Jones

OTTER TRAWL INVESTIGATIONS
PROGRESS REPORT
May through October, 1954

TABLE OF CONTENTS

LIST OF FIGURES

* Preceding page cited.

LIST OF TABLES

* Actual or preceding page cited.

OTTER TRAWL INVESTIGATIONS
PROGRESS REPORT

May through October, 1954

INTRODUCTION

The period May through October includes the "summer" season for the otter trawl fleet. The soles move onto the inshore fishing grounds and the weather generally permits uninterrupted trips. Our sampling program takes place during this period.

Two summer helpers were hired to aid in the sampling program. Ray Ward arrived, for his third season, June 14, and departed September 17, to return to Oregon State College. Guy Moore arrived, for his first season, June 14, and departed August 31, to return to teaching at Estacada High School.

FLEET ACTIVITIES

The markets for otter trawl-caught fish remained good throughout May and most of June. However, on June 24 the fleet ceased fishing due to a price dispute. The plant operators wished to reduce the price of fish 1¢ per pound for all species. However, one by one the boats returned to fishing until by September the entire fleet was operating once more, at the original prices.

Nine otter trawlers, part or full time, sailed south for albacore fishing during the summer. They were the "Wauna", "Bristol", "Valhalla II", "Nestucca", "Galaxy", "Daphne", "Madeline J", "New Mexico", and "Coolidge II". Most of these had returned by the middle of October.

The otter trawler "Shirley Lee" was equipped with an Edo "Fish-Finder" this summer, and the skipper reports good success with the new instrument.

FIELD ACTIVITIES

Field activities consisted of a mesh experiment, and market sampling. The mesh experiment was a PMFC-sponsored trip aboard the California research vessel, "N. B. Scofield", to the Dover sole grounds off Eureka, California. This project occupied the period of May 11 to June 8. Biologists from California, Washington, and Oregon took part. J. A. Aplin and Doyle E. Gates represented California; Dayton L. Alverson represented Washington; and Jergen Westrheim represented Oregon. High winds and rough seas restricted operations considerably. Thirty-six experimental drags were made and all Dover sole (13,746) caught were measured. The results were largely inconclusive, possibly because of the variation in size composition of the fish on the grounds.

The market sampling program undertaken in the summer of 1954 followed the same procedure as used in 1953 with a few improvements. Dover sole and whole fish landed for mink food were the subjects of the sampling program.

Market Sampling--Dover Sole

Market samples were taken only of Dover sole which were caught by trawl boats fishing the local area "off the Columbia River". This local area is bounded on the south by Cape Falcon (45°40' N. Lat.), which is near Neahkanie Mountain, and on the north by Willapa Bay (46°40' N. Lat.). Only landings from this area which consisted of 30 per cent or more Dover sole were sampled.

Thirteen market samples of Dover sole were taken during the period June 15 through August 27. The original plan called for two samples per week. However, few trawl boats fished during July and part of August due to the refusal by the fishermen to fish for a lower price offered by the

fillet plants. One of the major fillet plants continued to buy a limited amount of fish at the old price which enabled the biologists to obtain some samples of Dover sole during July and August.

A total of 5,168 Dover sole, 1,681 males and 3,487 females, were sampled from the 13 landings. Five samples were taken in June, two in July, and six in August. The market samples were composed of approximately 400 Dover sole each. The sex and length, to the nearer lower centimeter, of each fish was recorded and both otoliths of 55 fish picked at random from the sample were removed for age determination studies. A total of 715 pairs of otoliths, 233 pairs from males and 482 pairs from females, were collected.

Throughout the 1953 Dover sole sampling, difficulty was sometimes experienced by the samplers in obtaining a fish cart at the fillet plant for containing the fish while sampling. A fish cart, similar to the ones used in the fillet plants, was purchased for use by the samplers. Removable measuring boards were built to fit on the sides of the cart. The combination of the cart and special measuring boards greatly facilitated the sampling. Only about half of the samples could have been obtained had not the samplers had their own cart available.

A change in the sampling technique was tried on the last few samples of Dover sole and was found to improve and speed up the sampling. It has been the practice of the samplers to measure the Dover sole with the eyed side of the fish up, i.e. the blind side length, then flip the fish over to remove the otoliths and make the cut to determine the sex from the blind side of the fish. The Dover sole were measured with the blind, or flat side, down because it was felt that the curvature of the fish on the eyed side would adversely affect the total measurement of the fish. It was the

observations of the samplers, however, that this might not be so. If the fish could be measured with the blind side up, i.e. eyed side length, time could be saved by eliminating the process of turning the fish over. To compare the measurements on the blind side of the fish with those of the eyed side, 194 Dover sole were measured to the nearest millimeter on both sides.

The results of this experiment are included in Table 1. The frequencies of deviations of eyed side length from blind side lengths (for the same fish) indicated a somewhat skewed distribution about ± 0 millimeters. The range was +3 mm (1 fish) and -2 mm (6 fish). There was no difference between the two measurements for 101 of the 194 fish examined. It is interesting to note that 67 of the fish were longer when measured with the eyed side up, compared with only 26 fish for which the blind side was up.

However, the differences observed were considered to be not significant for our purposes.

Market Sampling--Mink Food

Samples of otter trawl-caught whole fish landed for mink food at the Oregon Fur Producers Association's plants at Astoria and Newport were taken to determine the species composition in the catch. All Dover, english, and petrale soles encountered in the samples were measured to determine the size composition of these fish in the mink food landings.

Between June 16 and September 8, 31 samples of fish landed for mink food were obtained; 19 at Astoria and 12 at Newport. A total of 20,492 fish of 36 species were recorded in the Astoria samples. At Newport, 9,663 fish of 33 species were counted in the samples. More samples of mink food landings will be taken in October, if possible. The species composition

Table 1. Comparison of Measurements of Blind Side Lengths* and Eyed Side Lengths* of 194 Dover Sole

(B - E)** mm	FREQUENCY	PER CENT
+3	1	0.5
+2	13	6.7
+1	53	27.3
±0	101	52.0
-1	20	10.3
-2	6	3.1
-3	0	0.0
TOTALS	194	99.9

* Blind Side Length is obtained when the fish is lying on the measuring board with the eyed side up. Eyed Side Length is obtained in the opposite manner.

** (Blind Side Length - Eyed Side Length)

by numbers and weight of the fish are given in Table 2. A number of fish of each species from several samples were weighed in order to determine the average weight of each species in the samples.

Table 2. Species Composition in the Mink Food Samples Taken at O.F.P.A. Plants at Astoria and Newport, June 18 to September 8, 1954

SPECIES	ASTORIA				NEWPORT			
	Number	Per Cent	Pounds	Per Cent	Number	Per Cent	Pounds	Per Cent
Dover Sole	2,305	11	3,101	12	1,013	10	1,563	10
English Sole	2,356	11	2,025	8	923	10	436	3
Petrale Sole	176	1	176	1	92	1	92	1
Turbot	2,281	11	7,527	29	2,594	27	5,188	35
Rex Sole	8,156	40	4,894	19	619	6	248	1
Flounder	1,526	7	3,815	14	7	tr	32	tr
Bellingham Sole	1,045	5	732	3	1,533	16	460	3
Misc. Rockfish	1,258	6	1,549	6	1,960	20	5,045	34
Misc. Fish	1,389	7	2,280	9	922	9	1,825	11
TOTALS	20,492	99	26,099	101	9,633	99	14,889	98

Turbot and rex sole were the dominant species in the mink food samples at Astoria while at Newport turbot and assorted rockfish were dominant. Dover and english sole composed about 20 per cent by numbers of the fish in the samples both at Astoria and Newport, but the english sole landed at Newport were much smaller in size than those landed at Astoria and therefore composed a much smaller per cent of the total pounds sampled at Newport. This was due mainly to one boat at Newport which fished close inshore for small english and Bellingham soles.

To the end of August, 1954, 3,900,357 pounds of whole fish were landed at the Astoria and Newport O.F.P.A. plants while for the same period in 1953, 3,244,282 pounds of whole fish were landed at the plants. This does not constitute an appreciable increase in landings of whole fish for mink food in 1954 over 1953.

LABORATORY ACTIVITIES

The paucity of field work due to the price dispute permitted the utilization of the summer help for compilation of some of the data accumulated over the past few years. This accumulation has taken place at a disconcerting rate and the "winters", when compilation and analysis generally takes place, seem to be growing shorter each year.

Progress Reports

The progress report covering the period November, 1953 through April, 1954 was written in June and July. This report is being written during October and November.

Statistics--General

Considerable time was spent compiling the landing records for Dover, english, and petrale soles, and Pacific Ocean perch. The chore of compilation has been considerably increased since 1951 when area of catch and number of drags per trip were incorporated into our statistical system. All back records for these four species have now been double-checked and are presumably free of errors.

For each of the four species, the identification of the "Local Area" (to the Astoria Fleet) was achieved by plotting the geographical distribution of the "significant" trips (those which contained greater than 29 per cent of the species in question). The areas reported by the fishermen are approximately 10 miles square, but all such areas in each parallel 10 mile-wide strip, parallel to the latitudes, have been combined so that only a north-south orientation is available. It is felt that the present system is not sufficiently precise to warrant a more detailed geographical distribution of the effort.

The landing records for each species will be presented separately. The compilations are not complete for some of the species and no time has been available for analysis of these data.

Statistics--Dover Sole

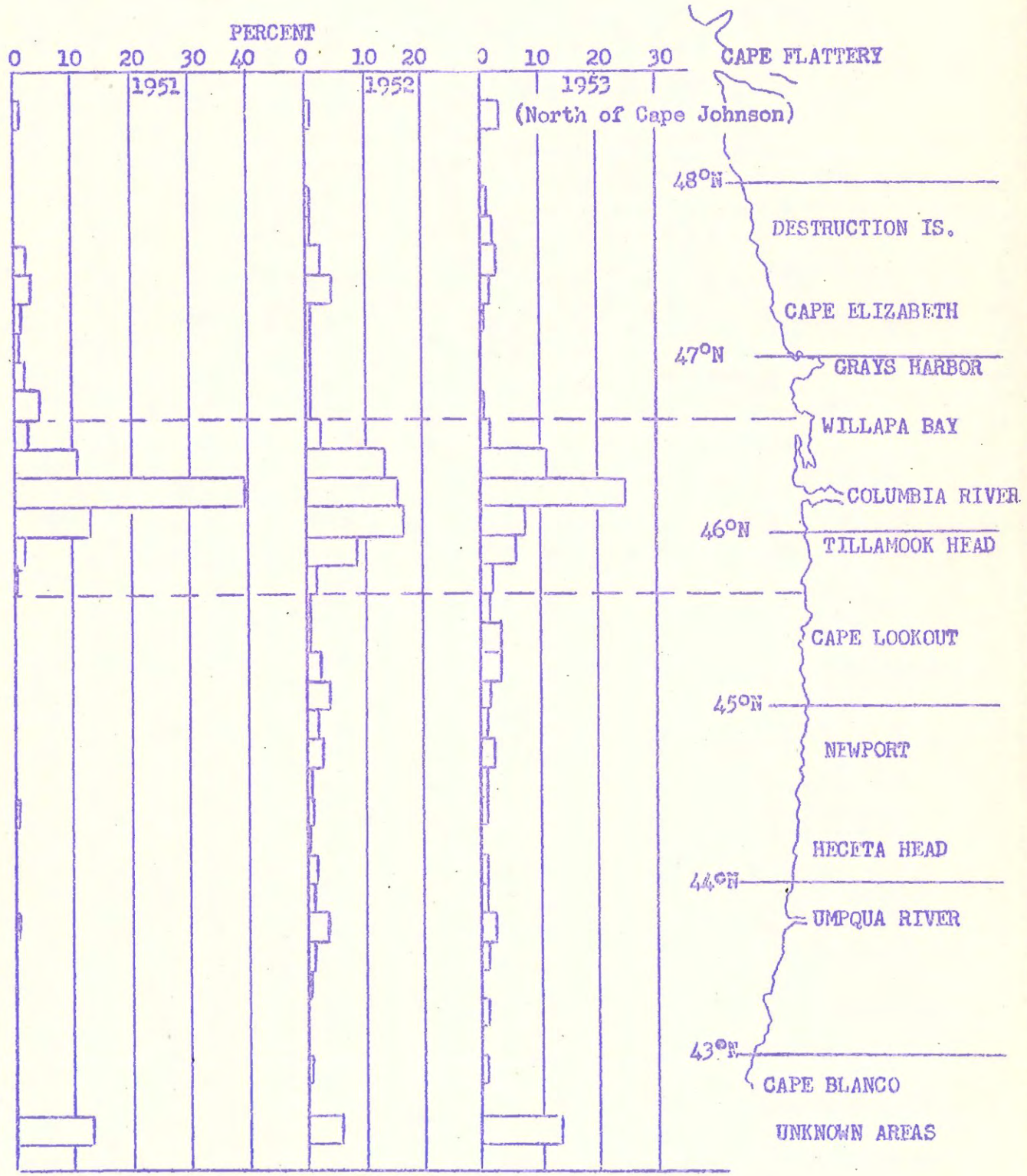
Figure 1 presents the geographical distribution of "significant" trips of Dover sole, in per cent, for 1951 through 1953. Each horizontal bar represents the per cent of the total significant Dover sole landings which came from the corresponding 10 mile-wide strip of area off the coast of Oregon or Washington, by year. The latitudes have been included for orientation. There are 60 nautical miles between consecutive degrees of latitude.

The Local Area for Dover sole has been defined as lying between Cape Falcon and Willapa Bay and is indicated in Figure 1 by two horizontal dashed lines. Cape Falcon lies approximately 10 miles south of Tillamook Head. Prior to 1951 virtually the entire catch of Dover sole landed in Astoria came from this area, according to the fishermen.

The data indicate that the Local Area absorbed the major portion of the fishing effort during 1951-53, but that the percentage attributable to the Local Area was decreasing. In 1951, 81 per cent of the "significant" landings of Dover sole in Astoria originated in the Local Area, whereas the corresponding percentages for 1952 and 1953 were 64 and 62, respectively. Four other areas appear to be developing as Dover sole fishing grounds in lieu of the Local Area. These are (1) off the Umpqua River; (2) between Newport and Cape Lookout; (3) Cape Elizabeth to Destruction Island; and (4) "North of Cape Johnson", which includes chiefly an area off Cape Flattery.

Unknown areas accounted for 14 per cent of the 1951 landings, 6 per cent of the 1952 landings, and 13 per cent of the 1953 landings.

Figure 1. Astoria - Dover Sole - Percent of Significant Landings by Area of Catch, 1951 - 53.



The lone fillet plant in Newport closed in 1952, and we were unable to obtain areas of catch for many of the landings made in Newport during 1951 and 1952. However few, if any, trips were made to Dover sole grounds north of Cape Lookout by the Newport fleet.

It is interesting to note that the operation of the Astoria fleet encompassed an area over 360 miles long.

The Astoria landings of Dover sole for the period 1942-53 are included in Table 3 together with the calculated numbers of landings and pounds per significant landing. For the period 1951-53 the figures have been allocated by "area", i.e. "south", "local", and "north". The "south" and "north" areas include all grounds south and north, respectively, of the Local Area, and consequently have little consequence as definitive fishing areas.

The methods employed to obtain these figures are detailed as follows, using the 1953 data for an example (Table 4).

Step One: The "significant" landings for which the area of catch was known were assembled in the usual manner, by area. This gives us "Pounds Landed", "Numbers of Landings", and "Pounds/Landing". The total pounds allocable by area was 1,606,476 out of a total of 1,783,331 pounds for the year. There were 164 of the 189 total "significant" landings allocable by area for the year.

The last part of Step One involves the "Per Cent Pounds Landed", by area, of the total allocable catch. Thus, for example, the pounds landed from the Local Area (902,670) was 56.2 per cent of the total allocable pounds (1,606,476) landed during the year.

Step Two: The "non-significant" catch of Dover sole was treated in a similar manner. A total of 498,961 pounds were landed and area allocation

Table 3. Total Pounds Landed, Calculated Numbers of Landings, and Pounds Per Significant Landing, in Astoria, for Dover Sole, by Year, 1942-53, by Area of Catch, 1951-53

YEAR	TOTAL POUNDS LANDED	CALCULATED NUMBERS OF LANDINGS	POUNDS PER SIGNIFICANT LANDING
1942	2,189,287	140	15,604
1943	6,567,312	379	17,395
1944	1,318,179	103	12,759
1945	2,570,845	164	15,722
1946	2,979,687	245	12,157
1947	1,737,933	145	11,990
1948	2,943,453	247	11,913
1949	2,457,719	191	12,848
1950	4,763,173	346	13,767
1951:	4,688,405	391	12,003
North	784,416	68	11,453
Local	3,804,559	314	12,105
South	99,430	8	13,034
1952:	5,801,715	567	10,225
North	727,697	69	10,536
Local	3,204,437	367	8,720
South	1,869,581	133	14,018
1953:	2,282,292	233	9,796
North	387,889	32	11,955
Local	1,254,706	140	8,937
South	639,697	60	10,584

Table 4. Allocation of 1953 Landings of Dover Sole at Astoria, by Area, for Pounds Landed, Calculated Landings, and Pounds Per Significant Landing

	AREA			
	NORTH	LOCAL	SOUTH	TOTAL
"SIGNIFICANT" LANDINGS (known area):				
1. Pounds Landed	322,772	902,670	381,034	1,606,476
2. Numbers of Landings	27	101	36	164
3. Pounds Per Landing	11,955	8,937	10,584	9,796
4. Per Cent Pounds Landed	20.1	56.2	23.7	100.0
"NON-SIGNIFICANT" LANDINGS (known area):				
5. Pounds Landed	26,338	227,730	196,004	450,072
6. Per Cent Pounds Landed	5.9	50.6	43.5	100.0
ALLOCATION (known + unknown areas):				
7. "Significant" Pounds Landed	358,450	1,002,232	422,649	1,783,331
8. "Non-Significant" Pounds Landed	29,439	252,474	217,048	498,961
9. Total Pounds Landed (7 + 8)	387,889	1,254,706	639,697	2,282,292
10. Calculated Numbers of Landings: (9)/(3)	32	140	60	233

was possible for 450,072 pounds. The percentages of the allocable catch were calculated (item 6). The Local Area accounted for 50.6 per cent of the total allocable catch of "non-significant" Dover sole landings in 1953.

Step Three: Using the per cent composition, by area, from Steps One and Two, the Total (known + unknown areas) Landings, "significant" and "non-significant", of Dover sole were allocated separately, by area, and summed by area. The results appear as Item 9.

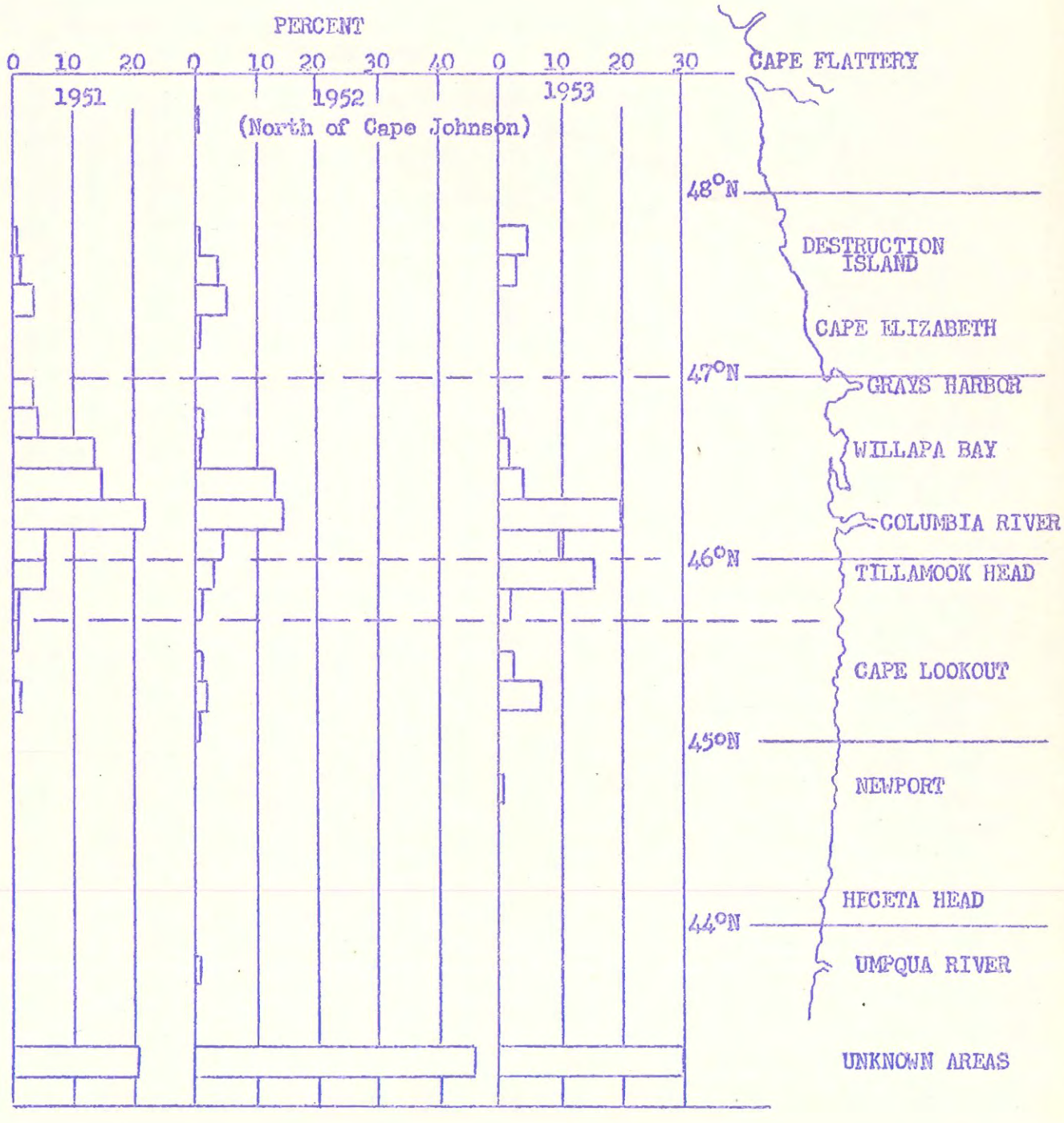
Step Four: "Calculated Numbersof Landings", Item 10, were obtained for each area by dividing the "Total Catch", Item 9, by the "Pounds Per Significant Landing", Item 3.

Significantly the catch records indicate a sharp decline in abundance of Dover sole in the Local Area. The contribution of this area to the total Astoria landings declined from approximately 100 per cent in 1950 to 62 per cent in 1953. Preliminary figures indicate that for 1954 the per cent of Local Area Dover in the Astoria landings will be less than 60 per cent. A second feature is the decline in pounds per significant landing. A secondary peak of 15,722 pounds occurred in 1945. Subsequently the catch/trip stabilized, more or less, at approximately 12,500 pounds, until 1952 when it dropped to 8,720 pounds. The slight rise to 8,937 pounds/trip in 1953 may be significant. If so, it possibly represents the lessening of competition between gear on the Local grounds.

Statistics--English Sole

The Astoria landing records for English sole have been organized similarly to those of Dover sole. In Figure 2 we see the percentage distribution of significant trips of english sole by area, by year, 1951-53. The Local Area extends from Cape Falcon to Grays Harbor. These sole are

Figure 2. Astoria - English Sole - Percent of Significant Landings by Area of Catch, 1951 - 53.



caught in three principal areas, viz., off Destruction Island, Local Area, and off Cape Lookout.

The high percentage of landings with unknown areas of catch resulted from inadequate man-hours for collecting missing areas from the fishermen. By choice, the major effort was directed on the Dover sole, and the records for the other species suffered accordingly.

The english sole catch records for Astoria are included in Table 5. The allocation, by area, of the landings in 1951 and 1952 are not complete.

Unfortunately the Astoria fleet began seeking the new english sole fishing grounds in 1946 or 1947 and so our introduction of catch areas in 1951 came too late to portray this initial dispersion of fishing effort. However it is interesting to note that even in 1951, 89 per cent of the significant landings came from the Local Area, and in 1952 and 1953 this percentage dropped to 71 and 75, respectively. The over-all catch per trip, disregarding areas, has fallen steadily from 10,602 in 1949 to 4,252 in 1953. This decline coincides with the fishermen's claim that all their regular grounds appear to be "fished out". The relatively small total annual landings (maximum = 2.96 million pounds in 1946) tend to indicate that the stocks of english sole were never large.

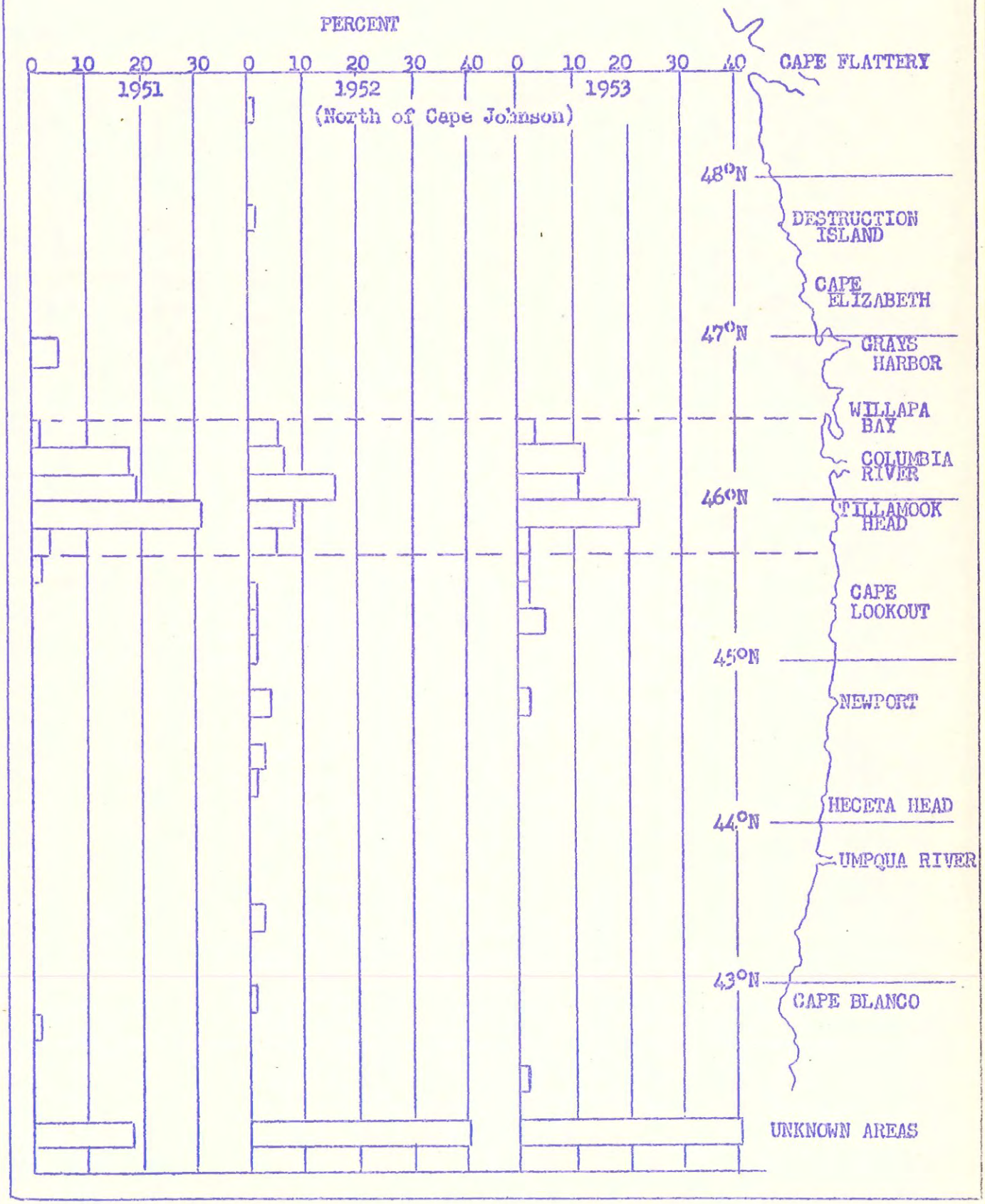
Statistics--Petrale Sole

The distribution of significant Astoria petrale sole landings for 1951-53 indicate a more localized fishery than was evident for either Dover or english sole (Figure 3). The Local Area has been defined as lying between Cape Falcon and Willapa Bay. The annual percentage of trips to this Local Area by the Astoria fleet are 90 in 1951; 69 in 1952; and 83 in 1953. As in the case of english sole, there was a considerable number of trips (18% in 1951; 40% in 1952; and 40% in 1953) for which no area was reported.

Table 5. Total Pounds Landed, Calculated Numbers of Landings, and Pounds Per Significant Landing, in Astoria, for English Sole, by Year, 1942-53, by Area of Catch, 1953

YEAR	TOTAL POUNDS LANDED	CALCULATED NUMBERS OF LANDINGS	POUNDS PER SIGNIFICANT LANDING
1942	181,126	138	1,311
1943	665,331	126	5,280
1944	766,236	264	2,897
1945	726,314	114	6,380
1946	2,956,058	417	7,091
1947	1,338,543	166	8,071
1948	2,214,577	212	10,426
1949	765,958	72	10,602
1950	1,903,658	208	9,158
1951	2,079,664	292	7,117
1952	1,736,007	338	5,134
1953:	937,468	220	4,252
North	171,882	17	10,053
Local	610,627	170	3,599
South	154,959	35	4,438

FIGURE 3. Astoria - Petrale Sole - Percent of Significant Landings - by Area of Catch - 1951 - 53.



The absence of any trips in 1952 and 1953 from the area off Grays Harbor was due to a price dispute which tied up the fleet during May of each year. The petrale sole presumably appear in that particular area for a relatively short time each year. Part of the Washington otter trawl fleet operated on these grounds during the tie-up each year.

The total catch of petrale sole attained a peak of 2.3 million pounds in 1942, and since that time has fluctuated around the million pound mark (Table 6). A secondary peak of 1.9 million pounds occurred in 1950. The catch/trip has fallen almost steadily from 8,408 pounds in 1943 to 4,049 pounds in 1953. These figures apply to the total Astoria landings and are not allocable by area prior to 1951. The fleet fished for these fish in areas other than the Local Area prior to 1951.

The allocation by area of the Astoria landings of petrale sole has been completed for 1953 only. No significant landings were reported from the northern area although 43,435 pounds of incidental landings were presumably from this area. The southern area produced 208,417 pounds in 20 "calculated trips", for an average of 10,364 pounds/trip. The Local Area produced 453,756 pounds in 111 "calculated trips" for an average of 4,080 pounds/trip. Presumably there are still some petrale available in fair quantities south of the Local Area, but the irregular availability and/or distance from Astoria precludes a more intensive fishery.

Statistics—Pacific Ocean Perch (Sebastodes alutus)

Prior to 1951 much of the Pacific Ocean perch landed in Astoria were sold as "rockfish" and did not enter our records as Rosefish or Pacific Ocean perch. However, the market was small and presumably the annual landings were not significant.

Table 6. Total Pounds Landed, Calculated Numbers of Landings, and Pounds Per Significant Landing, in Astoria, for Petrale Sole, by Year, 1942-53, by Area of Catch, 1953

YEAR	TOTAL POUNDS LANDED	CALCULATED NUMBERS OF LANDINGS	POUNDS PER SIGNIFICANT LANDING
1942	2,319,758	290	8,018
1943	1,693,983	201	8,408
1944	1,278,244	203	6,298
1945	905,428	163	5,546
1946	1,694,604	420	4,037
1947	957,082	201	4,755
1948	1,447,155	218	6,639
1949	864,113	164	5,256
1950	1,859,142	271	6,849
1951	1,049,240	231	4,539
1952	1,305,997	222	5,874
1953:	705,608	174	4,049
North	43,435	--	--
Local	453,756	111	4,080
South	208,417	20	10,364

During 1952 and 1953 the demand increased considerably. The annual landings for Astoria were 2.99 and 2.61 million pounds, respectively, for these two years.

The catch/trip is not a reliable measure of the abundance, at the present time at least, for these fish since the fishermen were subjected to limits off and on throughout this three year period. There were less limit trips in 1953, however, and this probably accounts for the higher catch/trip, i.e. 14,304 vs. 10,180 in 1952 and 11,711 in 1951.

The geographical distribution of the catches of Pacific Ocean perch in 1951-53 show a more or less steady expansion of the fleet's activities northward and southward from the Local Area (Figure 4). This Local Area is now designated as lying between Cape Falcon and Willapa Bay. The Local Area sustained 90 per cent of the significant trips in 1951, 69 per cent in 1952, and 83 per cent in 1953. The early expansion of the fleet to new grounds has been caused to a considerable extent by the unpredictable availability of these fish. They are not confined to the bottom as are the flatfish and consequently are not catchable with the present gear if they happen to be lying off the bottom a fathom or so.

The allocation of the 1953 landings by area (Table 7) indicates the catch per trip varies considerably by area, i.e. "north": 23,164; "local": 12,222; and "south": 16,486. The low value for the Local Area may be due to unavoidable inclusion of "limit" trips which of course tend to reduce the average landing. It is however not implausible that the local grounds now have significantly less Pacific Ocean perch than the other two regions.

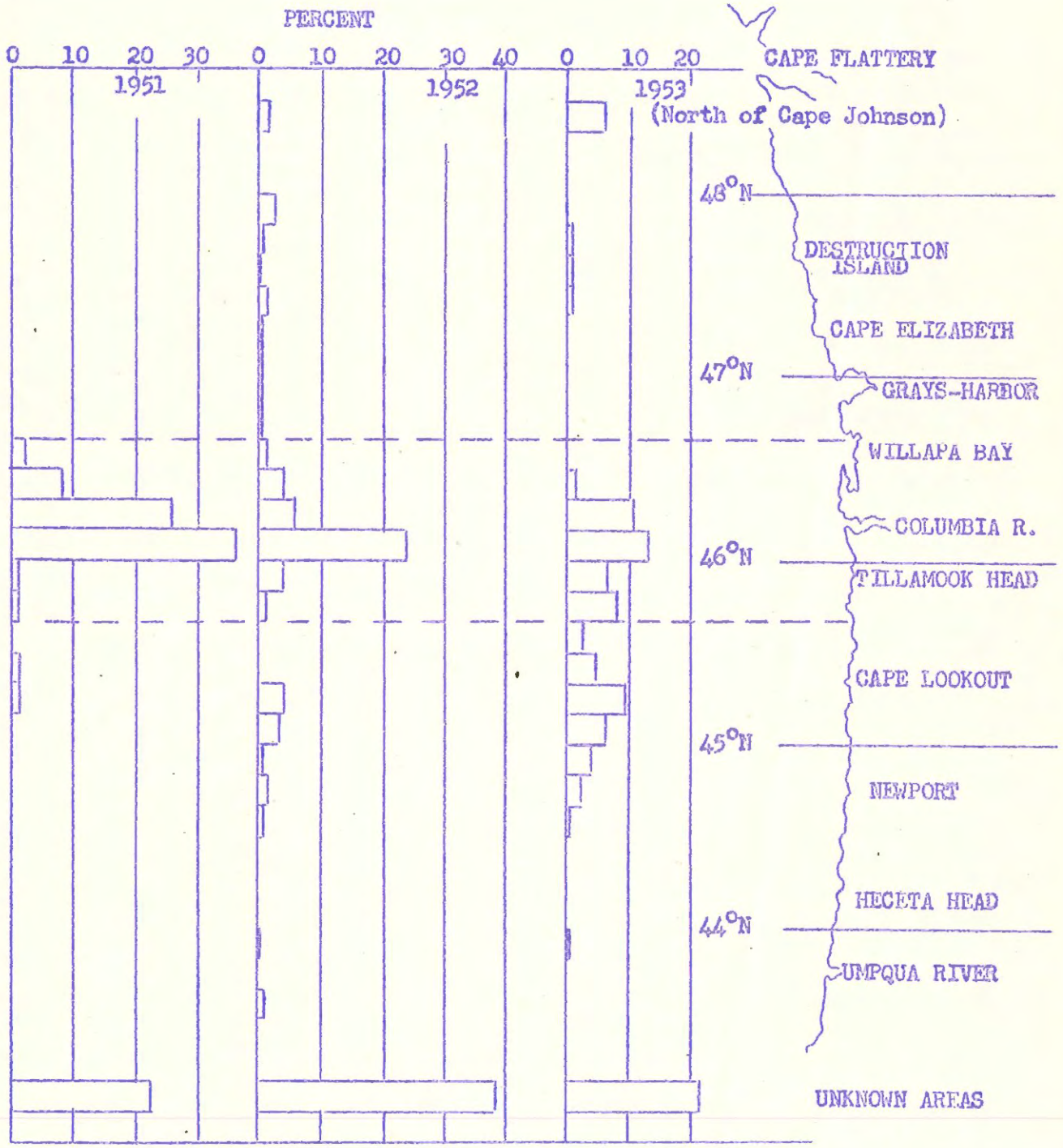
Sampling-at-Sea

Initial compilation and calculations were made for the sampling-at-sea data collected during 1951 and 1953. The preliminary results for 1951

Table 7. Total Pounds Landed, Calculated Numbers of Landings, and Pounds Per Significant Landing, in Astoria, for Pacific Ocean Perch, by Year, 1951-53, by Area of Catch, 1953

YEAR	TOTAL POUNDS LANDED	CALCULATED NUMBERS OF LANDINGS	POUNDS PER SIGNIFICANT LANDING
1951	1,023,390	87	11,711
1952	2,994,262	294	10,180
1953:	2,609,142	182	14,304
North	429,866	19	23,164
Local	1,063,590	87	12,222
South	1,115,686	68	16,486

Figure 4. Astoria - Pacific Ocean Perch - Percent of Significant Landings by Area of Catch, 1951 - 53.



are similar to those obtained in 1950. However, the 1953 data are not comparable with either 1950 or 1951 data. Presumably the sampling box method introduced in 1953 was biased against small fish as the per cent discard was exceptionally low for the net sizes used.

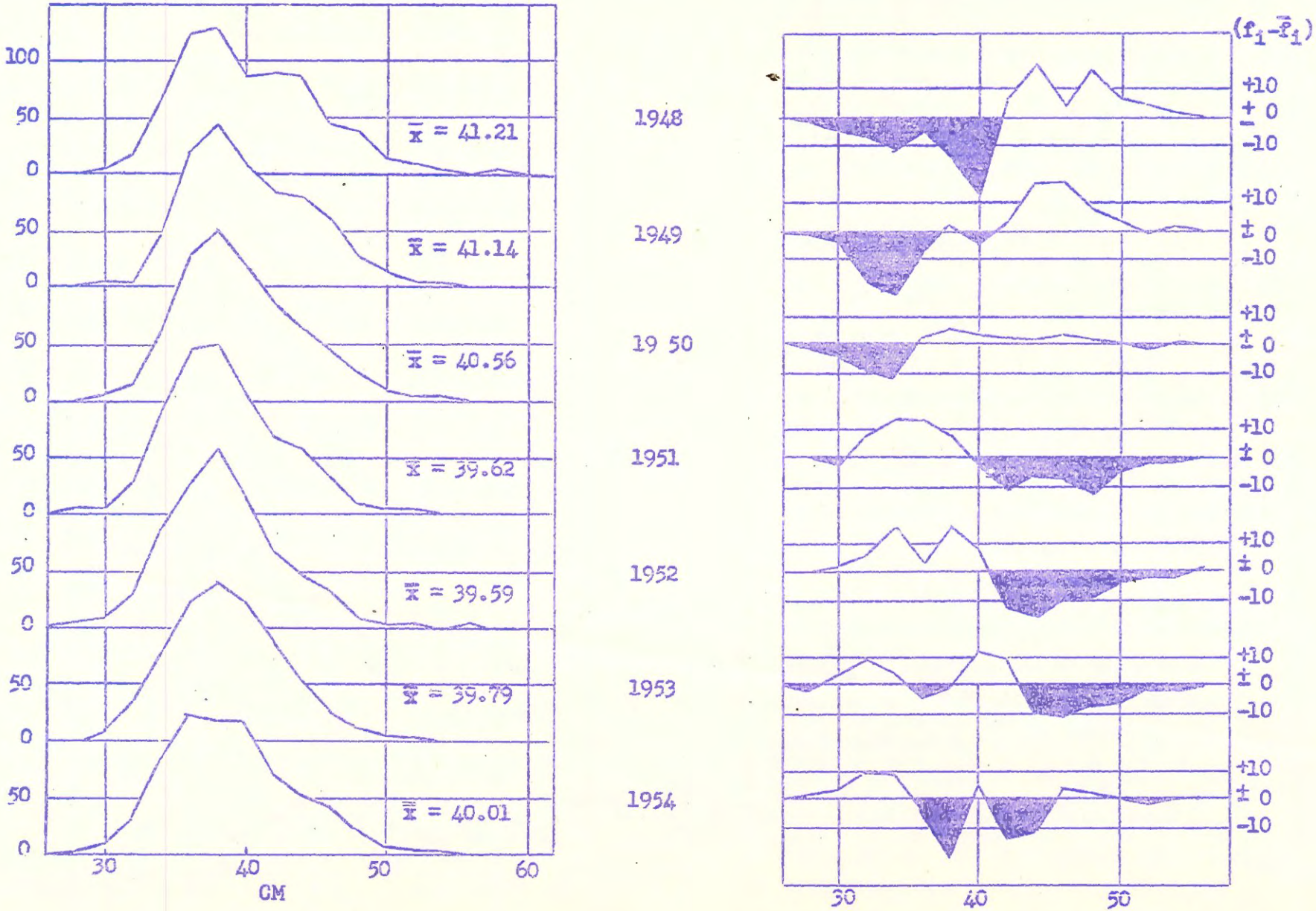
Size Composition of Catch--Dover Sole

The changes in the size and age composition of the annual catches from the Local Area are of interest as a potential source of corroborative data for conclusions suggested by the catch record analysis.

Market samples of Dover sole caught in the Local Area have been taken each year since 1948. These include length and sex of each fish, and otoliths from sub-samples within each sample. Thus we have available information as to the size and age composition of the catches as they are landed at the fillet plants. Unfortunately all the otoliths collected have not been read. The results to date are fragmentary at best and are not included in this report.

The size composition of the male Dover sole landed in Astoria from the Local Area, by year, is shown in the left-hand section of Figure 5. The polygons are quite similar in general outline. The mode occurs at about 38 cm and the range lies between 30 and 50 cm. The mean length is maximal at 41.21 cm in 1948; declines to 39.59 in 1952; and subsequently rises to 40.01 cm in 1954. These data have been grouped to the nearer even centimeter, and the 1949-54 polygons have been reduced to areas of 711 units to correspond with the number of male Dover sole sampled in 1948. These adjusted frequencies have been totalled and averaged for the seven-year period. The right-hand section of Figure 5 presents the deviations, for each 2 cm interval, of the annual length-frequencies, 1948-54, from the 7-year mean length-frequency.

Figure 5. Male Dover Sole



The resulting picture indicates the reduction of large males in the catches since 1950. This could also, of course, be interpreted as an absolute increase in numbers of small, hence young, fish entering the fishery during the last five years.

The female Dover sole length-frequencies were treated in the same manner and seem to present a more distinct pattern (Figure 6). The overall picture indicates a decrease (or increase) of larger (or smaller) fish, as was observed for the male Dover sole. In addition, however, a modal progression is evident which appears at the 34-42 cm interval in 1948 and reaches the 44-52 interval by 1954. This represents an increase of approximately 10 cm in 7 years, or 1.43 cm per year. Our tagging and otolith readings yield a similar growth rate for these fish. Presumably one or more dominant year-classes passed through the fishery during this period.

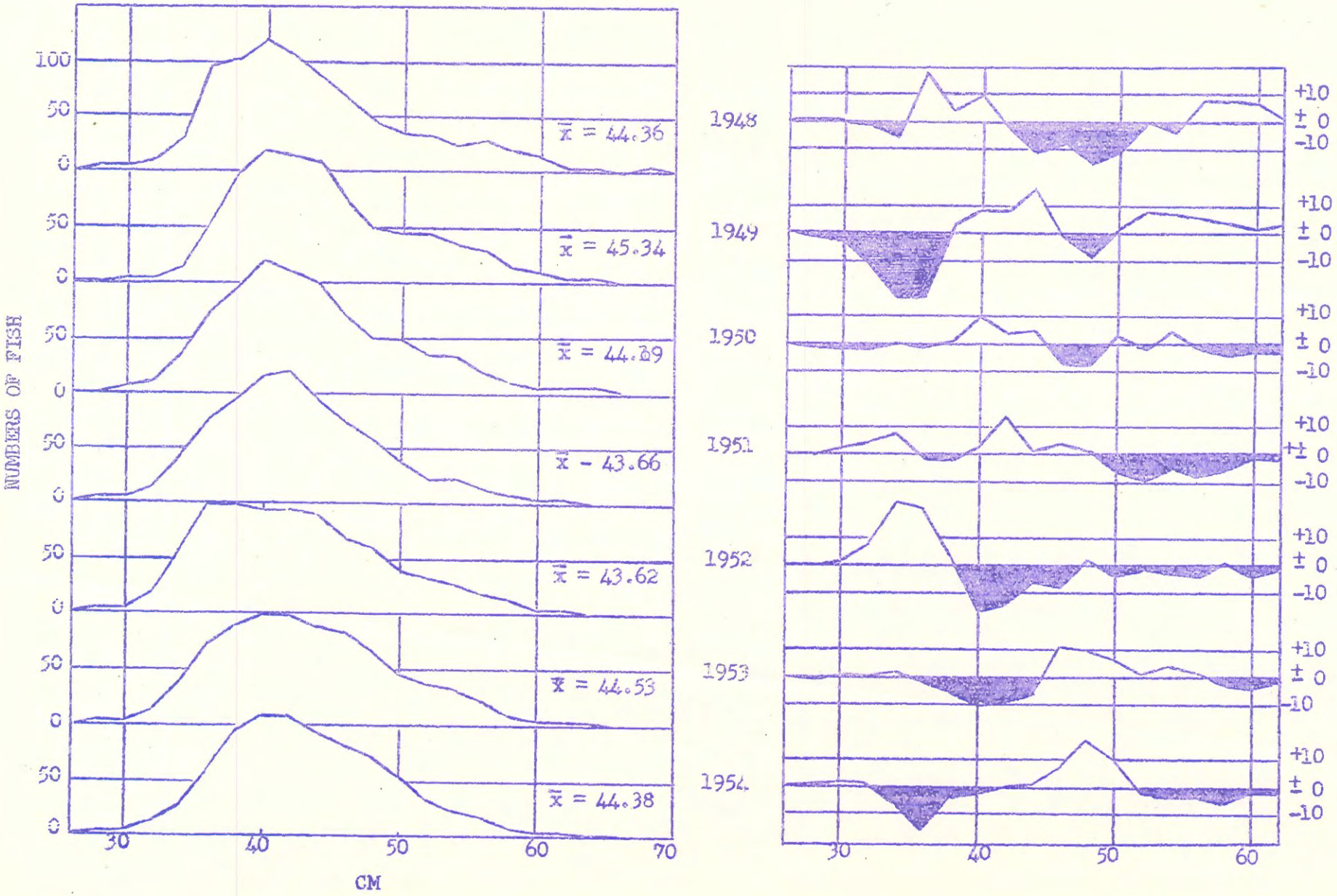
Fecundity--Pacific Ocean Perch

Calculations began for the fecundity of Pacific Ocean perch during the summer and now are nearly complete. These fish appear to produce 30,000 to 300,000 yolked eggs per female. Both age and size appear to be factors in the production. These fish are oviparous, but no attempt has been made to estimate the number of fry liberated per female.

Migration--Flounder

During the period September 6, 1951, through November 14, 1953, a fish trap was jointly operated on the lower Columbia River (first at Sand Island and then at Chinook, Washington) by the Washington State Department of Fisheries and the Fish Commission of Oregon. The purpose for operation was to tag upstream migrating salmon and steelhead in the Columbia

Figure 6. Female Dover Sole



River. Other species of fish such as shad, sturgeon, and flounder also entered the trap and were tagged as time permitted.

This section deals with the incidental flounders which were tagged during the aforementioned period. Preliminary compilation of data began during the summer of 1954, and terminated with the departure of the "summer help" for school in September.

Petersen-type plastic disks were attached on each side of the fish beneath the dorsal fin by means of nickel or stainless steel pins. The fish were measured to the nearest inch or half inch after tagging.

There were 1,844 flounder tagged and released during the period September 16, 1951 through November 14, 1953. This figure does not represent the total catch of flounder in the trap, nor was the trap operated continuously throughout the period.

We had records for 99 recovered tags (5.4% of total tagged) at this laboratory as of August 31, 1954. The general areas of tagging were categorized as "inside" and "outside" the Columbia River.

The Inside Area included all the Columbia River to the bar, but for practical purposes the upstream limit was approximately Knappa, Oregon, and the lower limit was the Ilwaco channel. We had 64 recoveries from this area and they were all caught by gill nets except one by hook and line. Curiously, only three tagged flounder were recovered from fish trap during its operation.

The Outside Area included all regions other than the Columbia River. We had 27 recoveries from this general region. There were 16 recoveries from the otter trawling grounds immediately off the mouth of the Columbia River. South of the Columbia River one fish was recovered off Gearhart; one in the Nehalem River; and one in the Yaquina River. North of the Columbia River one fish was recovered off Long Beach, Washington. Three

were recovered in Willapa Bay or its tributaries (see Table 8). One each was recovered from Grays Harbor, Quinnault River, and one off Umatilla Lightship.

All the ocean recoveries were made by otter trawl nets, and all bay and river recoveries were made by gill nets or hook and line.

These preliminary results indicate that the flounder may be a far-ranging fish.

/s/ Sigurd J. Westrheim
Walter G. Jones
Guy Moore
Ray Ward
Aquatic Biologists

Table 8. Distribution of Recovered Tagged Flounders in Outside Area

AREA	RECOVERIES
Off Columbia River	16
South of Columbia River	3
Off Gearhart	1
Nehalem River	1
Yaquina River	1
North of Columbia River	7
Off Long Beach	1
Willapa Bay	3
Bay	1
North River	1
Naselle River	1
Grays Harbor	1
Quinnault River	1
Off Umatilla Lightship	1
Unknown	1
TOTAL	27