

REPORT ON THE 1955 TRAWL INVESTIGATIONS

(Confidential)

Palmen

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Submitted April 12, 1956

State of Washington
Department of Fisheries

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The following report has been compiled by staff biologists assigned to the study of otter-trawl investigations. The report encompasses the various special trawl problems under study, statistical records of species production, and a detailed analyses of information obtained from interview records.

D. L. Alverson

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Trawler Santa Maria

The trawler Santa Maria was lost off Point Wells on the morning of March 10, 1955 after collision with a Navy LST. The vessel and crew assisted the Department in reopening the South Sound and were instrumental in bringing about a cooperative spirit between the sports groups and trawl fishermen within the South Sound area. The men aboard the Santa Maria were close friends with many of the Department's staff. Those lost included:

Obren Kokich	- Tacoma
Leigh Larson	- Tacoma
Sig Hovland	- Seattle

Report on the 1955 Trawl Investigations

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REPORT ON PROJECT

Special studies under investigation during 1955 included: (1) Puget Sound Studies, (2) Pacific Marine Fisheries Commission Cooperative Studies, (3) petrale sole work, (4) life history studies on true cod, (5) studies on gear efficiency changes, and (6) a collection of catch/effort data through interviewing. Results of these studies are summarized in the following report.

Puget Sound Studies

During 1955 several cruises were made as a cooperative study with the University of Washington School of Fisheries. This work entailed sampling of English sole stocks in Saratoga Passage, Holmes Harbor and in Carr and Case Inlets in Southern Puget Sound. A tagging experiment was also carried out in Everett Bay from December 17 to 20, 1955. During the experiment 485 English sole were tagged with red Petersen disc tags (UW-Wash. Dept. Fish Series) and 500 were tagged with yellow and white spaghetti tags (Series D). The objectives of this work was to obtain information on the selectivity of the two tags tested, their utility, relative recovery rates, and to compare differences in recovery rates.

Scrapfish and food fish production from the South Sound and Hood Canal were tabulated so that the effects of reopening these regions to trawling could be evaluated. The 1955 landings from the waters south of Point Defiance were rather poor although fair quantities of foodfish were landed from Hood Canal. The low production in 1955 (South Sound) resulted from both low availability and a poor market for animal food. The 1955-56 season was much improved and the fishery was helped by a tremendous increase in availability. Three days catches in Carr Inlet yielded catches from 20 to 45 thousand pounds of wormy English sole.

The fishing effort in Hood Canal fell off sharply ^{during the past season} and only sporadic trips were made into this area. The catches of food and scrapfish for the 1955-56 season are shown in Table 1.

Table 1 - Trawl catches for South Sound and Hood Canal.

South Sound			
Food fish	Pounds	Scrapfish	Pounds
English sole	71,600	Skates	64,000
Rock sole	22,000	Dogfish	50,000
Sand sole	17,000	Scrap	380,000
Flounder	13,500	Octopus	870
Rockfish	34,000	Wormy English sole	<u>600,000</u>
Truecod	20,000	Total scrap	1,094,870
Lingcod	1,800		
Perch	<u>2,700</u>		
Total food fish	182,600		
Hood Canal			
Food fish	Pounds	Scrapfish	Pounds
English sole	32,000	Skates	1,700
Rock sole	14,000	Scrap	<u>12,000</u>
Sand sole	150	Total scrap	13,700
Flounder	8,000		
Rockfish	3,000		
Truecod	8,000		
Lingcod	2,200		
Perch	<u>2,700</u>		
Total food fish	70,050		

Pacific Marine Fisheries Commission Studies

Washington trawl biologists participated in a four week Pacific Marine Fisheries Commission cooperative investigation aboard the California Fish and Game research vessel N. B. Scofield. The work included mesh experiments and tagging studies.

Mesh experiments

Otter trawl saving experiments were made to obtain further data on the selective action of single cod-ends with meshes larger than $4\frac{1}{2}$ inch stretch measure. A standard 400 mesh trawl was used for each haul and various size cod-ends were attached to the net. The results of a series of 13 tows (approximately one hour in length) are shown in Table 2.

Table 2 - Dover sole drags off Eureka, California by N. B. Scofield, July 22-27, 1955.

Drag number	Mesh size of cod-end	Length of drag	Number of dover caught		
			Total	Marketable	Percent marketable
55B2	3.9"	75 min.	829	781	94
55B3	4.7"	35 "	180	157	87
55B4	4.9"	60 "	37	25	68
55B5	5.5"	60 "	275	268	97
55B6	5.5"	60 "	75	72	99
55B7	4.6"	60 "	67	65	97
55B8	4.4"	55 "	43	39	91
55B9	4.4"	60 "	936	879	94
55B10	4.7"	65 "	145	133	92
55B11	?	60 "	59	53	90
55B12	5.4"	60 "	263	263	100
55B13	?	45 "	6	6	100
55B14	?	?	29	29	100
55B15	4.8"	95 "	34	29	85*
Total			2,976	2,799	94

Figure 1 shows the cumulative percent curves for the three sizes of cod-ends used. The $5\frac{1}{2}$ inch mesh apparently caught more of the larger fish while

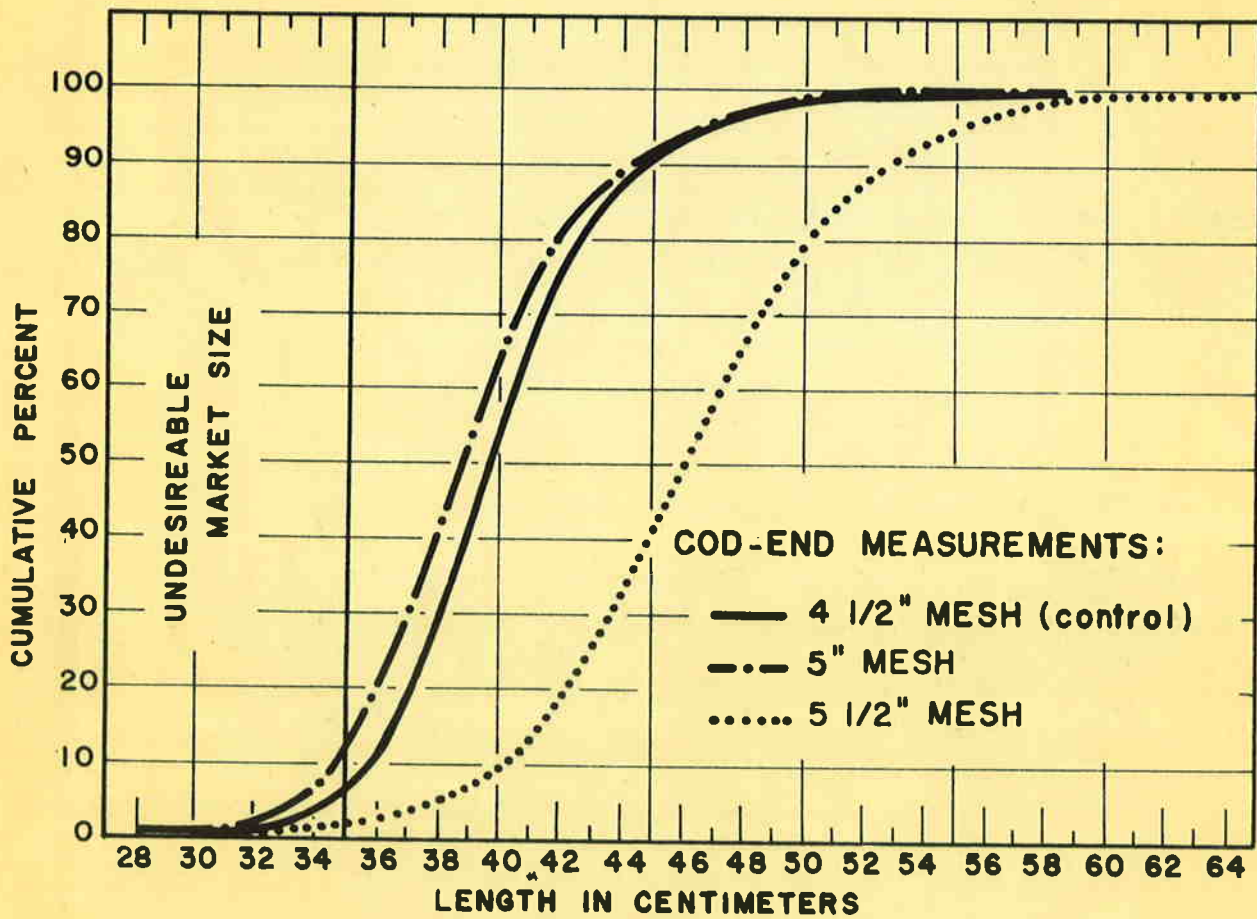


Figure 1 - Cumulative percentage plots for dover sole caught by 4 1/2", 5" and 5 1/2" single cod ends.

the 5 inch mesh retained more small fish than the $4\frac{1}{2}$ inch mesh. These results may reflect a non-homogenic size distribution of fish existing on various portions of the grounds. Retention of scrap fish may also have altered the results. Generally there was no great difference in the amounts of scrapfish for individual hauls except for large amounts of hake taken in two of the 5 inch tows.

Tagging

During the cruise a total of 678 blackcod, 407 lingcod, and 16 true cod were tagged. A variety of tags, (1) Petersen disc (2) plastic tubing (spaghetti and nylon leaders) were used so that the utility of the tags could be tested. The fish were caught and released off the Washington coast from Cape Flattery south to Destruction Island.

Petrale Investigation

During 1955 the investigation of movements of petrale sole from the in-shore summer feeding grounds to the winter spawning deeps was continued. Because of an indication of high mortality of fish tagged in 1954 the experiment was repeated in March of 1955 aboard the U. S. Fish and Wildlife Service Vessel John N. Cobb. The facilities and working space available aboard this vessel enhanced the chances for a successful tagging operation. Between March 23 and 28 a total of 2,007 tagged petrale sole were liberated on the Esteban grounds. The fish, caught at depths between 180 and 210 fathoms were tagged with the conventional Petersen disc tag.

The condition of many of the fish were rated as poor. Being brought up from a considerable depth and landed under relatively heavy sea conditions many suffered scale loss or were otherwise injured. On release the tagged fish generally swam away feebly.

As of the 31st of December 1955 a total of 56 tags were recovered. The pattern of recovery showed a northward movement from the Esteban (similar to the 1954 study) grounds to Hecate Strait (Figure 2). All recoveries were made on the inshore summer feeding grounds at depths shallower than 100 fathoms. The percentage of tag returns amounts to about 3 percent of the total Esteban release.

Cape Flattery tagging

A total of 429 petrale sole were tagged and released on the "Spit" which is the S.W. terminus of 40 Mile bank. These fish, caught at depths from 140-160 fathoms, were tagged during very heavy seas and were in extremely poor condition. Only one recovery was made which was caught on Swiftsure Bank near Cape Flattery.

Grays Harbor Deep

Approximately 19 tags were released in the Grays Harbor deep during January, 1955. The tags were released from the commercial trawler Mitkof. No recoveries have been reported.

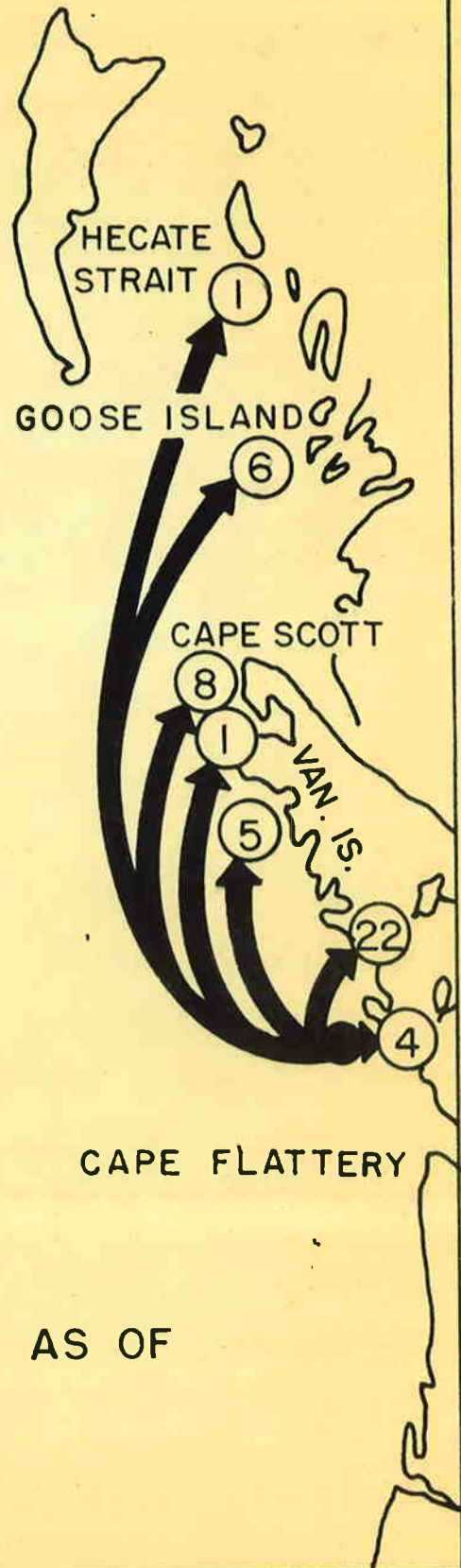
Analysis of Petrale Fishery

A long term measured decline in the availability of petrale sole necessitated a study of the statistical history and development of this fishery. In order that data would be available to interpret the measured change and to evaluate the decline, a review of information pertinent to the fishery was carried out in 1955.

Past records indicate the petrale sole was an important component of the trawl fishery as early as 1943 when 5.9 million pounds were landed. The catch

NUMBER TAGGED = 1985

3/23 - 28/55



ESTEBAN TAG RECOVERIES AS OF
DECEMBER 31, 1955

Figure 2 - Esteban tag recoveries as of December 31, 1955

remained somewhat stable until 1948 when ^{the} fishery peaked at 6.2 million pounds. Following 1948, the total catch declined steadily until 1953. (See Figure 3)

Petrale sole, the most highly desired flatfish, has played a decreasing rôle in the catch of flatfish since 1948 and the decline in availability has occurred during a period of continued demand (for this species), increasing fleet efficiency, and expanded range of the fishing fleet. A decrease in the measured availability of petrale sole on the grounds west of Vancouver Island has also been demonstrated by Canadian biologists. Both (Figure 4) the catch per trip and catch per hour trawling of petrale sole have been on the decrease for Canadian trawlers. American vessels fishing the Goose Island grounds north of Vancouver Island and in Hecate Strait have shown a drop from 26,000 pounds per trip in 1947 to 7,000 pounds per trip in 1955.

The discovery in 1953 and subsequent exploitation of the deep-water grounds (Esteban) added another facet to the petrale fishery. The result of two years tagging indicates that (1) the Esteban petrale stock represents a large mobile population which migrates north along the west coast of Vancouver Island during the spring-summer season and returns to the Esteban area during the late winter and early spring months, (2) the stock plays an important role in the inshore fishery along the north coast of Vancouver Island and in Hecate Strait, (3) the effort expended on the Esteban grounds will increase the total pressure being exerted against this population.

Washington petrale sole fishery may be summarized as having a high initial production which following 1948 showed a long term decline. This decline has taken place during a period of an expanding fishery, increased gear efficiency, and constant demand for sole fillets. Percentage-wise the fishery is probably placing a heavier burden on the stocks than during the early phase of the fishery.

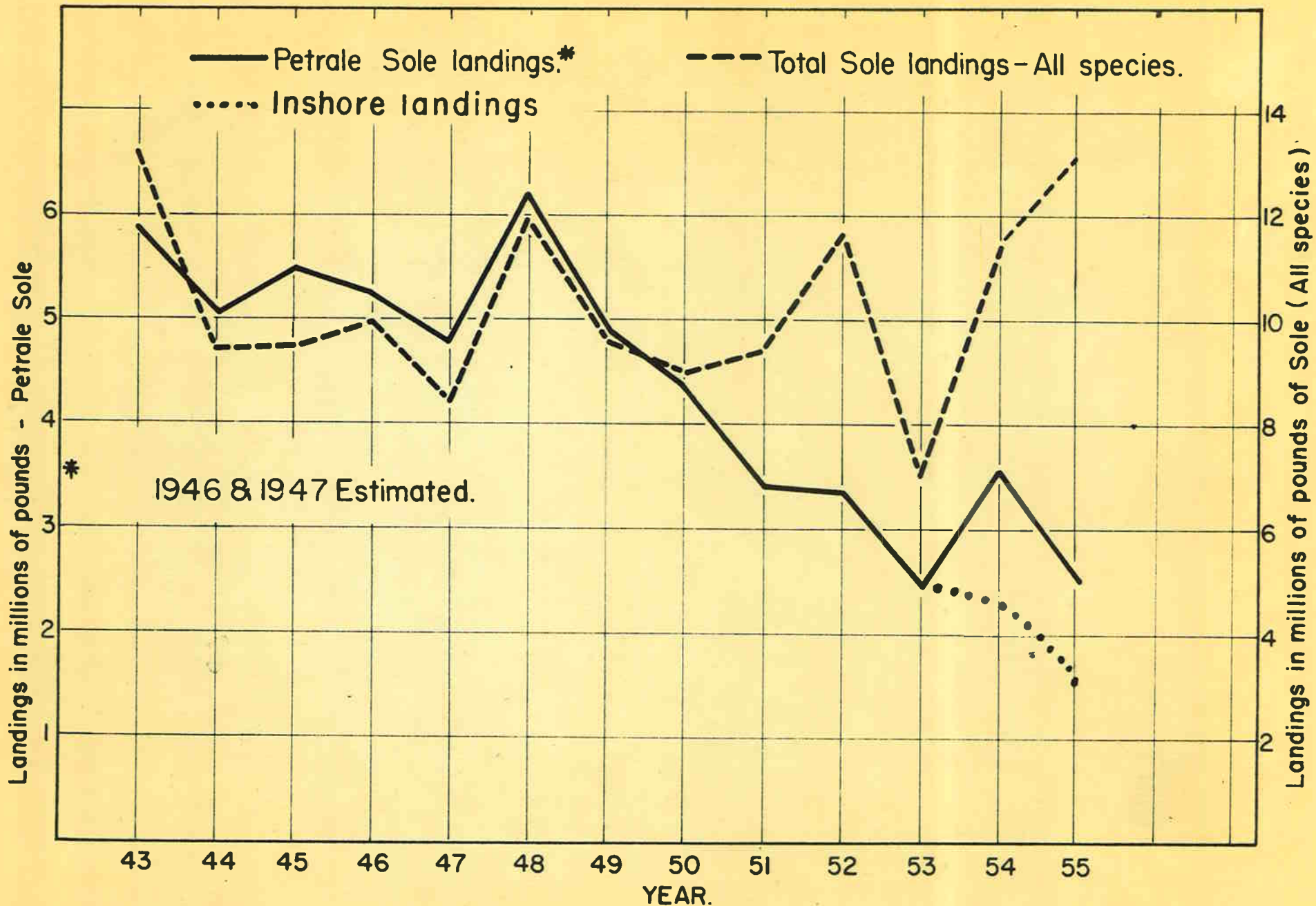


Fig. 3 - Catch by year for Washington Petrale Sole, as compared with all sole combined

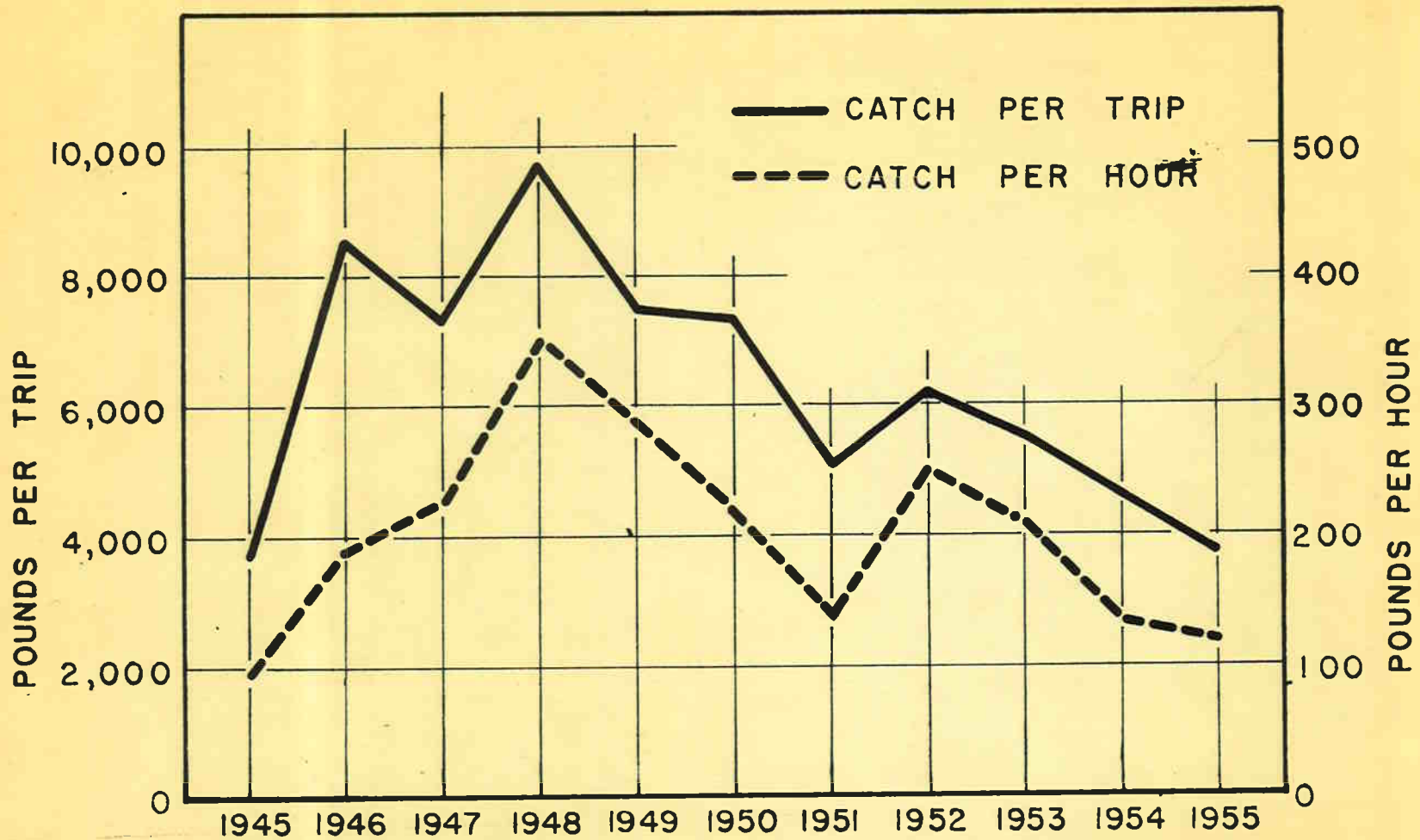


Figure 4 - AVAILABILITY (CATCH PER UNIT OF EFFORT) OF PETRALE OFF THE WEST COAST OF VANCOUVER ISLAND.

Appendix 2

Courtesy of Fisheries Research Board of Canada (Nanaimo)

The discovery of the deep-water spawning grounds has paved the way for increased fishing pressure through exploitation of highly vulnerable stocks.

As a recommendation for management and restoration of the stock the following recommendation was made to the Pacific Marine Fisheries Commission in December 1955.

[During the period from February 1 to April 15, petrale sole landings made in the State of Washington shall not exceed 5,000 pounds per trip and vessels shall not possess or transport through the waters under the jurisdiction of the State more than a maximum of 5,000 pounds of petrale sole. No vessel shall be allowed to land more than two maximum landings per month, or 10,000 pounds.]

True cod Studies

The Pacific true cod, Gadus macrocephalus, has become increasingly important in the Washington trawl catches and has for the past several years ranked first in both value and poundage. Because of the increased importance of this species in the economy of our fishery the Bellingham Marine Laboratory under the direction of Mr. Pasquale, was directed to obtain biological information regarding life history.

During the latter part of 1955 a series of market samples was taken to obtain length frequency records. The length frequency distributions indicated that there was little differential sex growth. Figures 5, 6 and 7 show graphed distributions for samples taken from Quillayute, Cape Scott, and Hecate Strait.

A complete study of the skull osteology was undertaken to determine the feasibility of any of the component bones for age analysis work. These were not considered satisfactory and abdominal vertebrae were investigated as a possible age indicating structure. The vertebrae centrum exhibited "annuli" which possibly could be used for age determination.

FIG. 5 - Length frequency of true cod from Quillayute

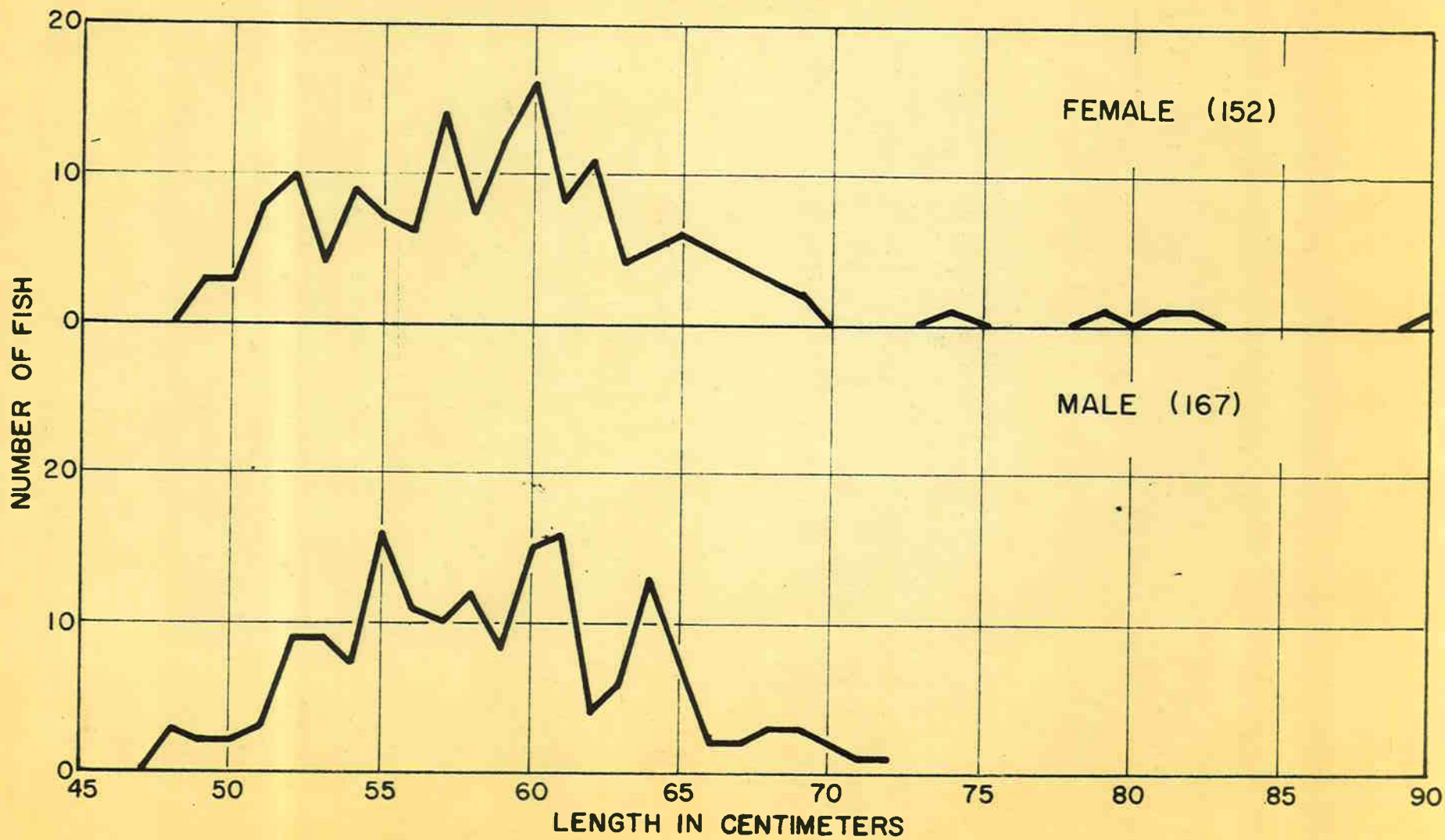
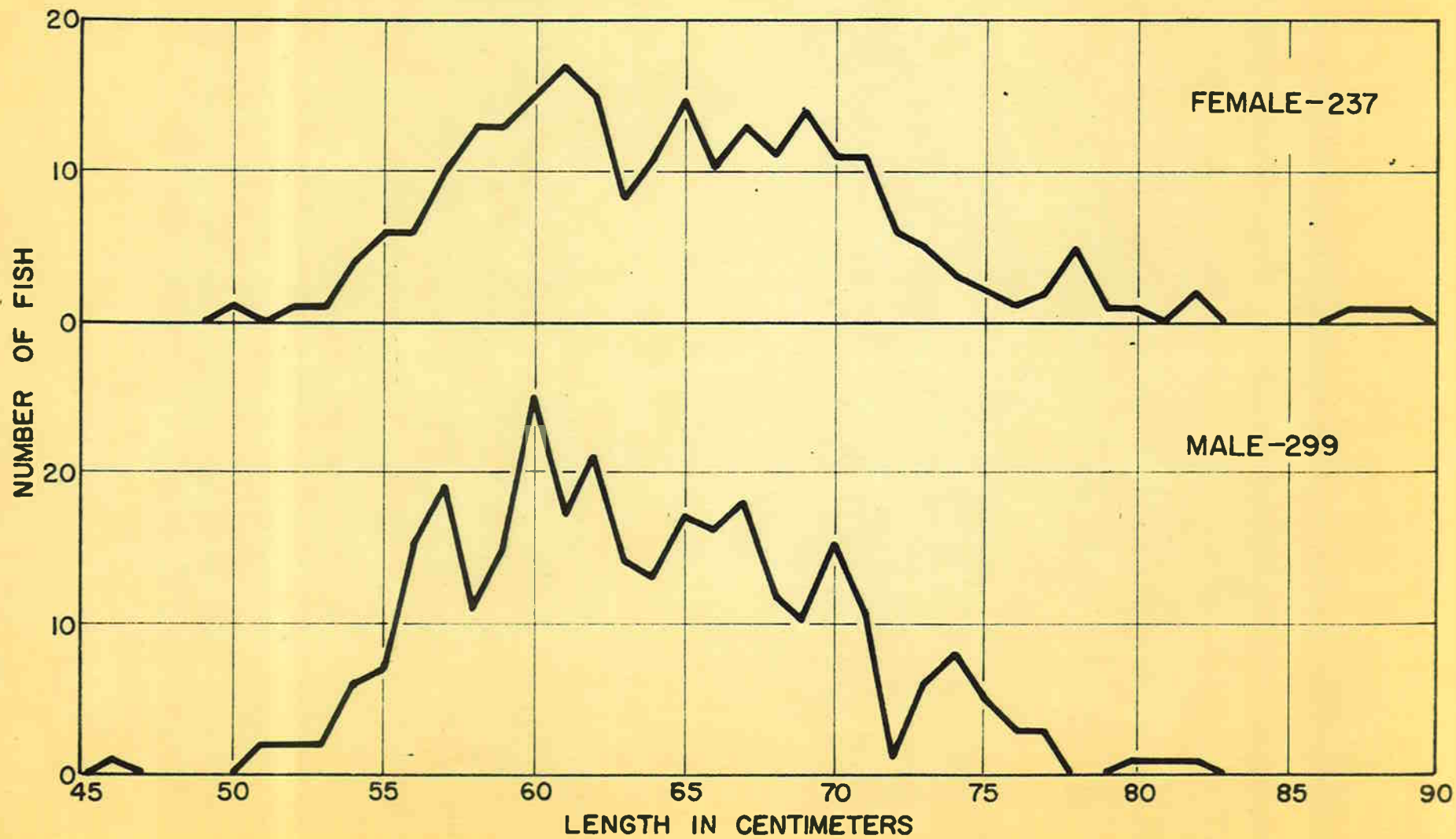


FIG. 6 - Length frequencies of true cod from Cape Scott.



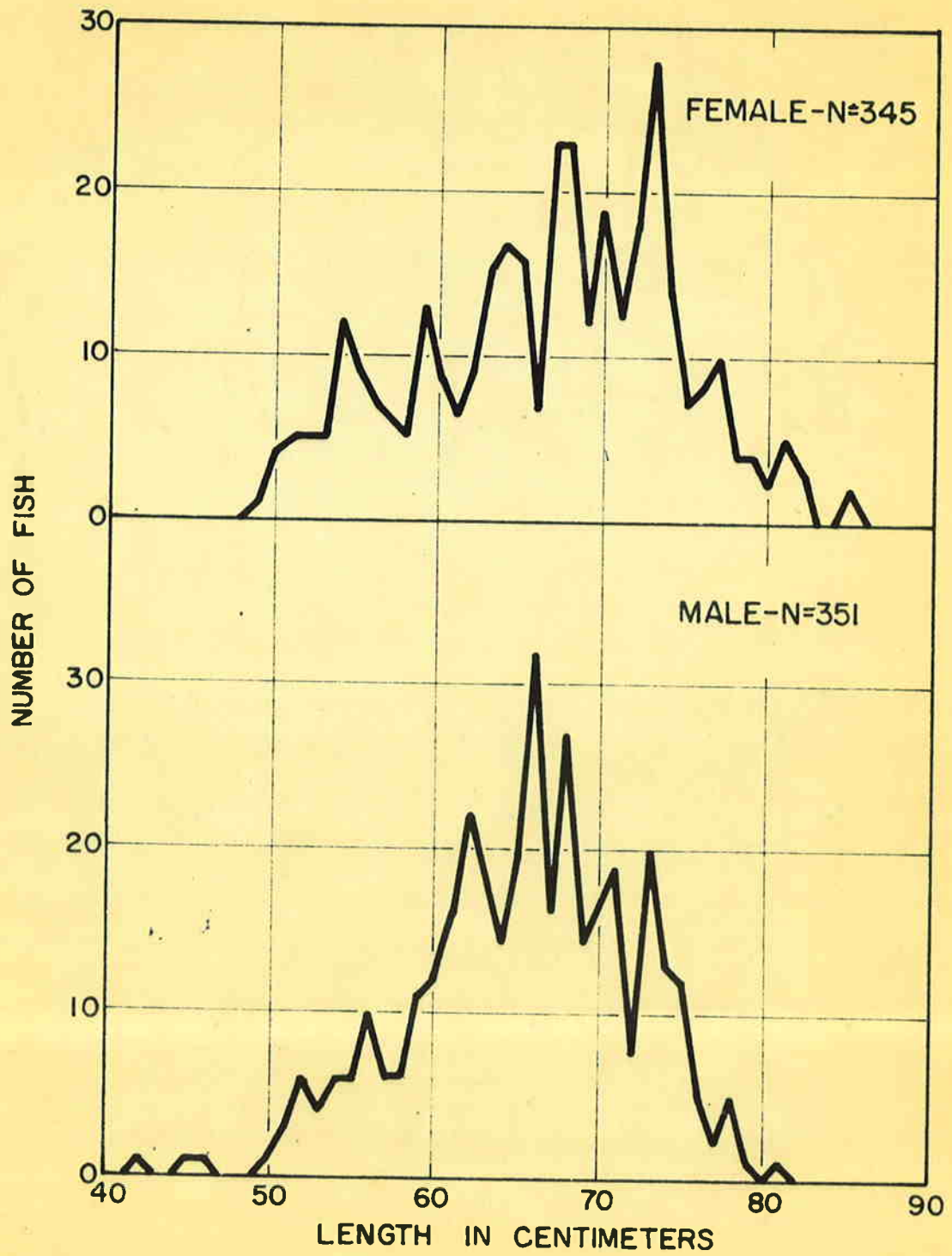


FIG. 7 - Length frequencies of true cod from Hecate Strait.

Food Studies and Reproduction

Several stomach samples of true cod were taken from fish caught in the Hecate Strait area. A list of the contents is shown in Table 3. Apparently candlefish were most available to the true cod caught in this area.

Table 3 - Stomach contents of true cod

	Hecate Strait August 29, 1955	Bonilla September 8, 1955	Bonilla and Two Peaks September 16, 1955
Candlefish	129	114	129
Herring	6		6
Black cod	2	1	1
Olive snail		1	
Turban snail		1	
Rocks		7	
Petrale		2	
Unidentified		2	

The general peak of the spawning activities of the true cod may vary within the geographic range of the species. Preliminary data indicates that many females are gravid during the winter and early spring months. Several samples of ovarian development have been examined and a gram weight of egg mass from one female totaled 2,392 eggs compared with a total egg mass weight of 409 grams. The extrapolated total egg estimate for this fish (700 mm) would be in the vicinity of one million. As the females approach a spawning condition the eggs become less tenacious and are easier to segregate. The size of females and ovary weights for fish taken in Hecate Strait are given in Table 4.

Table 4 - Ovary weights of true cod in relation to length

Fish length (mm)	Ovary weight	Condition of ovary
530	60 grams	early development
700	192 "	" "
806	155 "	" "
879	158 "	" "

Gear Efficiency Changes

The changes in fishing efficiency brought about by technological advancements and increased fishermen's knowledge of the grounds are difficult to measure. They are, however, quite important and real situations which evolve with in the growth of every fishery. A preliminary analyses of a possible efficiency change resulting from the introduction of the fish finder was described in the January-June (1955) progress report. An indication of some of the gear changes which have occurred during the past several years are shown in Table 5.

Table 5 - Gear changes for 20 trawl vessels fishing during 1952 and 1955

	Number and percent of vessels equipped with indicated electronic devices				
	1952		1955		Percent increase
	Number	Percent	Number	Percent	
Echo Sounder	20	100	20	100	00
Radio D/F	17	85	19	95	10
Loran	6	30	20	100	70
Radar	0	00	5	25	25
"Fish finders"	0	00	4	20	20
				1952	1955
Average maximum fishable depth				144	240
" " " horse power				144	152
*Average number of meshes in circumference of net (at throat)				406	370
*Use of smaller number of meshes result of increased mesh size					

Interview System

A total of 763 vessel landings were accounted for by port interviews during 1955. The interviewed catch amounted to 29,698,000 pounds which was in excess of two-thirds of the total state trawl-caught landings. Monthly sampling intensity for the ports of Seattle and Bellingham are given in Table 6.

Table 6 - Sampling by month (1955) of otter-trawl landings.

Month	Inside			Outside		
	Landings	Sampled	Percent	Landings	Sampled	Percent
January	68	33	49	74	57	77
February	32	19	59	100	67	67
March	20	12	60	119	70	59
April	18	6	33	101	71	71
May	23	5	22	78	61	78
June	9	3	33	60	54	90
July	6	5	83	44	31	70
August	6	4	67	54	48	89
September	5	5	100	54	45	83
October	19	6	32	68	50	74
November	21	8	38	65	46	70
December	28	15	54	69	42	60
Total	255	121	47	886	642	77

The extrapolated total state landings by species of trawl-caught fish are given in Table 7 including the fisherman value for each species. Total landings were estimated to be between 5 and 8 percent below the 1954 figure. Species showing heavy drops in landings included the true cod and Pacific ocean perch - the combined decrease shown for these species amounted to about 5,000,000 pounds. Changing market demands evidently largely influenced perch landings while both market demand and availability were reflected in the true cod landings. Petrale sole catches also fell off (17 percent) although the total effort expended toward this species was up. Catches of dover sole, lincod, starry flounder, and rock sole were up considerably from 1954. The English sole catch was about equal to that of the previous years catch.

The origin of the catches (all species combined), hours fished by area, the productive index, and the catch per hour is shown in Table 8. A comparison of these data with 1954 figures indicates that close to 10,000 more fishing hours were spent on the grounds in 1955. The average yield per hour towing fell from 1,224 pounds in 1954 to 925 pounds in 1955. The decrease in

availability in 1955 was manifest on practically all grounds; however, it was more evident on the normally productive northern areas. Several of the more southern grounds showed an increased yield per hour towing, probably as a result of a heavy recruitment of lingcod onto these banks.

Table 7 - Estimated total 1955 trawl landings and value

Species	Catch in thousands			Dollar value to fishermen
	Outside	Inside	Total	
True cod	12,351	551	12,902	440,000
Lingcod	3,539	53	3,592	140,000
Blackcod	430	---	430	35,000
Rockfish	5,623	45	5,668	220,000
Ocean Perch	3,885	---	3,885	135,000
Petracle sole	3,121	2	3,123	271,000
English sole	3,165	720	3,905	270,500
Dover sole	3,517	22	3,539	175,000
Rock sole	1,033	81	1,114	40,100
Flounder	1,267	322	1,590	64,000
Others	126	---	126	5,000
*Bellingham sole	500	---	500	7,800
*Turbot	750	---	750	10,000
**Scrap	---	1,750	1,750	7,500
Total	39,327	3,546	42,873	1,820,900

* Minkfood

** Dogfish - skate, etc.,

About 60 percent of the 1955 fleet effort was expended along the Washington coast as compared with 53 percent in 1954 while the production of fish by weight from the Washington coastal area accounted for 44 percent of the state's 1955 total. A graphic depiction of the effort/catch relation is shown in Figure 8. Total estimated catches of roundfish and flatfish by area are given in Table 9 and 10.

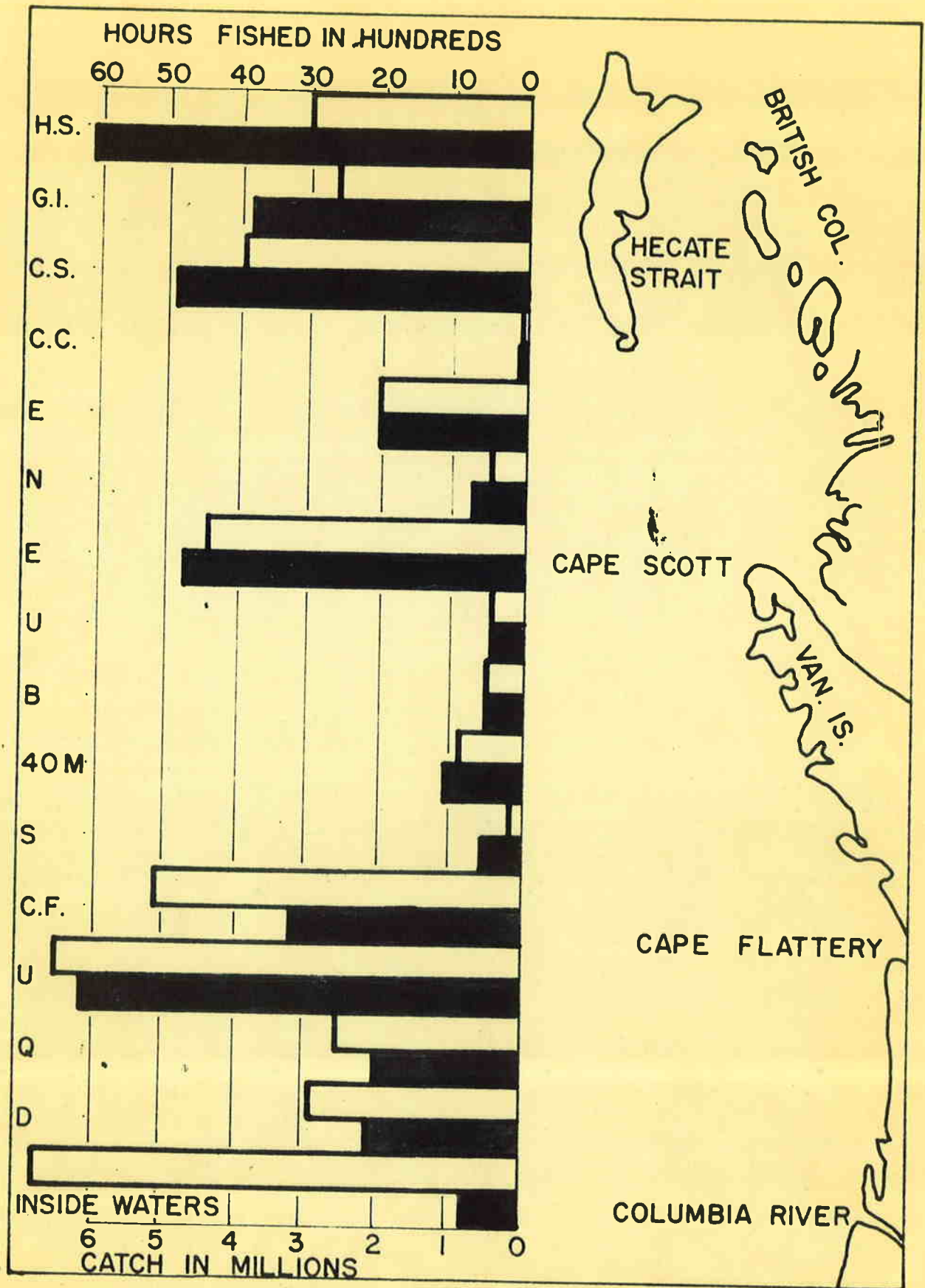


Fig. 8 - EFFORT AND PRODUCTION WASHINGTON TRAWL FLEET

EFFORT-1955
 CATCH-1955

Table 8 - Summary of catch/effort data and productive index* 1955 trawl landings (all species combined).

Area	Catch	Hours fished	Catch per hour	Productivity index
Hecate Strait	6,049,000	2,998	2,018	2.23
Goose Island	3,825,000	2,791	1,370	1.51
Cape Scott	4,716,000	3,916	1,240	1.33
Cape Cook	3,000	19	158	0.17
Esperanza	2,083,000	2,068	1,007	1.02
Nootka	627,000	434	1,445	1.59
Esteban	4,779,000	4,351	1,098	1.21
Ucluelet	316,000	369	856	.95
Barkley Sound	338,000	357	947	1.05
40 Mile	1,254,000	920	1,363	1.51
Swiftsure	492,000	298	1,651	1.82
Cape Flattery	3,440,000	5,223	659	.77
Umatilla	5,175,000	6,672	776	.86
Quillayute	1,946,000	2,473	787	.87
Destruction	2,025,000	2,998	675	.75
Grays Harbor and south	138,000	213	648	.72
Puget Sound	1,798,000	7,362	244	.27
Miscellaneous	743,000	430	1,728	1.91
Total	39,747,000	43,892	X = 905	1.00

*Catch per hour by area

Catch per hour all areas, 1955

Table 9 - Total catches of flatfish by area as estimated from interview forms.

Area	Petrals	English	Dover	Rocksole	Flounder
Hecate Strait	144,000	926,000	39,000	587,000	80,000
Goose Island	164,000	121,000	123,000	332,000	-----
Cape Scott	881,000	84,000	2,000	113,000	-----
Cape Cook	-----	-----	-----	-----	-----
Esperanza	220,000	17,000	43,000	-----	-----
Nootka	32,000	1,000	8,000	-----	-----
Esteban	991,000	22,000	1,139,000	-----	-----
Ucluelet	8,000	4,000	-----	-----	-----
Barkley Sound	4,000	1,000	-----	-----	-----
40 Mile	170,000	-----	2,000	-----	-----
Swiftsure	61,000	4,000	17,000	-----	-----
Cape Flattery	87,000	320,000	552,000	-----	18,000
Umatilla	194,000	704,000	782,000	-----	393,000
Quillayute	48,000	537,000	182,000	-----	29,000
Destruction	89,000	435,000	567,000	-----	4,000
Grays Harbor and south	28,000	9,000	60,000	-----	-----
Inside water	2,000	720,000	23,000	82,000	322,000
Total	3,123,000	3,905,000	3,539,000	1,114,000	1,589,000

Table 10 - Total catches of roundfish by area, as estimated from interview forms.

Area	Ocean perch	Rockfish*	Lingcod	Truecod	Blackcod
Hecate Strait	38,000	120,000	435,000	3,679,000	1,000
Goose Island	960,000	794,000	326,000	987,000	18,000
Cape Scott	394,000	1,519,000	197,000	1,524,000	2,000
Cape Cook	-	3,000	-	-	-
Esperanza	14,000	787,000	152,000	847,000	3,000
Nootka	438,000	38,000	54,000	11,000	3,000
Esteban	864,000	569,000	432,000	651,000	111,000
Ucluelet	-	4,000	103,000	197,000	-
Barkley Sound	-	6,000	117,000	209,000	1,000
40 Mile	1,000	17,000	671,000	354,000	39,000
Swiftsure	24,000	52,000	170,000	147,000	17,000
Cape Flattery	202,000	418,000	170,000	1,597,000	76,000
Umatilla	367,000	746,000	390,000	1,555,000	44,000
Quillayute	350,000	256,000	153,000	368,000	23,000
Destruction	189,000	267,000	162,000	221,000	91,000
Grays Harbor and south Inside waters	2,000 -	27,000 45,000	6,000 54,000	5,000 550,000	1,000 -
Total	3,885,000	5,668,000	3,592,000	12,902,000	430,000

* Includes red and black

All interview data obtained during 1955 was coded for I.B.N. records.

Approximately 5,600 cards were punched to accommodate the 1955 trawl information.

At the end of the year, a number of reports were tabulated to assist in evaluating catch trends. These included significant catch records, depth distribution by season and month, effort and catch by bank, and species analysis.

These summations have proved of considerable aid as time saving devices.

GENERAL INFORMATION ON THE 1955 TRAWL FISHERY

The 1955 trawl landings amounted to 42,500,000 pounds and may be considered as a relatively good year for the fishery. A total of 116 trawlers were known to have participated in the Washington fishery during the year (Table 11) as compared with an equal number in 1954. Vessels were recorded as having fished from the Columbia River north to the Wrangell area of S. E. Alaska.

Table 11 - List of trawl vessels participating in 1955 fishery.

Aloma 3	Havana 54	Rio Del Mar 127
Albany	Heather 56	Roberta 128
Alda B. 2	Hercules 60	Santa Maria
Alrita 11	Jeannette F. 62	Sockeye 139
Alsek 4	Karen T. 65	Sogn 141
Ann B. 6	Kristine 66	Soupin 140
Anna A. 5	Leading Lady 69	St. John 132
Arlice 7	Lemes 68	St. John II 145
Arthur H. 8	Lemes II 70	Sunbeam 146
Avalon 9	Lituya 71	Sunward 147
Barbara Anne	Lorenz 73	Susan 148
Betty Jane 10	Majestic (P.S.) 76	Theresa S. 153
Blanco 12	Majestic (S.) 77	Thoreen 154
Bobetta 14	Mariner 80	Tommy M. 155
Bonnie C. 173	Marie II 79	Tongass 155
Brisk 13	Midway 90	Tordenskjold 156
Celtic 15	Mildred 93	Tulip 157
Chelsea K. 16	Mitkof 92	Vernon 161
Christine (Eloise III) 3	Morning Star 83	Victory Maid 160
Claudia H. 19	Mylark 94	Vigorous 162
Commando	Nestor 100	Voyager 164
Confidence 18	New Elida 102	Western Flyer 165
Coolidge II 25	Newport 106	Western Maid 166
Crusader 20	Nick C. II 110	Yaquina 171
Dakota 22	Northern Light 114	Zarembo II 172
Dixie Maid 23	Notre Dame 115	
Dutchie C. 27	Opal 116	
Emblem 31	Pacific Breeze 117	Nina B 112
Emily Jane 33	Panther 118	Helen W 58
Estep 37	Paradise 121	
Excel II 36	Paragon 120	
Famous Maid 38	Patricia Joan 123	
Fenwick 40	Paul L. 122	
Frigidland 41	Plover 124	
Frostland 42	Pt. Augusta 125	
Gallant Maid	Pt. Defiance 174	
Gem 44	Puget Girl 125	
Grizzly II 48	Radio 129	
Guide 50	Regina 126	
Harmony 52		

The trend towards development and exploration of the deep-water grounds continued during 1955 with some fishing carried out at depths down to 250 fathoms. The percentage of fish caught in waters below the 100 fathom contour was less than in 1954: however, the reduction resulted from a decrease demand for Pacific ocean perch. The continued prospecting of deep-water grounds was predicated on expanding the dover sole grounds. The percentage of the total catch in 10 fathom intervals is shown in Figure 9 for 1954 and 1955 and a comparison of the 1954 and 1955 catches as caught in hundred fathom intervals is shown below (Table 12).

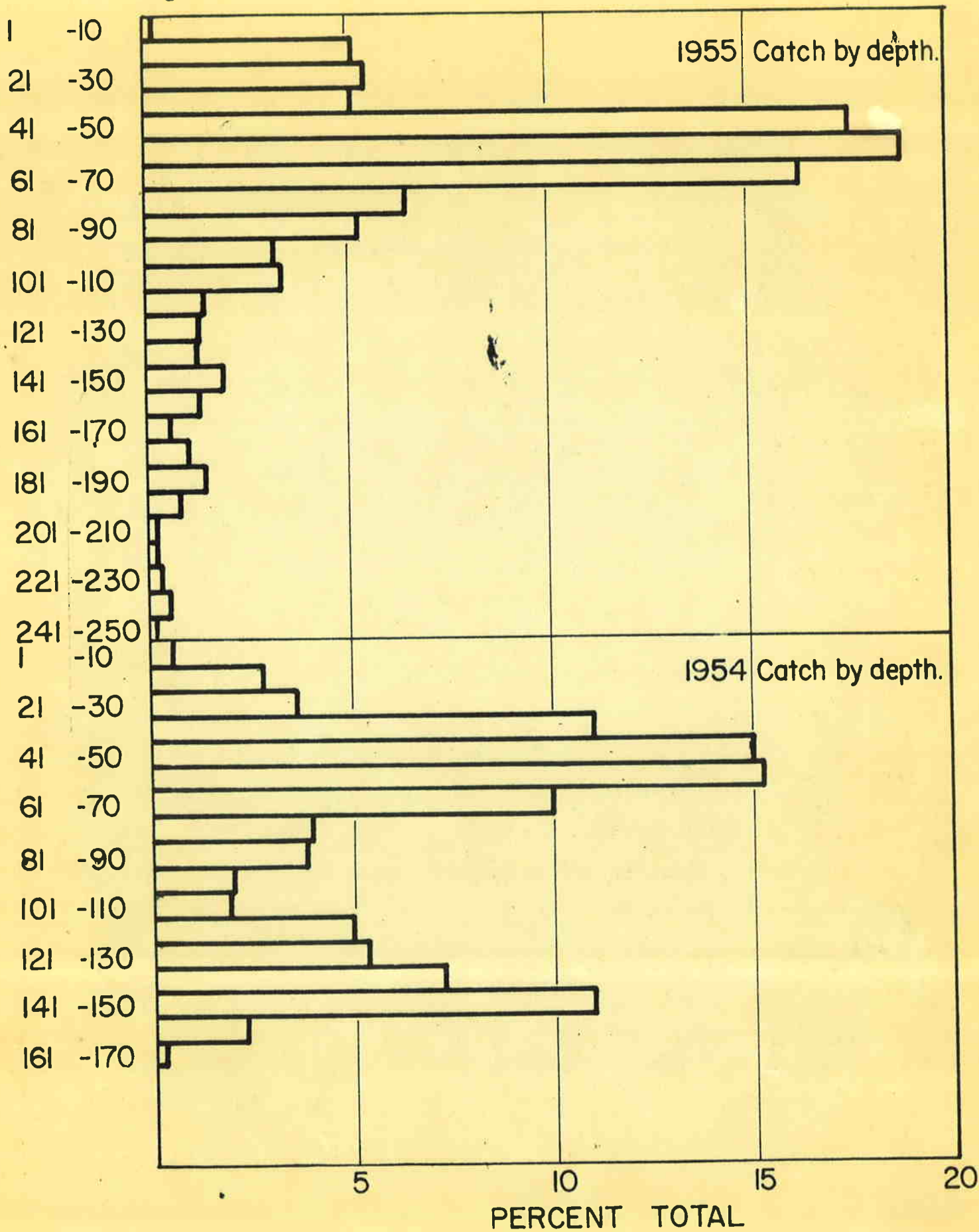
Table 12 - Percent of total 1955 catch by depth

Depth	Percent of total	
	1954	1955
0-99	67	85.5
100-199	33	12.9
200-299	0	1.6

Marketing Trends

In general the demand for bottom fish products was good, however utilization of imported cod-fish blocks for fish-stick production reduced the need for locally landed true cod and affected the production of the species. Although the true cod catch was number one in poundage and value for trawl caught fish, it was off several million pounds from the 1954 production. Pacific ocean perch, which ranked second in 1954 fell off sharply in 1955. The market was considered responsible for the decreased yield as availability of the species was good. Army orders, responsible for a large share of the perch consumption were under those of the past year. Demand for flatfish fillets was excellent and production of sole exceeded 13 million pounds, the best year on record.

Figure 9 - Catch by ten fathoms intervals for 1954 and 1955



Catch by depth (all species) for 1954 and 1955.

The main ports of landing were Seattle, Bellingham, and Everett. During the latter part of 1955 the New England Fish Company at Everett began processing trawl-caught fish which increased the importance of Everett as a bottom fish port. Fair quantities of trawl-caught fish were also landed at Blaine, Neah Bay, Anacortes, and Aberdeen. Fish landed at Blaine, Neah Bay, and Aberdeen are usually trucked to Seattle or Bellingham for processing.

Bottom fish processors, by port are listed below:

Seattle

Eardley Fish Company	Pier 62
Main Fish Company	Pier 49, Box 3092
Northwest Fisheries	Pier 24, Seattle
San Juan Fish Company	P. O. Box 3086
Seattle Seafood, Inc.,	Pier 61
Sea Port Fish Co.,	Pier 57

Bellingham

Bornstien	P. O. Box 188
Dahl Fish Company	601 West Chestnut
May Sea Food	1206 Central Avenue

Everett

Chase Sea Foods	P. O. Box 216
New England Fish Company	Pier 3

Anacortes

Skagit Fisheries	P. O. Box 275
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In addition to the regular fish producers, reduction plants handling scrap include.

Tacoma

Puget Sound Rendering Works	8317 Tyler St., S. W.
Carstons Packing Company	1623 East Jay Street

Everett

Puget Sound By-Products	Box 651
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Anacortes

Skagit Fisheries
J. E. Trafton and Sons

P. O. Box 275
Box 340

Blaine

Blaine Fish Products

Blaine, Washington

Scrap Fish Production

Scrap fish producers in 1955 showed increased interest in the use of whole bottom fish for animal food consumption. Both Bellingham sole and turbot were fished heavier during the past season than in past years. In addition to the whole fish caught for animal food practically the entire production of fillet waste sold for animal (mink) food. Scrapfish used for reduction were mostly Elasmobranchs with small amounts of halibut and wormy sole. Most of the catches landed for reduction are made in Puget Sound waters.

Petrale sole (Eopsetta jordani)

Petrale sole ranked seventh in poundage and second in value for trawl fish during 1955. The total catch was down from the 1954 figure and the species dropped from fifth to seventh in rank by poundage. Major areas of production included Cape Scott, Esperanza, Esteban, and Umatilla. Fair catches were also made on the Hecate Strait, Goose Island, and 40 Mile banks. Because of the apparent mobility of petrale sole the annual yields for any specific area may fluctuate considerably. Extreme annual variations have been observed on 40 Mile bank (500,000 - 1954, 170,000 - 1955,) Cape Scott (242,000 - 1954, 880,000 1955), and Hecate Strait (647,000 - 1954, 144,000 - 1955). These changes in yield by area are probably manifest by the erratic migration patterns of the petrale sole. The catches by interview area and catch per hour fishing are given in Table 13 while the monthly production for the main banks is shown in Table 14.

Table 13 - Summary catch/effort data and productive index,* 1955 trawl landings of petrale sole.

Areas	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H**
Hecate Strait	144,100	2,998	48	0.67	217
Goose Island	164,400	2,791	59	0.82	454
Cape Scott	880,500	3,916	225	3.13	391
Cape Cook	500	19	26	0.36	
Esperanza	220,000	2,068	106	1.47	
Nootka Sound	32,400	434	75	1.40	305
Esteban	991,100	4,351	228	3.17	598
Ucluelet	8,200	369	22	0.31	
Barkley Sound	4,400	357	12	0.17	
40 Mile	169,800	920	185	2.57	349
Swiftsure	60,600	298	203	2.82	394
Cape Flattery	86,700	5,223	17	0.24	90
Umatilla	194,000	6,672	29	0.40	446
Quillayute	48,000	2,473	19	0.26	300
Destruction	88,800	2,998	30	0.42	194
Grays Harbor and south	27,900	213	131	1.82	675
Puget Sound	2,200	7,362			
Total	3,123,600	43,462	72		

* Catch per hour by area

Catch per hour all areas, 1955

** Petrale sole in catch representing 25 percent or over of total fare made during particular effort.

Table 14 - Catch by month of petrale sole for major producing areas, 1955

Month	Hecate Strait Goose Island	Cape Scott	Esperanza	Esteban	40 Mile	Umatilla
January	130	22,260	---	1,170	--	3,400
February	--	165,250	---	9,110	--	3,450
March	6,375	126,655	54,255	591,890	--	3,120
April	22,500	44,830	73,820	131,690	--	9,040
May	28,075	7,800	67,415	87,025	16,970	73,105
June	55,610	4,680	13,140	134,470	26,435	14,380
July	17,185	33,555	---	8,675	2,080	12,275
August	79,230	64,390	1,125	--	560	12,010
September	46,505	5,865	6,375	--	60,590	19,030
October	40,495	41,045	---	---	62,805	35,665
November	12,420	212,610	---	8,005	--	6,845
December	--	151,595	3,870	19,025	325	1,640
Total	308,525	880,535	220,000	991,060	169,765	193,960

Results of tagging experiments have indicated that the population exploited from the Esteban area north is probably independent of those to the south. The aggregate yield from the northern banks is therefore considered in the evaluation of measured changes in availability. The migration pattern and stocks involved in the southern fishery are poorly defined, however we have tentatively divided the 40-Mile - Swiftsure grounds and Cape Flattery to Destruction banks into two independent stocks. Figure 10 plots the catch per hour fishing, significant catch per hour and aggregate catches for three geographic sub-divisions.

Depth distribution

As in 1954 catches of petrale sole made on the continental shelf were generally taken at depths between 40 and 70 fathoms while the deep water winter catches were made at depths from 170 to 200 fathoms. Figure 11 shows the catch distribution as indicated from interview forms for some of the major areas of catch. A definite bimodal catch range is noted in the composite (all areas) graphed depth distribution (Figure 11 A) and for the Esteban grounds. The bimodal distribution reflects the season depth migration of this species.

Management (see section on Petrale Investigations)

It is the opinion of the staff that the petrale sole populations have been reduced to a level below that which would produce maximum sustained yields to the fishery. Interpretations of the declining availability of this species is impaired by inadequate data for earlier years. The extent of the decline which has resulted from the fishery and that portion which has resulted from natural fluctuations in recruitment are questionable. The opinions as to the effects of the fishery are therefore more subjective than substantive. It is nevertheless, evident that the petrale sole along the Pacific coast have shown a similar

— CATCH PER HOUR — CATCH PER SIGNIFICANT EFFORT [] TOTAL CATCH

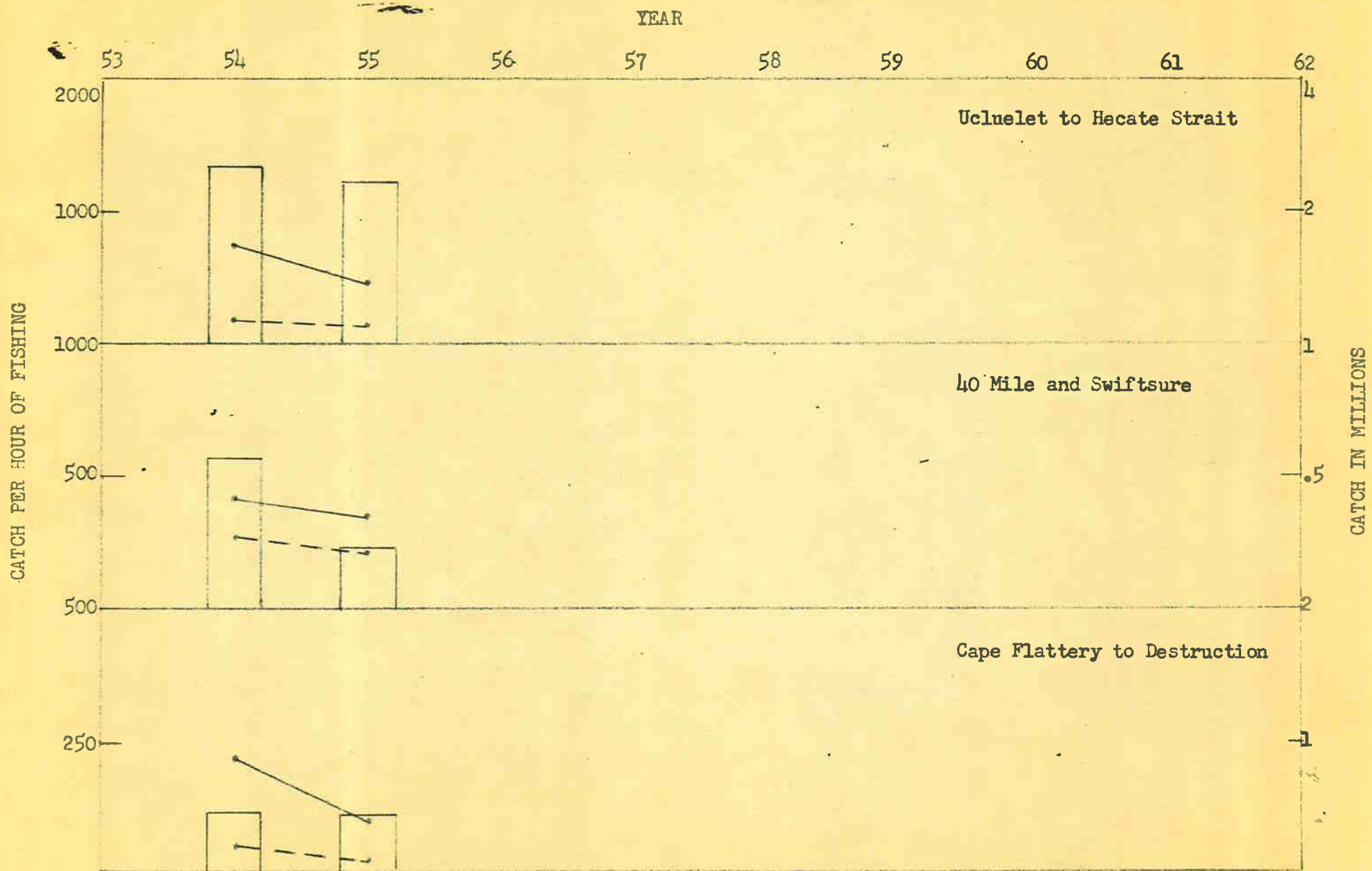


Figure 10 - Total catch, catch per hour and significant catch per effort for petrale sole

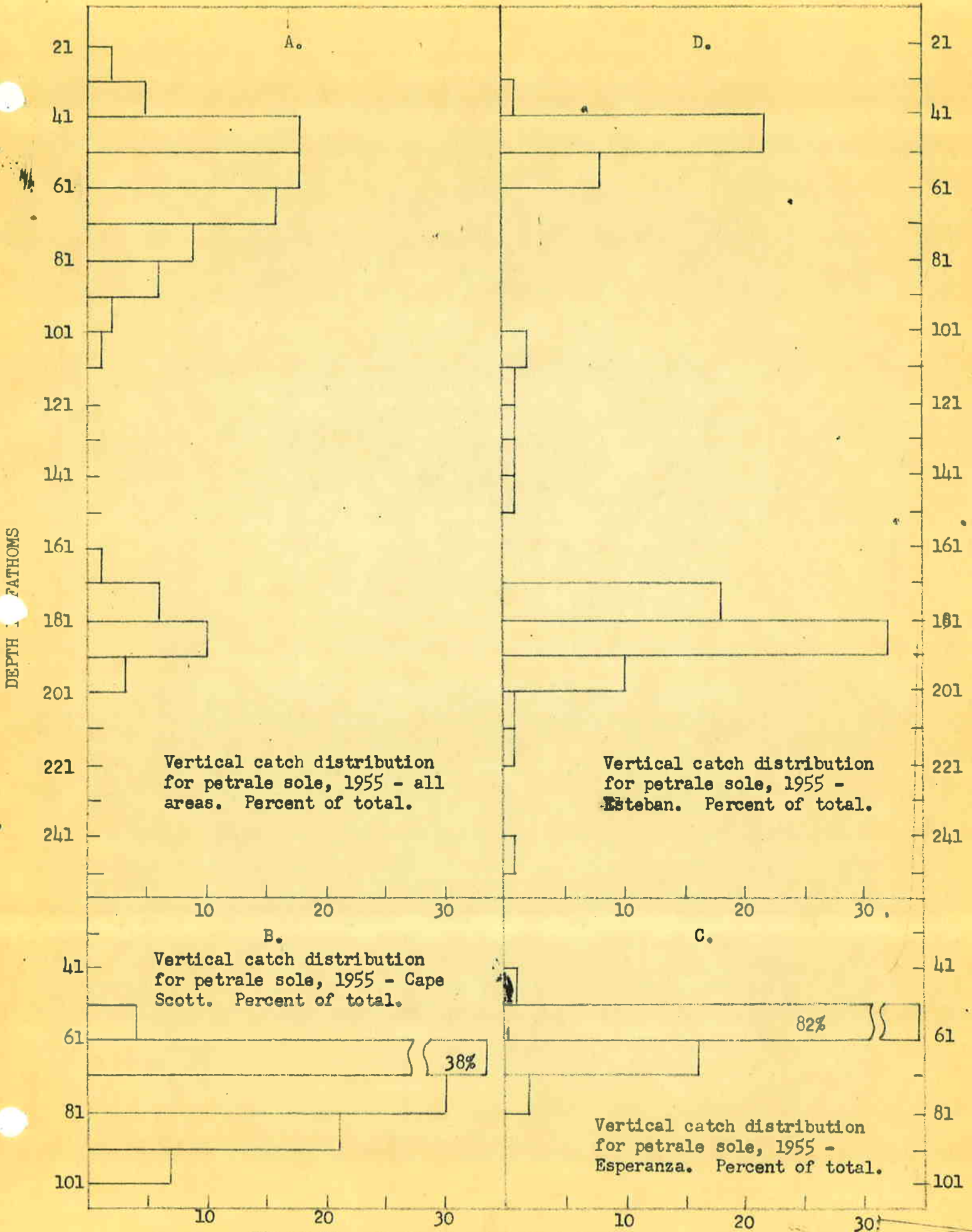


Figure 11 - Vertical catch distribution for petrale sole, 1955

reaction following intense exploitation and possibly do not have the tenacity to support present fishing rates.

English sole (Parophrys vetulus)

English sole ranked third in poundage and third in value for trawl-caught fish during 1955. Landings from the two main outside English sole grounds, Hecate Strait and Umatilla to Destruction, were up from the previous year. The catch per effort, however, was down in all areas. Catch effort data for 1955 is shown in Table 15.

Table 15 - Summary catch/effort data and productive index,* 1955 trawl landings of English sole

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H**
Hecate Strait	926,000	2,998	309	3.43	573
Goose Island	120,600	2,791	43	0.48	466
Cape Scott	84,100	3,916	21	0.23	
Cape Cook		19			
Esperanza	16,900	2,068	8	0.09	
Nootka Sound	1,300	434	3	0.03	
Esteban	22,400	4,351	5	0.06	416
Ucluelet	3,700	369	10	0.11	
Barkley Sound	600	357	2	0.02	
40 Mile	500	920			
Swiftsure	3,700	298	12	0.13	
Cape Flattery	319,900	5,223	61	0.68	219
Umatilla	704,200	6,672	106	1.18	228
Quillayute	536,800	2,473	217	2.41	333
Destruction Island	434,800	2,998	145	1.61	271
Grays Harbor and south	9,400	213	44	0.49	129
Puget Sound	720,000	7,362	98	1.09	171
	3,185,100	36,100	88		
Total	3,905,100	43,462	90		

*Catch per hour by area
Catch per hour all areas, 1955

**English sole in catch representing 25 percent or over of total fare made during particular effort.

In an analysis of the catch/effort relationship to populations, the catches from three geographic divisions are expected to act independently to fishery pressure. The catch per hour towing, significant catch per hour and total

catch for these areas are graphed in Figure 12. The outside fisheries seems to represent two distinct homogenous stocks while the inside fishery may represent the yield from several more or less discrete populations.

Depth distribution

Catches of English sole made by Washington trawlers are made almost exclusively over the continental shelf at depths between 10 and 90 fathoms. Each of the main fishing banks appear to have a characteristic depth stratification. The inside fishery which is limited by the depth topography of Puget Sound operates mostly in depths between 11 to 40 fathoms. There are several regions however (Everett Bay, Possession Pt.), in which the fishery is carried out in deeper water 50-90 fathoms.

The graphed catch distributions for the overall fishery, Hecate Strait and Cape Flattery to Destruction Island are shown in Figure 13.

A seasonal depth oscillation for the Cape Flattery to Destruction Island fishery has been observed for the past several years. The population appears to school in depths between 60-64 fathoms during the winter spawning period and move inshore to shallower water 28-35 fathoms during the summer months. The productive fishing season extends from December through March - the period of deep-water schooling. Figure 13 D., depicts the mean monthly depth pattern as indicated from catch records while Table 16 relates the landings by month for main fishing areas.

Management

The English sole has been subjugated to a rather intense fishery since the inception of off-shore trawling. The total landings have fluctuated in an erratic manner; however, the species has shown no signs of overfishing. Variations in recruitment and market conditions have probably largely influenced

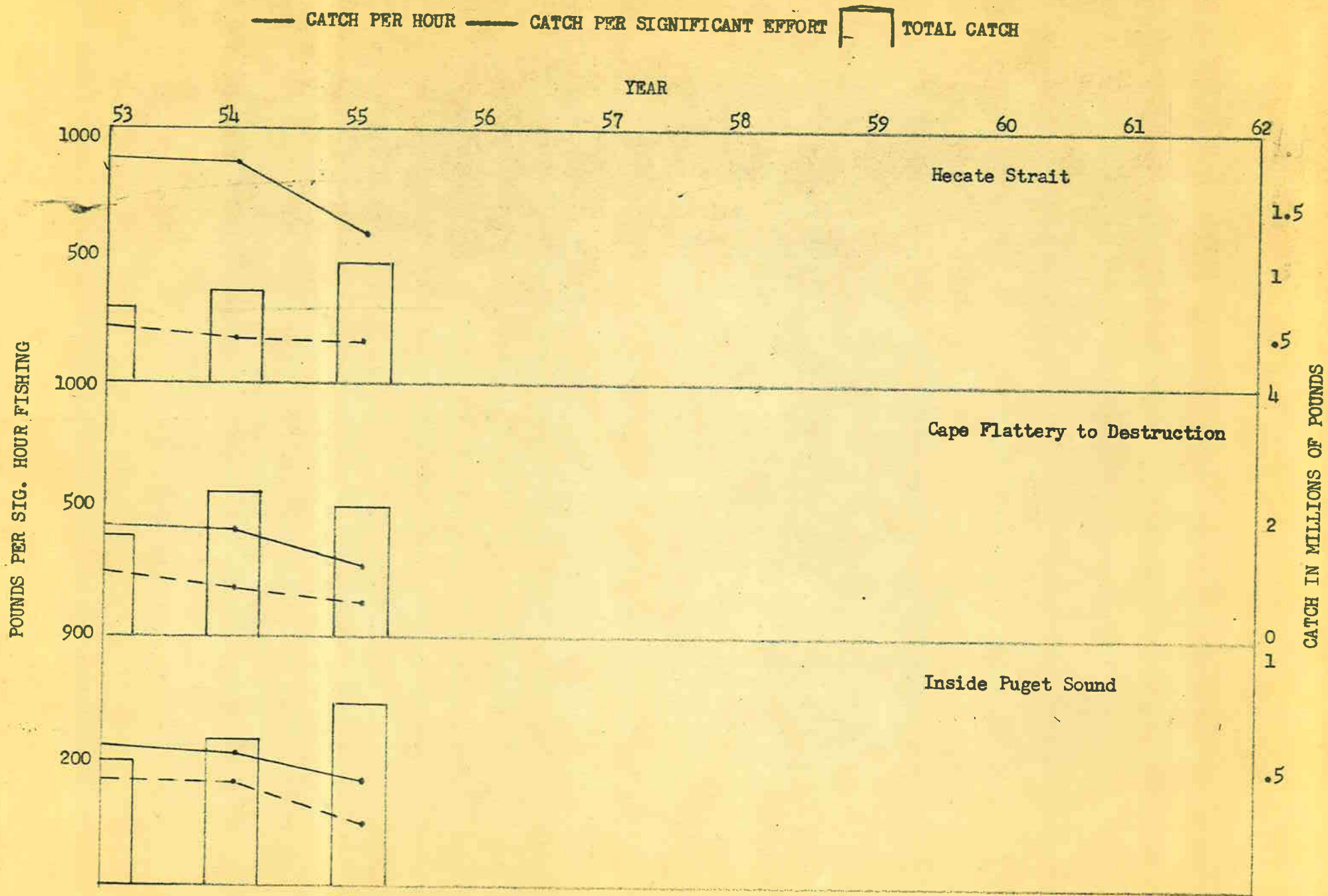


Figure 12 - Total catch, catch per hour, and catch per significant effort for english sole.

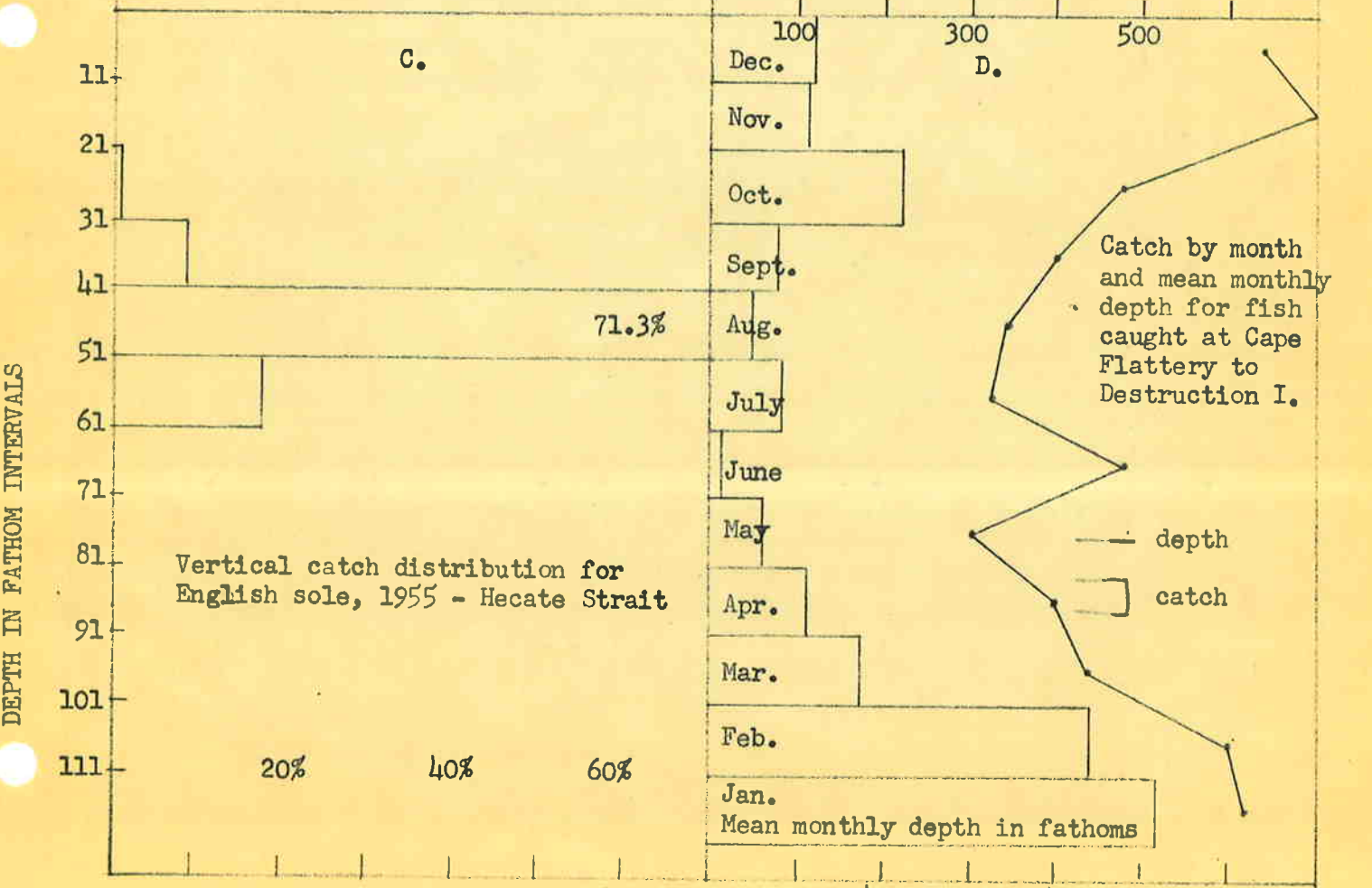
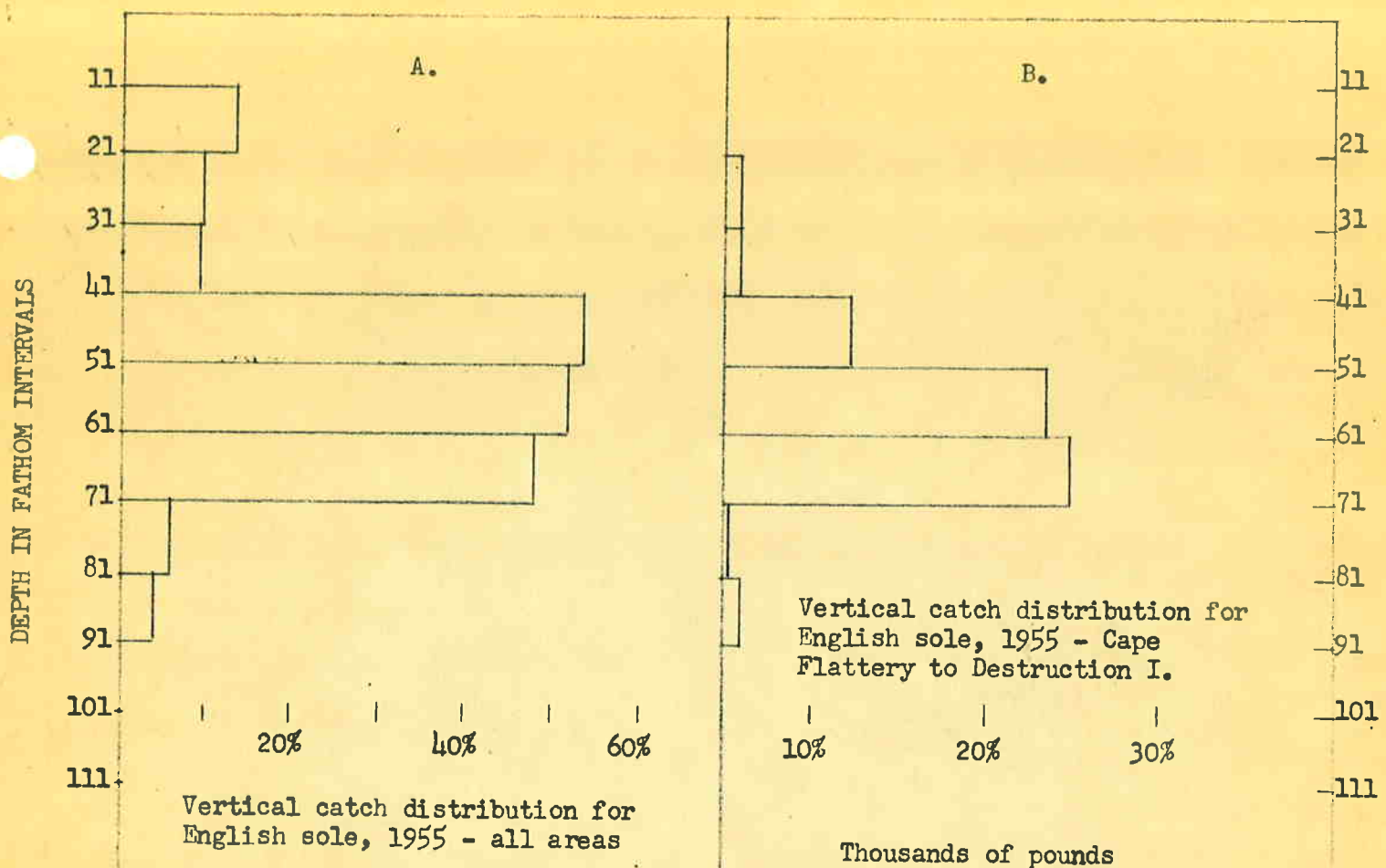


Figure 13 - Vertical depth distribution, English sole

the total annual catch records.

Age studies

Art Palmen completed studies on the use of interopercular bones for aging English sole. The method was considered successful and adopted for use. Results of the work were submitted for publication.

Table 16 - Catch by month of English sole for major producing areas, 1955

Month	Hecate Strait	Cape Flattery	Umatilla	Quillayute	Destruction
January	30,250	6,250	289,155	216,540	4,210
February	124,020	142,510	225,655	64,350	9,785
March	201,685	59,230	40,370	48,750	24,980
April	216,295	16,335	22,795	32,670	36,575
May	131,960	7,100	17,620	9,575	30,005
June	56,580	3,730	5,935	--	4,935
July	10,255	4,910	16,405	61,530	3,590
August	78,360	2,660	12,120	6,375	34,710
September	37,985	4,230	21,180	16,440	38,515
October	--	14,060	29,295	10,460	169,660
November	27,975	57,305	15,420	11,190	27,975
December	10,660	1,560	8,200	58,875	49,855
Total	926,025	319,860	704,150	536,755	434,795

Dover sole (Microstomous pacificus)

Dover sole ranked sixth in poundage and fifth in value for trawl caught fish during 1955. Production of dover sole was twice that of the previous year and the catch per hour fishing was maintained at a high level. Areas which yield good catches included Esteban and the grounds between Cape Flattery and Destruction Island. This species has become increasingly more important during the past several years. The 1955 catch was the highest on record and utilization of the species has resulted from greater consumer acceptance and from an insufficient supply of other species of sole. The catch by area, effort by

area and C/E are shown in Table 17 and in Figure 14. To date the dover sole fishery has yielded the best catches during the early spring months and late summer and fall. Production by month for the main areas are shown in Table 18.

Table 17 - Summary of catch/effort data and productive index,* 1955 trawl landings of dover sole.

Areas	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	39,200	2,998	13	0.16	1,180
Goose Island	112,700	2,791	44	0.54	346
Cape Scott	2,300	3,916			
Cape Cook		19			
Esperanza	42,800	2,068	21	0.26	440
Nootka Sound	7,800	434	18	0.22	1,000
Esteban	1,138,800	4,351	262	3.23	722
Ucluelet		369			
Barkley Sound	500	357	1	0.01	
40 Mile	1,700	920	2	0.02	150
Swiftsure	17,300	298	58	0.72	500
Cape Flattery	551,900	5,223	106	1.31	625
Umatilla	782,200	6,672	117	1.44	645
Quillayute	182,200	2,473	74	0.91	868
Destruction	567,400	2,998	189	2.33	384
Grays Harbor and south	59,500	213	28	0.35	
Puget Sound	22,800	7,362	31	0.38	
Total	3,539,100	43,462	81		

* Catch per hour by area
Catch per hour all areas, 1955

** Dover sole in catch representing 25 percent or over of total fare made during particular effort.

Depth distribution

Dover sole indicate a wide vertical depth distribution ranging from 30 to 280 fathoms. If each bank is studied as a separate habitat a definite bimodal depth distribution is indicated - much as in petrale sole. Production of fish caught in water deeper than 120 fathoms usually occurs during the winter and early spring months while the shallow water catches are made during the late summer and fall. The vertical depth distribution for dover sole by main grounds are shown in Figure 15.

--- CATCH PER HOUR ——— CATCH PER SIGNIFICANT EFFORT □ TOTAL CATCH

YEAR

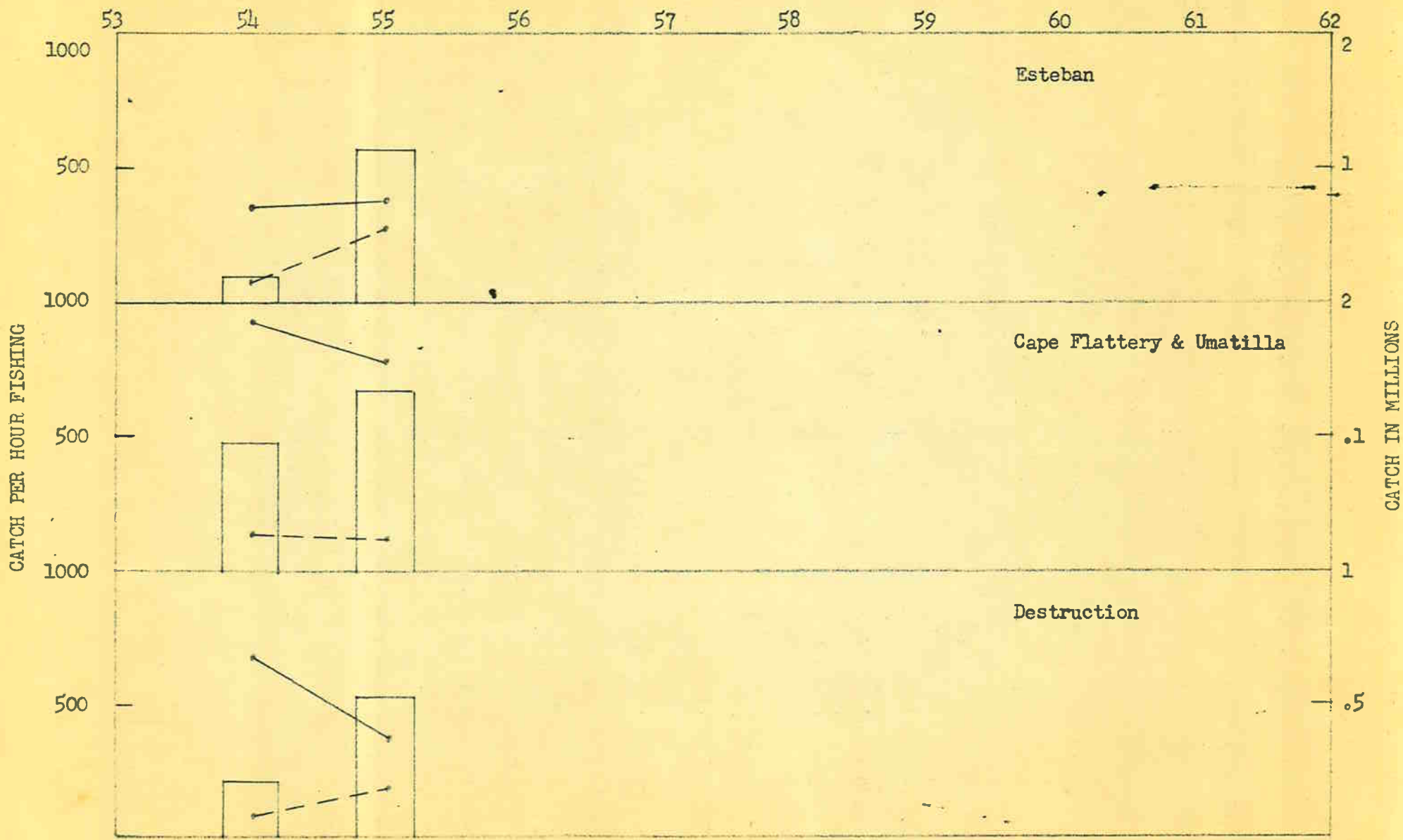


Figure 14 - Total catch, catch per hour, catch per significant effort for dover sole

DEPTH IN FATHOMS

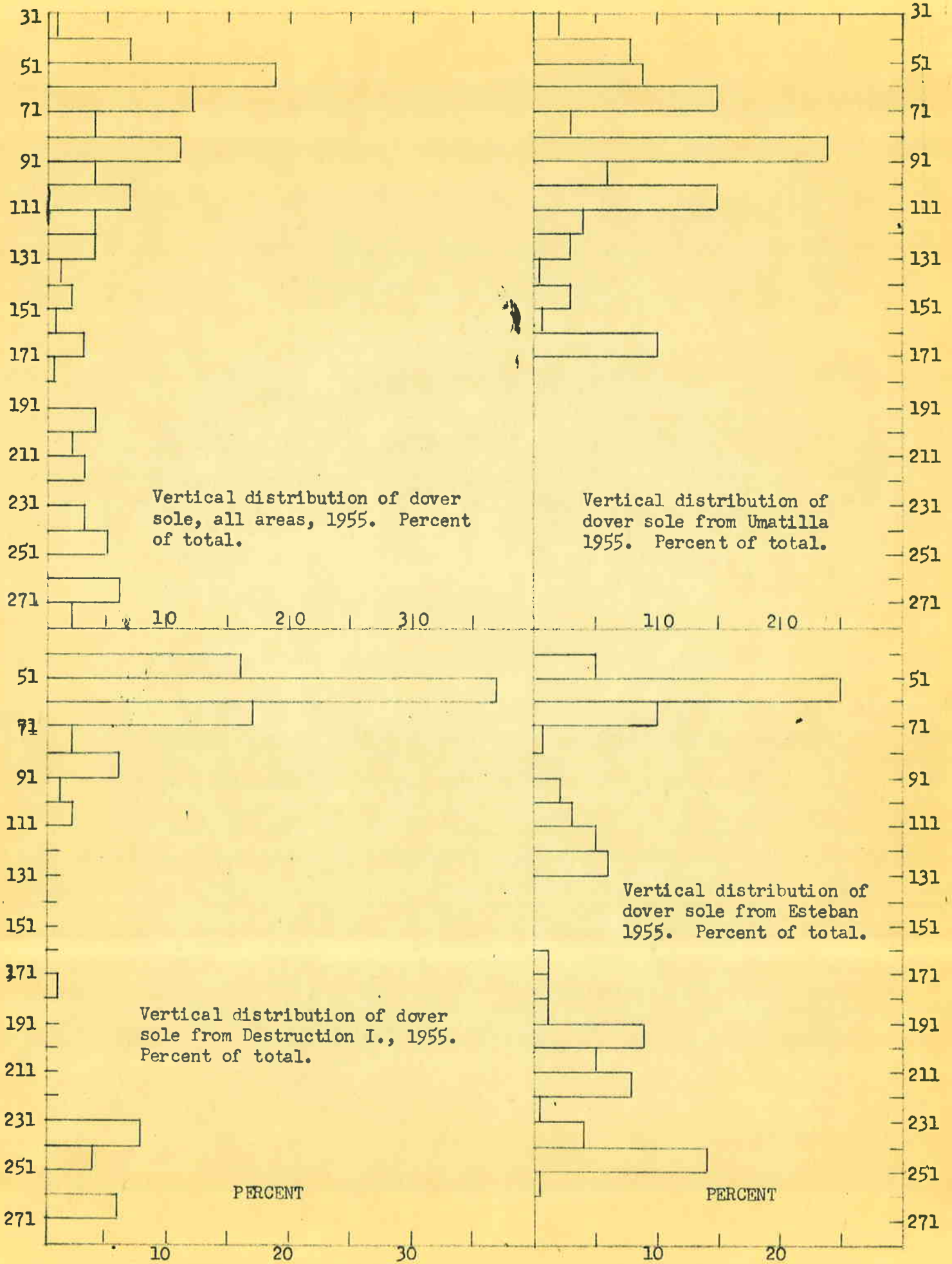


Figure 15 - Vertical distribution of dover sole, 1955

Table 18 - Catch by month of dover sole for major producing areas, 1955

	Esteban	Cape Flattery	Umatilla	Destruction
January	--	--	--	--
February	--	3,220	--	33,450
March	32,730	--	--	28,125
April	357,695	14,400	64,865	--
May	169,340	11,120	28,370	4,120
June	187,500	18,010	3,755	10,735
July	312,500	62,515	94,060	10,985
August	42,115	101,955	117,020	27,150
September	34,300	60,535	91,785	128,840
October	--	73,290	179,880	181,835
November	2,650	175,045	145,785	20,765
December	--	31,845	56,720	121,430
Total	1,138,830	551,935	782,240	567,435

Starry Flounder (Platichthys stellatus)

Starry flounder ranked eighth in poundage and eighth in value for trawl-caught fish during 1955. The four areas in which starry flounder are caught in fair amounts include Hecate Strait, S. E. Alaska, the grounds from Cape Flattery to Quillayute and inside Puget Sound.

Catch records indicate that the S. E. Alaska fishery takes place during the winter months when adverse weather conditions prevail on the offshore grounds. Some of the more productive Alaskan grounds fished by Washington trawlers include the waters (See Figure 16 and 17) to the south of Mitkof Island, north of Level Island in Summer Strait and in the entrance to Port Camden.

Starry flounder catches by area and by effort are shown in Table 19, while the catch by month for major producing banks is shown in Table 20. A graphic relationship of catch trends is shown in Figure 18.

Figure 16 - Trawl areas for starry flounder

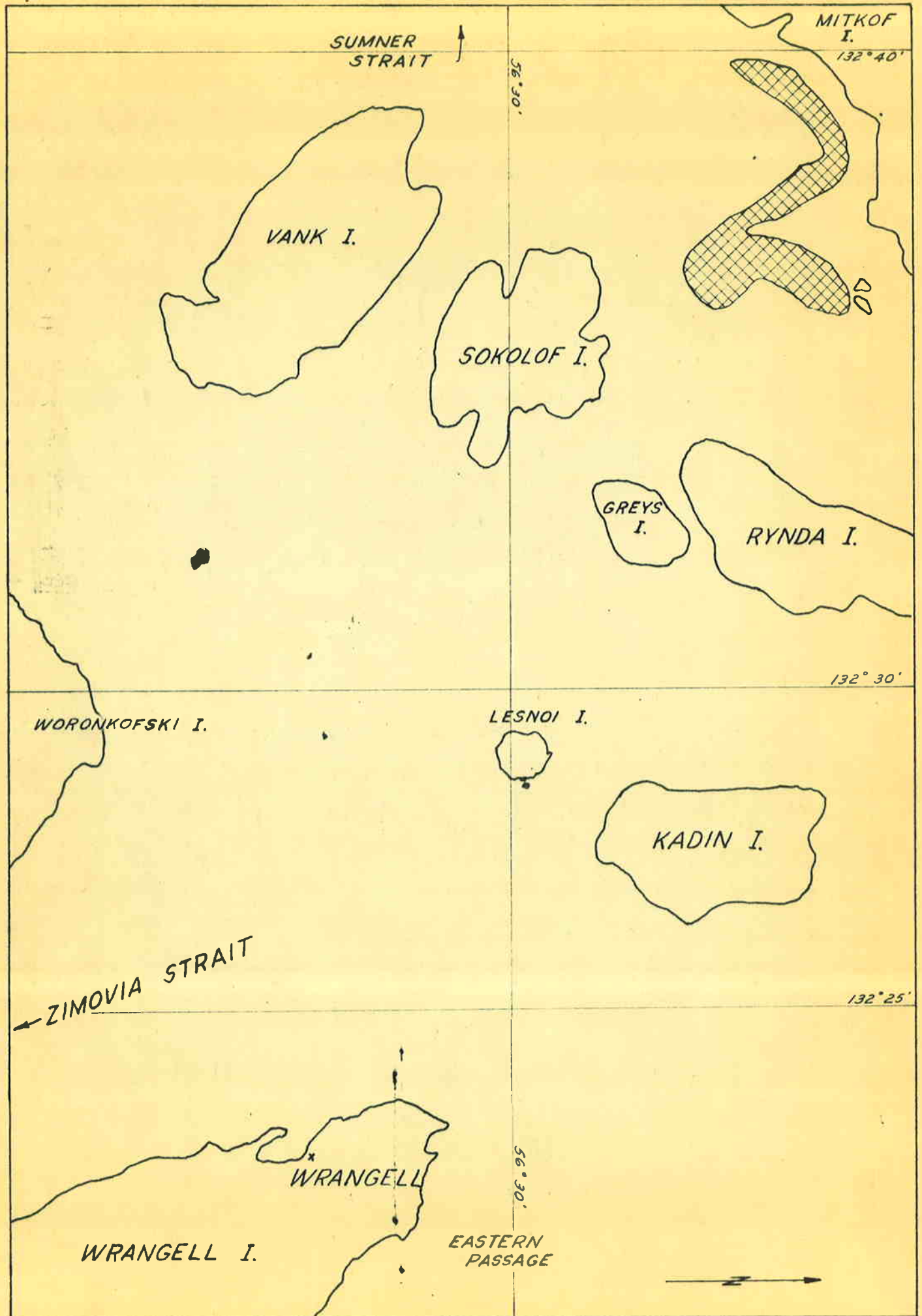
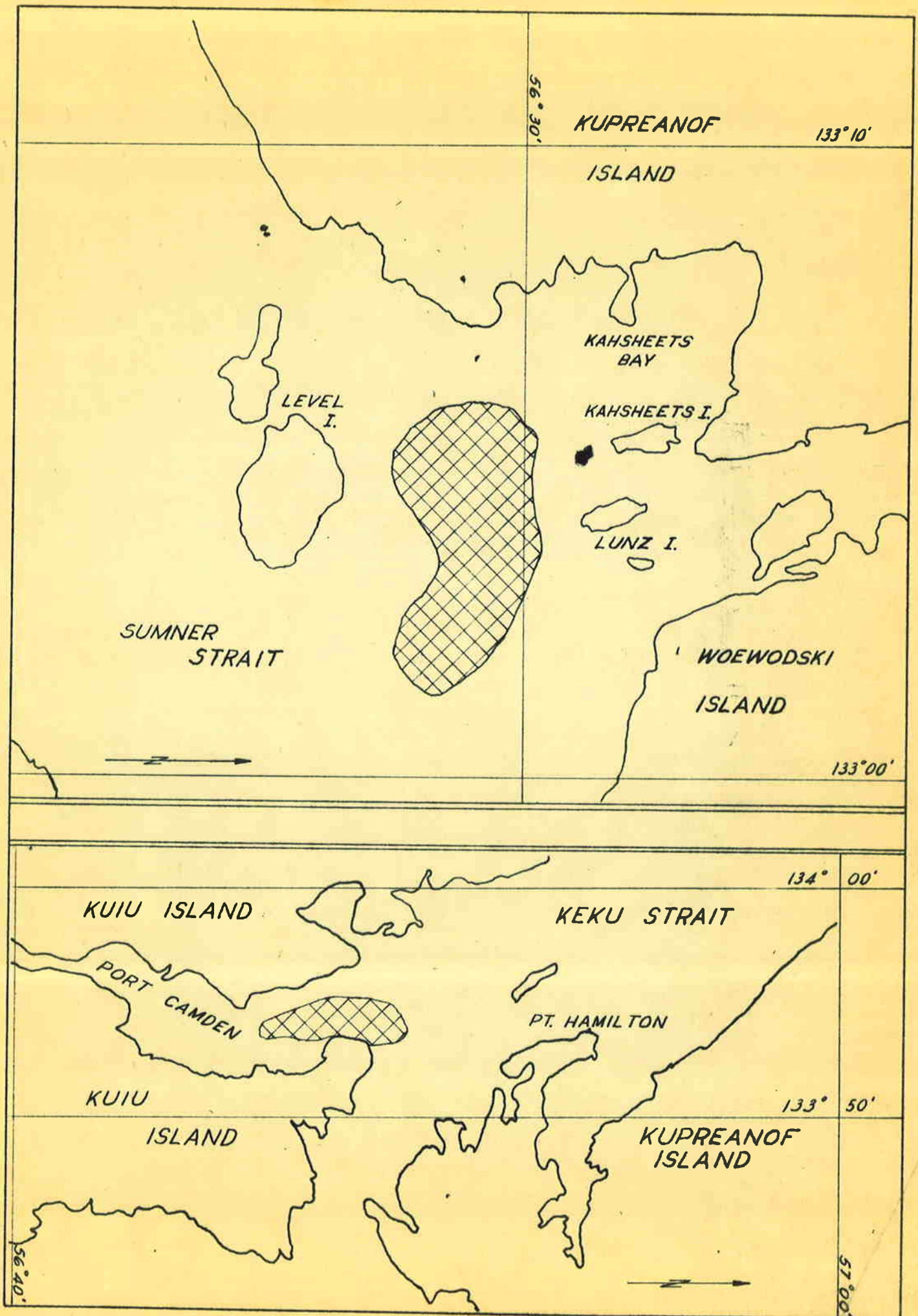


Figure 17 - Trawl areas for starry flounder



----- CATCH PER HOUR ——— CATCH PER SIGNIFICANT EFFORT [] TOTAL CATCH

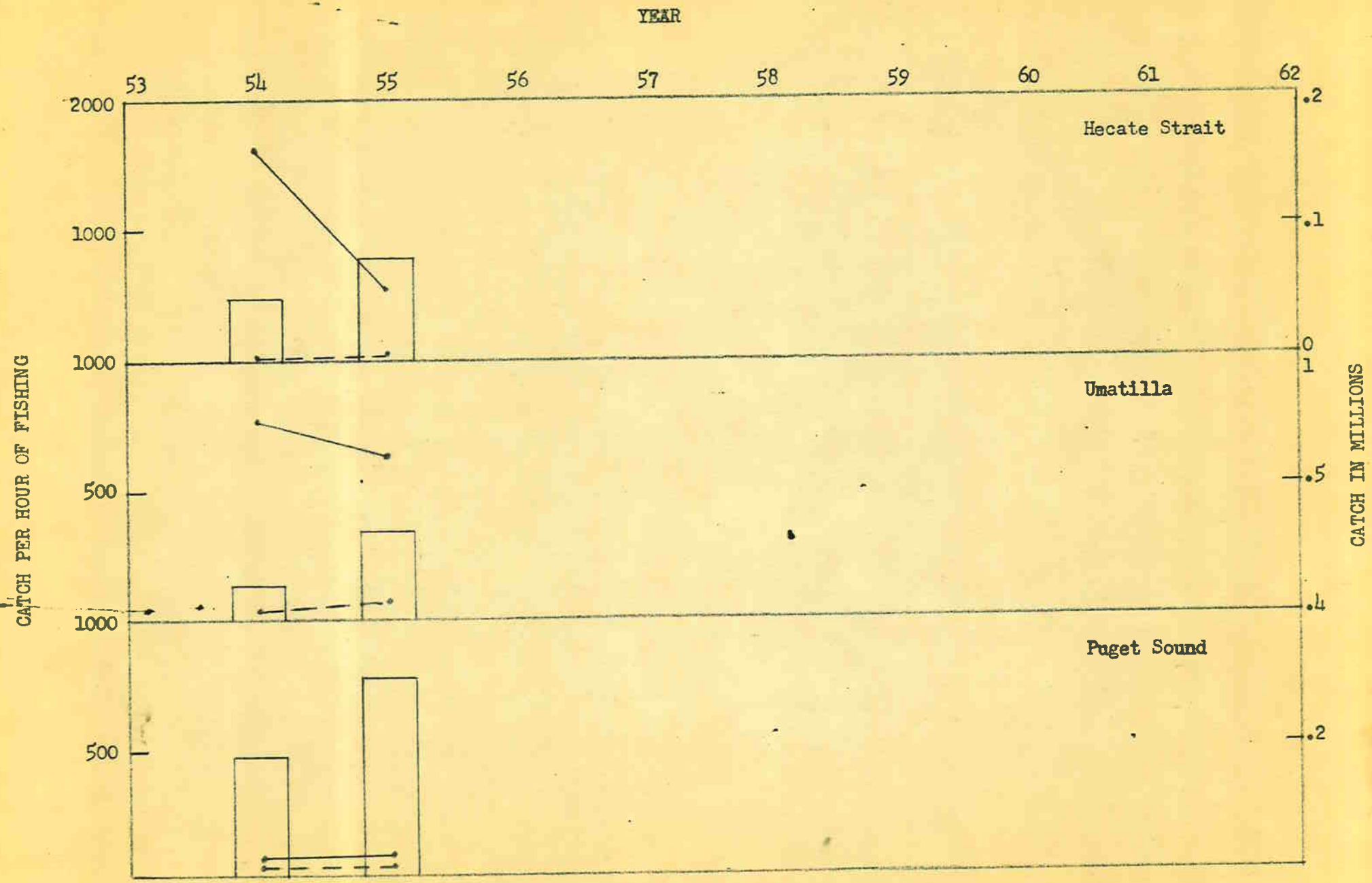


Figure 18 - Total catch, catch per hour, and catch per significant effort for starry flounder

Depth Distribution

Starry flounder are usually caught in shallow water at depths between 11-20 fathoms (Figure 19). They are common in areas of fresh water discharge.

Management

The volume of starry flounder landings is largely governed by market limits and the low recovery on fillets makes the species undesirable at present costs of production. The magnitude of stocks are not known, and catch/effort figures are probably not good measures of relative abundance when a species is mostly incidental in the catches.

Table 19 - Summary catch/effort data and productive index,* 1955 trawl landings of starry flounder

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	79,900	2,998	27	0.48	520
Goose Island		2,791			
Cape Scott		3,916			
Cape Cook		19			
Esperanza		2,068			
Nootka		434			
Esteban		4,351			
Ucluelet		369			
40 Mile		920			
Swiftsure		298			
Cape Flattery	17,800	5,223	35-3	.08	250
Umatilla	392,600	6,672	59	1.36	622
Quillayute	29,100	2,473	12	.33	302
Destruction Island	4,200	2,998	1	.03	
Grays Harbor and south		213			
Puget Sound	322,100	7,362	44	1.22	137
Miscellaneous	744,100	430	1,730	48.06	2,113
Total	1,589,000	43,892	36		

* Catch per hour by area $\frac{844,900}{43,892}$

Catch per hour all areas, 1955

$\frac{522,800}{20,364} = 26$

** Flounder in catch representing 25 percent or over of total fare made during particular effort.

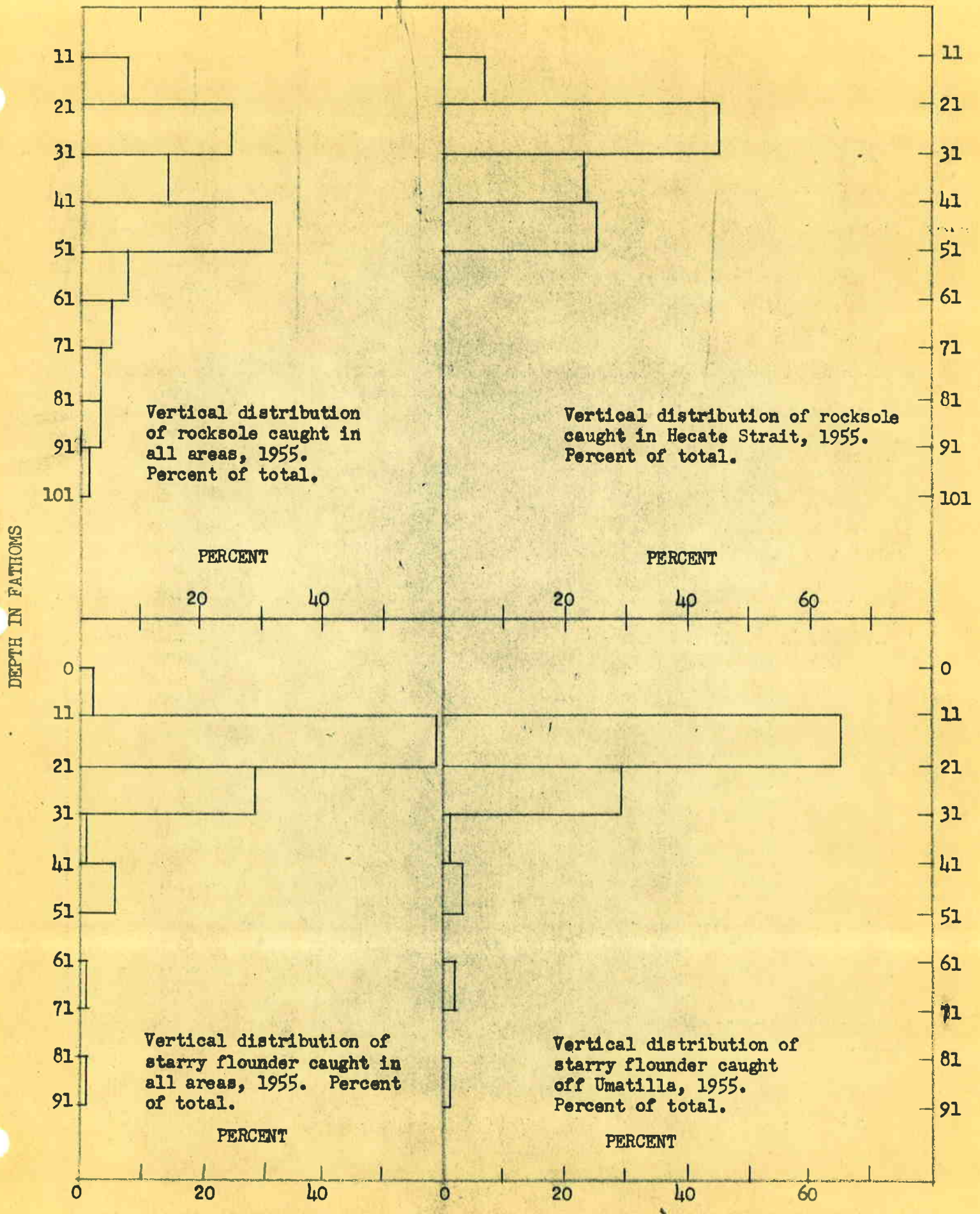


Figure 19 - Vertical distribution of rocksole and starry flounder, 1955

Table 20 -- Catch by month of starry flounder for major producing areas, 1955

Month	Hecate Strait	Umatilla	Puget Sound	S. E. Alaska
January	--	4,070	136,830	236,600
February	--	1,500	36,895	5,250
March	--	--	25,340	144,500
April	17,465	--	95	--
May	54,400	--	29,210	--
June	5,500	220	2,925	--
July	--	43,735	9,940	--
August	110	227,180	12,525	--
September	2,440	115,900	500	--
October	--	--	12,720	--
November	--	--	8,730	103,500
December	--	--	46,415	254,200
Total	79,915	392,605	322,125	744,050

Rock sole (*Lepidopsetta bilineata*)

Rocksole landings were about double the 1954 catch and exceeded 1,000,000 pounds. As in 1954 most of the catch was caught on northern grounds from Cape Scott to Hecate Strait. Availability of the species was good and the basic catch per effort was up for all three areas (Figure 20). The origin of catches, catch per hour and significant catch per effort are shown in Table 21. Rocksole catches are taken in waters ranging from 10 to 50 fathoms. They are most commonly landed during the winter and early spring months when market conditions are good. Fishermen report that rocksole are difficult to hold during warm weather and apparently become soft after a few days in ice.

Management

Rocksole like starry flounder are harvested only spasmodically by Washington trawlers and usually during periods when bottom fish are at a premium. The stocks fished by Washington trawlers appear to be in excellent condition and it is doubtful that present fishing rates will measurably affect population sizes.

----- CATCH PER HOUR ——— CATCH PER SIGNIFICANT EFFORT TOTAL CATCH

YEAR

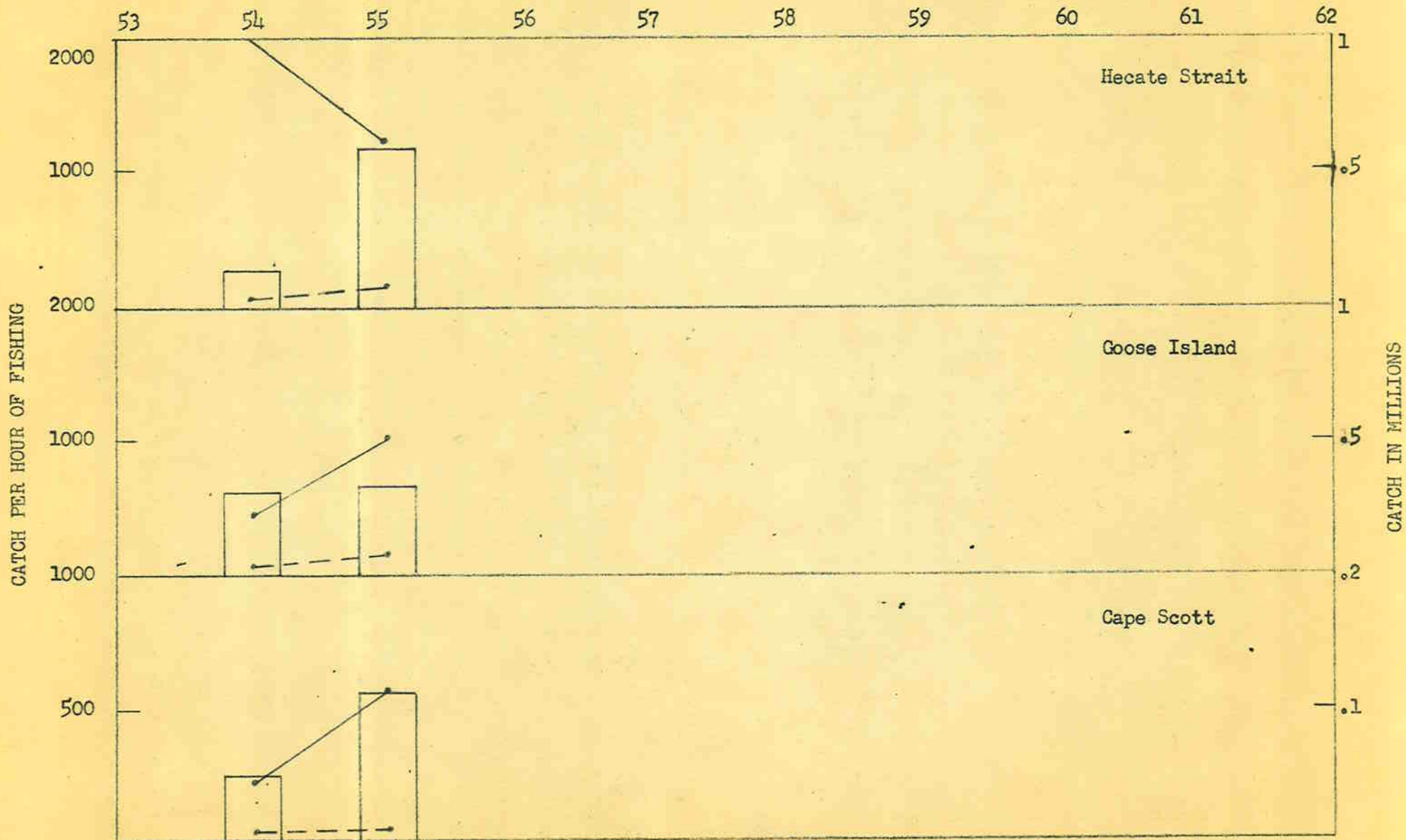


Figure 20 - Total catch, catch per hour, and catch per significant effort for Rocksole

Table 21 - Summary catch/effort data and productive index,* 1955 trawl landings of rocksole.

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	588,000	2,998	196	7.54	1,222
Goose Island	331,700	2,791	119	4.58	1,102
Cape Scott	112,700	3,916	29	1.12	559
Cape Cook		19			
Esperanza		2,068			
Nootka Sound		434			
Esteban		4,351			
Ucluelet		369			
Barkely Sound		357			
40 Mile		920			
Swiftsure		298			
Cape Flattery		5,223			
Umatilla		6,672			
Quillayute		2,473			
Destruction		2,998			
Grays Harbor and south		213			
Puget Sound	81,900	7,362	11	0.42	118
Total	1,114,300	43,462	26		

* Catch per hour by area ^{1,032,400} ~~1,032,400~~ ** ~~Rock sole~~ in catch representing 25 percent or over of total fare made during particular effort. ⁹⁷⁰⁹ ~~106~~

True cod (Gadus macrocephalus)

The true cod ranked first in poundage and first in value for trawl-caught fish during 1955. Areas of major productivity included Hecate Strait, Cape Scott, and the Cape Flattery to Umatilla grounds. Other areas yielding fair catches included Goose Island, Esteban, and the inside waters of Puget Sound. As in 1954 the major portion of the catch was derived from the more northern grounds from Cape Scott to Hecate Strait. Total landings of true cod were down 2 million pounds as compared with 1954 and the greater part of the decrease can be attributed to the smaller catches made from Goose Island and Cape Scott (See Figure 21). The more southern banks produced catches which were of equal magnitude or greater than those made in 1954 (Figure 22). The catch per hour, total landings by hour, and other statistical data on 1955 true cod landings is compiled in Table 22 and monthly catch records are shown in Table 23.

——— CATCH PER HOUR ——— CATCH PER SIGNIFICANT EFFORT TOTAL CATCH
 YEAR

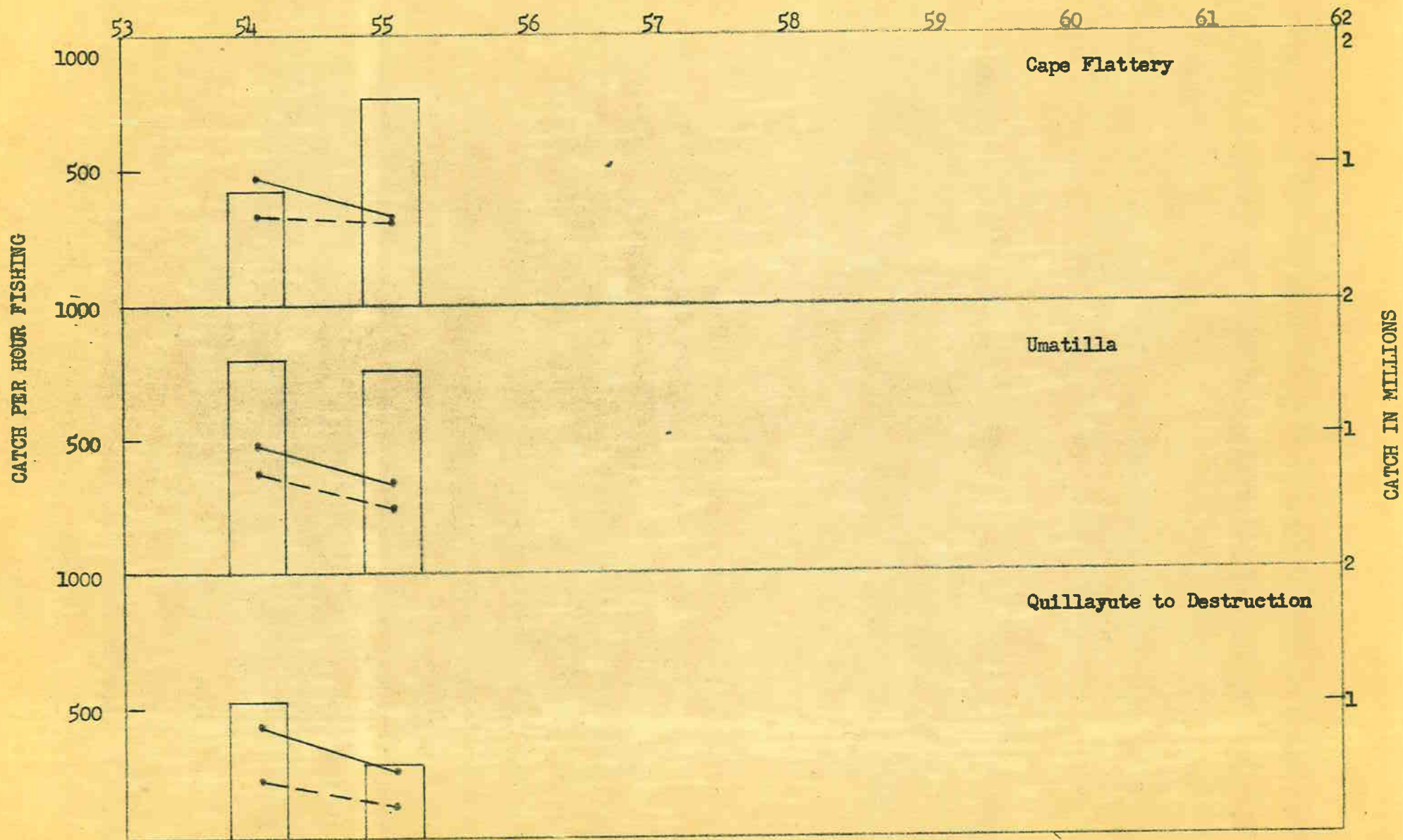


Figure 22 - Total catch, catch per hour, and catch per significant effort for Truecod (southern areas)

CATCH PER HOUR
 CATCH PER SIGNIFICANT EFFORT
 TOTAL CATCH

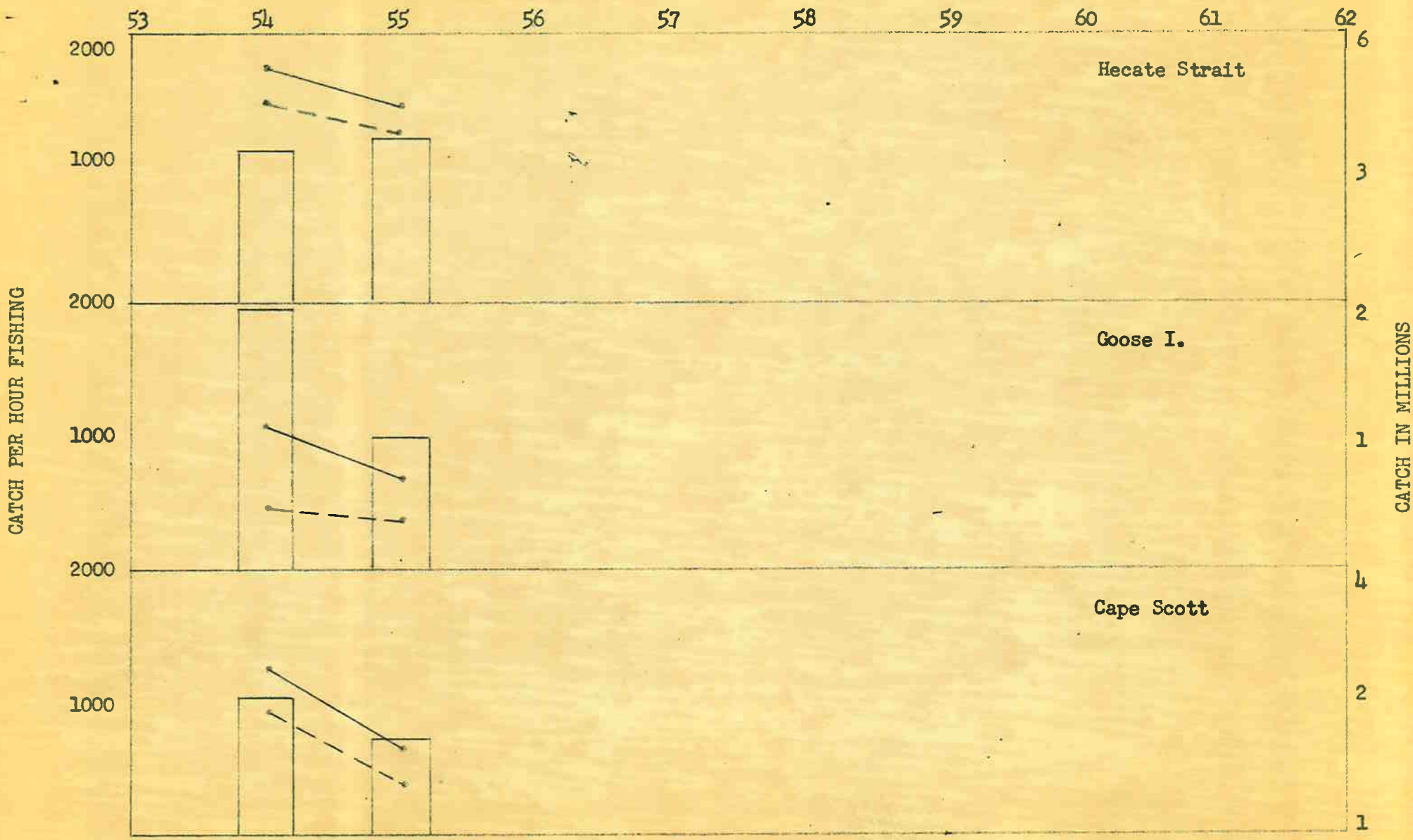


Figure 21 - Total catch, catch per hour, and catch per significant effort for True Cod (Northern areas)

Table 22 - Summary catch/effort data and productive index,* 1955 trawl landings of true cod.

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	3,676,600	2,998	1,226	4.13	1,490
Goose Island	987,000	2,791	354	1.19	678
Cape Scott	1,524,300	3,916	389	1.31	628
Cape Cook	-----	19	---	---	---
Esperanza	847,500	2,068	410	1.38	486
Nootka Sound	11,100	434	26	0.09	290
Esteban	650,600	4,351	150	0.51	483
Ucluelet	197,100	369	534	1.80	542
Barkley Sound	209,400	357	587	1.98	600
40 Mile	353,700	920	384	1.29	538
Swiftsure	147,400	298	495	1.67	685
Cape Flattery	1,597,300	5,223	306	1.03	438
Umatilla	1,554,600	6,672	233	0.78	335
Quillayute	368,100	2,473	149	0.50	271
Destruction Island	221,400	2,998	74	0.25	204
Grays Harbor and south	5,300	213	25	0.08	75
Puget Sound	550,900	7,362	75	0.25	---
Total	12,902,300	43,462	297		

* Catch per hour by area $\frac{12,902,300}{43,462} = 297$
 Catch per hour all areas, 1955

** True cod in catch representing 25 percent or over of total fare made during particular effort.

Table 23 - Catch by month of true cod for major producing areas, 1955

Month	Hecate Strait	Goose Island	Cape Scott	Esperanza	Cape Flattery	Umatilla
January	151,615	65,695	51,490	--	6,240	618,980
February	742,860	--	337,915	--	698,195	369,325
March	665,640	410,715	220,935	411,400	671,480	74,590
April	506,330	116,430	74,255	324,390	21,970	71,915
May	209,210	209,210	50,520	54,570	25,330	73,820
June	495,640	8,215	12,170	15,750	14,100	26,800
July	128,960	33,700	167,060	14,655	22,860	78,195
August	591,900	14,625	193,980	1,405	14,625	117,060
September	160,170	55,590	5,490	25,000	40,920	47,550
October	---	68,670	156,220	--	25,580	24,365
November	7,040	4,140	146,710	--	41,770	9,520
December	17,210	--	107,560	320	14,210	42,510
Total	3,676,575	986,990	1,524,305	847,490	1,597,280	1,554,630

Depth

Major production of true cod are caught at depths between 40 and 70 fathoms (Figure 23). Observations on seasonal depth movements indicates a movement into shallower water during the spring and summer months and a shift to deep water during the fall and winter.

Management

The catch per hour fishing for true cod declined in all major areas during 1955. Although market conditions were not up to those of 1954, abundance measures indicate the species was less available to the fishery and stock levels were down in most areas. The factors responsible for the decreased availability may have been the heavy 1954 fishery, poor recruitment, or both. As the species seems to have a relatively fast growth rate and only 3 or 4 age groups greatly effect the fishery, poor recruitment could be largely responsible for the lowered availability.

Pacific Ocean Perch (Sebastes alutus)

Pacific ocean perch ranked fourth in poundage and seventh in value during 1955. This may be compared with a ranking of second in poundage and fourth in value during 1954. The decrease in catch was especially manifest on the Goose Island grounds. This area which yielded in excess of 4 million during 1954, fell off nearly 3,000,000 pounds. Although all major areas demonstrated a decrease in the catch per hour (Figure 24), the drop in total yield was effected by a decrease demand for this species and small limits imposed on the fishermen. Production areas during 1955 included Goose Island, Esteban, and the grounds from Cape Flattery to Destruction Island. The catch/effort data for Pacific ocean perch for 1955 are shown in Table 24 and monthly landing figures are given in Table 25.

DEPTH IN FATHOMS

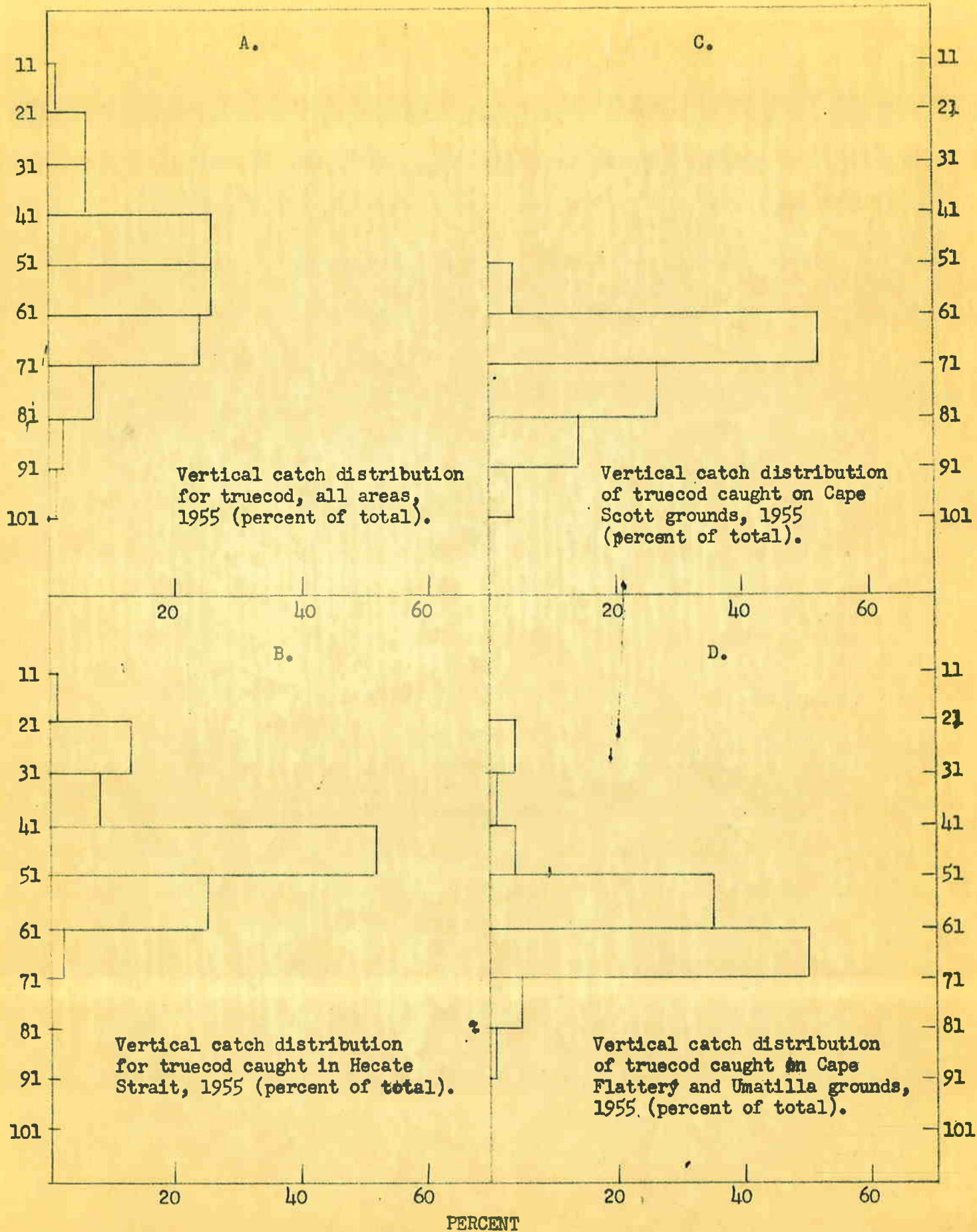


Figure 23 - Catch distribution for truecod, 1955

--- CATCH PER HOUR —●— CATCH PER SIGNIFICANT EFFORT □ TOTAL CATCH
 YEAR

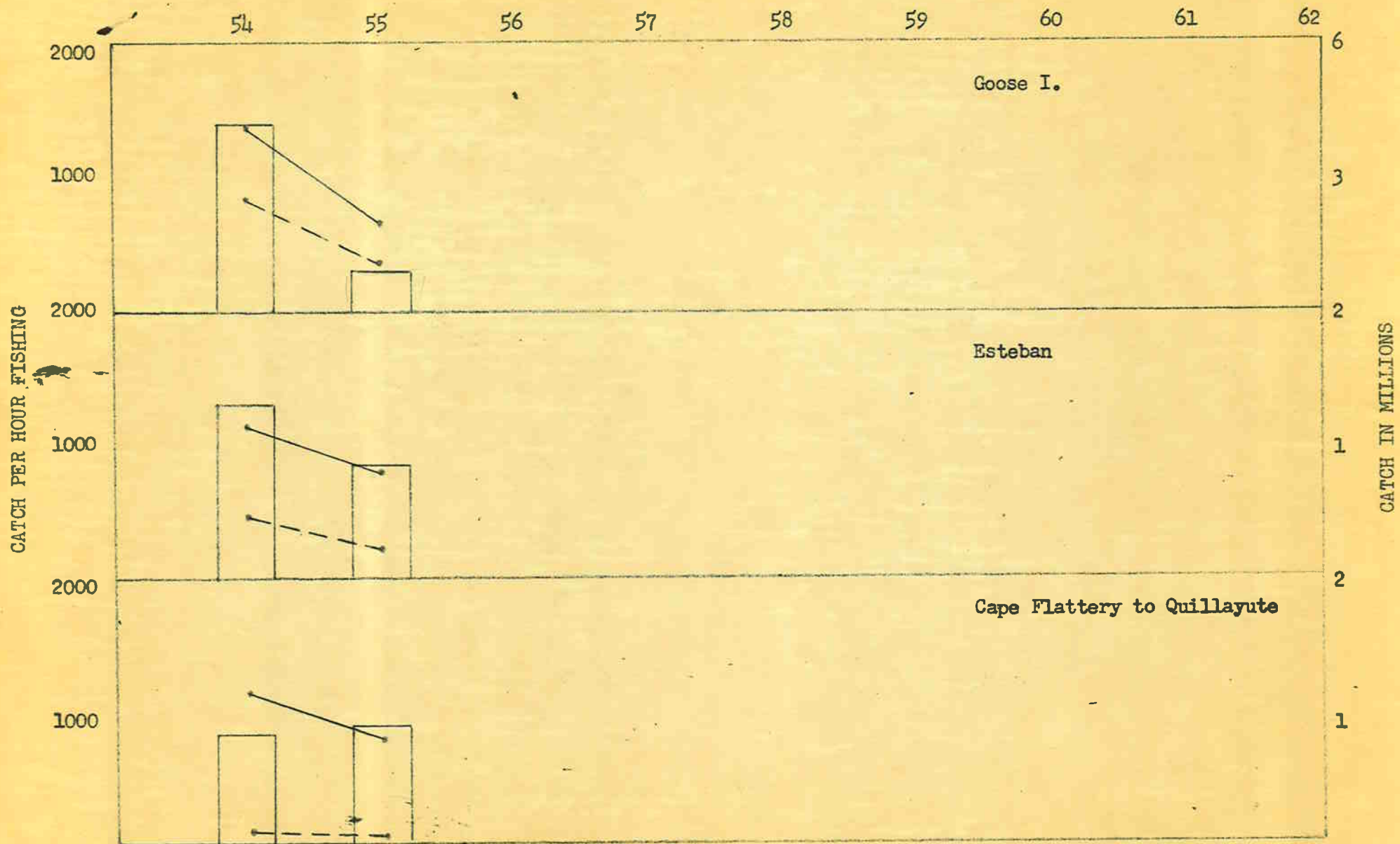


Figure 24 - Total catch, catch per hour, and significant catch per effort for ocean perch.

Table 24 - Summary catch/effort data and productive index,* 1955 trawl landings of ocean perch.

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	37,700	2,998	13	0.15	652
Goose Island	960,200	2,791	344	3.87	1,136
Cape Scott	394,500	3,916	101	1.13	1,642
Cape Cook	---	19	---	---	---
Esperanza	13,700	2,068	7	0.08	393
Nootka Sound	480,300	434	111	1.25	1,645
Esteban	862,700	4,351	198	2.22	801
Ucluelet	---	369	---	---	---
Barkley Sound	---	357	---	---	---
40 Mile	1,300	920	1	0.01	---
Swiftsure	23,900	298	8	0.09	---
Cape Flattery	202,500	5,223	39	0.44	---
Umatilla	367,300	6,672	55	0.62	1,107
Quillayute	350,500	2,473	142	1.60	1,421
Destruction Island	188,900	2,998	63	0.71	551
Grays Harbor and south	1,500	213	7	0.08	333
Puget Sound	---	7,362	---	---	---
Total	3,885,000	43,462	89		

* Catch per hour by area

Catch per hour all areas, 1955

** Ocean perch in catch representing 25 percent or over of total fare made during effort.

Depth

As indicated in Figure 25, the major production of perch is caught at depths from 90 to 190 fathoms. A comparison of the graphed depth catch distributions for 1954 and 1955 suggests the fish moved into somewhat shallower water in 1955. This shift might be due largely to adverse weather conditions which kept the fishermen off the more productive deeper grounds.

Management

There are three major stocks of ocean perch, which were exploited during 1955. These include the Goose Island grounds, Esteban, and Washington coast fishery. The catch per effort was noticeably down in all areas; however, weather conditions may have greatly affected these measures.

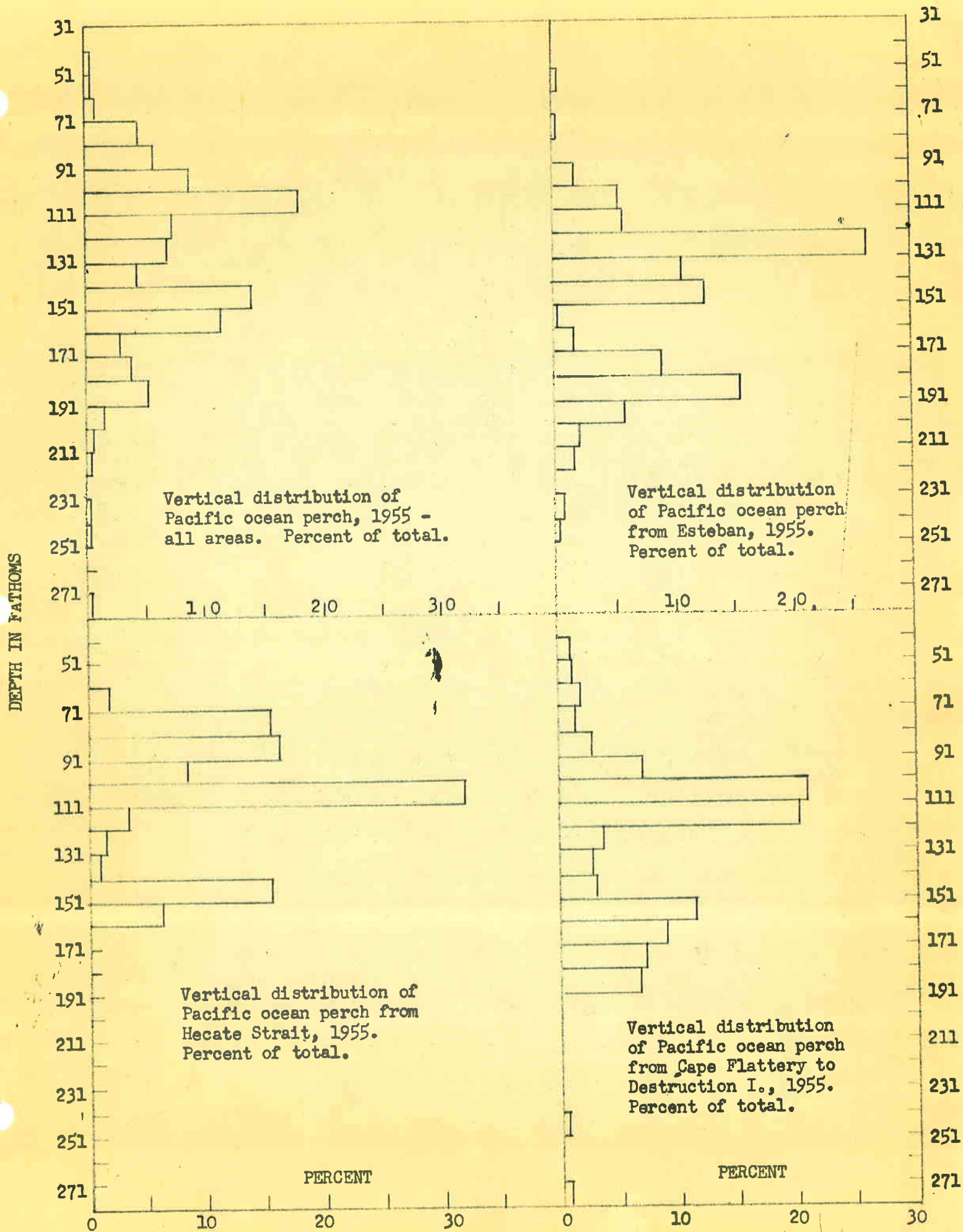


Figure 25 - Vertical distribution of Pacific ocean perch

Table 25 - Catch by month of Pacific ocean perch for major producing areas, 1955

Month	Goose Island	Cape Scott	Nootka Sound	Esteban	Umatilla	Quillayute
January	---	---	---	1,300	128,700	11,700
February	---	---	---	29,085	9,090	7,575
March	---	---	78,825	192,650	---	---
April	---	2,130	48,990	177,640	20,305	53,960
May	191,910	14,815	5,385	39,460	89,825	---
June	190,100	2,225	---	8,890	5,000	13,340
July	137,730	---	---	8,130	29,655	39,135
August	71,590	---	153,225	212,720	32,385	80,290
September	206,585	91,110	---	112,715	23,550	109,130
October	35,670	182,770	30,355	18,215	20,940	15,325
November	20,700	101,455	1,380	61,110	6,900	20,010
December	105,950	---	162,170	920	920	---
Total	960,235	394,505	480,330	862,835	367,270	350,465

Rockfish (Sebastes sp.)

Rockfish ranked second in poundage and fourth in value for trawl-caught species during 1955. The total catch was up somewhat from 1954 probably as a result of the scarcity of more desirable fish. Rockfish landed in the state of Washington include a variety of species; however, the majority of the catch consists of the yellow-tailed rockfish, Sebastes flavidus; the canary or orange rockfish, Sebastes pinniger; the rosefish, Sebastes diploproa; the black rockfish, Sebastes melanops; and the salmon rockfish, Sebastes paucispinis. A number of other species are landed in smaller amounts. Because of the difficulty in separating and identifying the rockfishes, no attempt is made to maintain catch records by species. The most convenient separation is that used by the commercial buyers whereby the rockfishes are divided into two groups - red and black. Interviews generally separate the rockfishes into these two categories. Catch per hour towing and other statistical data on rockfish are presented in Table 26.

Management

Because of the complexity of the scorpaenid landings, abundance measures of individual species are difficult to assess. Fishermen relate a diversity of opinions as to the relative abundance of rockfishes as compared with past years. Most agree that rockfish are not as abundant as in former years, but maintain there is a more than adequate amount to supply the market demand.

Table 26 - Summary catch/effort data and productive index,* 1955 trawl landings of rockfish (red and black combined)

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	119,600	2,998	40	0.31	431
Goose Island	794,300	2,791	285	2.19	550
Cape Scott	1,518,900	3,916	388	2.98	667
Cape Cook	3,300	19	174	1.34	357
Esperanza	786,600	2,068	380	2.92	513
Nootka Sound	38,100	434	88	0.68	---
Esteban	569,500	4,351	131	1.01	515
Ucluelet	3,600	369	10	0.08	83
Barkley Sound	6,200	357	17	0.13	278
40 Mile	16,700	920	18	0.14	188
Swiftsure	52,000	298	174	1.34	1,706
Cape Flattery	418,400	5,223	80	0.62	215
Umatilla	746,000	6,672	112	0.82	256
Quillayute	255,700	2,473	103	0.79	247
Destruction	267,300	2,998	89	0.68	188
Grays Harbor and south	27,100	213	127	0.98	421
Puget Sound	45,400	7,362	6	0.05	111
Total	5,668,700	43,462	130		

* Catch per hour by area $\frac{5,623,300}{36,100} = 156$
 Catch per hour all areas, 1955

** Rockfish in catch representing 25 percent or over of total fare made during particular effort.

Lingcod (*Ophiodon elongatus*)

Lingcod ranked fifth in poundage and sixth in value for trawl-caught species during 1955. The availability of lingcod during 1955 was excellent and the catch of this species by trawl gear was the highest on record - almost 1.5 million pounds over the previous year. Lingcod were especially abundant in Hecate Strait, on the Goose Island grounds, Esteban, 40 Mile bank and Umatilla. The basic catch per hour towing (Fig. 26 & 26A) was up on all the main banks while the significant catch per hour was up for most of these banks.

Lingcod, one of the few species showing an increase in availability during 1955, are caught in the spring and summer months. During the winter spawning season the fish are caught only in small amounts by trawlers. The catch by

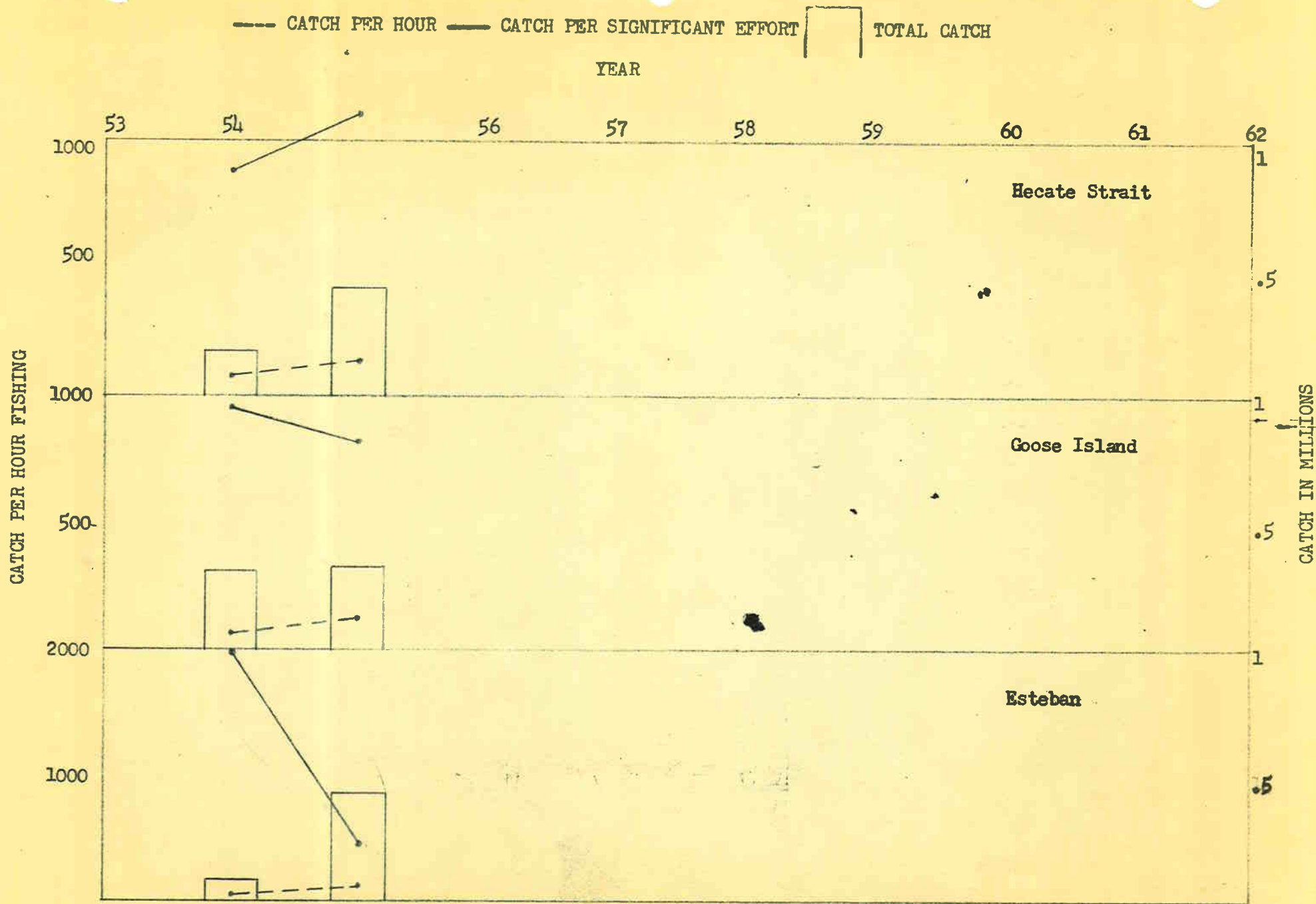


Figure 26 - Total catch, catch per hour, and catch per significant effort for Lingcod (Northern areas)

——— CATCH PER HOUR ——— CATCH PER SIGNIFICANT EFFORT TOTAL CATCH

YEAR

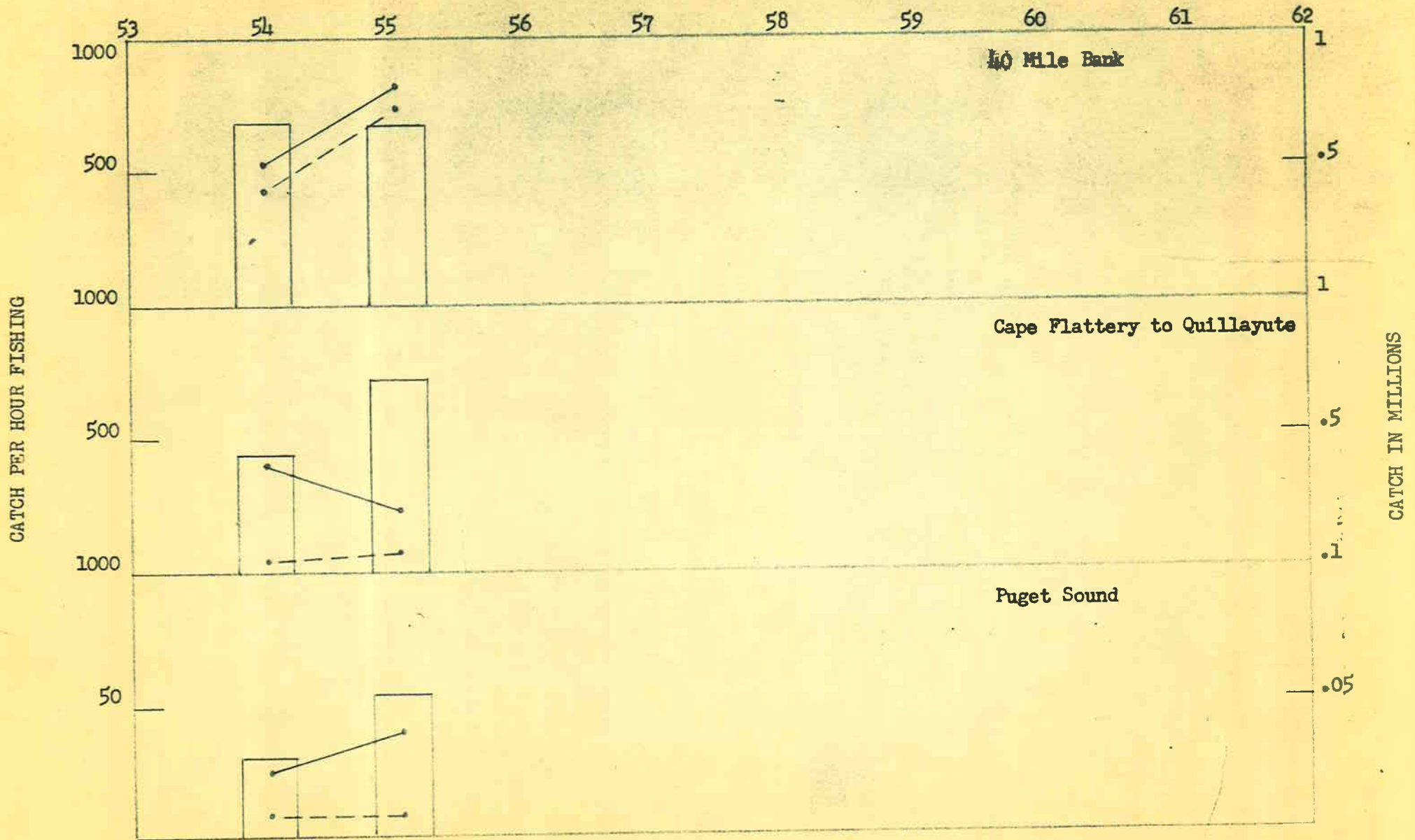


Figure 26A -- Total catch, catch per hour, and catch per significant effort for Lingcod (Southern areas)

month for the main fishing grounds are summarized in Table 27, while the catch by area and effort is shown in Table 28.

Table 27 - Catch by month of lingcod for major producing areas, 1955

Month	Hecate Strait	Goose Island	Esteban	40 Mile	Umatilla
January	1,575	575	---	--	32,070
February	75,115	---	---	--	22,630
March	32,570	7,260	15,170	--	3,405
April	24,480	25,795	62,910	--	9,955
May	23,670	38,145	176,920	103,305	54,420
June	35,595	40,600	141,815	312,635	32,650
July	60,060	60,490	28,640	21,100	30,555
August	66,075	37,345	---	27,810	76,760
September	112,950	110,665	755	110,230	78,575
October	---	3,400	---	96,600	35,890
November	1,420	1,420	2,060	680	9,665
December	1,340	---	4,025	335	3,355
Total	434,850	325,695	432,295	672,695	389,930

Table 28 - Summary catch/effort data and productive index,* 1955 trawl landings of lingcod.

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	434,900	2,998	145	1.75	1,209
Goose Island	325,700	2,791	117	1.41	827
Cape Scott	196,700	3,916	50	0.60	231
Cape Cook	---	19	-	--	---
Esperanza	152,400	2,068	74	0.89	223
Nootka Sound	53,800	434	124	1.49	698
Esteban	432,300	4,351	99	1.19	428
Ucluelet	103,100	369	279	3.36	442
Barkley Sound	117,000	357	328	3.95	440
40 Mile	672,700	920	731	8.81	827
Swiftsure	169,900	298	570	6.87	724
Cape Flattery	170,100	5,223	33	0.40	235
Umatilla	389,900	6,672	58	0.70	221
Quillayute	152,700	2,473	62	0.75	213
Destruction Island	161,900	2,998	54	0.64	116
Grays Harbor and south	5,500	213	26	0.31	---
Puget Sound	53,900	7,362	7	0.08	40
Total	3,592,500	43,462	83		

* Catch per hour by area $\frac{3,592,500}{43,462} = 82,660$ 36,100 98
 Catch per hour all areas, 1955

** Lingcod in catch representing 25 percent or more of total fare made during particular effort.

Depth Distribution

The majority of catches of lingcod taken by Washington trawlers is caught at depths between 30 and 60 fathoms as shown in Figure 27. Note the productive depths are the same for 40 Mile bank and Hecate Strait.

Management

Catches of lingcod have evidently been aided by the recruitment of several good year classes during the past few years. The offshore stocks are apparently in good shape and overfishing does not seem to be a problem.

Blackcod (Anoplopoma fimbria)

Blackcod catches made by the trawl fleet were small and the total value of the fishery amounted to only \$35,000. This species is generally considered incidental in trawl catches and the majority of the State's landings are made by the long-line fishery. Areas which yielded the best catches of blackcod (Table 29) included Esteban, 40 Mile bank, Swiftsure, Cape Flattery and Umatilla. The catch per hour fishing was up for Cape Flattery and adjacent grounds.

Depth

Otter-trawl caught blackcod are made over a considerable depth range (Figure 28) and there has been a trend in recent years for the fishery to extend into deeper water along the Continental slope. In the past, blackcod were taken by trawlers in the spring and summer months. The development of the deep-water fisheries has extended the blackcod season throughout the year.

Management

Analysis of length frequency records, catch/effort data and the weight relationship of blackcod (Cape Flattery) indicate a reduction in the availability

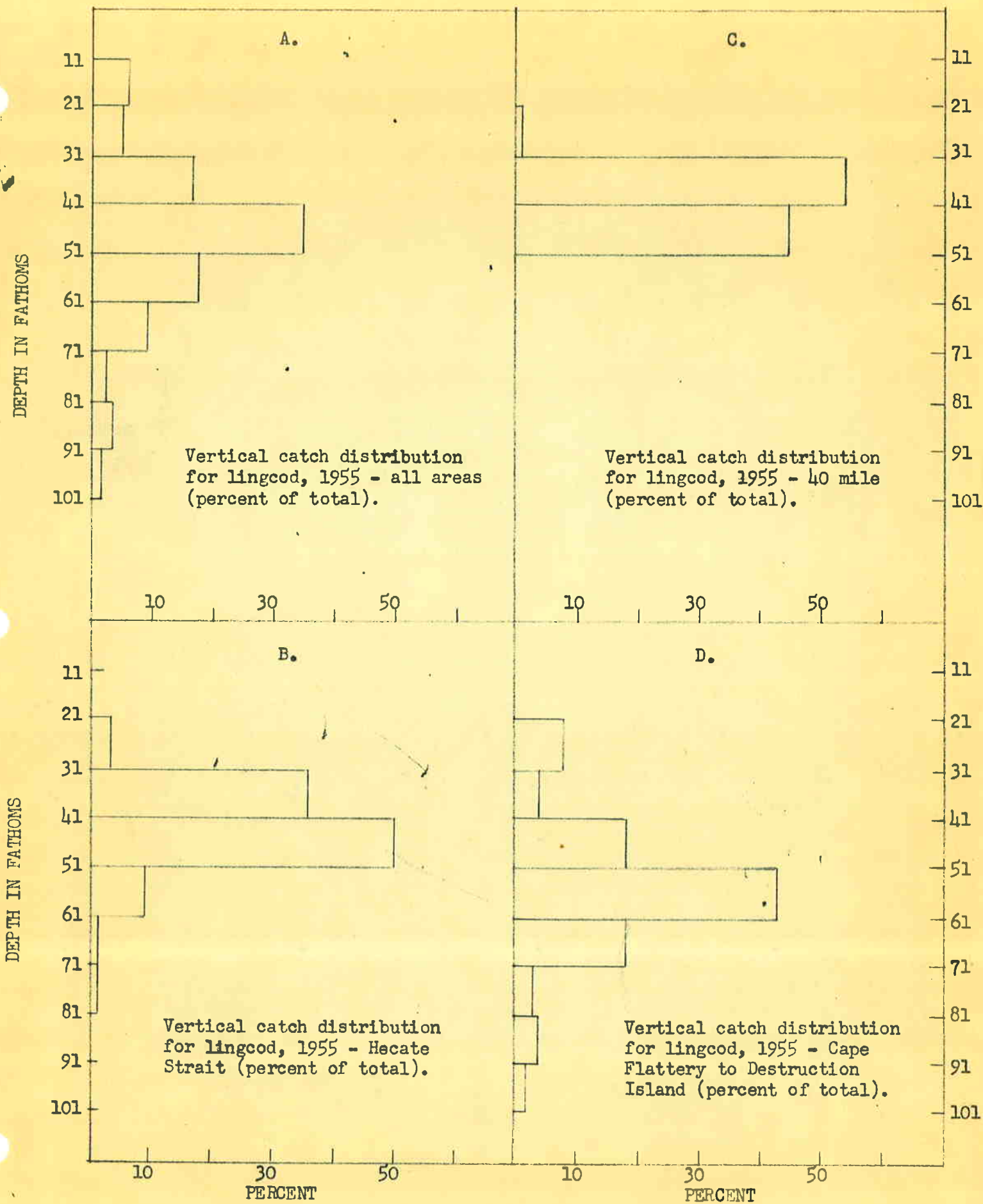
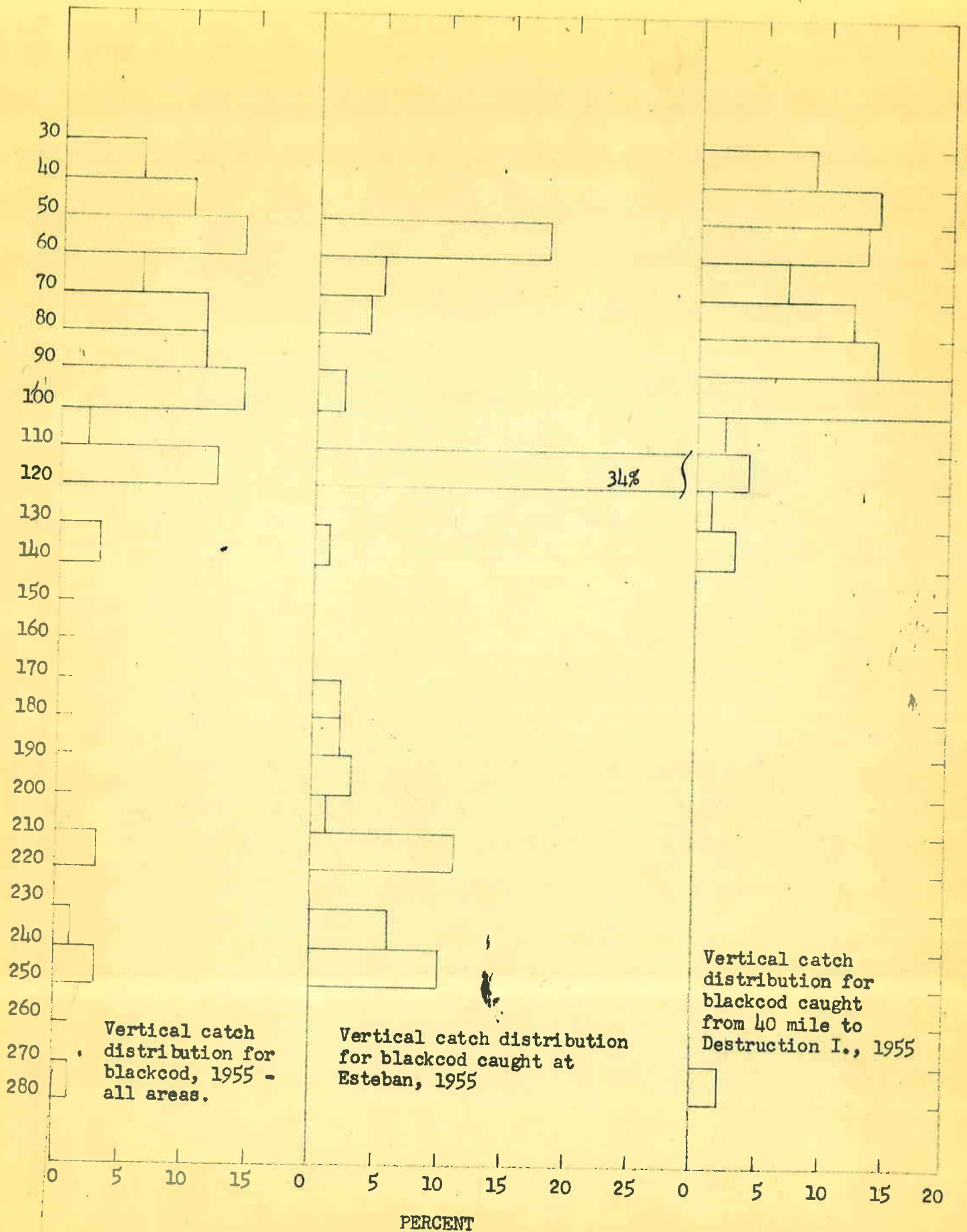


Figure 27 - Vertical catch distribution for lingcod, 1955

DEPTH BY 10-FATHOM INTERVALS



Vertical catch distribution for blackcod, 1955 - all areas.

Vertical catch distribution for blackcod caught at Esteban, 1955

Vertical catch distribution for blackcod caught from 40 mile to Destruction I., 1955

Figure 28 - Vertical catch distribution for blackcod, 1955

of large marketable fish. The decline in average size and the catch/effort has extended over a considerable time and it is felt that overfishing may have reduced the stock size and average size, below a level of maximum substantial economic yield.

Table 29 - Summary catch/effort data and productive index,* 1955 trawl landings of blackcod.

Area	Catch	Hours	C/H (lbs.)	Productive index	Significant C/H **
Hecate Strait	1,400	2,998	---	---	---
Goose Island	17,600	2,791	6	0.60	---
Cape Scott	2,100	3,916	---	---	---
Cape Cook	---	19	---	---	---
Esperanza	2,800	2,068	1	0.10	---
Nootka Sound	2,800	434	6	0.60	---
Esteban	113,100	4,351	26	2.60	341
Ucluelet	---	369	---	---	---
Barkley Sound	1,500	357	4	0.40	---
40 Mile	38,500	920	42	4.20	1,250
Swiftsure	16,700	298	56	5.60	---
Cape Flattery	75,700	5,223	14	1.40	476
Umatilla	44,300	6,672	7	0.70	335
Quillayute	23,100	2,473	9	0.90	171
Destruction Island	90,600	2,998	30	3.00	382
Grays Harbor and south	600	213	3	0.30	---
Puget Sound	---	7,362	---	---	---
Total	430,800	43,462	10		

* $\frac{\text{Catch per hour by area}}{\text{Catch per hour all areas, 1955}}$ 36081 12

** Blackcod in catch representing 25 percent or over of total fare made during particular effort.

THE HABITAT

The trawl grounds fished by the Washington trawl fleet extend from the Columbia River to waters near and adjacent to Wrangell in southeast Alaska.

The continental shelf along the Washington coast extends an average of 20 miles seaward. At the southern end of Vancouver Island the shelf broadens and extends some 35 miles seaward; however, the shelf narrows considerably to the northwest and is only seven miles wide at the northern extremity of Vancouver Island. North of Vancouver Island, the Queen Charlotte Islands extend some 140 miles in a northwesterly direction. The continental shelf is extremely narrow and in most areas may extend only one or two miles seaward. No trawling has been attempted in this area. East of these islands are the productive Hecate Strait grounds, which are mostly shallower than 100 fathoms and range between 30 and 60 miles in width.

Three submarine canyons transverse the continental shelf and may be considered the prominent topographic features influencing trawl activities within the range fished by Washington vessels. The Columbia River canyon extends westward from the river mouth and cuts a deep gorge across the coastal shelf. The boundaries of the canyon are irregular but the main slope to the abyssal depths may be considered to swing slightly to the south. The slope gradient is relatively steep and trawling below 100 fathoms is restricted to a few isolated tows. Boulders are commonly reported from the canyon areas.

North of the Columbia River the shelf is interrupted only by several small canyons (Grays Harbor and Willapa) until the deep water trough is encountered which enters Straits of Juan De Fuca. This trough, which extends well into the Strait, extends southwest from Cape Flattery and terminates on the continental slope some 25 miles west of Carrol Island. The deeper portions of the trough have a depth range between 100 and 200 fathoms. To the west of the trough the continental shelf broadens to form a large plateau-like area known as Forty Mile Bank or La Perouse Bank.

The Queen Charlotte Sound area separates Vancouver Island from the Queen Charlotte Islands and a deep water protrusion extends a considerable distance to the eastward in the Sound.

Because the trawl landings generally constitute a conglomeration of species which have their origin from various grounds, the definition of species habitat as related to the environments seems most complex. The consensus, however, that trawl catches are composed of a heterogeneous mixture of demersal fishes is not as valid as might be thought. Studies of landing records and bottom characteristics on trawl grounds indicate that most commercial species have somewhat definable habitats in which the species may dominate in relative abundance; that is, they have a definable depth range in which they are caught in the commercial fishery and usually inhabit areas with a particular type of bottom. This is especially true of soles. Figures 29 and 30 depict the vertical stratification of roundfish and flatfish as indicated from interview landings. Although considerable overlapping may occur, each species may predominate a particular depth. In the flatfishes, the starry flounder and rock sole are taken in the shallower waters, the English sole at depths between 40 - 60 fathoms, petrale sole slightly deeper and the Dover sole over a considerable depth range. With the roundfish there is a more definite depth-species relationship ranging from the lingcod in shallow water to the deep water Pacific ocean perch.

A preliminary analysis of the fishery indicates that lingcod are most abundant over gravel or rocky types of bottom and are abundant on grounds such as 40 Mile bank and reef areas such as those adjacent to Umatilla. English sole seem to prefer sand or shale types of habitats and are seldom taken over gravel or rocky bottoms. The true cod, apparently not as discriminate as to bottom features, is taken over various types of bottom. It is therefore less restricted

Fig. 29 - DEPTH DISTRIBUTION FOR ROUND FISH CAUGHT BY WASHINGTON TRAWL FLEET - 1955.

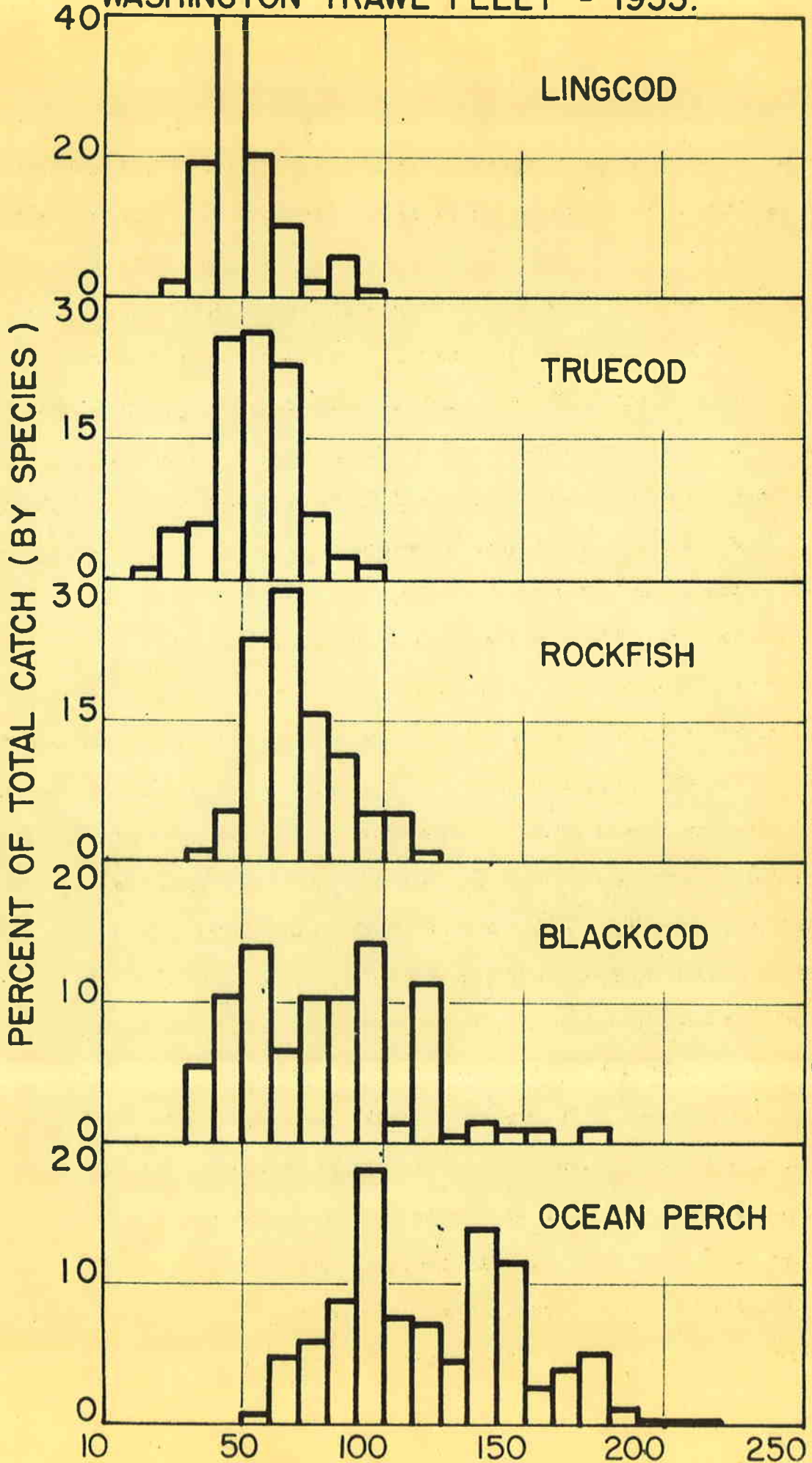
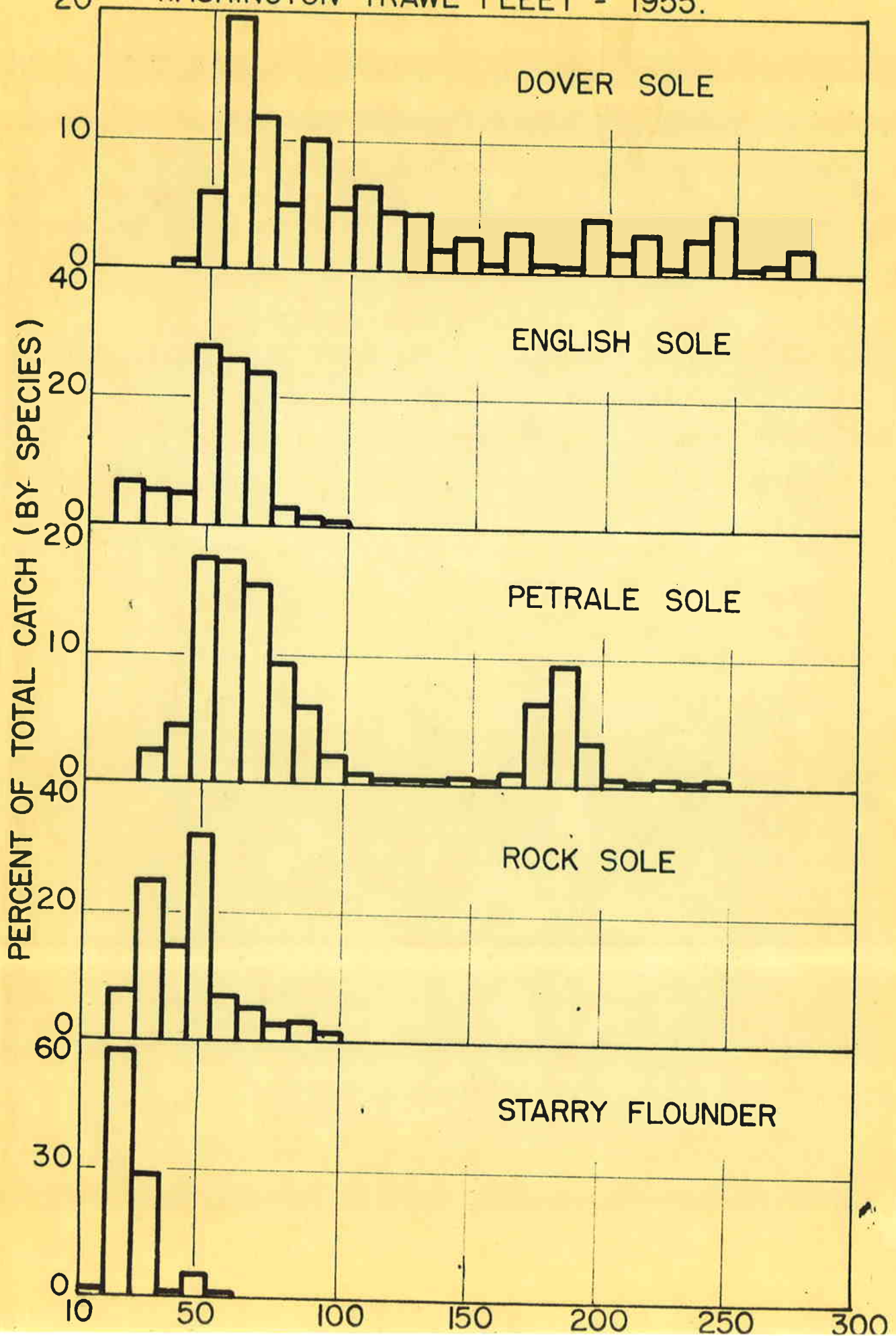


Fig. 30 - CATCH DISTRIBUTION FOR FLATFISH CAUGHT BY WASHINGTON TRAWL FLEET - 1955.



as to its distribution. Adult blackcod seem to prefer the slopes of canyons and gullies and are less vulnerable to trawl gear than most demersal species. The ocean perch, taken almost exclusively over the deeper continental slope areas, are abundant in gravel-rocky regions. Dover sole are taken over a wide depth range but are usually taken on muddy or clay type of bottom.

Because of the habitat preference for certain depth ranges and types of bottom, commercial catches are commonly dominated by one and, at the most, two species. Fishermen may therefore display a fair degree of selectivity in their fishing activities.