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MARINE FISHERIES PROGRESS REPORT
November 1952 through April 1953

OTTER TRAWL INVESTIGATIONS:

INTRODUCTION

The bottomfish market was poor during the period November through April. Three plants were closed during part or all of this time. Limited markets were available for red and black rockfish and some sole. There was no appreciable market for Pacific Ocean Perch such as in 1952 at this time.

Extra-curricular activities during this period included the public progress report to the industry by the marine fisheries division in January; Fish Commission public hearing on otter trawl mesh regulation in February; Pacific Fisheries Biologists meeting in March; and the research division staff meeting in April.

RESEARCH ACTIVITIES

Research activities other than preparation for some of the above-mentioned activities can be categorized as field work and analysis.

Field work included maintenance work on the otter trawl statistical system; monthly trips (except January) to Newport for a try-net trip on Yaquina Bay, and limited sampling of Pacific Ocean Perch landings to collect ovaries for fecundity studies.

Analytical work included the following items which will be discussed individually:

1. Landing Records
2. Statistical Analysis of 1952 Market Sampling Technique
3. Otolith Reading - Dover Sole
4. Dover Sole Market Sample Length-Frequencies, 1948-52, incl.
5. Early Life History Studies--English Sole
6. Scale Readings--Pacific Ocean Perch

1. Landing Records

The IBM sheets for the 1951 fiscal year (April 1951 through March 1952) were received in October of 1952. The gross summarization of the otter trawl landings for dover, english, and petrale sole together with the landings of dover sole by area of catch were completed in November.

The landing records for Newport for the period 1942-51, incl., for dover, english, and petrale soles were completed, without a recheck, in time for presentation at the public progress report in January. The rockfish landings at Newport for the period 1942-49, incl., were also completed, but not presented.

The landing records and calculations have now been rechecked for the period 1942-47, incl., and 1951. In conjunction with the recheck, the analysis procedures have been simplified. The "linkage" and size limitations on boats have been abandoned. Significant landings are now defined only by the percentage composition of the catch; that is, any landing containing more than 29 percent of one (or more) species is considered a trip principally directed at that (or those) species.

Dover Sole--Astoria (Table 1)

The dover sole landings at Astoria reached a peak in 1943 at 6.3 million pounds. After a sharp drop to 1.3 million pounds in 1944 (due to competition with tuna and rockfish for the fleet's energies) the annual production fluctuated around 2.0 million pounds until 1950. In 1950 and 1951 a sharp rise in demand brought the annual catch to 4.7 million pounds in both years. The bulk of the Astoria landings have come from the grounds off the mouth at the Columbia River, i.e., Tillamook Rock to Willapa Bay.

Table 1. Summary of Catch Analysis for <u>Dover Sole</u> -- Astoria

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	2,308,508	2,189,287	1,952,547	1,895,930	121	15,669
1943	6,431,666	6,587,312	6,453,248	6,315,720	354	17,841
1944	1,593,469	1,318,179	1,125,368	998,520	77	12,968
1945	2,704,216	2,570,845	2,110,334	2,033,113	109	13,652
1946	3,197,988	2,979,687	2,963,328	2,856,539	231	12,366
1947	2,031,905	1,606,587	1,477,335	1,390,936	116	11,991
1948	2,808,264	<u>2,628,548</u>	<u>2,347,823</u>	<u>2,145,394</u>**	<u>159</u>**	<u>13,493</u>**
1949	3,003,574	<u>2,457,719</u>	<u>2,252,050</u>	<u>2,135,734</u>**	<u>156</u>**	<u>13,691</u>**
1950	6,348,251	<u>4,695,667</u>	<u>4,581,416</u>	<u>4,447,810</u>	<u>319</u>	<u>13,943</u>
1951	8,227,444	4,691,128	4,282,028	4,036,716	337	11,978

Note. The underlined figures have not been rechecked for accuracy yet.

* In pounds.

** These figures are based on the old-type "significant" landings (see text).

The fishing effort, as measured by the number of significant landings, followed the same pattern as the catch. During the peak year of 1943 there were 354 significant dover sole landings in Astoria (Apr-Sep). The secondary peaks in 1950 and 1951 were 319 and 337 landings, respectively. It should be noted here, however, that the 6 percent increase in effort in 1951 over 1950 actually yielded 9 percent less pounds (significant landings).

The relative abundance, as measured by the average pounds per significant landing, followed a somewhat different pattern. The peak abundance (17,841 lbs./landing) was in 1943, but a secondary peak (13,943 lbs./landing) occurred in 1950. In 1951 there was a sharp drop (14 percent) in the relative abundance to a level comparable with that of 1947. The overall drop from 1943 to 1951 is approximately 33 percent. However, if the pronounced increase in efficiency of gear and fishermen is to be considered, this decrease is very probably in the magnitude of 70 percent.

If these data are reasonably reliable, it appears that the fishery may have driven the local stock of dover sole below the point of inflection on the sigmoid population curve. The extension of the fleet's activities away from the local dover sole grounds during the 1952 season lends some credence to this speculation.

English Sole--Astoria (Table 2)

The english sole fishery, unlike that of the dover sole, has had a considerable geographic range of operation at least since 1943. English sole are commonly fished off Cape Lookout (Oregon) to the south and off Destruction Island (Washington) to the north, in addition to the local grounds between Tillamook Rock and Grays Harbor. Since our tagging records indicate that fish in these three areas do not intermingle freely, it would be necessary to differentiate the landings by area. This was not possible prior to April of 1951 so that an analysis of the english sole landings is considerably handicapped at this time.

Table 2. Summary of Catch Analysis for *English Sole* -- Astoria.

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	227,793	181,126	115,568	6,557	5	1,311
1943	898,639	665,331	397,828	105,595	20	5,280
1944	1,057,701	766,236	512,430	150,620	52	2,897
1945	1,096,601	726,314	444,398	204,169	32	6,380
1946	3,950,609	2,956,058	2,741,610	2,127,256	300	7,091
1947	1,333,438	1,338,543	1,104,912	839,362	104	8,071
1948	3,320,869	2,227,152	1,955,812	1,443,999**	138**	10,464**
1949	1,092,493	757,940	598,678	390,486**	37**	10,554**
1950	2,420,639	1,918,975	1,686,000	967,478*	106*	9,127*
1951	2,420,333	2,032,214	1,459,207	396,710	102	8,791

Note. The underlined figures have not been rechecked for accuracy yet.

* In pounds.

** These figures are based on the old-type "significant" landings (see text).

A second serious limitation is the economic situation. English sole were apparently not in any appreciable demand until 1946 when 300 significant landings were made totaling 2.1 million pounds. Since 1946 the general trend has been downward. After 1948, the annual significant landings never reached 1.0 million pounds.

No analysis has been attempted at this time in view of these limitations.

Petrale Sole--Astoria (Table 3)

The petrale sole records suffer from similar limitations as those found for the english sole, viz., wide geographical range of the fishery.

This fishery is the oldest in the state and began about 1936. The fishery was operating steadily before 1942. Unfortunately the Fish Commission records only began in June 1941.

The petrale sole are the most valuable sole to the fishermen but this has, in general, appeared to limit the production somewhat.

No analysis has been included due to the aforementioned difficulties.

Rockfish--Astoria (Table 4)

The rockfish landings include at least four principal species which can only partially be differentiated in the landings. The figures were included more or less to indicate the potential rockfish production if the markets were available. The peak year (1945) saw some 17 million pounds landed in Oregon of which 11 million pounds were landed in Astoria. After July of 1945 the market collapsed and has never been strong since that time. There have been catch limits, imposed by the fillet plants, almost continuously since 1945.

Table 3. Summary of Catch Analysis for Petrale Sole -- Astoria.

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	3,745,236	2,319,758	1,942,637	1,730,117	216	8,010
1943	3,805,094	1,693,983	1,372,680	798,737	95	8,408
1944	2,019,162	1,278,244	1,190,498	610,932	97	6,298
1945	1,574,143	905,428	736,916	316,140	57	5,546
1946	2,934,093	1,694,604	1,607,820	952,690	236	4,037
1947	1,443,936	957,082	782,952	527,752	111	4,755
1948	2,658,550	1,452,869	1,287,692	813,133**	124**	6,558**
1949	1,514,762	863,615	681,384	367,380**	68**	5,403**
1950	3,175,310	1,871,434	1,690,289	1,175,243	174	6,754
1951	2,052,366	1,037,466	744,845	291,983	55	5,309

Note. The underlined figures have not been rechecked for accuracy yet.

* In pounds.

** These figures are based on the old-type "significant" landings (see text).

Table 4. Summary of Catch Analysis for Rockfish -- Astoria.

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Jan-Dec)	TOTAL ASTORIA LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS "SIGNIFICANT LANDING (Apr-Sep)
1942	1,898,438	1,531,014	1,132,506	709,502	112	6,335
1943	6,923,325	5,291,463	2,844,666	2,286,969	168	13,613
1944	11,367,169	6,945,218	4,654,390	4,643,444	358	12,971
1945	17,458,309	10,620,291	8,742,231	8,565,175	412	20,789
1946	10,867,187	5,074,179	3,389,684	2,929,818	299	9,799
1947	6,799,941	4,561,144	2,900,381	2,690,665	222	12,120
1948	4,658,388					
1949	4,737,478					

* In pounds.

Dover Sole--Newport (Table 5.)

The dover sole landings at Newport were negligible until 1950. Prior to that time the greatest annual landing was 174,000 pounds in 1949. In 1950 the total significant pounds landed was 1.2 million pounds and this was more than doubled to 2.7 million pounds in 1951.

This sudden rise was apparently due to improved market conditions since the fishermen report that no new grounds were discovered.

English Sole--Newport (Table 6)

The english sole fishery is completely negligible at Newport. The greatest annual landing was only 456,000 pounds (1946) during the 1942-51 period.

Petrale Sole--Newport (Table 7)

The earliest sustained Oregon otter trawl fishery began in 1936 or 1937 on the petrale sole in the Newport area. There is no record of these landings prior to June 1941.

The landings since 1942 have exceeded 1.0 million pounds in 1942, 1943, and 1950.

The catch per landing as a measure of abundance is of limited value since during the early years many of the boats fished on a one-day trip basis whereas at the present time the trips usually last three days. It is not possible to differentiate the "day-trips" from the "multiple-day trips".

Rockfish--Newport (Table 8)

The rockfish landings for Newport follow the same pattern as that of the Astoria landings. The peak in 1945 is 2.9 million pounds. Subsequent to 1946 the total annual landings have always been less than 1.0 million pounds.

Table 5. Summary of Catch Analysis for Dover Sole -- Newport.

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	2,308,508	77,067	76,489	---	-	-
1943	6,431,666	8,610	8,610	3,766	3	1,255
1944	1,593,469	59,104	59,104	38,664	9	4,296
1945	2,704,216	12,519	7,965	2,090	2	1,045
1946	3,197,988	33,911	33,374	13,083	3	4,361
1947	2,031,905	---	---	---	-	-
1948	2,808,264	22,628	22,628	6,312	1	6,312
1949	3,003,574	173,689	168,519	142,105	22	6,459
1950	6,348,251	1,333,316	1,316,298	1,232,069**	84**	14,667**
1951	8,227,444	2,901,213	2,880,200	2,724,797**	141**	19,325**

* In pounds.

** New-type "significant" landings (see text)

Table 6. Summary of Catch Analysis for <u>English Sole</u> -- Newport.

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	227,793	40,413	20,639	2,342	4	586
1943	898,639	66,734	20,737	218	1	218
1944	1,057,701	61,620	23,994	2,802	6	467
1945	1,096,601	99,081	5,259	-	-	-
1946	3,950,609	455,952	228,169	133,286	37	3,602
1947	1,883,438	239,732	48,935	32,580	20	1,629
1948	3,320,869	366,661	235,304	174,009	43	4,047
1949	1,092,493	135,086	46,558	12,447	7	1,778
1950	2,420,639	369,629	309,631	112,739**	39**	2,891**
1951	2,420,333	207,939	175,440	85,466**	33**	2,590**

* In pounds

** New-type "significant" landings (see text)

Table 7. Summary of Catch Analysis for <u>Petrale Sole</u> -- Newport

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	3,745,236	1,300,418	1,264,845	1,177,208	196	6,006
1943	3,305,094	1,191,640	1,161,240	825,059	199	4,141
1944	2,019,162	398,832	389,371	241,139	40	6,028
1945	1,574,143	149,921	131,253	12,214	4	3,054
1946	2,984,093	364,993	265,608	63,635	38	1,675
1947	1,443,936	275,760	240,960	168,545	43	3,920
1948	2,658,550	679,564	622,387	449,131	76	5,910
1949	1,514,762	493,487	438,653	403,520	71	5,683
1950	3,175,310	1,104,584	1,055,236	908,546**	123**	7,387**
1951	2,052,366	804,275	760,946	591,277**	78**	7,580**

* In pounds

**New-type "significant" landings (see text)

Table 8. Summary of Catch Analysis for Rockfish -- Newport

YEAR	TOTAL OREGON LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Jan-Dec)	TOTAL NEWPORT LANDINGS* (Apr-Sep)	TOTAL "SIGNIFICANT" LANDINGS* (Apr-Sep)	NO. OF "SIGNIFICANT" LANDINGS (Apr-Sep)	POUNDS PER "SIGNIFICANT" LANDING (Apr-Sep)
1942	1,898,488	107,063	82,099	17,502	11	1,591
1943	6,923,325	495,106	435,247	202,939	51	3,979
1944	11,367,169	2,528,729	2,432,268	1,810,464	231	7,838
1945	17,458,309	2,852,290	2,666,685	1,674,875	126	13,293
1946	10,867,187	1,801,940	1,396,923	959,629	117	8,202
1947	6,799,941	818,101	639,181	598,389	34	17,600
1948	4,658,388	302,929	239,222	191,675	30	6,389
1949	4,737,478	273,513	198,029	136,062	22	6,185

* In pounds.

2. Statistical Analysis of the 1952 Market Sampling Technique

The market sampling procedures have gradually changed since their inception in 1948. Originally samples of 100 fish or less were taken out of the fish bins at the various fillet plants. Each fish was measured to the nearest one-half centimeter and the sex was recorded. The left otolith was removed from each of the first 20 fish encountered in the sample.

During the middle of the 1949 season, the sample size was increased to 200 fish.

In 1951 the sample size was increased to 400 fish, and the otolith sub-sample was increased to 55 fish. The samples were still taken from the fish bins.

In 1952 the sampling technique was altered once more. The samples were taken, for the most part, from a fish cart instead of from the fish bins.

The fish are discharged from the boat into steel fish carts (inside diameter of box = 17" deep x 35" wide x 54" long) which have a capacity of 600-1,000 pounds of fish. These carts are used to transport the fish to the scales for weighing and thence either to the fish bins for icing or directly to the elevator which takes the fish to the fillet line.

It was felt that by taking a cartful and measuring all the fish in the cart, a more objective sample could be taken. Bias for or against any size of fish by the sampler would then be eliminated for the entire sample, if not for the otolith sample.

The following analysis was undertaken in order to answer, if possible, the following questions:

1. Is the otolith sub-sample representative of the total sample, by sex, by length?.

2. Would a more representative sub-sample of otoliths, by sex, by length, be obtained by removing the otolith from every 10th fish throughout the sample, instead of from the first 55 fish encountered?

3. Is there a digit bias for or against the half-centimeter measurements?

Materials

The materials available for these tests include the following:

1. All the market samples of dover sole taken in Astoria during the 1952 season, by length, sex, and date. In addition, for each individual sample, the length and sex of each fish was recorded in the order in which the fish appeared in the sample.

2. The first 55 fish in each sample provided the Regular Otolith Sample.

3. Theoretical Otolith Sample was constructed by selecting every 10th fish throughout each Total Sample.

Table 9 presents the summarized material by date, by sex, by type of sample, by method of sampling.

Representativeness of Otolith Sub-Samples, by Sex

The answers to the portions of questions (1) and (2) which apply to the sex ratio were obtained by use of the Chi-Square statistic. The sex ratio (expressed as the percent males) found in each total sample was taken to be the parameter of that population, and the sex ratios in the corresponding Regular and Theoretical Otolith Sub-Samples were tested against these parameters.

The results are presented in Table 10.

Table 9. Summary of the 1952 Dover Sole Market Samples, by Sex, males (M, m, or m') and females (F, f, or f'), by Date, by Method of Sampling (M/S).

DATE		REGULAR MARKET SAMPLE				REGULAR OTOLITH SAMPLE			THEORETICAL OTOLITH SAMPLE			
		M	F	T	M/T	m	f	t	m'	f'	t'	M/S
June	17	141	288	429	0.328671	27	28	55	13	29	42	Cart
	18	284	279	563	0.504440	21	34	55	24	32	56	Cart
	26	111	210	321	0.345794	17	38	55	9	23	32	Cart
	27	265	293	558	0.474910	29	26	55	25	30	55	Cart
	30	129	310	439	0.293850	16	38	54	13	30	43	Bin
	T	930	1380	2310	0.402597	110	164	274	84	144	228	
July	2	214	174	388	0.551546	25	30	55	22	16	38	Cart
	3	159	204	363	0.438017	21	34	55	16	20	36	Cart
	11	179	195	374	0.478610	29	26	55	19	18	37	Cart
	14	180	220	400	0.450000	25	30	55	20	20	40	Bin
	22	386	245	631	0.611727	31	24	55	39	24	63	Cart
	30	195	214	409	0!476773	25	30	55	17	23	40	Cart
	T	1313	1252	2565	0!511891	156	174	330	133	121	254	
Aug	6	97	216	313	0.309904	13	42	55	7	24	31	Cart
	(6)	(32)	(94)	(126)	(0.253968)	-	-	-	-	-	-	1/2 Cart
	11	173	237	410	0.421951	22	33	55	17	24	41	Bin
	12	224	418	642	0.348910	24	31	55	21	43	64	Cart
	13	111	326	437	0.254005	13	42	55	8	35	43	Cart
	15	237	220	457	0.518600	33	22	55	21	24	45	Cart
	20	230	223	453	0.507726	27	28	55	25	20	45	Cart
	22	278	122	400	0.695000	40	15	55	30	10	40	Bin
	29	136	251	387	0.351421	22	33	55	14	24	38	Cart
	T	1486	2013	3499	0.424693	194	246	440	143	204	347	
Sept	8	107	270	377	0.283820	12	43	55	8	29	37	Cart
	24	209	193	402	0.519900	24	31	55	15	25	40	Bin
	T	316	463	779	0.404365	36	74	110	23	54	77	
Oct	9	94	270	364	0.258242	9	46	55	5	31	36	Cart
TOTAL		4139	5378	9517	0.434906	505	704	1209	388	554	942	

Table 10. Chi-Square Test of the Sex Ratios (Expressed as Males per Total Fish) Found in the Regular and Theoretical Otolith Samples, Using the Sex Ratio in the Total Sample as the Parameter, by Date, for the 1952 Dover Sole Market Samples.

	REGULAR OTOLITH SAMPLE			THEORETICAL OTOLITH SAMPLE		
	Chi-Square*	Df**	P***	Chi-Square*	Df**	P***
June 17	6.789	1	<0.01	0.070	1	>0.70
18	3.303	1	>0.05	1.290	1	>0.20
26	0.328	1	>0.50	0.589	1	>0.30
27	0.605	1	>0.30	0.091	1	>0.70
30	0.002	1	>0.95	0.015	1	>0.90
T	0.001	1	0.93	1.107	1	>0.20
July 2	2.092	1	>0.10	0.115	1	>0.70
3	0.706	1	>0.30	0.006	1	>0.90
11	0.522	1	>0.30	0.181	1	>0.50
14	0.005	1	>0.90	0.404	1	>0.50
22	0.536	1	>0.30	0.014	1	>0.90
30	0.109	1	>0.70	0.430	1	>0.50
T	2.026	1	>0.10	0.140	1	>0.70
Aug 6	1.391	1	>0.20	1.025	1	>0.30
11	0.109	1	>0.70	0.009	1	>0.90
12	1.852	1	>0.10	0.122	1	>0.70
13	0.090	1	>0;70	1.043	1	>0.30
15	1.460	1	>0.20	0.468	1	>0.30
20	0.062	1	>0.80	0.412	1	>0.50
22	0.270	1	>0.50	0.571	1	>0.30
29	0.570	1	>0.30	0.048	1	>0.80
T	0.474	1	>0.30	0.225	1	>0.50
Sept 8	1.166	1	>0.20	0.832	1	>0.30
24	1.533	1	>0.20	3.365	1	>0.05
T	2.714	1	>0.05	3.569	1	>0.05
Oct 9	2.570	1	>0.10	2.678	1	>0.10
TOTAL	1.456	1	>0.20	2.030	1	>0.10

* Chi-Square = $\frac{(M - m)^2}{m} + \frac{(M - m)^2}{f}$, where M = Observed No. of males
m = Expected No. of males
f = Expected No. females

** Df = Degrees of Freedom

*** P = The probability that a larger value for Chi-Square would occur due to chance alone.

For the Regular Otolith Samples, only one had a Chi-Square value sufficiently high that the probability was less than 0.01 that a greater value would occur due to chance alone. Also only one other sample had a Chi-Square probability of less than 0.10. The probability for the combined samples was greater than 0.20.

For the Theoretical Otolith Sample the results are somewhat better in some cases and poorer in others. However, there were no cases in which the probability was less than 0.05, and only two cases in which the probability was less than 0.10. The overall probability, for combined samples for the year, was greater than 0.10.

These results have been interpreted to indicate that the sex ratio in each Regular Otolith Sample does not significantly depart from that in the corresponding total sample from which it was taken. There appears to be little advantage in changing the method of selecting the otoliths, from the standpoint of the sex ratio.

Representativeness of Otolith Sub-Samples, by Size of Fish

The answers to the second portion of questions (1) and (2) were also obtained by means of Chi-Square. In this case the sex was ignored and the combined length-frequencies, by month and season, for the Total Samples were taken to be populations from which two types of sub-samples, i.e., Regular and Theoretical Otolith Samples, were drawn. Each of the two sub-samples were tested against the common parent Total Sample.

The results, as shown in Table 11, indicate that the Regular Otolith Sample length-frequency did not differ significantly from the Total Sample length-frequency. The Theoretical Otolith Sample also proved to be a representative sample of the population, although the Chi-Square values tended to be larger than those of the Regular Otolith Sample. The probabilities of chance occurrence of higher values of Chi-Square were, of course, also lower.

As a check on the sensitivity of the Chi-Square test applied to these length-frequency data, monthly and annual length-frequency distributions of the Regular Otolith Sample together with the annual length-frequency distribution of the Theoretical Otolith Sample were shifted one or two centimeters to the left and right of their original positions. The Chi-Square values were then re-calculated after each of these shifts. The results are included in Table 11.

With the exception of the September-October sample, a shift of ± 1 centimeter was sufficient to increase Chi-Square to a significant size. That is, the probability that such values would occur due to chance alone was at least less than 0.05 and in all but one case less than 0.01.

It was concluded that the Chi-Square test was sufficiently sensitive for application in this case. Furthermore, the Regular Otolith Samples were considered representative, with respect to size of fish, of their respective Total Samples. The Theoretical Otolith Samples were somewhat less representative of the Total Samples, but not significantly so.

A second method used was to study the relationship of the Regular Otolith Sample to the Total Sample within individual samples rather than from grouped data. In these individual samples, graphical and statistical tests were applied.

The graphical method consisted of plotting, for each individual sample, the deviations, in centimeter, of the mean length of each successive sub-sample of 50 fish, disregarding sex, from the mean length calculated from all the sub-samples. (Figure 1)

Table 11. Chi-Square Test of the Length-Frequency Distributions of the Regular and Theoretical Otolith Samples (disregarding sex), Using the Lenth-Frequency Distribution of the Total Sample as the Parameter, by Month, for the 1952 Dover Sole Market Samples

		REGULAR OTOLITH SAMPLE			THEORETICAL OTOLITH SAMPLE		
MONTH	D*	Chi-Square**	Df***	P****	Chi-Square**	Df***	P****
	+1	42.369	20	<0.01			
June	0	22.102	20	>0.30	18.931	17	>0.30
	-1	47.652	20	<0.01			
	+1	41.442	18	<0.01			
July	0	17.886	18	>0.30	24.180	17	>0.10
	-1	62.054	18	<0.01			
	+1	33.674	17	0.02-0.01			
August	0	9.074	17	>0.95	13.804	17	>0.50
	-1	50.900	17	<0.01			
	+1	38.424	16	<0.01			
Sep-Oct	0	18.593	16	>0.20	12.684	9	>0.10
	-1	17.829	16	>0.30			
	-2	28.352	16	0.05-0.02			
	+1	86.344	26	<0.01	66.972	27	<0.01
TOTAL	0	22.416	26	>0.50	29.142	27	>0.30
	-1	93.353	26	<0.01	117.792	27	<0.01

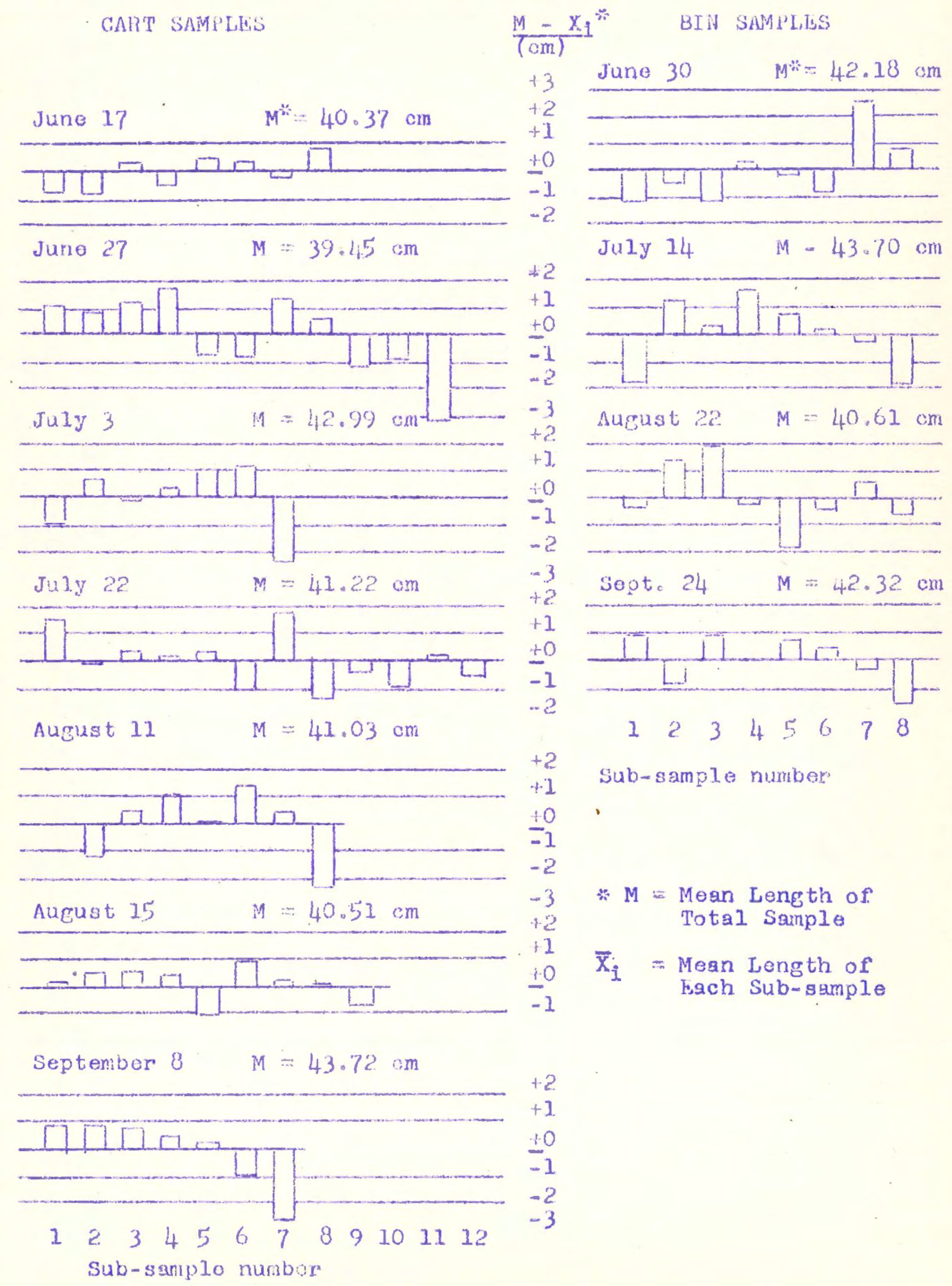
* Displacement, in centimeters, of the length-frequency distribution of the otolith sample

** Chi-Square = $\frac{(F - f)^2}{f}$, where F = Observed frequency. f = Expected frequency.

*** Df = Degrees of Freedom

**** P = The probability that a larger value for Chi-Square would occur due to chance alone.

Figure 1. DOVER SOLE - 1952



A third attack on question (2) was made with the purpose of determining if there were stratification or sampler bias which would cause the first 55 fish to be non-representative of the total sample. In other words, are the fish stratified by size in a fish bin or cart, or is the sampler prone to select larger or smaller fish among the first 55 from which otoliths are taken?

Graphical and statistical tests were applied to selected samples in order to detect these potential aberrations in the sampling technique.

For each of 11 selected samples, the mean length, disregarding sex, was computed for each successive group of 50 fish in the sample, together with the mean length of the fish in all the sub-samples. The deviations of the sub-sample means from their respective population means were plotted for each of these samples (Figure 1).

The first group of seven samples selected by chance included no bin samples. Therefore a second group of four samples was selected which consisted of only bin samples for comparison with the original group of seven cart samples.

For the cart samples the smaller fish appear at the end of the sample, i.e., at the bottom of the cart. This is evident from the fact that in all cases but one the mean length of the last sub-sample of 50 fish exhibits negative deviation from the overall mean. The most marked change in size throughout the sample occurs in the September 8 cart sample. This could have been caused by stratification of the fish or the sampler's bias in selecting larger fish first. Unfortunately these two factors are not separable.

Considering sub-sample 1 which contains 50 of the 55 otoliths, in each of these samples the deviations from the total mean appear to be more frequently positive than negative (4 are positive, 2 negative, and 1 zero). However, the deviations are less than one centimeter in five of the seven cases. A one-centimeter deviation of 50 fish with a range in size of some 25 centimeters is probably not significant.

For the bin samples the smaller fish also appear at the end of the sample, in three of the four samples. A similar trend is apparent to that found in the cart samples.

The first sub-sample in each of the bin samples appears to have an opposite deviation from the total mean to that exhibited in the cart samples. In this case three of the four have negative deviations.

It would appear that the otolith sub-sample contains somewhat larger fish than the total sample when the sample is taken from a fish cart, and that the reverse is true when the sample is taken from a fish bin. The presence of more small fish at the bottom of a fish cart could be explained by sampler's bias, but this same phenomenon also appears in the bin samples. Since, in a bin sample, only 400 fish are removed from a volume containing many thousands of fish, it is improbable that the small ones could have been left to the last. Generally the hole formed in a bin of fish by the sampling tends to refill itself due to the slipperiness of the fish, so that there is a constant influx of new fish into the sampling area.

These same data were further tested statistically by means of the analysis of variance. The results are summarized in Table 12. Only one F value (June 27) was significant at the 1 percent level, but six were significant at the 5 percent level. The heterogeneity of the June 27 sub-samples was probably due to the large (greater than -3 cm) negative deviation in the last sub-sample. The large number of near significant (0.05<P>0.01) F values indicate that these sub-samples are probably on the borderline of heterogeneity.

Table 12. Results of the Analysis of Variance of the size Distribution in Consecutive Sub-Samples of 50 fish each, Within Each of 11 Selected Market Samples of Dover Sole Taken During 1952.

DATE	F	F*	
		0.05	0.01
Cart:			
June 17	1.356	3.24	5.67
June 27	<u>3.424</u>	1.85	2.37
July 3	2.448*	2.12	2.85
July 22	1.874*	1.81	2.29
August 11	2.164*	2.03	2.69
August 15	1.097	2.94	4.88
Sept. 8	2.559*	2.12	2.85
Bin:			
June 30	1.737	2.03	2.69
July 14	2.162*	2.03	2.69
August 22	2.467*	2.03	2.69
Sept. 24	1.244	2.03	2.69

Note. The underlined value for F indicates a probability of less than 0.01 that such a value of F would occur due to chance alone.

The asterisked values for F indicate a probability of less than 0.05 but greater than 0.01 that such a value of F would occur due to chance alone.

A "t" test was made of the deviation ($m - \bar{X}_1$) between the population mean length and the mean length in sub-sample one, for each of the eleven samples (Table 13).

One cart sub-sample (July 22) with a deviation of +1.475 cm had a "t" value whose probability of chance occurrence lay between 0.05 and 0.01. The six other cart sub-samples had non-significant deviations (0.021 - 1.055 cm). One bin sub-sample (July 14) with a deviation of -1.751 cm, had a "t" value whose probability of chance occurrence was less than 0.01. The other three sub-samples had non-significant deviations (0.380 - 1.089 cm).

The results of the "t" test indicate that the deviation ($m - \bar{X}_1$) of the sub-sample mean length from the population mean length are significant when those deviations approximate $\pm$ 1.5 cm. This large a deviation was observed in only 2 of the 11 samples tested.

The results of the graphical and statistical analyses indicate that there may be stratification or sampler bias which has caused the smaller fish to predominate in the later portions of each sample. It is not possible, however, to differentiate the effects of these two factors.

There appears to be little adverse effect upon the representativeness of the Regular Otolith Sample due to this stratification or sampler bias.

<u>Digit Bias</u>

All Dover, english, and petrale soles in the market samples have been measured to the nearest one-half centimeter. The question has often arisen whether there may be a digit bias against the half-centimeter measurement.

Table 13. A "t" test of the Deviation Between the Mean Length ($\overline{X}_1$) in Sub-sample One and the Mean Length (m) in the Total Sample, for 11 Selected Market Samples of Dover Sole Taken in 1952, by Method of Sampling, by Date.

DATE	$(m - \overline{X}_1)$	"t"	Df	P
<u>Cart:</u>				
June 17	0.738	1.005	48	0.05
June 27	1.055	1.156	48	0.05
July 3	0.903	1.096	48	0.05
July 22	1.475	2.031	48	0.05-0.01
August 11	0.021	0.027	48	0.05
August 15	0.168	0.302	48	0.05
Sept 8	0.871	1.225	48	0.05
<u>Bin:</u>				
June 30	1.039	1.228	48	0.05
July 14	1.751	2.736	48	0.01
August 22	0.330	0.458	48	0.05
Sept 24	0.866	1.029	48	0.05

A Chi-Square test was applied to the assembled data of the seven selected samples taken from fish carts (Table 14). The number of half (H) and whole (W) centimeter measurements, disregarding sex and size, in each successive sub-sample of 50 fish, and for the total sample, were tested by Chi-Square. The null hypothesis was that the ratio H:W was not 1:1.

The results indicate that there is a digit bias against the half centimeter, and further that it might be greater during the later portion of the season than at the beginning.

As a result of this analysis, the measurement method will be changed in the 1953 season and hereafter all sole will be measured to the nearest lower centimeter.

3. Otolith Reading--Dover Sole, 1948 and 1952

During the summer season of 1952 most of the Dover sole otoliths were read once while fresh. During the winter of 1952-53 the readings were completed on the 1952 otoliths. Each otolith was read at least twice. If there was no agreement between these two readings, a third reading was made to compromise the difference. Complications arose which made it necessary to discard the otolith samples (3) taken in September and October.

The 1948 otoliths had been read by a different reader during the winter of 1948-49.

Figure 2 presents the age composition, including both sexes, obtained in 1948 and 1952 for the period June through August. Superficially it would appear that the Dover sole must be more abundant in 1952 than in 1948, since age-classes 8, 9, 10, and 11 are so prominent in the 1952 catches, and not so in the 1948 catches. However, Figure 3 indicates that there were more large fish in the 1948 sample

Table 14. Numbers of Half (H) and Whole (W) Centimeter Measurements Occurring in Consecutive Sub-Samples of 50 Fish, in Each of Seven Selected Dover Sole Market Samples, Together with the Probability of the Chance Occurrence of the Observed Number of Half-Centimeter Measurements as Determined by Chi-Square (H_0:H:W$\neq$1:1).

SUB-SAMPLE NUMBER	DATE (1952) 6/17		6/27		7/3		7/22		8/11		8/15		9/8	
1	25	25	18*	32	19	31	19	31	<u>9</u>	41	16*	34	19	31
2	23	27	29	21	26	24	29	21	19	31	<u>14</u>	36	<u>14</u>	36
3	24	26	21	29	24	26	20	30	25	25	18*	32	19	31
4	23	27	19	31	27	23	21	29	<u>15</u>	35	20	30	<u>12</u>	38
5	24	26	19	31	18*	32	18*	32	<u>16</u>	34	19	31	<u>12</u>	38
6	20	30	18*	32	21	29	22	28	18*	32	<u>13</u>	37	22	28
7	21	29	19	31	24	26	22	28	<u>12</u>	38	26	24	<u>15</u>	35
8	24	26	18*	32	--	--	19	31	17*	33	16*	34	--	--
9	--	--	31	19	--	--	21	29	--	--	21	29	--	--
10	--	--	30	20	--	--	23	27	--	--	--	--	--	--
11	--	--	20	30	--	--	22	28	--	--	--	--	--	--
12	--	--	--	--	--	--	22	28	--	--	--	--	--	--
TOTALS	184	216	<u>242</u>	308	159	191	<u>258</u>	342	<u>131</u>	269	<u>163</u>	237	<u>113</u>	237

Note. The underlined values for H indicate a probability of less than 0.01 that such a value of H would occur due to chance alone.

The asterisked values for H indicate a probability of less than 0.05 but greater than 0.01 that such a value of H would occur due to chance alone.

All unmarked values for H indicate a probability of greater than 0.05 that such values would occur due to chance alone.

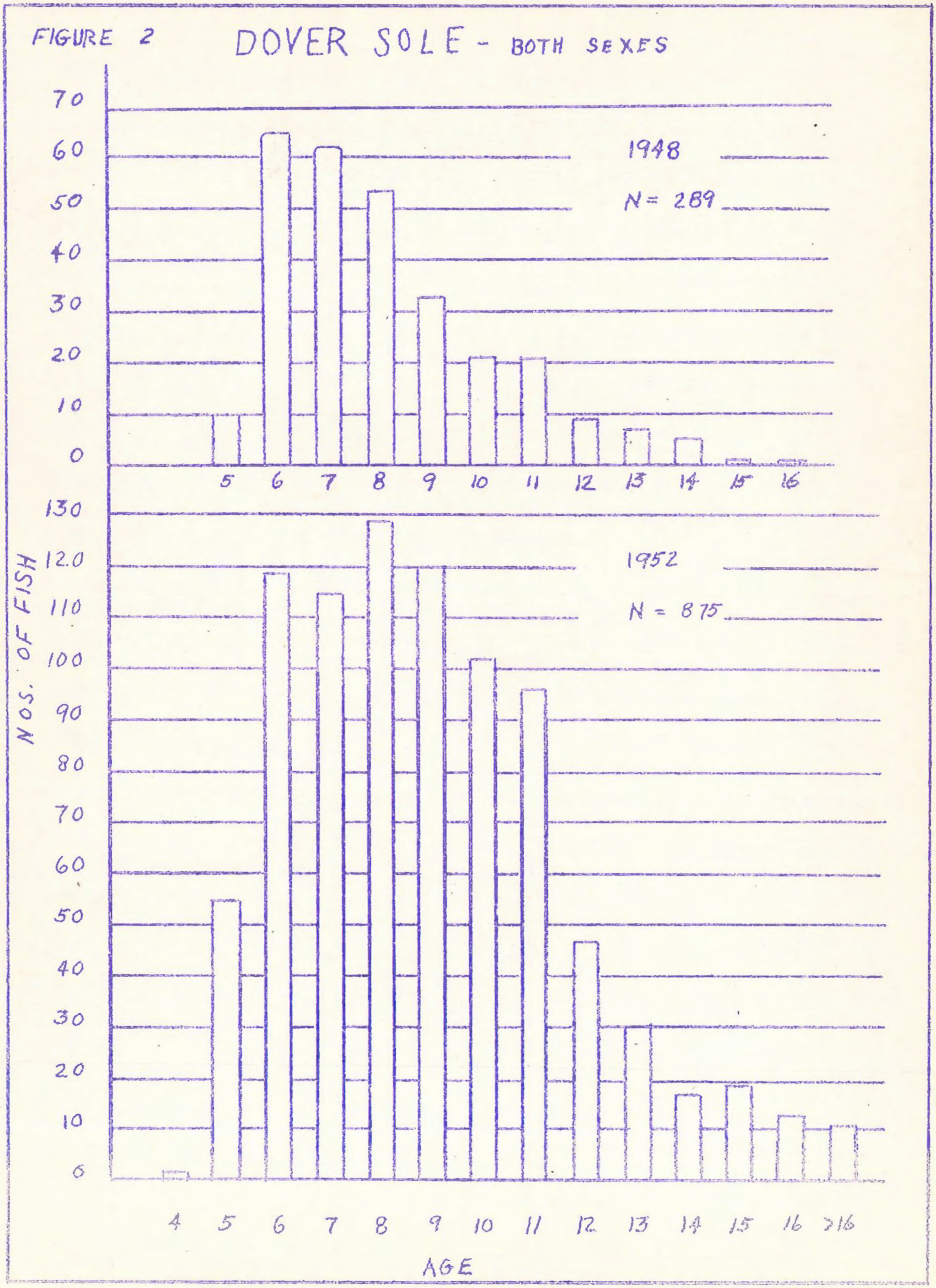
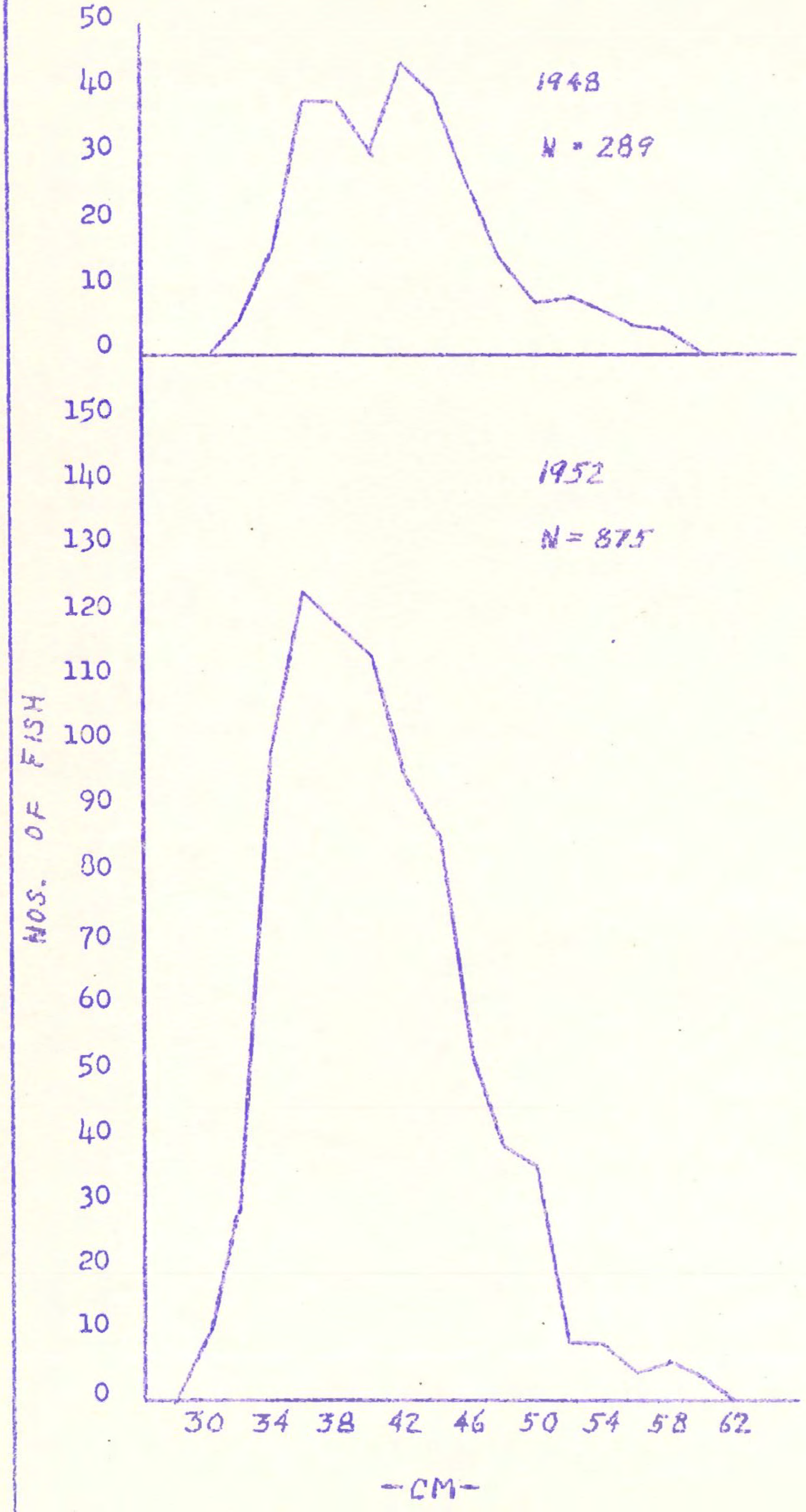


FIGURE 2
DOVER SOLE - BOTH SEXES
1948
N = 289
1952
N = 875
NOS. OF FISH
AGE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
4
5
6
7
8
9
10
11
12
13
14
15
16
>16

FIGURE 3 DOVER SOLE - BOTH SEXES



than in the 1952 sample. This contradiction seems to indicate that the otolith readings of the two readers are not comparable.

4. Compilation of Dover Sole Market Sample Length-Frequencies, 1948-52, incl.

The Dover sole market sample length-frequency distributions for the period June through September, 1948-52, incl., by sex, are shown in Figure 4.

These data indicate a general decrease in the size of the Dover Sole during this period. The decrease is particularly evident among the larger fish in each sex. For the males, the percentage of fish greater than 43 centimeters for 1948-52 are 28, 26, 23, 15, and 14, respectively. For the females the percentages of fish greater than 47 centimeters for the same period are 25, 29, 25, 22, and 25, respectively.

The causes for this decline are not readily explainable at this time. Three causes are suggested.

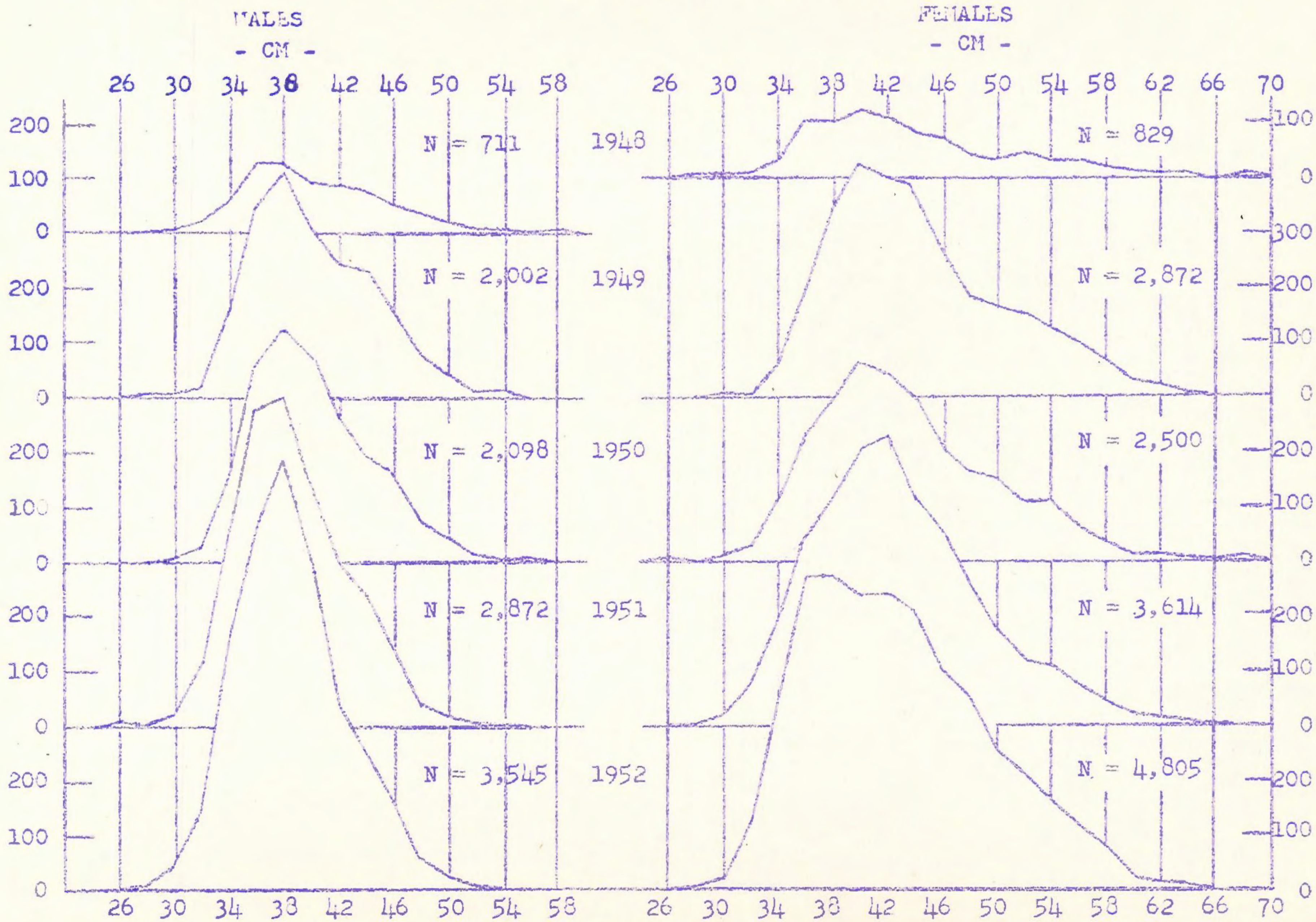
1. Decline in the size of the fish on the grounds. That is a decrease in the numbers of older fish surviving and/or the appearance of one or more new (young) dominant year-classes.

2. Differences in sampling technique.

3. A change in the fishermen's sorting methods at sea.

The dover sole landing records indicate that the relative abundance rose from 1948 through 1950 and fell sharply in 1951. The overall abundance trend was downward for the period 1948-52. Our index of the average size of fish follows this trend fairly well for the male dover sole, but not so well for the females. The age composition for each year for this period has not been worked out so that the presence of one or more new dominant year classes is not detectable at this time.

Figure 4. DOVER SOLE L-F, JUN - SEPT



If differences in sampling techniques are considered, two explanations are offered. During 1943-52, incl., the sample size was 100-200 fish, whereas during 1951-52 the sample size was 400-600 fish. With an increased sample size, the range of the size distribution is also increased somewhat, so that more larger fish should appear in the later samples. However, it is not known whether proportionately more large fish would be obtained in the larger samples. Empirical tests would be necessary in order to determine this.

A second aberration could result from the method of sampling. When a fixed small number (100-400 fish) of fish are removed from a bin containing many thousands of fish, the possibility of human bias against any particular size of fish is quite possible. Such samples may not be random. Conversely by taking a fixed volume of fish, i.e., one cartful, and measuring all the fish in this volume there is no longer any sampler's bias against a particular size of fish with regard to the total sample.

A third variable is the sorting at sea by the fishermen. There has been no change in the minimum size of fish acceptable to the fillet plants, but observations at sea have indicated that various factors can influence the degree to which the fishermen adhere to the minimum size while sorting. Often the sorting will be quite generous when the catch is large, and conversely quite close when the catch is small.

During 1948 and 1949, the otter trawl fishery was operating on a restricted basis due to adverse economic conditions and this may have caused the fishermen to sort generously, i.e., land fish of a larger average size, in order to maintain their markets. The economic conditions improved steadily after 1949, and there may have been a corresponding change in the sorting so that as the demand for dover sole increased, the fishermen tended to become less generous when sorting at sea.

The fishermen's sorting could also have been altered by a real decline in abundance. That is, as the catches in general decreased in size, there would be a natural tendency to crowd the minimum size.

The analysis of the market sample length-frequencies will remain in a preliminary stage until the corrected landing records are completed so that the samples can be weighted to the total catch.

5. Early Life History Studies--English Sole

Progress during this period on the early life-history study of the english sole has consisted of an analysis of the size distribution, modal growth, and seasonal abundance of a population which inhabits Yaquina Bay. It must be remembered that no explorations have been made for the young of this species in the ocean and that the population in Yaquina Bay may or may not have attributes similar to english sole of the same age which undoubtedly are to be found in the ocean.

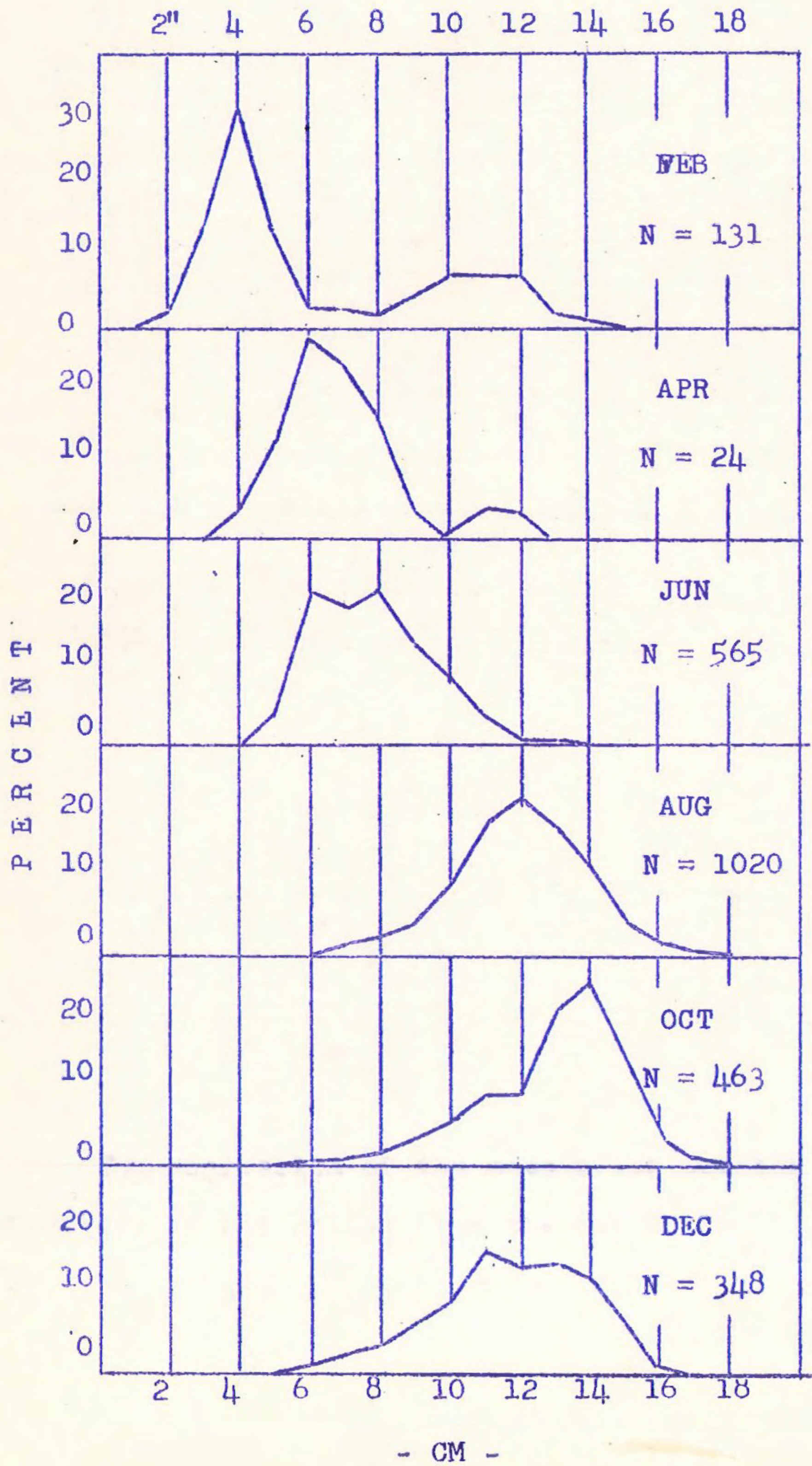
Size Distribution

Figure 5 shows the size distribution, in centimeters, of the english sole caught with the shrimp try-net, a miniature otter trawl, during the period July 1951, through February 1953. Due to space limitations, size distributions for only every other month are included. However, in the separate box on the right the modal sizes are shown for each month for which data are available.

During the period February through April a bimodal size distribution is apparent. The modal sizes in February are 4 and 10-12 centimeters, respectively. The 4 cm mode gradually increases until October when it reaches a maximum at 14 cm. Subsequently it regresses to the 10-12 cm mode the following February and finally disappears in May.

Figure 5

E N G L I S H   S O L E



MO.	MODES I	MODES II
	-CM-	
F	4	10-12
M	5	11.5
A	6	11.5
M	6	--
J	6&8	--
J	10.5	--
A	12	--
S	13	--
O	14	--
N	13	--
D	11	--

The 4 cm mode in February must logically represent the fish which were spawned that winter, whereas the 10-12 cm mode in the same month must represent fish approximately one year older.

No english sole greater than 18 cm were caught in any month. Adult forms of starry flounder and sand sole were commonly caught throughout the study period. Presumably then the net is capable of catching adult english sole if they were present in the bay. This indicates that the young english sole must enter the bay either as pelagic eggs and **larvae** or as immigrating, bottom-dwelling juveniles.

It is interesting to note that there were some english sole less than 8 cm in the catches for every month in the year. Apparently there must be a small amount of spawning throughout the year, although the bulk of the spawning probably occurs over a limited time range.

The bell-shaped size distribution in August probably indicates the true size distribution of the year-class. That is, the selectivity of the mesh size and the migration factor are probably not operating. It is somewhat discouraging, from the standpoint of otolith reading, to note that this size range (c. 10-12 cm) for a single year class is also approximately the same as that (c. 15 cm) found in the market samples of adult english sole which include many age classes.

Modal Growth

The modal growth of these fish appears to be approximately 10 cm from February to October.

The regression of the mode after October has been interpreted to indicate an emigration from the bay during the autumn months of those fish which have reached some pre-determined age and/or size (12 cm).

Seasonal Abundance

Although this study was not designed to yield quantitative data concerning the population, it is interesting to note that the catch per drag, i.e., numbers of english sole per drag, follows a pattern which had been partially indicated from the study of the modal growth. In Figure 6 the catch per drag by month has been graphed. The abundance, as measured by the catch per drag, rises rapidly during the spring and early summer and reaches a peak in August. A 95 percent decline occurs between August and December.

If this measure of the seasonal abundance is reasonably approximate, the fish represented by the 10-12 cm mode in Figure 5 must constitute approximately 5 percent of the year class which inhabited the bay the previous year.

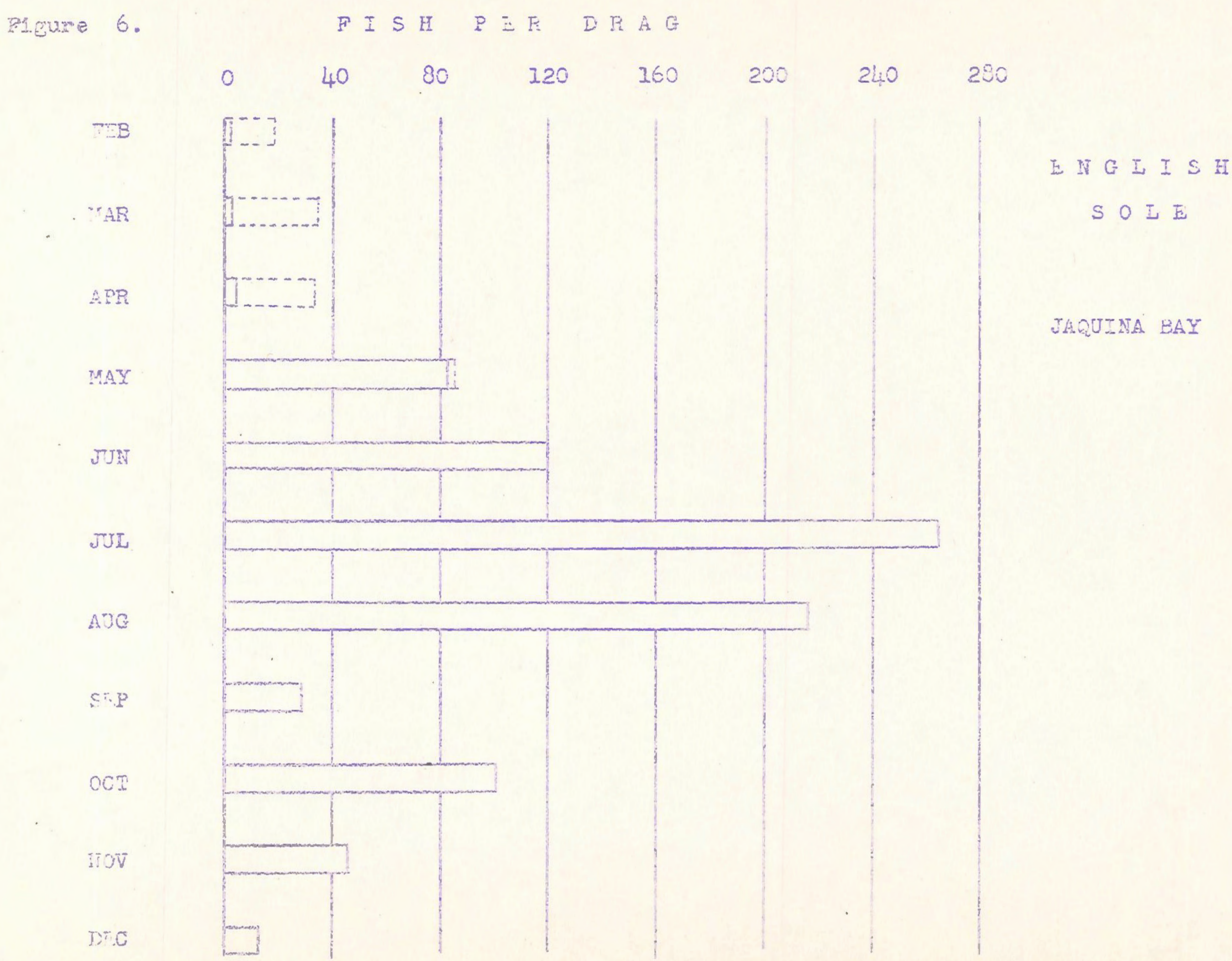
The potential errors inherent in this tenuous analysis are certainly obvious, but a discussion at this time would contribute little to this preliminary report.

6. Scale Readings--Pacific Ocean Perch

During the winter of 1952-53 the age readings of the Pacific Ocean Perch (*S. alutus*) were completed. The term age at this stage of the investigation is somewhat illusory and has been used largely for economy of effort. It has not been demonstrated that the rings observed on these scales represent relative or absolute age of the fish.

There is an obvious positive correlation between number of "age" rings on the scale and the corresponding body length of the fish from which the scale was taken. This has been summarized for male and female Pacific Ocean Perch in Tables 15 and 16, respectively.

Figure 6.



F I S H P E R D R A G
0
40
80
120
160
200
240
280
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
E N G L I S H
S O L E
JAQUINA BAY

Table 15. Age-Length Relationship for 304 Female Pacific Ocean Perch (*Sebastodes alutus*).

LENGTH (cm)*	AGE 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	... >20	Totals
27	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
8	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
9	-	0	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
30	-	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	0
1	1	0	2	0	1	-	-	-	-	-	-	-	-	-	-	-	4
2	0	1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	5
3	0	3	0	3	0	2	-	-	-	-	-	-	-	-	-	-	8
4	1	2	5	3	1	3	1	-	-	-	-	-	-	-	-	-	16
5	-	2	4	3	4	1	1	1	-	-	-	-	-	-	-	-	16
6	-	1	2	5	5	4	0	-	-	-	1	-	-	-	-	-	22
7	-	-	2	3	6	12	5	1	1	1	1	-	-	-	-	-	32
8	-	-	2	4	6	9	11	8	3	2	1	1	-	-	-	-	47
9	-	-	-	-	3	10	10	5	3	2	1	0	-	-	-	-	34
40	-	-	-	-	2	7	3	8	2	4	3	2	-	1	-	-	32
1	-	-	-	-	2	2	6	4	2	3	3	2	3	1	-	-	28
2	-	-	-	-	-	1	0	1	3	0	4	1	2	1	1	2	16
3	-	-	-	-	-	1	1	-	3	2	1	2	1	1	2	3	17
4	-	-	-	-	-	-	1	-	-	0	4	0	3	2	0	1	11
5	-	-	-	-	-	-	-	-	-	2	2	1	2	-	2	0	9
6	-	-	-	-	-	-	-	-	-	-	2	-	-	-	0	1	3
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1
48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Totals	2	10	19	23	31	52	43	28	17	16	23	9	11	6	6	8	304

* Grouped to the nearest lower centimeter.

Table 16. Age-Length Relationship for 239 Male Pacific Ocean Perch (*Sebastodes alutus*).

LENGTH (cm)*	AGE 2 ...	4	5	6	7	8	9	10	11	12	13	14	15	16	17 ...	19	Totals
18	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
8	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
9	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	1
30	-	-	1	2	1	-	0	0	-	-	-	-	-	-	-	-	4
1	-	-	-	2	2	2	3	1	-	-	-	-	-	-	-	-	10
2	-	-	-	1	3	3	2	0	-	-	-	-	-	-	-	-	9
3	-	-	-	1	2	5	5	4	1	1	-	-	-	-	-	-	19
4	-	-	-	-	1	2	7	10	2	2	-	-	-	-	-	-	24
5	-	-	-	-	0	2	5	6	6	4	-	-	-	-	-	-	23
6	-	-	-	-	0	1	6	6	9	9	1	1	0	1	-	-	34
7	-	-	-	-	0	2	5	5	9	10	7	3	1	1	-	-	43
8	-	-	-	-	0	0	2	6	2	3	8	2	2	2	1	-	28
9	-	-	-	-	0	2	1	0	3	3	2	2	6	-	0	-	19
40	-	-	-	-	1	-	2	2	1	1	5	2	-	-	1	-	15
1	-	-	-	-	-	-	-	-	1	1	0	1	-	-	1	-	4
2	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	1	2
3	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	0
44	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
Totals	1 ...	1	1	6	10	19	39	41	34	34	24	12	9	4	3 ...	1	239

* Grouped to the nearest lower centimeter.

The males appear to grow more slowly than the females and also live a shorter time. The modal age for males is 10, and the modal size 37 cm. For the females the modal age is 11, and the modal size is 38 cm. These data were, in general, obtained from random samples of the landings of Pacific Ocean Perch in Astoria and Newport.

The samples from which these scales were secured are heterogeneous with space and time. The fishery itself has been erratic and the time and manpower available for sampling has seldom coincided with heavy landings of these fish.

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