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**INVESTIGATION OF THE ABUNDANCE AND RECRUITMENT
OF BOTTOMFISH OFF OREGON, WITH EMPHASIS ON DOVER SOLE**

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ANNUAL REPORT

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INVESTIGATION OF THE ABUNDANCE AND RECRUITMENT
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ABSTRACT

Market sampling continues. Aging structures have been read, and all aging work is current.

Age composition of Dover sole shows that stocks off Coos Bay are fully recruited 1-2 years later than stocks off the Columbia River. Age composition of English sole reveals a very strong 1961 year class.

The aquarium experiment involving a study of Dover sole scale growth indicates that scales of Dover sole are sensitive indicators of stress. Stress marks associated with handling the fish when scales are taken are evident on nearly all fish.

Work on the population dynamics of Dover sole is accelerating. Year-class strength calculations show that year classes of the early 1940's and middle 1950's were stronger than normal.

REPORTS AND PUBLICATIONS

Three quarterly progress reports were prepared during the year. Major effort during the year was directed toward preparing two papers for publication. The paper on aging Dover sole by scales underwent major revision. A second paper on the depth distribution of juvenile Dover sole also underwent revision. Both manuscripts were submitted to proper authority within the Fish Commission for editing. A third short paper was written describing the occurrence of some tailless Dover sole.

A talk on the distribution of juvenile Dover sole was presented to the Oregon chapter of the American Fisheries Society at Corvallis in January.

PHASE PROGRESS

Activities during fiscal year 1968-69 were in four main areas: (1) market sampling and the work-up of age data; (2) Dover sole aging studies; (3) reports and publications; and (4) population dynamics of Dover sole.

Market sampling

Market sampling for age and size composition of Dover, English and petrale sole and Pacific ocean perch continued at the level established in

1966, i.e., 400 Dover sole, 150 English sole, 200 petrale sole and 400 Pacific ocean perch per month. These monthly quotas were seldom met except during the favorable spring and summer fishing months. With the decrease in perch fishing due to depleted stocks few perch were sampled.

The numbers of fish sampled by port are shown in Table 1. Newport and Coos Bay sampling is for the summer months only. The aging structures collected from sole have been read, and all aging work is current. Pacific ocean perch otoliths have been sent to the federal-state aging unit at Seattle for reading.

Table 1. Numbers of fish sampled by port, July 1, 1968, to June 27, 1969

Port	Dover sole	English sole	Petrале sole	Pacific ocean perch
Astoria	2,800	1,614	1,831	475
Newport	100	473	490	755
Coos Bay	<u>1,400</u>	<u>354</u>	<u>405</u>	<u>250</u>
Total	4,300	2,441	2,724	1,470

Age composition data of Dover sole have been collected at Astoria and Coos Bay since 1966. Age composition of Dover sole stocks off the southern coast (PMFC area 2B) is different than that of stocks off the northern Oregon-southern Washington coasts (PMFC area 3A). For the period 1966-68 males and females from area 3A are recruited to the fishery at a younger age than they are in area 2B. Males are fully recruited at age 8 and 9 in area 3A and at age 10 in area 2B. Females in area 3A are fully recruited at age 8 but at age 10 and 11 in area 2B (Figure 1).

Age samples of English sole have been taken since 1966. With 3 years of data available, it is now possible to show something of the age structure of English sole from area 3A. The 1961 year class still dominates the

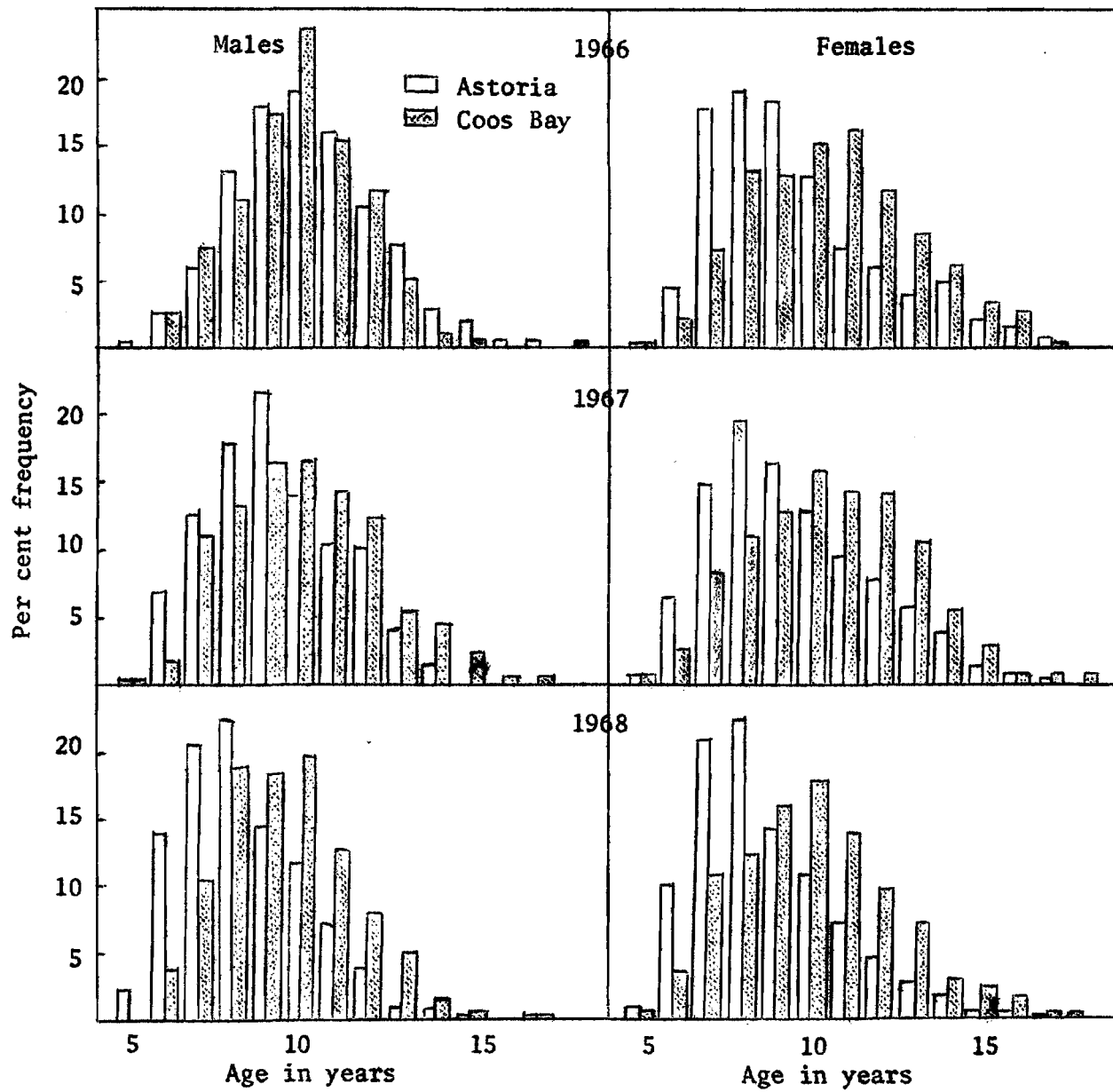


Figure 1. Age composition of Dover sole from PMFC areas 3A (Astoria) and 2B (Coos Bay), May-September, 1966-68

catch since they were detected as 5-year fish in 1966 (Figure 2). Limited data from area 2B show similar results. There is a marked difference in the age composition of male and female English sole. Males are 50% mature at 22 cm (Harry, 1959) and are less likely to capture. Because of their slower growth rate they remain in the fishery several years more. From 1966-68 males comprised only 13% of English sole landings from area 3A. Even at older age few males reach a desirable market size. Females are 50% mature at 31 cm which corresponds to an age of about 3.5 years.

The picture of English sole year-class strength will be broadened in the near future when length-frequency data from 1959-65 are dissected into constituent age groups by age-length keys.

Although petrale sole age composition data are available from 1966 to present, little can be discussed at this time. Males and females are fully recruited to the fishery by age 7 or 8 (Figure 3). Females are longer lived than males and thus remain in the fishery a longer time. Females of the 1960 year class, first showing as age 6 in 1966, were dominant in 1967 and 1968 age samples.

DOVER SOLE AGING STUDIES

In 1967 a two-pronged study was started on trying to resolve discrepancies between scale readings of tagged Dover sole and the length of time at liberty. A sea-water aquarium of 150-gallon capacity was purchased and stocked with juvenile Dover sole. These fish were tagged with Petersen discs for individual identity and a scale collection procedure was established. The second attack was to tag a number of Dover sole at sea, at which time scales were taken so that direct comparisons could be made upon recapture.

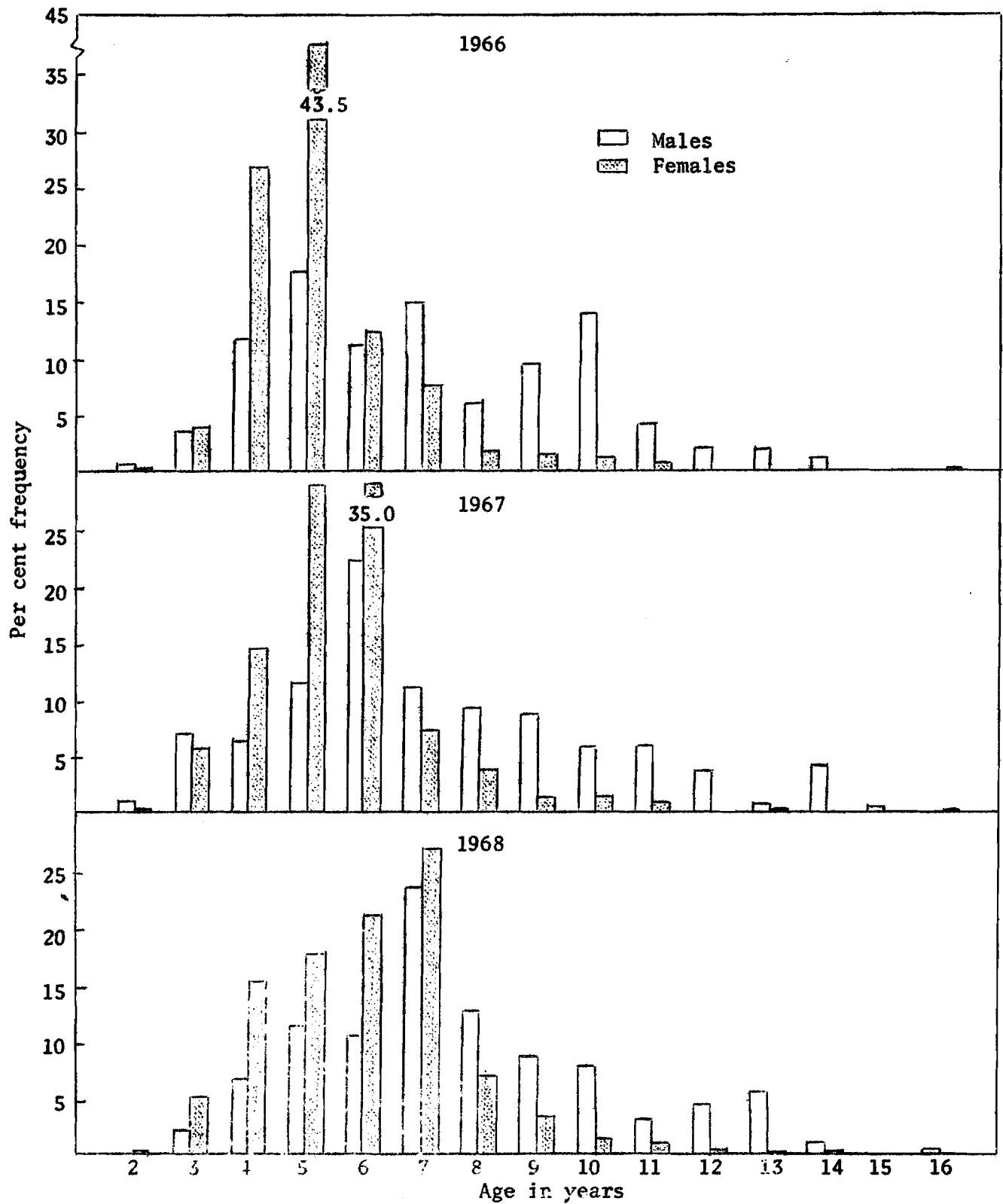


Figure 2. Age composition of English sole from PMFC area 3A, 1966-68

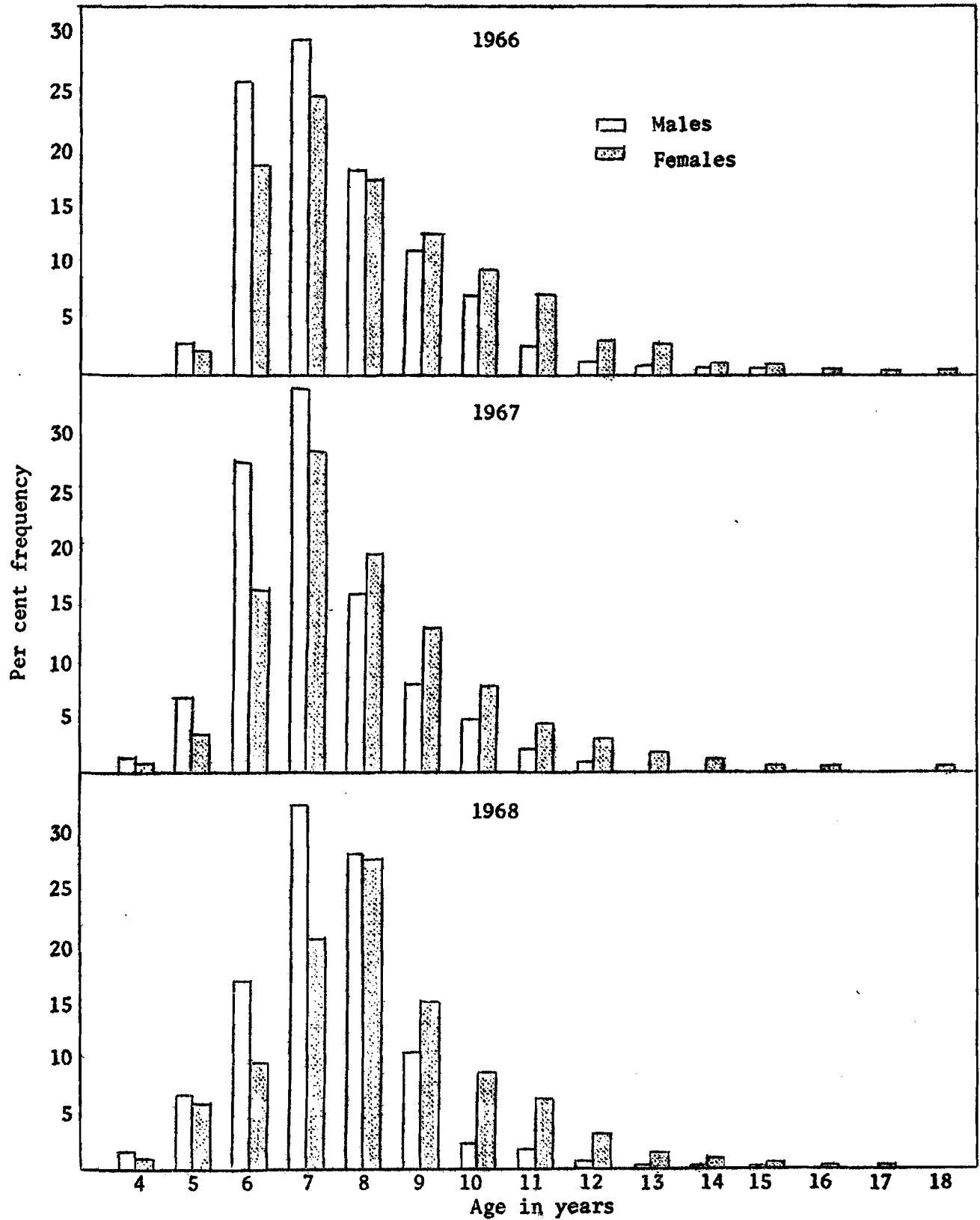


Figure 3. Age composition of petrale sole from PMFC area 3A, 1966-68

The aquarium experiment is still underway. Scales have been taken monthly (except April 1968) since the experiment started in February 1968. Eight of the 12 fish in the experiment are still living. Four fish have been lost since April 1969 because of disease. This was due in part to nearly simultaneous failure of the pump and refrigerating unit.

This experiment has yielded tangible results. It was noticed on scales of certain fish that a mark, termed a stress mark, was present and apparently caused by handling when scales were collected. For example, fish number 2 showed stress marks on scales collected in May, June and August that corresponded with scale collections made in March (no scales in April), May and July, respectively. The mark that showed in the June sample, resulting from the May handling, so resembled an annulus that had I not known the history of the fish, the mark would have been called an annulus.

Stress marks were not common to all fish; however, 8 of 12 fish showed at least one stress mark. Fish number 2 was the only fish to show more than one stress mark.

Tagging cruises in November 1967 and April 1968 resulted in 1,494 fish being tagged. Twenty-four fish have been recaptured as of June 16, 1969. Of the 24 tags recovered 17 were with the fish. Days at liberty of the 17 recovered fish ranged from 14 to 557. Four of these fish had been at liberty a year or more. Thus far, the tagging experiment has not aided scale interpretation. The scale patterns were clear and annuli easily identifiable. However, since 75% of the fish tagged were of sub-legal size (<28 cm) it will probably be several years before really tangible results will be obtained.

Population dynamics of Dover sole

This part of the progress report will briefly discuss results of analysis of past data collected at Astoria from PMFC area 3A since 1948. The subject, by no means, is exhausted and much remains to be done in order to calculate yield.

Fishing season. Because of the migratory behavior of mature fish, i.e., moving offshore during the late fall and winter months to spawn, it was necessary to select a standard fishing season. Dover sole landings occur mainly during the period of May through September. In fact, for the years 1959-67 the average catch during this period was 80% of the total. It is during this period that most sampling occurs. Accordingly a standard fishing season of May through September was established.

Fishing area. Since nearly all sample data from 1948 to the present were collected from landings of fish caught from the area between Cape Falcon and Willapa Bay, it was also necessary to limit the fishing area. Calculations of year class strength are based on the stocks inhabiting this area. These stocks may or may not be representative but the data limitations allow no other choice.

Catch per unit of effort. Three different measures of catch per unit of effort were tried. These were: (1) at the 0% threshold level, or the total catch of Dover sole hailed^{1/} regardless of the per cent of Dover sole caught by tow, (2) at the 30% catch level, i.e., those trips in which the catch was 30% or more of Dover sole, this is called a significant landing^{2/}, and (3) pounds caught per hour of trawling per significant landing.

1/ A hail is visual weight estimate by species of the amount of fish retained.

2/ Catch per significant landing as a measure of catch per effort was established in 1953 and extrapolated back to 1948.

The best measure of catch per unit of effort would be pounds per tow; however, this type of data is nonexistent prior to 1958. Unless hauls were made by tow, it is impossible to determine which tows were made primarily for Dover sole and, conversely, on which tows Dover sole was incidental. Catch per effort at the 0% threshold level was fairly constant between 250 and 350 pounds per hour but useless for showing long-term fluctuations because of the short time period involved.

Catch per significant landing provided a usable measure of catch per effort but, since it was based on the entire catch of a trip, factors like weather and market conditions exerted considerable but not readily measurable influence on catch per effort. The advantage was that it included data back to 1942.

The measure of catch per effort finally chosen was catch per hour per significant landing. This measure was chosen for two reasons: it provided a measure of catch per effort over a longer period of time than effort at the 0% catch level (1948 to present) and it eliminated the two factors that influence the length of a trip.

Catch per effort shows a downward trend since 1948 (Figure 4). Since 1948 catch per effort has ranged from 288-680 pounds per hour and averaged 442 pounds per hour. Since 1956 catch per effort has been average or below average; however, more years of data are necessary to establish long-term trends. The results shown may reflect a normal occurrence.

Conversion of pounds to numbers. Table 2 shows the steps necessary to convert pounds of fish caught per hour of trawling to numbers of fish caught per hour of trawling. The procedure is as follows: (1) convert average length to average weight for each sex by means of length-weight

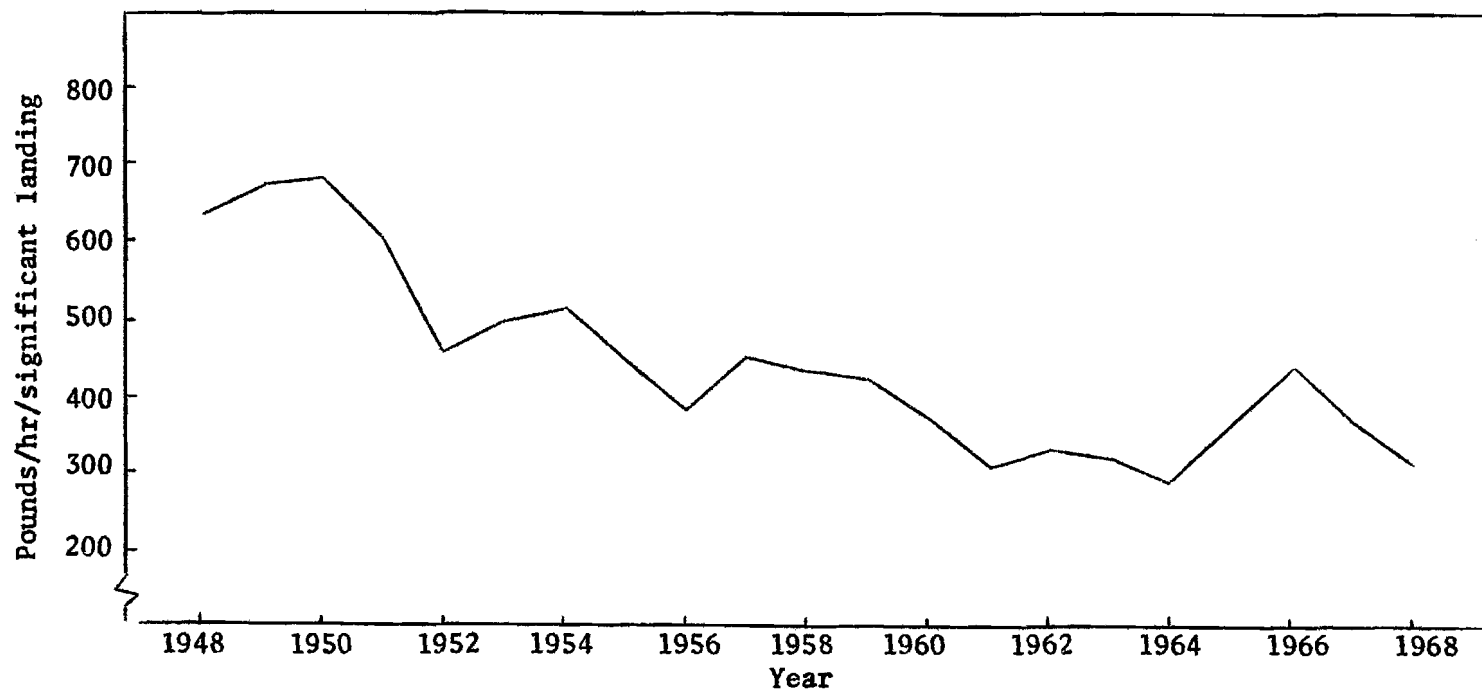


Figure 4. Catch per effort of Dover sole from area 3A, May-September. The horizontal line is the average catch per hour per significant landing

Table 2. Conversion of pounds of Dover sole caught per hour per significant landing to numbers caught per hour per significant landing in area 3A

Year	Males			Females			Total wt. of males & females in sample	Per cent males by wt.	Per cent females by wt.	Catch per significant landing				
	No. in sample	Ave. wt.	Total wt.	No. in sample	Ave. wt.	Total wt.				Weight			Numbers	
										Total	Males	Females	Males	Females
1948	655	1.30	852	798	1.72	1,373	2,225	38.3	61.7	634	243	391	187	227
1949	2,002	1.30	2,603	2,873	1.83	5,258	7,861	33.1	66.9	671	222	449	171	245
1950	2,385	1.18	2,814	2,915	1.69	4,426	7,740	36.4	63.6	680	248	432	210	256
1951	2,634	1.19	3,134	3,355	1.66	5,569	8,703	36.0	64.0	603	217	386	182	233
1952	3,717	1.18	4,386	4,842	1.66	8,038	12,424	35.3	64.7	455	161	294	136	177
1953	3,641	1.18	4,296	4,608	1.76	8,110	12,406	34.6	65.4	496	172	324	146	184
1954	1,681	1.20	2,017	3,487	1.76	6,137	9,984	38.5	61.5	517	199	318	166	181
1955	2,111	1.26	2,660	3,591	1.79	6,428	10,019	35.8	64.2	440	158	282	125	158
1956	1,835	1.22	2,239	2,204	1.73	3,813	6,017	36.6	63.4	381	139	242	114	140
1957	1,469	1.22	1,825	2,331	1.73	4,033	6,364	36.6	63.4	449	164	285	134	165
1958	961	1.19	1,144	1,811	1.61	2,916	4,727	38.3	61.7	433	166	267	139	166
1959	1,236	1.23	1,520	2,364	1.69	3,995	6,359	37.2	62.8	422	157	265	128	157
1960	1,477	1.22	1,802	2,932	1.83	5,349	8,272	35.3	64.7	373	132	241	108	132
1961	1,354	1.19	1,611	2,246	1.64	3,683	5,929	37.9	62.1	309	117	192	98	117
1962	1,081	1.19	1,286	2,661	1.62	4,311	6,972	38.2	61.8	332	127	205	107	127
1963	513	1.19	610	1,143	1.63	1,863	3,006	38.0	62.0	312	119	193	100	118
1964	686	1.04	713	1,127	1.50	1,691	2,818	40.0	60.0	288	115	173	111	115
1965	1,326	1.03	1,432	1,864	1.49	2,777	4,641	40.2	59.8	362	146	216	135	145
1966	705	1.01	712	1,288	1.37	1,765	3,053	42.2	57.8	441	186	255	184	186
1967	627	1.04	652	1,097	1.41	1,547	2,644	41.5	58.5	371	154	217	148	154
1968	523	0.96	502	1,211	1.27	1,538	2,040	24.5	75.5	317	78	239	81	188

formulae^{1/}; (2) multiply number of fish in sample by average weight to obtain total weight for each sex; (3) combine weights and determine percentage weight by sex; (4) multiply weight of fish caught per hour of trawling by the percentage weight of each sex; and (5) divide weight of each sex caught per hour by respective average weight to get numbers of each sex caught per hour of trawling. The number of fish by sex caught per hour was allocated among the age classes by year by multiplying the percentage frequency of each age class in Table 3 by the number caught per hour. The numbers of fish caught per hour by sex and age class are shown in Table 4. These data were then rearranged by year class for certain age groups as shown in Table 5.

Year class strength

Year class strength was determined for year classes 1941-55 for age groups 7-13. Year classes of 1941-43 were superior to any of the year classes following (Figure 5). There is a steady decline in year class strength from 1941-44 followed by a small surge in 1945. There was further decline from 1945 until 1952 at which time year class strength has steadily increased. The 1955-56 year classes, though much stronger than in the early 1950's, are still inferior to the 1941-43 year classes.

Year class strength of petrale sole off southern Vancouver Island, British Columbia, as calculated by Ketchen and Forrester (1966), are nearly identical with respect to the trends shown for Dover sole. This suggests that oceanic conditions determine year class strength.

^{1/} Length-weight formulae are $W = 0.01166L^{2.9153}$ and $W = 0.001002L^{3.0302}$ for males and females respectively, where W = grams and L = centimeters. Grams were converted to pounds by dividing number of grams by 453.6.

Table 3. Age composition (per cent frequency) of Dover sole from PMFC area 3A

Year	Age																	No. of fish	Ave. age	
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			>20
	<u>Males</u>																			
1948	-	-	5.2	27.7	24.9	18.3	11.3	6.1	3.3	1.9	-	0.9	0.5	-	-	-	-	-	213	8.5
1949 <u>1/</u>	-	0.3	5.8	17.4	22.0	17.4	16.6	9.0	5.3	3.0	1.8	0.7	0.3	-	-	-	-	-	304	9.0
1950 <u>1/</u>	-	0.3	5.8	17.4	22.0	17.4	16.6	9.0	5.3	3.0	1.8	0.7	0.3	-	-	-	-	-	304	9.0
1951	0.5	0.5	6.1	11.9	20.5	17.0	19.5	10.6	6.3	3.5	2.8	0.5	0.3	-	-	-	-	-	295	9.3
1952	-	0.5	5.9	13.9	15.0	14.4	17.6	12.6	9.1	5.3	2.4	0.5	1.9	0.5	-	0.3	-	-	374	9.6
1953 <u>2/</u>	-	0.6	2.6	6.3	12.7	11.9	13.9	11.7	7.9	4.6	-	-	-	-	-	-	-	-	495	-
1954 <u>2/</u>	-	1.7	5.6	10.3	20.2	16.7	11.2	6.4	5.2	4.3	-	-	-	-	-	-	-	-	233	-
1955 <u>2/</u>	-	-	2.0	4.4	12.2	10.2	12.6	8.2	10.9	3.1	-	-	-	-	-	-	-	-	294	-
1956 <u>2/</u>	-	0.4	2.5	4.6	8.8	13.4	14.6	10.0	9.6	6.7	-	-	-	-	-	-	-	-	239	-
1957	0.6	0.6	1.2	6.9	14.4	15.5	17.2	10.9	10.3	7.5	4.0	5.7	2.3	1.7	1.2	-	-	-	174	10.6
1958	-	3.3	6.7	13.3	12.5	20.0	15.8	10.0	5.8	7.5	1.7	0.8	0.8	1.7	-	-	-	-	120	9.4
1959	-	-	4.9	14.7	18.2	16.8	14.7	14.7	7.0	3.5	3.5	0.7	-	0.7	-	-	-	0.7	143	9.5
1960	-	-	0.6	4.5	8.4	18.0	21.9	16.9	12.4	8.4	5.1	0.6	2.2	0.6	-	0.6	-	-	178	10.6
1961	-	-	2.5	13.1	20.6	14.4	16.3	15.0	9.4	4.4	1.3	0.6	0.6	0.6	0.6	0.6	-	-	160	9.7
1962	-	-	7.4	15.0	25.2	23.6	17.3	8.7	1.6	-	-	-	-	0.8	-	-	-	-	127	8.7
1963	0.6	3.1	7.5	18.0	30.4	19.9	12.4	5.0	2.5	0.6	-	-	-	-	-	-	-	-	161	8.3
1964	0.5	4.7	12.1	21.9	31.2	15.8	9.3	2.8	1.9	-	-	-	-	-	-	-	-	-	215	7.9
1965	-	3.0	8.5	18.4	27.3	20.5	10.7	5.1	3.8	0.9	0.9	0.4	0.4	-	-	-	-	-	234	8.4
1966	-	0.3	2.4	5.9	13.3	18.0	19.3	16.1	10.6	7.8	3.1	2.1	0.5	0.5	-	-	-	-	615	10.1
1967	-	0.4	6.9	12.6	18.0	21.9	14.1	10.4	10.2	4.1	1.5	-	-	-	-	-	-	-	462	9.2
1968	0.2	2.3	14.1	20.5	22.9	14.3	12.2	7.1	4.0	1.0	0.8	0.2	-	0.2	-	-	0.2	-	523	8.3

Table 3. Continued

Year	Age																		No. of fish	Ave. age	
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	>20			
	<u>Females</u>																				
1948	-	0.3	4.5	17.8	19.2	18.5	12.9	7.3	5.9	3.8	4.9	2.1	1.7	0.7	-	-	-	-	286	9.4	
1949	<u>1/</u>	0.1	0.5	5.2	11.5	17.7	15.3	14.2	11.5	8.9	5.4	4.2	2.4	2.0	0.8	0.1	-	-	373	9.8	
1950	<u>1/</u>	0.1	0.5	5.2	11.5	17.7	15.3	14.2	11.5	8.9	5.4	4.2	2.4	2.0	0.8	0.1	-	-	373	9.8	
1951		0.2	0.7	5.7	7.6	16.8	13.3	15.0	14.2	10.7	6.3	3.7	2.6	2.2	0.9	0.2	-	-	459	10.1	
1952		-	-	7.0	14.1	11.0	14.3	11.0	10.3	12.2	6.6	3.9	3.3	2.5	1.9	1.0	-	-	1.0	517	10.3
1953	<u>2/</u>	0.2	0.3	2.2	5.8	12.6	11.3	9.3	6.8	8.6	6.8	-	-	-	-	-	-	-	603	-	
1954	<u>2/</u>	-	1.7	3.1	5.8	14.1	15.4	7.9	10.6	8.1	7.9	-	-	-	-	-	-	-	481	-	
1955	<u>2/</u>	-	0.2	2.6	5.5	5.3	15.9	14.5	10.4	7.2	4.6	-	-	-	-	-	-	-	585	-	
1956	<u>2/</u>	-	-	5.5	6.8	6.5	7.4	17.8	15.2	7.1	6.4	-	-	-	-	-	-	-	309	-	
1957		-	-	1.8	6.6	6.2	10.9	12.8	14.6	13.9	10.9	7.7	2.2	3.6	2.2	1.1	1.5	1.5	2.2	274	11.7
1958		0.4	1.3	4.8	10.1	14.0	14.0	8.3	13.6	12.7	3.5	6.1	6.1	2.2	0.9	-	1.3	-	0.4	228	10.4
1959		0.3	0.3	3.9	8.2	17.4	17.4	9.5	8.6	7.6	5.3	4.3	5.9	3.9	1.6	2.0	1.0	1.0	1.6	304	10.8
1960		-	-	-	2.5	4.9	11.7	12.5	15.8	13.6	11.7	8.7	7.6	4.4	3.0	1.4	1.6	-	0.6	376	12.0
1961		-	-	2.1	7.6	10.7	17.3	16.3	15.2	11.8	6.6	5.9	2.8	1.7	0.7	1.0	-	0.3	-	289	10.5
1962		-	1.3	6.0	13.2	22.4	17.7	16.7	10.1	6.0	1.6	3.2	0.9	0.3	0.6	-	-	-	-	317	9.2
1963		0.3	1.8	7.8	20.4	24.3	18.0	9.9	5.4	5.4	5.4	1.8	3.0	0.6	0.9	0.3	-	-	-	333	8.7
1964		-	1.4	9.0	19.0	22.4	16.0	13.7	7.8	3.9	3.4	2.0	0.6	0.7	-	-	0.3	-	-	357	8.8
1965		-	2.4	6.1	13.8	19.9	19.2	15.3	9.2	5.6	4.1	0.7	1.5	1.2	0.7	0.2	-	-	-	412	9.2
1966		-	0.3	2.3	8.4	15.6	15.5	17.7	11.5	9.7	6.1	5.5	1.7	2.4	1.4	0.5	0.5	0.3	0.6	1,109	10.4
1967		0.1	0.3	6.5	14.7	19.5	16.4	12.9	9.4	7.7	5.9	3.8	1.3	0.9	0.3	-	-	0.1	-	870	9.4
1968		-	1.1	11.6	21.1	22.6	14.4	10.7	7.4	4.8	2.9	1.8	0.6	0.5	0.2	0.2	0.1	-	-	1,211	8.7

1/ Age composition is the average of years 1948 and 1951.

2/ Otoliths not read beyond 13 years.

Table 4. Numbers of Dover sole caught by age group per hour per significant landing from area 3A

Year	Age																
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	>20
<u>Males</u>																	
1948	0	10	53	47	34	21	11	6	4	0	2	1	0	0	0	0	0
1949	1	10	30	38	30	28	15	9	5	3	1	1	0	0	0	0	0
1950	1	12	37	46	37	35	19	11	6	4	1	1	0	0	0	0	0
1951	1	11	22	37	31	35	19	11	6	5	1	0	0	0	0	0	0
1952	1	8	19	20	20	24	17	12	7	3	1	3	1	0	0	0	0
1953	1	4	9	19	17	20	17	12	7	0	0	0	0	0	0	0	0
1954	3	9	17	34	28	19	11	9	7	0	0	0	0	0	0	0	0
1955	0	3	6	15	13	17	10	14	4	0	0	0	0	0	0	0	0
1956	0	3	5	10	15	17	11	11	8	0	0	0	0	0	0	0	0
1957	1	2	9	19	21	23	15	14	10	5	8	3	2	2	0	0	0
1958	5	9	18	17	28	22	14	8	10	2	1	1	2	0	0	0	0
1959	0	6	19	23	22	19	19	9	4	4	1	0	1	0	0	0	1
1960	0	1	5	9	19	24	18	13	9	6	1	2	1	0	1	0	0
1961	0	2	13	20	14	16	15	9	4	1	1	1	1	1	1	0	0
1962	0	8	16	27	25	19	9	2	1	0	0	0	1	0	0	0	0
1963	3	8	18	30	20	12	5	3	0	0	0	0	0	0	0	0	0
1964	5	13	24	35	18	10	3	2	0	0	0	0	0	0	0	0	0
1965	4	11	25	37	28	14	7	5	1	1	1	1	0	0	0	0	0
1966	1	4	11	25	33	35	29	19	14	6	0	1	1	0	0	0	0
1967	1	10	19	27	32	21	15	15	6	2	0	0	0	0	0	0	0
1968	2	11	17	19	12	10	6	3	1	1	0	0	0	0	0	0	0
<u>Females</u>																	
1948	1	10	40	44	42	29	17	13	9	11	5	4	2	0	0	0	0
1949	1	13	28	43	37	35	28	22	13	10	6	5	2	0	0	0	0
1950	1	13	29	45	39	36	29	23	14	11	6	5	2	0	0	0	0
1951	2	13	18	39	31	35	33	25	15	9	6	5	2	0	0	0	0
1952	0	12	25	19	25	19	18	22	12	7	6	4	3	2	0	0	2
1953	1	4	11	23	21	17	13	16	13	0	0	0	0	0	0	0	0
1954	3	6	10	26	28	14	19	15	14	0	0	0	0	0	0	0	0
1955	0	4	9	8	25	23	16	11	7	0	0	0	0	0	0	0	0
1956	0	8	10	9	10	25	21	10	9	0	0	0	0	0	0	0	0
1957	0	3	11	10	18	21	24	23	18	13	4	6	4	2	2	2	4
1958	2	8	17	23	23	14	23	21	6	10	10	4	1	0	2	0	1
1959	0	6	13	27	27	15	14	12	8	7	9	6	3	3	2	2	3
1960	0	0	3	6	15	17	21	18	15	11	10	6	4	2	2	0	1
1961	0	2	9	13	20	19	18	14	8	7	3	2	1	1	0	0	0
1962	2	8	17	28	22	21	13	8	2	4	1	0	1	0	0	0	0
1963	2	9	24	29	21	12	6	6	2	4	1	1	0	0	0	0	0
1964	2	10	22	26	21	11	6	6	2	3	1	1	0	0	0	0	0
1965	3	9	20	29	28	22	13	8	6	1	2	2	1	0	0	0	0
1966	1	4	14	28	31	35	24	18	12	8	3	3	2	0	1	1	1
1967	0	10	23	30	25	20	14	12	9	6	2	1	0	0	0	0	0
1968	2	22	40	42	27	20	14	9	5	3	1	1	0	0	0	0	0

Table 5. Numbers of Dover sole, ages 7-13, caught per hour per significant landing from area 3A. Data arranged by year class for year classes 1941-55. Data taken from Table 4.

Age	Year class														
	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
	<u>Males</u>														
7	53	30	37	22	19	9	17	6	5	9	18	19	5	13	16
8	38	46	37	20	19	34	15	10	19	17	23	9	20	27	30
9	37	31	20	17	28	13	15	21	28	22	19	14	25	20	18
10	35	24	20	19	17	17	23	22	19	24	16	19	12	10	14
11	17	17	11	10	11	15	14	19	18	15	9	5	3	7	29
12	12	9	14	11	14	8	9	13	9	2	3	2	5	19	15
13	7	4	8	10	10	4	9	4	1	0	0	1	14	6	1
Total	199	161	147	109	118	100	102	95	99	89	88	69	84	102	103
	<u>Females</u>														
7	40	28	29	18	25	11	10	9	10	11	17	13	3	9	17
8	43	45	39	19	23	26	8	9	10	23	27	6	13	28	29
9	39	31	25	21	28	25	10	18	23	27	15	20	22	21	21
10	35	19	17	14	23	25	21	14	15	17	19	21	12	11	22
11	18	13	19	16	21	24	23	14	21	18	13	6	6	13	24
12	16	15	11	10	23	21	12	18	14	8	6	6	8	18	12
13	14	7	9	18	6	8	15	8	2	2	2	6	12	9	9
Total	205	158	149	116	149	140	99	90	95	106	99	78	76	109	134
Combined sexes total	404	319	296	225	267	240	201	185	194	195	187	147	160	211	275

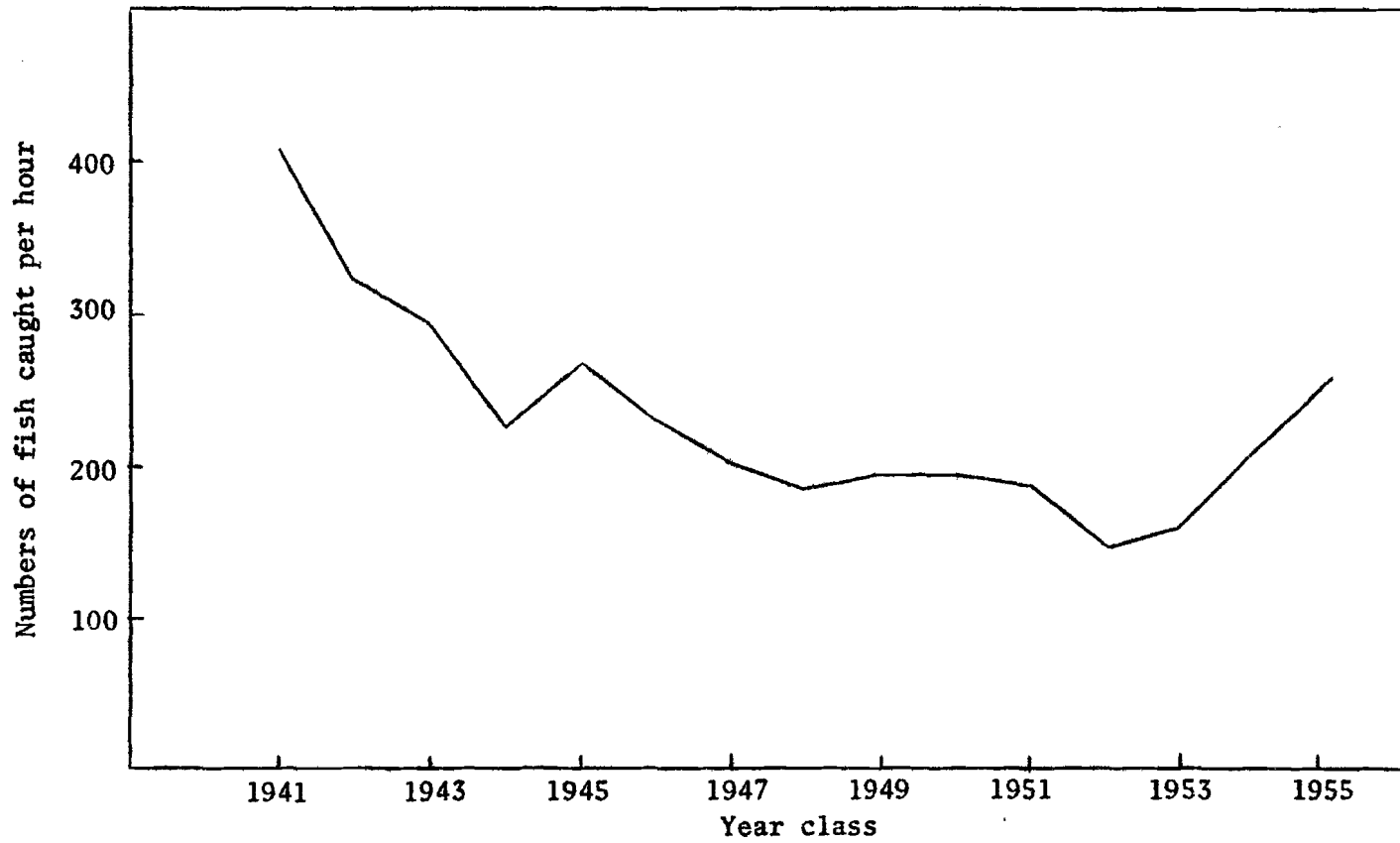


Figure 5. Dover sole year-class strength in area 3A based on measures of catch per effort for ages 7-13

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