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Trawl Survey
of Groundfish Resources
in the Gulf of Alaska,
Summer 1978

Gene C. Feldman
and
Craig S. Rose

August 1981

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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by

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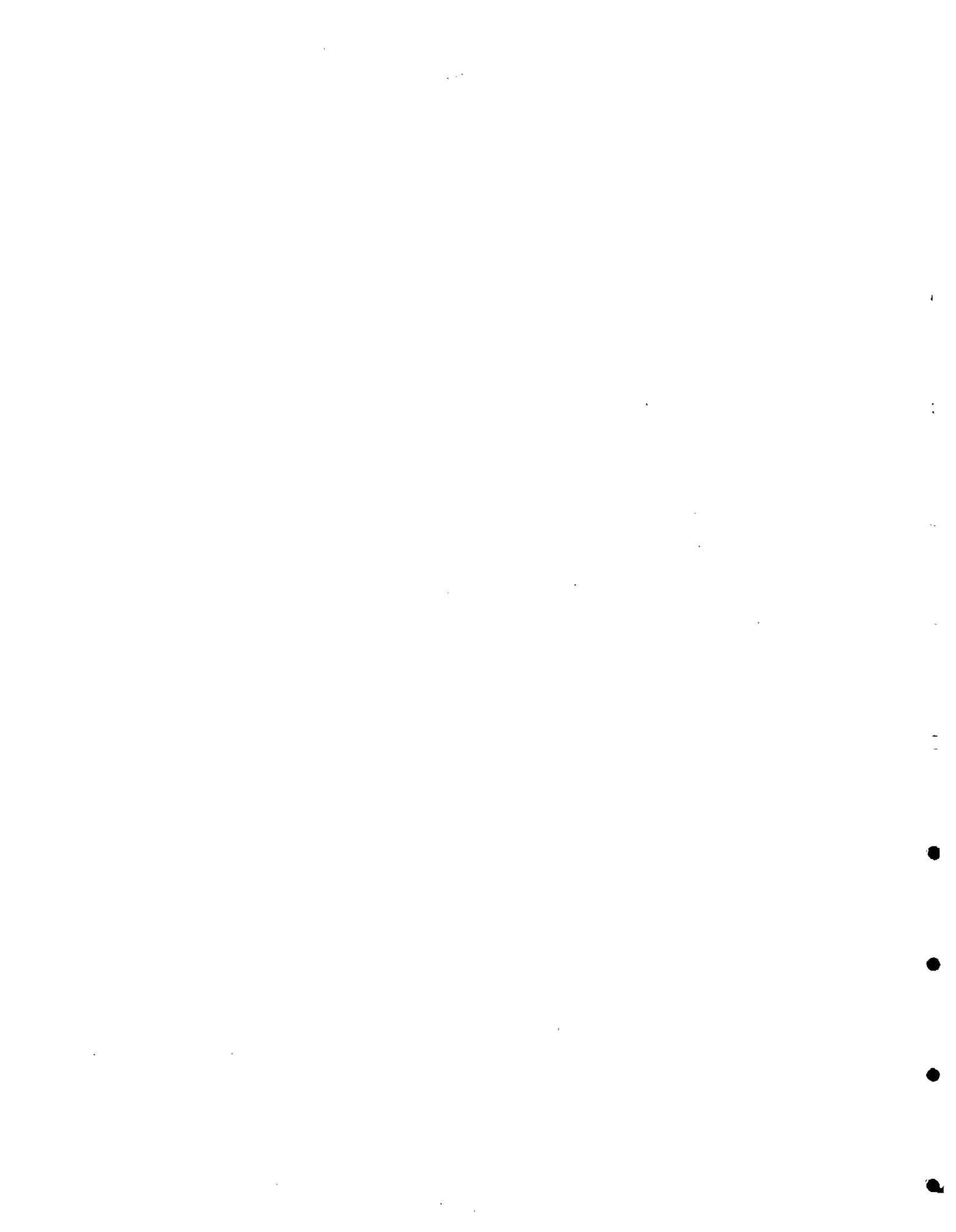
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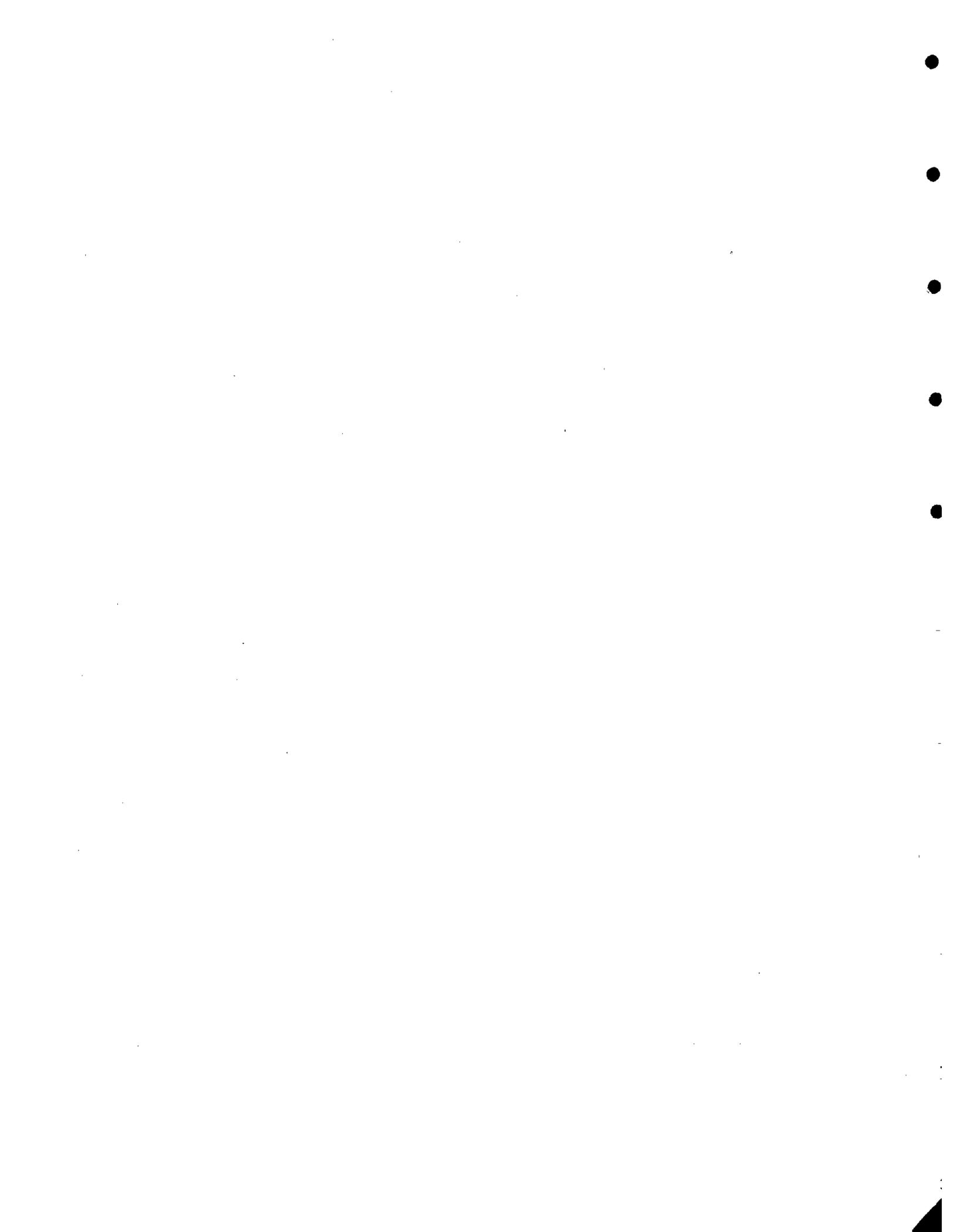
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ABSTRACT

The results of a resource assessment survey of groundfish in the eastern and central Gulf of Alaska are presented with emphasis on data most relevant to the needs of the commercial fishing industry. Species encountered in highest abundance include walleye pollock, Theragra chalcogramma, and Pacific cod, Gadus macrocephalus, in the vicinity of Kodiak Island, as well as several species of rockfish, Sebastes spp., off southeastern Alaska. Information on principal species occurring in the catches includes catch rates, depth distributions, size compositions, and locations of highest catch rates.



INTRODUCTION

During the summer and fall of 1978, the Northwest and Alaska Fisheries Center, Seattle, of the National Marine Fisheries Service (NMFS) conducted a comprehensive groundfish survey of the eastern and central Gulf of Alaska. This survey was part of the NMFS Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program which provides data to meet the needs of fishery management and the U.S. fishing industry. The principal objectives of the survey were to obtain data on the distribution, relative abundance, and size-sex-age composition of the rockfish, Sebastes spp., and walleye pollock, Theragra chalcogramma, stocks within the survey area.

In the past, exploitation of the groundfish stocks of the Gulf of Alaska has been carried primarily out by the distant water fleets of foreign nations, particularly those of Japan and the Soviet Union, which have been active since the early 1960s. A general summary of recent foreign fishery catches in the survey area is presented by International North Pacific Fishery Commission (INPFC) statistical areas (Fig. 1, Table 1). The most productive area in the Gulf was the Kodiak area where the catch was primarily made up of walleye pollock and rockfish. In the Kodiak area, a Soviet fishery for Atka mackerel, Pleurogrammus monopterygius, made up a major portion of the catch for species other than pollock, rockfish, and flatfish. In the Chirikof area, the catch composition was similar to the Kodiak area; however, in the Yakutat and Southeastern Alaska areas, rockfish made up the major portion of the catch and the pollock landings were greatly reduced. The Japanese and Korean longline sablefish catch contributed a large portion to the catch in the "other" species category in these areas.

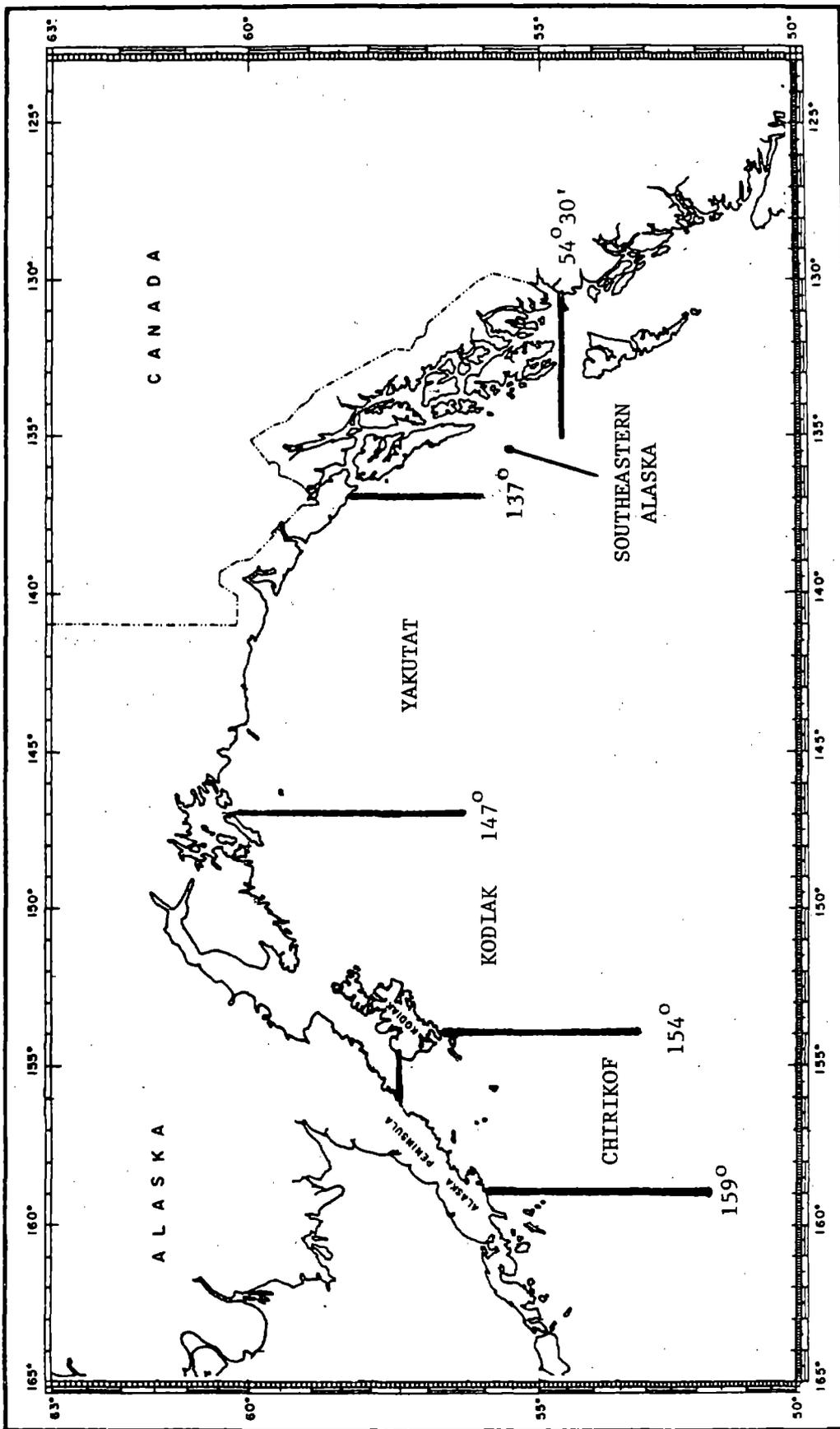


Figure 1.--Area of 1978 groundfish survey and INPFC regional divisions.

Table 1.--Foreign fisheries catches from survey area by INPFC regions, 1973-77.

Year and type of fish	INPFC Region				Total
	Chirikof	Kodiak	Yakutat	Southeastern	
-----Metric tons (thousands)-----					
<u>1973</u>					
Flatfish	3.1	3.4	5.6	6.7	18.8
Rockfish	7.2	13.5	20.2	15.5	56.4
Pollock	9.1	21.0	1.7	2.7	34.5
Others	<u>11.9</u>	<u>15.2</u>	<u>11.6</u>	<u>3.7</u>	<u>42.4</u>
Total	31.3	53.1	39.1	28.6	152.1
<u>1974</u>					
Flatfish	1.7	2.7	1.6	0.1	6.1
Rockfish	6.7	16.6	14.5	11.9	49.7
Pollock	8.7	38.4	3.2	0.7	51.0
Others	<u>4.7</u>	<u>14.2</u>	<u>9.1</u>	<u>9.6</u>	<u>37.6</u>
Total	21.8	71.9	28.4	22.3	144.4
<u>1975</u>					
Flatfish	0.2	3.2	1.0	0.3	4.7
Rockfish	5.7	21.3	12.9	10.9	50.8
Pollock	6.9	33.5	2.4	0.2	43.0
Others	<u>4.6</u>	<u>38.6</u>	<u>10.1</u>	<u>7.7</u>	<u>61.0</u>
Total	17.4	96.6	26.4	19.1	159.5
<u>1976</u>					
Flatfish	1.0	1.2	1.2	0.5	3.9
Rockfish	4.1	10.6	13.1	12.6	40.4
Pollock	17.6	26.1	2.0	0.1	45.8
Others	<u>8.4</u>	<u>29.7</u>	<u>11.7</u>	<u>9.0</u>	<u>58.8</u>
Total	31.1	67.6	28.0	22.2	148.9
<u>1977</u>					
Flatfish	2.6	5.4	5.2	4.2	17.4
Rockfish	3.3	6.1	6.1	5.4	20.9
Pollock	27.7	28.2	6.3	1.4	63.6
Others	<u>4.8</u>	<u>23.2</u>	<u>6.2</u>	<u>3.2</u>	<u>37.4</u>
Total	38.4	62.9	23.8	14.2	139.3

Source: Catch reports from foreign governments.

The domestic groundfish fishery in the survey area has been comparatively small (Table 2) with the exception of the U.S./Canada fishery for Pacific halibut, Hippoglossus stenolepis. As a consequence of congressional enactment

of the Magnusson Fishery Conservation and Management Act of 1976 which gives domestic interests priority in the exploitation of these resources, U.S. fishermen will be taking a larger portion of the catch in the future.

The survey described in this report was a continuation of the MARMAP research program into the distribution and condition of the groundfish resource in the Gulf of Alaska. From 1948 to 1970, exploratory fishing cruises were conducted to locate commercially important concentrations of fish and shellfish throughout the Gulf of Alaska. The first large-scale, systematic assessment of the groundfish resources was a trawl survey carried out by the International Pacific Halibut Commission, with the cooperation of the U.S. Bureau of Commercial Fisheries (BCF), in 1961 and 1962. Later, during 1973-76, the National Marine Fisheries Service, successor to the BCF, again conducted a series of resource assessment surveys in the area. Descriptions and results of both the exploratory fishing and resource assessment surveys were reported by Ronholt, Shippen, and Brown (1978a, 1978b, 1978c, and 1978d).

SURVEY METHODS AND GEAR

The 1978 rockfish-pollock survey was conducted using four vessels--two NMFS chartered vessels (Heidi-J and Nore-Dick), the NOAA research vessel Miller Freeman, and a vessel chartered by the Canadian Fisheries and Marine Service (Freeport) (Table 3). The Freeport operated only in the Dixon Entrance to Cape Ommaney area, the Miller Freeman in the Kodiak to Cape St. Elias area, while the Nore-Dick and Heidi-J operated over the entire survey area, from Dixon Entrance to Chirikof Island.

Table 2.--Domestic catches from survey area by INPFC regions, 1973-77.

Year and type of fish	INPFC Region				Total
	Chirikof	Kodiak	Yakutat	Southeastern	
-----Metric tons (thousands)-----					
<u>1973</u>					
Halibut	1,742	4,501	1,622	2,711	10,576
Other flatfish	2	48	1	399	450
Rockfish	5	60	-	46	111
Cod	-	23	4	31	58
Sablefish	1	16	3	846	866
Other	-	8	6	36	50
Total	<u>1,750</u>	<u>4,656</u>	<u>1,636</u>	<u>4,069</u>	<u>12,111</u>
<u>1974</u>					
Halibut	636	2,473	1,241	2,693	7,043
Other flatfish	-	-	-	-	-
Rockfish	-	14	21	52	87
Cod	4	71	2	67	144
Sablefish	-	-	2	777	779
Other	<u>138</u>	<u>174</u>	<u>2</u>	<u>266</u>	<u>580</u>
Total	<u>778</u>	<u>2,732</u>	<u>1,268</u>	<u>3,855</u>	<u>8,633</u>
<u>1975</u>					
Halibut	913	2,947	1,862	2,969	8,691
Other flatfish	-	2	-	-	2
Rockfish	-	<.5	8	86	94.5
Cod	42	40	10	34	126
Sablefish	-	<.5	115	973	1,088.5
Other	<u>1</u>	<u>13</u>	<u>3</u>	<u>32</u>	<u>49</u>
Total	<u>956</u>	<u>3,003</u>	<u>1,998</u>	<u>4,094</u>	<u>10,051</u>
<u>1976</u>					
Halibut	970	3,072	1,938	2,577	8,557
Other flatfish	-	24	-	129	153
Rockfish	2	-	5	119	126
Cod	53	96	6	49	204
Sablefish	-	-	5	798	803
Other	-	<u>128</u>	<u>5</u>	<u>85</u>	<u>218</u>
Total	<u>1,025</u>	<u>3,320</u>	<u>1,959</u>	<u>3,757</u>	<u>10,061</u>
<u>1977</u>					
Halibut	870	2,725	1,195	1,527	6,317
Other flatfish	-	14	-	670	684
Rockfish	-	-	16	138	154
Cod	17	140	6	54	217
Sablefish	-	2	147	673	822
Other	-	<u>146</u>	<u>33</u>	<u>211</u>	<u>390</u>
Total	<u>887</u>	<u>3,027</u>	<u>1,397</u>	<u>3,273</u>	<u>8,584</u>

Source: Pacific Marine Fisheries Commission bottom or trawl fish data series.

Table 3.--Vessel and operation specifications for the 1978 rockfish-pollock survey.

Ship	Length (m)	Power (bhp)	Stations trawled	Months worked	Areas worked
<u>Miller Freeman</u>	65.5	2,150	63	Sept-Nov	Kodiak-Yakutat
<u>Nore-Dick</u>	23.8	500	99	July-Sept	SE-Chirikof
<u>Heidi-J</u>	26.2	565	104	July-Sept	SE-Chirikof
<u>Freeport</u>	24.1	565	39	July-Aug	Southeastern

All sampling during the survey was conducted with the 90'/105' Nor'eastern high-opening trawl equipped with roller gear (Fig. 2, Table 4). This trawl was chosen because of its capacity to sample fish which school slightly above the bottom and often over rough terrain (i.e., rockfish and pollock). This gear is less effective in sampling bottom-dwelling species such as flatfish, a factor which should be taken into account when considering the data on these species.

Table 4.--Rigging and roller gear used during the 1978 rockfish-pollock survey.

Type of gear	Description
Floats	22, 30.5 cm (12 in) plastic
Roller gear	(a) 5, 35.6 cm (14 in) half-egg bobbins along each wing (b) 8, 45.7 cm (18 in) half-egg bobbins across bosom
Danleno assembly	35.6 cm (14 in) bobbin with 35.6 cm butterfly
Sweep wire length	54.9 m (30 fm)
Trawl doors	635 kg (1400 lb) each, 1.5 x 2.1 m (5 ft x 7 ft), rectangular, steel, V-type doors

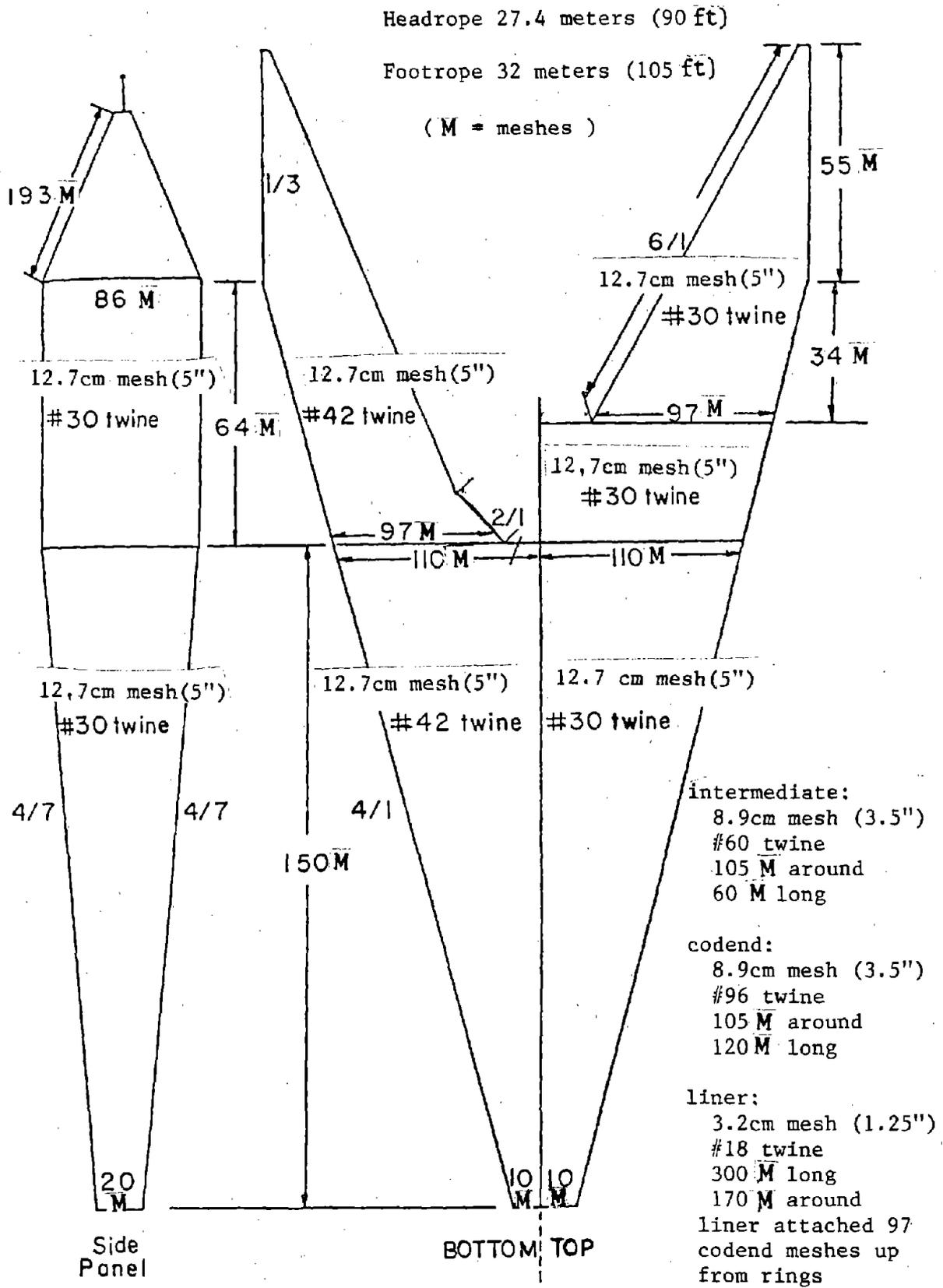


Figure 2.--Schematic diagram of the Nor'easter net.

A random stratified survey pattern was used throughout the survey. Tracklines were established perpendicular to the 30-fathom (55 m) contour at 10-nautical mile (nmi) (18.5 km) intervals starting at Dixon Entrance in southeastern Alaska. Sampling was conducted between 30-250 fm (55-457 m). This range was divided into four depth strata with the number of sampling stations in each stratum dependent on the length of the trackline over its depth range. At least one station per stratum was planned with an additional station added for: each 20 nmi of trackline for strata shallower than 100 fm (183 m) west of long. 147°W, each 10 nmi for shallow strata east of long. 147°W, and each 5 nmi for all strata deeper than 100 fm. The location of each station along the trackline was randomly selected within the strata. Undersea canyons over 10 nmi (18.5 km) were treated as separate sampling areas with tracklines established across the canyon at 10 nmi (18.5 km) intervals starting at the mouth. Sampling stations were selected using the same methods as for the shelf areas. Many stations were located in areas considered only marginally trawlable but were sampled as long as there appeared to be even the slightest chance for successfully completing the tow. This was necessary to minimize bias in the sampling, since rockfish are often most abundant in these areas.

Before the gear was set, each station was surveyed with the echo sounder to determine whether or not the bottom was suitable for trawling. If it appeared untrawlable, an additional half hour was allowed to search for trawlable bottom within a 1 nmi (1.85 km) radius around the station. If the vessel was unable to locate trawlable bottom within the time allotted, it would proceed to the next station. Once trawlable bottom was found, the vessel would set the gear and tow, usually for 30 minutes. Only good performance tows, those that were completed without damaging the gear, were counted in the survey results and used for analysis.

After a tow was completed and the catch brought on board, the catch was sorted by species and the components weighed and counted. Biological observations were taken on the principal groundfish species and included length-frequency measurements, age structures, length-weight relationships, and tissue samples for genetic studies. Fork length, measured from the tip of the snout to the midpoint of the tail, was used as the length measurement for all species.

DATA ANALYSIS AND PRESENTATION

For presentation in this report, the results of the 1978 rockfish-pollock survey have been analyzed by INPFC statistical areas. Each INPFC area was further subdivided into five depth intervals or strata (Table 5). Species composition, mean catch rates, size composition, and positions of large catches are presented for each area and depth strata for which data are available. Mean catch rates are calculated by standardizing each catch to one hour of fishing effort, summing the catches and dividing by the number of tows:

$$\text{Catch Per Hour (CPUE)} = \frac{\text{Catch (60)}}{\text{minutes fished}}$$

$$\text{Mean CPUE} = \frac{\sum \text{CPUE'S}}{\text{No. of tows (n)}}$$

Table 5.--Depth strata used in analysis.

Stratum	Depth Range	
	Meters	Fathoms
I	0-100	0-54
II	101-200	55-109
III	201-300	110-164
IV	301-400	165-218
V	401-500	219-273

The size composition graphs are designed to show the proportion of the population greater than any selected minimum length (Fig. 3). The proportion of the catch from an area or depth strata larger than a minimum acceptable size can be determined by tracing straight up or down from the selected length on the horizontal axis to the appropriate graph line, then moving straight across to the vertical axis and read off the proportion. In the example shown in Figure 3, the proportion of fish greater than 30 cm (11.8 in) in Strata II is 25%. The largest and smallest fish occurring are indicated by the points where the graph line crosses the 0% and 100% lines, 36 cm and 17 cm, respectively, (14 in and 7 in).

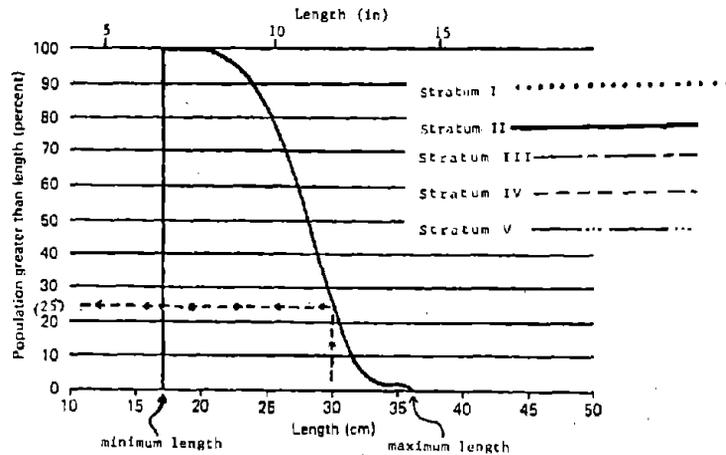


Figure 3.--Example of a size composition graph.

RESULTS

Southeastern Alaska Region

The INPFC southeastern Alaska region, extending from Dixon Entrance to Cape Spencer (Fig. 1), was sampled by 74 successful stations with 91% of the sampling effort in water deeper than 150 m (82 fm) (Fig. 4). The catch rates

and species composition data will not be representative for species caught in water shallower than 150 m due to the relatively small number of samples taken.

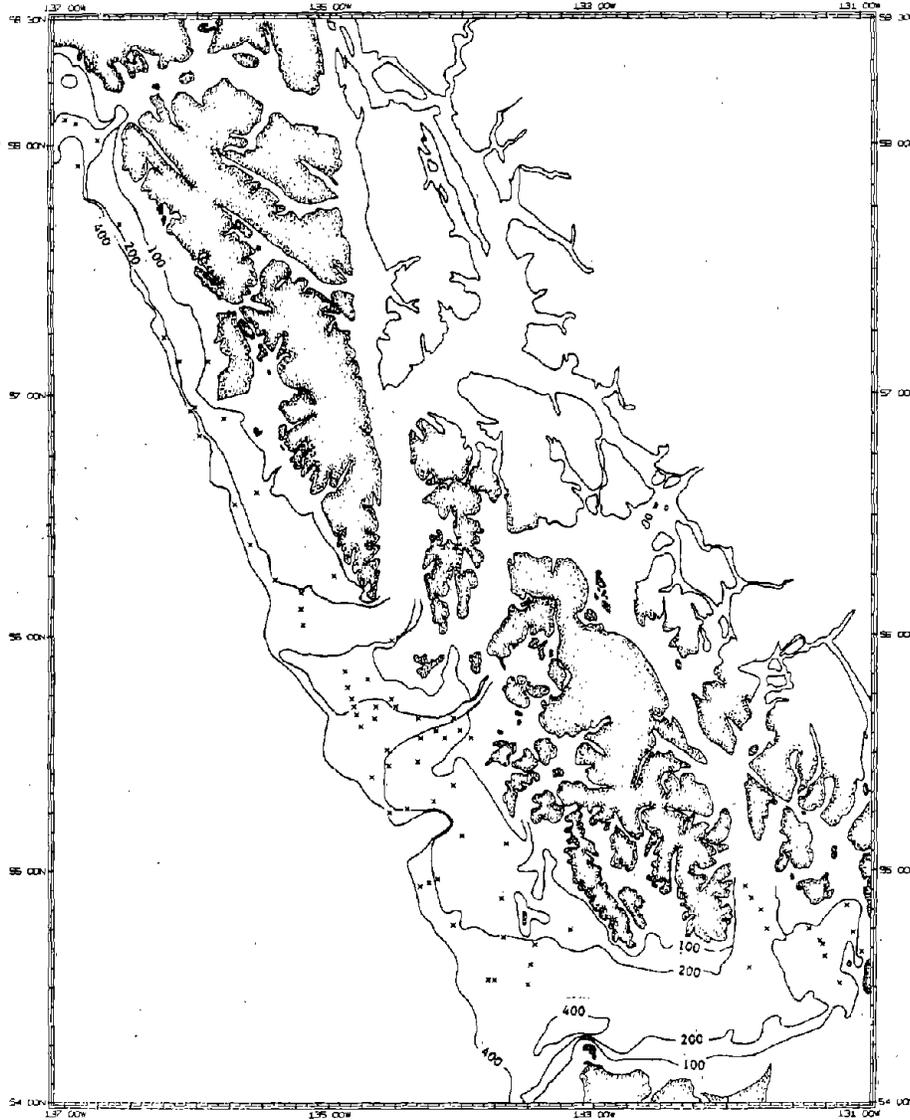


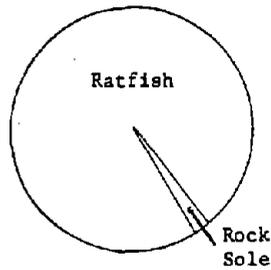
Figure 4.--Stations successfully completed in the INPFC southeastern Alaska region, July-August 1978.

Fifty-seven fish species were encountered within this region. The rockfish group, of which 21 species were captured, had the highest mean catch rate in all depths, except the 0-110 and 401-500 m depth zone, and accounted for nearly 68% of the total catch (Fig. 5). Of the rockfish caught in the Southeastern region, harlequin rockfish, Sebastes variegatus, had the highest mean catch rate and made up 14% of the total catch, followed by Pacific ocean perch, S. alutus, (13%); silvergray rockfish, S. brevispinis, (11%); sharpchin rockfish, S. zacentrus, (10%); and the redstripe rockfish, S. proriger, (7%) (Table 6). Other abundant species included the arrowtooth flounder, Atheresthes stomias, which made up 13% of the total catch, followed by Dover sole, Microstomus pacificus, (4%); sablefish, Anoplopoma fimbria, (4%); Pacific halibut (3%); and walleye pollock (1%).

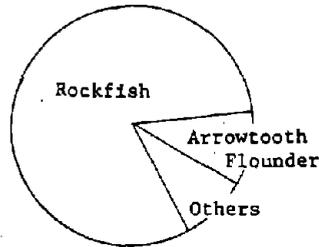
Table 6.--Composition of the rockfish catch in the INPFC Southeastern Alaska region.

Species	Percentage	Species	Percentage
Harlequin rockfish	21	Shortraker rockfish	1
Pacific ocean perch	19	Yellowtail rockfish	-
Silvergrey rockfish	16	Canary rockfish	-
Sharpchin rockfish	15	Redbanded rockfish	-
Redstripe rockfish	10	Rosethorn rockfish	-
Rougheye rockfish	7	Dusky rockfish	-
Yellowmouth rockfish	3	Yelloweye rockfish	-
Shortspine thornyhead	3	Darkblotched rockfish	-
Stripetail rockfish	2	Greenstriped rockfish	-
Black rockfish	1	Widow rockfish	-

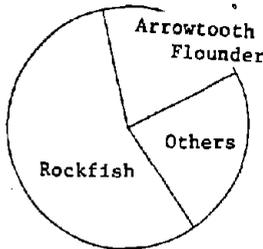
Harlequin rockfish was the most abundant fish species encountered in this region. Most of these fish were taken in three large catches (Heidi-J, hauls 20, 28, and 32) at depths near 185 m (101 fm), which averaged 1,338 kg/hr



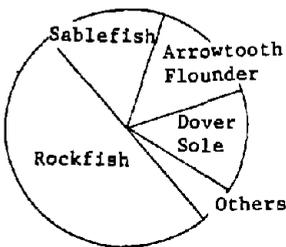
0-100 meters		1 station
Species	Catch per Unit	Effort (kg/hr)
Ratfish	59	
Rock Sole	1	60



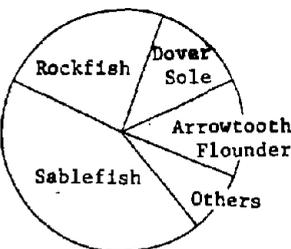
101-200 meters		29 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	476	
Arrowtooth Flounder	59	
Pacific Halibut	15	
Ratfish	14	
Rex Sole	6	
Other Species	17	587



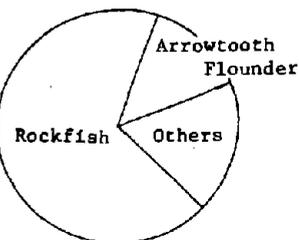
210-300 meters		31 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	155	
Arrowtooth Flounder	58	
Pacific Halibut	11	
Dover Sole	11	
Walleye Pollock	99	
Other Species	33	277



301-400 meters		8 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	242	
Sablefish	76	
Arrowtooth Flounder	75	
Dover Sole	70	
Rex Sole	14	
Other Species	8	485



401-500 meters		5 stations
Species	Catch per Unit	Effort (kg/hr)
Sablefish	61	
Rockfish Group	33	
Dover Sole	18	
Arrowtooth Flounder	18	
Rex Sole	3	
Other Species	9	142



All Depths		74 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	280	
Arrowtooth Flounder	57	
Dover Sole	15	
Sablefish	15	
Pacific Halibut	10	
Other Species	22	409

Figure 5.--Catch composition by depth strata - INPFC southeastern Alaska region.

(2,949 lb/hr) (Figure 6). Harlequin rockfish ranged in size from 17-36 cm (7-14 in), with only 2% of the fish longer than 35 cm (14 in) (Fig. 7).

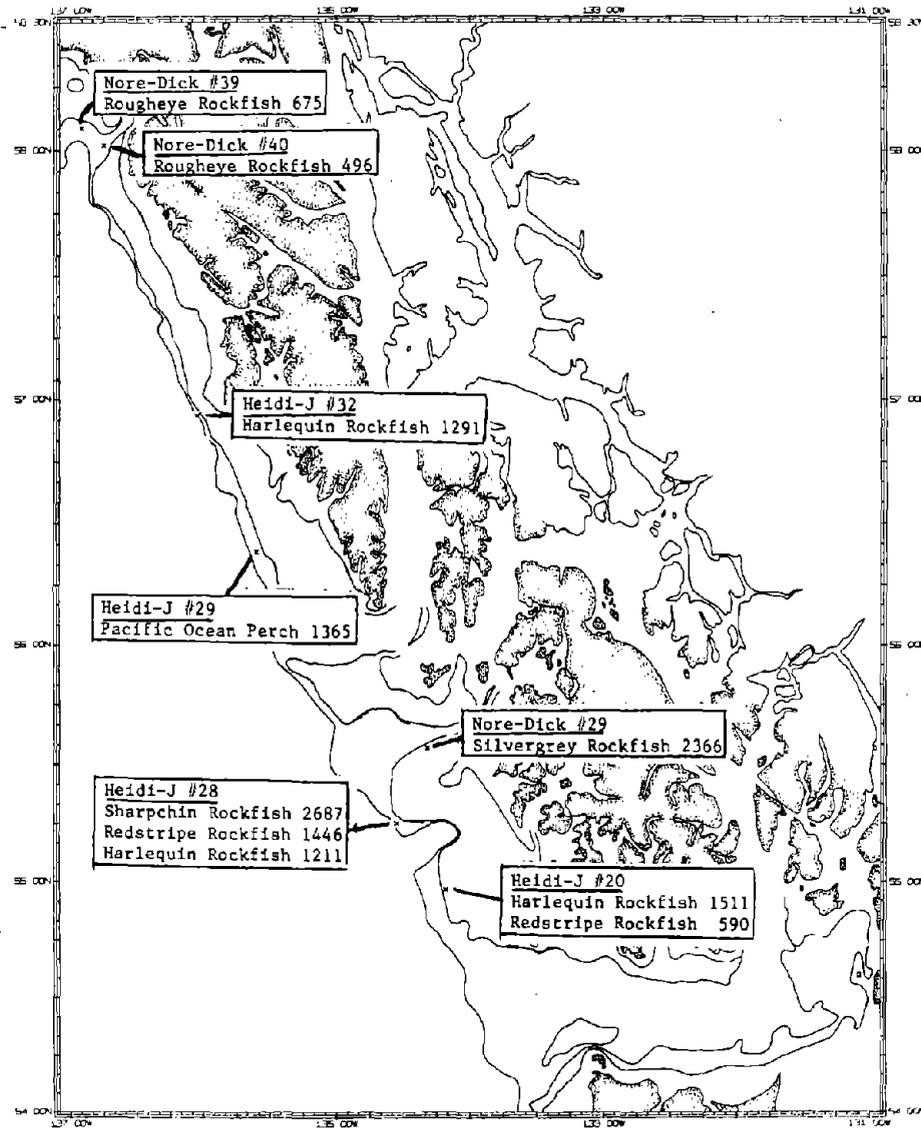


Figure 6.--Positions of individual species catches greater than 450 kg/hr - INPFC southeastern Alaska region (catch rates in kg/hr).

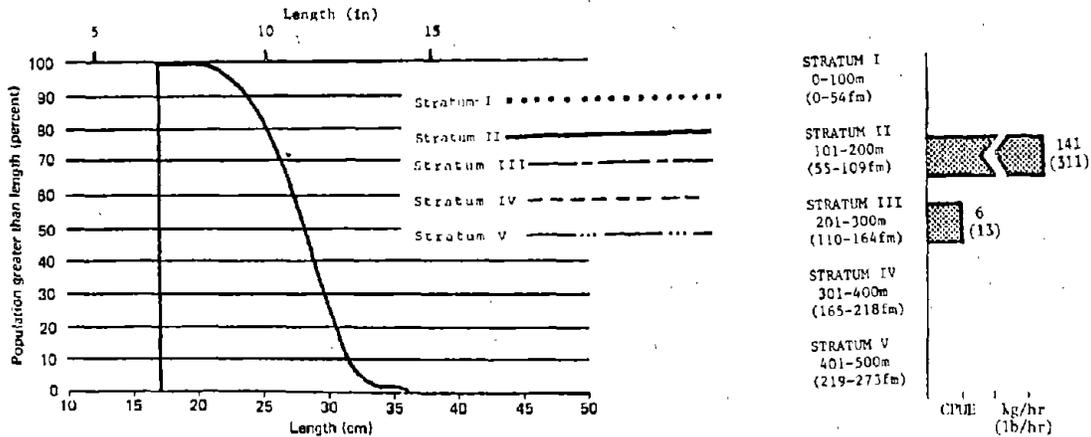


Figure 7.--Size composition and depth distribution of harlequin rockfish- INPFC Southeastern Alaska region

Pacific ocean perch were encountered in all depth intervals from 100-400 m (55-218 fm) with the highest catch rates occurring in the 201-300 m (110-164 fm) depth interval (Fig. 8). Only one large individual catch of this species [Heidi-J, haul 29, 1,300 kg/hr (2,866 lb/hr)] occurred in the Southeastern Alaska region (Fig. 6). In this region, Pacific ocean perch lengths ranged from 14-48 cm (6-19 in) with larger fish occurring in deeper water. Individuals larger than 35 cm (14 in) made up over 97% of the catch in the 301-400 m

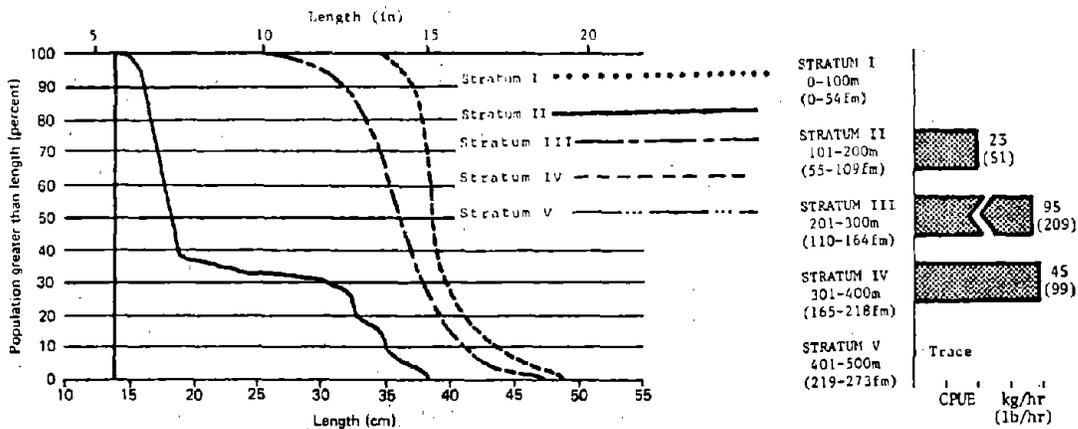


Figure 8.--Size composition and depth distribution of Pacific ocean perch - INPFC southeastern Alaska region.

(165-218 fm) depth zone and 52% in the 201-300 m (110-164 fm) interval but only 6% in the 101-200 m (55-109 fm) interval. In this shallower depth zone, over half of the catch was smaller than 18 cm (7 in).

Silvergray rockfish catch rates were highest in depths from 101-200 m (55-109 fm) and decreased in deeper strata (Fig. 9). The only catch of this species over 450 kg/hr [Nore-Dick, haul 29, 2,366 kg/hr (5,216 lb/hr)] occurred in 192 m (105 fm) of water (Fig. 6). Silvergray rockfish was one of the largest rockfish species caught, with individuals ranging up to 68 cm (27 in) in length. A greater proportion of large fish was caught in the shallow end of this species' depth range, with fish longer than 50 cm (20 in) making up 81% of the catch in the 101-200 m (55-109 fm) depth range but only 54% in the 201-300 m (110-164 fm) range.

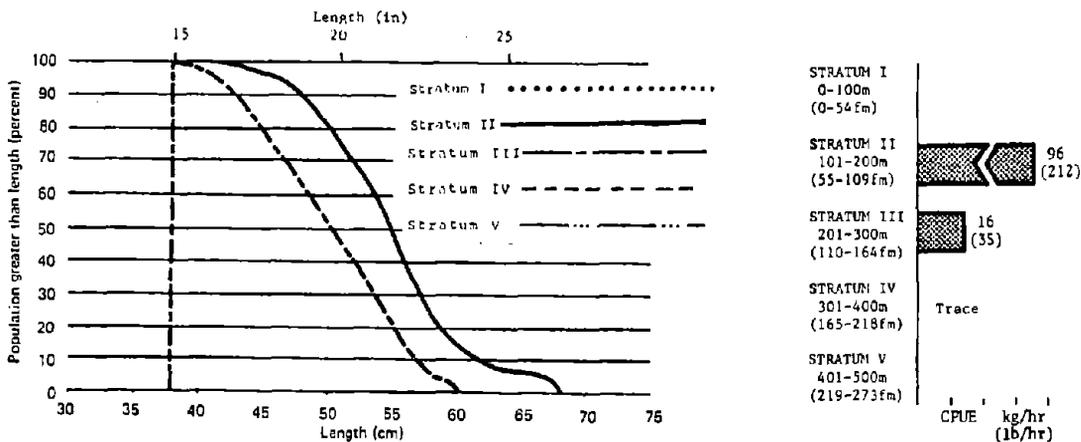


Figure 9.--Size composition and depth distribution of silvergrey rockfish - INPFC southeastern Alaska region.

Sharpchin rockfish were encountered only in depths from 101-300 m (55-164 fm) with higher catch rates occurring in the shallower half of this depth interval (Fig. 10). Eighty-one percent of the total catch of this species was

taken in a single tow [Heidi-J, haul 28, 2,687 kg/hr (5924 lb/hr)] in 194 m (106 fm) of water (Fig. 6). This was one of the smallest rockfish species captured with less than 1% longer than 35 cm (14 in). The size distribution was fairly constant over the depth range of this species.

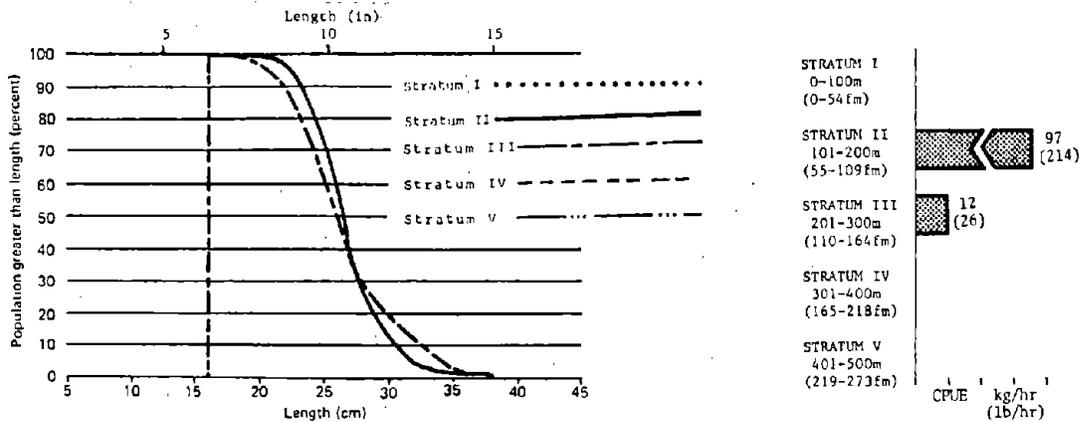


Figure 10.--Size composition and depth distribution of sharpchin rockfish - INPFC southeastern Alaska region.

Redstripe rockfish are a medium-sized rockfish and were taken principally in the 101-200 m (55-109 fm) depth zone, with sharply reduced catch rates in the next shallower and deeper strata (Fig. 11). The two largest catches of this species [Heidi-J, hauls 20 and 28, 1,151 and 1,446 kg/hr (2,537 and 3,188 lb/hr)] were taken with even larger catches of the smaller sharpchin or harlequin rockfish (Fig. 6). Redstripe rockfish ranged from 25-43 cm (10-17 in) in length, with 35% of the sampled population 35 cm (14 in) or longer.

Rougheye rockfish (S. aleutianus) were captured only between 201-500 m (110-273 fm) with almost all of the catch coming from the 301-400 m (165-218 fm) depth interval (Fig. 12). There were two large catches of this species off the mouth of Cross Sound (Fig. 6) at about 350 m (191 fm) depth (Nore-Dick,

hauls 39 and 40) of 678 and 496 kg/hr (1,495 and 1,093 lb/hr). These large, thick-bodied rockfish ranged from 28-58 cm (11-23 in) in length with the largest fish coming from the 301-400 m (165-218 fm) depth interval.

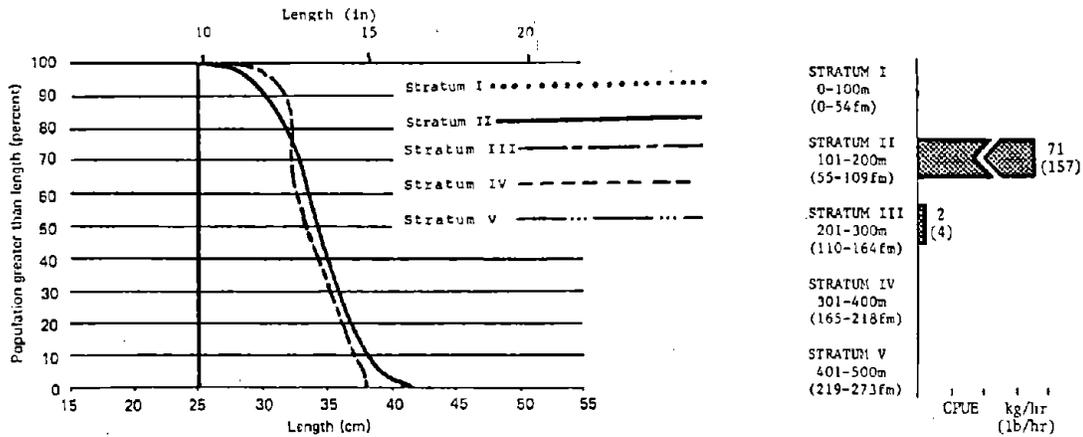


Figure 11.--Size composition and depth distribution of redstripe rockfish - INPFC southeastern Alaska region.

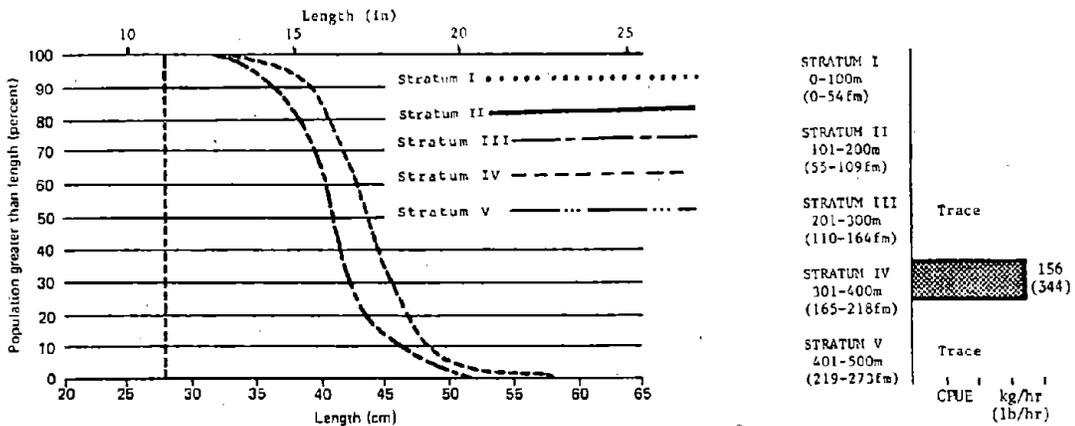


Figure 12.--Size composition and depth distribution of rougheye rockfish - INPFC southeastern Alaska region.

Arrowtooth flounder, also commonly called turbot, was the most abundant non-rockfish species. They were found at fairly uniform catch rates in all depths sampled except for smaller catches in the deepest stratum (Fig. 13). The largest single catch of this species (Nore-Dick, haul 17) was made in 161 m (88 fm) with a catch rate just under 450 kg/hr (992 kg/hr). Arrowtooth flounder had a wide range in length (22-76 cm, 9-30 in) with larger fish found in the deeper waters.

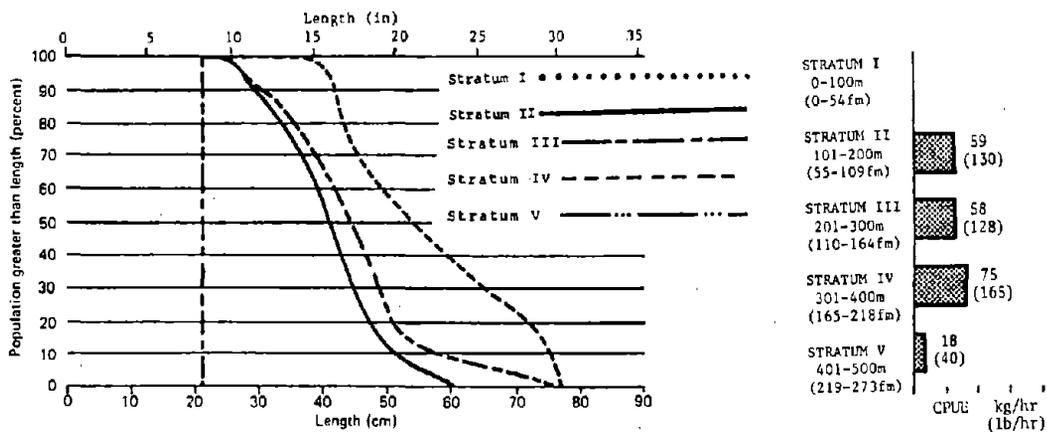


Figure 13.--Size composition and depth distribution of arrowtooth flounder - INPFC southeastern Alaska region.

Yakutat Region

The Yakutat region extends from Cape Spencer west to Cape Hinchinbrook (Fig. 1). The eastern half of the region from Cape Spencer to Icy Bay was sampled exclusively by the Nore-Dick and the Heidi-J. Sampling was again concentrated in the deeper waters with only one of the 100 successfully sampled stations in water shallower than 150 m (Fig. 14a). The western half of the

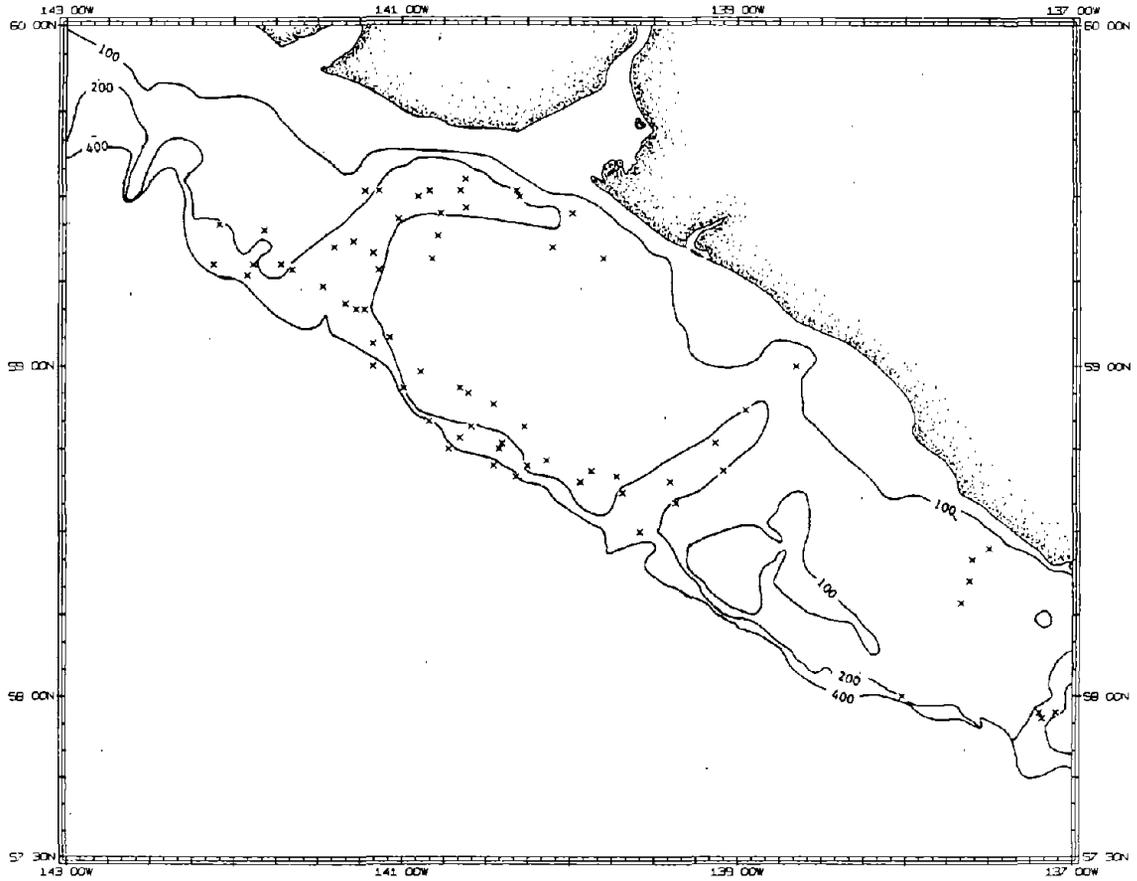


Figure 14a.--Stations successfully completed in the Yakutat region (eastern portion), August 1978.

region from Icy Bay to Cape Hinchinbrook was sampled solely by the Miller Freeman which concentrated its sampling effort in water shallower than 190 m (Fig. 14b) because of adverse weather conditions and lack of trawlable bottom.

Of the 56 fish species encountered in the Yakutat region, arrowtooth flounder were the most frequently taken and made up 31% of the total fish catch (Fig. 15) while the rockfish group, of which 13 species were taken, made up nearly 20% of the catch (Table 7). Other abundant species encountered included flathead sole, Hippoglossoides elassodon; Pacific halibut; sablefish; and rex sole, Glyptocephalus zachirus. Catches of walleye pollock were low throughout the region accounting for only 2% of the total fish catch.

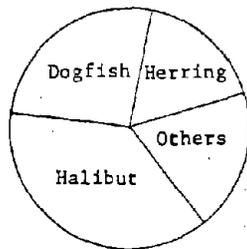
Table 7.--Composition of the rockfish catch in the INPFC Yakutat region.

Species	Percentage	Species	Percentage
Silvergrey rockfish	20	Harlequin rockfish	4
Rougheye rockfish	18	Redbanded rockfish	1
Shortspine thornyhead	13	Blackgill rockfish	-
Dusky rockfish	13	Rosethorn rockfish	-
Shortraker rockfish	8	Yellowmouth rockfish	-
Pacific ocean perch	8	Darkblotched rockfish	-
Sharpchin rockfish	6		

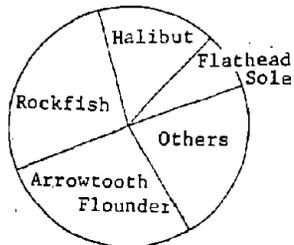
Arrowtooth flounder, as stated above, had the highest overall catch rate (77 kg/hr, 170 lb/hr) with the highest catch per effort in the 201-300 m (110-164 fm) depth interval and decreasing catch rates in both shallower and deeper depths (Fig. 16). The two large catches of this species [Nore-Dick, hauls 58 and 60, 812 and 551 kg/hr (1,790 and 1,215 lb/hr)] were made in 256 and 385 m (140 and 156 fm) of water (Fig. 17). These fish ranged from 11-76 cm (4-30 in) with a higher proportion of larger fish in the deeper depths. Fish



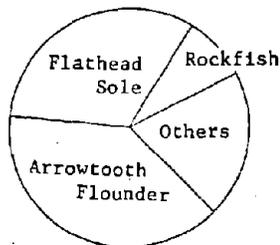
Figure 14b.--Stations successfully completed in the Yakutat region (western portion), November 1978.



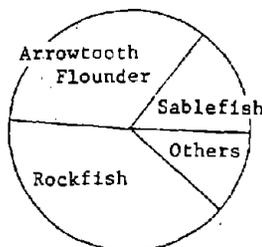
0-100 meters		11 stations
Species	Catch per Unit	Effort (kg/hr)
Pacific Halibut	56	
Spiny Dogfish	38	
Pacific Herring	24	
Big Skate	11	
Pacific Cod	5	
Other Species	12	
		146



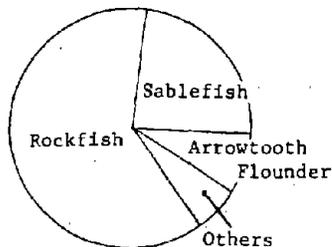
101-200 meters		56 stations
Species	Catch per Unit	Effort (kg/hr)
Arrowtooth Flounder	52	
Rockfish Group	51	
Pacific Halibut	30	
Flathead Sole	15	
Walleye Pollock	8	
Other Species	29	
		185



201-300 meters		22 stations
Species	Catch per Unit	Effort (kg/hr)
Arrowtooth Flounder	174	
Flathead Sole	142	
Rockfish Group	39	
Rex Sole	22	
Sablefish	21	
Other Species	50	
		448

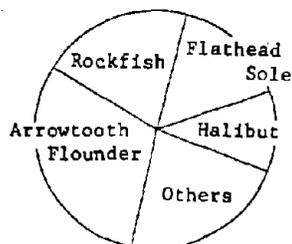


301-400 meters		10 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	109	
Arrowtooth Flounder	91	
Sablefish	40	
Dover Sole	18	
Rex Sole	8	
Other Species	5	
		271



401-500 meters		10 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	332	
Sablefish	131	
Arrowtooth Flounder	44	
Dover Sole	18	
Lanternfish	14	
		539

Figure 15.--Catch composition by depth strata - INPPC Yakutat region.



All Depths		100 stations
Species	Catch per Unit	Effort (kg/hr)
Arrowtooth Flounder	77	
Rockfish Group	51	
Flathead Sole	40	
Pacific Halibut	27	
Sablefish	11	
Other Species	45	
		251

larger than 40 cm (16 in) made up over 94% of the catch in the 301-400 m (165-218 fm) interval and 71% in the 201-300 m (110-164 fm) interval but only 37% in the 101-200 m (55-109 fm) depth interval.

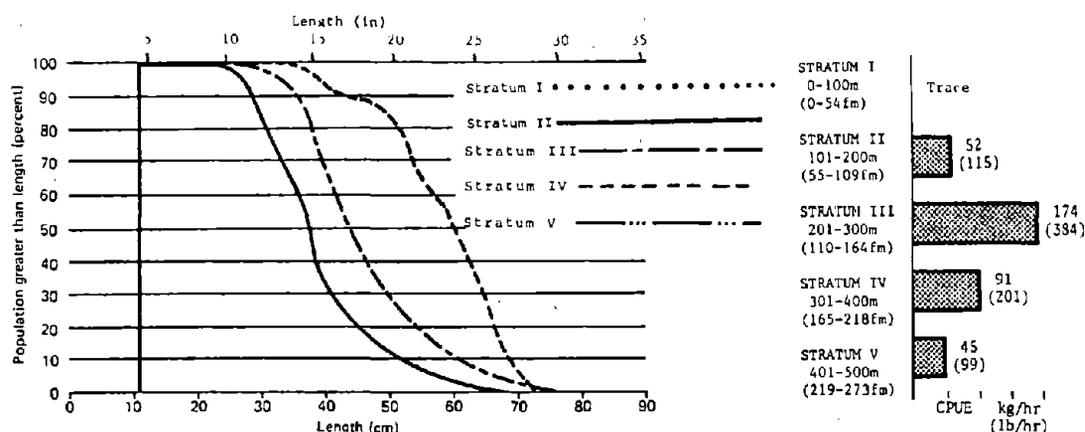


Figure 16.--Size composition and depth distribution of arrowtooth flounder - INPFC Yakutat region.

Silvergrey rockfish were taken primarily in the 101-200 m (55-109 fm) depth interval with only a trace catch in the 201-300 m (110-164 fm) interval. A single large catch (Heidi-J, haul 51) of 903 kg/hr (1,990 lb/hr) in 196 m (107 fm) of water accounted for 91% of the catch of this species (Fig. 17). No length data were recorded for this species in the Yakutat region.

Rougheye rockfish were encountered in four of the five depth zones sampled but at relatively low catch rates, the largest occurring in the 301-400 m (165-219 fm) zone (Fig. 18). These fish ranged from 22-52 cm (7-20 in), with larger fish being found in deeper water. Fish larger than 35 cm (14 in) made up more than 81% of the catch in the 301-400 m (165-218 fm) interval, nearly 50% in the 201-300 m (110-164 fm) interval, but only 18% in the 101-200 m (55-109 fm) interval.

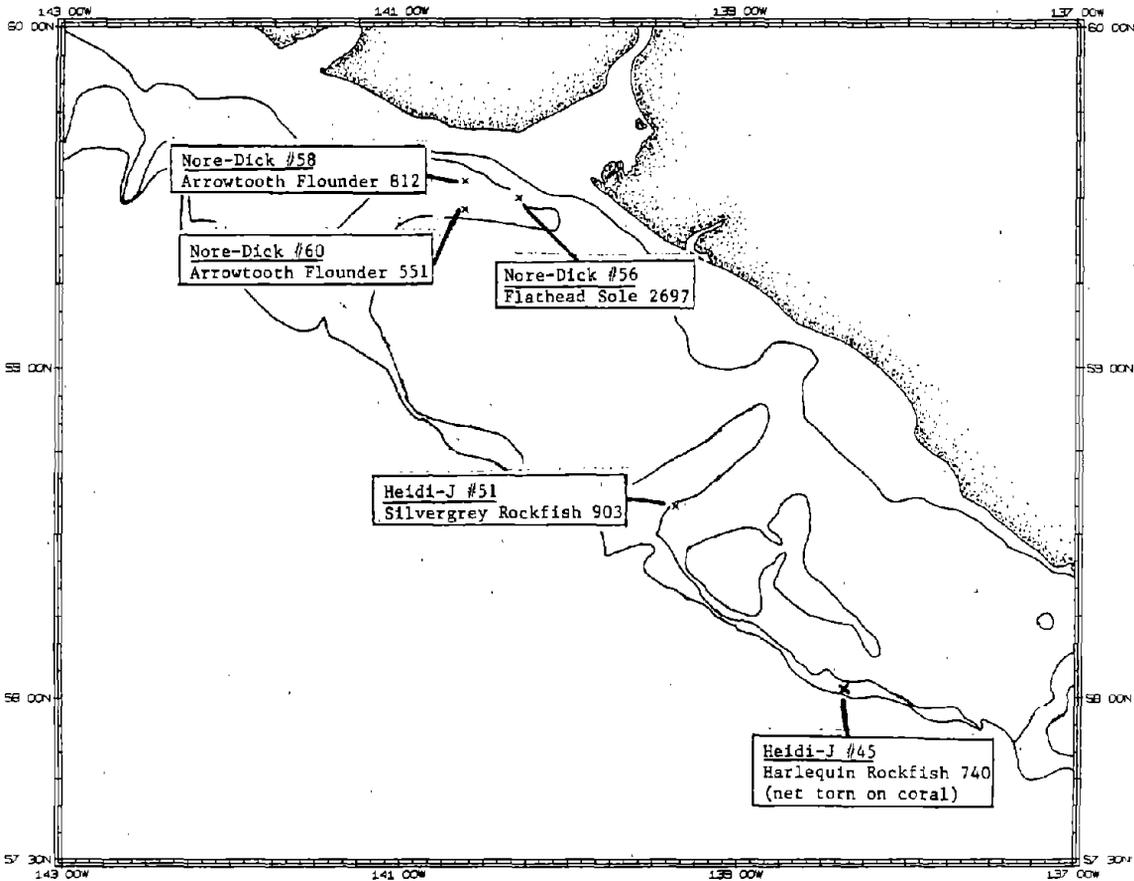


Figure 17.--Positions of individual species catches greater than 450 kg/hr - INPFC Yakutat region (catch rates in kg/hr).

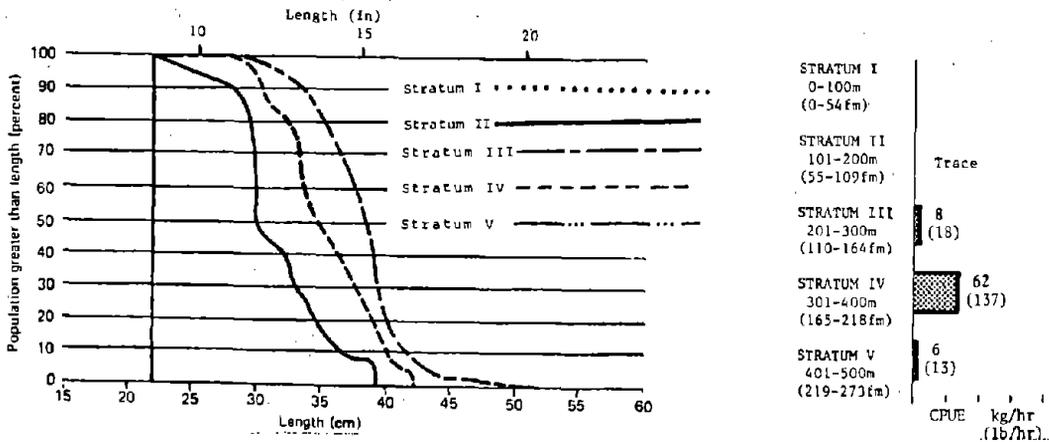


Figure 18.--Size composition and depth distribution of rougheye rockfish - INPFC Yakutat region.

Shortraker rockfish (*S. borealis*) were taken in the three deeper depth strata, with one large catch [Nore-Dick, haul 42, 302 kg/hr (666 lb/hr)] resulting in a much higher mean catch rate in the deepest depth interval (Fig. 19). These fish ranged from 45-77 cm (18-30 in) in length with the largest individuals found in the 301-400 m (165-218 fm) depth interval. Because the length data are based on the measurements of a small number of fish, they can only be considered rough indicators of the population's structure.

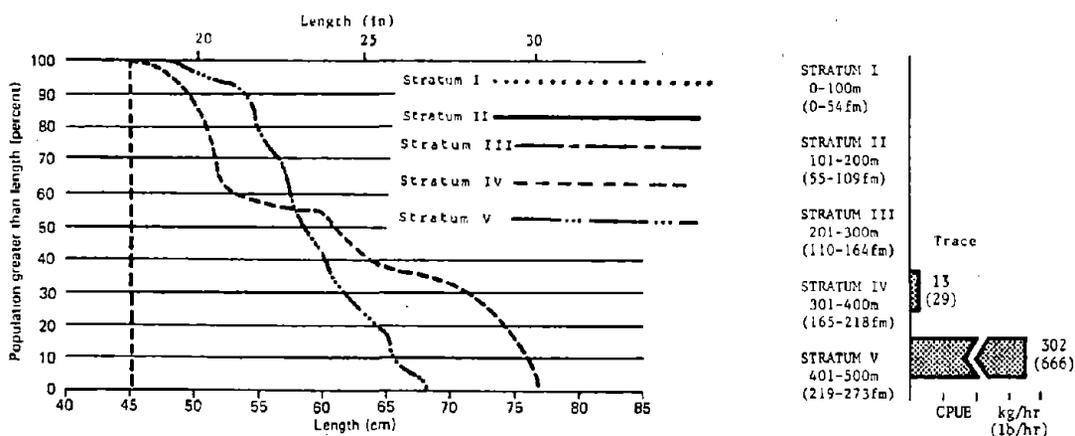


Figure 19.--Size composition and depth distribution of shortraker rockfish - INPFC Yakutat region.

Flathead sole was the second most abundant flatfish encountered in the Yakutat area. The highest mean catch rate of this species was in the 101-200 m (55-109 fm) depth interval with catches decreasing in both shallower and deeper depths (Fig. 20). The largest single catch of flathead sole [Nore-Dick, haul 56, 2,696 kg/hr (5,944 lb/hr)] occurred in 219 m (120 fm) of water (Fig. 17). In the Yakutat area, this species ranged from 22-47 cm (9-19 in) in length, with 98% longer than 30 cm (12 in).

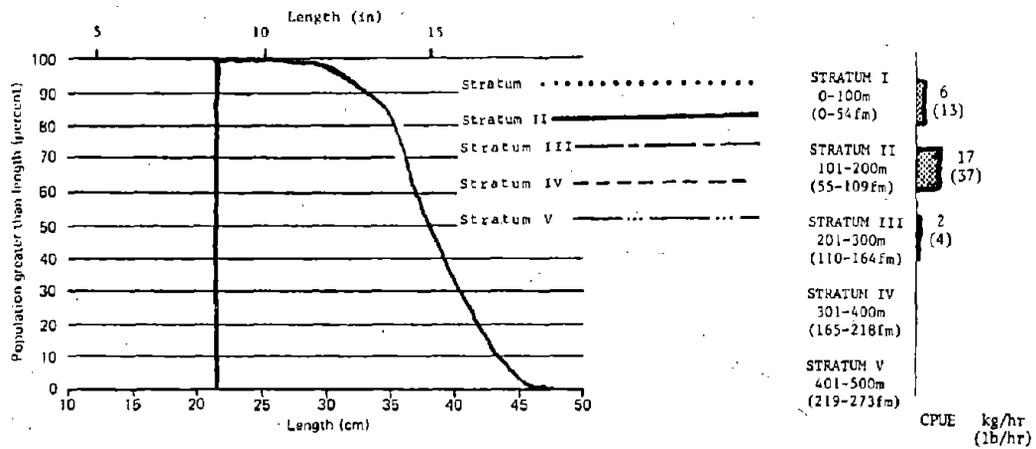


Figure 20.--Size composition and depth distribution of flathead sole - INPFC Yakutat region.

Dover sole appeared to be fairly evenly distributed at low density through the three deepest depth strata (Fig. 21) and ranged from 33-55 cm (13-22 in) in length with larger individuals in the deeper depths.

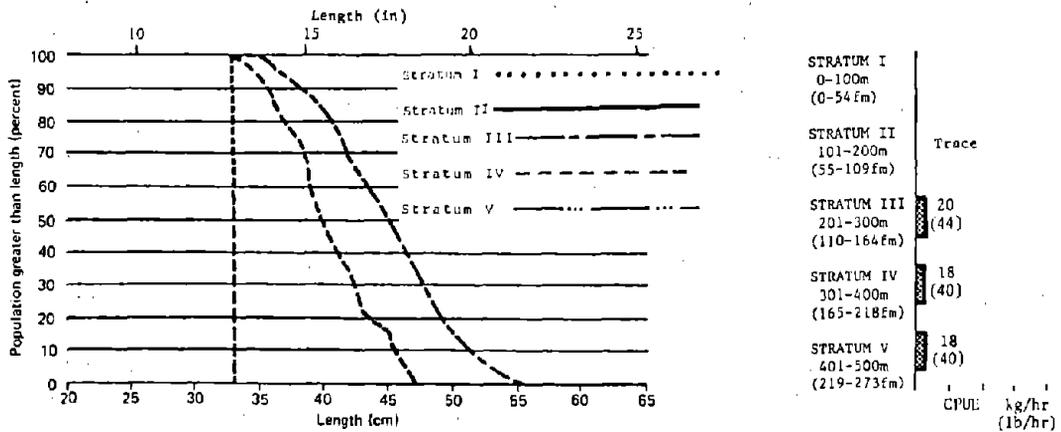


Figure 21.--Size composition and depth distribution of Dover sole - INPFC Yakutat region.

Kodiak Region

The Kodiak region extends from Cape Hinchinbrook west to Cape Trinity on Kodiak Island (Fig. 1). The area was surveyed by the Nore-Dick, Heidi-J, and Miller Freeman with 53 successfully completed stations (Fig. 22). Sampling effort was concentrated in the shallower depth intervals due to adverse weather conditions which resulted in only four stations being sampled in water deeper than 300 m.

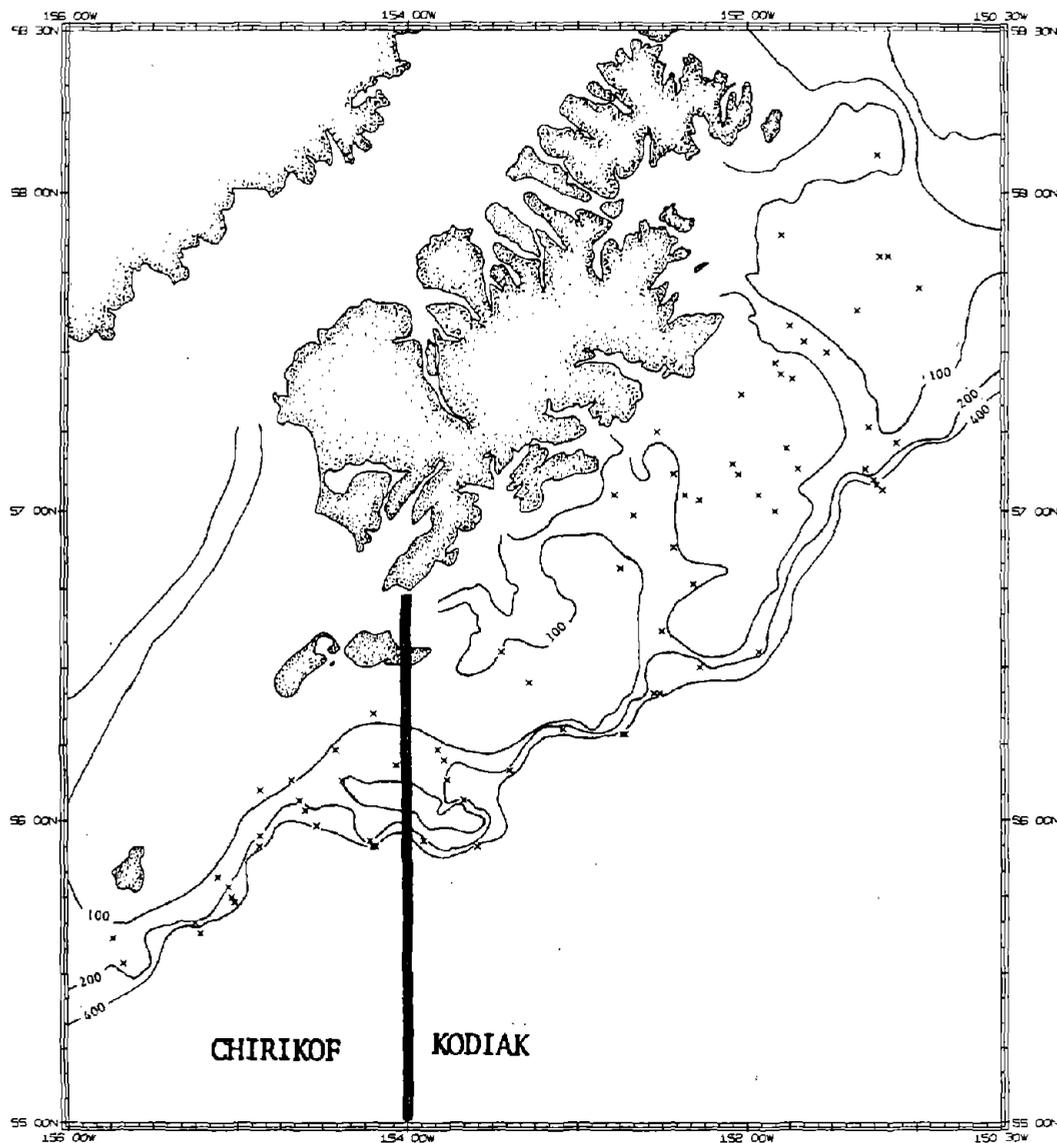


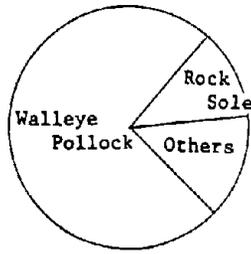
Figure 22.--Stations successfully completed in the INPFC Kodiak and Chirikof regions, September-October 1978.

Of the 57 fish species encountered in the Kodiak region, walleye pollock had the highest mean catch rate (Fig. 23) with 11 stations producing pollock catch rates greater than 450 kg/hr (Fig. 24). The rockfish group, of which only nine species were encountered in the Kodiak region, made up only 6% of the catch (Table 8). There were, however, a few large catches of rockfish, particularly rougheye, in the 401-500 m depth interval. Other abundant species caught included Pacific cod, Gadus macrocephalus, which made up 9% of the total catch, arrowtooth flounder (5%), rock sole (5%), and Pacific halibut (4%).

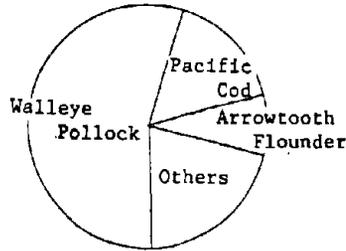
Table 8.--Composition of the rockfish catch in the INPFC Kodiak region.

Species	Percentage	Species	Percentage
Rougheye rockfish	56	Dusky rockfish	1
Shortraker rockfish	15	Northern rockfish	-
Shortspine thornyhead	15	Yellowtail rockfish	-
Pacific ocean perch	8	Yelloweye rockfish	-
Harlequin rockfish	4		

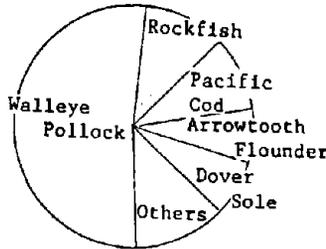
Walleye pollock dominated the catches in the Kodiak region, making up nearly 57% of the total fish catch. The catch rates for pollock were highest in the 0-100 m (0-54 fm) depth interval and decreased with depth (Fig. 25). As shown in Figure 24, the biggest of many large catches of pollock in this area were two trawl tows on middle Albatross Bank [Nore-Dick, hauls 94 and 95, 6,500 and 4,200 kg/hr (14,330 and 9,259 lb/hr)]. These fish ranged from 21-74 cm (8-29 in) with larger individuals being found in deeper depths; pollock larger than 40 cm (14 in) made up 90% of the catch in the 201-300 m (110-164 fm) depth interval and 50% in the next shallower interval but only 5% in the shallowest stratum.



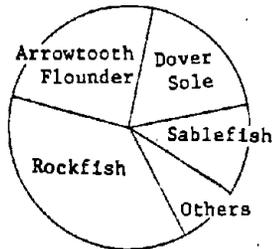
0-100 meters		20 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	537	
Rock Sole	86	
Pacific Halibut	32	
Pacific Cod	15	
Yellowfin Sole	14	
Other Species	36	
		720



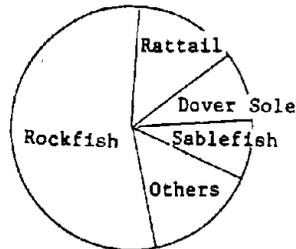
101-200 meters		20 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	458	
Pacific Cod	136	
Arrowtooth Flounder	69	
Flathead Sole	45	
Pacific Halibut	45	
Other Species	80	
		833



201-300 meters		9 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	264	
Rockfish Group	55	
Pacific Cod	49	
Arrowtooth Flounder	37	
Dover Sole	35	
Other Species	72	
		512

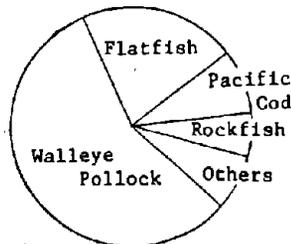


301-400 meters		2 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	93	
Arrowtooth Flounder	61	
Dover Sole	48	
Sablefish	30	
Bigmouth Sculpin	66	
Other Species	15	
		253



401-500 meters		2 stations
Species	Catch per Unit	Effort (kg/hr)
Rockfish Group	855	
Pectoral Rattail	228	
Dover Sole	148	
Sablefish	118	
Arrowtooth Flounder	117	
Other Species	108	
		1574

Figure 23.--Catch composition by depth strata - INPFC Kodiak region.



All Depths		53 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	421	
Pacific Cod	65	
Rockfish Group	48	
Arrowtooth Flounder	41	
Rock Sole	39	
Other Species	128	
		742

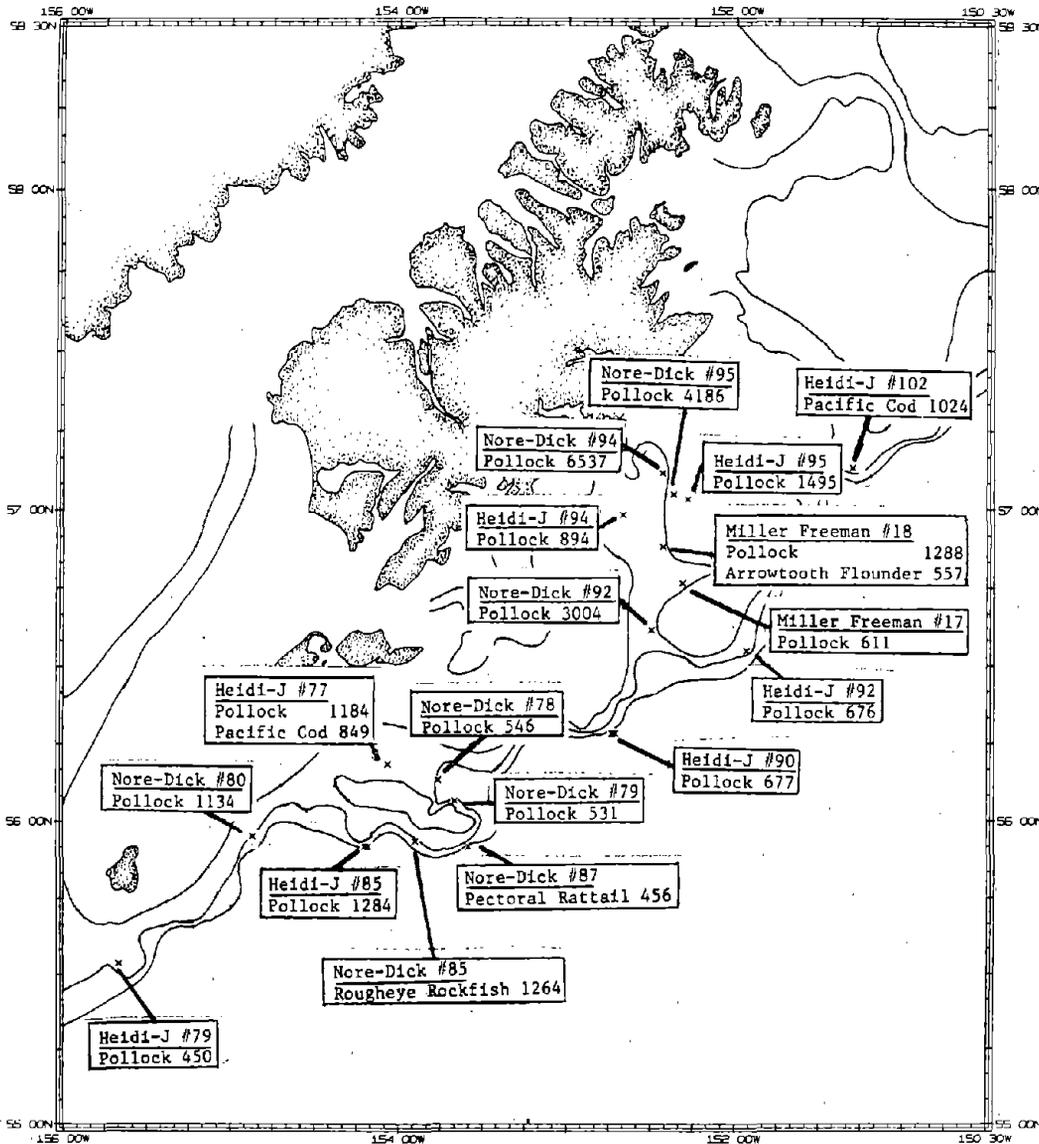


Figure 24.--Positions of individual species catches greater than 450 kg/hr - INPFC Kodiak and Chirikof regions.

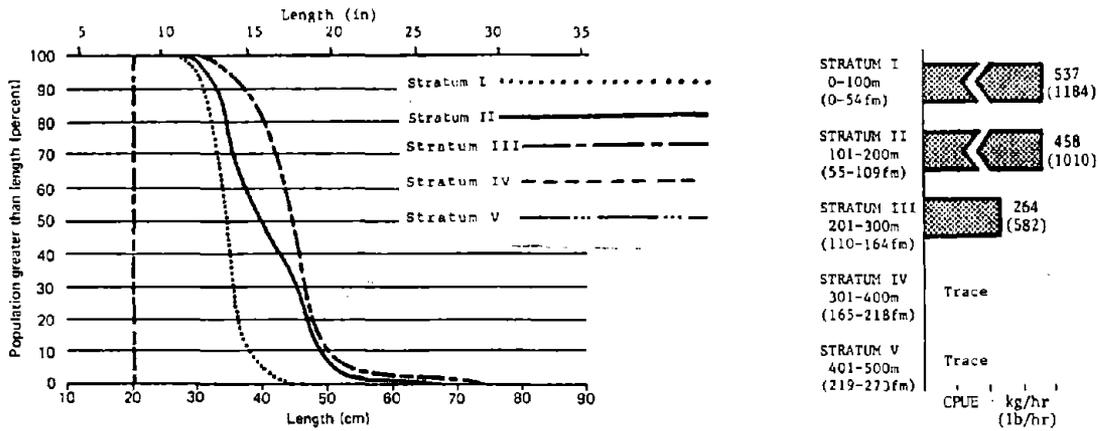


Figure 25.--Size composition and depth distribution of walleye pollock - INPFC Kodiak region.

Pacific cod were the second most abundant fish species encountered in the Kodiak area. Their highest apparent abundance occurred in the 101-200 m (55-109 fm) depth interval with smaller catch rates in the two adjoining strata (Fig. 26). The largest single catch of this species [Heidi-J, haul 102,

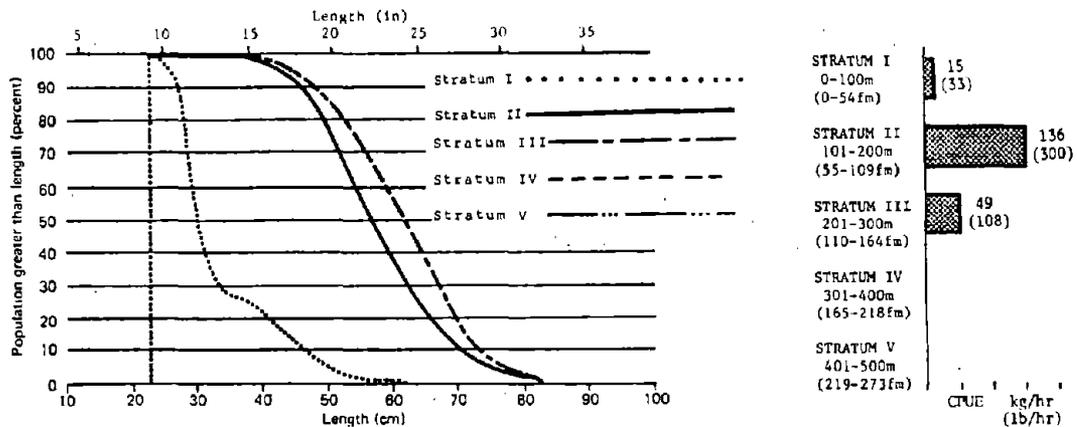


Figure 26.--Size composition and depth distribution of Pacific cod - INPFC Kodiak region.

1,024 kg/hr (2,257 lb/hr)] was made in 135 m (74 fm) of water (Fig. 24). Cod were the largest commonly encountered fish with individuals up to 83 cm (33 in) in length. Cod in the shallowest depth interval were generally smaller, with only 4% longer than 50 cm (20 in) compared to 81% and 86% in the 101-200 m (55-109 fm) and 201-300 m (110-164 fm) depth intervals.

Rougheye rockfish were the dominant rockfish in this area with the highest catch rates in the 401-500 m (219-273 fm) depth interval and decreasing catches in shallower strata (Fig. 27). The largest catch of this species [Nore-Dick, haul 85, 1,264 kg/hr (2,787 lb/hr)] was made at a depth of 402 m (220 fm) (Fig.24). These fish ranged from 20-62 cm (8-24 in) with a fairly uniform size distribution over all depths except for several large [>52 cm (20 in)] individuals taken in the 301-400 m (165-218 fm) depth interval.

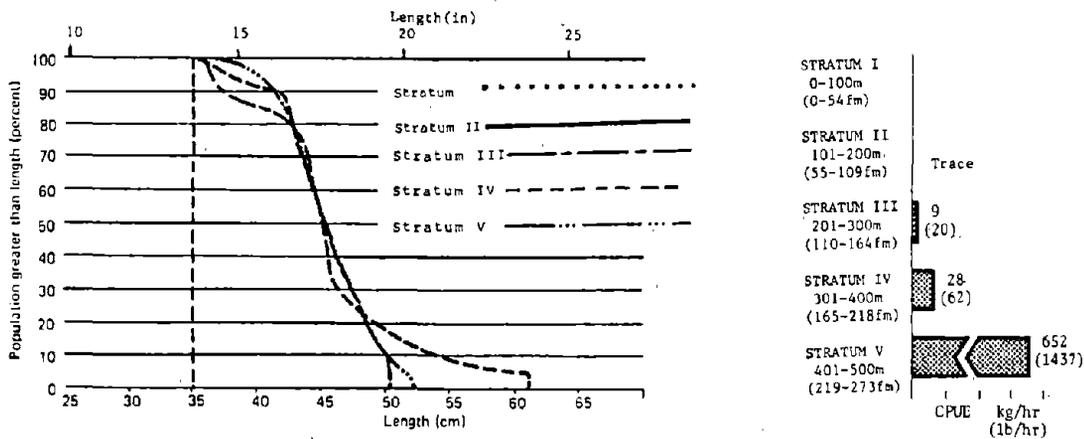


Figure 27.--Size composition and depth distribution of rougheye rockfish INPFC Kodiak region.

Arrowtooth flounder showed a more uniform depth distribution than other species encountered in this area with fair catch rates in all depth zones except for the shallowest (Fig. 28). A large catch of this species [Miller Freeman, haul 18, 557 kg/hr (1,228 lb/hr)] was made in 172 m (94 fm) of water (Fig. 24). More large fish, up to 67 cm (26 in), were captured in deeper water with fish longer than 40 cm making up 97% of the catch in 301-400 m (165-218 fm) and 80% in 201-300 m (110-164 fm), but only 37% in 101-200 m (55-109 fm).

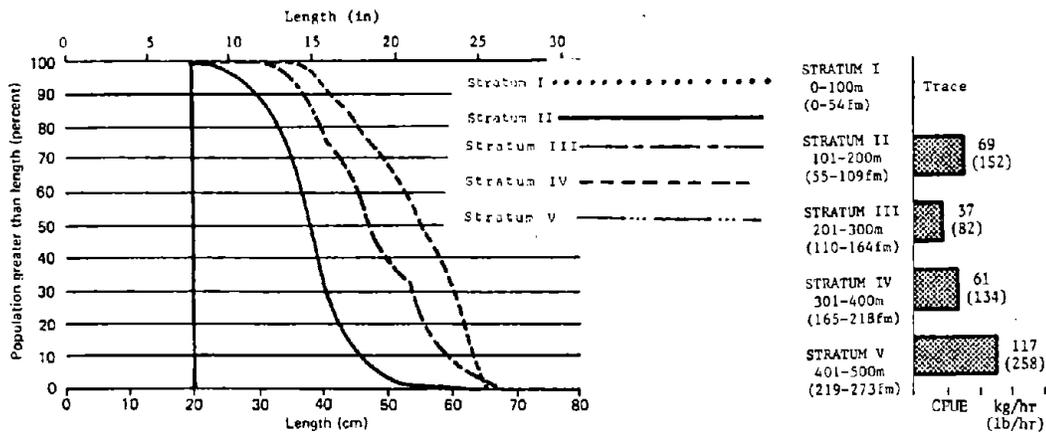


Figure 28.--Size composition and depth distribution of arrowtooth flounder - INPPC Kodiak region.

Rock sole, Lepidopsetta bilineata, were concentrated in shallower depths, with highest catch rates in the 0-100 m (0-54 fm) depth zone (Fig. 29). There was a lower proportion of larger fish in this zone with only 25% over 30 cm (12 in) compared to 40% in 101-200 m (55-109 fm); however, the few very large fish encountered over 40 cm (16 in) were taken in the shallower depth interval.

Dover sole catch rates were highest in the 401-500 m (219-273 fm) depth interval and decreased with shallower depths (Fig. 30). Over 80% of these fish, which ranged from 29-48 cm (11-19 in) in length, were longer than 35 cm (14 in) in all strata.

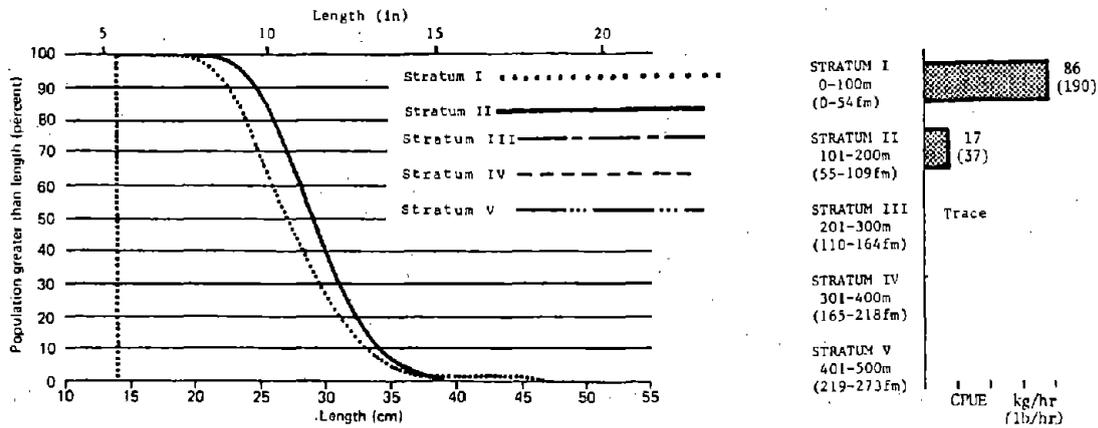


Figure 29.--Size composition and depth distribution of rock sole - INPFC Kodiak region.

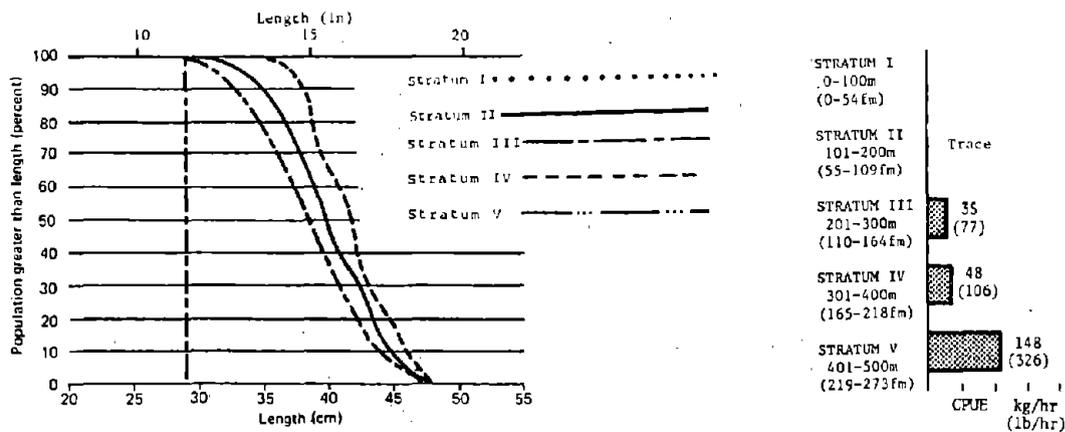


Figure 30.--Size composition and depth distribution of Dover sole - INPFC Kodiak region.

Chirikof Region

The INPFC Chirikof region extends from Cape Trinity on Kodiak Island westward to long. 159°00'W (Fig. 1); however, sampling in this region, conducted by the Nore-Dick, Heidi-J, and Miller Freeman, was restricted to the most eastern portion near Chirikof Island (Fig. 22).

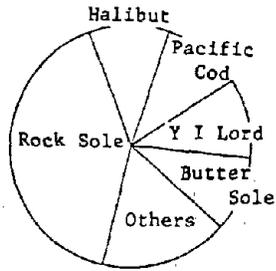
Twenty-four stations were successfully sampled in the Chirikof region, capturing 44 fish species. Walleye pollock was the most abundant species taken and made up 50% of the total catch (Fig. 31). The rockfish group, of which only seven species were taken (Table 9), accounted for only 5% of the catch.

Table 9.--Composition of the rockfish catch in the INPFC Chirikof region.

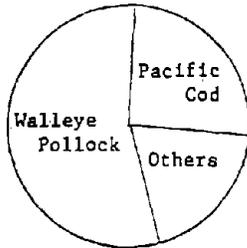
Species	Percentage	Species	Percentage
Rougheye rockfish	35	Harlequin rockfish	3
Shortspine thornyhead	35	Blackgill rockfish	2
Pacific ocean perch	17	Dusky rockfish	1
Northern rockfish	9		

Other abundant species encountered in the Chirikof region included Pacific cod, which made up 17% of the catch, arrowtooth flounder (6%), Dover sole (5%), and rex sole (5%).

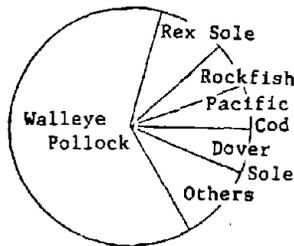
Walleye pollock, the dominant species in this region, were caught primarily in the two depth zones between 101-300 m (55-164 fm) with only trace catches in the shallowest and deepest depth zones (Fig. 32). Of the four large pollock catches shown in Figure 24, the largest (Heidi-J, haul 85) captured 1,284 kg/hr (2,831 lb/hr) in 192 m (105 fm) of water. In the Chirikof area, species ranged from 28-59 cm (11-23 in), with the average size increasing with depth except



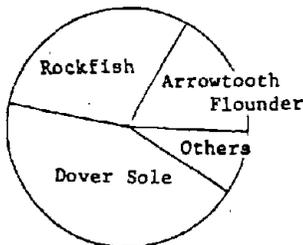
0-100 meters		3 stations
Species	Catch per Unit	Effort (kg/hr)
Rock Sole	42	
Pacific Halibut	11	
Pacific Cod	11	
Yellow Irish Lord	11	
Butter Sole	10	
Other Species	18	
		103



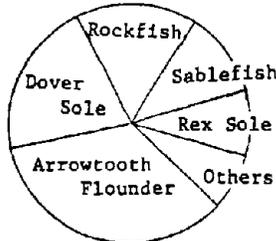
101-200 meters		11 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	308	
Pacific Cod	145	
Arrowtooth Flounder	20	
Pacific Halibut	17	
Rex Sole	16	
Other Species	52	
		558



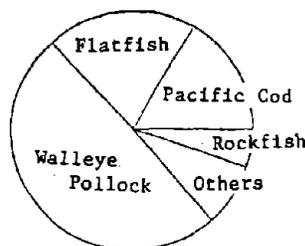
201-300 meters		7 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	257	
Rex Sole	37	
Pacific Cod	25	
Rockfish Group	25	
Dover Sole	23	
Other Species	51	
		418



301-400 meters		1 station
Species	Catch per Unit	Effort (kg/hr)
Dover Sole	271	
Rockfish Group	184	
Arrowtooth Flounder	112	
Rex Sole	26	
Sablefish	12	
Other Species	18	
		623



401-500 meters		2 stations
Species	Catch per Unit	Effort (kg/hr)
Arrowtooth Flounder	73	
Dover Sole	44	
Rockfish Group	34	
Sablefish	26	
Rex Sole	18	
Other Species	16	
		211



All Depths		24 stations
Species	Catch per Unit	Effort (kg/hr)
Walleye Pollock	216	
Pacific Cod	75	
Arrowtooth Flounder	27	
Rockfish Group	23	
Dover Sole	23	
Other Species	70	
		434

Figure 31.--Catch composition by depth strata - INPFC Chirikof region.

for a few large individuals [58 and 59 cm (23 in)] found in the 101-200 m (55-109 fm) depth interval. Pollock longer than 40 cm made up 93% of the catch in the 201-300 m (110-164 fm) interval but only 31% in the 101-200 m (55-109 fm) interval.

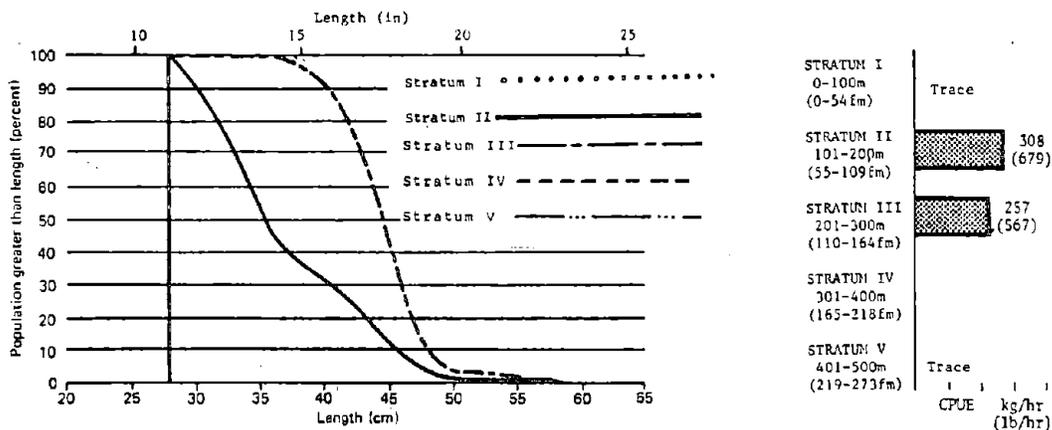


Figure 32.--Size composition and depth distribution of walleye pollock - INPFC Chirikof region.

Pacific cod in this region were taken primarily in the 101-200 m (55-109 fm) depth interval, with much smaller catches in the deeper and shallower depths (Fig. 33). The only catch in this region over 450 kg/hr [Heidi-J, haul 77, 849 kg/hr (1,872 lb/hr)] was made in 150 m (82 fm) of water (Fig. 24). Cod ranged up to 82 cm (32 in) in length with fish over 68 cm (27 in) found exclusively in the 101-200 m (54-109 fm) depth zone and fish under 31 cm (27 in) found only in the 0-100 m (0-54 fm) interval.

Arrowtooth flounder were distributed throughout all of the depth zones sampled, with higher catches in the two deepest strata (Fig. 34). Large fish, up to 73 cm (29 in), were found primarily in the 401-500 m (219-273 fm) depth

zone where fish over 50 cm made up 78% of the catch, compared to only 31% in the 201-300 m (110-164 fm) interval and 2% in the 101-200 m (55-109 fm) depth interval.

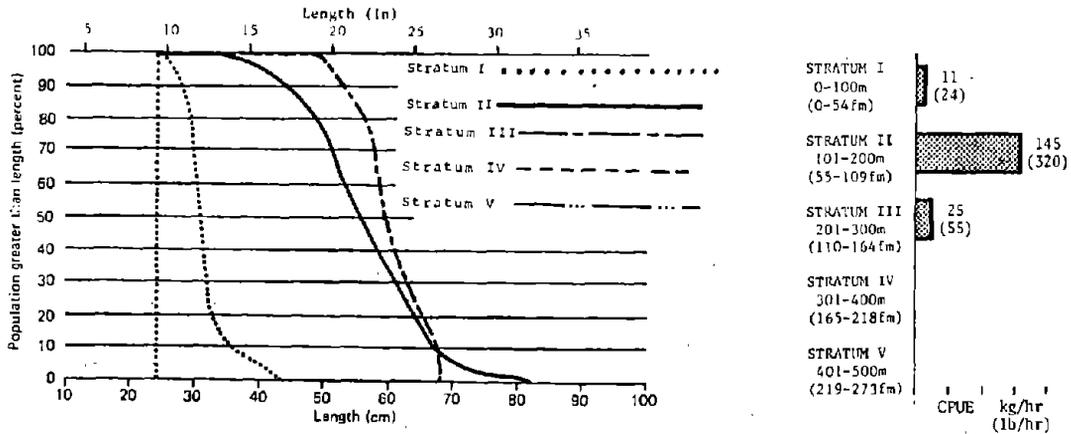


Figure 33.--Size composition and depth distribution of Pacific cod - INPFC Chirikof region.

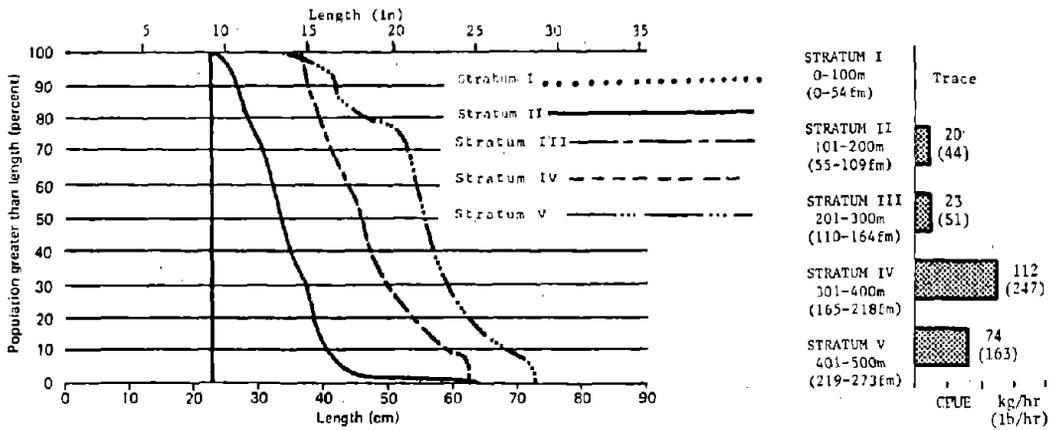


Figure 34.--Size composition and depth distribution of arrowtooth flounder - INPFC Chirikof region.

Rougheye rockfish catches were low throughout this region, except for the 301-400 m (165-218 fm) stratum where the single successful station (Nore-Dick, haul 83) resulted in a catch rate of 142 kg/hr (313 lb/hr) (Fig. 35). These fish ranged from 38-51 cm (15-20 in) in length.

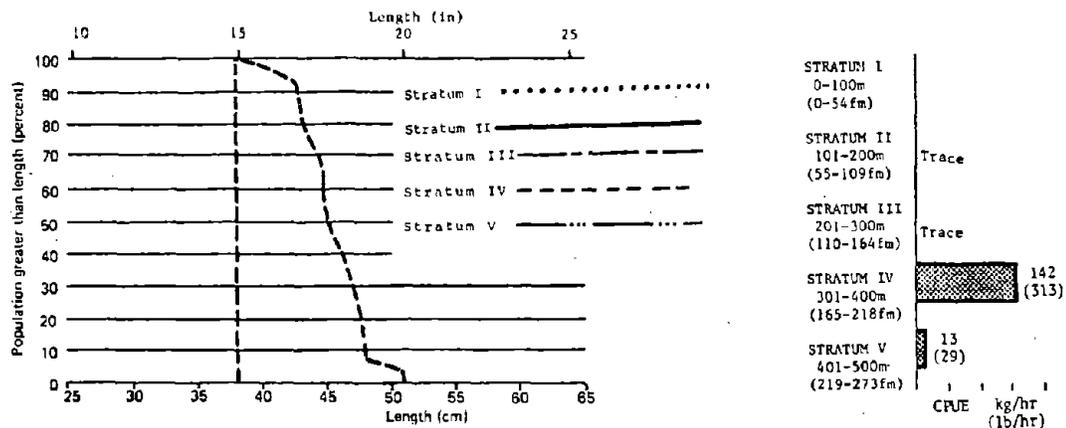


Figure 35.--Size composition and depth distribution of rougheye rockfish INPFC Chirikof region.

Dover sole were taken in all strata deeper than 100 m (55 fm), with the highest catch rate (271 kg/hr, 597 lb/hr) occurring at the only successful station in the 301-400 m (165-218 fm) depth zone (Fig. 36). The Dover sole in this region were all over 30 cm (12 in) in length with individuals ranging up to 49 cm (19 in).

Rock sole catches were concentrated in the shallower depth zones and decreased with increasing depth (Fig. 37). Catches in the 0-100 m (0-54 fm) zone consisted primarily of smaller fish with 83% less than 30 cm (12 in) in length compared with 14% in the 101-200 m (55-109 fm) interval.

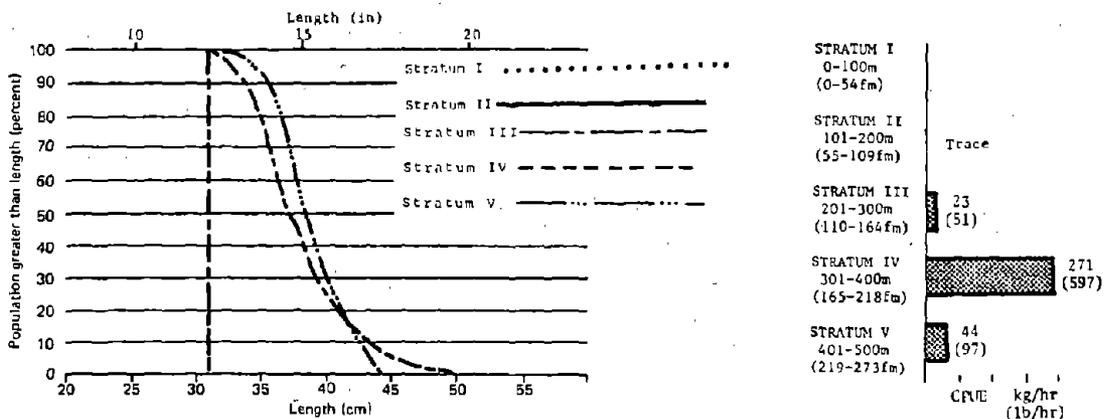


Figure 36.--Size composition and depth distribution of Dover sole - INPFC Chirikof region.

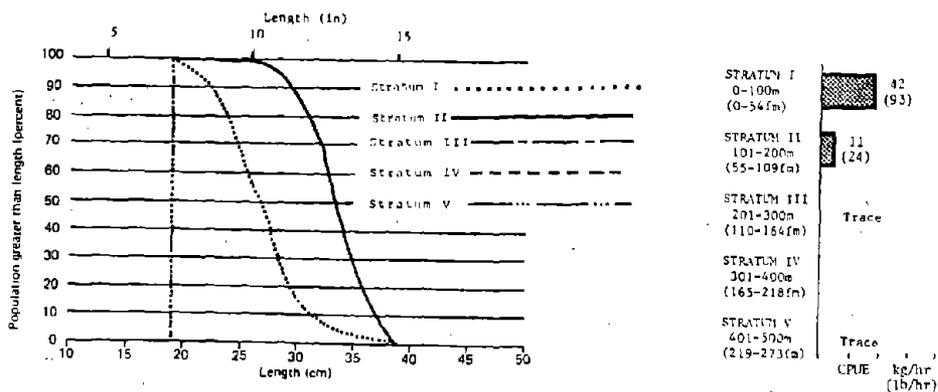


Figure 37.--Size composition and depth distribution of rock sole - INPFC Chirikof region.

SUMMARY AND CONCLUSIONS

The results presented in this paper are useful indicators of fish population characteristics within the limits of the survey's sampling distribution and gear capabilities. As mentioned before, this survey did not adequately sample depths less than 150 m (82 fm) in the INPFC Southeastern Alaska and Yakutat regions. Sparse sampling of waters deeper than 300 m (165 fm) in the two western regions, Kodiak and Chirikof, resulted in an inadequate measure of the relative abundance of rockfish in those regions.

Certain limitations of the sampling gear should also be noted. First, the use of bottom trawls precluded sampling any fish more than 30 feet off the bottom. This limitation principally influenced the sampling of rockfish, walleye pollock, and Pacific cod--species which are known to move up higher in the water column--although the effect of gear limitation was mitigated by a behavioral pattern to school closest to the bottom during the daylight hours when most of the sampling was done. Secondly, some areas of ocean bottom were too rough to be trawled, even with the protective roller gear. The stocks in these areas, of which rockfish are a major portion, are not represented in the results of this survey. The third limitation, mentioned earlier, is that flatfish and other on-bottom fish were undersampled due to the roller gear on the footrope.

In using these survey results to project catches from a commercial fishery, one should keep in mind that these trawl stations were randomly located. A directed commercial fishery could expect catch rates closer to the largest individual catches than to the mean CPUEs. More specific data on the catches and positions of each station are available from the Northwest and Alaska Fisheries Center.

Results for the target species showed walleye pollock to be abundant in the Kodiak and Chirikof regions with large concentrations of Pacific cod also occurring in these areas. Rockfish catches were concentrated in the Southeastern Alaska region except for the roughey and shortraker rockfish which occurred throughout the survey area, mainly at depths of 300 m and deeper. There were significant catches of the full size range of rockfishes, from the harlequin and sharpchin, few being longer than 35 cm, to the roughey, shortraker and silvergrey, which were mostly larger than 40 cm. These rockfish, however, are slow growing; most species take at least 10 years to reach a length of 35 cm, and the smaller harlequin and sharpchin take as long to reach 25 cm. This slow growth results in lower replacement rates, making a long term fishery more difficult to sustain as has been found with the Pacific ocean perch stocks in this area.

The most abundant and wide-ranging flatfish encountered in this survey was the arrowtooth flounder. Though these fish were both large and abundant, they are the least desirable flatfish commercially. The most likely flatfishes for commercial exploitation in this area appear to be flathead sole in the Yakutat region, rock sole in shallow areas of the Kodiak and Chirikof regions, and perhaps Dover sole in deeper areas of the central Gulf.

It should be noted that this survey did not cover the region from long. 148°00' to 151°00' which includes Portlock and Blying Banks. Nor was the portion of the Gulf west of long. 156°00' included. These areas were surveyed in the summer of 1979 and a report of that survey is now in preparation.

ACKNOWLEDGMENTS

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