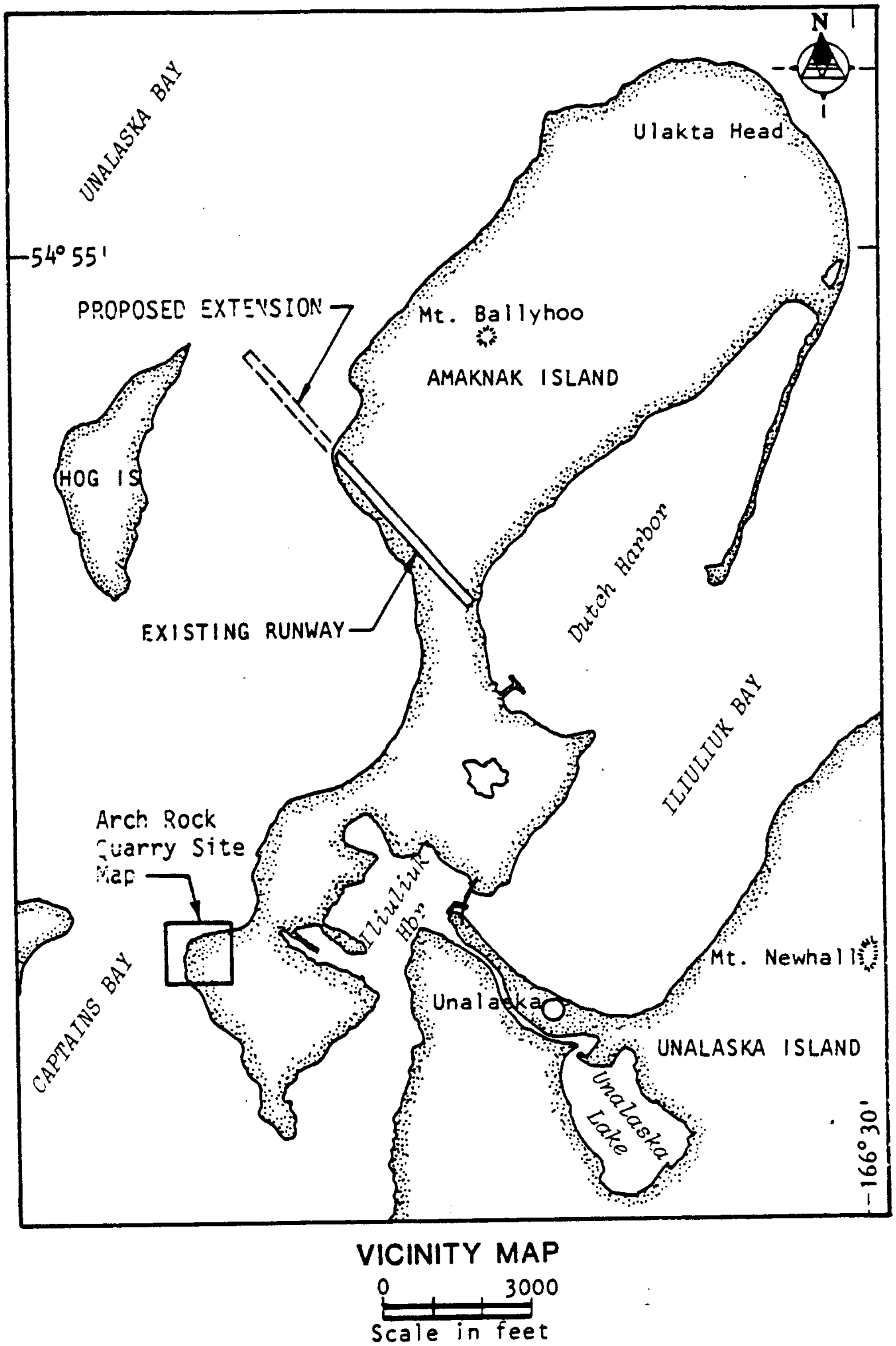
The harbor of Chernofski is only 12 miles from Dutch Harbor and could be developed by both the fishing and offshore industries. This would have to be a major development project and would not alleviate the need for an airstrip to also be built at Chernofski.

In order to mitigate impacts on the fishing industry's use of airport facilities in Dutch Harbor, the offshore industry may need to charter its own flights in and out of Unalaska. This would be beneficial for both industries to prevent unwanted delays for parts, materials and labor. Close cooperation between the City, the State's DOT/PF and the fishing and oil industries would be needed to prevent bottlenecks associated with the airport.

However, it does not seem totally logical to expend a large amount of money developing airport facilities at remote areas other than Dutch Harbor/Unalaska. No other port offers deepwater facilities, has an existing infrastructure, nor the population to take advantage of an airport as does Dutch Harbor/Unalaska. If OCS companies did locate in the port and decided that construction of an expanded airstrip would be to their advantage, many possibilities exist.

As shown in Exhibit 6-31, the proposed runway extends towards Hog Island with a quarry site near Captains Bay. Further extending the runway and adjacent area onto Hog Island would create a breakwater and on-shore storage areas at the quarry site, at Hog Island and along the airstrip. A man-made bay would be created, separate from the fishing industry and could be used as a dock area for supply boats.

Exhibit 6-31



VICINITY MAP

Of course, close cooperation between the City, State and the offshore companies would be necessary to undertake a project like this, but it certainly appears to be physically possible and would positvely impact Unalaska by having an improved runway suitable for jets. This in turn would help the local fishing industry. If runway facilities are not improved and/or decisions are delayed to accomodate the expected increase in local air traffic, major negative impacts should be expected on the ability of the fishing industry to find space on the limited number of aircraft using Dutch Harbor's airport.

6.8.7 Road Maintenance

Roads in the Dutch Harbor/Unalaska area are gravel which means they need to be maintained by road grader, as needed, by the City of Unalaska Public Works Department. Roads in the area would be negatively impacted by OCS activities because of an additional number of cars and trucks associated with this activity. Impacts would be even more noticeable if storage yards were located away from OCS loading docks and trucks were used to transport pipe and other drilling materials.

To mitigate this impact, the OCS companies may have to supply their own road maintenance equipment. The City should also plan to have the OCS companies support additional road maintenance through their local taxes. The fishing industry would not be impacted in this area. Some traffic delays may occur in the area during shift change and during increased fishing and offshore activities.

6 8.8 Housing

Housing in Unalaska has historically been in short supply. Recently supply has been about equal to demand but additional population caused by increased OCS activities in the area will impact the local housing market. Currently, the City owns housing for some of its employees. Also, the individual seafood processors provide bunk and board accomodations for their employees. Fishing vessel crews generally stay on-board ship if they don't have a local home. Therefore, the fishing industry should not be impacted by OCS support bases in Dutch Harbor/Unalaska. However, the City's supply of housing would be impacted by additional people moving into the area. Also, if the size of government were to increase, the supply of housing for City employees would also increase.

As in the rest of remote Alaska where resource developments have occured, it will be necessary to construct crew quarters for OCS personnel. This will alleviate pressure on local developers and the city to provide housing. Crew quarters should be located as close as possible to the OCS work sites to minimize other impacts on the community such as on roads.

6.8.9 Municipal Dock Space

Municipal dock facilities were recently constructed on the Dutch Harbor spit. Space is primarily to be used for permanently-based and transient fishing vessels. And, because there are docks under construction for use by the offshore industry, the short term impacts on this dock facility should be zero. However, given long term projections as to the number of supply boats needed offshore, use of municipal docks by the offshore vessels would occur.

Unless docks were constructed to specifically moor OCS vessels, future impacts on municipal docking facilities should be significant. This would directly impact the fishing industry causing rafting, exclusion, and possible vessel damage from the elements or from banging against other vessels while moored alongside each other.

To mitigate the impact on dock space, OCS vessels using the municipal or transient dock space could be charged a higher docking fee than fishing vessels. This will discourage OCS vessels from using the dock and would raise revenues so that additional docks could be constructed. The City should also encourage dedicated OCS docking facilities located away from fishing vessel docks to minimize interactions.

6.8.10 Municipal Government

With additional economic growth and the growth of the offshore industry's presence in Dutch Harbor/Unalaska, the growth of Unalaska's government should be expected. Government will be called on to issue and administer permits, plan future developments, serve the community and tax its industries and citizens. Basically, government will be impacted by having to do "more". This may in turn impact the fishing industry by having less time devoted to its needs and having services spread over a larger populace.

The State of Alaska has many programs designed to assist local government in planning and mitigating adverse impacts resulting from oil and gas development. These include the State's Community and Regional Affairs Department and the Coastal Energy Impact Program to name just a few. Local officials are very familiar with sources of State assistance so that governmental growth and transition should be smooth.

6.8.11 Summary of Impacts

Basic utility services in Dutch Harbor/Unalaska need to be improved. The most important component of the City's infrastructure which needs improvement is the water system. If the water system is not improved, in the long run, OCS activities will have a major negative impact on the fishing industry's use of fresh water. If the water system's distribution lines, storage tanks and supply sources were improved the OCS industry should have no impact on the system.

Another component of the municipality infrastructure which may experience major impacts if adjustments aren't made to the increase in local OCS activity is police protection. This will be primarily because of the need to police more area and a greater number of people.

Roads may experience a major impact from increased vehicle traffic over the long term, particularly if OCS storage yards are located away from docks. Housing also would be negatively impacted with an increase in local population and OCS workers unless housing is provided for the OCS employees.

Unless dock space is constructed for OCS vessels, a major negative impact can be expected on the present amount of local dock space. Airport facilites also are in need of major improvements to accomodate increasing flights into and out of Dutch Harbor/Unalaska.

Anticipated impacts on these various components of Dutch Harbor/Unalaska's infrastructure are summarized in Exhibit 6-32.

6.9 St. Paul Infrastructure Impacts

While the great majority of offshore oil and gas onshore activity is expected to operate out of Dutch Harbor/Unalaska, some onshore support for offshore oil and gas development may be located in St. Paul. This activity is expected to be minimal primarily because St. Paul does not now have a port and because what infrastructure exists, exists to support a small community, not any sizeable industry. Improvements would be needed literally from the ground up to accomodate the docking of vessels, the transfer of supplies and the onshore storage of materials.

The people of St. Paul are dependent on the Federal Government for their employ. Specifically, the National Marine Fisheries Service employs villagers to harvest the Northern Fur Seal. As required under international treaty, only the Federal Government may harvest the seals, so the villagers became employees of the Government to carry on their historical occupation. Because St. Paul was under the jurisdiction of NMFS and formerly the Bureau of Fisheries, NMFS took care of the community's provisions, its water, fuel, housing, roads, airport, communications, and all other needs.

With the advent of the Alaska Native Claims Settlement Act and the enactment of the Federal Government's relatively recent policy of selectively minimizing some actions of government, NMFS is withdrawing

Exhibit 6-32

Potential Impacts on the Infrastructure and the Fishing Industry in Dutch Harbor/Unalaska

Facility	Degree of Impact	Explanation	Mitigation
Municipal Water	Short term impacts: minor negative or none Long term impacts: if water system improvements are not made, major negative. If water system improvements are made, there should be minor negative or none on the system but a positive income on municipal water sales to OCS companies.	OCS water needs are relatively minor so that meeting water demands should not impact the City's system. Major storage, and distribution work needed on existing facilities. Charges on the OCS industry's use of water could be used to enhance system.	Use water delivery truck instead of distribution lines to OCS docks. Gather water onsite. Obtain water from sources other than city's system.
Police Protection	Short term impacts: minor negative Long term impacts: major negative	OCS storage areas need to be patroled. Additional workers in town on a transient basis will add burden on enforcement. More population will require police protection.	Require OCS companies to hire their own security forces. Use adequate security precautions around dock and storage facilities including fences, locks and lights. Increase size of local police force.
Fire Protection	Short term impacts: none to very minor negative. Long term impacts: minor negative	Storage of fuel on-site will increase fire hazard. However, OCS materials are not generally flammable and water would be available to fight fires using seawater.	Sea water pumps should be required onsite for fire fighting. Fuel storage tanks should be located away from office and crew quarters. Workers should be acquainted with local volunteer fire fighting methods to assist the city.

Exhibit 6-32 (Cont.)

Potential Impacts on the Infrastructure and the Fishing Industry in Dutch Harbor/Unalaska

Facility	Degree of Impact	Explanation	Mitigation
Health Services	Short term impacts: minor negative Long term impacts: minor negative to major positive	An increase in the number of OCS workers locally will increase the demand on local services to provide first aid, emergency treatment and medical transport to Anchorage. Increased OCS activity in the long term will increase the availability of aircraft and vessels in the area to aid local emergency personnel in the care and transport of the affirmed.	Use OCS helicopters and airplane charters for medical rescue and transportation.
Sewer System	Short term: none Long term: minor negative	Sewage generated at OCS sites will be minor and disposed of using septic tanks and leech fields. In the long term, if enough sewage were generated, the receiving waters could be affected negatively and could impact the fishing industry which uses seawater for processing.	Close monitoring by local and state environmental quality officials to prevent water quality degradation. Early planning and judicious use of leech fields, bilge discharge recepticles and sewage pipe outfalls to prevent contamination of seafood processing waters.
Electricity	Short term: none Long term: minor negative	Electricity will be generated onsite as is the practice of all local industrial power users. If central power sources are constructed, OCS user would probably tie in with the distribution system but still maintain generators during central system down times.	Continue use of individually generated power.

Exhibit 6-32 (Cont.)

Potential Impacts on the Infrastructure
and the Fishing Industry in Dutch Harbor/Unalaska

Facility	Degree of Impact	Explanation	Mitigation
Road Maintenance	Short term: minor negative Long term: minor-major negative	All roads in area are gravel which require maintenance. Additional cars and trucks will require additional maintenance, particularly if storage yards are located away from loading docks.	Assess road users fee upon OCS companies to defray additional costs of road maintenance. OCS companies may need to provide their own maintenance equipment.
Airport Facilities	Short term: major negative Long term: major negative	OCS operations at Dutch Harbor will be very dependent upon labor, parts, and cargo flown in from Anchorage. Helicopter use of the area will also increase. Displacement of fishing-related labor and cargo would occur. Existing airport and runway inadequate to handle increased traffic.	Extend runway and adjacent open area and construct warehouse area to facilitate additional use. Construct and/or enhance airport facilities at other locations such as Cold Bay, Chernofsky and Fort Glen.
Municipal Dock Space	Short term: none to minor negative Long term: major negative	Dock facilities are being constructed to accomodate short term OCS vessel use. Increased OCS vessel use in the long term would impact public dock space primarily because of the large number of OCS vessels projected.	Construct dedicated OCS dock facilities. Prevent OCS vessels from using dock space set aside for fishing vessels. Encourage dock developments by OCS companies seperate from fishing industry activities.
Fuel Facilities	Short term: none Long term: none	This is not a municipal facility. All fuel sales handled by the Chevron bulk dealer.	To prevent delays in obtaining fuel, large orders should be planned in advance with the Chevron dealer.

Exhibit 6-32 (Cont.)

Potential Impacts on the Infrastructure
and the Fishing Industry in Dutch Harbor/Unalaska

Facility	Degree of Impact	Explanation	Mitigation
Municipal Government	Short term: none - minor negative Long term: minor negative	Increased burden on the city of Unalaska to plan, process and administer development activities and permits. Some growth of government should be expected with growth of local population and development activities.	Work with the States Community and Regional Affairs and the Coastal Energy Impact Program (CEIP) to assist in local planning and to obtain revenues to offset the cost of government.
Housing	Short term: minor negative Long term: major negative	Historically there has been surplus demand for housing in Unalaska. City housing is reserved for city employees generally. An increase in the amount of OCS activity will increase the demand for housing and an increase in government services will increase the number of city employees and their need for housing.	OCS companies should construct their own crew quarters at the OCS docking sites. This would minimize other impacts associated with OCS work such as impacts on the areas roads.

Source: Summarized from text.

from St. Paul and turning over the Island's administration to the locals. Local natives will still need to be employees of the government to harvest the seal hides but management and harvest quotas will be set through a sort of "observer program", as is presently the situation onboard foreign fishing vessels, instead of NMFS being present en masse. Because St. Paul is going through this reins transfer, adding an element of local fisheries and OCS development could add to possible confusions arising out of the general transition of government authority. Because of the lack of port facilities and infrastructure, emphasis in this section is on the planning of OCS development in conjunction with fishing growth which is planned for the area. The major impact of any activity in St. Paul may indeed be on the government of St. Paul to make a smooth transition from a ward of NMFS to an independent community while also having to plan for a proposed fishing port on the island.

Much of the discussion in terms of OCS impacts is speculative and impacts from onshore OCS development must be considered: if a port is built, if the fishing industry locates there, and if the OCS industry is allowed to build a support base -- all of which is uncertain at this point.

Also, tempering any port development for the fishing and OCS industries is the desire of St. Paul leaders that the local character of the island be maintained. This would bar large developments not geared for local employment possibilities or which disturb the cultural and/or community atmosphere of St. Paul. Most of the information on the St. Paul infrastructure and the proposed harbor development comes from personal communications with Norgard, U.S.A. which is designing the harbor, the NMFS engineer at St. Paul, Dick Fraser, the State's DEC representative, John Collins, and the St. Paul planner.

6.9.1 Proposed Harbor Plan

The basic layout of the harbor was shown in Exhibit 6-10. There would be a 1,770 foot breakwater which would be about 80 feet wide. The breakwater would be used to moor one floating processor, a number of fishing vessels and for offloading cargo and other goods.

Behind the breakwater, a 17 acre boat harbor would be created with an average depth of 17 feet. Along the breakwater water depths would average 20 to 25 feet. The goal of the boat harbor is to provide the basic port facilities necessary to support one processor, smaller local fishing boats and a few larger non-local boats. The harbor would offer docking and an ice and fuel facility. Some onshore work for open storage and developing a borrow pit for the breakwater construction have also been discussed by planners. Onshore processing facilities are, however, not a part of this harbor plan. Also, onshore service bases for OCS activity have not been included in the design of the St. Paul harbor.

6.9.2 Water

St. Paul's present water system is supplied by two, 80 foot deep wells near the airport. Capacity of these wells is about 100,000 gpd but only one four inch pipe delivers the water to storage tanks which limits flows to about 120,000 gpd. Water is stored in three 200,000 gallon cement storage tanks which are showing signs of age and need to be repaired and relined. A recent U.S. Geological Survey reconnaissance study of St. Paul reported the potential to develop one million gpd on the Island. If this water were developed it would be more than adequate to supply the needs of the fishing industry activity planned for St. Paul.

Water distribution lines are iron and there has been relatively few problems associated with the system. The fishing industry would have to develop water lines to the proposed harbor to tap into existing supply. Fresh water would be needed for personal needs, processing and ice.

6.9.3 Sewer

Most of sewage and water effluent in St. Paul is disposed of using septic tanks and leach fields. These tanks are fairly large and due to a lack of maintenance and pumping out of the leach field's sludge, the drain fields often get plugged with solids.

Fishing industry activity would not use these facilities but would discharge directly into the ocean. If the OCS companies located in the harbor, attention would have to be paid so that sewage and bilge discharges did not enter the saltwater intake pipes of the processors.

6.9.4 Electricity

The City will soon replace its existing generators with three 350 KW diesel plants and use three 175 KW diesel plants for backup. Ordinarily the community has a 350 to 500 KW load on the system. Energy use is highest in the summer. The largest energy users are the St. Paul residents and two small seal blubber and meat rendering plants.

Both the fishing and OCS industries will probably be self-supplied if they locate in St. Paul and impacts should not be noticeable on St. Paul's electrical infrastructure.

6.9.5 Fuel

Fuel is brought into St. Paul once a year by Navy barges. Deliveries are made by anchoring the barge offshore and using a floating boom to transfer the fuel onshore. Diesel storage capacity onshore is 800.000 gallons and gasoline storage is 100,000 gallons.

If fuel facilities were not developed by the fishing and OCS companies locating in St. Paul, barge frequency would have to be increased or on-shore storage tank capacity increased.

6.9.6 Airport

The St. Paul airport is one mile long and 150 feet wide with a gravel service. Reeves Airlines has scheduled flights into St. Paul on prop-jets twice a week in the winter and three times a week in the summer. A Lear Jet often uses the airport during medical emergencies and Hercules and Electras also use the airport. However, pot holes, improper drainage, and loose gravel necessitate a continued maintenance program. If the fishing and OCS industries use St. Paul, major impacts on the airport facilities would occur and resurfacing and lengthening of the airstrip would be required.

6.9.7 Public Services

The Public Health Service sponsors a doctor in town and the City also has one policeman, a volunteer fire department, and takes care of the road maintenance. Also, NMFS and now the city government is responsible for bringing in grocery and spare part provisions four times per year. Provision barges are lightered onshore using surplus military landing vehicles. Services would be impacted by port development due to an increase in population but provisioning of the town would be made easier by constructing a dock facility for barges.

6.9.8 Summary of Impacts

The major impact on St. Paul's infrastructure if OCS onshore support bases located there would be on the local airport runway. Improvements to the surface of the runway to accomodate the increase in air traffic would be required. Also, the port which is being planned would be impacted if OCS activities were introduced and not planned for. Competition for docking and loading space would occur. Therefore, any anticipated OCS activity in St. Paul should be designed into the local harbor development before being constructed.

6.10 St. George Infrastructure Impacts

St. George lacks a protected harbor and therefore Dames and Moore, et. al. (1982) proposed the harbor which was shown and discussed in Section 6.1.20. Presently fishermen on both St. Paul and St. George are restricted to small outboard skiffs with shallow drafts which can be beached when not in use. Also, because of a lack of harbor facilities, any new docks which may be used by the OCS or fishing industry could also be used by the village to offload supplies and materials. Information in this section comes primarily from Dames and Moore, et. al. (1982).

6.10.1 Water

Water is supplied to the village of St. George by two wells. Because the water is too salty for human consumption, drinking water is obtained from the public health source clinic which operates a reverse osmosis unit to remove minerals. Because of the poor quantity and quality of St. George water, any fisheries or OCS operations locating there would be expected to operate their own desalination plants. Since both industries would have to develop fresh water supplies from a limitless supply (saltwater) the fishing industry should not be impacted by the OCS industry's use of water.

6.10.2 Sewer

Fish processing wastes will probably be discharged directly into the ocean. OCS companies will also discharge in this manner unless septic tanks are required by permit agencies. The fishing industry would not be impacted by OCS discharge if the discharge is located away from any intake pipes.

6.10.3 Electricity

Power on St. George Island is presently supplied by three 125 KW generators and one 375 KW generator. Fuel is stored at the plant in a 4,000 gallon tank. As is the practice in all Bering Sea ports, if fishing and OCS activities were based in St. George, both would have to supply their own power. Therefore, none of the power users on St. George would be impacted by another.

6.10.4 Fuel

Because of limited fuel supplies, fuel storage would need to be increased as well as the frequency of deliveries if fishing or OCS companies located here. This would probably be done in conjunction with any onshore development or harbor construction but fishing and the OCS companies should also maintain separate supplies for refueling their vessels.

6.10.5 Airport

Existing airport facilities consist of a gravel runway, 3,000 feet long and 100 feet wide. Presently, only small twin engine aircraft use the airport. Any fishing or OCS development in St. George would necessitate the construction of a longer, improved runway.

6.10.6 Summary

Construction of a boat harbor at St. George would benefit the island in several ways. It would allow easier unloading of fuel and supplies; it would give local villages a place to develop alternative employment opportunities such as construction and fishing, and it would allow villagers a permanent docking facility. Development of a harbor for the fishing industry and/or the OCS industry would impact St. George in various ways as discussed in Dames and Moore and Norgaard, USA (1982a). However, if accomodation of OCS, fishing and local village needs are addressed early on in the planning and construction of a boat harbor, negative impacts can be minimized.

6.11 Chernofski Infrastructure Impacts

Since there is not a port or any infrastructure in Chernofski, possible future impacts cannot be discussed. The proposed harbor development as shown in 6.1.22 indicated that OCS activity would be located at a sufficient distance such that potential interaction between fishing and OCS activities would be minimized.

6.12 Akutan Infrastructure Impacts

The majority of fishing activity in Akutan is presently done in Akutan Harbor. Only two plants are located onshore and up to 13 floating processors have been in the Harbor during past busy shellfish seasons. According to the Alaska Department of Community and Regional Affairs (DCRA, 1982a), a world class onshore processing plant operating year round has been proposed. Included in this proposal is a two acre boat harbor and a dock facility for about 15 boats in the 60 to 90 foot class. Construction of this facility does not seem emminent and Akutan should continue to play host to a large number of catchers and floating processors. The two onshore processing plants should also continue to expand and improve their facilities.

These processing plants can be expected to supply their own infrastructure needs and if OCS operations occur in Akutan they would be expected to also develop their own infrastructure. Akutan has neither the municipal infrastructure, nor does the village seem financially capable of providing these needs. OCS activity which has been allocated to Akutan should be transitory -- anchoring in the Bay, etc. -- until such time as an OCS enclave is actually constructed there. Municipal and fishing industry infrastructure should not be impacted by this construction.

6.13 Nome Infrastructure Impacts

The construction of a harbor/breakewater in Nome would not impact the fishing industry infrastructure because of the limited amount of fishing activity which takes place in Nome. This activity is limited to local herring and salmon fishing and to offshore processing and fish buying.

The major benefit to the fishing industry which would occur if a port were built would be to give the industry a base of operations in the Northern Bering Sea. There is presently no dock or deepwater port in the Norton Sound region capable of accomodating large deep draft fishing vessels.

Impacts on the community infrastructure of Nome would occur with this port development. These impacts need to be weighed against the benefits of having a port at Nome which would serve the fishing, OCS, mining, and transportation industries. The proposed harbor development project will provide a significant beneficial increase in industrial storage and warehousing land use activities in Nome and no permanent adverse land use impacts or conflicting uses are anticipated (Environmental Services Limited, 1981). The harbor will offer significant benefits in harbor and mooring safety, improved cargo handling and increased shallow water fishing (Environmental Services Limited, 1981).

6.13.1 Water

Water distribution lines will have to be extended out the causeway in order to meet the fresh water needs of vessels using the port. The most serious shortcoming in the present water system is the lack of adequate supply. Based on Nome's water use of 201,000 gpd, the local storage reservoir has the capacity to provide a reserve of 1.5 days (Environmental Services Limited, 1981); the minimum amount for reserve purposes is considered three days. This lack of storage is a detriment to local fire fighting capabilities.

Additional construction and population growth will impact the City's water supply. The needs of the fishing and OCS industries for water will cause an additional impact on the supply. To minimize impacts on the city, additional water sources and supplies will have to be constructed.

6.13.2 Sewage

Increased population associated with harbor development will impact the city's sewer system. Wastes from any OCS or fishing activity which operates in the proposed harbor will probably be treated and discharged at sea and should not impact Nome's sewage infrastructure.

6.13.3 Electricity and Fuel

Nome's electricity is generated by eight diesel generators and most structures within the city limits receive electric service (Environmental Services Limited, 1981). A fuel oil tank farm operated by Chevron borders the eastern boundary of the proposed port development. The main city power plant lies to the north of the site. Therefore, both fuel storage and transfer, and electrical connections are available to the port.

Fuel supplies would be impacted by a port development and storage would need to be increased to meet the demand of larger vessels for fuel. Also while the city will probably extend electricity to the port, fishing vessels will operate their own power plants onboard the processors. Also, standby generators will probably be used by OCS companies increase of a municipal supply system shutdown.

6.13.4 Airport

Practical annual capacity at Nome Field has been estimated by Environmental Services Limited (1981) at 175,000 yearly operations and it appears that the airport is adequate for long term future needs --with or without additional OCS and fishing activity. Impacts on the main city airport, Nome Field, are further mitigated by the existence of Nome City Airport which could be leased out and/or used by frequent users of air facilities.

6.13.5 Public Services and Municipal Infrastructure

The addition of fishing and/or OCS activities will strain municipal services including road maintenace and traffic control, public safety, the fire department, and medical facilities. However, unless bunk and rooming facilities are constructed for the additional population directly associated with the two industries, housing will be the most critically impacted. It is expected that fish processing personnel will live on-board the processors and OCS personnel will stay in company-supplied quarters.

6.13.6 Summary

Nome will benefit from having a port facility in that fewer port closures due to rough weather and shallow water can be expected. Because of the presence of sea ice from November through May the port will be used only in the summer. Fish processing will be done on floating processors and the processors should be self-sufficient. The OCS industry and fishing industry will impact fuel storage, road, housing and water supplies in Nome. The airport and sewage treatment facilities should not be impacted to a major extent.

6.14 Support Industries Impacts

Support industries to the fishing industry include firms, business, and even individuals which have special skills, which provide goods and services to the commercial fishing industry. Support industries include marine repair outlets, welders, diesel mechanics, electricians, and electric supply businesses. Centaur Associates (1980) has found that competition for labor in support industries has taken place in areas where OCS development has occured. Usually, skilled technicians which support the fishing industry are not bid away to work directly in OCS jobs. Rather, repair and other skilled services required by OCS companies may raise their costs because of increased demand or because the skilled services believe OCS companies will be willing to pay more for their services.

Skilled services in the Bering Sea are basically limited to those provided in Dutch Harbor. Many communities or canneries in the Bering Sea communities have marine repair services or marine ways which are used to service fishing vessels. These physical facilities would not be impacted by OCS development because of their small size relative to the size of OCS vessels.

Dutch Harbor offers essential services to the fishing industry and would also serve the OCS industry. Because Unalaska is a small remote community, there has historically been very few facilities dedicated to servicing the marine industry. However, with increasing use of the Dutch Harbor area by large fishing vessels, several repair outlets have established themselves locally. There are at least four electronic repair outlets in Unalaska which sell and service marine electronic equipment (Centaur Associates, et. al. 1983). There are several welders which have their own equipment and both above- and below-water welding is available. Only one vessel haul-out service is in port and it has the capacity to haul vessels up to 250 feet weighing 350 tons. The facility will also have a complete machine shop but do only very limited diesel maintenance. There are about five acres onshore for vessel storage and repair work allowing only one vessel on the ways at a time but the facility plans on gradually working its way into various services depending on the volume of business demand.

While extensive diesel repair facilities and skilled diesel mechanics are not in the Unalaska area, it is common practice to order parts and/or labor out of Anchorage and have these flown in. The demand for skilled labor is really from a statewide labor pool based in Anchorage and therefore any demand for skilled services in the Dutch Habor area by OCS companies may actually create a beneficial impact on the fishing industry by providing greater availability of these services for fishermen.

OCS vessels requiring haul-out for bottom inspection, Coast Guard certification, and maintenance are expected to use large shipyards located in the Seattle area. During peak years of OCS activity it will probably be necessary to have a full-time service facility, short of a haul out and marine ways, dedicated to maintenance and repair on the OCS vessels. This would leave the current marine ways available for fishing vessels only and eliminate an excess demand on the repair facilities giving fishermen better access to skilled labor and repair equipment. Such a dedicated service facility could be integrated with the OCS docking facility previously discussed into a type of offshore service industrial park.

The presence of the OCS industry may beneficially impact the fishing industry's support services by bringing in additional skilled workers. Because of the present dirth of these types of services in Dutch Habor, any additional access to vessel parts and the labor to repair vessels would help reduce downtime resulting from equipment needing repair.

7.0 SPACE USAGE AND CATCH LOSS IMPACTS

This section addresses the estimated physical space occupied by OCS oil and gas structures in the North Aleutian Shelf. Navarin Basin, St. George Basin, and Norton Sound lease sale areas and the associated loss of catch (and dollar loss) to the fishing industry. Such loss of space is potentially due to:

- Exploration rigs,
- Production platforms,
- Subsea completions, and
- Pipelines.

The loss of space includes the size of the structure itself as well as a buffer zone around the structure that vessels may hesitate to enter. Exhibit 7-1 summarizes the distances used for the Bering Sea space loss calculations. Exploration rigs are assumed to be semi-submersibles and have an associated anchoring system effectively taking up a circle with a 1700 feet radius. To this is added a buffer zone that is estimated to be one quarter mile or 1320 feet. In the North Sea an effective buffer zone of 500 meters (1640 feet) is legally enforced. Trawlers probably can physically fish somewhat closer than this. However, since debris tends to be associated with the area immediately around platforms, they may hesitate to get too close. For this analysis the buffer zone distance is taken to be one quarter mile. This is due to the criteria for payment under the U.S. Fisherman's Contingency Fund. Fishing within one quarter mile of a known obstruction may invalidate a claim (Centaur Associates, 1981).

Based on this, the total exclusion zone around exploration rigs is 3020 feet which is the sum of the extent of the anchoring system plus the buffer zone. In a similar manner production platforms were estimated to have an exclusion zone of 1520 feet. This is based on the use of steel jacket or gravity platforms (Dames and Moore, 1982a) that do not have an extended anchoring system.

Exhibit 7-1

OCS Fixed Structure Exclusion Zones
(distances in feet)

Type of Structure	Geometry of Exclusion Zone	Size of Structure (radius or half width)	Buffer Zone	Total Exclusion Zone (radius or half width)
Exploration Rig	Circular	1700[1]	1320	3020
Production Platform	Circular	200	1320	1520
Subsea Completion System	Variable[2]	negligible	1320	1320[2]
Pipeline	Rectangular	negligible	1320	1320

---

[1] Assumes structure itself has a radius of 200 feet and anchoring system extends around the structure to three times the water depth. Water depths in the Bering Sea areas of geologic potential range roughly from 100 to 200 meters. Taking 150 meters (500 feet) as a typical depth, the associated structure requires 1500 feet for anchors plus 200 feet for the structure itself.

[2] The subsea completion system can extend in a rather complex manner depending on the characteristics of the field. For the purpose of this analysis it is assumed that each subsea completion stretches out linearly from a production platform and is connected to it (or another subsea completion in line) by small diameter flow lines which must be avoided by bottom trawl gear. The exclusion zone thus consists of a rectangular area of 1320 feet half width by a distance equal to the spacing of each subsea completion unit.

Source: Assumptions for space loss calculation.

While explorations rigs and production platforms occupy surface space, subsea completion systems and pipelines occupy subsurface space which may interfere with bottom trawl gear. A number of variables affect the issue of whether bottom trawls can effectively operate across pipelines. These includes the size of the pipeline, bottom conditions, whether the pipeline is buried, the effectiveness of any such burial, whether there is bridging of the pipeline, etc. For the purposes of this analysis here, it is assumed that bottom trawling would not be conducted across pipelines, and so the results of the space lost to fishing, can be thought of as an upper bound. The buffer zone for subsurface structures is also taken here to be one quarter mile which in addition to being the criteria under the Fisherman's Contingency Fund is a figure typically associated with LORAN-C accuracy within which the fishing vessel could locate the potential underwater obstruction (Panshin, Roberts, and Vars, 1977).

Exhibit 7-2 shows the area closed to fishing for each type of structure based on the distances and geometry from Exhibit 7-1. Exhibit 7-3 shows the number of surface and subsurface structures in the North Aleutian Shelf based on the mean development scenario given in Section 4.0, Exhibits 4-1 and 4-2. Exhibit 7-4 gives the number of OCS structures expected in the St. George Basin. Exhibit 7-5 gives the number of OCS structures expected in the Navarin Basin. Exhibit 7-6 gives the number of structures expected in the Norton Sound lease sale area. Exhibit 7-7 gives the cumulative number of OCS structures expected in the Bering Sea.

In addition to the main trunk pipelines associated with the North Aleutian and Navarin developments, assumptions are made pertaining to the amount of gathering pipelines which will connect the production platforms to these trunk pipelines. The total area potentially forclosed to fishing is then presented in Exhibit 7-8 for the North Aleutian Shelf. The potential area closed to fishing in the St. George Basin is given in Exhibit 7-9. The potential area closed to fishing in the Navarin Basin is given in Exhibit 7-10. The potential area closed to fishing in Norton Sound is given in Exhibit 7-11 and the cumulative

Exhibit 7-2

Space Loss Due to OCS Fixed Structures

Type of Structure	Seasonal Factor	Spatial Loss	
Exploration Rig	June through November	1.03	square miles/rig
Production Platform	Year round	0.26	square miles/platform
Subsea Completion System	Year round	1.50[1]	square miles/subsea completion
Pipeline	Year round	0.50	square miles/mile of pipeline

---

[1] The subsea completion system consists of a rectangle of half-width equal to the buffer zone distance and length equal to the spacing of subsea completions which is estimated to be three miles.

Source: Calculated from size of exclusion zone given in Exhibit 7-1.

Exhibit 7-3

Number of OCS Structures in the North Aleutian Shelf

Year	Number of Exploration Rigs	Cumulative Number of Production Platforms	Cumulative Number of of Subsea Completions	Miles of Trunk Pipeline	Miles of Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	1	-	-	-	-
1990	1	-	-	-	-
1991	1	1	-	-	-
1992	-	2	-	40	-
1993	-	2	1	80	25
1994	-	2	3	160	25
1995	-	2	4	160	25
1996	-	2	4	160	25
1997	-	2	4	160	25
1998	-	2	4	160	25
1999	-	2	4	160	25
2000	-	2	4	160	25
2001	-	2	4	160	25
2002	-	2	4	160	25
2003	-	2	4	160	25
2004	-	2	4	160	25
2005	-	2	4	160	25
2006	-	2	4	160	25
2007	-	2	4	160	25

Source: Mean development scenario, Exhibits 4-1, 4-2.

Exhibit 7-4

Number of OCS Structures in the St. George Basin

Year	Number of Exploration Rigs	Cumulative Number of Production Platforms	Cumulative Number of of Subsea Completions	Miles of Trunk Pipeline	Miles of Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	3	-	-	-	-
1987	5	-	-	-	-
1988	5	-	-	-	-
1989	5	-	-	-	-
1990	2	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-

Source: Based on development scenario in Exhibit 4-2.

Exhibit 7-5

Number of OCS Structures in the Navarin Basin

Year	Number of Exploration Rigs	Cumulative Number of Production Platforms	Cumulative Number of of Subsea Completions	Miles of Trunk Pipeline	Miles of Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	1	-	-	-	-
1987	3	-	-	-	-
1988	3	-	-	-	-
1989	3	-	-	-	-
1990	2	-	-	-	-
1991	1	2	-	-	-
1992	1	5	-	85	-
1993	-	9	2	175	15
1994	-	12	6	350	60
1995	-	13	10	350	120
1996	-	13	14	350	165
1997	-	13	18	350	180
1998	-	13	23	350	180
1999	-	13	23	350	180
2000	-	13	23	350	180
2001	-	13	23	350	180
2002	-	13	23	350	180
2003	-	13	23	350	180
2004	-	13	23	350	180
2005	-	13	23	350	180
2006	-	13	23	350	180
2007	-	13	23	350	180

Source: Based on Exhibit 4-2.

Exhibit 7-6

Number of OCS Structures in the Norton Sound

Year	Number of Exploration Rigs	Cumulative Number of Production Platforms	Cumulative Number of of Subsea Completions	Miles of Trunk Pipeline	Miles of Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	2	-	-	-	-
1987	4	-	-	-	-
1988	5	-	-	-	-
1989	4	-	-	-	-
1990	2	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-

Source: Exhibit 4-2.

Exhibit 7-7

Cumulative Number of OCS Structures in the Bering Sea

Year	Number of Exploration Rigs	Cumulative Number of Production Platforms	Cumulative Number of of Subsea Completions	Miles of Trunk Pipeline	Miles of Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	6	-	-	-	-
1987	12	-	-	-	-
1988	13	-	-	-	-
1989	13	-	-	-	-
1990	7	-	-	-	-
1991	2	3	3	125	-
1992	1	7	9	255	-
1993	-	11	14	510	40
1994	-	14	18	510	85
1995	-	15	22	510	145
1996	-	15	27	510	190
1997	-	15	27	510	205
1998	-	15	27	510	205
1999	-	15	27	510	205
2000	-	15	27	510	205
2001	-	15	27	510	205
2002	-	15	27	510	205
2003	-	15	27	510	205
2004	-	15	27	510	205
2005	-	15	27	510	205
2006	-	15	27	510	205
2007	-	15	27	510	205

Source: Sum of Exhibits 7-3, 7-4, 7-5 and 7-6.

Exhibit 7-8

Total Potential Space Loss Due to OCS Structures in the North Aleutian Shelf (square miles)

Year	Exploration Rigs	Production Platforms	Subsea Completion	Trunk Pipeline	Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	1.0	-	-	-	-
1990	1.0	-	-	-	-
1991	1.0	0.3	-	20	-
1992	-	0.5	-	40	12.5
1993	-	0.5	1.5	80	12.5
1994	-	0.5	4.5	80	12.5
1995	-	0.5	6.0	80	12.5
1996	-	0.5	6.0	80	12.5
1997	-	0.5	6.0	80	12.5
1998	-	0.5	6.0	80	12.5
1999	-	0.5	6.0	80	12.5
2000	-	0.5	6.0	80	12.5
2001	-	0.5	6.0	80	12.5
2002	-	0.5	6.0	80	12.5
2003	-	0.5	6.0	80	12.5
2004	-	0.5	6.0	80	12.5
2005	-	0.5	6.0	80	12.5
2006	-	0.5	6.0	80	12.5
2007	-	0.5	6.0	80	12.5

Source: Based on Exhibits 7-2 and 7-3.

Exhibit 7-9

Total Potential Space Loss Due to OCS Structures in the St. George Basin (square miles)

Year	Exploration Rigs	Production Platforms	Subsea Completion	Trunk Pipeline	Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	3.1	-	-	-	-
1987	5.1	-	-	-	-
1988	5.1	-	-	-	-
1989	5.1	-	-	-	-
1990	2.1	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-

Source: Based on Exhibits 7-2 and 7-4.

Exhibit 7-10

Total Potential Space Loss Due to OCS Structures in the Navarin Basin (square miles)

Year	Exploration Rigs	Production Platforms	Subsea Completion	Trunk Pipeline	Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	1.0	-	-	-	-
1987	3.1	-	-	-	-
1988	3.1	-	-	-	-
1989	2.1	-	-	-	-
1990	1.0	0.5	-	-	-
1991	1.0	1.3	-	43	-
1992	-	2.3	3.0	88	8
1993	-	3.1	9.0	175	30
1994	-	3.4	15.0	175	60
1995	-	3.4	21.0	175	83
1996	-	3.4	27.0	175	90
1997	-	3.4	34.5	175	90
1998	-	3.4	34.5	175	90
1999	-	3.4	34.5	175	90
2000	-	3.4	34.5	175	90
2001	-	3.4	34.5	175	90
2002	-	3.4	34.5	175	90
2003	-	3.4	34.5	175	90
2004	-	3.4	34.5	175	90
2005	-	3.4	34.5	175	90
2006	-	3.4	34.5	175	90
2007	-	3.4	34.5	175	90

Source: Based on Exhibits 7-2 and 7-5.

Exhibit 7-11

Total Potential Space Loss Due to OCS Structures in the Norton Sound (square miles)

Year	Exploration Rigs	Production Platforms	Subsea Completion	Trunk Pipeline	Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	2.1	-	-	-	-
1987	4.2	-	-	-	-
1988	5.2	-	-	-	-
1989	4.2	-	-	-	-
1990	2.1	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	-
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	-	-	-
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-

Source: Based on Exhibits 7-2 and 7-6.

amount of area potentially foreclosed to fishing in the Bering Sea is presented in Exhibit 7-12.

Once the types and amounts of structures are determined it is necessary to consider the relative location of OCS structures in major fishing areas within each lease sale area. In Exhibit 7-13, the probable area of geologic potential in the North Aleutian Shelf is shown. Production platforms and exploration rigs are assumed to have an evenly distributed probability of being located throughout the area of geologic potential. Given a trunk pipeline to Morzhovoi Bay (as explained in Section 4.0), the pipeline's location also has an evenly distributed probability of being located in the potential pipeline area shown.

Exhibit 7-14 shows the area of geologic potential in the St. George Basin. Exploration rigs have even chance of being distributed throughout the area shown. In Exhibit 7-15, the area of geologic potential for the Navarin Basin is shown. Production platforms and exploration rigs can be thought of as having an evenly distributed chance of being located throughout this area. Also, given a trunk pipeline to St. Matthew (as explained in Section 4.0), the pipeline has an evenly distributed probability of being located in the area shown as the potential pipeline area.

Exhibit 7-16 shows the area of geologic potential in the Norton Basin. The exploratory rigs expected in the Norton Basin can also be thought of as having an evenly distributed probability of being located throughout the area shown. Catch loss calculations for each lease sale were based upon information presented in Section 3.0. Herring were projected to be caught in the Navarin Basin (Table 3-18) and in the St. George Basin (Table 3-11). However, herring were believed to be sufficiently pelagic so as not be affected by space loss. Shellfish (King and Tanner Crab) can be effectively fished around subsea obstructions (which, as will be shown, accounts for the major portion of catch loss).

Exhibit 7-12

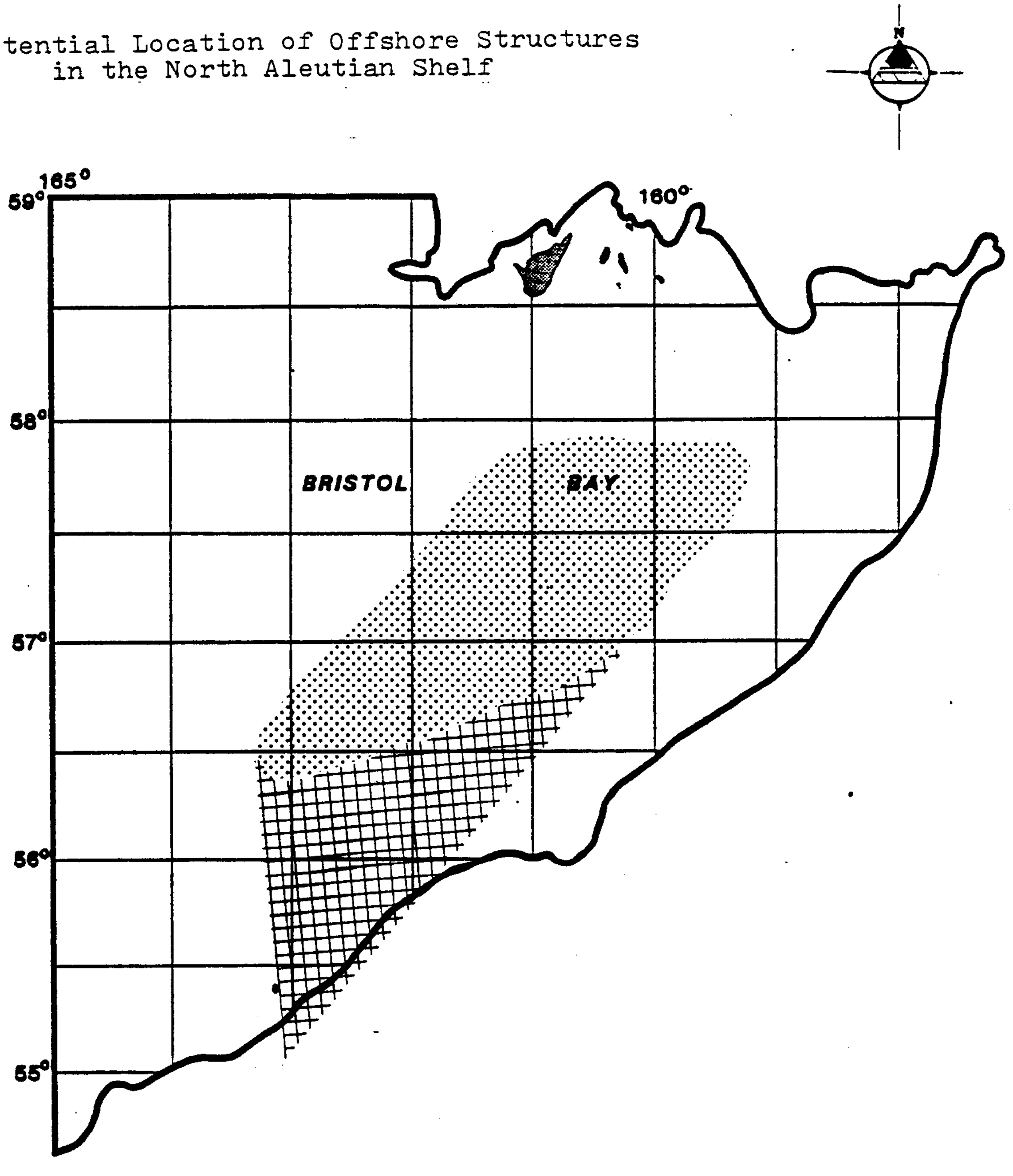
Total Potential Space Loss Due to OCS Structures in the Bering Sea (square miles)

Year	Exploration Rigs	Production Platforms	Subsea Completion	Trunk Pipeline	Gathering Line
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	6.1	-	-	-	-
1987	12.1	-	-	-	-
1988	13.1	-	-	-	-
1989	13.1	-	-	-	-
1990	7.1	-	-	-	-
1991	2.0	0.8	4.5	63	-
1992	1.0	1.8	13.5	128	-
1993	-	2.9	21.0	255	20
1994	-	3.6	27.0	255	43
1995	-	4.0	40.5	255	73
1996	-	4.0	40.5	255	95
1997	-	4.0	40.5	255	103
1998	-	4.0	40.5	255	103
1999	-	4.0	40.5	255	103
2000	-	4.0	40.5	255	103
2001	-	4.0	40.5	255	103
2002	-	4.0	40.5	255	103
2003	-	4.0	40.5	255	103
2004	-	4.0	40.5	255	103
2005	-	4.0	40.5	255	103
2006	-	4.0	40.5	255	103
2007	-	4.0	40.5	255	103

Source: Based on Exhibits 7-2 and 7-7.

Exhibit 7-13

Potential Location of Offshore Structures in the North Aleutian Shelf



NORTH ALEUTIAN SHELF LEASE SALE AREA

INCLUDING THE 1/2° x 1° GRID AREAS

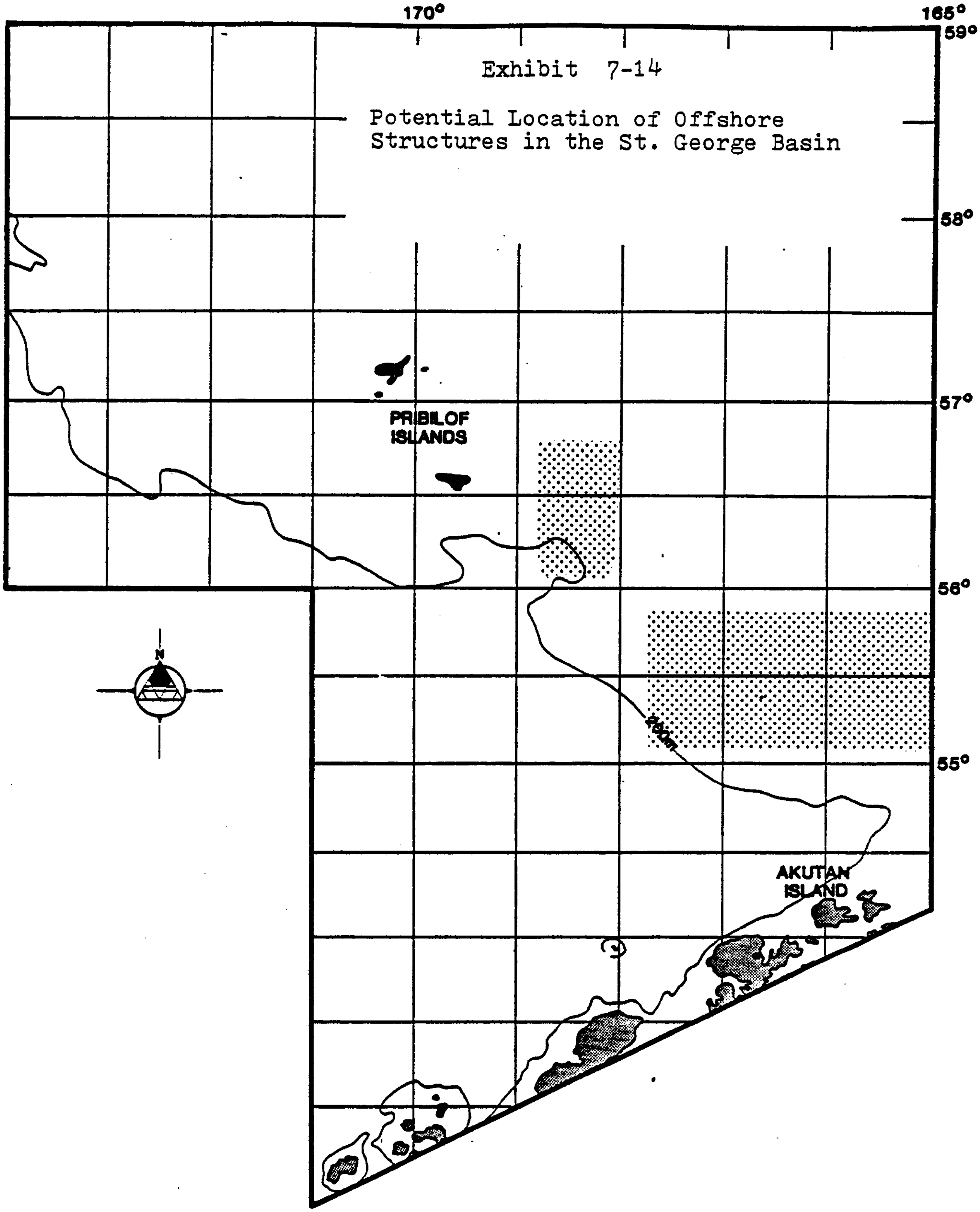
▦ Potential Pipeline Location

▒ Area of Geologic Potential

Source: Dames and Moore, et. al. 1982

Exhibit 7-14

Potential Location of Offshore Structures in the St. George Basin



ST. GEORGE BASIN LEASE SALE AREA

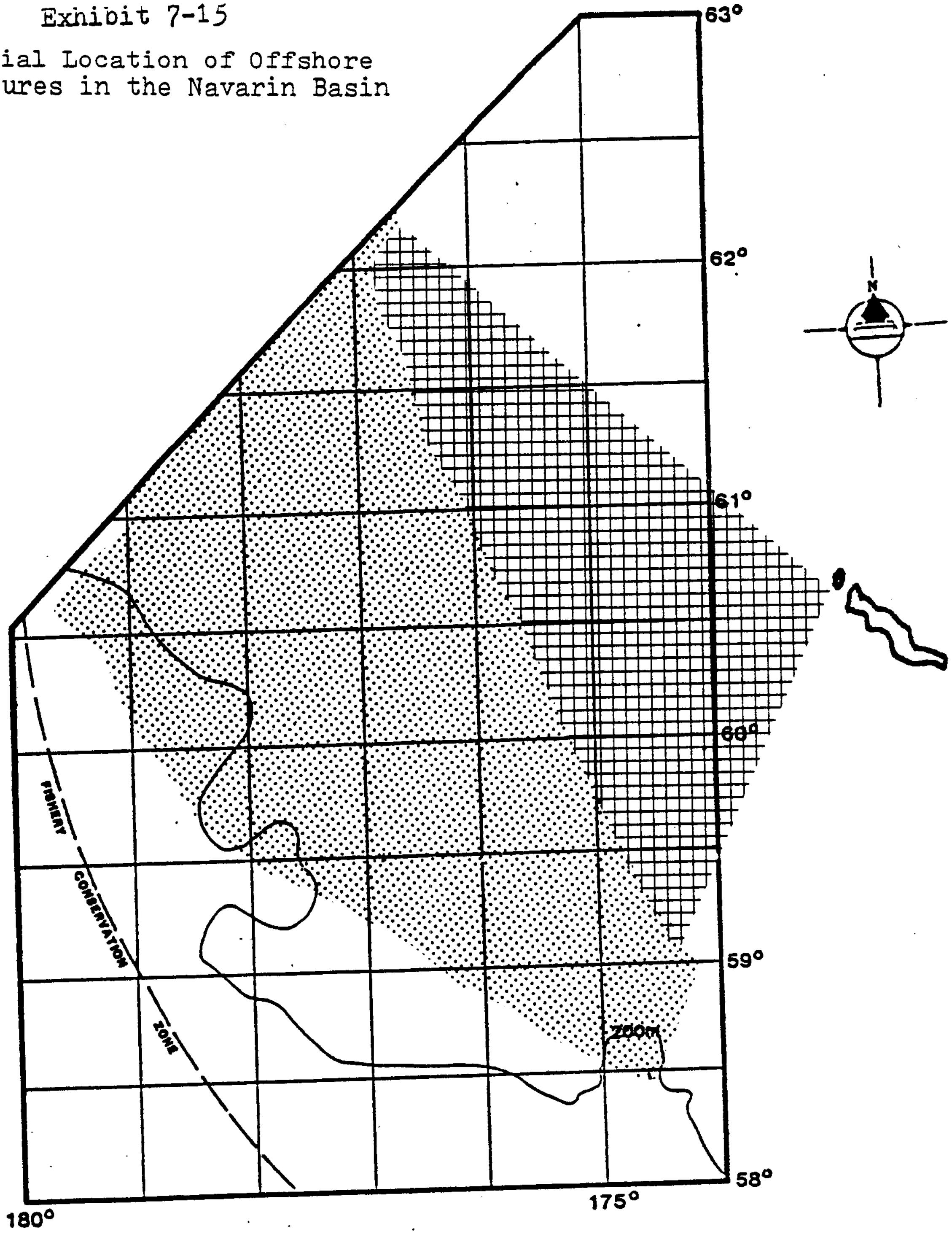
INCLUDING THE 1/2°x 1° GRID AREAS

▒ Area of Geologic Potential

Source: BLM, 1981

Exhibit 7-15

Potential Location of Offshore Structures in the Navarin Basin



NAVARIN BASIN LEASE SALE AREA
INCLUDING THE 1/2°x 1° GRID AREAS

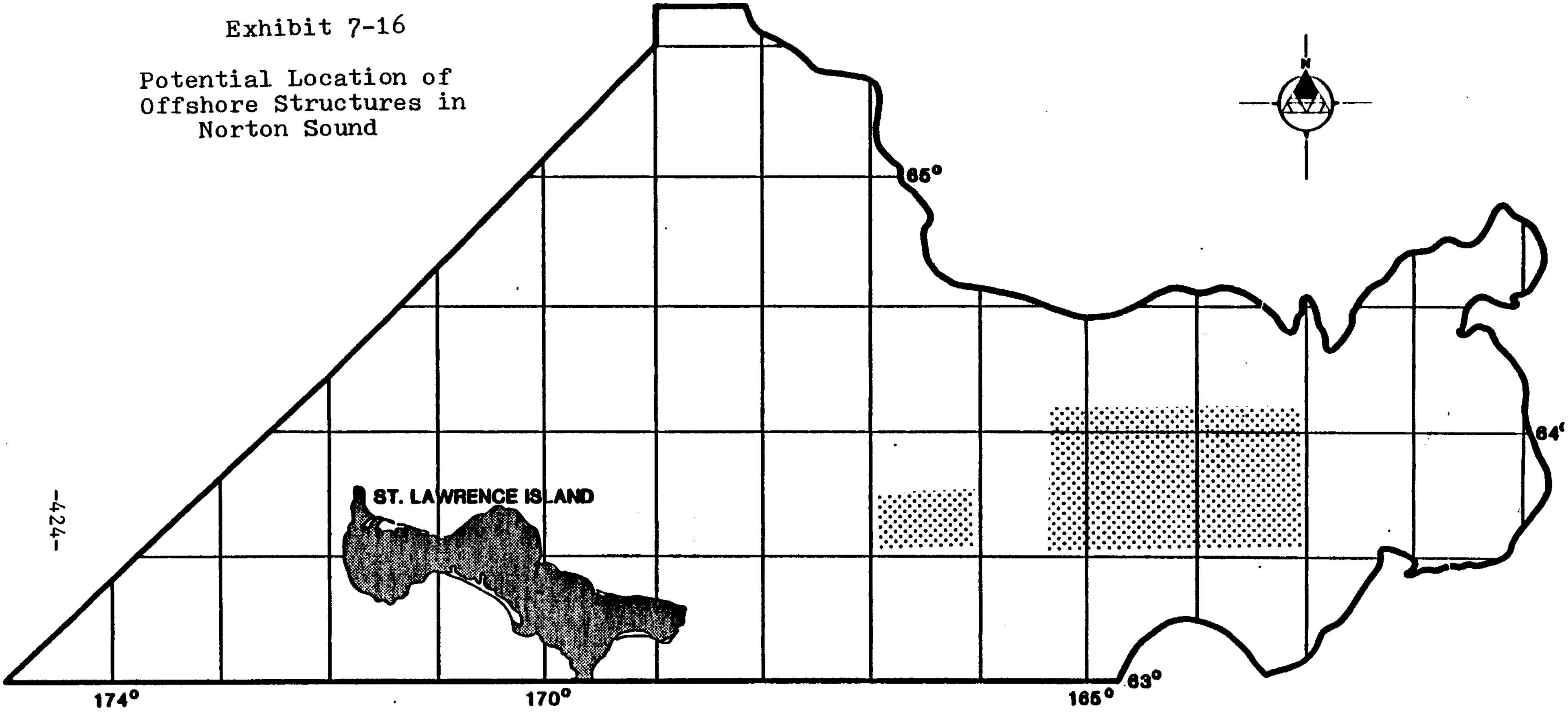
░ Area of Geologic Potential

▦ Potential Pipeline Location

Source: Centaur Associates, Inc. et. al., 1983

Exhibit 7-16

Potential Location of
Offshore Structures in
Norton Sound



NORTON BASIN LEASE SALE AREA
INCLUDING THE 1/2° x 1° GRID AREAS

▨ Area of Geologic Potential

Source: BLM, 1982

For these calculations, it was assumed that Pacific cod and flatfish were fished exclusively by bottom trawls (although a significant portion of Pacific cod may be caught by longlines, this calculation functions as an upper bound). It was projected that 85 percent of the trawling for pollock and "other groundfish", which is basically an incidental catch in the pollock fishery, was conducted by bottom trawls (as opposed to pelagic trawls which are not affected by subsea obstructions). This is based on the relative portion of foreign trawl activity over the past five years (Centaur Associates, et. al., 1983).

For each of the species groups, the percent of each lease area in the area of geologic potential was estimated based on the historical catch data (Appendix A). This was used to estimate the portion of catch potentially affected by platforms and exploration rigs. Similarly, the percent of catch in the potential areas of pipeline location was calculated for the North Aleutian and Navarin Basins. Taking this times the percentage expected to be harvested by bottom trawls gives the percent of catch potentially affected by subsurface structures in these two lease sales.

Given the area foreclosed to fishing, one method of estimating catch loss is to assume that the catch loss is proportional to the area foreclosed. This results in an overestimate, however, because fish will move in and out of the closed area and have a certain probability of being caught while outside of the buffer zone. In order to estimate this effect a Markov random movement type of probabilistic model of fish movement and catch was used. In this model a series of states were defined corresponding to spatial areas occupied by a stock of fish. The spatial areas are long, thin rectangles spaced within, and to either side of, the buffer zone. In any given period of time a fish in a given state has a certain probability of moving to either state adjacent to it. In addition, for those states outside the buffer zone there is a probability that a fish will be caught and enter a state known as "catch". The width of the buffer zone is defined by a parameter "b" measured from the center of the structure to the edge of the buffer zone. The model estimates catch loss as a function of the area of water foreclosed (i.e., size of the buffer zone), a measure of the relative distance that a given species of fish randomly moves over a given period of time defined as the dispersion coefficient "a^2" (the parameter "a^2" is analogous to the variance of the probabilistic distribution of the total distance fish move from a given point over time and is used to estimate the probability of moving from one spatial state to another in the model), and a measure of the intensity with which fish are being exploited defined as "F", the instantaneous fishing mortality in fishery population dynamics. This is used to estimate the probability that a fish will be caught in the model. A detailed description of the model is presented in Appendix C.

For the catch loss calculations, the species expected to be affected from Section 3.0 were divided into those shown in Exhibit 7-17 for each lease sale.

Exhibit 7-18 shows the parameters used for the Bering Sea catch loss estimate. For a given stock of fish, the dispersion coefficient, can be estimated based on relative movement as may be indicated from tagging data. Unfortunately, there appears to be no adequate data for estimating "a^2" directly applicable to the Bering Sea species. However, data for analogous (i.e., species from other regions believed to be similar in terms of their movement behavior) species were used. For pollock and Pacific cod "a^2" was assumed to be that for North Sea haddock. For flatfish and for other groundfish "a^2" was assumed to be that for winter flounder. The instantaneous fishing mortality, "F", was estimated to be in the range of 0.4 to 0.6 based on biomass estimates and expected catch from the North Pacific Fishery Management Council (1977a). As presented in Appendix C, these parameters can be used to calculate a parameter termed the catch loss parameter which is the expected loss in catch for the case where one percent of the fishery is foreclosed to fishing. For other areas the estimated catch loss is scaled accordingly (i.e., if two percent is foreclosed, the catch loss as a fraction of catch is two times the catch parameter).

Exhibit 7-17

Portion of Bering Sea Lease Sales Affected by Offshore Oil and Gas Structures

Lease Area	Species	Percent Expected to Harvested with Bottom Trawls	Percent of Catch in Area of Geologic Potential	Percent of Catch in Potential Area of Pipeline Location	Percent of Catch Affected by Sub-Surface Structures
North Aleutian	Pollock	85	1.4	6.5	5.5
	Pacific Cod	100	0.8	5.9	5.9
	Flatfish[1]	100	2.0	7.4	7.4
	Other Groundfish[2]	85	2.1	8.4	7.1
St. George	Pollock	85	17.0	-	0
	Pacific Cod	100	19.0	-	0
	Flatfish[1]	100	14.1	-	0
	Other Groundfish[2]	85	13.8	-	0
Navarin	Pollock	85	65.2	74.2	63.1
	Pacific Cod	100	57.3	78.1	78.1
	Flatfish[1]	100	59.2	71.3	71.3
	Other Groundfish[2]	85	65.2	74.2	63.1
Norton	Pollock	85	6.6	-	0
	Other Groundfish[2]	85		-	0

---

[1] Includes flounders, yellowfin sole, turbots.

[2] Includes other incidental catch, rockfish, and Atka mackerel.

Source: Percent of catch in areas of geologic potential and possible pipeline locations based upon areas shown in Exhibit 7-13, 7-14, 7-15 and 7-16 for each respective lease sale. Catch data is from Section 3.0 and Appendix A. Pollock and "Other Groundfish" (groundfish are an incidental catch to the pollock fishery) are assumed to be harvested about 85 percent with bottom trawls (Centaur Associates, et. al. 1983).

Exhibit 7-18

Parameters for Calculating Estimated Catch Loss

Species	Daily a^2	Daily a^2/b^2	F	Catch Loss Parameter M
Pollock	2.2	8.8	0.4-0.6	0.00004
Pacific Cod	2.2	8.8	0.4-0.6	0.00004
Flatfish[1]	0.03	0.12	0.4-0.6	0.0005
Other Groundfish[2]	0.03	0.12	0.4-0.6	0.0005

---

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

Source: Daily a^2 for pollock and Pacific cod assumed to be that for haddock and for flatfish and "other groundfish" that of winter flounder (Centaur Associates, Inc., 1981). F is based on data from NPFMC (1977a). The parameter "b" is the width of the buffer area and is taken as one half mile.

The data given above are then used to estimate the catch loss for each lease sale and for the cumulative Bering Sea case for surface structures (exploration rigs and production platforms). Catch loss for the North Aleutian Shelf are given in Exhibit 7-19; catch loss estimates for the St. George Basin in Exhibit 7-20; catch loss estimates for the Navarin Basin in Exhibit 7-21; catch loss estimates for the Norton Sound in Exhibit 7-22 and catch loss estimates for cumulative Bering Sea OCS development in Exhibit 7-23.

Shown is the projected catch by domestic vessels by five year interval by lease sale from Section 3.0. The portion of this catch that is estimated to be caught in the area of geologic potential throughout which the production platforms and exploration rigs can be expected to be located is then shown. This was calculated from the percent figures given in Exhibit 7-17. The portion of this area expressed as a percent (note that this is a fraction of one percent) occupied by the area foreclosed by surface structures from Exhibits 7-8 through 7-12 is then presented. This is taken times the catch in the area of geologic potential to estimate what the catch loss would be assuming that catch loss were simply proportional to the portion of area foreclosed. The catch loss parameter from Exhibit 7-18 is then applied to this number (to do this the catch loss parameter is first divided by 0.01 since it represents the loss of catch for a situation where one percent of the area of a fishery is foreclosed to fishing) to estimate the catch loss based on the random movement model.

The results indicate that the catch lost as a result of OCS surface structures in the North Aleutian shelf is negligible. In the St. George Basin during 1987 when exploration occurs, a total of 0.26 metric tons of catch is estimated to be lost with a value of $113.6 in 1982 dollars. Note that the value of the catch in each of the projected impact periods is based upon the average projected ex-vessel unit value of the affected fisheries from Section 3.0, Table 3-4. As stated in Table 3-4, the 1982 base prices used to project the value of catch loss are: pollock -- six cents per pound; Pacific cod -- 24 cents per pound; flatfish --33 cents per pound; other groundfish -- 33 cents per pound.

Exhibit 7-19

North Aleutian Shelf Catch Loss Due to Surface Structures

	Projected No. Aleutian Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[3] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987						
Pollock	16,700	234	0	0	0	0
Pacific Cod	7,600	61	0	0	0	0
Flatfish[1]	1,200	24	0	0	0	0
Other Groundfish[2]	299	6	0	0	0	0
Total	25,807	325	0	0	0	0
1992						
Pollock	33,540	470	0.008	0.04	neg	neg
Pacific Cod	10,144	81	0.008	0.006	neg	neg
Flatfish[1]	1,800	36	0.008	0.003	neg	neg
Other Groundfish[2]	599	13	0.008	0.001	neg	neg
Total	46,083	600	0.008	0.05	neg	neg
1997						
Pollock	53,664	751	0.008	0.06	neg	neg
Pacific Cod	12,680	101	0.008	0.008	neg	neg
Flatfish[1]	3,600	72	0.008	0.002	neg	neg
Other Groundfish[2]	999	21	0.008	0.08	neg	neg
Total	70,943	945	0.008	0.08	neg	neg
2002						
Pollock	67,080	939	0.008	0.08	neg	neg
Pacific Cod	12,680	101	0.008	0.008	neg	neg
Flatfish[1]	4,200	84	0.008	0.007	neg	neg
Other Groundfish[2]	1,198	25	0.008	0.002	neg	neg
Total	85,158	1,149	0.008	0.09	neg	neg
2007						
Pollock	67,080	939	0.008	0.08	neg	neg
Pacific Cod	12,680	101	0.008	0.008	neg	neg
Flatfish[1]	6,000	120	0.008	0.01	neg	neg
Other Groundfish[2]	1,998	42	0.008	0.003	neg	neg
Total	87,758	1,202	0.008	0.1	neg	neg

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] Area of exploration rigs and platforms from Exhibit 7-8 divided by area of geologic potential which was estimated to be 5,940 square miles based on Exhibit 7-13.

[4] Value of catch loss based on a 1982 price of 6 cents per pound for Pollock, 24 cents per pound for cod, and 33 cents for flatfish and groundfish.

Source: Calculations based on procedures described in text.

Exhibit 7-20

St. George Catch Loss
Due to Surface Structures

	Projected St. George Basin Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[3] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987						
Pollock	167,700	28,509	0.1	27.6	0.11	14.6
Pacific Cod	63,400	12,046	0.1	11.7	0.05	24.7
Flatfish[1]	12,000	1,692	0.1	1.7	0.08	59.7
Other Groundfish[2]	2,997	414	0.1	0.4	neg	14.6
Total	246,097	42,661	0.1	41.4	0.26	113.6
1992						
Pollock	335,400	57,018	0	0	0	0
Pacific Cod	101,440	19,274	0	0	0	0
Flatfish[1]	18,000	2,538	0	0	0	0
Other Groundfish[2]	5,994	827	0	0	0	0
Total	460,835	79,657	0	0	0	0
1997						
Pollock	536,640	91,229	0	0	0	0
Pacific Cod	126,800	24,092	0	0	0	0
Flatfish[1]	36,000	5,076	0	0	0	0
Other Groundfish[2]	9,990	1,379	0	0	0	0
Total	709,430	121,363	0	0	0	0
2002						
Pollock	670,800	114,036	0	0	0	0
Pacific Cod	126,800	24,092	0	0	0	0
Flatfish[1]	42,000	5,922	0	0	0	0
Other Groundfish[2]	11,988	1,654	0	0	0	0
Total	851,588	145,704	0	0	0	0
2007						
Pollock	670,800	114,036	0	0	0	0
Pacific Cod	126,800	24,092	0	0	0	0
Flatfish[1]	60,000	8,460	0	0	0	0
Other Groundfish[2]	19,980	2,757	0	0	0	0
Total	877,580	149,345	0	0	0	0

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] Area of exploration rigs from Exhibit 7-9 divided by area of geologic potential which was estimated to be 5,310 square miles based on Exhibit 7-14.

[4] Value of catch loss based on average value of BSAI species from Table 3-4.

Source: Calculations based on procedures described in text.

Exhibit 7-21

Navarin Basin Catch Loss Due to Surface Structures

	Projected Navarin Basin Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[3] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987						
Pollock	22,980	14,983	0.018	2.7	neg	neg
Pacific Cod	342	196	0.018	0.04	neg	neg
Flatfish[1]	267	158	0.018	0.03	neg	neg
Other Groundfish[2]	109	71	0.018	0.01	neg	neg
Total	23,698	15,408	0.018	2.8	neg	neg
1992						
Pollock	45,960	29,966	0.013	3.9	neg	neg
Pacific Cod	10,260	5,879	0.013	0.8	neg	neg
Flatfish[1]	1,335	790	0.013	0.1	neg	neg
Other Groundfish[2]	549	358	0.013	0.05	neg	neg
Total	58,104	36,993	0.013	4.8	neg	neg
1997						
Pollock	137,880	89,898	0.020	18.0	0.07	9.2
Pacific Cod	23,940	13,718	0.020	2.7	neg	neg
Flatfish[1]	8,010	4,742	0.020	0.9	neg	neg
Other Groundfish[2]	3,294	2,148	0.020	0.4	neg	neg
Total	173,124	110,506	0.020	22.1	0.09	9.2
2002						
Pollock	321,720	209,761	0.020	42.0	0.17	22.4
Pacific Cod	27,360	15,677	0.020	3.1	neg	neg
Flatfish[1]	18,690	11,064	0.020	2.2	neg	neg
Other Groundfish[2]	7,686	5,011	0.020	1.0	neg	neg
Total	375,456	241,513	0.020	48.3	0.19	22.4
2007						
Pollock	459,600	299,659	0.020	59.9	0.24	31.7
Pacific Cod	34,200	19,597	0.020	3.9	neg	neg
Flatfish[1]	26,700	15,806	0.020	3.2	neg	neg
Other Groundfish[2]	10,980	7,159	0.020	1.4	neg	neg
Total	531,480	342,221	0.020	68.4	0.27	31.7

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] Area of exploration rigs and platforms from Exhibit 7-10 divided by area of geologic potential which was estimated to be 17,100 square miles based on Exhibit 7-15.

[4] Value of catch loss based on value of BSAI species from Table 3-4.

Source: Calculations based on procedures described in text.

Exhibit 7-22

Norton Sound Shelf Catch Loss Due to Surface Structures

	Projected Norton Sound Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[2] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987						
Pollock	1,200	79	0.145	0.11	neg	neg
Other Groundfish[1]	600	neg	0.145	neg	neg	neg
Total	1,800	79	0.145	0.11	neg	neg
1992						
Pollock	1,200	79	0	0	0	0
Other Groundfish[1]	600	neg	0	0	0	0
Total	1,800	79	0	0	0	0
1997						
Pollock	1,200	79	0	0	0	0
Other Groundfish[1]	600	neg	0	0	0	0
Total	1,800	79	0	0	0	0
2002						
Pollock	1,200	79	0	0	0	0
Other Groundfish[1]	600	neg	0	0	0	0
Total	1,800	79	0	0	0	0
2007						
Pollock	1,200	79	0	0	0	0
Other Groundfish[1]	600	neg	0	0	0	0
Total	1,800	79	0	0	0	0

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes rockfish, atka mackerel, and other incidental catch.

[2] Area of exploration rigs and platforms from Exhibit 7-11 divided by area of geologic potential which was estimated to be 2,898 square miles based on Exhibit 7-16.

[3] Value of catch loss based on value of BSAI species from Table 3-4.

Source: Calculations based on procedures described in text.

Exhibit 7-23

Bering Sea Catch Loss
Due to Surface Structures

	Projected Bering Sea Domestic Catch (metric tons)	Catch in Areas of Geologic Potential (metric tons)	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987					
Pollock	208,580	43,805	31.31	0.11	14.6
Pacific Cod	71,350	12,303	12.14	0.05	24.7
Flatfish[1]	13,467	1,874	1.73	0.8	59.7
Other Groundfish[2]	4,005	491	0.51	neg	14.6
Total	297,402	58,473	44.69	0.26	113.6
1992					
Pollock	416,100	87,533	3.94	neg	neg
Pacific Cod	121,844	25,234	0.806	neg	neg
Flatfish[1]	21,135	3,364	0.103	neg	neg
Other Groundfish[2]	7,742	1,198	0.051	neg	neg
Total	566,821	117,329	4.88	neg	neg
1997					
Pollack	729,384	181,957	18.06	0.07	9.2
Pacific Cod	163,420	37,911	2.708	neg	neg
Flatfish[1]	47,610	9,890	0.906	neg	neg
Other Groundfish[2]	14,883	3,135	0.402	neg	neg
Total	955,297	232,814	22.18	0.19	9.2
2002					
Pollack	1,060,800	324,815	42.08	0.17	22.2
Pacific Cod	166,840	39,870	3.108	neg	neg
Flatfish[1]	64,890	17,070	2.207	neg	neg
Other Groundfish[2]	21,472	6,690	1.002	neg	neg
Total	1,314,002	388,445	48.39	0.19	22.4
2007					
Pollack	1,198,680	414,713	59.98	0.24	31.7
Pacific Cod	173,680	43,790	3.908	neg	neg
Flatfish[1]	92,700	24,386	3.21	neg	neg
Other Groundfish[1]	33,558	9,958	1.403	neg	neg
Total	1,498,618	492,847	68.5	0.27	31.7

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

Source: Summation of Exhibits 7-19, 7-20, 7-21 and 7-22.

In the Navarin Basin in 2007 when domestic fishing activity is projected to be at its peak, the total estimated catch loss due to surface structures is projected to be 0.27 metric tons or 31.7 dollars. Norton Sound should have neglibible catch loss due to OCS surface structures.

Catch loss for subsurface OCS structures were also estimated in the North Aleutian and Navarin areas is a manner similar to that used to determine catch loss for surface structures. Calculations were based upon the assumption that bottom trawlers do not trawl across pipelines. It was also assumed that they do not trawl in the vicinity of subsurface completions. For subsurface structures in the North Aleutian shelf (Exhibit 7-24) the total catch loss in 2007 is projected to be 0.45 metric tons which equals about $249 in value (values of species based on Table 3-4 as described above). Navarin Basin losses are projected to be 21.6 metric tons or $9,075 in the peak year of fisheries development, 2007, as shown in Exhibit 7-25. Total Bering Sea catch loss in 2007 (Exhibit 7-26) resulting from subsurface structures is projected to be 40.0 metric tons or about $9,324.

7.1 Additional Potential Catch Loss Impacts

Because of the uncertainties involved with OCS development, it is possible that scenarios other than those given in Section 4 could occur. While the possibilities for OCS development are many (including exploration in all four lease sales and development in just the Navarin and North Aleutian, there are hundreds of combinations of exploration and development alternatives). Rather than present an exhaustive review of catch loss in the Bering Sea given the myriad of exploration and development alternatives, this section presents the results of the catch loss model in five-year increments on fisheries in the St. George and Norton Basins if exploration and development occurs. Mean development scenarios for the Norton Sound and St. George Basins were obtained from BLM (1982) and BLM (1981). The number of structures and miles of pipeline were obtained from these sources and the potential amount of space loss calculated according to the text are given in Exhibit 7-27 for the Norton Sound and in Exhibit 7-28 for the St. George Basin.

Exhibit 7-24

North Aleutian Catch Loss Due To Sub-Surface Structures

	Domestic Catch in Sector Where Pipeline Is Likely To Be Located (metric tons)	Catch Affected By Sub-surface Structures (metric tons)	Percent of Pipeline[3] Sector Foreclosed To Fishing	Catch Loss Based On Proportional Area (metric tons)	Catch Loss Based On Random Movement Model (metric tons)	Value of Catch[4] Loss Based On Random-Movement Model (dollars)
1987						
Pollock	919	0	0	0	0	0
Pacific Cod	448	0	0	0	0	0
Flatfish[1]	89	0	0	0	0	0
Other Groundfish[2]	21	0	0	0	0	0
Total	1,477	0	0	0	0	0
1992						
Pollock	1,845	1,568	0.21	3.3	neg	neg
Pacific Cod	598	598	0.21	1.3	neg	neg
Flatfish[1]	133	133	0.21	0.3	neg	neg
Other Groundfish[2]	43	36	0.21	0.08	neg	neg
Total	2,619	2,336	0.21	5.0	neg	neg
1997						
Pollock	2,952	2,509	1.0	26.3	0.11	13.9
Pacific Cod	748	748	1.0	7.8	0.03	16.6
Flatfish[1]	266	266	1.0	2.8	0.14	101.4
Other Groundfish[2]	71	60	1.0	0.6	0.03	23.0
Total	4,037	3,584	1.0	37.5	.31	154.9
2002						
Pollock	3,689	3,136	1.0	32.8	0.13	17.4
Pacific Cod	748	748	1.0	7.8	0.03	16.6
Flatfish[1]	311	311	1.0	3.3	0.16	118.4
Other Groundfish[2]	85	72	1.0	0.8	0.04	27.5
Total	4,833	4,267	1.0	44.7	0.36	179.9
2007						
Pollock	3,689	3,136	1.0	32.8	0.13	17.4
Pacific Cod	748	748	1.0	7.8	0.03	16.6
Flatfish[1]	444	444	1.0	4.7	0.23	169.4
Other Groundfish[2]	142	121	1.0	1.3	0.06	45.9
Total	5,023	4,449	1.0	46.6	0.45	249.0

---

neq means amount is less than 0.5 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] The pipeline sector is that area where the pipeline is judged to have a uniform probability of being located anywhere throughout the sector. This area was estimated to contain 9,405 square miles.

[4] Value of catch loss based on value of BSAI fisheries from table 3-4.

Source: Calculations based on procedures described in text.

Exhibit 7-25

Navarin Basin Catch Loss Due To Sub-Surface Structures

	Domestic Catch in Sector Where Pipeline Is Likely To Be Located (metric tons)	Catch Affected By Sub-surface Structures (metric tons)	Percent of Pipeline[3] Sector Foreclosed To Fishing	Catch Loss Based On Proportional Area (metric tons)	Catch Loss Based On Random Movement Model (metric tons)	Value of Catch[4] Loss Based On Random-Movement Model (dollars)
1987						
Pollock	15,445	0	0	0	0	0
Pacific Cod	223	0	0	0	0	0
Flatfish[1]	177	0	0	0	0	0
Other Groundfish[2]	71	0	0	0	0	0
Total	15,916	0	0	0	0	0
1992						
Pollock	30,966	26,321	0.13	34.2	0.14	18.5
Pacific Cod	10,430	10,430	0.13	13.6	0.05	26.4
Flatfish[1]	871	871	0.13	1.1	0.06	43.6
Other Groundfish[2]	360	306	0.13	0.4	0.02	14.5
Total	42,627	37,928	0.13	49.3	0.27	103.0
1997						
Pollock	92,692	78,788	0.92	709.1	2.84	374.9
Pacific Cod	14,121	12,125	0.92	127.1	0.5	264.0
Flatfish[1]	4,868	4,868	0.92	43.8	2.2	1,597.2
Other Groundfish[2]	2,150	1,828	0.92	16.5	0.8	580.8
Total	113,835	19,431	0.92	896.5	6.34	2,816.9
2002						
Pollock	216,767	184,252	0.92	1,695.1	6.8	897.6
Pacific Cod	16,142	16,142	0.92	148.5	0.6	316.8
Flatfish[1]	11,353	11,353	0.92	104.4	5.2	3,775.2
Other Groundfish[2]	5,016	4,264	0.92	39.2	2.0	1,452.0
Total	249,278	216,011	0.92	1,987.3	14.6	6,441.6
2007						
Pollock	309,512	263,085	0.92	2,420.4	9.7	1,280.4
Pacific Cod	20,178	20,178	0.92	182.6	0.7	369.6
Flatfish[1]	16,228	16,228	0.92	149.3	7.5	5,445.0
Other Groundfish[2]	7,166	6,091	0.92	54.4	2.7	1,979.7
Total	353,084	305,582	0.92	2,756.0	21.6	9,074.7

---

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] The pipeline sector is that area where the pipeline is judged to have a uniform probability of being located anywhere throughout the sector. This area was estimated to contain 32,400 square miles.

[4] Value of catch loss based on value of BSAI fisheries from Table 3-4.

Source: Calculations based on procedures described in text.

Exhibit 7-26

Bering Sea Catch Loss Due To Sub-Surface Structures

	Domestic Catch in Sector Where Pipelines are Likely To Be Located (metric tons)	Catch Affected By Sub-surface Structures (metric tons)	Catch Loss Based On Proportional Area (metric tons)	Catch Loss Based On Random Movement Model (metric tons)	Value of Catch Loss Based On Random-Movement Model (dollars)
1987					
Pollock	16,222	0	-	-	-
Pacific Cod	2,451	0	-	-	-
Flatfish[1]	391	0	-	-	-
Other Groundfish[2]	77	0	-	-	-
Total	19,218	0	-	-	-
1992					
Pollock	32,121	27,303	36.3	0.14	18.5
Pacific Cod	13,400	13,400	19.8	0.05	26.4
Flatfish[1]	1,132	1,132	1.6	0.06	43.6
Other Groundfish[2]	373	317	0.9	0.02	14.5
Total	47,026	42,152	58.2	0.27	103.0
1997					
Pollock	95,179	80,902	730.2	2.92	385.5
Pacific Cod	17,837	17,837	164.2	0.2	343.2
Flatfish[1]	5,391	5,391	49.0	2.5	1,815.0
Other Groundfish[2]	2,171	1,846	16.7	0.8	580.8
Total	120,578	25,798	960.2	6.87	3,124.5
2002					
Pollock	219,876	186,895	1,721.5	6.91	912.1
Pacific Cod	19,854	19,854	185.6	0.75	396.0
Flatfish[1]	11,963	11,963	110.5	5.51	4,000.3
Other Groundfish[2]	5,042	4,286	39.4	2.0	1,452.0
Total	258,322	224,585	2,073.1	15.9	6,760.4
2007					
Pollock	312,622	265,729	2,446.8	9.81	1,297.8
Pacific Cod	23,909	23,909	222.9	0.85	486.2
Flatfish[1]	17,099	17,099	158.0	7.94	5,563.4
Other Groundfish[2]	7,209	6,128	64.7	13.2	2,025.6
Total	360,839	312,865	5,636.5	40.0	9,323.7

---

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

Source: Sum of Exhibits 7-24 and 7-25.

Exhibit 7-27

Norton Sound Mean Development and Production Scenario

Year	Exploration Rigs	Production Platforms	Pipeline Miles
1987	4	3	0
1992	0	9	186
1997	0	9	186
2002	0	9	186
2007	0	9	186

Potential Space Loss Due to Structures (square miles)

Year	Exploration Rigs	Production Platforms	Pipeline Miles
1987	4.1	0.8	0
1992	0	2.3	93
1997	0	2.3	93
2002	0	2.3	93
2007	0	2.3	93

Source: OCS development scenario from BLM, (1981). Area calculated from text.

Exhibit 7-28

St. George Basin Mean Development Scenario

Year	Exploration Rigs	Production Platforms	Pipeline Miles
1987	5	4	0
1992	0	11	611
1997	0	11	611
2002	0	11	611
2007	0	11	611

Potential Space Loss Due to Structures (square miles)

Year	Exploration Rigs	Production Platforms	Pipeline
1987	5.2	1.0	0
1992	0	2.9	306
1997	0	2.9	306
2002	0	2.9	306
2007	0	2.9	306

Source: OCS development scenario from BLM, (1982). Other calculations from text.

The results presented here are based upon similar methodologies and calculations as presented in Section 7.0. Estimates of fishery stocks were obtained from Appendix A. Measurements and area calculations come from Exhibit 7-14 for the Norton Basin. Identical parameters for measuring the size of the OCS areas precluded and the amount of catch loss were used here as in previous calculations. The results of the catch loss calculations for St. George Basin due to surface structures are given in Exhibit 7-29. The results of catch loss calculations for the Norton Basin due to surface structures are given in Exhibit 7-30. St. George catch loss calculations for sub-surface structures are given in Exhibit 7-31. Norton Basin catch loss calculations for sub-surface structures are given in Exhibit 7-32.

Exhibit 7-29

St. George Basin Catch Loss
Due to Surface Structures -- Mean Development Scenario

	Projected St. George Basin Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[3] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[4] Loss Based on Random Movement Model (dollars)
1987						
Pollock	167,700	28,509	0.12	34.2	0.14	18.5
Pacific Cod	63,400	12,046	0.12	14.5	0.06	31.7
Flatfish[1]	12,000	1,692	0.12	2.0	0.1	72.6
Other Groundfish[2]	2,997	414	0.12	0.5	neg	neg
Total	246,097	42,661	0.12	51.2	0.3	122.8
1992						
Pollock	335,400	57,018	0.05	28.5	0.11	14.5
Pacific Cod	101,440	19,274	0.05	9.6	neg	neg
Flatfish[1]	18,000	2,538	0.05	1.3	0.7	508.2
Other Groundfish[2]	5,994	827	0.05	0.4	neg	neg
Total	460,834	79,657	0.05	39.8	0.81	522.7
1997						
Pollock	536,640	91,229	0.05	45.6	0.18	23.8
Pacific Cod	126,800	24,092	0.05	12.0	0.05	26.4
Flatfish[1]	36,000	5,076	0.05	2.5	0.13	94.4
Other Groundfish[2]	9,990	966	0.05	0.5	neg	neg
Total	716,430	121,363	0.05	60.7	0.36	144.6
2002						
Pollock	670,800	114,036	0.05	57.0	0.23	30.4
Pacific Cod	126,800	24,092	0.05	12.0	0.05	26.4
Flatfish[1]	42,000	5,922	0.05	3.0	0.15	108.9
Other Groundfish[2]	11,988	1,654	0.05	0.8	neg	neg
Total	851,588	145,704	0.05	72.9	0.43	165.7
2007						
Pollock	670,800	114,036	0.05	57.0	0.23	30.4
Pacific Cod	126,800	24,092	0.05	12.0	0.05	26.4
Flatfish[1]	60,000	8,460	0.05	4.2	0.21	152.5
Other Groundfish[2]	19,980	2,757	0.05	1.4	0.07	50.8
Total	877,580	149,345	0.05	74.7	0.56	260.1

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] Area of exploration rigs from Exhibit 7-9 divided by area of geologic potential which was estimated to be 5,310 square miles based on Exhibit 7-15.

[4] Value of catch loss based on current prices estimated to be 6 cents per puond for pollack, 24 cents from Pacific cod, and 33 cents per pound for platfish and other groundfish.

Source: Calculations based on procedures described in text.

Exhibit 7-30

Norton Basin Catch Loss
Due to Surface Structures -- Mean Development Scenario

	Projected Norton Basin Domestic Catch (metric tons)	Catch in Area of Geologic Potential (metric tons)	Percent of Area[2] of Geologic Potential Foreclosed	Catch Loss Based on Proportional Area (metric tons)	Catch Loss Based on Random Movement Model (metric tons)	Value of Catch[3] Loss Based on Random Movement Model (dollars)
1987						
Pollock	1,200	79	0.17	0.13	neg	neg
Other Groundfish[1]	600	-	0.17	-	-	-
Total	1,800	79	0.17	0.13	neg	neg
1992						
Pollock	1,200	79	0.1	0.08	neg	neg
Other Groundfish[1]	600	-	0.1	-	-	-
Total	1,800	79	0.1	0.08	neg	neg
1997						
Pollock	1,200	79	0.1	0.08	neg	neg
Other Groundfish[1]	600	-	0.1	-	-	-
Total	1,800	79	0.1	0.08	neg	neg
2002						
Pollock	1,200	79	0.1	0.08	neg	neg
Other Groundfish[1]	600	-	0.1	-	-	-
Total	1,800	79	0.1	0.08	neg	neg
2007						
Pollock	1,200	79	0.1	0.08	neg	neg
Other Groundfish[1]	600	-	0.1	-	-	-
Total	1,800	79	0.1	0.08	neg	neg

---

neg means amount is less than 0.05 metric tons or 10 dollars.

[1] Includes rockfish, atka mackerel, and other incidental catch.

[2] Area of exploration rigs from Exhibit 7-11 divided by area of geologic potential which was estimated to be 2,898 square miles based on Exhibit 7-16.

[3] Value of catch loss based on current prices estimated to be 6 cents per pound for pollack, 24 cents from Pacific cod, and 33 cents per pound for flatfish and other groundfish.

Source: Calculations based on procedures described in text.

Exhibit 7-31

St. George Basin Catch Loss Due To Sub-Surface Structures -- Mean Development Scenario

	Domestic Catch in Sector Where Pipeline Is Likely To Be Located (metric tons)	Catch Affected By Sub-surface Structures (metric tons)	Percent of Pipeline[3] Sector Foreclosed To Fishing	Catch Loss Based On Proportional Area (metric tons)	Catch Loss Based On Random Movement Model (metric tons)	Value of Catch[4] Loss Based On Random-Movement Model (dollars)
1987						
Pollock	41,646.6	35,399.6	-	-	-	-
Pacific Cod	17,081.3	17,081.3	-	-	-	-
Flatfish[1]	2,891.3	2,891.3	-	-	-	-
Other Groundfish[2]	472.9	401.9	-	-	-	-
Total	62,092.1	55,774.1	-	-	-	-
1992						
Pollock	83,293.9	70,799.8	3.1	2,194.8	8.8	1,161.6
Pacific Cod	25,988.7	25,988.7	3.1	805.6	3.2	1,689.6
Flatfish[1]	4,379.0	4,379.0	3.1	135.7	6.8	4,936.8
Other Groundfish[2]	944.7	803.0	3.1	24.9	1.2	871.2
Total	114,606.3	101,970.5	3.1	3,161.0	20.0	8,659.2
1997						
Pollock	143,379.9	121,872.9	3.1	3,778.1	15.1	1,993.2
Pacific Cod	32,485.3	32,485.3	3.1	1,007.0	4.0	2,112.0
Flatfish[1]	3,739.8	3,739.8	3.1	115.9	5.8	4,210.8
Other Groundfish[2]	1,162.3	988.0	3.1	30.6	1.5	1,089.0
Total	180,767.3	159,086.0	3.1	4,931.6	26.4	9,405.0
2002						
Pollock	164,188.0	139,559.8	3.1	4,326.4	17.3	2,283.6
Pacific Cod	32,485.4	32,485.4	3.1	1,007.0	4.0	2,112.0
Flatfish[1]	9,439.1	9,439.1	3.1	292.6	14.6	10,599.6
Other Groundfish[2]	1,889.5	1,606.1	3.1	49.8	2.5	1,815.0
Total	208,002.0	183,090.4	3.1	5,675.8	38.4	16,810.2
2007						
Pollock	164,188.0	139,559.8	3.1	4,326.4	17.3	2,283.6
Pacific Cod	32,485.4	32,485.4	3.1	1,007.0	4.0	2,112.0
Flatfish[1]	14,693.4	14,693.4	3.1	455.5	22.7	16,480.2
Other Groundfish[2]	3,149.5	2,677.1	3.1	83.0	4.2	3,049.2
Total	214,516.3	189,415.7	3.1	5,871.9	48.2	23,925.0

---

[1] Includes flounders, yellowfin sole and turbots.

[2] Includes rockfish, atka mackerel, and other incidental catch.

[3] The pipeline sector is that area where the pipeline is judged to have a uniform probability of being located anywhere throughout the sector. This area was estimated to contain 9,720 square miles with a landfill on the Alaska Peninsula.

[4] Value of catch loss based on current prices estimated to be 6 cents per pound for pollack, 24 cents from pacific cod, and 33 cents per pound for flatfish and other groundfish.

Source: Calculations based on procedures described in text.

Exhibit 7-32

Norton Basin Catch Loss Due To Sub-Surface Structures -- Mean Development Sceanario

	Domestic Catch in Sector Where Pipeline Is Likely To Be Located (metric tons)	Catch Affected By Sub-surface Structures (metric tons)	Percent of Pipeline[1] Sector Foreclosed To Fishing	Catch Loss Based On Proportional Area (metric tons)	Catch Loss Based On Random Movement Model (metric tons)	Value of Catch[2] Loss Based On Random-Movement Model (dollars)
1987						
Pollock	79	67	-	-	-	-
Other Groundfish[3]	-	-	-	-	-	-
Total	79	67	-	-	-	-
1992						
Pollock	79	67	1.6	1.1	neg	neg
Other Groundfish[3]	-	-	-	-	-	-
Total	79	67	1.6	1.1	neg	neg
1997						
Pollock	79	67	1.6	1.1	neg	neg
Other Groundfish[3]	-	-	-	-	-	-
Total	79	67	1.6	1.1	neg	neg
2002						
Pollock	79	67	1.6	1.1	neg	neg
Other Groundfish[3]	-	-	-	-	-	-
Total	79	67	1.6	1.1	neg	neg
2007						
Pollock	79	67	1.6	1.1	neg	neg
Other Groundfish[3]	-	-	-	-	-	-
Total	79	67	1.6	1.1	neg	neg

---

neq means amount is less than 0.5 metric tons or 10 dollars.

[1] The pipeline sector is that area where the pipeline is judged to have a uniform probability of being located anythwere throughout the sector. This area was estimated to contain 5,838 square miles.

[2] Value of catch loss based on current prices estimated to be 6 cents per pound for pollock, 24 cents from Pacific cod, and 33 cents per pound for flatfish and other groundfish.

[3] Includes rockfish, atka mackerel, and other incidental catch.

Source: Calculations based on procedures described in text.

8.0 LABOR IMPACTS

Labor impacts can potentially take place in the following sectors associated with the commercial fishing industry:

- o harvesting,
- o processing, and
- o support industries.

Support industries include marine repair and other business establishments providing goods and services to the commercial fishing industry. Competition for labor in the support industries has historically taken place most notably among skilled technicians including diesel mechanics, electronic repairmen, and welders. Usually these people are not bid away to directly work in direct OCS jobs. Rather the demand for repair and other skilled services required by OCS development increases. This increased demand for these services and skills may raise costs or create temporary shortages for these skills (Centaur Associates, 1981).

However it was found that in Unalaska/Dutch Harbor, which is the focal point of shore-based interactions between the two industries, OCS development may have positive benefits. Currently, for major diesel and other types of repairs, mechanics must frequently be flown in from other parts of Alaska. OCS development could spur the development of a significant amount of shore-based support activity for these types of services in Unalaska. This would increase the availability of such services to the fishing industry by having such services more available locally. OCS activity could create a large enough "market" for such services that more extensive repairs could be undertaken locally. In many instances this would decrease costs by eliminating the need for expensive travel.

Exhibit 8-1 shows the total harvesting (fishermen) and processing employment projections for Bering Sea fisheries based on data from Section 3.0. Processing employment is broken down into employment on processing vessels at sea and onshore processing plants. Future fishing industry labor requirements for the Bering Sea are also assessed in terms of local versus non-local employment. Here local employment refers to persons living permanently in the Aleutian Islands Census Division on a more or less year-round basis. Non-local employment refers either to harvesting or processing employees who work either on transient vessels or reside temporarily on a seasonal basis in the area. Current fishery employment in the Aleutian area is predominantly non-local.

The great majority of the persons currently working on crab vessels operating out of Unalaska and the other Aleutian ports have a permanent residence elsewhere, either one of the other main population centers of Alaska as a whole, or Seattle and other fishing ports of the northwestern part of the "lower 48" states. In fact in 1977 only 12 permanent residents of Unalaska derived their primary income from fishing (Alaska Department of Community and Regional Affairs, 1979).

It is possible that this situation may change over the years as the general population of Unalaska and the Aleutians grows such that the infrastructure and urban facilities develop to the point that will encourage the in-migration of a permanent fishing industry employment core. The major factor that would encourage this would be the eventual development of land-based groundfish processing which would tend to be on a year-round basis rather than the current seasonal basis to crab processing. Factors that may discourage this however, would be the

Exhibit 8-1

Fishing Industry Labor Requirements
(Number of Persons)

	Fishermen on Catcher Vessels		Employees on Catcher/Processor Vessels			Onshore Processing Employees	
Year	Employed in Operations in Bering Sea[1]	Number Residing in Aleutian Islands Census Division[2]	Number Employed in Operations in Bering Sea[3]	Domestic Employees in Operations in Bering Sea[4]	Number Residing in Aleutian Islands Census Division[5]	Total[6]	Number Residing in Aleutian Islands Census Division[5]
1987	984	-	2,659	665	-	760	See text
1992	1,200	96	4,751	1,916	77	1,251	"
1997	1,518	121	7,711	3,856	154	1,840	"
2002	1,752	140	10,498	5,774	231	2,400	"
2007	1,902	152	11,611	6,967	279	2,736	"

---

[1] Sum of harvesting employees from Table 3-22.

[2] Eight percent of persons employed in Bering Sea operations were assumed to reside in the Aleutian Islands Census Division beginning in 1992 based on procedures described in text.

[3] Sum of offshore processing employees from Table 3-23.

[4] Of the number of processor vessels projected, 25 percent projected were assumed to be domestic in 1987 (the rest being joint ventures), 40 percent in 1992, 50 percent in 1997, 55 percent in 2002, and 60 percent in 2007.

[5] Four percent of persons employed in Bering Sea operations were assumed to reside in the Aleutian Islands Census Division beginning in 1992 based on procedures described in text.

[6] Sum of onshore processing employees from Table 3-23.

propensity of vessels to establish home ports and for crews to choose to reside closer to major population centers. Until now most new residents of Unalaska have tended to be employed in government, management, or service industries and not the fishing industry.

Both bottomfish and OCS development are expected to contribute to population growth in Unalaska/Dutch Harbor. Also, the port's role as the central trans-shipment point in the region will continue to be enhanced, adding to overall growth (Peat, Marwick, Mitchell and Co. et. al., 1981). Associated growth in the construction and services sectors, and total community employment and population are also expected to increase. Additionally, the future resident population of Unalaska is expected to show a disproportionate number of unattached adults with relatively few children and older person (Alaska Consultants, Inc., 1981).

In order to project the pattern of the degree of local residence in the Bering Sea fisheries, examples were drawn from the other fisheries in Alaska. Non-residents of Alaska form a significant portion of the Alaskan king crab fishery. In 1980-81 the following percentage of vessels from each respective fishing area were registered to non-residents: Southeastern Bering Sea - 67 percent, Dutch Harbor - 41 percent, Adak -94 percent, and Northern Bering Sea - 84 percent. Approximately 72 percent of the total catch from all these areas was taken by non-residents (NPFMC, 1981). In contrast, in the Alaska halibut fishery the percentage of non-residents holding use permits for vessels greater than five tons has been approximately 15 percent in recent years (NPFMC, 1978a).

This pattern can be interpreted as follows. The king crab fishery developed quite rapidly in the 1970's creating a continuing demand for employees. The halibut fishery is relatively mature and has a very short season. Thus, it is difficult for non-residents to gear up for the short halibut season.

Since the groundfish fishery is expected to be developing steadily, it could be expected that the residence patterns will be similar to those for the king crab fishery. Thus for the projections for local residence for fishermen in Exhibit 8-1, it is assumed that 16 percent of fishermen will be residents of Alaska.

Furthermore, if "local" residence is taken to mean residence to the Aleutian Census Division, residence of Alaska groundfish fishermen will be split between "local" and other areas of Alaska. Alaska's bottomfish resources are split between the Bering Sea/Aleutian area and the Gulf of Alaska on a roughly 75 percent/25 percent basis. On the one hand there would be a tendency for the vessel, crew, and processing bases to be in ports nearer to the Gulf of Alaska such as Kodiak, Seward, Yakutat, or Sitka which are also closer to major population centers. On the other hand, having crews based at Unalaska or other Aleutian sites would reduce travel for vessels concentrating on Bering Sea fisheries. Based on the above it is assumed that roughly 50 percent of Bering Sea fishermen who are Alaska residents would eventually reside within the Aleutian Census Division. A certain period of time would be required for places such as Unalaska to develop the necessary infrastructure and housing facilities to support in-migration. Thus eight percent (16 percent times 50 percent) of Bering Sea fishermen are assumed to have "local" residence by 1992.

Exhibit 8-1 also shows projections of the number of domestic employees on catcher/processor vessels. Initially, a substantial proportion of sea-based processing will be done on foreign vessels through joint ventures. However, over the years a greater proportion of sea-based processing is expected to be performed by domestic catcher/processors.

The projections for domestic catcher/processor employment in Exhibit 8-1 assumed that in 1987 25 percent of the processing vessels projected for the Bering Sea would be domestic vessels. It was assumed that 40 percent of the vessels projected in 1992 would be domestic, 50 percent in 1997, 55 percent in 2002, and 60 percent in 2007. It is estimated that there are 60 employees per processing vessel.

On these domestic vessels it is expected that procesing workers will initially follow the traditional pattern of transient non-local employment in Unalaska, but will increasingly adopt "local" residence in a pattern similar to that for fishermen. However, the percentage of sea-based processing employees having local residence in the Aleutian area was assumed to be half of the above figures for fishermen because of the larger size and geographic range of the vessels. Thus it was assumed that four percent of employees on domestic processing vessels would have "local" residence by 1992.

Employment associated with OCS development in the Bering Sea is highly seasonal, particularly in the exploration and construction phases. Employment on vessels is mainly associated with supply and other support vessels. Construction employment is mainly associated with the construction of the oil and gas terminals and the pipeline. In fact much of the OCS employment are jobs which by virtue of their skill requirements do not compete in the local or general regional labor markets and which will likely require specialized skills and be filled from outside the area. Only construction activity and perhaps employment on vessels offer significant alternative employment opportunities for fishermen in the early phases of development. With regard to employment on vessels, licensing requirements (which do not apply to the smaller fishing vessels) would be an impediment to labor transfer. In the latter production phases of development there would be a greater tendency to absorb local residents.

It has been found (Centaur Associates, Inc, 1981) that, historically in areas where there has been concurrent fishing and OCS oil and gas development activity, there have not been significant labor market interactions in the fish harvesting sector. This has typically been because fishermen could expect to earn more in fishing than in the OCS jobs for which they could qualify.

Data from the Alaska Department of Labor (1983) and the Alaska Commercial Fisheries Entry Commission (1983) on gross earnings to fishermen engaged in Bering Sea fisheries for halibut, king crab, Tanner crab, and groundfish are presented in Exhibit 8-2. The gross earnings per crew member are not a reliable indicator of net amounts actually received by fishermen because they do not consider vessel operating expenses and such data are generally skewed by the fact that much of the activity is seasonal or part time. Also, individual fishermen may participate in more than one fishery. Gross earnings for dedicated full-time fishermen may be substantially higher than the figures presented in Exhibit 8-2.

As an indicator of the potential net income to fishermen in this area Browning (1980) reported that (apparently for the late 1970's) each crewman's earnings on a particular Tanner and king crab vessel was $97,000 (for a seven month season) and that "it is virtually impossible to find a crewman's job unless you have a relative who owns a crab boat or know a skipper personally". This may have been a particularly successful vessel. However, this figure is indicative of the high potential incomes that existed in those years. In recent years because of reduced catch levels, income has fallen considerably in the crab fisheries as is indicated in Exhibit 8-2.

As a general conclusion it appears that in good years fishermen's earnings could not be matched by OCS-related employment in the positions

Exhibit 8-2

Earnings per Crew Members in Bering Sea Fisheries

Census Area	Year	Fishery	Gear Type	Number of Fishermen	Number of Permits Fished	Pounds Landed (X 1,000)	Estimated Gross Earnings (X 1,000)	Estimated Gross Earnings per Vessel (X 1,000)	Crew Factor	Earnings per Crew Member (X 1,000)
Aleutian Islands (10)	1980	Halibut	Longline #1 (12)	17	17	34.8	31.1	1.8	4.3	0.4
		King Crab	Pots #1 (13)	10	10	247.7	220.5	22.1	4.1	5.4
		King Crab	Pots #2 (14)	39	39	8,037.1	7,351.8	188.5	4.1	46.0
		Tanner Crab	Pots #1	27	27	1,808.7	1,301.2	48.2	4.1	11.8
		Tanner Crab	Pots #2	52	51	6,738.1	4,221.9	82.8	4.1	20.2
		Other (11)	Trawl (15)	3	3	NA	NA	NA	4.0	NA
	1981	Halibut	Longline #2 (16)	11	11	74.2	73.0	6.6	4.3	1.5
		King Crab	Pots #1	9	9	79.5	80.9	9.0	4.1	2.2
		King Crab	Pots #2	28	28	2,127.0	2,140.0	76.4	4.1	18.7
		Tanner Crab	Pots #2	44	44	3,966.4	2,052.4	46.6	4.1	11.4
		Other	Trawl	5	5	1,007.5	176.5	35.3	4.0	8.8
		Other	Longline #2	4	4	40.4	7.2	1.8	2.0	0.9
	1982	Halibut	Longline #2	37	37	144.0	153.4	4.1	4.3	1.0
		King Crab	Pots #1	4	4	13.2	27.6	6.9	4.1	1.7
		King Crab	Pots #2	46	46	1,533.0	3,407.9	74.1	4.1	18.7
		Tanner Crab	Pots #2	55	55	5,546.9	5,820.6	105.8	4.1	25.8
		Other	Trawl	7	7	2,603.8	353.1	50.4	4.0	12.6
		Other	Longline #2	1	1	NA	NA	NA	2.0	NA
Nome (17)	1980	King Crab	Pots #1	1	1	NA	NA	NA	2.5	NA
		King Crab	NA	1	1	NA	NA	NA	2.5	NA
Kodiak	1980	Halibut	Longline #2	58	58	272.0	243.3	4.2	3.5	1.2
		King Crab	Pots #2	59	59	18,531.1	17,009.9	288.3	3.5	82.4
		Tanner Crab	Pots #2	165	165	22,962.8	14,031.4	85.0	3.75	26.7
		Other	Trawl	18	18	2,145.3	385.1	21.4	3.75	5.7
Kodiak	1981	Halibut	Longline #2	99	99	1,270.8	1,249.0	12.6	3.5	3.6
		King Crab	Pots #2	12	12	613.6	651.9	54.3	3.5	15.5
		Tanner Crab	Pots #1	86	86	2,488.5	1,957.1	22.8	NA	NA
		Tanner Crab	Pots #2	137	137	15,840.4	10,056.4	73.4	3.75	19.6
		Other	Trawl	14	14	3,125.9	443.0	31.6	3.75	8.4

Exhibit 8-2 (Cont.)

Earnings per Crew Members in Bering Sea Fisheries

Census[1] Area	Year	Fishery[2]	Gear Type[3]	Number of Fishermen[4]	Number of[5] Permits Fished	Pounds[6] Landed (X 1,000)	Estimated Gross Earnings (X 1,000)	Estimated Gross[7] Earnings per Vessel (X 1,000)	Crew Factor[8]	Earnings per Crew Member[9] (X 1,000)
	1982	Halibut	Longline #1	191	191	190.6	200.1	1.0	1.5	0.7
		Halibut	Longline #2	115	115	2,466.7	2,658.6	23.1	3.5	6.6
		King Crab	Pots #2	10	10	833.2	1,913.4	191.3	3.5	54.7
		Tanner Crab	Pots #2	136	136	12,113.5	21,428.5	157.6	3.75	42.0
		Other	Trawl	15	15	7,541.0	826.1	55.1	3.75	14.7
Kenai-Peninsula Borough	1980	Halibut	Longline #2	238	238	1,044.1	923.5	3.9	3.5	1.1
		King Crab	Pots #2	22	22	3,705.7	3,484.8	158.4	3.5	45.3
		Tanner Crab	Pots #2	54	54	5,721.4	3,068.3	56.8	3.25	17.5
		Other	Trawl	7	7	517.4	113.8	16.3	3.0	5.4
		Other	Longline #2	5	5	13.0	6.5	1.3	2.0	0.7
	1981	Halibut	Longline #2	252	252	1,497.6	1,402.4	5.6	3.5	1.6
		King Crab	Pots #2	5	5	340.4	345.6	69.1	3.5	19.7
		Tanner Crab	Pots #2	14	14	2,045.9	936.9	66.9	3.25	20.6
		Other	Trawl	4	4	832.1	134.1	33.5	3.0	11.2
		Other	Longline #2	7	7	15.2	7.5	1.1	2.0	0.6
	1982	Halibut	Longline #2	238	238	2,047.5	2,094.9	8.8	3.5	2.5
		King Crab	Pots #2	13	13	636.9	1,427.5	109.8	3.5	31.4
		Tanner Crab	Pots #2	12	12	1,630.0	1,589.5	132.5	3.25	40.8
		Other	Longline #2	7	7	17.4	6.7	1.0	2.0	0.5

Sources: Alaska Department of Labor (1983). Alaska Fish Harvesting Employment, Research and Analysis Section. Juneau, Alaska. Alaska Commercial Fisheries Entry Commission (1983) Unpublished data. Juneau, Alaska.

(Footnotes on the following page)

Exhibit 8-2 (Cont.)

Earnings per Crew Members in Bering Sea Fisheries

(Footnotes from the previous page)

NA means not available.

[1] The Census Areas correspond to those given in Alaska Planning Information (1983) and indicate the residence of the permit.

[2] The fisheries listed are those most likely to be impacted by OCS development in the Bering Sea. They are taken from the Alaska Fisheries Entry Commission data.

[3] Only those gears used in OCS areas were taken from the Fisheries Entry Commission data.

[4] The number of fishermen is given as "number of SSN's" in the Fisheries Entry Commission data. This presents the number of person's holding permits in the fishery.

[5] The number of permits fished may be less than or equal to the number of fishermen (SSN's).

[6] Data are not reported for fisheries with less than four permits issued due to confidentiality.

[7] Determined by dividing the estimated gross earnings in each fishery by the number of permits fished.

[8] Crew Factors derived from the Alaska Department of Labor (1983), Alaska Fish Harvesting Employment, Page 2: "Crew Factor is the estimated average number of people working on a commercial fishing vessel. It includes fish harvesters (crew members and captains) but not tender and packer crews or on-shore processing employment." Data were determined by species, gear and region. The regions did not correspond between data obtained from the Alaska Department of Labor (1983) and the Alaska Commercial Entry Commission (1983). Therefore, Cook Inlet Crew Factors are used for Kenai; Kodiak for Kodiak; Aleutian Peninsula, Dutch Harbor and Bering-Western Aleutians Crew Factors are used with the Aleutian earnings data; and Arctic/Yukon/Kuskokwim Crew Factors are used with Nome earnings data. See pages 3 and 4 of Alaska Dept. of Labor (1983).

[9] Determined by dividing estimated gross earnings per vessel by crew factor.

[10] The Aleutian Island Census Area includes catch landed at Dutch Harbor, Bering Sea Ports (excluding Norton Sound), and Adak.

[11] Other is miscellaneous saltwater finfish and would include such species as pollock, flounders, cod (excluding sablefish) and all other flatfish, roundfish, and white fish not specifically designated in the data.

[12] Longline #1 signifies the longline were fished from a vessel under five net tons.

[13] Pots #1 signifies the pots were fished from vessels with a length of 50 feet or less.

[14] Pots #2 signifies the pots were fished from vessels with a length greater than 50 feet.

[15] Trawl signifies the fish were caught with an otter trawl.

[16] Longline #2 signifies the longline were fished from a vessel over five net tons.

[17] No data are available for 1981 and 1982. The predominant species caught in the Nome area are salmon and herring.

Note: For each census area, the fisheries are broken out by: fishery species, gear type and area. For purposes of analysis, only those fishery permits related to Dutch Habor, Adak and the Bering Sea were included for king crab. Only statewide permits (excluding Cook Inlet and Prince William Sound) were included for Tanner crab. Halibut and other species are given on a state-wide basis only.

for which most fishermen could qualify. Thus it is highly unlikely that OCS development will have any adverse impact on employment in the fish harvesting sector.

In fact it has been noted that OCS jobs could provide supplemental or contra-cyclical employment opportunities in times when the fishing industry is depressed (Centaur Associates, Inc., 1981). This is not an adverse impact, but is actually a positive benefit. The king and Tanner crab fisheries typically operate between September and May or June. Thus some of the seasonal OCS employment such as construction could provide contra-cyclical employment. Also, the OCS industry can provide benificial employment opportunities during periods when a fishery is depressed such has been the case in the crab fishery recently.

In the processing sector (Centaur Associates, 1981) it was found that in isolated labor markets which are heavily dependent on fishing, significant labor impacts on fish processing employment occured in certain areas. Fish processing establishments found availability of labor to be a problem and there was a tendency to bid up wages causing cost impacts on processors. However this only occured in those cases where fish processing employment was a great percentage of the total local labor market and potential OCS job opportunities caused significant local labor shortages and labor cost increases.

In view of this, certain unique characteristics of the employment associated with Bering Sea OCS development with respect to fish processing must be noted. The majority of shoreside effects (both OCS and fishing related) will occur around Dutch Harbor/Unalaska. Currently, virtually all fish processing (which is now mainly crab) workers are imported from outside the State, typically on six month contracts. These contracts includes airfare from a point which is usually Seattle (Alaska Department of Community and Regional Affairs, 1979). This pattern will probably continue in the early phases of

Bering Sea development. However, as groundfish processing develops, there may be in-migration as processing workers develop permanent resident status within the Aleutian Island Census Division. Assuming that impediments to in-migration such as lack of housing and infrastructure can be overcome, it could be expected that a substantial proportion of the onshore processing employees presented in Exhibit 8-1 would become "local" residents.

The in-migration of processing workers would be occuring at about the same time period as the in-migration for OCS development. Thus the labor pool for fish processing as well as the potentially competitive OCS jobs for the Bering Sea can be thought of as consisting of all of Alaska, and parts of the Northwest of the "lower 48" states. In such a large labor market the effect of OCS lease activity would not be significant on recruitment.

Thus it can be concluded that OCS activity will have little adverse effect on employment in either the processing or harvesting sectors. There is a positive benefit, if anything associated with additional employment opportunities during periods of poor earnings in the fishery. However, there would be a secondary type of conflict, not within the labor market itself. The development of OCS resident employment would tend to exacerbate competition for housing opportunities and strain the community infrastructure during those periods when resident employment associated with groundfish development would be growing rapidly.

9.0 LITERATURE AND REFERENCES CITED

This section presents literature and other references cited for sections 1.0 through 8.0. The bibliography for Appendix B, Technical Memorandum BC-1 is provided separately at the end of Appendix B.

Alaska Commercial Fisheries Entry Commission, 1983. Unpublished data. Juneau, Alaska.

Alaska Consultants, Inc., 1981. St. George Basin petroleum development scenarios local socioeconomic systems analysis. Technical Report 59. Bureau of Land Management, Anchorage, Alaska.

Alaska Department of Community and Regional Affairs, 1979. Community planning and development for the bottomfish industry, Phase I Report. Juneau, Alaska.

Alaska Department of Fish & Game (ADF&G), 1980, Alaska 1979 catch and production, commercial fisheries statistics.

Alaska Department of Fish & Game (ADF&G), 1982, Alaska 1980 catch and production commercial fisheries statistics.

Alaska Department of Fish & Game (ADF&G), 1982a, Alaska Peninsula, Bristol Bay, Kushokwim, Yukon, and Norton Sound area - salmon reports to the Alaska Board of Fisheries, Commercial Fisheries Division.

Alaska Department of Fish & Game (ADF&G), 1982b, Westward regional shellfish report to the Alaska Board of Fisheries. Commercial Fisheries Division. Kodiak. 395 pp.

Alaska Department of Labor, 1980. Alaska fisheries statistics bottomfish labor study, Part IV, Juneau, Alaska.

Alaska Department of Labor, 1983. Alaska fish harvesting employment. Research and Anlaysis Section. Juneau, Alaska.

Alaska Fisheries Development Corporation (AFDC), 1978. Development proposed for bottomfish off Alaska.

Alaska Fisheries Development Foundation (AFDF), 1981. Operations of a European factory trawler in the Alaska Bering Sea groundfish fishery. Anchorage. 53 pp.

Alaska Fisheries Development Foundation (AFDF), 1982. Alaska pollock: is it a red herring? Proceedings of a Conference, November 18 and 19, 1982. Anchorage, AK. 259 pp.

Alaska Native Foundation, 1981. Assessment and marketing analysis of western Alaska's herring fishery. Report for the Economic Development Administration, Anchorage. 183 pp.

Alaska Planning Information, 1983. Alaska Department of Labor, Research and Analysis Section. Juneau, Alaska.

Alverson, D.L., A.T. Pruter, and L.L. Ronholt, 1964. A study of demersal fishes and fisheries of the northeast Pacific Ocean. H.R. MacMillan Lect. Fish., Inst. Fish., Univ. B.C., Vancouver, 190 p.

Baker, M. Alaska Longline Fishermen's Association. Sitka, Alaska.

Bailey, J., 1969. Alaska's fishery resources. The pink salmon. U.S. Fish Wildl. Serv., Fish. Leafl. 619.

Bailey, J.E., and J.J. Pella, 1976. Pink salmon fry production in a gravel incubator hatchery Auke Creek, Alaska, with evaluation of adult return of the 1972 brood. Auke Bay Fisheries Laboratory, Manuscr. Rpt. File No. 124.

Bakkala, R.W., V. Wespestad, T. Sample, R. Narita, R. Nelson, D. Ito, M. Alton, L. Low, J. Wall and R. French, 1982. Condition of groundfish resources of the eastern Bering Sea and Aleutian Islands region in 1981.

Bakkala, R.G., V.G. Wespestad and L.L. Low, 1982. The yellowfish sole (Limanda aspera) resource of the eastern Bering Sea - its current and future potential for commercial fisheries. NOAA T.M. NMFS F/NWC-33.

Bams, R.A., 1970. Evaluation of a revised hatchery method tested on pink and chum salmon fry. J. Fish. Res. Bd. Con. 27:1429-1452.

Barton, L., and V. Wespestad, 1981. Distribution, biology and stock assessment of western Alaska's herring stock. pp. 27-54. In Proceedings of the Alaska Herring Symposium, Feb. 19-21, 1980, Anchorage. Alaska Sea Grant Report 80-4.

Best, E.A., 1981. The eastern Bering Sea shelf: oceanography and resources. Vol. 1.

Beyer Engineering, 1981. Water system master plan, City of Unalaska, Alaska.

Browning, R.J., 1980. Fisheries of the North Pacific. Alaska Northwest Publishing Company. Anchorage, Alaska.

BLM (Bureau of Land Management), 1981. Draft environmental impact statement proposed OCS lease sale St. George Basin. Alaska OCS Office. Anchorage, Alaska.

BLM (Bureau of Land Management), 1982. Final environmental impact statement for proposed Outer Continental Shelf Oil and Gas Lease Sale, Norton Sound. Alaska Outer Continental Shelf Office. Anchorage, Alaska.

Carter, G. Oregon Marine Advisory Program. Portland, Oregon.

Centaur Associates, 1981. Assessment of space and use conflicts between fishing and oil industries, Vol. III. Prepared for Bureau of Land Management, Outer Continental Shelf Office, New York, New York.

Centaur Associates, Inc., and Dames and Moore, 1983. Navarin Basin commercial fishing industry impact analysis. Prepared for Minerals Management Service, Alaska OCS Office, Anchorage, Alaska.

City of Unalaska, 1982. Aleutian Regional Airport, Project Documentation.

Cobb, J.N., 1927. Pacific cod fisheries, Rep. U.S. Comm. Fish. for 1926. Appendix VII (Doc, No. 1014): 385-499.

Combs, Earl R., Inc. 1978. A study to determine the export and domestic markets for currently underutilized fish and shellfish. Prepared for U.S. Department of Commerce Contract No. MO-A01-78-00-4037. 416 pp.

Combs, Earl R. Inc., 1979. Prospectus for the development of the United States fisheries. Report for the Fisheries Development Task Force, U.S. National Oceanic and Atmospheric Administration. 442 pp.

Combs, Earl, R. Inc., 1980. System strategy to support fisheries development in Alaska. Economic Development Administration and NMFS.

Combs, Earl R. Inc., 1981. St. George Basin and North Aleutian Shelf commercial fishing analysis. Technical Report No. 60. Alaska OCS Office, Alaska OCS Socioeconomic Studies Program.

Corp of Engineers, 1980. Waterborne commerce of the United States, Part 4. waterways and harbors -- Pacific Coast, Alaska, and Hawaii. New Orleans, LA. 183 pp.

Curl, H., and C.A. Manen, 1982. Shellfish resources. PP. 141-159. In The St. George Environment and Possible Consequences of Planned Offshore Oil and Gas Development (M.T. Hameedi, ed.) OCSEAP. Juneau 162 pp.

Dames and Moore, 1980. Offshore runway extension at Unalaska Airport, Alaska. Prepared for State of Alaska Department of Transportation and Public Facilities, Division of Aviation Design. Anchorage, Alaska.

Dames and Moore, et. al., 1981. Chernofski harbor development plan. State of Alaska Department of Transportation and Public Facilities. Anchorage, Alaska.

Dames and Moore, Gordon S. Harrison, 1982. Bering Sea cumulative economic OCS petroleum development. Technical Report No. 80. Bureau of Land Management, Alaska OCS Office. Anchorage, Alaska.

Dames and Moore, and Norgaard USA, Inc., 1982. St. Paul harbor development plan. Prepared for State of Alaska Department of Transporation and Public Facilities. Anchorage, Alaska.

Dames and Moore, and Norgaard USA, Inc., 1982a. St. George harbor development plan. Prepared for the State of Alaska Department of Transportation and Public Facilities. Anchorage, Alaska.

Dames and Moore, 1982a. Navarin Basin petroleum technology assessment. Technical Report No. 83. Bureau of Land Management, Alaska Outer Continental Shelf Office.

Darbyshire and Associates, 1979. Emmonak community profile. Prepared For Alaska Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

Data Resources, Inc., 1982. U.S. long term review, fall 1982. McGraw-Hill.

DCRA (Department of Community and Regional Affairs), 1981. City of King Cove, Alaska 1981 comprehensive plan. Division of Community Planning. Anchorage, Alaska.

DCRA (Department of Community and Regional Affairs), 1981a. City of Sand Point community comprehensive plan. Division of Community Planning. Anchorage, Alaska.

DCRA (Department of Community and Regional Affairs), 1982. King Salmon community profile. Division of Community Planning. Juneau, Alaska.

DCRA (Department of Community and Regional Affairs), 1982a. City of Akutan comprehensive plan. Division of Community Planning. Anchorage, Alaska.

DOWL Engineers, 1982. Cold Bay community profile. Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

DOWL Engineers, 1982a. Village of Togiak community profile. Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

DOWL Engineers, 1982b. Dillingham community profile. Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

Drucker, B., 1972. Some life history characteristics of coho salmon of the Karhuk River system, Kodiak Island, Alaska. NMFS, Fish Bull. 70:79-94.

Dunlop, H.A., F.H. Bell, R.J. Myhre, W.H. Hardman, and C.M. Southward, 1964. Investigation, utilization and regulation of the halibut in southeastern Bering Sea. Inter. Pac. Halibut Comm. Rep. 35.

Environmental Services Limited, 1980. Saint Michael community profile. Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

Environmental Services Limited, 1980a. Unalakleet community profile. Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

Environmental Services Limited, 1980b. Golovin community profile. Alaska Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

Environmental Services Limited, 1981. City of Nome Coastal Management Program background report. Nome, Alaska.

Environmental Services Limited, 1982. Naknek community profile. Department of Community and Regional Affairs, Division of Community Planning. Anchorage, Alaska.

Environmental Services Limited, 1982a. South Naknek community profile. Department of Community and Regional Affairs, Division of Community Planning. Anchorage, Alaska.

Environmental Services Limited, 1982b. Bristol Bay Borough community profile. Department of Community and Regional Affairs, Division of Community Planning. Anchorage, Alaska.

Fisher, Capt. Barry, 1980. A US/USSR joint venture for yellowfin sole in the eastern Bering Sea. Prepared for the Alaskan Fisheries Development Foundation. Anchorage.

Food and Agricultural Organization, 1978. 1977 yearbook of Fishery statistics-catches and landings. FDA, United Nations, Rome.

French, R., H. Bilton, M. Osako, and A. Hartt, 1976. Distribution and origin of sockeye salmon (Oncorhynchus nerka) in offshore waters of the North Pacific Ocean. Inter. N. Pac, Fish, Comm. Bull. 34.

Freed, L., Kodiak Borough Planner. Kodiak, Alaska.

Fried, S.F., C. Whitmore, and D. Bergstrom, 1982. Pacific herring stocks and fisheries in the eastern Bering Sea, Alaska, 1982. ADF&G Div. of Commercial Fisheries Report to the Alaska Board of Fisheries. Anchorage, 21 pp.

Gilbreath, O.K. Assistant Executive Director, Alaska oil and Gas Association, Anchorage, Alaska.

Hale, L.Z., 1983. Capelin: The feasibility of establishing a commercial fishery in Alaska. LZH Inc. Associates Report for Arctic Sea, Inc. Anchorage. 97 pp.

Hartman, W.L., 1971. Alaska's fishery resources. The sockeye salmon. Nat. Oceanic Atmos. Admin., Nat. Mar. Fish. Serv., Fish. Leafl. 636.

Higgins, B., 1978. An assessment of certain living marine resources and potential resource-use conflicts between commercial fisheries and petroleum development activities in outer Bristol Basin and Bristol Bay, southeastern Bering Sea. NMFS. Juneau. 242 pp.

Hutton, Mark, 1981. The fisheries and fishery resources of the Chernofski area. Dames & Moore Technical Memorandum No. 3. Anchorage. 83 pp.

Hutton, M.I. Marine Extension Agent (Ret.), Anchorage, Alaska.

International Pacific Halibut Commission, 1981. Annual Report 1980.

Ketchen, K.S., 1964. Preliminary results of studies on growth and mortality of Pacific cod (Gadus macrocephalus) in Hecate Strait, British Columbia. J. Fish. Res. Board Can. 21:1051-1067.

Knechtel, C.D., and L. J. Bledsoe, 1981. A numerical simulation model of the population dynamics of walleye pollock Theragra chalcogramma (Pallas 1811), in a simplified ecosystem. NOAA Technical Memorandum NMFS F/NWC-19.

Low, L.L., 1974. A study of four major groundfish fisheries of the Bering Sea. Ph.D. Thesis, Univ. of Wash. Seattle, 240 pp.

Low, L., M. Alton, L. Ronholt, V. Wespestad, E. Brown, and K. Edwards, 1980. Condition of groundfish resources of the Gulf of Alaska in 1980. Document submitted to the annual meeting of the International North Pacific Fisheries Center, National Marine Fisheries Service.

MacIntosh, R.A., and A.J. Paul, 1977. The relation of shell length to total weight, tissue weight, edible-meat-weight, and reproductive organ weight of the gastropods Neptunea heros, N. lyrata, N. pribiloffensis, and N. ventricosa of the eastern Bering Sea. Proc. Nat. Shellfish Assoc. 67:103-122.

MacIntosh, R.A., 1980. The snail resource of the eastern Bering Sea and its fishery. Mar. Fish. Rev. 42:15-20.

MacKay, G.A. and Moir, A.C., 1980. the conflict between the oil and fishing industries in the UK sector of the North Sea, the debris problem, background note. Institute for the Study of Sparsely Populated Areas, University of Aberdeen, Aberdeen, Scotland. pp. 1-7.

Major, R.L., J. Ito, S. Ito, and H. Godfrey, 1978. Distribution and origin of chinook salmon (Oncorhynchus tshawtscha) in offshore waters of the North Pacific Ocean, Inter. N. Pac. Comm. Bull. 38.

McBride, J., D. Fraser and J. Reeves, 1982. Information on the distribution and biology of the golden (brown) king crab in the Bering Sea and Aleutian Islands area. NWAFC Processed Rept. 82-02. 22 pp.

Merrell, T.R., 1970. Alaska's fishery resources. The chum salmon. U.S.F.W.S., Fish. Leafl. 632.

Miller, D.J., and R.N. Lea, 1972. Guides to the coastal marine fisheries of California. Fish. Bull. 157. Dept. of Fish & Game, California; 249 pp.

Moiseev, P.A., 1956. Factors of population dynamics of the commercial fauna in the northwest Pacific Ocean. Zool. Zh. 35(11):1601-1607.

Morris, Byron, F., 1981. An assessment of the living marine resources of the central Bering Sea and potential resource use conflicts between commercial fisheries and petroleum development in the Navarin Basin, proposed sale No. 83. Anchorage. 232 pp.

Myhre, R.J., G.J. Peltonen, G. St.-Pierre, B.E. Skud, and R.E. Walden, 1977. The catch, effort, and CPEU, 1929-1975. Inter. Pac. Halibut Comm. Tech. Rep. 14. Supplement.

NERBC (New England River Basins Commission). 1976. RALI factbook: onshore facilities related to offshore oil and gas development, Boston, Massachusetts.

NMFS (National Marine Fisheries Service), 1981. Conditions of groundfish resources in the eastern Bering Sea and Aleutian Islands region in 1981. NOAA/NMFS.

NMFS (National Marine Fisheries Service), 1982. Fisheries of the United States, 1981.

NMFS (National Marine Fisheries Service), 1982a. Environmental Assessment of Regulatory Amendment Implementing the Fishery Management Plan for the Commercial Tanner Crab Fishery Off the Coast of Alaska. Juneau, Alaska.

NMFS (National Marine Fisheries Service), unpublished data. (1) All nation catches in the Navarin Basin 1977-1980, by month, by 1/2° x 1° longitude by species, (2) Japanese catches, 1972-1982 by month and annual by 1/2° latitude x 1° longitude in the Navarin Basin.

National Ocean Survey, 1983. United States coast pilot, Pacific and Arctic Coasts Alaska: Cape Spencer to Beaufort Sea. Series 9, Eleventh Edition. Washington, D.C.

Natural Resource Consultants, 1981. Pacific pollock: resources fisheries, products and markets. Published by Alaska Fisheries Development Foundation, Anchorage. 131 pp.

National Resource Consultants, 1982. Fisheries of Alaska 1981. Prepared for Alaska Fisheries Development Foundation, Anchorage. 53 pp.

Nishiyama, T., T. Fujii, S. Yamamota, K. Masuda, and G. Kobayashi, 1968. Chum salmon population in the Gulf of Anadyr and the adjacent high seas in late July 1966. Contribu. No. 21, Res. Inst. N. Pac. Fish., Faculty Fish., Hakkaido Univ. Bull. 18:291-305.

NPFMC (North Pacific Fishery Management Council), 1977a. Fishery management plan for the trawl fisheries and herring gillnet fishery of Eastern Bering Sea and Northeast Pacific. Anchorage, Alaska.

NPFMC (North Pacific Fishery Management Council), 1977b. Fishery management plan for the Eastern Bering Sea king and Tanner crab fisheries. Anchorage, Alaska.

NPFMC (North Pacific Fishery Management Council), 1978. Fishery management plan for the commercial Tanner crab fishery off the coast of Alaska. Anchorage, Alaska.

NPFMC (North Pacific Fishery Management Council), 1978a. Fishery management plan and draft environmental impact statement for hailbut off the coast of Alaska. Anchorage, AK: NPFMC.

NPFMC (North Pacific Fishery Management Council), 1978b. Fishery management plan and draft environmental impact statement for the high seas salmon fishery off the coast of Alaska east of 175 degrees longitude. Anchorage, AK: NPFMC.

NPFMC (North Pacific Fishery Management Council), 1979. Fishery management plan and draft environmental impact statement for the Pribilof area shrimp fishery in the Bering Sea (draft). Anchorage, AK.

NPFMC (North Pacific Fishery Management Council), 1981a. Amended fishery management plan for the commercial tanner crab fishery off the coast of Alaska. Anchorage, AK. 93 pp.

NPFMC (North Pacific Fishery Management Council), 1981b. Bering Sea/Aleutian Islands king crab draft environmental impact statement and fisheries management plan. Anchorage, AK. 93 pp.

NPFMC (North Pacific Fishery Management Council), 1981c. Fishery management plan for the groundfish fishery in the Bering Sea/Aleutian Island area (Final). Anchorage, Alaska.

Organization for Economic Co-Operation and Development, 1965. Waqes and labour mobility. Paris: OECD.

Orth, F.L., J.A. Richardson, S.M. Piddle, 1979. Market structure of the Alaska seafood processing indsutry. University of Alaska Sea Grant Report 78-10. 2 volumes.

Otto, R.S., 1981. Eastern Bering Sea crab fisheries, 2:1037-1066. In D.W. Hood and J.A. Calder (eds.), The eastern Bering Sea shelf: Oceanography and resources. NOAA/OMPA, Seattle, Wash.

Pahlke, K., 1981. Capeline, Mallotus villosis (Muller), life history and utilization. Briefing report to the ADF&G Bering Sea Herring Staff. 16 pp.

Panshin, D.A., R.S. Roberts, R.C. Vars, 1977. Termination of loran-A: an evaluation of alternative policies. Sea Grant Publication No. ORESU-T-77-008. Oregon State Universit , Corvallis, Oregon.

Pautzke, C (NPFMC), 1982. Personal communication.

Peat, Marwick, Mitchell and Co., et al., 1980. Bering-Norton petroleum development scenarios transportation systems analysis. Prepared for Bureau of Land Management, Alaska Outer Continental Shelf Office, Technical Report No. 52. Anchorage, Alaska.

Peat, Marwick, Mitchell & Co., et al., 1981. St. George Basin transportation systems impact analysis. Prepared for Bureau of Land Management, Alaska Outer Continental Shelf Office, Technical Report No. 58. Anchorage, Alaska.

Pruter, A.T., 1980. Preliminary analysis of data obtained by foreign fishery observers in 1978. NWAFC. Processed Report 80-7.

Riordan, Bryson. Dutch Harbor, Alaska Harbormaster.

Royce, W.F., L.S. Smith, and A.C. Hartt, 1968. Models of ocean migration of Pacific salmon and comments on guidance mechanisms. U.S. fish, Wildl. Serv. Fish. Bull. 66:441-62.

Shubnikov, D.A., 1963. Data on the biology of sablefish in the Bering Sea. Translated in Soviet Fisheries Investigations in the Northwestern Pacific, Part I, pq. 287-296, by Israel Program Sci. Transl., 1968. Avail. Natl. Tech. Inf. Serv., Springfield, VA, as TT 67-51203.

Shuntov, V.P., 1970. Seasonal distribution of black and arrowtoothed halibuts in the Bering Sea. Transl. In Soviet Fisheries Investigations in the Northeastern Pacific, Part V, p. 397-408, by Israel Prog., Sci., Transl., 1972. Avail. Natl. Tech. Inf. Serv., Springfield, VA, as TT71-50127.

Smith, Gary B., 1979 The biology of walleye pollock. In Fisheries oceanography - eastern Bering Sea shelf, NWAFC Processed Report 79-20.

Smith, G.B., R.S. Hadley, R. French, R. Nelson, Jr., J. Wall, 1981. A summary of productive foreign fishing locations in the Alaska Region during 1977-80: Trawl Fisheries. University of Alaska Sea Grant Program Report 81-4. Fairbanks, Alaska.

TAMS Engineers, 1982. Port of Nome economic development analysis, Nome, Alaska.

Terry, J.M. et. al., 1980. Western Alaska and Bering-Norton petroleum development scenarios: commercial fishing industry analysis. Prepared for Bureau of Land Management Alaska OCS Office. Anchorage, Alaska. Technical Report No. 51.

Thompson, W.F. Jr., 1941. A note on the spawning of black cod (*Anaplopoma fibria*). Copeia 1941(4):270.

Thompson, W.F., and N.L. Freeman, 1930 History of the Pacific halibut fishery. Int. Fish. Comm., Rep. 5, 61 p.

Thorsteinson, F.V. and L.K. Thorsteinsen, 1982. Finfish resources. pp. 11-39. *In* the St. George Basin Environment and Possible Consequences of Planned Offshore Oil and Gas Development (M.J. Hameedi, ed.). OCSEAP. Juneau. 162 pp.

Trasky, L.L., 1974. Yukon River anadromous fish investigations. Completion Rep. for July 1, 1973 to June 30, 1974. Proj. No. AFC-47,. Anadromous Fish Conservation Act. NOAA.

United Kingdom Department of Energy, 1981. Development of oil and gas resources of the United Kingdom. Her Majesty's Stationary Office. London, England.

University of Alaska, 1978. Nelson Lagoon community profile. Arctic Environmental Information and Data Center. Prepared For Alaska Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

University of Alaska, 1978a. False Pass community profile. Arctic Environmental Information and Data Center. Prepared for Alaska Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

University of Alaska, 1978b. King Cove community profile. Arctic Environmental Information and Data Center. Prepared for Alaska Department of Community and Regional Affairs, Division of Community Planning. Juneau, Alaska.

U.S. Department of Commerce. 1981. United States coastal pilot: Pacific and Arctic Coasts Alaska: Cape Spencer to Beaufort Sea. Tenth Edition. National Oceanic and Atmospheric Administration, National Ocean Survey. Washington, D.C.

U.S. Department of Labor, Bureau of Labor Statistics, 1979. Monthly labor review.

Wall, J. and R. Nelson, Jr.. 1982. Preliminary information on the 1982 joint venture fisheries. NMFS, NOAA.

Wespestad, V. (NMFS), 1982. Personal communication.

Wespestad, V. and L.H. Barton, 1980. Distribution and migration and status of Pacific herring. In D.W. hood and R. Calder (eds.): Bering Sea Shelf Oceanography and Resources, Vol. I., in press.

Wespestad, V. and L. H. Barton, 1981. Distribution, migration and status of Pacific herring, 1:509-525. In D.W. Hood and J.A. Calder (eds.) The eastern Bering Sea: Oceanography and resource, NOAA/OMPA, Seattle, Wash.

Wolotira, J., Jr., T. Sample, and M. Morris Jr.. 1977. Baseline studies of fish and shellfish resources of Norton Sound and the southeastern Chukchi Sea. Final Report Contract No. 712082. Northwest and Alaska Fisheries Center, NMFS. Seattle. 292 pp.

Yonemori, T., 1967. On the distribution of Pacific salmon (genus Oncorhynchus) in the waters adjacent to St Lawrence Island and Anadyr Bay. Hokkaido Pref. Fish. Res. Lab., Spec. Rep. No. 33: 109-124 (In Japanese.).

Zimmerman, S. (ed), 1981. Draft Norton Sound synthesis meeting report. OCSEAP. Juneau.

Appendix A

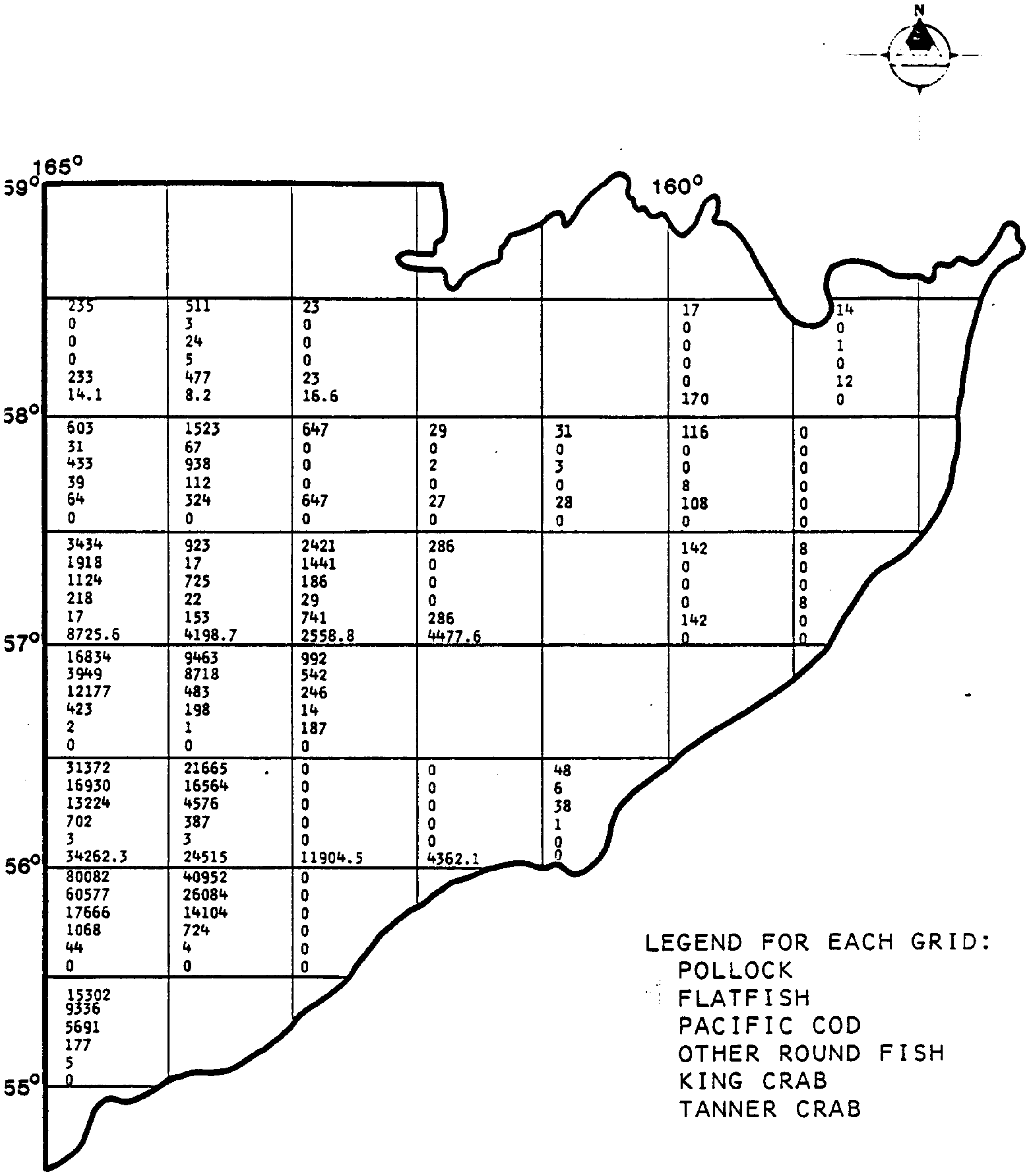
Included in this appendix are historical yearly catch, total projected domestic catch, and projected number of domestic fishing boat-days for 1987, 1992, 1997, 2002, and 2007. This information is broken out by one degree by one-half degree reporting grids.

These historical and projected data are presented for the lease sale areas of the North Aleutian Shelf, the St. George Basin, the Norton Basin, and the Navarin Basin.

This information is presented as a background to the fishing industry projections of Chapter 3. The following charts were developed as part of the projections, and were used later in the impact analysis. The interested reader may use the charts to determine concentrations of catches and vessel activity within each planning area. The figures show:

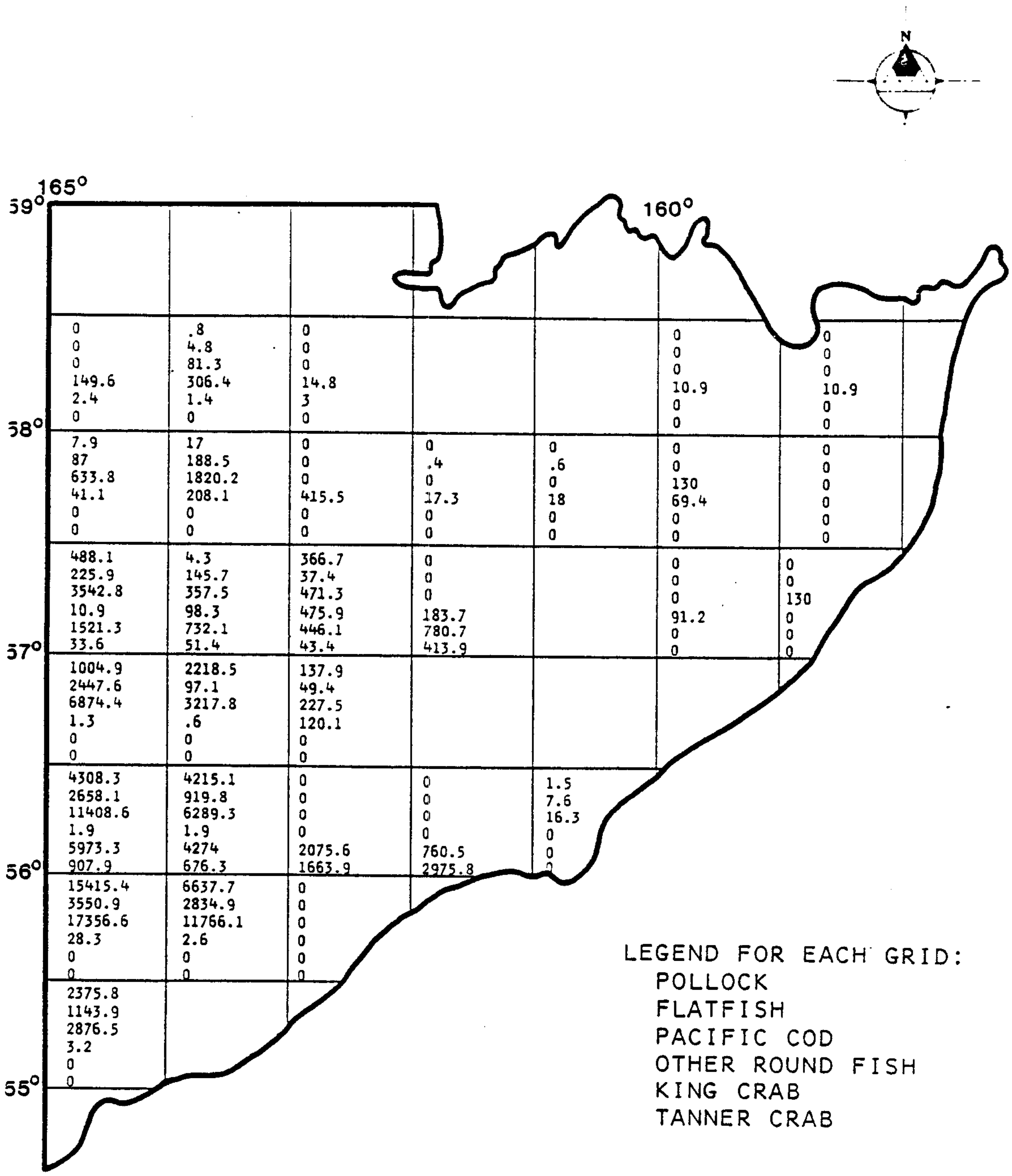
- o Historical Yearly Catch: The average (1971-1982) annual catch for a basin, apportioned into the 1/2 x 1° sub-areas, based on average proportions. This includes foreign and domestic harvest.
- o Total Projected Domestic Catch: The annual catch taken when MSY is fully utilized by the domestic industry, at some future time.
- o Projected Domestic Catch, Year X: As the domestic industry displaces foreign operations, it will take an increasing proportion of a basin's MSY. These figures show that catch for that year.
- o Projected Number of Domestic Fishing Boat-Days, Year X: The number of boat-days required the harvest the projected catch, for that year.

The reader is also referred to the discussion of Methodology at the beginning of Chapter 3.



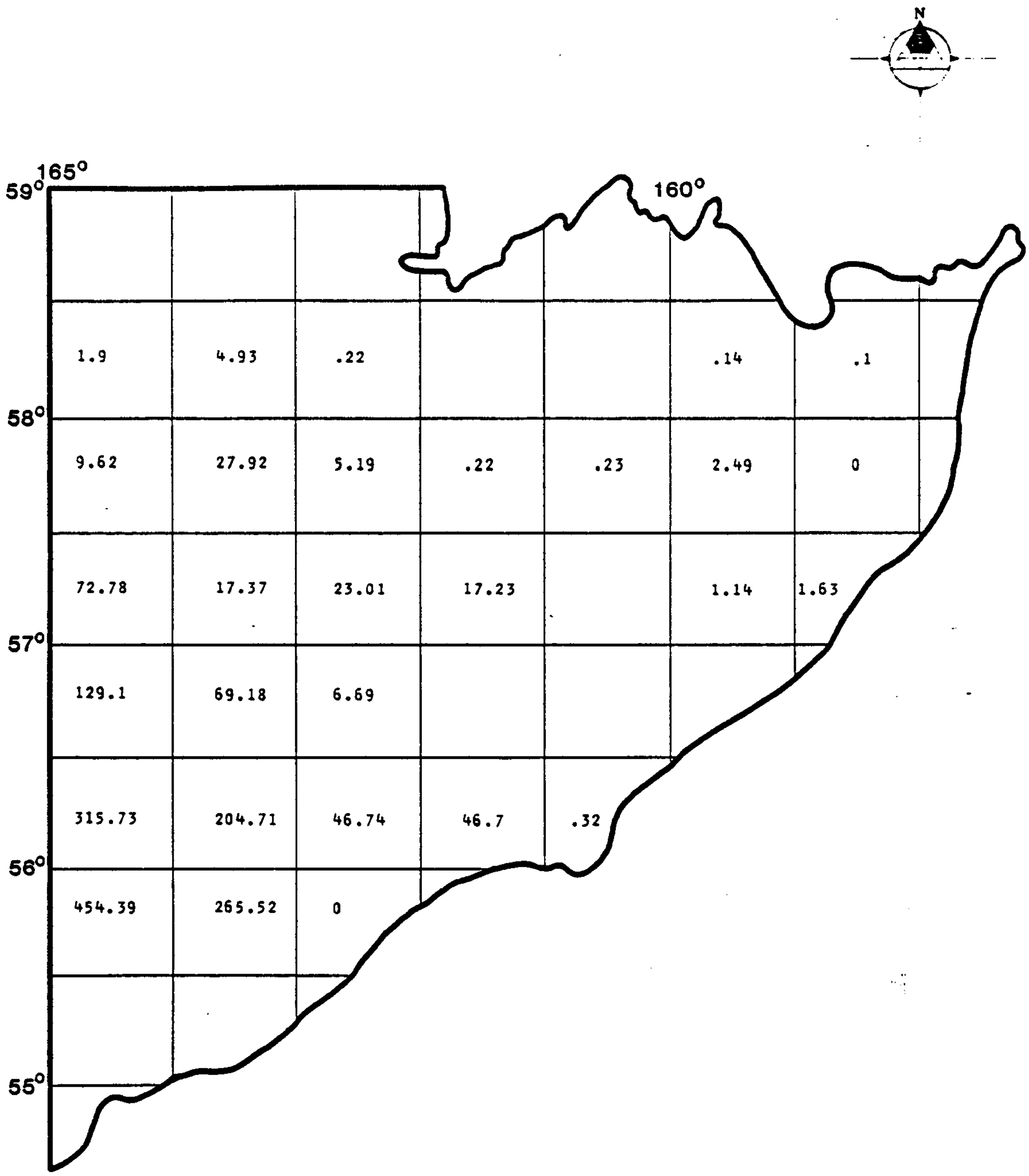
NORTH ALEUTIAN SHELF LEASE SALE AREA

HISTORICAL YEARLY CATCH



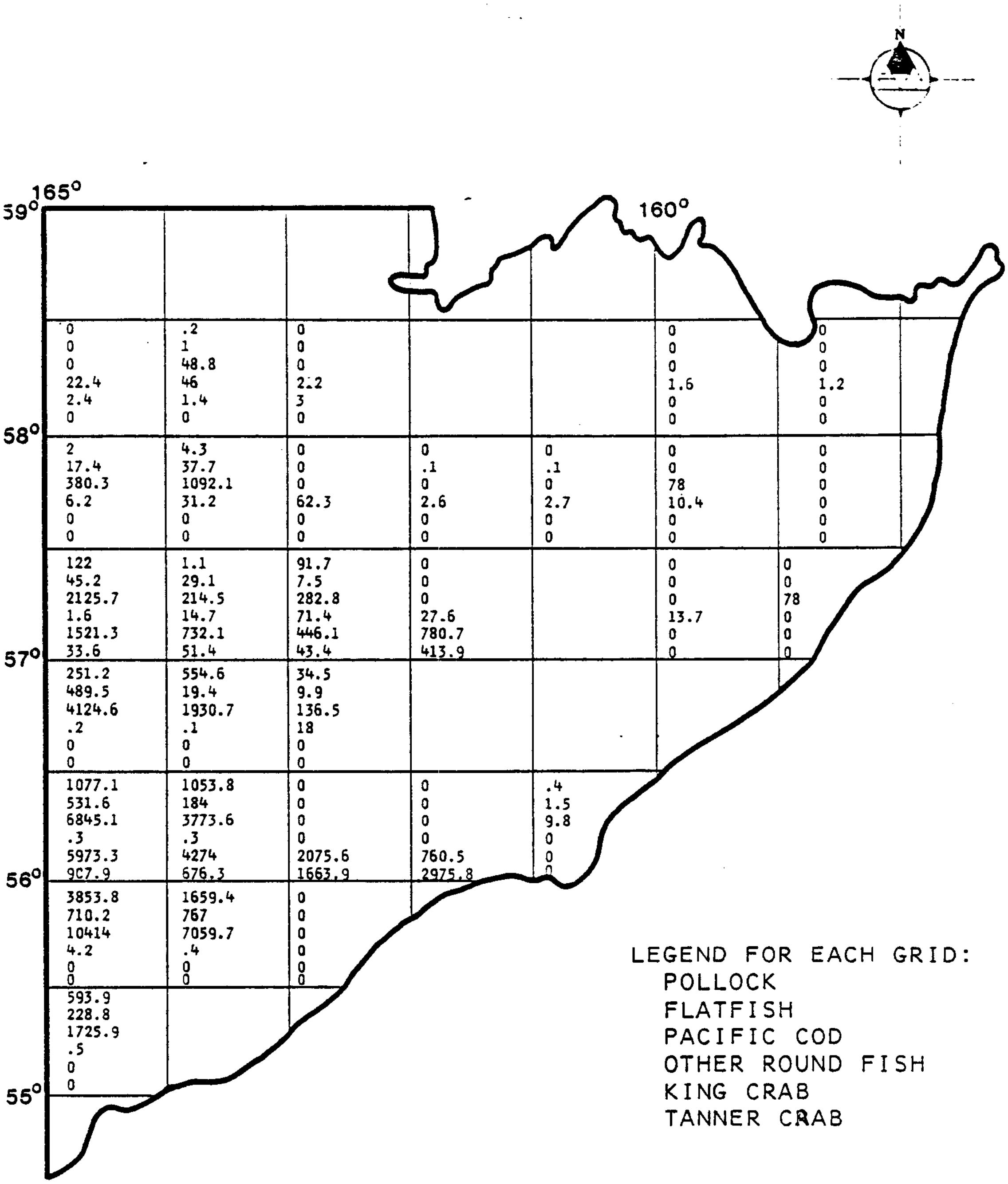
NORTH ALEUTIAN SHELF LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS



NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY

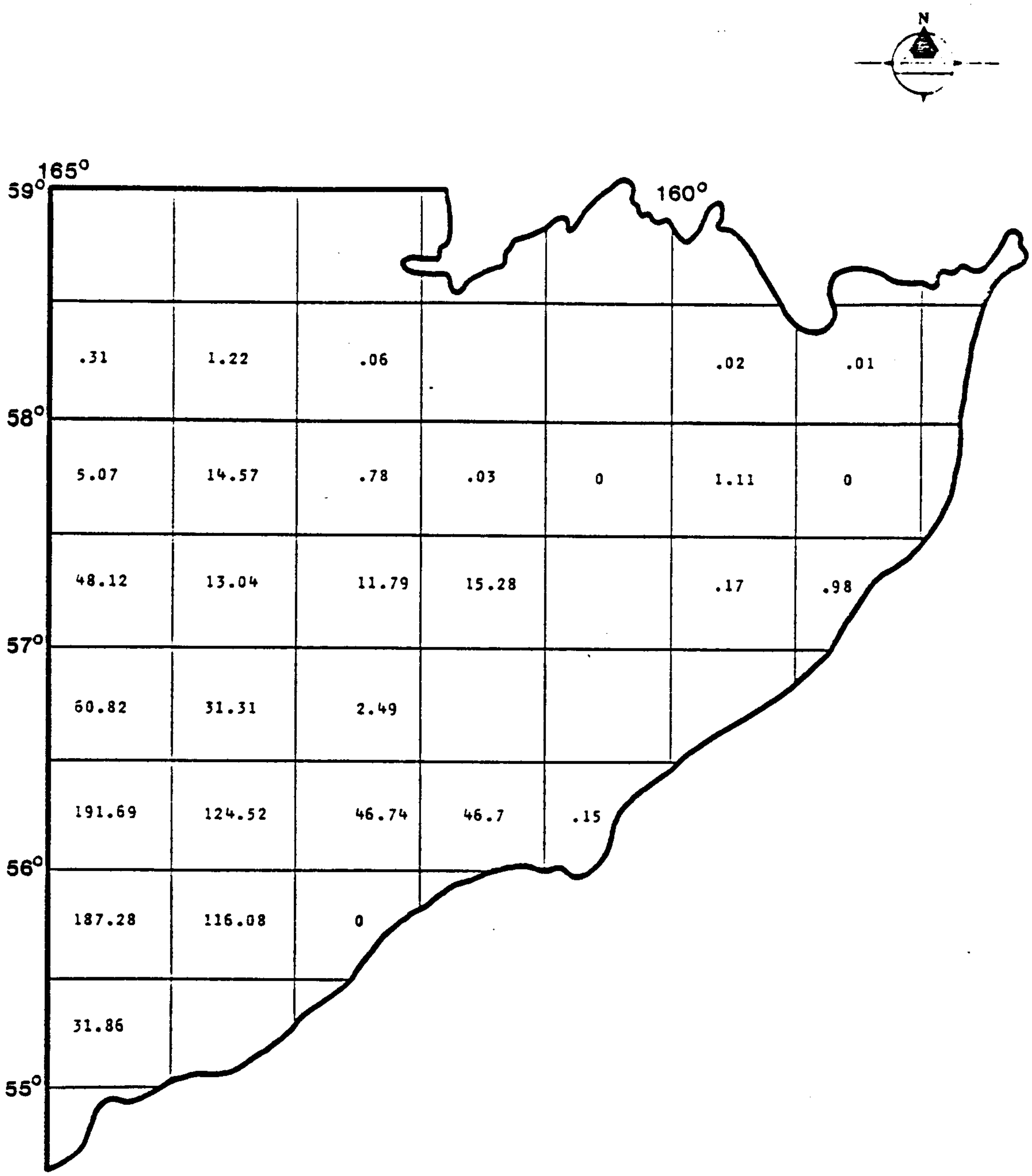


0 0 0 22.4 2.4 0	.2 1 48.8 46 1.4 0	0 0 0 2.2 3 0			0 0 0 1.6 0 0	0 0 0 1.2 0 0
2 17.4 380.3 6.2 0 0	4.3 37.7 1092.1 31.2 0 0	0 0 0 62.3 0 0	0 .1 0 2.6 0 0	0 .1 0 2.7 0 0	0 0 78 10.4 0 0	0 0 0 0 0 0
122 45.2 2125.7 1.6 1521.3 33.6	1.1 29.1 214.5 14.7 732.1 51.4	91.7 7.5 282.8 71.4 446.1 43.4	0 0 0 27.6 780.7 413.9		0 0 0 13.7 0 0	0 0 78 0 0 0
251.2 489.5 4124.6 .2 0 0	554.6 19.4 1930.7 .1 0 0	34.5 9.9 136.5 18 0 0				
1077.1 531.6 6845.1 .3 5973.3 907.9	1053.8 184 3773.6 .3 4274 676.3	0 0 0 0 2075.6 1663.9	0 0 0 0 760.5 2975.8	.4 1.5 9.8 0 0 0		
3853.8 710.2 10414 4.2 0 0	1659.4 767 7059.7 .4 0 0	0 0 0 0 0 0				
593.9 228.8 1725.9 .5 0 0						

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

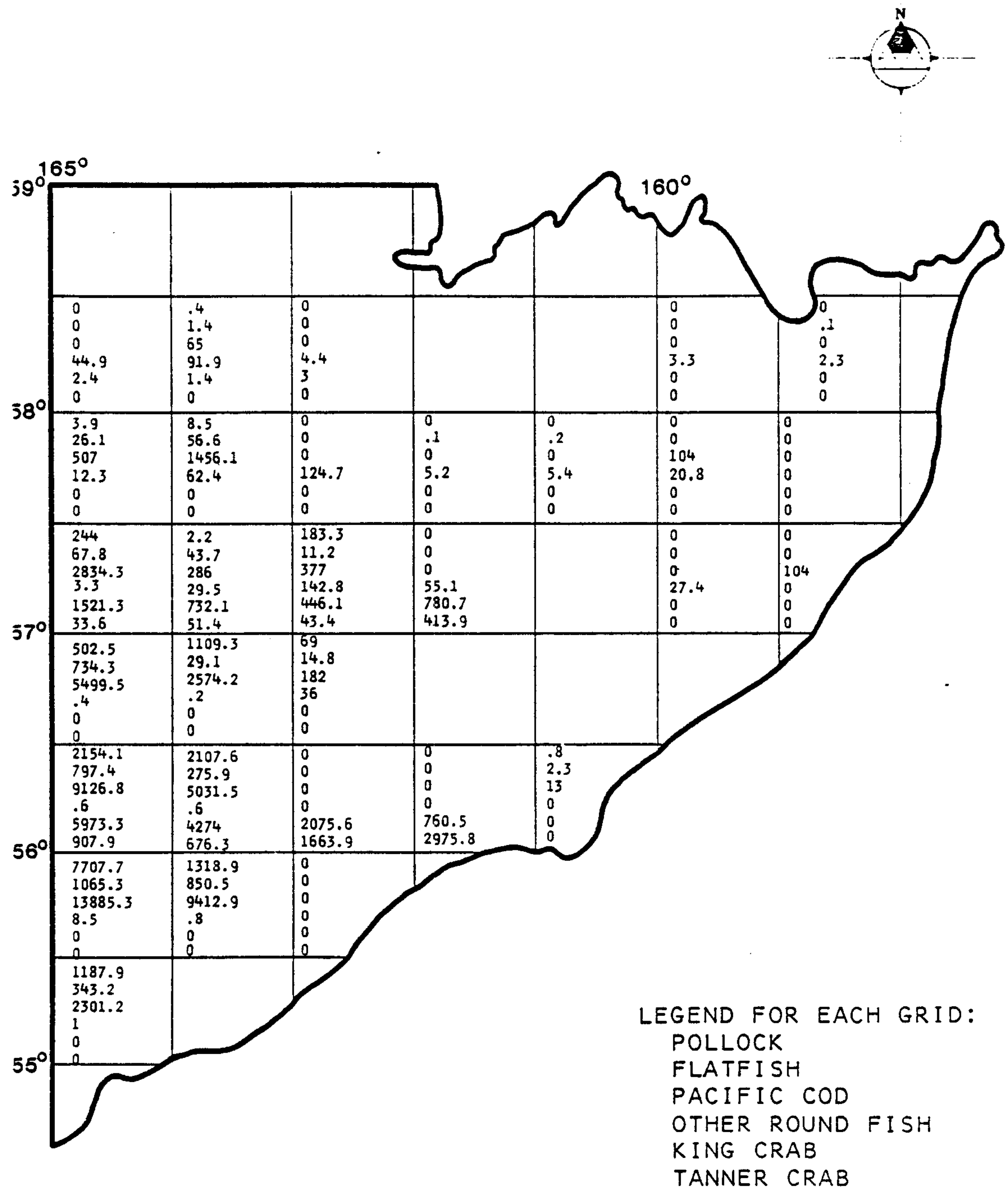
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1987, IN METRIC TONS



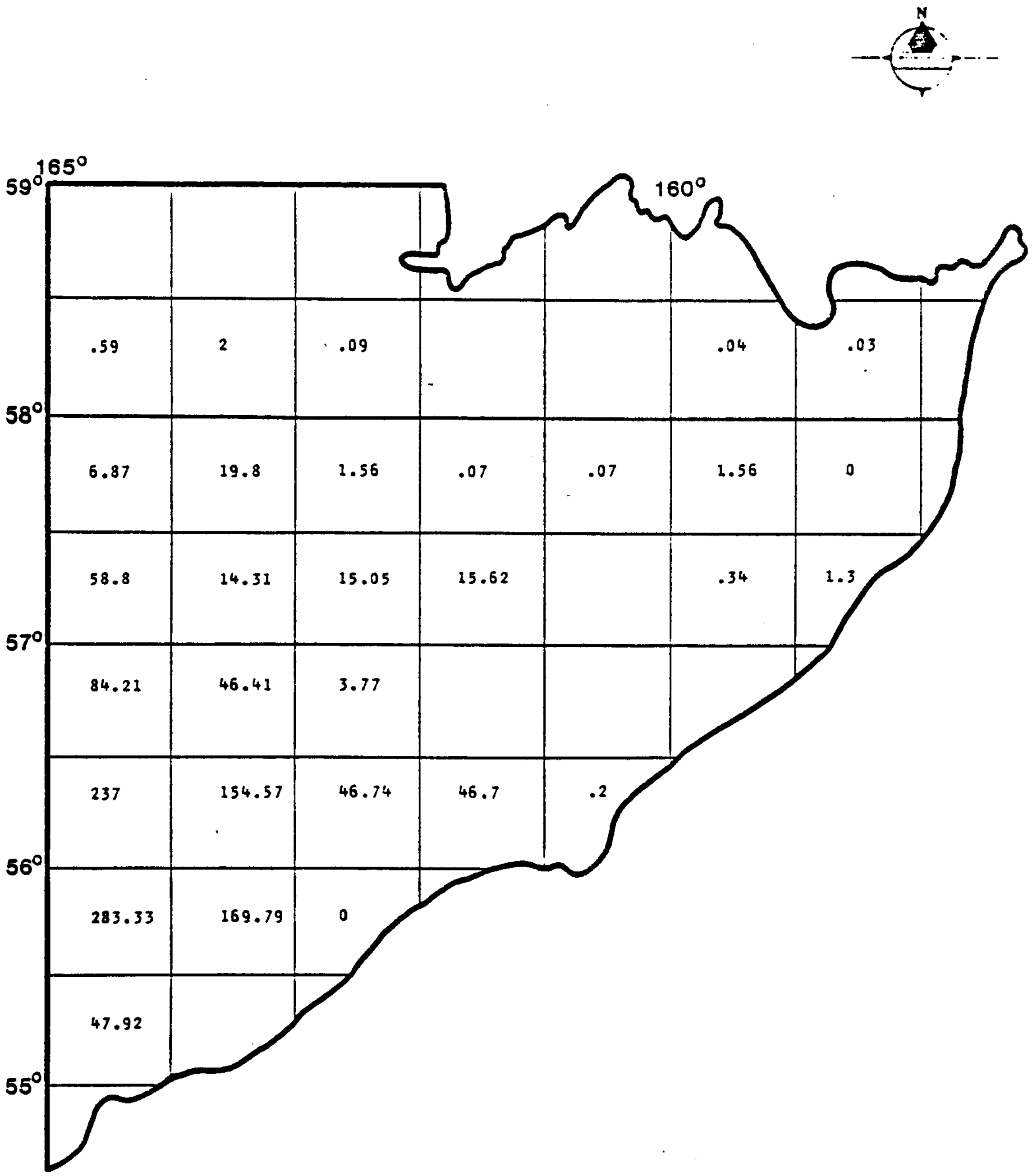
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1987:
CATCH RATE = 80 METRIC TONS/DAY



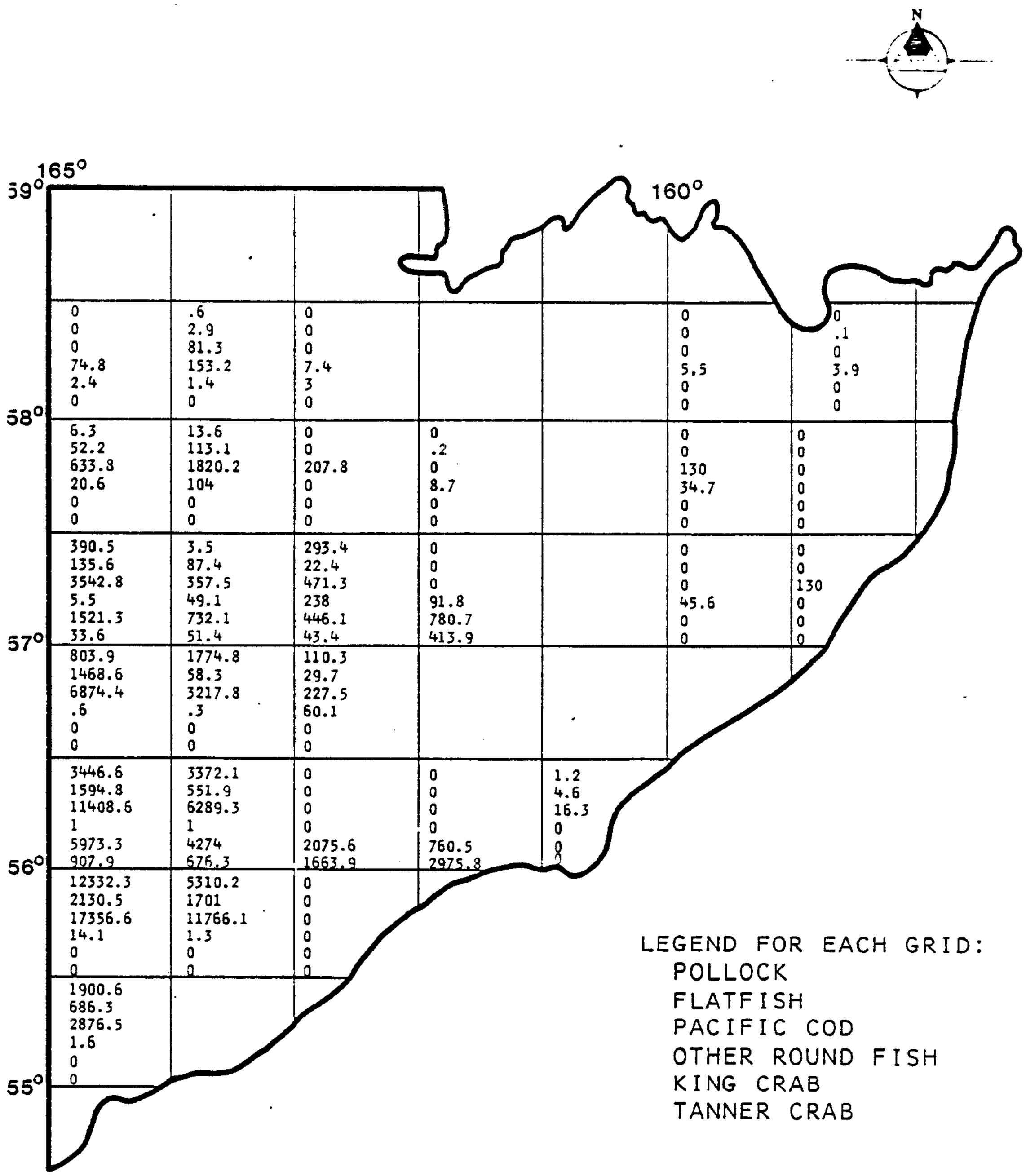
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1992, IN METRIC TONS



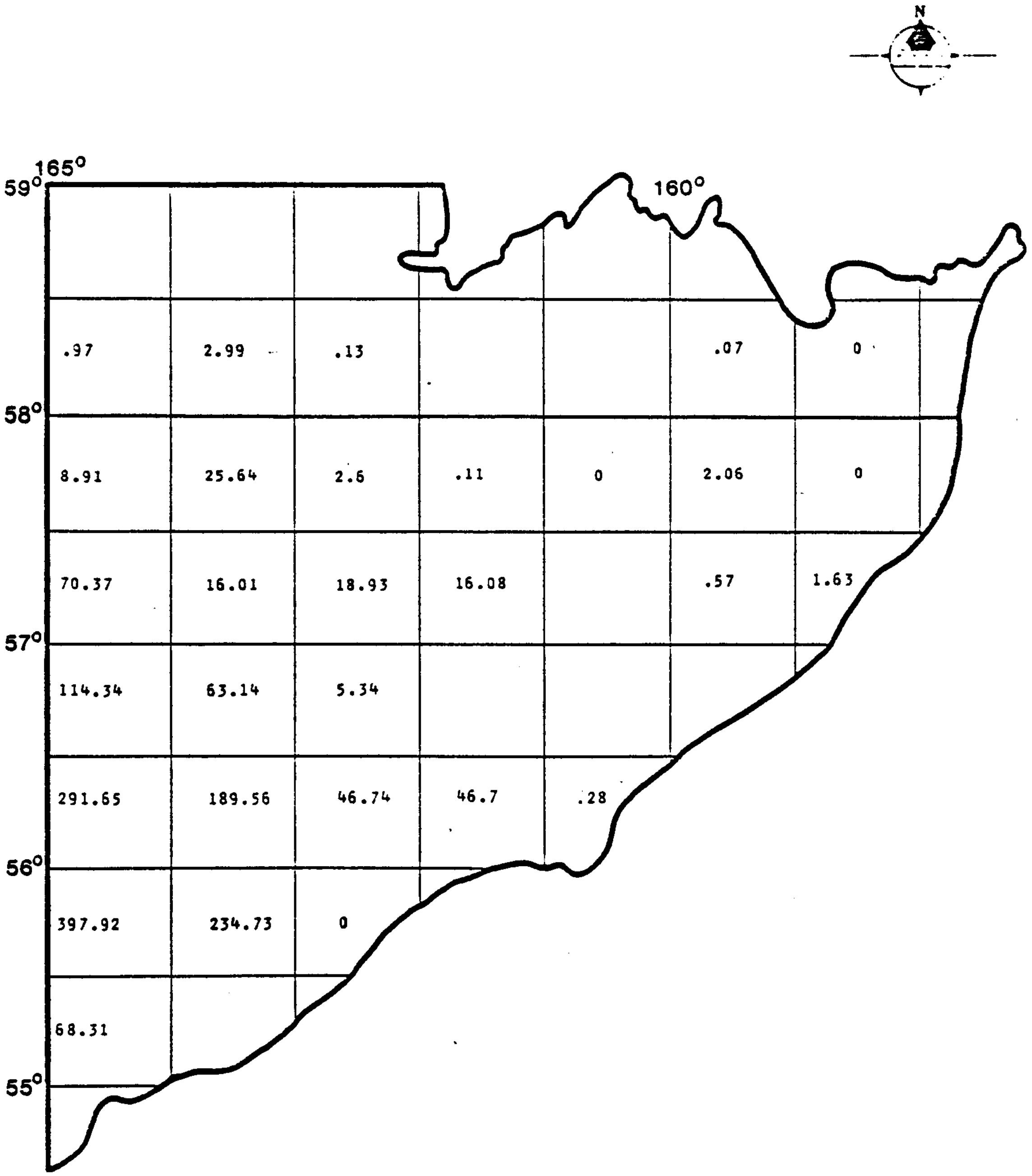
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1992:
CATCH RATE = 80 METRIC TONS/DAY



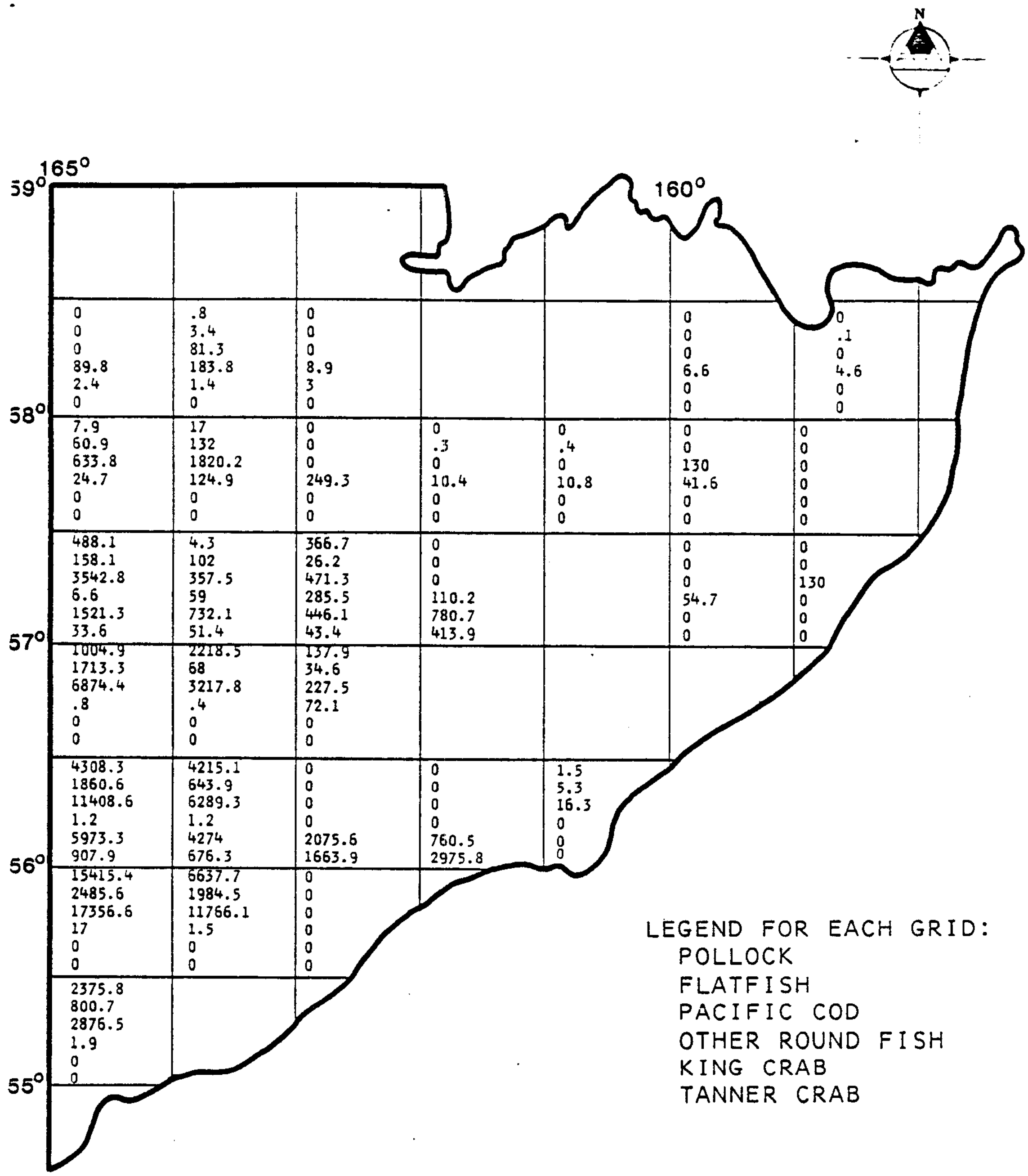
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1997, IN METRIC TONS



NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1997:
CATCH RATE = 80 METRIC TONS/DAY

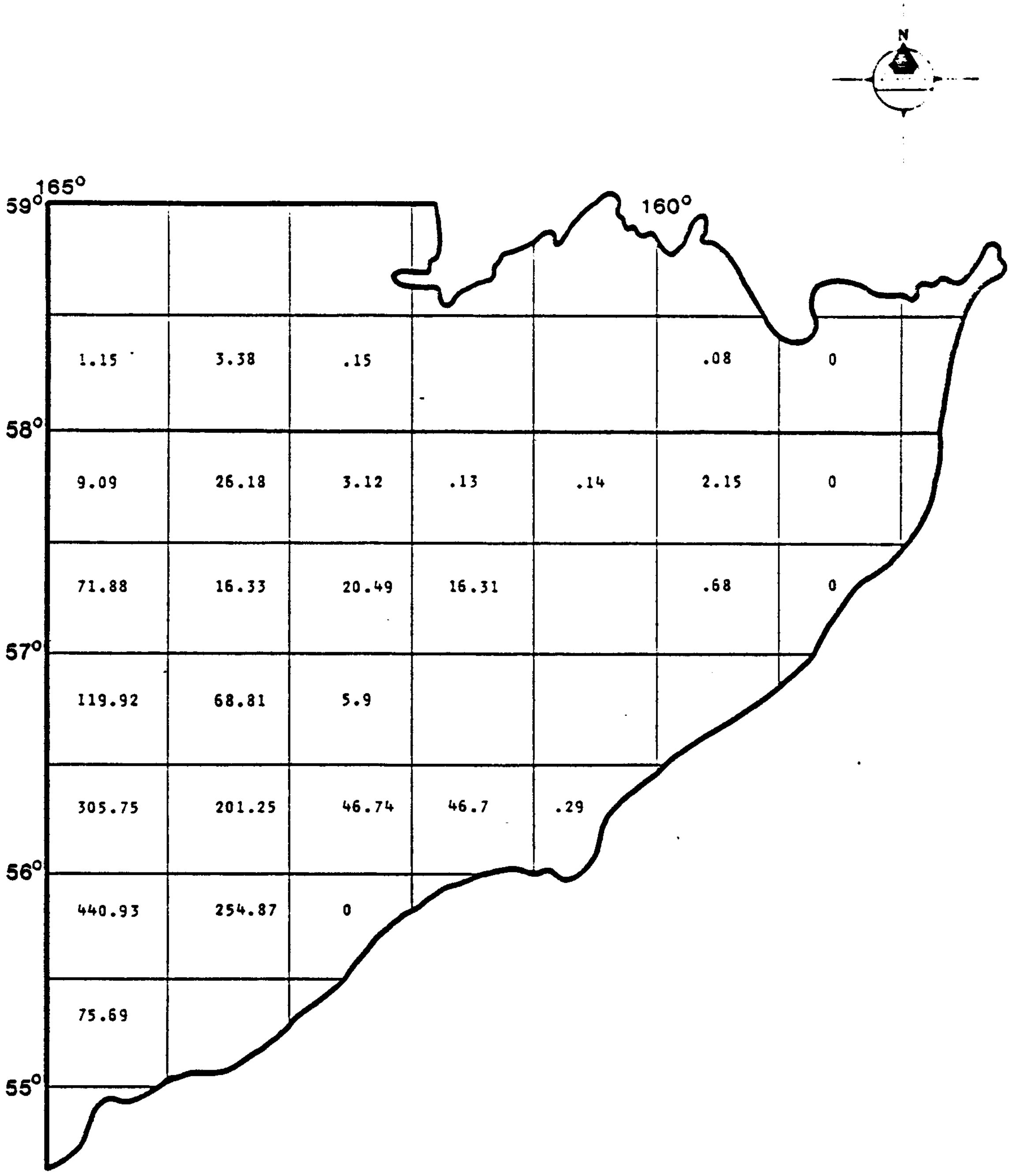


0 0 0 89.8 2.4 0	.8 3.4 81.3 183.8 1.4 0	0 0 0 8.9 3 0			0 0 0 6.6 0 0	0 .1 0 4.6 0 0
7.9 60.9 633.8 24.7 0 0	17 132 1820.2 124.9 0 0	0 0 0 249.3 0 0	0 .3 0 10.4 0 0	0 .4 0 10.8 0 0	0 0 130 41.6 0 0	0 0 0 0 0 0
488.1 158.1 3542.8 6.6 1521.3 33.6	4.3 102 357.5 59 732.1 51.4	366.7 26.2 471.3 285.5 446.1 43.4	0 0 0 110.2 780.7 413.9		0 0 0 54.7 0 0	0 0 130 0 0 0
1004.9 1713.3 6874.4 .8 0 0	2218.5 68 3217.8 .4 0 0	137.9 34.6 227.5 72.1 0 0				
4308.3 1860.6 11408.6 1.2 5973.3 907.9	4215.1 643.9 6289.3 1.2 4274 676.3	0 0 0 0 2075.6 1663.9	0 0 0 0 760.5 2975.8	1.5 5.3 16.3 0 0 0		
15415.4 2485.6 17356.6 17 0 0	6637.7 1984.5 11766.1 1.5 0 0	0 0 0 0 0 0				
2375.8 800.7 2876.5 1.9 0 0						

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

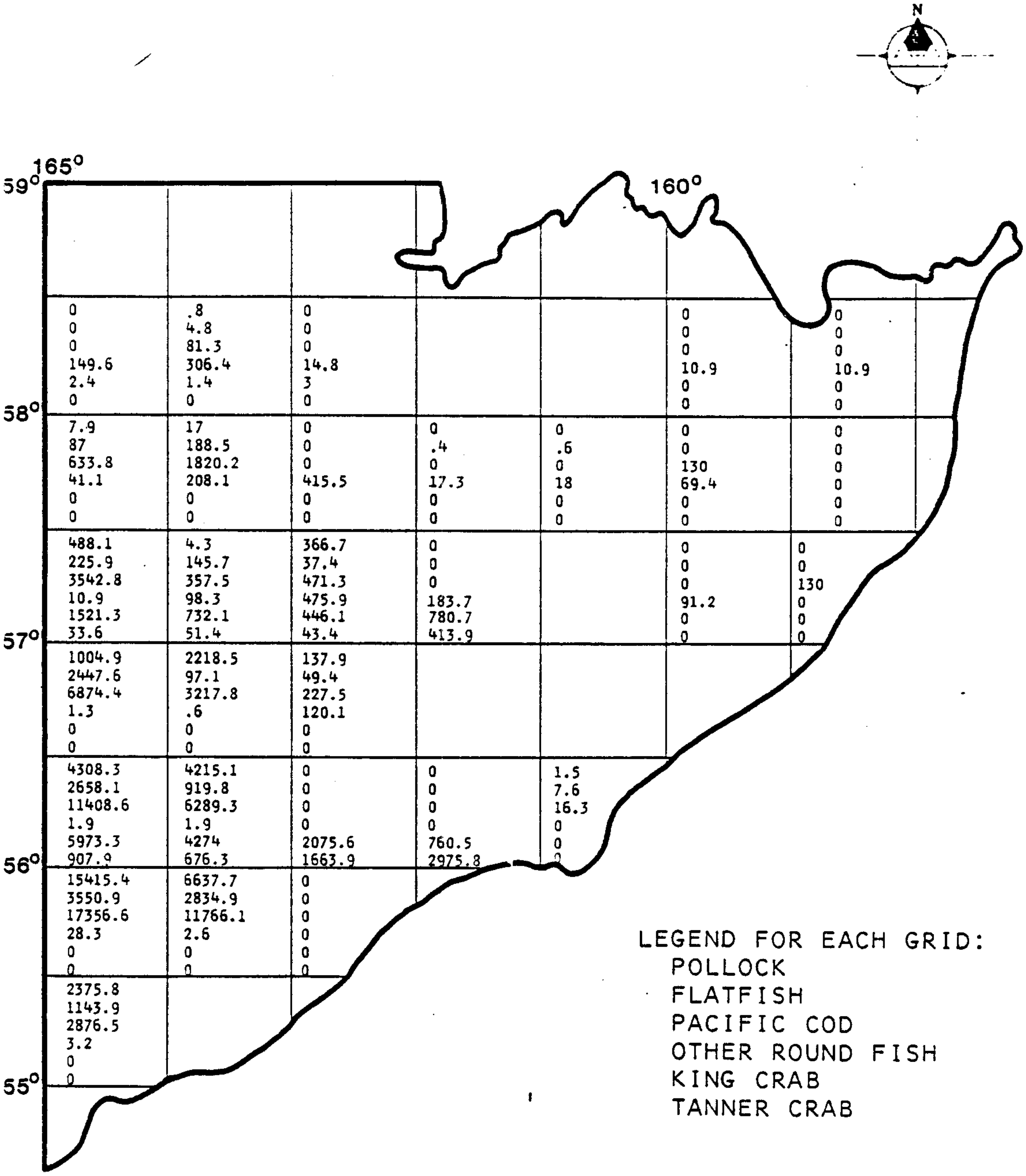
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2002, IN METRIC TONS



NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2002:
CATCH RATE = 80 METRIC TONS/DAY

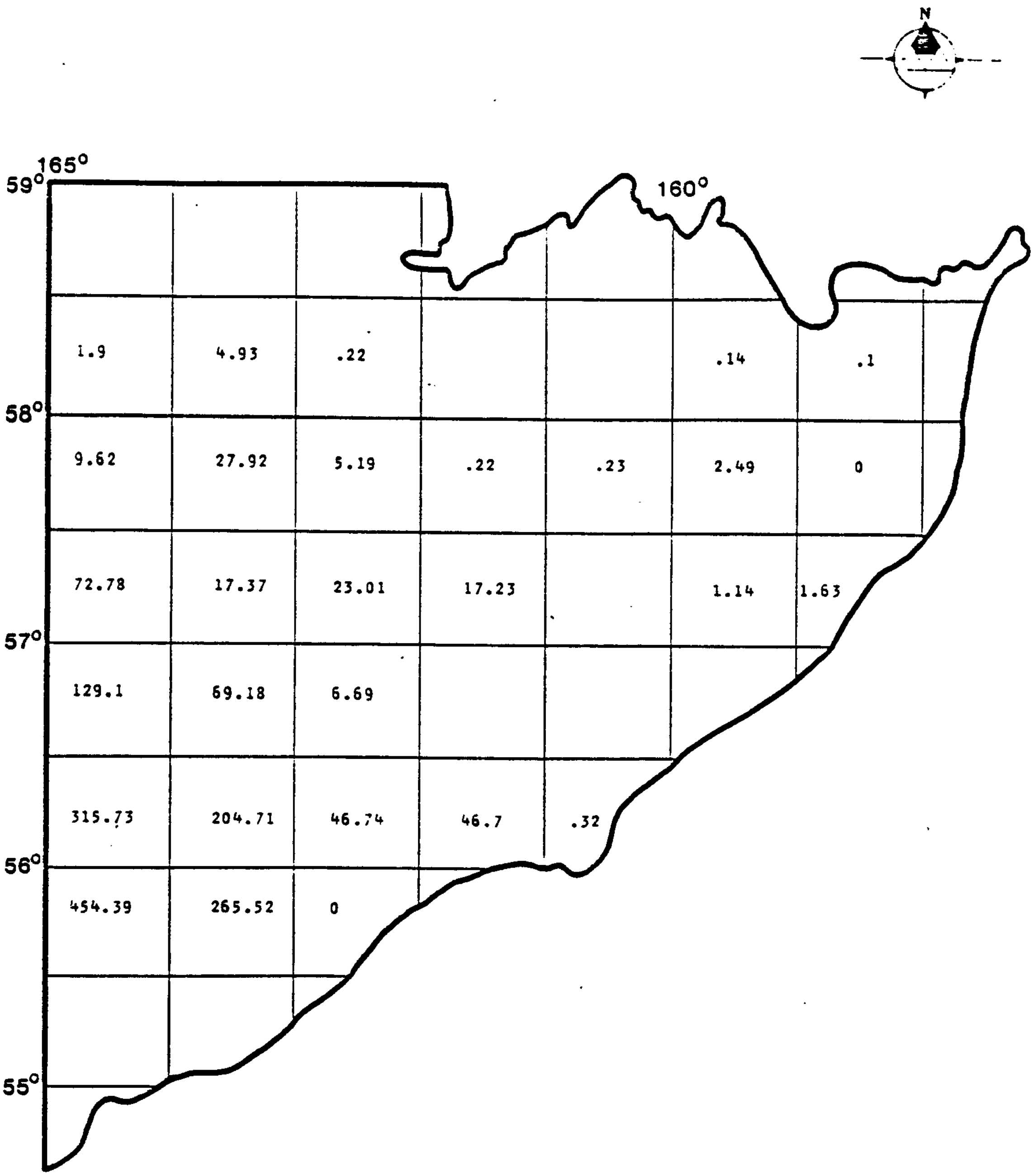


0 0 0 149.6 2.4 0	.8 4.8 81.3 306.4 1.4 0	0 0 0 14.8 3 0			0 0 0 10.9 0 0	0 0 0 10.9 0 0	
7.9 87 633.8 41.1 0 0	17 188.5 1820.2 208.1 0 0	0 0 0 415.5 0 0	0 .4 0 17.3 0 0	0 .6 0 18 0 0	0 0 130 69.4 0 0	0 0 0 0 0 0	
488.1 225.9 3542.8 10.9 1521.3 33.6	4.3 145.7 357.5 98.3 732.1 51.4	366.7 37.4 471.3 475.9 446.1 43.4	0 0 0 183.7 780.7 413.9		0 0 0 91.2 0 0	0 0 130 0 0 0	
1004.9 2447.6 6874.4 1.3 0 0	2218.5 97.1 3217.8 .6 0 0	137.9 49.4 227.5 120.1 0 0					
4308.3 2658.1 11408.6 1.9 5973.3 907.9	4215.1 919.8 6289.3 1.9 4274 676.3	0 0 0 0 2075.6 1663.9	0 0 0 0 760.5 2975.8	1.5 7.6 16.3 0 0 0			
15415.4 3550.9 17356.6 28.3 0 0	6637.7 2834.9 11766.1 2.6 0 0	0 0 0 0 0 0					
2375.8 1143.9 2876.5 3.2 0 0							

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

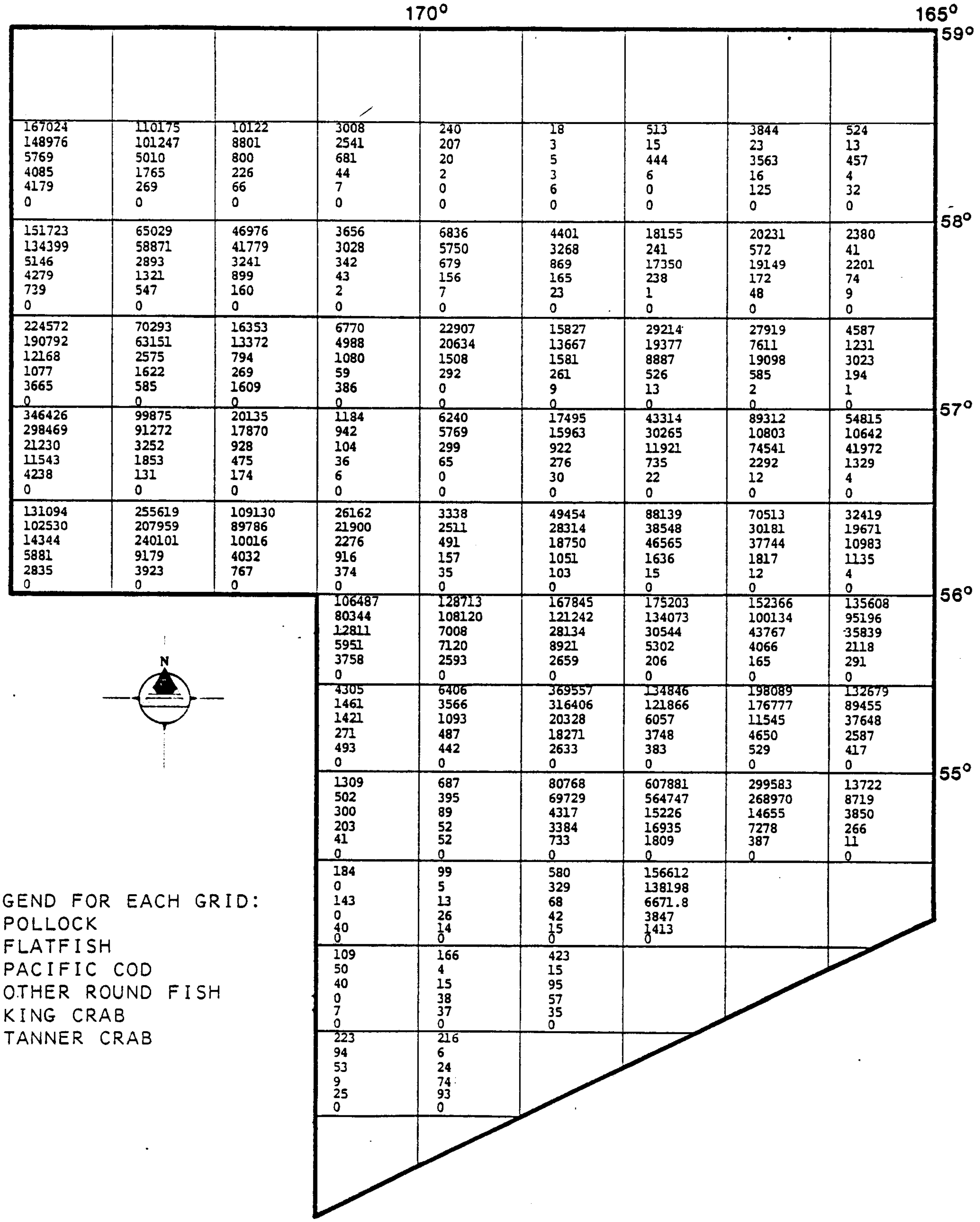
NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2007, IN METRIC TONS



NORTH ALEUTIAN SHELF LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2007:
CATCH RATE = 80 METRIC TONS/DAY

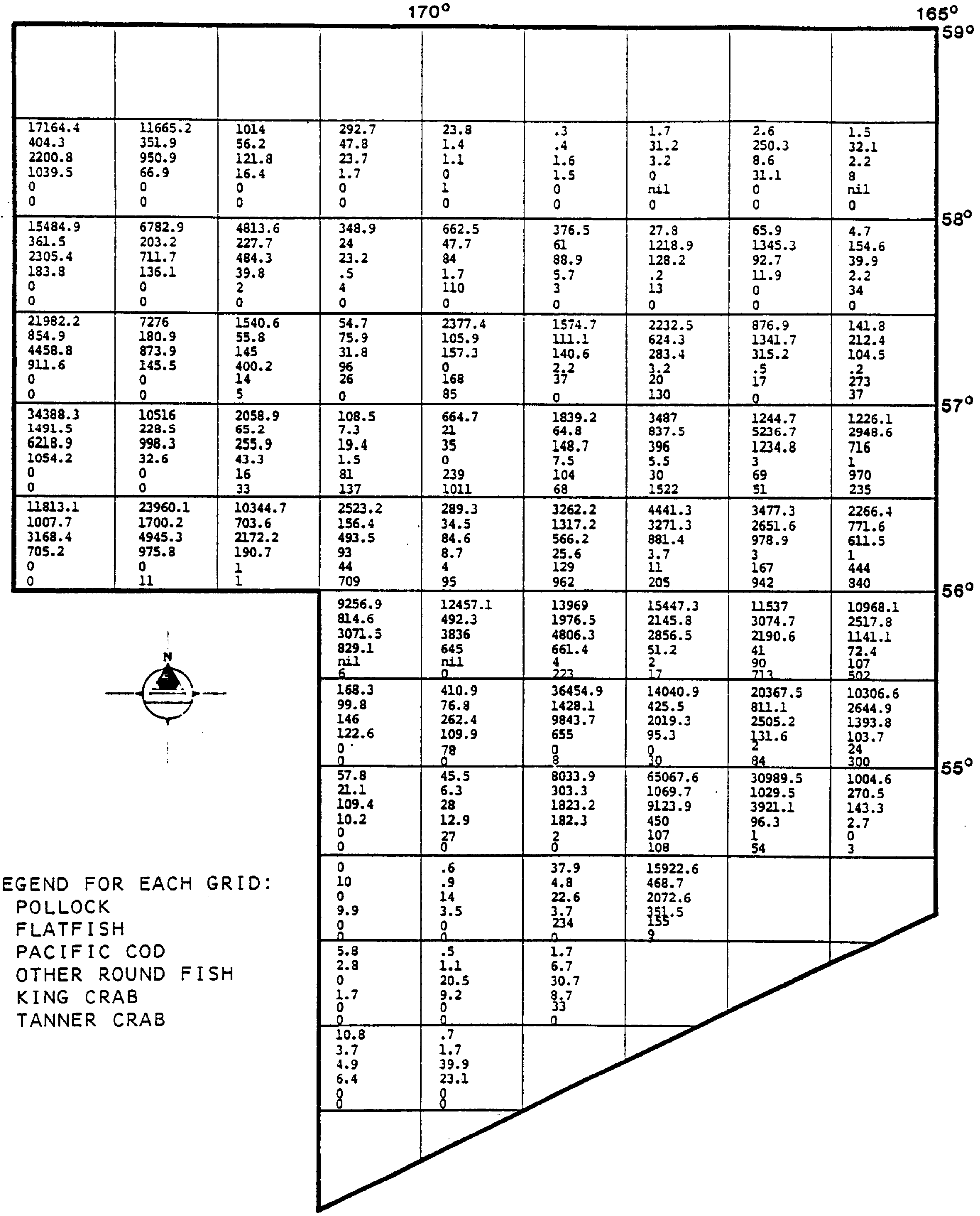


167024 148976 5769 4085 4179 0	110175 101247 5010 1765 269 0	10122 8801 800 226 66 0	3008 2541 681 44 7 0	240 207 20 2 0 0	18 3 5 3 6 0	513 15 444 6 0 0	3844 23 3563 16 125 0	524 13 457 4 32 0
151723 134399 5146 4279 739 0	65029 58871 2893 1321 547 0	46976 41779 3241 899 160 0	3656 3028 342 43 2 0	6836 5750 679 156 7 0	4401 3268 869 165 23 0	18155 241 17350 238 1 0	20231 572 19149 172 48 0	2380 41 2201 74 9 0
224572 190792 12168 1077 3665 0	70293 63151 2575 1622 585 0	16353 13372 794 269 1609 0	6770 4988 1080 59 386 0	22907 20634 1508 292 0 0	15827 13667 1581 261 9 0	29214 19377 8887 526 13 0	27919 7611 19098 585 2 0	4587 1231 3023 194 1 0
346426 298469 21230 11543 4238 0	99875 91272 3252 1853 131 0	20135 17870 928 475 174 0	1184 942 104 36 6 0	6240 5769 299 65 0 0	17495 15963 922 276 30 0	43314 30265 11921 735 22 0	89312 10803 74541 2292 12 0	54815 10642 41972 1329 4 0
131094 102530 14344 5881 2835 0	255619 207959 240101 9179 3923 0	109130 89786 10016 4032 767 0	26162 21900 2276 916 374 0	3338 2511 491 157 35 0	49454 28314 18750 1051 103 0	88139 38548 46565 1636 15 0	70513 30181 37744 1817 12 0	32419 19671 10983 1135 4 0
			106487 80344 12811 5951 3758 0	128713 108120 7008 7120 2593 0	167845 121242 28134 8921 2659 0	175203 134073 30544 5302 206 0	152366 100134 43767 4066 165 0	135608 95196 35839 2118 291 0
			4305 1461 1421 271 493 0	6406 3566 1093 487 442 0	369557 316406 20328 18271 2633 0	134846 121866 6057 3748 383 0	198089 176777 11545 4650 529 0	132679 89455 37648 2587 417 0
			1309 502 300 203 41 0	687 395 89 52 52 0	80768 69729 4317 3384 733 0	607881 564747 15226 16935 1809 0	299583 268970 14655 7278 387 0	13722 8719 3850 266 11 0
			184 0 143 0 40 0	99 5 13 26 14 0	580 329 68 42 15 0	156612 138198 6671.8 3847 1413 0		
			109 50 40 0 7 0	166 4 15 38 37 0	423 15 95 57 35 0			
			223 94 53 9 25 0	216 6 24 74 93 0				

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

HISTORICAL YEARLY CATCH

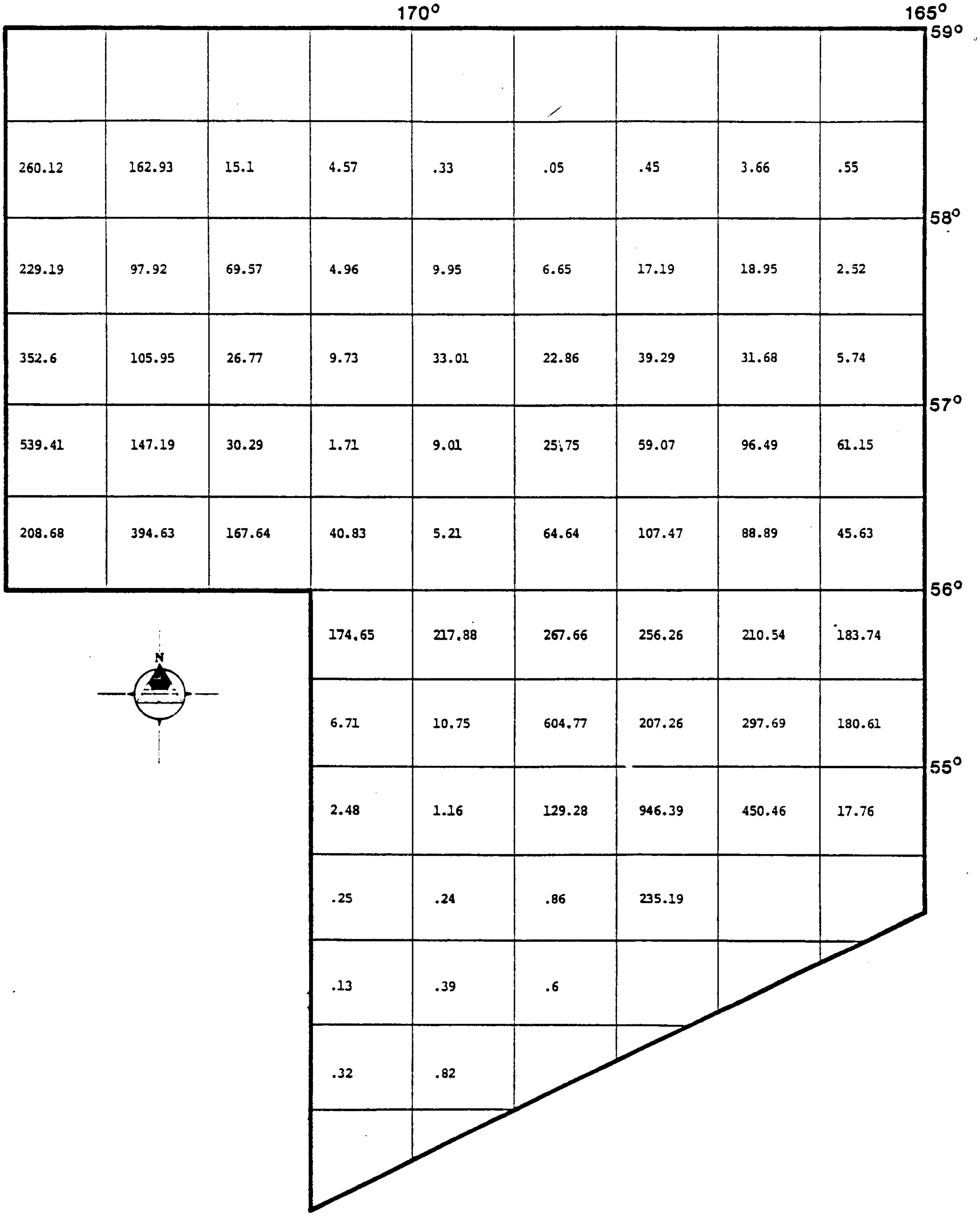


17164.4 404.3 2200.8 1039.5 0 0	11665.2 351.9 950.9 66.9 0 0	1014 56.2 121.8 16.4 0 0	292.7 47.8 23.7 1.7 0 0	23.8 1.4 1.1 0 1 0	.3 .4 1.6 1.5 0 0	1.7 31.2 3.2 0 nil 0	2.6 250.3 8.6 31.1 0 0	1.5 32.1 2.2 8 nil 0
15484.9 361.5 2305.4 183.8 0 0	6782.9 203.2 711.7 136.1 0 0	4813.6 227.7 484.3 39.8 2 0	348.9 24 23.2 .5 4 0	662.5 47.7 84 1.7 110 0	376.5 61 88.9 5.7 3 0	27.8 1218.9 128.2 .2 13 0	65.9 1345.3 92.7 11.9 0 0	4.7 154.6 39.9 2.2 34 0
21982.2 854.9 4458.8 911.6 0 0	7276 180.9 873.9 145.5 0 0	1540.6 55.8 145 400.2 14 5	54.7 75.9 31.8 96 26 0	2377.4 105.9 157.3 0 168 85	1574.7 111.1 140.6 2.2 37 0	2232.5 624.3 283.4 3.2 20 130	876.9 1341.7 315.2 .5 17 0	141.8 212.4 104.5 .2 273 37
34388.3 1491.5 6218.9 1054.2 0 0	10516 228.5 998.3 32.6 0 0	2058.9 65.2 255.9 43.3 16 33	108.5 7.3 19.4 1.5 81 137	664.7 21 35 0 239 1011	1839.2 64.8 148.7 7.5 104 68	3487 837.5 396 5.5 30 1522	1244.7 5236.7 1234.8 3 69 51	1226.1 2948.6 716 1 970 235
11813.1 1007.7 3168.4 705.2 0 0	23960.1 1700.2 4945.3 975.8 0 11	10344.7 703.6 2172.2 190.7 1 1	2523.2 156.4 493.5 93 44 709	289.3 34.5 84.6 8.7 4 95	3262.2 1317.2 566.2 25.6 129 962	4441.3 3271.3 881.4 3.7 11 205	3477.3 2651.6 978.9 3 167 942	2266.4 771.6 611.5 1 444 840
			9256.9 814.6 3071.5 829.1 nil 6	12457.1 492.3 3836 645 nil 0	13969 1976.5 4806.3 661.4 4 223	15447.3 2145.8 2856.5 51.2 2 17	11537 3074.7 2190.6 41 90 713	10968.1 2517.8 1141.1 72.4 107 502
			168.3 99.8 146 122.6 0 0	410.9 76.8 262.4 109.9 78 0	36454.9 1428.1 9843.7 655 0 8	14040.9 425.5 2019.3 95.3 0 30	20367.5 811.1 2505.2 131.6 2 84	10306.6 2644.9 1393.8 103.7 24 300
			57.8 21.1 109.4 10.2 0 0	45.5 6.3 28 12.9 27 0	8033.9 303.3 1823.2 182.3 2 0	65067.6 1069.7 9123.9 450 107 108	30989.5 1029.5 3921.1 96.3 1 54	1004.6 270.5 143.3 2.7 0 3
			0 10 0 9.9 0 0	.6 .9 14 3.5 0 0	37.9 4.8 22.6 3.7 234 0	15922.6 468.7 2072.6 351.5 155 9		
			5.8 2.8 0 1.7 0 0	.5 1.1 20.5 9.2 0 0	1.7 6.7 30.7 8.7 33 0			
			10.8 3.7 4.9 6.4 0 0	.7 1.7 39.9 23.1 0 0				

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

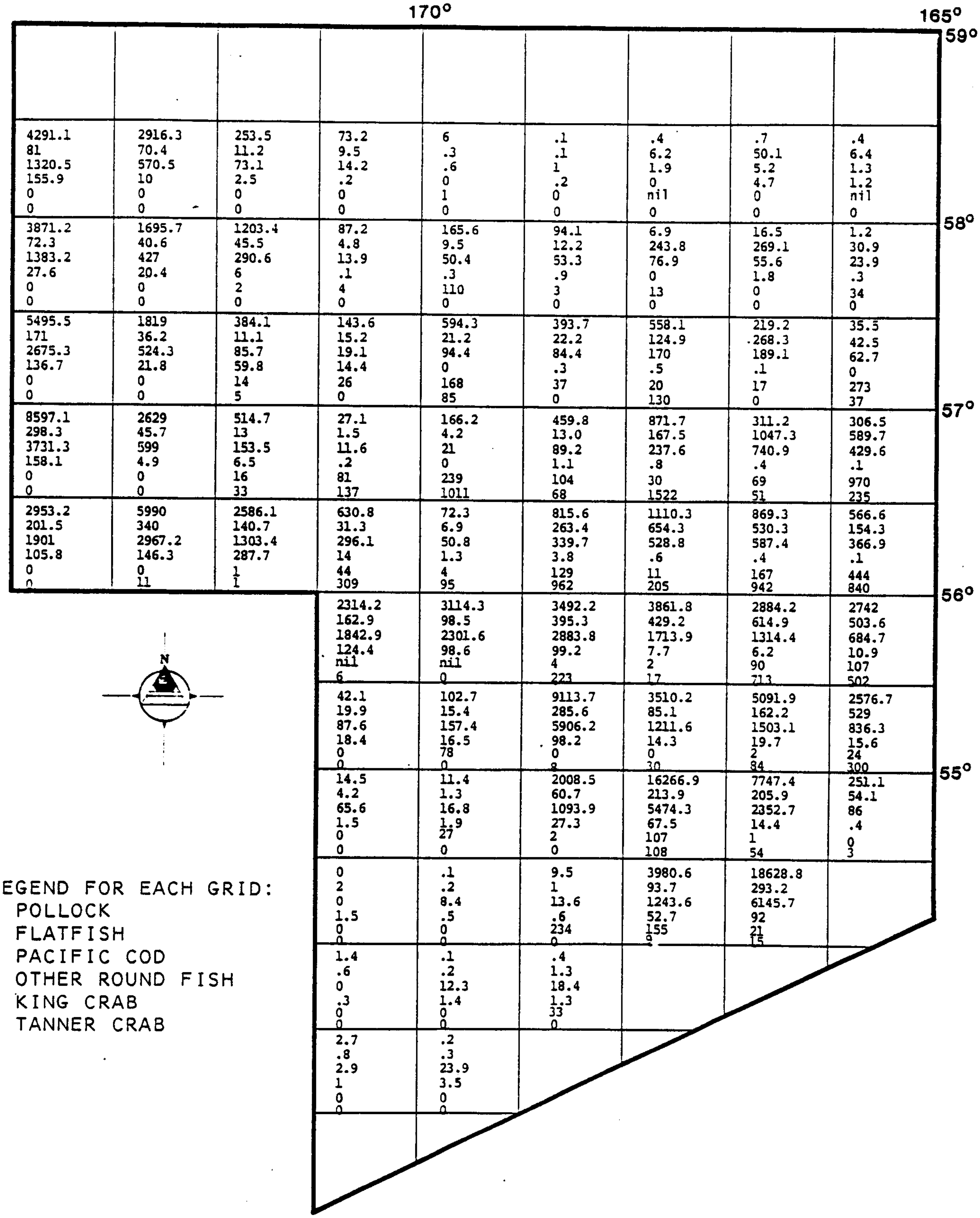
TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS



260.12	162.93	15.1	4.57	.33	.05	.45	3.66	.55
229.19	97.92	69.57	4.96	9.95	6.65	17.19	18.95	2.52
352.6	105.95	26.77	9.73	33.01	22.86	39.29	31.68	5.74
539.41	147.19	30.29	1.71	9.01	25.75	59.07	96.49	61.15
208.68	394.63	167.64	40.83	5.21	64.64	107.47	88.89	45.63
			174.65	217.88	267.66	256.26	210.54	183.74
			6.71	10.75	604.77	207.26	297.69	180.61
			2.48	1.16	129.28	946.39	450.46	17.76
			.25	.24	.86	235.19		
			.13	.39	.6			
			.32	.82				

ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY

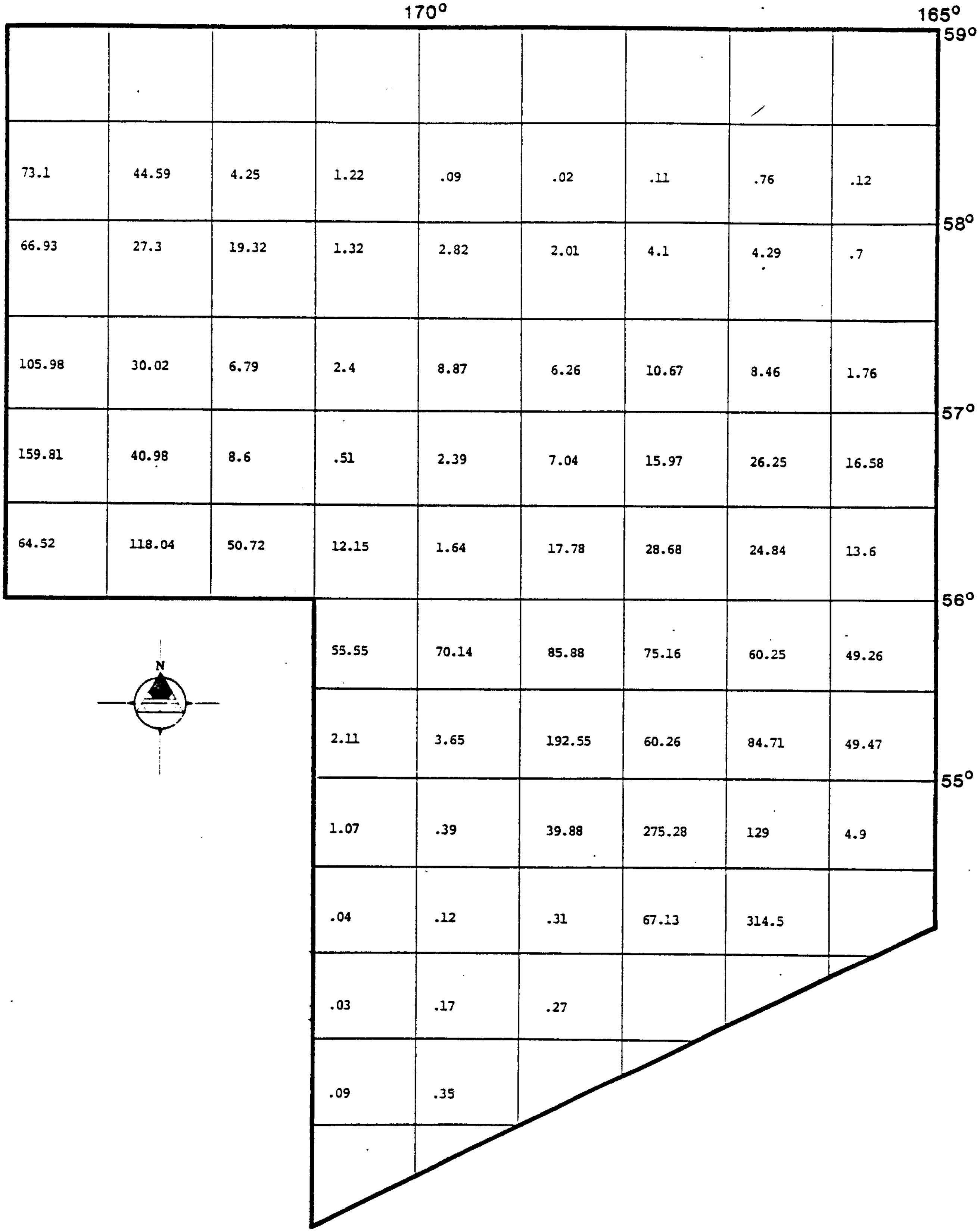


4291.1 81 1320.5 155.9 0 0	2916.3 70.4 570.5 10 0 0	253.5 11.2 73.1 2.5 0 0	73.2 9.5 14.2 .2 0 0	6 .3 .6 0 1 0	.1 .1 1 .2 0 0	.4 6.2 1.9 0 nil 0	.7 50.1 5.2 4.7 0 0	.4 6.4 1.3 1.2 nil 0
3871.2 72.3 1383.2 27.6 0 0	1695.7 40.6 427 20.4 0 0	1203.4 45.5 290.6 6 2 0	87.2 4.8 13.9 .1 4 0	165.6 9.5 50.4 .3 110 0	94.1 12.2 53.3 .9 3 0	6.9 243.8 76.9 0 13 0	16.5 269.1 55.6 1.8 0 0	1.2 30.9 23.9 .3 34 0
5495.5 171 2675.3 136.7 0 0	1819 36.2 524.3 21.8 0 0	384.1 11.1 85.7 59.8 14 5	143.6 15.2 19.1 14.4 26 0	594.3 21.2 94.4 0 168 85	393.7 22.2 84.4 .3 37 0	558.1 124.9 170 .5 20 130	219.2 268.3 189.1 .1 17 0	35.5 42.5 62.7 0 273 37
8597.1 298.3 3731.3 158.1 0 0	2629 45.7 599 4.9 0 0	514.7 13 153.5 6.5 16 33	27.1 1.5 11.6 .2 81 137	166.2 4.2 21 0 239 1011	459.8 13.0 89.2 1.1 104 68	871.7 167.5 237.6 .8 30 1522	311.2 1047.3 740.9 .4 69 51	306.5 589.7 429.6 .1 970 235
2953.2 201.5 1901 105.8 0 0	5990 340 2967.2 146.3 0 11	2586.1 140.7 1303.4 287.7 1 1	630.8 31.3 296.1 14 44 309	72.3 6.9 50.8 1.3 4 95	815.6 263.4 339.7 3.8 129 962	1110.3 654.3 528.8 .6 11 205	869.3 530.3 587.4 .4 167 942	566.6 154.3 366.9 .1 444 840
			2314.2 162.9 1842.9 124.4 nil 6	3114.3 98.5 2301.6 98.6 nil 0	3492.2 395.3 2883.8 99.2 4 223	3861.8 429.2 1713.9 7.7 2 17	2884.2 614.9 1314.4 6.2 90 713	2742 503.6 684.7 10.9 107 502
			42.1 19.9 87.6 18.4 0 0	102.7 15.4 157.4 16.5 78 0	9113.7 285.6 5906.2 98.2 0 8	3510.2 85.1 1211.6 14.3 0 30	5091.9 162.2 1503.1 19.7 2 84	2576.7 529 836.3 15.6 24 300
			14.5 4.2 65.6 1.5 0 0	11.4 1.3 16.8 1.9 27 0	2008.5 60.7 1093.9 27.3 2 0	16266.9 213.9 5474.3 67.5 107 108	7747.4 205.9 2352.7 14.4 1 54	251.1 54.1 86 .4 0 3
			0 2 0 1.5 0 0	.1 .2 8.4 .5 0 0	9.5 1 13.6 .6 234 0	3980.6 93.7 1243.6 52.7 155 9	18628.8 293.2 6145.7 92 21 15	
			1.4 .6 0 .3 0 0	.1 .2 12.3 1.4 0 0	.4 1.3 18.4 1.3 33 0			
			2.7 .8 2.9 1 0 0	.2 .3 23.9 3.5 0 0				

LEGEND FOR EACH GRID:
- POLLOCK
- FLATFISH
- PACIFIC COD
- OTHER ROUND FISH
- KING CRAB
- TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

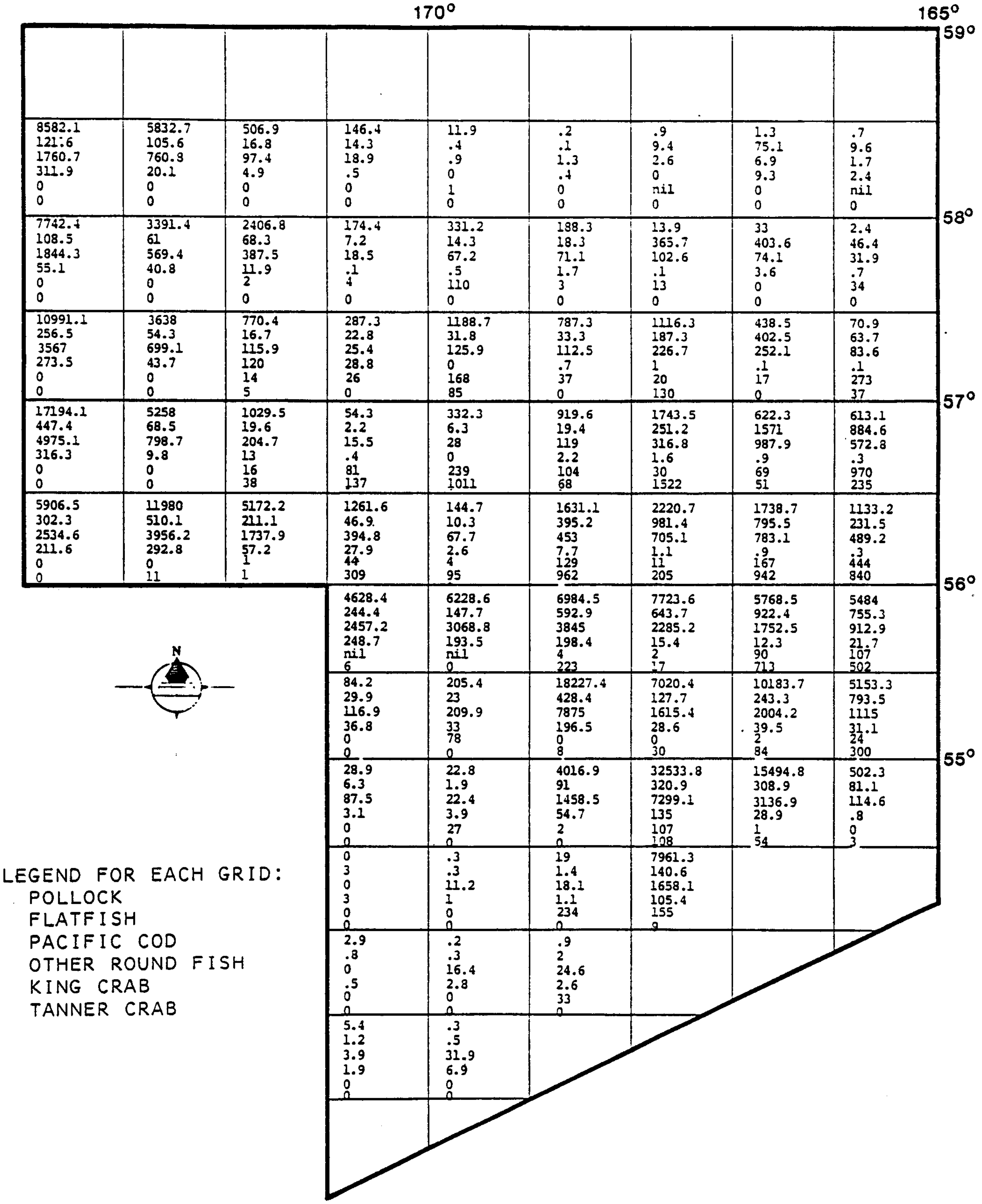
PROJECTED DOMESTIC CATCH, 1987, IN METRIC TONS



73.1	44.59	4.25	1.22	.09	.02	.11	.76	.12
66.93	27.3	19.32	1.32	2.82	2.01	4.1	4.29	.7
105.98	30.02	6.79	2.4	8.87	6.26	10.67	8.46	1.76
159.81	40.98	8.6	.51	2.39	7.04	15.97	26.25	16.58
64.52	118.04	50.72	12.15	1.64	17.78	28.68	24.84	13.6
			55.55	70.14	85.88	75.16	60.25	49.26
			2.11	3.65	192.55	60.26	84.71	49.47
			1.07	.39	39.88	275.28	129	4.9
			.04	.12	.31	67.13	314.5	
			.03	.17	.27			
			.09	.35				

ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1987:
CATCH RATE = 80 METRIC TONS/DAY

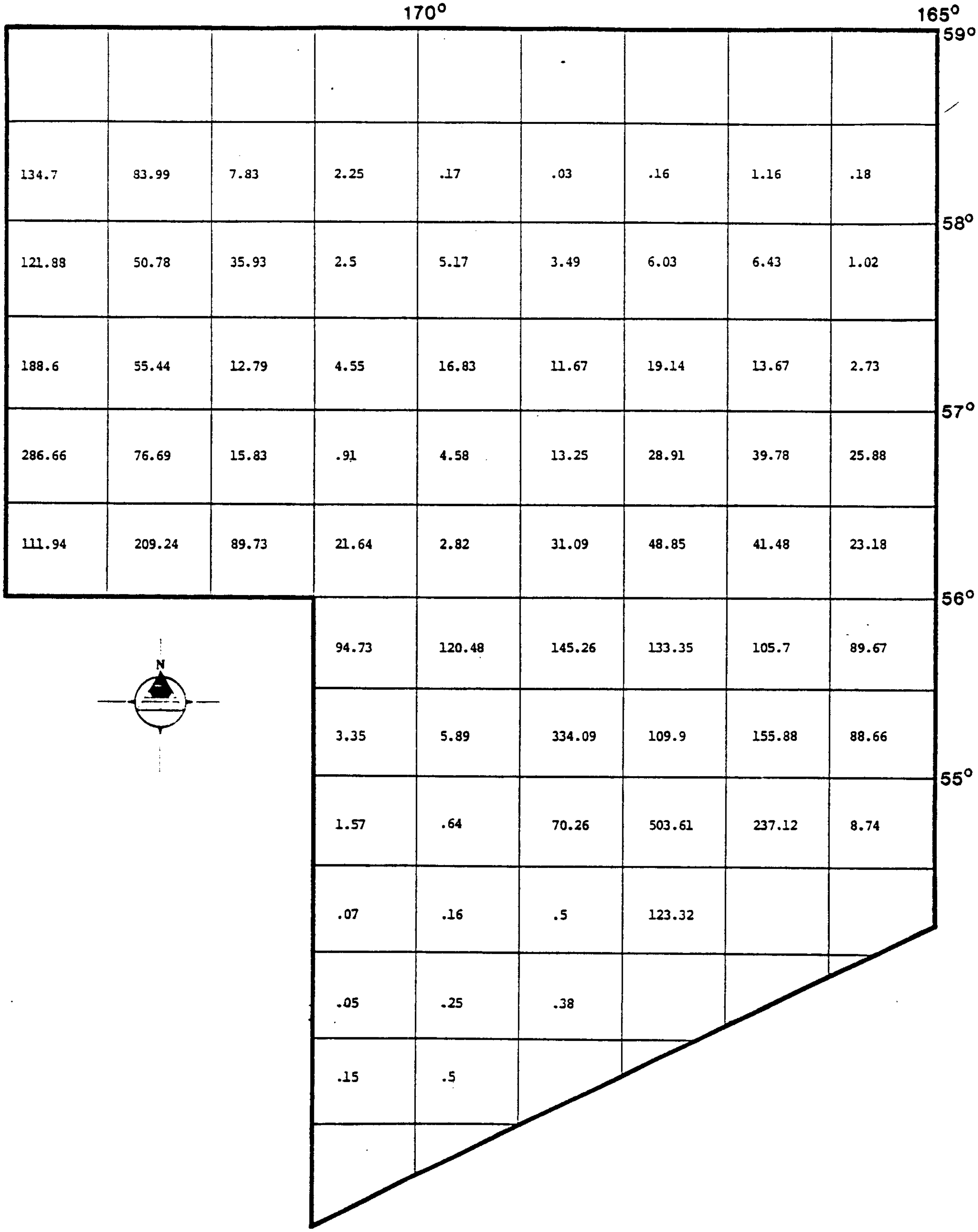


8582.1 121.6 1760.7 311.9 0 0	5832.7 105.6 760.8 20.1 0 0	506.9 16.8 97.4 4.9 0 0	146.4 14.3 18.9 .5 0 0	11.9 .4 .9 0 1 0	.2 .1 1.3 .4 0 0	.9 9.4 2.6 0 nil 0	1.3 75.1 6.9 9.3 0 0	.7 9.6 1.7 2.4 nil 0
7742.4 108.5 1844.3 55.1 0 0	3391.4 61 569.4 40.8 0 0	2406.8 68.3 387.5 11.9 2 0	174.4 7.2 18.5 .1 4 0	331.2 14.3 67.2 .5 110 0	188.3 18.3 71.1 1.7 3 0	13.9 365.7 102.6 .1 13 0	33 403.6 74.1 3.6 0 0	2.4 46.4 31.9 .7 34 0
10991.1 256.5 3567 273.5 0 0	3638 54.3 699.1 43.7 0 0	770.4 16.7 115.9 120 14 5	287.3 22.8 25.4 28.8 26 0	1188.7 31.8 125.9 0 168 85	787.3 33.3 112.5 .7 37 0	1116.3 187.3 226.7 1 20 130	438.5 402.5 252.1 .1 17 0	70.9 63.7 83.6 .1 273 37
17194.1 447.4 4975.1 316.3 0 0	5258 68.5 798.7 9.8 0 0	1029.5 19.6 204.7 13 16 38	54.3 2.2 15.5 .4 81 137	332.3 6.3 28 0 239 1011	919.6 19.4 119 2.2 104 68	1743.5 251.2 316.8 1.6 30 1522	622.3 1571 987.9 .9 69 51	613.1 884.6 572.8 .3 970 235
5906.5 302.3 2534.6 211.6 0 0	11980 510.1 3956.2 292.8 0 11	5172.2 211.1 1737.9 57.2 1 1	1261.6 46.9 394.8 27.9 44 309	144.7 10.3 67.7 2.6 4 95	1631.1 395.2 453 7.7 129 962	2220.7 981.4 705.1 1.1 11 205	1738.7 795.5 783.1 .9 167 942	1133.2 231.5 489.2 .3 444 840
			4628.4 244.4 2457.2 248.7 nil 6	6228.6 147.7 3068.8 193.5 nil 0	6984.5 592.9 3845 198.4 4 223	7723.6 643.7 2285.2 15.4 2 17	5768.5 922.4 1752.5 12.3 90 713	5484 755.3 912.9 21.7 107 502
			84.2 29.9 116.9 36.8 0 0	205.4 23 209.9 33 78 0	18227.4 428.4 7875 196.5 0 8	7020.4 127.7 1615.4 28.6 0 30	10183.7 243.3 2004.2 39.5 2 84	5153.3 793.5 1115 31.1 24 300
			28.9 6.3 87.5 3.1 0 0	22.8 1.9 22.4 3.9 27 0	4016.9 91 1458.5 54.7 2 0	32533.8 320.9 7299.1 135 107 108	15494.8 308.9 3136.9 28.9 1 54	502.3 81.1 114.6 .8 0 3
			0 3 0 3 0 0	.3 .3 11.2 1 0 0	19 1.4 18.1 1.1 234 0	7961.3 140.6 1658.1 105.4 155 9		
			2.9 .8 0 .5 0 0	.2 .3 16.4 2.8 0 0	.9 2 24.6 2.6 33 0			
			5.4 1.2 3.9 1.9 0 0	.3 .5 31.9 6.9 0 0				

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

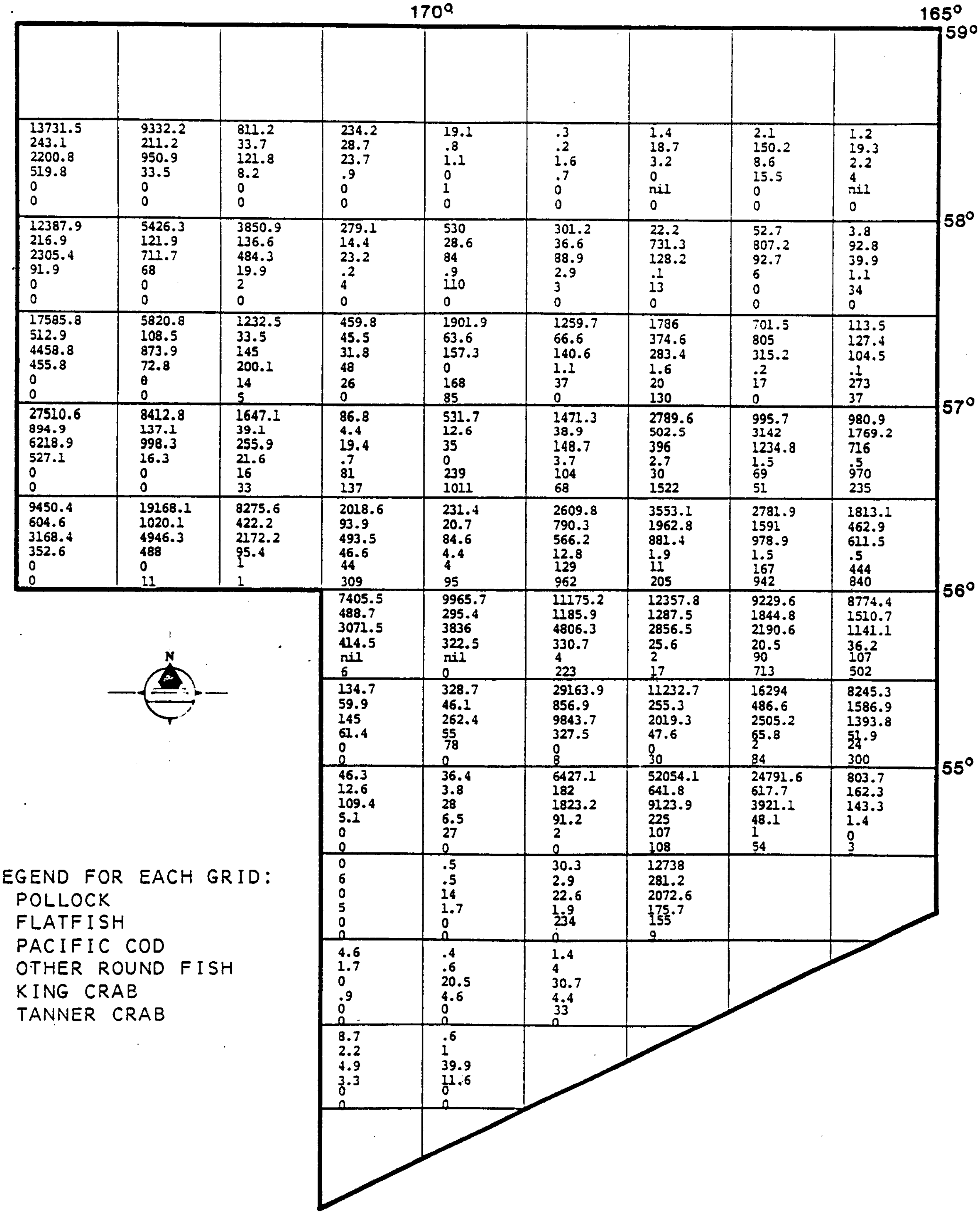
PROJECTED DOMESTIC CATCH, 1992, IN METRIC TONS



134.7	83.99	7.83	2.25	.17	.03	.16	1.16	.18
121.88	50.78	35.93	2.5	5.17	3.49	6.03	6.43	1.02
188.6	55.44	12.79	4.55	16.83	11.67	19.14	13.67	2.73
286.66	76.69	15.83	.91	4.58	13.25	28.91	39.78	25.88
111.94	209.24	89.73	21.64	2.82	31.09	48.85	41.48	23.18
			94.73	120.48	145.26	133.35	105.7	89.67
			3.35	5.89	334.09	109.9	155.88	88.66
			1.57	.64	70.26	503.61	237.12	8.74
			.07	.16	.5	123.32		
			.05	.25	.38			
			.15	.5				

ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-EAYS, 1992:
CATCH RATE = 80 METRIC TONS/DAY

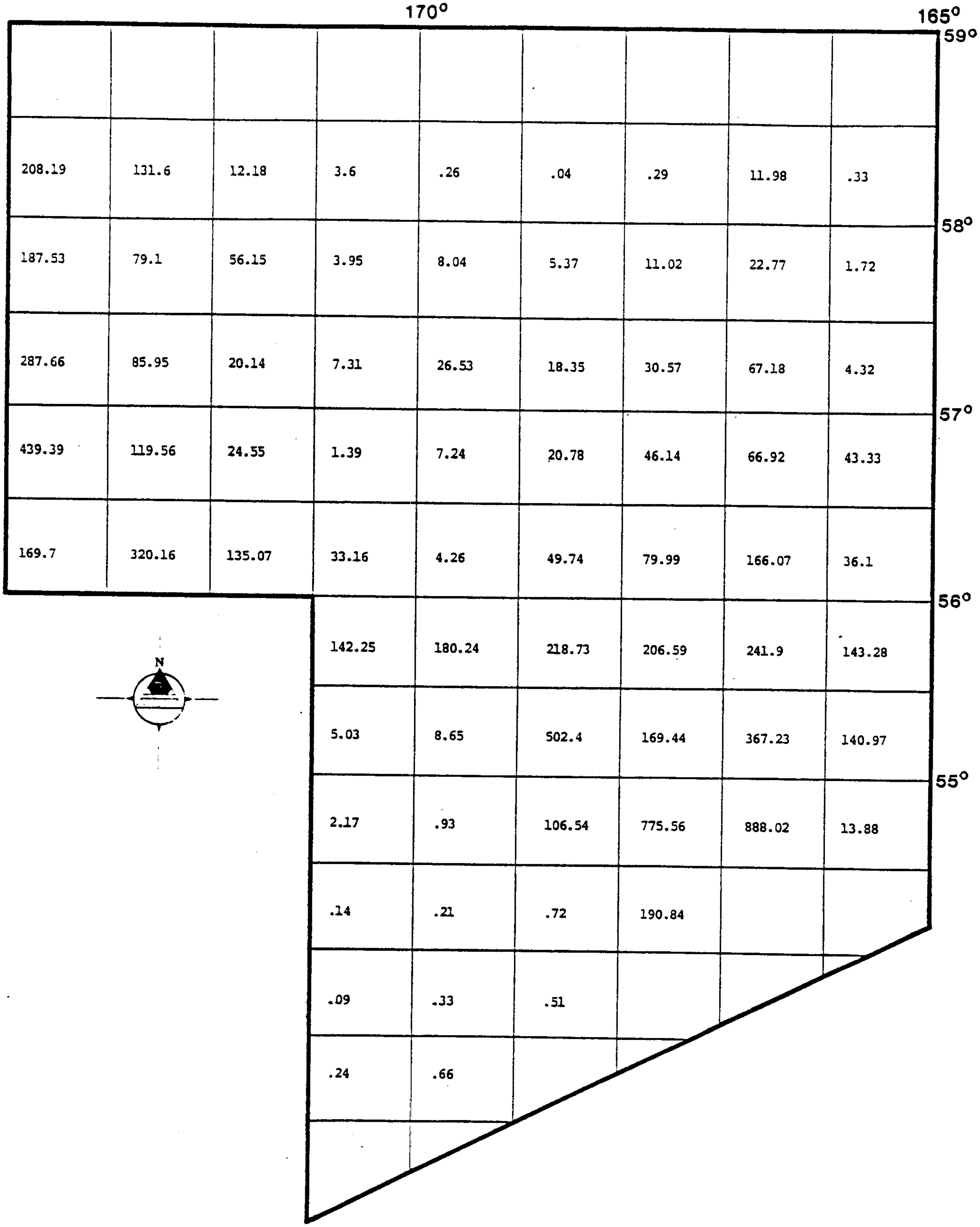


13731.5 243.1 2200.8 519.8 0 0	9332.2 211.2 950.9 33.5 0 0	811.2 33.7 121.8 8.2 0 0	234.2 28.7 23.7 .9 0 0	19.1 .8 1.1 0 1 0	.3 .2 1.6 .7 0 0	1.4 18.7 3.2 0 nil 0	2.1 150.2 8.6 15.5 0 0	1.2 19.3 2.2 4 nil 0
12387.9 216.9 2305.4 91.9 0 0	5426.3 121.9 711.7 68 0 0	3850.9 136.6 484.3 19.9 2 0	279.1 14.4 23.2 .2 4 0	530 28.6 84 .9 110 0	301.2 36.6 88.9 2.9 3 0	22.2 731.3 128.2 .1 13 0	52.7 807.2 92.7 6 0 0	3.8 92.8 39.9 1.1 34 0
17585.8 512.9 4458.8 455.8 0 0	5820.8 108.5 873.9 72.8 0 0	1232.5 33.5 145 200.1 14 5	459.8 45.5 31.8 48 26 0	1901.9 63.6 157.3 0 168 85	1259.7 66.6 140.6 1.1 37 0	1786 374.6 283.4 1.6 20 130	701.5 805 315.2 .2 17 0	113.5 127.4 104.5 .1 273 37
27510.6 894.9 6218.9 527.1 0 0	8412.8 137.1 998.3 16.3 0 0	1647.1 39.1 255.9 21.6 16 33	86.8 4.4 19.4 .7 81 137	531.7 12.6 35 0 239 1011	1471.3 38.9 148.7 3.7 104 68	2789.6 502.5 396 2.7 30 1522	995.7 3142 1234.8 1.5 69 51	980.9 1769.2 716 .5 970 235
9450.4 604.6 3168.4 352.6 0 0	19168.1 1020.1 4946.3 488 0 11	8275.6 422.2 2172.2 95.4 1 1	2018.6 93.9 493.5 46.6 44 309	231.4 20.7 84.6 4.4 4 95	2609.8 790.3 566.2 12.8 129 962	3553.1 1962.8 881.4 1.9 11 205	2781.9 1591 978.9 1.5 167 942	1813.1 462.9 611.5 .5 444 840
			7405.5 488.7 3071.5 414.5 nil 6	9965.7 295.4 3836 322.5 nil 0	11175.2 1185.9 4806.3 330.7 4 223	12357.8 1287.5 2856.5 25.6 2 17	9229.6 1844.8 2190.6 20.5 90 713	8774.4 1510.7 1141.1 36.2 107 502
			134.7 59.9 145 61.4 0 0	328.7 46.1 262.4 55 78 0	29163.9 856.9 9843.7 327.5 0 8	11232.7 255.3 2019.3 47.6 0 30	16294 486.6 2505.2 65.8 2 84	8245.3 1586.9 1393.8 51.9 24 300
			46.3 12.6 109.4 5.1 0 0	36.4 3.8 28 6.5 27 0	6427.1 182 1823.2 91.2 2 0	52054.1 641.8 9123.9 225 107 108	24791.6 617.7 3921.1 48.1 1 54	803.7 162.3 143.3 1.4 0 3
			0 6 0 5 0 0	.5 .5 14 1.7 0 0	30.3 2.9 22.6 1.9 234 0	12738 281.2 2072.6 175.7 155 9		
			4.6 1.7 0 .9 0 0	.4 .6 20.5 4.6 0 0	1.4 4 30.7 4.4 33 0			
			8.7 2.2 4.9 3.3 0 0	.6 1 39.9 11.6 0 0				

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

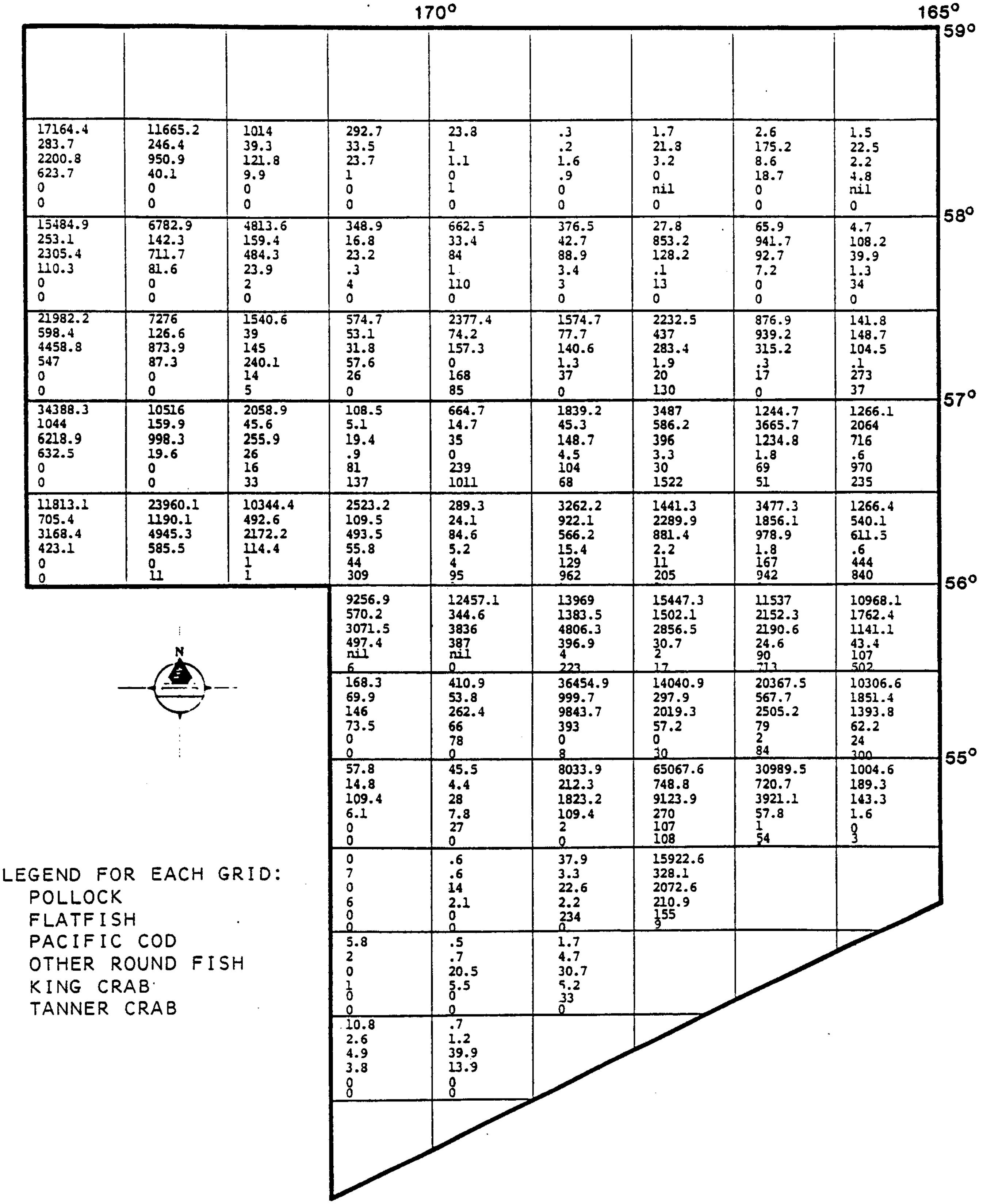
PROJECTED DOMESTIC CATCH, 1997, IN METRIC TONS



208.19	131.6	12.18	3.6	.26	.04	.29	11.98	.33
187.53	79.1	56.15	3.95	8.04	5.37	11.02	22.77	1.72
287.66	85.95	20.14	7.31	26.53	18.35	30.57	67.18	4.32
439.39	119.56	24.55	1.39	7.24	20.78	46.14	66.92	43.33
169.7	320.16	135.07	33.16	4.26	49.74	79.99	166.07	36.1
			142.25	180.24	218.73	206.59	241.9	143.28
			5.03	8.65	502.4	169.44	367.23	140.97
			2.17	.93	106.54	775.56	888.02	13.88
			.14	.21	.72	190.84		
			.09	.33	.51			
			.24	.66				

ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1997:
CATCH RATE = 80 METRIC TONS/DAY

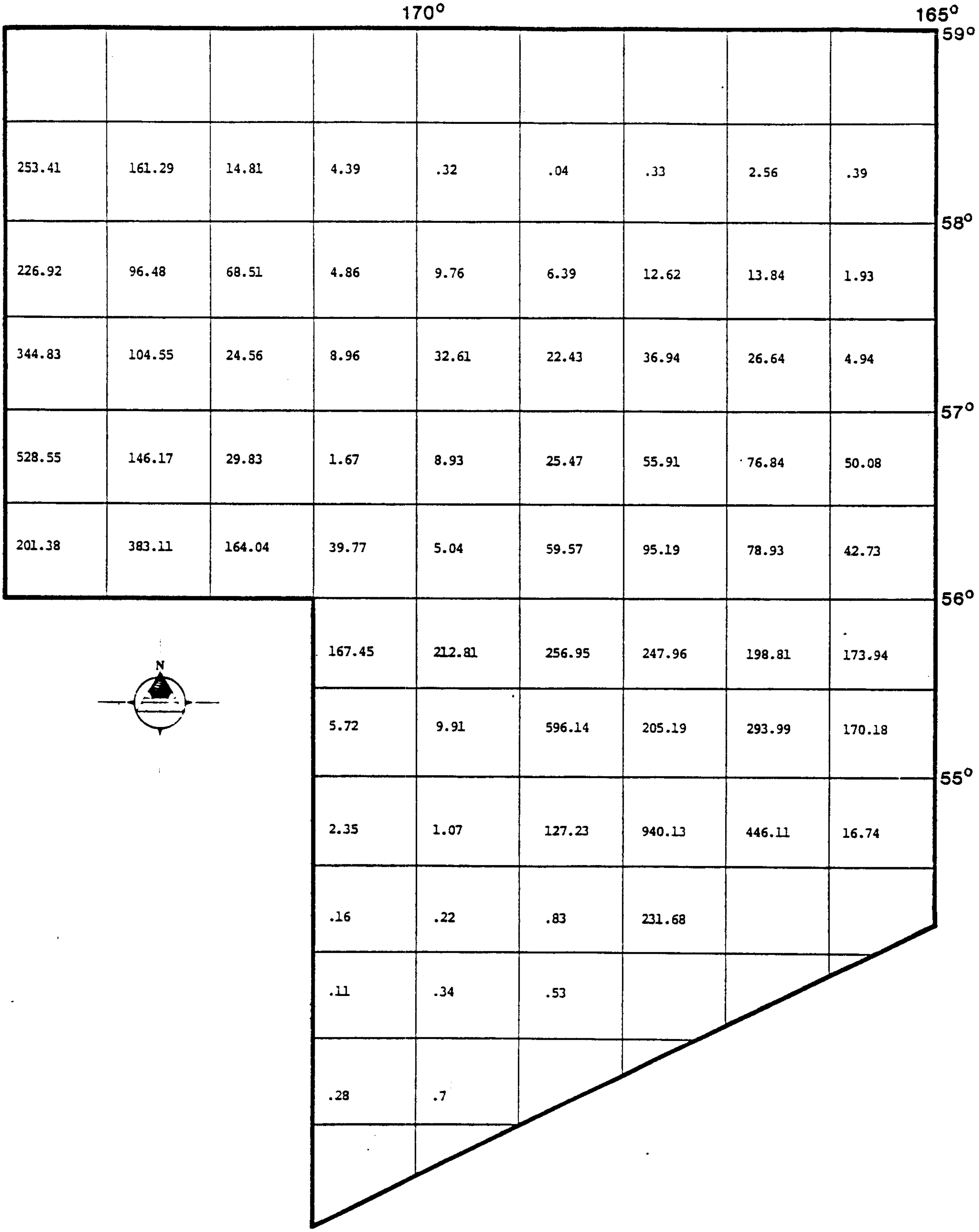


17164.4 283.7 2200.8 623.7 0 0	11665.2 246.4 950.9 40.1 0 0	1014 39.3 121.8 9.9 0 0	292.7 33.5 23.7 1 0 0	23.8 1 1.1 0 1 0	.3 .2 1.6 .9 0 0	1.7 21.8 3.2 0 nil 0	2.6 175.2 8.6 18.7 0 0	1.5 22.5 2.2 4.8 nil 0
15484.9 253.1 2305.4 110.3 0 0	6782.9 142.3 711.7 81.6 0 0	4813.6 159.4 484.3 23.9 2 0	348.9 16.8 23.2 .3 4 0	662.5 33.4 84 1 110 0	376.5 42.7 88.9 3.4 3 0	27.8 853.2 128.2 .1 13 0	65.9 941.7 92.7 7.2 0 0	4.7 108.2 39.9 1.3 34 0
21982.2 598.4 4458.8 547 0 0	7276 126.6 873.9 87.3 0 0	1540.6 39 145 240.1 14 5	574.7 53.1 31.8 57.6 26 0	2377.4 74.2 157.3 0 168 85	1574.7 77.7 140.6 1.3 37 0	2232.5 437 283.4 1.9 20 130	876.9 939.2 315.2 .3 17 0	141.8 148.7 104.5 .1 273 37
34388.3 1044 6218.9 632.5 0 0	10516 159.9 998.3 19.6 0 0	2058.9 45.6 255.9 26 16 33	108.5 5.1 19.4 .9 81 137	664.7 14.7 35 0 239 1011	1839.2 45.3 148.7 4.5 104 68	3487 586.2 396 3.3 30 1522	1244.7 3665.7 1234.8 1.8 69 51	1266.1 2064 716 .6 970 235
11813.1 705.4 3168.4 423.1 0 0	23960.1 1190.1 4945.3 585.5 0 11	10344.4 492.6 2172.2 114.4 1 1	2523.2 109.5 493.5 55.8 44 309	289.3 24.1 84.6 5.2 4 95	3262.2 922.1 566.2 15.4 129 962	1441.3 2289.9 881.4 2.2 11 205	3477.3 1856.1 978.9 1.8 167 942	1266.4 540.1 611.5 .6 444 840
			9256.9 570.2 3071.5 497.4 nil 6	12457.1 344.6 3836 387 nil 0	13969 1383.5 4806.3 396.9 4 223	15447.3 1502.1 2856.5 30.7 2 17	11537 2152.3 2190.6 24.6 90 713	10968.1 1762.4 1141.1 43.4 107 502
			168.3 69.9 146 73.5 0 0	410.9 53.8 262.4 66 78 0	36454.9 999.7 9843.7 393 0 8	14040.9 297.9 2019.3 57.2 0 30	20367.5 567.7 2505.2 79 2 84	10306.6 1851.4 1393.8 62.2 24 300
			57.8 14.8 109.4 6.1 0 0	45.5 4.4 28 7.8 27 0	8033.9 212.3 1823.2 109.4 2 0	65067.6 748.8 9123.9 270 107 108	30989.5 720.7 3921.1 57.8 1 54	1004.6 189.3 143.3 1.6 0 3
			0 7 0 6 0 0	.6 .6 14 2.1 0 0	37.9 3.3 22.6 2.2 234 0	15922.6 328.1 2072.6 210.9 155 9		
			5.8 2 0 1 0 0	.5 .7 20.5 5.5 0 0	1.7 4.7 30.7 5.2 33 0			
			10.8 2.6 4.9 3.8 0 0	.7 1.2 39.9 13.9 0 0				

LEGEND FOR EACH GRID:
- POLLOCK
- FLATFISH
- PACIFIC COD
- OTHER ROUND FISH
- KING CRAB
- TANNER CRAB

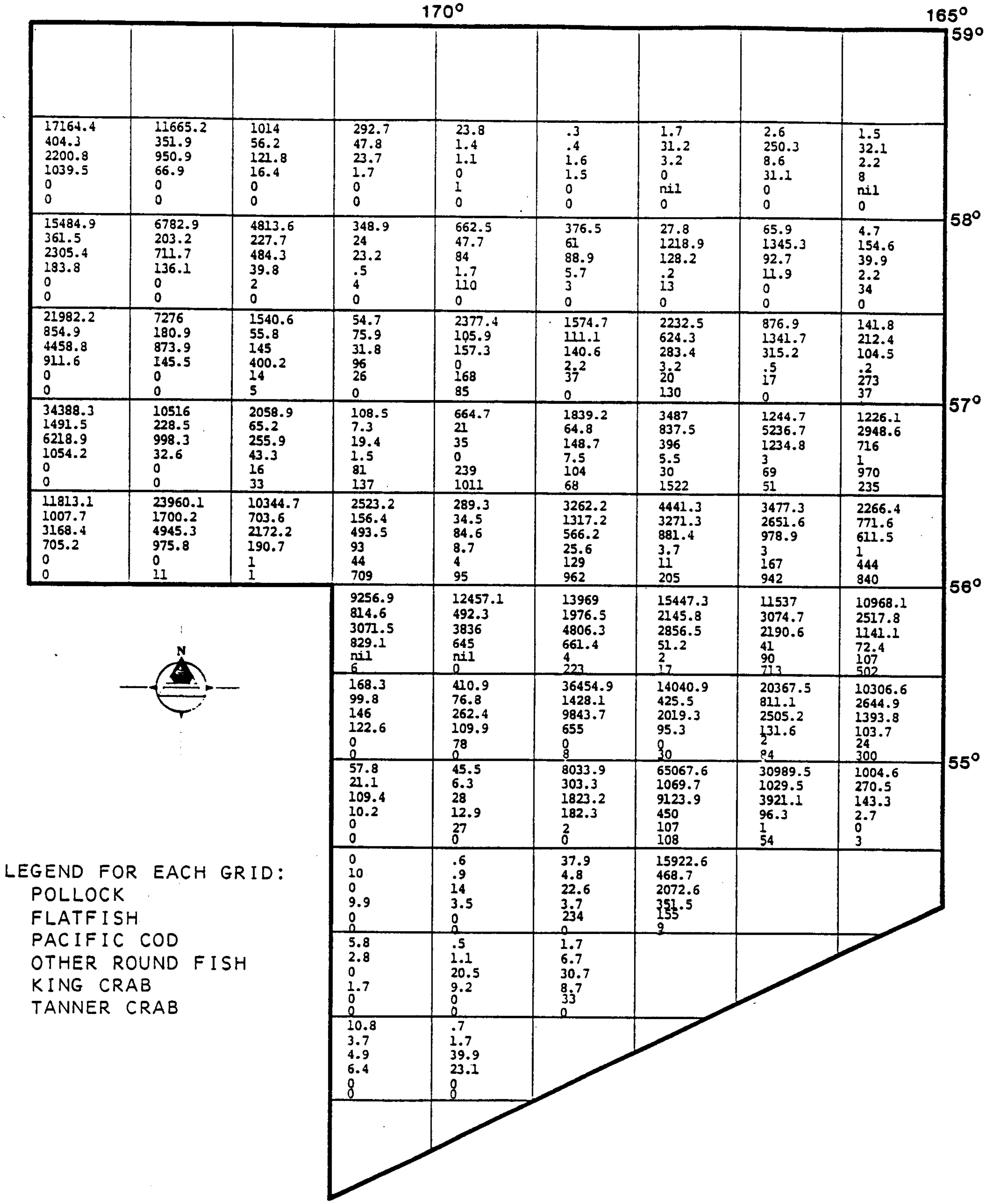
ST. GEORGE BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2002, IN METRIC TONS



ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2002:
CATCH RATE = 80 METRIC TONS/DAY

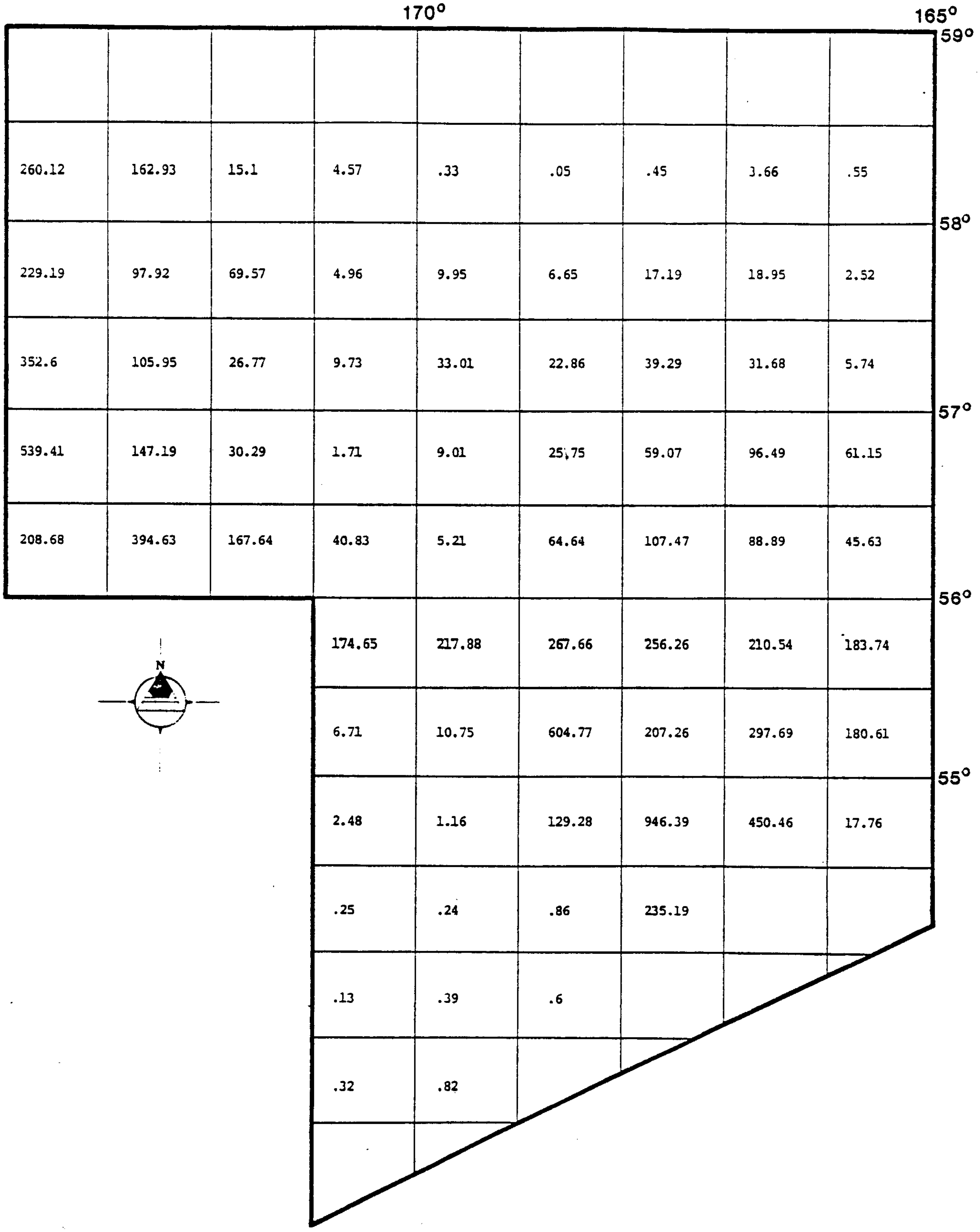


17164.4 404.3 2200.8 1039.5 0 0	11665.2 351.9 950.9 66.9 0 0	1014 56.2 121.8 16.4 0 0	292.7 47.8 23.7 1.7 0 0	23.8 1.4 1.1 0 1 0	.3 .4 1.6 1.5 0 0	1.7 31.2 3.2 0 nil 0	2.6 250.3 8.6 31.1 0 0	1.5 32.1 2.2 8 nil 0
15484.9 361.5 2305.4 183.8 0 0	6782.9 203.2 711.7 136.1 0 0	4813.6 227.7 484.3 39.8 2 0	348.9 24 23.2 .5 4 0	662.5 47.7 84 1.7 110 0	376.5 61 88.9 5.7 3 0	27.8 1218.9 128.2 .2 13 0	65.9 1345.3 92.7 11.9 0 0	4.7 154.6 39.9 2.2 34 0
21982.2 854.9 4458.8 911.6 0 0	7276 180.9 873.9 145.5 0 0	1540.6 55.8 145 400.2 14 5	54.7 75.9 31.8 96 26 0	2377.4 105.9 157.3 0 168 85	1574.7 111.1 140.6 2.2 37 0	2232.5 624.3 283.4 3.2 20 130	876.9 1341.7 315.2 .5 17 0	141.8 212.4 104.5 .2 273 37
34388.3 1491.5 6218.9 1054.2 0 0	10516 228.5 998.3 32.6 0 0	2058.9 65.2 255.9 43.3 16 33	108.5 7.3 19.4 1.5 81 137	664.7 21 35 0 239 1011	1839.2 64.8 148.7 7.5 104 68	3487 837.5 396 5.5 30 1522	1244.7 5236.7 1234.8 3 69 51	1226.1 2948.6 716 1 970 235
11813.1 1007.7 3168.4 705.2 0 0	23960.1 1700.2 4945.3 975.8 0 11	10344.7 703.6 2172.2 190.7 1 1	2523.2 156.4 493.5 93 44 709	289.3 34.5 84.6 8.7 4 95	3262.2 1317.2 566.2 25.6 129 962	4441.3 3271.3 881.4 3.7 11 205	3477.3 2651.6 978.9 3 167 942	2266.4 771.6 611.5 1 444 840
			9256.9 814.6 3071.5 829.1 nil 6	12457.1 492.3 3836 645 nil 0	13969 1976.5 4806.3 661.4 4 223	15447.3 2145.8 2856.5 51.2 2 17	11537 3074.7 2190.6 41 90 713	10968.1 2517.8 1141.1 72.4 107 502
			168.3 99.8 146 122.6 0 0	410.9 76.8 262.4 109.9 78 0	36454.9 1428.1 9843.7 655 0 8	14040.9 425.5 2019.3 95.3 0 30	20367.5 811.1 2505.2 131.6 2 84	10306.6 2644.9 1393.8 103.7 24 300
			57.8 21.1 109.4 10.2 0 0	45.5 6.3 28 12.9 27 0	8033.9 303.3 1823.2 182.3 2 0	65067.6 1069.7 9123.9 450 107 108	30989.5 1029.5 3921.1 96.3 1 54	1004.6 270.5 143.3 2.7 0 3
			0 10 0 9.9 0 0	.6 .9 14 3.5 0 0	37.9 4.8 22.6 3.7 234 0	15922.6 468.7 2072.6 351.5 155 9		
			5.8 2.8 0 1.7 0 0	.5 1.1 20.5 9.2 0 0	1.7 6.7 30.7 8.7 33 0			
			10.8 3.7 4.9 6.4 0 0	.7 1.7 39.9 23.1 0 0				

LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

ST. GEORGE BASIN LEASE SALE AREA

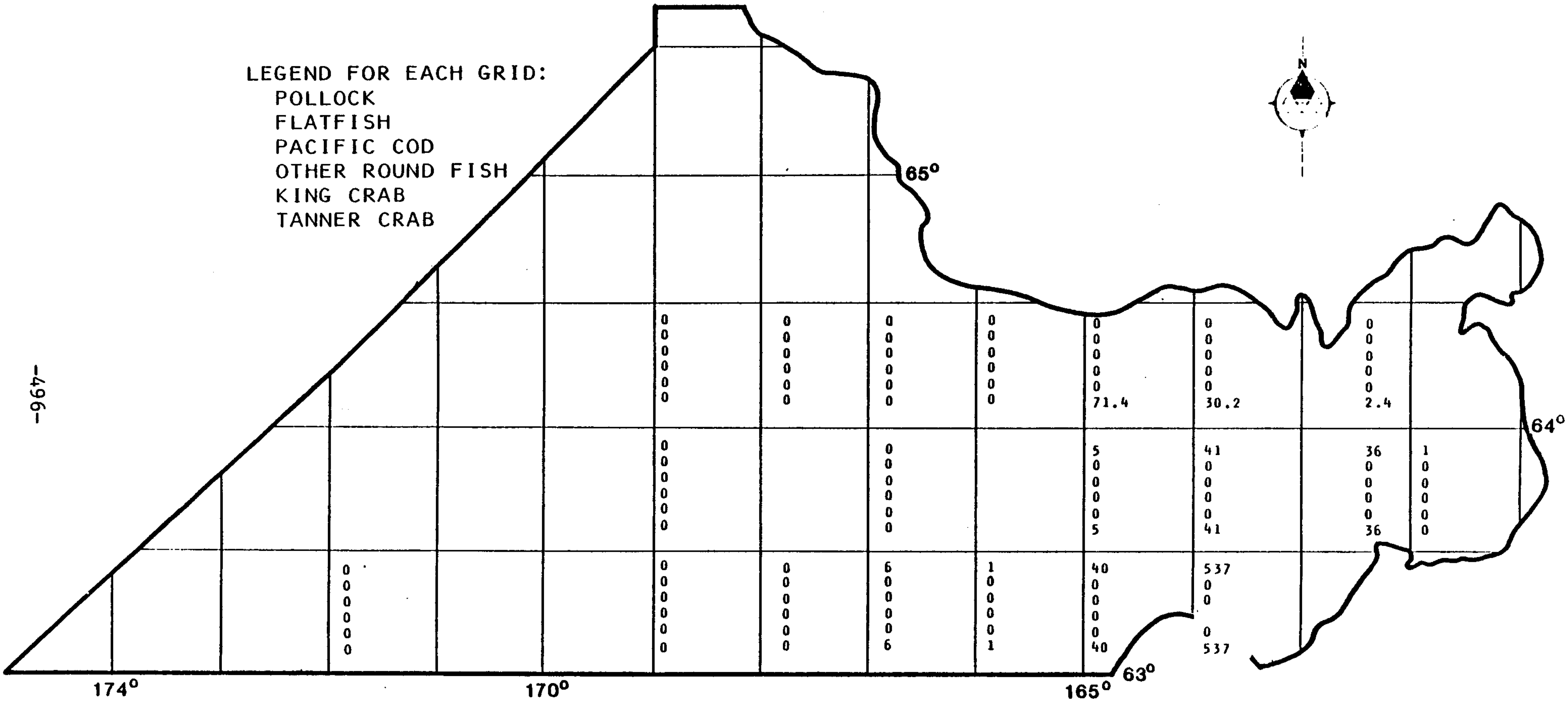
PROJECTED DOMESTIC CATCH, 2007, IN METRIC TONS



260.12	162.93	15.1	4.57	.33	.05	.45	3.66	.55
229.19	97.92	69.57	4.96	9.95	6.65	17.19	18.95	2.52
352.6	105.95	26.77	9.73	33.01	22.86	39.29	31.68	5.74
539.41	147.19	30.29	1.71	9.01	25.75	59.07	96.49	61.15
208.68	394.63	167.64	40.83	5.21	64.64	107.47	88.89	45.63
			174.65	217.88	267.66	256.26	210.54	183.74
			6.71	10.75	604.77	207.26	297.69	180.61
			2.48	1.16	129.28	946.39	450.46	17.76
			.25	.24	.86	235.19		
			.13	.39	.6			
			.32	.82				

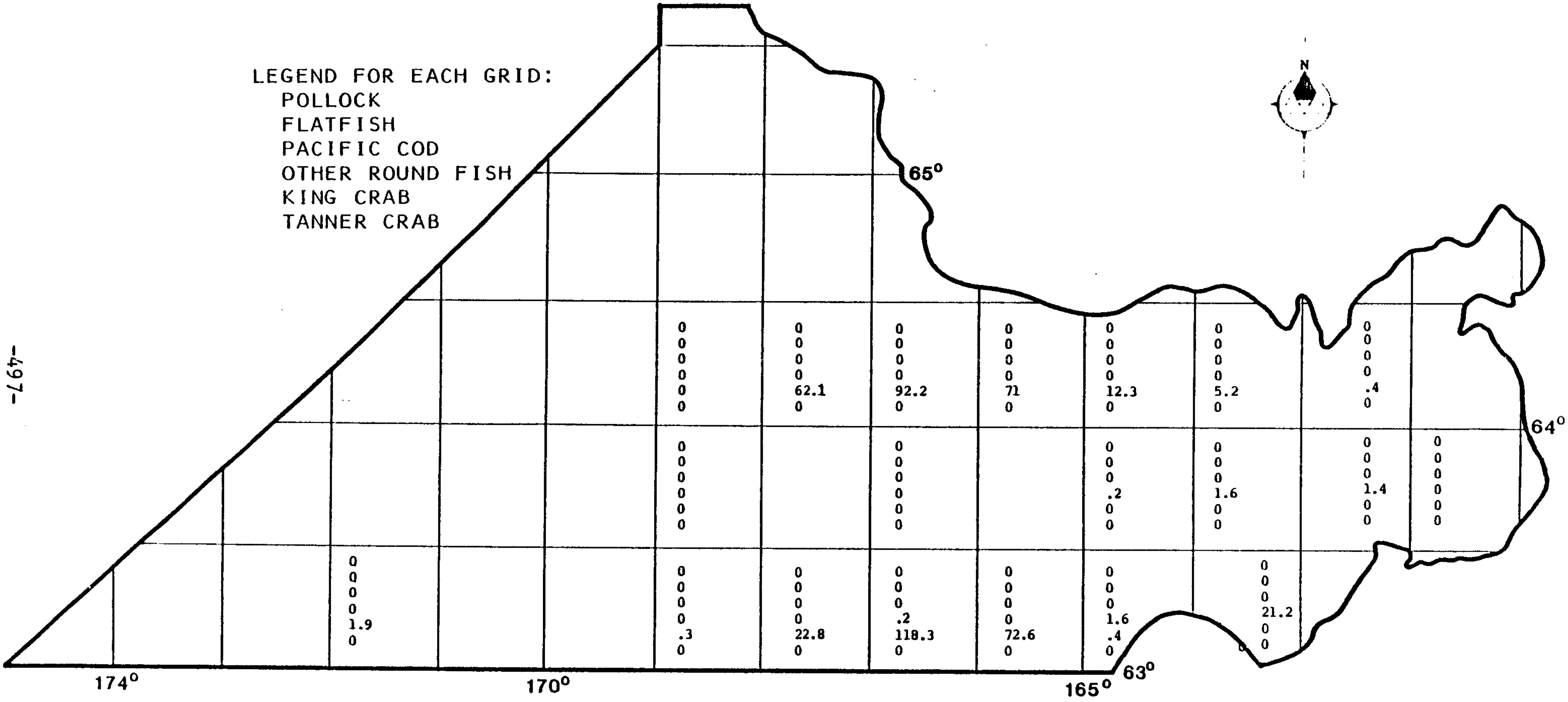
ST. GEORGE BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2007:
CATCH RATE = 80 METRIC TONS/DAY



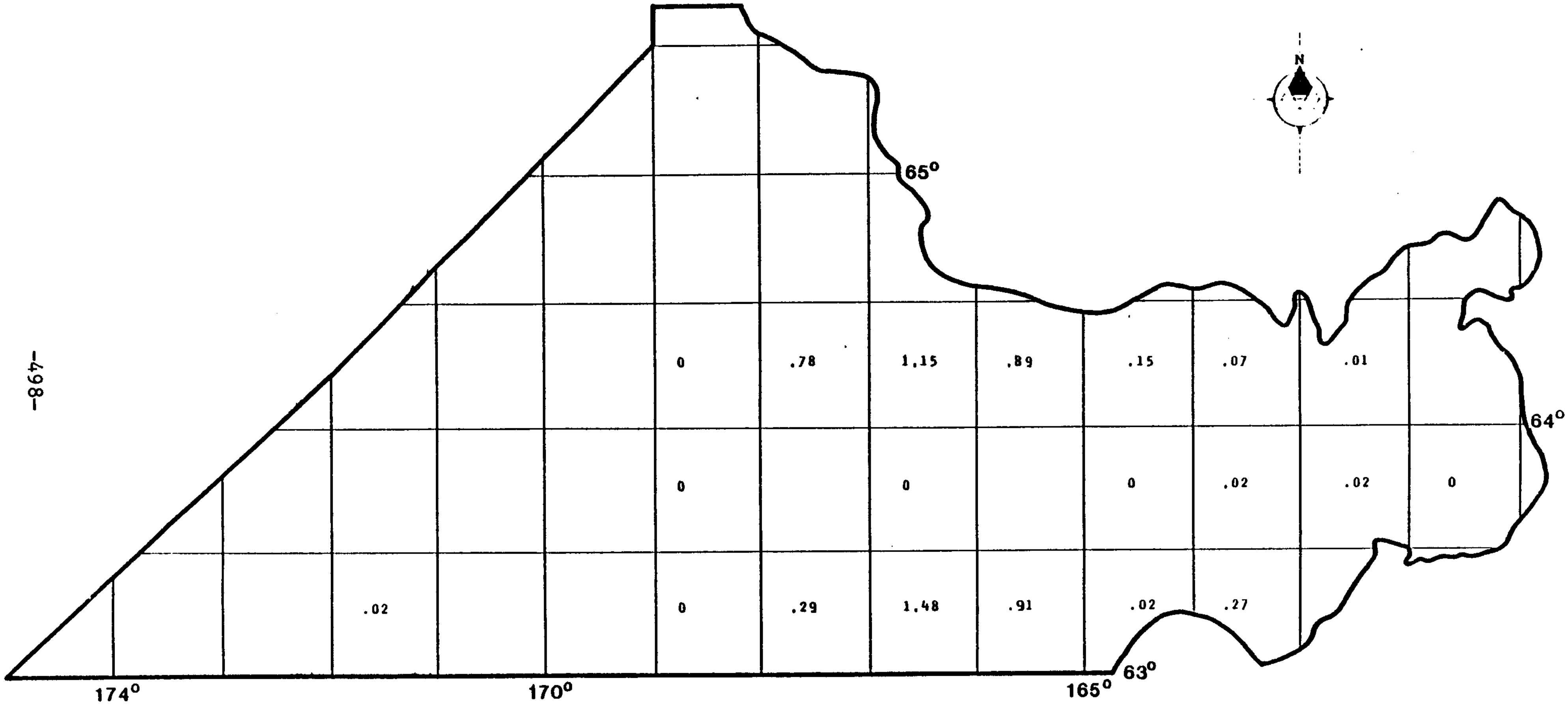
NORTON BASIN LEASE SALE AREA

HISTORICAL YEARLY CATCH



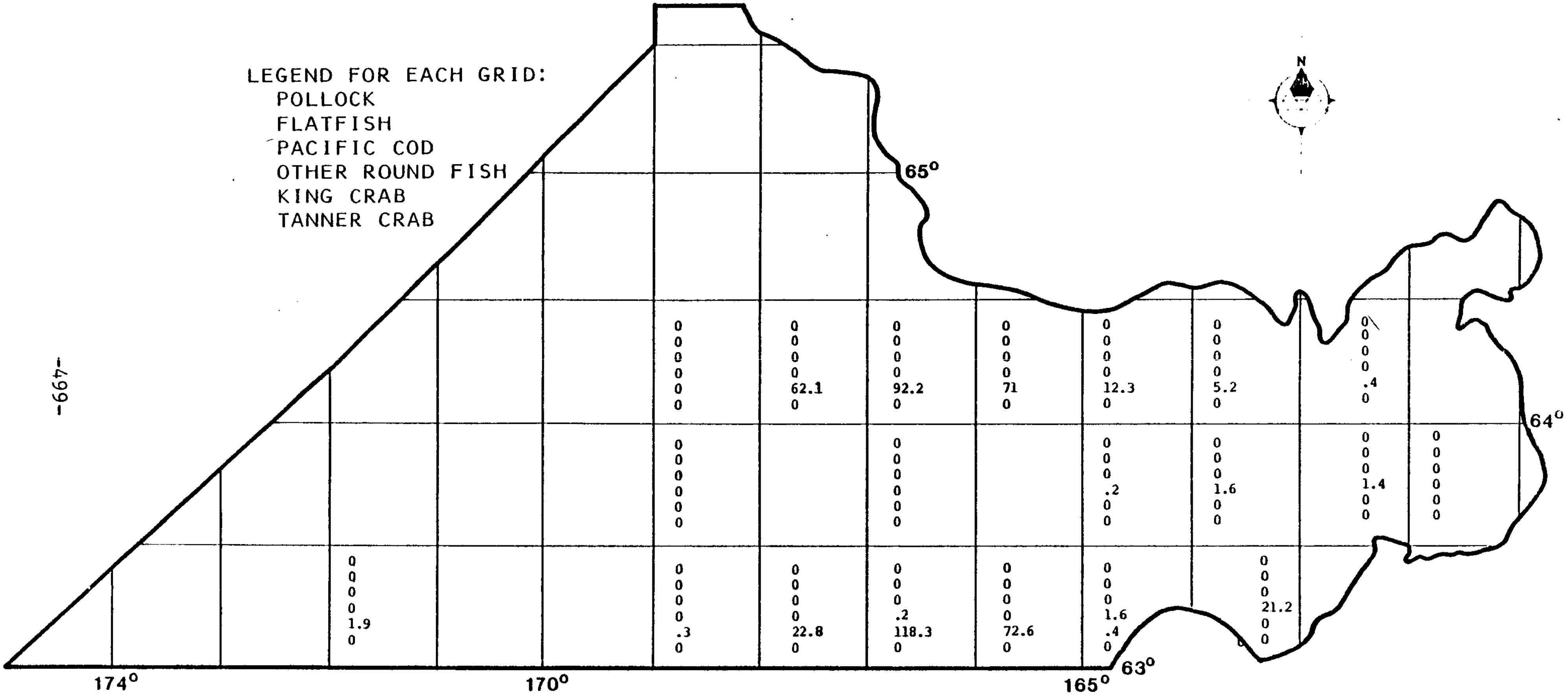
NORTON BASIN LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS



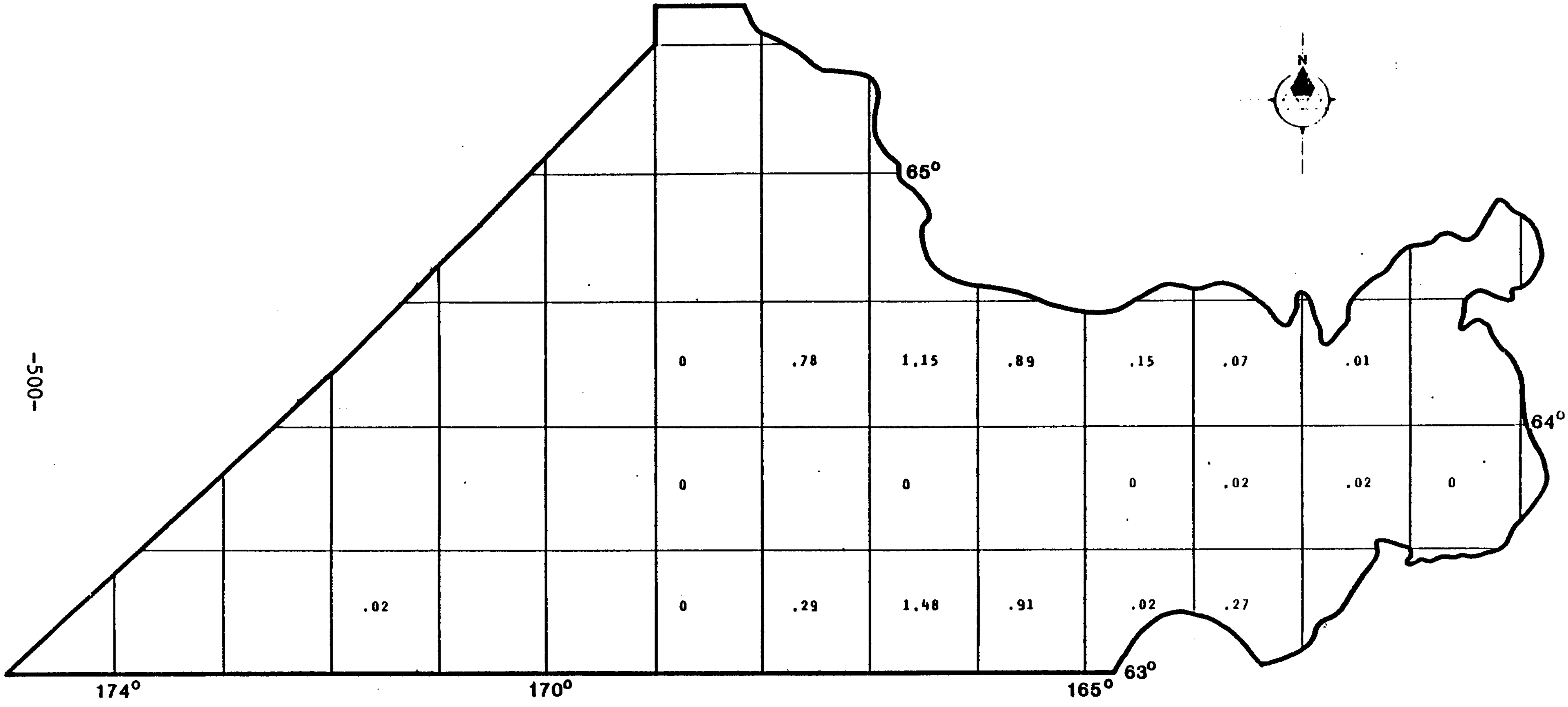
NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, TOTAL:
CATCH RATE = 80 METRIC TONS/DAY



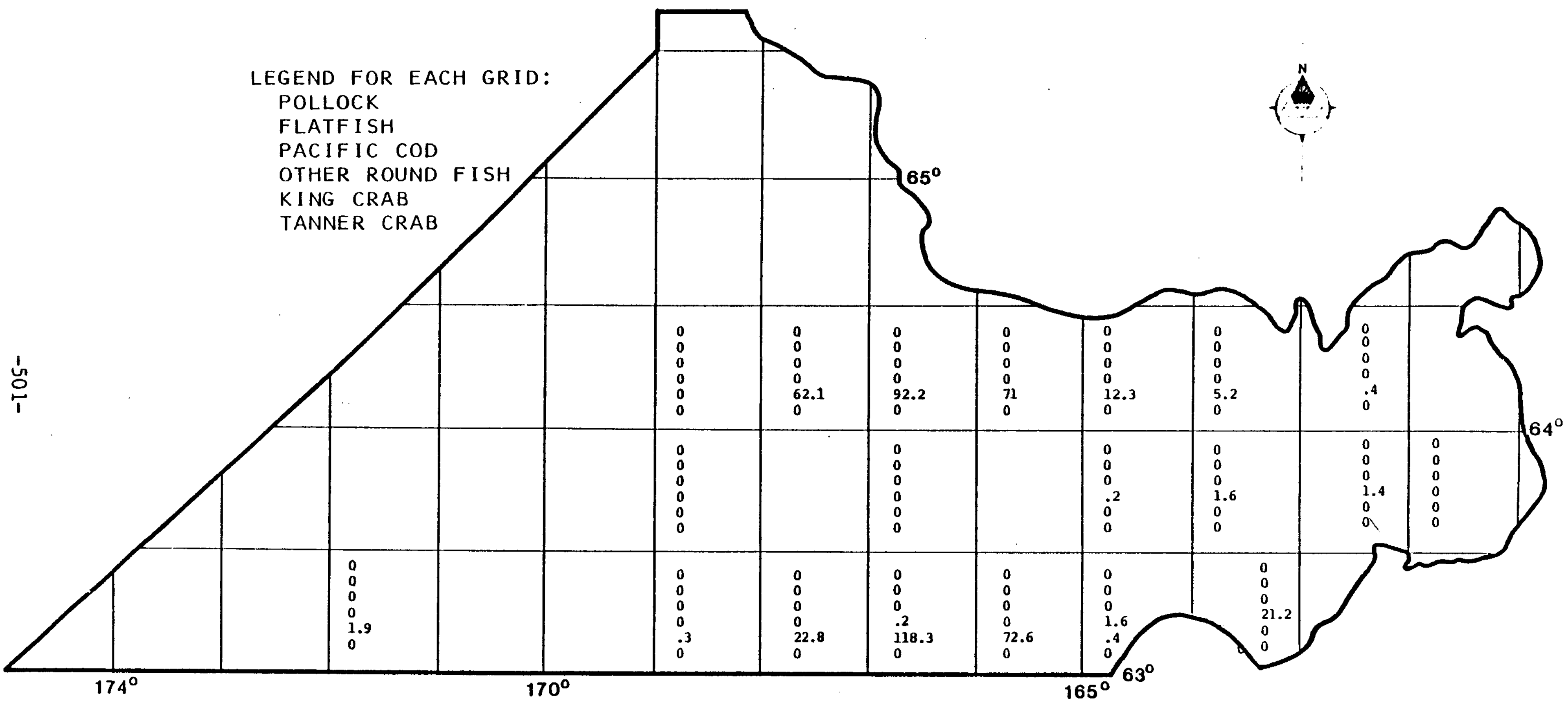
NORTON BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1987, IN METRIC TONS



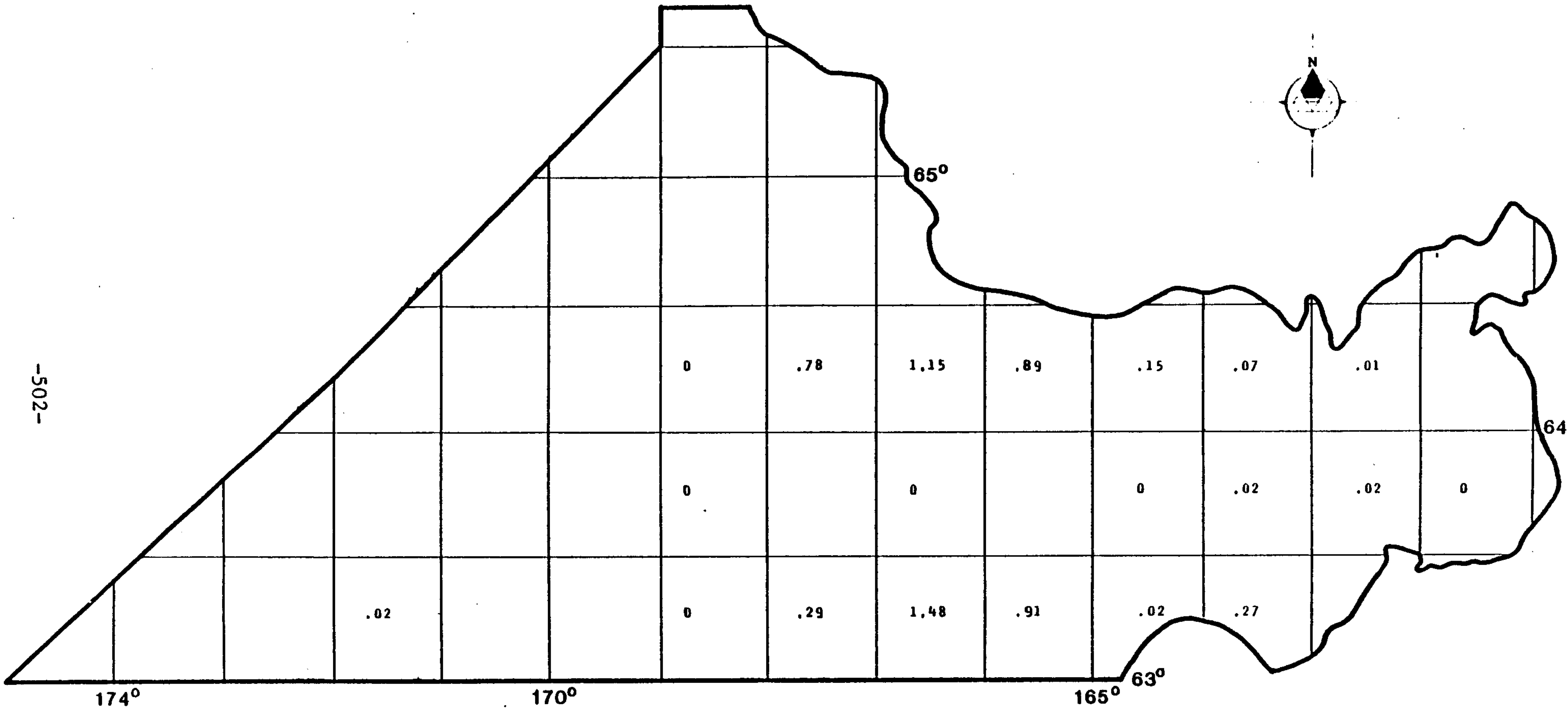
NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1987:
CATCH RATE = 80 METRIC TONS/DAY



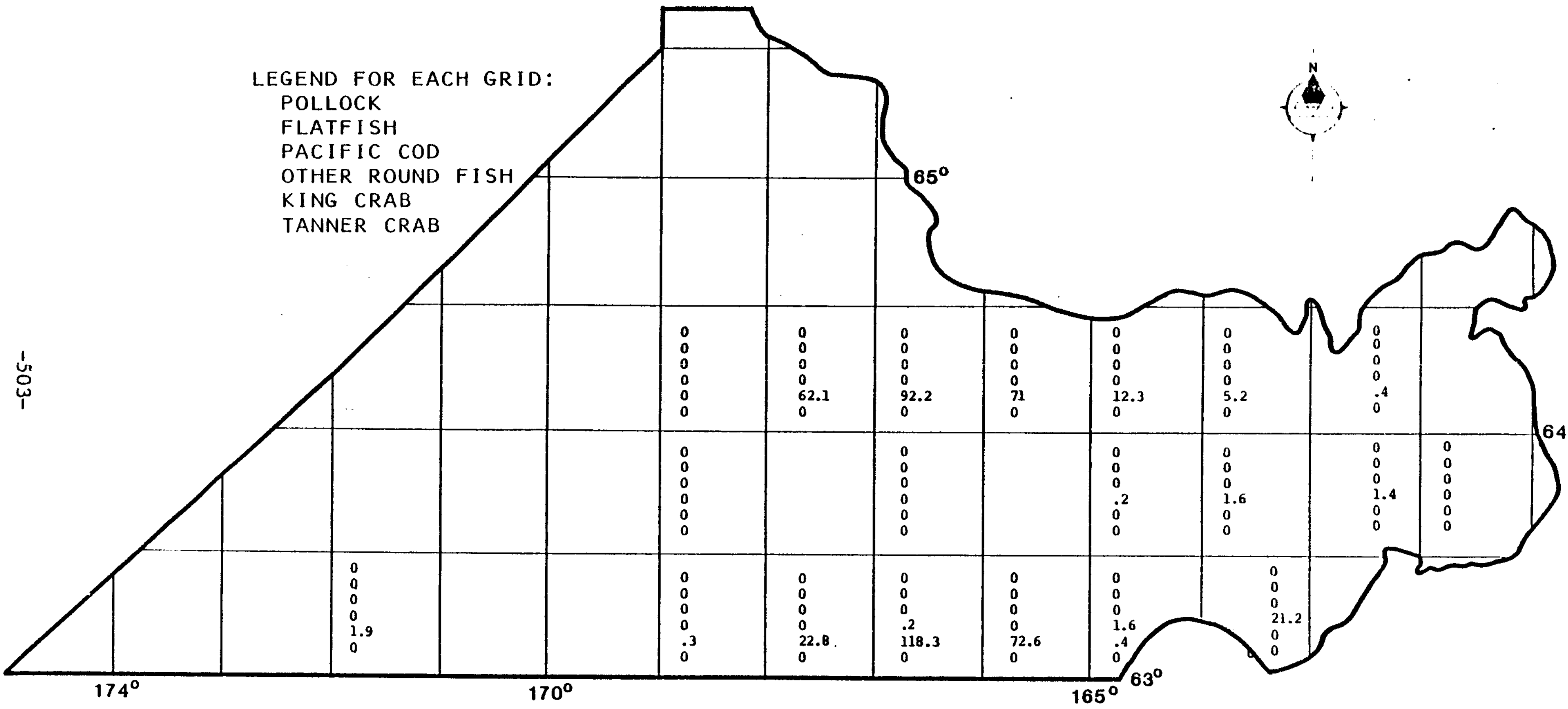
NORTON BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1992, IN METRIC TONS



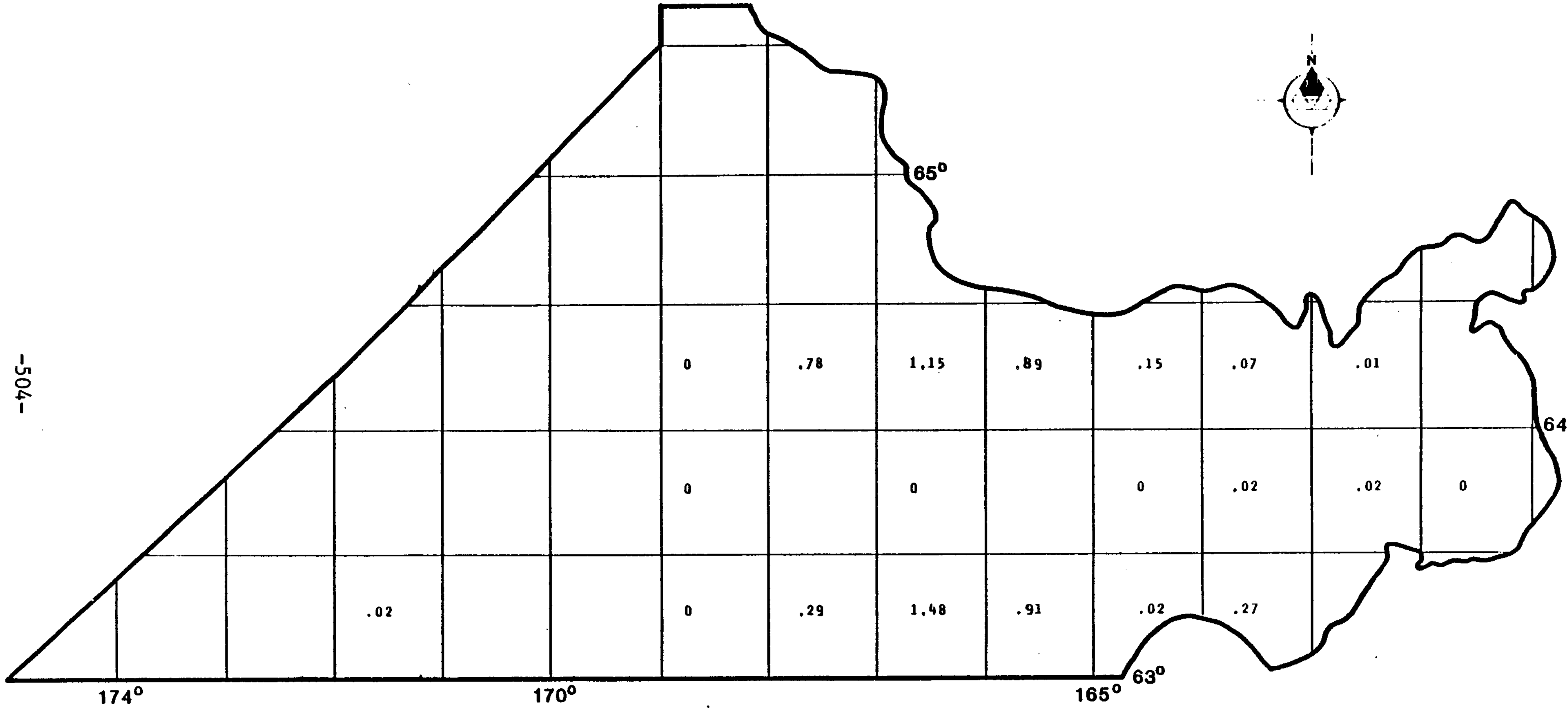
NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1992:
CATCH RATE = 80 METRIC TONS/DAY



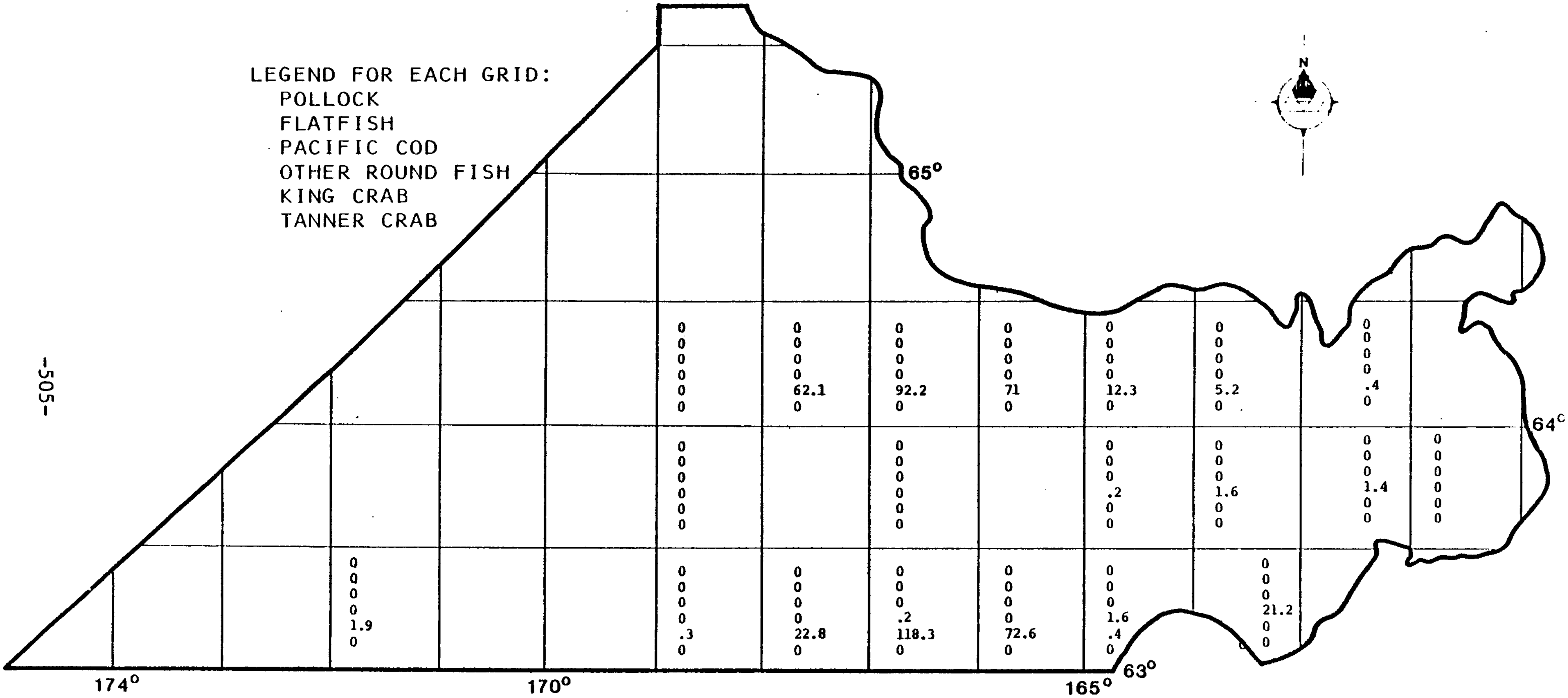
NORTON BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1997, IN METRIC TONS



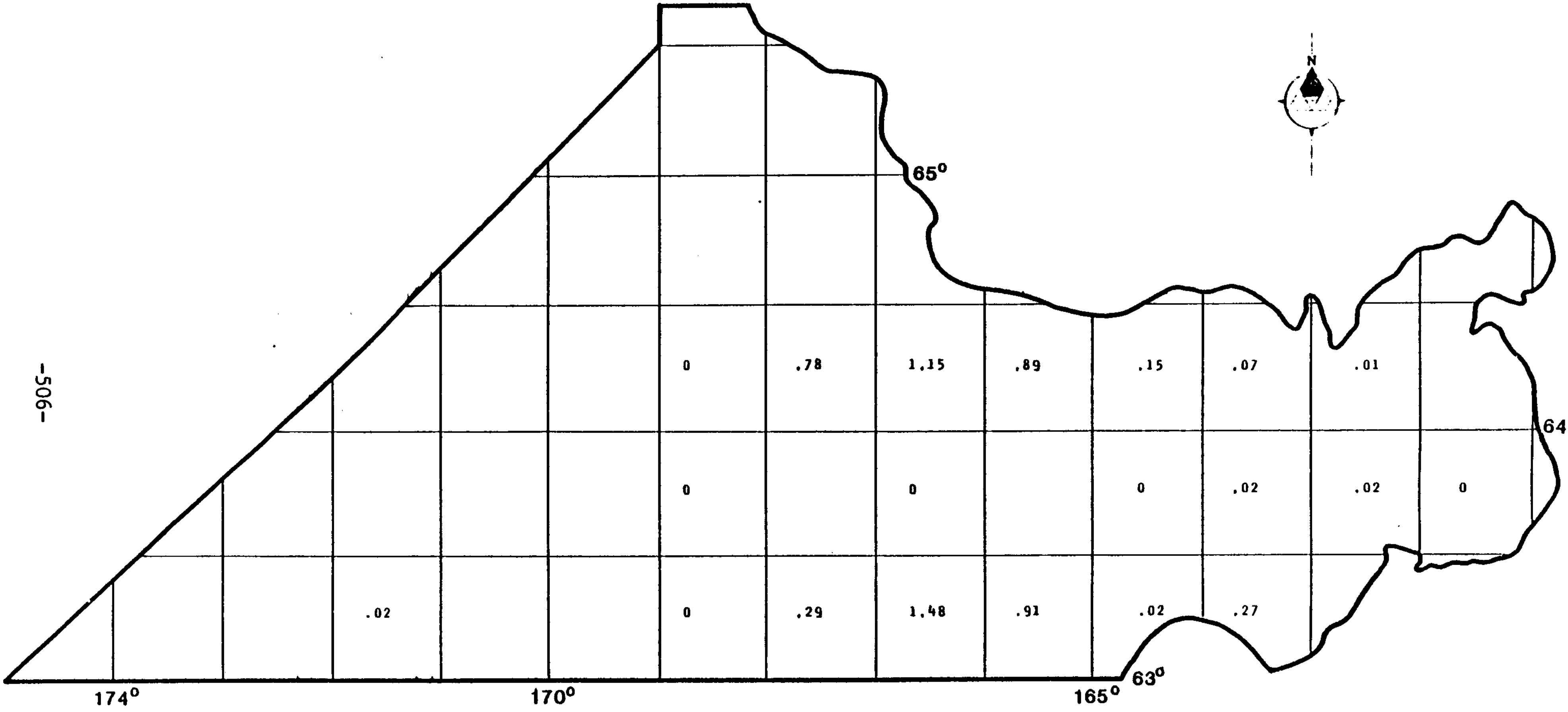
NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1997:
CATCH RATE = 80 METRIC TONS/DAY



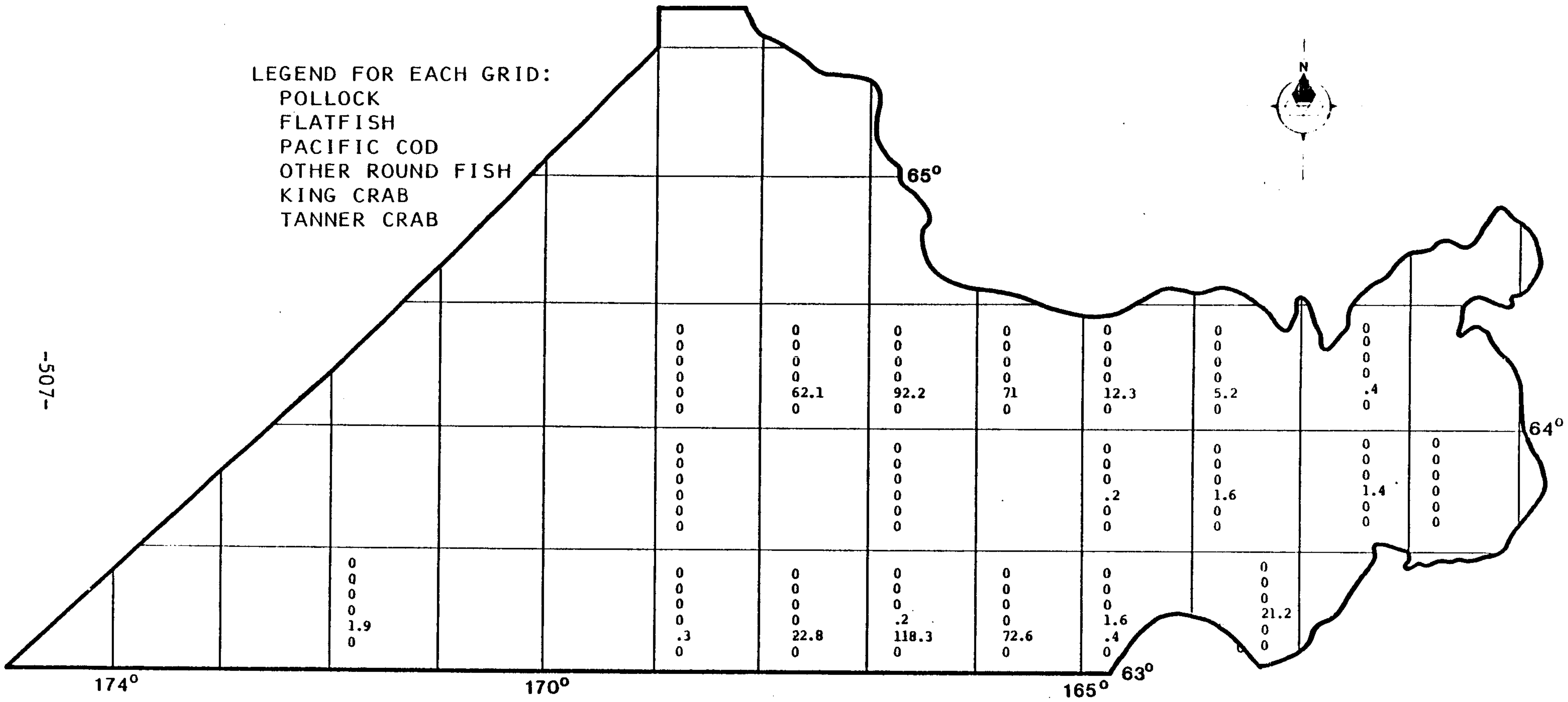
NORTON BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2002, IN METRIC TONS



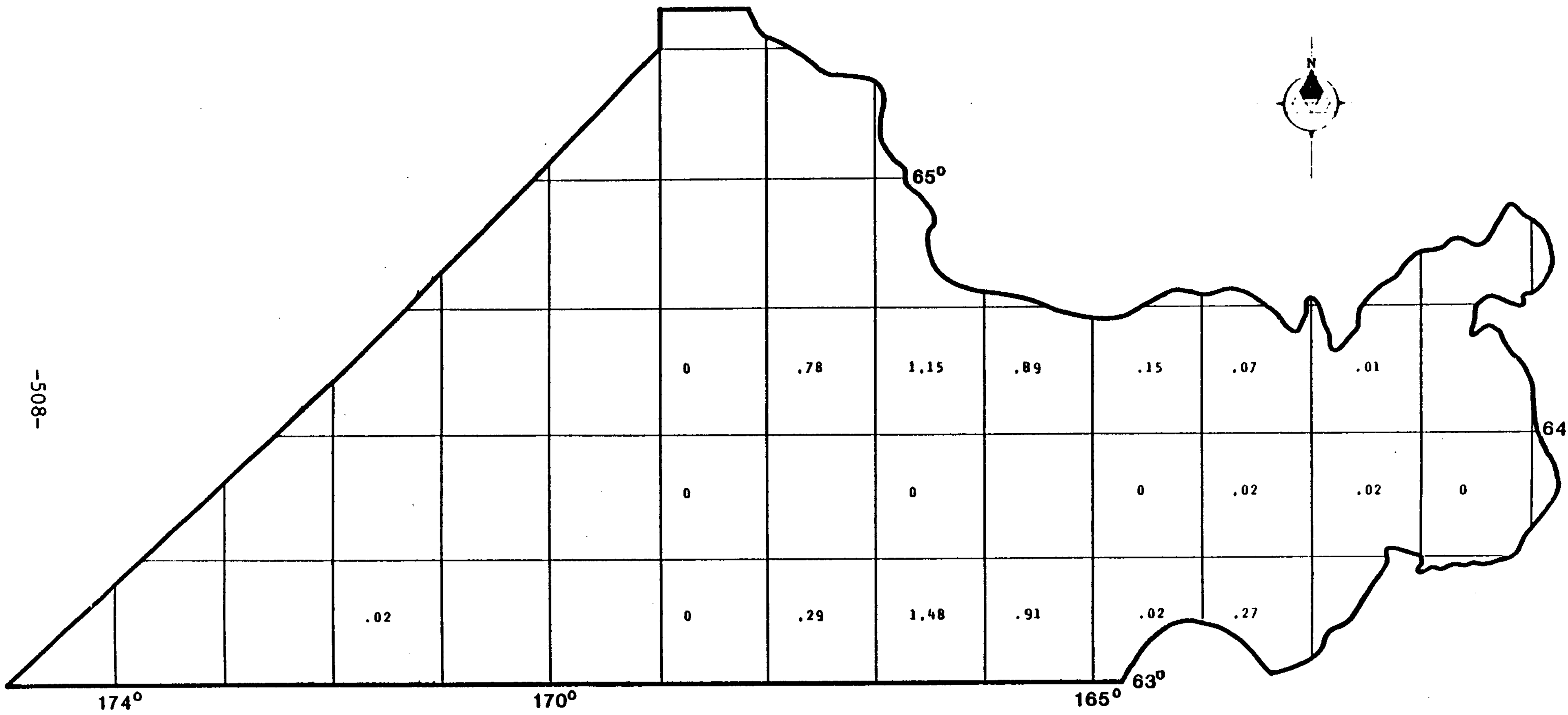
NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2002:
CATCH RATE = 80 METRIC TONS/DAY



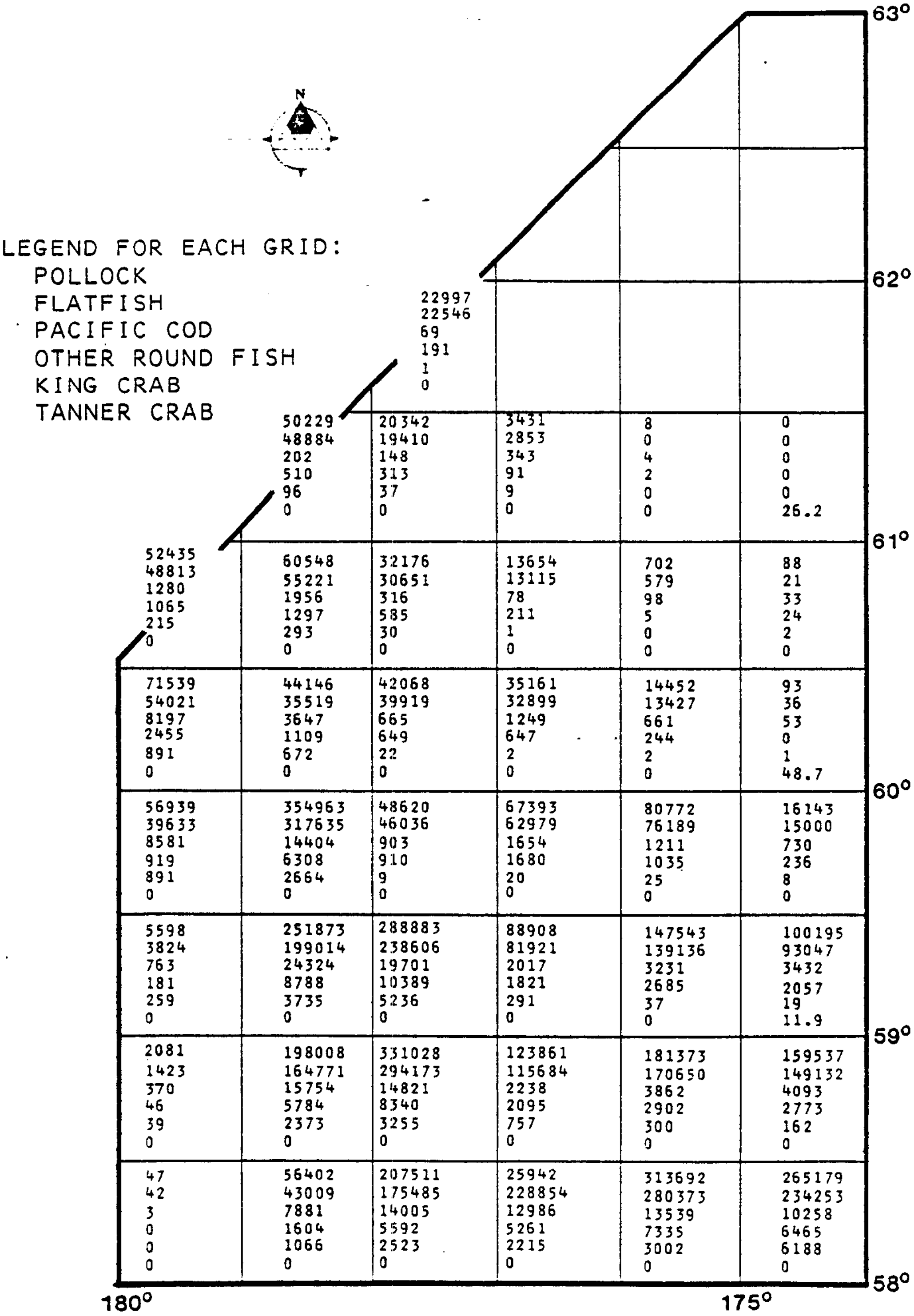
NORTON BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2007, IN METRIC TONS



NORTON BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2007:
CATCH RATE = 80 METRIC TONS/DAY

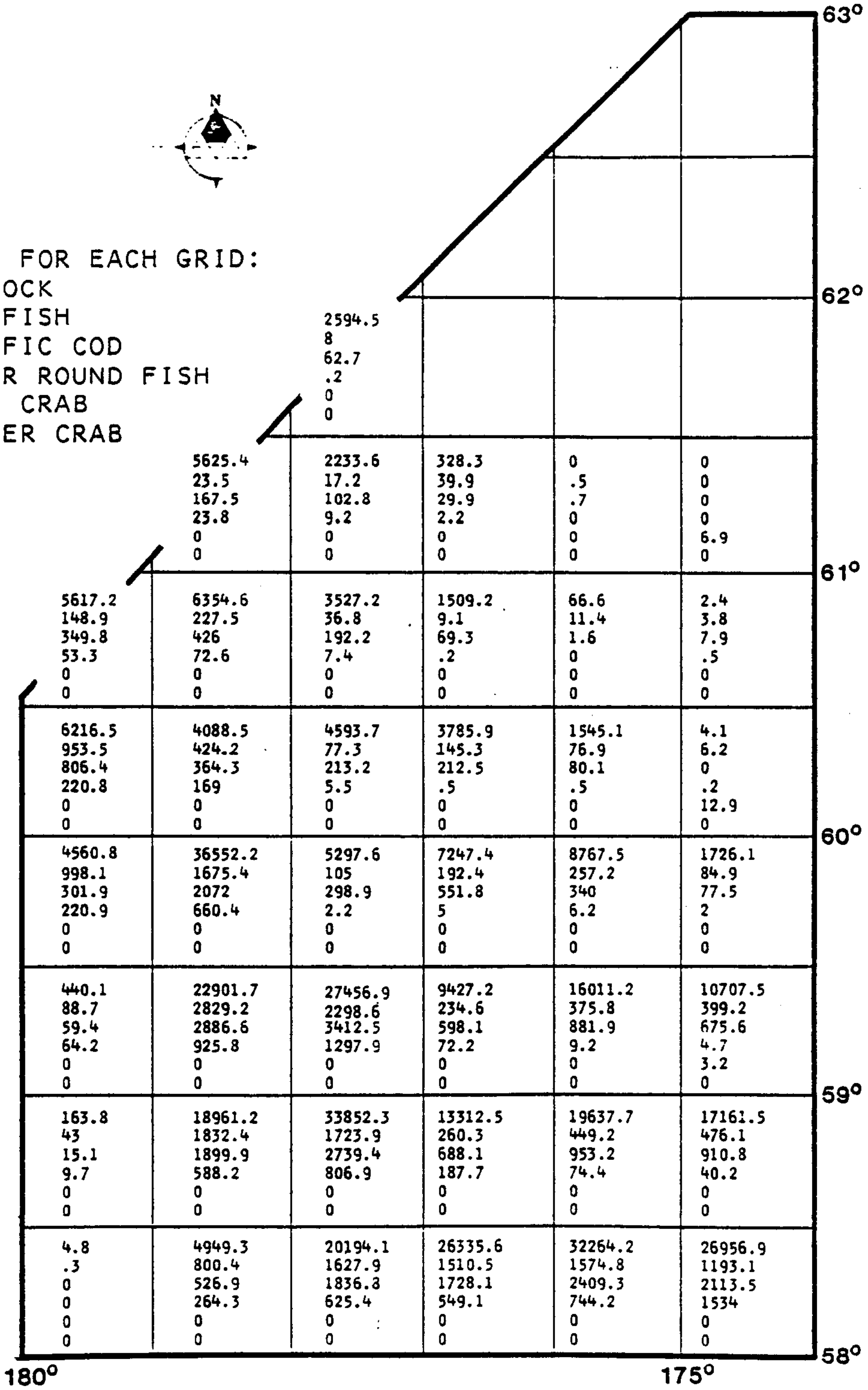


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		22997 22546 69 191 1 0			
	50229 48884 202 510 96 0	20342 19410 148 313 37 0	3431 2853 343 91 9 0	8 0 4 2 0 0	0 0 0 0 0 26.2
52435 48813 1280 1065 215 0	60548 55221 1956 1297 293 0	32176 30651 316 585 30 0	13654 13115 78 211 1 0	702 579 98 5 0 0	88 21 33 24 2 0
71539 54021 8197 2455 891 0	44146 35519 3647 1109 672 0	42068 39919 665 649 22 0	35161 32899 1249 647 2 0	14452 13427 661 244 2 0	93 36 53 0 1 48.7
56939 39633 8581 919 891 0	354963 317635 14404 6308 2664 0	48620 46036 903 910 9 0	67393 62979 1654 1680 20 0	80772 76189 1211 1035 25 0	16143 15000 730 236 8 0
5598 3824 763 181 259 0	251873 199014 24324 8788 3735 0	288883 238606 19701 10389 5236 0	88908 81921 2017 1821 291 0	147543 139136 3231 2685 37 0	100195 93047 3432 2057 19 11.9
2081 1423 370 46 39 0	198008 164771 15754 5784 2373 0	331028 294173 14821 8340 3255 0	123861 115684 2238 2095 757 0	181373 170650 3862 2902 300 0	159537 149132 4093 2773 162 0
47 42 3 0 0 0	56402 43009 7881 1604 1066 0	207511 175485 14005 5592 2523 0	25942 228854 12986 5261 2215 0	313692 280373 13539 7335 3002 0	265179 234253 10258 6465 6188 0

NAVARIN BASIN LEASE SALE AREA

HISTORICAL YEARLY CATCH

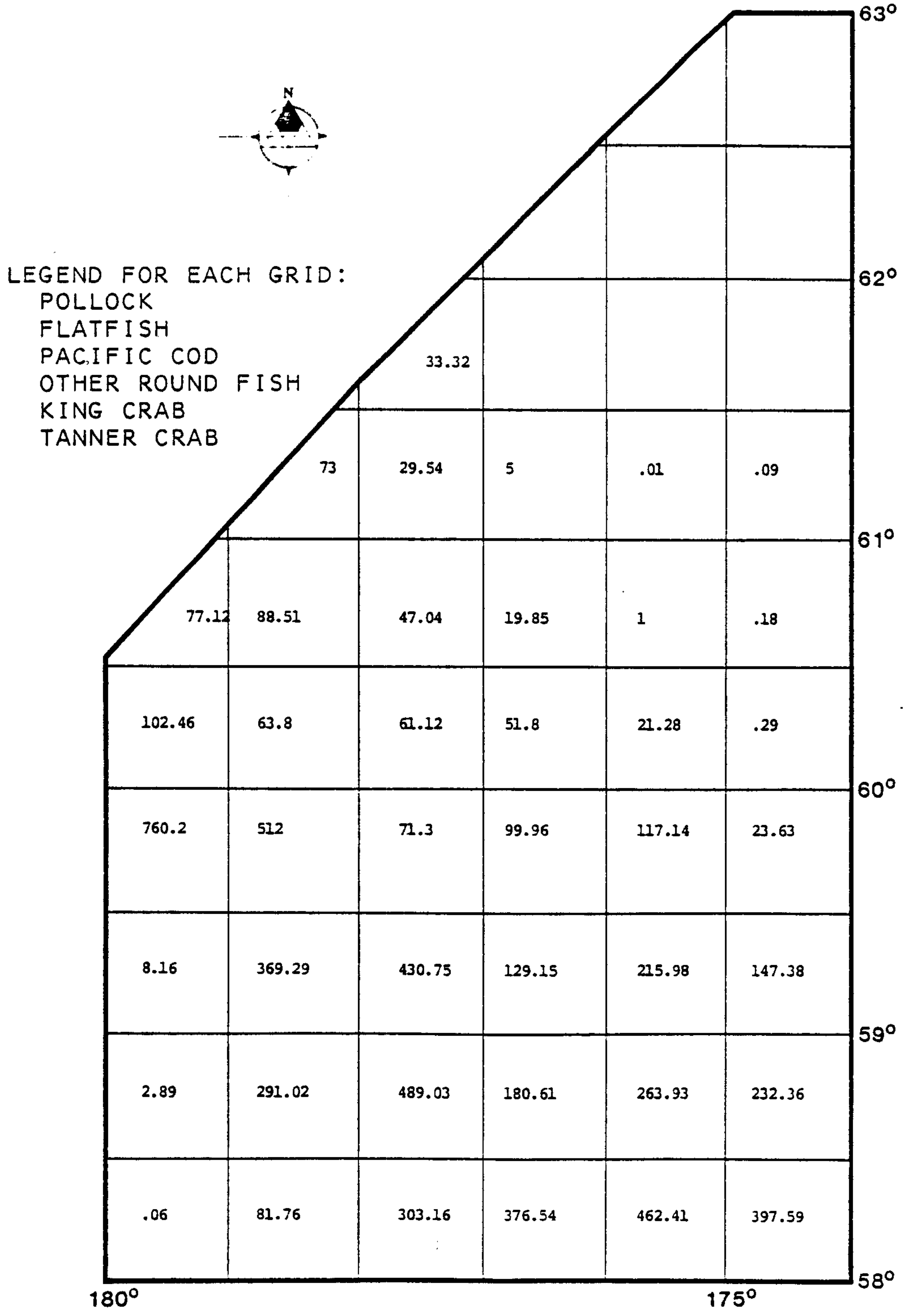


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		2594.5 8 62.7 .2 0 0			
	5625.4 23.5 167.5 23.8 0 0	2233.6 17.2 102.8 9.2 0 0	328.3 39.9 29.9 2.2 0 0	0 .5 .7 0 0 0	0 0 0 0 6.9 0
5617.2 148.9 349.8 53.3 0 0	6354.6 227.5 426 72.6 0 0	3527.2 36.8 192.2 7.4 0 0	1509.2 9.1 69.3 .2 0 0	66.6 11.4 1.6 0 0 0	2.4 3.8 7.9 .5 0 0
6216.5 953.5 806.4 220.8 0 0	4088.5 424.2 364.3 169 0 0	4593.7 77.3 213.2 5.5 0 0	3785.9 145.3 212.5 .5 0 0	1545.1 76.9 80.1 .5 0 0	4.1 6.2 0 .2 12.9 0
4560.8 998.1 301.9 220.9 0 0	36552.2 1675.4 2072 660.4 0 0	5297.6 105 298.9 2.2 0 0	7247.4 192.4 551.8 5 0 0	8767.5 257.2 340 6.2 0 0	1726.1 84.9 77.5 2 0 0
440.1 88.7 59.4 64.2 0 0	22901.7 2829.2 2886.6 925.8 0 0	27456.9 2298.6 3412.5 1297.9 0 0	9427.2 234.6 598.1 72.2 0 0	16011.2 375.8 881.9 9.2 0 0	10707.5 399.2 675.6 4.7 3.2 0
163.8 43 15.1 9.7 0 0	18961.2 1832.4 1899.9 588.2 0 0	33852.3 1723.9 2739.4 806.9 0 0	13312.5 260.3 688.1 187.7 0 0	19637.7 449.2 953.2 74.4 0 0	17161.5 476.1 910.8 40.2 0 0
4.8 .3 0 0 0 0	4949.3 800.4 526.9 264.3 0 0	20194.1 1627.9 1836.8 625.4 0 0	26335.6 1510.5 1728.1 549.1 0 0	32264.2 1574.8 2409.3 744.2 0 0	26956.9 1193.1 2113.5 1534 0 0

NAVARIN BASIN LEASE SALE AREA

TOTAL PROJECTED DOMESTIC CATCH IN METRIC TONS

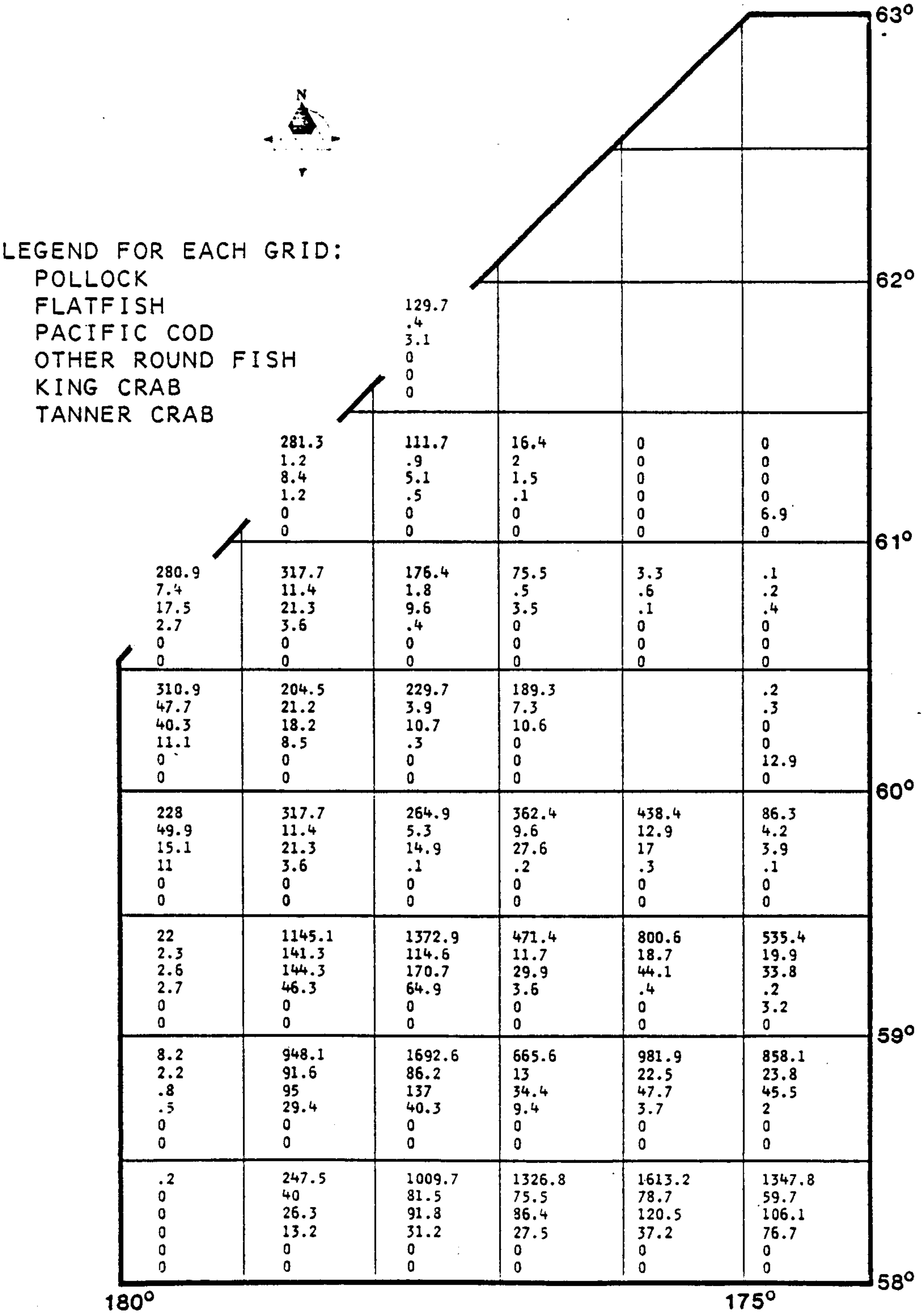


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		33.32			
	73	29.54	5	.01	.09
77.12	88.51	47.04	19.85	1	.18
102.46	63.8	61.12	51.8	21.28	.29
760.2	512	71.3	99.96	117.14	23.63
8.16	369.29	430.75	129.15	215.98	147.38
2.89	291.02	489.03	180.61	263.93	232.36
.06	81.76	303.16	376.54	462.41	397.59

NAVARIN BASIN LEASE SALE AREA

TOTAL NUMBER OF DOMESTIC FISHING BOAT-DAYS:
CATCH RATE = 80 METRIC TONS/DAY

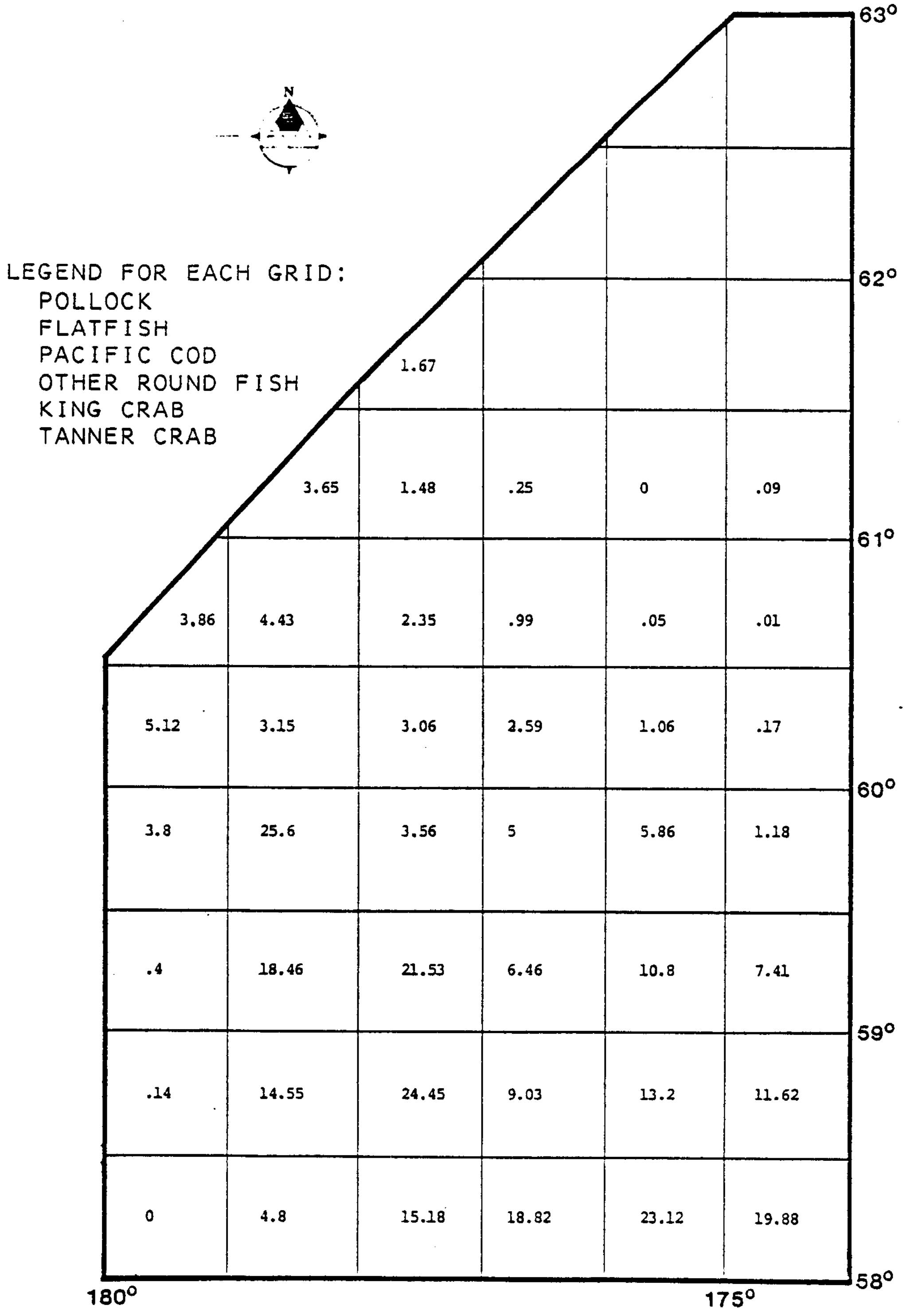


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		129.7 .4 3.1 0 0 0			
	281.3 1.2 8.4 1.2 0 0	111.7 .9 5.1 .5 0 0	16.4 2 1.5 .1 0 0	0 0 0 0 0 0	0 0 0 0 6.9 0
280.9 7.4 17.5 2.7 0 0	317.7 11.4 21.3 3.6 0 0	176.4 1.8 9.6 .4 0 0	75.5 .5 3.5 0 0 0	3.3 .6 .1 0 0 0	.1 .2 .4 0 0 0
310.9 47.7 40.3 11.1 0 0	204.5 21.2 18.2 8.5 0 0	229.7 3.9 10.7 .3 0 0	189.3 7.3 10.6 0 0 0		.2 .3 0 0 12.9 0
228 49.9 15.1 11 0 0	317.7 11.4 21.3 3.6 0 0	264.9 5.3 14.9 .1 0 0	362.4 9.6 27.6 .2 0 0	438.4 12.9 17 .3 0 0	86.3 4.2 3.9 .1 0 0
22 2.3 2.6 2.7 0 0	1145.1 141.3 144.3 46.3 0 0	1372.9 114.6 170.7 64.9 0 0	471.4 11.7 29.9 3.6 0 0	800.6 18.7 44.1 .4 0 0	535.4 19.9 33.8 .2 3.2 0
8.2 2.2 .8 .5 0 0	948.1 91.6 95 29.4 0 0	1692.6 86.2 137 40.3 0 0	665.6 13 34.4 9.4 0 0	981.9 22.5 47.7 3.7 0 0	858.1 23.8 45.5 2 0 0
.2 0 0 0 0 0	247.5 40 26.3 13.2 0 0	1009.7 81.5 91.8 31.2 0 0	1326.8 75.5 86.4 27.5 0 0	1613.2 78.7 120.5 37.2 0 0	1347.8 59.7 106.1 76.7 0 0

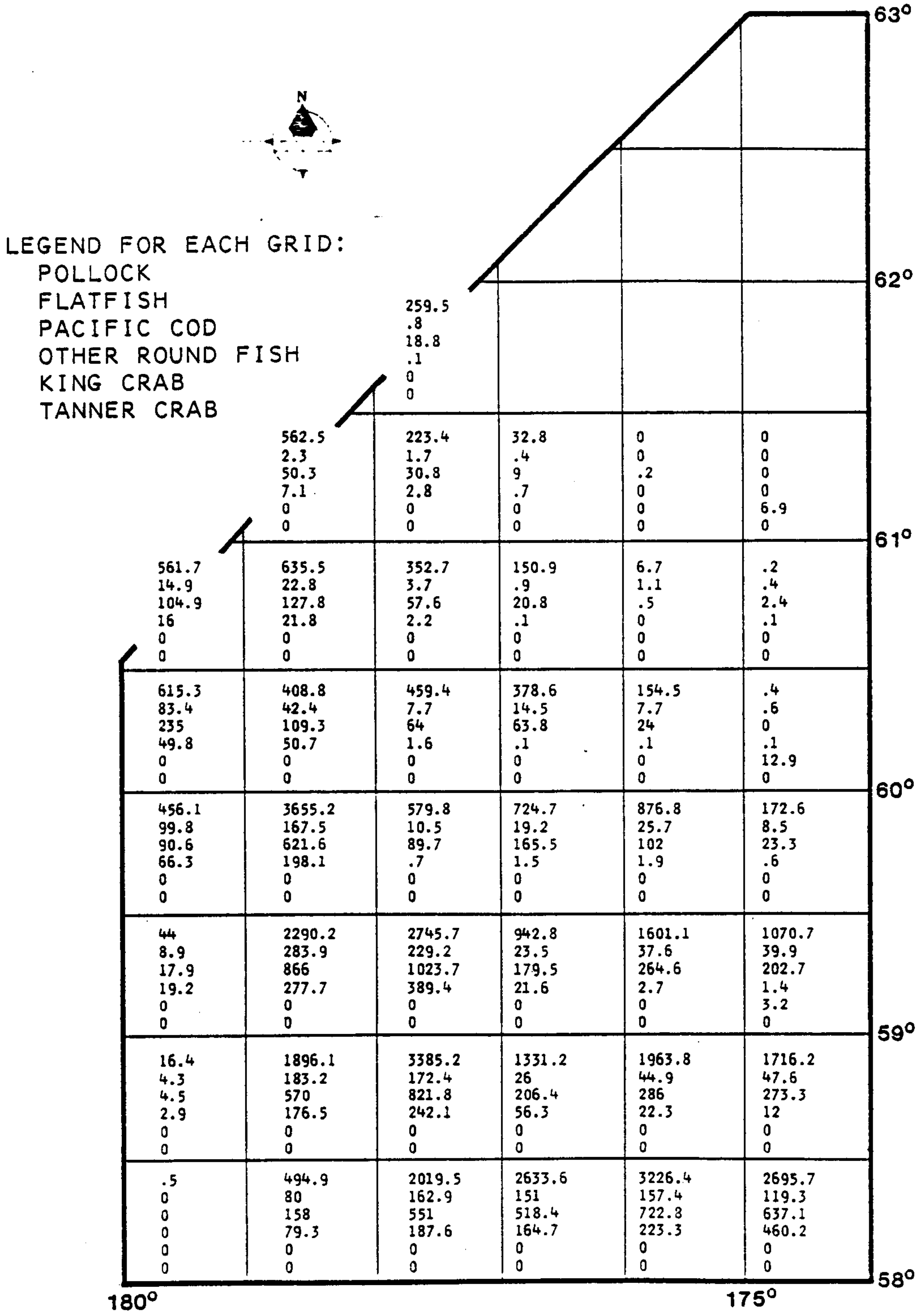
NAVARIN BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1987, IN METRIC TONS



NAVARIN BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1987:
CATCH RATE = 80 METRIC TONS/DAYS

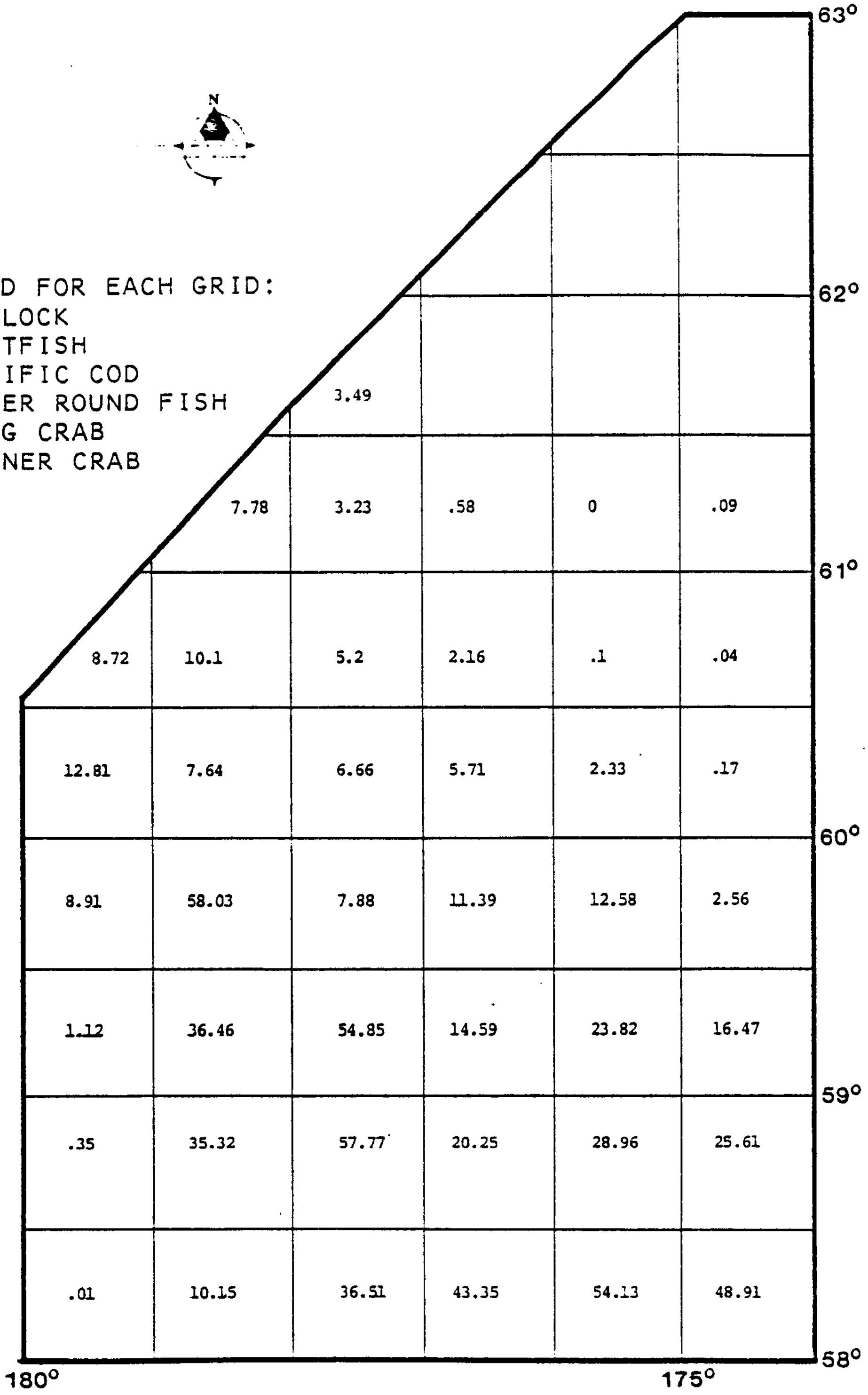


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		259.5 .8 18.8 .1 0 0			
	562.5 2.3 50.3 7.1 0 0	223.4 1.7 30.8 2.8 0 0	32.8 .4 9 .7 0 0	0 0 .2 0 0 0	0 0 0 0 6.9 0
561.7 14.9 104.9 16 0 0	635.5 22.8 127.8 21.8 0 0	352.7 3.7 57.6 2.2 0 0	150.9 .9 20.8 .1 0 0	6.7 1.1 .5 0 0 0	.2 .4 2.4 .1 0 0
615.3 83.4 235 49.8 0 0	408.8 42.4 109.3 50.7 0 0	459.4 7.7 64 1.6 0 0	378.6 14.5 63.8 .1 0 0	154.5 7.7 24 .1 0 0	.4 .6 0 .1 12.9 0
456.1 99.8 90.6 66.3 0 0	3655.2 167.5 621.6 198.1 0 0	579.8 10.5 89.7 .7 0 0	724.7 19.2 165.5 1.5 0 0	876.8 25.7 102 1.9 0 0	172.6 8.5 23.3 .6 0 0
44 8.9 17.9 19.2 0 0	2290.2 283.9 866 277.7 0 0	2745.7 229.2 1023.7 389.4 0 0	942.8 23.5 179.5 21.6 0 0	1601.1 37.6 264.6 2.7 0 0	1070.7 39.9 202.7 1.4 3.2 0
16.4 4.3 4.5 2.9 0 0	1896.1 183.2 570 176.5 0 0	3385.2 172.4 821.8 242.1 0 0	1331.2 26 206.4 56.3 0 0	1963.8 44.9 286 22.3 0 0	1716.2 47.6 273.3 12 0 0
.5 0 0 0 0 0	494.9 80 158 79.3 0 0	2019.5 162.9 551 187.6 0 0	2633.6 151 518.4 164.7 0 0	3226.4 157.4 722.8 223.3 0 0	2695.7 119.3 637.1 460.2 0 0

NAVARIN BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1992, IN METRIC TONS



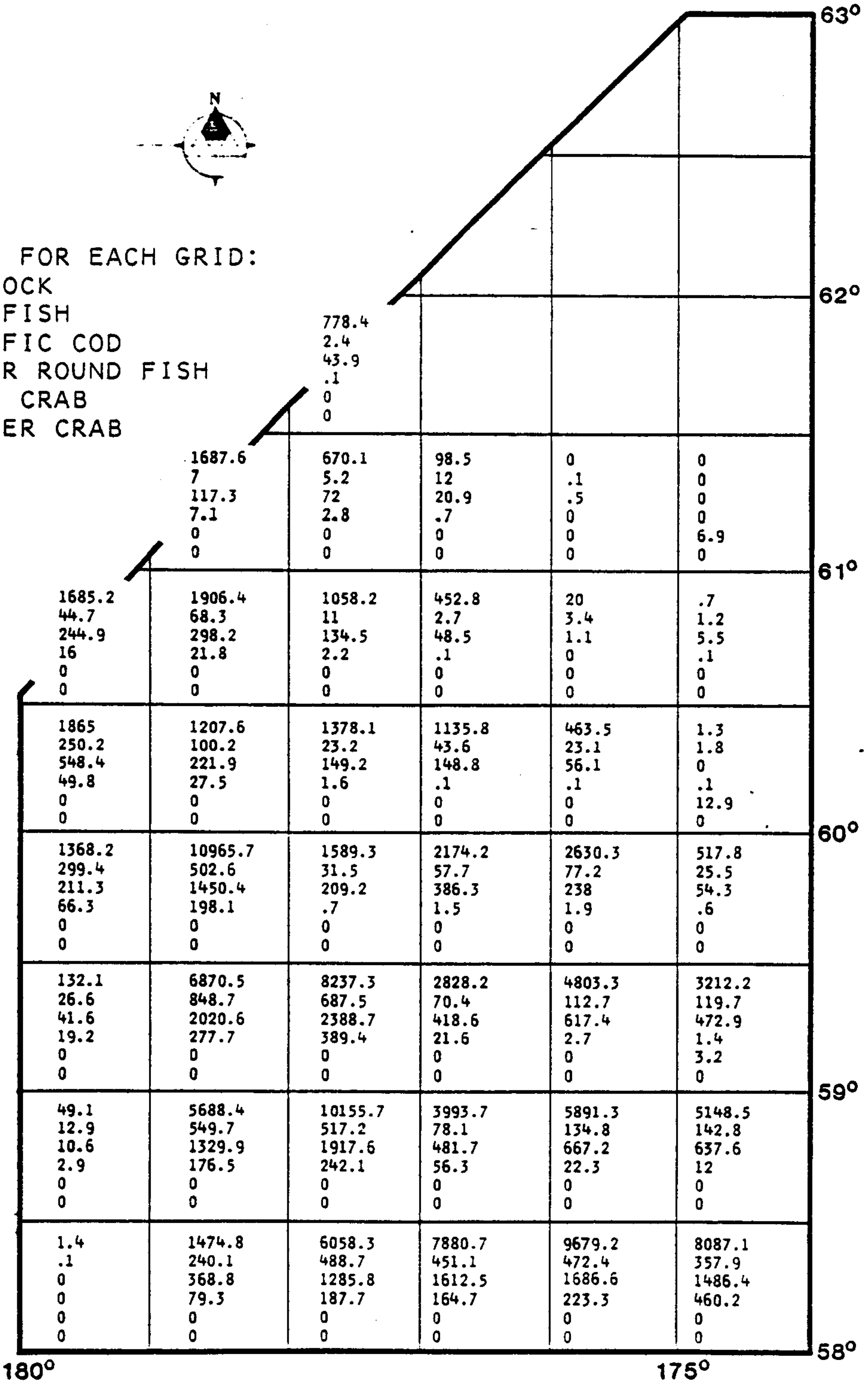
LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		3.49			
	7.78	3.23	.58	0	.09
8.72	10.1	5.2	2.16	.1	.04
12.81	7.64	6.66	5.71	2.33	.17
8.91	58.03	7.88	11.39	12.58	2.56
1.12	36.46	54.85	14.59	23.82	16.47
.35	35.32	57.77	20.25	28.96	25.61
.01	10.15	36.51	43.35	54.13	48.91

NAVARIN BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1992:
CATCH RATE = 80 METRIC TONS/DAY

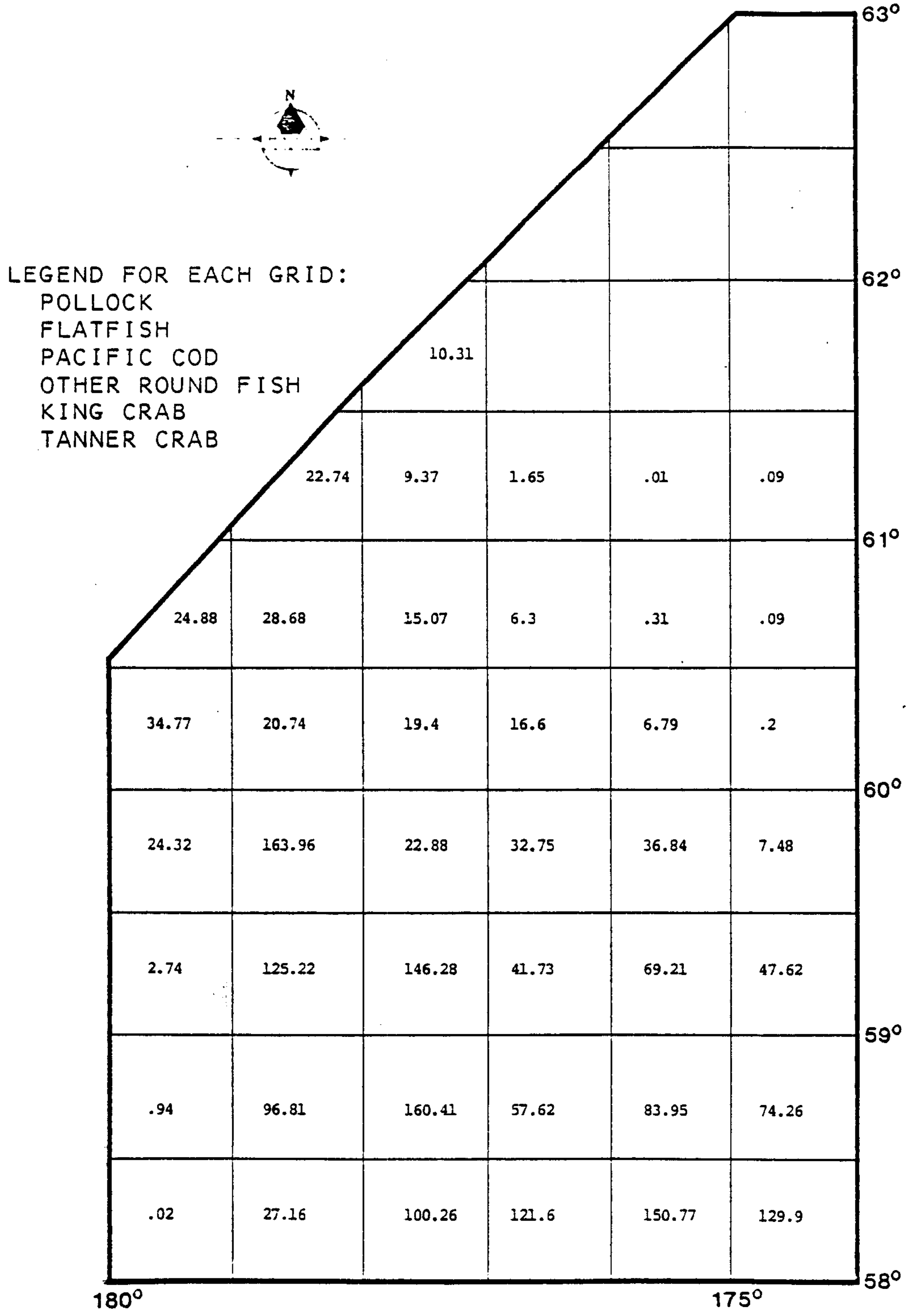
LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB



		778.4 2.4 43.9 .1 0 0			
	1687.6 7 117.3 7.1 0 0	670.1 5.2 72 2.8 0 0	98.5 12 20.9 .7 0 0	0 .1 .5 0 0 0	0 0 0 0 6.9 0
1685.2 44.7 244.9 16 0 0	1906.4 68.3 298.2 21.8 0 0	1058.2 11 134.5 2.2 0 0	452.8 2.7 48.5 .1 0 0	20 3.4 1.1 0 0 0	.7 1.2 5.5 .1 0 0
1865 250.2 548.4 49.8 0 0	1207.6 100.2 221.9 27.5 0 0	1378.1 23.2 149.2 1.6 0 0	1135.8 43.6 148.8 .1 0 0	463.5 23.1 56.1 .1 0 0	1.3 1.8 0 .1 12.9 0
1368.2 299.4 211.3 66.3 0 0	10965.7 502.6 1450.4 198.1 0 0	1589.3 31.5 209.2 .7 0 0	2174.2 57.7 386.3 1.5 0 0	2630.3 77.2 238 1.9 0 0	517.8 25.5 54.3 .6 0 0
132.1 26.6 41.6 19.2 0 0	6870.5 848.7 2020.6 277.7 0 0	8237.3 687.5 2388.7 389.4 0 0	2828.2 70.4 418.6 21.6 0 0	4803.3 112.7 617.4 2.7 0 0	3212.2 119.7 472.9 1.4 3.2 0
49.1 12.9 10.6 2.9 0 0	5688.4 549.7 1329.9 176.5 0 0	10155.7 517.2 1917.6 242.1 0 0	3993.7 78.1 481.7 56.3 0 0	5891.3 134.8 667.2 22.3 0 0	5148.5 142.8 637.6 12 0 0
1.4 .1 0 0 0 0	1474.8 240.1 368.8 79.3 0 0	6058.3 488.7 1285.8 187.7 0 0	7880.7 451.1 1612.5 164.7 0 0	9679.2 472.4 1686.6 223.3 0 0	8087.1 357.9 1486.4 460.2 0 0

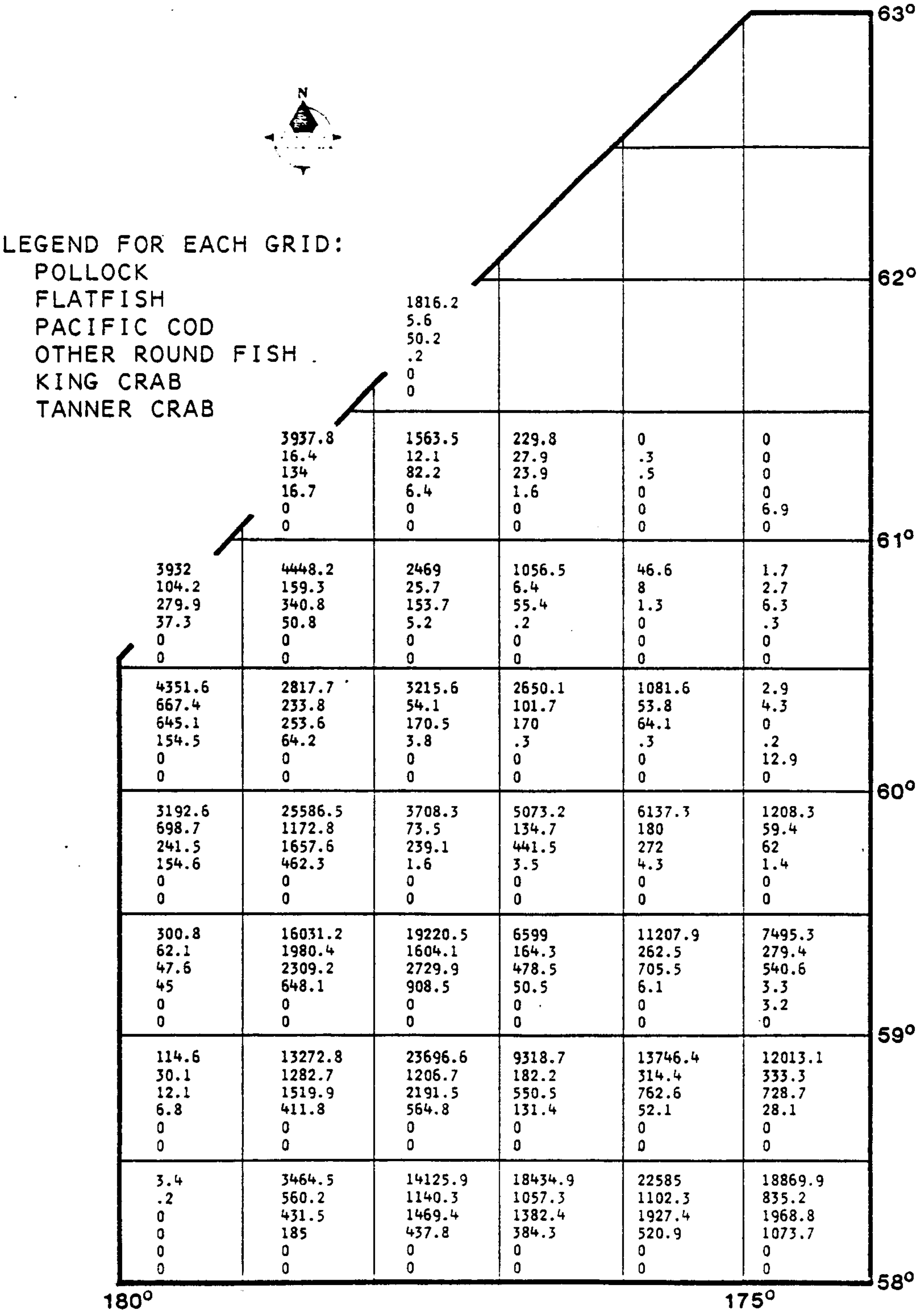
NAVARIN BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 1997, IN METRIC TONS



NAVARIN BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 1997:
CATCH RATE = 80 METRIC TONS/DAY

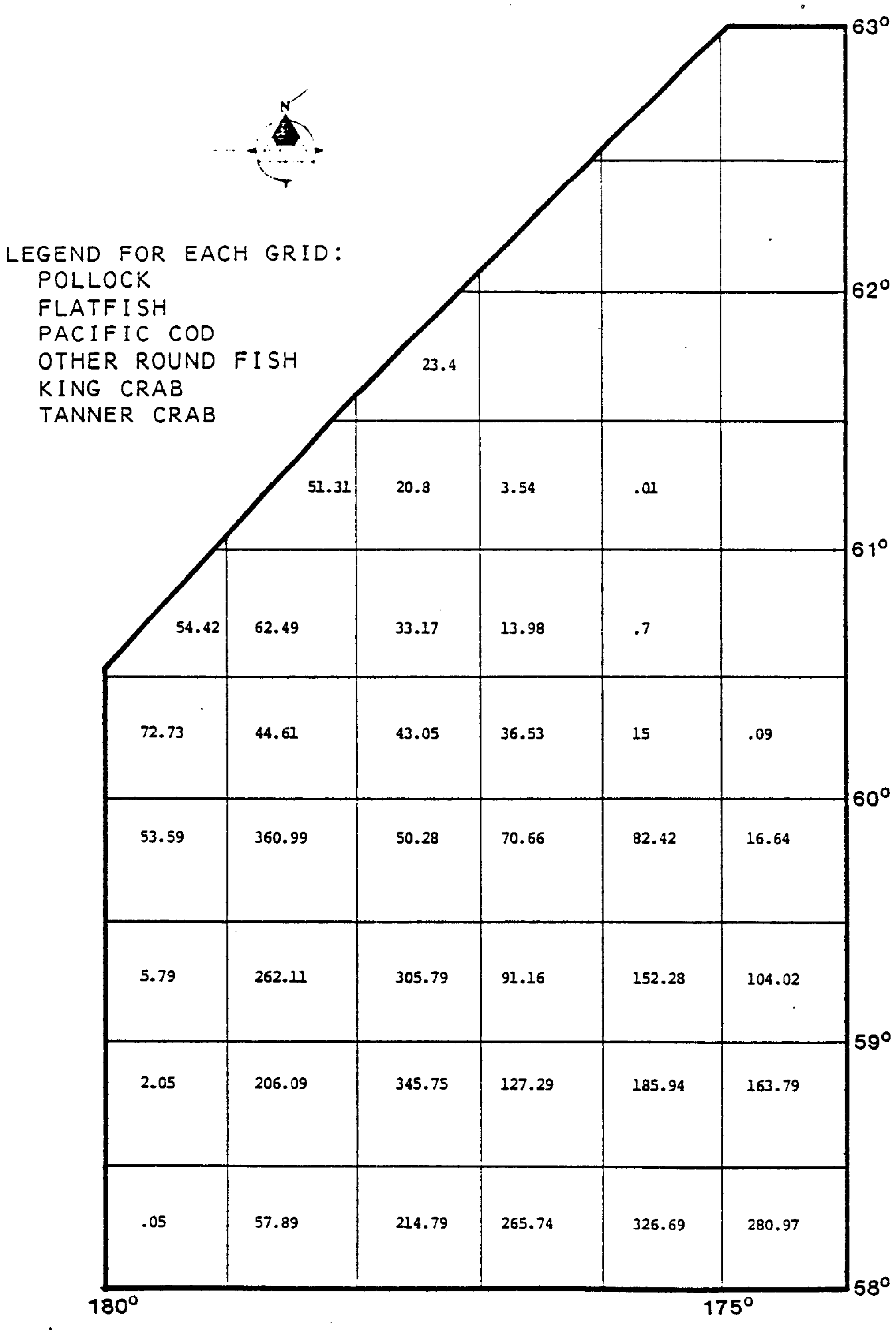


LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB

		1816.2 5.6 50.2 .2 0 0			
	3937.8 16.4 134 16.7 0 0	1563.5 12.1 82.2 6.4 0 0	229.8 27.9 23.9 1.6 0 0	0 .3 .5 0 0 0	0 0 0 0 6.9 0
3932 104.2 279.9 37.3 0 0	4448.2 159.3 340.8 50.8 0 0	2469 25.7 153.7 5.2 0 0	1056.5 6.4 55.4 .2 0 0	46.6 8 1.3 0 0 0	1.7 2.7 6.3 .3 0 0
4351.6 667.4 645.1 154.5 0 0	2817.7 233.8 253.6 64.2 0 0	3215.6 54.1 170.5 3.8 0 0	2650.1 101.7 170 .3 0 0	1081.6 53.8 64.1 .3 0 0	2.9 4.3 0 .2 12.9 0
3192.6 698.7 241.5 154.6 0 0	25586.5 1172.8 1657.6 462.3 0 0	3708.3 73.5 239.1 1.6 0 0	5073.2 134.7 441.5 3.5 0 0	6137.3 180 272 4.3 0 0	1208.3 59.4 62 1.4 0 0
300.8 62.1 47.6 45 0 0	16031.2 1980.4 2309.2 648.1 0 0	19220.5 1604.1 2729.9 908.5 0 0	6599 164.3 478.5 50.5 0 0	11207.9 262.5 705.5 6.1 0 0	7495.3 279.4 540.6 3.3 3.2 0
114.6 30.1 12.1 6.8 0 0	13272.8 1282.7 1519.9 411.8 0 0	23696.6 1206.7 2191.5 564.8 0 0	9318.7 182.2 550.5 131.4 0 0	13746.4 314.4 762.6 52.1 0 0	12013.1 333.3 728.7 28.1 0 0
3.4 .2 0 0 0 0	3464.5 560.2 431.5 185 0 0	14125.9 1140.3 1469.4 437.8 0 0	18434.9 1057.3 1382.4 384.3 0 0	22585 1102.3 1927.4 520.9 0 0	18869.9 835.2 1968.8 1073.7 0 0

NAVARIN BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2002, IN METRIC TONS

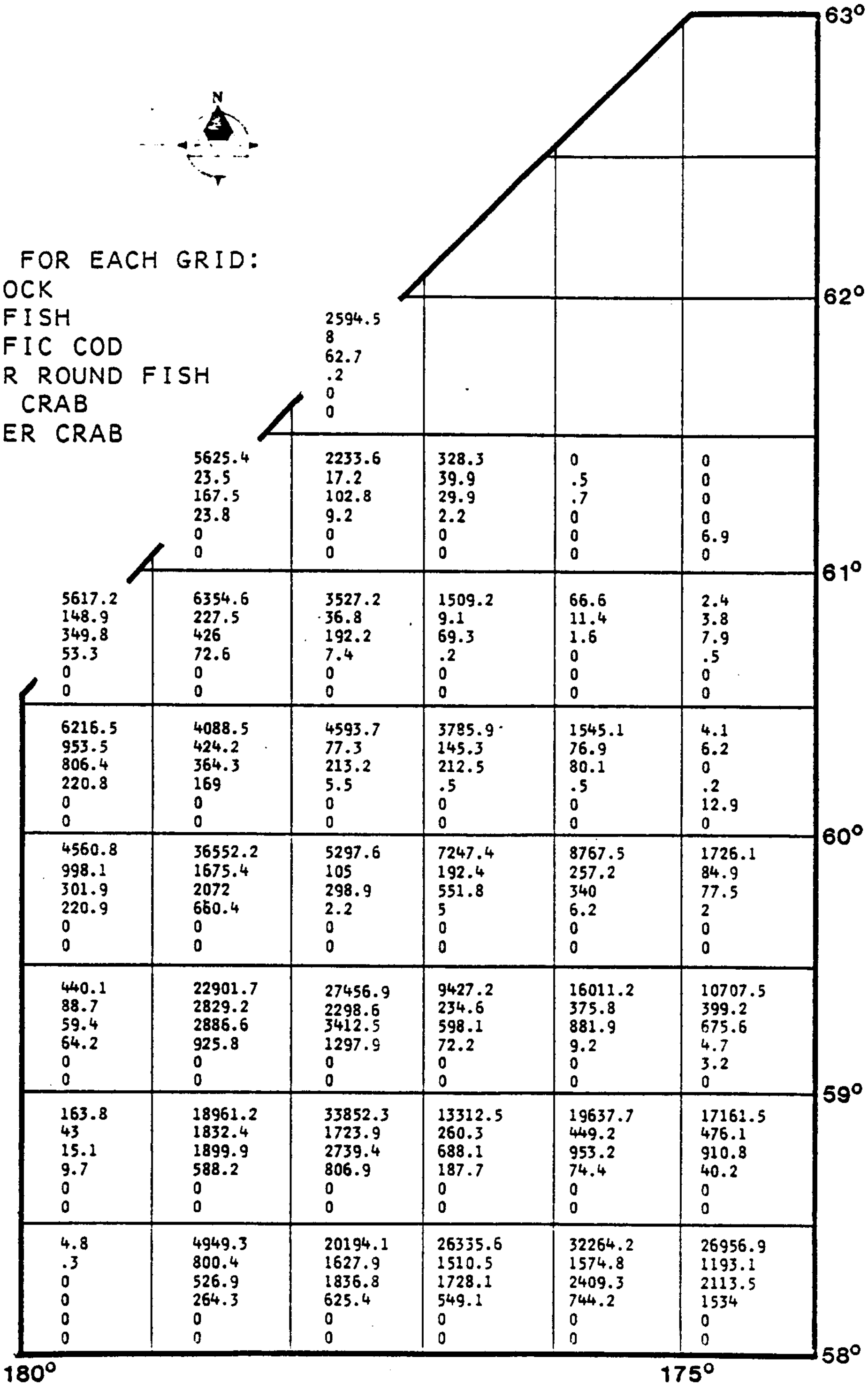


		23.4			
	51.31	20.8	3.54	.01	
54.42	62.49	33.17	13.98	.7	
72.73	44.61	43.05	36.53	15	.09
53.59	360.99	50.28	70.66	82.42	16.64
5.79	262.11	305.79	91.16	152.28	104.02
2.05	206.09	345.75	127.29	185.94	163.79
.05	57.89	214.79	265.74	326.69	280.97

NAVARIN BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2002:
CATCH RATE = 80 METRIC RONS/DAY

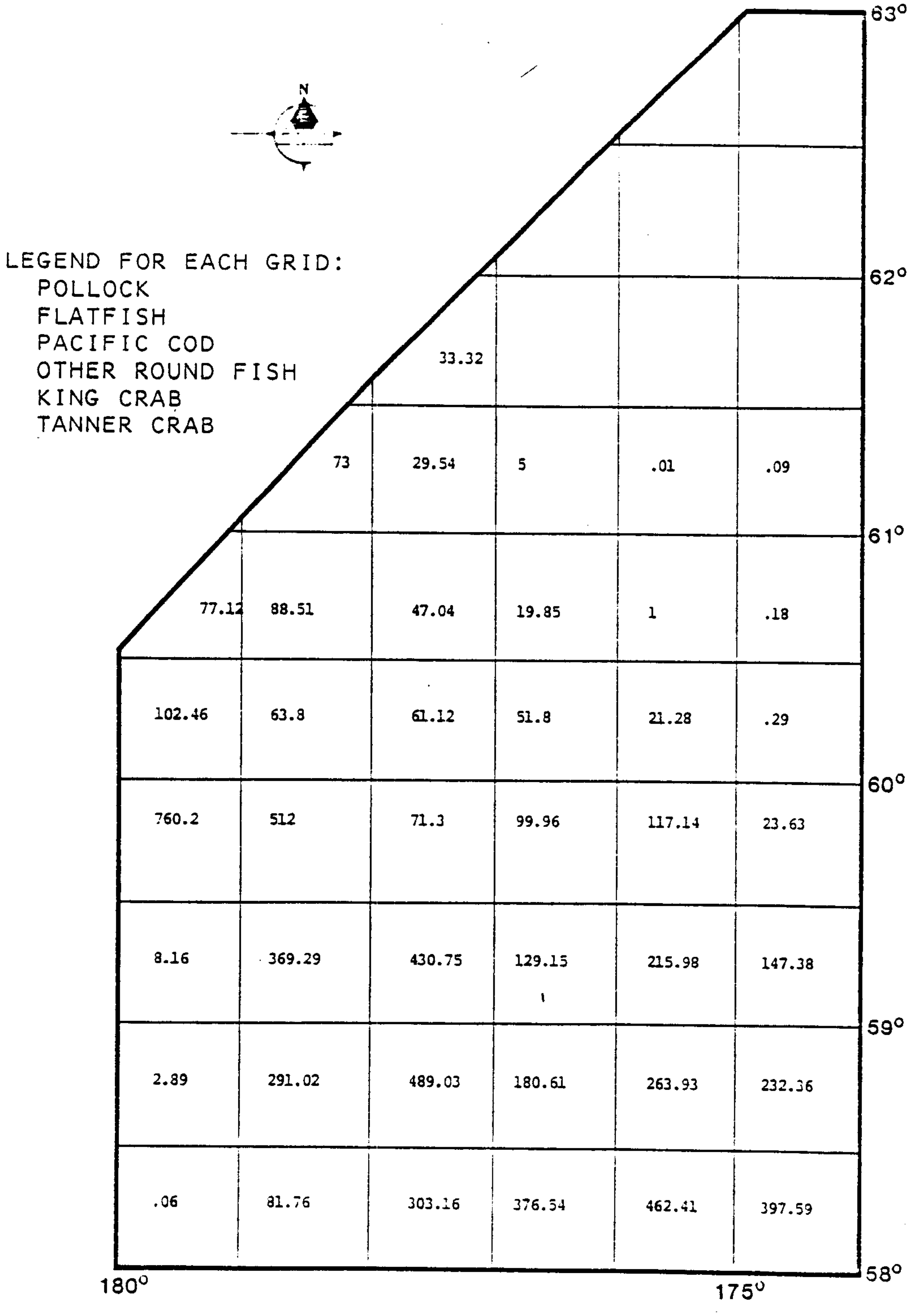
LEGEND FOR EACH GRID:
POLLOCK
FLATFISH
PACIFIC COD
OTHER ROUND FISH
KING CRAB
TANNER CRAB



		2594.5 8 62.7 .2 0 0			
	5625.4 23.5 167.5 23.8 0 0	2233.6 17.2 102.8 9.2 0 0	328.3 39.9 29.9 2.2 0 0	0 .5 .7 0 0 0	0 0 0 0 6.9 0
5617.2 148.9 349.8 53.3 0 0	6354.6 227.5 426 72.6 0 0	3527.2 36.8 192.2 7.4 0 0	1509.2 9.1 69.3 .2 0 0	66.6 11.4 1.6 0 0 0	2.4 3.8 7.9 .5 0 0
6216.5 953.5 806.4 220.8 0 0	4088.5 424.2 364.3 169 0 0	4593.7 77.3 213.2 5.5 0 0	3785.9 145.3 212.5 .5 0 0	1545.1 76.9 80.1 .5 0 0	4.1 6.2 0 .2 12.9 0
4560.8 998.1 301.9 220.9 0 0	36552.2 1675.4 2072 660.4 0 0	5297.6 105 298.9 2.2 0 0	7247.4 192.4 551.8 5 0 0	8767.5 257.2 340 6.2 0 0	1726.1 84.9 77.5 2 0 0
440.1 88.7 59.4 64.2 0 0	22901.7 2829.2 2886.6 925.8 0 0	27456.9 2298.6 3412.5 1297.9 0 0	9427.2 234.6 598.1 72.2 0 0	16011.2 375.8 881.9 9.2 0 0	10707.5 399.2 675.6 4.7 3.2 0
163.8 43 15.1 9.7 0 0	18961.2 1832.4 1899.9 588.2 0 0	33852.3 1723.9 2739.4 806.9 0 0	13312.5 260.3 688.1 187.7 0 0	19637.7 449.2 953.2 74.4 0 0	17161.5 476.1 910.8 40.2 0 0
4.8 .3 0 0 0 0	4949.3 800.4 526.9 264.3 0 0	20194.1 1627.9 1836.8 625.4 0 0	26335.6 1510.5 1728.1 549.1 0 0	32264.2 1574.8 2409.3 744.2 0 0	26956.9 1193.1 2113.5 1534 0 0

NAVARIN BASIN LEASE SALE AREA

PROJECTED DOMESTIC CATCH, 2007, IN METRIC TONS



NAVARIN BASIN LEASE SALE AREA

PROJECTED NUMBER OF DOMESTIC FISHING BOAT-DAYS, 2007:
CATCH RATE = 80 METRIC TONS/DAY

APPENDIX B

COMMERCIAL FISHING INDUSTRY IMPACT ANALYSIS FOR THE NAVARIN BASIN & FOR THE CUMULATIVE BERING SEA/ALEUTIAN ISLANDS CASE

TECHNICAL MEMORANDUM BC-1:

STANDARDS, METHODS & ASSUMPTIONS, BERING SEA/ ALEUTIAN ISLANDS COMMERCIAL FISHING INDUSTRY IMPACT ANALYSIS

Centaur Associates, Inc.
and
Dames & Moore

February 7, 1983

United States Department of the Interior Contract Number AA851-CT2-46

FOREWORD

This memorandum was intended to serve as the initial scoping document for the subsequent projections of fishing activity and petroleum-related impacts. It is appended to this report only as general background information.

1.0 INTRODUCTION

This memorandum outlines the methods, standards, and assumptions proposed by Centaur Associates, Inc. and Dames & Moore for the Bering Sea/ Aleutian Islands (BSAI) Commercial Fishing Industry Impact Analysis. This constitutes deliverable BC-1 under MMS contract No. AA851-CT2-46. The scope of the BSAI phase of the project includes projections of activity associated with the fishing industry in the Bering Sea.

This memorandum is organized as follows. Section 2.0 presents some key assumptions upon which the projections will be based. Section 3.0 is a discussion of the factors of change upon which the assumptions in Section 2.0 are based. Section 4.0 discusses forecast methods. Section 5.0 discusses the relationship of key data generated in the fishing industry forecast to the later impact analysis. Section 6.0 presents current areas of uncertainty. Section 7.0 discusses data sources and Section 8.0 presents a bibliography that has been compiled to date.

2.0 ASSUMPTIONS

This section lists the key assumptions made for the Bering Sea/Aleutian Islands commercial fishing industry projections. Many assumptions made for the Navarin Basin fisheries projections are also true for this analysis and are repeated here. The assumptions are supported by the discussion of factors of change (Section 3.0).

- Historic data suggest that the run strength of Bristol Bay salmon will be significantly reduced over the second half of the 25-year planning horizon (Section 3.1).

- The once-dominant Bristol Bay/Bering Sea/Unalaska king crab fishery will probably not recover to the record catch levels of 4 years ago, in spite of the replacement of red and blue king crab by golden (brown) king crab (Section 3.1).

- Whitefish (i.e. groundfish, bottomfish), especially pollock, have great potential for exploitation by domestic commercial fishing operations. Fisheries for other species may develop to some extent in the future (Section 3.1).

- Existing ports can support Bering Sea/Aleutian fisheries: Dutch Harbor/Unalaska, Akutan and Nome. Other ports that may be developed in the future for offshore (mostly whitefish) fishing include Chernofski, St. Paul, St. George and, possibly, St. Matthew. A number of smaller ports support nearshore fisheries (salmon, herring), but few of these ports could be significantly impacted by petroleum development activity (Section 3.2).

- Harvest technology is not a limiting factor. Potential gear changes, intended to reduce incidental catches, may mitigate the conflict between the fishing gear and petroleum-related structures (Section 3.3).

- Processing technology relevant to BSAI fisheries will evolve rapidly and is not expected to be a limiting factor (Section 3.4).

- Vessel sizes, numbers of crew, and harvest and production capacities per vessel will remain at current levels, or will increase with development of domestic Bering Sea/Aleutian Island fisheries (Section 3.5).

- Limited entry will probably not be a major factor in determining domestic fishing effort for whitefish or shellfish in the BSAI. It will continue to play a major role in the region's salmon fisheries (Section 3.6).

- Aquaculture and enhancement activities are not expected to make measurable contributions to BSAI fisheries (Section 3.7).

- Because of a variety of economic influences, development of domestic whitefish fishing will begin near shore and move further offshore - from North Aleutian to St. George to Navarin. Domestic replacement of foreign fishing should occur over the next 20 to 25 years if certain conditions occur (Section 3.8).

- Changes in domestic marketing strategy will influence, and be influenced by, the development of BSAI fisheries (Section 3.9).

- Potential changes in state and federal policies can accelerate the domestic fishing industry in the BSAI (Section 3.10).

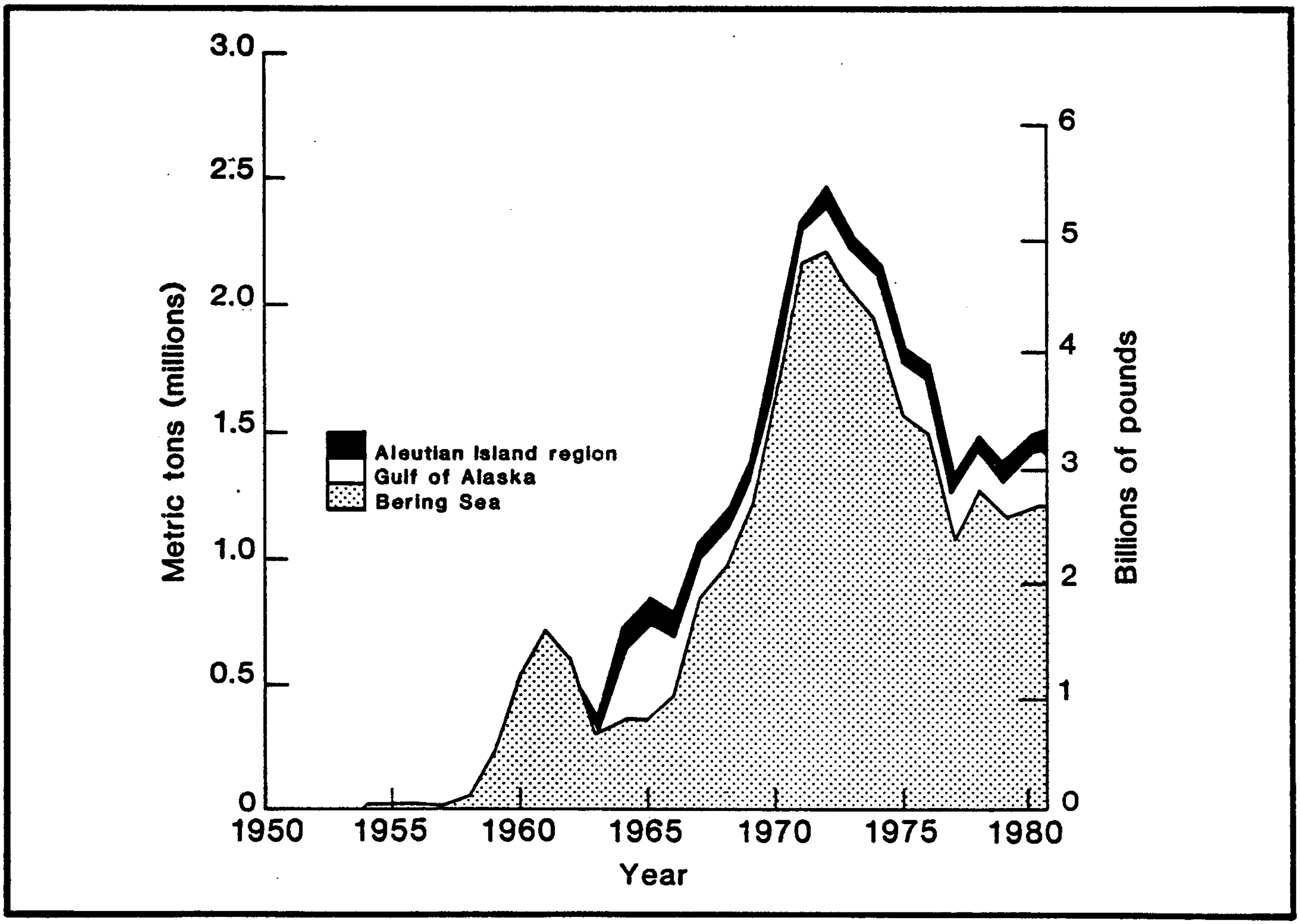
- Port congestion is likely to be a significant factor regardless of OCS development (Section 3.11).

3.0 BERING SEA/ALEUTIAN ISLANDS COMMERCIAL FISHERIES

The commercial fisheries of the Bering Sea and Aleutian Islands are of tremendous importance on both a state and worldwide basis. The estimated maximum sustainable yield (MSY) for groundfish in the entire U.S. Fishery Conservation Zone (FCZ) from California to Alaska is 2.95 million metric tons. The BSAI accounts for 1.9 million metric tons (64 percent) of this total (NRC 1981). The relative importance of the foreign BSAI groundfish catches to the total foreign harvests from waters off Alaska is shown in Figure 1. Domestic catches in the BSAI are also of tremendous importance. The total catch of species harvested by domestic fishermen and their value as a percentage of state totals are shown in Table 1. BSAI fisheries accounted for large proportions of Alaska's 1980 fisheries production: 40 percent of salmon, 56 percent of herring, and over 90 percent of crab. From a local perspective, the coastal salmon and herring provide a large proportion of the total cash income of many of the residents of the small villages along the BSAI coast.

For this analysis of BSAI fisheries, the following general points must be understood:

- Fishing activity is not uniformly spread throughout the BSAI; there are specific fishing grounds for each species.
- Catches in different areas can vary significantly from year to year because of weather, ice conditions, regulations, markets and resource availability.
- Fishing activity for different species occurs at different times of the year but there is some kind of commercial fishing activity throughout the year.
- The fishing operations in this area are extremely diverse. Salmon and herring are harvested by coastal residents in open skiffs as small as 12 feet and there are BSAI king crab catcher-processors exceeding 200 feet.



Source: Natural Resources Consultants 1982

FOREIGN CATCHES OF WHITEFISH (ALL SPECIES)
FROM WATERS OFF ALASKA, 1950-1981

Figure 1

TABLE 1

DOMESTIC CATCH AND VALUE TO FISHERMEN BY SPECIES FOR THE BERING SEA (ADF&G Western Region) AND THE TOTAL STATE IN 1980[1]

Species	Catch (x 1000 lbs)			Value (x $1000)		
	Western	State Total	%	Western	State Total	%
Salmon						
Roe	155	354	44%	263	599	44%
King	6,628	12,536	53%	6,381	17,035	37%
Red	140,796	186,664	75%	80,477	114,123	71%
Coho	6,046	22,462	27%	3,535	17,797	20%
Pink	19,673	217,886	9%	6,206	84,517	7%
Chum	29,283	71,812	41%	10,666	34,386	31%
Total	202,582	511,714	40%	107,528	264,456	40%
Herring						
Roe on kelp	668	1,274	52%	536	1,197	45%
Sac roe	40,824	73,697	55%	6,099	13,216	46%
Bait	2,545	6,173	41%	76	622	12%
Food	3,102	3,150	98%	93	103	90%
Total	47,139	84,294	56%	6,804	15,138	45%
Halibut[2]	1,152	14,203	8%	1,866	23,362	8%
Other Finfish						
Pacific cod	11,462	12,800	90%	1,176	1,494	79%
Pollock	266	2,254	12%	16	148	11%
Flounder, general	96	553	17%	17	104	16%
Sablefish	4	3,644	0.1%	2	1,429	0.1%
Other whitefish[3]	72	1,619	4.4%	20	331	6%
Shellfish						
Red king crab[4]	147,137	149,936	98%	144,312	147,585	98%
Blue king crab	10,829	10,835	100%	10,178	10,184	100%
Brown king crab	23	221	10%	17	221	8%
Tanner crab [4] (bairdi)	37,776	42,663	89%	21,897	24,583	89%
Tanner crab [4] (opilio)	39,365	39,365	100%	10,234	10,234	100%
Horsehair crab	68	68	100%	128	128	100%
Shrimp	2,480	52,308	5%	570	16,843	3%
Other shellfish[5]	4	32	13%	2	22	9%

---

[1] 1980 is the last year for which complete data are available

[2] 1978 data from Frank Orth & Associates, Inc. 1982

[3] Includes rockfish, Pacific Ocean perch, sharks, skates, sculpins, greenlings, eels and mackerel

[4] Adapted from ADF&G, 1982

[5] Includes squid, octopus and coral

- Different fisheries in the BSAI are regulated and managed by different groups (Table 2).

3.1 Commercial Fishing: Species and Operations

Commercially utilized species in the Bering Sea and Aleutian Islands (BSAI) are listed in Table 3. The gear used for each species and the OCS planning areas in which they are caught are shown in Table 4.

The statistical reporting agencies responsible for each fishery and the data format used are shown in Table 5. The major statistical areas for each species group in the Bering Sea are shown in Figure 2.

The maximum sustainable yield (MSY), equilibrium yield (EY) and 1981 allowable biological catch (ABC) for currently exploited BSAI fisheries are shown in Table 6.

Domestic commercial fishing operations in the BSAI are characterized by their great importance to the state and the nation and by their variety. There are small-boat coastal fisheries for salmon and herring in state waters, medium-boat halibut and crab fisheries that occur both within state waters and the FCZ, and large-boat, offshore fisheries for whitefish. In general, the offshore fisheries are dominated by large boats from outside the region, and the coastal small-boat fisheries are dominated by, or have significant participation from, the region's residents. A summary of the seasonality of the major fisheries in the Bering Sea is shown in Figure 3.

A brief summary of the major domestic fisheries that occur in the BSAI is given below. Only illustrative data on each fishery is included here; the forthcoming fisheries analysis will include catch data for the last 10 to 11 years (1971 to 1981 plus 1982 where available).

Salmon: The major fishing areas for salmon along the BSAI coast and the gear used in each area are shown in Figure 4. Catch statistics for 1980 for

TABLE 2

FISHERIES REGULATORY REGIME IN THE BERING SEA/ALEUTIAN ISLANDS

SPECIES	WITHIN STATE WATERS	WITHIN FCZ(1)	OUTSIDE FCZ(6)
Groundfish			
Walleye pollock	ADF&G	USA(2)	(No Fishery)
Pacific cod	ADF&G	USA(2)	(No Fishery)
Flounders (other)	ADF&G	USA(2)	(No Fishery)
Yellowfin sole	ADF&G	USA(2)	(No Fishery)
Turbot	ADF&G	USA(2)	(No Fishery)
Pacific halibut	ADF&G	IPHC(3)	(No Fishery)
Pacific Ocean perch	ADF&G	USA(2)	(No Fishery)
Rockfish (other)			
Sablefish	ADF&G	USA(2)	(No Fishery)
Atka mackerel	ADF&G	USA(2)	(No Fishery)
Other groundfish species	ADF&G	USA(2)	(No Fishery)
Pelagic Fish			
Salmon	ADF&G	USA(2)	INPFC(4)
Herring	ADF&G	USA (pending)(5)	(No Fishery)
Shellfish			
Tanner crab	ADF&G	USA(2)	(No Fishery)
King crab	ADF&G	USA (pending)(5)	(No Fishery)
Squid	No Fishery	USA(2)	(No Fishery)
Snails	No Fishery	USA(2)	(No Fishery)
Shrimp	ADF&G	USA(2)	(No Fishery)

---

(1) FCZ = U.S. Fishery Conservation Zone, 3-200 miles offshore.

(2) Regulated by the USA under a fishery management plan of the North Pacific Fisheries Management Council.

(3) IPHC = International Pacific Halibut Council.

(4) INPFC = International North Pacific Fisheries Commission.

(5) Regulated by the USA under a preliminary management plan of the Secretary of Commerce.

(6) Most species (benthic and demersal) do not exist in fishable concentrations in this area because of unsuitable depths and conditions. Only salmon are fished in this area now, by the Japanese mothership fishery.

TABLE 3

COMMERCIALLY UTILIZED FISH AND SHELLFISH IN THE EASTERN BERING SEA AND ALEUTIAN ISLAND REGION

	Common Name	Scientific Name
TARGET SPECIES:	Walleye pollock	*Theragra chalcogramma*
	Pacific Ocean perch	*Sebastes alutus*
	Atka mackerel	*Pleurogrammus monopterygius*
	Sablefish	*Anoplopoma fimbria*
	Yellowfin sole	*Limanda aspera*
	Greenland turbot	*Reinhardtius hippoglossoides*
	Pacific halibut	*Hippoglossus stenolepis*
	Sockeye salmon	*Oncorhychus nerka*
	Pink salmon	*O. gorbuscha*
	Chum salmon	*O. keta*
	Chinook salmon	*O. tshawytscha*
	Coho salmon	*O. kisutch*
	Pacific herring	*Clupea harengus pallasii*
	Pacific cod	*Gadus macrocephalus*
	Red king crab	*Paralithodes camtschatica*
	Blue king crab	*P. platypus*
	Brown king crab	*Lithodes aequispina*
	Tanner crab (bairdi)	*Chionoecetes bairdi*
	Tanner crab (opilio)	*C. opilio*
	Korean hair crab	*Erimacrus isenbeckii*
	Pink shrimp	*Pandalus borealis*
	Humpy shrimp	*P. gonivrus*
	Snails	*Neptunea spp* *Buccinum spp*
	Squid	*Berrytheuthis magister* *Onychoteuthis banskii*
OCCASIONAL TARGET SPECIES:	Rock sole	*Lepidopsetta bilineata*
	Flathead sole	*Hippoglossoides elassodon*
	Arrowtooth flounder	*Atheresthes stomias*
	Rattails	*Corphaenoides* spp.
MINOR COMMERCIAL SPECIES[1]:	Rougheye rockfish	*Sebastes aleutianus*
	Dusky rockfish	*Sebastes ciliatus*
	Northern rockfish	*Sebastes alascanus*
	Shortspine thornyhead	*Sebastolobus alascanus*
	Shortraker rockfish	*Sebastes borealis*
	Dark botcher rockfish	*Sebastes crameri*
	Yelloweye rockfish	*Sebastes ruberrimus*
	Blue rockfish	*Sebastes mystinus*
	Alaska plaice	*Pleuronectes quadrituberculatus*
	Rex sole	*Glytocephalus zachirus*
	Butter sole	*Isopsetta isolepis*
	Longhead dab	*Limanda proboscidea*
	Dover sole	*Microstomus pacificus*
	Starry flounder	*Platichthys stellatus*
	Skates	Rajidae

---

[1] Includes species that may be marketable, but have low abundance.

Sources: Science Applications 1981, Hammeedi 1982.

TABLE 4

MAJOR EXISTING COMMERCIAL FISHERIES IN THE BERING SEA

Species	Gear	OCS PLANNING AREAS Norton Basin	Navarin Basin	St. George Basin	North Aleutian Basin
Whitefish					
Walleye pollock	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pacific cod	Longline/Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Flounders (Other)	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Yellowfin sole	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Turbot	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pacific halibut[1]	Longline	No Fishery	No Fishery	Domestic	Domestic
Pacific Ocean perch	Trawl	No Fishery	Foreign	Foreign	Foreign
Rockfish (Other)	Trawl	No Fishery	Foreign	Foreign	Foreign
Sablefish	Longline/Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Atka mackerel	Trawl	No Fishery	Foreign	Foreign/Domestic	No Fishery
Other whitefish species	Trawl	No Fishery	Foreign	Foreign/Domestic	Foreign/Domestic
Pelagic Fish					
Salmon[1]	Gillnet/Seine	Domestic	Foreign	Domestic	Domestic
Herring[1]	Seine/Gillnet/Trawl	Domestic	No Fishery	Domestic	Domestic
Shellfish					
Tanner crab[1]	Pot	No Fishery		Domestic	Domestic
C. opilio			Domestic		
C. bairdi			No Fishery		
King crab[1]	Pot				
Red king crab		Domestic	No Fishery	Domestic	Domestic
Blue king crab		Domestic	No Fishery	Domestic	Domestic
Golden king crab		No Fishery	No Fishery	Domestic	No Fishery
Korean hair crab	Pot	No Fishery	No Fishery	Domestic	Domestic
Snails	Pot	No Fishery	Foreign	Foreign	Foreign
Shrimp	Trawl	No Fishery	No Fishery	No Fishery	No Fishery
Pink shrimp					
Humpy shrimp					
Squid	Gillnet/Longline	No Fishery	Foreign	Foreign	No Fishery
Octopus	Trawl/Pot	No Fishery	No Fishery	Domestic	Domestic

---

[1] Incidental foreign catch (by foreign fleets targeting on other species) of these species in 1979 was 3,238 metric tons of halibut, 1,162,949 king crabs (mostly brown) 18,269,582 Tanner crabs, 110,473 salmon and 6,547 metric tons of herring.

TABLE 5

AGENCIES RESPONSIBLE FOR FISHERY STATISTICS COLLECTION

Species Group	Agency	Data Form
Whitefish	NMFS[1]	1° longitude x 1/2° latitude
Salmon		
Outside FCZ[2]	INPFC[3]	1° longitude x 1° latitude for 10-day period
Within FCZ	NMFS	1° longitude x 1/2° latitude
Within State Waters	ADF&G[4]	Statistical blocks of variable size grouped into districts.
Crab	ADF&G	1° longitude x 1/2° latitude (blocks end at 176° W longitude)
Halibut	IPHC[5]	1° longitude x 1/2° latitude
Herring		
Within FCZ	NMFS	1° longitude x 1/2° latitude
Within State Waters	ADF&G	Statistical blocks of various sized grouped into districts.

---

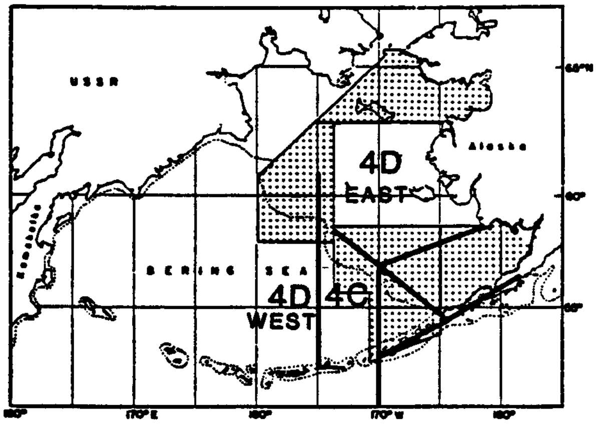
[1] National Marine Fisheries Service

[2] Fishery Conservation Zone, 3-200 miles offshore

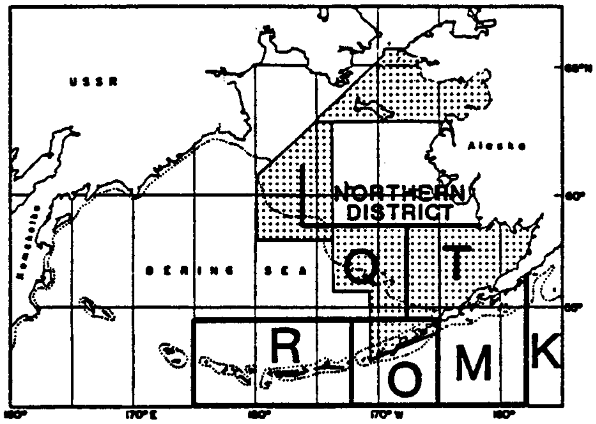
[3] International North Pacific Fisheries Commission

[4] Alaska Department of Fish and Game

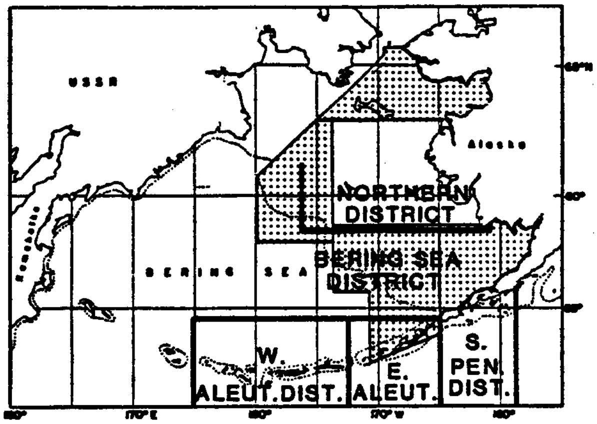
[5] International Pacific Halibut Commission



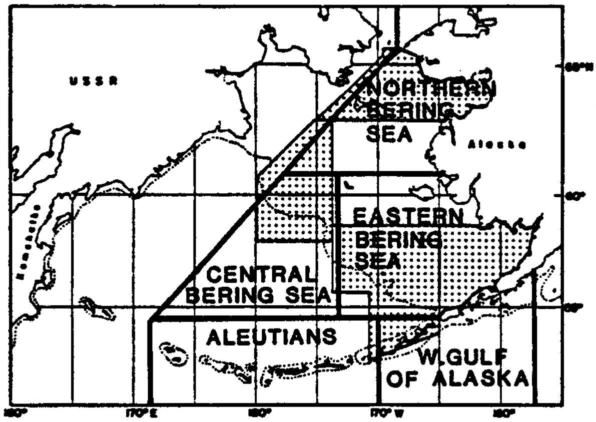
Halibut IPHC Regulatory Areas



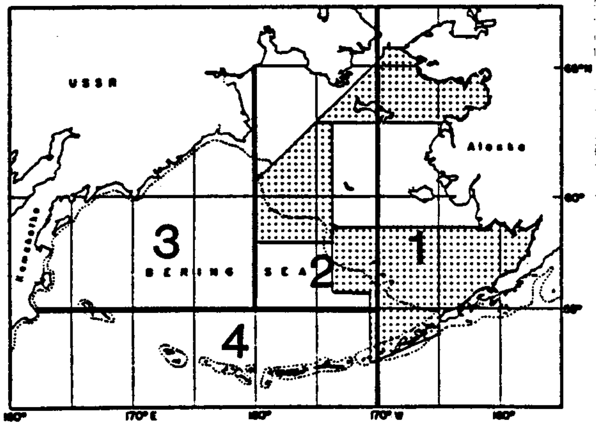
King Crab ADFG Statistical Areas



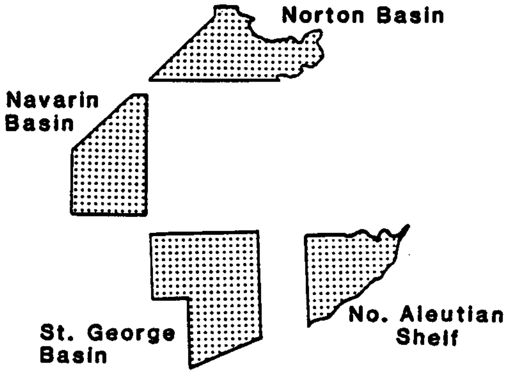
Tanner Crab ADFG Statistical Areas



DOC/NPFMC Statistical & Regulatory Areas



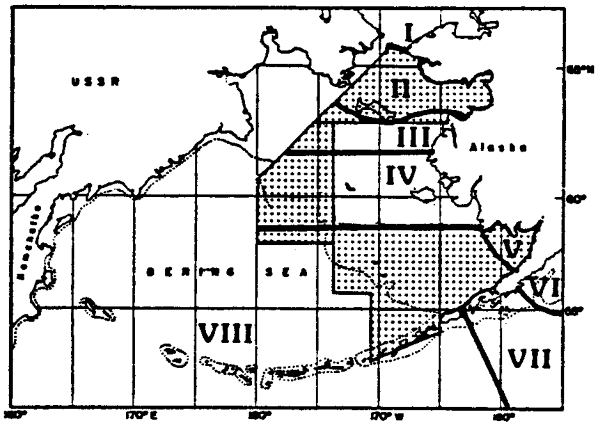
INPFC BERING SEA & Aleutian Statistical Areas



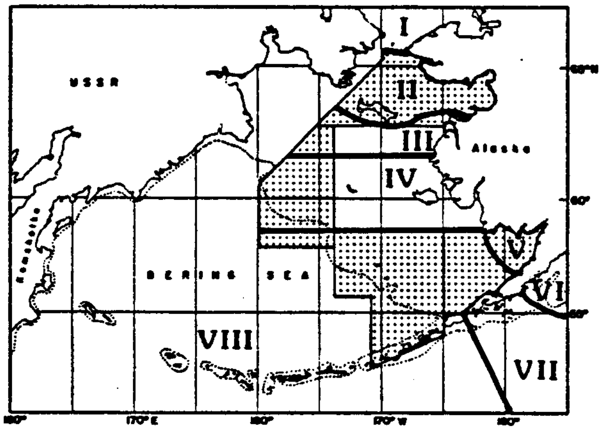
Lease Sale Areas

REGULATORY & STATISTICAL AREAS
IN THE BERING SEA & ALEUTIAN ISLANDS

Figure 2
(1 of 2)



Herring ADFG Management Areas



Salmon ADFG Management Areas

KEY:

I	KOTZEBUE MGMT. AREA
II	NORTON SOUND MGMT. AREA
III	YUKON MGMT. AREA
IV	KUSKOKWIM MGMT. AREA
V	BRISTOL BAY MGMT. AREA
VI	KODIAK MGMT. AREA
VII	CHIGNIK MGMT. AREA
VIII	ALASKA PENINSULA - ALEUTIAN ISLANDS MGMT. AREA

REGULATORY & STATISTICAL AREAS
IN THE BERING SEA & ALEUTIAN ISLANDS

Figure 2
(2 of 2)

TABLE 6

MAXIMUM SUSTAINABLE YIELD, EQUILIBRIUM YIELD, AND ALLOWABLE BIOLOGICAL CATCH FOR FISH AND SHELLFISH IN THE BERING SEA/ALEUTIAN REGION THAT ARE COMMERCIALLY IMPORTANT (x1000 metric tons)

Whitefish	MSY[1]	EY[2]	ABC[3]	Stock Condition[4]
Walleye pollock	1,100-1,600[5]	1,000	1,000	Healthy
Cod	58.7[5]	= MSY	78.7	Healthy
Flounders (other)[6]	44.3-76.8[5]	= MSY	61	Healthy
Yellowfin sole	169-260[5]	117	117	Healthy
Turbots	100[5]	90-95	90	Healthy
Rockfish (other)	-- Not Available --		7.7[5]	Healthy
Pacific Ocean perch	32[5]	6.5	3.25	Depleted
Sablefish	11.35[5]	3.5	3.5	Depleted
Pacific halibut	22.7	4.5	4.5	Depleted
Atka mackerel	35[5]	Unknown	Unknown	Healthy
Other whitefish species	89.4[5]	89.4	74.2	Healthy
Pelagic Fish				
Herring	48[5]	N/A[7]	49.6[8]	Healthy
Salmon	---------- Not Applicable -------			Healthy
Shellfish				
Red king crab	33[5]	N/A	8.9-18.1[8]	Depleted
Blue king crab	6[5]	N/A	3.6-6.8[8]	Depleted[9]
Tanner crab (C. opilio)	20.4[5]	N/A	14.5[8]	Depleted
Tanner crab (C. bairdii)	11.2[5]	N/A	6[8]	Depleted
Korean hair crab	---------- Not Available --------			Healthy
Snails	27[5]	27	3	Healthy

FOOTNOTES TO TABLE 6

[1] MAXIMUM SUSTAINABLE YIELD (MSY) - An average over a reasonable length of time of the largest catch that can be taken continuously from a stock under current environmental conditions. It should normally be presented with a range of values around its point estimate. Where sufficient scientific data as to the biological characteristics of the stock do not exist or the period of exploitation or investigation has not been long enough for adequate understanding of stock dynamics, the MSY is usually estimated from the best available information.

[2] EQUILIBRIUM YIELD (EY) - The annual or seasonal harvest that allows the stock to be maintained at approximately the same level of abundance (apart from the effects of environmental variation) in successive seasons or years.

[3] ACCEPTABLE BIOLOGICAL CATCH (ABC) - A seasonally determined catch that may differ from MSY for biological reasons. It may be lower or higher than MSY in some years for species with fluctuating recruitment. It may be set lower than MSY in order to rebuild overfished stocks. Except where noted figures given are for 1981.

[4] Healthy: capable of producing near MSY
Depleted: current EY less than MSY and no sign of improvement

[5] Includes both Bering Sea and Aleutian region.

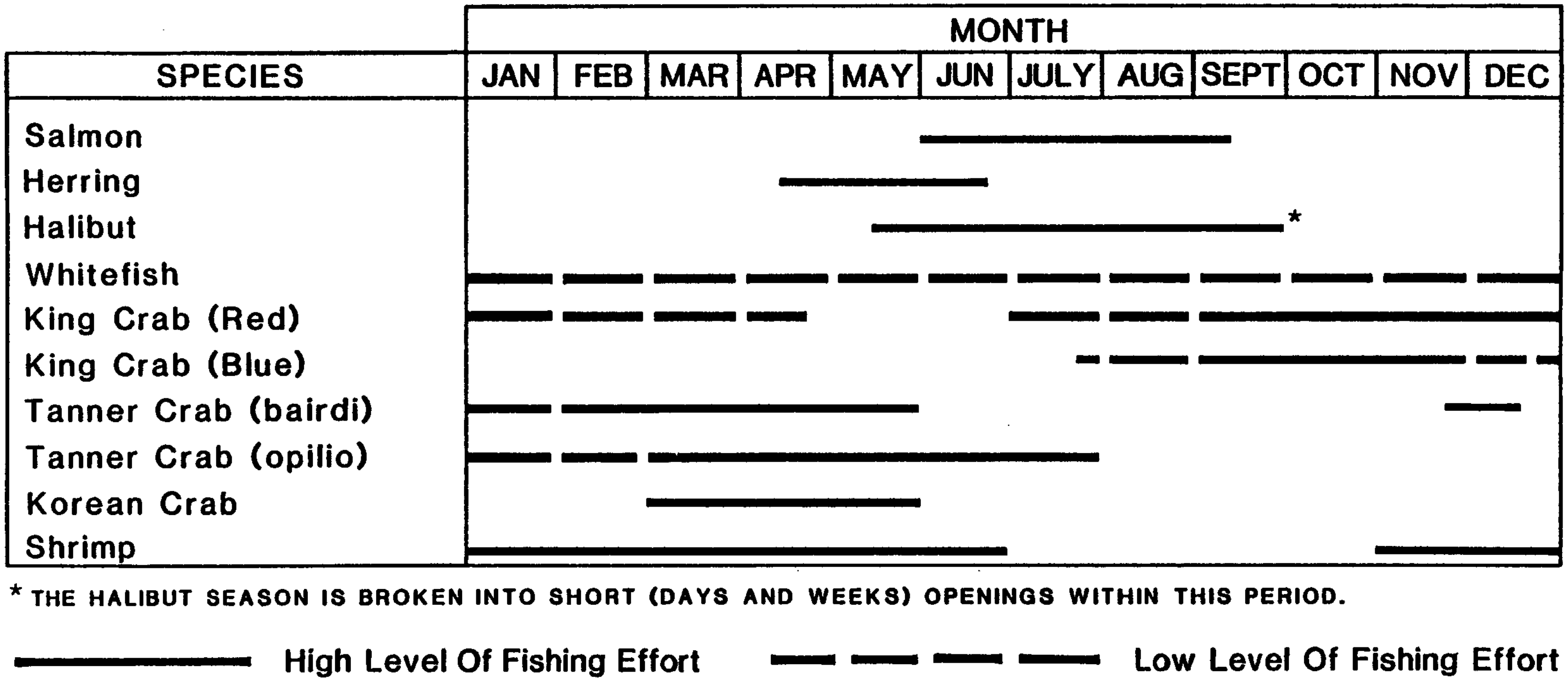
[6] Other flatfishes does _not_ include Pacific halibut.

[7] Not applicable.

[8] Preseason harvest guidelines are set for herring and crab. In-season limits are determined by ADF&G by preseason and within-season surveys and within-season sampling of commercial catches. Figures for crab are for the 1982-1983 season. Actual harvest may vary significantly from these harvest guidelines.

[9] Blue king crab populations around the Pribilof Islands are declining while those around St. Matthew Island are increasing.

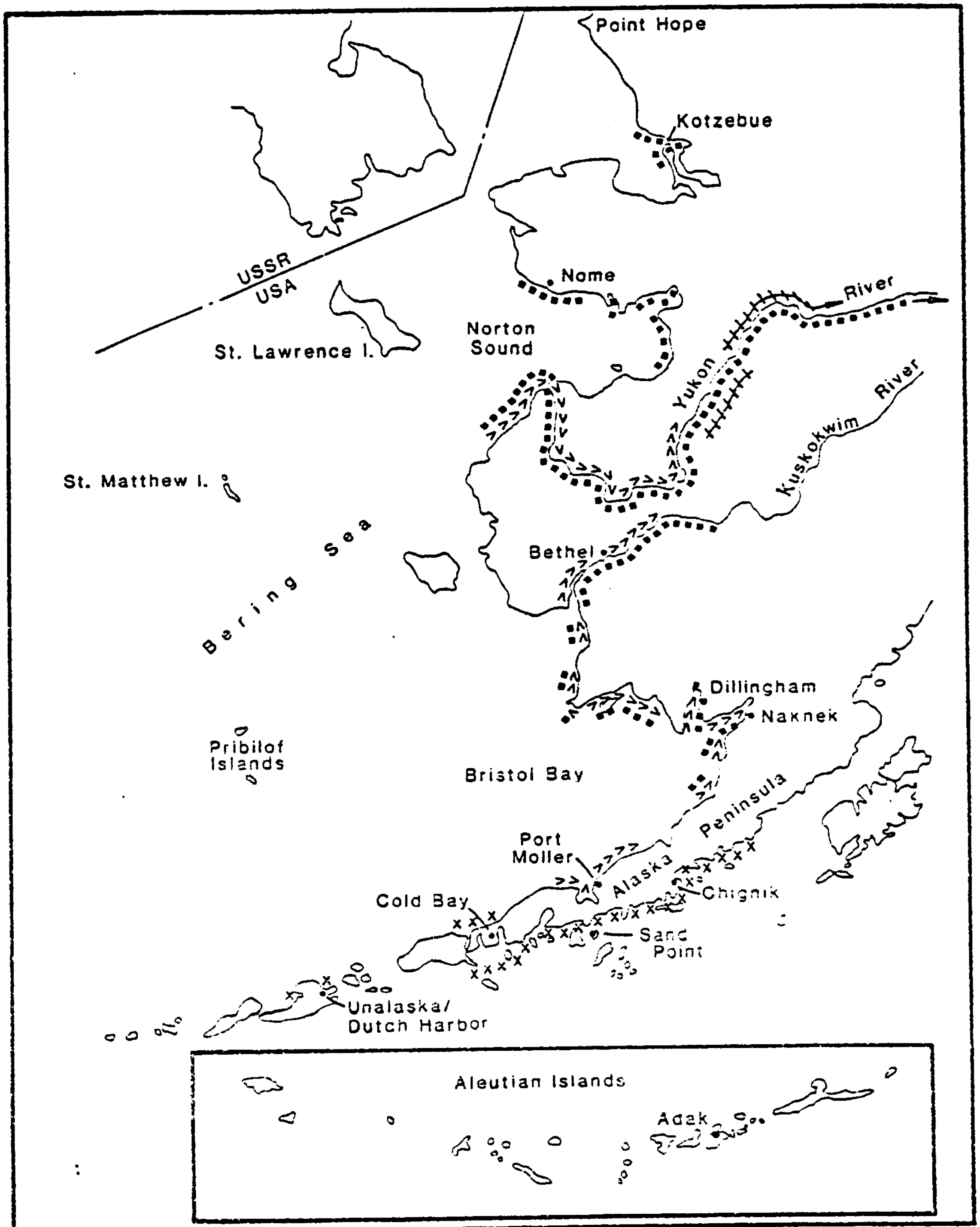
Source: NPFMC 1978, 1979, 1981a,b; Morris 1981; INPFC 1981; ADF&G 1982; IPHC 1982.



* THE HALIBUT SEASON IS BROKEN INTO SHORT (DAYS AND WEEKS) OPENINGS WITHIN THIS PERIOD.

SEASONAL DISTRIBUTION OF
MAJOR DOMESTIC FISHERIES IN THE BERING SEA

Figure 3



Sources:
Alaska Department of Fish and Game, Alaska's Fisheries Atlas 1978,
University of Alaska, 1980.

MAJOR SALMON FISHING AREAS, WESTERN ALASKA

Figure 4

each management area are shown in Table 7. Salmon harvests have been above historical averages for the last several years in most districts. Biologists believe this is a result of both conservation practices (including the reduction of foreign fishing) and favorable environmental conditions. Bristol Bay, with its large run of sockeye (red) salmon, produces by far the largest proportion of salmon caught in the BSAI. The salmon season starts with king (chinook) runs in early June in Bristol Bay and lasts until September when fall runs of chum salmon are harvested in the Yukon and Kuskokwim Rivers.

Herring: Domestic herring catches in the BSAI started increasing rapidly in 1978, and in 1982 totaled 27,836 metric tons. Since 1981, herring has been a prohibited species for foreign trawl fleets and all herring harvested in the Bering Sea is now taken by domestic fishermen within state waters. While most herring is harvested for the Japanese roe market, herring for food and bait is harvested in significant quantities in the Alaska Peninsula district (2900 metric tons in 1982) and there are roe-on-kelp fisheries in both Bristol Bay and Norton Sound. The Bristol Bay district accounts for the largest herring catches in the region (70 percent of the 1982 catch). Major fishing areas and the gear types used in each district are shown in Figure 5. The roe herring fishery is very short and intense, lasting only 2 to 3 weeks in each fishing district. Fishing generally starts soon after the ice goes out, in late April in Bristol Bay, and progresses north, starting in late May or early June in Norton Sound.

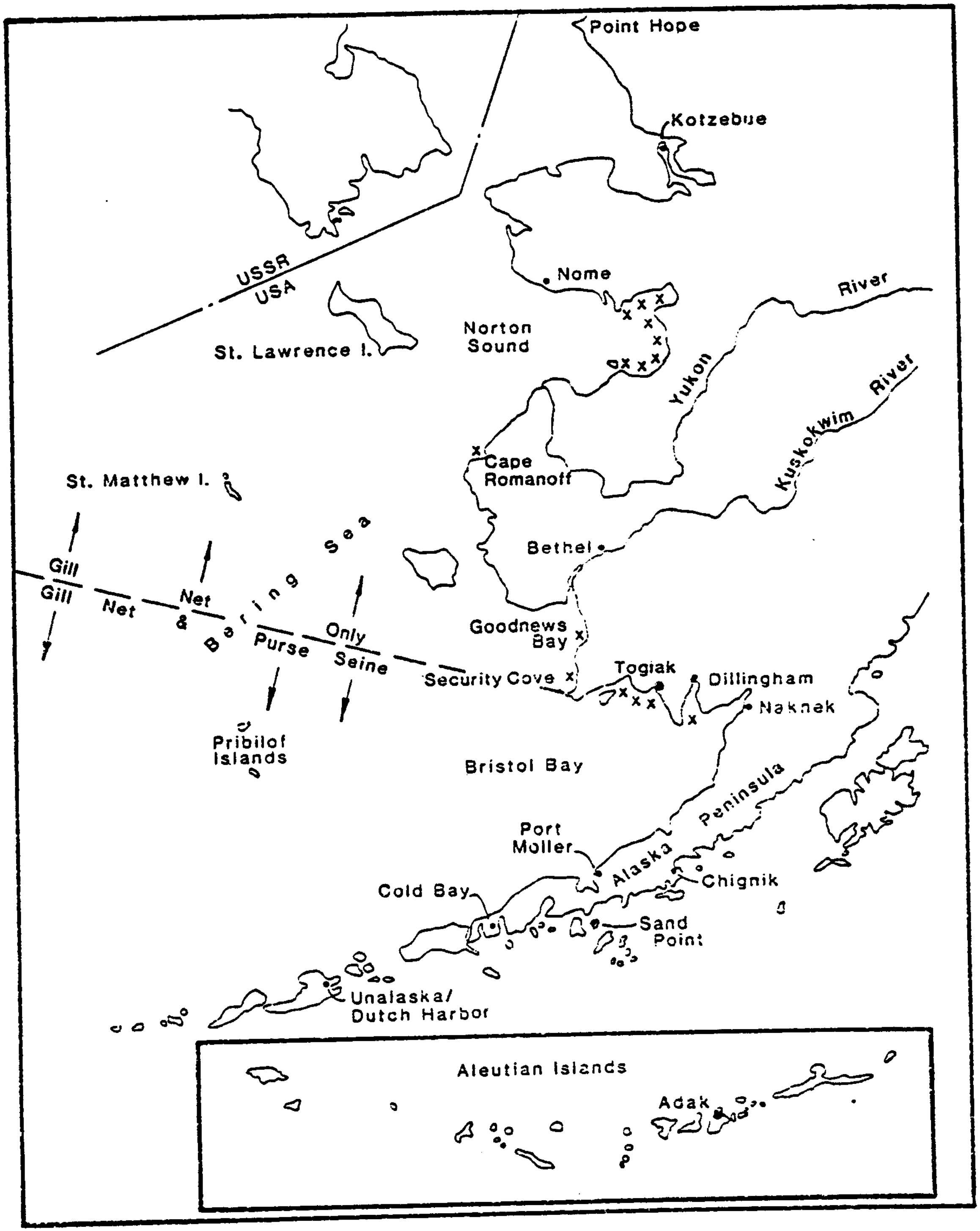
Halibut: Two distinct halibut fisheries operate in the Bering Sea: a large-boat fleet that ranges throughout the Gulf of Alaska and the Bering Sea and a small-boat fleet that generally fishes in protected waters near their home ports. In the last 2 years, locally-based skiff halibut fisheries have been started by residents of the Pribilofs and Nelson Islands. Halibut catches in the Bering Sea have been severely depressed since the early 1970s and, despite conservation measures, the stocks still appear to be in poor condition. In 1981, about 1.2 million pounds of halibut were harvested from the Bering Sea. Major fishing grounds are shown in Figure 6. Halibut fishing is confined to the summer months, although low catch quotas and large

TABLE 7

1980 SALMON HARVESTS IN THE BERING SEA AND ALEUTIAN ISLANDS BY AREA AND SPECIES

	SPECIES (in thousands)											
	King (Chinook)		Red (Sockeye)		Coho (Silver)		Pink (Humpback)		Chum (Dog)		All Species	
AREA	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
North Peninsula/ Aleutians	17	333	1,406	7,507	128	1,030	2,900	10,213	706	5,032	5,157	24,115
Bristol Bay	101	1,909	23,756	132,996	349	2,486	2,564	8,624	1,300	7,807	28,070	153,822
Kuskokwim	49	8,111	43	293	328	2,270	30	111	559	3,645	1,009	7,130
Yukon River	154	3,436	0	0	9	56	0	0	1,222	8,345	1,385	11,837
Norton Sound	6	136	0	0	30	204	227	719	181	1,296	444	2,355
TOTAL	327	6,625	25,205	140,796	844	6,046	5,721	19,667	3,112	26,125	35,048	190,589

Source: ADF&G, 1981.

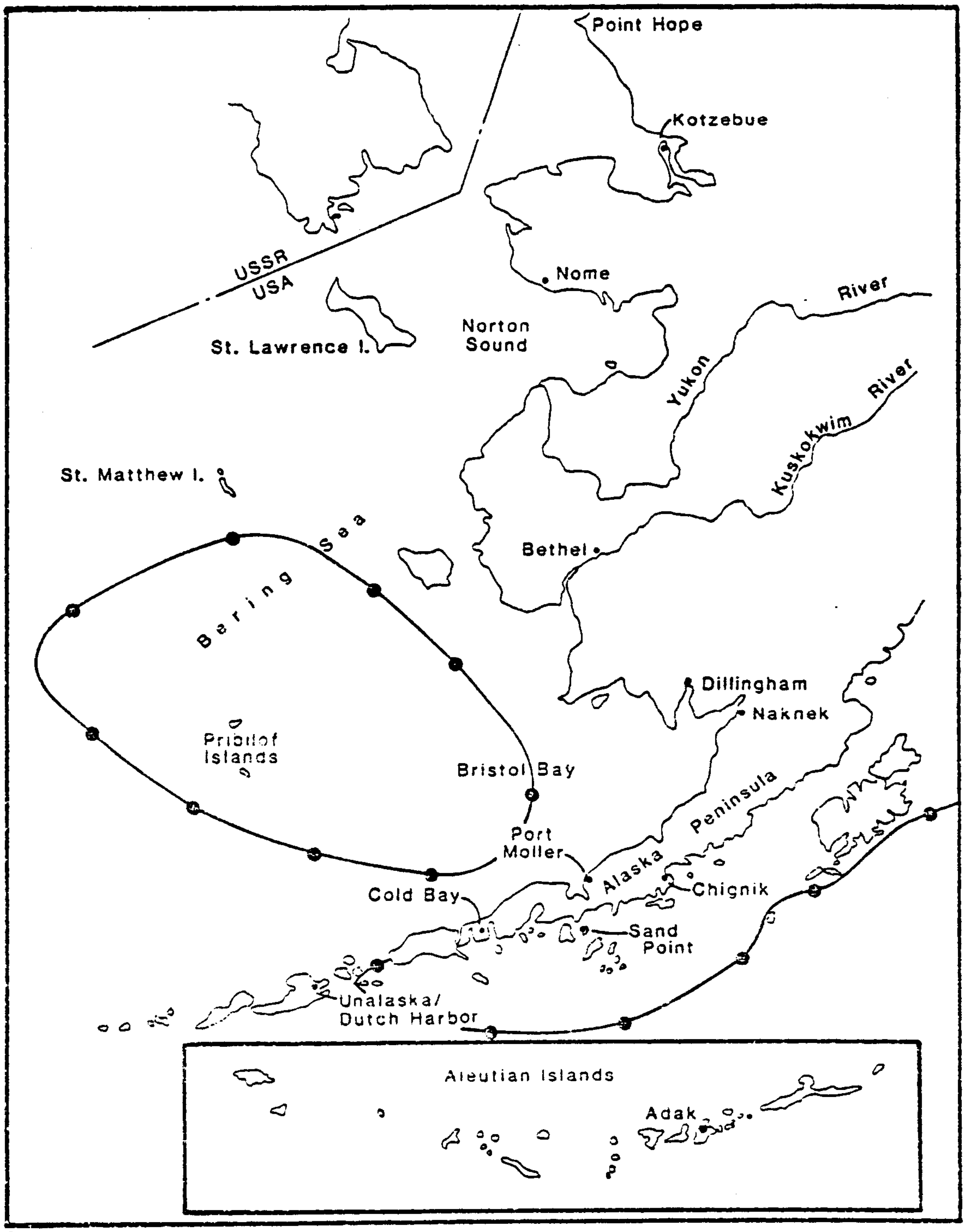


Sources:
Alaska Department of Fish and Game,
Alaska's Fisheries Atlas 1978,
University of Alaska 1980.

x x x x x x x Major Herring Fishing Areas

MAJOR HERRING FISHING AREAS

Figure 5



Sources:
International Pacific Halibut Commission, Technical Report No. 6;
Alaska Department of Fish and Game;
University of Alaska 1980.

—●——●——● Major Halibut Fishing Areas

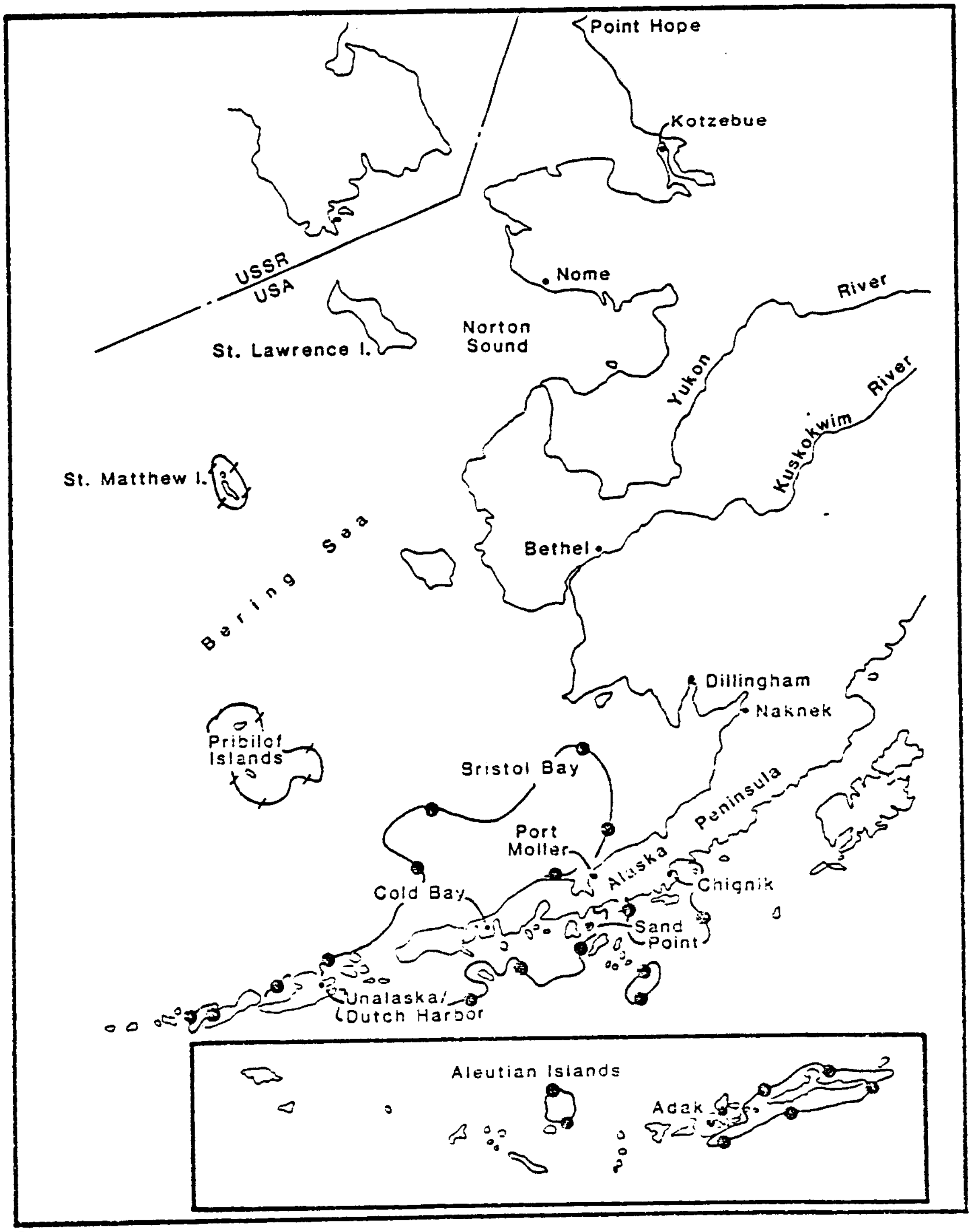
MAJOR HALIBUT FISHING AREAS

Figure 6

numbers of boats limited the 1981 Bering Sea halibut fishery to two fishing periods that together totaled 42 days.

Whitefish: Domestic harvests of whitefish (excluding halibut) in the BSAI are just beginning to occur. In 1976, there were no domestic landings of whitefish from the Bering Sea; in 1982, there were landings of over 108,566 metric tons, mostly pollock, yellowfin sole, Pacific cod and Atka mackerel. The great majority of the landings are made by American trawlers delivering their catch to a foreign processor in joint venture arrangements. In addition, domestic fishermen are harvesting Pacific cod for a burgeoning salt cod fishery that is centered in the Aleutians from Unimak to Seaguam Island.

King Crab: The BSAI king crab fishery has collapsed. Alaska king crab harvests have been dominated by landings from the BSAI since the mid 1970s. While red king crab accounts for the greatest proportion of the harvests, an important blue king crab fishery is centered around the Pribilof Islands and a brown king crab fishery is just getting started (total landings of 415,000 pounds during the 1981-1982 season). Red king crab landings increased steadily from the fishery's beginning in Bristol Bay in 1953 until 1980, when close to 190 million pounds were harvested. In the 1981-1982 season, catches plummeted to about 85 million pounds and catches during the 1982-1983 season further declined to crisis levels. Blue king crab landings were first made in 1973, and have generally increased since then with just over 11 million pounds harvested during the 1980-1981 season. Brown king crab catches are beginning to increase as landings of red king crab drop off. Traditional king crab fishing grounds are shown in Figure 7. The Bering Sea king crab season has changed dramatically since the early 1970s when it lasted most of the year. Now because of vastly increased fishing effort and reduced stocks, the season begins in earnest in September and is mostly over by late November. The relatively small Norton Sound king crab fishery, which began in 1977, and the Bristol Bay 6-1/2" shell crab fishery both occur during the summer. There is also a small local shorebased through-the-ice fishery for king crab around Nome that occurs from February through April.



Sources:
Alaska Department of Fish and Game; Alaska's Fisheries Atlas 1978, University of Alaska 1980.

—●—●—●—●— Major Blue King Crab Fishing Areas

—+—+—+—+—+— Major Red King Crab Fishing Areas

MAJOR KING CRAB FISHING AREAS, WESTERN ALASKA

Figure 7

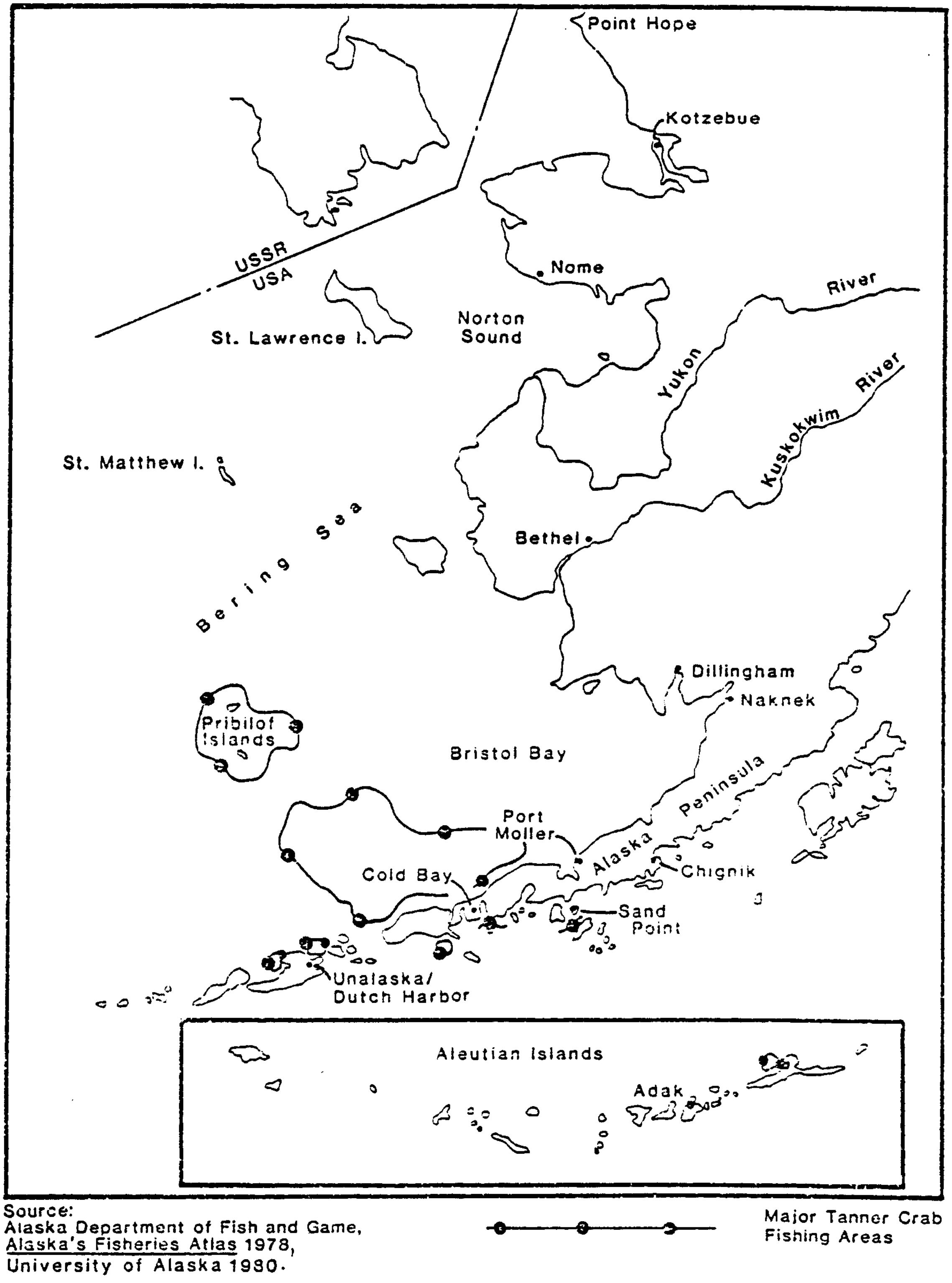
Tanner Crab: The Bering Sea Tanner crab fishery (for both C. bairdi and C. opilio) has grown dramatically in the last 15 years, from just over a million pounds in 1969, to almost 80 million pounds in 1981. Catches in 1982 dropped sharply. It is ironic that the increasing catches were made, and the Tanner crab fleet was built, on a resource that was on a declining trend. Some fisheries scientists suggest that the resource has bottomed out and will rebuild over the next 10 years. However, the decrease in catches is expected to continue for several years, especially from the traditional fishing grounds (Figure 8). Harvests occur from January through July with most activity concentrated in March, April, and May.

Korean Hair Crab: The Korean hair crab was first fished commercially by the U.S. fleet in the Bering Sea in 1979. Landings have increased rapidly from 5,213 pounds to over 2.4 million pounds in the 1980-1981 season. Over 50 percent of the Bering Sea hair crab stocks are located near the Pribilof Islands and fishing is concentrated in this area. ADF&G expects this crab fishery to continue to grow.

Shrimp: The Bering Sea pink shrimp stocks were severely overfished by the Japanese during the 1960s and have not yet recovered adequately to support a commercial fishery. A small domestic shrimp fishery started in the Bering Sea in 1975 in the waters surrounding Unalaska Island (Unalaska Bay, Makushin Bay, Usof Bay, Beaver Inlet). Catches peaked in 1978 at just over 6.6 million pounds. Reduced harvests have been required in recent years because of depressed stocks, and Unalaska Bay has been closed to shrimping since the 1980-1981 season. Total catch for the 1981-1982 season totaled just under 2.2 million pounds. During its peak years, the shrimp fishery occurred throughout the year, but activity during the last several years has been confined to the months from November through June.

Over the 20-year planning horizon of this study, the following fisheries may develop:

- Offshore Herring: Herring have historically been caught in the offshore waters of the Bering Sea. Since 1981, all offshore



Source:
Alaska Department of Fish and Game,
Alaska's Fisheries Atlas 1978,
University of Alaska 1980.

MAJOR TANNER CRAB FISHING AREAS

Figure 8

herring fishing in the Bering Sea has been prohibited because the domestic nearshore spring roe herring fishery takes the total quota. The roe herring fishery is highly dependant on a single market - the Japanese kazanoko market. Should this shore-based roe fishery decline, or management strategies change, a trawl fishery for herring (probably domestic) could again develop in the southeastern Bering Sea.

- Capelin: Capelin (Mallotus villosus) is a small (5 to 7 inches) member of the smelt family. While there are huge fisheries for capelin in the Atlantic (mostly for reduction), only very small landings have been made in the western Pacific Ocean by the U.S.S.R. There is currently interest in both Norton Sound and Bristol Bay to develop spring fisheries for roe capelin. Since capelin usually move to coastal waters just after herring season, it is anticipated that the herring seine fleet and shore-based beach seiners would harvest spawning capelin for the Japanese market for roe-containing fish. Because of the limited market for roe capelin and the lack of large reduction plants in the Bering Sea region, it is anticipated that the total Bering Sea catch would never exceed 10,000 metric tons.

- Squid: A variety of squid species are abundant in the Bering Sea. Japanese stern and pair trawls have caught squid of the species Berrytheuthis magister and Onychoteuthis banskii in the waters just off the Aleutians and along the shelf edge of the Bering Sea. While the economics of this fishery for domestic fishermen are not promising at the moment, its potential may increase due to the vast size of the resource and the world's need for protein (Wilson and Gorham 1982).

- Clams: In 1977 a subtidal stock of Alaska surf clam (Spisula polynyma) was discovered in the southeastern Bering Sea and assessed to be of excellent commercial potential with estimated yields of about 39 million pounds annually. Alaska surf clams appear to lack toxin in their edible parts and give 35 percent meat yields. Major constraints to development include competition from the long established East Coast clam industry, inefficient harvest technology, and overall economic uncertainty (NRC 1982). In addition, there is concern that a commercial clam fishery using hydraulic dredges may deplete the clam resource and thereby impact the large walrus population by reducing its primary food source (Kauwling and Bakus 1979).

- Snails: Large marine snails, some reaching 6 inches in shell length, are abundant in waters of the central Bering Sea. The most common are of the genera *Neptunea* and *Buccinum*. The Japanese currently harvest about 3,000 metric tons of edible snail meat in a pot fishery that primarily occurs on the outer continental shelf east of longitude 175° W. Snail meats are a delicacy in Japan, and are traditionally eaten with "sake" or rice wine. Attempts to initiate a U.S. snail fishery in Alaska have not been productive to date. While the crab fishing industry has the capability to harvest the snail resource, processing and marketing techniques will have to be developed. There is promise of a potential off-season operation in the next few years using existing domestic crab vessels (Morris 1981).

- Octopus: Octopus are found in many locations in the BSAI. In 1982, over 26,900 pounds were landed as an incidental catch in the tanner crab fishery. There is little information on the size of the resource, but if additional markets develop for octopus, a small fishery may arise.

- Sea urchins: Sea urchins are abundant around the Aleutian Islands. They are marketed for their roe, which is considered a delicacy. If a sea urchin fishery develops, it is expected that it will be relatively small and of local importance only.

3.2 Existing and Future Ports

The offshore fisheries (crab and whitefish) of the BSAI are, and will be, supported from three existing major ports:

- Dutch Harbor/Unalaska
- Akutan
- Nome

Kodiak, a more distant port, may also be involved in Bering Sea fishing.

Infrastructure improvement plans are now being implemented at Dutch Harbor/Unalaska (airport runway extension, drydock facilities) and Nome (port improvement, dock facilities). In fact, the shipyard facility at Unalaska is already operational.

Because of present and projected congestion at the three major ports and elsewhere, the Alaska Department of Transportation & Public Facilities (ADOT/PF) has performed port and harbor planning studies for:

- Chernofski
- Akutan
- St. Paul
- St. George

There is impetus within the State of Alaska to develop these new port facilities, primarily to serve the evolving BSAI whitefish industry. The U.S. Army Corps of Engineers has approved funding for the next phase of port development at St. Paul/St. George.

Inshore fisheries (salmon, herring, etc.) will continue to be supported from a number of smaller ports, in addition to the major ports already mentioned. These smaller ports include Cold Bay, False Pass, Togiak, Dillingham, Port Moller, Port Heyden, King Cove, Nelson Lagoon, Sand Point, King Salmon, Naknek, Kvichak, Bethel, Goodnews Bay, Emmonak, St. Michael's, Unalakleet, and Golovin. Because of requirements for infrastructure, land space, sheltered harbor space, and deep draft, it appears that these smaller ports will not be likely places for the support of the development of the BSAI whitefish or petroleum industries.

Finally, negotiations are currently underway between Cook Inlet Region, Inc. (CIRI) and U.S. Department of Interior (USDOI) for CIRI to obtain temporary or permanent ownership of portions of St. Matthew Island, the nearest potential port site to the Navarin Basin. The present view is that, if land ownership was obtained, CIRI would allow OCS oil and gas activities to be based there. At this stage, it is not clear if any fisheries-related development would be allowed on St. Matthew.

It should be noted that not all of the ports (large and small) listed in this section can support OCS petroleum development activity. Petroleum groups typically need deeper draft and more developed infrastructure than is present in most western Alaska coastal communities. Nevertheless, all ports will be considered, albeit briefly, in the forthcoming fisheries analysis because of potential secondary impacts from relatively distant petroleum activities.

3.3 Harvest Technology

Harvest technology is not a major limiting factor in the development of the BSAI fisheries. No significant changes are expected, except for those intended to reduce incidental catches of prohibited species, and to reduce conflicts with subsea obstacles (natural and man-made).

Changes in harvesting techniques for whitefish may significantly reduce the incidental catch of prohibited species in the BSAI area and would have a positive effect on the traditional domestic fisheries. A significant by-catch of traditionally "prohibited" species (salmon, halibut, crab, herring) is currently taken by the foreign trawl whitefish fisheries in the Bering Sea. This incidental catch reduces the yield available to both foreign and domestic target fisheries. When a certain level of prohibited species is caught in a foreign trawl fishery, that fishery is closed.

Research is underway on possible gear changes to reduce the catch of prohibited species. Wespestad et al. (1982) report that the incidental catch of prohibited species is generally less with longlines or off-bottom trawls than with the on-bottom trawl gear now most commonly used. Most available whitefish could probably be harvested with longlines and off-bottom trawls with a substantial reduction (over 80 percent) in the incidental catch of prohibited species.

Current conflicts between on-bottom trawls and petroleum related structures are expected to be mitigated by the use of off-bottom trawls.

Very few changes in salmon, herring, and crab harvest technology are expected. Salmon and herring are fished close inshore, away from most areas of potential petroleum exploration and development. Moreover, the gear types and fishing techniques for all three of these species groups are fairly standardized.

Other potential conflicts between petroleum and fishing activities (e.g., seismic exploration cables vs pot and longline buoys), and between fisheries (e.g., trawls vs crab pots) are expected to be mitigated more by changes in techniques and timing, rather than by technology changes.

3.4 Processing Technology

The evolution of processing technology will greatly influence the development of fisheries in the BSAI; especially those fisheries that occur great distances from onshore processing plants, such as in the northwest portions of the St. George Basin or in the Navarin Basin. Processing technology for traditional species (e.g., salmon, crab) is well developed, although there does appear to be a trend from canning to freezing. Processing technology for whitefish is developing, and this development will accelerate as the University of Alaska's new Fisheries Industrial Technology Institute and the Alaska Fisheries Development Foundation's vertically-integrated minced pollock processing project get underway. The North Aleutian Shelf will be the last Bering Sea lease sale area to be explored.

By the time it is impacted by OCS activities, processing technology will be advanced much further than at present. This analysis will assume that domestic processing technology will not be limiting within the 20-year planning period of this study.

3.5 Harvest and Production Capacities

Almost every conceivable type and size of fishing boat and processing operation can be found in the cumulative Bering Sea/Aleutian Island fisheries.

Fishing boat categories to be evaluated include:

Drift gill net boats (≤ 32 feet)
Small seine boats (≤ 32 feet)
Longline boats (48-116 feet)
Crab boats (85-150 feet)
Trawlers, small (65-150 feet)
Trawlers, large (150-400 feet)

Catcher/processor boats categories to be evaluated include:

Domestic (150-400 feet)

Large offshore processor categories to be evaluated include:

Barges (100-400 feet)
Factory processors (100-600 feet)

The majority of all onshore domestic processing is for salmon and crab; a few isolated processors receive and process halibut, shrimp, cod and pollock. Few, if any, new crab or salmon processing plants are envisioned for the next 25 years. Most new construction will probably focus on pollock and cod. The fishery development scenario will include a survey of existing onshore processing plants, to the extent their operations could be impacted by an oil development activity. The primary focus will be for onshore processing operations that may conflict (temporally and spatially) with onshore oil development activities and then onshore plants that may be impacted directly by loss of product.

3.6 Limited Entry

Limited entry programs are in place for all salmon fisheries that occur in the BSAI region. No limited entry programs are in effect for herring; however, exclusive registration areas were established for Goodnews Bay, Security Cove, Cape Romanzof and Norton Sound for the 1983 herring season. Exclusive registration is another management technique to limit fishing effort. The NPFMC is in the process of holding public hearings on a proposed moratorium on new entries to the halibut fishery off Alaska for 1983. This is the first step toward establishing a limited entry program. Estimates for when the halibut limited entry system will be in place range from 1984 to never. There are no limited entry programs for king crab, Tanner crab or hair crab, although both statistical area T (Bristol Bay) and O (Unalaska) are exclusive registration areas for king crab. No limited entry programs are planned for whitefish.

For fisheries with limited entry, fishing effort (number of vessels) will remain at a relatively constant level unless a major economic dislocation occurs. Effort in fisheries without limited entry can be much more variable. The forthcoming fisheries analysis will examine trends in fishing effort for each fishery in each area and make projections based both on these trends and the projected resource base and markets. Data on fishing effort will be obtained from ADF&G and the Commercial Fisheries Entry Commission for salmon, herring and crab; the International Pacific Halibut Commission and ADF&G for halibut; and the NPFMC and ADF&G for whitefish.

3.7 Aquaculture and Enhancement Activities

Three aquaculture facilities release salmon fry into river systems that drain into the BSAI area. There is a small research facility on Clear Air

Force Base (Yukon River), a small (2 million egg capacity) experimental hatchery on the Noatak River (Kotzebue Sound), and a 20 million egg capacity hatchery on Russel Creek in Cold Bay. There are two nonprofit aquaculture associations in the region -- Imarkpik (Bristol Bay) and the Yukon - Kuskokwim Aquaculture Association. At present neither group has production facilities, nor are any planned. There are small educational hatcheries in Unalaska, Sand Point, and Bethel. The State of Alaska operated a sockeye salmon hatchery on East Creek in Bristol Bay, but the facility was closed due to budget constraints and there are no plans to reopen it. It is conceivable that another group could acquire and operate the facility. The Russel Creek hatchery is scheduled to close in 1983 for budgetary reasons, although ADF&G is also issuing a contract to redesign the facility to increase its capacity to 100 million eggs. If the Russel Creek hatchery is redesigned and successfully reopened, it could eventually produce more than a million adult chum salmon each year. Except perhaps in the Cold Bay area, it is unlikely that salmon aquaculture or enhancement activities will significantly impact commercial fisheries in the Bering Sea-Aleutian Island area.

3.8 Economics

Development of the domestic fishery in the Bering Sea and Aleutian Island area over the next 25 years will be guided by economics. At present, it appears paradoxical to speak of the potential growth (and wealth) of the domestic fishery in that region when the domestic seafood industry is hard pressed by industry-specific problems and the U.S. economic climate. However, all evidence points to the almost automatic realization that in 25 years the domestic fishing industry will be harvesting the resources of the BSAI and will be processing most of it.

The rate and magnitude of development will be linked to the economics of several factors that will be examined in the 25-year domestic fishery projections. These factors include:

- At-sea processing, e.g. Icicle at Bristol Bay (salmon), F/V _Golden Alaska_ in the Bering Sea

- On-shore processing, e.g. Trident at Akutan (bottomfish)
- Joint-ventures, e.g. Marine Resources Co.
- Large boat vs small boat economics and efficiency
- Distribution and abundance of important species, both current and developing
- Export markets, e.g. Japan
- Regulation (fishery processing), e.g. seafood sanitation and waste discharge regulations
- Transportation/cold storage, in and outside of Alaska
- Technology: harvesting and processing
- Limited entry: salmon and other species
- New domestic corporate "actors", e.g. Con-Agra and Campbell's/Mrs. Paul's
- Foreign aquaculture and its effect on domestic prices
- Foreign investment in the domestic industry
- Foreign import restrictions
- Vessel construction and ownership, i.e. restrictions such as the Jones Act

The importance of these factors will be translated into economic decision points. This means that each factor influencing the rate of development of the domestic fishery can have a cause and effect relationship with development, i.e., if a positive economic factor happens, then growth will proceed as projected, or if a negative economic factor appears, growth will be limited.

3.9 Changes in Marketing Strategy

Factors of change that will accelerate, influence and evolve with the domestic fisheries in the BSAI are the changing strategy of domestic seafood marketing and the penetration of foreign markets. These changes will be consumer- and product-oriented, relating to changes in markets, products and product form, consumer preference, etc. Examples of these potential changes are:

- Lifting of foreign import restrictions.
- Individual quick-frozen (IQF) pollock fillets replacing surimi.
- Surimi replacing fish meal.
- IQF pollock fillets replacing whole block frozen pollock.
- General growth of the IQF form.
- Potential use of Alaska bottomfish by some major U.S. fast seafood firms.

Furthermore, the domestic (and Alaskan) seafood industry, as it builds in volume and economic visibility, is beginning to overcome obstacles to the growth of all markets, and the fresh seafood market in particular. These obstacles include unreliable airline service, poor handling in transit and unattractive retail display. It is not clear how these changes will affect the fishing industry in the BSAI and an exhaustive, quantitative analysis of these changes is outside the scope of this study. Nevertheless, the projections task of this analysis will include an appropriate qualitative discussion.

3.10 Federal and State Policies to Assist the Domestic Fisheries

If continued, several state and federal "pro-fisheries" development policies will benefit and assist the U.S. fishing industry in entering the whitefish fisheries of the Bering Sea and the Navarin Basin area. Unless modified, at least one major U.S. policy (the Jones Act) will continue to deter the development of the U.S. industry by generally requiring more expensive U.S.-built hulls on all larger fishing and processing boats.

These policies will be evaluated cumulatively to determine their total influence on the development of the U.S. fishing industry in the study area. A judgement will be made regarding the overall qualitative impact of these state and federal policies on the development plans of the industry and the ensuing development scenarios of this study.

Policies that may affect development include:

- International trade agreements
- Research and development programs
- Federal tax incentive programs
- State/federal loan guarantee and low interest loan programs
- State/federal domestic fishery incentive management policies
- Federal labor and construction policies

3.11 Vessel Traffic

An analysis of fishing vessel traffic patterns (and the associated patterns of gear deployment for fixed gear) will be used in the impact analysis both for vessel collision and gear loss predictions. Also port usage by fishing vessels will be assessed to determine harbor and port infrastructure requirements.

The magnitude of vessel traffic for the fisheries under analysis will be estimated based on the overall development scenarios for the respective fisheries. Expected catch rates per vessel will be assessed to estimate total number of vessels operating in a particular area. Typical trip patterns (in terms of number of days operation per month and typical trip length) will be assessed to estimate number of miles traveled by area.

The geographical pattern of trips will be assessed based on an analysis of historical catch data or summary information of the location of major fishing grounds (from NMFS and ADFG) for the developed fishing areas. For fisheries expected to develop over the study time horizon the location of vessel traffic patterns will be estimated based on information (to the extent it is available) on the geographical pattern of resource potential.

Consideration will be given both to trip patterns while on the fishing grounds as well as to patterns of travel between major fishing grounds and offloading ports. Ports to be considered have been discussed in Section 3.2. It is expected that Dutch Harbor/Unalaska will remain the major port for the Bering Sea high seas fisheries (i.e. groundfish, halibut, crab, etc.). To the extent Kodiak is involved, trip patterns will be similar as traffic must pass through passes near Unalaska. Based on the development potential vessel trips will also be allocated to Akutan, Chernofski, Nome, St. Paul and St. George. Traffic patterns associated with the inshore fisheries utilizing the smaller ports in western Alaska will be briefly assessed. However the potential for these trip patterns interacting with OCS vessel activity is small.

4.0 METHODS OF ASSUMPTIONS. UPDATES AND FORECASTS

4.1 Methods for Projecting Future Harvest by Species

- Assemble historic (10-20 year) data for foreign and domestic catch in the Bering Sea and Aleutian Islands for species of interest: foreign whitefish and Tanner crab; domestic whitefish, salmon, cod, king crab, Tanner crab, shrimp, halibut, and herring; and domestic and foreign incidental species associated with whitefish (quantitative).

- Determine the percent of the Bering Sea/Aleutian Islands catches that were taken in each of three lease sale areas, i.e., Norton, St. George, North Aleutian (quantitative). Include the Navarin projections.

- Examine the long-term trends in each fishery, and interpolate to determine the fraction of MSY and/or ABC taken currently and in the future (quantitative).

- Examine the expansion of the fisheries (best professional judgement). Items of particular importance include:
  - Market expansion
  - Domestic takeover
  - Increased use of joint ventures
  - Transfer of boats from the crab fisheries to other fisheries

- Identify assumptions, e.g., MSY will not be influenced by OCS activities.

This analysis and projection will be sychronized internally and with other events, so that a change in the OCS development schedule (e.g., delay of leasing) will not decrease its usefulness.

4.2 Methods for Projecting Number of Vessels and Participants in the Fisheries

- Use 1978-1982 data on numbers of boats fishing Bering Sea and Bristol Bay including crab boats, catcher-processors, cod boats, halibut boats, trawlers, and salmon boats. Data mostly come from Alaska Board of Fisheries reports, NMFS records and Alaska Commercial Fisheries Entry Commission. New entrants will be estimated using boat conversions, new construction, and attrition.

4.3 Methods for Projecting the Magnitude of Processing Activity

- This determination will be directly linked to the above two findings. Processing activity is a derivative of pounds, species, locations, economics and seasons. To a lesser extent, it is influenced by nationality, processing modes, and markets. We will translate these variables into numbers of floating processors, shorebased processors, total volume (dollars and numbers), location, seasonality and processing form.

4.4 Methods for Projecting Labor Costs and Mobility

As this study team discussed in the recent Navaran Basin fisheries analysis, fishermen's employment and earnings data are not collected by the Alaska Department of Labor. Therefore, reasonable projections of fisheries related employment were impossible, and are also impossible for this study.

The domestic fishing industry projections for the cumulative Bering Sea/Aleutian Islands case will estimate fishermen's employment by multiplying the number of catcher vessels (to be projected) by the number of fishermen per vessel (to be estimated). Ex-vessel values of the catches will be forecast by applying low, medium and high rates of inflation to the current unit prices, in a simplistic compound-interest fashion. The combination of these two calculations will allow estimation of gross income per fishing vessel. Income to individual fisherman or boat captains cannot be reliably extrapolated, however, because of widely varying arrangements for crew shares.

Based on a current understanding of processing technology, processing employment will be estimated by calculating the number of workers necessary to process the projected catches. The data base, however, is not sufficient to allow projection of earnings of individual processing workers or species-specific total earnings. "Alaska Economic Trends" (Alaska Department of Labor monthly) will be used to estimate recent earnings by individual processing worker.

Generally, the competition for unskilled and skilled labor between the fisheries and oil industries will be small. It will be dictated by the relatively small number of jobs available within the oil industry regardless of the supply of labor. To the extent practicable, labor mobility for the cumulative Bering Sea/Aleutian Islands case will be estimated based on such factors as average crew shares, average crew size, total pounds per boat, and comparing these to potential movement of labor into the oil industry.

4.5 Methods for Estimating Future Geographic Centers of Fishing Activity

The geographical distribution of the fishing industry is based on economics and is therefore related to the location of fish species, the distance to ports, and the economics of catching and processing. We will look at the existing major ports, their potential for growth, and influencing factors.

Dames & Moore's information on port and harbor plans for St. Paul, Dutch Harbor, Chernofski and Akutan will be used to locate the next generation of geographic fishing centers.

Fishing activity is also a spatial and temporal function. Based on foreign and domestic catch data, the commercial fishing activity will be proportioned as to time and area, by species.

4.6 Methods for Projecting the Cumulative Case

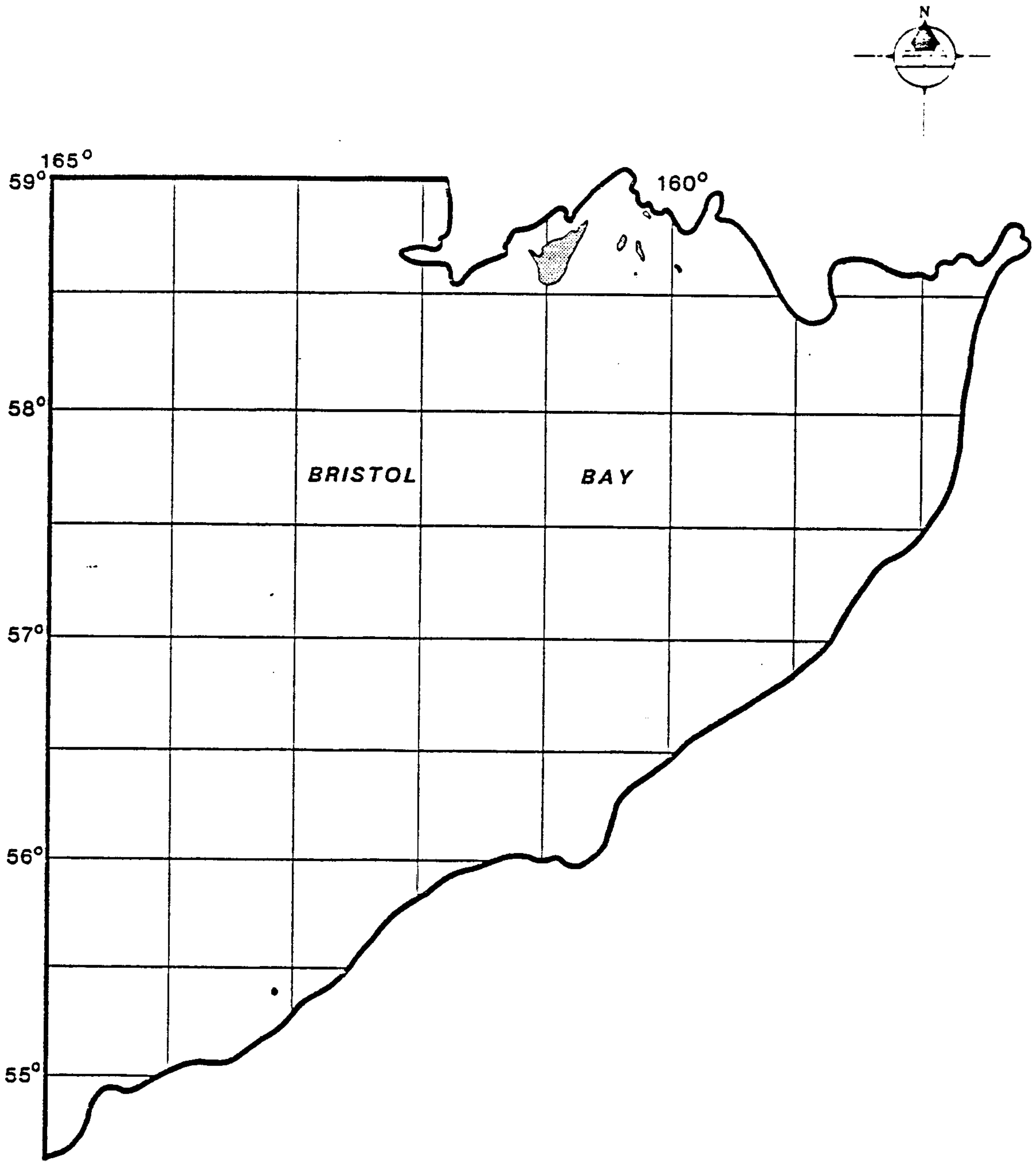
A 25-year time line for the development and expansion of the domestic fishing industry into the fisheries of the BSAI area (Plate 1) will be constructed. Three sub-set time lines will be constructed for the North Aleutian Shelf (Figure 9), St. George Basin (Figure 10) and Norton Basin areas (Figure 11), in which future catches will be apportioned by 1/2° x 1° grid area. These, when combined with the Navarin 25-year scenario (Figure 12), will reflect what may be happening in each of the four proposed lease sale areas. We will identify the critical factors of changes which will influence these development scenarios.

The important methodology to explain is how we will estimate impacts of oil activities from one lease sale area on the fishery development activities of the other lease sale areas. The impact analysis is reasonably straightforward for impacts associated with oil and fish in the same lease sale area. However, it becomes more convoluted to discuss impacts in other areas. Unfortunately, most of the fisheries of three of the four areas (excluding Norton) are interrelated to some degree.

The interrelationship is based on several assumptions:

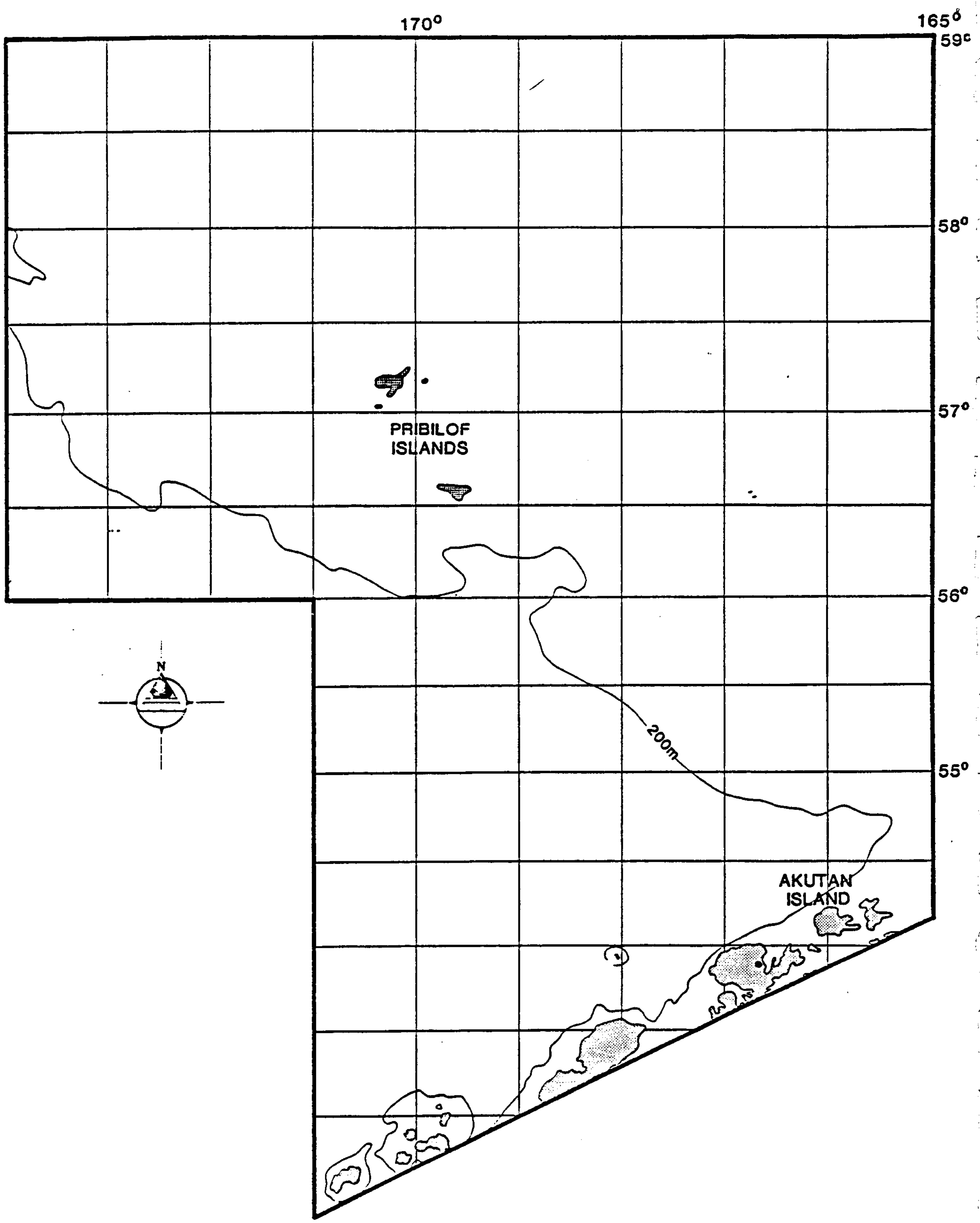
- The present salmon fisheries (domestic) are relatively stable, but will decline possibly in the second half of the 25-year scenario. The results will affect processors more than fishermen insofar as most salmon fishermen are not likely to be involved in other regional fisheries. A loss in revenues to the processors could either force them into other fisheries in other regions, or decrease their willingness and capability to venture into other areas.

- The declining crab harvests will probably continue through the first half of the 25-year scenario, but rebuild in the second half.



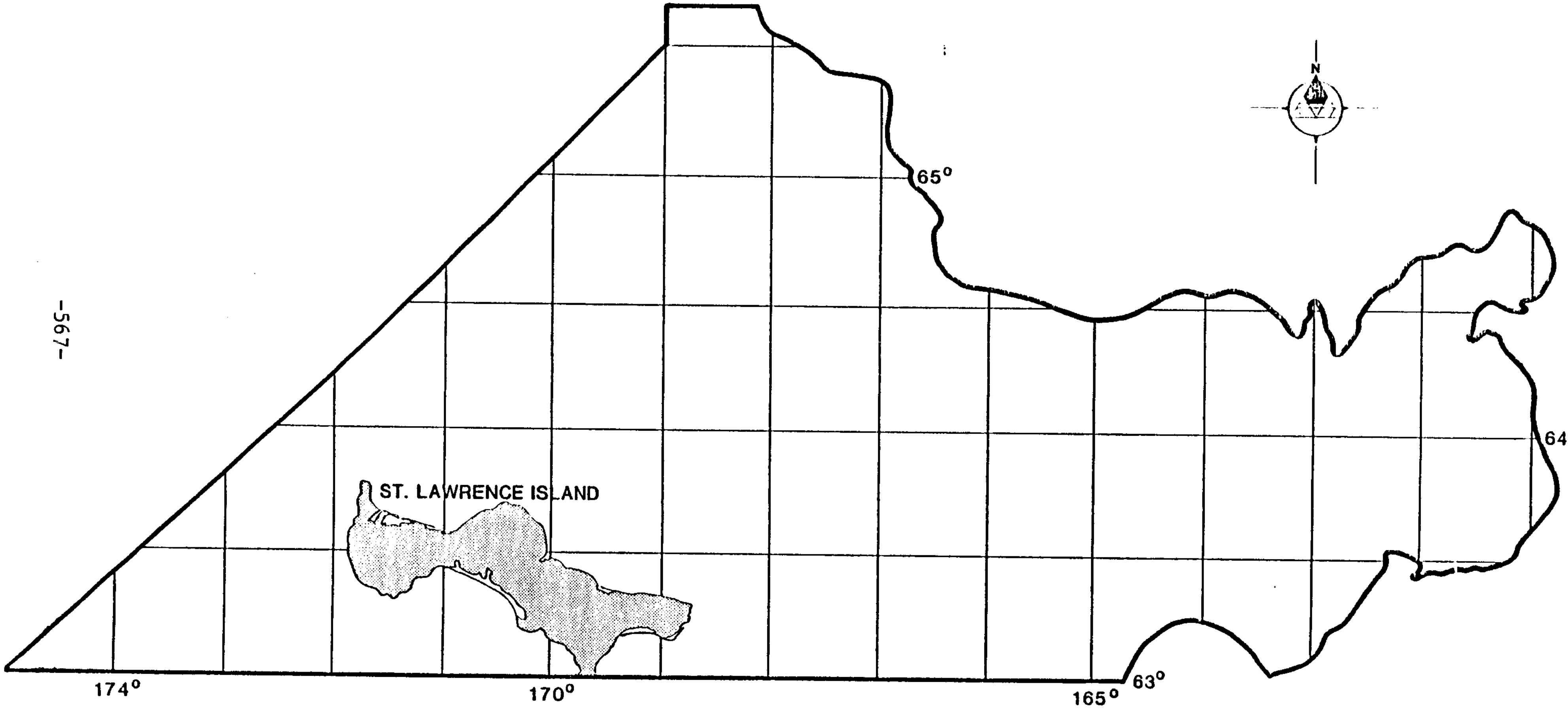
NORTH ALEUTIAN SHELF LEASE SALE AREA
INCLUDING THE 1/2° x 1° GRID AREAS
IN WHICH THE PROJECTED FISH HARVESTS WILL BE PROPORTIONED

Figure 9



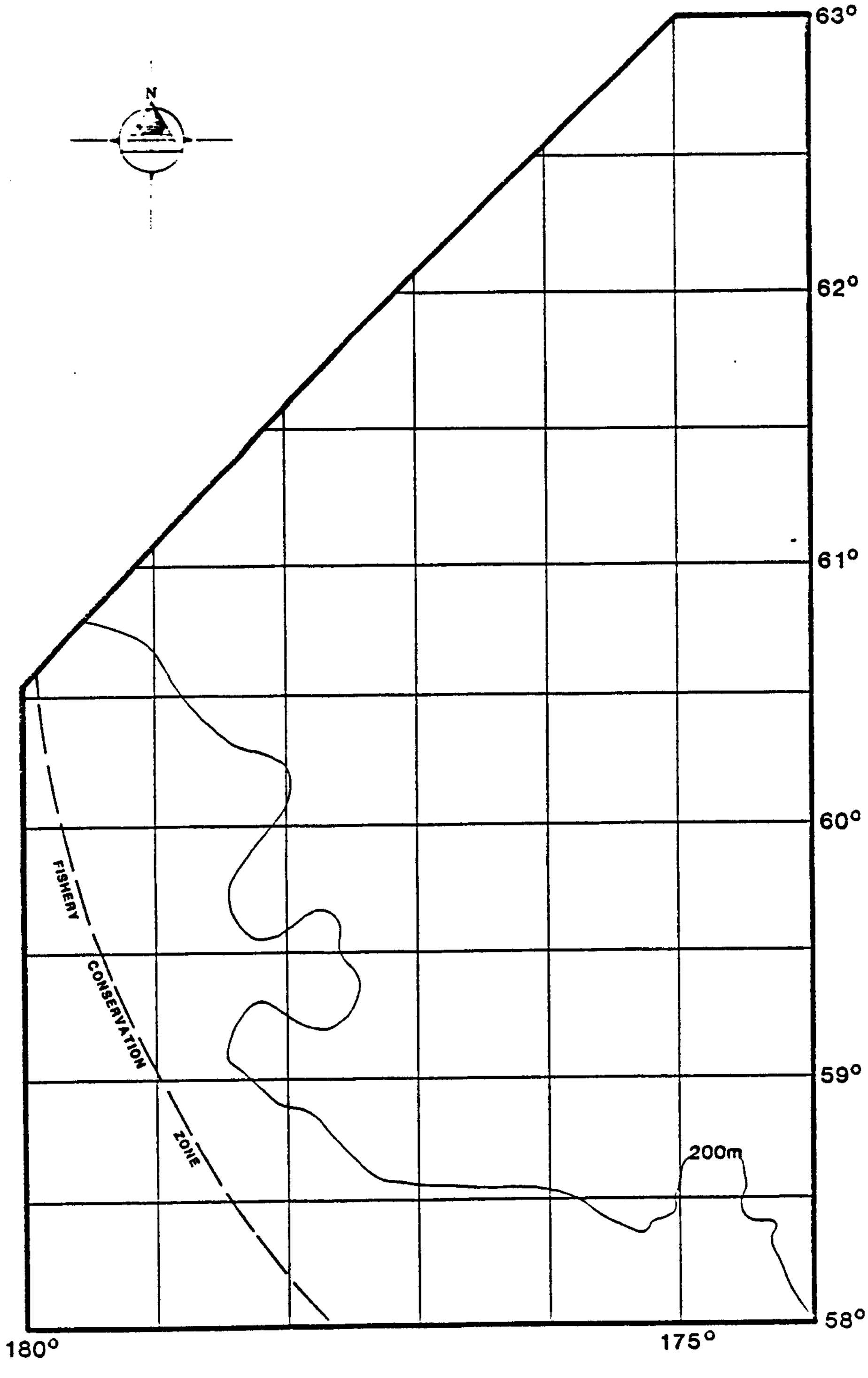
ST. GEORGE BASIN LEASE SALE AREA
INCLUDING THE 1/2°x 1° GRID AREAS
IN WHICH THE PROJECTED FISH HARVESTS WILL BE PROPORTIONED

Figure 10



NORTON BASIN LEASE SALE AREA
INCLUDING THE 1/2° x 1° GRID AREAS
IN WHICH THE PROJECTED FISH HARVESTS WILL BE PROPORTIONED

Figure 11



NAVARIN BASIN LEASE SALE AREA
INCLUDING THE 1/2° x 1° GRID AREAS
IN WHICH THE PROJECTED FISH HARVESTS WILL BE PROPORTIONED

Figure 12

- Domestic fisheries are fully utilized (salmon, crab, halibut, shrimp).

- Most "whitefish" or "bottomfish" fisheries will follow a pattern of development beginning with:

  - joint ventures near shore, then
  - joint ventures and onshore processing near shore, then
  - joint ventures, domestic offshore processing and onshore processing nearshore, then
  - joint ventures far from shore, and
  - joint ventures and domestic offshore processing far from shore

- Therefore, we expect the general sequence for development of the domestic fishery to be:

  1. North Aleutian Basin
  2. Norton Basin plus St. George Basin
  3. St. George Basin
  4. Navarin Basin

- Fishermen will participate in more than one area:

  - North Aleutian Basin and St. George Basin
  - St. George Basin and Navarin Basin

- The impacts of oil development (an oil event) in one area can affect the fisheries of another area. The most probable phenomenon affecting another area would be displacement.

Realistically, the displacement of a fisherman or a group of fishermen can be traced to a loss of fishing grounds, either through competition for space or lost resources. Displacement is the result of lost production or competition for space and/or resources.

The methodology to determine the baseline data for the impact assessment (of an oil event affecting the fisheries in another area) is based on a comparison of the probable chronology of fishery development activities and oil events (Table 8). Displacement due to lost production will be estimated. Displacement resulting from competition is difficult to estimate; but subjective judgements can be made.

These estimates and judgements will be weighed against the answers to the following questions.

- Was the impacted fishery fully utilized by the U.S. industry?
- Are there alternative domestic developed fisheries available?
- Was the fishery a whitefish fishery? If so, what was its chronological stage of development.
- What kind of a whitefish fishery was affected; a joint venture, an offshore floating U.S. processor, or an onshore domestic processor?
- Was the affected fishery seasonal or part of a year-round fishing strategy?
- Are there alternative fisheries spatially and temporally affected?
- Are the alternative fisheries fully developed; are they U.S. or foreign?
- Are there other factors to be considered?

The answers to these questions will focus the baseline fisheries data in four significant areas:

1. Geographic and economic displacement.
2. Numbers of fishermen displaced.

TABLE 8

QUALITATIVE SCHEDULE OF DOMESTIC BERING SEA/ ALEUTIAN ISLANDS CUMULATIVE FISHERIES AND OIL DEVELOPMENT(1)

Order of Development	Fisheries				Petroleum
	Salmon	Herring	Crab	Whitefish	
First	North Aleutian Norton, and St. George are approximately simultaneous	North Aleutian	North Aleutian Norton, and St. George are approximately simultaneous	St. George	Norton
Second		Norton		North Aleutian	St. George
Third		St. George		Navarin	Navarin
Fourth	—(2)	Navarin	Navarin	—(3)	North Aleutian

---

(1) The Fisheries Projections will confirm and quantify this.

(2) Domestic salmon fishing will not occur in the Navarin Basin.

(3) Little, if any, whitefish fishing will occur in Norton Basin.

3. Affected fisheries.

4. Impact on processors

The critical issue in the development of this baseline data is the relationship between the chronology of fishery development events and oil events. In this chronology we will estimate the development threshold, which will appear as a point in time beyond which fisheries activities will not be subject to the same impact interpretation as if they had been affected earlier in their development.

5.0 RELATION TO IMPACT ANALYSIS

This Section briefly discusses how the information generated in the Bering Sea fishing industry analysis will tie into the latter impact analysis of the cumulative Bering Sea OCS development scenarios. The development scenarios to be analyzed consists of:

1. Norton Sound (Sale 57) alone
2. St. George Basin (Sale 70) alone
3. Navarin Basin (Sale 83) alone
4. North Aleutian Shelf (Sale 92) alone
5. St. George plus North Aleutian
6. St. George plus Norton
7. St. George plus Navarin
8. Navarin plus Norton

These are consistent with the scenarios analyzed in Technical Report No. 80. In practice certain simplifications to the above combinations will make themselves apparent in the analysis. For instance the space usage and catch loss impacts for multiple sale area scenarios are simply an additive function of those for individual lease sales. Also, labor impacts and port congestion impacts tend to be a function of the total amount of OCS activity by port or regional area. Since these impacts will center around Dutch Harbor/Unalaska for the Navarin, St. George, and North Aleutian Basins and both Nome and Dutch Harbor/Unalaska for the Norton Basin the above combinations can be simplified into a series of aggregate demand curves for the respective areas.

On the other hand vessel collision and gear loss impacts are very site specific and special attention will be paid to assessing these in detail. This is especially true since the previous Navarin Basin Impact Analysis has shown these (particularly fixed gear loss) to be the relatively more significant of the impacts and of particular concern to the fishing industry.

The following types of impacts will be assessed:

- Catch loss associated with space loss
- Labor interactions
- Vessel collision and gear loss impacts
- Port and infrasture interactions

The previous analysis has shown that catch loss is relatively insignificant. However calculations similar to those performed in Document NV-3 will be carried out for each of the four lease sales since the procedure for doing this is well developed. These impacts can then be summed to arrive at summary impact estimates for the four multiple lease sale scenarios.

The labor interaction analysis will begin with the computation of aggregate labor demand for both the OCS industry and the fishing industry. OCS labor demand will be calculated by general skill class and allocated as appropriate to the Aleutian Islands area (primarily Dutch Harbor/ Unalaska) and the Nome area (for the Norton Basin analysis). Fishing industry employment will be estimated for the Bering Sea/ Aleutian Islands region and will be based on the fishing industry development scenarios as discussed in Section 4.0. Employment will be broken out by harvesting (fishermen on vessels), sea-based processing, and shore-based processing. Special attention will be paid to the issue of local versus non-local employment. Presently, fisheries-related employment in the Unalaska area is primarily non-local and of a transient character. This is because of the relative isolation and lack of urban development in the area. As a result little interaction between the two industries is expected in the near term because both industries essentially compete within a very large labor market area consisting of all of Alaska and the Pacific Northwest. Attention will be paid to possible intermediate or long term interactions within a localized labor market due to development of an expanded "local" employment base for either or both industries. This will be based on a review of community develoment and regional planning studies both specific to Alaska and in the general literature.

Gear loss is potentially associated with:

- Damage or loss to trawl gear
- Loss of shellfish pots
- Loss of long-line marker bouys

Trawl gear damage will be assessed based on historical data from the North Sea with adjustments made for the relative amount of OCS development activity and fishing activity. It should be noted however that mitigating measures can probably reduce the incidence of gear loss below the estimate obtained from the above estimating procedure.

Loss of marker bouys for shellfish pots as well as long lines requires a detailed analysis of the relative location of the respective fisheries as well as likely navigation routes for OCS supply and exploration vessels. OCS development of the Navarin Basin affects Tanner and king crab fishing areas around the Pribilof Islands as well as potential future pot fishing grounds within and on the approaches to the Navarin Basin. Development of the Norton Basin will affect Tanner crab fisheries just north of the Aleutians as OCS vessels travel north from Dutch Harbor. Development in the St. George Basin and/or the North Aleutian Shelf will affect the major king and Tanner crab grounds north of the Aleutian Islands and possibly around the Pribilof Islands depending on the location of activity within the St. George Basin. All of the lease sale areas will affect halibut and Pacific cod longline areas depending on the specific OCS vessel routes.

Because the previous Navarin Basin analysis has shown these impacts to be relatively significant, particular attention will be paid to analyzing these potential impacts in detail. For each lease sale a probabilistic range of potential OCS vessel routes will be computed based on the likely drilling sites within each lease sale area. The potential fishing grounds for each of the affected fisheries will then be compared with the OCS vessel routes based on data from ADFG. Within the areas of overlap the future number of pieces of gear will be estimated based on the fishery development scenarios and expected trends in catch per unit effort. As in the Navarin Basin analysis the theoretical pot loss will be calculated based on the expected value of the number crab pots hit by the "area swept" by OCS vessels operating in the crab pot areas. Relatively more effort will be placed however, on uncovering and analyzing any historical data on number of crab pots that were actually hit and on assessing the effect of potential mitigating measures such as OCS vessel corridors that route traffic away from heavy concentrations of pots. Vessel collision impacts will be assessed based on the collision prediction models used in the Navarin Basin analysis using future estimates of the number of vessels in the waters specific to each of the lease sale areas.

Port and infrastrucrture impacts will be assessed based on estimates of aggregate demand by major port for both the fishing and offshore oil industries. These levels of demand will then be compared to an assessment of the development potential and development plans for these key ports.

6.0 LIMITATIONS

We have made the following limiting assumptions:

- No recreational fishing exists, or will occur, in the Navarin lease sale area.

- The increased demand on the recreational fisheries of the Bering Sea, resulting from the increased numbers of petroleum-related personnel and other population growth, will be evaluated as appropriate.

- An examination of subsistence fishing in the BSAI is outside the scope of the study.

- It is recognized that an oil spill may impact fisheries remote from the spill itself, e.g., an offshore spill may affect adult salmon that would be captured in a nearshore fishery. However, except for a brief review, it is not necessary to exhaustively examine the strictly biological impacts (lethal/acute and sublethal/chronic) of oil spills on the fish populations.

7.0 DATA AND DATA SOURCES

Data: Catch by species by all gear types according to the 1° longitude by 1/2° latitude areas (whitefish, shellfish) and by regulatory district (salmon and herring); pounds and value; specification of data by place-of-catch or by place-of-landing.

Sources: National Marine Fisheries Service (NMFS); Vidar Wespestad
International North Pacific Fisheries Commission (INPFC)
Alaska Commercial Fisheries Entry Commission (CFEC); Curt Schelle
Alaska Department of Fish & Game (ADF&G)

Data: Level of fishing effort (number of vessels by type and size, total employment, and income, distinguishing between local and non-local effort where feasible and meaningful) by fishery.

Sources: National Marine Fisheries Service (NMFS); Vicki Vaughn
Alaska CFEC
ADF&G

Data: Fish processing (number of plants by community location, type, employment and income).

Sources: ADF&G
NMFS
Alaska Department of Labor (ADL)

Data: Fish markets (descriptive information by species).

Sources: Alaska Seafood Marketing Institute
ADF&G
AFDF

Data: Factors of change: past, present, and future (limited entry, technology, 200-mile limit, rehabilitation, joint ventures, aquaculture, whitefish potential, proposed clam fishery, current political and economic trends, and the relationship between foreign and domestic fishing effort as affected by these other factors).

Sources: North Pacific Fisheries Management Council (NPFMC)
ADF&G
Alaska Fisheries Development Foundation (AFDF)
Alaska Department of Transportation & Public Facilities (ADOTPF)

Data: Frequency and seasonality of ocean space and harbor use by type and size of fishing boat, and by pattern of fishing related to type and location of target species.

Source: NMFS Enforcement
CFEC

Data: Existing capacity, suitability and location of local ports and harbors including size and composition of fishing fleets; type of processor, number, and processing capacity; and availability of public services.

Source: ADOTPF

Data: Siting and public service (power, water, and sewage) requirements for commercial harbors and onshore processing plants.

Source: ADOTPF

Data: Areas of current conflict in ocean space use such as congested harbors, trawl lanes, collisions, commercial non-fishing vessel traffic, and recreational boat traffic (where such traffic is significant). The analysis shall include estimates of gear loss by type and replacement cost.

Sources: NMFS
USCG

Data: Types of conflict between recreational and commercial fishing activities, but only where such conflicts are significant.

Sources: ADF&G

Data: General organization of the fish and fish processing industries and current political or economic trends that are critical or immediate to the future of these industries.

Sources: AFDF
ADFG

Data: Estimate the effect of the identified changes, beneficial or adverse, on the level of catch in pounds or value, as appropriate, and the ability of the industries (services, fishermen and fish processing) to compensate for adverse effects, e.g. relocate, modify methods, or substitute factors of production.

Sources: Various

Further contacts will be made with:

Jim Branson: NPFMC

Vidar Wespestad, NMFS

Marty Eaton, ADF&G Shellfish Biologist, Kodiak

Dick Goldsmith, Executive Director, North Pacific Vessel Owners Assoc., Seattle

Chris Mitchell, AFDF

Sharon Gwinn, AFDF

Clarence Pautzke, NPFMC

Bill Aberle, Office of Commercial Fisheries Development

Byron Morris, NMFS

Gary Hennick, ADOTPF

Ken Griffin, ADF&G

8.0 BIBLIOGRAPHY APPENDIX B

Alaska Department of Fish and Game, 1981. Westward region staff reports to the Board of Fisheries, Anchorage, Alaska, March 1981.

__________, 1961-1982. Commercial finfish and shellfish fishing regulations.

__________, 1981. Information on the Navarin Basin lease sale area. Habitat Division. Anchorage, 2 charts.

Alaska Department of Fish and Game, 1982a. Westward region staff reports to the Board of Fisheries, Anchorage, Alaska, December, 1982; March, 1982.

__________, 1982b. Alaska 1980 catch and production commercial fisheries stastics. Juneau, AK.

Alaska Department of Labor, Employment Security Division. Data files.

__________, 1980. Alaska fishermen's survey. Juneau, AK.

__________, 1980. Alaska seafood processor survey. Juneau, AK.

Alaska Fisheries Development Corporation, February, 1978. Development proposal for bottomfish off Alaska.

Alaska Fisheries Development Foundation, 1981. Operations of a European factory trawler in the Alaska Bering Sea groundfish fishery. Anchorage. 53 pp.

Anonymous, 1978. Report of the meeting between U.S. and Japanese scientists for the exchange of information on the condition of fishery stocks in the Bering Sea and northeastern Pacific. U.S. Dept. of Commerce, NOAA, NMFS, NWAFC, Seattle, WA (unpubl.).

Arthur D. Little, Inc., 1978. The development of Alaska bottomfish industry: strategies for the State of Alaska. Executive Summary. Prepared for Office of the Governor.

Bakkala, R.G., V. Wespestad, L. Low, and J. Traynor, 1980. Condition of the groundfish resources of the eastern Bering Sea and Aleutian Islands region in 1980. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Anchorage, Alaska, Oct. 1980). 98 pages. Northwest and Alaska Fisheries Center. National Marine Fisheries Service.

Bakkala, Richard G., and Gary Smith, 1978. Demersal fish resources of the eastern Bering Sea: Spring 1976 and Data Appendices. 233 and 404 p. Northwest and Alaska Fisheries Center. National Marine Fisheries Service.

__________, 1979. Fisheries oceanography-eastern Bering Sea shelf. 481 pp. Northwest and Alaska Fisheries Center. National Marine Fisheries Services.

__________, L. Low, and Wespestad, 1979. Condition of groundfish resources in the Bering Sea and Aleutian area. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Toyko, Japan, Oct. 1979) 105 p. Northwest and Alaska Fisheries Center, Nat'l Mar. Fish. Serv., NOAA, Seattle.

Bottomfish Task Force, 1979. State of Alaska program for development of the bottomfish industry (PDGI). Juneau, AK.

Browning, R.J., 1974. Fisheries of the North Pacific. Alaska Northwest Publishing Co. Anchorage, AK. 408 pp.

Combs, Earl R., Inc., 1979. Prospectus for the development of the United States fisheries. Mercer Island, WA. Report for the Fisheries Development Task Force, U.S. National Oceanic and Atmospheric Administration. 442 pp.

__________, 1980. Program for development of the bottomfish industry. Prepared for the AK Dept. of Commerce and Economic Development, Office of Commercial Fisheries Development. 80 p.

__________, 1981. St. George Basin and North Aleutian Shelf commercial fishing analysis. Technical Report No. 60. Alaska OCS Office, Alaska OCS Socioeconomic Studies Program. Sectionally paged.

Deconsult A/S, Ltd., 1979. State of Alaska: community planning for bottomfish development. Phase I and Executive Summary. Copenhagen, Denmark.

__________, 1979. Community planning and development for the bottomfish industry. Phase One Report, Executive Summary. Department of Community and Regional Affairs, State of Alaska Division of Community Planning.

Dunlop, H.A., F.H. Bell, R.J. Myhre, W.H. Hardman, and G.M. Suthward, 1964. Investigation, utilization, and regulation of the halibut in the southeastern Bering Sea. Int. Pac. Halibut Comm., Sci. Rep. 35, 72 p.

Fisher, Capt. Barry, 1980. A US/USSR joint venture for yellowfin sole in the eastern Bering Sea. Prepared for the Alaskan Fisheries Development Foundation. Anchorage.

Food and Agriculture Organization, Annual. Yearbook of fishery statistics, Rome.

French, Robert, 1979. Observer program for the domestic groundfish fishery in the Gulf of Alaska. North Pacific Fishery Management Council Document. 38 pages.

Hameedi, M.J. (ed.), 1982. Proceedings of a synthesis meeting: The St. George Basin environment and possible consequences of planned offshore oil and gas development. Outer Continental Shelf Environmental Assessment Program, Juneau, 162 pp.

Hutton, Mark, 1981. The Fisheries and fishery resources of the Chernofski area. Dames & Moore Technical Memorandum No. 3. Anchorage. 83 pp.

Ikeda, I., 1979. Rockfish biomass in the eastern Bering slope and Aleutian area. (Document submitted to the annual meeting of the INPFC, Toyko, Japan, Oct. 19790. 12 pages. Far Seas Fisheries Research Laboratory, Fisheries Agency of Japan.

International North Pacific Fisheries Commission. 1981. Proceedings of the 28th Annual Meeting -- 1981. INPFC. Vancouver, Canada. 401 pp.

International Pacific Halibut Commission, 1982. Annual report 1981. Seattle, WA.

Kauwling, T.J. and G.J. Bakus, 1979. Effects of hydraulic clam harvesting in the Bering Sea. Tetra Tech Rept. TC 3224. Prepared for the North Pacific Fisheries Management Council. Passadena, CA 181 pp.

Kramer, Lois, Clark, Veronica C. and George J. Cannelos, 1978. Planning for offshore oil development: Gulf of Alaska OCS handbook. Juneau: Alaska Dept. of Community and Regional Affairs, Division of Community Planning.

Low, L., 1976. 1976. Status of major demersal fishery resources of the northeastern Pacific: Bering Sea and Aleutian Islands. U.S. Dept. Commercie, NOAA, NMFS, Seattle, WA. Processed Rept. 115 p.

Macy, Paul T., Janet M. Wall, Nickolas D. Lampsakis and James E. Mason, 1978. Resources on non-salmonid pelagic fisheries of the Gulf of Alaska and eastern Bering Sea. Parts 1, 2, and 3. 715 p. in parts 1 and 2, 329 p. in Part 3. Northwest and Alaska Fisheries Center. National Marine Fisheries Service.

Morris, Byron F., 1981. An assessment of the living marine resources of the central Bering Sea and potential resource use conflicts between commercial fisheries and petroleum development in the Navarin Basin, proposed sale No. 83. Anchorage. 232 pp.

National Marine Fisheries Service, (NMFS), (monthly). Current fishery statistics. NOAA. Washington, D.C.

__________, 1969. Alaska NMFS exploratory fishing drags. Parts 1-5, U.S. Dept. Comm. NMFS, Northwest and Alaska Fisheries Center, Seattle.

Nelson, Russel, Jr., Robert French and Janet Wall, 1980. Summary of U.S. observer sampling on foreign fishing vessels in Bering Sea Aleutian Islands region, 1979. 85 pages. Northwest and Alaska Fisheries Center. National Marine Fisheries Service.

Niggol, Karl, 1980. Data on fish species from Bering Sea and Gulf of Alaska for a NWAFC species thesaurus for ecosystems simulation. 38 pages. Northwest and Alaska Fisheries Center. National Marine Fisheries Service.

North Pacific Fishery Management Council, 1978. Fishery management plan and draft environmental impact statement for halibut off the coast of Alaska. Anchorage, AK: NPFMC.

__________, 1979. Fishery management plan and draft environmental impact statement for the groundfish fishery in the Bering Sea/Aleutian Island area (Draft). Anchorage, AK: NPFMC.

__________, 1978. Fishery management plan and draft environmental impact statement for the high seas salmon fishery off the coast of Alaska east of 175 degrees longitude. Anchorage, AK: NPFMC.

__________, 1979. Draft fishery management plan and draft environmental impact statement Bering - Chukchi Sea. Herring. Anchorage, AK.

North Pacific Fishery Management Council, 1981. Amended fishery management plan for the commercial Tanner crab fishery off the coast of Alaska. Anchorage.

__________, 1981. Bering Sea/Aleutian Islands king crab draft env. impact statement and fisheries management plan. Anchorage, AK. 93 pp.

NOAA, 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975 - Northwest & Alaska Fisheries Center Processed Report, October 1976.

Okada, K., H. Yamaguchi, T. Sasaki, and K. Wakabayashi, 1980. Trends of groundfish stocks in the Bering Sea and the northeastern Pacific based on additional preliminary statistical data in 1979. (Document submitted to the U.S.-Japan Bilateral Meeting in Tokyo, Japan, May 1980). 37 p. Far Seas Fisheries Research Laboratory, Fisheries Agency of Japan, 1000 Orido, Shimizu 424, Japan.

Olsen, S., S.B. Saila, and T. Kowalski, 1977. Section 8: The potential impact on commercial fisheries of ground pre-empted by petroleum-related structures on Georges Bank. Pages 219-270 in Fishing and Petroleum Interactions on Georges Bank. Volume II: The Characteristics of the Two Industries, Potential Future Trends, and an Assessment of Foreseeable Conflicts. Prepared for the New England Regional Commission by the Coastal Resource Center, Graduate School of Oceanography, University of Rhode Island. 323 pp.

Orth, Frank, 1981. Draft. Alaska longline demonstation project F/V Aleutian Mistress, first observation period trip report. 33 p. Prepared for the Alaska Fisheries Development Foundation.

Pereyra, W.T., J.E. Reeves, and R. G. Bakkala, 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. U.S. Dept. Comm., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Northwest Fish Center, Seattle, WA, Processed rep., 619 p.

Quast, J.C., 1972. Reduction in stocks of Pacific Ocean perch and important demersal fish off Alaska. Trans. Am. Fish. Soc. 101:64-74.

Riggs, R.F., A short study of statistics of collisions between merchant vessels, Navigation, v. 12, no. 3, Autumn 1965.

Schneider, D.M., ed., 1977. Planning for onshore development: discussion papers. U.S. Dept. of the Interior and U.S. Environmental Protection Agency. American Society of Planning Officials, Chicago, IL.

Science Applications, Inc., 1981. A summary of available environmental knowledge of the Navarin Basin. Draft Report for NOAA/OMPA Alaska Office. Boulder, Colorado. 116 pp.

Smith, G.B., R.S. Hadley, R. French, R. Nelson, Jr., and J. Wall, 1981. A summary of productive foreign fishing locations in the Alaska region during 1977-1980: trawl fisheries. Alaska Sea Grant Rept. 81-4. Fairbanks. 410 pp.

__________, R.S. Hadley, Robert French, Russel Nelson, Jr., and Janet Wall, 1980. A summary of productive foreign fishing locations in the Alaska region during 1977-79: Longline Fisheries, 180 p. Alaska Sea Grant Report 80-1.

Synergy, Inc., 1974. An economic forecast of the U.S. fishing industry: the national fisheries plan baseline forecast, 1974-1985. Report for the U.S. National Marine Fisheries Service.

Thompson, W.F., and R. Van Cleve, 1936. Life history of the Pacific halibut: (2) Distribution and early life history. Int. Fish. Comm. Rept. 9, Seattle, 184.

Tryck, Nyman and Hayes, 1977. Recommended community development plans, City of Unalaska, Alaska. Anchorage, AK.

U.S. Army Corps of Engineers, 1981. Harbor feasibility report, St. Paul Island, Alaska. Alaska District, Anchorage.

U.S. Coast Guard, 1971-1977. Proceedings of the Merchant Marine Safety Council. Washington, D.C.: USCG.

U.S. Department of Labor, Bureau of Labor Statistics, 1977-1979. Monthly labor review. Washington, D.C.: GPO.

U.S. National Marine Fisheries Service, Annual. Fishery statistics of the U.S. Washington, D.C.

U.S. National Marine Fisheries Service, 1980. Food fish market review. Current Economic Analysis, F-30. Washington, D.C. 47 pp.

University of Aberdeen. Department of Political Economy and the Institute for the Study of Sparsely Populated Areas, 1978. A physical and economic evaluation of loss of access to fishing grounds due to oil and gas installations in the North Sea. Aberdeen, Scotland: University of Aberdeen, Research Report No. 1. 152 pp.

University of Alaska, Alaska Sea Grant Program, 1980. Western Alaska and Bering-Norton petroleum development scenarios: Commercial fishing industry analysis, draft final, Technical Report 51. Alaska OCS Office, Bureau of Land Management, Anchorage. Alaska OCS Socioeconomic Studies Program. Sectionally paged.

Wakabayashi, K. and R. Bakkala. 1978. Estimated catches of flounders by species in the Bering Sea updated through 1976. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, Canada, Oct. 1978). 14 p. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA,

Wespestad, V.G., and L.H. Barton, 1980. Distribution and migration and status of Pacific herring. In D.W. Hood and R. Calder (eds.): Bering Sea Shelf Oceanography and Resources, Vol. I., in press.

Wespestad, V.G., S.H. Hoag and R. Narita, 1982. Reducing the incidental catch of prohibited species in the Bering Sea groundfish fishery through gear restrictions. IPHC Technical Report No. 19. Seattle. 14 pp.

Wilson, J.R., and A.H. Gorham 1982. Alaska underutilized species, Volume 1: Squid. Alaska Sea Grant Report 82-1, Fairbanks. 77 pp.

Yamaguchi, Hirotsune, 1980. Report of multi-vessel trawl survey on bottomfishes in the eastern Bering Continental Shelf in 1979. (Document submitted to the U.S.-Japan Bilaterial Meeting in Tokyo, Japan, May 1980). 13 p. Far Seas Fisheries Research Laboratory, Fisheries Agency of Japan, 1000 Orido, Shimizu 424, Japan.

APPENDIX C - CATCH LOSS METHODOLOGY

Structures associated with OCS oil/gas development will occupy physical space in the waters of the continental shelf. These have the potential for affecting catch in fisheries in the waters which the OCS structures may occupy. There is the potential for a loss of fishing waters for fishing vessels. Such a spatial loss may be potentially associated with both surface and subsurface OCS structures. The spatial loss can be expressed in terms of a buffer zone around particular structures in which fishing is effectively foreclosed.

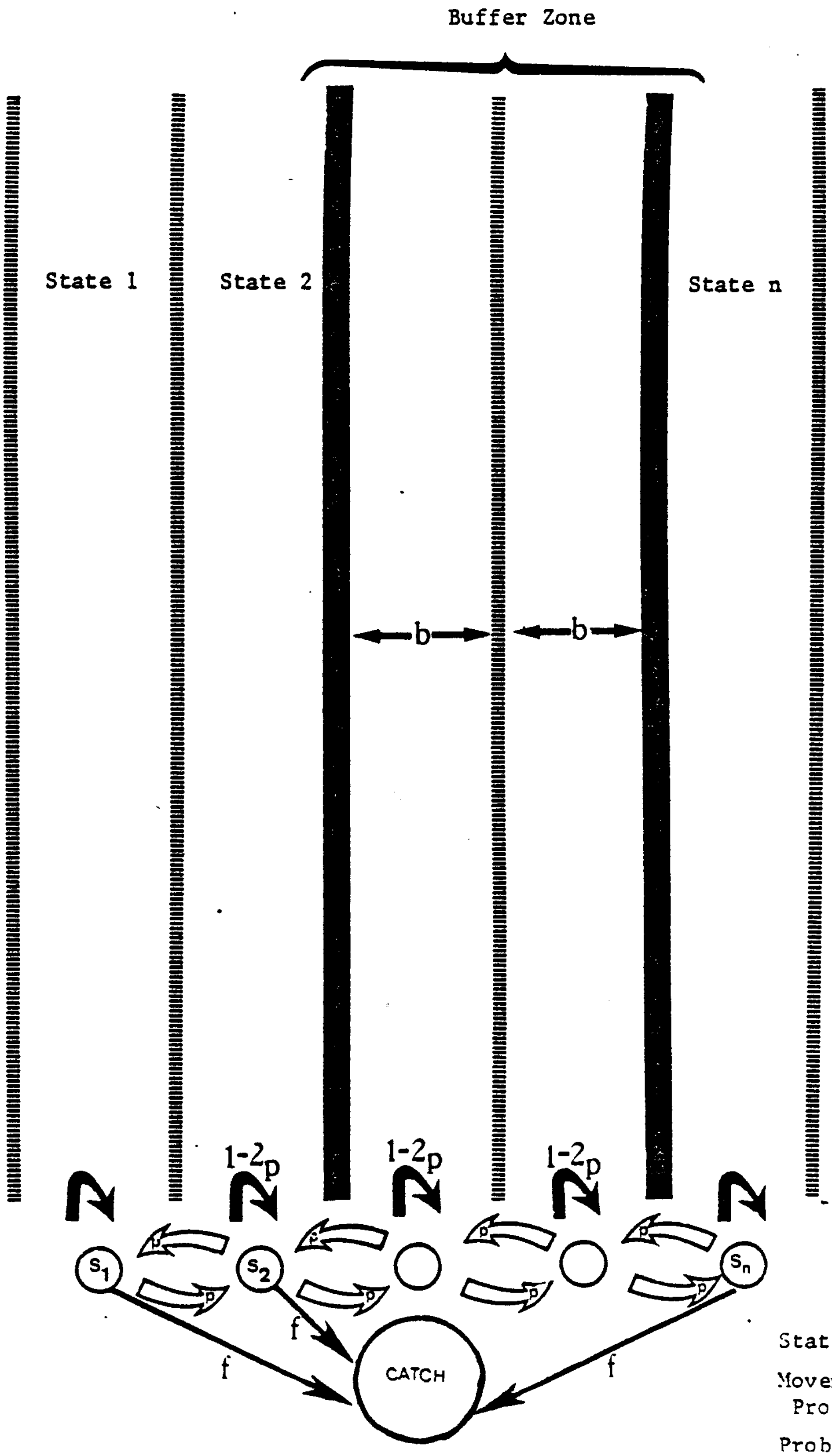
Given a buffer zone, the question remains as to the effect on total catch that such a foreclosure would have. To our knowledge the only previous attempts have included: 1) statistical analysis of historical catch-by-area data over a time period during which OCS structures were placed in an area; and 2) estimating the catch effect as being proportional to the area of a fishery foreclosed to fishing. In the attempts we are aware of the first method has not produced usable results. This has been no doubt due to the lack of an adequate historical data base giving fine enough resolution coupled with the great year-to-year variation (due to natural factors as well as changes in the exploitation rate) inherent in fisheries. The second method provides a reasonable first-order approximation to the catch loss. However, it does not allow consideration of the fact that certain fish may, during a season, move in and out of the buffer zone and that some of these fish may be caught when outside the buffer zone. Thus in many instances the catch loss will be less than proportional to the area foreclosed. Also, the second method does not directly consider the fact that foreclosure of a certain fishing area may increase the exploitation rate in other areas of the fishery such that catch may not decrease in direct proportion to the ratio of area foreclosed.

The objective of this methodology is to build upon the second method by taking into explicit account the effect of both fish movement and the exploitation rate. The model calculates the expected catch loss due to the placement of OCS structures as a function of the amount of various types of such structures and various parameters describing the fishery.

C.1 Approach

The overall appraoch consisted of using a Markov "random walk" type of probabilistic model of fish movement and catch. The basic structure of the model is illustrated in Exhibit C-1. In this model a series of states were defined corresponding to spatial areas occupied by a stock of fish. The spacial areas are long, thin rectangles spaced within and to either side of the buffer zone. In any given period of time a fish in state has a certain probability (defined by p) of moving to either state adjacent to it. In addition, for those states outside the buffer zone there is a probability (defined by f) that a fish will be caught and enter a state known as "catch". The width of the buffer zone is

Exhibit C-1



State i = S_i

Movement Probability = p

Probability of Getting Caught = f

Buffer Zone Distance = b

defined by a parameter b measured from the center of the structure to the edge of the buffer zone.

The model reduces to one dimension what is essentially a two dimensional process. That is, fish can swim in random directions not just left and right along a line. However, when the buffer zone is long relative to its width (such as in the case of a pipeline) random movement between states along the axis perpendicular to the long axis of the buffer zone are probabilistically identical at the limit to a two dimensional modeling. For other cases such as buffer zones around platforms this is not as true. However, the effect of any error in this approximation is to overestimate the catch loss associated with OCS structures. This is because a more nearly circular or square buffer zone allows fish to move outside the buffer zone along the other axis.

The model begins with a set of initial conditions and is run through many iterations. Over a large number of iterations the transition probabilities (p) model a probabilistic process analogous to one in which for a given fish which starts at state i at time equals 0, the probability distribution of its location at a later time t can be described by a normal or Gaussian distribution function. The variance (square of the standard deviation) of this function is typically referred to as the dispersion coefficient and expressed as a^2. The parameter a^2 is normally expressed in units of miles^2 per day. The dispersion coefficient is related to the transition probabilities as follows:

1) $p = a^2/(2 * d^2) * \underline{t}$

where $\underline{t}$ is the time period for each model iteration and d is the physical width of each spatial state as represented in the model. Throughout this report the character "*" represents multiplication and "/" division using typical computer notation. If a^2 is expressed in miles^2 / day, d in miles, and t in days, the probability p is dimensionless.

The derivation of Expression 1 can be shown as follows. The generalized formula for the variance of a probability distribution function is

2) $$\sum_{i=1}^{I} p_i * (x_i - E(\underline{x}))^2$$

where x_i is a value of the random variable, p_i is the probability of the distribution function taking on that value, and $E(\underline{x})$ is the mean of the distribution function. Thus in the Markov model the probability distribution function for the location of a fish in state i after one model iteration can be described as

Location state	$x_i - E(x)$	Probability of being in this state	$p_i(x_i - E(x))^2$
i-1	-d	p	pd^2
i	0	1-2p	0
i+1	d	p	pd^2
Variance = Sum =			$2pd^2$

The variance for one model iteration equals $a^2 * t$ since the variance of a sum of n random varibles equals n times the variance of one random variable and because one model iteration can be viewed as the sum of *t* daily iterations. From the central limit theorem it can be seen that the sum of a large number of the above probability distribution functions will approach a normal function.

When $(a^2 * t)$ is substituted for the variance in the above derivation expression 1 results.

The parameters *t* and d are selected for each model run depending upon the number of iterations and states to be used when running the model. The variables *t* and d must be large enough to obtain a reasonable representation of reality.

Expression 1 can be rearranged as follows:

$$3) \qquad p = (a / b)^2 / (2 * \underline{t}) * (b^2/d^2)$$

The right-most expression in parenthesis is simply one half the number of states in the buffer zone as represented in the model (i.e. as shown in Exhibit C-1 b divided by d equals one half the number of states in the buffer zone). This is determined when setting up each model run. Expression 3 shows that the model input variables a and b can be collapsed into one parameter, $(a/b)^2$, for input into the model.

A series of variables $s_{i,t}$ defines the expected stock of fish in state i at time period t, where t is measured from some starting time t = 0. Using Markov theory the probability distribution of stock at time period t+1 can be defined as follows:

$$4)\ \sum_{i=1}^{N} s_{i,t+1} = s_{i-1,t} * p + s_{i+1,t} * p + s_{i,t} * (1-2p)$$

where N is the total number of states being modeled. In practice N is selected so that the states furthest from the buffer zone show no difference in the stock they contain from the baseline case of no buffer zone.

c_t is defined as accumulated catch (from some starting time t= 0) The addition to c in time period t can be calculated as:

$$5)\qquad s_{i,t} * f \text{ for all states i outside the buffer zone}$$

Note that s_i need not be the actual distribution of stock in state i but can be thought of probabilistically as the expected value of the stock in state i at a given time period. Fish of course are not uniformly distributed at all times. Rather the model assumes that the probability distibution of fish over the area being modeled is uniform for the baseline case without the intrusion of the buffer zone. In other words, for the baseline case at any given time the probability of finding fish at any given point in the area being modeled is considered to be the same. This same assumption of uniform probability distribution is applied to the buffer zone case at some initial time period (t=0). This is conceived to correspond to the time of an annual recruitment of new stock to the fishery at which point a new period of annual fishing begins. When a buffer zone is added the probabilistic distribution of fish changes relative to the baseline case of no buffer zone and to the initial condition in the buffer zone case. This is because the expected stock within the buffer zone does not decrease due to fishing pressure. Inside the buffer zone the stock does not change due to fishing pressure in the buffer zone itself, however it does change as fish move randomly to states outside the buffer zone where they are subsequently caught.

The model assumes an initial biomass m_i in each state, the probability distribution of which is distributed uniformly among the states.

Conceptually the model is run twice. Once for the baseline catch where there is no buffer zone and fishing takes place in all states. The model is then run again with certain states designated as no-fishing states corresponding to areas within a buffer zone. This can be described as follows:

$$6) \quad c_T = \sum_{\substack{\text{for } i \text{ outside} \\ \text{the buffer zone}}}^{N} \sum_{t=1}^{T} g_{i,t} * f * m_i$$

where c_T is total accumulated catch through some time period T and g is the relative stock size in each state relative to the initial expected value biomass m at time period 0.

If c_T is defined as catch with a buffer zone, c'_T as catch without the buffer zone (i.e. baseline case), and g' and f' as the analog to g and f respectively for the baseline case, the expected catch loss percentage L can be expressed as:

$$7) \quad L = 1 - c/c'$$

or:

$$8) \quad L = 1 - \left[\frac{\sum g_{i,t} * f * m_i}{\sum g'_{i,t} * f' * m_i}\right] = 1 - \left[\frac{\sum g_{i,t} * f}{\sum g'_{i,t} * f'}\right]$$

where the summation is taken as in expression 6 and where m_i cancels out. Thus it is not necessary to know the absolute value of m_i. Rather, m_i is a function of recruitment of fish to the fishery and is constant between the baseline and buffer zone cases.

When the model is run to calculate catch loss, T is chosen to represent one year or 365 days. This is based on the generalized assumption that fisheries typically have an annual recruitment of new additions to stocks.

The parameters f and f' are analogous to the fishing exploitation rate F as commonly seen in fishery population dynamics. F represents the instantaneous fishing mortality or exploitation rate and is a function of the fishing pressure in a given fishery. Using this concept catch in a given area through time period t with an initial biomass m can be defined as

$$9) \qquad m * (1-e^{-Ft})$$

See Beverton and Holt (1957) for a detailed explanation of the theory behind the concept of the parameter F.

Expression 6 as used in the catch loss model is really the descrete time period analogy to expression 9. The f and f' as used in the model represents the fishing exploitation rate over the time period of each discrete model iteration. Each model iteration represents the time between which the new state variables $g_{i,t}$ are calculated. The parameter f' as used in the model is related to F as follows:

$$10) \qquad f' = 1 - e^{-F*\underline{t}}$$

This is because m * f' must equal expression 9 where $t = \underline{t}$.

Note that the probabilities of fish being caught (f and f') in any model iteration can be different between the baseline and buffer zone cases. When a buffer zone is introduced the effective fishing area is decreased. However the number of vessels and total fishing effort is assumed to remain the same. This means that the effective fishing effort per area increases. Specifically, if A = the total area of the fishery, r = the percentage of the fishery occupied by buffer zones, F = the fishing pressure (or probability of fish being caught) with the buffer zone, and F_b = the fishing pressure with the buffer zone, then because the effective fishing area is reduced by a factor of (1-r) with the buffer zone:

$$11) \qquad \begin{aligned} F &= h * w/A \\ F_b &= h * w/(A * (1-r)) \end{aligned}$$

where w is the total amount of water "fished" (which is equal to the average vessel speed times the time fished times the effective sweep width of the gear with an allowance for losses), and h is a scaling parameter which relates the real world fishing exploitation rate to the total amount of water "fished". Note that the actual value of h need not be known because it is constant between the two cases and therefore cancels out.

Thus:

$$12) \qquad F_b = F / (1-r)$$

The value of f can be calculated in a manner analogous to equation 10 when the F_b from expression 12 is substituted for F in expression 9. This yields the following:

$$13) \qquad f = 1 - e^{-F * \underline{t} / (1-r)}$$

C-2 Model Computation

The model uses a two stage procedure for calculating the expected catch loss on a digital computer. Stage 1 calculates the catch loss for a fishery where r (the ratio of the areas of the buffer zones to the area of the fishery) is equal to one percent. The resultant catch loss for this one percent case is termed the catch loss parameter, or M, and is a function of the dispersion coefficient divided by the square of the buffer zone, a^2/b^2 and the instantaneous fishing mortality, F. Exhibit C-2 presents the results of Stage I. Stage II uses as inputs the catch loss parameter M, the fishery exploitation rate F, the area of the fishery A and data on the number of OCS structures and the width of associated buffer zones. From this the total area of buffer zones is calculated for a particular lease sale scenario and a particular value of the ratio of the area of buffer zones to area of fishery is calculated. Through a procedure described later the parameter M is then used to calculate the catch loss for the actual value of this ratio.

It was necessary to use this two-stage procedure because of the large amount of computer time required for each run. This procedure allows a smooth curve to be fitted through points plotted from the results of a series of runs. The intermediate output shown in Exhibit C-2 can then be used to estimate the catch loss parameter M without having to make further runs of Stage 1. An additional advantage of the two stage procedure is the fact that the intermediate results as presented in Exhibit C-2 show clearly the effects of variations in F and a^2/b^2.

As the dispersion coefficient decreases relative to the buffer zone distance it levels off and converges toward the value associated with no movement of the fish. This reflects the fact that at zero or low values of the dispersion coefficient there is little movement of the fish into and out of the buffer zone. The catch loss is less than proportional to the percentage of fishing area foreclosed because increased fishing effort is applied to the remaining fishing area and stock. The catch loss increases with increasing F because at higher F there are diminishing returns associated with adding a marginal unit of fishing effort relative to the area and stock as the overall fishing effort increases.

As the dispersion coefficient approaches and exceeds the buffer zone distance the catch loss begins to decrease rapidly. This represents the fact that fish are moving more freely into and out of the buffer zone and have a relatively greater chance of being caught because of the higher proportion of time outside the buffer zone. There is no longer a certain percentage of the total stock that effectively remains in a sanctuary. At the extreme very mobile species such as tuna or mackerel would have a very insignificant catch loss. In fact a negligible catch loss would be associated with nearly all pelagic species.

The results of Stage I were produced by running a series of computations for various values of the two parameters and fitting the parametric curves.

Exhibit C-2

Catch Loss Parameter As a Function of F and Dispersion Coefficient