

FISKERIDIREKTORATETS SKRIFTER

Serie Havundersøkelser

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On the Age and Growth
of the Pollack (*Gadus pollachius* L.)
from the Norwegian Skagerrack Coast

By

ALF DANNEVIG
and ADOLF SØRENSEN

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The Flødevig Sea-Fish Hatchery
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A.s John Griegs Boktrykkeri, Bergen

Earlier examinations of the scales of the cod from the waters near the Norwegian Skagerrack coast revealed that the ordinary scale theory did not hold good for this species. The narrow parts of the scales were formed, as a rule, during late Summer, not during Winter. (Alf Dannevig: "On the Growth of the Cod and the Formation of Annual Zones in the Scales. Experiments at the Flødevig Sea-Fish Hatchery", Bergen 1925. And Alf Dannevig: "On the Age and Growth of the Cod from the Norwegian Skagerrack Coast", Bergen 1933.

From these investigations it is obvious that the first zone is formed in the calendar year of hatching — according to the old theory it is formed in the following Winter. We have thus a constant difference in age of one year between the results of the two methods for the cod collected during Autumn & Winter. A cod caught in November showing one distinct zone belongs to the brood of the same year.

In addition we had some uncertainty in reading the cod scales. It proved that in some fish an additional zone was formed during Winter — and it was impossible to distinguish between the two zones. (In the cod, however, the otoliths were much easier to decipher).

In the case of young salmon it was also found that the first zone was formed in late Summer. (Alf Dannevig: "Om dannelsen av år-ringer i lakseungenes skjell", Oslo 1928 *).

When dealing with the pollack from our waters it was found necessary to examine the scales on this point.

The pollack scale has well defined zones (Fig. 1), and secondary zones, which are of a character apt to give rise to uncertainty, seldom occur. In the scales of most pollack, however, a faint zone is found near the centre — probably of the same character as the Summer zone in the cod scale, but far less prominent. Fig. 2.

By examining the scales it was found that the zone with narrow sclerites was ordinarily found near the margin of the scale, if the fish

*) Arwidson (1910) was of the opinion that the first zone was formed when the young salmon had attained a definite size — and that this size was often reached in late Summer. Hence the occurrence of "Winter-zones" in that season.

was caught during Spring. In order to have this point verified some of our material (i.e. scales from 2145 pollack caught in traps in the years 1922 — 1930 incl.), was examined to this end.



Fig. 1. Scale of Pollack 41 cm. $\frac{26}{4}$. 1928 Søndeledfjord. Showing two distinct zones, the third at the margin.

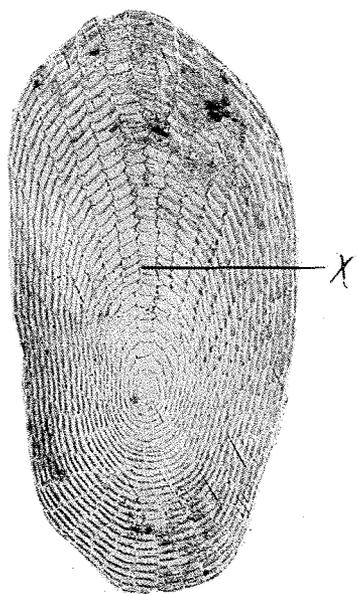


Fig. 2. Scale of Pollack 19 cm. $\frac{6}{1}$. 1926 Søndeledfjord. Showing the Summer check (X).

The material was collected from the following localities:

Bærøfjord (Kragero)	109 specimens
Kjøbmandsfjord "	77 "
Søndeledfjord (Risør)	962 "
Flødevigen (Arendal)	298 "
Topdalsfjord (Kristiansand)	699 "

In tab. 1a & 1b the material is grouped for each month according to the number of zones found in the scales. It is evident that the new zones occur in May—June for the young fish, and in June—July for the older. The zones of narrow sclerites must, therefore, have been formed during the previous months — apparently during the biological Winter.

As will be understood this stands in direct contrast to the results previously arrived at for the cod from the same waters, and is more in conformity with the general scale theory. The new growth, however, occurs much later in the season. The difference between the two species may be ascribed to the difference in the normal occurrence of the two species. In our waters the cod is to be regarded as a northerly form — the pollack, however, as a southerly form.

By the examination of the material it was also noted that the relatively fast growing fish seemed to form the zones at an earlier date than the slow growers. It also appeared that the zone was formed at an earlier date in years with high sea-temperatures than with low ones.

The material is, however, too scanty to enable us to give definite figures.

The distance between the “centre” of the scales and the margin of the different zones was measured, and on the assumption that the growth of the scale and the growth of the fish were proportional, the length increment of the fish t_0 , t_1 , t_2 etc. was reckoned for each season of growth.

The measurement of the margin of the scale expressed as the corresponding growth of the fish in centimetres is compiled in tab. 2. For the older fish the material is scanty, (see tab. 1 b.) and as the time of the formation of the zone is not so strictly defined as in the case of the younger fish, we wish especially to draw attention to the younger classes.

The table shows that the margin was smallest in May—June, and augmented till July of the next year. In the months of May—July some fish were found with narrow sclerities near the margin — in others the new growth had begun. The two modifications are tabulated in the lower and the upper part of the table respectively.

In fig. 3 the width of the margin is given graphically for each month during one year. On account of the material being scanty the older fish are excluded, and the few specimens forming their zones very early or very late are also omitted.

It is evident that the margin of the scale is relatively great in the youngest fish — and that the chief increment occurs during Summer.

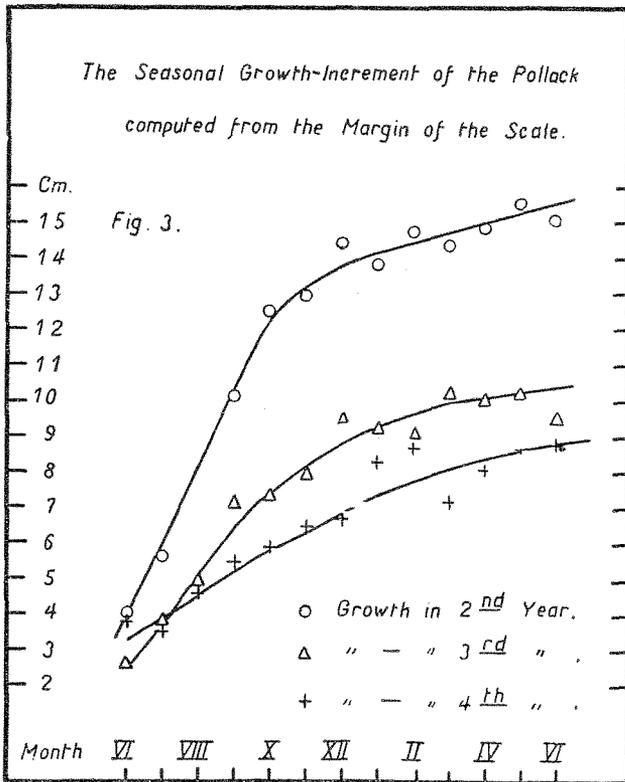
Tab. 1 a. *Pollack grouped according to number of zones.*

	No. examined	Average length	No. of Zones:			
			0	1	2	3
December	2	19.5	2	—	—	—
January	5	20.4	5	—	—	—
February	5	20.0	5	—	—	—
March	2	21.0	2	—	—	—
April	3	21.3	3	—	—	—
May	1	22.0	—	1	—	—
June	9	22.9	—	9	—	—
July	75	23.5	—	75	—	—
August	206	25.2	—	206	—	—
September	163	26.2	—	163	—	—
October	162	28.0	—	162	—	—
November	217	28.4	—	217	—	—
December	136	29.5	—	136	—	—
January	47	30.9	—	47	—	—
February	34	30.2	—	34	—	—
March	44	31.6	—	44	—	—
April	69	31.0	—	69	—	—
May	39	32.3	—	39	—	—
June	45	32.6	—	24	21	—
July	70	33.1	—	1	69	—
August	88	34.9	—	—	88	—
September	58	37.0	—	—	58	—
October	34	36.3	—	—	34	—
November	57	35.2	—	—	57	—
December	28	37.5	—	—	28	—
January	16	38.3	—	—	16	—
February	7	41.1	—	—	7	—
March	12	39.3	—	—	12	—
April	29	40.8	—	—	29	—
May	33	40.6	—	—	33	—
June	28	41.4	—	—	17	11
July	15	42.7	—	—	2	13
August	36	44.8	—	—	2	34
September	30	46.2	—	—	—	30
October	23	47.4	—	—	—	23
November	19	47.0	—	—	—	19
December	9	45.0	—	—	—	9

Tab. 1 b. *Pollack grouped according to number of zones.*

	No examined	Average length	No. of zones:			
			3	4	5	6
January.....	3	48.7	3	—	—	—
February.....	5	47.6	5	—	—	—
March.....	9	47.8	9	—	—	—
April.....	20	47.7	20	—	—	—
May.....	35	47.9	35	—	—	—
June.....	22	49.5	18	4	—	—
July.....	27	52.4	1	26	—	—
August.....	13	52.6	—	13	—	—
September.....	15	53.7	—	15	—	—
October.....	10	53.0	—	10	—	—
November.....	6	52.7	—	6	—	—
December.....	8	50.6	—	8	—	—
January.....	2	58.5	—	2	—	—
February.....	4	51.8	—	4	—	—
March.....	4	52.0	—	4	—	—
April.....	8	51.1	—	8	—	—
May.....	15	53.2	—	15	—	—
June.....	12	55.8	—	9	3	—
July.....	2	54.5	—	2	0	—
August.....	1	57.0	—	1	0	—
September.....	5	57.0	—	—	5	—
October.....	5	54.8	—	—	5	—
November.....	2	59.0	—	—	2	—
December.....	1	55.0	—	—	1	—
January.....	2	61.5	—	—	2	—
February.....	0	—	—	—	0	—
March.....	1	55.0	—	—	1	—
April.....	4	56.8	—	—	4	—
May.....	3	56.0	—	—	3	—
June.....	6	60.3	—	—	6	—
July.....	5	59.6	—	—	5	—
August.....	7	60.6	—	—	6	1
September.....	8	61.5	—	—	7	1
October.....	1	59.0	—	—	—	1
November.....	1	51.0	—	—	—	1
December.....	1	67.0	—	—	—	1

In table 3 the computed length of the fish is given for the 1924 year-group. The values are given for each age (number of zones) separately. It will be seen that the l_1 diminishes as we pass from the young to the older fish. This means that the method of calculating l_1 cannot be very accurate. Here we have to do with the phenomenon of Miss Lee (1912) found by her in both herring and haddock.



In table 4 the total result for all year-groups from the Søndeled-fjord is given. The results arrived at from the single year-groups are confirmed, the l_1 diminishing when more zones are formed.

There remains the fact that the calculated length of the fish of the same year-group at the time of the finishing of the zones diminishes when the fish grows older; we are not, however, in a position to discuss the cause of this phenomenon on the basis of the material at hand. We will only draw attention to the fact that it will not be safe to study the growth of the pollack from year to year by ordinary scale measurements. It is possible, however, that a correction may be found which will eliminate the discrepancies in the measurements.

Tab. 2. *Width of the margin of the scale after zone No.:*

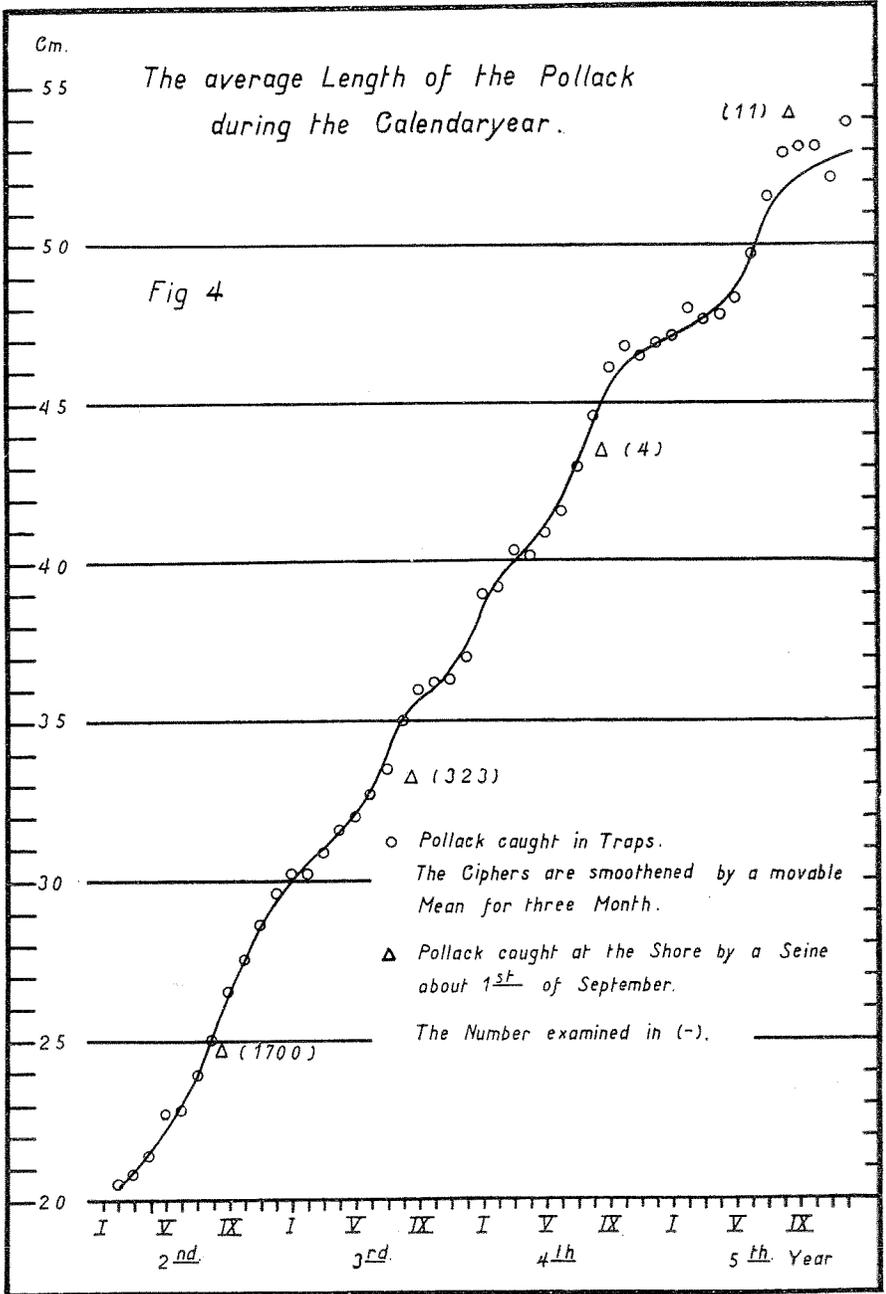
Month	1	2	3	4	5	6	7	8
V	2.0	—	—	—	—	—	—	—
VI	4.1	2.6	3.8	4.5	2.3	—	—	—
VII	5.7	3.8	3.5	5.7	—	—	—	—
VIII	8.5	4.9	4.6	4.8	—	3.0	—	—
IX	10.2	7.1	5.5	7.7	3.9	3.0	—	3.0
X	12.6	7.3	5.9	4.2	4.2	5.0	—	—
XI	13.0	7.9	6.5	4.7	3.7	3.0	4.0	—
XII	14.5	9.5	6.7	5.7	7.0	5.0	—	—
I	13.9	9.2	8.3	6.0	6.5	—	—	—
II	14.8	9.0	8.7	5.3	—	—	—	—
III	14.4	10.2	7.2	4.7	7.0	4.0	—	—
IV	14.9	10.0	8.1	5.5	5.7	4.0	—	—
V	15.6	10.2	8.7	6.1	6.5	5.0	—	—
VI	15.1	9.5	8.8	7.2	5.9	—	5.0	—
VII	15.5	14.0	9.0	6.9	6.0	6.5	7.0	—
VIII	—	14.0	—	11.0	6.6	5.2	—	—
IX	—	—	—	—	6.6	7.0	—	—

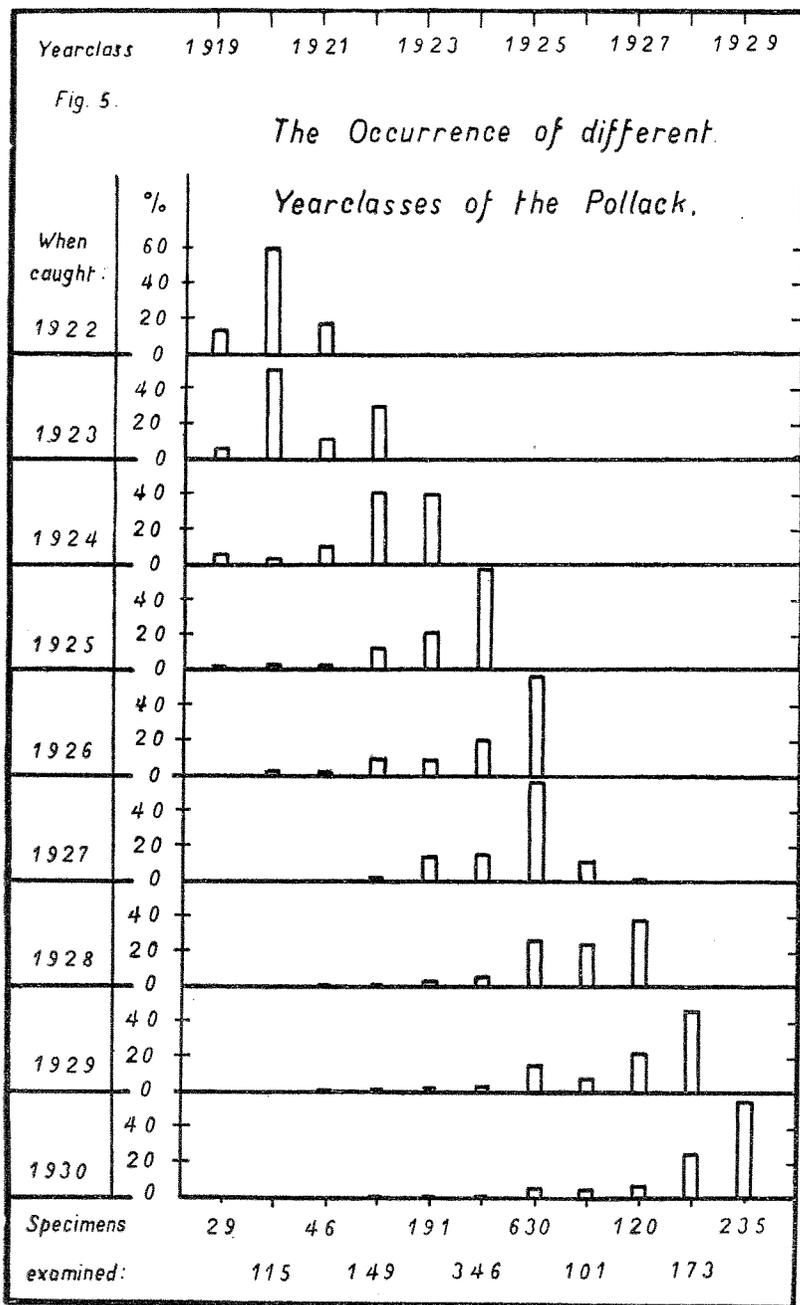
Tab. 3. *Year-group 1924. Søndeledfjord.*

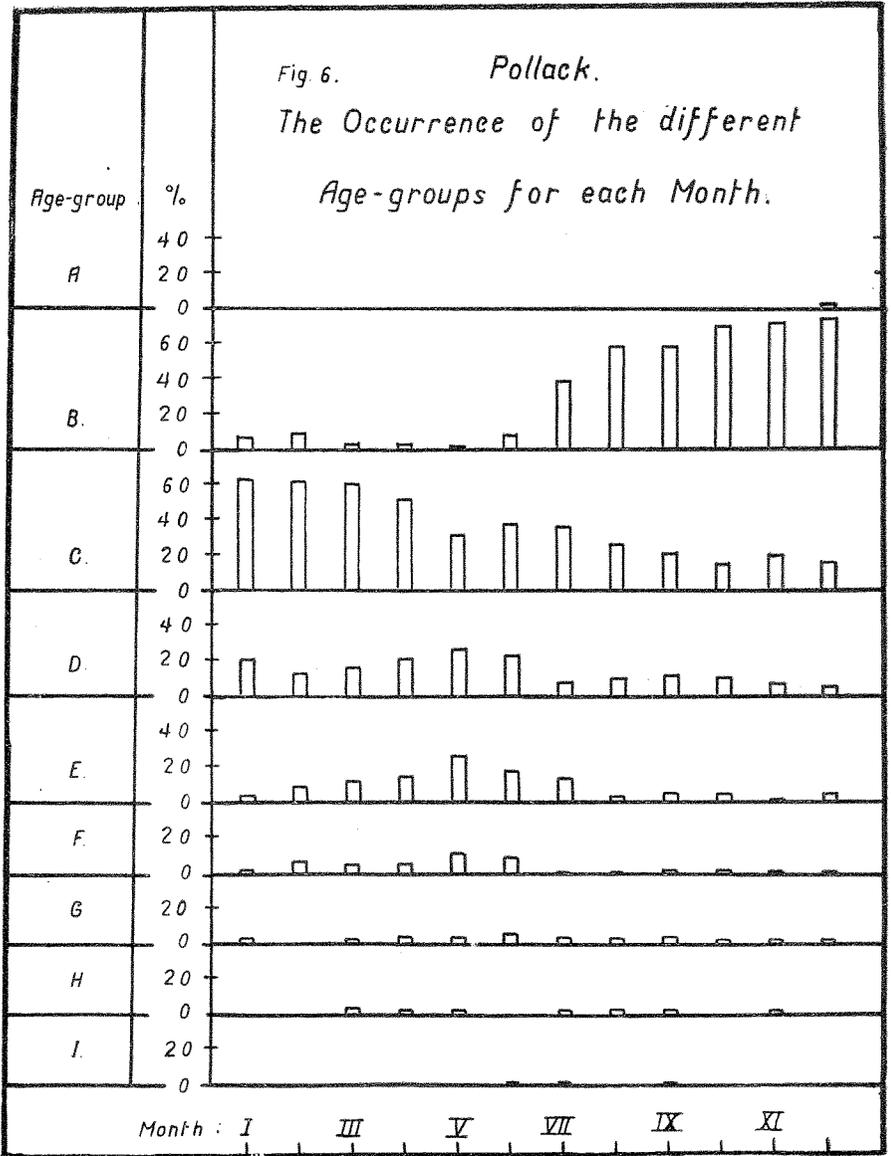
When caught:	1 ₁	1 ₂	1 ₃	1 ₄	1 ₅
1925—26.....	16.2	—	—	—	—
1926—27.....	15.2	31.0	—	—	—
1927—28.....	15.0	28.4	38.2	—	—
1928—29.....	14.5	29.2	39.2	48.8	—
1929—30.....	13.5	26.2	37.3	45.4	52.3

Tab. 4. *All Year-classes. Søndeledfjord.*

Age of fish:	1 ₁	1 ₂	1 ₃	1 ₄	1 ₅
2 years.....	17.1	—	—	—	—
3 ".....	16.6	31.2	—	—	—
4 ".....	16.0	30.0	40.2	—	—
5 ".....	15.1	29.1	38.8	47.6	—
6 ".....	13.5	26.2	37.3	45.4	52.3







The length of the pollack found by direct measurements of the fish from each season and of different ages is given in fig. 4. It will be seen that the curve is undulating, which means that the intensity of growth varies. The less intense growth occurs near the middle of Winter.

Each Autumn (August—September) about 100 hauls are made with a seine in the littoral region of our Skagerrack coast. The pollack caught here is distinctly smaller than the fish of the same age caught in traps at the same season — as will be seen from the same figure.

As to the size of the pollack in different waters, the variations are too small to be dealt with in this booklet, the material being too scanty.

Table 5 and fig. 5 give the total results as to the occurrence of different year-groups. The 1925 year-group is especially rich.

The total number of fish examined in each month is given in table 6. From the total it is evident that the pollack occurs in the traps especially in the late Summer and Autumn. By studying the table, however, it will be seen that the high number in that season is chiefly due to the very young fish. The older fish are best represented in Spring and early Summer. During the actual Winter the catches are low. The relative catches of the different age groups are given in fig. 6.

The right-hand column of tab. 6 shows that the pollack is caught in the traps at a very early age, about 46 % being fish in their second year, and about 29 % in their third.

The catches in the traps are not representative, however, the relatively large pollack being chiefly caught by hook and line, or in nets.

Tab. 5. *The occurrence of different year-groups.*

	Year-group											Total
	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	
When caught:												
1922	15	67	20	—	—	—	—	—	—	—	—	102
1) %	13.5	60.4	18.0	—	—	—	—	—	—	—	—	
1923	2	17	4	10	—	—	—	—	—	—	—	33
%	6.1	51.5	12.2	30.3	—	—	—	—	—	—	—	
1924	3	2	6	24	23	—	—	—	—	—	—	58
%	5.2	3.5	10.7	41.4	39.6	—	—	—	—	—	—	
1925	2	8	7	32	54	145	1	—	—	—	—	249
2) %	0.8	3.2	2.8	12.8	21.6	58.0	0.4	—	—	—	—	
1926	7	21	6	71	68	141	392	—	—	—	—	706
%	1.0	3.0	0.9	10.5	9.6	20.0	55.5	—	—	—	—	
1927	—	—	—	7	35	39	146	30	1	—	—	258
%	—	—	—	2.7	13.6	15.1	56.6	11.6	0.4	—	—	
1928	—	—	1	2	6	10	43	40	62	—	—	164
%	—	—	0.6	1.2	3.7	6.1	26.2	24.5	37.9	—	—	
1929	—	—	2	2	4	4	22	11	31	67	—	143
%	—	—	1.4	1.4	2.8	2.8	15.4	7.7	21.7	46.8	—	
1930	—	—	—	1	1	7	26	20	26	106	235	422
%	—	—	—	0.2	0.2	1.7	6.2	4.7	6.2	25.1	55.6	
Total	29	115	46	149	191	346	630	101	120	173	235	2 135

1) 9 older specimens not included. 2) 1 older specimen not included.

Tab. 6. *Pollack caught in traps 1922—1930.*

The occurrence of different year-groups during the year. Group A means fish caught in the calendar year when hatched, group B in the next year, and so on.

Group	Months												Total	
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	No.	%
A	0	0	0	0	0	0	0	0	0	0	0	2	2	0.1
B	5	5	2	3	1	9	75	206	163	162	217	136	984	45.8
C	47	34	44	69	39	45	70	88	58	34	57	28	613	28.5
D	16	7	12	29	33	28	15	36	30	23	19	9	257	12.0
E	3	5	9	20	35	22	27	13	15	10	6	8	173	8.1
F	2	4	4	8	15	12	2	1	5	5	2	1	61	2.8
G	2	0	1	4	3	6	5	7	8	1	1	1	39	1.8
H	0	0	2	1	1	0	1	5	1	0	2	0	13	0.6
I	0	0	0	0	0	1	1	0	1	0	0	0	3	0.1
Total	75	55	74	134	127	123	196	356	281	235	304	185	2145	99.8