

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

824 SCOMM29: HOUSE INTERIM COMM. FOREIGN INVESTMENTS 1979

may be set higher than ABC in order to produce higher yields from other more desirable species in a multispecies fishery. It might be set lower than ABC in order to provide larger sized individuals or a higher average catch per unit effort.

1. Determination of domestic annual fishing capacity, expected harvest, and fishing capacity.

a. Domestic annual fishing capacity (DAC) is the total potential physical capacity of the fleets, modified by logistic factors. The components of the concept are:

- (1) An inventory of total potential physical capacity, defined in terms of appropriate vessel and gear characteristics (e.g. size, horsepower, hold capacity, gear design, etc.).
- (2) Logistic factors determining total annual fishing capacity (e.g., variations in vessel and gear performance, trip length between fishing locations and landing points, weather constraints, etc.).

b. Expected domestic annual fisheries harvest (DAH) is the domestic annual fishing capacity modified by other factors which will determine estimates of what the fleets will harvest (e.g., how fishermen will respond to price changes in the subject species and other species, etc.).

b. Expected domestic annual processing capacity (DAP) includes an estimation of the processors as well as the amount of harvest they intend to process in any given plan year. In this management plan, DAH is equal to DAP.

These concepts should be placed in a dynamic context of past trends and future projections. For example, physical fleet capacity should not simply be last season's inventory of vessels and hold measurements (although this is appropriate for present interim planning), but also next year's projected movement into and out of the fishery. Vessels under construction should be included and attrition should be estimated.

The determination of domestic annual fishing capacity, expected harvest and processing capacity and intent should be made on the best available information.

3. Determination of total allowable level of foreign fishing (TALFF). The foreign allowable catch is determined by deducting the expected domestic annual expected harvest from the optimum yield.

5.0 DESCRIPTION OF FISHERY

5.1 Areas and Stocks Involved

5.1.1 Description of areas

The Bering Sea/Aleutian Island region with respect to U.S. extended jurisdiction is defined as those waters lying south of the Bering Strait, east of the U.S.-U.S.S.R. convention line of 1867, and extending south of the Aleutian Islands for 200 miles between the convention line and 170°W (Figures 1 and 2). Waters lying south of lines joining headlands in the eastern Aleutian Islands, east of 170°W, are considered a part of the Gulf of Alaska management area. The most prominent and unique feature of the Bering Sea is the extensive continental shelf in the eastern and northern portion of the sea. It constitutes approximately 30% of the total shelf area in the Bering Sea (Hood and Kelly 1974) and is one of the world's largest. For the Bering Sea as a whole, 44% of its 2.3 million km² area is continental shelf, 13% continental slope, and 43% deepwater basin. A number of large bays, including Bristol and

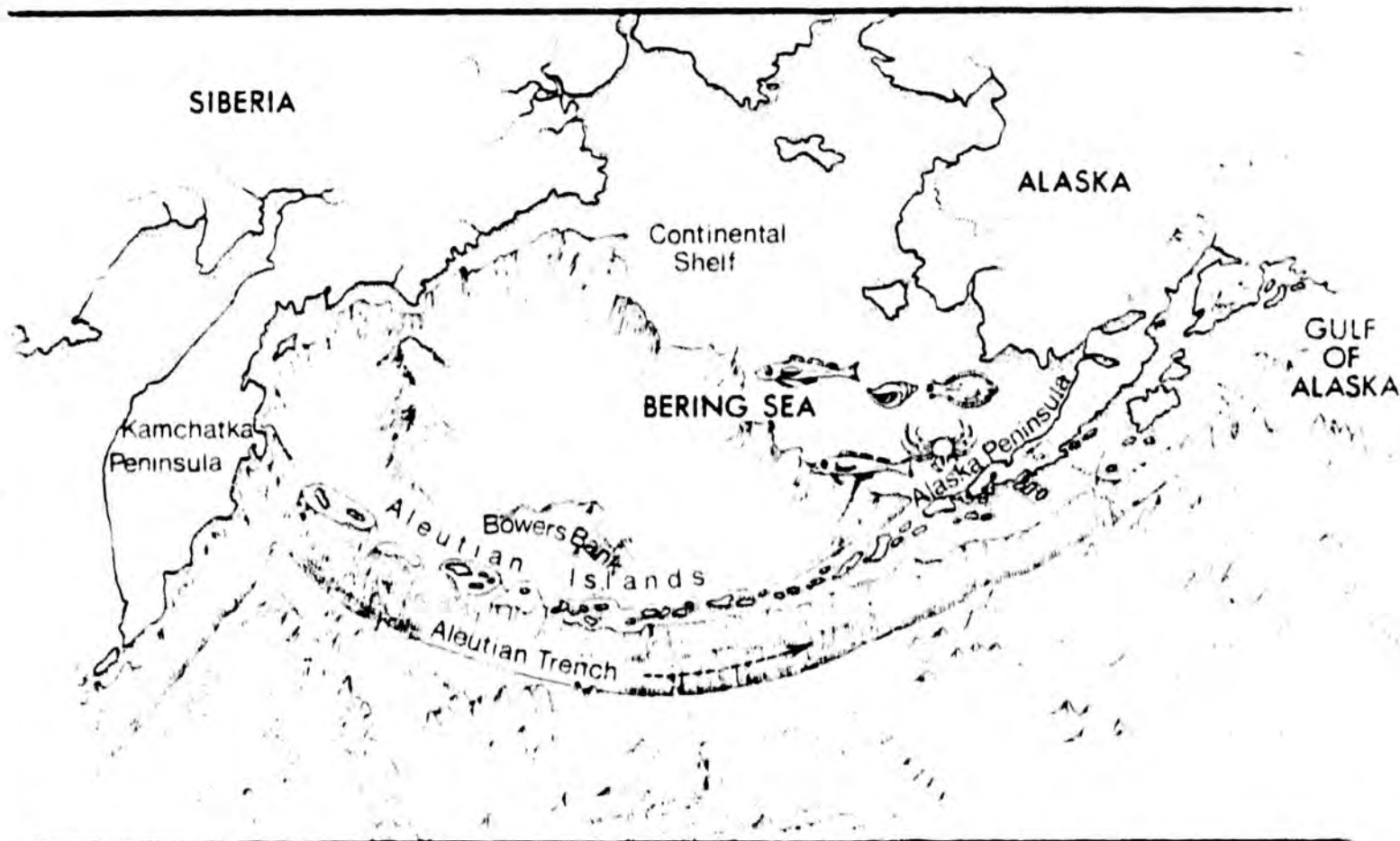


Figure 1.--Bottom features of Bering Sea and Aleutian Islands regions

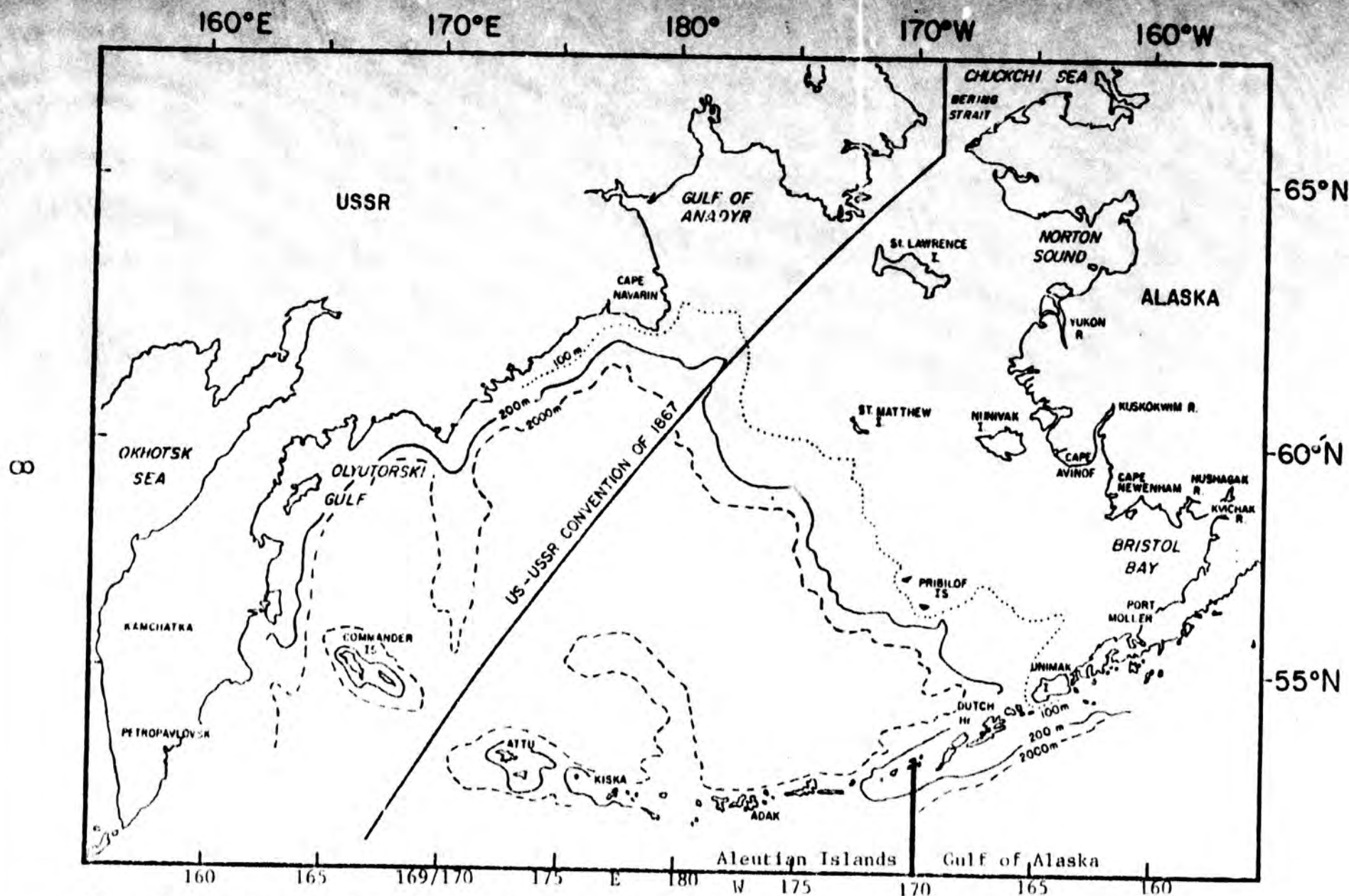


Figure 2.--Geographical locations in the eastern Bering Sea and Aleutian Islands.

Kuskokwim Bays and Norton Sound on the Alaska coast, makes the coast line of the Bering Sea highly irregular. The area of all bays in the Bering Sea makes up 11.1% of the total area of the sea (Gershanovich 1963).

The broad eastern Bering Sea shelf is extremely smooth and has a gentle uniform gradient resulting from sediment deposits (Sharma 1974). The sediments, originating along the coast and transported offshore in graded suspension by storm waves, are predominantly sands over the inner shelf and silt and clay sediments on the outer shelf and slope.

The continental slope bordering the eastern Bering Sea shelf is abrupt and very steep and is scoured with valleys and large submarine canyons (Sharma 1974).

Forming a partial barrier to the exchange of Bering Sea and Pacific Ocean water is the Aleutian-Commander Islands arc. This chain is made up of more than 150 islands and has a total length of approximately 2260 km (Gershanovich 1963). Shelf areas throughout most of the Aleutians portion of the chain are narrow (and frequently discontinuous between islands) ranging in width on the north and south sides of the island from about 4 km or less to 42-46 km. The shelf broadens in the eastern Aleutians.

An additional geographical feature of the Aleutian Island region of fishery interest is Bowers Ridge. The submerged ridge, forming an arc off the west-central Aleutian Islands, is about 550 km long and 75-110 km wide, becoming even wider in the vicinity of the Rat Islands (Gershanovich 1963). The southern portion of the ridge summit is 150-200 m deep, the central portion is 600-700 m deep, and the northern portion 800-1000 m deep.

Exchange of water between the Bering Sea and the Pacific Ocean occurs through the various Aleutian Island passes with an estimated 14% of the Pacific water remaining in the Bering Sea (Sharma 1974). The net gain from Pacific water and surface runoff from rivers is lost to the Arctic Ocean through the Bering Strait, creating a net movement of water northward.

The dominant water movement on the eastern Bering Sea continental shelf originates from Pacific waters entering the Bering Sea in the vicinity of Unimak Island. These waters move northward toward St. Matthews Islands and eastward toward Bristol Bay. The northward stream divides near St. Matthews Island before joining again and passing through the Bering Strait.

The eastward flowing current along the Alaska Peninsula upon reaching the head of Bristol Bay is deflected westward by waters from the Kvichak and Nushagak Rivers (Sharma 1974). These westward flowing waters are mixed with Kuskokwim River water near the mouth of Kuskokwim Bay and directed southward, forming a cyclonic gyre in the southeastern Bering Sea.

The Bering Sea is influenced mainly by subarctic climate, except for the southernmost part, which can be included in the temperate zone (Sharma 1974). It lies in a region of moderate to strong atmospheric pressure gradients and is subject to numerous storms. A major environmental feature of the Bering Sea is the pack ice which covers most of the continental shelf in the eastern and northern sections of the sea in winter and spring. The ice edge begins to intrude into the northern Bering Sea in November, and normally reaches its maximum in late March (Potocsky 1975). At its maximum the ice pack may cover the continental shelf south to the Pribilof Islands and extend from the Pribilof Islands eastward to the vicinity of Port Moller. The areas of the outer shelf between the Pribilof Islands and Unimak Island and deeper waters of the Bering Sea are generally ice free throughout the year because of the intrusion of warmer Pacific Ocean water. In April and May the ice edge begins to retreat and by early summer the Bering Sea is normally free of ice.

The physical, climatic, and oceanographic features in the eastern Bering Sea combine to create conditions highly favorable for primary biological productivity. These conditions are only surpassed by some of the upwelling regions in the eastern Pacific and Atlantic Oceans (Hood and Kelly 1974). This productivity supports some of the largest fish, marine mammal, and bird populations in the world. Although the processes for this high productivity are not fully understood, they probably originate from the upwelling of nutrient-rich water along the Aleutian Island chain (Sharma 1974), the mixing of Pacific Ocean and Bering Sea waters, the seasonable extremes in climate with a buildup of nutrients during the winter months (Gershonovich, et al 1974) and the expansive nature of the continental shelf.

5.1.2 Description of stocks

The Bering Sea supports about 300 species of fishes, the majority of which are found near or on the bottom (Wilimovsky 1974). Among the pelagic species are the commercially important, or potentially important groups such as the salmon (Oncorhynchus), herring (Clupea), smelts (Osmerus), and capelin (Mallotus). The fish groups of primary concern in this plan are the bottom or near-bottom dwelling forms--the flounders, rockfish, sabelfish, cod, pollock, and Atka mackerel. Although not bottom-dwelling, squids (Cephalopoda) are also included in the plan.

There is a general simplification in the diversity of bottomfish species in the Bering Sea compared to the more southern regions of the Gulf of Alaska and Washington to California. As a result, certain species inhabiting the Bering Sea are some of the largest bottomfish resources found anywhere in the world. In terms of biomass, the bottomfish community in the Bering Sea is much larger than its counterparts in other areas of the northeastern Pacific. The commercial production by all nations from the eastern Bering Sea/Aleutians has ranged from 1.6 to 2.3 million mt during the five year period of 1971-1975, representing 69 to 86 percent of the groundfish catch for the entire region from the Bering Sea to California.

Relatively few roundfishes form aggregations in the eastern Bering Sea and Aleutian Islands areas large enough to attract target, or occasional target fisheries: Pacific cod, Pacific ocean perch, sablefish, Atka mackerel, and rattails (Table 1). A number of other rockfishes are taken while fishing for Pacific ocean perch, the most common of which are listed in Table 1.

In contrast to the relatively few species of commercially exploited roundfishes, the flatfish community of the Bering Sea is very diverse. Yellowfin sole dominates this group and has the longest history of intense exploitation by foreign fisheries. Other flounder species that are known to occur in aggregations large enough to form target species or occasional target species are Greenland turbot, Pacific halibut, rock sole, flathead sole, and arrowtooth flounder. Alaska plaice is also relatively abundant, but has not been intensively fished, apparently because of their low market value. A number of other flounders having commercial importance in regions to the south, also occur in the eastern Bering Sea (Table 1), but their abundance is low.

Elasmobranchs (sharks and rays) which commonly occur off Washington to California, are relatively scarce in the eastern Bering Sea. Only skates (Rajidae) occur in significant quantities, but less so than in waters south of the Bering Sea.

Commercial catches illustrate the much greater magnitude of groundfish stocks in the eastern Bering Sea compared to the Aleutian Island region (Figure 3). For the five-year period of 1971 to 1975, the all-nation commercial catch in the eastern Bering Sea averaged 2.0 million mt compared to only 59,000 mt in the Aleutian Islands. The major share of the catch in the eastern Bering Sea from 1971 to 1975 (1.6 million mt or 81%) was made up of pollock. Other roundfish contributed 3% to the average catch and flounders 11%. Roundfish also contributed the major share of the catch in the Aleutian Island area (84%), but the principal roundfish species in the Aleutian region was Pacific ocean perch rather than pollock. Pollock catches in the Aleutians averaged only about 10,000 mt annually in 1971-1975.

Table 1.--Commercially utilized demersal fishes in the eastern Bering Sea and Aleutian Island region.

Common name	Scientific name
TARGET SPECIES	
Pollock	<u>Theragra chalcogramma</u>
Pacific ocean perch	<u>Sebastes alutus</u>
Atka mackerel	<u>Pleurogrammus monopterygius</u>
Blackcod	<u>Anoplopoma fimbria</u>
Yellowfin sole	<u>Limanda aspera</u>
Greenland turbot	<u>Reinhardtius hippoglossoides</u>
Pacific halibut	<u>Hippoglossus stenolepis</u>
OCCASIONAL TARGET SPECIES	
Pacific cod	<u>Gadus morhua macrocephalus</u>
Rock sole	<u>Lepidopsetta bilineata</u>
Flathead sole	<u>Hippoglossoides elassodon</u>
Arrowtooth flounder	<u>Atheresthes stomias</u>
Rattails	<u>Coryphaenoides</u> sp.
MINOR COMMERCIAL SPECIES ^{1/}	
Rougheye rockfish	<u>Sebastes aleutianus</u>
Dusky rockfish	<u>Sebastes ciliatus</u>
Northern rockfish	<u>Sebastes polyspinis</u>
Shortspine thornyhead	<u>Sebastolobus alascanus</u>
Shortraker rockfish	<u>Sebastes borealis</u>
Dark blotched rockfish	<u>Sebastes crameri</u>
Yelloweye rockfish	<u>Sebastes ruberrimus</u>
Blue rockfish	<u>Sebastes mystinus</u>
Alaska plaice	<u>Pleuronectes quadrituberculatus</u>
Rex sole	<u>Glyptocephalus zachirus</u>
Butter sole	<u>Isopsetta isolepis</u>
Longhead dab	<u>Limanda proboscidea</u>
Dover sole	<u>Microstomus pacificus</u>
Starry flounder	<u>Platichthys stellatus</u>
Skates	<u>Rajidae</u>

^{1/} Includes species that may be marketable, but have low abundance.

ALEUTIAN ISLANDS AREA

59,000 mt



EASTERN BERING SEA

2,032,000 mt

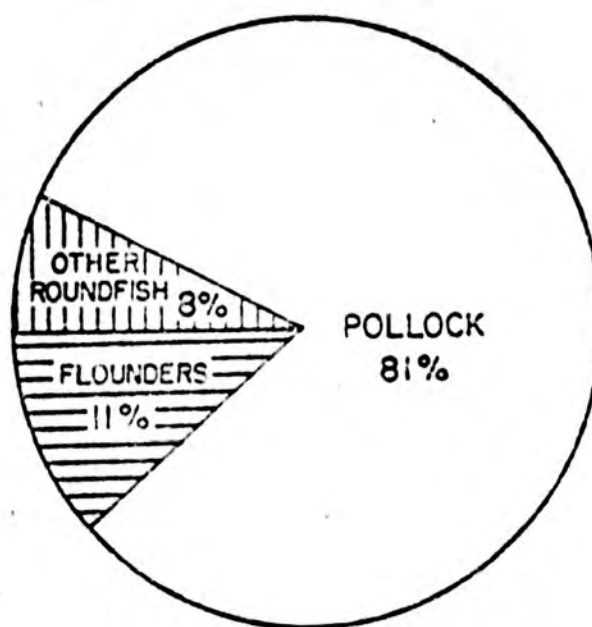


Figure 3.--Average annual catches of groundfish in the Aleutian Island area and the eastern Bering Sea, 1971-75.

The species make-up of catches in the two regions exclusive of pollock are illustrated in Figure 4. The data demonstrate that catches of both roundfish (other than pollock) and flounders were much greater in the eastern Bering Sea than in the Aleutians. Catches of flounders in the eastern Bering Sea were predominated by yellowfin sole (79,000 mt), but catches of Greenland turbot (71,000 mt) in this recent period has approached those of yellowfin sole. Rock sole, flathead sole, and arrowtooth flounders were other principal species of flounders taken in the eastern Bering Sea. Flounders form only an incidental part of the catch in the Aleutian Islands area with Greenland turbot the principal species in that area.

The principal roundfish in eastern Bering Sea catches after pollock was Pacific cod with an annual average catch in 1971-75 of 55,000 mt. The next most abundant species were Pacific ocean perch (17,000 mt) and sablefish (9,000 mt). The catch of "other groundfish" was also relatively high, averaging 69,000 mt annually, and forming 5.6% of the overall catch in the eastern Bering Sea. Although the species in this category were not identified, they most likely consist primarily of sculpins (Cottidae), eelpouts (Zoarcidae), skates (Rajidae), poachers (Agonidae) and rattails.

Pacific ocean perch have been the principal species of roundfish in Aleutian Island catches and in 1971-75 annual catches have averaged 22,000 mt. Other than pollock (10,000 mt), the next most abundant species in catches were Atka mackerel (4,000 mt), sablefish (2,700 mt), and cod (1,500 mt).

Little is known about the extent of the squid resource in the eastern Bering Sea and Aleutian Islands area. The Japanese apparently target on squid to a limited degree. They took 4,300 mt and 5,900 mt in 1975 and 1976. Fishing was mainly in the Aleutian Islands area in 1975 and mainly in the eastern Bering Sea in 1976.

The depth distribution of principal commercial species varies by species and by season. Species of flounders that occupy the shallowest depths on the continental shelf (generally shallower than 100 m during

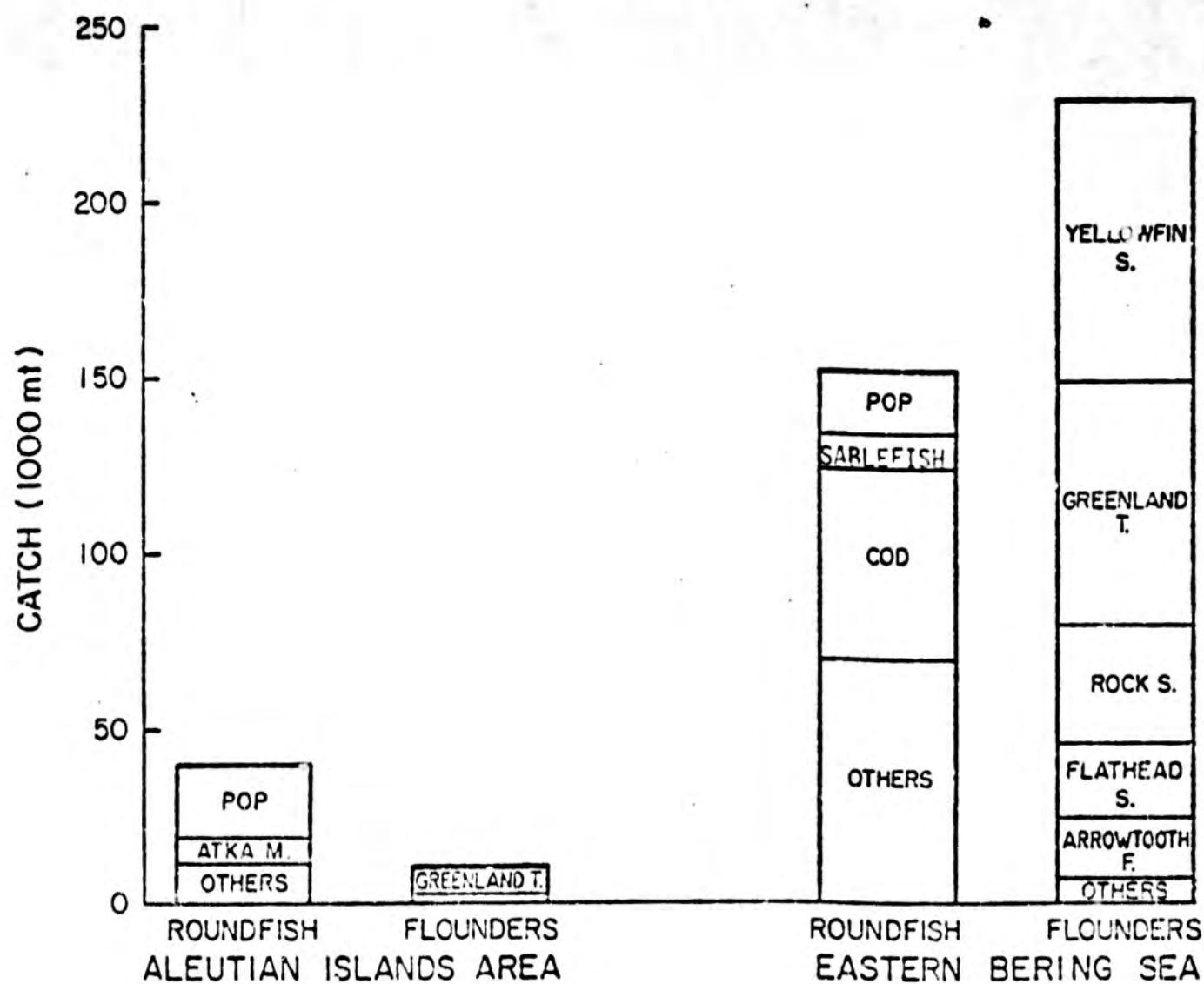


Figure 4.--Average annual catches of groundfish (excluding pollock) in the Aleutian Island area and eastern Bering Sea, 1971-75.

summer) are yellowfin sole, Pacific halibut, rock sole, and Alaska plaice. The distribution of flathead sole is centered in deeper water than the above species, mainly occupying waters on the outer shelf (100-200 m), but also ranging onto the continental slope. The large flounders (Greenland turbot and arrowtooth flounder) occupy the deepest water with adults mainly located on the continental slope; they also occupy shelf waters, but mainly only the juvenile portion of the population.

In winter most of the flounders retreat to waters of the outer shelf and upper slope to avoid the sub-zero temperatures that extend over much of the eastern Bering Sea shelf in winter and early spring. These bathymetric migrations are most extensive for those flounders occupying the inter shelf in summer such as yellowfin sole, rock sole, Alaska plaice, and Pacific halibut. The migrations of Pacific halibut result in their occupying the greatest depth range of all flounders, extending from shallow bays to slope waters of over 500 m in depth.

Major commercial species of roundfish are mainly found on the outer shelf and slope. The distributions of pollock and Pacific cod are centered on the outer shelf in summer with some shifting to upper slope water in winter. Pacific ocean perch and other rockfishes are residents of the relatively deep water of the outer shelf and upper continental slope. Sablefish inhabit the deepest waters occurring to depths of perhaps over 1000 m.

5.2 History of Exploitation

5.2.1 Domestic fishery

5.2.1.1 General description of fishery

The earliest fisheries for groundfish in the eastern Bering Sea and Aleutian Islands were the Native subsistence fisheries. There were an important part of the life of Native people, and dependence on demersal species of fish may have been critical to their survival in periods of the year when other sources of food were scarce or lacking. Fishing was in near-shore waters utilizing such species as cod, halibut, rockfish, and other species. These small-scale subsistence fisheries have continued to the present time.

The first commercial venture for bottomfish occurred in 1864 when a single schooner fished for Pacific cod in the Bering Sea (Cobb 1927). The cod fishery did not commence on a regular annual basis until 1882. This domestic fishery continued until 1950 when demand for cod declined and economic conditions caused the fishery to be discontinued (Alverson et al. 1964). Fishing areas in the eastern Bering Sea were from north of Unimak Island and the Alaska Peninsula to Bristol Bay (Cobb 1927). Vessels operated from home ports in Washington and California and from shore stations in the eastern Aleutian Islands. Canadian vessels also participated in the cod fishery to a limited extent.

The cod fishery reached its peak during WWI when the demand for cod was high. Numbers of schooners operating in the fishery ranged from 1-16 up to 1914 and increased to 13-24 in the period 1915-20. Estimated catches during the peak of the fishery ranged annually from 12,000-14,000 mt (Pereyra et al. 1976). Numbers of vessels in the fishery declined following 1920 until the fishery was terminated in 1950.

Halibut were reported as being present in the Bering Sea by United States cod vessels as early as the 1800's. However, halibut from the Bering Sea did not reach North American markets until 1928 (Thompson and Freeman 1930). Small and infrequent landings of halibut were made by United States and Canadian vessels between 1928 and 1950, but catches were not landed every year until 1952 (Dunlop et al. 1964). The catch by North American setline vessels increased sharply between 1958 and 1963 and then declined steadily until 1972. Since 1972, the catch has remained stable at a relatively low level. The decline in the catch was a result of reduced abundance which led to severe restriction on the fleet. The reduction in abundance was caused by a combination of factors: the North American setline fishery, the Japanese setline fishery, incidental catches of juvenile halibut in foreign trawl fisheries, and adverse environmental conditions. The relative importance of each of these factors is not clear at this time.

In the Aleutians, exploitation by the North American setline fishery is relatively low. There was no fishing before 1960 and since then catches have been less than 200 mt. However, stocks in this area are relatively small, and tagging studies indicate that they are an intermingling component of stocks in the Gulf of Alaska. Consequently, fish from this area should not be considered unexploited.

The number of Canadian and U.S. vessels is shown in Table 2, and the units of fishing effort have been summarized by Myhre et al. (1977) and IPHC (1977). In general, fishing effort in the Bering Sea was meager before 1958, increased sharply during the late 1950's and early 1960's, and then declined steadily until the early 1970's. Effort during the 1970's has been relatively low although a modest increase did occur in 1976 and 1977. The low effort during the 1970's is the result of reduced abundance and restrictions on the North American fleet.

Fishing effort in the Aleutians is very low because halibut stocks are relatively small and the distance to major ports is long.

Present participation by North American nationals in commercial fisheries for bottomfish in the Bering Sea and Aleutian Islands is confined mainly to the relatively small longline fishery for halibut by United States and Canadian fishermen. Some crab vessels may also fish bottomfish occasionally for use as crab bait. A brief, one-vessel exploratory effort occurred for sablefish in the southeastern Bering Sea in 1977. The native subsistence fishery mainly utilizes non-demersal species such as herring and salmon.

5.2.1.2 Description of vessels and gear

The domestic cod fishery was carried out mainly to sailing schooners ranging in length from 30-46 m and equipped for dory fishing (Alverson et al. 1964). The dories were approximately 4 m in length and operated by a single fisherman using handlines to take cod.

Most of the halibut fishing vessels are schooners or seine-type vessels that are over 30 net tons and land their catch in major ports. Smaller vessels out of Unalaska and Adak also fish halibut but these vessels account for less than 10% of the total landings. There is also a small subsistence fishery in the Pribilof Islands and a few other locations, but little is known about the vessels or catch involved.

Table 2. Number of U.S. and Canadian vessels over 5 net tons that fished halibut in the Bering Sea, 1930-1977.

Year	United States	Canada
1930	3	-
1931	8	-
-	-	-
1933	1	-
-	-	-
1945	1	-
-	-	-
1950	1	-
-	-	-
1952	9	-
1953	6	-
1954	2	-
1955	1	-
1956	3	2
1957	1	-
1958	7	14
1959	19	20
1960	35	31
1961	34	27
1962	43	33
1963	51	53
1964	36	32
1965	19	15
1966	4	11
1967	17	19
1968	11	17
1969	7	16
1970	6	13
1971	4	13
1972	6	9
1973	7	3
1974	6	1
1975	8	3
1976	10	1
1977	19	1

The halibut vessels use setline gear which consists of a longline on which branchlines (gangions), each with a hook, are attached at regular intervals, usually about every 6-8 meters. A unit of setline gear is called a "skate" and is about 550 m in length. The gear is left on the bottom for periods from 4 to 30 hours (soaking time). Fishing usually is conducted at depths between 90 and 275 m, but may take place as shallow as 27 m or as deep as 550 m.

The vessels and gear used in the Aleutians are similar to those in the Bering Sea although the amount of effort is much less.

5.2.1.3 Catch trends

The numbers of vessels used and estimated catches in the eastern Bering Sea during the history of the domestic cod fishery are given in Table 3. The catches shown in Table 3 are estimates for the Bering Sea in metric tons roundweight as given by Pereyra et al. (1976). The estimates are based on weights of processed products from Cobb (1927) and Bower (1927-53). As indicated by Pereyra et al. (1974) the catches should be considered as approximations because of some uncertainty about the conversion factors used and some portion of the catches may have originated from the Gulf of Alaska.

Numbers of vessels in the cod fishery and estimated catches reached their peak during World War I when the demand for cod was high. During the period of 1915-19, estimated catches ranged from about 12,000 to 14,000 mt. Following this period, catches declined until termination of the fishery in 1950.

Estimated peak catches of cod in the domestic fishery are relatively small when contrasted with those from the recent foreign fisheries in the eastern Bering Sea which have ranged over 50,000 mt in some years.

Table 4 shows the annual catch of halibut in the Bering Sea and Aleutian areas by Canadian and U.S. fishermen from 1930 to 1977. In the Bering Sea, the annual catch was less than 200 mt before 1958, but then rose sharply to about 4,900 mt in 1963. The catch then declined steadily to a low of 173 mt in 1973. Since then, the catch has increased slightly and was about 450 mt in 1977. The decline in catch since 1963 was the

Table 3.--Estimated catches of Pacific cod in the eastern Bering Sea,
1864, 1882-1950^{1/} (from Pereyra et al. 1976).

Year	Number Vessels	Estimated ^{2/} Catch (mt)	Year	Number Vessels	Estimated ^{2/} Catch (mt)
1864	1	23	1915	13	12,016
1882	2	673	1916	13	13,947
1883	5	1,944	1917	16	13,946
1884	3	1,867	1918	17	12,719
1885	3	1,510	1919	17	12,140
1886	2	1,219	1920	24	8,576
1887	1	944	1921	6	3,102
1888	2	1,500	1922	10	5,923
1889	0	0	1923	17	8,951
1890	1	245	1924	15	9,889
1891	6	2,102	1925	14	10,489
1892	6	3,316	1926	7	9,924
1893	4	1,658	1927	7	6,887
1894	5	2,699	1928	8	7,083
1895	5	2,638	1929	9	7,851
1896	7	3,633	1930	8	7,674
1897	8	4,337	1931	4	4,314
1898	4	1,745	1932	5	4,692
1899	7	3,995	1933	5	5,779
1900	8	4,168	1934	7	6,361
1901	7	4,015	1935	5	5,713
1902	12	6,270	1936	5	5,008
1903	10	6,116	1937	4	4,885
1904	11	6,400	1938	3	3,963
1905	16	8,654	1939	3	3,960
1906	11	7,758	1940	4	4,129
1907	9	6,216	1941	3	2,940
1908	11	7,643	1942	1	814
1909	12	8,511	1943	0	0
1910	9	6,589	1944	1	656
1911	10	7,867	1945	1	639
1912	9	5,485	1946	2	997
1913	9	6,180	1947	2	1,041
1914	13	9,817	1948	1	1,006
			1949	1	850
			1950	1	668

^{1/} Original catch data in numbers of fish for 1864, 1882-1925 from Cobb (1927) and weight of cured products for 1926-1950 from Bower (1927 1953) are converted to round weight in metric tons from conversion factors provided by Cobb (1927).

^{2/} Catches for 1916 to 1925 also include offshore catches from the North Pacific Ocean.

Table 4. Catch of halibut by Canadian and U.S. vessels in the Bering Sea and Aleutian areas, 1930-1977. Catch in metric tons, round weight.

Year	Bering Sea			Aleutian		
	Canada	U.S.	Total	Canada	U.S.	Total
1930	-	62	62	-	-	-
1931	-	62	62	-	-	-
-	-	-	-	-	-	-
1933	-	11	11	-	-	-
-	-	-	-	-	-	-
1945	-	3	3	-	-	-
-	-	-	-	-	-	-
1952	-	152	152	-	-	-
1953	-	137	137	-	-	-
1954	-	24	24	-	-	-
1955	-	27	27	-	-	-
1956	51	107	158	-	-	-
1957	-	24	24	-	-	-
1958	731	582	1,313	-	-	-
1959	1,442	1,065	2,507	-	-	-
1960	2,016	1,392	3,408	10	-	10
1961	1,163	1,231	2,394	-	-	-
1962	2,113	2,304	4,417	-	12	12
1963	2,886	2,022	4,908	38	-	38
1964	758	647	1,605	-	1	1
1965	356	449	805	-	-	-
1966	385	336	721	45	-	45
1967	668	776	1,444	-	9	9
1968	402	395	797	5	-	5
1969	404	340	744	-	53	53
1970	536	148	684	33	32	65
1971	440	83	523	-	1	1
1972	149	293	442	7	12	19
1973	58	115	173	28	-	28
1974	101	162	263	60	3	63
1975	102	215	317	3	-	3
1976	37	278	315	56	11	67
1977*	84	366	450	162	16	178

* preliminary

result of reduced abundance and restrictions on the fishery. In years of high production, the catch was split about evenly between Canadian and U.S. vessels although since 1972 the U.S. share has been larger.

There was no catch reported in the Aleutian area before 1960. Until 1976, annual catches fluctuated between 1 and 67 mt; in 1977 preliminary data indicate a catch of 178 mt.

5.2.2 Foreign Fishery

5.2.2.1 General description of fisheries

Nationals from six foreign countries have conducted groundfish fisheries in the eastern Bering Sea and Aleutian Islands. One of these, the Canadian halibut fishery, was previously described under the domestic fishery because of its small size and similarity to the U.S. fishery for halibut. Of the other foreign fisheries, Japan has had the longest history of exploitation in the region and has mounted the greatest effort over the years. The first documented fishery for demersal species by the Japanese in the eastern Bering Sea dates back to an exploratory effort in 1930. This was followed by a relatively small-scale fishery which had its origin in 1954. Excluding Canada, the second foreign nation to send demersal fishing fleets to the eastern Bering Sea and the nation having the second largest removals of groundfish in the region has been the USSR. Their fisheries commenced in 1958.

In 1966 a trawler from the Republic of Korea (ROK) explored fishing grounds in the eastern Bering Sea and Aleutian Islands. A commercial operation followed in 1967 but the number of vessels and magnitude of the catch by ROK fishermen has remained much smaller than that by Japan and the USSR. The Republic of China (Taiwan) has also had a fishery in the eastern Bering Sea since late 1974, but involving only one or two trawlers.

Polish vessels fished briefly in the eastern Bering Sea in 1973 (Law Enforcement Division 1975). Since then, Poland has agreed to abstain from further fishing in the eastern Bering Sea. Although allowed to fish in certain waters of the Aleutian Islands, Polish vessels have not operated there.

5.2.2.1.1 Japanese fishery

Following the initial exploratory effort by two trawlers in 1930, the Japanese returned to the eastern Bering Sea with a mothership-catcher boat operation in 1933 (Forrester, et al. 1974). The fleet was composed of an 8,000 ton mothership and several catcher boats including 400 gross ton side-trawlers and 88 gross ton pair trawlers. Fishing was off Bristol Bay with the emphasis on pollock for the production of fish meal. The catch was processed aboard the mothership and transported back to Japan aboard transport vessels. This fishery continued to operate until 1937 when prices of fish meal declined causing the fisheries to terminate. Catches in this period ranged up to 43,000 mt with pollock the major species taken.

A second mothership-type operation was conducted in the eastern Bering Sea by Japan in 1940-41 (Forrester, et al. 1974). Target species was yellowfin sole that were frozen for human consumption. Catches in the two-year period ranged from 9,600 to 12,200 mt (Table 5).

With the signing of the peace treaty between the United States and Japan in 1952, restrictions on Japanese distant-water fisheries were removed, and in 1954, fishing in the eastern Bering Sea was resumed. The Japanese post-war fishery for groundfish developed into several components, the four principal ones being the mothership fishery, North Pacific trawl fishery, North Pacific longline-gillnet fishery, and the landbased trawl fishery.

The number of mothership fleets and number of vessels in the other fisheries are given in Table 6 along with a description of each type of fishery in the accompanying footnotes. As shown in Table 6, the mothership fishery can be divided into four additional types depending on the target species and processing methods. These are the freezing fleets which targeted on flounders in the period 1954-60; the freezing fleets operating since 1960 that continued to target on flounders, but also targeted on other species, the meal and minced fish fleets which originally took flounders for fish meal, but since 1964 have targeted on pollock for the production of minced fish, as well as fish meal and the longline-gillnet fleet which took halibut, cod, sablefish and herring for freezing.

Table 5.—Number of Japanese vessels operating in the eastern Bering Sea and their catches, 1933-37 and 1940-41 (from Forrester et al., 1974).

Year	Number of fleets	No. of catcher boats			Catch (metric tons)			
		Total	Trawl	Pair trawl	Total	Flat-fishes	Pacific pollock	Other fishes
1933	1	5	5	—	3,300	?	?	?
1934	1	5	5	—	14,953	1,385	11,645	1,923
1935	1	11	3	8	28,629	2,869	23,553	2,207
1936	1	8	4	4	26,622	1,003	23,000	2,610
1937	1	13	3	10	43,383	9,310	31,316	2,757
1940	1	8	—	8	9,577	6,941	24	2,612
1941	1	12	4	8	12,226	9,839	1,287	1,100

Japanese North Pacific trawl and longline-gillnet fisheries and fisheries for fishery (data from Forrester et al. 1974; Yamaguchi 1974, 1975; Sasaki 1977).

Year	Number of mothership fleets					Number of independent vessels		
	Freezing fleet ^{1/} for flounders only)	Freezing fleet ^{2/} (including other than flounder)	Meal and mince-fleet ^{3/}	Long-line-gill-net fleet ^{4/}	Total	North Pacific trawl fishery ^{5/}	North Pacific longline-gillnet fishery ^{6/}	Land-based trawl fishery ^{7/}
1954	2	--	--	--	2	2	--	--
1955	2	--	--	--	2	3	--	--
1956	4	--	--	--	4	1	--	--
1957	4	--	--	--	4	--	--	--
1958	2	--	1	1	4	--	--	--
1959	4	--	1	1	6	2	--	--
1960	3	1	5	4	13	--	--	--
1961	--	13	5	14	32	3	--	54
1962	--	11	5	5	21	2	--	70
1963	--	10	2	5	17	2	--	93
1964	--	6	4	2	12	2	--	103
1965	--	6	4	2	12	2	--	126
1966	--	8	4	1	13	2	--	172
1967	--	7	5	2	14	42	22	173
1968	--	6	5	1	12	42	22	184
1969	--	5	5	1	11	42	21	182
1970	--	3	6	1	10	42	22	182
1971	--	5	6	1	12	42	22	182
1972	--	4	6	8/	10	42	22	182
1973	--	4	6	--	10	42	26	182
1974	--	4	6	--	10	42	30	182
1975	--	3	5	--	8	35	27	182
1976	--	3	5	--	8	54	32	182

^{1/} Flounder fleet: The fleets, each composed of a mothership of 7,000-9,000 tons, equipped with freezing facilities and having several 300-ton class trawlers attached to it, caught mainly yellowfin sole for freezing off Bristol Bay.

^{2/} Freezing fleet: The fleets, each composed of a mothership of 5,000-10,000 tons with freezing equipment, accompanied by trawlers as well as Danish seiners, which also fished longlines and gillnets, caught halibut, blackcod, herring, Pacific ocean perch, etc. These fleets operated along the continental slope between Unimak Pass and Cape Navarin, in the Gulf of Olyutorskii, and in Aleutian waters.

Table 6:--(continued)

3/ Fish meal (minced fish) fleet: The fleets, each composed of a mothership of 9,000-14,000 tons, equipped with fish-meal plants, accompanied by 20-30 pair trawlers and Danish seiners, caught yellowfin sole on the eastern Bering Sea flats, and turbot along the continental slope in the eastern Bering Sea for production of fish meal. From 1964, the fleet switched to production of minced fish with a minced-fish plant, utilizing pollock caught in the eastern Bering Sea. The fleet also has freezing facilities and produces frozen fish.

4/ Longline-gillnet fleet: The fleets, each composed of a small mothership of 200-2,500 tons, accompanied by gillnetters and longliners, caught halibut, cod, blackcod, and herring to be frozen. The fishing grounds were along the continental slope from the Pribilof Islands and Cape Navarin-Gulf of Olyutorskii.

5/ North Pacific trawl fishery: This fishery is conducted by independent large trawlers, and the catch is frozen on board. The number of trawlers larger than 3,000 tons engaged in this fishery, on board which minced fish and fish meal are produced, has increased since 1968. Transport vessels were not used in this fishery until 1966. However, since 1967 a considerable number of transport ships have been used to carry the products of this fishery. The figures for 1967 and thereafter indicate the numbers of vessels licensed for this fishery.

6/ North Pacific longline-gillnet fishery: This fishery is conducted by independent longline-gillnetters, and the catch is processed on board. When filled with frozen products they return to their bases in Japan. The numbers of vessels in this table are the numbers licensed annually for this fishery.

7/ Landbased trawl fishery: This fishery consists of independent operations by Danish seiners and stern trawlers of 100-350 tons. The vessels process the catch on board, produce frozen goods, and return to Japan when they are filled. Extensive areas, including the Okhotsk Sea and waters around the northern Kurile Islands, are permitted for their operation. The number of vessels operated in the Bering Sea is not known. The figures in this table indicate the number of vessels licensed.

8/ From 1972-76 these fleets are included in the freezing fleets.

The mothership fishery has accounted for the largest share of the Japanese catch in the Bering Sea since 1954. In the recent period of 1971-76 the mothership fishery took 64% of the total catch, the North Pacific trawl fishery 31%, the land-based fishery 5%, and North Pacific longline-gillnet fishery 0.3% (Sasaki 1977).

Mothership fishery.--Forrester et al. (1974) divided the history of the mothership fishery into three periods based on target species, methods of processing catches, and expansion of fishing grounds.

In the first period (1954-57), the fishery was relatively small involving two to four 8,000 gross ton motherships of the freezer-factoryship type and trawlers of the 200-300 ton class as catcher boats. The fleets operated for about one month between August and October between the salmon driftnet and Antarctic whaling seasons. Fishing was off Bristol Bay and the catch, consisting of flounders (primarily yellowfin sole) was frozen.

In the second period (1958-63), the fishery expanded throughout the Bering Sea with diversification of fishing methods and target species (Table 6). Fish meal operations were initiated in 1958 utilizing flounders in the eastern Bering Sea which were processed by 9,000 gross ton motherships operating from April to September. Each mothership was supplied with fish by 20 Danish seiners and pair trawlers. The freezing fleets described in the previous period also continued to fish and catches of yellowfin sole reached their peak in this period, ranging between 420,000 and 554,000 mt annually in 1960-62 including catches by the USSR.

Another mothership operation beginning in the 1958-63 period was the longline-gillnet fishery consisting of 500 gross ton motherships and 100 gross ton longliners. These vessels fished for halibut and sablefish for freezing along the continental slope off Cape Navarin starting in 1958. In 1960 they began fishing operations for Pacific ocean perch along the continental slope between the Pribilof Islands and Cape Navarin and in 1963 expanded their area of operations to Bowers Banks off the Aleutian Islands.

The fleets involved in the yellowfin sole fishery for freezing also extended their operations to include halibut, sablefish, and Pacific ocean perch and together with the longline-gillnet fleets expanded their area of operations to the continental slope in the central and northern Bering Sea and to Aleutian Island waters. The fishing season which had previously been about one month was lengthened to four to nine months and winter fishing was initiated in 1961-62.

The third period (1964 to present) is characterized by the development of the pollock fishery. With the decline in abundance of yellowfin sole (due to overfishing in the early 1960's), and the development in 1964 of techniques for processing minced fish (surimi) on-board motherships, the main Japanese effort shifted to pollock. Fish meal and frozen products became a by-product of these operations. Pollock has dominated Japanese catches since 1962 and from 1971-76 has formed over 80% of the total Japanese groundfish catch in the eastern Bering Sea and Aleutian Islands area. The pollock fishery has become a year-around effort while the flounder fishery principally for yellowfin sole became a winter fishery in 1969-70 with the season generally lasting from October to March. Catcher boats in the mothership fishery have been pair trawlers, Danish seiners, side-trawlers, and stern trawlers. Side-trawlers have been phased out of the fishery and the number of Danish seiners has declined with pair trawlers becoming the mainstay of the fleet.

The winter fishing grounds for flounders were mainly north of Unimak Island and occasionally west and east of the Pribilof Islands. The major fishing grounds for pollock have been along the outer continental slope and upper slope from Unimak Pass northwestward toward Cape Navarin. Typical fishing areas of the mothership fishery are shown in Figure 5.

North Pacific trawl fishery.--This second major type of Japanese fishery consists of independent factory trawlers larger than 500 tons that both fish and process their own catch (Forrester et al. 1974). Products are minced fish, frozen fish, and fish meal. The products are transshipped to Japan by refrigerated transport.

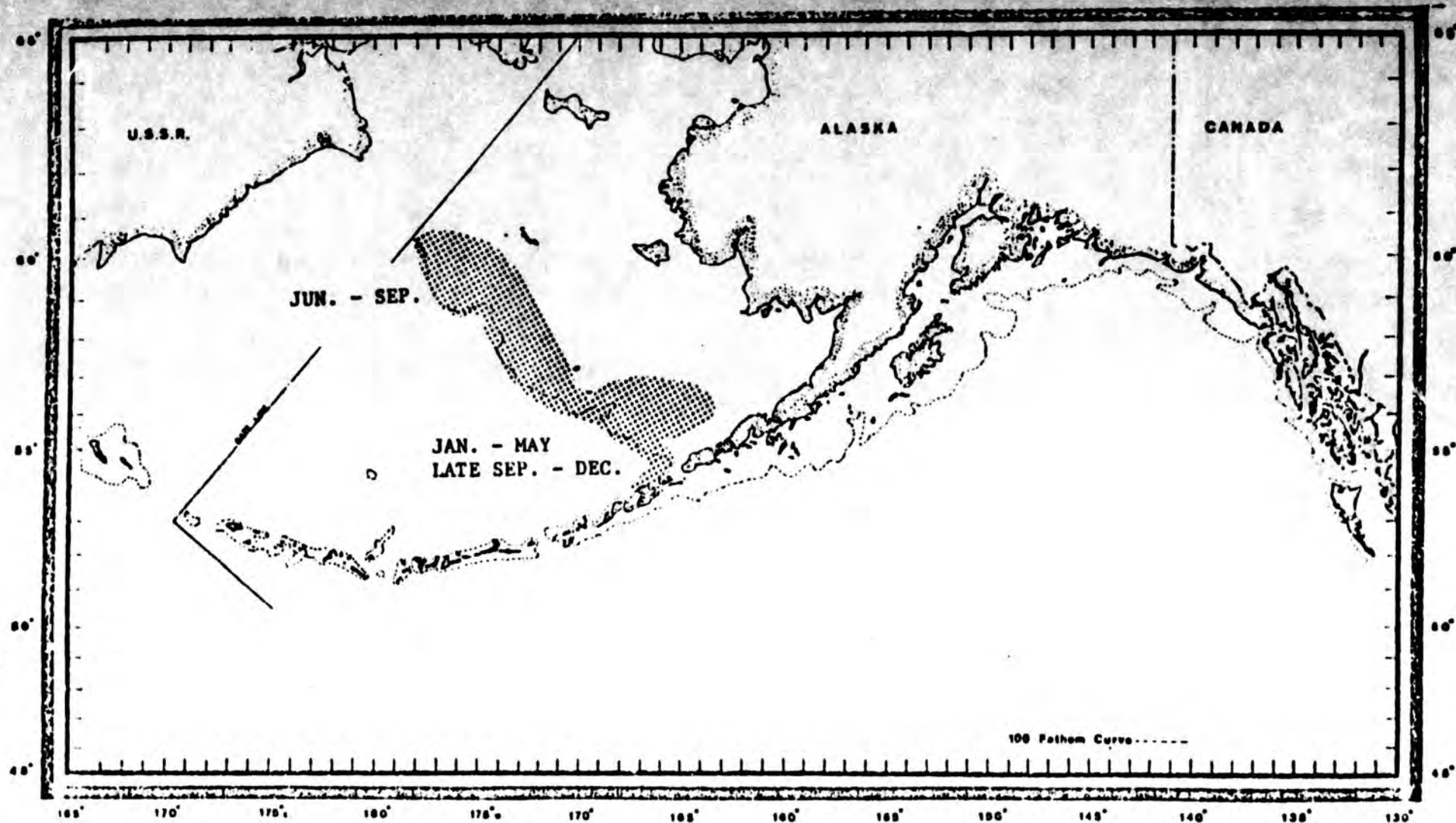


Figure 5.--Areas fished by the Japanese mothership fleets in 1972 (from Law Enforcement Division 1974).

In the initial period of this fishery (1954-59), one to three independent trawlers fished in the eastern Bering Sea for yellowfin sole. Since 1961 they have also exploited (for freezing) halibut, sablefish, Pacific ocean perch, and other species along the continental slope in the central and northern Bering Sea and in Aleutian Island waters. In 1967 the number of licenses issued for independent trawlers was increased to 42 and has ranged from 35 to 54 in later years (Table 6). Greater numbers of larger trawlers in the 3,000-5,000 ton class (equipped with machinery for producing surimi) resulted in a rapid increase in the pollock catch by this fishery. By 1970, 80% of the total groundfish catch by these vessels was pollock.

The main effort by the independent trawlers is in the eastern Bering Sea where year-around operations are conducted for pollock. Other species taken are cod and various flounders. The number of vessels generally increase from a low in mid-winter to a peak in summer involving from 20 to 40 trawlers (Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

In the Aleutian Islands the trawlers target on Pacific ocean perch and take lesser amounts of pollock and various other groundfish. Fishing in the Aleutians is concentrated along the shelf edge in the central and western part of the chain with some effort in the eastern Islands. Maximum effort is in summer or early fall with the number of vessels reaching 7 to 18 in peak months (Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

Areas of the fishery are illustrated in Figure 6.

North Pacific longline-gillnet fishery.--Herring and sablefish are the principal species taken by this fishery. The vessels operate independently, and when filled with fresh fish or frozen products, return to Japan. From 1963 to 1966 there were 18-19 vessels licensed in this fishery to operate north of 50°N and between 170°E and 170°W, but records of the number of vessels actually operating, the areas of operation, and the species taken are not available (Forrester et al. 1974).

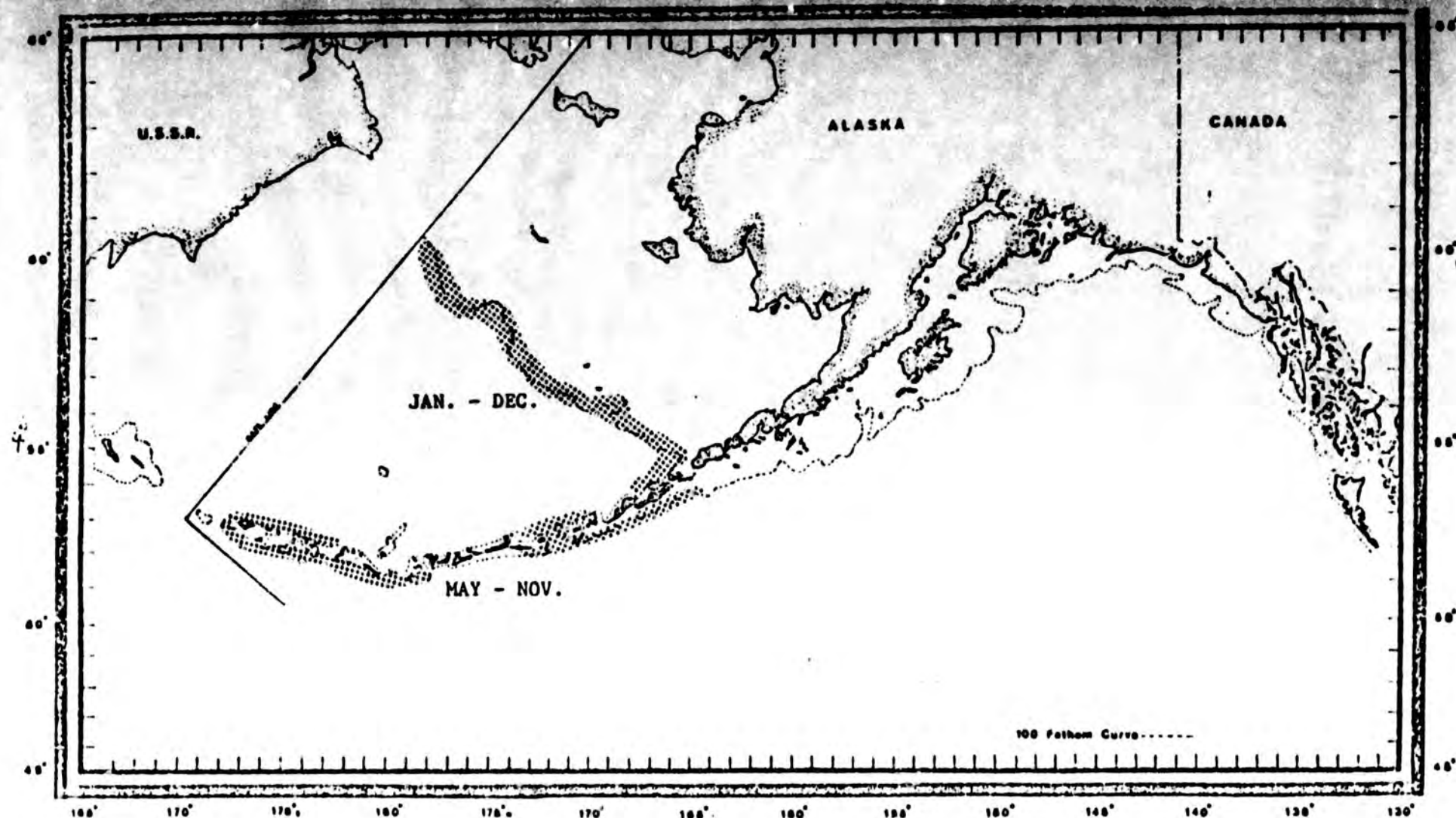


Figure 6.--Areas of the eastern Bering Sea and Aleutian Islands fished by the Japanese North Pacific trawl fishery (Law Enforcement Division 1974).

In 1967 the number of longline-gillnet vessels licensed was increased to 22. Fishing by these 200-500 gross ton vessels has mainly been in the northeastern Pacific ocean where the catch was almost exclusively sablefish with some rockfish taken. The vessels operate year-around and normally remain on the grounds for two to four month periods until their hold capacity of about 400 mt is reached (Law Enforcement Division 1974).

Fishing for sablefish in the eastern Bering Sea and along the Aleutian Islands by the North Pacific longline vessels has been sporadic with only a few vessels fishing briefly each year. The areas of fishing in these regions as well as in the Gulf of Alaska in 1974 are shown in Figure 7.

Landbased trawl fishery.--This fishery, conducted by independent trawlers of 100-350 tons are prohibited by regulation from transshipping their catch in offshore waters (Forrester et al. 1974) and therefore return to Japan when storage capacity is filled. Their catches are chiefly flounders, Pacific ocean perch, and sablefish. When initiated in the early 1960's, the fishery was restricted to waters north of 48°N and between 153°E and 170°E. In June 1963 the area was expanded eastward to 175°W and in September 1967 to 170°W. Major fishing grounds are along the continental slope from Cape Olyutorskii to Cape Navarin and off the Pribilof Islands. Gear consisted mainly of Danish seines early in the fishery but stern trawls became the major gear in later years. From the 54 vessels licensed to operate in the fishery in 1961, the number grew to 184 in 1968 and has been 182 since 1969 (Table 6). The number of licensed vessels actually operating in this fishery is unknown.

5.2.2.1.2 Soviet fishery

The first commercial-scale operations by the USSR off Alaska, following exploratory work in 1957-58, was a fishery for flounders in the eastern Bering Sea starting in 1959 (Chitwood 1969). Like the Japanese, the Soviets have expanded their fisheries since its inception in terms of effort, target species, and fishing areas. There have been three major groundfish fisheries in the eastern Bering Sea and Aleutian Islands: a flounder fishery in the southeastern Bering Sea, a rockfish

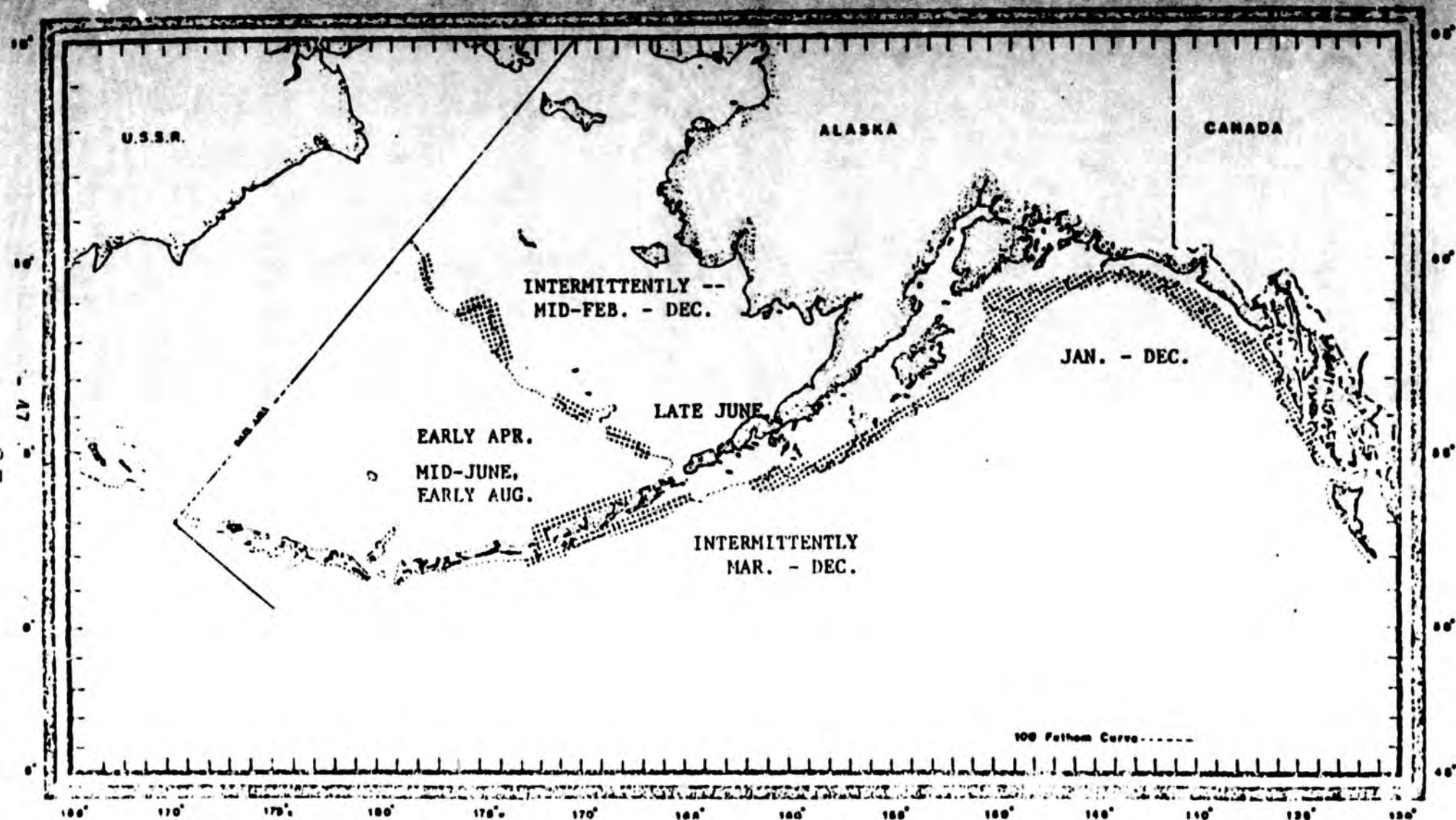


Figure 7.--Areas fished by Japanese North Pacific longline vessels in 1974 (Law Enforcement Division 1977).

fishery primarily in the Aleutian Islands, and a pollock fishery along the other continental shelf from Unimak Pass to northwest of the Pribilof Islands. In describing these fisheries, information is used from Chitwood (1969), Forrester et al. (1974), Haskell (1964), Office of Enforcement and Surveillance (1965, 1967-70), Enforcement and Surveillance Division (1971, 1973), and Law Enforcement Division (1974, 1975, 1977).

Flounder fishery.--The Soviet flounder fishery was a winter operation throughout its history extending usually from November to April and peaking in February or March. The fishing grounds (Figure 8) were in areas where aggregations of yellowfin sole and other flounders form in winter after migrations from shallower waters of the inner shelf. The primary target species was yellowfin sole which comprised a high proportion of the catches with other flounders such as rock sole, flathead sole, Alaska plaice, starry flounder, and arrowtooth flounder making up most of the remainder. Vessels participating in this fishery have ranged from smaller side trawlers (SRT) to medium (SRTM) and large independent stern trawlers (BMRT) and support vessels (see Section 5.2.2.2 for description of vessel types). Side trawlers delivered this catches to factory ships or processing refrigerated transports, which froze the fish for later transport to the Soviet Union. The larger trawlers freeze their own catches.

The first few years of the Soviet flounder fishery (1959-63) involved about 30 trawlers supported by a factory ship and refrigerated transport vessels. Catches in that period probably ranged between 60,000 and 155,000 mt. In the next three years effort was increased in this fishery with the number of trawlers rising to 40 in 1964, 50-60 in 1965, and 70-100 in 1966. The fishery peaked in terms of numbers of trawlers from 1966 and 1968 with the maximum number reaching 70-100 in the peak months of fishing in January, February or March. In those peak years, the flounder fishery represented the largest effort by the Soviets in Alaskan waters.

Starting in 1969, the Soviet effort for flounders generally declined, presumably because abundance of yellowfin sole was lower than in previous

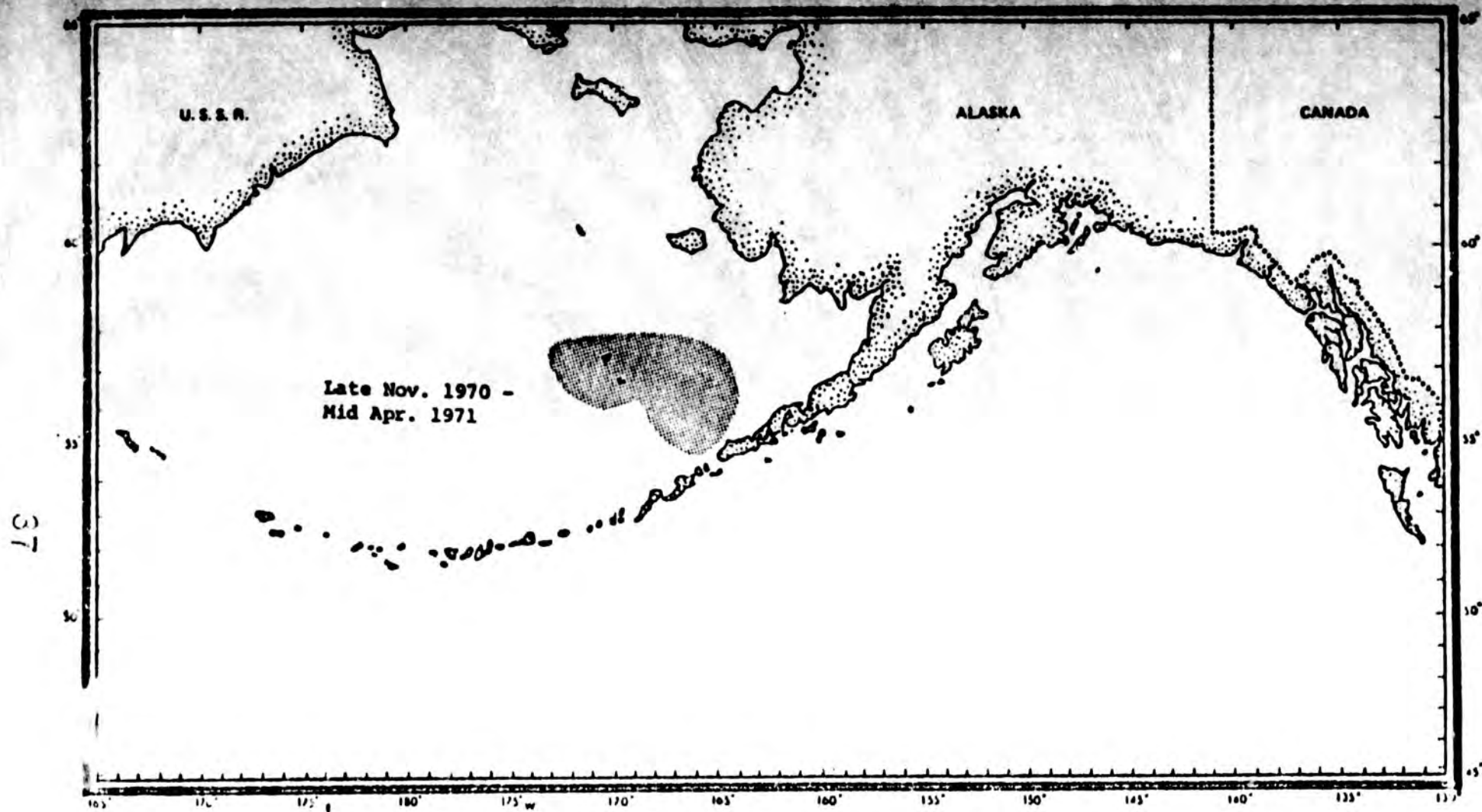


Figure 8.--USSR fishing area for flounders in the eastern Bering Sea in 1971 (Enforcement and Surveillance Division 1973).

years. The numbers of vessels in peak months decreased to between 50 and 80 in 1969-72. Although a peak of 70 vessels fished in 1972, there was a sharp drop in catches of flounders to about 13,000 mt from over 70,000 mt or more in the previous three years. In 1973 the flounder fishery failed to develop. Effort was limited to a two-week period by four trawlers. The Soviets have not resumed this fishery to the present time.

Pacific ocean perch fishery.--The Soviet fishery for Pacific ocean perch and other rockfish began in 1960 when 25 to 30 trawlers fished along the edge of the continental shelf in the eastern and central Bering Sea. In subsequent years the fishery became centered in the Aleutian Islands and Gulf of Alaska (Figure 9). The Aleutian Island fishery has been mainly by larger BMRT factory trawlers fishing along the continental shelf edge at depths of about 15-280 m. Catches were headed, eviscerated, and frozen until transferred to refrigerated transport vessels for delivery to the Soviet Union.

Following concentration of effort for Pacific ocean perch in the Aleutians and Gulf of Alaska in 1963, directed effort to Pacific ocean perch in the eastern Bering Sea decreased and was eventually eliminated. Catches from this region in later years were a by-catch of the pollock fishery. The early years of the Aleutian Island fishery were the most productive with reported catches of 61,000 mt in 1974 and 71,000 in 1965. Although the catch increased in 1965, the catch per trawler declined and search time for concentrations of perch increased substantially.

Whereas the fishery was continuous through 1965, effort in 1966 was sporadic, apparently because of reduced abundance of rockfish. The effort in 1967 and 1968 was approximately the same as in 1966 with fishing starting in spring months and continuing through the end of the year. In 1969 there was further reduction in effort with only one-half to two-thirds the number of vessels fishing compared to 1968. This level of effort generally continued in the next few years with relatively few vessels targeting on Pacific ocean perch, and then for relatively short periods in widely separated areas of the Aleutian Islands. By

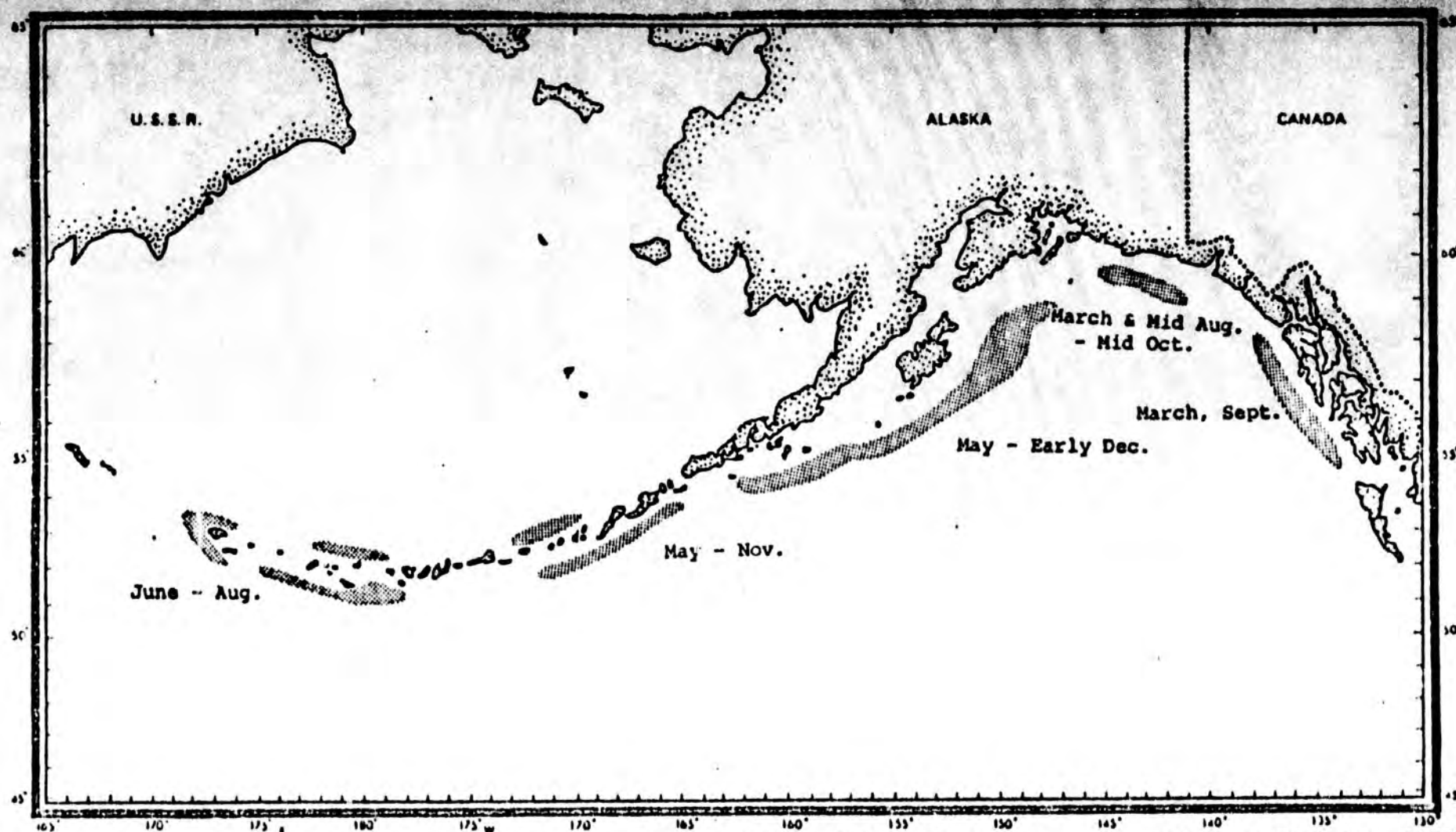


Figure 9 .--Areas fished for Pacific ocean perch by the USSR in 1971 (Enforcement and Surveillance Division, 1973).

1973 and 1974 the fishery was at an extremely low level with catches of only about 3,000 mt in 1973 and 800 mt in 1974. Catches in 1975 and 1976 were somewhat higher, ranging from 7,000 - 8,000 mt.

Pollock fishery.--The fishery that eventually developed into the pollock fishery began in 1967, but initially targeted on sablefish and large flounders (arrowtooth flounder and Greenland turbot) in the region immediately north of the eastern Aleutian Islands. Fishing was at depths of about 550 to 730 m on the fairly extensive deep-water plateau in the area immediately north of Dutch Harbor in the eastern Aleutian Islands. This fishery was continued in 1968, but the area of fishing was extended north along the edge of the continental shelf to the central Bering Sea. Sablefish and arrowtooth flounder were the principal species taken just north of Dutch Harbor, but farther north, pollock, cod, rockfish, and various flatfish were principal species. In 1969, this fishery became a year-around operation and took on the general appearance that has characterized the fishery to the present time. Vessels utilized in the fishery changed from primarily medium-sized SRTM trawlers to also include the smaller SRT trawlers and large BMRT trawlers. The two larger type trawlers processed their own catches and periodically off-loaded to refrigerated transports for shipment to the USSR. The SRT side trawlers off-loaded their catches to factory ships and other support ships for processing. The fishing area became relatively standardized (Figure 10) with two principal areas used, the first immediately north of the eastern Aleutian Islands and the other northwest of the Pribilof Islands. Effort normally peaked in late winter when fishing vessels from the herring and flounder fishery joined the pollock fleet.

In 1969 and 1970 the fishery targeted on arrowtooth flounder, sablefish, and pollock with incidental catches of cod, rockfish, and other bottomfish. Emphasis of the fishery shifted mainly to pollock in 1971 with catches rising from about 36,000 mt in 1970 to 234,000 mt in 1971. Pollock has remained the predominant species in the catch to the present time. Peak catches of pollock occurred in 1974 when almost 310,000 mt was taken. Catches of other species since 1972 have not exceeded 20,000 mt annually with the exception of rockfish in 1974 at 32,000 mt and rattails at 48,000 in 1972. Large catches of rattails were taken in 1972.

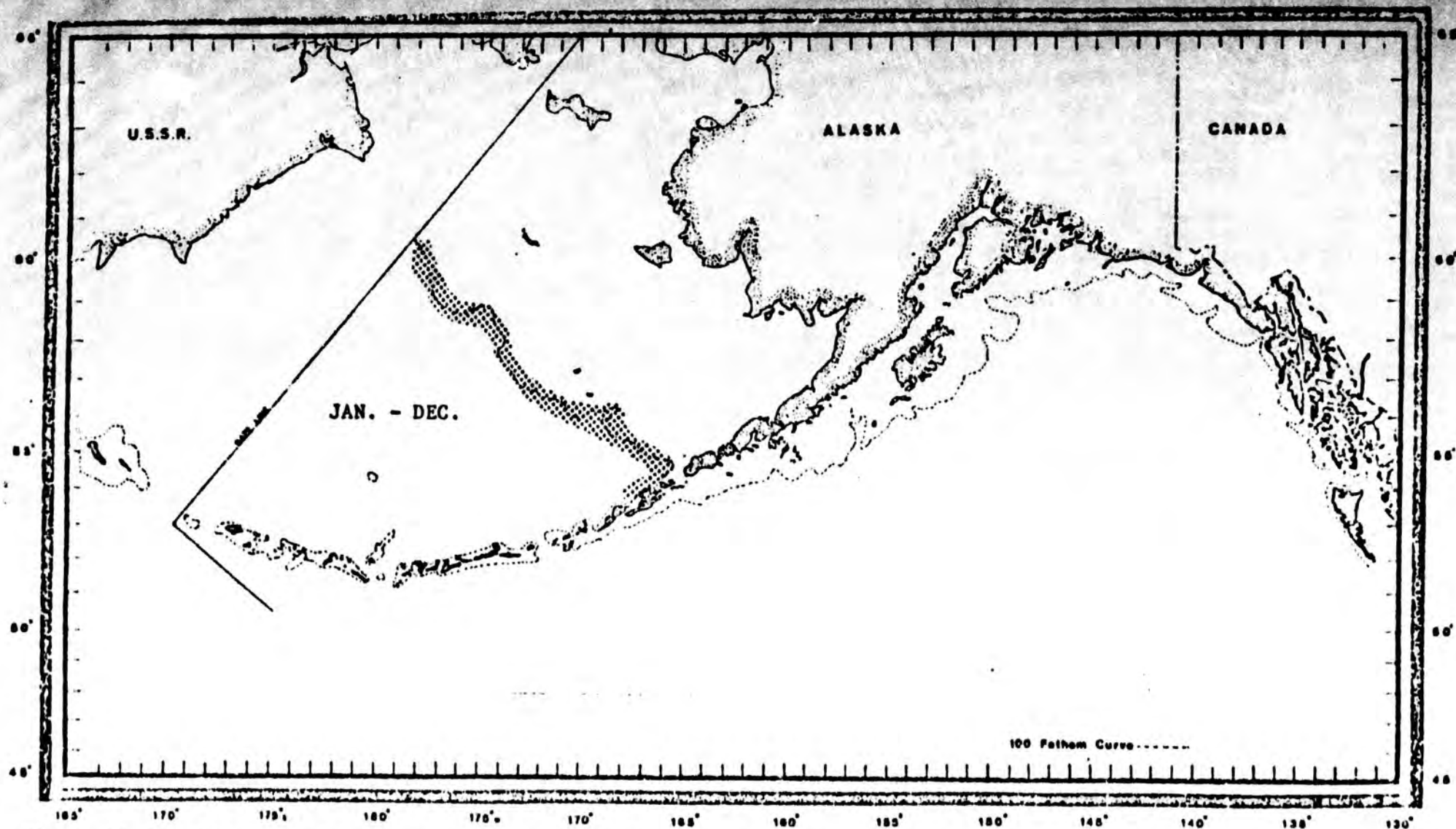


Figure 10.--Fishing areas in the eastern Bering Sea for the USSR fishery targeting mainly on pollock (Law Enforcement Division 1974).

The USSR has continued to trawl along the Aleutians in recent years, but at a relatively low level of effort. Major species in the catches besides rockfish have been pollock and Atka mackerel. Atka mackerel has become a target species of this fishery in winter and spring months.

The monthly range in numbers of vessels employed in the USSR fishery in the eastern Bering Sea and Aleutian Islands is given in Table 7. Peak periods of fishing in the eastern Bering Sea have been in winter, usually in February. In the Aleutian Islands the peak period of fishing has varied, reflecting apparent changes in target species or other factors.

5.2.2.1.3 Korean (ROK) fishery

Fisheries by the Republic of Korea in the eastern Bering Sea and Aleutian Islands have been much smaller than those of Japan and the USSR (Office of Enforcement and Surveillance 1968, 1969 and 1970; Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975 and 1977). Following exploratory fishing in these regions in 1966, an ROK fleet returned to Alaskan waters in September-November 1967 with a commercial operation consisting of a refrigerated transport vessel and eight pair trawlers. The operation was plagued by bad weather and tragedy. Crew members and two of the pair trawlers were lost enroute to the fishing grounds in a storm south of the Aleutian Islands. Continued stormy weather permitted only five days of fishing, two of which were south of Unimak Island and the remainder in the Gulf of Alaska.

The ROK expedition was more successful in 1968 conducting operations around the eastern Aleutian Islands and west of the Pribilof Islands from May to July. The fleet, targeting on pollock, consisted of a processor, six pair trawlers, and a refrigerated transport vessel. An independent stern trawler also operated in the eastern Bering Sea in 1968, but the purpose of their fishing activity is not known; it may have been exploratory in nature.

In later years the ROK fishing fleet was enlarged to include factory ships and additional pair trawlers and independent stern trawlers, and

Table 7.--Monthly range in number of USSR vessels operating in the eastern Bering Sea and Aleutian Islands in 1966-77 (Office of Enforcement and Surveillance 1967-70; Enforcement and Surveillance Division 1971 and 1973; Law Enforcement Division 1974, 1975, and 1977).

Year	Range in monthly number				Total	Month of maximum number
	Factory ships ^{1/}	Factory stern trawlers	Other trawlers	Support ^{2/}		
<u>Eastern Bering Sea</u>						
1966	0-14	0-15	0-40	0-3	0-72	Mar.
1967	0-15	0-12	0-60	0-3	0-90	Feb. - Mar.
1968	0-13	0-25	2-60	0-2	2-99	Feb.
1969	0-8	0-50	6-67	1-23	7-147	Feb.
1970	0-7	0-52	8-92	0-22	9-173	Feb.
1971	0-8	0-65	5-87	0-21	6-171	Feb.
1972	0-8	0-39	1-89	0-21	3-155	Feb.
1973	0-6	1-27	6-60	0-6	7-82	Feb.
1974	0-5	4-30	6-51	1-10	14-79	Feb. and Apr.
1975	0-4	4-13	5-36	1-7	13-51	June
1976	0-5	2-30	7-48	0-6	13-86	Apr.
<u>Aleutian Islands</u>						
1966	0-3	0-10	0-10	0-1	0-24	Aug.
1967	0-6	0-12	0-21	0-3	0-42	June
1968	0-4	0-14	0-23	0-1	7-28	Mar.
1969	0	0-7	0-13	0-1	3-14	Jan. and Dec.
1970	0	0-5	0-14	0-1	1-15	Jan.
1971	0	0-6	2-15	0-1	6-17	May
1972	0-1	0-5	3-19	0-1	4-21	Dec.
1973	0	0-4	6-17	0-3	6-20	Apr.
1974	0	0-2	0-19	0-5	0-24	Mar.
1975	0-1	0-30	0-10	0-4	2-33	Sept.
1976	0	0-27	0-4	0-5	0-32	May

^{1/} Including all processing and refrigerated transport vessels.

^{2/} Including tankers, tugs, cargo, and repair ships.

eventually longliners and a Danish seiner (Table 8). Based on the number of vessels in the fishery, ROK effort reached its maximum in 1976. The number of vessels shown in Table 8 includes those fishing for herring in the eastern Bering Sea and for other species in the Gulf of Alaska. The principal target species along the edge of the continental shelf in the eastern Bering Sea has continued to be pollock. Some of the trawlers have also fished in the Aleutian Islands for rockfish and pollock. Until 1972, fishing was limited to spring and summer months, but by 1973 the independent stern trawlers had begun to fish in winter months as well. By 1974 the areas of fishing by the trawl fleet had become fairly extensive (Figure 11). Estimates by U.S. surveillance of the ROK fishery indicated that pollock catches ranged between 1,200 and 26,000 mt from 1968 to 1975. The pollock catch reported by the Koreans for 1976 was 85,000 mt in the eastern Bering Sea and 500 mt in the Aleutian Islands area.

An ROK longline fleet, which has mainly fished sablefish in the Gulf of Alaska, began fishing sablefish for brief periods in the Aleutian Islands in 1974. The effort by longliners in Aleutian waters has apparently increased in more recent years.

5.2.2.1.4 Taiwanese (ROC) fishery

The Taiwanese fishery, which began in December 1974, has involved only one or two independent stern trawlers. The trawlers have fished in winter and spring months along the continental shelf edge west and southwest of the Pribilof Islands. The vessels are believed to have targeted on pollock and flounders.

5.2.2.2 Description of vessels and gear

5.2.2.2.1 Japanese fishery

As outlined in Section 5.2.2.1, the Japanese employ two types of operations in their groundfish fishery, fleet operations involving a factory mothership and catcher boats and vessels that operate independently and process their own catch. Vessels used in each of these fisheries are discussed separately.

Table 8.--Number of vessels operating in the Korean groundfish fishery in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, 1968-74 (Office of Enforcement and Surveillance 1969, 1970; Enforcement and Surveillance Division 1971, 1973; Law Enforcement Division 1974, 1975, and 1977).

Year	Pair trawlers	Stern trawlers	Long- liners	Danish seiners	Factory ships	Processors and/or transport vessels	Total
1968	6	1	0	0	0	2	9
1969	7	4	0	0	1	3	15
1970	11	2	0	0	2	2	17
1971	10	3	0	0	1	3	17
1972	0	6	0	0	0	0	6
1973	8	10	1	0	3	0	22
1974	22	5	8	1	2	3	41
1975	0	13	9	1	0	0	23
1976	29	16	12	0	1	0	58

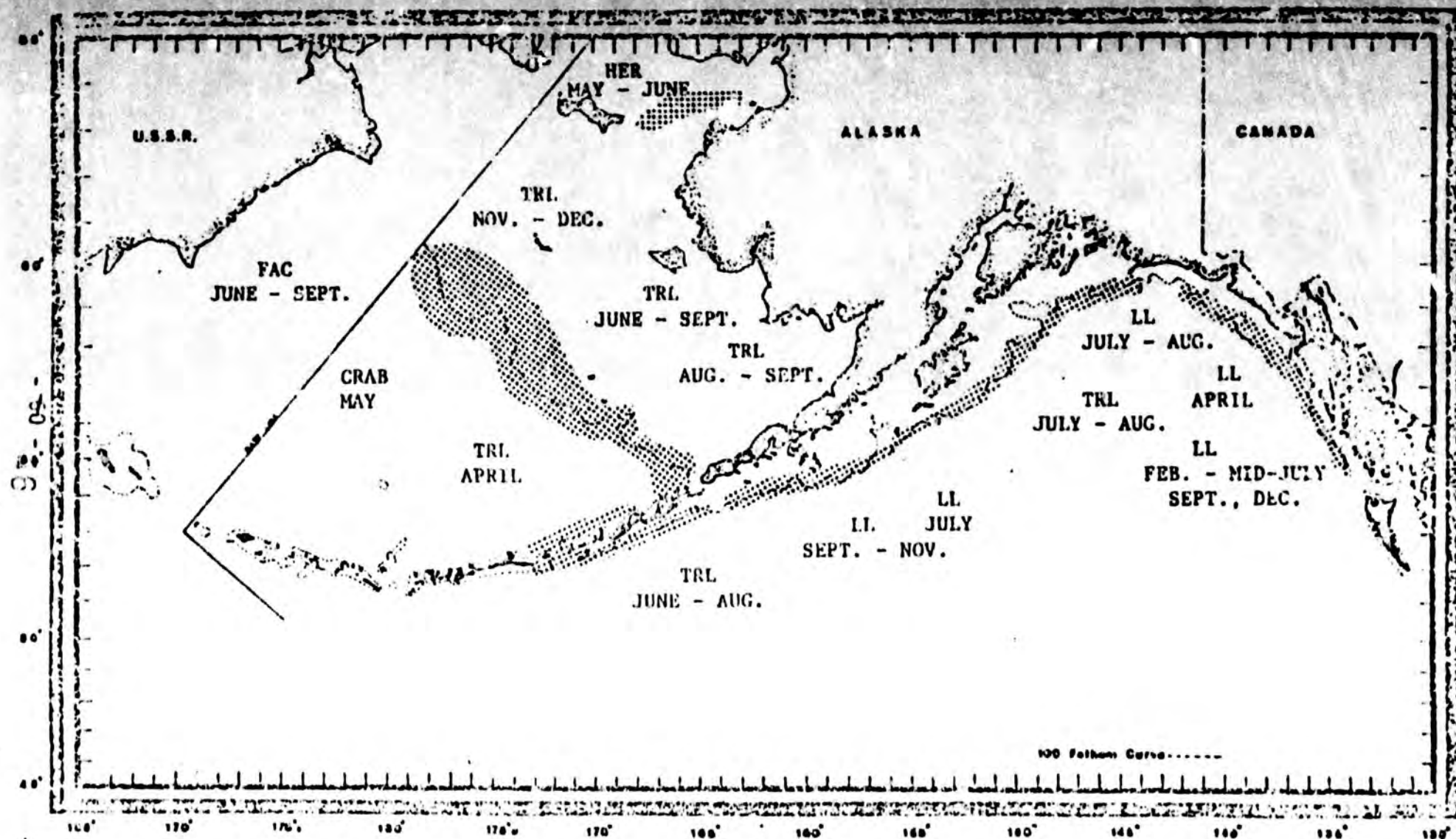


Figure 11.--Fishing areas of the Republic of Korea fisheries in 1974 (Law Enforcement Division 1977).

Types of mothership fleets and the range in size of motherships as reported by Forrester et al. 1974 are as follows:

<u>Type of fleet</u>	<u>Size of Motherships (gross tons)</u>
Flounder freezing fleets	7,000 - 9,000
General freezing fleets	5,000 - 10,000
Minced fish and fish-meal fleets	9,000 - 27,000
Longline-gillnet fleets	200 - 2,500

The motherships are equipped to process catches into such products as frozen fish for human consumption, minced fish (surimi), and meal and oil. Catcher boats supplying the motherships with fish have been of five major types: longline-gillnetters, side trawlers, pair trawlers, Danish seiners, and stern trawlers. Side trawlers have been phased out of the fishery and the number of Danish seiners have declined. Pair trawlers have become the principal vessel type in the freezing and minced fish and fish-meal fleet.

Side trawlers that operated in the fishery were 30 to 52 m long, 150 to 370 gross tons, and had crews of 20 to 30 (Dickinson 1973). The side trawlers usually set and retrieved the trawl from the starboard side, but some were rigged to set from the stern and retrieve to the side. The trawlers usually operated within 55 m of the mothership and used detachable codends so that a number of tows could be made prior to returning to the mothership.

Danish seiners are generally 27 to 46 m in length and 100 to 150 gross tons with crews of 18 to 20 (Dickinson 1973). Danish seiners set the net over the stern and usually retrieve on the port side. The catch is normally brailled aboard, but some newer seiners have stern ramps to haul the catch aboard. Typical gear dimensions of the Danish seiners as determined from a sample of the Japanese fleet are given in Table 9.

Pair trawlers work in two-boat teams, one vessel setting the trawl and the second vessel securing its warp to one wing of the net. When the tow is completed, the net is hauled until one wing can be passed to

Table 9 . Range in size of catcher boats in the Japanese motherhip fishery and typical trawl gear used based on a sample of the fleets in 1970 and 1975 (Data for 1969 from Forrester et al., 1974 and for 1975 from Fisheries Agency of Japan 1975).

Year	Type	Vessels		Typical gear type			
		Range in gross tons	Range in horsepower	Headrope length (m)	Groundrope length (m)	Cod-end mesh size (cm)	Otter board size (m)
1970	Danish seine	85 - 300	440 - 850	93	101	7.3	--
1975	Danish seine	96 - 125	450 -1350	115	130	9.0	--
1970	Pair trawl	88 - 195	310 -1200	139	152	9.1	--
1975	Pair trawl	115 - 215	650 -1400	146	162	9.0	--
1975	Stern trawl	297 - 349	1200 -2500	48	57	9.0	1.9 x 3.2

the other vessel to complete the haul. Detachable cod-ends are used on pair trawlers. Older pair trawlers are 27 to 46 m in length and 100 to 150 gross tons with crews of 15 to 20 (Dickinson 1973). Newer pair trawlers are 37 m in length and 185 gross tons with crews of 14 to 16 men. Typical trawl dimensions used by pair trawlers are observed from sampling the fleet in 1970 and 1975 are shown in Table 9. These data indicate that the average size of vessels and gear increased between 1970 and 1975.

Stern trawlers operating as catcher boats in the mothership fishery are mainly of the 300-350 ton class (Table 9). These smaller stern trawlers average 43 to 50 m in length and carry 20 to 30 men (Dickinson 1973).

Vessels in the Japanese groundfish fishery operating independently of the motherships and processing their own catches consist of stern trawlers and longliners. The independent stern trawlers range in size from about 350 gross tons to over 5,000 gross tons (Table 10). The smaller of these trawlers have operated in the flounder and rockfish fisheries while those targeting on pollock in 1974 and 1976 were larger than 2,000 gross tons. Trawl dimensions were greatest for the larger vessels operating in the pollock fishery (Table 10).

An example of a smaller independent stern trawler is a 500 gross ton vessel averaging 52 to 58 m in length and carrying a crew of 20 to 35 men (Dickinson 1973). The vessels are usually equipped with limited processing equipment, ship freezing units, and refrigerated holds. A medium sized independent stern trawler is 1,500 gross tons, averages 70 to 82 m in length, and carries 70 to 90 men. They normally have a large processing area with modern machinery for washing, heading, gutting and filleting the catch. Plate freezers and refrigerated holds are standard equipment along with reduction plants for producing fish meal. The larger stern trawlers of 2,500 to over 5,000 gross tons range in length from 88 m to over 120 m and carry crews of from 90 to 135. These vessels have equipment for heading, gutting, filleting, and skinning the catch and freezing facilities. Most have reduction plants for producing meal and oil and the larger vessels have equipment for producing minced fish.

Table 10.--Range in size of vessels in the North Pacific trawl fishery and typical gear used for principal target species from a sample of the fleet in 1974 and 1976 (Fisheries Agency of Japan 1974 and 1976).

Target Species	Year	Range in vessel size		Gear			
		gross tons	horsepower	Headrope length (m)	Groundrope length (m)	Cod-end mesh size (cm)	Ottor board size (m)
Pollock	1974	3037-5460	4000-5900	66	65	10	3.2 x 5.0
	1976	2455-5470	3500-5700	66	89	10	2.6 - 4.3
Yellowfin sole	1974	349- 499	2100-2500	53	60	9	2.1 - 3.3
	1976	349-3500	1600-4000	57	69	10	2.4 x 3.0
Rockfish	1974	499-3608	1500-4400	50	64	9	2.4 x 3.8
	1976	349-3914	1420-4400	60	73	10	2.2 x 3.3

Independent longline vessels are 36 to 52 m long and 200 to 500 gross tons with crews of 25 to 30 (Dickinson 1973). Their primary target species is sablefish. Some rockfish are taken incidentally. Individual vessels fish about 23 km of longline with approximately 8,000 hooks. The gear is allowed to soak for 12 hours. Frozen squid is used for bait. Typical dimensions of fishing gear is given in Table 11. The vessels are equipped with sharp freezers and refrigerated holds. The longlines remain on the fishing grounds from two to four months until the maximum hold capacities of about 400 mt is reached, after which they return to home ports (Law Enforcement Division 1974).

5.2.2.2.2 Soviet fishery

Similar to the Japanese groundfish operations, the USSR fishery also employ catcher boats that deliver their catches to factory ships or to processing and freezing transport vessels and vessels that operate independently of factoryships and process their own catches. The USSR has perhaps utilized the flotilla concept of fishing operations to a greater degree than any other nation (Pruter 1976). To allow the fishing vessels to operate at sea for long periods, they are closely supported by numerous other types of vessels including base ships that carry fleet administrators and staff and provide logistic support, factoryships for processing catches, refrigerator transports to replenish stores on the catcher vessels and to receive, freeze, and transport their catches to home ports, and oil tankers, passenger ships, tugs, patrol vessels and occasionally even hospital ships. Refrigerated transports are the mainstays of the support operations. They are of various sizes ranging from 46 to 151 m and from 650 to almost 9,700 gross tons (Law Enforcement Division 1977). Base and factory ships are 110 to 174 m and 5,000 to 18,000 gross tons.

Two basic kinds of fishing vessels have been used by the Soviets, side trawlers and factory stern trawlers (Pruter 1976). Three size classes of side trawlers have been used. Smallest and oldest of the side trawlers is the SRT of 265-335 gross tons, 38 m in length with crews of 22-26 men. The next larger of the side trawlers is the SRTR class of refrigerated medium trawlers of 505-630 gross tons and about 52 m, carrying crews of 26-28. Largest of the refrigerated side trawlers

Table 11--Range in size of longline vessels and typical fishing gear used in the North Pacific longline-gillnet fishery from a sample of the fleet in 1969, 1972 and 1976 (Fishery Agency of Japan 1969 1973 and 1976).

	Vessels		Groundline			Gangion		Size of hook (mm) or size number	Bait
	Range in gross tons	Range in horsepower	Length of hachi (m)	Gear diameter (mm)	Number hooks per hachi	Length (m)	Diameter (mm)		
1969	275-499	510-1230	75	9.0	40	1.5	2.0	63 x 14	Frozen squid
1972	300-500	710-1800	75	8.0	35	1.3	---	20	Frozen squid
1976	332-500	540-1110	75	8.0	42	1.3	---	20	Frozen squid

is the SRTM class of about 700 gross tons and 54 m with a crew of about 30. The larger of the side trawlers, particularly the SRTM's frequently operate independently processing and freezing their own catches, but some may tranship their catches to factoryships for processing. A new class of trawler designated as SRTK's have appeared in the fishery in more recent years and are apparently an improvement on the SRTM's. The SRTK's are about 775 gross tons, have stern ramps for more efficient trawling over the stern

The largest of the Soviet fishing vessels are the factory stern trawlers, the most common of which is the BMRT of 3,170 gross tons, 85 m in length, and carrying a crew of about 90 (Pruter 1976). The factory trawlers usually process and freeze their own catch. A newer class of factory stern trawler, the RTM has come into increasing use in recent years. They are somewhat smaller than the BMRT's, the most common of which is 2,657 gross tons and 82 m long, but has the advantage of a larger deck area aft for handling gear and fish.

Dimensions of typical gear used on Soviet BMRT trawlers fishing for pollock and Atka mackerel are given in Table 12. Data from U.S. observer reports indicate that vertical openings on trawls used for pollock may range from 5-30 m.

5.2.2.2.3 Korean and Taiwanese fisheries

Information on vessels and gear used in the ROK groundfish fisheries is not as well documented as that for the Japanese and the USSR fisheries. Methods of operation are similar to those of the Japanese and Soviets in that they also use factoryship-catcher boat operations as well as stern trawlers, longliners and Danish seiners operating independent of factoryships. The number and size of vessels has increased since the fishery began. Initially, the Koreans used pair trawlers of about 33 m and 133 gross tons and processed the catch aboard vessels ranging in size from 828-957 gross tons (Office of Enforcement and Surveillance 1969). In 1969 they employed a 9,400 gross ton factoryship, 142 m long to process catches of the pair trawl fleet. Independent stern trawlers also entered the fishery in 1969 ranging in size from 131-1,518 gross tons and 35 to 77 m in length (Office of Enforcement and Surveillance 1970).

Table 12.--Typical trawl dimensions used on Soviet BMRT factory stern trawlers for pollock and Atka mackerel based on data of U.S. Observers in 1976 and 1977.

Target Species	Range in vessel size			Typical gear dimensions				Otter boards
	Length (m)	gross tons	Horsepower	Headrope length (m)	Groundrope length (m)	Cod-end mesh size (cm)	Cod-end liner mesh size (cm)	
Pollock	78-87	2657-3837	2000-2320	77.4	77.4	5.0 - 6.0	3	Round to oval variable in size 1600-1800 kgs.
Atka mackerel	78-87	2581-3510	2000	31.0	44.0	5.0	3	Round to oval 1200 kgs.

The subsequent modernization of the Korean fleet is illustrated by information from U.S. Observer reports in 1977 (Table 13). These data indicate that independent stern trawlers in the ROK fleet are comparable in size to the largest trawlers in the Japanese and Soviet fleets with some exceeding 5,000 gross tons. The three vessels observed were targeting on pollock and gear dimensions given in Table 13 may be representative of trawls used by ROK independent trawlers in the pollock fishery.

The Taiwanese have used 1 or 2 independent stern trawlers in their small scale fishery in the eastern Bering Sea. The size of the vessels and dimensions of the gear used are unknown.

5.2.2.3 Catch trends

Complete catch statistics for groundfish taken by foreign fisheries in the eastern Bering Sea and Aleutian Islands regions have not been available throughout the history of the fishery. Japan has provided the longest and most detailed series of catch data. However, even the Japanese have not always identified some of the flounders to species in their catch data (INPFC 1976). Beginning in 1964, Japan has submitted detailed statistics for their groundfish fisheries to the United States and Canada through INPFC. The identification of catches and reporting of all principal commercial species has probably improved since then. The USSR began to report catch statistics to the United States through bilateral agreement in 1967. Not until 1972 was there a reasonably good breakdown of catches to individual species and even then a detailed area breakdown of their catches was not available. The ROK did not report their catch statistics in detail until 1976. Prior to the reporting of statistics by the USSR and the ROK, their catches have been estimated through U.S. surveillance of the fisheries.

Because of the lack of statistics from some nations and the irregular method of reporting certain species, available catch data for foreign fisheries may not reflect actual exploitation of all species. Statistics for primary target species such as pollock, yellowfin sole, rockfish and sablefish are assumed to be relatively accurate. Since 1970 the catch data for most other commercially important species has probably improved.

Table 13.--Vessel size and fishing gear dimensions of three ROK independent stern trawlers boarded by U.S. Observers in 1977.

Vessels					Gear				
Name	Length (m)	Gross tons	Horsepower	Number in crew	Headrope length (m)	Groundrope length (m)	Vertical opening (m)	Cod-end mesh size (cm)	Otter board size (m)
Salvia	84	2285	3200	58	59	78	6	10	2.5 x 3.8
Shin An Ho	106	5680	6000	157	80	75	7	10	3.0 x 5.0
Heung Yang Ho	104	5377	5800	92	74	105	38	10	3.0 x 4.8

(C)
(C)

Eastern Bering Sea.--Historical trends in total groundfish catches by foreign fisheries in the eastern Bering Sea since 1954 are illustrated in Figure 12; catch statistics by individual species and nation are given in Annex IV. Total catches of groundfish in the eastern Bering Sea have reached two peaks. The first and smaller of these peaks occurred between 1959 and 1963 when Japan and the USSR were targeting on yellowfin sole. Total estimated catches of yellowfin sole and other species reached a maximum of 715,000 mt in 1961. Catches dropped sharply in the succeeding two years, because of a decline in abundance of yellowfin sole, ranging between 300,000 and 400,000 mt during 1963-65. With the development of the Japanese pollock fishery, total groundfish catches rose rapidly after 1965 and by 1971 exceeded 2 million mt. The total catches of groundfish peaked at 2.2 million mt in 1972 and then declined as catch restrictions were placed on pollock and other species through bilateral agreements between the United States and Japan and the USSR. These catch restrictions stemmed from evidence of deterioration of the various resources. By 1976 total catches had been reduced to less than 1.5 million mt. Throughout the history of foreign exploitation of groundfish in the eastern Bering Sea, Japan has been by far the major user nation (Figure 12). In the early years of the fishery, when yellowfin sole was the major target species, Japan accounted for 68-90% of the total annual groundfish catch in the eastern Bering Sea. This proportion has remained high in later years as pollock became the major target species, ranging from 76-89% annually. Japanese catches peaked at 1.8 million mt in 1972.

Through 1970, the USSR fished primarily for flounders in the eastern Bering Sea and until that year their total catches of groundfish remained less than 200,000 mt (Figure 12). In subsequent years, as their pollock fishery developed, catches of groundfish increased, peaking at 410,000 mt in 1974.

Catches by the ROK have apparently been relatively small. Estimated catches based on U.S. surveillance of their fisheries were no larger than 26,000 mt through 1975 (Annex IV). In 1976, however, the ROK reported a total groundfish catch in the eastern Bering Sea of 88,000 mt. Pollock accounted for 85,000 mt of this total.

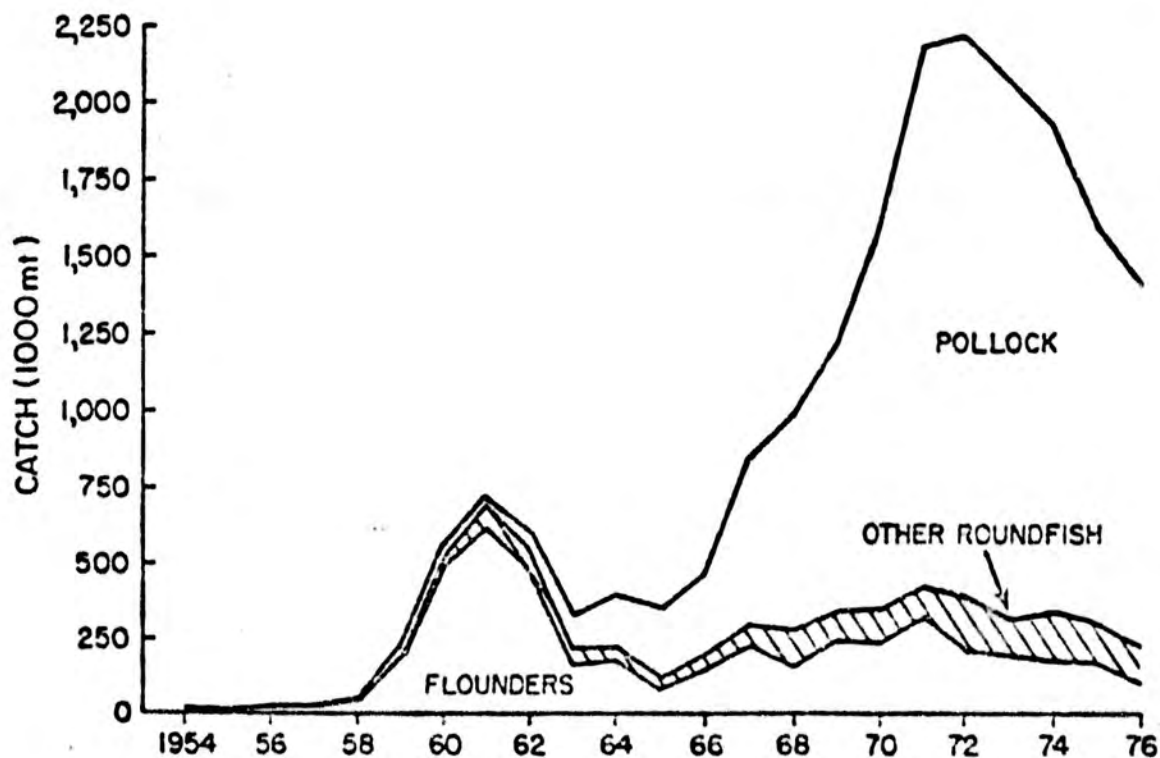
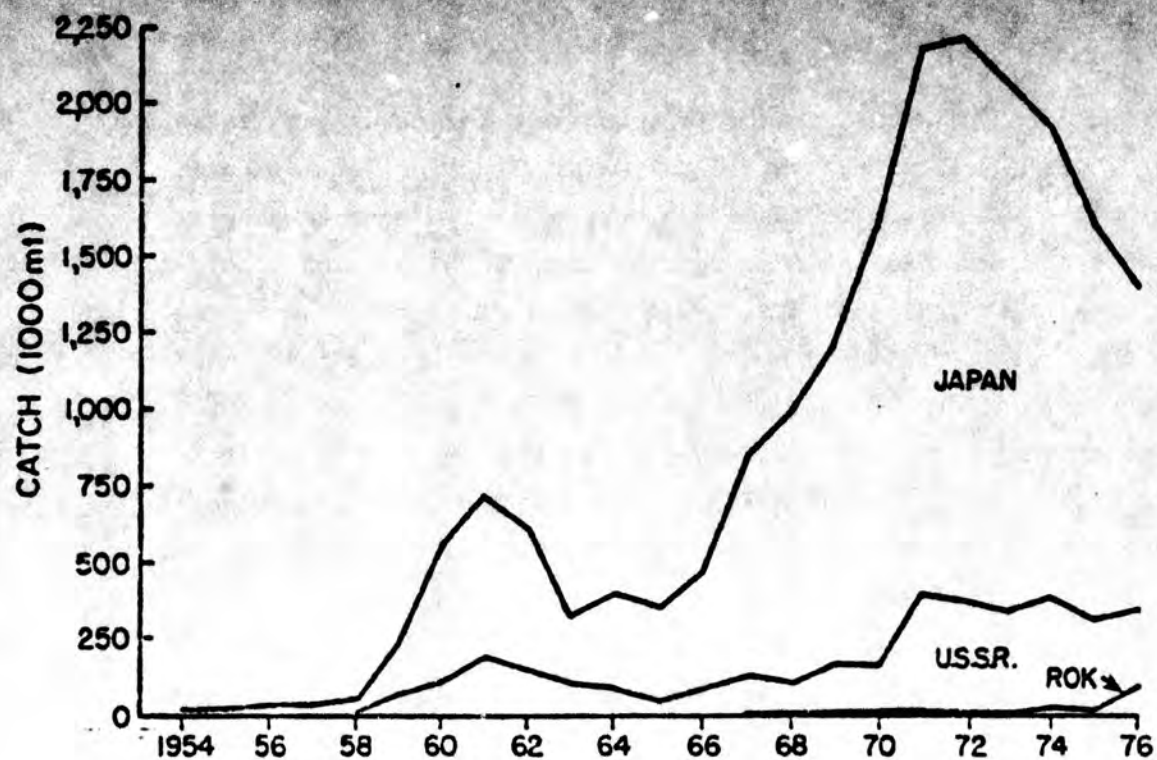


Figure 12.--Foreign catches of groundfish in the eastern Bering Sea (east of 180°) by nation (upper panel) and by species or species group (lower panel), 1954-76.

Flounders (primarily yellowfin sole) were the major species in the eastern Bering Sea catches until 1964, after which pollock predominated (Figure 12). The proportions of pollock in foreign catches generally increased between 1965 and 1970 ranging from 57-79%. From 1971 to 1976 they formed 81-85% of the total groundfish catch. Species of roundfish, other than pollock, have been less abundant than pollock and flounders in catches.

Catch trends of individual species of flounders in the eastern Bering Sea are illustrated in Figure 13. Catches of yellowfin sole reached extremely high levels from 1960 to 1962 with removals of over 1.4 million mt by Japan and the USSR. Catches of this magnitude were more than the stock could sustain and abundance of yellowfin sole declined. Following this deterioration of the resource, catches fell to about 100,000 mt or less, but increased again to reach the 160,000-170,000 mt level in some years between 1967 and 1971. Since 1971, catches have fallen well below 100,000 mt, in part due to the absence of a directed fishery on flounders by the USSR and perhaps to winter area closures in the southeastern Bering Sea which may have reduced catches of yellowfin sole by Japan.

As discussed previously, rock sole, flathead sole, and Alaska plaice have not always been identified in catches, particularly prior to about 1970. Reported catch statistics may therefore inaccurately reflect actual catch trends for these species. Catches of flathead sole apparently peaked in 1971 at 51,000 mt and those for rock sole in 1972 at 61,000 mt (Figure 13). Catches have declined substantially in more recent years which may have resulted to some degree from the reduction in the yellowfin sole fishery where these species are taken incidental to yellowfin sole. There have been no indications of recent substantial reductions in abundance of these species (Bakkala and Wakabayashi 1977).

Catches of Alaska plaice have not shown major fluctuations (Annex IV). This species is also taken incidentally in the yellowfin sole fishery and may not always have been identified in catches. The largest reported catch for this species was about 6,900 mt in 1969. Catches since 1969 have ranged from about 300 mt to 3,400 mt.

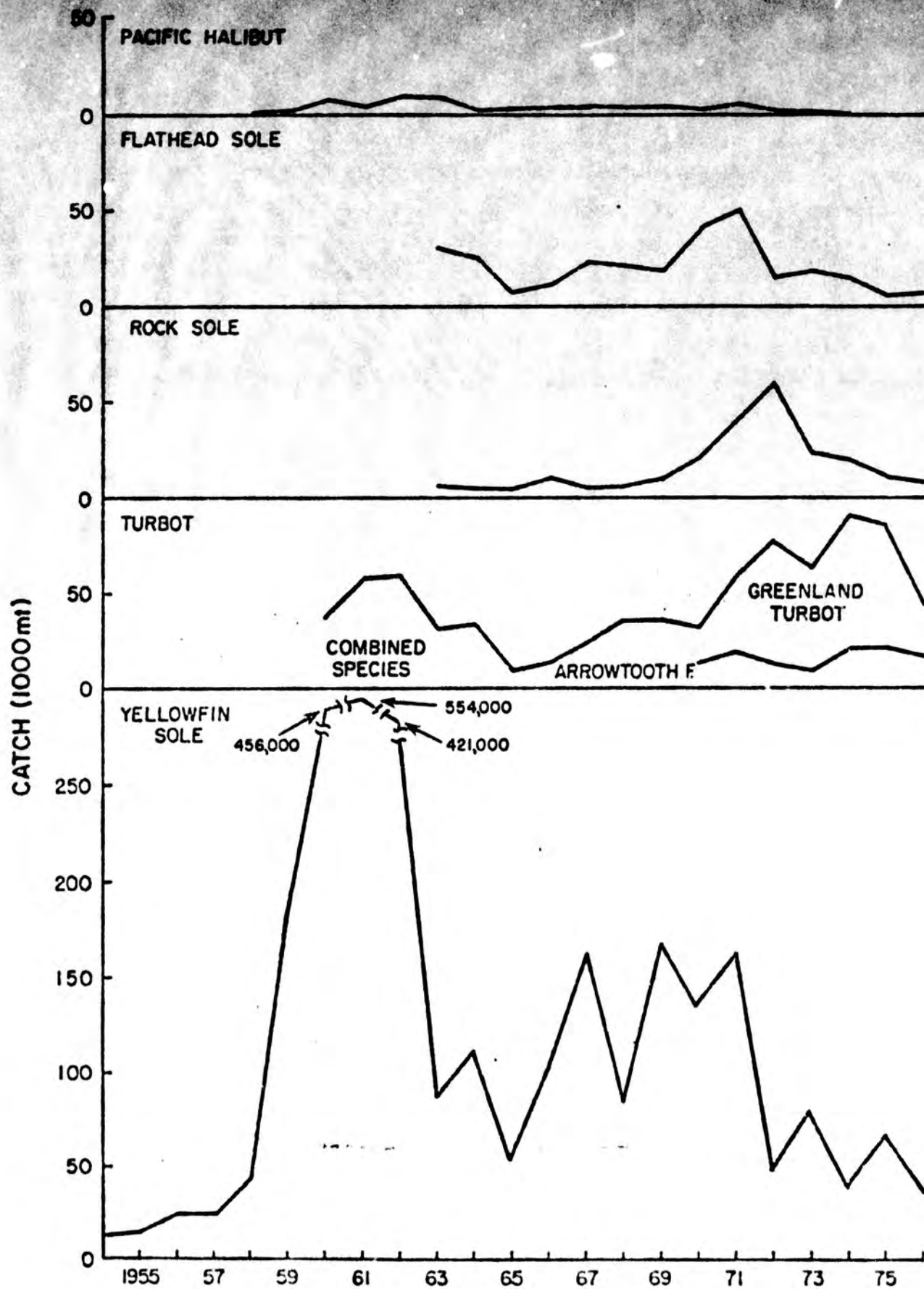


Figure 13.--Catch trends of flounders by foreign fisheries in the eastern Bering Sea, 1954-76.

Catches of turbot (arrowtooth flounder and Greenland turbot) were relatively high in early years of the eastern Bering Sea fishery ranging over 50,000 mt in 1961 and 1962. Japanese fisheries targeted on arrowtooth flounder in this period for the production of fish meal (Takahashi 1976). Catches dropped below 40,000 mt in 1963-70 as these species were only taken incidentally in the pollock and other directed fisheries. Catches of Greenland turbot increased markedly after 1970 in both the Japanese and the USSR fisheries (Annex IV). Total catches of Greenland turbot reached almost 70,000 mt in 1974 and since 1972 have approached or exceeded catches of yellowfin sole.

Reported catches of Pacific halibut in the eastern Bering Sea were relatively small compared to those of other principal flounders. Largest annual catches were made in 1960 (6,900 mt), 1962 (7,900 mt), and 1963 (7,500 mt), and 1971 (4,900 mt). Catches have declined in subsequent years reaching a low of 145 mt in 1976.

Not shown in Annex IV are incidental catches of halibut taken by Japanese trawl fisheries targeting on other species. Japan is prohibited from retaining trawl-caught halibut in the eastern Bering Sea, but most released fish die from injuries received during capture. Estimates from observer data indicate that the incidental catch in the eastern Bering Sea increased from about 50 mt in 1954 to over 2,000 mt in 1961; after declining during 1962-63, the catch again increased and peaked at about 3,000 mt in 1971-72 (Hoag and French 1976). Since then, the incidental catch has declined as a result of reduced fishing effort and time/area closures, designed to protect halibut.

Before 1977, Soviet trawlers retained trawl-caught halibut in the Bering Sea. Their catch of halibut, however, was included with other species and not reported separately until 1972. The reported catch since then declined from 490 mt in 1972 to 58 mt in 1976 (Annex IV). The reported catch, however, may be too low. Hoag and French (1976) estimated that the Soviet halibut catch averaged about 750 mt during 1959-1970 and then increased sharply to about 2,000 mt during 1971-1974. The catch has probably declined since then due to restrictions on the Soviet fishery.

With the concentration of Japanese fishing effort on pollock starting in 1964, catches of this species rose rapidly to reach 700,000 mt in 1968 (Figure 12). With the entry of the USSR and the ROK into the pollock fishery and greater effort by the Japanese, catches continued to increase reaching a peak of over 1.8 million mt in 1972. With the implementation of catch limitations stemming from evidence of overfishing on pollock, catches declined, falling to about 1.2 million mt in 1976.

Catch trends of demersal roundfish, other than pollock, are illustrated in Figure 14. Peak catches of sablefish and Pacific ocean perch were taken rather early in the fishery. Maximum harvests of sablefish occurred in 1961 and 1962 when 26,000 and 28,500 mt were taken. Catches were relatively stable at a lower level of 9,500-16,000 mt from 1966 to 1972, but declined thereafter falling to 2,700 mt in 1976. Following the peak catch of Pacific ocean perch in 1961 of 47,000 mt, catches dropped to a level of 17,000-29,000 mt from 1962 to 1968 and then declined to 3,600 mt in 1973. A second peak of 39,000 mt was reached in 1974 which was followed by another decline to 16,000 mt in 1976.

Catches of Pacific cod increased steadily in earlier years of the fishery to reach levels of more than 50,000 mt by 1968. Annual catches have been relatively stable since then, ranging around 50,000 mt with the largest catch of 70,000 mt taken in 1970.

The "other groundfish" category represents catches of various species of non- or low commercial value that are taken incidental to target species. Major species groups in this category are probably sculpins, poachers, eelpouts, skates and rattails. Reported catches of this group increased sharply after 1970. A large catch of rattails (48,500 mt) by the USSR mainly accounted for the exceptionally large total catch of "other groundfish" in 1972. The recent general increase in catches of this species category may stem from better reporting rather than an actual increase in catches.

Aleutian Island.--Characteristics of the foreign fisheries in the Aleutian Island region differ from those in the eastern Bering Sea in a number of respects. Overall catches have been much lower in the Aleutians, trends in catches and major species in catches have differed in the two

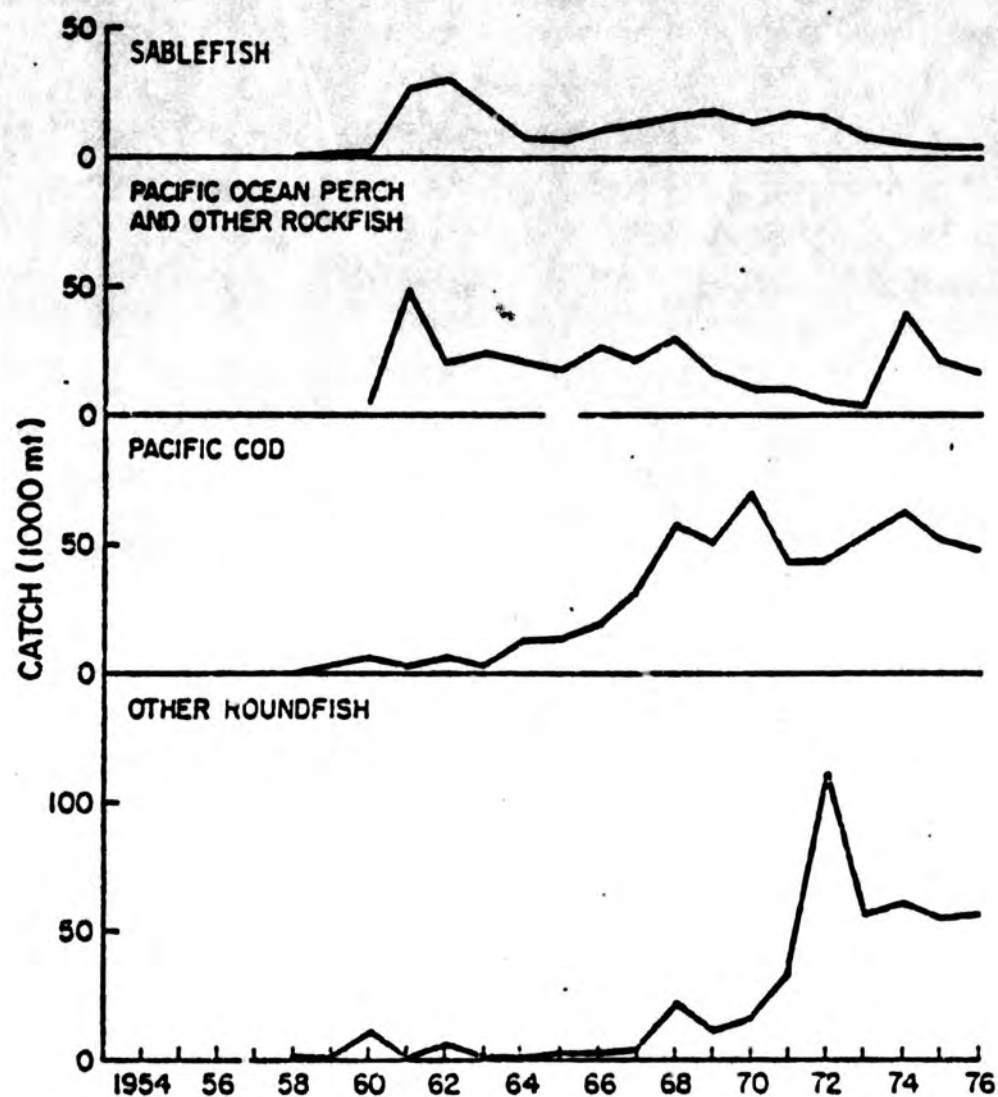


Figure 14.--Catch trends of roundfish (other than pollock) by foreign fisheries in the eastern Bering Sea, 1954-76.

regions, and the USSR rather than Japan has taken the greatest share of the catches in the Aleutians (Figure 15, Annex IV). Total catches of groundfish reached their peak early in the history of foreign exploitation of the Aleutian Island resources (Figure 15). Due almost entirely to catches of Pacific ocean perch and other rockfish, catches of all groundfish reached a peak of 114,000 mt in 1965. Since then, total catches have fluctuated at a lower level and shown a general overall decline. In 1975 and 1976, catches were in the range of 55,000-60,000 mt. The USSR has taken the largest share of the catches in the Aleutians with the exception of some recent years. Rockfish (mainly Pacific ocean perch) has been the primary target species in the Aleutians of both Japan and the USSR. Catches of demersal roundfish have increased markedly since 1973, perhaps due in part to better reporting of these species, but also because the USSR has had a target fishery on Atka mackerel in this period. Catches of Atka mackerel reached 20,000 mt in 1976. Catches of "other roundfish" have exceeded those of rockfish since 1973 because of the decline in abundance of Pacific ocean perch (Low et al. 1977) and the increase in catches of Atka mackerel and better reporting or actual increases in catches of such species as pollock and Pacific cod.

Flounders have formed a relatively small proportion of the total catches in the Aleutians. The small flounders (yellowfin sole, rock sole, flathead sole and Alaska plaice) occupy this region in low abundance based on catch statistics (Annex IV). The main species of flounders taken have been Greenland turbot and arrowtooth flounder.

Catches of Pacific ocean perch and other rockfish reached their peak in 1965 at 109,000 mt (Figure 15). Since then they have shown an almost continual decline with minor increases in 1970, 1972, and 1974. Catches fell again following 1974 to range from about 17,000-18,000 mt in 1975 and 1976.

Catch trends for individual species of roundfish, other than rockfish, are illustrated in Figure 16. Catches of Pacific cod have been small, showing some increases in recent years with a peak catch of 3,800 mt in 1976. This increase may simply reflect better identification and reporting

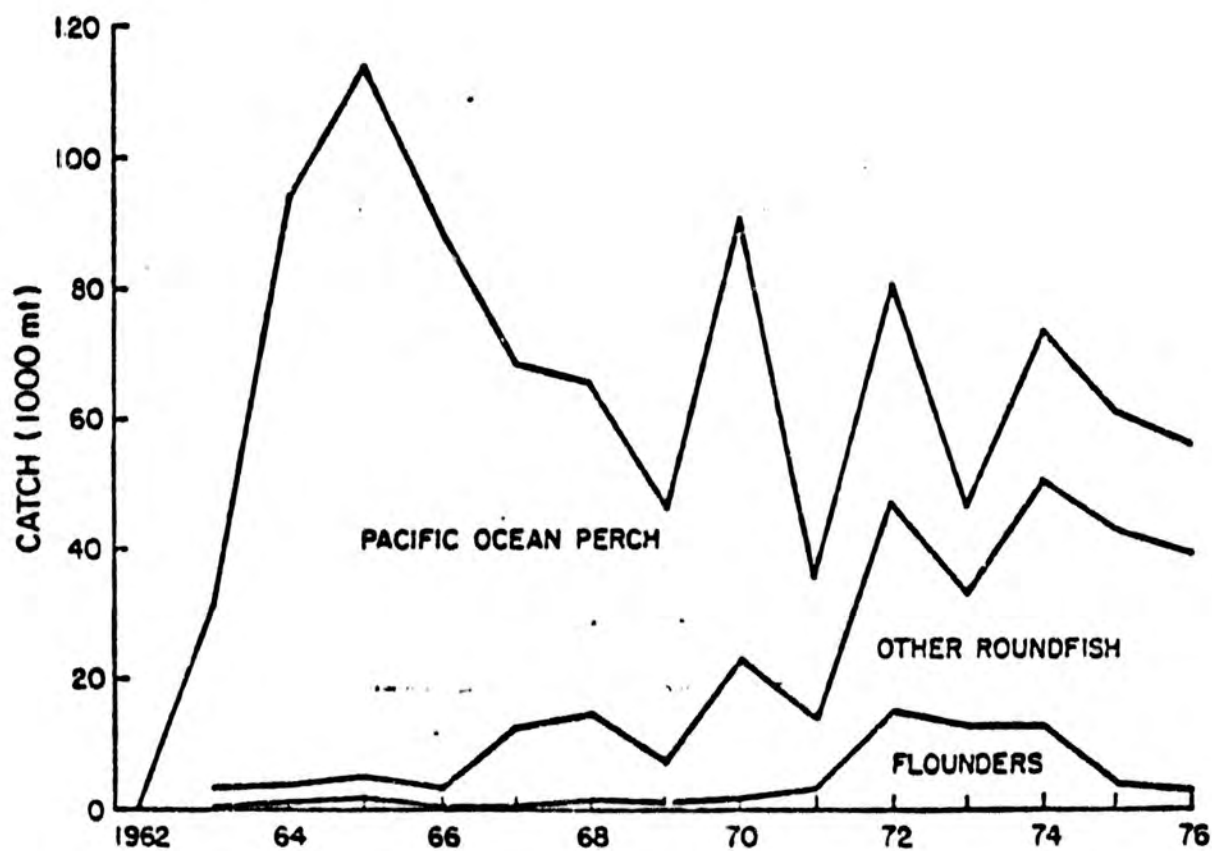
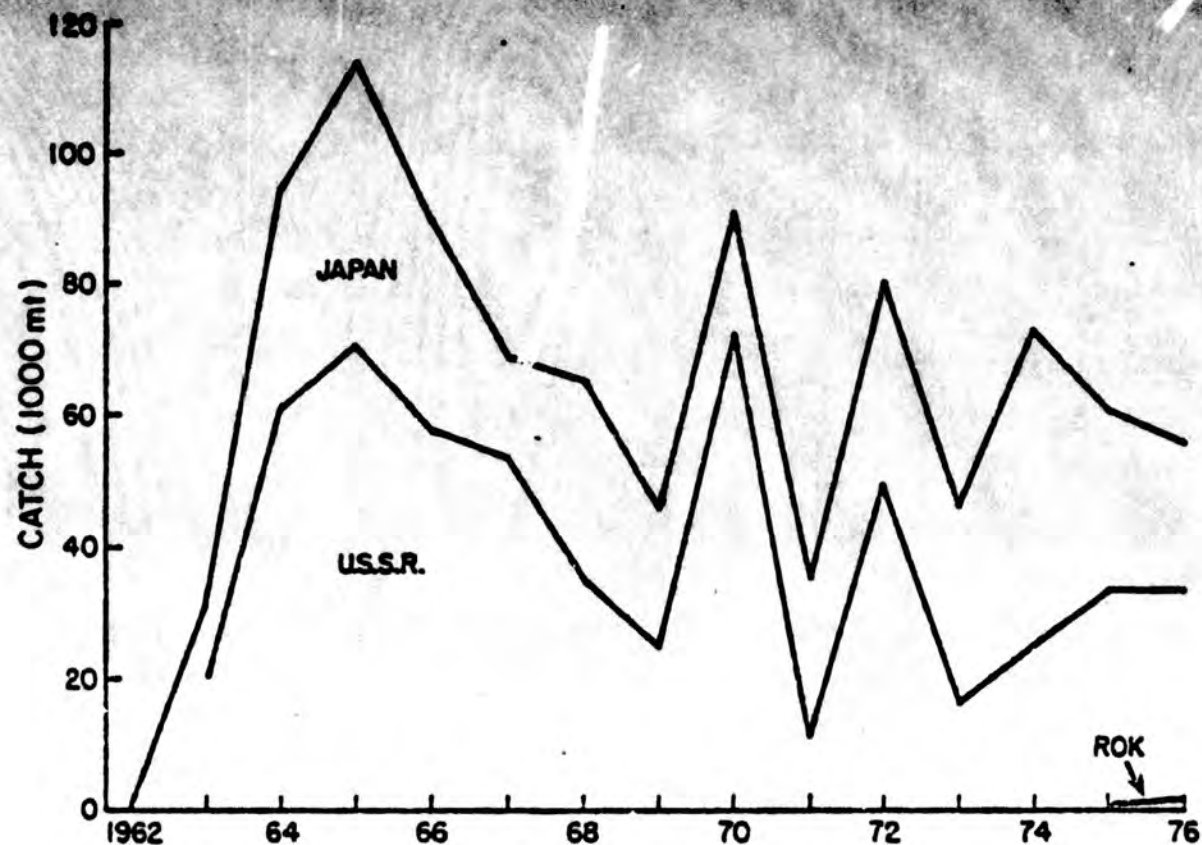


Figure 15.--Foreign catches of groundfish in the Aleutian Island area (170°W - 170°E) by nation (upper panel) and by species or species group (lower panel), 1962-76.

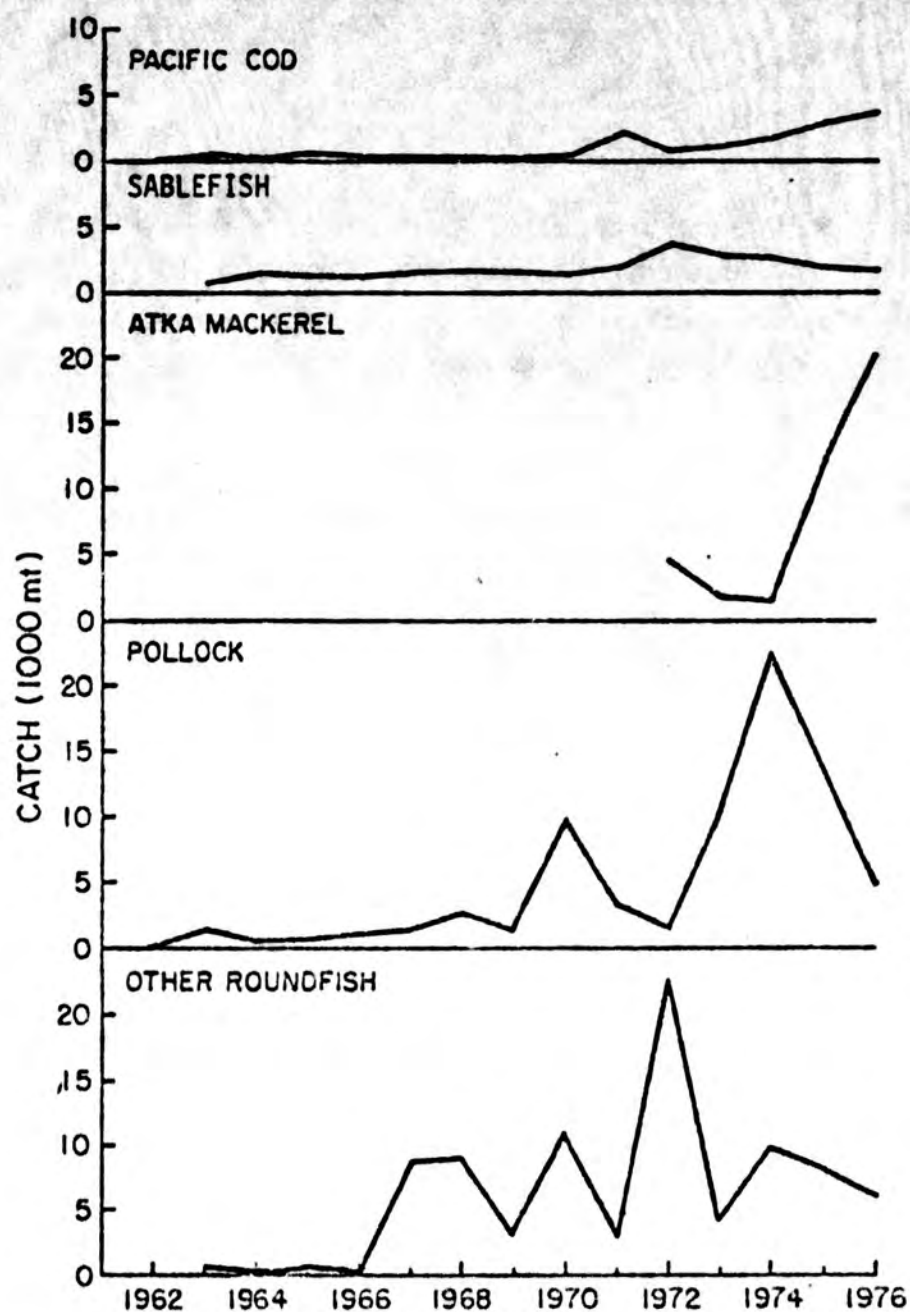


Figure 16.--Foreign catches of commercially-important species of roundfish (other than Pacific ocean perch) in the Aleutian Island area, 1962-76.

of cod in the fisheries. Catches of sablefish have remained relatively stable at a low level throughout the period of foreign fishing in the Aleutians. The largest catch of 3,600 mt was taken in 1972. Sablefish have been a target species of longline fisheries by Japan and the ROK in Aleutian Island waters.

The USSR began to report significant catches of Atka mackerel in 1972. From 1974 to 1976 catches rose rapidly as the Soviets concentrated effort on this species, reaching 20,000 mt in 1976 and exceeding catches of any other groundfish species in the Aleutians in that year. Reported catches of pollock have also increased in recent years reaching a peak of 23,000 mt in 1974. Almost all of the catch in 1973-76 was taken by USSR fisheries. It is unknown whether the Soviets directed some effort to pollock in the Aleutian region in these years or whether they were an incidental part of catches in other fisheries.

Catches of "other groundfish" have shown fluctuations from year to year, but no definite trend. This category probably consists mainly of non-commercial species or species of low commercial value such as sculpins and rattails. Fluctuations in this catch category may result partially from methods of recording and reporting these species. In 1972, when the largest catch of "other groundfish" occurred, the USSR reported 5,300 mt of rattails and 9,700 mt of sculpins. In later years the Soviets did not identify these species in their catch statistics and their total annual catches of "other roundfish" ranged from only about 200-1,600 mt. The reported Japanese catches of "other groundfish" increased from 1968 reaching 8,000 mt in 1974 and 1975.

Flounders have in most years formed only a minor part of the total groundfish catch in the Aleutian Islands area (Figure 17). Reported annual catches of small flounders have usually been less than 100 mt. After reaching a peak of almost 1,300 mt in 1975, annual catches of Pacific halibut have ranged from about 400 mt to less than 150 mt. Reported catches of arrowtooth flounder and Greenland turbot were also low until 1970, after which they increased sharply, with Greenland turbot the primary species taken. Catches in 1972-75 ranged from about 12,000 to 14,000 mt. Japanese fisheries were responsible for this rise in catches of turbot (Annex IV).

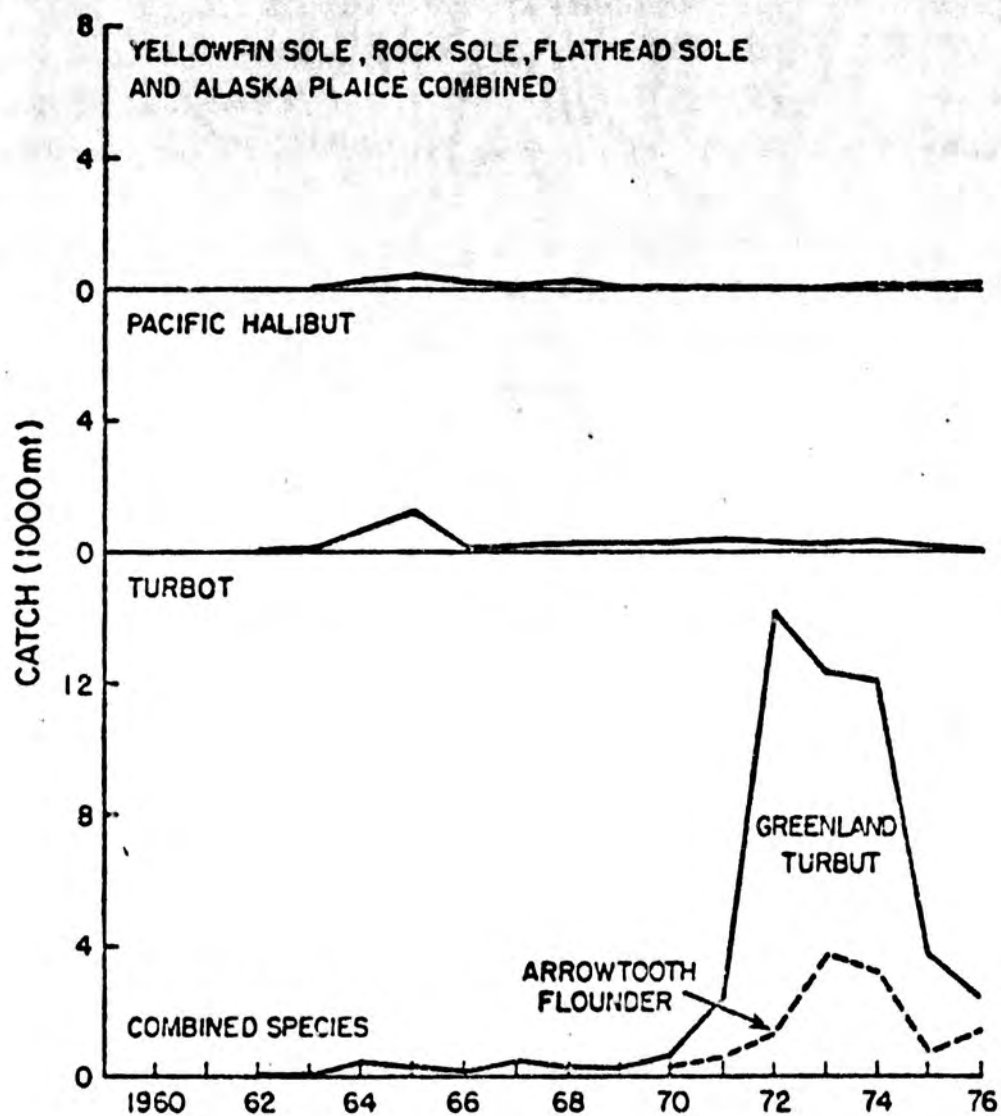


Figure 17.--Catch trends of flounders by foreign fisheries in the Aleutian Island area, 1962-76.

6.0 HISTORY OF MANAGEMENT

6.1 Domestic

6.1.1 Measures employed to regulate fishery

Fishery restrictions on U.S. Nationals have been established by the U.S. Bureau of Commercial Fisheries (the predecessor of the National Marine Fisheries Service), the State of Alaska and the International Pacific Halibut Commission. The BCF was responsible for both research and management of domestic fisheries in Alaska before statehood in 1958. The BCF imposed restrictions on the size, character, and operation of trawls to be used to capture groundfish (Table 14). In 1959 the State of Alaska assumed responsibility for regulating the groundfish fisheries of Alaska. A history of the state's groundfish regulations is included in Table 14. Many of the regulations were specific to the Gulf of Alaska where domestic fisheries have been more active.

In addition to regulations given in Table 14, the State of Alaska requires all commercial fishermen landing any species of fish or shellfish in Alaska to possess a commercial fishing license, and the captain or owner of all fishing vessels are required to license their vessels and the fishing gear employed. Buyers are required to keep records of each purchase and show the number and name of the vessel, the State license number of the vessel, date of landing, pounds purchased of each species, statistical area in which the fish was caught, and the kind of gear used in taking the fish.

The chronology of different regulatory measures for the Pacific halibut fishery as well as their rationale are discussed by Dunlop et al. (1964), Bell (1967) and Skud (1977). Before 1963, the North American halibut fishery in the Bering Sea was managed by the International Pacific Halibut Commission (IPHC). From 1963 to 1977, IPHC recommended regulations, but these had to be approved by the International North Pacific Fisheries Commission (INPFC). Since the onset of regulations in 1932, several changes have occurred in the boundaries defining regulatory areas in the Bering Sea and Aleutians. Some of the changes were in response to tagging studies that indicated a relationship between halibut

Table 14. —Historical summary of Alaska groundfish regulations.

Year	Legal gear, definitions, and other regulations
- - - - - Earlier records not available- - - - -	
1940	Use of trawls prohibited except for shrimp, flounders when not capturing, injuring or destroying other food fish, and spider and King crab west of 150°W. longitude exclusive of Cook Inlet.
1942	Trawls prohibited in fishing for salmon, herring, and Dungeness crab.
1948	Gear restrictions: Trawls. The size, character, and operation of otter trawls in Alaskan waters are limited as follows: (a) Otter trawls having mesh smaller than 5 inches stretched measure between knots in the bag and 6 inches stretched measure between knots in the wings are prohibited: Provided, that otter trawls now in use having mesh smaller than that specified may be used through the calendar year 1949 if registered with the Regional Director, Fish and Wildlife Service, Juneau, Alaska. (b) The use of any devices attached to the footrope or elsewhere, such as chain "ticklers", which may cause undue disturbance or destruction of the bottom, is prohibited. (c) The use of otter trawls in any area which the International Fisheries Commission has found to be populated by small immature halibut and accordingly has closed to all halibut fishing, is prohibited. (d) All operators of otter trawls shall maintain a running log on forms furnished showing date, type and size of mesh of trawl used, each locality fished, the time and duration of each tow and the estimated poundage and number or average weight of each species caught. Such logs shall be available for inspection by representatives of the Fish and Wildlife Service at any reasonable time, and the duplicate sheets shall be transmitted to the Fish and Wildlife Service at periodic intervals. On or before December 15 of each year complete statistics of operation shall be submitted to the Fish and Wildlife Service on forms provided for the purpose. (e) The use of any trawl in commercial fishing for salmon, herring, and Dungeness crabs is prohibited.

Table 14. --Historical summary of Alaska groundfish regulations. (Cont'd)

Year	Legal gear, definitions, and other regulations
1949	The following species besides salmon were defined as commercial fish: Albacore (<u>Germo alalunga</u>) tuna Cod (<u>Gadus macrocephalus</u>) codfish, true cod, grey cod Eulachon (<u>Thaleichthys pacificus</u>) smelt, hooligan Halibut (<u>Hippoglossus stenolepis</u>) Herring (<u>Clupea pallasii</u>) Lingcod (<u>Ophiodon elongatus</u>) Rockfish (all species of genus <u>Sebastes</u> also known as rockcod and sea bass) Sablefish (<u>Anoplopoma fimbria</u>) black cod Sheefish (<u>Stenodus mackenzii</u>) inconnu Sole and flounder (all species of family Pleuronectidae)
1958	Trawl fishermen no longer required to fill out log books.
1959	<u>Alaska Statehood</u> Trawls illegal for taking crab.
1960	Longlines and trawls may be used to take groundfish. Longlines are the only legal gear with which to take sablefish within S.E. Alaska. Halibut are to be regulated according to IPHC regulations 5AAC 39.390.
1961	All defined legal gear became legal for the taking of groundfish excepting S.E. sablefish.
1967	S.E. sablefish: a 2½", #20 thread or less gillnet may be aboard vessel for taking bait.
1968	S.E.: sablefish taken incidentally by longline or otter trawl may be retained in an amount not to exceed ten percent, by weight, of each landing.
1970	Pots became legal sablefish gear within S.E.
1972	Incidental allowable catch of sablefish increased to 20%. 1962 regulation (5 AAC 39.390) referring to IPHC management of halibut repealed.

Table 1A. — Historical summary of Alaska groundfish regulations. (Cont'd)

Year	Legal gear, definitions, and other regulations
1976	An untreated cotton escape for sablefish pots required within S.E. Also under General Provisions, Groundfish Fishery, Gear for Groundfish. (a) Groundfish may be taken by trawls, hand troll gear, seines, longlines and pots except as legal gear may be further restricted by groundfish gear regulations of chs. 03-39 of this title and except as follows: (1) king and tanner crab pots as defined in chs 34 and 35 of this title may not be used to take groundfish in the areas where the regulations define those pots: (2) groundfish taken by power gurdy troll gear being fished for salmon consistent with applicable state laws and regulations are legally taken and possessed. (3) All commercial longline or skate gear buoys or kegs shall be marked with the permanent department registration number of the vessel fishing this gear.
1977	Crab pots are not defined for all areas. The most restrictive definitions are as follows: A king crab pot is a pot with rigid tunnel eye openings and which individually are a <u>minimum</u> of five inches in one dimension, and tunnel eye opening perimeters which individually are larger than 30 inches. A tanner crab pot is a pot with rigid tunnel eye openings which individually are a <u>maximum</u> of five inches in one dimension, and tunnel eye opening perimeters which individually are larger than 30 inches; or a pot which tapers from its base to a top consisting of one horizontal opening of undescribed size. Same as 1976 except that sunken or diving gillnets may be used for groundfish upon issuance of a permit by the commissioner (ADF&G).

stocks in the Aleutians and the Gulf of Alaska. However, most of the changes were designed to obtain a desired distribution of fishing effort and to facilitate enforcement.

Except for a period in the late 1940's and early 1950's and again in 1963-64, quotas have not been used to manage Bering Sea halibut stocks. Instead, restrictions have been based on the length of the season. Until the late 1950's, the Bering Sea season coincided with that of IPHC Area 3 (the Gulf of Alaska west of Cape Spencer), but by the early 1960's, the opening of the Bering Sea often was a month earlier than in Area 3. The earlier opening was established to encourage fishermen to exploit Bering Sea stocks. Since 1965, the fishing time has been limited to three weeks or less in the spring and fall or both. This curtailment was necessary because of the drastic decline in abundance of halibut.

Other regulations include licensing requirements, gear restrictions, minimum size limits, and closed areas. IPHC requires that all setline vessels over 5 net tons be licensed; there is no fee and annual renewal is not required. Licensed vessels must maintain a log book showing the daily catch, effort, and the fishing area. From 1932 to 1973, vessels also were required to "clear" for fishing a particular area and submit a "statistical return" at the completion of each trip. These requirements have since been deleted.

In 1938, the regulations prohibited the use of set nets for catching halibut. Nets of any kind were prohibited in 1944, and this restriction has continued to the present day. The definition of nets was expanded to include pots in 1972. IPHC's justification of trawl prohibition was based on evidence that halibut caught by trawls usually are below the optimum harvesting size.

The size limit of halibut was introduced into the regulations in 1940. The minimum size at that time was 5 pounds, head-off, dressed. The purpose of the size limit was to reduce the catch of halibut that were below the optimum harvest size, but there also was an economic reason. The industry favored the regulation because small halibut were often of poorer shipping quality and of lower value. In 1973, the minimum size

limit was increased and expressed in terms of length: 32 inches from the tip of the lower jaw to the end of the middle of the tail. The increase was justified based on an increase in growth rate.

In 1967, IPHC Area 4E in southeastern Bering Sea was declared a nursery area and a year-round closure was instituted that still is in effect.

6.1.2 Purposes of regulatory measures

The limited number of groundfish regulations implemented by the State of Alaska were primarily designed for the protection of species of high commercial value such as salmon, herring, juvenile halibut, and shellfish. Examples of such regulations were the restrictions on use of pot gear, gillnets, otter trawls, and seines (Table 14).

With regard to halibut, IPHC is restricted by the present convention to manage for MSY and cannot consider other goals or economic factors. Regulations in the Bering Sea and Aleutians were designed to accomplish this goal. Specifically, season and quota restrictions controlled fishing mortality; minimum size limits, gear restrictions, and closed areas reduced the mortality on optimum sized halibut; the timing of the seasons and the area designations affected the distribution of fishing effort and facilitated enforcement; licensing, and statistical requirements provided scientific information on stock condition.

6.2 Foreign

6.2.1 Measures employed to regulate the fishery

A number of regulatory measures affecting groundfish fisheries have been implemented through public laws and international agreements prior to enactment of the U.S. Fishery Conservation and Management Act of 1976. Initial regulatory measures originated from the International Convention for the High Seas Fisheries of the North Pacific Ocean involving Canada, Japan, and the United States, which was brought into force in 1953. The Convention provided for establishment of the International North Pacific Fisheries Commission (INPFC) to provide and coordinate scientific studies necessary to ascertain and recommend conservation

measures required to ensure maximum sustained productivity of fishery resources in the Convention area (Forrester et al. 1974). One of the provisions of the Convention prohibited Japan from fishing halibut in certain areas and, starting in 1958 Japan agreed to abstain from fishing halibut providing that stocks of halibut continued to meet qualifications for abstention, e.g., that the stocks were under substantial exploitation by two or more of the contracting parties.

In 1962 member nations of INPFC agreed that halibut east of 175° W in the Bering Sea no longer continued to qualify for abstention (Forrester et al. 1974). Following the removal of halibut from the abstention list, joint conservation measures were implemented by member nations of INPFC in 1963 which included a catch quota of 5,000 mt in a triangular area east of 170° W. Following a catch of 5,000 mt in the quota area in 1963, catches dropped abruptly and Japan withdrew her longline fleet from the quota area after 1964. Although agreement between INPFC member nations was never reached to return halibut to the abstention list, Japan has not chosen to conduct a target fishery on halibut east of 175° W since 1964.

U.S. Public Law 88-308, enacted in May 1964, made it unlawful for foreign vessels to fish within the 3-mile territorial waters of the United States or to fish for designated fishery resources of the adjacent U.S. Continental Shelf. In October 1966, U.S. Public Law 89-658 established a 9-mile contiguous fishery zone adjacent to the U.S. 3-mile territorial sea. The law provided that the United State would have the same jurisdiction over fisheries within this newly created zone as it had within its 3-mile territorial waters subject to the continuation of traditional fisheries by foreign nations.

In 1964, the U.S. initiated bilateral agreements with Japan and the USSR to allow continuation of their traditional fisheries within the contiguous zone in certain areas of Alaska (Office of Enforcement and Surveillance 1968). One provision of the 1964 agreements was the establishment of a king crab pot sanctuary adjacent to the north side of Unimak Island and the western Alaska Peninsula that prohibited trawling

year-round. The purpose of the sanctuary was to prevent gear conflicts between mobile foreign gear and domestic fixed gear. An adjacent area, closed to trawling during winter, in order to reduce incidental catches of juvenile halibut, was added in later bilateral agreements.

The agreements with Japan and the USSR were renegotiated at two-year intervals. Subsequent agreements created some changes in areas of fishing within the U.S. contiguous zone, and provided areas within the zone for transshipment of cargo between foreign fishing and support vessels. This series of agreements was expanded to include Canada in 1970, allowing for reciprocal fishing privileges within the contiguous fishing zone. Agreements were also signed with the ROK in November 1972, and with Poland in May 1975. No fishery agreements have been signed with Taiwan.

Starting in 1973, the bilateral agreements between the United States and Japan and the USSR begin to include catch quotas for these nations in the eastern Bering Sea and Aleutian Island regions. Annual quotas for the years 1973-76 are given in Table 15.

In addition to the crab pot sanctuary, the bilateral agreements have provided other area-time closures to Japanese and Soviet trawl fisheries for the protection of halibut. These closures are designed to reduce the incidental catch of halibut by trawl fisheries in areas and time periods that halibut form concentrations. Area-time closures currently in effect for these fisheries are shown in Figures 17 and 18.

Restrictions on Polish and ROK fishing vessels in the eastern Bering Sea and Aleutian Island regions are shown in Figures 19 and 20.

Current regulations pertaining to foreign groundfish fisheries are found in Section V-A of the Preliminary Fishery Management Plan for the Trawl Fishery of the Bering Sea and Aleutian Islands, and include catch limitations, prohibition on the retention of certain species of importance to the United States, and time-area closures to prevent gear conflicts and provide protection to halibut. Catch limitations imposed on foreign fisheries in 1977 are listed in Table 16.

Table 15.—Catch quotas applicable to Japanese and Soviet fisheries in the eastern Bering Sea and Aleutian Island region in 1973-76. (MT)

Area/fishery	Species	1973	1974	1975-76
<u>Japan</u>				
Eastern Bering Sea Mothership-North Pacific Trawl	Pollock	1,500,000	1,200,000	1,100,000
	Groundfish other than pollock	—	—	160,000
	Herring	1969 level (33,000)	1969 level (33,000)	15,000
North Pacific Longline-Gillnet	Herring	1971 level (4,600)	1971 level (4,600)	3,000
Landbased Dragnet	Groundfish (All species)	—	—	35,000
Aleutian Region Mothership-North Pacific Trawl and Longline-Gillnet	Pacific ocean perch	—	—	9,600
	Sablefish	—	—	1,200
	Landbased Dragnet Groundfish (All species)	—	—	8,500
<u>U.S.S.R.</u> (1973-74)				
Eastern Bering Sea	Flatfish	100,000		(Included in other species)
	Pollock	—		210,000
	Herring	—		30,000
	Other species	—		120,000
Aleutian Region	Rockfish	—		12,000
	Other species	—		16,000

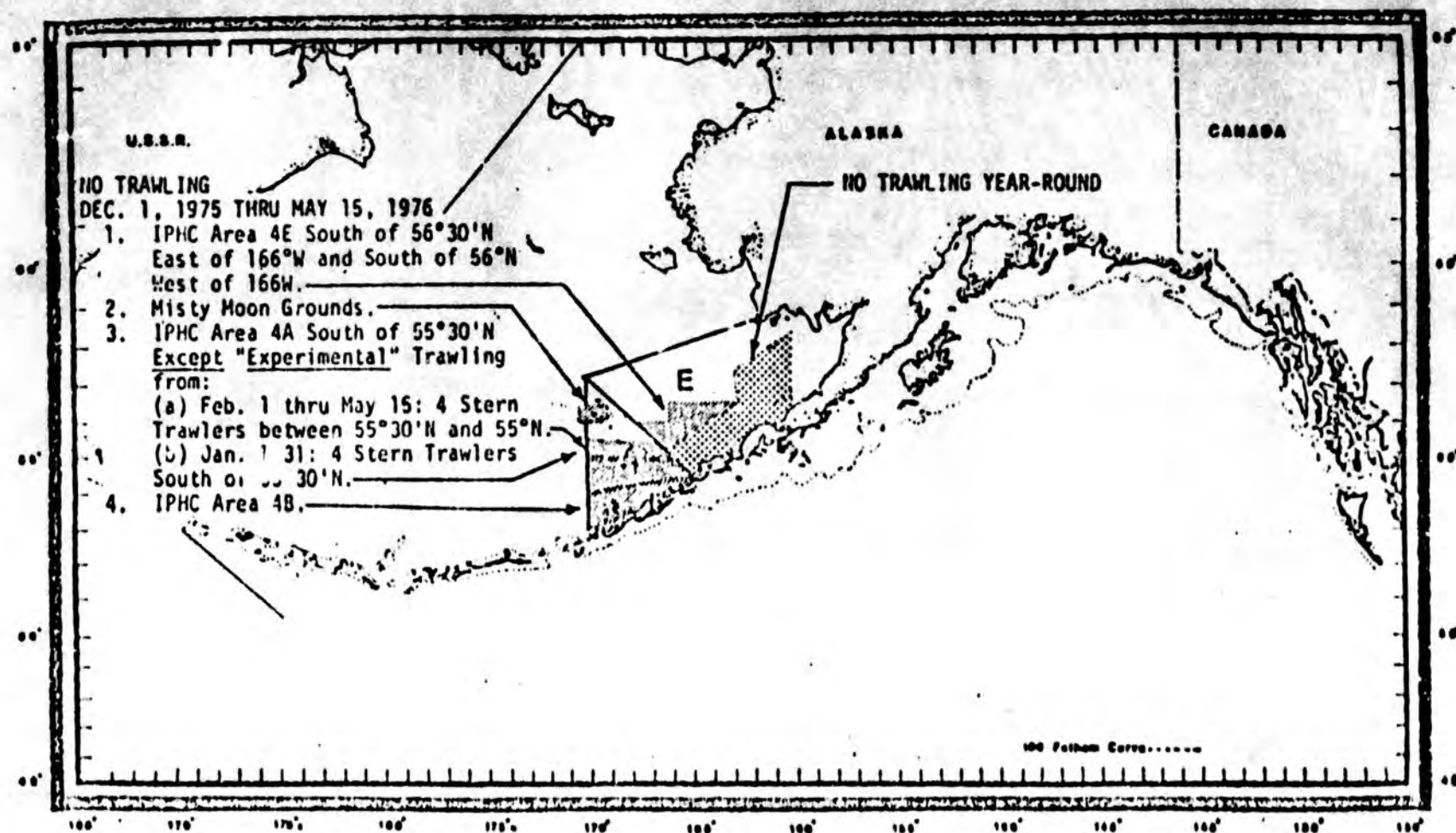


Figure 12--Area-time closures and restrictions for Japanese trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

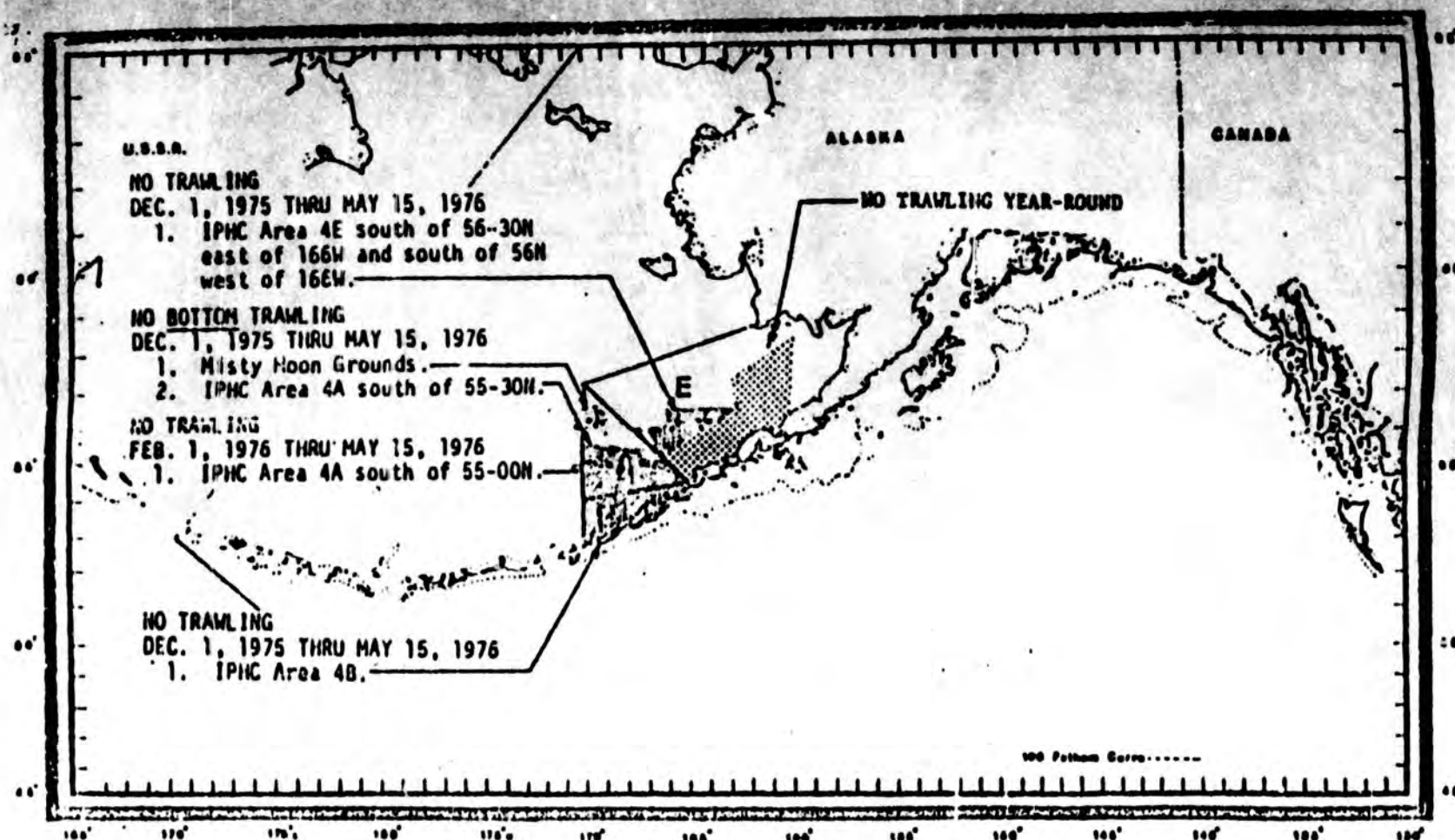


Figure 18.--Area-time closures and restrictions for Soviet trawl fisheries in southeastern Bering Sea, effective through December 31, 1976.

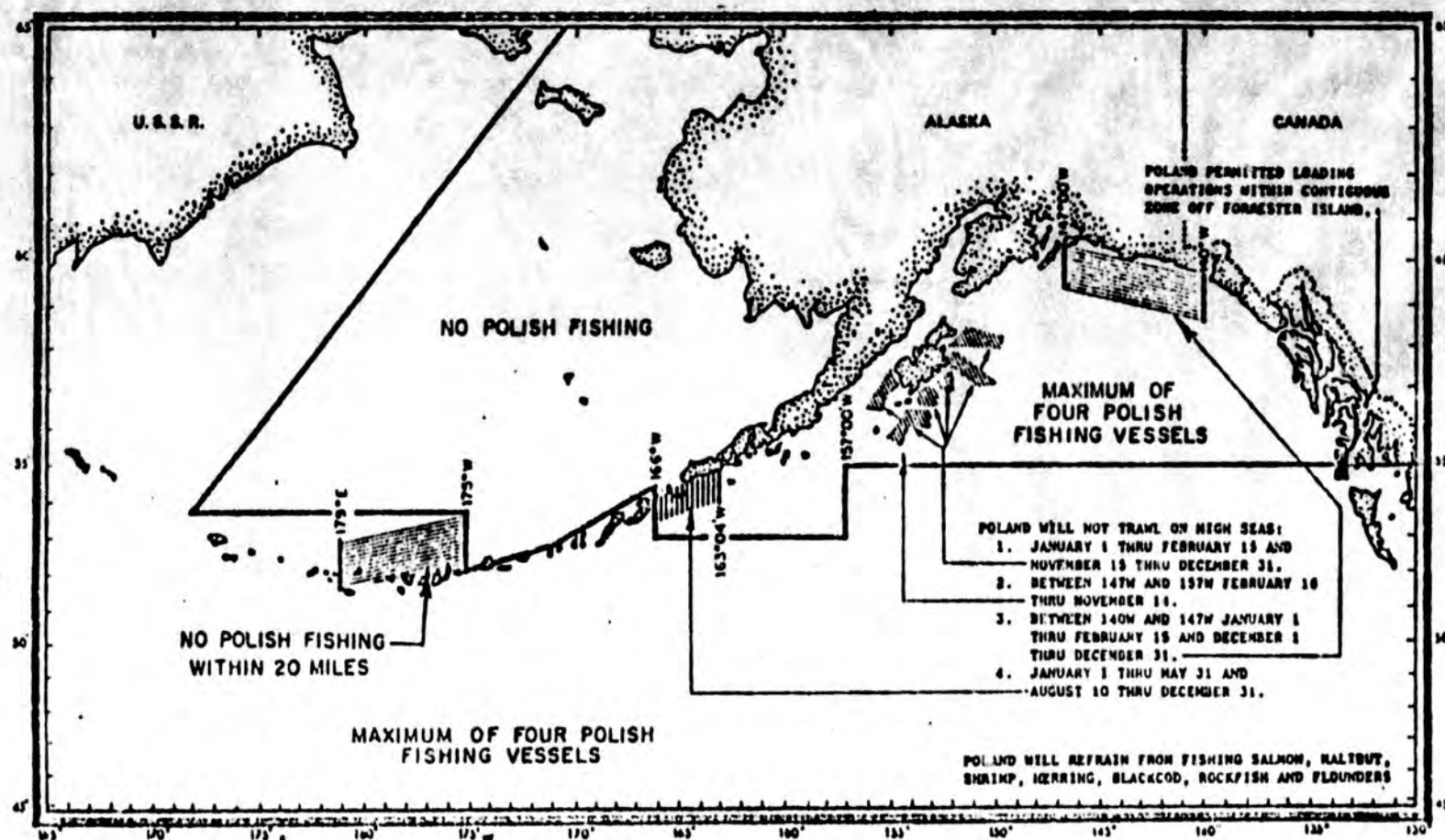


Figure 19.--Area-time closures and restrictions for fisheries of the Polish People's Republic in the Gulf of Alaska and Bering Sea, effective through December 31, 1976.

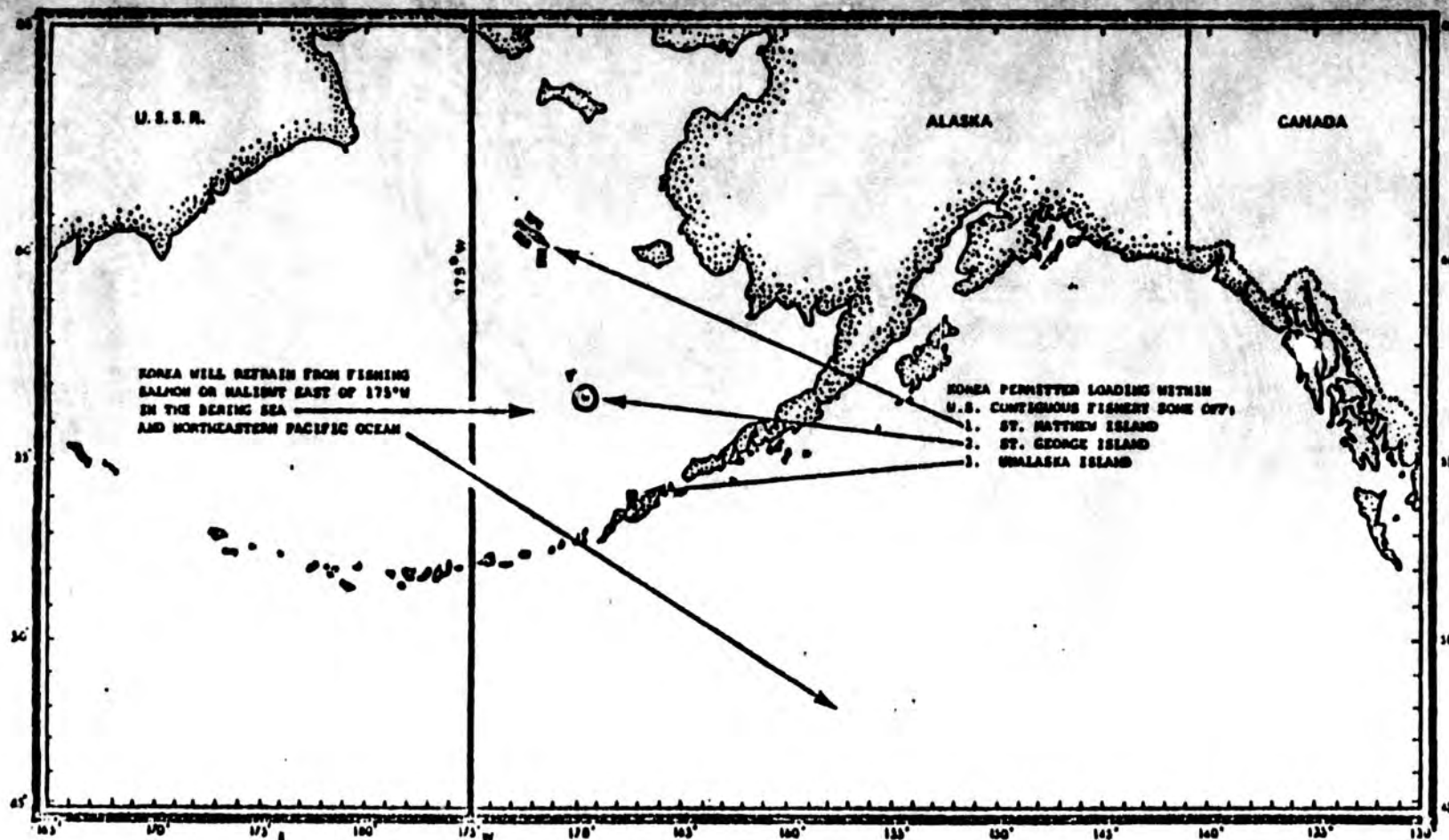


Figure 20.--Provisions of the United States-Republic of Korea Fisheries Agreement effective through December 12, 1977.

Table 16.—1977 Groundfish and squid catch limitations (1000 mt) for foreign fisheries in the eastern Bering Sea and Aleutian Islands region.

Species	Area	Nation				Total assigned	Unassigned ^{1/}	Total foreign allocation
		Japan	USSR	ROC	Taiwan			
Pollock	Bering Sea/ Aleutians	792.3	112.7	40.0	5.0	950.0	0	950.0
Sablefish	Bering Sea	3.6 ^{2/}	0.6 ^{3/}	0.4 ^{2/}	0.2 ^{3/}	4.8	0.2	5.0
	Aleutians	2.0 ^{2/}	0.2 ^{3/}	0.2 ^{2/}	0	2.4	0	2.4
Pacific cod	Bering Sea/ Aleutians	38.1	17.2	0	0	55.3	2.7	58.0
Yellowfin sole	Bering Sea/ Aleutians	62.1	40.8	0	0	102.9	3.1	106.0
Other flounders	Bering Sea/ Aleutians	61.5	40.4	0	0	101.9	3.1	105.0
Pacific ocean perch	Bering Sea	2.8	3.5	0	0	6.3	0.2	6.5
	Aleutians	6.5	8.1	0	0	14.6	0.4	15.0
Other groundfish	Bering Sea	40.4	17.4	1.6	0.2	59.6	0	59.6
	Aleutians	23.1	9.9	0.89	0.11	34.0	0	34.0
Squid	Bering Sea/ Aleutians	10.0	0	0	0	10.0	0	10.0

^{1/} Portion of total foreign allocation unassigned for possible use by a domestic fishery.

^{2/} Includes incidental trawl catch.

^{3/} Incidental catch only.

5.2.2 Purposes of regulatory measures

Most of the regulatory measures pertaining to foreign groundfish fisheries in the eastern Bering Sea and Aleutian Islands were implemented for conservation of halibut stocks and to prevent gear conflicts between foreign trawlers and domestic fixed gear (crab pots and halibut setlines). In negotiating these restrictions on foreign fisheries in international waters, certain concessions were provided the fisheries involved in terms of fishing and landing privileges within the U.S. contiguous fishing zone.

With the decline in abundance of halibut in the eastern Bering Sea in the mid-1960's, negotiations were directed toward reducing or preventing foreign fisheries from targeting on halibut. When it became apparent that these measures were not creating the desired improvement in the condition of the halibut stock, other measures involving time-area closures were negotiated to reduce the incidental catch of halibut by foreign trawl fleets. The retention of trawl-caught halibut was also prohibited.

As evidence became available of deterioration in the condition of other bottomfish stocks in the eastern Bering Sea and Aleutian Islands, negotiations were initiated to limit or reduce foreign catches of these species in an attempt to arrest these declines and restore the resources to higher productivity. Catch quotas for Japanese and Soviet fisheries were first implemented in 1973 and were carried forward, with some modifications, until 1977 when foreign fisheries came under jurisdiction of the U.S. Fishery Conservation and Management Act.

6.3 Effectiveness of Management Measures (foreign and domestic)

Closures to foreign trawling of crab and halibut fishing areas have undoubtedly reduced conflicts between the foreign trawlers and U.S. fixed gear. Gear losses have continued, but recent losses have occurred outside areas closed to foreign trawling.

Restrictions on the North American setline fishery have reduced fishing mortality on stocks of adult halibut, but the primary problem

appears to be a reduction in the number of young halibut entering the fishery. Recent time-area closures have reduced the incidental catch by foreign trawlers and the abundance of young has increased since 1972 (Table 17). Although the increase is encouraging, it will not improve conditions in the setline fishery for several years, and abundance is still well below that in the 1960's. The present poor condition of the resource probably is a result of several factors: excessive setline removals in the early 1960's, high incidental catches of juvenile halibut by foreign trawlers in the 1960's and early 1970's, and reduced productivity from adverse environmental conditions (Hoag, 1976). Because halibut are a long-lived species, rehabilitation of the resource will be a lengthy process regardless of present management measures.

Regulations in the form of catch quotas implemented in 1973 and later years to mitigate the deterioration in condition of other groundfish species in the eastern Bering Sea and Aleutians have perhaps begun to show some benefit for certain species while not for others. Other factors such as year-class strength, time-area closures designed to protect halibut but also beneficial to other species, and the reduction of effort on some species, may have also influenced the current status of some stocks.

Catch limitations have reduced the catch of pollock from over 1.8 million mt in 1972 to 950,000 mt in 1977. Based on analysis of catch and effort data from the commercial fishery the abundance of pollock declined through 1975 (Low et al. 1977). Preliminary evidence that abundance in 1976 was similar to that in 1975 (INPFC 1977) offers some indication of an arrest in the decline of pollock abundance in the eastern Bering Sea. Lower fishing mortality, stemming from the catch limitations, have probably helped to lessen the decline in the pollock stock and may be contributing to a halt in this decline.

For species such as Pacific ocean perch and sablefish there has been, as yet, no evidence that catch restrictions have improved the poor condition of these stocks. In the case of long-lived and slow growing species like Pacific ocean perch and sablefish several years will be required before evidence is available to judge the effectiveness of current management policies.

Table 17. Relative abundance of juvenile halibut by age groups from the Bering Sea Index Stations, 1966-1977 (from IPHC 1977b).

Year	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Total
<u>Number per hour trawled</u>							
1966	0.2	17.2	4.9	7.6	0.9	0.2	31.0
1967	0.6	4.3	4.6	6.0	0.5	0.6	16.6
1968	0.3	6.4	1.8	3.1	0.5	0.4	12.5
1969	2.7	4.1	4.7	0.4	0.7	0.2	12.8
1970	0.4	8.8	2.0	0.7	0.2	-	12.1
1971	3.7	2.6	7.6	0.3	-	-	14.2
1972	0.1	2.0	0.5	0.4	0.1	-	3.1
1973	0.1	3.7	1.9	0.7	0.2	-	6.6
1974	0.1	1.2	3.7	0.8	0.3	-	6.1
1975	0.5	3.2	5.3	2.0	0.7	0.1	11.8
1976	0.3	6.5	4.5	1.2	0.3	0.1	12.9
1977	0.4	5.4	9.5	2.1	1.4	0.1	18.9

There is evidence that the condition of stocks of yellowfin sole, rock sole, flathead sole and Alaska plaice have improved or remained relatively stable in recent years (Wakabayashi and Bakkala 1977; Bakkala and Wakabayashi 1977). Their condition has benefited from a series of relatively strong year-classes originating in the late 1960's. Winter time-area closures in the southeastern Bering Sea, designed for the protection of halibut, also benefit these species because they form winter concentrations in this area as well. The absence of a directed Soviet fishery on these species of flounders since 1972 may have additionally benefited the stocks. Thus, factors other than management measures directly applicable to the four small flounder species may be responsible for their current status. Catch limitations, however, are designed to maintain and improve their productivity.

For other principal species considered in the plan (Pacific cod, Atka mackerel, arrowtooth flounder, Greenland turbot, and squid) information is lacking to adequately assess the current condition of the stocks relative to the recent past. There is no evidence to suggest that the stocks are depressed and catch limitations are designed to maintain the population at current levels.