

# Sampling by U.S. Observers on Foreign Fishing Vessels in the Eastern Bering Sea and Aleutian Island Region, 1977-78

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## Introduction

Passage of the Fishery Conservation and Management Act (FCMA) of 1976 (PL 94-265) gave the United States management authority over the fisheries resources of the eastern Bering Sea and Aleutian Islands region (Fig. 1), an area in which foreign vessels have annually harvested over 1 million metric tons (t) of groundfish since 1968<sup>1</sup>. The FCMA requires, as one of its conditions, that any foreign

<sup>1</sup>The eastern Bering Sea is defined as the Bering Sea waters south of the Chukchi Sea and east of long. 180°. The Aleutian Islands region includes the area on the north and south sides of the Aleutian Islands between long. 170°W and 170°E.

**ABSTRACT**—During 1977 and 1978, the first 2 years of fisheries management under the authority of the Fishery Conservation and Management Act of 1976 (FCMA), 122 observers sampled on 128 different foreign vessels in the eastern Bering Sea and Aleutian Islands region. Prior to the passage of the FCMA, observers had sampled on Japanese and Soviet vessels through agreements made between the United States and each of these two nations. During this period, observer data were mainly used to determine the incidental catches of Pacific halibut, *Hippoglossus stenolepis*; king crab, *Paralithodes* and *Lithodes* spp.; snow (Tanner) crab, *Chionoecetes* spp.; and Pacific salmon, *Oncorhynchus* spp. With the passage of the FCMA, the uses of data collected by observers were expanded to include estimation of the foreign ground-

vessel fishing within the U.S. 200-mile fishery conservation zone (FCZ) accept and provide accommodations for a U.S. fisheries observer at no cost to the government of the United States.

During 1977 and 1978, the first 2 years of fisheries management under the FCMA, 122 fisheries observers sampled on 128 foreign fishing vessels in the eastern Bering Sea and Aleutian Islands region. The purpose of placing fisheries observers aboard foreign vessels is to collect data which are applied by the United States to estimate the foreign commercial catch, determine the incidental catch of species whose retention was prohibited by U.S. regulations, provide information needed to assess the biological status of the various stocks of fish, and

fish catch, evaluation of fish stock conditions, and reports of violations of U.S. fishery regulations.

It was estimated from observer data that foreign vessels harvested 1.29 million t of groundfish in the eastern Bering Sea and Aleutian Islands region in 1977 and 1.38 million t in 1978. The estimated 1977 and 1978 incidental catches of species whose retention is prohibited were, respectively, about: 345,000 and 600,000 Pacific halibut, 17.6 million and 17.3 million snow crab, 0.6 million and 1.3 million king crab, and 48,000 and 44,000 Pacific salmon.

Sampling by observers showed that three species composed approximately 91 percent of the foreign flatfish catch in the region, and six species of rockfish accounted for more than 97 percent of the rockfish catch during both years.

report on compliance by foreign vessels with U.S. fishing regulations.

While on the ship, the fisheries observer obtains such basic information as: Location, speed, duration, and landed weight of each haul on stern trawlers; the location and daily catch by type of catcher boat on motherships; and the location, number of hooks per set, and the total daily catch on longline vessels. In addition, the observer intensively samples the catch to determine species composition by weight; the incidence in the catch of Pacific halibut, *Hippoglossus stenolepis*; Pacific salmon, *Oncorhynchus* spp.; king crab, *Lithodes* and *Paralithodes* spp.; and snow crab, *Chionoecetes* spp.; whose retention is prohibited by U.S. regulations; and the age and length composition of designated species in the catch.

A description of the operation of the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands region during the first 2 years of fisheries management under FCMA is presented in this paper with analyses of data collected by U.S. fisheries observers aboard foreign vessels fishing in these areas during 1977 and 1978.

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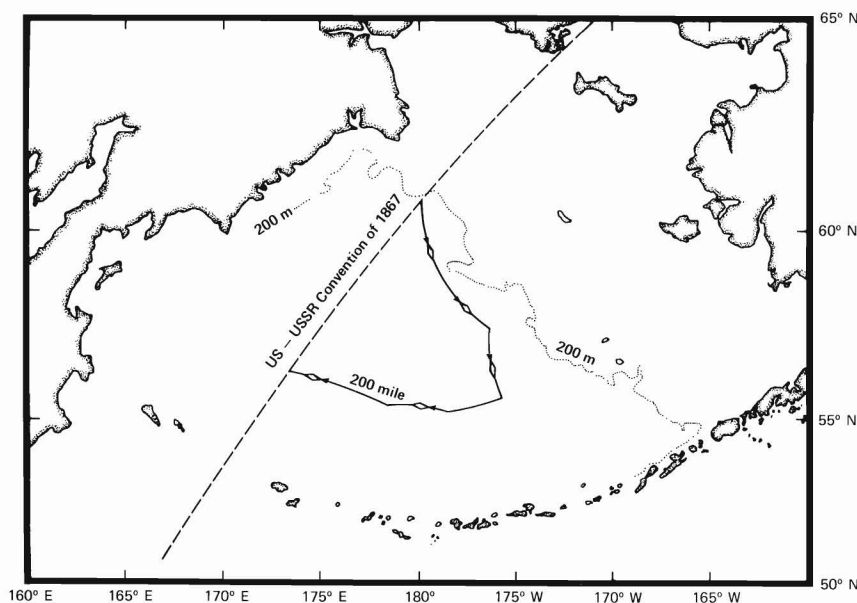


Figure 1.—The eastern Bering Sea and Aleutian Islands areas included within the 200-mile U.S. Fishery Conservation Zone.

### Description of the Foreign Fishery

#### History

The historical development of the foreign groundfish fishery in what is now included within the U.S. 200-mile FCZ in the eastern Bering Sea and Aleutian Islands region has been described in detail by Chitwood (1969), Forrester et al. (1978), and Bakkala et al. (1979). Japan was the first foreign nation to commercially exploit the groundfish resources in the eastern Bering Sea when in 1933 a mothership operation for yellowfin sole, *Limanda aspera*, was initiated in the waters off Bristol Bay (Forrester et al., 1978). This fishery was continued (except 1938 and 1939) until 1941 when it was terminated by the entry of the United States into World War II. The fishery was resumed in 1954 after fisheries restrictions placed upon Japan at the end of the war by the U.S. Occupational Force were lifted.

From 1958 through 1963, the Japanese fishery in the Bering Sea expanded greatly in the numbers of

vessels participating in the fishery, in the types of species targeted on, and areas fished. The major portion of the Japanese fishery was conducted by motherships which produced either fish meal or frozen products and operated with a variety of catcher vessels (Table 1). In 1959, the U.S.S.R. initiated a fishery for flounders in the eastern Bering Sea with a fleet of about 30 trawlers and supporting factory and cargo vessels (Chitwood, 1969). As in the Japanese fishery, the Soviet fishery quickly expanded in the numbers of vessels involved in the fishery, the species sought, and areas fished.

The development by the Japanese in 1964 of techniques for the processing of minced fish flesh, "surimi", on motherships and factory stern trawlers (Forrester et al., 1978) and the decrease in abundance of yellowfin sole during the early 1960's (Bakkala et al., 1979) led to the replacement of yellowfin sole by walleye pollock, *Theragra chalcogramma*, as the dominant species taken in the eastern Bering Sea by both Japan and the U.S.S.R. Dur-

ing the late 1960's and early 1970's, the importance within the Japanese fishery of independent factory stern trawl vessels and longline vessels increased, whereas the number of mothership fleets began to decrease (Table 1). By 1970, large independent freezer trawlers had replaced the smaller independent and dependent trawlers in the Soviet fishery (Forrester et al., 1978). Vessels from the Republic of Korea first entered the eastern Bering Sea fishery in 1968, and Taiwan entered the fishery in 1974 (Pereyra et al.<sup>2</sup>).

#### The Fishery Under FCMA

Since the early 1970's, the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands region has remained relatively unchanged. The implementation of FCMA in March of 1977 placed licensing, catch, and area restrictions on all foreign vessels fishing in the U.S. 200-mile FCZ in the eastern Bering Sea and Aleutian Islands region. Walleye pollock continues to be the dominant species in the fishery conducted by the four nations (Japan, U.S.S.R., Republic of Korea, and Taiwan), but substantial fisheries for other groundfish species also occur (Table 2).

The Japanese fishery currently comprises the largest portion of the fishery in both numbers of vessels and catch allocations. Japan was allocated 1.05 million t of fish in the eastern Bering Sea and Aleutian Islands region in 1977 and 1.11 million t in 1978. In those 2 years, six Japanese mothership fleets operated in the fishery, five of which were minced fish fleets targeting on pollock and one freezer fleet which targeted on yellowfin sole (Table 1). This was a reduction of two mothership fleets from the 2 years preceding the FCMA. The mothership fleets are composed of varying numbers of pair trawlers, Danish seiners, and depen-

<sup>2</sup>Pereyra, W. T., J. E. Reeves, and R. G. Bakkala (Principal Investigators). 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. Processed rep., 619 p. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

Table 1.—The number of fleets in the Japanese mothership fishery and the number of vessels in the Japanese North Pacific trawl fishery, North Pacific longline-gillnet fishery, and land-based trawl fishery, 1954-78 (from Forrester et al. (1978) for 1954-70; Pereyra et al., for 1971-74; Sasaki<sup>1</sup> for 1975-76; and NMFS<sup>2</sup> data for 1977-78).

Year	Mothership fleets			Total	Independent vessels		
	Freezing fleet	Meal and minced fleet	Longline-gillnet fleet		North Pacific trawl fishery	N.Pacific longline-gillnet fishery	Land-based trawl fishery
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	4	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	—	10	68	33	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	57	32	182
1977	1	5	—	6	51	23	143
1978	1	5	—	6	54	22	75

<sup>1</sup>Pereyra, W.T., J.E. Reeves, and R.G. Bakkala (Principal Investigators). 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. Processed rep., 619 p. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

<sup>2</sup>Sasaki, R. 1977. Outline of the Japanese groundfish fishery in the Bering Sea, 1976 (November 1975-October 1976). Unpubl. manuscr., 11 p. Fisheries Agency of Japan, Far Seas Fish. Res. Lab., Shimizu 424, Japan.

<sup>3</sup>Data on file at Law Enforcement Division, Alaska Regional Office, Natl. Mar. Fish. Serv., NOAA, P.O. Box 1668, Juneau, AK 99802.

dent stern trawlers; the size of an individual fleet is dependent upon the processing capacity of the mothership, with 6 vessels being the smallest fleet currently used and 20 vessels the largest.

Japan licenses two types of trawl fleets, the North Pacific trawl fleet and the land-based trawl fleet; but within these two fleets, there are three basic types of trawlers: 1) Small independent stern trawlers are defined as being less than 1,500 gross registered tons (GRT) and have the capacity to produce frozen products. The majority of these vessels are between 350 and 500 GRT, 50 and 60 m in length, have a propulsion engine of 1,200-2,700 horsepower, and a complement of 22-32 crew members. 2) Trawlers in excess of 1,500 GRT are classified as either large freezer

trawlers or large "surimi" trawlers. The ability to produce "surimi" in addition to meal and frozen products distinguishes the large "surimi" trawlers from the large freezer trawlers. Large "surimi" trawlers range from 2,700 to 5,500 GRT, 92 to 112 m in length, have engines of 3,400-5,900 horsepower, and a crew of 60-100. 3) In contrast, large freezer trawlers are from 75 to 102 m in length, 2,000 to 4,000 GRT, have propulsion engines of 3,400-4,400 horsepower, and are crewed by 45-60 people. There has been a reduction in fishing effort by Japan's independent trawl fleet of about 15 percent, since the implementation of the FCMA<sup>3</sup>.

<sup>3</sup>Data on file at Law Enforcement Division, Alaska Regional Office, Natl. Mar. Fish. Serv., NOAA, P.O. Box 1668, Juneau, AK 99802.

Table 2.—Species, or groups of species, commonly targeted on by foreign vessels fishing in the eastern Bering Sea and Aleutian Island area during 1977-78.

Common name	Scientific name
Yellowfin sole	<i>Limanda aspera</i>
Greenland turbot	<i>Reinhardtius hippoglossoides</i>
Other flounders	<i>Pleuronectiformes</i>
Walleye pollock	<i>Theragra chalcogramma</i>
Pacific cod	<i>Gadus macrocephalus</i>
Sablefish	<i>Anoplopoma fimbria</i>
Atka mackerel	<i>Pleurogrammus monopterygius</i>
Pacific ocean perch	<i>Sebastes alutus</i>
Other rockfishes	<i>Sebastes</i> and <i>Sebastolobus</i>
Pacific herring	<i>Clupea harengus pallasii</i>
Squids	<i>Decapoda</i>

The independent longline vessels licensed by Japan are typically 499 GRT, 50-52 m in length, have a propulsion engine of 1,500 to 1,800 horsepower, and are crewed by 27 to 30. Restrictions on the allowable catch of sablefish in the U.S. FCZ have not resulted in a decrease in the number of longline vessels as compared with the number of vessels found in the late 1960's and early 1970's (Table 1).

The Soviet fishery is the second largest foreign fishery conducted in the eastern Bering Sea and Aleutian Islands region, with an allocation of 264,400 t of groundfish in 1977 and 288,705 t in 1978. Two standard types of factory stern trawlers are used by the U.S.S.R. in this fishery: 1) The BMRT stern trawler is usually from 76 to 89 m long, 2,300 to 3,800 GRT, has a propulsion engine of 2,000 horsepower, and is crewed by 87-96. 2) The RTM class stern trawler is from 82 to 83 m long, 2,100 to 2,200 GRT, has two propulsion engines with a total of 2,320 horsepower, and is crewed by 78-80. Both the RTM and BMRT class stern trawlers are equipped to produce frozen fish products and meal. Other than the termination of the Soviet mothership fishery, the Soviet trawl effort in the eastern Bering Sea has remained at about the same level as in the years immediately preceding FCMA (footnote 3).

The Republic of Korea was allocated 43,090 t of groundfish in

1977 and 69,755 t in 1978. The 12 stern trawlers in the Korean fleet are similar in size and design to the large Japanese freezer trawlers.

Taiwan was allocated 5,510 t of groundfish in 1977 and 6,285 t in 1978. Three stern trawlers ranging in size from 900 to 1,900 GRT and with the capacity to produce frozen fish products were used by the Taiwanese in 1977 and 1978.

The size and type of fishing gear used by the foreign fleet varies considerably with the nation, the size of the vessel, and type of fishery in which the vessels are involved. General descriptions of the types of gear observed by U.S. observers during 1977 and 1978 are listed by nation and vessel type in Table 3.

### Historical Groundfish Catches

The total foreign groundfish catches from the eastern Bering Sea and Aleutian Islands region for 1933-78 are listed by nation in Table 4. Since the initiation of foreign fishing in 1933, the total annual catch

has grown from 3,300 t to a high of 2.4 million t in 1972. During 1977 and 1978, approximately 1.16 million and 1.34 million t of groundfish, respectively, were harvested by foreign vessels in the eastern Bering Sea and Aleutian Islands region. Walleye pollock composed 78-86 percent of the total catch during the initial years of the foreign fishery (1934-37), but from 1940 through 1962, yellowfin sole was the dominant species caught by the foreign fishery, accounting for 69-100 percent of the reported total foreign groundfish catch during those years. The catch of yellowfin sole peaked in 1961 when Japan and the U.S.S.R. caught about 554,000 t.

In 1963, the catch of walleye pollock began to replace yellowfin sole as the dominant species taken in the foreign fishery. By 1968, the catch of pollock accounted for 72 percent of the groundfish catch and from 1971 through 1977 over 80 percent of the total catch taken by foreign vessels was pollock. The catch of pollock was greatest from 1971 through 1974

when the catch averaged over 1.7 million t per year. Since 1974, the pollock catch has declined and during 1977 and 1978, the total allowable level of harvest was set by the United States at 950,000 t.

### Regulation of the Foreign Fishery

Under the FCMA, fishing is permitted by foreign nations within the FCZ, if the U.S. fishing industry is not able to harvest the total allowable catch established by the regional fisheries management councils. Additionally, the FCMA authorizes the establishment of fees and permits for the licensing of foreign fishing vessels,

Table 3.—General description of the gear used in the foreign mothership, stern trawl, and longline fisheries during 1977-78 in the eastern Bering Sea and Aleutian Islands region. Ranges in gear dimensions were taken from U.S. observer data.

Nation and vessel type	Gear type	Head-rope (m)	Ground rope (m)	Codend mesh (mm)	Otterboard		
					Dimensions	Shape	
Japan Mothership	Danish seine	120-130	130-140	90	NA <sup>1</sup>	NA	
	Pair trawl	130-155	155-175	90	NA	NA	
	Otter trawl	47-54	57-65	90-100	2.2 m × 3.4 m	Rectangular	
Independent stern trawl					2.6 m × 4.3 m		
					to		
Large trawlers	Otter trawl	42-100	51-122	90-110	3.3 m × 5.8 m	Rectangular	
Small trawlers	Otter trawl	45-55	45-65	90-110	2.2 m × 3.4 m	Rectangular	
U.S.S.R.	Independent stern trawl	Otter trawl (bottom)	30-50	44-65	100-120	5.5-6.0 m <sup>2</sup>	Disc
		Otter trawl (pelagic)	77	77	100-120	5.5-6.0 m <sup>2</sup>	Disc
	Republic of Korea Independent stern trawl	Otter trawl	65-80	75-100	90-100	2.8 m × 4.7 m	Rectangular
Nation and vessel type	Hachi <sup>2</sup> length (m)	No. of hachi/set	No. of hooks/hachi	Gangion length (m)	Bait		
Japan Longliner	70-100	390-420	35-50	1.0-1.5	Frozen squid or pollock		

<sup>1</sup>NA = Not applicable.

<sup>2</sup>A hachi is a unit of length in the Japanese longline fishery used to describe a unit of gear containing a number of baited hooks which are attached to the groundline by gangions. The term "skate" is used in North American longline fisheries.

Table 4.—Annual catches of groundfish (x1,000 t) reported by foreign nations as caught in the eastern Bering Sea and Aleutian Islands region, 1933-78. Catch statistics for Forrester et al. (1978) for 1933-63. Catch statistics for 1964-78 from Murai et al.<sup>1</sup>

Year	Japan <sup>2</sup>	U.S.S.R.	Rep. of		Total
			Korea	Taiwan	
1933	3.3	0	0	0	3.3
1934	15.0	0	0	0	15.0
1935	28.6	0	0	0	28.6
1936	26.6	0	0	0	26.6
1937	43.4	0	0	0	43.4
1938-39	0	0	0	0	0
1940	9.6	0	0	0	9.6
1941	12.2	0	0	0	12.6
1941-53	0	0	0	0	0
1954	12.6	0	0	0	12.6
1955	14.7	0	0	0	14.7
1956	24.7	0	0	0	24.7
1957	24.1	0	0	0	24.1
1958	46.6	5.0	0	0	51.6
1959	160.2	62.2	0	0	222.4
1960	448.9	101.0	0	0	549.9
1961	526.8	188.2	0	0	715.0
1962	459.6	146.6	0	0	606.2
1963	223.1	119.4	0	0	342.5
1964	391.6	330.0	0	0	721.6
1965	387.6	115.0	0	0	502.6
1966	442.9	100.0	0	0	542.9
1967	776.4	177.7	>0.1	0	954.1
1968	962.5	128.5	1.2	0	1,092.2
1969	1,109.5	281.2	11.3	0	1,402.0
1970	1,513.6	349.1	4.6	0	8,867.3
1971	1,825.6	420.5	10.0	0	2,256.1
1972	1,918.0	466.9	9.2	0	2,394.1
1973	1,758.2	382.3	3.4	0	2,143.9
1974	1,537.0	454.8	34.8	0	2,026.6
1975	1,310.2	352.6	4.8	0.3	1,667.9
1976	1,238.6	296.5	90.0	NA <sup>3</sup>	1,625.1
1977	1,004.2	112.0	42.3	1.5	1,160.0
1978	1,056.3	219.6	65.4	3.2	1,344.5

<sup>1</sup>Murai, S., H. Gangmark, and R. French. 1979. All nation removals of groundfish, herring, and shrimp from the eastern Bering Sea and northeast Pacific Ocean, 1964-78. Unpubl. manuscr. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

<sup>2</sup>Fishing operations by Japan suspended 1938-39 and fishing suspended 1941-53 because of World War II and restrictions placed on Japan after the war.

<sup>3</sup>NA = Data not available.

the setting of catch allocations and charges for the fish caught, the requirement for the submission of detailed catch and effort data, the placement of U.S. observers on any foreign fishing vessel, and the establishment and enforcement of time, area, and gear restrictions on the fishing by foreign vessels as deemed appropriate by the councils.

Prior to FCMA implementation, foreign fisheries were regulated by treaty or bilateral agreements. Of primary importance was the International North Pacific Fisheries Commission (INPFC) which was established in 1953 by Canada, Japan, and the United States as the result of an agreement of the International Convention of the High Seas Fisheries of the North Pacific Ocean. The main purpose of the agreement and the INPFC was the promotion and coordination of "scientific studies necessary to ascertain and recommend conservation measures required to secure the maximum productivity of fisheries of joint interest" in the North Pacific Ocean (Forrester et al., 1978). Most of the regulatory measures established by INPFC pertaining to the ground-fish fisheries in the eastern Bering Sea, have dealt with the conservation of the Pacific halibut resource.

Bilateral agreements with Japan and the U.S.S.R. were negotiated in 1964 and renewed at 2-year intervals to provide for the continuation of traditional Soviet and Japanese fisheries in certain areas within the 9-mile fishery zone established in 1966 and adjacent to the U.S. 3-mile territorial sea. These agreements also led to the establishment of sanctuaries, where trawling by foreign vessels was prohibited to reduce the incidental catch of juvenile halibut and prevent gear conflicts with U.S. crab-pot operations. In addition, areas within the 9-mile fishery zone where foreign vessels could transship cargo to support vessels were established. In 1970, these agreements were expanded to include Canada and, in 1972 and 1975, agreements were signed with the Republic of Korea and Poland, respectively. The establishment of

catch quotas for the eastern Bering Sea was first included in 1973, in the bilateral agreements between the United States and Japan, and between the United States and the U.S.S.R.

### **U.S. Observer Program in Eastern Bering Sea and Aleutian Islands Region**

#### **History of the Program**

The FCMA provided a means for the placement of a fisheries observer on any foreign vessel fishing in the U.S. FCZ after 1 March 1977; but, as the result of prior agreements between the United States, Japan, and the U.S.S.R., the observers had been sampling on Japanese vessels in the eastern Bering Sea and Aleutian Islands region since 1973 and on Soviet vessels since 1975. The acceptance of U.S. observers on Japanese fishing vessels resulted from concern by U.S. and Canadian scientists over the decreased catch of Pacific halibut by U.S. and Canadian setline vessels during the late 1960's and early 1970's (Miller et al., 1976). The catch in 1963 of about 5,000 t of halibut by 104 U.S. and Canadian setline vessels decreased to less than 200 t caught by 10 vessels in 1973 (Skud, 1973). Skud (1973) suggested that excessive fishing by the United States, Canada, and Japan under quotas set by the INPFC resulted in the initial decline in the fishery and that a large incidental catch by foreign trawlers further added to the decline, negating the effects of restrictions placed on the setline fishery by the International Pacific Halibut Commission.

Conflicting estimates made by Japan and the United States of the incidental trawl catch of halibut led to agreement by Japan in 1973 to allow U.S. observers aboard a limited number of vessels throughout the year. Japan agreed to the placement of two observers on each of two motherships and one observer on each of two stern trawlers for 1-month observation periods each quarter of the year. Unfortunately, all quarters were not sampled if motherships were not fishing. The program was con-

ducted at that level from 1973 through 1976. As the result of a bilateral agreement between the United States and the U.S.S.R., a limited number of U.S. fisheries observers were permitted to sample on Soviet fishing vessels for 2-week periods during 1975 and 1976. Prior to the implementation of the FCMA, observers had not sampled on vessels from Taiwan and the Republic of Korea fishing in the eastern Bering Sea.

During the pre-FCMA period, the purpose of the U.S. observer program was the determination of the incidental catch and mortality of Pacific halibut, king crab, and snow crab in the foreign trawl fisheries; the collection of biological data on Pacific halibut, crab, and important commercial target species (usually walleye pollock and flatfish); and the collection of catch statistics.

With the implementation of the FCMA in 1977, the observer program provided a unique means for obtaining some of the data needed by U.S. fisheries managers to effectively manage the fisheries and help assure compliance with U.S. fishing regulations. Under the FCMA, additional objectives were added to the program. In addition to collecting information on the incidental catch of species whose retention was prohibited by U.S. regulation, observers were placed on foreign vessels to collect data which would allow U.S. biologists to estimate the foreign catch, provide information needed to assess the biological status of the various stocks of fish, and to report on suspected violations of fishing regulations.

#### **Observer Sampling Procedures**

Prior to carrying out their duties on foreign fishing vessels, all observers spent 7-10 days at the Northwest and Alaska Fisheries Center in Seattle, Wash., where they were trained in shipboard sampling procedures, species recognition, the proper way to record data on computer forms, and U.S. fishing regulations pertaining to foreign fisheries. The data forms provided information on: Position and



Figure 2.—U.S. fisheries observer obtaining a sample to determine the species composition of the groundfish catch delivered to a Japanese mothership whose target species was yellowfin sole, *Limanda aspera*.

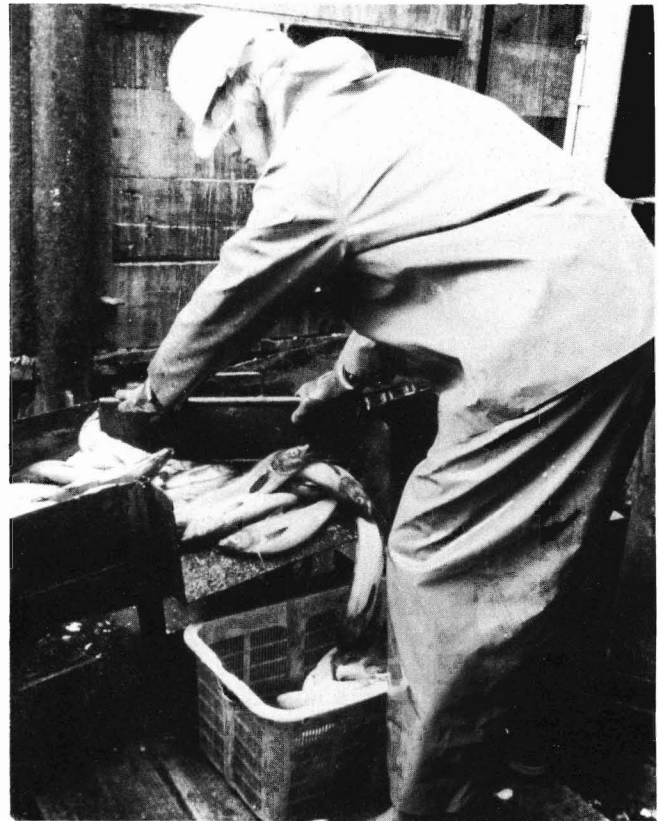


Figure 3.—U.S. fisheries observer obtaining a sample to determine the species composition of the groundfish catch delivered to a Japanese mothership by diverting the fish from a conveyor belt into baskets.

depth of fishing; species composition and catch rates; incidence (number per metric ton of catch) of salmon, Pacific halibut, and crab; and age and size of important commercial species. Observers were then placed on foreign vessels fishing in the eastern Bering Sea and Aleutian Islands region for 2-3 months.

While on the vessel, each observer determined the species composition of the catch by taking representative samples of the trawl hauls or longline sets and then counting and weighing all the individuals of each species in the samples (Fig. 2, 3). At times, observers may have separated and weighed an entire trawl catch by species. For those species for which additional biological information was desired, length frequency measurements were taken from random

samples, and otoliths or scales were taken from subsamples stratified by length and sex (Fig. 4). Observers monitored conveyor belts, watched the emptying of the nets or the landing of the longline catch, and recorded the number of salmon, Pacific halibut, king crab, and snow crab per unit weight of groundfish catch (Fig. 5, 6). Upon the observers' return to Seattle, the data were keypunched onto cards for computer analysis, and each observer submitted a written report. The reports summarized data obtained on the design of the fishing gear used by the vessel; the types of fish products produced on the vessel; the average sizes and size ranges of the species targeted upon by the vessel, and similar data for the incidental catches of Pacific halibut, salmon, and crab; conditions on the vessel

which might have influenced the validity of the data; and documentation of any violation of fishery regulations that the observer might have witnessed.

#### Observer Coverage, 1977-78

During 1977, observers spent 59.3 months (1,660 days) on foreign groundfish vessels in the eastern Bering Sea and Aleutian Islands region (Table 5). This sampling effort accounted for 5.6 percent of the 1,057.1 vessel months (29,599 vessel days) of fishing effort exerted by foreign vessels in the region in 1977. Observer coverage<sup>4</sup> by nation in 1977 was:

<sup>4</sup>Coverage is defined as the percentage of the foreign effort sampled by observers, i.e. (no. of observer months  $\times$  100/no. foreign vessel months).



Figure 4.—U.S. fisheries observer measuring lengths of flathead sole, *Hippoglossoides elassodon*, for a length-frequency sample which will be used by U.S. scientists for stock assessment analyses.

Japan 4.5 percent, U.S.S.R. 12.2 percent, Republic of Korea 16.4 percent, and Taiwan 0 percent. Observer coverage of foreign fishing effort in the same region increased to 8.7 percent in 1978 with observers spending 117.4 months (3,288 days) on foreign fishing vessels (Table 6). The total foreign effort in 1978 also increased to 1,346.6 months (37,705 vessel days), an increase of 289.5 vessel months over the foreign effort expended in 1977. Observer coverage of Japanese vessels was increased to 9 percent of Japan's fishing effort in 1978, but coverage of Soviet and Korean fishing effort decreased to 7.6 percent and 8.4 percent, respectively. There was no sampling on Taiwanese vessels in 1978.

#### Results of Observer Sampling in 1977 and 1978

#### Estimates of Foreign Groundfish Catches

Catches of groundfish taken by foreign vessels in the eastern Bering Sea and Aleutian Islands region were estimated by applying weekly averages of daily catch rates by species, statistical areas defined by the



Figure 5.—U.S. fisheries observer watching the groundfish catch emptied from a bin on a Japanese mothership to determine the incidence (no./t) of prohibited species.



Figure 6.—U.S. fisheries observer collecting scale samples from salmon, *Oncorhynchus* spp., and length measurements of salmon and Pacific halibut, *Hippoglossus stenolepis*, which were taken as an incidental catch by a large Japanese stern trawler targeting on walleye pollock, *Theragra chalcogramma*. The retention of these species is prohibited.

**Table 5.—Summary of observer effort, foreign vessel effort, and observer coverage (observer month x 100/foreign vessel effort) in the eastern Bering Sea and Aleutian Islands region during 1977-78<sup>1</sup>.**

Nation	Vessel type	1977			1978		
		Observer month	Vessel month	Percent coverage	Observer month	Vessel month	Percent coverage
Japan	Pollock mothership	15.9	28.5	55.8	18.6	26.3	70.7
	Yellowfin mothership	3.9	4.3	90.7	5.6	5.8	96.7
	Small stern trawl	10.6	709.4	1.5	44.6	805.4	5.5
	Large stern trawl	10.7	118.5	9.0	22.0	160.8	13.7
	Longline	0.0	53.4	0.0	5.8	70.2	8.3
U.S.S.R.	Large stern trawl	14.0	114.5	12.2	15.8	207.2	7.6
Rep. of Korea	Large stern trawl	4.2	23.8	17.6	5.3	62.4	8.5
Taiwan	Longline	0.0	1.8	0.0	0.0	1.0	0.0
	Large stern trawl	0.0	2.9	0.0	0.0	7.5	0.0
	Total	59.3	1,057.1	5.6	117.4	1,346.6	8.7

<sup>1</sup>One vessel or observer month is equal to 28 days.

**Table 6.—Estimates made from U.S. observer data of the 1977-78 groundfish catches (metric tons) made by foreign nations in the eastern Bering Sea and Aleutian Islands region<sup>1</sup>.**

Species and nation	Estimated catch (t)		Species and nation	Estimated catch (t)	
	1977	1978		1977	1978
Squid			Atka mackerel		
Japan	8,362	9,138	Japan	— <sup>2</sup>	1,531
U.S.S.R.	n.a.	23	U.S.S.R.	— <sup>2</sup>	22,622
Rep. of Korea	n.a.	210	Rep. of Korea	— <sup>2</sup>	72
Taiwan	n.a.	35	Taiwan	— <sup>2</sup>	>1
	8,362	9,406		— <sup>2</sup>	24,225
Yellowfin sole			Pacific ocean perch		
Japan	47,034	59,737	Japan	9,527	6,776
U.S.S.R.	284	81,105	U.S.S.R.	806	242
Rep. of Korea	n.a.	41	Rep. of Korea	483	483
Taiwan	n.a.	1	Taiwan	0	7
	47,318	140,884		10,816	7,508
Other flatfishes			Pacific herring		
Japan	83,092	87,786	Japan	6,178	2,315
U.S.S.R.	6,224	6,806	U.S.S.R.	13,145	6,106
Rep. of Korea	n.a.	265	Rep. of Korea	n.a.	12
Taiwan	n.a.	68	Taiwan	n.a.	0
	89,316	94,925			
Walleye pollock			Other fish		
Japan	868,728	821,306	Japan	58,190	58,041
U.S.S.R.	63,466	92,714	U.S.S.R.	34,525	10,776
Rep. of Korea	45,226	60,689	Rep. of Korea	1,892	2,712
Taiwan	944	3,040	Taiwan	103	0
	978,364	977,749			
Pacific cod			All groundfish		
Japan	35,607	45,015	Japan	1,121,215	1,093,450
U.S.S.R.	282	560	U.S.S.R.	118,732	220,954
Rep. of Korea	n.a.	1,141	Rep. of Korea	47,690	65,774
Taiwan	n.a.	70	Taiwan	1,100	3,226
	35,889	46,786		1,288,737	1,383,404
Sablefish					
Japan	4,497	1,805			
U.S.S.R.	n.a.	>1			
Rep. of Korea	89	149			
Taiwan	53	5			
	4,639	1,959			

<sup>1</sup>An "n.a." means no allocation was given in 1977 to that nation for that species.

<sup>2</sup>In 1977 Atka mackerel was included in the allocation category "other fish."

United States (Fig. 7), and vessel class obtained from observer sampling to the corresponding total number of foreign vessel days on the grounds. While stationed on the ship, each observer determined the vessel's daily catch by fishing area and species by applying the results of sampling for species composition to the ship's estimate of the day's total landed catch. At the end of each week (2400 hours Saturday, Greenwich Mean Time), the observers summed their estimates of daily catches by species and fishing area and determined the number of days the vessel fished in each area. The information was then transmitted by the vessel to the National Marine Fisheries Service (NMFS) via the U.S. Coast Guard radio receiving stations in Alaska. An estimate of the mean catch per vessel day on the grounds (metric tons per vessel day) was made for each species by nation, vessel class, and area for the week from the data received from the observers' weekly catch messages.

Data on fishing effort in vessel days on the grounds were obtained from the U.S. Coast Guard/NMFS check-in and check-out system which requires all foreign vessels to report the date, time, and position of their entry into or departure from the U.S. 200-mile FCZ. During 1978, vessels were also required to report changes in fishing area within the U.S. 200-mile FCZ but in 1977, the effort was apportioned among the fishing areas by NMFS through the use of vessel sightings made by the U.S. Coast Guard or NMFS enforcement agents. Because of the low coverage by observers of certain segments of the foreign fleets, catch estimates based solely on U.S. data might not be reliable. To provide a "best estimate," the weekly estimates were used when observer coverage of a week-area-vessel class element was at least 20 percent, and the foreign reported catch was used for those elements where observer coverage was less than 20 percent. The estimates of the foreign groundfish catches made through the use of this technique are shown in Table 6 for 1977 and 1978



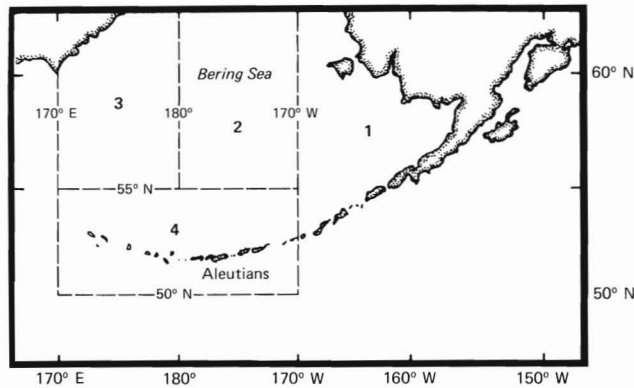


Figure 7.—The statistical areas in the Bering Sea and northeast Pacific Ocean defined and utilized by the United States to summarize fisheries catch and effort statistics.

by nation and species.

In 1977 and 1978, approximately 1.29 and 1.38 million t of groundfish were estimated to have been caught in the region by foreign vessels. Walleye pollock was the dominant species taken by all nations during both years accounting for 75 percent of the total groundfish catch in 1977 and 78.7 percent of the total catch in 1978. The important species caught by Japan in 1977 were walleye pollock (77.5 percent), other flounders (7 percent), yellowfin sole (4 percent), and Pacific cod, *Gadus macrocephalus*, (3 percent). These same species were again important in the Japanese fishery in 1978, when the catch was composed of 75.1 percent walleye pollock, 8 percent other flounders, 5 percent yellowfin sole, and 4 percent Pacific cod. In 1977, walleye pollock composed 53.4 percent of the groundfish catch taken by Soviet vessels. The remaining portion of the Soviet catch was composed of Atka mackerel, *Pleurogrammus monopterygius* (20.9 percent of total catch or 72 percent of the Soviet's catch of "other fish"); Pacific herring, *Clupea harengus pallasi* (11 percent); and other flounders (5 percent). Only 42 percent of the Soviet catch in 1978 was made up of walleye pollock, but the catch of yellowfin sole increased to 37 percent of the total catch in 1978, and Atka mackerel composed 10 percent of the catch. Within the Korean and

Taiwanese fisheries, species other than walleye pollock were only taken as a by-catch and amounted to 8 percent or less of catches made by vessels from these nations in 1977 and 1978.

#### **Incidence and Incidental Catch of Pacific Halibut, King Crab, Snow Crab, and Pacific Salmon in 1977-78**

The mean incidence (number of individuals caught per metric ton of groundfish catch) and the incidental catch (numbers and metric tons) of Pacific halibut, king crab, snow crab, and Pacific salmon in the 1977-78 foreign groundfish fisheries were estimated from data collected by U.S. observers. The methods used to estimate the incidence and average weight per individual are shown in Table 7. The incidental catch, in numbers, of these species was estimated by multiplying the average incidence for each nation, area, and vessel class by the total groundfish catch for the same nation, area, and vessel class. The incidental catch by weight was found by multiplying the estimated number of fish or crab caught by the average weight per individual for that same nation, area, and vessel class. Because of the large number of unsampled month-area strata in 1977, estimates of incidental catches of these species were made using annual means of incidence and average weights derived from

observer data. Increased levels of sampling in 1978 allowed estimates to be made on a month by month basis and, where data were unavailable, the annual means for the area and vessel class were used. In the instances where no incidence data were available for a particular nation or vessel class, a judgment was made to substitute the rates from another nation or vessel class, whose fishery was similar to the one lacking data. No estimates were made for Japanese and Korean longline incidental catches in 1977, since only a small sampling effort was conducted on longline vessels in the region in 1977.

#### **Pacific Halibut**

The incidence of Pacific halibut (number per metric ton of catch) and the average weight per individual of those fish (kilograms), as determined from observer sampling of the foreign groundfish catch, are listed for 1977 and 1978 in Table 8 by nation, vessel class, and area. In 1977, the highest incidence rates of Pacific halibut were observed on Japanese stern trawlers, where the average incidence was found to be 1.29 fish/t of catch on small Japanese trawlers and 0.40 fish/t on large Japanese trawlers. Groundfish catches made by small Japanese stern trawlers were found to have a high incidence of Pacific halibut in 1978 also, averaging 2.01 fish/t. The highest incidence of Pacific halibut in 1978 was observed on Japanese longline vessels, where the average rate was 6.13 fish/t. During both 1977 and 1978, the incidence of Pacific halibut was lowest on Soviet vessels, averaging less than 0.1 fish/t for both years.

The highest incidence rates of halibut were generally observed during the winter months of 1977 and 1978 (December-May) and in fishing operations conducted at depths less than 500 m. In 1978, the incidence of halibut on Japanese longliners in U.S. Statistical Area 1 during the winter was 18.4 fish/t at depths less than 500 m while the vessels were targeting on Pacific cod, and 1.4 fish/t at depths greater than 500 m. The halibut in-

Table 7. — The procedure used for estimating the average incidence rate and average weight of salmon (and other prohibited species) on foreign groundfish trawlers (French et al., 1981).

mean kg/individ.	=	mean kg per t
	=	mean no. (n) per t
mean no. per t	=	$\frac{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{n_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]}{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z (HW_{ijh}) / 1,000}$
mean kg per t	=	$\frac{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{W_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]}{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z (HW_{ijh}) / 1,000}$
where:		$W_{ijh} = (n_{ijh})(AW_{ijh})$
therefore:		
mean kg/individ.	=	$\frac{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z (HW_{ijh})}{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{n_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]} \Bigg/ \frac{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z (HW_{ijh})}{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{W_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]}$
mean kg/individ.	=	$\frac{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{W_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]}{\sum_{i=1}^x \sum_{j=1}^y \sum_{h=1}^z \left[ \frac{n_{ijh}}{SW_{ijh}} (HW_{ijh}) \right]}$
mean kg/individ.	=	$\frac{\text{Estimated total weight of species from all hauls sampled}}{\text{Estimated number of species from all hauls sampled}}$
where:		$x$ = number of days; $y$ = number of vessels fishing on day $i$ , and $z$ = number of hauls by vessel $j$ on day $i$ .
		$n_{ijh}$ = number of salmon observed by the observer on day $i$ , vessel $j$ and haul $h$
		$SW_{ijh}$ = weight (in kg) sampled for the occurrence of salmon by the observer on day $i$ , vessel $j$ , and haul $h$ .
		$HW_{ijh}$ = total weight (in kg) of haul $h$ on day $i$ and vessel $j$ .
		$AW_{ijh}$ = average weight (in kg) of the salmon weighed by the observer on day $i$ , vessel $j$ , and haul $h$ .
		$W_{ijh}$ = estimated weight of all salmon observed determined by $W_{ijh} = (n_{ijh})(AW_{ijh})$ for day $i$ , vessel $j$ , and haul $h$ .

cidence on small Japanese stern trawlers at depths less than 500 m in Area 1 was 5 fish/t in 1977 and 7 fish/t in 1978; whereas at depths greater than 500 m, the incidence of halibut averaged 0.7 fish/t during both years. The higher incidence of Pacific halibut at depths less than 500 m during the winter was not unexpected, since Novikov (1964) reported

that Pacific halibut concentrate in the southeastern Bering Sea during the winter at depths of 100-450 m. Hoag and French (1976) also reported that sampling conducted in the Bering Sea on Japanese vessels during 1973-75 and on Soviet vessels during 1974-75 showed that the incidence of Pacific halibut was highest during the winter and in those fisheries conducted at

depths less than 500 m.

A plot of the average incidence of halibut on small Japanese stern trawlers by 1° longitude and ½° latitude over 1977 and 1978 (Fig. 8) showed that "significant" rates (> 1.0 fish/t) occurred along the 200 m contour from the Alaska Peninsula to about lat. 59°30'N with the area of highest halibut incidence concentrated south of lat. 57°N. Areas of high halibut incidence were also found along the Aleutian chain near long. 180° and in the area located between long. 174° to 175°E.

The estimated incidental catch of Pacific halibut in the foreign groundfish fishery in 1977 was 344,973 fish or 1,453 t, of which Japanese vessels were responsible for 97.8 percent of the incidental catch (Table 9). It was estimated that the incidental Pacific halibut catch in 1978 was 599,852 fish (2,853 t), an increase of 74 percent over that of 1977. Japanese vessels again accounted for the greatest proportion of the incidental catch, 89.3 percent, but the proportion of the incidental catch taken by each vessel class within the Japanese fishery changed between 1977 and 1978. In 1977, 38 percent of the Pacific halibut catch was taken by large Japanese trawlers, 30 percent by the mothership fleets and 29 percent by small Japanese trawlers. In contrast, 54 percent of the 1978 Pacific halibut catch was taken by the small Japanese trawlers, 17 percent by the mothership fleets, and 8 percent by the large Japanese trawlers. The incidental catches from the eastern Bering Sea accounted for the largest portions of the incidental Pacific halibut catches in both years, with only 5.6 percent of the 1977 catch and 10.5 percent of the 1978 incidental catch taken in the Aleutian area.

Although the incidental catch of halibut in 1978 was roughly 1.7 times greater than that of 1977, the catches from both years were substantially less than those estimated for 1964 through 1974 by Hoag and French (1976). During those years, the estimated incidental halibut catch ranged from 1 million to 7 million fish

**Table 8.—Mean annual incidence (number per metric ton of catch) and average weight (kg) of Pacific halibut, *Hippoglossus stenolepis*, in the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands during 1977-78 by nation, vessel class, and area<sup>1</sup> (U.S. observer data).**

Year, nation, and vessel class	Area 1		Area 2		Area 3		Area 4	
	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.
1977								
Japan								
Mothership	0.058	4.64	0.372	1.59	—	—	—	—
Small stern trawler	2.021	5.99	0.371	12.96	—	—	0.478	19.31
Large surimi trawler	0.198	1.39	0.504	1.38	—	—	—	—
U.S.S.R.								
Large stern trawler	0.000	0.00	0.001	15.00	—	—	0.007	51.91
Republic of Korea								
Large stern trawler	0.139	2.30	0.002	3.00	—	—	—	—
1978								
Japan								
Mothership	0.236	3.56	0.117	4.90	—	—	—	—
Small stern trawler	3.875	3.34	1.451	5.88	—	—	0.889	9.34
Large surimi trawler	0.169	3.77	0.067	3.56	—	—	—	—
Large freezer trawler	0.543	2.28	1.268	1.20	—	—	—	—
Longline	10.605	4.32	—	—	—	—	2.695	4.10
U.S.S.R.								
Large stern trawler	0.118	3.62	0.004	71.10	—	—	0.037	10.58
Republic of Korea								
Large stern trawler	0.261	3.27	0.363	2.35	—	—	—	—

<sup>1</sup>U.S. statistical area (Fig. 7).

**Table 9.—The estimated incidental catch (numbers and metric tons) of halibut, *Hippoglossus stenolepis*, in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1977-78 by nation and vessel class (U.S. observer data).**

Nation and vessel class	1977						1978					
	Eastern Bering Sea		Aleutian Islands		Totals		Eastern Bering Sea		Aleutian Islands		Totals	
	No.	t	No.	t	No.	t	No.	t	No.	t	No.	t
Japan												
Mothership	105,111	229.1	—	—	105,111	229.1	104,557	429.2	—	—	104,557	429.2
Small stern trawler	81,965	683.8	17,945	313.1	99,910	996.9	274,435	1,300.8	49,693	478.2	324,128	1,780.7
Large stern trawler	131,551	176.8	664	11.9	132,215	188.7	43,094	143.3	3,229	30.2	46,323	173.5
Longline <sup>1</sup>	—	—	—	—	—	—	52,314	194.0	8,167	36.2	60,481	230.2
U.S.S.R.												
Large stern trawler	31	0.4	354	14.5	385	14.9	11,761	72.5	955	10.5	12,716	83.0
Republic of Korea												
Large stern trawler	5,999	11.4	160	2.7	6,159	14.1	41,828	111.8	987	9.2	42,815	121.0
Longline <sup>1</sup>	—	—	—	—	—	—	—	—	60	0.2	60	0.2
Taiwan												
Small stern trawler	1,193	9.6	—	—	1,193	9.6	8,772	34.9	—	—	8,772	34.9
Annual totals	325,850	1,111.1	19,123	342.2	344,973	1,453.3	536,761	2,288.2	63,091	564.5	599,852	2,852.7

<sup>1</sup>There was no sampling by U.S. observers on longline vessels in 1977. Therefore, no estimates of incidental catch were made.

**Table 10.—The incidental catch (numbers and metric tons) of Pacific halibut, *Hippoglossus stenolepis*, for 1973-78 and the average weight (kg) of halibut sampled from Japan's mothership and large trawl fishery and Japan's small stern trawl fishery during that period.**

Year	Incidental catch		Avg. wt. (kg) Japanese mothership-large trawl	Avg. wt. (kg) Japanese small trawl
	No.	t		
1973 <sup>1</sup>	4,645,000	7,097.0	1.2	NA <sup>2</sup>
1974 <sup>1</sup>	3,817,800	5,955.0	1.6	NA
1975 <sup>3</sup>	596,017	1,165.1	2.0	NA
1976 <sup>3</sup>	541,093	1,211.5	1.8	NA
1977	344,973	1,453.3	1.7	7.6
1978	599,852	2,852.7	3.7	5.4

<sup>1</sup>From Hoag and French (1976).

<sup>2</sup>NA = No available observer data for that year.

<sup>3</sup>Previously unpublished data on file with Foreign Fisheries Observer Program, Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, Seattle, WA 98112.

annually and averaged about 3.7 million fish per year. The estimated incidental halibut catches for 1973 through 1978 are compared in Table 10. The incidental halibut catch, expressed in numbers of fish, has remained at about the same level since 1975, but the catch in metric tons of halibut has increased during 1977 and 1978, indicating that the mean size (kilograms) per fish taken in the fishery has increased. The average weight of halibut occurring in observer samples taken on Japanese motherships and large stern trawlers

ranged from 1.2 to 2.0 kg between 1973 and 1977, but the average weight of halibut from these two vessel classes increased to 3.7 kg per fish in 1978. Sampling was conducted on small Japanese stern trawlers for the first time in 1977 and 1978, and the incidental halibut sampled on these vessels were larger than the halibut previously observed on the other vessel classes averaging 7.6 kg per fish in 1977 and 5.4 kg per fish in 1978. The greater average size of halibut taken by Japan's small stern trawlers, which prior to 1977 were assumed to

be of similar size to those observed in other fleets, and the increase in size of fish observed on Japan's large trawler and mothership fleet in 1978 have been responsible for the increase in weight of halibut taken by the foreign fishery in 1977 and 1978.

### Snow Crab

The incidence of snow crab in the foreign groundfish fishery in the eastern Bering Sea and Aleutian

Islands is shown by nation, vessel class, and area for 1977 and 1978 (Table 11). The highest incidence rates for both years were observed on Japanese small trawlers fishing in Areas 1 and 2, where the annual averages were greater than 40 crabs/t. High rates were also observed on Japanese motherships targeting on yellowfin sole in both years (30 crabs/t in 1977 and 33 crabs/t in 1978) and on large Japanese (16.9

crabs/t) and Soviet trawlers (46.8 crabs/t) targeting on yellowfin sole in Area 1 in 1978.

The distribution of the mean incidence rates of snow crab over 1977 and 1978 are shown by 1° longitude and ½° latitude by vessel class in Figures 9-11. High rates of incidence (>25 crabs/t) were observed on Japanese small trawlers in both years along the 200 m contour from the Alaska Peninsula to lat. 61°N, whereas on large trawlers and motherships, the highest rates were observed in the area lat. 56°-58°30'N and long. 164°-169°W, while the vessels were fishing for yellowfin sole.

The estimated incidental catch of snow crab by foreign vessels was 17,592,838 crabs in 1977 and 17,306,064 crabs in 1978 (Table 12). Ninety-nine percent of the incidental catch of snow crab in 1977 was taken by Japanese vessels, with mothership fleets accounting for 48.4 percent of the total, and the catch by small trawlers accounting for 44.5 percent. In 1978, Japanese vessels were responsible for 68.6 percent of the snow crab catch, whereas Soviet vessels took 26.1 percent of the catch. The incidental snow crab catches in 1977 and 1978 were comprised of 75 percent *Chionoecetes opilio* and 25 percent *C. bairdi*. The average crab size was 0.3 kg in 1977 and 0.2 kg in 1978.

Table 11.—Mean annual incidence (number per metric ton of catch) and average weight (kg) of snow crab, *Chionoecetes* spp., in the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands during 1977-78 by nation, vessel class, and area<sup>1</sup> (U.S. observer data).

Year, nation, and vessel class	Area 1		Area 2		Area 3		Area 4	
	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.
1977								
Japan								
Mothership	18.247	0.17	10.483	0.22	—	—	—	—
Small stern trawler	62.971	0.46	88.634	0.22	—	—	0.000	0.00
Large surimi trawler	0.880	0.22	6.150	0.24	—	—	—	—
U.S.S.R.								
Large stern trawler	0.000	0.00	0.273	0.56	—	—	0.000	0.00
Republic of Korea								
Large stern trawler	0.746	0.23	1.540	0.51	—	—	—	—
1978								
Japan								
Mothership	14.214	0.22	6.645	0.20	—	—	—	—
Small stern trawler	50.434	0.27	40.954	0.26	—	—	3.309	0.16
Large surimi trawler	10.100	0.15	7.627	0.15	—	—	—	—
Large freezer trawler	16.936	0.24	15.711	0.06	—	—	—	—
Longline	0.594	0.86	—	—	—	—	0.138	0.70
U.S.S.R.								
Large stern trawler	46.773	0.35	0.092	0.50	—	—	0.000	0.00
Republic of Korea								
Large stern trawler	5.257	0.11	13.639	0.05	—	—	—	—

<sup>1</sup>U.S. statistical area (Fig. 7).

Table 12.—The estimated incidental catch (numbers and metric tons) of snow crab, *Chionoecetes* spp., in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1977-78 by year, nation, and vessel class (U.S. observer data).

Nation and vessel class	1977						1978					
	Eastern Bering Sea		Aleutian Islands		Totals		Eastern Bering Sea		Aleutian Islands		Totals	
	No.	t	No.	t	No.	t	No.	t	No.	t	No.	t
Japan												
Mothership	8,510,735	1,585.3	—	—	8,510,735	1,585.3	5,876,605	1,198.6	—	—	5,876,605	1,198.6
Small stern trawler	7,826,034	1,833.9	—	—	7,826,034	1,833.9	3,502,579	962.6	168,228	37.9	3,670,807	1,000.5
Large stern trawler	1,109,184	264.8	—	—	1,109,184	264.8	2,309,172	414.0	12,020	1.9	2,321,192	415.9
Longline <sup>1</sup>	—	—	—	—	—	—	3,571	2.9	358	0.2	3,929	3.1
U.S.S.R.												
Large stern trawler	3,530	2.0	—	—	3,530	2.0	4,521,054	1,543.4	—	—	4,521,054	1,543.4
Republic of Korea												
Large stern trawler	53,956	19.9	—	—	53,956	19.9	758,686	66.0	3,675	0.6	762,361	66.6
Longline <sup>1</sup>	—	—	—	—	—	—	—	—	T <sup>2</sup>	T	T	T
Taiwan												
Small stern trawler	89,399	21.9	—	—	89,399	21.9	148,116	39.3	—	—	148,116	39.3
Annual totals	17,592,838	3,727.8	—	—	17,592,838	3,727.8	17,119,783	4,226.8	184,281	40.6	17,306,064	4,267.4

<sup>1</sup>There was no sampling by U.S. observers on longline vessels in 1977. Therefore, no estimates of incidental catch were made.

<sup>2</sup>T = Trace.

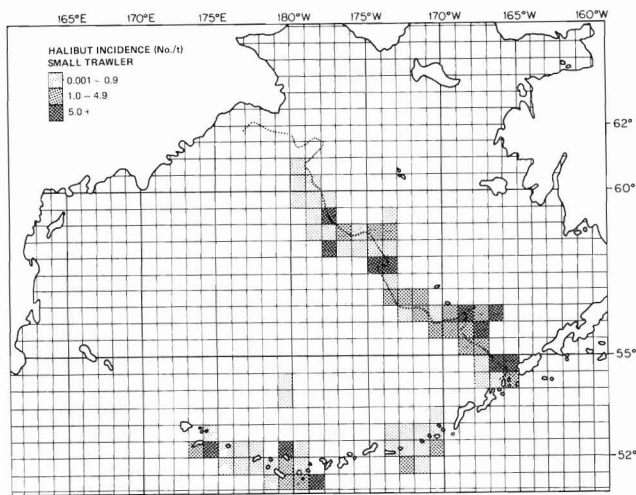


Figure 8.—The average incidence (no./t) of Pacific halibut, *Hippoglossus stenolepis*, on small Japanese stern trawlers during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Island areas.

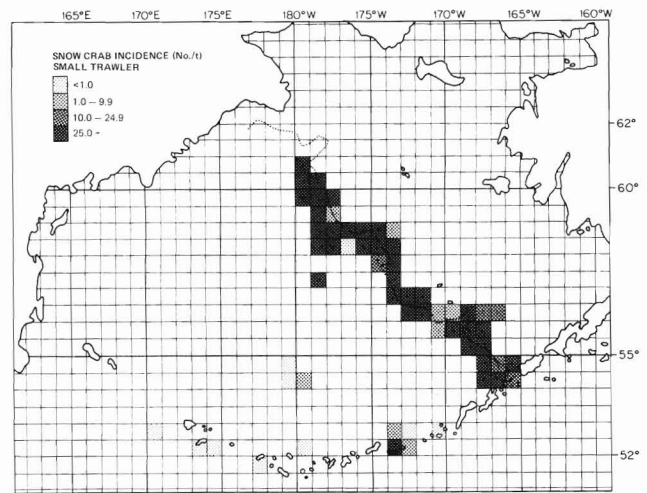


Figure 9.—The average incidence (no./t) of snow crab, *Chionoecetes* spp., on small Japanese stern trawlers during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Islands areas.

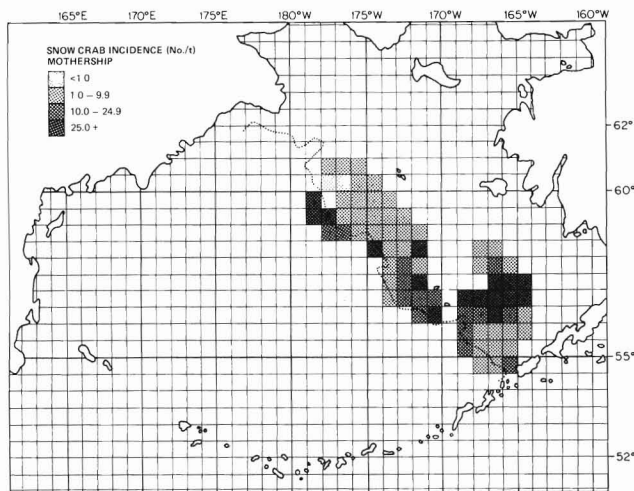


Figure 10.—The average incidence (no./t) of snow crab, *Chionoecetes* spp., on Japanese motherships during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Islands areas.

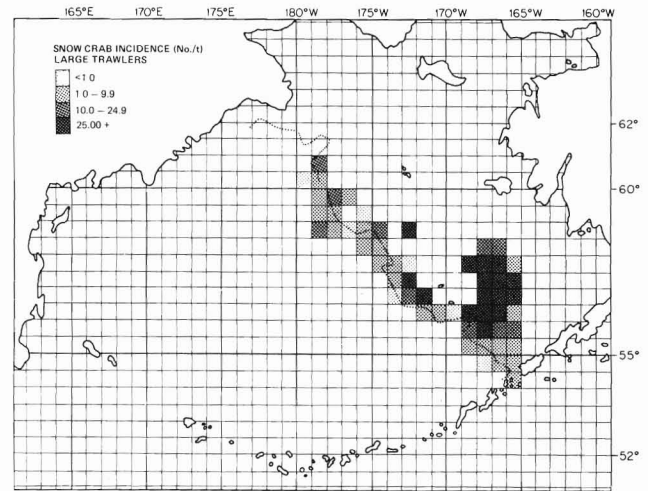


Figure 11.—The average incidence (no./t) of snow crab, *Chionoecetes* spp., on large stern trawlers (Japanese, Soviet, and Korean) during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Islands areas.

The incidental snow crab catch by the foreign groundfish fishery has decreased from the estimated 112.5 million crabs in 1973 and 155 million crabs in 1974 to 17 million crabs in 1977 and 1978 (Table 13). The reason for the declining incidental catch has been a combination of a reduction in groundfish catches (Table 5) and a decrease in snow crab incidence in catches taken by the Japanese

mothership fishery from a high of 119.1 crabs/t in 1974 to 10.4 crabs/t in 1978. A similar decline has also been observed in the snow crab incidence in catches on large Japanese trawlers, although not as pronounced. The decreases in snow crab incidence on motherships in 1977 and 1978 were counteracted to some extent by the high levels of incidence observed on small trawlers and the high incidence

observed on Soviet trawlers in 1978 in the Soviet yellowfin sole fishery.

### King Crab

Catches landed by Japanese small stern trawlers were found to have the greatest incidence of king crab in 1977 and 1978 (Table 14). The average incidence of king crab in catches landed by the Japanese small trawlers exceeded 3 crabs/t in all areas during both

**Table 13.—The estimated incidental catches (millions of crab) of snow crab, *Chionoectes* spp., in the eastern Bering Sea and Aleutian Islands for 1973-78, and the mean annual incidence (number per metric ton) of snow crab on Japanese motherships and large stern trawlers for the same period<sup>1</sup>.**

Year	Estimated incidental snow crab catches	Mean annual incidence	
		Large Japanese trawlers	Japanese motherships
1973	112,500,000	31.3	81.8
1974	155,000,000	10.0	119.1
1975	59,000,000	8.5	78.0
1976	29,500,000	5.7	31.9
1977	17,600,000	3.4	14.9
1978	17,300,000	8.9	10.4

<sup>1</sup>Incidental catch estimates for 1973-76 from: Nelson, R., R. French, J. Wall, and D. Hennick. 1978. Summary of U.S. observer sampling on foreign fishing vessels in the Bering Sea/Aleutian Islands Areas, 1977. Unpubl. manuscr., 73 p. Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

**Table 14.—Mean annual incidence (number per metric ton of catch) and average weight (kg) of king crab, *Lithodes* and *Paralithodes* spp., in the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands during 1977-78 by nation, vessel class, and area<sup>1</sup> (U.S. observer data).**

Year, nation, and vessel class	Area 1		Area 2		Area 3		Area 4	
	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.
1977								
Japan								
Mothership	0.434	1.58	0.144	1.22	—	—	—	—
Small stern trawler	6.656	0.70	3.234	0.54	—	—	0.465	1.38
Large surimi trawler	0.032	0.84	0.201	0.45	—	—	—	—
U.S.S.R.								
Large stern trawler	0.000	0.00	0.001	1.45	—	—	0.014	0.66
Republic of Korea								
Large stern trawler	0.306	1.54	0.081	0.40	—	—	—	—
1978								
Japan								
Mothership	0.505	1.94	0.160	1.29	—	—	—	—
Small stern trawler	4.734	0.69	9.391	0.41	—	—	4.270	1.07
Large surimi trawler	0.148	1.43	0.124	0.60	—	—	—	—
Large freezer trawler	0.046	2.70	0.000	0.00	—	—	—	—
Longline	0.654	0.80	—	—	—	—	1.670	0.87
U.S.S.R.								
Large stern trawler	0.248	2.12	0.001	1.35	—	—	0.354	0.36
Republic of Korea								
Large stern trawler	0.219	1.63	0.000	0.00	—	—	—	—

<sup>1</sup>U.S. statistical area (Fig. 7).

**Table 15.—The estimated incidental catch (numbers and metric tons) of king crab, *Lithodes* and *Paralithodes* spp., in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1977-78 by year, nation, and vessel class (U.S. observer data).**

Nation and vessel class	1977						1978					
	Eastern Bering Sea		Aleutian Islands		Totals		Eastern Bering Sea		Aleutian Islands		Totals	
	No.	t	No.	t	No.	t	No.	t	No.	t	No.	t
Japan												
Mothership	274,492	409.0	—	—	274,492	409.0	177,642	312.5	—	—	177,642	312.5
Small stern trawler	277,982	189.2	8,204	11.3	286,186	200.5	706,381	310.6	245,033	305.7	951,414	616.3
Large stern trawler	22,461	10.8	301	0.4	22,762	11.2	49,610	45.8	15,507	16.7	65,117	62.5
Longline <sup>1</sup>	—	—	—	—	—	—	6,546	5.1	4,496	3.9	11,042	9.0
U.S.S.R.												
Large stern trawler	364	0.5	840	0.5	1,204	1.0	23,792	50.7	5,240	2.1	28,969	52.8
Republic of Korea												
Large stern trawler	11,076	16.7	109	0.1	11,185	16.8	16,533	27.4	4,741	5.1	21,274	32.5
Longline <sup>1</sup>	—	—	—	—	—	—	—	—	37	T	37	T
Taiwan												
Small stern trawler	3,794	2.6	—	—	3,794	2.6	22,436	11.5	—	—	22,436	11.5
Annual totals	590,169	628.8	9,454	12.3	599,623	641.1	1,002,940	763.6	275,054	333.5	1,277,931	1,097.1

<sup>1</sup>There was no sampling by U.S. observers on longline vessels in 1977. Therefore, no estimates of incidental catch were made.

<sup>T</sup>T = Trace.

years except Area 4 during 1977, where the mean rate was 0.465 crab/t. An average incidence of 1.67 crabs/t from Japanese longliners which fished in Area 4 in 1978 was the only other instance in 1977 and 1978 where the annual mean for a vessel class within any area exceeded 0.7 crab/t. High incidence (>5.0 crab/t) of king crab was found on small Japanese stern trawlers along the 200 m contour from the Alaska Peninsula to lat. 61°N and in isolated areas along the Aleutian chain in 1977 and 1978 (Fig. 12). The concentrations of highest king crab incidence were located

north of lat. 58°30'N and south of lat. 56°30'N along the 200 m contour and along Bowers Ridge (lat. 53°30'-55°N by long. 179°W-178°E).

The total incidental king crab catch was estimated to be 599,623 crabs (641.1 t) in 1977 and 1,277,931 crabs (1,097.1 t) in 1978 (Table 15). The 113 percent increase in the incidental king crab catch in 1978 over that of 1977 was primarily due to an increase in incidence rates observed on small Japanese stern trawlers. Japanese small trawlers caught 47.7 percent of the total catch of incidental king crabs in 1977 and 74 percent of the incident-

tal catch in 1978, whereas the incidental catch in the Japanese mothership fishery composed 45.8 percent of the total in 1977 and only 14 percent of 1978's total catch. The increase in the proportion of the incidental king crab catch taken by the small trawlers was the result of the increased incidence of king crabs observed on these vessels in Areas 1 and 4. The decrease in the proportion of the catch due to motherships was not a result of a decreased incidence but the large increase in the incidental king crab catch as a result of the increased incidence on the small trawlers. The

1978 incidental king crab catch was found to be comprised of 72 percent golden king crab, *Lithodes aequispina*; 24.9 percent red king crab, *Paralithodes camtschatica*; and 3.1 percent blue king crab, *P. platypus*; with golden king crab the predominant species taken in all areas. Within the 1978 catch, the golden king crab averaged 0.6 kg, whereas the red king crab was found to average 1.9 kg and the blue king crab averaged 1.3 kg. There were no data available in 1977 to separate the king crab catch by species, but the average weight of king crabs caught was 1.2 kg.

The incidental catches of king crabs in 1977 and 1978 were larger than those estimated for 1973-76, when the incidental catch averaged about 374,500 crabs (Table 16). The absence of data from small trawlers for the years prior to 1977 was most likely the reason for the differences in the estimated levels of the king crab catch. During 1973-76, incidence rates observed on large Japanese trawlers were applied to the groundfish catches taken by the small trawlers, but those data were probably lower than the true rates on the small trawlers as indicated by observer sampling in 1977 and 1978.

### Pacific Salmon

The mean incidence of Pacific salmon by vessel class and area was generally low (<0.1 fish/t) in 1977 and 1978 (Table 17). The annual averages are deceptive, however; in both 1977 and 1978 observer sampling indicated that salmon incidence along

the continental slope (200 m contour) during the winter months (November through April) was roughly 24 times higher on Japanese vessels than during May through October. The average incidence on small Japanese stern trawlers during the November through April period was 0.245 fish/t in 1978; whereas during the remaining portion of the year, salmon incidence

averaged 0.011 fish/t. On large Japanese stern trawlers in 1978, the winter average was 0.092 fish/t compared with 0.004 fish/t during May through October. There was no sampling conducted by observers on small trawlers in January through April in 1977, but a high incidence of salmon was observed in December (0.568 fish/t) compared with the

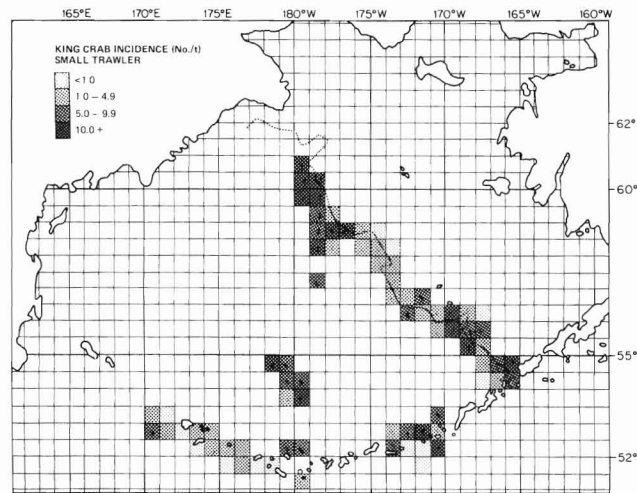


Figure 12.—The average incidence (no./t) of king crab, *Lithodes* and *Paralithodes* spp., on small Japanese stern trawlers during 1977-78 by 1/2° latitude and 1° longitude in the eastern Bering Sea and Aleutian Islands areas.

Table 17.—Mean annual incidence (number per metric ton of catch) and average weight (kg) of Pacific salmon, *Oncorhynchus* spp., in the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands during 1977-78 by nation, vessel class, and area<sup>1</sup> (U.S. observer data).

Year, nation, and vessel class	Area 1		Area 2		Area 3		Area 4	
	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.	Incidence	Avg. wt.
1977								
Japan								
Mothership	0.001	4.00	T <sup>2</sup>	4.56	—	—	—	—
Small stern trawler	0.054	4.09	0.081	5.22	—	—	0.000	0.00
Large surimi trawler	0.005	4.03	0.031	4.16	—	—	—	—
U.S.S.R.								
Large stern trawler	0.000	0.00	0.007	9.50	—	—	0.001	11.25
Republic of Korea								
Large stern trawler	0.05	3.92	0.224	3.61	—	—	—	—
1978								
Japan								
Mothership	0.004	0.95	T	6.00	—	—	—	—
Small stern trawler	0.062	2.98	0.083	3.75	—	—	0.012	2.56
Large surimi trawler	0.004	5.28	0.049	4.31	—	—	—	—
Large freezer trawler	0.001	9.20	0.054	1.60	—	—	—	—
Longline	0.000	0.00	—	—	—	—	0.000	0.00
U.S.S.R.								
Large stern trawler	0.001	7.37	0.012	3.93	—	—	0.000	2.28
Republic of Korea								
Large stern trawler	0.007	4.40	0.000	—	—	—	0.001	2.28

<sup>1</sup>U.S. statistical area (Fig. 7).

<sup>2</sup>T < 0.001 fish per metric ton of catch.

Table 16.—The estimated incidental catch of king crab, *Lithodes* and *Paralithodes* spp., in the foreign groundfish fishery in the eastern Bering Sea and Aleutian Islands region during 1973-78 (U.S. observer data)<sup>1</sup>.

Year	Incidental catch (no.)	Year	Incidental catch (no.)
1973	465,581	1976	386,765
1974	489,896	1977	599,623
1975	155,914	1978	1,277,931

<sup>1</sup>Estimates of the incidental catch of king crab for 1973-76 previously unpublished. Data on file with Foreign Fisheries Observer Program, Northwest and Alaska Fisheries Center, Natl. Mar. Fish. Serv., NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

warmer months (0 fish/t). On large Japanese trawlers, the average incidence during the winter of 1977 was 0.077 fish/t compared with the summer's average of 0.003 fish/t. During the winter and summer, there was no substantial change in the operation of the Japanese trawl fishery. Therefore, the great difference in the incidence of salmon in the trawl fishery between the two seasons indicates a seasonal change in the distribution of the salmon (predominantly chinook salmon, *O. tshawytscha*) in the eastern Bering Sea. The availability of maturing salmon would be reduced during the summer months, since these fish would be returning to spawning sites; however, little is known of the seasonal changes in distribution in the Bering Sea of the immature chinook salmon which were the predominant salmon taken in 1977 and 1978 by the foreign groundfish fishery. The incidence of salmon was low on Soviet vessels during both years (<0.012 fish/t). An average incidence of 0.224 fish/t was observed on Korean trawlers in Area 2 during 1977, but this high incidence was a result of a high incidental catch of approximately 160 salmon in 1 day during October. The salmon incidence in

1978 on Korean vessels was low (<0.01 fish/t).

The average incidence of salmon in foreign groundfish catches over 1977 and 1978 was shown by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude for small Japanese trawlers and for large trawlers (from all nations combined) in Figures 13 and 14. The highest rates of salmon incidence occurred on Japanese small trawlers along the 200 m contour from lat.  $56^\circ 30'$  to  $58^\circ 30'N$  and in the area located between lat.  $55^\circ 30' - 56^\circ 30'N$  by long.  $166^\circ - 169^\circ W$ . Salmon occurred throughout the year in groundfish catches made by large trawlers along the 200 m contour with the highest rates occurring north of lat.  $57^\circ N$ .

The total estimated incidental catch of 47,840 salmon (197.9 t) by foreign vessels in 1977 was slightly larger than the estimated incidental catch of 44,548 salmon (137.0 t) by foreign vessels in 1978 (Table 18). There was, however, a substantial difference in the nations and vessel classes responsible for the incidental salmon catch in the 2 years. In 1977, a low level of sampling on Korean vessels, but with a single instance of a high incidence rate, resulted in an estimated incidental catch of salmon by Korean vessels

of 23,798 fish or roughly 50 percent of the total catch. In contrast in 1978, 70 percent of the estimated incidental salmon catch was taken by small Japanese trawlers and only 3 percent by Korean vessels. In 1978, observer coverage of all types of vessels increased over that of 1977 in many areas and time periods. It was felt that the 1978 data may have been a more reliable measure of the distribution of the salmon catch by nation, area, and vessel class because of the increased level of sampling. There were no estimates made of the incidental salmon catch from 1973 through 1976, since during those years, sampling by observers for the incidence of salmon was sporadic, as the infrequent occurrence of salmon in the catches was considered insignificant compared with the incidence of Pacific halibut, snow crab, and king crab.

Chinook salmon, averaging 66 cm in fork length and 4.15 kg, composed 91 percent of the 1977 incidental salmon catch, and chum salmon, averaging 65 cm fork length and 3.87 kg, composed the remaining 9 percent of the catch. The incidental catch of salmon in 1978 was comprised of 87.8 percent chinook salmon of an average

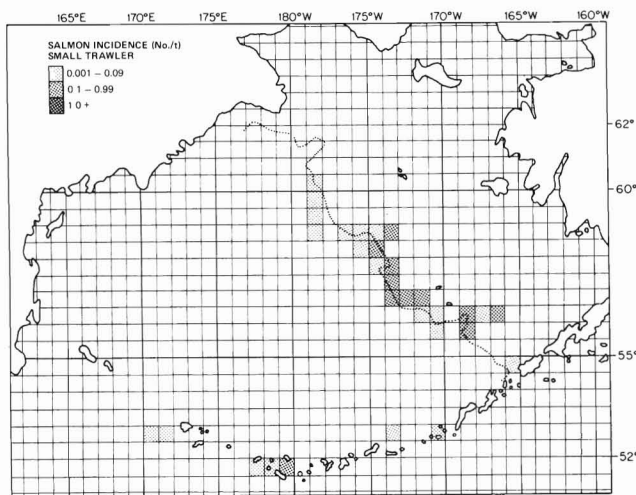


Figure 13.—The average incidence (no./t) of Pacific salmon, *Oncorhynchus* spp., on small Japanese stern trawlers during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Islands areas.

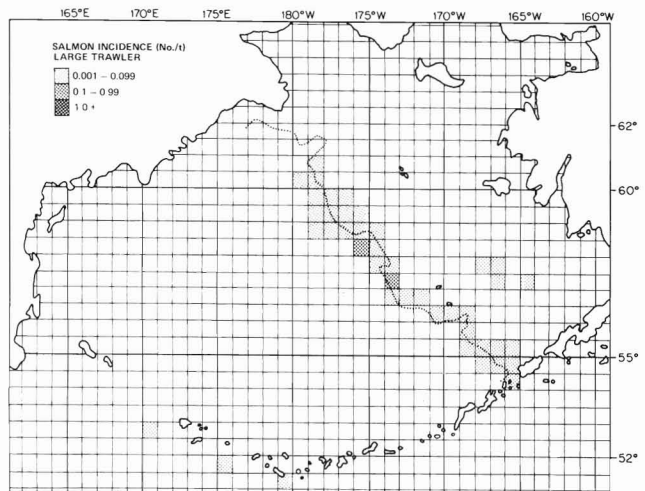


Figure 14.—The average incidence (no./t) of Pacific salmon, *Oncorhynchus* spp., on large stern trawlers (Japanese, Soviet, and Korean) during 1977-78 by  $\frac{1}{2}^\circ$  latitude and  $1^\circ$  longitude in the eastern Bering Sea and Aleutian Islands areas.



fork length of 64 cm and weight of 4.15 kg, 10.8 percent chum salmon averaging 63 cm in fork length and 3.65 kg, and the remaining 1.4 percent of the catch was made up of pink salmon, *O. gorbuscha*; sockeye salmon, *O. nerka*; and coho salmon, *O. kisutch*.

### Species Composition and Catch of Flatfish and Rockfish in the 1977-78 Foreign Groundfish Fishery

Estimates by species of the 1977-78 foreign catches of flatfish and rockfish in the eastern Bering Sea and Aleutian Islands region were made by applying the annual species composition (percentage of catch by weight) computed from U.S. observer data and stratified by nation, statistical area (Fig. 7), and vessel class to the corresponding total catches of flatfish and rockfish. Reported total catches of flatfish and rockfish were used with the 1977 observer data, and U.S. estimates of the all species catch of flatfish and rockfish were used with the 1978 data. Yellowfin sole and Pacific ocean perch, *Sebastes alutus*, allocations were given to foreign nations in both 1977 and 1978. Therefore, the reported catches of these two species were used for 1977, and the U.S. estimates of catch of yellowfin sole and Pacific ocean perch were used for 1978. In cases where no species composition data from observers were available, a judgment was made as to whether data from another nation, area, or vessel class would best reflect the expected composition of the catch of flatfish or rockfish for the data cell in question. In 1977 neither the Republic of Korea nor Taiwan were given catch allocations for flatfish. As a result, there were no official records of the catch of flatfish, although data were available from observer samples on Korean vessels as to which species of flatfish occurred in the catch.

#### Catch of Flatfish

In 1977 and 1978, 14 species of flatfish were identified in samples taken by observers from the foreign groundfish fishery but, during both years,

Table 18.—The estimated incidental catch (numbers and metric tons) of Pacific salmon, *Oncorhynchus* spp., in the eastern Bering Sea and Aleutian Islands foreign groundfish fishery during 1977-78 by year, nation, and vessel class (U.S. observer data).

Nation and vessel class	1977						1978					
	Eastern Bering Sea		Aleutian Islands		Totals		Eastern Bering Sea		Aleutian Islands		Totals	
	No.	t	No.	t	No.	t	No.	t	No.	t	No.	t
Japan												
Mothership	392	1.6	—	—	392	1.6	1,140	1.0	—	—	1,140	1.0
Small stern trawler	9,475	48.5	—	—	9,475	48.5	31,157	86.5	273	0.6	31,430	87.1
Large stern trawler	14,023	58.2	—	—	14,023	58.2	8,334	34.4	44	0.1	8,378	34.5
Longline	—	—	—	—	—	—	—	—	—	—	—	—
U.S.S.R.												
Large stern trawler	25	0.2	17	0.2	42	0.4	1,964	8.1	22	0.1	1,986	8.2
Republic of Korea												
Large stern trawler	23,798	88.6	—	—	23,798	88.6	1,368	5.4	13	T <sup>1</sup>	1,381	5.4
Longline	—	—	—	—	—	—	—	—	—	—	—	—
Taiwan												
Small stern trawler	110	0.6	—	—	110	0.6	233	0.8	—	—	233	0.8
Annual totals	47,823	197.7	17	0.2	47,840	197.9	44,196	136.2	352	0.8	44,548	137.0

<sup>1</sup>There was no sampling by U.S. observers on longline vessels in 1977. Therefore, no estimates of incidental catch were made.

<sup>2</sup>T = Trace.

three species were dominant within the catch (Table 19). In 1977, the catches of yellowfin sole; Greenland turbot, *Reinhardtius hippoglossoides*; and arrowtooth flounder, *Atheresthes stomias*; amounted to 89.6 percent of the total flatfish catch of 124,000 t. In 1978, these three species composed 92.1 percent of the 235,821 t of flatfish taken by foreign vessels in the eastern Bering Sea and Aleutian Islands region. Alaska plaice, *Pleuronectes quadrituberculatus*; flathead sole, *Hippoglossoides elassodon*; and rock sole, *Lepidopsetta bilineata*; accounted for most of the remaining catches of flatfish in both 1977 (10.1 percent) and 1978 (7.7 percent).

Yellowfin sole was the dominant species taken by foreign vessels in the eastern Bering Sea prior to 1963 (Forrester et al., 1978) but, after 1963, the catch of yellowfin sole by foreign vessels decreased owing to decreased abundance of the species. In 1977, 99.5 percent of the 58,524 t of yellowfin sole caught in the eastern Bering Sea was taken by Japanese vessels, whereas in 1978, the Soviets resumed a large fishery for yellowfin sole for the first time since 1971, accounting for 56.6 percent of the 137,638 t of yellowfin sole caught. The Japanese catch composed 43.4 percent of the 1978 catch of yellowfin sole. The total foreign catch of yellowfin sole in 1978 was the largest since 1971 and the level was com-

parable with catches landed by the foreign fleets between 1963 and 1971.

Small Japanese freezer trawlers operating along the continental slope and near the Aleutian Islands caught 67 percent of the Greenland turbot landed by foreign vessels in 1977 and 70 percent of the 1978 catch. The Greenland turbot fishery conducted by the Japanese small trawlers usually occurred at depths from 400 to 1,000 m. The remaining portion of the Greenland turbot catch is taken either as a by-catch in the walleye pollock and yellowfin sole fisheries or by longline vessels targeting on sablefish, *Anoplopoma fimbria*, and Greenland turbot in deep water (>500 m).

Arrowtooth flounder, Alaska plaice, flathead sole, and rock sole were generally taken as a by-catch while vessels were targeting on other species, although at times individual vessels may target on one or more of these four species specifically.

#### Catch of Rockfish

The combined catches of dusky rockfish; *Sebastes ciliatus*; northern rockfish, *S. polyspinis*; Pacific ocean perch; roughey rockfish, *S. aleutianus*; shortraker rockfish, *S. borealis*; and shortspine thornyhead, *Sebastolobus alascanus*; accounted for 99.8 percent of the foreign rockfish catches in the eastern Bering sea and Aleutian Islands in 1977 and 97.8 percent of the rockfish catches in

1978 (Table 20). The remaining catches of rockfish during the 2 years were comprised of 17 different species that were identified by observers, but the identification and occurrence of some of these species had not previously been reported and, therefore, may be questionable.

Among the six species of rockfish which were predominant in the 1977 catches, Pacific ocean perch accounted for 48.8 percent of the total rockfish catch and was the dominant species taken in all areas. Northern rockfish (25.6 percent), dusky rockfish (13.3 percent), and rougheye rockfish (9.9 percent) were also important in 1977 with large catches of northern and dusky rockfish being taken in the Aleutian area and roughly equal proportions of rougheye rockfish taken.

The catch of rockfish in 1978 was more diversified than that of 1977. Shortraker rockfish composed 34.8 percent of the catch but were mainly caught in the eastern Bering Sea areas by small Japanese trawlers in conjunction with the deepwater (>300 m) fishery for Greenland turbot. Pacific ocean perch, which composed 26.4 percent of the catches in 1978, were taken in both the eastern Bering Sea areas and Aleutian area but were predominant in the Aleutian area, where they were the dominant species of rockfish taken at depths less than 400 m. Northern and rougheye rockfish (13.8 percent and 12.6 percent, respectively) were also important in the 1978 catch with the largest proportion of the catches of each of these species taken in the Aleutian area. In the Aleutian area, northern rockfish were generally taken in fishing operations conducted at depths less than 200 m, whereas rougheye rockfish were taken at depths greater than 200 m. Rougheye was the dominant rockfish caught at depths greater than 400 m. Ten percent of the 1978 rockfish catch was shortspine thornyhead, mainly caught at depths greater than 400 m in the eastern Bering Sea and was the main species of rockfish found in catches taken by Japanese longliners.

Table 19.—The estimated catch (in metric tons) of flatfish, order *Pleuronectiformes*, by species taken by the foreign groundfish fisheries in the eastern Bering Sea and Aleutian Islands during 1977-78 (U.S. observer data).

Species	1977				1978			
	E. Bering Sea	Aleutian Islands	Total	Percent	E. Bering Sea	Aleutian Islands	Total	Percent
Alaska plaice, <i>Pleuronectes quadrituberculatus</i>	3,498.5		3,498.5	2.8	10,043.2		10,043.2	4.2
Arrowtooth flounder (turbot) <i>Atheresthes stomias</i>	11,141.7	3,505.4	14,647.1	11.8	13,186.0	1,812.0	14,998.0	6.4
Bering flounder, <i>Hippoglossoides robustus</i>					41.3	0.1	41.4	T
Deep-sea sole, <i>Embassichthys bathybis</i>	1.2		1.2	T <sup>1</sup>	11.1	6.5	17.6	T
Dover sole, <i>Microstomus pacificus</i>	0.6		0.6	T	64.4	27.1	91.5	T
Flathead sole, <i>Hippoglossoides elassodon</i>	6,456.4	60.6	6,517.0	5.2	6,355.4	2.3	6,357.7	2.7
Greenland turbot, <i>Reinhardtius hippoglossoides</i>	36,410.9	1,549.7	37,960.6	30.6	56,243.9	8,240.3	64,484.2	27.3
Pacific sandbar, <i>Citharichthys sordidus</i>	10.7		10.7	T	7.9	3.1	11.0	T
Petrale sole, <i>Eopsetta jordani</i>	0.6		0.6	T	173.2	1.5	174.7	0.1
Rex sole, <i>Glyptocephalus zachirus</i>	146.0	67.2	213.2	0.2	122.7	16.7	139.4	T
Rock sole, <i>Lepidopsetta bilineata</i>	2,335.0	271.2	2,606.2	2.1	1,553.5	222.6	1,776.1	0.8
Roughscale sole, <i>Clidoderma asperimum</i>						0.3	0.3	T
Starry flounder, <i>Platichthys stellatus</i>	28.1		28.1	T	41.3	2.9	44.2	T
Yellowfin sole, <i>Limanda aspera</i>	58,423.7	100.0	58,523.7	47.2	136,896.4	741.3	137,637.7	58.4
Annual total	118,453.4	5,554.1	124,007.5	299.9	224,740.3	11,080.7	235,921.0	299.9

<sup>1</sup>T = <0.1 metric tons.

<sup>2</sup>0.1 percent due to catch of species occurring in trace quantities.

Japanese vessels landed 86.6 percent (19,058.6 t) of the total rockfish catch in 1977 and 95.7 percent (27,234 t) of the 1978 catch. Within the Japanese fleet, the small stern trawlers accounted for the major portion of the catch by landing 77 percent of the total rockfish catch in 1977 and 87 percent in 1978. The catches of rockfish by nations other than Japan were restricted by small allocation; therefore, rockfish were only taken as a by-catch in fisheries for walleye pollock, yellowfin sole, or Atka mackerel.

### Summary

#### The Foreign Fisheries Observer

Program provides a means for monitoring the foreign fisheries and for the collection of a wide variety of fisheries data from foreign vessels in the eastern Bering Sea and Aleutian Islands region which were needed for the management of the fisheries resources placed under U.S. jurisdiction by the Fishery Conservation and Management Act of 1976. Foreign vessels have annually harvested more than 1 million t of groundfish from the eastern Bering Sea and Aleutian Islands region since 1968. The foreign fishery in this region was begun in 1933 when Japan initiated a fishery, and since that time the U.S.S.R., Republic of Korea, and Taiwan have also developed fisheries.

Table 20.—The estimated catch (metric tons) of rockfish, *Sebastes* and *Sebastolobus* spp., by species taken by the foreign groundfish fisheries in the eastern Bering Sea and Aleutian Islands during 1977-78 (U.S. observer data).

Species	1977				1978			
	E. Bering Sea	Aleutian Islands	Total	Percent	E. Bering Sea	Aleutian Islands	Total	Percent
Dusky rockfish, <i>Sebastes ciliatus</i>	3.1	2,932.9	2,936.0	13.3	56.5	11.3	67.8	0.2
Northern rockfish, <i>S. polyspinis</i>	321.7	5,311.2	5,632.9	25.6	147.6	3,781.9	3,929.5	13.8
Pacific ocean perch, <i>S. alutus</i>	2,654.2	8,079.9	10,734.1	48.8	2,221.4	5,285.7	7,507.1	26.4
Rougheye rockfish, <i>S. aleutianus</i>	1,043.6	1,127.6	2,171.2	9.9	660.2	2,938.4	3,598.6	12.6
Shortraker rockfish, <i>S. borealis</i>	1.4	102.9	104.3	0.5	8,800.2	1,094.6	9,894.8	34.8
Shortspine thornyhead, <i>Sebastolobus alascanus</i>	292.2	89.1	381.3	1.7	2,288.8	546.8	2,835.6	10.0
Other rockfish <sup>1</sup>	15.6	23.7	39.3	0.2	269.1	364.3	633.4	2.2
Annual total	4,331.8	17,667.3	21,999.1	100.0	14,443.8	14,023.0	28,466.8	100.0

<sup>1</sup>The group "Other rockfish" is made up of the following: Black rockfish, *Sebastes melanops*; Blue rockfish, *S. mystinus*; Bocaccio, *S. paucispinis*; Dark blotched rockfish, *S. crameri*; Harlequin rockfish, *S. variegatus*; Longspine thornyhead, *Sebastolobus altivelis*; Redbanded rockfish, *Sebastes babcocki*; Redstripe rockfish, *S. proriger*; Rosethorn rockfish, *S. helvomaculatus*; Sharpchin rockfish, *S. zacentrus*; Silvergray rockfish, *S. brevispinis*; Splittnose rockfish, *S. diploproa*; Vermilion rockfish, *S. miniatus*; Widow rockfish, *S. entomelas*; Yelloweye rockfish, *S. ruberrimus*; Yellowmouth rockfish, *S. reedi*; and Yellowtail rockfish, *S. flavidus*. These species were identified by observers during 1977-78. Within this group, the possibility of misidentification exists and the occurrence of species not previously reported from the eastern Bering Sea and Aleutian Islands should be noted with caution.

Prior to the passage of the FCMA, the Observer Program was mainly used to collect data on the incidental catches of Pacific halibut, snow crab, and king crab in the foreign groundfish fishery. Sampling had been conducted by invitation of the host nation by observers on Japanese ships since 1973 and on Soviet vessels since 1975. Under the management authority provided by the FCMA, the Observer Program's objectives were expanded to include the collection of data needed to estimate the foreign catch of groundfish and the incidental catches of Pacific halibut, snow crab, king crab, and salmon; the collection of biological data on important commercial species for use in stock assessment; and to report on suspected violations of U.S. fishing regulations.

During 1977 and 1978, 122 fisheries observers sampled on 128 different foreign vessels, resulting in observer coverage of 5.6 percent of the total foreign groundfish effort in 1977 and 8.7 percent of the foreign effort in 1978. From the data collected by observers, it was estimated that 1.29 million t of groundfish were caught by foreign vessels in 1977 and that 1.38 million t were caught in 1978. Walleye pollock was the dominant

species taken by all nations during both years, accounting for 75 percent of the 1977 groundfish catch and 78.7 percent of the catch in 1978. Other species or groups of species important in the catch were yellowfin sole, other flounders, Pacific cod, and Atka mackerel. Japanese vessels harvested the largest portion of the catch, landing 1.12 million t in 1977 and 1.09 million t in 1978. The U.S.S.R. conducted the second largest fishery during both years, and the Republic of Korea and Taiwan also fished during both years; however, catches made by these two nations were substantially less than those made by Japan and the U.S.S.R.

The data collected by observers on the incidence (number caught/t of groundfish) of Pacific halibut, king crab, snow crab, and salmon resulted in an incidental catch in 1977 estimated to be 344,973 Pacific halibut (1,453.3 t); 17,592,838 snow crab (3,727.8 t); 599,623 king crab (641.1 t); and 47,840 salmon (197.7 t). In 1978, the estimated incidental catches were: 599,852 Pacific halibut (2,852.7 t); 17,306,064 snow crab (4,267.4 t); 1,277,931 king crab (1,097.1 t); and 44,548 salmon (137.0 t).

From data collected by observers on the composition of the foreign catch, it was estimated that three species of flatfish accounted for 89.6 percent of the 124,008 t of flatfish caught in 1977 and 92.1 percent of the 235,821 t of flatfish caught in 1978. The three important species of flatfish were yellowfin sole, Greenland turbot, and arrowtooth flounder. The combined catches of dusky rockfish, northern rockfish, Pacific ocean perch, rougheye rockfish, shortraker rockfish, and shortspine thornyhead accounted for 99.8 percent of the foreign rockfish catch in 1977 and 97.8 percent in 1978. The results of these data along with those from succeeding years will have continued importance, as management decisions are made on the impact of domestic and foreign fisheries on the fisheries resources of this region.

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