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BOTTOM TRAWLING SURVEYS OF THE NORTHEASTERN GULF OF ALASKA

(Summer and Fall of 1961 and Spring of 1962)

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ABSTRACT

The U. S. Bureau of Commercial Fisheries in cooperation with the International Pacific Halibut Commission used otter trawls to survey bottomfish and shellfish on the Continental Shelf and upper continental slope in the Gulf of Alaska. Much of the area surveyed was judged to be untrawlable with conventional bottom trawls used in the surveys. Flatfish made up 43 percent of the total catch of fish and invertebrates. The arrowtooth flounder or turbot was a dominant species at all depths, comprising 60 percent of the flatfish catch and 26 percent of the combined fish and invertebrate catch.

INTRODUCTION

In the summer and fall of 1961 and spring of 1962 otter trawls were used to survey the ttomfish and shellfish on the Continental Shelf and upper continental slope in the Gulf of aska. The survey was part of a long-range program begun in 1950 to determine the size of ttomfish stocks in the northeastern Pacific Ocean between southern Oregon and northwest aska. The general purpose of the surveys has been to investigate all bottomfish in areas being fished commercially. Results of previous investigations have been reported by lson, Knake, and Dassow 1949; Ellson, Powell, and Hildebrand 1950; Schaefers, Smith, and eenwood 1955; Alverson 1951, 1953; Greenwood 1958; Johnson 1959; Hitz, Johnson, and ter 1961; Hitz and Alverson 1963.

The International Pacific Halibut Comsion (IPHC) began a survey in 1961 in the of Alaska from Unimak Pass to Cape ncer (fig. 1) to determine the availability libut and other bottomfish to trawl gear. perating with the Commission, the U. S. au of Commercial Fisheries assigned hartered vessel Tordenskjold and the Bu- 's research vessel John N. Cobb to sur- hat part of the Gulf from the west end of iak Island to Cape Spencer (fig. 1). There been a considerable amount of interest in t is available to trawl gear in that area, e the Soviets and Japanese began trawl- in the Gulf of Alaska. The Soviets were wling for bottomfish in the Gulf in 1960 on xploratory basis and by 1963 were involved in large-scale commercial operations. Through , Japanese activities were confined to exploratory fishing and limited commercial oper- ns.

Fig. 1 - The Gulf of Alaska.

The data collected from both Bureau vessels during the survey have been incorporated other data (Alverson, Pruter, and Ronholt 1964) into a general analysis of the distribu-

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tion and relative abundance of demersal fish along the Pacific coast of North America, north of California. This study will relate the detailed features as shown by the surveys of the John N. Cobb and Tordenskjold in the Gulf of Alaska.

The Bureau's aims in this particular trawl survey were (1) to determine the general species composition and relative abundance of demersal fish and shellfish; (2) to obtain accurate records of the bottom topography for determining probable extent of trawlable grounds; and (3) using tags furnished by IPHC, to tag and return to the water all viable halibut captured.

METHODS AND GEAR

A prescheduled sampling pattern was followed in measuring species composition and relative abundance of demersal fish and invertebrates. The sampling pattern followed an overall plan suggested by IPHC for the entire Gulf of Alaska region. The basic pattern provided stations 6 miles apart on sectors at each 15 minutes of longitude with the stations staggered from one sector to the next (fig. 2). Beyond the 100-fathom line the pattern provided stations at depths of 150 and 250 fathoms, regardless of the distance between stations. The lines of stations were numbered from west to east, and each station was designated by a letter of the alphabet starting from the closest station inshore and moving outward. Figure 2 shows the arrangement of the station lines and stations assigned to the Bureau of Commercial Fisheries. Lines 59 to 82 were the responsibility of the Bureau's Exploratory Fishing and Gear Research Base, Seattle, Wash., while lines 83 to 114 were assigned to the Exploratory Fishing and Gear Research Base, Juneau, Alaska.

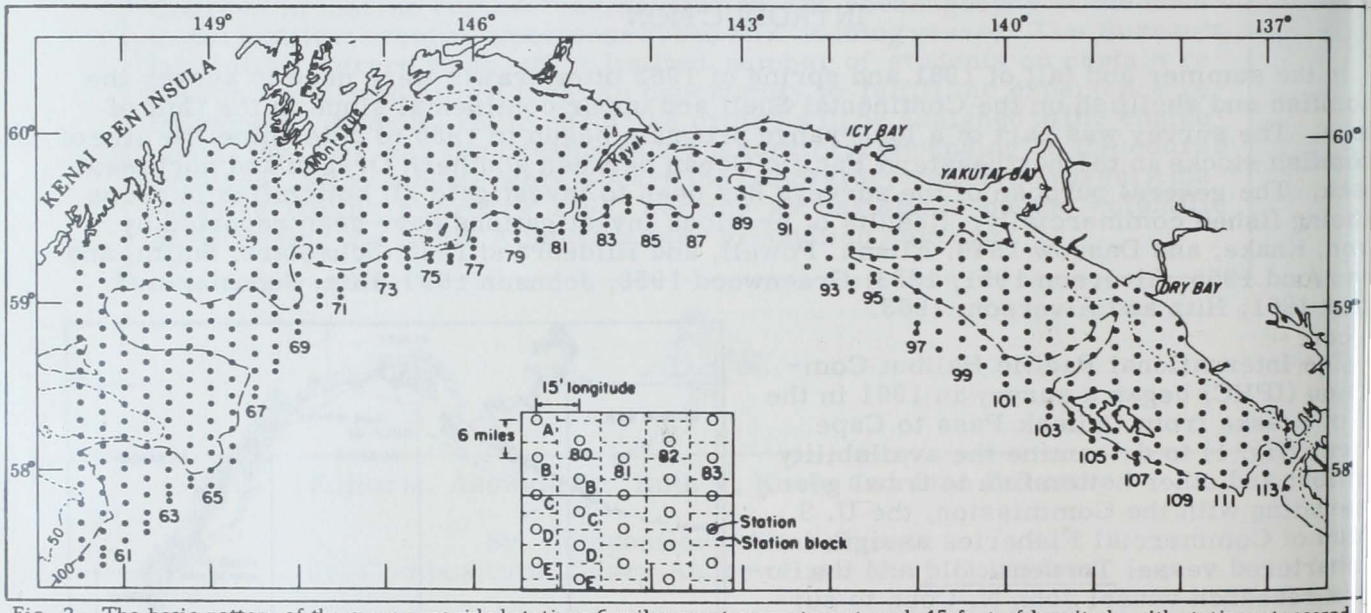

Fig. 2 - The basic pattern of the survey provided stations 6 miles apart on sectors at each 15 feet of longitude with stations staggered from one sector to the next.

Two vessels were used in surveying the Bureau's area. The Base at Juneau chartered a schooner-type trawler, the Tordenskjold (fig. 3). This vessel has an overall length of 75 feet, a beam of 18 feet, and a mean load draft of 9 feet (Greenwood 1958). The Base at Seattle used the Bureau's research vessel John N. Cobb (fig. 4). It is a West Coast purse seiner in general design with an overall length of 93 feet, a beam of 25 feet, and a mean load draft of 9 feet (Ellson 1950). Both vessels tow their trawls from the stern and haul over the starboard side; the Tordenskjold sets from the starboard side while the John N. Cobb sets over the stern.

A 400-mesh eastern otter trawl net (Greenwood 1958) with a $1\frac{1}{2}$-inch mesh liner, 100 meshes in length, placed in the cod end of the net to retain small organisms such as shrimp, was used to sample each of the stations. A snag cable 30 fathoms long and $\frac{3}{8}$-inch diameter

as attached between the otter boards and dragged on the ocean floor ahead of the net. By hanging up" on bottom obstacles the snag cable minimized damage to the net.

A drag was attempted in each station block (fig. 2); however, since much of the ocean bot- m was too rough for trawling, many stations could not be sampled. To determine if the bot- m was trawlable, an echo-sounding transect was generally made along the station line. If e bottom appeared level and soft, a 1-hour drag was attempted.

ig. 3 - The chartered vessel Tordenskjold, a schooner-type rawler.

Fig. 4 - The exploratory fishing and gear research vessel John N. Cobb.

Because of the limited time allowed to survey a rather large area, intensive echo-sound- g transects could not be made. Thus, many of the sampling blocks judged to be untrawlable sampling gear used in the described surveys may in fact contain trawlable grounds which ould be located if more thorough echo-sounding surveys were made, or other types of trawl ear were used.

Aside from enumerating the catch, the following data were collected for each station. ocation was determined by loran or radar bearings. Meteorological data were obtained and corded. A sample of bottom sediments was obtained with a Dietz-LaFond bottom grab, and bottom ocean temperature was taken with either a bathythermograph or a reversing ther- meter at the end of each haul.

When obvious snags were not encountered during a haul, the otter trawl was towed for 1 ur. The catch was then brought aboard and dumped into checkers, where it was sorted by ecies and counts and weights of individual species were recorded. Ranges in lengths and ights were determined for each species. Length-frequency samples of the two dominant ecies were often obtained. Otoliths and scales were removed for subsequent age and growth termination from representative sizes of the dominant species encountered. When catches re larger than 5,000 pounds, subsamples were taken to determine quantities and sizes of ch species.

During the sorting of the catch, all halibut weighing less than 40 pounds were placed into live box, from which the viable ones were subsequently removed for tagging and release. he larger halibut that were not placed into the live box were tagged from the deck and re- rned to the sea immediately. Untagged halibut were measured, their sex determined, and e otoliths removed for age and growth studies made by IPHC.

AREA SURVEYED

The Continental Shelf in the Gulf of Alaska is relatively wide, extending some 50 miles eaward as it curves westerly towards Kodiak Island. The continental slope in that area is tremely steep and penetrated by numerous submarine canyons.

Major features of the Continental Shelf surveyed by the Bureau are shown in fig. 5. To the west are a number of well-known halibut fishing grounds such as Albatross Gully, Portlock Bank, and Seward Gully. Between Cape Cleare and Cape St. Elias is a large flat area which forms Middle Bank and the Cape Cleare grounds. Between Cape St. Elias and Dry Bay the Continental Shelf is penetrated by five submarine canyons: Kayak, Tsivat, Icy, Yakutat, and Alsak. East of Yakutat Canyon there are two large flats, Yakutat Bank and the Fairweather Grounds, which are major halibut fishing grounds.

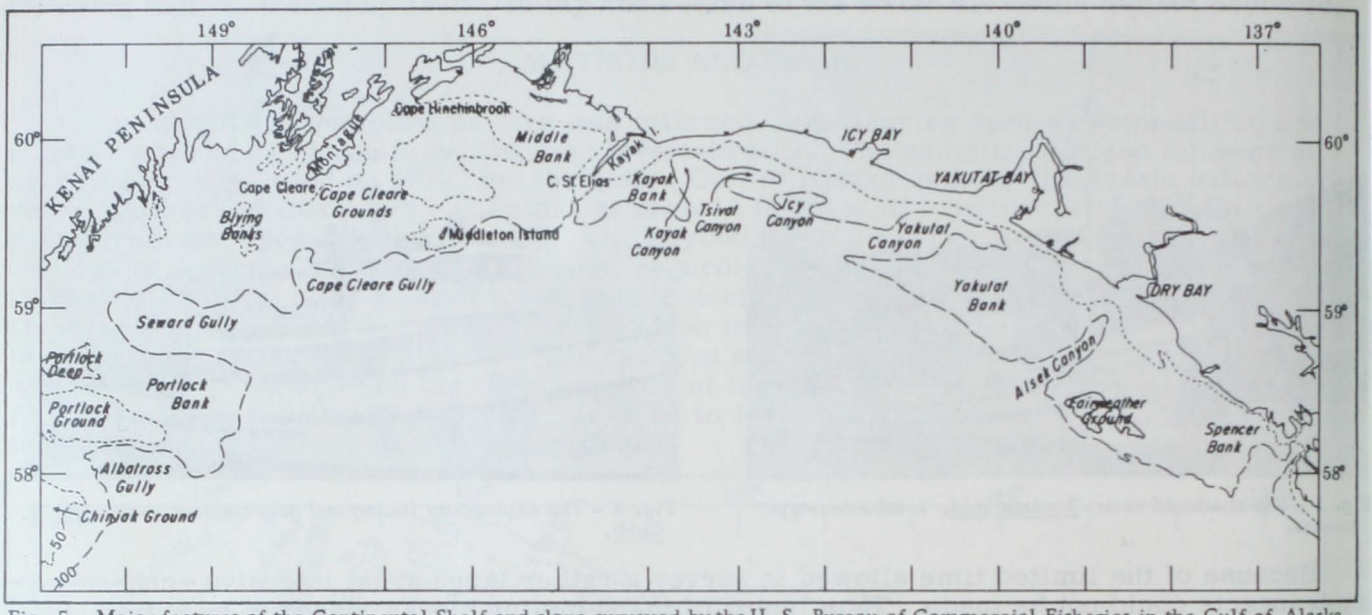

Fig. 5 - Major features of the Continental Shelf and slope surveyed by the U. S. Bureau of Commercial Fisheries in the Gulf of Alaska.

RESULTS

LIMITATIONS OF THE DATA: Major limitations of the surveys are those imposed by (1) the selectivity of the otter trawls used and (2) the seasonal movements of certain species. Otter trawls of the type used in the surveys can be fished only on relatively smooth bottom free of rocks and other obstructions. Moreover, all trawls are selective toward certain species of fish and certain size groups within each species. The work of Soviet investigators (Lyubimova 1962, 1963) in the Gulf of Alaska clearly illustrates this selectivity in trawls. She found that ocean perch were very mobile and as a rule 6 to 9 feet off the bottom, hence a light trawl fished just off the bottom was effective in harvesting this species. On May 5, 1962, the personnel aboard the John N. Cobb had an opportunity to observe the Soviet gear in operation (Pruter 1962). The catches appeared to consist entirely of Pacific ocean perch. Many species of bottomfish inhabiting the survey area probably perform seasonal onshore-offshore migrations as well as movements along the coast. Thus, their availability to capture may have been different if the surveys had taken place at other times of the year. These factors undoubtedly influenced the results described here.

SAMPLING EFFORT: The Bureau's survey area had 617 stations. Of that total, 210 stations were considered successful, while 304 were considered unsuccessful, and 103 were not occupied (fig. 6).

Successful stations are defined as those where the net was trawled for 1 hour with no resultant net damage; the unsuccessful stations are those where the net was trawled less than an hour, where the net was damaged, or where echo-soundings indicated untrawlable grounds; unoccupied stations were either missed because of time limitations or because the bottom topography shown on navigations charts indicated they were not suitable for trawling. Aproximately 50 percent of the stations were found to be untrawlable to the conventional otter trawl.

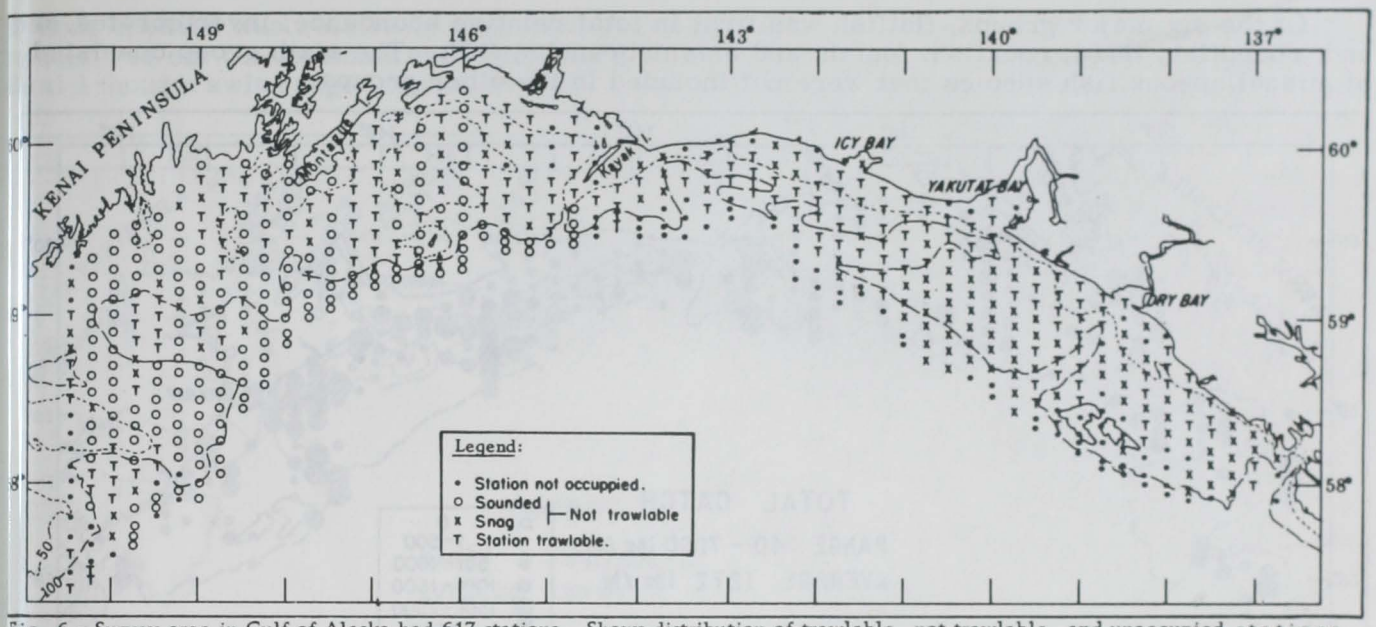

Fig. 6 - Survey area in Gulf of Alaska had 617 stations. Shows distribution of trawlable, not trawlable, and unoccupied stations.

Trawling at depths less than 51 fathoms was restricted because of much hard and uneven bottom. About 80 percent of the successful sampling occurred within the depth range of 51-150 fathoms (table 1). Only 3 percent of the total samples was made in the greatest depths sampled (201-250 fathoms), primarily because the continental slope was steep.

Table 1 - Distribution of Sampling Effort for Successful Hauls by Depth Interval

Depth Interval	Hours Fished	Percentage of Effort
Fathoms		%
0-50	27.11	12.4
51-100	104.91	48.0
101-150	69.35	31.7
151-200	11.03	5.0
201-250	6.06	2.8
Total	218.48	99.9

ANALYSIS OF CATCHES: Catches from the successful stations are shown in table 2 by major groups and by depth intervals. The catches of individual groups per unit of trawling effort are shown in table 3. Catches of all species combined in individual hauls ranged from 0 to 7,000 pounds and averaged 1,272 pounds per hour trawled (fig. 7). The most productive area was between Icy Bay and Dry Bay.

Table 2 - Total Indicated Species Groups Caught by Depth Intervals

Depth Interval	Flatfish	Invertebrates	Roundfish	Rockfish	Elasmobranchs	Other Species	Total
Fathoms	(Pounds)						
1-50	16,307	3,670	8,664	13	603	124	29,381
51-100	56,053	26,812	19,137	6,583	4,258	535	113,378
101-150	36,022	29,655	9,979	18,837	2,633	482	97,608
151-200	7,784	13,183	546	2,010	197	58	23,778
201-250	4,547	1,864	2,598	2,489	122	2,185	13,805
Total	120,713	75,184	40,924	29,932	7,813	3,384	277,950
Percentage	43.4	27.0	14.7	10.8	2.8	1.2	99.9

Table 3 - Indicated Species Groups Caught Per Hour Trawled

Depth Interval	Flatfish	Invertebrates	Roundfish	Rockfish	Elasmobranchs	Other Species	Total
Fathoms	(Pounds)						
1-50	601.5	135.4	319.6	.5	22.2	4.6	1,083.8
51-100	534.3	255.6	182.4	62.8	40.6	5.1	1,080.7
101-150	519.4	427.6	143.9	271.6	38.0	7.0	1,644.6
151-200	705.7	1,195.2	49.5	182.2	17.9	5.3	2,155.8
201-250	750.3	307.6	428.7	410.7	20.1	360.6	2,278.0
Average	552.5	344.1	187.3	137.0	35.8	15.5	1,272.2

Of the six major groups, flatfish was first in total relative abundance; invertebrates, second; roundfish, third; rockfish, fourth; and elasmobranchs, fifth. The sixth group consisted of miscellaneous fish species that were not included in the other groups.

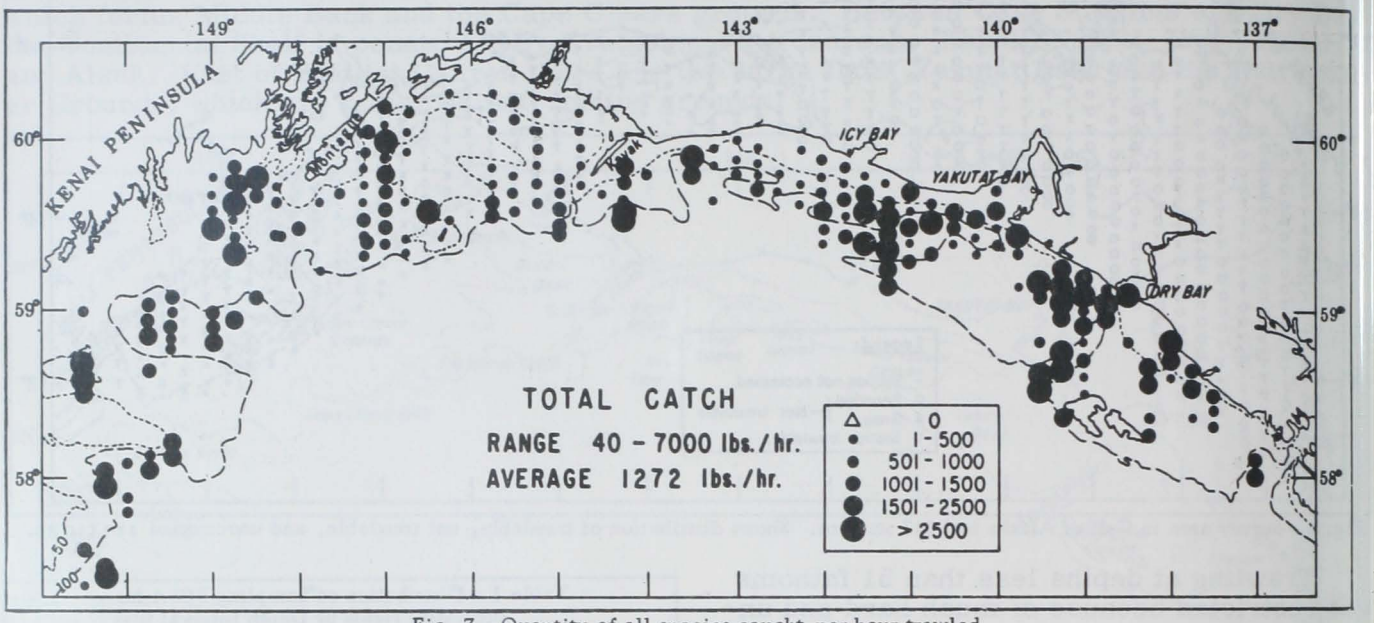

Fig. 7 - Quantity of all species caught per hour trawled.

Flatfish: The flatfish group which comprised 43 percent of the total catch numbered more species than any of the other 4 major fish groups. Species caught were: arrowtooth flounder or turbot, Atheresthes stomias; flathead sole, Hippoglossoides elassodon; Dover sole, Microstomus pacificus; Pacific halibut, Hippoglossus stenolepis; butter sole, Isopsetta isolepis; rex sole, Glyptocephalus zachirus; starry flounder, Platichthys stellatus; English sole, Parophrys vetulus; rock sole, Lepidopsetta bilineata; petrale sole, Eopsetta jordani; and sand sole, Psettichthys melanostictus.

Table 4 - Total Individual Species of Flatfish Taken by Depth Intervals

Depth Interval	Turbot	Flathead Sole	Dover Sole	Halibut	Butter Sole	Rex Sole	Starry Flounder	English Sole	Rock Sole	Petrale Sole	Sand Sole	Total
Fathoms	(Pounds)											
1-50	3,491	672	6	1,652	5,498	274	3,402	1,010	241	7	53	16,30
51-100	38,447	11,029	694	3,575	167	1,106	143	667	213	12	-	56,05
101-150	24,645	5,425	2,398	1,215	-	2,150	-	1	13	175	-	36,02
151-200	4,264	791	1,491	585	-	653	-	-	-	-	-	7,78
201-250	1,325	-	3,025	50	-	147	-	-	-	-	-	4,54
Total	72,172	17,917	7,614	7,077	5,665	4,330	3,545	1,678	467	194	53	120,71
Percentage	59.8	14.8	6.3	5.9	4.7	3.6	2.9	1.4	0.4	0.1	0.0	100.0

Turbot accounted for about 60 percent of the total flatfish (table 4) and 26 percent of the total catch by weight. The average catch rate (all depth intervals) for that species was 330 pounds per hour trawled; that rate was over four times greater than that for flathead sole, the second most abundant species (table 5). The availability of turbot as measured by the catch

Table 5 - Individual Species of Flatfish Caught Per Hour Trawled

Depth Interval	Turbot	Flathead Sole	Dover Sole	Halibut	Butter Sole	Rex Sole	Starry Flounder	English Sole	Rock Sole	Petrale Sole	Sand Sole	Total
Fathoms	(Pounds)											
1-50	128.8	24.8	0.2	60.9	202.8	10.1	125.5	37.3	8.9	0.3	2.0	601.5
51-100	366.5	105.1	6.6	34.1	1.6	10.5	1.4	6.4	2.0	0.1	-	534.3
101-150	355.4	78.2	34.6	17.5	-	31.0	-	-	0.2	2.5	-	519.4
151-200	386.6	71.7	135.2	53.0	-	59.2	-	-	-	-	-	705.7
201-250	218.6	-	499.2	8.3	-	24.3	-	-	-	-	-	750.3
Average	330.3	82.0	34.9	32.4	25.9	19.8	16.2	7.7	2.1	0.9	0.2	552.5

hour trawled was relatively high and fairly constant at all depths (table 5); however, that nder was not the dominant species in all depth intervals (table 14). Turbot catches in indi- al 1-hour trawls ranged from 0 to 4,500 pounds, with largest catches near Dry Bay (fig. 8).

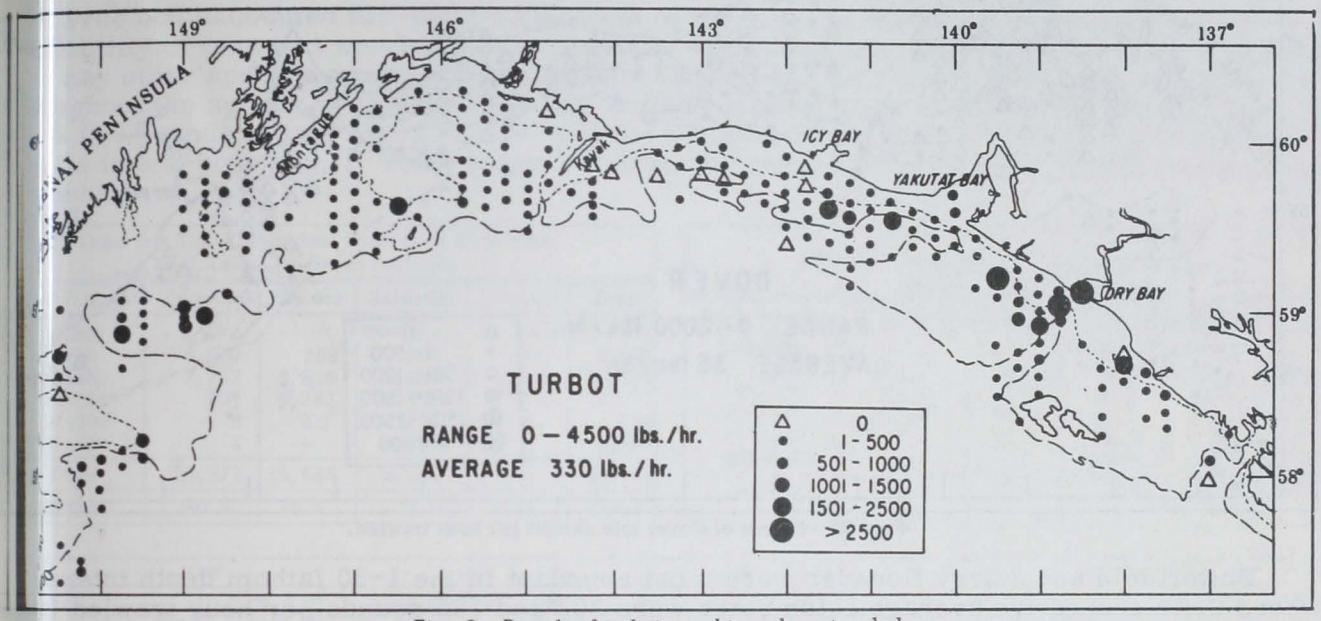

Fig. 8 - Pounds of turbot caught per hour trawled.

Flathead sole ranked second to turbot in the flatfish catches and accounted for about 15 ent of the total flatfish caught (table 4). The catch rate of flathead sole was highest in the to 100-fathom interval (tables 5 and 14). Most of the successful trawls west of Kayak Is- contained flathead sole, but to the east many did not. The largest catches of up to 2,250 ds per hour trawled were between Yakutat Bay and Dry Bay (fig. 9).

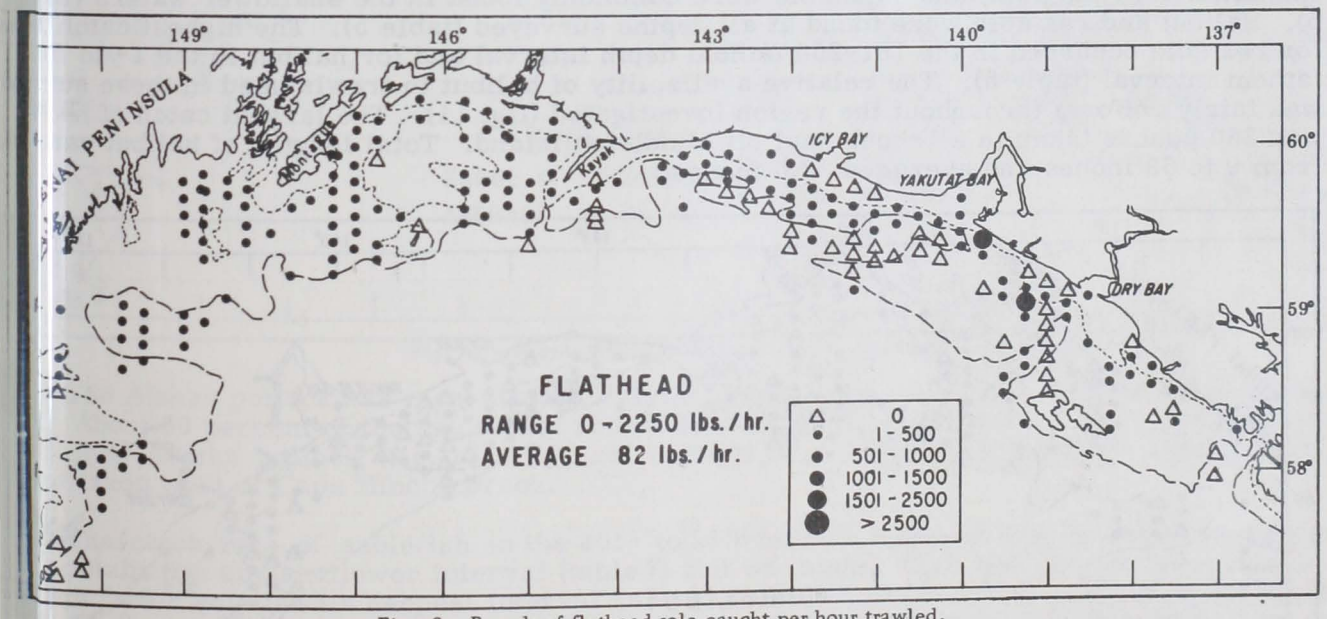

Fig. 9 - Pounds of flathead sole caught per hour trawled.

Dover sole dominated the flatfish catches in the 201-250 fathom interval (tables 4 and 5) the catch rates in that depth interval were higher than for any other fish species (table Although about 50 percent of the hauls did not contain Dover sole, two 1-hour hauls south lbatross Gully yielded the largest Dover sole catches--1,000 and 2,000 pounds (fig. 10). l lengths of Dover sole ranged from 9 to 25 inches and averaged 13.4 inches.

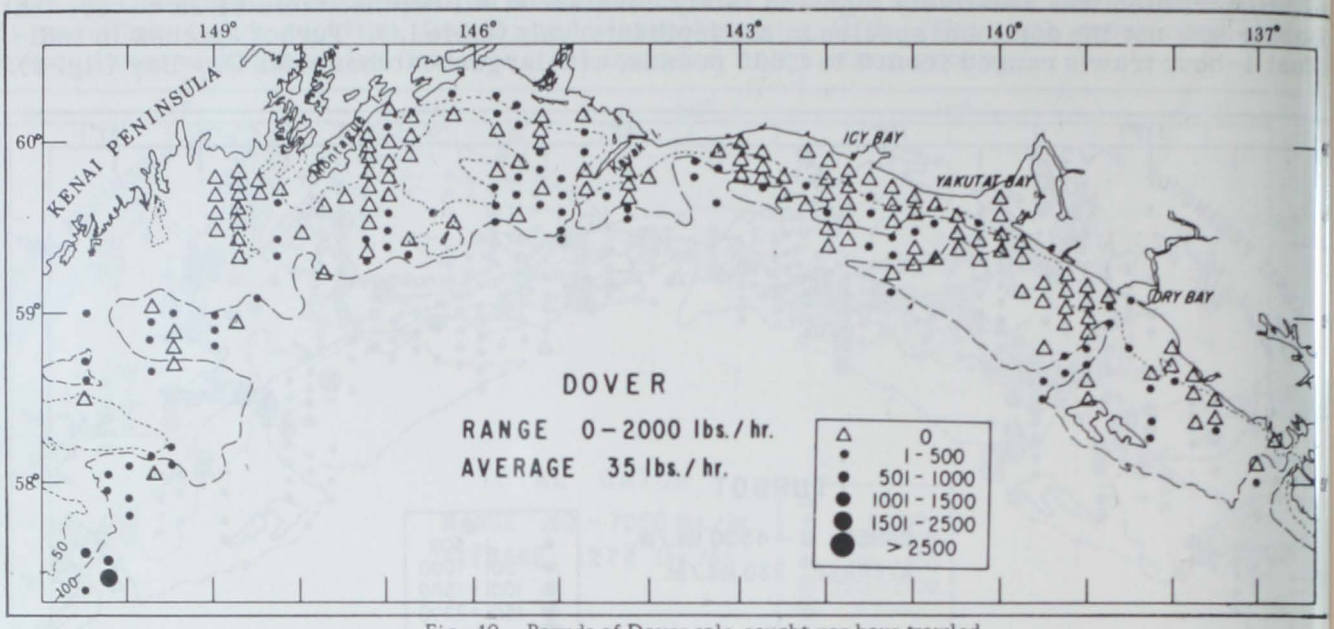

Fig. 10 - Pounds of Dover sole caught per hour trawled.

Butter sole and starry flounder were most abundant in the 1-50 fathom depth intervals where their respective average catch rates were 202 and 125 pounds per hour trawled (tab 5 and 14). In three drags just outside Dry Bay over 1,000 pounds of butter sole were caug per hour trawled. A catch of 1,000 pounds of starry flounders was taken outside of Yakuta Bay.

The remaining six species of flatfish (halibut, rex sole, English sole, rock sole, petra sole, and sand sole) comprised 11 percent of the total pounds of that species group (table 4 English sole, rock sole, and sand sole were commonly found in the shallower waters (table 5). Halibut and rex sole were found at all depths surveyed (table 5). The highest catch ra for rex sole occurred in the 151-200 fathom depth interval and for halibut in the 1- to 50- fathom interval (table 5). The relative availability of halibut to trawls used in these surve was fairly uniform throughout the region investigated (fig. 11). The largest catch of halibu was 360 pounds taken in a 1-hour haul off Middleton Island. Total lengths of halibut range from 9 to 69 inches and averaged 23.6 inches.

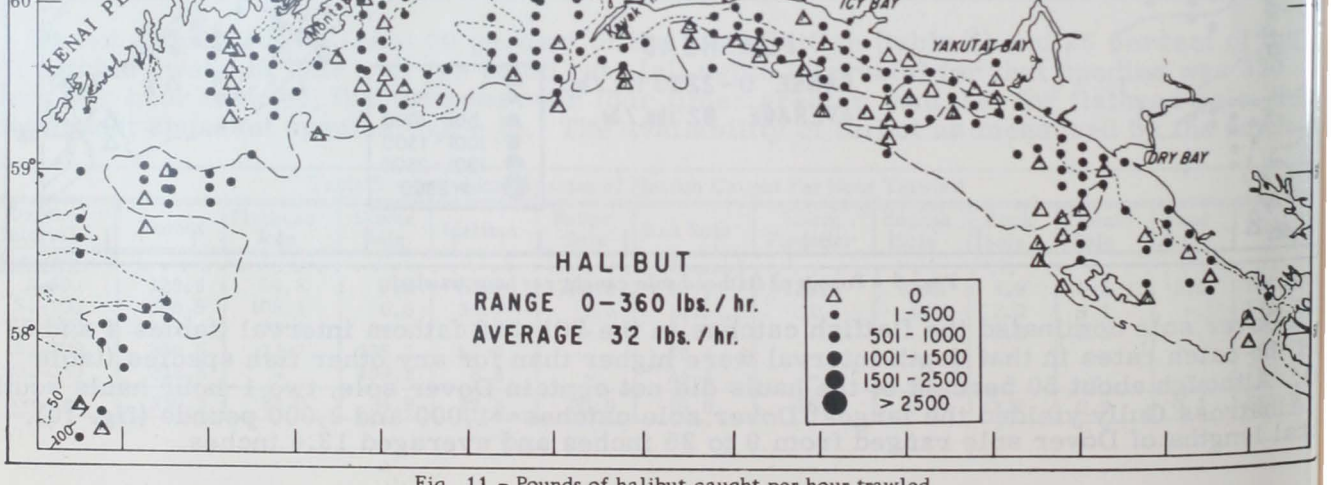

Fig. 11 - Pounds of halibut caught per hour trawled.

Roundfish: The roundfish group (exclusive of rockfish) which comprised 15 percent of e total catch was made up of four species; true cod (Gadus macrocephalus), Alaska pollock Theragra chalcogrammus), sablefish (Anoplopoma fimbria), and lingcod (Ophiodon elongatus).

True cod accounted for about 40 percent of the total roundfish captured (table 6). The ailability of true cod was highest in the 1- to 50-fathom interval (table 7) and also higher n any other species caught in that interval (table 14). Catches of true cod were scattered oughout the survey area (fig. 12). The largest catches were taken on Yakutat Flats (1,000 d 6,000 pounds in two 1-hour hauls) and near Blying Banks southwest of Cape Cleare (4,500 nds in a 1-hour haul). Total lengths of true cod ranged from 11 to 30 inches and averaged inches.

Table 6 - Total Individual Species of Roundfish Taken by Depth Intervals

th Interval	True Cod	Pollock	Sablefish	Lingcod	Total
athoms	(Pounds)				
1-50	8,030	262	364	8	8,664
51-100	7,732	8,816	2,544	45	19,137
101-150	801	6,283	2,889	6	9,979
151-200	8	327	211	-	546
201-250	2	-	2,596	-	2,598
Total	16,573	15,688	8,604	59	40,924
rcentage	40.5	38.3	21.0	0.1	99.9

Table 7 - Individual Species of Roundfish Caught Per Hour Trawled

Depth Interval	True Cod	Pollock	Sablefish	Lingcod	Total
Fathoms	(Pounds)				
1-50	296.2	9.7	13.4	0.3	319.6
51-100	73.7	84.0	24.2	0.4	182.4
101-150	11.6	90.6	41.7	0.1	143.9
151-200	0.7	29.7	19.1	-	49.5
201-250	0.3	-	428.4	-	428.7
Average	75.9	71.8	39.4	0.3	187.3

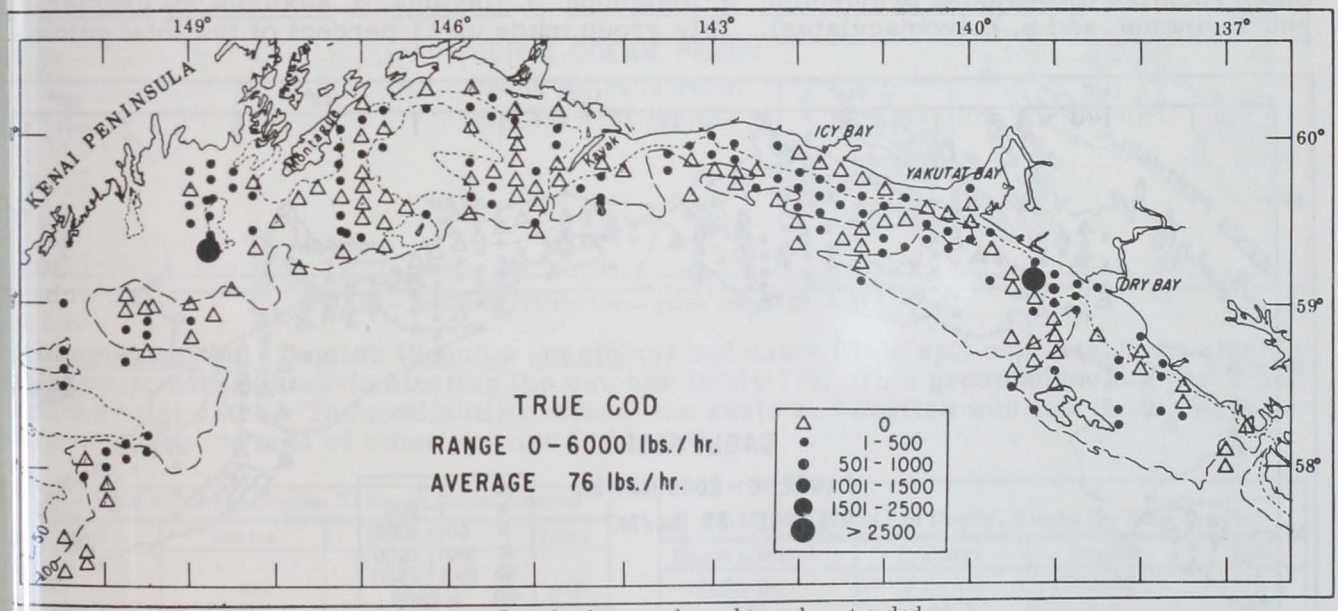

Fig. 12 - Pounds of true cod caught per hour trawled.

The Alaska pollock was most available in the depth range of 51-150 fathoms (tables 7 and). About 50 percent of the hauls east and 83 percent of the hauls west of Cape Hinchinbrook ntained Alaska pollock (fig. 13). Several catches of over 1,000 pounds per hour trawled re taken west of Cape Hinchinbrook.

The catch rate of sablefish in the 201- to 250-fathom interval was 10 times as high as t obtained in any shallower interval (table 7) and was higher than that for any other species cept Dover sole in this deepest interval surveyed (table 14). About 76 percent of the hauls de during the survey contained sablefish. The two largest catches of 1,500 and 2,000 pounds sablefish per hour trawled of sablefish were taken off Cape Spencer and near the Fairweather Grounds (fig. 14).

Rockfish: For convenience rockfish are divided into four groups: Pacific ocean perch ebastodes alutus), idiots (Sebastolobus sp.), rougheye rockfish (Sebastodes aleutianus), and

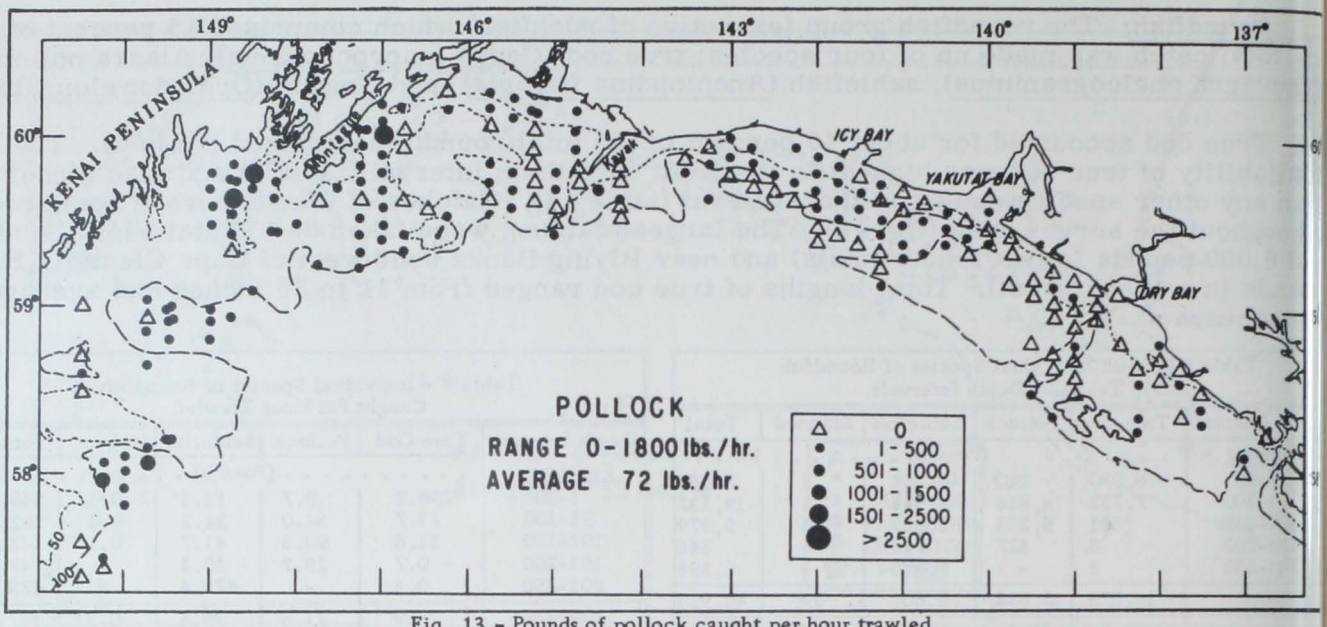

Fig. 13 - Pounds of pollock caught per hour trawled.

other rockfish (Sebastodes brevispinis, S. melanops, S. flavidus, S. saxicola, S. crameri, S. rubrinvinctus, and S. halvomaculatus). This group made up 11 percent of the total catch.

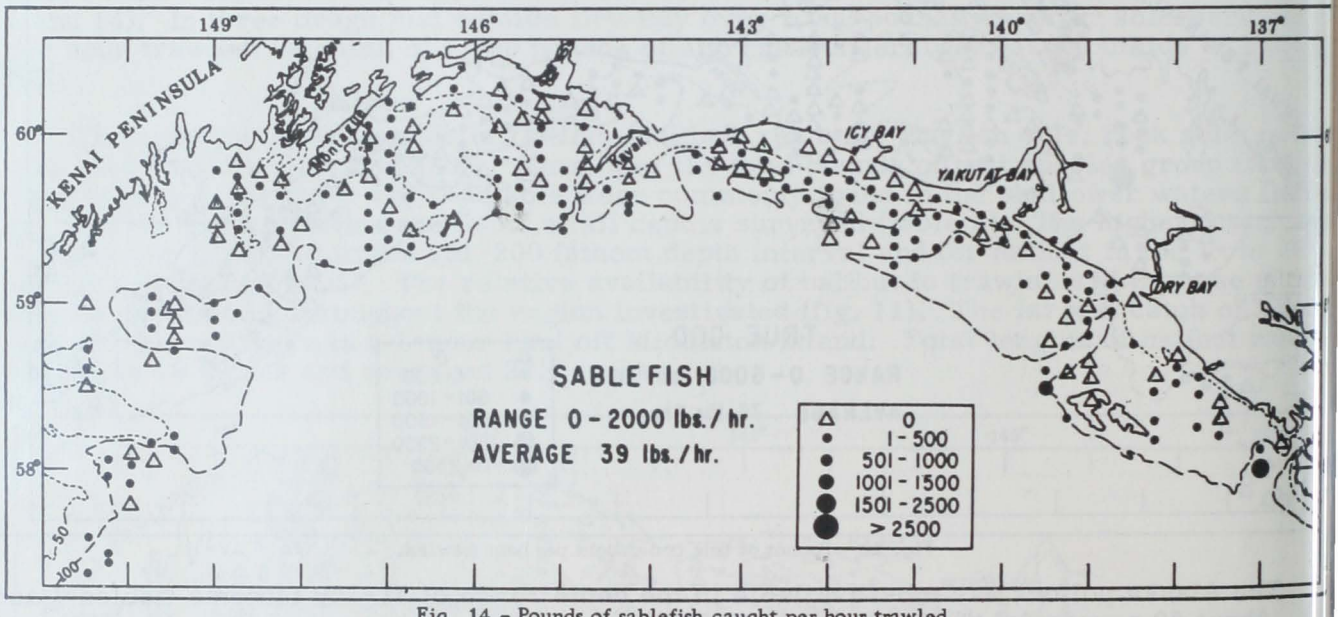

Fig. 14 - Pounds of sablefish caught per hour trawled.

Pacific ocean perch represented 74 percent of the total rockfish catch (table 8). Catch rates of that species were highest in the 101- to 200-fathom depth range (tables 9 and 14). About 63 percent of the hauls made during the survey contained Pacific ocean perch, with t large catches of over 1,000 pounds occurring near the 100-fathom contour (fig. 15).

The remaining three groups of rockfish accounted for 26 percent of the total rockfish ca (table 8). Catch rates of both Sebastolobus and the rougheye rockfish generally increased w depth (table 9). The indicated relative abundance of rougheye rockfish was highest (336 pou per hour trawled) in the 201- to 250-fathom interval (tables 9 and 14).

Table 8 - Total Individual Species or Groups of Rockfish Taken by Depth Interval

pth rval	Pacific Ocean Perch	Sebastolobus	Rougheye	Others	Total
oms	(Pounds)				
50	2	-	1	10	13
100	6,059	243	182	99	6,583
150	14,185	3,817	616	219	18,837
200	1,748	253	5	4	2,010
250	-	451	2,034	4	2,489
tal	21,994	4,764	2,838	336	29,932
ntage	73.5	15.9	9.5	1.1	100.0

Table 9 - Individual Species or Groups of Rockfish Caught Per Hour Trawled

Depth Interval	Pacific Ocean Perch	Sebastolobus	Rougheye	Others	Total
Fathoms	(Pounds)				
1-50	0.1	-	0.0	0.4	0.5
51-100	57.8	2.3	1.7	0.9	62.8
101-150	204.5	55.0	8.9	3.2	271.6
151-200	158.5	22.9	0.5	0.4	182.2
201-250	-	74.4	335.6	0.7	410.7
Average	100.7	21.8	13.0	1.5	137.0

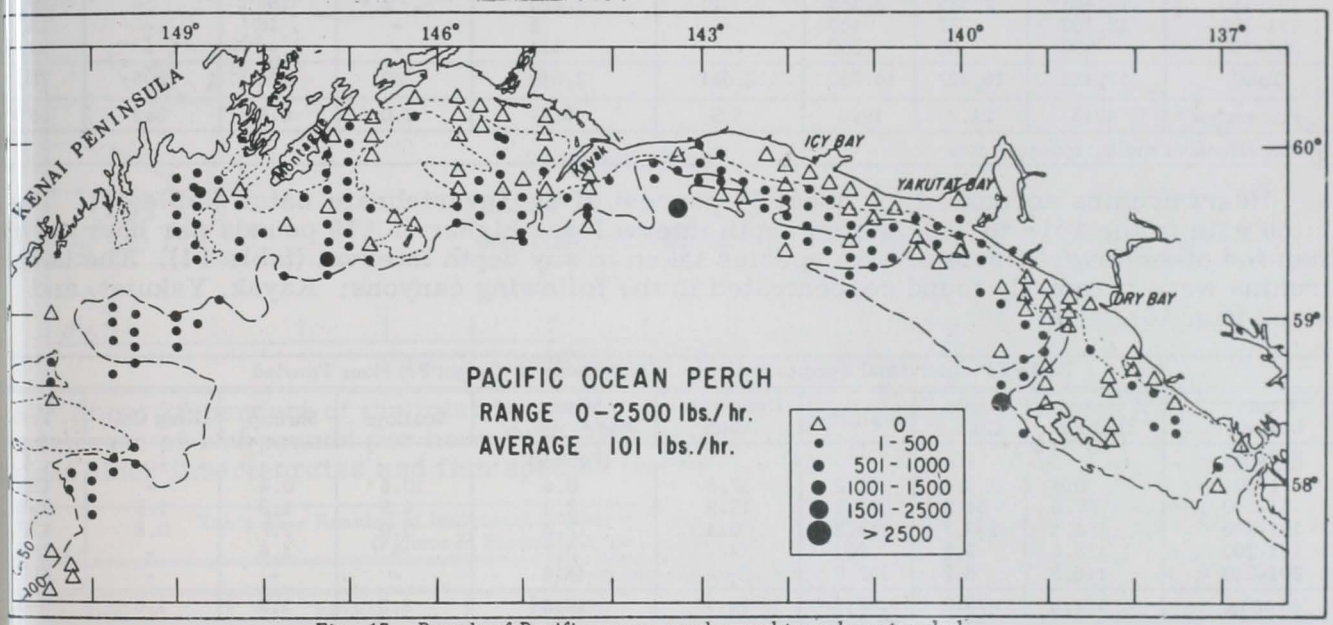

Fig. 15 - Pounds of Pacific ocean perch caught per hour trawled.

Elasmobranchs: Dogfish (Squalus acanthias) and skate (Raja sp.) comprised the elasmo- nch group, with skates dominating the catches (table 10). This group accounted for 3 per- t of the total catch. The availability of both the skate and dogfish was low in all depth in- vals compared to that of other species (table 14).

e 10 - Total Skate and Dogfish Taken by Depth Interval

Interval	Skates	Dogfish	Total
homs	(Pounds)		
1-50	362	241	603
1-100	3,274	984	4,258
1-150	2,506	127	2,633
1-200	197	-	197
1-250	122	-	122
Total	6,461	1,352	7,813
ercentage	82.7	17.3	100.0

Table 11 - Skate and Dogfish Caught Per Hour Trawled

Depth Interval	Skates	Dogfish	Total
Fathoms	(Pounds)		
1-50	13.4	8.9	22.2
51-100	31.2	9.4	40.6
101-150	36.1	1.8	38.0
151-200	17.9	-	17.9
201-250	20.1	-	20.1
Average	29.6	6.2	35.8

Other Fish Species: This group consists of many different families including herring upeidae), sculpin (Cottidae), poacher (Agonidae), ronquil (Bathymasteridae), eelpout (Zoar- ae), and rattail (Coryphaenoididae). This group accounted for only one percent of the total ch. Most of the catches in this group were insignificant except in the 201- to 250-fathom rval where a value of 360 pounds per hour trawled was attained (table 3), over 99 percent which consisted of rattail. This rate was higher than that of any other single species taken hat depth, except Dover sole and sablefish (table 14). Total lengths of the rattail ranged m 29 to 38 inches and averaged 23.9 inches in total length.

Invertebrates: Invertebrates comprising 27 percent of the total catch were grouped int eight categories; heart urchins (Echinoidea), tanner crab (Chionoecetes opilio), starfish (Asteroidea), Dungeness crab (Cancer magister), scallop (Pecten caurinus), shrimp (Pandal borealis, P. platyceros, and Pandalopsis dispar), king crab (Paralithodes camtschatica), an miscellaneous invertebrates (shells, sponges, etc.)

Table 12 - Total Individual Species or Groups of Invertebrates by Depth Intervals

Depth Interval	Heart Urchins	Tanner Crab	Starfish	Dungeness Crab	Misc. Invert. spp. 1/	Scallops	Shrimp	King Crab	Tota
Fathoms	(Pounds)								
1-50	10	125	2,201	1,025	12	286	11	-	3,6
51-100	6,047	8,862	8,224	1,606	1,256	472	191	154	26,8
101-150	17,465	7,333	3,385	10	1,220	2	186	54	29,6
151-200	13,100	57	100	-	8	-	18	-	13,1
201-250	900	50	800	-	114	-	-	-	1,8
Total	37,422	16,427	14,710	2,641	2,610	760	406	208	75,1
Percentage	49.8	21.9	19.6	3.5	3.4	1.0	0.5	0.3	99.

1/Miscellaneous shells, sponges, etc.

Heart urchins accounted for about 50 percent of the invertebrate catch (table 12). The catch rate in the 151- to 200-fathom depth interval was higher (1,179 pounds per hour trawle than for other invertebrate or fish species taken in any depth interval (table 14). The heart urchins were primarily found concentrated in the following canyons: Kayak, Yakutat, and Alsek (fig. 16).

Table 13 - Individual Species or Groups of Invertebrates Caught Per Hour Trawled

Depth Interval	Heart Urchins	Tanner Crab	Starfish	Dungeness Crab	Misc. Invert. spp. 1/	Scallops	Shrimp	King Crab	Total
Fathoms	(Pounds)								
1-50	0.4	4.6	81.2	37.8	0.4	10.6	0.4	-	135.4
51-100	57.6	84.5	78.4	15.3	12.0	4.5	1.8	1.5	255.6
101-150	251.8	105.7	48.8	0.1	17.6	0.0	2.7	0.8	427.6
151-200	1,178.6	5.2	9.1	-	0.7	-	1.6	-	1,195.2
201-250	148.5	8.2	132.0	-	18.8	-	-	-	307.6
Average	171.3	75.2	67.3	12.1	12.0	3.5	1.9	1.0	344.1

1/Miscellaneous shells, sponges, etc.

Tanner crab ranked second to heart urchins and represented about 22 percent of the in vertebrate catch (table 12). The catch rate of tanner crab was highest in the 101- to 150-

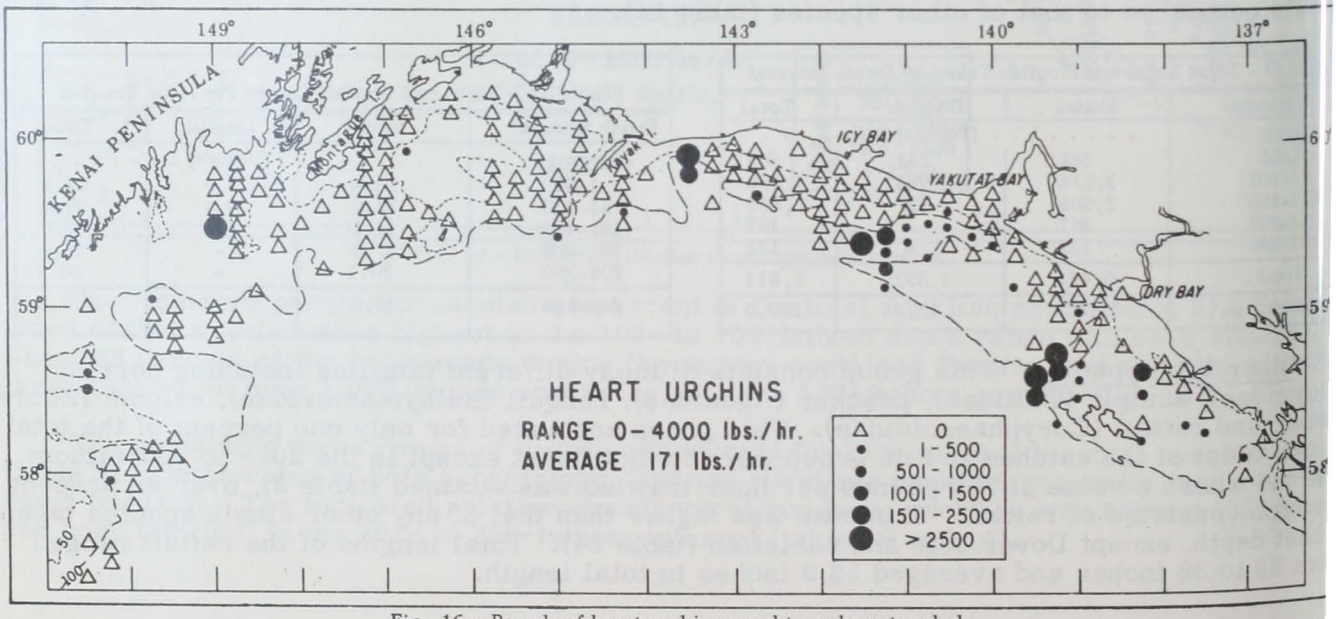

Fig. 16 - Pounds of heart urchins caught per hour trawled.

athom interval (tables 13 and 14). Eighty-five percent of the catches west and 50 percent of he catches east of Middleton Island had tanner crab. The largest catch of 2,390 pounds per our trawled occurred northwest of Middleton Island (fig. 17).

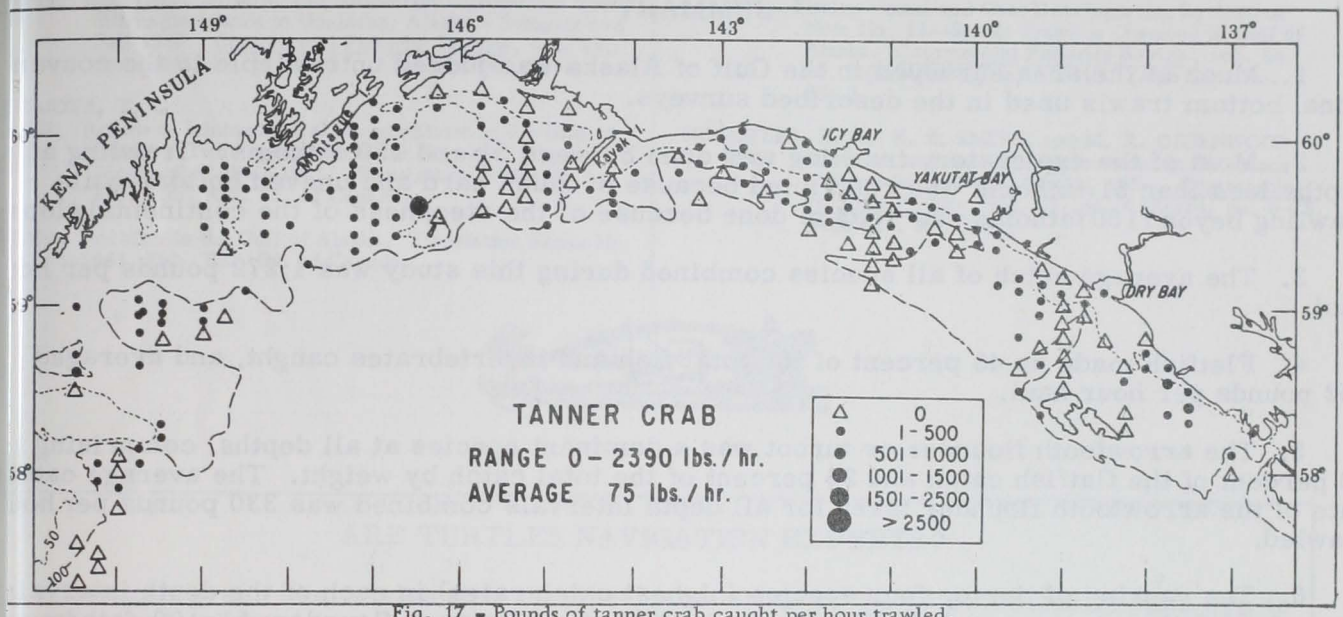

Fig. 17 - Pounds of tanner crab caught per hour trawled.

About 20 percent of the total invertebrate catch was composed of starfish (table 6). The atch rate of 132 pounds per hour in the 201- to 250-fathom interval was higher than that for ost other invertebrates and fish species (tables 13 and 14).

Table 14 - Ranking of Individual Species or Species Groups by Catch Per Unit of Effort and Depth (Figures in Parenthesis are Pounds Caught Per Hour Trawled)

Depth Interval in Fathoms					
1-50	51-100	101-150	151-200	201-250	All Depths (1-250)
rue cod (296)	Turbot (366)	Turbot (355)	Heart urchin (1179)	Dover (499)	Turbot (330)
utter sole (203)	Flathead (105)	Heart urchins (252)	Turbot (386)	Sablefish (428)	Heart urchins (171)
urbot (129)	Tanner crab (84)	P.O.P. (204)	P.O.P. (158)	Other fish sp. (361)	P.O.P. (101)
tarry flounder (125)	Pollock (84)	Tanner crab (106)	Dover (135)	Rougheye (336)	Flathead (82)
tarfish (81)	Starfish (78)	Pollock (91)	Flathead (72)	Turbot (218)	True cod (76)
alibut (61)	True cod (74)	Flathead (78)	Rex (59)	Heart urchins (148)	Tanner crab (76)
ungeness (38)	P.O.P. (58)	Sebastolobus (55)	Halibut (53)	Starfish (132)	Pollock (72)
nglish (37)	Heart urchins (58)	Starfish (49)	Pollock (30)	Sebastolobus (74)	Starfish (67)
lathead (25)	Halibut (34)	Sablefish (42)	Sebastolobus (23)	Rex (24)	Sablefish (39)
ablefish (13)	Skate (31)	Skate (36)	Sablefish (19)	Skate (20)	Dover sole (35)
kate (13)	Sablefish (24)	Dover (35)	Skate (18)	Misc. inver. (19)	Halibut (32)
callop (10)	Dungeness (15)	Rex (31)	Starfish (9)	Halibut (8)	Skate (29)
ex (10)	Misc. inver. (12)	Misc. inver. (18)	Tanner crab (5)	Tanner crab (8)	Butter sole (26)
ollock (10)	Rex (11)	Halibut (17)	Other fish sp. (5)	Other rockfish (1)	Sebastolobus (22)
ock sole (9)	Dogfish (9)	True cod (12)	Shrimp (2)	True cod (0.3)	Rex sole (20)
ogfish (9)	Dover (7)	Rougheye (9)	Misc. inver. (1)	Dogfish (0)	Starry flounder (16)
anner crab (5)	English (6)	Other fish sp. (5)	True cod (1)	P.O.P. (0)	Other fish sp. (5)
ther fish sp. (5)	Other fish sp. (5)	Other rockfish (3)	Rougheye (0.5)	Lingcod (0)	Rougheye (13)
isc. inver. (0.4)	Scallop (4)	Shrimp (3)	Other rockfish (0.1)	Pollock (0)	Dungeness (12)
hrimp (0.4)	Sebastolobus (2)	King crab (3)	Rock sole (0)	Shrimp (0)	Misc. inver. (12)
eart urchins (0.4)	Rock sole (2)	Petrale (2)	Petrale (0)	King crab (0)	English sole (8)
ther rockfish (0.4)	Shrimp (2)	Dogfish (2)	English (0)	Dungeness (0)	Dogfish (6)
ingcod (0.3)	Rougheye (2)	Rock sole (0.2)	Butter sole (0)	Scallop (0)	Scallop (3)
etrale (0.3)	Butter sole (2)	Dungeness (0.1)	Starry flounder (0)	Rock sole (0)	Rock sole (2)
and sole (0.2)	King crab (1)	Lingcod (0.1)	Sand sole (0)	Petrale (0)	Shrimp (2)
over (0.2)	Starry flounder (1)	Scallop (0)	King crab (0)	Flathead (0)	Other rockfish (2)
.O.P. (0.1)	Other rockfish (1)	English (0)	Dungeness (0)	English (0)	King crab (1)
ougheye (0.1)	Lingcod (0.4)	Butter sole (0)	Scallop (0)	Butter sole (0)	Petrale (1)
ing crab (0)	Petrale (0.1)	Starry flounder (0)	Lingcod (0)	Starry flounder (0)	Lingcod (0.3)
ebastolobus (0)	Sand sole (0)	Sand sole (0)	Dogfish (0)	Sand sole (0)	Sand sole (0.2)

The remainder of the invertebrate catches consisted of Dungeness crab, scallop, shrimp, ing crab, and miscellaneous species (table 12). Dungeness crab and scallop were primarily

found in shallow water (table 13). Catches of both those species were small with the exception of a 1,000-pound haul of scallop taken just east of Cape St. Elias.

SUMMARY

1. Much of the area surveyed in the Gulf of Alaska was judged untrawlable to the conventional bottom trawls used in the described surveys.

2. Most of the exploratory trawling was done between 51 and 150 fathoms. Trawling at depths less than 51 fathoms was restricted because of much hard and uneven bottom while trawling beyond 150 fathoms was seldom done because of the steepness of the continental slope.

3. The average catch of all species combined during this study was 1,272 pounds per hour haul.

4. Flatfish made up 43 percent of the total fish and invertebrates caught, and averaged 552 pounds per hour haul.

5. The arrowtooth flounder or turbot was a dominant species at all depths, comprising 60 percent of the flatfish catch and 26 percent of the total catch by weight. The average catch rate of the arrowtooth flounder taken for all depth intervals combined was 330 pounds per hour trawled.

6. The ranking of the top four species (highest catch rates) in each of the depth intervals was: 0-50 fathoms--true cod, Bellingham sole, turbot, and starry flounder; 51-100 fathoms--turbot, flathead sole, tanner crab and pollock; 101-150--turbot, heart urchins, Pacific ocean perch, and tanner crab; 151-200 fathoms--heart urchins, turbot, Pacific ocean perch, and Dover sole; 201-250--Dover sole, sablefish, rougheye rockfish, and miscellaneous species.

FISHING LOG

A detailed fishing log showing the fishing positions, time on bottom, catch particulars, and other pertinent data for each drag is available by writing the Seattle office[1] for the John N. Cobb's Cruise Nos. 52 and 54 and the Juneau office[2] for the Tordenskjold Cruise No. 2.

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ARE TURTLES NAVIGATION EXPERTS?

How can green sea turtles find their way across more than 1,000 miles of open sea to tiny Ascension Island in the South Atlantic? That is one of the intriguing questions posed by the theory that Brazilian green sea turtles travel to Ascension Island to nest. A tagging project that may throw more light on the mystery was discussed by a University of Florida herpetologist in Bioscience, Vol. 14, No. 8.

In 1960 on Ascension Island beaches, a total of 206 turtles were tagged before they returned to the sea. (Turtles completely disappear from Ascension waters by June of each year.) By 1964, eight of the tagged turtles had been recovered along the coast of Brazil. The recoveries came from both north and south of the Brazilian Bulge, at sites located "downstream" from both the Equatorial and the Brazilian ocean currents. (No returns came from the West African coast east of Ascension Island.)

Meanwhile, observers on Ascension Island checked nesting turtles for tag returns. Green sea turtles reproduce in accordance with two different rhythms. About 70 percent follow the major 3-year reproductive rhythm, and the remaining 30 percent reproduce on the minor 2-year rhythm. Possible recovery on Ascension beaches of the 1960-tagged turtles was first tested by means of a tag-check patrol at three beaches in 1963 to catch survivors of the major rhythm group. Three tags were recovered at the identical beaches where the turtles were tagged. In 1964, a similar check was made for possible survivors of the minor rhythm group, making their second round trip since tagging 4 years earlier. As a result, two more tags were recovered at or near the orginal tagging beach.

These two-way tag returns tend to confirm the theory that green sea turtles found off Brazil nest on Ascension Island. (It is known that the mature female turtles that occur along the Brazilian coast do not nest in Brazil.) The turtles could probably travel from the middle Atlantic to Brazil merely by drifting with ocean currents. But the largest question remains--how after spending 2 or 3 years in Brazil do the turtles find their way back to the 1-mile rock that is Ascension Island through more than 1,000 miles of open sea?

The University of Florida scientist suggests that this remarkable feat may be accomplished by some sort of bi-coordinate navigation. Compass-sense alone would not be enough to keep the turtles on course. The scientist said the solution to this puzzle would depend at least partly upon the precise plotting of actual travel courses of individual turtles. (SFI Bulletin, No. 159, February 1965.)