

MARINE FISHERIES PROGRESS REPORT
September, 1949 through May, 1950

The major projects carried out by the Marine Fisheries Section during the 1949-50 winter were as follows:

1. Reading of otoliths.

Much of the time when other projects did not require immediate attention was spent reading otoliths. The 1948 otoliths were finished and all of the 1949 otoliths read. All otoliths were read once by Jergen Westrheim and once by George Harry and where differences occurred the otoliths were again examined carefully and a final decision made.

2. Mink food study.

Questionnaires were sent to practically all of the mink farmers in the State inquiring about the pounds of whole fish and fillet scrap used. The returns have been analyzed. The samples of whole fish taken for mink food have also been analyzed. A report on the mink food study will be submitted shortly.

3. Punch card system.

Landing records of the otter trawl fishery are being hand punched on cards from the time the first records were collected in 1941 until 1947 when the landings were recorded on the IBM machine. Mrs. Westrheim is doing the hand punch work. All of the tag recoveries have been hand-punched.

4. Statistical Report.

The annual and monthly landings of all marine fisheries have been compiled from the time the first records were kept. This time varies with different species but in general the records began in 1941.

5. Bibliography.

A bibliography of the otter trawl work in Europe and this country has been compiled.

6. Work at sea in 1950.

George Harry and Jergen Westrheim spent a week at sea working out the details of the boat work for the coming summer. The boat catches will be sampled this summer at sea and all fish tallied. In addition the English, petrale, and Dover soles will be measured. The mesh size of the net will also be taken in order to correlate mesh size with size of fish caught. Otoliths and stomach samples will be taken.

7. Length-weight relationship.

Length-weight formulas for the English, petrale, and Dover soles, both male and female, have been worked out.

8. Pilchard.

A report on the Oregon Pilchard Fishery was written and published in Research Briefs.

9. Bait Fishery.

A report on the Oregon Bait Fishery was submitted.

10. Surf Smelt.

A short report on the surf smelt was submitted to the Fish Commission for use at the April hearing.

11. Albacore.

The albacore report for the 1949 season was submitted.

12. Soupfin Shark.

The shark data collected during 1949 have been analyzed and a report written.

13. The following meetings have been attended,

a. September 6-9 Tri-State meeting in San Francisco attended by George Harry.

b. October 7-11, first annual tuna conference in Los Angeles attended by George Harry.

- c. December 11, 12, Tri-State meeting in Portland attended by George Harry and Jergen Westrheim.
- d. June 18-22, staff meeting at Clackamas.
- e. March 23,24, Pacific Fisheries Biologists meeting at Lake Quinault attended by George Harry.
- f. April 14, meeting of Fish Commission in Portland attended by George Harry and Jergen Westrheim.

Progress reports have already been submitted covering the major marine fisheries with the exception of the otter-trawl. The following discussion brings the otter trawl progress up to the present time (May 1).

Dover

Length-Frequency

Due to the seasonal occurrence of the dover sole on the fishing banks, length-frequencies were only obtainable during June, July, August, and September of 1949. During this period a total of 4,874 Dover sole were measured and sexed. Of this total, 2,872 were found to be females and 2,002 were males.

Figure 1 presents the length-frequency data by sex for 1948 and 1949 using percentage frequencies for comparison purposes. The mid-points for the centimeter midpoints fall at the one-quarter fraction of each centimeter. This is due to the fact that the fish were measured to the nearest one-half centimeter and the lengths were combined into whole centimeter intervals.

The increased samples taken in 1949 have evidently smoothed the curves considerably, but there has been little or no change in the general features of the curves. The mode for females remains at 41.25 centimeters while the mode for males remains at 39.25 centimeters.

The length-frequencies for the 1949 dover sole were also compiled by month using the frequencies by actual number (Fig. 2). There appears to be no evidence of intraseasonal change with respect to the major modes for males and females. There does appear to be a dearth of males in June and September. This will be discussed more completely under Sex Ratios.

Sex Ratios

The sex ratios, expressed as percentage males, appear to exhibit a trend for each year (Table 1). It appears that many of the females return to the fishing banks. The percentage males begins low each year, May, -1948, 13.2 percent; June, -1949, 25.1 percent, rises to about 50 percent during the middle portion of the season, June-September in 1948 and July-August in 1949, then subsides at the end of the season, 19.3 percent males in October, 1948 and 37.7 percent males in September, 1949.

The overall sex ratio, expressed as percentage males, remained relatively constant for the two years, e.g., in 1948 there were 39.9 percent males in 2,002 fish sampled, while in 1949 these were 41.1 percent males out of 4,874 males sampled (Fig. 3).^{**}

The Dover sole apparently migrate into deeper waters (beyond the 100 fathom line) during the winter months. Some evidence of this movement has turned up in April of this year with the recovery of three Dover sole which had been tagged in 28, 35, and 40 fathoms, respectively, during the summer of 1949 (one in June, two in August) on the grounds off the Columbia River. These three fish were recovered April 24 and 25, 1950 by an otter trawler conducting some experimental fishing along the 200 fathom line southwest of the Columbia River.

^{**} It is evident that a change in the discard size by the fishermen can materially affect the number of males in the landings because of the smaller size of the males.

Maturation Data

The condition of the ovaries, mature or immature, was recorded for each female Dover sole sampled during the season. During the season of 1948 and 1949, 2,086 Dover sole ovaries were examined. Figure 4 presents the results recorded as percent mature females found at each centimeter interval.

Fifty percent of the females examined were mature at approximately 38 centimeters. No mature females were found smaller than 29 centimeters and no immature females longer than 46 centimeters.

Age Determination

Approximately 1,150 Dover sole otoliths were taken during 1949, but none of these have been read as yet.

Length-Weight

The length-weight data collected for 1948 and 1949 were combined. This represented lengths and weights for 380 males and 490 females. The length-weight relationships were tested for linearity on semi-log and log-log graph paper. It was apparent that the log-log relationship more closely approximated a linear relationship for both males and females.

Accordingly, curves were fitted to the male and female length-weight data using the frequencies to weight the calculation. The following formula were calculated: Females, $W=0.000020513 L^{3.01760}$; Males, $W=0.000014226 L^{3.10620}$; where W =weight in pounds and L =length in centimeters. (Fig. 5).

There is apparently little difference in weight between males and females (Dover sole) for any given length during the months from May to October when the length-weight samples were obtained.

Stomach Analysis

A total of 15 Dover sole stomachs were collected at sea and preserved in 10 percent formaline for future study. To date these have not been examined.

Fecundity

Only a few Dover sole ovaries have been collected as the Dover are not present on the fishing grounds during the winter and early spring months when they presumably spawn.

Table 1. Dover Sole Sex Ratios for 1948 and 1949 by Month

	1948				1949			
	M	F	T	Percent Males	M	F	T	Percent Males
May	5	33	38	13.2	-	-	-	-
June	20	20	40	50.0	90	268	358	25.1
July	175	185	360	48.6	269	339	608	44.2
August	329	447	776	42.5	1252	1619	2871	43.6
September	187	177	364	51.4	391	646	1037	37.7
October	82	342	424	19.3	-	-	-	-
	798	1204	2002	39.9	2002	2872	4874	41.1

English

Length-Frequency

During 1949 a total of 2,400 English sole, 2,056 females and 344 males, were sampled. The limited operation of the fleet due to a price dispute impaired the sampling program for English and petrale sole from April through December.

The total length frequencies for 1948 and 1949 (Fig. 6), expressed as percentage frequencies, appear to be quite similar. There is a one centimeter difference in the modes of the 1948 and 1949 male English sole, e.g., 1948 males have a mode at 32.25 centimeters while the 1949 males have a mode at 33.25 centimeters. The discard size for English sole has been 13 inches, or approximately 33 centimeters and a variation of only one centimeter in the mode of the males may only indicate a variation in selection among the fishermen.

The length-frequencies by month for 1949, expressed in actual number, (Fig. 7) give no indication of intraseasonal growth. The small samples, particularly in June (27 females and 2 males) and the overlap in age groups hamper this type of analysis.

Sex Ratios

The percentage of males in the landed catches of English sole during 1948 and 1949 is very small, e.g., 4 - 29 percent (Fig. 8). The males grow much more slowly than the females and are not represented in any large number in the size groups above the selectivity line (approximately 33 centimeters).

The sex ratio, expressed as percentage males, has remained relatively unchanged for 1948 and 1949. In 1948, 12 percent of the 2,272 English sole samples were males, while in 1949, 14 percent of the 2,400 English sole sampled were males.

Maturation Data

During the winter of 1947-48, 1948-49, and 1949-50, the ovaries of all English sole sampled were examined and the condition, mature or immature, was noted.

A total of 1,200 sole were examined, of which 1,081 were found to be mature. The percentage mature females was calculated for each centimeter interval and the results were graphed (see Fig. 9). The 50 percent maturity length is approximately 31 centimeters.

Age Determination

During the winter of 1949-50 all the English sole otoliths which had been collected through December, 1949 were read. This represented 381 otoliths taken in 1949 and approximately 200 taken in 1948.

The age readings have not been compiled or analyzed at this time.

Length-Weight

The length-weight data collected during 1948 and 1949 were combined. This represents the lengths and weights for 142 males and 349 females. The length-weights were plotted for linearity on semi-log and log-log graph paper. It was apparent that the log-log relationship more closely approximated a linear relationship for both males and females.

Accordingly, curves were fitted to the male and female length-weight data by the method of least squares, using frequencies to weight the calculations. The following formulas were calculated: Females,

$W=0.000010972 L^{3.18651}$; Males, $W=0.000014226 L^{2.83891}$; where W = weight in pounds and L = length in centimeters. (Fig. 10).

The weights were taken during the spring and summer months at a time when the gonads would have only slight effect upon the weight of the fish. During the period the females are heavier than the males for each length. However the difference is not great, i.e., not greater than 0.216.

Stomach Analysis

No English sole stomach samples have been collected to date. The program for collecting stomach samples for all three species will be intensified this/coming summer.

Fecundity

Ripe ovaries have been collected during the winter of 1949-50 whenever possible for^a study of the fecundity of the English sole. Unfortunately, the spawning season occurs during months when the weather usually prevents the fishing fleet from leaving port.

The ovaries have been preserved in four percent formalin solution and egg counts will be made at a later date. A tag is attached to each ovary giving the date the fish was taken and the length to the nearest one-half centimeter.

Petrале

Length-Frequency

The 1949 fishery for petrale sole was also limited to a great extent by the price dispute. However, a total of 2,737 fish were sampled during the season of which 1,329 were females and 1,408 were males.

When the length-frequencies, expressed in percentages, for 1948 and 1949 are compared (Fig. 11), it is found that there were more large petrale landed in 1948 than in 1949. This is particularly evident with the female petrale length-frequency in which the mode for the 1948 sample (N = 756) is at 44.25 centimeters while the mode for the 1949 sample (N = 1,329) is at 42.25 centimeters.

A second measure of this decline in size is indicated when one calculates the percentage of females sampled which were equal to or greater than the length at the 50 percent maturation level, i.e. 39 centimeters. For 1948, 77.5 percent of the females sampled were 39 centimeters or larger, while in 1949, only 69.6 percent of the females were 39 centimeters or larger. As an additional measure of this difference, the number of petrale, male and female, greater than 35 centimeters for 1948 and 1949 were treated as separate entities in order to remove most of the effect of the discard size. For 1948, 1,142 fish sampled were greater than 35 centimeters, of which 313, or 31.7 percent were greater than 44 centimeters. For 1949, 2,150 fish sampled were greater than 35 centimeters, of which 378, or 17.6 percent were greater than 55 centimeters.

This decline in size of the fish sampled could be due to a number of causes. It could be due to sampling from different areas or populations. However, great care was exercised by the samplers to insure that the catches they were sampling came from a single area, i.e., Tillamook Rock to Willapa Bay. It seems doubtful that such a sampling aberration could occur

in such a small area.

A second alternative is that the smaller size indicates the presence of one or more younger dominant age classes in the fishery. Since the 1949 petrale otoliths have not been read yet, this alternative must remain a conjecture for the present.

A third alternative is that the size reduction represents a decline in the abundance of the older, larger petrale sole on the grounds mentioned above.

The 1949 length-frequencies for male and female petrale sole have been plotted by month (Fig. 12). Unfortunately the monthly samples are, for the most part, too small for comparison purposes.

Sex Ratios

The male petrale sole constituted 51 percent of the fish sampled in 1949. In contrast, the 1948 male petrale only constituted 33 percent of the petrale sole sampled (Fig. 13). Since the size ranges and modes of the male petrale sole for the two years were approximately similar, i.e., 1948; mode at 37.25 centimeters, range of 29.25 to 51.25 centimeters; and 1949; mode at 37.25 centimeters, range of 26.25 to 49.25 centimeters, it appears that there may have been either a decline in the numbers of females available, a sampling aberration, or a combination of both.

If the males and females were to appear on the fishing grounds in unequal numbers at certain times during the year, a sampling aberration could easily occur if proportionate samples were not taken at similar times for the two years.

With this in mind, Figure 14 was constructed to indicate the monthly change, if any, in the sex ratios during the year. It is apparent that such a trend does occur for both 1948 and 1949. The females are present in the grounds in greater numbers (60-85 percent of females) during the

months of December, January, February, and March. The males predominate (41 - 75 percent males) from April through October.

The samples for 1948 and 1949 were re-examined with regard to the time of sampling. It was found that 51.2 percent (584 fish) of the 1948 petrale sample (N = 1,142) were taken during January, February, March, and December, the period when the greatest number of females are present on the banks. During 1949, only 19.1 percent (525 fish) of the year's sample (N = 2,738) were taken during January, February, and March. No samples were taken during December.

Sex Ratios

The sampling aberration probably accounts for most of the difference in the percentage of males in the samples for 1948 (33 percent) and 1949 (51 percent). However, for the months (January, March, April, June, July, and September) for which data are available for both 1948 and 1949, the percentage males is consistently lower for 1948 than 1949 (Fig. 14).

The percentage males in the landings would also be affected by the fishermen's discard size, i.e., a decrease in the discard size would increase the percentage males in the landings because of the smaller size. A check was made with the various processing plants in Astoria and it was found that no formal change in minimum size for petrale has occurred between 1948 and 1949. However, our sampling shows that the discard size was slightly smaller in 1949 than 1948, although not enough to account for the big difference in the sex ratio. (Fig. 15).

The indication of a decline in the number of large female petrale in 1949 has already been demonstrated (see Length-Frequency). The decline in the number of females must be considered as a factor altering the sex ratios.

Thus it would seem that the difference in the sex ratios of the 1948

and 1949 samples of petrale sole are due to a combination of causes, i.e., variation in time of sampling, slightly smaller discard size, and the apparent decline in number of large female petrale sole from 1948 to 1949.

Maturation Data

During the winter of 1947-48, 1948-49, and 1949-50, the ovaries of all petrale sole sampled were examined and the condition, mature or immature, was noted.

A total of 1,187 female petrale sole were examined of which 770 were found to be mature. The relationship between length and maturation is presented in Figure 16. The 50 percent level of maturity falls at 39.25 centimeters. No mature female petrale sole were found less than 31 centimeters in length and no immature female petrale sole were found larger than 47 centimeters.

Age Determination

During 1949, 602 petrale otoliths were collected. There were no petrale otoliths read during the winter of 1949-50.

Length-Weight

The length-weight data collected during 1948 and 1949 were combined. This represents the lengths and weights for 235 females and 274 males (petrale). The length-weights were plotted on semi-log and log-log graph paper to test for linearity. It was apparent that the log-log relationship more closely approximated a linear relationship for both males and females.

Curves were fitted to the male and female length-weight data using the frequencies to weight the calculation. The following formulas were calculated:

Females, $W = 0.000010972 L^{3.18651}$; Males, $W = 0.000014226 L^{2.83891}$; where

W = weight in pounds and L = length in centimeters (Fig. 17).

The weights were taken during the spring and summer months at a time when the gonads would have very slight effect upon the weight of the fish.

It appears that the males and females increase in weight at an equal rate until they reach 39 centimeters. At this length the females begin to gain in weight at a more rapid rate than the males.

Stomach Analysis

During August, 1949 a sample (of 20 each) of petrale stomachs were taken during each of two tagging trips off the Columbia River. The 40 petrale stomachs have been preserved in a four percent formalin solution for future analysis.

The length and sex of each fish whose stomach was taken have been recorded.

These stomachs have not been analyzed to date.

Fecundity

Ripe ovaries have been collected during the winter months of 1949-50 whenever possible for a study of the fecundity of the petrale sole. Unfortunately, as with English sole, the spawning season occurs during the winter months and samples are difficult to find.

The ovaries have been collected and preserved in the same manner as those of the English sole.

Turbot

During the latter part of the 1949 season one of the Astoria plants (New England Fish Company) began buying considerable quantities of turbot (Atheresthes stomias).

It was decided that market samples of these fish should be taken in event that the fishery expanded or at least became a regular event. Hitherto it had been quite sporadic.

A total of 481 fish (453 females and 28 males) were sampled during September and October of 1949. Lengths, to the nearest one-half centimeter, and sex were noted of each fish. In addition, 133 otoliths were also collected, but have not been examined.

The length-frequency polygon (Fig. 18) exhibits a much larger range in size than for the other three species of flatfish discussed. From this small sample at least, it appears that discard size is also much larger, i.e. 42 centimeters, than for the other three species. The males constitute a very small portion of the sample.

Tagging Program

The 1949 tagging program out of Astoria ended prematurely on August 30 due to a lack of available boats. A total of 3,900 fish were tagged of which 1,592 were dover sole, 1,675 were English, and 499 were petrale sole. (Table 2)

A total of 5,659 fish weretagged on trips out of Astoria for 1948 and 1949.

During the summer of 1949 three short tagging trips were made from Newport. The following fish were tagged: Dover sole, 109; English sole, 64; petrale sole, 64; Bellingham sole, 1; halibut, 1; rex sole, 2; rosefish, 1; sablefish, 1; spiny-cheeked rockfish, 9; turbot, 6.

There were four recoveries, all English sole, which were recovered during August, 1949. There have been no further recoveries to date.

Further analysis of the tagged fish return has yielded little more than was obtained at the writing of the last marine fisheries progress report (July-August, 1949). The dover sole are ^{either} sedentary or move out into deeper water during the winter months. The English sole were slightly more mobile, i.e. 90 percent of the recoveries had moved northward, but 90 percent had moved less than 15 miles. The petrale sole were poorly represented in the tag returns (see Table 2). There also, almost 90 percent of the tagged fish recovered had moved northward, and 73 percent had moved less than 15 miles.

Punch Cards

As of May 31, 1950 the compilation of the otter trawl catch statistics for 1941-1947 has been completed through 1943 at the time (May 31, 1950) of this writing. This includes entering the data on the punch cards, punching, and checking.

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Table 2 Tagged Fish, 1948 and 1949 and Recoveries Through
May 31, 1950. (Includes all Trips from Astoria.)

	Tagged		RECOVERED						Tagged		RECOVERED					
	1948	1948	%	1949	%	1950*	%	T	%	1949	1949	%	1950*	%	T	%
Bellingham Sole	2	0	-	0	-	0	-	0		7	0	-	0	-	0	
Black Rockfish	9	0	-	0	-	0	-	0		1	0	-	0	-	0	
Chinook Salmon	3	1	33.3	0	-	0	-	1	33.3	1	0	-	0	-	0	
Crab	11	1	9.1	0	-	0	-	1	9.1	0	-	-	-	-	-	
Dogfish Shark	39	0	-	1	2.6	0	-	1	2.6	2	0	-	0	-	0	
Dover Sole	474	3	0.6	12	2.5	1	0.2	16	3.4	1592	44	2.8	3	0.2	47	3.0
English Sole	857	31	3.6	23	2.7	2	0.2	56	6.5	1675	59	3.5	25	1.5	84	5.0
Flounder	10	0	-	0	-	0	-	0		10	0	-	0	-	0	
Halibut	0	-	-	-	-	-	-	-		1	0	-	0	-	0	
Ling Cod	32	1	3.1	0	-	0	-	1	3.1	28	2	7.1	0	-	2	7.1
Petrale Sole	171	6	3.5	2	1.2	2	1.2	10	5.8	499	10	2.0	13	2.6	23	4.6
Ratfish	0	-	-	-	-	-	-	-		1	0	-	0	-	0	
Red Rockfish	0	-	-	-	-	-	-	-		1	0	-	0	-	0	
Rex Sole	7	0	-	0	-	0	-	0		11	0	-	0	-	0	
Rock Sole	0	-	-	-	-	-	-	-		1	0	-	0	-	0	
Sablefish	18	0	-	0	-	0	-	0		35	0	-	0	-	0	
Sand Dab	0	-	-	-	-	-	-	-		2	0	-	0	-	0	
Sand Sole	11	1	9.1	1	9.1	0	-	2	18.2	2	0	-	0	-	0	
Skate	0	-	-	-	-	-	-	-		2	0	-	0	-	0	
Slender Sole	0	-	-	-	-	-	-	-		1	0	-	0	-	0	
Southern Shark	1	0	-	0	-	0	-	0		0	-	-	-	-	0	
Spiny-Cheeked Rockfish	1	0	-	0	-	0	-	0		0	-	-	-	-	-	
Sturgeon, Green	17	0	-	1	5.9	0	-	1	5.9	0	-	-	-	-	-	
Sturgeon, White	3	0	-	0	-	0	-	0		0	-	-	-	-	-	
True Cod	4	0	-	0	-	0	-	0		1	0	-	0	-	0	
Turbot	1	0	-	0	-	0	-	0		4	0	-	0	-	0	
Yellow-Tailed Rockfish	44	0	-	0	-	0	-	0		15	0	-	0	-	0	
Unclassified	44	0	-	0	-	0	-	0		8	0	-	0	-	0	
TOTAL	1759	44		40		5		89	5.1	3900	115	41	41		156	4.0