

RESEARCH REPORT ON THE WASHINGTON TRAWL FISHERY
1960 and 1961

(Confidential)

State of Washington
DEPARTMENT OF FISHERIES
Research Division

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RESEARCH REPORT of the 1960-1961 TRAWL FISHERY INVESTIGATION

Table of Contents

	Page
Introduction	1
Research Program	1
The Trawl Fishery 1960-1961	3
Comparison of Washington and P.M.F.C. Statistical Areas	10
Catch Statistics	15
Petrale Sole	16a
English Sole	19
Dover Sole	22
Rock Sole	26
Starry Flounder	29
Pacific (true) Cod	31
Lingcod	34
Sablefish	37
Rockfish	38
Ocean Perch	43
Dogfish Shark.	45
Discussion	48
Market Sampling	49

List of Figures

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
1.	Number of Otter Trawl Boats Participating in the Washington Trawl Fishery by Month during 1961.	6
2.	Number of Days per Trip Compared to Number of Days Fished per Trip by Month for Outside (Ocean) Boats only, in 1961.	9
3.	P.M.F.C. Statistical Areas.	10a
4.	Washington Statistical Areas.	11a
5.	Puget Sound Dogfish Liver Landings, Effort, and Catch per trip.	46a

List of Tables

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
1.	Ports of Landings and Fish Processors.	3
2.	Trawlers Participating in the 1961 Washington Trawl Fishery.	4
3.	Months of Activity of Trawl Vessels Reporting Landings in 1961.	5
4.	Per Cent of Boat Trips Interviewed by Month during 1961.	7
5.	Number of Days per Trip and Number of Interviewed Trips by Month for Inside (Puget Sound) Boats, 1961.	10
6.	Petrale sole Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings for Esteban Deep Northward.	16b
7.	Petrale sole Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings for Sydney Inlet Southward.	17b
8.	English sole Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	21
9.	Dover sole Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	24
10.	Rock sole Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	28
11.	Starry Flounder Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	30

List of Tables (cont.)

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
12.	Pacific cod catch statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	32
13.	Lingcod Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	35
14.	Sablefish Catch, Effort, and Catch per Hour from Estebau Deep in 1961.	37
15.	Sablefish Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	39
16.	Poundage, Hours, and Catch per Hour of Rockfish Landed off Estebau in 1961.	39
17.	Rockfish Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	41
18.	Ocean Perch Catch Statistics for 1955 through 1961. Interview Data Adjusted to Total Landings.	44

Research Report of the 1960-1961 Trawl Fishery Investigation
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Introduction

This is the fifth report on the trawl fishery which primarily concerns the trends in the catch statistics for the trawl-caught species of fish. Other reports were written for 1954, 1955, 1956 and 1959. The latter included the period from 1957 through 1959. The following report includes the period 1960 and 1961.

The press of other activities prevents the discussion of any except the major elements of the fishery. The ten principal species will be considered from those areas that contribute the largest percentages to the total landings. There were no revisions to the trawl regulations during this period.

Research Program

It is interesting to note that Mr. Richard T. Smith in his report on Puget Sound otter trawl investigations, Biological Report No. 36B in October, 1936 outlined the program objective very well: "The program is planned to effect the proper conservation of the species supporting the trawl fishery in order that the maximum sustained yield may be maintained." The objectives remain the same at this writing. The fishery had just moved out of Puget Sound in 1933, a relatively small fleet was involved, and mostly petrale sole was sought along the coast. Now the Puget Sound fishery is much more intensively fished, although it is primarily a winter fishery. The ocean fishery is exploited from southeastern Alaska to Oregon. The outside fleet varies seasonally from about 25 boats during the summer months when halibut and salmon are on the market to 60 or 100 boats during the winter when bottomfish supply the fresh market demand.

Research investigations have varied considerably in the number of individuals studying the fishery. The number of investigators has not kept pace with the

growth of the fishery. For instance, the two investigators during the 1936 period could be expected to accomplish more than a similar number of investigators 25 years later. During the 1940-1947 period several biologists (2-3) were engaged in bottomfish studies, dogfish were studied extensively at this time. Interest seemed to reach a peak during the 1950-1956 period when as many as six individuals were involved in some form of research on bottomfish. At present, there are two biologists working full time on trawl, and two working part time.

The early work did much toward identification of Puget Sound stocks, and good starts were made on life history studies. Catch statistics were initiated then and have become increasingly improved. During the 1950's work was accelerated on the ocean fishery. The method of interviewing fishermen regarding effort and area of fishing was established and the use of machine tabulation was initiated. This record is far from complete as it is based mainly on reported results. For example, the escapement of small fish from various sizes of mesh were studied, but the only trace of this work that resulted in a $4\frac{1}{2}$ -inch mesh regulation appears in the first PMFC bulletin. The point is that to match the growth and complexity of this fishery would require a staff of about 20 investigators. At one time Canada employed 17 persons on their investigations of groundfish. With the present staff it is difficult to accomplish little else beside the routine catch statistics. Much of the time in the last year was spent on revising the Washington data to conform to Pacific Marine Fisheries Commission areas. This required a hand sort of material because the Washington areas and the PMFC areas differ extensively, and the material was coded for machine tabulation by the Washington areas. Subdivisions have been made which will allow easier tabulation for PMFC purposes in the future, and still retain the historic continuity for the state analysis.

In addition to the statistical work, some tagging work was done mostly on lingcod and some biological samples were taken. These aspects will be reported upon further.

The Trawl Fishery 1960-1961

The 1961 Washington otter trawl catch was landed by a fleet of 117 vessels. There were 59 trawlers fishing offshore waters, 44 trawlers operating strictly in Puget Sound and 14 boats which fished both inside and outside waters (Table 2). Ports of landing were Anacortes, Blaine, Bellingham, Everett, Neah Bay, Port Angeles, Seattle and Hoquiam. The following is a list of bottom fish processors by port.

Table 1 - Ports of Landings and Fish Processors

Bellingham

Bellingham Fish Company	1206 Central Avenue
Bornstein Seafoods Inc.	P. O. Box 188
Dahl Fish Company	601 W. Chestnut St.
Fisherman's Market	514 West Holly

Blaine

Blaine Marina	Box 97
Gulf Fish Company	Box 183
Sea K Fish Company	Box 517

Everett

Everett Fish Company	Fisherman's 14th St. Dock
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Hoquiam

Roy Stritmatter	Foot of Karr Street
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Neah Bay

Bay Fish Company	Neah Bay
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Port Angeles

Hegg and Hegg Smoked Salmon Inc.	801 Marine Drive
Evergreen Meats and Seafoods	235 W. 1st Street

Seattle

Eardley Fisheries Co., Inc.	Pier 65
Main Fish Co., Inc.	Pier 60
McCallum-Legaz Fish Co.	Pier 66
Northwest Fisheries Inc.	Pier 24
Seaport Fish Co.	Pier 57

Table 2 - Trawlers, participating in the 1961 Washington Trawl Fishery

Outside Boats 59

Aloma	Georgene	Marie II	Sunbeam
Alda B	Gallant Maid	Morning Star	Thoreen
Alrite	Havanna	Mylark	Traveler
Anna A	Hazel H	Nina B	Tordenskjold
Ann B	Heather	Northern Light II	Tula
Arthur H	Jo-Be	Paragon	Valiant Lady
Carol M	Kristine	Patricia Joan	Verona
Christy	Karen T	Paul L	Vigorous
Coolidge II	Kodiak	Pacific Trawler	Washington
Corregidor	Lady Olga	Radio	Western Flyer
Dakota	Lemes II	Regina	Western Maid
Dixie Maid	Lituya	Roberta	Yaquia
Don Edwards	Marsha Lynn	Sogn	Yankee Maid
Excell II	McKinley	St. Michael	Zarembo II
Guide	Mildred	Sonny Boy	

Inside Boats 44

Barbara Ann	Elfin II	Mermaid II	Shushartie
Bonnie C	Freeland	Merna Jane	Sunbeam
Blue Jay	Fidalgo III	Martle	Solta
Calendar	Frisco	Myrtle	Sunlight
Carman B	Howard B	New Elida	Tongass Queen
Carlton	Hydra	Pacific Raider	Tagatoff
Clio	La Conner	Pt. Defiance	Tongass
Chinook	Linda Jo	Puget Girl	Tulip
Crusader	Lemes	Pacific Breeze	Ursula L
Dutchie C	Laurie Ann	Ralph	Vernon
Emancipator	Marcy M	Secure	White Eagle

Boats Fishing Inside and Outside Waters 14

Bobetta	Merit	Peter LE	Reliance
Confidence	Notre Dame	Paradise	Silverland
Daisy	Olympic	Panther	Theresa S.
Ginger			Voyager

In addition to the regular food fish processors, there were three mink food dealers and two reduction plants buying trawl-caught fish in Washington.

Mink Food Dealers

Northwest Fur Breeders Coop
P. O. Box 399
Edmonds, Washington

R. V. Moore
P. O. Box 38
LaConner, Wash.

McCauley's Inc.
2228 Occidental Ave.
Seattle, Wash.

Rendering Plants

Blaine Fish Products Co.
Blaine, Washington

Puget Sound By-Products
P. O. Box 651
Everett, Washington

The Washington otter trawl fishery is very seasonal. This is due to market demand and not in any way to availability. A large part of the fleet turns to halibut fishing, purse-seining, gill-netting, packing, etc. during the summer resulting in July and August being a very slack period for the trawl fishery (Figure 1). This seasonal variation is further illustrated by the fact only 16 of the 59 outside trawlers and 3 of the 44 inside boats fished 10 or more months (Table 3). Outside trawlers fished an average of 7 months and inside boats 5.4 months.

Table 3 - Months activity of trawl vessels reporting landings in 1961.

Inside Boats				Outside Boats			
Months Active	Number of boats	Per Cent of boats	Per Cent active	Months active	Number of boats	Per Cent of boats	Per Cent active
1	3	6.8	100.0	1	1	1.7	100.0
2	4	9.1	93.1	2	4	6.8	98.6
3	9	20.5	84.0	3	6	10.2	91.8
4	4	9.1	63.5	4	4	6.8	81.6
5	3	6.8	54.4	5	3	5.1	74.8
6	3	6.8	47.6	6	6	10.2	69.7
7	6	13.6	40.8	7	8	13.6	59.5
8	6	13.6	27.2	8	6	10.2	45.9
9	3	6.8	13.6	9	5	8.5	35.7
10	2	4.5	6.8	10	7	11.9	27.2
11	0	-	2.3	11	6	10.2	15.3
12	1	2.3	2.3	12	3	5.1	5.1
	44	100.0*			59	100.0*	

*Columns will not add up to 100 per cent due to rounding.

Approximately 57 per cent of the ocean trawlers (outside boats) landed in Bellingham or Anacortes and 72 per cent of the Puget Sound (inside boats) landed in Bellingham or Blaine. This is consistent with previous years.

During the past year 76.2 per cent or 624 of the 819 outside boat trips were interviewed. Inside boat trips covered were much lower with only 21.1 per cent of all trips interviewed (Table 4). Greater coverage occurred in the Seattle-Everett area due to two full-time biologists stationed there compared to one part-time man in Bellingham and Blaine.

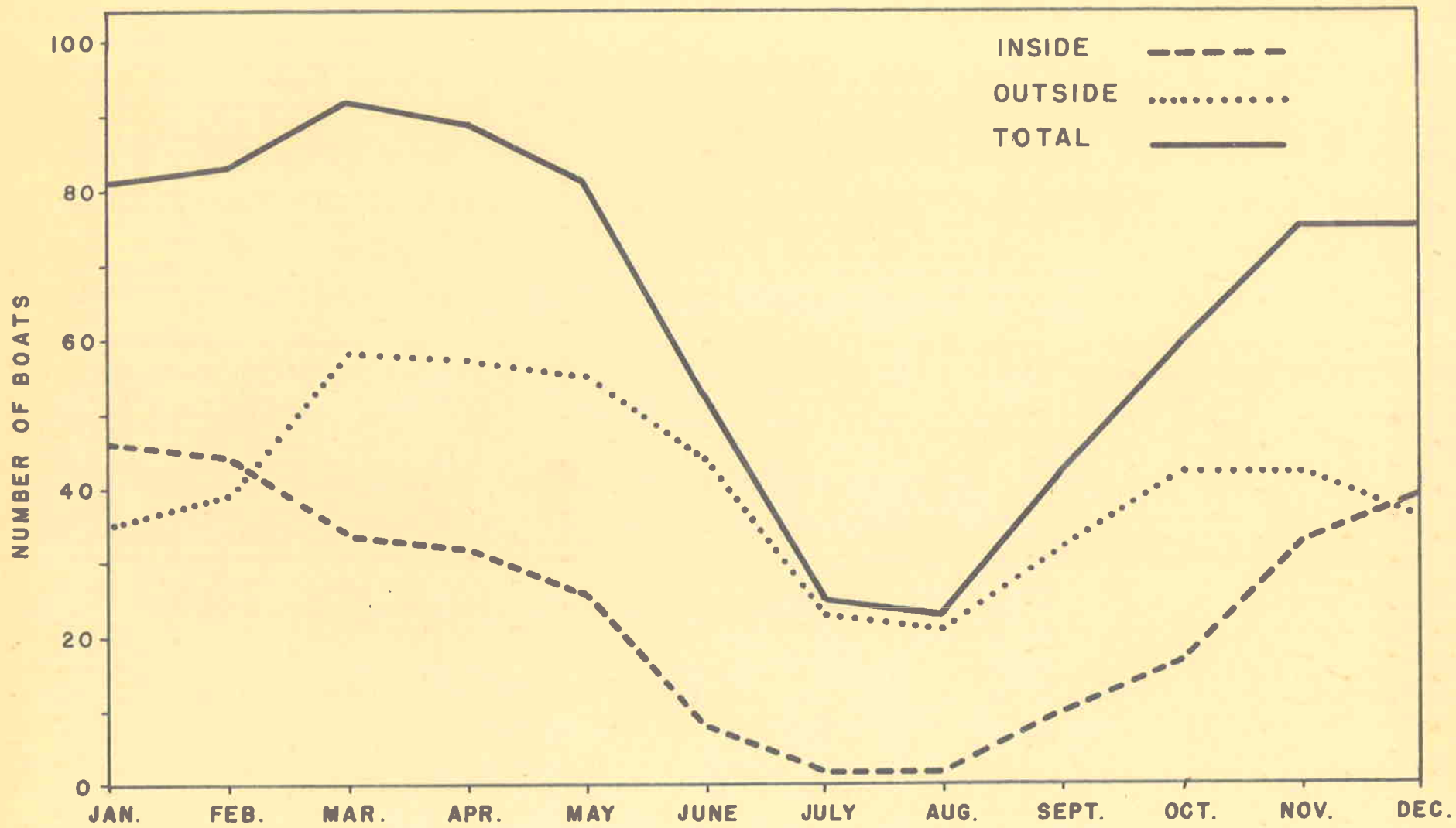


FIGURE 1: NUMBER OF OTTER TRAWL BOATS PARTICIPATING IN THE WASHINGTON TRAWL FISHERY BY MONTH DURING 1961

Table 4 - Per cent of boat trips interviewed by month during 1961

Outside		Month	Inside	
Seattle	Bellingham		Seattle	Bellingham
$\frac{21}{24} = 87.5$	$\frac{17}{21} = 81.0$	Jan.	$\frac{50}{102} = 49.0$	$\frac{62}{195} = 31.8$
$\frac{14}{19} = 73.7$	$\frac{24}{31} = 77.4$	Feb.	$\frac{15}{73} = 20.5$	$\frac{5}{189} = 2.6$
$\frac{23}{36} = 63.9$	$\frac{33}{50} = 66.0$	March	$\frac{15}{18} = 83.3$	$\frac{2}{205} = 1.0$
$\frac{34}{38} = 89.5$	$\frac{31}{57} = 54.4$	April	$\frac{1}{27} = 3.7$	$\frac{0}{173} = 0.0$
$\frac{38}{47} = 80.9$	$\frac{40}{65} = 61.5$	May	$\frac{2}{8} = 25.0$	$\frac{1}{166} = 0.6$
$\frac{27}{37} = 73.0$	$\frac{37}{50} = 74.0$	June	—*	$\frac{0}{30} = 0.0$
$\frac{21}{24} = 87.5$	$\frac{15}{23} = 65.2$	July	—*	$\frac{0}{4} = 0.0$
$\frac{24}{24} = 100.0$	$\frac{20}{25} = 80.0$	Aug.	—*	$\frac{0}{9} = 0.0$
$\frac{22}{20} = 95.7$	$\frac{21}{29} = 72.4$	Sept.	$\frac{0}{15} = 0.0$	$\frac{3}{47} = 6.4$
$\frac{35}{36} = 97.2$	$\frac{30}{39} = 76.9$	Oct.	$\frac{5}{26} = 19.2$	$\frac{39}{88} = 44.3$
$\frac{28}{33} = 84.8$	$\frac{26}{38} = 68.4$	Nov.	$\frac{8}{44} = 18.2$	$\frac{79}{216} = 36.6$
$\frac{22}{27} = 81.5$	$\frac{21}{23} = 91.3$	Dec.	$\frac{32}{52} = 61.5$	$\frac{88}{245} = 35.9$
$\frac{309}{368} = 84.0$	$\frac{315}{451} = 69.8$	Totals	$\frac{128}{365} = 35.1$	$\frac{279}{1,567} = 17.8$
$\frac{624}{819} = 76.2$			$\frac{407}{1,932} = 21.1$	

*No trips during these months.

Although there were over twice as many inside boat trips compared to outside trips, the length of time for an inside trip is much shorter. A vast majority are one day only. The boats land their day's catch that evening, and since the poundage for one day is usually small, the unloading is done very quickly. The two main ports for these "day boats" are Everett and Blaine, which means traveling from Seattle or Bellingham in the evening to interview. This is why the percentage interviewed for inside boats is low.

In the fall of 1961, by emphasizing the use of log books an increased effort was made to cover these boats. The results of this effort can be seen

in the increasing number of interviews during the last three months of the year. This effort for greater inside coverage will continue to be emphasized in 1962.

Figure 2 shows the average number of days fished per trip by outside trawlers to be generally $5-6\frac{1}{2}$ days throughout the year. The average length of trip ranged from 15.9 days in March to 8.2 days in July. The difference between the number of days fished and total length of trips is the time spent traveling to and from the fishing grounds and the days lost to poor weather. The effects of the weather can be seen during the winter and early spring months, which were especially poor in 1961.

The inside Puget Sound fishery picture is quite different. The number of days per trip and the number of days fished per trip are virtually the same for inside boats due to the close proximity of the landing ports and the relatively sheltered waters of Puget Sound. Table 5 gives a breakdown of inside trips showing the average length of trip by month by port. The number of interviewed trips is included in the table as they explain the wide fluctuations that are due simply to the lack of interviews during these months.

Seattle (included Everett) and Bellingham (included Blaine) are shown separately due to the difference in the areas fished by the boats and the corresponding difference in the average length of trip. The inside boats landing in Seattle trawl Case and Carr Inlet, Saratoga Passage, Hood Canal, and Port Angeles. These trips average 5-8 days. In Everett, most of the boats are "day boats" fishing the Everett Bay area. There are no landings in Everett between February 15-April 15 due to a closure of the Everett Bay area during this time.

In Bellingham, inside boats trawl Saratoga Passage, Gulf of Georgia and Bellingham Bay. These boat trips average 5-6 days. In Blaine where virtually half of the inside trawl fleet land their catch, all of the boats are "day boats" and all fish the Gulf of Georgia and Boundary Bay. This is the primary reason why the average length of trip in Bellingham is less than Seattle, being only

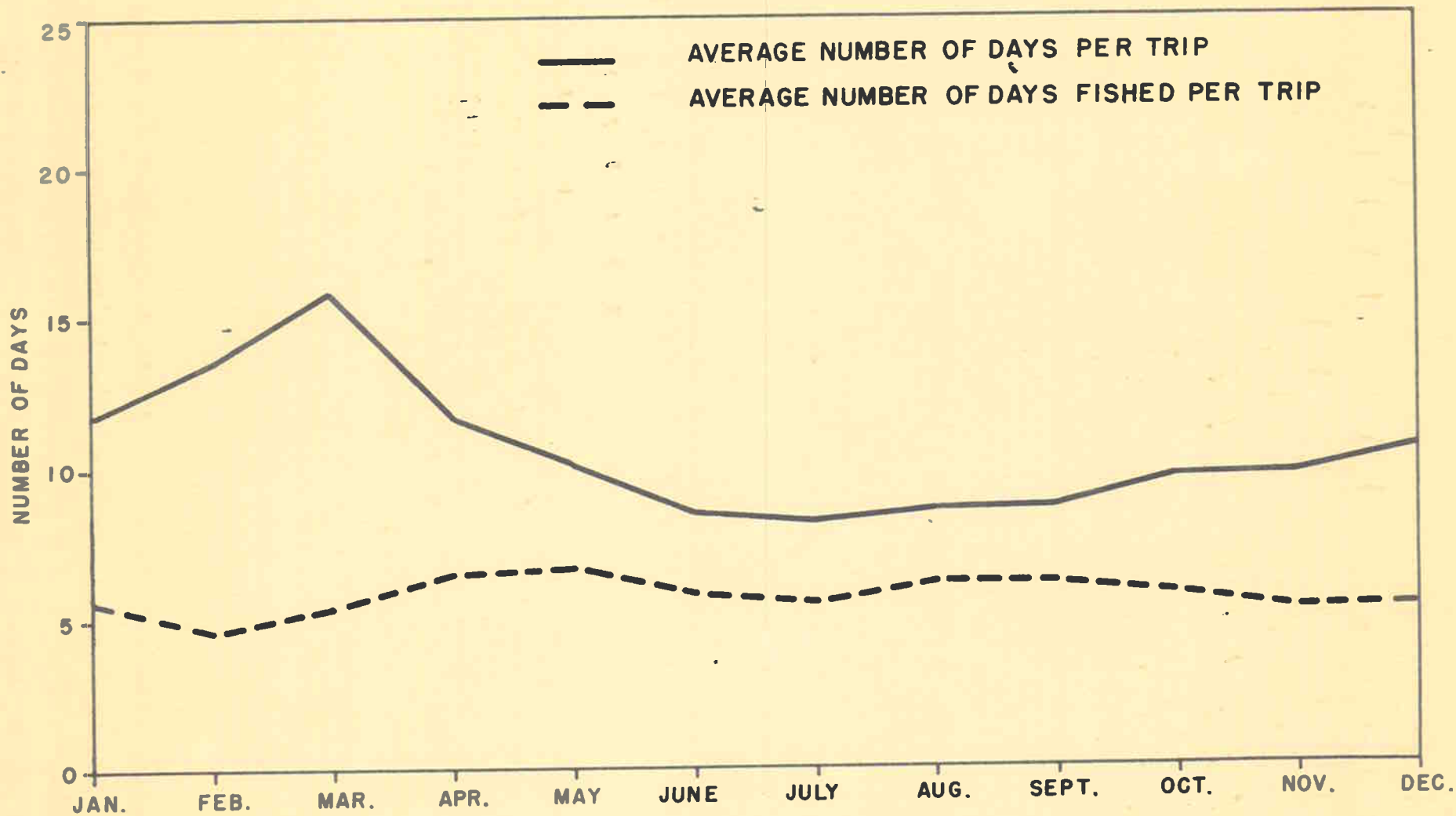


FIGURE 2: NUMBER OF DAYS PER TRIP COMPARED TO NUMBER OF DAYS FISHED PER TRIP BY MONTH FOR OUTSIDE (OCEAN) BOATS ONLY, IN 1961.

Table 5 - Number of days per trip and number of interviewed trips by month for inside boats. $\frac{N}{D} = \frac{\text{Average number of days per trip}}{\text{Number of interviewed trips}}$

Seattle	Month	Bellingham
$\frac{2.9}{50}$	January	$\frac{1.5}{62}$
$\frac{5.8}{15}$	February	$\frac{5.5}{5}$
$\frac{6.4}{15}$	March	$\frac{5.0}{2}$
$\frac{13.0}{1}$	April	*
$\frac{7.0}{2}$	May	$\frac{10.0}{1}$
*	June	*
*	July	*
*	August	*
*	September	$\frac{2.3}{3}$
$\frac{5.4}{5}$	October	$\frac{1.2}{39}$
$\frac{5.4}{8}$	November	$\frac{1.4}{79}$
$\frac{3.0}{32}$	December	$\frac{1.2}{88}$
$\frac{4.1}{128}$	Average	$\frac{1.4}{279}$

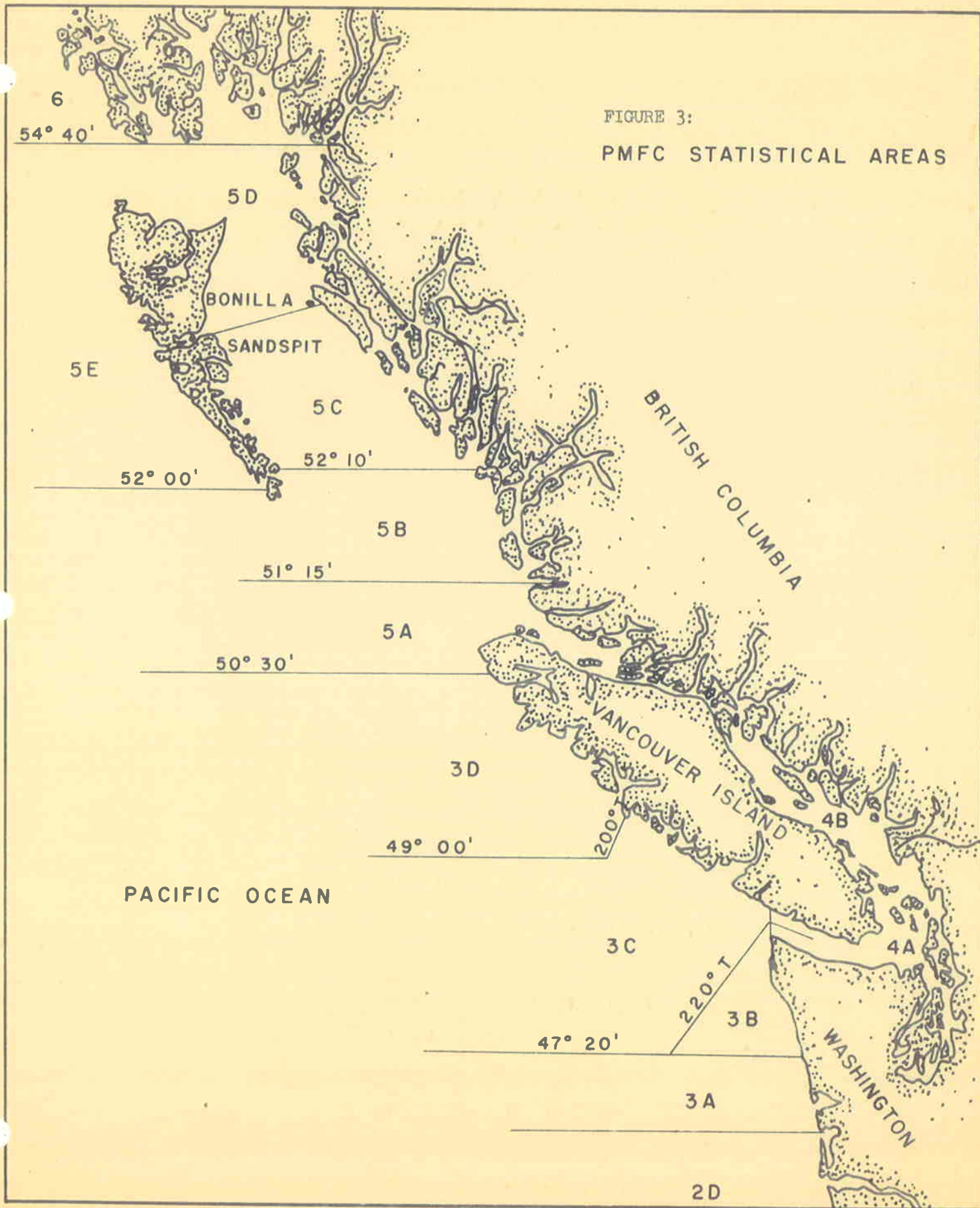
*No interview trips.

1.4 days. The average included Bellingham boats that often make week long trips.

Comparison of Washington and PMFC Statistical Areas

Lacking an international system of statistical subdivisions, the breakdown of the fishery area has been evolved mainly about the distribution of the petrale sole. Much shuffling and scuffling has taken place, and should be recorded.

Figure 3 shows the final result of an attempt during 1961 to straighten and finalize the boundaries for reporting statistics to PMFC. Starting to the south

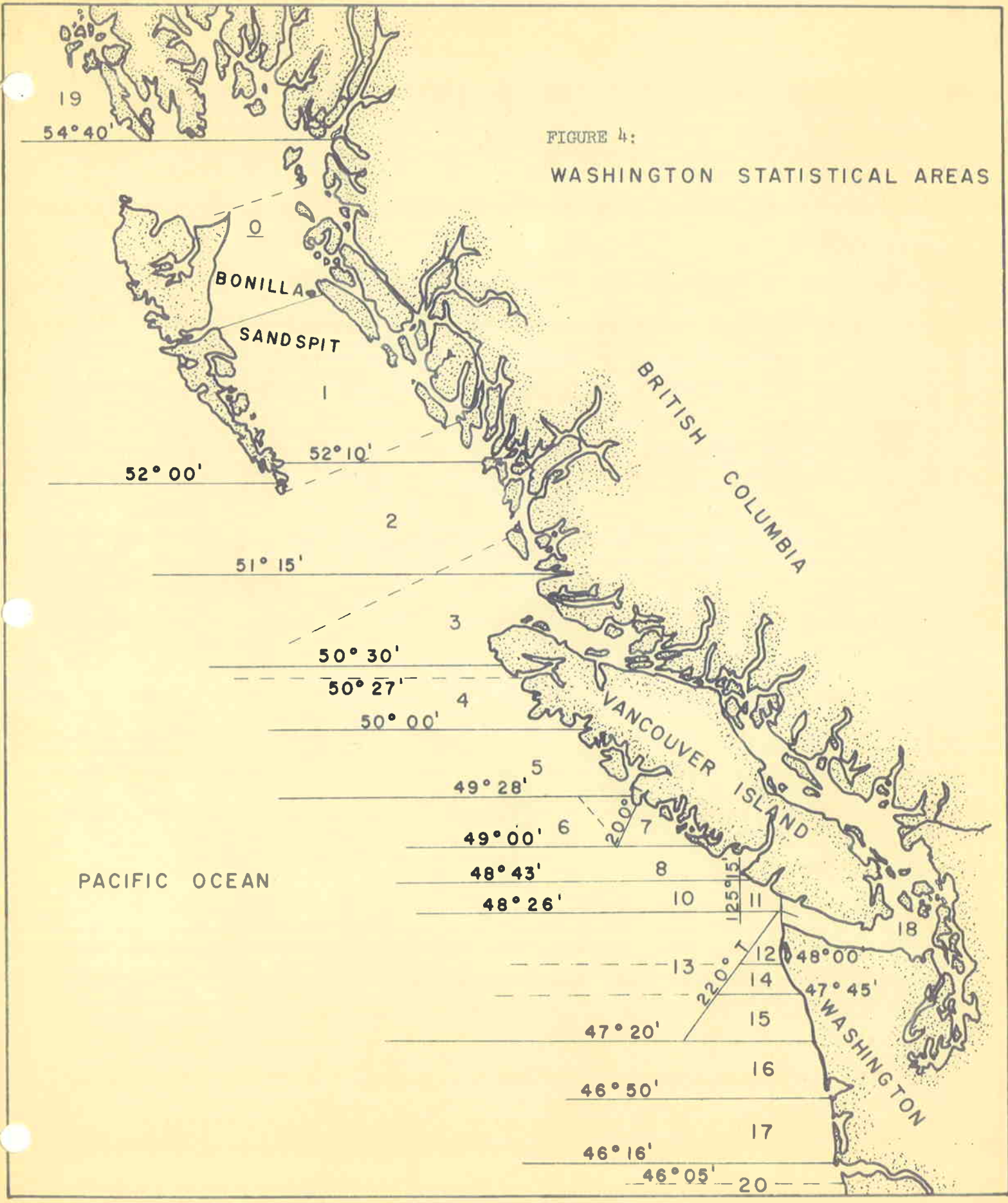


below the chart, the IBM coding system was modified so that the peregrinations of the Washington fishermen could be reported southward to Cape Blanco, the southern boundary of Washington area 24 and PMFC area 2B. A line westward from Hecate Head separates Washington areas 24 and 22 and PMFC areas 2B and 2C. Area 2B lies along south central Oregon. Washington area 22 and PMFC area 2C lies along north central Oregon northward to a line drawn westerly from Cape Falcon. This line forms the southern boundary for Washington area 20 and PMFC 2D, the Columbia River area.

A line drawn along $46^{\circ} 40'$ N near entrance to Willapa Bay forms the northern boundary of PMFC area 2D. In Washington statistics this line was put southward to $46^{\circ} 05'$ N. This is shown by a dotted line in Figure 4, which shows the Washington statistical areas. Replaced lines were left dotted. Washington area 17 (Willapa Bay area) is now bounded on the south by the line at $46^{\circ} 16'$ N and on the north by a line at $46^{\circ} 50'$ N. The latter forms the southern boundary for Washington area 16. The northern boundary of area 16 (the Grays Harbor area) is put at $47^{\circ} 20'$ N. Areas 16 and 17 constitute the PMFC area 3A, and all data from Washington since 1954 has been so tabulated.

PMFC area 3B off the northern coast of Washington is bounded on the south by $47^{\circ} 20'$ N. The area is bounded on the northwest by a line extending 220° true from the intersection of the International boundary between Canada and the United States and a line extending between Tatoosh Island and Bonilla Point. The 220° true line ends at its intersection with parallel $47^{\circ} 20'$ N. Area 3B is composed of three Washington sub-areas 12, 14 and 15. Areas 12 and 14 are divided at $48^{\circ} 00'$ N. Areas 14 and 15 are separated at $47^{\circ} 45'$ N. These areas extended westerly prior to the 1961 revision. The purpose was to place catches from the LaPerouse spit with those off of the southwest coast of Vancouver Island of which the spit is connected. A deep trench extending from the Strait of Juan de Fuca

FIGURE 4:
WASHINGTON STATISTICAL AREAS



separates the spit from the Washington coast. Actually the spit extends to slightly south of $48^{\circ} 00' N$, the southern boundary at area 12 and in practice there is no fishing seaward from areas 14 and 15 past the 220° true line. Catches from Cobb No. 9 tow, which lies in the trench along the $220^{\circ} T$ line, are tabulated in the coastal areas to avoid confusion with the deep catches outboard of the spit. This separates these catches fairly satisfactorily. Washington area 15 is named after Destruction Island. Area 14 is called by its prominent feature Quillayute (River). And, area 12, is termed for Cape Flattery. Outboard of the 220° True line lies Cape Flattery spit or more properly LaPerouse spit. Area 13 is bounded on the north by the parallel $48^{\circ} 26' N$. North of this line lie two Washington areas, 10 and 11 - Forty-mile Bank and Swiftsure, respectively. Both areas have as their northern boundary a line along $48^{\circ} 43' N$. The inshore area, Swiftsure No. 11, is bounded on the east by the Bonilla-Tatoosh line and on the west by the longitude $125^{\circ} 15' West$. Swiftsure contains local areas such as: Clo-oose and Carmanah. The offshore area, Forty-mile No. 10, extends indefinitely westward into deep water.

Washington area No. 8 is bounded on the south by $48^{\circ} 43' N$. and on the north by $49^{\circ} 00' N$. latitude. This area is called Ucluelet from the inlet by this name. Other grounds and landmarks include: the Firing Range, SW Corner, Barclay Sound, Gunsight, Bamfield, and the northern portion of LaPerouse Bank. This area was subdivided, but the separation could not be maintained. This explains the reason for there being no area No. 9.

Washington area No. 7 is now named for the geographic feature: Sydney Inlet. The Sydney Inlet area is bounded on the south by $49^{\circ} 00' N$. latitude and on the northwest by a line extending $200^{\circ} T$ from Esteban Point. This line ends where it intersects with $49^{\circ} 00' N$, latitude. Lennard Island is included in this relatively small triangular area.

PMFC Area 3C is composed of Washington statistical areas 7, 8, 10, 11 and 13. It is understood that the inshore boundary of the fishing areas is the international three-mile limit along the Canadian coast.

Originally, for the Washington statistics, the Esteban area (No. 7) included all landings from $49^{\circ} 00'$ N. on the south and $49^{\circ} 28'$ N. on the north, which included the area just described as Sydney Inlet (the new area No. 7). When it was found that most petrale after spawning in Esteban Deep moved inshore and northward, a separation of these stocks was attempted. Lacking a good division for the Washington data, a division was made at the 100 fathom mark. All petrale sole landings less than 100 fathoms in depth were included in PMFC area 3C and all landings from greater than 100 fathoms are included to the northward (PMFC area 3D). Esteban catches of all other species were included in PMFC area 3D. The Esteban area as it now exists has as its inshore boundary the 200° True line from Esteban Point. All species are now included in PMFC Area 3D. The past data were not corrected as there is a continuous fishery across this line, and it would be impossible to determine from which side of the line the fish were caught. It would be advantageous to place the northern boundary of the Esteban area along $49^{\circ} 30'$ N instead of $49^{\circ} 28'$ N except that there is a fishing area inshore which fishermen call Nootka (off Nootka Sound). This area would lie wholly within Esteban if the line were moved and at present the catches are placed in Area 5 (Esperanza). The northern boundary of the Esperanza area lies along $50^{\circ} 00'$ N latitude. This area was divided into two areas originally. The old Nootka area was Washington area No. 6. Washington area 6 is now used for Esteban. The Esperanza area also included Nootka Sound, Esperanza Inlet, and Kyuquot Sound.

Washington area 4 (Cape Cook) lies between $50^{\circ} 00'$ N and $50^{\circ} 30'$ N latitude, and includes Quatsino Sound area. Originally the northern boundary was $50^{\circ} 27'$ N,

and early data were not corrected for this change. PMFC area 3D includes Washington areas 4, 5 and the new 6.

PMFC area 4 is used to designate waters inside the Bonilla-Tatoosh line. Canadian inside waters are designated 4B and U. S. waters are 4A. In the Washington statistics PMFC area 4A is area No. 18.

The Cape Scott area designated No. 3 by Washington and 5A by PMFC is bounded by $50^{\circ} 30'$ N on the south and $51^{\circ} 15'$ N on the north. It includes such grounds as Top Knot, Triangle Island, Cox Island, and Scott Island. The southern boundary was $50^{\circ} 27'$ N, but there is little fishing activity along this region so the multiple of ten minutes was used ($50^{\circ} 30'$ N). The northern boundary of area 3 was a line from the intersection of 51° N latitude and 130° W longitude to the intersection of $51^{\circ} 30'$ N latitude and the coast of Calvert Island (dotted on Figure 2). The division of Cape Scott (Area 3) and Goose Island grounds (Area 2) is a difficult one as a lot of the region is fishable.

The Goose Island area (No. 2) is separated from Cape Scott grounds on the south by $51^{\circ} 15'$ N latitude and inshore on the north by $52^{\circ} 10'$ N latitude. Offshore of Cape St. James the division is made along $52^{\circ} 00'$ N latitude. This is PMFC area 5B. The Goose Island bank has its southeast edge, a SW corner, a NW corner, a NE corner, a Goslings, and a Spider Island tow. Areas 2 and 3 constitute Queen Charlotte Sound. The Washington inshore northern line of Goose Island originally ran from Cape St. James to the southeastern tip of Aristazabel Island. Originally, too, Washington statistics made no division of Hecate Strait, and the whole was known as Area No. 1. To conform to the Canadian system, a line was drawn from Sandspit northeasterly past the southern edge of Bonilla Island to Banks Island. This forms the northern edge of new Washington area 1, PMFC area 5C, or perhaps best, lower Hecate Strait. Horseshoe and Ole's spot are found in this area. The Sandspit-Bonilla line forms the southern boundary of new

Washington area 0, PMFC area 5D, or Upper Hecate Strait. Actually, this area now includes most of the waters of Dixon Entrance with the northern boundary along $54^{\circ} 40'$ N latitude. The original northern boundary of Hecate Strait ran between the Whistle buoy on Rose Spit easterly through Triple Island to the mainland. However, fishing was conducted northward of this line. Bonilla Island grounds, Warrior Rocks, White Rocks, Two Peaks, and Butterworth grounds are in this area.

PMFC adds an area 5E outboard of the Queen Charlotte Islands. Its southern edge lies along $52^{\circ} 00'$ N latitude and its northern limit is $54^{\circ} 40'$ N latitude. A line is drawn down 133° West longitude to exclude the waters of Dixon Entrance. The continental shelf is reported to be too steep and rocky for fishing in this area.

Alaskan waters are coded area 19 in Washington statistics and area 6 for PMFC. Eventually the statistical boundary between Alaska and Canada may have to be moved to the center of Dixon Entrance when and if a fishery develops on the Alaskan side, but that appears far into the future.

Catch Statistics

The regular landings obtained on the fish receiving tickets are augmented by interviewing the vessel captains usually at the time of landing their fish. The fishing locations, time spent fishing, depth of fishing, and various other items of information pertinent to fishing are obtained. The interview poundage is corrected to the ticket poundage, and any aberrancies in either record are rectified. Often the interview record is used to identify species which may appear as mink feed or scrap on the receiving ticket. The interview poundage is used to obtain the rate of fishing success by species by area in the form of pounds per hour of fishing. The poundage and hours are then adjusted to total ticket poundage by month for each species. Puget Sound and ocean landings are

factored separately. New hours are calculated by dividing the adjusted poundage by the catch per hour which was derived from the interview data originally.

Petrале sole

Total landings of petrale sole increased in 1961 after a slight decline during 1960 from the 1959 landings. The 1955 through 1961 (7 year) average was 3.1 million pounds. The peak occurred in 1957 with 4.7 million pounds mostly from Esteban Deep. The 1960 landings were below average with 2.5 million pounds while the 1961 landings were above average with 3.5 million pounds. Most of the 1961 increase catch came from Esteban Deep, some from off the Washington coast, and some from the LaPerouse spit.

The increased catch during 1961 boosted petrale sole from the 7th to 5th in poundage rank among the top ten trawl-caught fish. For the seven-year average petrale ranked sixth. In value petrale does better because of its price (10 cents per pound). Petrale ranked second in 1961, fourth in 1960, and third for the average over the past seven years.

Washington trawl fishermen encounter three groups or populations of petrale sole in the process of fishing. Lines drawn southwest from Esteban Point, and the Strait of Juan de Fuca separate the groups fairly well. The divisions are based primarily upon tagging studies, but are borne out by the trends in catch statistics.

The catch statistics for the northern group of petrale sole are given in Table 6. The history of this fishery has been well documented. Briefly, trawl fishermen looking for ocean perch found a large spawning concentration in deep water (180 to 250 fathoms) southwest of Esteban Point. Tagging showed an interchange of fish between the deep and inshore fisheries northward in to Hecate Strait. The inshore stocks were declining, and regulations were imposed to

Table 6 - Petrale sole catch statistics for 1955 through 1961. Inverview data adjusted to total landings for Esteban Deep northward.

	1955	1956	1957	1958	1959	1960	1961	7 Yr. Average
<u>HECATE STRAIT - 3.25 per cent of ocean total</u>								
Pounds	162,899	47,088	159,182	78,438	226,286	20,549	10,858	100,757
Hours	856	673	717	853	1,196	243	80	659
Lbs/hr.	190	83	222	92	189	85	136	153
Index	100	44	117	48	99	45	72	81
<u>GOOSE ISLAND - 2.64 per cent of ocean total</u>								
Pounds	172,655	90,571	69,400	96,147	34,879	62,149	47,040	81,834
Hours	1,331	952	758	455	461	452	619	717
Lbs/hr.	130	95	92	216	76	138	76	114
Index	100	73	71	166	58	106	58	88
<u>CAPE SCOTT - 13.62 per cent of ocean total</u>								
Pounds	814,490	977,696	467,112	247,630	187,561	155,107	105,821	422,202
Hours	3,318	5,635	3,109	2,597	1,671	1,282	1,171	2,683
Lbs/hr.	245	174	150	95	112	121	90	157
Index	100	71	61	39	46	49	37	64
<u>CAPE COOK to Esteban Deep - 27.50 per cent of ocean total</u>								
Pounds	859,273	609,401	2,896,125	345,555	487,775	187,091	589,465	853,528
Hours	3,280	3,112	4,051	1,922	2,091	1,699	2,809	2,709
Lbs/hr.	262	196	715	180	233	110	210	315
Index	100	75	273	69	89	42	80	120
<u>ESTEBAN DEEP - 21.23 per cent of ocean total</u>								
Pounds	621,444	465,400	2,673,130	150,886	150,221	89,838	455,037	657,995
Hours	1,535	1,389	2,890	725	771	615	2,148	1,438
Lbs/hr.	405	335	925	208	195	146	212	458
Index	100	83	228	51	48	36	52	113
<u>TOTAL NORTHWARD - EXCLUDING ESTEBAN DEEP - 25.82 per cent</u>								
Pounds	1,387,873	1,259,356	918,689	616,884	786,280	335,058	298,147	800,328
Hours	7,250	8,983	5,745	5,092	4,648	3,061	2,531	5,330
Lbs/hr.	191	140	160	121	169	109	118	150
Index	100	73	84	63	88	57	62	79
<u>TOTAL - NORTHWARD - INCLUDING ESTEBAN DEEP - 47.05 per cent</u>								
Pounds	2,009,317	1,724,756	3,591,819	767,770	936,501	424,896	753,184	1,458,322
Hours	8,785	10,372	8,635	5,817	5,419	3,676	4,679	6,769
Lbs/hr.	229	166	416	132	173	116	161	211
Index	100	72	182	58	76	51	70	92

protect the vulnerable stocks during the spawning season. Protection was fully effective in the winter of 1957-1958, and as petrale enter the fishery in their fourth year of life any increase in the stocks from the protection provided by the regulation should occur in the 1961-1962 season. It is too early for the data presented here to show the effects of the regulation.

Forty-seven per cent of the ocean catch of petrale sole by Washington fishermen in the last seven years has been taken from the area northward of Esteban point. The deep area off Esteban produced 21 per cent of the ocean total. The big year was 1957 with almost three million pounds taken. Effort and success (catch per hour) decreased through 1960, but activity and success both increased in 1961 when catch increased to about one-half million pounds. Exclusive of the deep catch, the rest of the northern areas show generally decreased effort with success variable and generally decreasing. An index number of the catch per hour using 1955 as the base year (100) has been included in the tables to indicate the relative changes in fishing success.

Another 40 per cent of the ocean catch of petrale sole is taken off the southwest coast of Vancouver Island from Sydney Inlet on the north to the deep waters off LaPerouse spit which extends part way south off the coast of Washington (Table 7). Effort and catch has increased in this large area while fishing success has remained relatively stable. The spit area statistics were separated from the Cape Flattery area data as it was thought that these fish belonged to the population found off the lower west coast of Vancouver Island. The history of the petrale fishery on LaPerouse spit has been interesting as it started with a relatively good success figure of 300 pounds per hour. Petrale were taken here incidentally to the ocean perch fishery. Success declined until a new fishing spot was found in 1960. Effort increased and fishing success has produced better than 300 pounds per hour. A few fish tagged on the new spot

Table 7 - Petrale sole statistics for 1955 through 1961. Interview data adjusted to total landings for Sydney Inlet southward.

	1955	1956	1957	1958	1959	1960	1961	7 year average
FORTY MILE BANK - 20.78 per cent								
Pounds	192,482	417,375	643,407	603,602	1,480,956	780,922	389,531	644,039
Hours	889	1,492	1,196	990	3,882	2,989	1,790	1,890
Lbs/hr	217	250	538	610	381	261	218	341
Index	100	115	248	281	176	120	100	157
LAPEROUSE SPIT - 7.33 per cent								
Pounds	42,095	52,393	19,234	63,040	71,762	513,721	826,998	227,035
Hours	136	208	187	793	734	1,598	2,378	862
Lbs/hr	310	252	103	79	98	321	348	263
Index	100	81	33	25	32	104	112	85
SYDNEY INLET TO SPIT - 39.67 per cent								
Pounds	576,006	872,155	866,799	780,280	1,805,943	1,713,734	1,992,332	1,229,607
Hours	3,066	2,775	2,453	2,463	5,443	6,174	6,988	4,195
Lbs/hr	188	314	353	317	332	278	285	293
Index	100	167	188	169	177	148	152	156
CAPE FLATTERY TO DESTRUCTION ISLAND - 11.94 per cent								
Pounds	377,198	235,995	212,725	502,270	250,392	328,556	683,069	370,029
Hours	7,975	7,089	3,948	6,380	5,290	6,230	6,976	6,262
Lbs/hr	47	33	54	79	47	53	98	59
Index	100	70	115	168	100	113	209	126
OCEAN TOTAL - EXCLUDING ESTEBAN DEEP - 78.77 per cent								
Pounds	2,367,756	2,417,046	2,025,256	1,948,629	2,902,409	2,380,312	3,048,353	2,441,398
Hours	18,201	19,196	12,345	14,086	15,584	15,699	16,787	15,986
Lbs/hr	130	126	164	138	186	152	182	153
Index	100	97	126	106	143	117	140	118
OCEAN TOTAL - INCLUDING ESTEBAN DEEP								
Pounds	2,989,200	2,882,446	4,698,386	2,099,515	3,052,630	2,470,150	3,503,390	3,099,392
Hours	19,736	20,585	15,235	14,811	16,355	16,314	18,935	17,425
Lbs/hr	151	140	308	142	187	151	185	178
Index	100	93	204	94	124	100	123	118

scattered to the Forty-Mile, Swiftsure, and Umatilla areas with the most recoveries from the Forty-Mile Bank.

Forty-Mile Bank, an area about midway out LaPerouse Bank, produces half of the catch for the entire Sydney Inlet to the spit area. Dogfish shark often inhibit fishing, especially on Swiftsure, but can be a restraining factor on the Forty-Mile Bank as well as northward to Esperanza. However, the great effort in 1959 which produced a good catch and a decrease in catch per hour is a classical example of the effects of overfishing. Dogfish were not a factor in 1959 and 1960. They were a factor during the 1961 season on Forty-Mile Bank. Petrale sole are taken here incidental to the lingcod fishery, but it appears that when effort exceeds around 2,000 hours or catch exceeds 800,000 pounds fishing success decreases. Reproduction and growth of petrale sole is too slow to supply the present fishing demand. Fishing pressure has decreased in the last two years, and stocks could be increasing. Future success figures should supply the answer.

The petrale sole population from Cape Flattery to Destruction Island became an incidental fishery before the collection of effort data began. Evidently the great effort, 4,000 to 8,000 hours per year does not allow the increase of petrale stocks. Without these past data it is impossible to determine the yield or effort at which stocks could increase.

In summary, the petrale stocks to the northward of Esteban are static, but with catch and effort decreasing a recovery in fishing success should occur. Stocks off the west coast of Vancouver Island are being exploited more and fishing success there has decreased and could continue to decrease. Stocks off the Washington coast are exploited to such an extent that they are not expected to increase under present fishing pressure.

English sole

English sole ranked fourth in poundage and in value for all trawl-caught bottomfish landed in 1961. The total English sole catch of 3,582,000 pounds is down almost 2.2 million pounds from 1960 and approximately one million pounds from the 1955-1961 average (Table 8).

Virtually the entire English sole catch is caught from three main areas: Upper Hecate Strait, Cape Flattery-Destruction Island, and Puget Sound.

Upper Hecate Strait contributed 22.5 per cent of the total ocean catch of English sole during the last seven years. The bulk of the catch occurred during the months of February, March and April although some fish were taken throughout most of the year. Poundage was down to less than half of the 1955-1961 average and was the lowest total landed during this period, effort was down substantially and the catch per hour of 217 pounds was next to the lowest recorded in the past seven years. There has been a very noticeable drop in fishing effort in this area. This decrease in effort is due to a large extent to the failure of the Pacific cod fishery the last two years. This was the primary fishery in this area through 1959, and was the one that attracted American boats to make the long trip to these grounds. These data are not adequate to detect any trend in condition of stocks.

During 1961 a total of 2,004,904 pounds or 80 per cent of the total ocean catch of English sole was landed from the Washington coast between Cape Flattery and Destruction Island. This area has contributed 71 per cent of the ocean catch in the last seven-year period.

The Quillayute-Destruction Island grounds are similar to one another in that they both provide a heavy winter and spring fishery. This fishery, concentrated on a spawning group of fish begins about November and lasts through March. The

center of abundance of these fish varies from year to year, sometimes being concentrated heaviest in the Destruction Island area and other times such as 1961 located more northerly off the Quillayute grounds.

English sole tagged off Quillayute and Destruction Island show a movement north to Cape Flattery and south as far as central California. This indicates these particular fish are not of a distinct population found off the Washington coast.

During 1961, although poundage from Quillayute and Destruction fell to almost half the 1960 catch, effort was down over one-half so that catch per hour actually increased. This same situation held true for Destruction Island, poundage and effort were down substantially from 1961 with catch per hour increasing. In both areas poundage and effort were below the 1955-1961 average. The probable explanation for this is the winter and early spring months of 1961 were exceptionally poor weatherwise. Most of the boats simply could not get on the fishing grounds, and when they did, large amounts of Bellingham sole mixed with the English sole made fishing very discouraging at times.

English sole were found on the Cape Flattery-Umatilla grounds throughout the year indicating the presence of a year-long population. Catch, effort and catch per hour were all up compared to 1960 and the 1955-1961 average. Heavier than normal fishing pressure and resulting catch during the winter months accounted for the increase. The effects of poor weather had an opposite result on the Cape Flattery grounds. This was due to the boats making short runs off Cape Flattery to fish during breaks in the winter storms instead of making the longer run further south to fish Quillayute and Destruction Island. A decline in poundage is expected for the Washington coastal areas combined.

English sole landing from inside Puget Sound totaled 1,085,908 pounds. This was down almost one million pounds from 1960 and also down from the 1955-1961

Table 8 - English sole catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7 year average
HECATE STRAIT - 22.56 per cent								
Pounds	937,787	600,113	642,583	623,583	805,717	864,113	317,483	684,401
Hours	2,554	2,232	2,295	2,710	3,990	1,527	1,460	2,395
Lbs/hr	367	269	280	230	202	566	217	286
Index	100	73	76	63	55	154	59	---
CAPE FLATTERY UMATILLA - 19.77 per cent								
Pounds	932,742	315,023	271,509	443,365	684,886	680,026	870,384	599,705
Hours	9,798	5,303	2,533	3,463	4,520	5,720	6,648	5,426
Lbs/hr	95	59	107	128	152	119	131	111
Index	100	62	113	135	160	125	138	---
QUILLAYUTE - 25.11 per cent								
Pounds	520,457	1,103,654	389,656	448,573	725,932	1,398,032	746,667	761,853
Hours	2,165	2,988	1,461	1,201	1,238	2,670	1,319	1,863
Lbs/hr	240	369	267	374	586	524	566	409
Index	100	154	111	156	244	218	236	---
DESTRUCTION ISLAND - 25.75 per cent								
Pounds	433,338	495,112	654,235	1,288,558	1,666,253	543,332	387,853	781,240
Hours	2,647	2,230	2,-49	3,211	2,839	1,911	11,162	2,298
Lbs/hr	164	222	319	401	587	284	334	340
Index	100	135	195	245	358	173	204	---
CAPE FLATTERY to DESTRUCTION ISLAND - 70.64 per cent								
Pounds	1,886,537	1,913,789	1,315,400	2,180,496	3,077,071	2,621,390	2,004,904	2,142,798
Hours	14,610	10,521	6,043	7,875	8,597	10,301	9,129	9,582
Lbs/hr	129	182	218	277	358	254	220	224
Index	100	141	169	215	278	197	171	---
OCEAN TOTAL								
Pounds	3,075,536	2,762,918	2,253,050	2,965,518	3,997,774	3,684,235	2,496,270	3,033,614
Hours	22,251	17,205	11,337	13,218	14,251	14,096	14,403	15,252
Lbs/hr	138	161	199	224	281	261	173	199
Index	100	117	144	162	204	189	125	---
PUGET SOUND								
Pounds	1,058,971	1,723,705	1,567,122	2,011,263	1,636,897	2,054,494	1,085,908	1,591,194
Hours	8,692	13,168	22,624	28,507	25,072	18,169	10,983	18,174
Lbs/hr	122	131	69	71	65	113	99	88

average. Effort was also down substantially. Catch per hour decreased from 1960 but was still above the 1955-1961 average. Puget Sound contributed 30 per cent of the total English sole catch in 1961. The fishery is very intense, beginning in the fall and lasting through the following spring, although there are closed periods in specific areas within the Sound during this time. Approximately 1,700,000 pounds seems to be the critical point around which Puget Sound stocks range.

Approximately 350,000 pounds of the English sole total from Puget Sound in 1961 are wormy fish used for mink food. These fish are from the extreme southern end of Puget Sound (Case and Carr Inlets) and have a special exemption of allow them to be used for this purpose.

Dover sole

Interest in Dover sole began to increase in Washington during 1953. Seasonally these fish appear on the grounds in the spring. They are most available in summer and catches decrease in the fall. Dover has ranked seventh in poundage and value over the past seven years. The peak production of 3.7 million pounds was made in 1956, and production has declined since. The production subdivisions are poorly known in the area fished by Washington trawlers. When the fluctuations in catch per hour are used as criteria to identify populations some odd matches result. For instance, Hecate Strait, Swiftsure and Cape Flattery look similar; Cape Scott and Esperanza have very similar patterns; Esteban and Forty-Mile are somewhat comparable; and the rest oscillate in fashions peculiar to themselves. We have followed the procedure of linking low producing areas to the nearest principal area of production except where two or more adjacent areas have similar patterns separable from areas on either side, such as: Swiftsure and Cape Flattery, Quillayute and Destruction Island. The explanation for the dissimilarity is that

the populations are probably independent; Dover is suspected of being a less mobile fish than, say English sole. The similarity of widely separated areas occurs by chance. There are a limited number of ways in which populations can react to fishing pressure.

Although the Dover sole catch is composed of many populations, the total ocean catch appears to oscillate around 2.5 million pounds a year. Statistics for Dover sole are given in Table 9. This, of course, does not include the Canadian catch. The combined landings of the fishermen of both countries was around four million pounds in 1956. American fishermen are equipped to fish the deeper water inhabited by Dover sole, and therefore, take the majority of the landings of this species. The good catches and the rather large effort needed to make the catches could not be maintained in 1957 and catch per hour toppled. Gradual recovery was made until 1960 only to decline again. In 1961 the largest amount of effort produced an average catch. Undoubtedly catch per unit will have to decline again for several years while the population recovers again.

When the Dover sole catch statistics are considered by sub-areas, different situations emerge. For instance in the northern area which is composed of Hecate Strait, Goose Island, and Cape Scott grounds, catch per hour is relatively low. Success does not bear any relation to the amount of effort put forth. This is probably best explained by the incidental nature of this species from this fishery area. The Canadians fish the northern area, and perhaps combined catch and effort data would make more sense than the Washington data along. At present the combined data for effort are not available. About 14 per cent of the Washington landings came from the northern area.

About 29 per cent of the ocean catch by Washington trawlers comes from Cape Cook to Sydney Inlet. Esteban contributes most, 88 per cent of the catch from this area.

Table 9 - Dover sole catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7 year average
HECATE STRAIT, GOOSE ISLAND & GAPE SCOTT - 13.8 per cent								
Pounds	151,028	572,727	255,289	302,384	380,062	610,988	335,162	368,234
Hours	797	2,905	1,128	799	1,491	1,972	1,530	1,517
Lbs/hr	189	197	200	378	255	310	219	243
Index	100	104	106	200	135	164	116	129
ESTEBAN DEEP - 25.4 per cent								
Pounds	963,049	1,290,232	450,534	448,169	552,139	514,315	529,450	678,270
Hours	1,914	1,555	2,156	910	1,202	898	1,705	1,477
Lbs/hr	503	830	209	492	459	573	311	459
Index	100	165	42	98	91	114	62	91
CAPE COOK TO SYDNEY INLET - 28.9 per cent								
Pounds	999,273	1,328,735	519,314	511,937	735,802	613,091	675,807	769,137
Hours	2,104	1,667	2,526	1,159	1,786	1,204	2,016	1,780
Lbs/hr	475	797	206	442	412	509	335	432
Index	100	168	43	93	87	107	71	91
UCLUELET TO LA PEROUSE SPIT - 6.0 per cent								
Pounds	2,019	36,377	38,407	12,154	33,734	514,493	481,771	159,851
Hours	6	205	213	89	39	1,631	2,197	626
Lbs/hr	337	177	180	137	865	315	219	255
Index	100	53	53	41	257	93	65	76
SWIFTSURE AND CAPE FLATTERY - 38.0 per cent								
Pounds	1,346,135	1,277,942	378,612	679,545	916,877	1,547,794	935,933	1,011,834
Hours	4,010	3,922	1,305	1,851	1,731	3,306	3,931	2,865
Lbs/hr	336	326	290	367	530	468	238	353
Index	100	97	86	109	158	139	71	105
QUILLAYUTE AND DESTRUCTION ISLAND - 11.9 per cent								
Pounds	721,663	398,436	276,605	306,414	143,224	168,957	209,934	317,890
Hours	2,742	1,036	1,038	1,903	776	726	1,033	1,322
Lbs/hr	263	384	266	161	185	233	203	240
Index	100	146	101	61	70	89	77	91
OCEAN TOTAL								
Pounds	3,267,291	3,626,381	1,448,591	1,906,509	2,309,688	3,460,682	2,642,409	2,665,936
Hours	9,704	9,804	6,252	5,905	6,050	8,880	10,792	8,198
Index	100	110	69	96	113	116	75	96
Lbs/hr	337	370	232	323	382	390	252	325

Catches in 1955 and 1956 were good, but could not be maintained. More effort in 1957 produced less poundage. Catches seem to have stabilized around 675,000 pounds, which is all the area can produce annually. The Canadian catch of Dover sole is small for this area.

From Ucluelet to the LaPerouse Spit there has been very little fishing effort for Dover sole. Only 6 per cent of the ocean catch came from this area. During 1960 and 1961 effort has increased tremendously, and it remains to be seen what pressure these stocks will support. It is suspected the fishing success will continue to decrease until the pressure of fishing is relieved and stocks are allowed to replenish themselves.

Fishing for Dover sole in the Swiftsure and Cape Flattery areas takes place in the trench extending from the Strait of Juan de Fuca. The familiar Cobb Hunter Number Nine tow lies in the trench and most the species caught in these deep areas could be expected to belong to the same populations. Ocean catches of Dover sole have averaged around one million pounds annually during the past seven years for this area. A greater amount of fishing is done in this area for Dover sole, and 38 per cent of the ocean catch comes from these two areas. Catches were good and success was high in 1955, 1956 and 1961. A decline in both effort and catch in 1957 was thought to be a decrease in demand as success remained good. Effort remained low during 1958 and 1959 with improving success. It was predicted that stocks were in good abundance at this time. During 1960 effort was increased with fishing success remaining good. In fact, catches peaked in 1960 at 1.5 million pounds. More effort in 1961 produced lesser results, and it seems safe to say that effort will again have to diminish to the 1957-1958 level to allow growth and recruitment to replenish the Dover sole stocks.

Dover sole are exceptional in that a relatively large fish, 16 inches in length, is needed to produce a marketable-sized fillet. Using three-inch-mesh

nets, fishermen must discard many small Dover sole. In fact, the males being smaller than the females, they are barely utilized. This means that many small fish are possibly killed by being handled, and some could be caught and discarded repeatedly in an intensive fishery. With such a situation there would be little or no relationship between effort and the resulting catch. Because there is a demonstrable relationship between effort and catch the extreme situation must not exist at the present time.

Fishing for Dover sole in the Quillayute-Destruction Island area is less intensive than in the Swiftsure-Cape Flattery area. Twelve per cent of the ocean catch is taken here. Catches have averaged about a third of a million pounds. The declining catch in the early years (1955, 1956 through 1957) is puzzling. The decline in fishing success in 1957 must be a reflection of the removal of a large number of fish in earlier years, or simply poor availability. The optimal exploitation rate appears to be about 250,000 pounds annually for this area.

A small poundage of Dover sole is landed from Puget Sound waters, but the inside catch has never been of any importance.

One gets the impression of under-utilization from the interpretation of these data which is thought to be erroneous. Catch statistics from all areas indicate a peak in their cycle and if exploited at their present effort, a decline must be endured to allow the stocks to replenish. In other words, Dover stocks show depletion in the last two years, and it will require several years of low intensity to allow a recovery.

Rock sole

Over 90 per cent of the rock sole ocean catches come from the Hecate Strait Goose Island, and Cape Scott areas. In the past, Washington fishermen have taken about 15 per cent of the total catches in this combined area. Canadian fishermen

account for the other 85 per cent. The landings by Washington trawlers has not constituted a representative sample of the fishery in the northern area.

Rock sole landings rank tenth both in poundage and in value when the last seven years are averaged. These fish are also taken in Puget Sound. Large poundages of these fish often appear from Esteban deep during the closed petrale sole season, but the statistical records are corrected of these deceptions.

Small poundages of rock sole are at times found at Esteban and Forty-Mile Bank.

Seasonally, rock sole are taken from April through October. The slight decline in summer months is more a reflection of fleet strength rather than of availability of these fish. Total effort has declined in the northern range of the Washington fleet as was explained in the trawl-fishery section of this report. Fishermen have changed to king crab and shrimp fishing, and some that habitually fished these grounds have been chartered for exploratory work elsewhere.

Washington trawl fishermen spent less time fishing for rock sole in Hecate Strait and caught less poundage in 1961 than in any of the past seven years. Fishing success was also at an all time low for years of record (Table 10).

The decline in effort applies to the Goose Island and Cape Scott rock sole fishing except that the catch per hour improved on Goose Island grounds. Washington landings for the entire northern area have revolved around 500,000 pounds. The 1961 catch was about average which makes it difficult to predict other than the trend. With decreasing fishing effort, fishing success should improve. Again, these data are minimal; the activities of the Canadian fishermen will determine the future of this fishery.

Puget Sound annual landings have averaged about 75,000 pounds in seven years. In fact, the inside statistics for rock sole are classic in that for three years effort was low, catches remained fair, and catch per unit remained fairly uniform. Then in the next three years, effort increased threefold, catches did

Table 10 - Rock sole catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7 year average
HECATE STRAIT - 38.0 per cent								
Pounds	488,069	259,753	88,400	192,978	203,523	299,563	33,591	213,697
Hours	577	380	104	649	768	501	316	471
Lbs/hr	846	684	850	297	265	458	106	454
Index	100	81	100	35	31	54	13	54
GOOSE ISLAND - 31.5 per cent								
Pounds	300,761	84,117	65,969	134,774	79,302	251,983	322,576	177,069
Hours	637	565	369	246	261	713	669	494
Lbs/hr	472	149	179	548	304	353	482	358
Index	100	32	38	116	64	75	102	76
CAPE SCOTT - 21.8 per cent								
Pounds	96,023	276,061	63,988	71,767	101,705	162,470	85,978	122,570
Hours	590	2,313	732	679	401	849	486	605
Lbs/hr	163	119	87	106	254	191	177	203
Index	100	73	53	65	156	117	109	125
OCEAN TOTAL								
Pounds	884,853	628,248	261,137	409,804	474,496	779,264	493,233	561,576
Hours	1,804	3,481	2,060	1,711	3,812	5,565	3,030	3,066
Lbs/hr	491	180	127	240	124	140	163	183
Index	100	37	26	49	25	29	33	37
PUGET SOUND								
Pounds	78,695	87,686	52,231	72,822	59,361	84,072	90,860	75,104
Hours	1,026	953	692	2,568	2,414	3,301	1,264	1,745
Lbs/hr	77	92	75	28	25	25	72	43
Index	100	119	97	36	32	32	94	56

not change appreciably, but fishing success declined to a third of its former level. In 1961 there was a return to the effort and success levels of the earlier years with a corresponding increase in fishing success. This shows that effort should be held to around 1,500 hours to adequately harvest the annual catch of 75 to 85,000 pounds of rock sole in Puget Sound.

Starry flounder

All of our flatfish except the sand dabs belong to the flounder family, but when a person in the fishing industry of Washington says flounder, this is the fish to which they refer. These shallow-water species gained in poundage rank since the last report. Flounder in the past seven years averaged eighth in rank for poundage among the 10 principal trawl-caught species, and ninth in value. Flounder landings have improved slightly in the past two years, and sablefish have decreased.

Flounder are taken in commercial quantities in four separate areas, and it is felt these represent fairly distinct population groups. The areas are: S. E. Alaska, Hecate Strait, Coast of Washington and Puget Sound (Table 11). In S. E. Alaska where 31 per cent of the ocean catch is taken, the season usually starts as flounder ripen and migrate to their shallow spawning areas in November. By February, the fish are no longer available or desirable on these grounds, but during 1961, flounder remained in the shallows into April. The few boats that specialize in fishing this species in Alaska kept on fishing. This increased the amount of fishing effort and the catch, but the catch per hour was only slightly increased. The seven-year average landings from this area have been around 250,000 pounds. Exceeding this level, if it is critical, will result in a smaller catch in the immediate future with the present level of effort.

The bottom literally dropped out of the Hecate Strait flounder fishing. Twenty-four per cent of the ocean catch is made here, and stocks were thought to be in good abundance. But during 1961 catch diminished by about half for the second consecutive year. Effort was almost doubled during 1961, which causes the catch per hour to decline to about one fifth its former amount. It appears now that fishing during 1959 took place on a different level of availability than in other years. We are now paying the price of this good fishing by enduring less

Table 11 - Starry Flounder catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7-Year Average
S. E. ALASKA - 31 per cent								
Pounds	666,623	308,738	174,451	23,645	97,551	177,267	357,162	257,920
Hours	470	185	73	36	65	130	245	172
Lbs/hr.	1,418	1,669	2,390	657	1,501	1,364	1,458	1,500
Index	100	118	169	46	106	96	103	106
HECATE STRAIT - 24 per cent								
Pounds	98,365	129,608	163,926	192,919	471,883	238,210	90,755	197,967
Hours	477	425	264	788	642	739	1,354	670
Lbs/hr.	206	305	621	245	735	322	67	295
Index	100	148	301	119	357	156	33	143
CAPE FLATTERY to DESTRUCTION ISLAND								
Pounds	489,766	902,583	660,000	227,855	84,937	49,177	206,438	374,394
Hours	3,670	2,443	4,194	1,441	978	963	2,057	2,249
Lbs/hr.	133	369	157	158	87	51	100	166
Index	100	277	118	119	65	38	75	125
OCEAN TOTAL								
Pounds	1,254,854	1,344,099	1,010,001	447,895	667,233	464,866	655,113	834,866
Hours	4,617	3,055	4,640	2,347	1,725	1,850	3,662	3,128
Lbs/hr.	272	440	218	191	387	251	179	267
Index	100	162	80	70	142	92	66	98
PUGET SOUND								
Pounds	275,531	286,761	280,462	469,749	209,182	639,914	518,985	382,941
Hours	4,125	4,579	6,141	7,097	6,157	11,270	9,223	6,942
Lbs/hr.	67	63	46	66	34	57	56	55
Index	100	94	69	99	51	85	84	82

success until the stock can reproduce its former abundance. Effort will probably fall off until fishing improves unless the flounder are being taken incidentally to some more lucrative species, although this is not thought to be the case.

Off the Washington coast there was some improvement over the decline of four years' duration. Effort, catch, and catch per hour all increased. A decrease in effort preceeded the decline and makes it look like a simple lack of interest, although catch per hour should not have declined in such a situation. This means that fish were simply less available, and all that can be done is hope that they

become increasingly available to the fishermen in the future. Only 45 per cent of the ocean-caught flounder are now taken off the northern Washington coast.

Within Puget Sound, the last two years has seen increases in catch, effort and catch per hour. Some decline occurred in 1961, and more is expected until poundage returns to the 350,000 pound point at which inside stocks seem to revolve.

Pacific (true) cod

For many years this was the most important fish in the trawl landings both in poundage and in value. The year 1961 was a dismal failure for this species. All statistics except catch per hour in Puget Sound were downward in trend. In 1960 Pacific cod catches slipped from first to fourth in rank by poundage, and to third in value. It declined still further in 1961 to sixth by poundage and seventh place for value. The importance of this species is shown by the fact that it still ranks first in both poundage and value when averaged over the seven-year period, 1955 through 1961.

Catch statistics for Pacific cod are divided into six separate areas. These divisions have not been verified conclusively with tagging studies, but seem adequate for these purposes. The areas are: Hecate Strait, Goose Island to Cape Scott, Esperanza to Esteban, Ucluelet to Swiftsure, Cape Flattery to Destruction Island, and Puget Sound. Catch and Effort have declined in all areas, and fishing success (catch per hour) has declined in all but the Puget Sound area (Table 12).

The theory is that the warm-water year of 1958 had two adverse effects upon the availability of cod. First, in many areas the warmer water displaced cod from their usual habitat which made them less available to the fishermen. Second, spawning and survival of cod must have been affected which decreased the amount of fish available to the fishery in the last few years. Warmer water temperatures

Table 12 - Pacific (true) cod, catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7-Year Average
HECATE STRAIT - 37.81 per cent								
Pounds	3,497,879	1,500,116	2,802,100	5,056,074	6,544,400	1,360,605	833,290	3,084,925
Hours	2,659	1,824	2,424	2,619	4,677	1,945	1,206	2,479
Lbs/hr.	1,315	822	1,156	1,931	1,399	700	691	1,244
Index	100	63	88	147	106	53	53	95
GOOSE ISLAND-CAPE SCOTT - 21.15 per cent								
Pounds	2,380,278	3,163,626	3,610,296	1,526,565	714,012	495,730	186,476	1,725,283
Hours	5,005	5,992	4,226	2,888	1,836	2,185	1,815	3,421
Lbs/hr.	476	528	854	529	389	227	103	504
Index	100	111	179	111	82	48	22	106
ESPERANZA-ESTERBAN - 5.73 per cent								
Pounds	1,378,271	485,093	480,702	127,778	533,024	205,003	64,417	467,755
Hours	3,799	2,056	2,276	1,106	1,381	1,636	1,589	1,978
Lbs/hr.	363	236	211	116	386	125	41	236
Index	100	65	58	32	106	34	11	65
UCLUELET - FORTY MILE - SWIFTSURE - 8.85 per cent								
Pounds	884,000	1,202,407	1,067,535	467,173	570,776	601,795	260,524	722,030
Hours	1,799	2,192	1,666	1,216	3,130	3,511	2,379	2,270
Lbs/hr.	491	549	641	384	182	171	110	318
Index	100	112	131	78	37	35	22	65
CAPE FLATTERY - DESTRUCTION ISLAND - 25.90 per cent								
Pounds	3,528,378	1,988,864	1,557,150	2,541,499	2,854,676	1,571,115	750,787	2,113,210
Hours	13,883	9,883	6,032	8,698	7,782	10,066	7,457	9,114
Lbs/hr.	254	201	258	292	367	156	101	232
Index	100	79	102	115	144	61	40	91
OCEAN TOTAL								
Pounds	11,673,684	8,433,503	9,591,725	9,813,000	11,228,364	4,243,484	2,122,760	8,158,074
Hours	27,186	22,349	16,929	16,647	18,895	19,575	15,517	19,585
Lbs/hr.	429	377	567	589	594	217	137	417
Index	100	88	132	137	138	51	32	97
PUGET SOUND								
Pounds	934,439	1,127,411	1,688,690	2,388,801	1,701,350	891,076	832,068	1,366,262
Hours	12,345	13,508	18,927	18,902	19,309	19,919	12,974	16,555
Lbs/hr	76	83	89	126	88	45	64	83
Index	100	109	117	166	116	59	84	109

had the effect of moving the southern limit of the cod northward. At least that is the reason given for cod being more subject to temperature change than other trawl-caught species. It is hoped that cod populations will increase with the advent of cooler water temperatures throughout the region.

Catch figures in all ocean areas seem to move around the ten-million-pound level for five years (Table 12). Then in 1960, the level dropped to four million pounds after no apparent over-exploitation. Effort diminished in the Hecate Strait area as fishermen sought other species to fill their holds. The catch per hour was relatively unchanged from 1960 to 1961. Both effort and success decreased from 1959 to 1960.

A decline in catch per hour but little difference in the amount of fishing was found in both the Goose Island to Cape Scott and the Esperanza to Esteban areas. Along the southwest coast of Vancouver Island, catch, effort, and success all decreased. Similar events occurred along the northern Washington coast. Puget Sound was the only bright spot with a significant increase in catch per hour despite declines in both effort and poundage. This could be an indication that the population abundance of Pacific cod is increasing. Logically, any recovery indications would appear toward the northern parts of the cod range rather than the south if temperature and therefore latitude was the causal factor involved in the depletion.

According to Canadian studies, Pacific cod enter the fishery as recruits when they are four years old. They also showed that the decrease in catch in the recent years was a lack of new recruits into the fishery. As water temperatures cool in subsequent years, an increase in the abundance of cod should be gradual and could start in about the 1964 season. This is based upon the supposition that water temperatures had returned to levels favorable to cod by 1960.

Lingcod

Nothing has changed regarding the fundamental facts about lingcod, Ophiodan elongatus since the last report. Other gears take a good proportion (ca. 25 per cent) of the total catch. The trawl catch is usually incidental to other more numerous or more valuable species except on Forty-Mile Bank. Lingcod held its rank of fifth place among trawl-caught species in poundage over the seven-year period. Average value improved from seventh to sixth rank.

Total trawl landings of lingcod increased in 1960. The amount of effort also increased but catch per hour declined (Table 13). All three statistics remained surprisingly constant from 1960 to 1961. Lingcod production is at a peak, and a decline is anticipated. Three and a half million pounds seems to be the nearly optimal level of trawl production for the Washington fleet.

Incidental catches of lingcod from Hecate Strait continue at a low level, four per cent of the ocean catch, attendant with the general decrease in fishing effort being expended on the northern grounds.

Lingcod has shown very little tendency to migrate, although several tagged off Ucluelet were recovered northward in the Sydney Inlet area, and fishermen consider the fish from Swiftsure and Forty-Mile Bank northward to at least Sydney Inlet the same population.

In past reports, the various areas have been treated separately in deference to the lack of migration. However, in this study several groupings were attempted among areas that had similar catch trends with fair success. The combined Goose Island-Cape Scott area is an example of this. Here optimum poundage removal appears to be approximately 700,000 pounds annually. Effort is in decline, but stocks seem to be producing in fair quantity as catch per unit or fishing success is good. Increased fishing would only lessen the catch per hour.

Table 13 - Lingcod catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7-Year Average
HECATA STRAIT								4%
Pounds	391,658	118,199	152,401	86,394	127,184	74,083	73,224	146,306
Hours	1,838	1,217	1,605	1,541	1,891	594	1,051	1,391
Lbs/hr.	213	97	95	56	67	126	70	105
Index	100	46	45	26	31	59	33	49
GOOSE ISLAND - CAPE SCOTT								19%
Pounds	471,914	808,222	765,454	578,892	527,260	775,170	733,421	665,761
Hours	4,102	5,282	3,448	2,499	1,450	2,679	2,190	3,093
Lbs/hr.	115	153	222	232	364	289	335	215
Index	100	133	193	202	317	251	291	187
ESPERANZA - LA PEROUSE SPIT-SWIFTSURE								59%
Pounds	1,664,277	1,165,336	1,222,056	1,251,221	3,163,294	3,170,721	3,072,332	2,101,320
Hours	5,276	4,402	4,725	3,575	6,684	7,595	8,812	5,867
Lbs/hr.	315	265	259	350	473	417	349	358
Index	100	84	82	111	150	132	111	114
FORTY-MILE								38%
Pounds	566,955	741,690	909,415	988,568	2,719,370	2,356,747	1,169,286	1,350,290
Hours	619	1,497	1,340	1,102	4,254	3,535	1,964	2,044
Lbs/hr.	916	495	679	897	639	667	565	661
Index	100	54	74	98	70	73	65	72
CAPE FLATTERY - DESTRUCTION ISLAND								17%
Pounds	823,276	606,866	277,488	629,434	542,452	625,699	733,826	605,577
Hours	12,767	8,680	4,767	6,812	6,060	9,630	8,164	8,126
Lbs/hr.	64	70	58	92	90	65	90	75
Index	100	109	91	144	141	102	141	116
OCEAN TOTAL								
Pounds	3,356,637	2,718,004	2,458,721	2,620,069	4,376,604	4,654,519	4,624,148	3,544,100
Hours	24,073	19,969	15,018	14,657	16,297	20,481	20,481	18,711
Lbs/hr.	139	136	164	179	269	227	226	189
Index	100	98	118	129	194	163	163	136
PUGET SOUND								
Pounds	71,563	91,459	101,119	68,286	80,384	47,356	108,059	81,175
Hours	6,135	8,914	9,149	12,225	3,813	4,502	6,488	7,318
Lbs/hr.	12	10	11	6	21	11	17	11
Index	100	83	92	50	175	92	142	92

The largest number of areas to be grouped extend from Esperanza to Swiftsure and includes Forty-Mile and LaPercouse Spit. The grouping was based upon similar trends in the catch data. Similar trends could also be caused by similar environmental factors and similar fishing pressures. There was some interchange of tagged lingcod between Forty-Mile and the Ucluelet (Firing Range) areas, but none were indisputable. Returns were either from the filleters who are not absolutely infallible about what boat load of fish they are filleting, or a boat fished in both areas with no knowledge of the exact recovery area. Within the large area lingcod availability seems to have doubled from 1.5 to 3 million pounds. Effort is increasing, poundage has been relatively stable for three years, but success (catch per hour) is decreasing. There may be a readjustment of stocks in this area. About 60 per cent of the lingcod landings are taken in this area. Approximately two-thirds of the catch in the whole area comes from the Forty-Mile Bank where an adjustment seems in progress. Catches peaked in 1959; effort has declined since then, although catch per hour has only slightly decreased. Dogfish shark are found in abundance in some years anywhere in the large area (Esperanza to Swiftsure), and could be the factor affecting availability of lingcod to the fishermen.

The areas adjacent to the northern coast of Washington were combined. About 17 per cent of the ocean lingcod catch came from this area. Production declined one year, 1957, otherwise it has been relatively stable at around 600,000 pounds annually. Effort was less in 1961, but catch per unit increased indicating that stocks are in good abundance.

Catch statistics for lingcod catches in Puget Sound are inscrutable which is not unexpected as all inside stocks seem to be at low production levels. Then, too, lingcod catches are incidental to catches of other species. For what it is worth, Puget Sound catches are averaging around 80,000 pounds annually.

Sablefish

Sablefish landings have averaged ninth in poundage and eighth in value over the past seven years. In 1961, there was 523,000 pounds of this fish landed by the Washington trawl fleet.

The trawl fishery is not the major fishery on sablefish. The set-line fishery accounts for about three-fourths of the total landings of sablefish in the state. The trawl fleet characteristically takes smaller fish than those caught by the set-liners and much of the catch is landed in dressed, head-off condition.

When other fish are in good supply, the demand for sablefish lessens. This species is seldom sought directly. Therefore, sablefish are almost always taken incidentally with other species, except at certain times off the Washington coast. Here schools of fish, barely legal in size show in very heavy concentrations for short periods and are fished intensively.

The fishing in the Hecate Strait-Queen Charlotte Sound region remains, as one can see from Table 15, strictly incidental. Catch per hour is very low even though effort has averaged about 1,000 pounds the past seven years.

Sablefish of large size are taken in Esteban Deep incidental to the heavy winter fishery for Dover sole, petrale sole and ocean perch. The amount of sablefish in each catch is usually less than 2,000 pounds but a few large fish are almost always taken. The sablefish catch from Esteban Deep, available only for 1961 is shown in Table 14.

Table 14 - Sablefish catch, effort and catch per hour from Esteban deep in 1961

76,597 Pounds	2,054 Hours	37 Lbs/hr.
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In the Forty-Mile-Swiftsure area, sablefish are taken in the late summer and early fall incidental to the intensive lingcod fishery going on at this time.

However, some fair catches of these fish are made on these grounds.

The catch off Cape Flattery-Umatilla has fluctuated considerably over the past seven years (Table 15). The reason for this is due to large concentrations of fish being available for short periods in some years and not available at all in others. This also accounts for the wide fluctuations in catch per hour. When these large schools of fish are found and a fishery develops on them, catch per hour is very high, otherwise, the catch per hour reflects the strictly incidental nature of the fishery.

The Quillayute-Destruction Island fishery also shows these large fluctuations in poundage and even wider ranges in catch per hour. These extremes, once again are due to the availability of these large schools of small fish showing only for short periods of time.

In summary, the Washington otter-trawl fishery for sablefish is in most cases strictly incidental. About one-fourth of the total catch of sablefish landed in the state is trawl-caught. Since we are able to see only a segment of the total fishery, very little can be ascertained regarding the true picture of these stocks of fish.

Rockfish

Trawl landings of rockfish consist of all species of rockfish other than Pacific Ocean perch, which is treated separately. Many species are included in the catch, however, four or five constitute the great majority. The more common species include Sebastes brevispinis, S. pinniger, S. flavidus, S. rubrivinctus and S. diploproa. Some rockfish commonly caught such as S. paucispinis, S. entomelas, S. saxicola and S. elongatus are not utilized to any extent. These fish are thrown back and are a waste since their air bladders have expanded, resulting in a complete inability to swim.

Table 15 - Sablefish catch statistics for 1955 through 1961. Interview data adjusted to total landings.

	1955	1956	1957	1958	1959	1960	1961	7-Year Average
<u>HECATE STRAIT-GOOSE ISLAND-CAPE SCOTT - 5 per cent</u>								
Pounds	22,858	30,385	87,271	24,402	41,269	77,593	34,997	45,539
Hours	625	1,619	1,493	487	809	1,311	1,046	1,056
Lbs/hr.	37	19	58	50	51	59	33	43
Index	100	51	157	135	138	159	89	--
<u>FORTY-MILE-SWIFTSURE - 15 per cent</u>								
Pounds	64,394	191,-91	62,824	125,826	85,543	350,366	141,636	145,954
Hours	614	860	999	3,275	723	1,737	1,484	1,385
Lbs/hr.	105	222	63	38	118	202	95	105
Index	100	211	60	36	112	192	90	--
<u>CAPE FLATTERY-UMATILLA - 29 per cent</u>								
Pounds	145,306	2,713,440	239,580	75,585	197,274	406,756	114,082	290,167
Hours	2,290	3,475	925	1,857	794	2,160	1,912	1,916
Lbs/hr.	63	781	259	41	248	188	60	151
Index	100	1,240	411	65	394	298	95	--
<u>QUILLAYUTE-DESTRUCTION ISLAND - 15 per cent</u>								
Pounds	109,434	242,647	55,278	31,417	518,425	44,471	62,665	152,048
Hours	2,319	552	611	1,151	410	527	576	878
Lbs/hr.	47	440	90	27	1,264	84	109	173
Index	100	936	191	57	2,689	178	232	--
<u>OCEAN TOTAL</u>								
Pounds	442,666	3,266,456	562,367	342,324	921,138	961,968	521,427	1,022,621
Hours	7,519	7,966	5,900	8,123	4,150	7,505	8,973	7,162
Lbs/hr.	59	410	95	42	222	128	58	140
Index	100	695	161	71	376	217	98	--

Table 16 - Poundage, Hours and Catch per hour of Rockfish landed off Esteban in 1961.

Esteban < 100 fms.

605,902 lbs.

899 hrs.

674 Lbs/hr.

Esteban > 100 fms.

770,263 lbs.

2,174 hrs.

354 Lbs/hr.

Rockfish ranked second in poundage and third in value in 1961 with 6.7 million pounds being landed. The demand for rockfish is greatest during the winter and spring months due to the scarcity of fresh fish such as salmon, halibut and other bottomfish because of closed seasons and inclement weather.

Rockfish were landed principally from Goose Island, Cape Scott, Esperanza, Esteban and Cape Flattery. In other areas, they are usually taken incidental to the species primarily fished for (Table 17).

On the Goose Island grounds, poundage and effort increased slightly compared to 1960 with the catch per hour decreasing slightly. All three indices remained very close to the 1955-1961 average with catch per hour still better than the average.

Poundage from the Cape Scott grounds increased substantially even though effort decreased somewhat in 1961 resulting in the highest catch per hour in the past seven years for this area. Poundage was still somewhat down from the 1955-1961 average and quite a bit lower than the peak years of 1955 and 1956. Stocks in those areas are considered a good abundance, and increased effort could increase the catch.

Landings from Esperanza in 1961 as in the past six years have been relatively stable. Effort dropped considerably, however, resulting in an increased catch per hour to 784 pounds. This is the highest catch per hour recorded during the 1955-1961 period for this area. Stocks should be in good abundance here also.

Because of the new statistical division of the Esteban grounds into the Esteban deep (greater than 100 fathoms) and Esteban shallows (less than 100 fathoms), catches for these areas are available only for 1961. The breakdown of the 1,350,000 pounds of rockfish landed off Esteban, 20 per cent of the total ocean catch, is shown in Table 16.

Table 17 - Rockfish catch statistics for 1955 through 1961. Interview data adjusted to total landings (Excludes Pacific Ocean perch).

	1955	1956	1957	1958	1959	1960	1961	7-Year Average
<u>GOOSE ISLAND - 10 per cent</u>								
Pounds	788,233	685,041	629,932	452,404	300,191	534,517	572,771	566,155
Hours	2,235	2,336	1,818	936	680	1,361	1,495	1,552
Lbs/hr.	353	293	347	483	442	393	383	365
Index	97	80	95	132	121	108	105	--
<u>CAPE SCOTT - 18 per cent</u>								
Pounds	1,416,968	1,435,776	683,342	861,447	1,037,488	458,703	901,655	970,516
Hours	3,631	4,776	2,683	3,412	2,723	1,535	1,457	2,887
Lbs/hr.	390	301	255	252	381	299	619	336
Index	116	90	78	75	113	89	184	--
<u>ESPERANZA - 13 per cent</u>								
Pounds	818,159	820,781	812,216	519,523	722,062	641,971	679,002	716,137
Hours	2,080	1,596	1,495	1,223	1,418	1,124	866	1,400
Lbs/hr.	393	514	543	425	509	571	784	512
Index	77	100	106	83	99	112	153	--
<u>CAPE FLATTERY SPIT - 15 per cent</u>								
Pounds	691	5,118	12,920	772,089	1,593,027	1,824,190	1,454,411	808,920
Hours	14	54	52	812	1,540	1,867	2,908	1,035
Lbs/hr.	50	95	248	951	1,034	977	500	782
Index	6	12	32	122	132	125	64	--
<u>CAPE FLATTERY - 14 per cent</u>								
Pounds	1,171,054	883,920	708,190	519,325	801,254	634,958	699,668	774,052
Hours	10,206	5,074	2,171	3,627	3,995	4,297	5,670	5,006
Lbs/hr.	115	174	326	143	201	148	123	155
Index	74	112	210	92	130	95	79	--
<u>OCEAN TOTAL</u>								
Pounds	5,521,165	5,601,683	4,131,295	5,136,463	5,970,936	5,308,980	6,631,432	5,471,707
Hours	25,593	20,818	13,847	17,669	16,766	17,001	20,342	18,862
Lbs/hr.	216	269	298	291	356	312	326	290
Index	74	93	103	100	123	108	112	--
<u>PUGET SOUND</u>								
Pounds	62,314	93,339	99,005	73,946	89,102	118,062	74,801	87,224
Hours	4,550	8,291	4,723	8,281	5,082	8,042	5,467	6,348
Lbs/hr.	14	11	21	9	18	15	14	14
Index	100	79	150	64	129	107	100	--

Esteban shallow grounds produced almost 606 thousand pounds. March and April accounted for the heaviest landings with the fish being taken between 75 and 90 fathoms.

About 770,000 pounds were landed from Esteban deep. The greatest concentrations of rockfish were found between 110-120 fathoms. However, since much effort was expended in greater depths fishing for species other than rockfish, the catch per hour is much lower than what it actually is when fishing primarily for rockfish.

The catch record off the Cape Flattery spit clearly shows that prior to 1958, rockfish were caught only incidental to a small perch fishery going on at that time. In 1958, "new" grounds were discovered and the rockfish catch increased tremendously. In 1961 the first decrease in the expansion of the catch occurred and with an increase in hours lowered the catch per hour to 500 pounds. This may be an indication that the original abundant population has now been removed.

The inshore Cape Flattery catch was 700,000 pounds, but with an increase in effort catch per hour dropped to 123 pounds. With the very high effort, catch per hour remains relatively low and rockfish in this area remains an incidental catch to other species most all of the time.

Rockfish in Puget Sound are strictly an incidentally caught fish. Approximately 75,000 pounds were landed in 1961 with a catch per hour of 14 pounds. The rockfish catch in Puget Sound is composed of two species not caught in the offshore grounds, namely S. caurinus and S. maliger.

In summarization, much of the decline in poundage of other species such as petrale sole and Pacific cod is being taken up by increased landings of rockfish. By exploitation of new areas and by increased utilization of now-discarded species of rockfish, it is felt that rockfish will assume a position of increasing importance in the Washington trawl fishery.

Ocean Perch

The decline in production of several trawl species has been compensated by an increase in the production of ocean perch, a small rockfish (*Sebastes alutus*) *S. pinniger*, *S. diploproa*, *S. zacentrus*, *S. saxicola*, *S. nigrocinctus*, *S. crameri*, *S. helvomaculatus*, and *S. jordani*. Most of these species are smaller than *S. alut* with the exception of *S. pinniger*, of course. There will be very few of the latter in the catches as most buyers ask that the larger and usually half-cent cheaper species be separated. If only the larger perch are kept, most of the other species will be sorted out and discarded. When small perch are caught and kept, then a variety of species enter the catch.

Over the seven-year period from 1955 through 1961, perch have averaged third rank in poundage and fifth rank in value. In 1960 perch were in first place by poundage and second in value. By 1961 perch had gained first place in both pounds and value. The decline of Pacific cod production coupled with increased perch landings accounted for the gains.

The biology and stock identification of perch is imperfectly known. Naturally no tagging has been accomplished. Comparison of catch data trends indicates three general areas within which the reactions to fishing effort are similar. There may be population groups within the areas that respond in like manner to the fishery. The three areas are: the Goose Island-Cape Scott area which is fairly discrete, the Esperanza to La Perouse spit area, the Swiftsure to Quillayute area, and the fourth area off Destruction Island compares most favorably with the Esperanza to La Perouse spit fish than with the Swiftsure to Quillayute group.

The total catch (none are taken with Puget Sound) averaged around five million pounds in the seven-year period of study, Table 18. This has been possible with the increased catch in the last few years. The Bureau of Commercial Fisheries

Exploratory and Gear Development Section opened up a new area off Forty-mile bank which partially explains the increase. Other areas such as: Destruction Island, have experienced increased availability of perch.

Table 18 - Ocean Perch Catch Statistics for 1955 through 1961.
Interview Data Adjusted to Total Landings.

	1955	1956	1957	1958	1959	1960	1961	7 Year Average
<u>GOOSE ISLAND-CAPE SCOTT -- 43.51%</u>								
Pounds	1,241,954	2,409,504	1,473,599	1,358,179	3,672,787	2,914,304	2,382,947	2,207,610
Hours	1,603	2,463	1,629	1,269	2,477	2,294	1,676	1,916
Lbs/hr.	775	978	905	1,070	1,483	1,270	1,422	1,152
Index	100	126	117	138	191	164	183	149
<u>ESPERANZA TO LA PEROUSE SPIT -- 36.56%</u>								
Pounds	1,489,702	1,775,995	1,943,804	845,818	1,540,310	1,745,404	3,643,490	1,854,931
Hours	2,428	2,246	2,983	1,245	1,843	2,760	4,863	2,624
Lbs/hr.	614	791	652	679	836	632	749	707
Index	100	129	106	111	136	103	122	115
<u>SWIFTSURE TO QUILLAYUTE -- 12.18%</u>								
Pounds	571,261	386,221	374,440	245,937	447,543	1,225,834	1,073,590	617,832
Hours	1,297	1,093	1,442	525	770	3,390	2,211	1,533
Lbs/hr.	440	353	260	468	581	362	486	403
Index	100	80	59	106	132	82	110	92
<u>DESTRUCTION ISLAND -- 5.15%</u>								
Pounds	191,602	217,083	223,513	222,636	141,041	113,092	719,879	261,264
Hours	512	341	360	352	219	104	482	339
Lbs/hr.	374	637	621	632	644	1,087	1,494	771
Index	100	170	166	169	172	291	399	206
<u>OCEAN TOTAL</u>								
Pounds	3,498,758	4,994,310	4,514,949	2,736,207	5,839,951	6,064,356	7,870,891	5,074,203
Hours	5,905	6,222	5,812	3,536	5,557	7,879	9,370	6,326
Lbs/hr.	593	803	777	774	1,051	770	840	802
Index	100	135	131	131	177	130	142	135

Catches in the Goose Island-Cape Scott area averaged around 2.5 million pounds or 44 per cent of the total catch. Availability increased in 1959 and has declined since. It is expected that the decline in effort will continue which will result in improved catch per hour.

In the broad Esperanza to La Perouse Spit area catches varied around 1.6 million pounds until the availability change in 1961 which indicated a new population group being exploited. With a new population, production starts high and declines, but a higher level or average for the area should be maintained unless over-exploited. Production here is expected to decline.

Greater availability of perch was experienced in the Swiftsure to Quillayute area. Catches averaged around half a million pounds here for five years, and then increased to over one million pounds for two years. Whether the area can continue to produce this catch is questionable. Effort decreased in 1961 with a favorable increase in catch per hour. It is thought that production will continue at a high level if fishing effort remains moderate.

Better availability occurred in the Destruction Island area after several years of declining effort. It is doubted whether the population can maintain the increased effort. A decline in production is expected.

Generally, catch per hour will decline somewhat unless new populations are found to bolster the availability. This is the only species available to support the demand of the trawl fishery. It is doubtful whether this slow-growing species can support the increased fishing pressure for very many years.

Dogfish Shark

The alleged increase in abundance of these fish in recent years has become a primary factor in attempting to use conservation measures to ensure the continued productivity of the trawl fishery. The increase is alleged because there is no measure of it. There has undoubtedly been an increase in the number of dogfish shark since the end of the vitamin fishery. But, this population surge should

have leveled off, and dogfish should be no more numerous now than before the vitamin fishery. Considerable study was done on dogfish shark at the time of the vitamin days, and it was found that the low reproduction potential of dogfish shark left them vulnerable to an intense fishery. In fact, regulation to decrease the fishing effort was being considered when word was received that a synthetic vitamin A would soon make such regulation unnecessary. The synthetic proved more cheaply produced than the natural vitamin which eliminated all but minor pursuit of the fish containing natural vitamin A.

Catch per trip for Puget Sound trawlers fishing for sharks, Figure 5, shows the population explosion following the cessation of demand for vitamin A. Reports indicate that certain waters in south Puget Sound, Swiftsure, Forty-mile Bank northward to Esperanza contain dogfish shark in such abundance that towing a trawl net for more than twenty minutes is to risk the loss of the net. If three or three and one-half inch mesh is being used, clearing of the net of dogfish is not too difficult as relative few fish will get their gills caught in this size mesh webbing. But, if four and a half or larger mesh is used a dogfish shark can become lodged in almost every mesh. Each mesh must be pushed or pulled out by hand. While this is being done, there is the danger of the net tearing in half from the weight of the dogfish hanging in the web. The abrasive action of the dogfish skin wore the cotton nets rapidly. This factor is lessened with the almost universal use of nylon web.

To the fishermen, the dramatic, physical sight of their nets hanging full of dogfish far outweighed any intangible advantage gained in saving of small fish with the use of four and one-half inch mesh nets.

Elimination of the dogfish shark is of primary concern in order to renew the use of large-size mesh in the trawl nets, thereby preventing the destruction of small fish in the small-mesh nets, and gain the increased production that the growth of the saved fish will create almost immediately. There is still the problem of fishing ocean perch with small-mesh nets to solve.

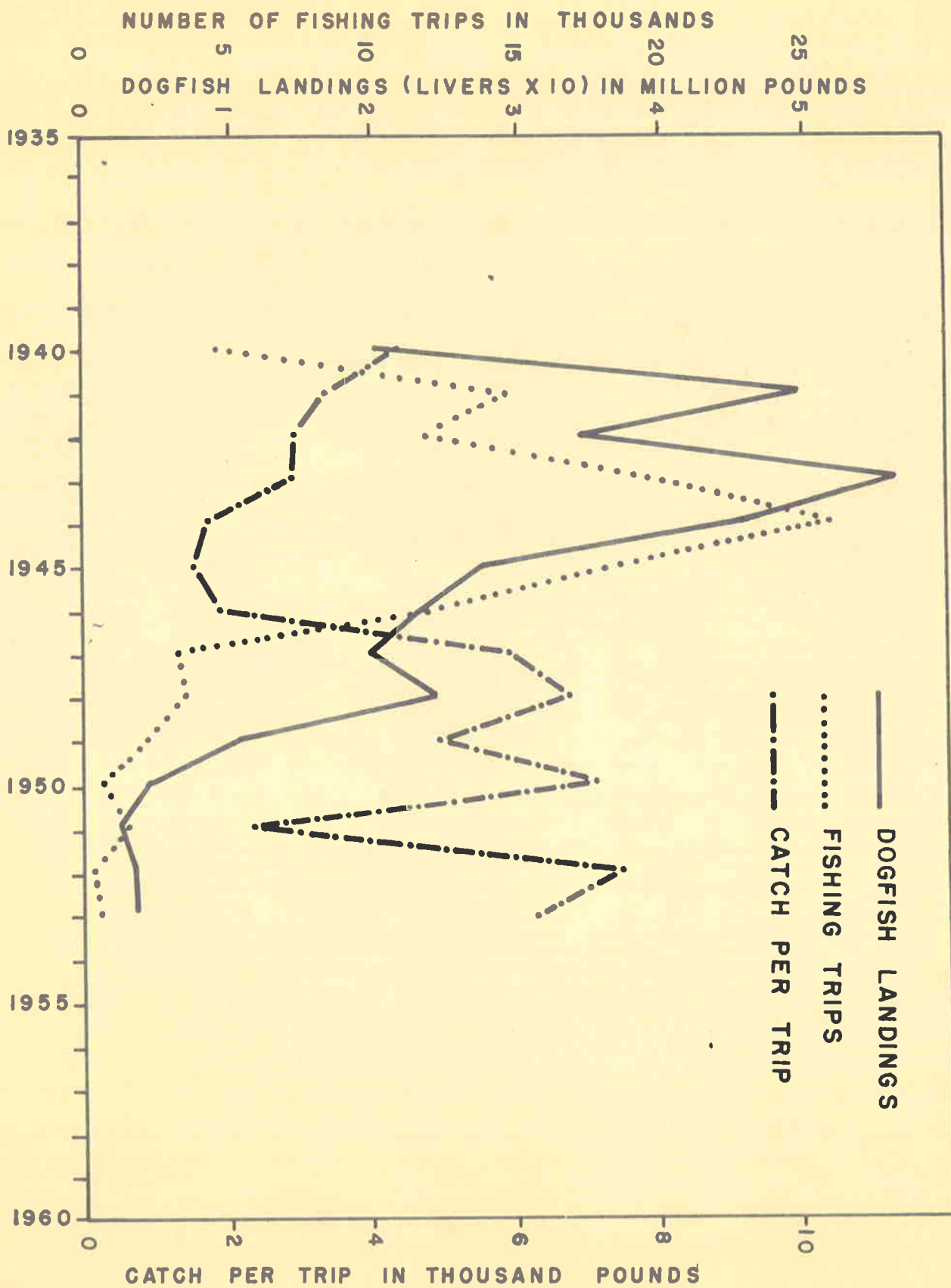


FIGURE 5: DOGFISH LANDINGS, TRIPS, AND CATCH PER TRIP.

There are several possibilities for decreasing the numbers of dogfish shark which are also a nuisance to sport fisherman inside Puget Sound primarily.

1. Overfishing
 - (a) new product (food or chemical)
 - (b) bounty
2. Repellant (electric, sound or chemical)
3. Biological control (predator or parasite)
4. Poison

This list can be condensed rather rapidly down to the biological controls or poisons. Any product from dogfish can be produced more economically by fishermen of other countries. Our people refuse to accept the flesh for food. There is a new method of preparing a protein concentrate that may have possibilities. Using the fishing rate found during the vitamin fishery it would cost the combined Governments of U. S. and Canada \$700,000 a year in bounties to equal the dogfish shark landings of that time. This is based upon ten cents a pound for livers, or seven million pounds of round fish must be caught annually. Any less would reduce the competition for food and space between individual dogfish and only increase the population potential of the species.

Many repellants have been tried with no success. This would only give temporary relief to one area at the expense of another at best.

Evidently dogfish are not preyed upon by many other species, and, then, too, an introduced predator may turn upon other species after depleting the dogfish. Little is written about dogfish shark parasites, and a special study would be required. Perhaps the European dogfish has a parasite not found here that would decimate the species here upon introduction. Then too, the latest fad with insect control is to introduce over-sexed sterile mutants.

The usual method of broadcasting poisons would probably prove too expensive, but if the physiology of the dogfish in storing area as a salt-balance in its blood were attacked, some specific and economical method might be found to poison dogfish shark. It is planned to explore this approach in the future as time and duties will permit.

Discussion

The catch statistics for some unknown reason are optimistic. It is believed that the fishery and the stocks are in worse shape than the impression given by these data. Fishermen are leaving the fleet, the effort is declining especially in the northern areas. Washington fishermen must catch their fish quickly and easily in order to make the long northerly run feasible. Pacific cod, English sole and rock sole catches have declined. Ocean perch and rockfish catches remain good in the Goose Island and Cape Scott areas. With the decline in Pacific cod landings most fish houses removed their restrictions and allowed fishermen to bring in lingcod catches. Lingcod withstood the pressure for a few years, but now it is threatened. Approaching closer to Washington the situation gets more desperate. Except for perch and rockfish there would be little to fish upon. There have been some new patches or petrale sole located, but new fishing areas just postpone the day when we must face up to the fact that we are overfishing the entire area. The inside waters with catch rates of 25 to 100 pounds per hour are a disgraceful waste of resource. Use of large-mesh ($4\frac{1}{2}$ to 5 inch) will protect many small fish that are now being destroyed by the small mesh (3 to $3\frac{1}{2}$ inch) nets being used. This method is working successfully in other parts of the world to sustain trawl fisheries of similar intensity. The North Sea, New England, coastal areas, Grand Banks, and California waters are some of the areas where mesh size is controlled to allow small fish to survive, grow, and maintain the fisheries. In Washington there is a small but influential element that is more

interested in a fast buck than the welfare of the resource. Maybe the coming decline in the fishery will shake out this element, and some means of putting the fishery on a sustaining basis can be found. Perhaps quota regulations on several of the important species perch, cod, and English sole can be used to control fishing effort until reserve stocks can be reproduced. For instance, the English sole stocks of Hecate strait, Washington Coast, and Georgia Strait all appear capable of producing three million pounds annually. The Hecate Strait stocks were doing this, but the George Strait stocks could not after the reserve stocks were depleted. Perch fishing is admittedly a problem with large mesh, but dogfish would soon be avoided. One element of encouragement lies in the fact that barring a rise in price, which would increase the demand for bottomfish, fishermen tend to never completely destroy a species. There is usually enough of a remnant left to rebuild the resource. Demand increased for pilchards as it is doing for salmon which may drive these species past the point if possible return. Salmon are being further complicated by the desecrating of their fresh-water environment

Market Sampling

Due to the emphasis these past two years of bringing otter-trawl catch statistics up-to-date and the continuation of a high coverage interview program, the market sampling program has been limited.

There has been no systematic sampling program started as yet due primarily to the tremendous amount of effort it takes just to keep the statistical data up-to-date. This in itself is almost a full-time job for the present personnel.

During the past two years, an increased effort was made on age determination. Petrale sole and dover sole otoliths, interopercles and otoliths of English sole and Pacific Ocean perch scales were studied to determine their readability. Due

to the rapid growth of lingcod and Pacific cod in their first three years, it is believed the age of these fish may be determined through the interpretation of length frequency distributions.

Some rockfish identification work is being carried out in order to determine what particular species are found in the trawl catch and what per cent they contribute to it. The three most common species found in the sampled catches are Sebastes brevispinis, S. pinniger and S. flavidus.

Sampling of the winter Pacific cod and English sole fisheries in the Gulf of Georgia was initiated in 1961 due to the intense fishing pressure and low abundance of the stocks in this area. These grounds are also adjacent to Canadian waters where there is a $4\frac{1}{2}$ inch minimum mesh size.

A much needed tagging program on Pacific cod and English sole is planned in order to determine whether or not there is a mixing of these stocks between Canadian and American waters.