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REPORT ON THE FISH EGGS AND LARVÆ

COLLECTED BY

THE DANISH RESEARCH STEAMER „THOR" IN THE LANGELANDSBELT IN 1909

BY

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During the months of April, May and June 1909 the Danish research steamer »Thor« was anchored in the deep channel east of Langeland in the Belt Sea, Lat. 54° 55.7′ N., Long. 10° 52.2′ E., ca. 1 mile off Spodsbjerg. At this place the depth of the channel is 35 m. The anchoring was carried out in the following manner: Two big anchors were laid out at some distance from each other in the direction of the channel, nearly N—S, connected by means of a tight chain cable, to the middle of which two other chains were fastened, going to the winch in the front part of the ship, thus keeping the stem, from which all the investigations were carried out, as near as possible over the same point of the bottom, notwithstanding the turning of the stern towards the north or the south according to the current.

6 times in every twenty-four hours hydrographical investigations were carried out with the purpose of determining the temperature and salinity of the water and the direction and speed of the current at every 5 m from the surface to the bottom[1]). In the bottom layers the current almost always ran from the north to the south; in the upper water layers the main direction was from the south to the north, though often the opposite way. In most cases there was a fairly sharp limit between the two layers of the water, visible especially in regard to the salinity, and to the current, when this had another direction at the surface than at the bottom. The position of the limit varied between ca. 10 and ca. 25 m, most frequently it was found about 15 m below the surface.

Between 9 and 10 o'clock in the forenoon and about 11 o'clock in the evening vertical hauls were made with the Hensen net, as a rule in the following manner: In the forenoon one haul was made from the bottom to the surface and one haul through the upper water layers only, beginning at a short distance (usually 2.5—5 m) above the boundary stratum as just determined by the hydrographical observations. In the evening one haul was made through the upper strata; occasionally also one haul from the bottom. Altogether, 165 hauls were made, viz. 67 from the bottom to the surface, and 98 through the upper strata only, beginning on an average $11^1/_3$ m below the surface. The net was made of Müller gauze Nr. 4. The diameter of the opening was 67 cm, and its area 3526 cm². The net described in Hensen & Apstein: Ueber die Eimenge der im Winter laichenden Fische. Wiss. Meeresunters. N. F. Bd. II, Heft. 2. Kiel 1897, pag. 5, had an opening area of 3959 cm². Taking into consideration the different circumstances influencing the capture, Hensen multiplied the catch by 3 in order to obtain the number of fish eggs and larvæ per m² surface. In the investigations here described the opening area of the net is somewhat smaller, it is true, but on the other hand, off Spodsbjerg we usually have a fairly strong current which probably renders the volume of water filtered through the net somewhat larger than it ought to be according to the length of wire used. I think therefore, that we may, in order to ascertain the number of eggs and larvæ pr. m² surface, usually be allowed to multiply the catch by three. We should however add, that the figures found are not quite correct on account of the varying speed of the current, but will only be approximate.

[1]) See: J. P. Jacobsen: Gezeitenströme und resultierende Ströme im Grossen Belt. Medd. Komm. f. Havundersøgelser, Ser. Hydrografi, Bd. I, Nr. 14. 1910.

Remarks on the Hydrographical Conditions.

The methods of the hydrographical investigations and the difficulties in measuring the current by means of EKMANN's apparatus have been dealt with by Dr. J. P. JACOBSEN in the above mentioned paper (1910).

In the following I will give a short account of the most important facts as regards the temperature, the salinity, and the current.

As to the temperature there is not very much to say; the temperature of the bottom layers increased very evenly from 4° C on the 10th of April to 7° on the 27th of June. The temperature of the surface water naturally varied somewhat, though on the whole increasing from 2°.8 on the 13th of April to 14°.7 on the 27th of June; during the greater part of April the temperature at the surface was lower than in the bottom layers.

The main direction of the current was N 20° E — S 20° W at the bottom, the same or, most frequently, S 20° W—N 20° E at the surface. In the following, the direction towards the Kattegat (S—N) is expressed by means of a +, the direction towards the Baltic (N—S) by a ÷. The figures used are the means of the six observations in the twenty-four hours, thus disregarding the variations within one and the same day, variations due largely to the tides. Fig. 2 represents the variations of the current from day to day at 5 m and 30 m below the surface; the speeds are given in cm per sec. From April 25th to May 2nd no information is to hand. It will be seen, that the current in the upper strata is usually S—N, though not seldom N—S, varying very much as regards speed; at 30 m depth the direction of the current is always N—S, and the variations of the speed are not nearly so great as in the upper strata. It will also be observed, that the curve for the deeper layers follows, on the whole, the curve for the upper strata; when the current at the surface is very strong in the positive direction, it will restrain the negative current in the deeper water layers. On the other hand, when the current at the surface is negative, there is no hindrance in the way of the bottom current; accordingly, when there is a strong negative current in the surface layers, the current at the bottom is also, as a rule, comparatively strong.

As to the salinity I have worked out the curves for the following depths: 0 m, 10 m, 15 m, 20 m, 30 m (fig. 1). Quite close to the bottom (35 m) the facts were somewhat irregular, as the sea-floor at this place formed a trough; I have therefore not included the observations for 35 m in fig. 1. There is hardly any difference between the salinities at 5 m and 0 m. The oscillations of the salinity in every single stratum are very considerable:

depth	extreme limits of salinity observed	difference
0 m	9.0—20.6 ‰	11.6
10 -	11.0—21.5 -	10.5
15 -	11.7—27.9 -	16.2
20 -	16.8—31.0 -	14.2
30 -	26.4—31.8 -	5.4

On May 28th the boundary stratum was found deeper than 20 m, and the salinity at 20 m depth was unusually low; excluding this single observation the lower limit of the salinity at 20 m depth would be 22.1 ‰. Usually the boundary stratum has been found about 15 m below the surface, whence the great variations of the salinity at this depth.

A comparison between fig. 1 and fig. 2 will show the dependence of the salinity upon the current. We will look first at the facts in the upper layers of the water. It will be seen that some days' current from the Baltic towards the Kattegat, especially when increasing in speed, is always followed by a con-

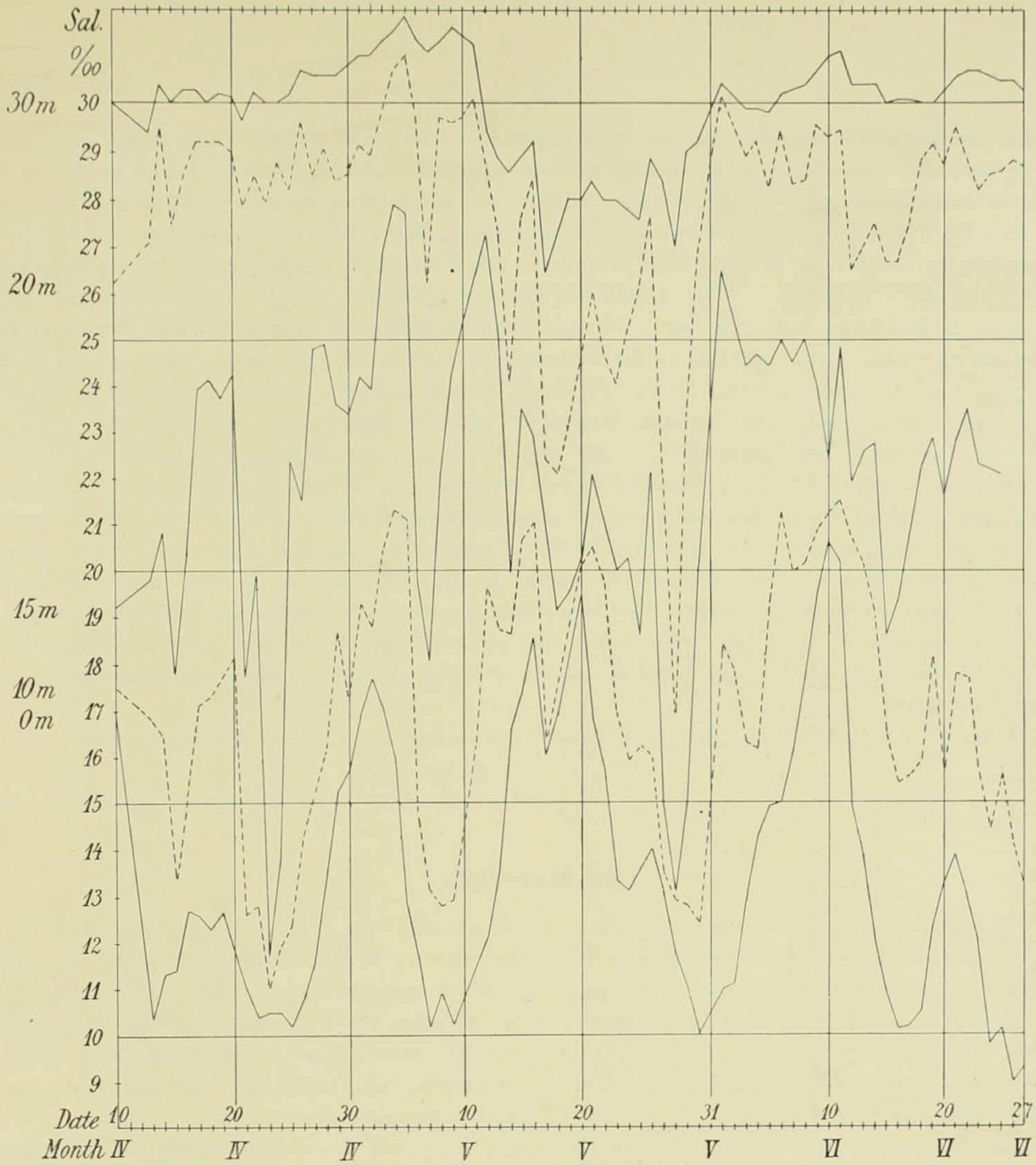

Fig. 1. Daily mean of salinity at different depths.

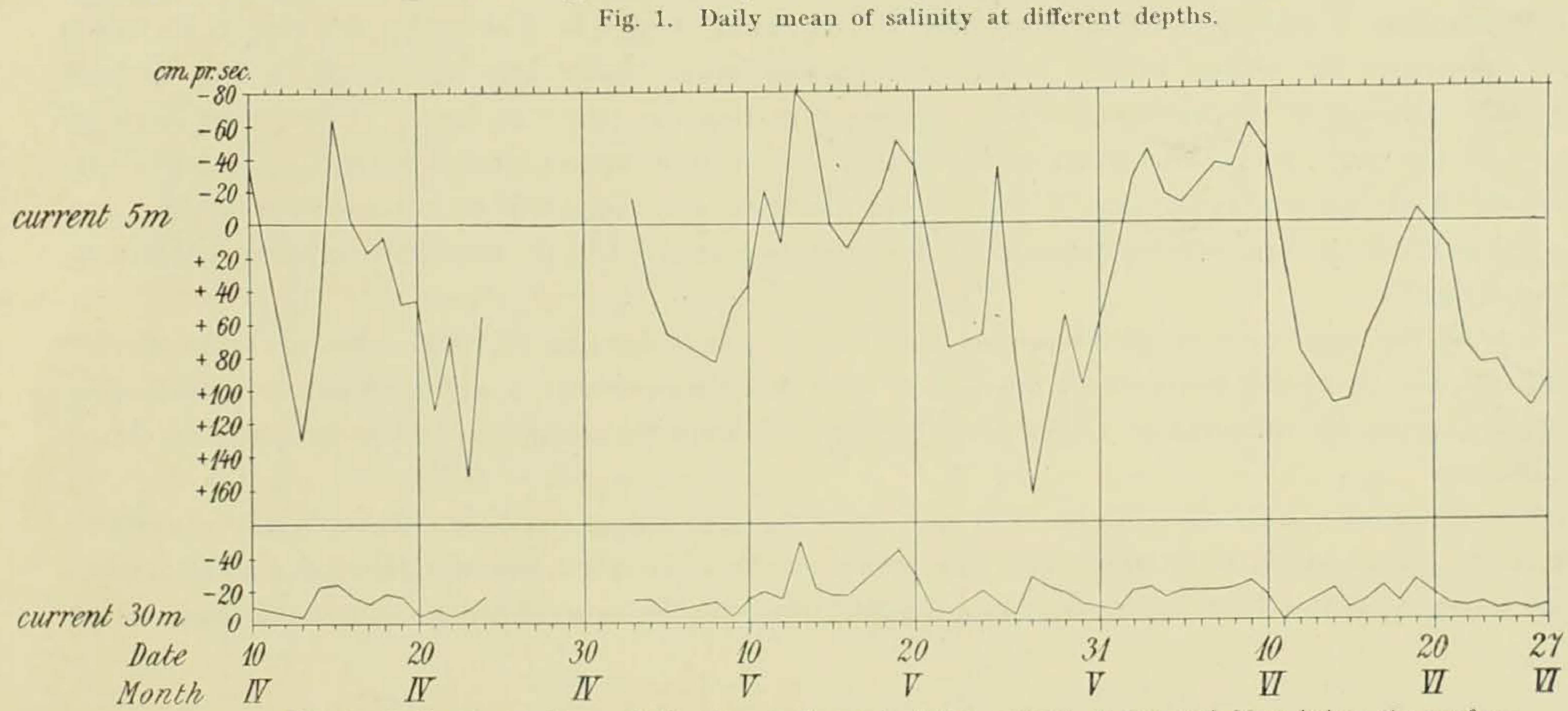

Fig. 2. Daily observations of direction and speed of the current at 5 m and 30 m below the surface.
The speed is given in cm pr. sec. ÷ = N—S, + = S—N.

siderable decrease of the salinity. On the other hand, when the current becomes weak or even turns towards the south, the salinity will increase, the water becoming mixed with the salter water from the Great Belt and the Kattegat. The effect of the current will often not be observed until one or two days later, thus for instance the sudden turning of the current on May 25th was followed the next day by a considerable increase of the salinity at all depths. It will frequently even be possible to see the effects of one single day's changing current; I shall not however go further into the matter but only refer to the curves. As mentioned above the current at the bottom is constantly running towards the south, and the variations of speed are mostly due to the restraining or precipitating influence of the current in the upper strata; in like manner, this is also the cause of the oscillations of the salinity in the bottom layers, in any case indirectly. During some periods the influence seems to be very slight; thus the very strong current on April 23rd caused an extremely low salinity in the upper water layers (11.7 ‰ at 15 m), but scarcely any trace of this fall is found at 20 and 30 m depth. During the period from May 10th to the beginning of June the surface water current seems to have greatly influenced the salinity at the bottom, in such wise, however, that the small oscillations follow the oscillations in the upper layers fairly well; on the whole however, the salinity of the bottom layers was comparatively low, while that of the upper layers was comparatively high. This is undoubtedly due to the fact, that during the period in question, the current of the upper water layers frequently changed its direction, attaining also a high degree of velocity in the one as well as in the other direction, so that a considerable intermixture of the various water layers took place.

Later on we shall see the influence of these facts on the appearance of the fish eggs.

The Material.

The method of collecting the material has been mentioned above. The entire samples of plancton were preserved in formalin; later the fish eggs and larvæ were taken out and preserved in 2 % formalin. This material I have worked through; it contained 3830 fish eggs belonging to the following species: *Gadus callarias, Onos cimbrius* (possibly also *Onos mustela*), *Rhombus laevis, Pleuronectes platessa, Pl. limanda, Pl. flesus, Clupea sprattus,* and some undeterminated eggs. Moreover 121 larvæ belonging to the species: *Liparis liparis, Agonus cataphractus, Gadus callarias, Ammodytes sp., Rhombus maximus, Pleuronectes limanda, Gobius sp., Clupea harengus, Cl. sprattus,* and one undeterminated larva.

In identification and investigation of the eggs I have used a microscope from Leitz, Wetzlar. With the exception of the eggs of *Clupea sprattus*, which could always be known by the cleft yolk, every egg was measured by means of the ocular micrometer No. 2, Leitz objective No. 3, length of tube 15.2 cm, each division of the micrometer thus representing 15 μ. I always measured at least two crossing diameters of the egg, taking the mean of the observations. It is of importance when measuring a fish egg, that the fluid just covers the egg; if there is too much fluid the egg will be constantly trembling and rolling, if too little, the egg will be flattened by the surface tension, and the refraction of light will disturb the measurement.

Among the eggs with oil globules one had the considerable size of 1365 μ, but a comparatively small oil globule, $^1/_6$ of the diameter of the egg; I have therefore referred it to *Rhombus laevis*; according to the figures given by Ehrenbaum and others the eggs of *Rhombus maximus* and *Onos cimbrius* never reach this size.

The other eggs with oil globules (100 eggs) all belong to the genus *Onos*. *O. cimbrius* is the only species of the genus which is tolerably common in the southern Belt Sea and the Baltic, but as *O. mustela* has been taken now and then in the Belt Sea, among other places near Masnedsund on the south coast of Sealand, we cannot exclude the possibility that some of the *Onos* eggs from Spodsbjerg belong to this species. It is also probable that *Onos mustela* is in reality more common in the area than has hitherto been known; the grown up rocklings live quite at the bottom or even bored down in the sea-floor itself, and in deeper water, thus undoubtedly often escaping the trawl; even where the eggs of the one or the other species of *Onos* are found abundantly in the plancton, the adult fishes are not brought up in any great abundance at the same localities. But it is true, from what is known about the distribution of the species in question, that by far the greater part of the *Onos* eggs collected off Spodsbjerg belong to *O. cimbrius*; this also appears from the sizes of the eggs. According to Ehrenbaum the diameter of the egg of *O. mustela* varies between 660 and 980 μ, of *O. cimbrius* (in the western Baltic) between 810 and 1100 μ; the size of the *Onos*-eggs from Spodsbjerg varies from 810 to 1095 μ, average 927 μ, fairly regularly grouped on either side of this average. Furthermore, two of the eggs contained almost fully developed embryos showing the characteristic postanal pigmentation in two belts as in *O. cimbrius*, not in three as in *O. mustela*, leaving no doubt as to the identification. — These facts seem to show that in any case by far the greater part of the eggs are of *O. cimbrius*.

Of *Pleuronectes platessa* only 16 eggs were found. The eggs of the plaice are easily known by the considerable size and the very iridescent pellicula. The eggs in hand vary from 1600 to 1860 μ, average 1750 μ; the smallest one contained a pigmented embryo, and was thus identified without any doubt.

The eggs of *Gadus callarias* (when not containing pigmented embryos) are identified by the size in connection with the non-iridescent pellicula and the yolk, preserving as a rule the yellowish colour. 112 eggs of the cod were found, measuring 1200—1485 μ, average 1323 μ. In a few cases it has been impossible to state, whether an egg belonged to *Gadus callarias* or perhaps to *Pleuronectes flesus*; they have been referred to the undeterminated eggs.

Table I. Size of all the eggs measured.

μ	Eggs with oil globules		Eggs without oil globules		
	Onos	Rhombus laevis	Pl. limanda + flesus	Gadus callarias	Pleuron. platessa
735	.	.	1	.	.
50	.	.	6	.	.
65	.	.	14	.	.
80	.	.	47	.	.
95	.	.	117	.	.
810	1	.	180	.	.
25	1	.	273	.	.
40	3	.	314	.	.
55	3	.	328	.	.
70	9	.	269	.	.
85	11	.	191	.	.
900	12	.	112	.	.
15	11	.	71	.	.
30	10	.	50	.	.
45	7	.	46	.	.
60	7	.	40	.	.
75	9	.	41	.	.
90	6	.	47	.	.
1005	2	.	66	.	.
20	2	.	57	.	.
35	1	.	58	.	.
50	2	.	51	.	.
65	.	.	37	.	.
80	.	.	25	.	.
95	1	.	18	.	.
1110	.	.	17	.	.
25	.	.	6	.	.
40	.	.	6	.	.
55	.	.	4	.	.
70	.	.	2	.	.
85	.	.	1	.	.
1200	.	.	1	2	.
15	.	.	.	.	.
30	.	.	.	8	.
45	.	.	.	6	.
60	.	.	.	6	.
75	.	.	.	9	.
90	.	.	.	7	.
1305	.	.	.	7	.
20	.	.	.	9	.
35	.	.	.	14	.
50	.	.	.	10	.
65	.	1	.	8	.
80	.	.	.	6	.
95	.	.	.	4	.
1410	.	.	.	3	.
25	.	.	.	3	.
40	.	.	.	2	.
55	.	.	.	1	.
70	.	.	.	.	.
85	.	.	.	2	.
1600	.	.	.	.	1
50	.	.	.	.	2
1700	.	.	.	.	2
50	.	.	.	.	5
1800	.	.	.	.	3
50	.	.	.	.	3
Total	98	1	2496	107	16
Average, μ	927	(1365)	—	1323	1750

2697 eggs belong to *Pleuronectes limanda + flesus*. — In the material to hand it has been possible to distinguish the two species one from another with tolerable certainty. In the following only 68 eggs are mentioned as *Pl. limanda* or *flesus*; of the rest 2095 are referred with great probability to *Pl. limanda*, 534 with great probability to *Pl. flesus*. When containing well developed embryos the eggs are easily recognizable by the much denser pigment in *Pl. flesus*. Embryos with incipient pigmentation are usually recognizable by the mode of development of the pigment, beginning in *Pl. flesus* as a number of fine points, in *Pl. limanda* as a few delicately branched chromatophores. In the young stages the size is the only feature for identification, but on account of the variation the method of measuring is not usually of much value in distinguishing the two species. Ehrenbaum (1905) and Heinen (1912) state the following sizes for *Pleuronectes* eggs in the western Baltic: 0.78—0.95 mm: certain *limanda*, 1.05—1.27 mm: certain *flesus*, 0.95—1.05 mm: *limanda* or *flesus*; a very considerable part of Heinen's material falls within the limits for the undeterminable eggs, so that the value of the material is in reality very small. In order to obtain some knowledge as to the number of eggs of each species, Heinen uses the following method: he notes the numbers of 1) *flesus* + *limanda*, 2) certain *flesus*, 3) certain *limanda* for each month, calculates the percentage of certainly determinated eggs of each species, and then apportions the undeterminated eggs according to the percentages found (tables 27—28, pag. 175). This method seems to me to be somewhat open to objection, as the undeterminated material is so very large (in May 46 %, in June 35 %). Moreover no attention has been paid to the decrease in average size of the eggs in course of the advancing season; thus we do not possess any certainty at all, that the numerical proportion between the two species is the same within as without the limits for the undeterminated material. Ehrenbaum & Strodtmann (1904) try to determinate the »dünnsten Werte« of the range of variates (l. c. p. 90 ff.) and from this to calculate the number of eggs of each species; this method is based on an arbitrary selection of the interval, in which the value in question is estimated to be deposited; accordingly the method is only practicable, when the intervals are comparatively large, as in the investigations of Ehrenbaum and Strodtmann, where each division represents 31.44 μ.

The *Pleuronectes* eggs from Spodsbjerg vary between 735 and 1200 μ. If we arrange the whole of the material in groups of size (table I) we shall find two maxima in the series of variates, viz: at 855 μ and 1005 μ, corresponding to the two species. There is however no space between the two groups; the variates run into each other, and it is impossible from these figures to dermine the number of eggs belonging to each species. The average size of the eggs decreases a great deal during the advancing season, and with the average the whole curve of variation will be displaced; therefore, when considering at once the whole material from all the three months, the cleft must be partially filled up. On the other hand, if we consider the material within shorter periods, we shall find a fairly sharp limit between the two groups, so that it is possible to state with a high degree of probability the number of eggs belonging to each species. It is obviously impossible, in most cases, to obtain absolutely certain results; but it seems to me more valuable to have some results for the correctness of which there is a high degree of probability, than to exlude a great part of the material, the exclusion of which will certainly have a considerable influence on the conclusions we desire to draw as to the biological facts of the species in question. As a matter of fact Ehrenbaum, Strodtmann, Apstein and Heinen can draw no conclusions of any value as to the biological habits of the eggs of *Pl. limanda* and *flesus*. On the other hand, from the material of Spodsbjerg several conclusions can be drawn with a probability sufficient for the purpose. Reasons for my view will be seen from the following discussion.

If we put down the range of variates of the *Pleuronectes* eggs within a shorter period or from one single haul, different cases may arise. If the material falls into two well separated groups (table II examples 1 and 2), there is a predominant probability that each of the groups will represent one of the two species. Within a time when the one of the species is known to be greatly predominant, and when all the variates fall within the limits of variation of this species, they may all be supposed to belong to this species, e. g. by far the most of the samples from late in May and the whole of June (exp. 3). If however the outermost variates of the range (on the side nearest the average size of the other species) form a secondary summit on the curve of variation, or are somewhat removed from the bulk of the variates (exp. 4, 5 and 6), one must take into consideration the possibility, that some few eggs of the other species are intermingled. In such case all the outermost variates must be excluded. When two groups are present, but running into each other (forming one bimodal curve) some part of the eggs must be regarded as undeterminable. But here we must consider two cases, according to what we desire to know about the material. In order to ascertain anything about the stages of development of the eggs, it is necessary to point out every single specimen in the range belonging to the one and the other species, in which case we are obliged to exclude all the specimens within certain classes of size (except when some specimens can be identified by morphological characteristics). How many size-classes must be excluded is in every single case a matter of judgement, but we have certain points on which to base our judgements. In the material from Spodsbjerg there are fortunately always within short periods (when both species are tolerably common) two well marked groups of variates, each forming a fairly clean and symmetrical curve around the average and with a fairly sharp cleft between (a bimodal curve with a small index of isolation). This is undoubtedly owing to the comparatively great difference between the average sizes of the two species, viz: 172 μ. In the material measured by Ehrenbaum and Strodtmann (1904) the difference was much smaller: near Skagen in the month of March 120 and 129 μ, in the western Baltic in May 119 μ, near Bornholm in May 131 μ. I think the great difference between the average sizes of the eggs of the two species caught off Spodsbjerg is due to the fact that the *limanda* eggs of this locality are for by far the most part imported from the north with the salter water, while the *flesus* eggs probably come from the south or from the neighbouring coastal areas, where the salinity of the water is somewhat low (see p. 30). The average size of the eggs of *Pleuronectes limanda* and *flesus* is, as is known, larger in the Baltic than in the Kattegat and larger in the eastern than in the western Baltic. See example 7, where it is highly probable that all the eggs of less than 60 divisions belong to *Pl. limanda*, all those of more than 62 divisions to *flesus*, only the eggs of the two classes 61 and 62 being doubtful

Table II. Examples of ranges of variations of Pleuronectes limanda and flesus.

Example No.	1	2	3	4	5	6	7	8	9	10
Date	27/4	13/5	3/6	12/6	13/6	24/5	29/4	26/4	20/4	8/5
Divisions à 15 μ										
49	.	.	.	.	.	.	.	.	.	.
50	.	.	.	.	.	.	.	.	.	.
51	.	.	.	.	.	.	.	.	.	.
52	.	1	1	1	2	.	.	.	.	.
53	.	4	1	.	3	1	1	.	.	.
54	.	1	6	2	5	6	1	.	.	.
55	.	5	10	4	3	5	.	1	.	.
56	.	15	21	4	2	7	4	1	.	1
57	2	25	8	3	5	11	3	.	.	.
58	1	25	7	1	3	14	4	1	.	.
59	2	13	8	1	3	4	5	2	.	2
60	3	8	3	1	1	6	5	3	.	.
61	.	4	1	2	.	1	2	.	1	.
62	.	3	.	1	.	2	3[2]	5	.	1
63	.	1	1[1]	.	2	.	7	1	.	.
64	.	1	.	.	1	5[2]	7	1[2]	.	.
65	2	.	.	.	.	2[2]	9	1	.	.
66	2	.	.	.	.	.	7	2	1[2]	.
67	1	2	.	.	.	.	6	7	1	.
68	.	1	.	.	.	.	7	4	.	.
69	2	1	.	.	.	.	8	3	1	.
70	.	.	.	.	.	.	8	5	.	1
71	1	.	.	.	.	.	6	1	.	.
72	.	.	.	.	.	.	3	1	.	.
73	.	.	.	.	.	.	1	.	.	.
74	.	.	.	.	.	.	.	.	.	.
75	.	.	.	.	.	.	2	.	.	.
76	.	.	.	.	.	.	1	1	.	.
77	.	.	.	.	.	.	.	.	.	.
78	.	.	.	.	.	.	1	.	.	.
79	.	.	.	.	.	.	.	.	.	.
80	.	.	.	.	.	.	.	.	.	.
limanda	8	106	67	17	27	57	23	8	1	3
?	0	0	0	3	3	5	4	6	0	1
flesus	8	4	0	0	0	2	74	26	3	1

[1] one certain *limanda*. [2] one certain *flesus*.

Table III. General view of th

Date		HYDROGRAPHICAL OBSERVATIONS[1] Meters below the surface 35	30	25	20	15	10	5	0
10/4	Sal.	30.0	30.0	29.4	26.2	19.2	17.5	17.1	16.7
	Temp.	4.0	4.0	4.0	3.6	3.1	3.1	3.3	3.6
	Current	—4	—11	—16	—31	—12	—29	—33	—37
13/4	Sal.	30.0	29.4	29.6	27.1	19.8	16.8	10.8	10.3
	Temp.	4.0	4.1	4.0	3.6	3.0	3.0	3.0	2.8
	Current	2	—3	—11	—3	46	49	130	102
14/4	Sal.	30.3	30.4	29.8	29.4	20.8	16.4	12.3	11.3
	Temp.	4.1	4.0	4.0	3.9	3.0	3.0	3.1	2.9
	Current	—12	—21	—20	—32	—1	38	70	104
15/4	Sal.	30.0	30.0	29.2	27.4	17.7	13.4	12.0	11.4
	Temp.	4.0	4.0	4.0	3.7	3.2	3.0	3.0	3.1
	Current	10	—24	—38	—42	—44	—27	—63	—31
16/4	Sal.	30.6	30.3	30.0	28.5	20.1	15.3	13.4	12.7
	Temp.	4.2	4.1	4.1	4.0	3.4	3.2	3.3	3.2
	Current	—14	—16	—14	—18	3	—10	—3	—16
17/4	Sal.	30.5	30.3	30.1	29.2	23.9	17.1	13.4	12.6
	Temp.	4.2	4.2	4.2	4.1	3.6	3.3	3.4	3.6
	Current	—16	—12	—15	—20	—8	10	16	39
18/4	Sal.	30.3	30.0		29.2	24.1	17.3	14.0	12.3
	Temp.	4.2	4.2		4.1	3.7	3.4	3.3	4.0
	Current	0	—18		—12	—11	—9	9	30
19/4	Sal.	30.5	30.2	30.0	29.2	23.7	17.7	13.8	12.7
	Temp.	4.2	4.2	4.1	4.0	3.6	3.0	3.9	4.4
	Current	—13	—16	—18	—21	—12	23	49	52
20/4	Sal.	30.1	30.1	29.8	29.0	24.3	18.1	13.2	11.9
	Temp.	4.1	4.2	4.1	4.1	3.7	3.1	4.2	4.3
	Current	4	—4	—3	—18	—11	14	47	54
21/4	Sal.	30.2	29.6		27.8	17.7	12.6	11.2	11.1
	Temp.	4.1	4.1		4.0	3.6	4.0	3.8	3.9
	Current	—7	—8		—20	14	89	112	111
22/4	Sal.	30.3	30.2	29.8	28.5	19.9	12.8	11.0	10.4
	Temp.	4.2	4.2	4.1	4.1	3.9	3.9	4.0	4.2
	Current	0	—3	—6	—12	8	53	69	104
23/4	Sal.	30.1	30.0	30.0	27.9	11.7	11.0	10.7	10.5
	Temp.	4.2	4.2	4.2	4.1	4.0	3.9	3.9	3.9
	Current	—3	—7	—19	3	94	111	152	147
24/4	Sal.	30.1	30.0	29.8	28.8	13.7	11.9	11.4	10.5
	Temp.	4.2	4.2	4.2	4.1	4.1	4.0	4.0	4.0
	Current	—6	—15	—22	—22	27	52	56	67
25/4	Sal.	30.4	30.2	29.4	28.2	22.4	12.4	10.7	10.2
	Temp.	4.2	4.2	4.2	4.2	4.0	4.0	4.0	4.2
	Current								
26/4	Sal.	30.7	30.7	30.4	29.6	21.5	14.3	11.7	10.8
	Temp.	4.3	4.3	4.3	4.3	4.2	4.5	4.6	4.9
	Current								
27/4	Sal.	30.9	30.6	30.4	28.5	24.8	15.2	12.2	11.6
	Temp.	4.4	4.4	4.4	4.5	4.5	4.9	5.0	5.1
	Current								
28/4	Sal.	30.7	30.6	30.3	29.0	24.9	16.1	13.6	13.4
	Temp.	4.4	4.4	4.4	4.4	4.5	5.1	5.4	5.5
	Current								
29/4	Sal.	30.8	30.6	30.1	28.4	23.6	18.7	15.6	15.2
	Temp.	4.5	4.5	4.5	4.5	4.7	5.3	5.7	5.8
	Current								
30/4	Sal.	30.9	30.8	30.0	28.5	23.4	17.2	16.0	15.7
	Temp.	4.6	4.6	4.6	4.6	4.9	5.7	5.9	6.0
	Current								

Date	Hour	Depth m.	Gadus callarias								Onos sp.							Pl. platessa					Pl. limanda							Pl. flesus							Pl. o	
			Total	?	d	nE	G	yE	pE	pO	Total	?	d	nE	G	yE	pE	Total	d	G	pE	pO	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?
10/4		35—0	3	.	.	.	3	.	.	.	2	.	.	.	2	.	.	.	.	.	.	.	4	.	1	.	3	.	.	16	.	.	.	14	.	2	.	.
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27/4	9^{55} a. m.	35—0	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	1	.	.	5	.	2	8	1	.	.	6	.	1	.	.
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28/4	9^{45} a. m.	35—0	19	.	2	.	10	1	6	.	8	.	.	.	7	1	.	3	.	.	2	1	16	.	2	.	9	1	4	134	4	7	.	65	26	32	4	.
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29/4	10^{10} a. m.	35—0	14	1	.	.	4	4	4	1	10	.	.	.	6	2	2	4	1	.	.	3	26	3	.	.	13	4	6	79	1	4	.	29	11	34	4	1
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30/4	9^{45} a. m.	35—0	2	.	.	.	2	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	8	.	.	.	7	1	.	5	.	1	.	1	2	1	.	.
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[1] Every figure represents the mean of six observations in the twenty-four hours. The salinity is given in $^0/_{00}$, the temperature in centigrades, the speed of the current in cm pr. sec. The direction of the current is expressed by means of + (S—N) or ÷ (N—S).

of the material collected.

Pl. limanda or flesus						Ova sp. indet.						undeterminable	Larvæ			Hour	Depth m.	Gadus callarias								Onos sp.							Pl. platessa					Pl. limanda							Pl. flesus							Larvæ			
Total	?	nE	G	yE	pE	Total	?	d	nE	G	pE	d	Pleur. limanda	Ammodytes sp.	Clupea sp.			Total	?	d	nE	G	yE	pE	pO	Total	?	d	nE	G	yE	pE	Total	d	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	Agonus cataphractus	Gadus callarias	Ammodytes sp.	Pleur. limanda
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(Table III continued).

Date	HYDROGRAPHICAL OBSERVATIONS	Meters below the surface: 35	30	25	20	15	10	5	0	Hour	Depth m.
1/5	Sal.	31.1	31.0	30.6	29.1	24.2	19.3	17.0	16.9	9^{40} a. m.	35—0
	Temp.	4.7	4.7	4.7	4.8	5.0	5.5	5.8	5.8		
	Current										
2/5	Sal.	31.2	31.0	30.1	28.9	23.9	18.8	17.9	17.7	9^{40} a. m.	35—0
	Temp.	4.8	4.8	4.8	4.8	5.0	5.8	5.8	5.8		
	Current										
3/5	Sal.	31.3	31.3	31.0	29.8	27.0	20.5	18.2	17.0	9^{30} a. m.	35—0
	Temp.	4.8	4.8	4.8	4.8	5.0	5.7	6.2	6.7		
	Current	—7	—14	—14	—17	—15	—4	—15	—13		
4/5	Sal.	31.7	31.5	31.4	30.7	27.9	21.3	18.6	15.9	9^{15} a. m.	35—0
	Temp.	4.8	4.8	4.8	4.9	5.0	5.8	6.2	7.2	11^{15} p. m.	35—0
	Current	—9	—14	—13	—16	—11	16	37	46		
5/5	Sal.	31.6	31.8	31.6	31.0	27.7	21.1	15.9	12.8	9^{30} a. m.	35—0
	Temp.	4.8	4.8	4.8	4.8	5.0	5.6	6.4	7.2		
	Current	2	—6	—10	—20	—20	7	66	59		
6/5	Sal.	31.5	31.4	30.6	29.6	19.8	14.7	12.3	11.6		
	Temp.	4.8	4.8	4.8	4.9	5.9	6.2	6.5	6.6		
	Current										
7/5	Sal.	31.4	31.1	30.1	26.2	18.0	13.1	12.2	10.1	10 a. m.	35—0
	Temp.	4.8	4.8	4.8	5.0	6.0	6.2	6.2	6.0		
	Current										
8/5	Sal.	31.6	31.3	30.6	29.7	22.0	12.8	11.6	10.9	9^{30} a. m.	34—0
	Temp.	4.9	4.9	4.9	4.9	5.4	6.1	6.4	6.7		
	Current	0	—12	—42	—26	—7	52	84	89		
9/5	Sal.	31.8	31.6	31.3	29.6	24.3	12.9	11.1	10.2	9^{20} a. m.	34—0
	Temp.	4.9	4.8	4.9	5.0	5.1	6.2	6.5	7.0		
	Current	—6	—4	—24	—20	—5	64	51	48		
10/5	Sal.	31.6	31.4	31.0	29.7	25.4	14.6	11.6	10.8	9^{20} a. m.	34½—0
	Temp.	4.9	4.9	4.9	5.0	5.3	5.9	7.2	7.5		
	Current	—7	—13	—23	—26	—30	24	38	34		
11/5	Sal.	31.2	31.2	31.0	30.1	26.4	16.4	12.2	11.5	9^{30} a. m.	34½—0
	Temp.	5.0	5.0	5.0	5.0	5.5	6.0	7.3	7.4		
	Current	—9	—18	—23	—34	—32	—36	—19	21		
12/5	Sal.	29.6	29.5	29.3	28.8	27.3	19.7	12.4	12.1	9^{30} a. m.	34½—0
	Temp.	5.0	5.0	5.0	5.1	5.4	6.3	7.2	7.3		
	Current	—8	—14	—19	—27	—21	—25	11	19		
13/5	Sal.	29.5	28.9	29.0	27.4	25.0	18.7	14.6	13.7	9^{30} a. m.	34—0
	Temp.	5.0	5.1	5.2	5.5	5.7	6.6	7.0	7.2		
	Current	—30	—48	—49	—62	—55	—87	—80	—78		
14/5	Sal.	28.2	28.6	27.4	24.0	19.9	18.6	17.0	16.6	9^{30} a. m.	35—0
	Temp.	5.2	5.3	5.5	6.0	6.6	6.9	7.2	7.3		
	Current	—16	—20	—29	—43	—38	—46	—65	—72		
15/5	Sal.	29.2	28.9	28.7	27.6	23.5	20.6	18.2	17.4	9^{30} a. m.	34½—0
	Temp.	5.2	5.2	5.3	5.5	6.1	6.7	7.1	7.3		
	Current	—7	—16	—16	—26	—8	6	2	19		
16/5	Sal.	29.3	29.2	28.9	28.4	22.9	21.0	19.2	18.6	9^{30} a. m.	34½—0
	Temp.	5.2	5.2	5.3	5.4	6.2	6.6	6.8	6.8		
	Current	—15	—15	—15	—16	—10	—2	14	35		

Date	Hour	Gadus callarias								Onos sp.							Pl. limanda							Pl. flesus							Pl. limanda or flesus						Clu	
		Total	?	d	nE	G	yE	pE	pO	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?	nE	G	yE	pE	Total	?
1/5	9^{40} a. m.	1	.	.	.	1	.	.	.	6	1	.	.	2	2	1	32	1	.	.	17	6	8	28	.	.	.	14	5	9	3	.	.	1	2	.	.	.
2/5	9^{40} a. m.	2	.	1	.	1	.	.	.	2	.	.	.	1	1	.	12	.	.	2	9	.	1	2	.	.	.	.	.	2	.	.	.	.	.	.	.	.
3/5	9^{30} a. m.	4	.	.	.	4	.	.	.	2	.	.	.	2	.	.	7	.	.	.	3	2	2	8	.	.	.	8	.	.	2	.	.	2	.	.	.	.
4/5	9^{15} a. m.	1	.	.	.	1	.	.	.	1	.	.	.	1	.	.	10	1	.	.	7	2	.	3	.	.	.	3	.	.	.	.	.	.	.	.	.	.
	11^{15} p. m.	.	.	.	.	.	.	.	.	2	.	.	.	1	.	1	12	.	.	1	8	3	.	4	.	.	.	.	.	4	.	.	.	.	.	.	.	.
5/5	9^{30} a. m.	3	.	2	.	1	.	.	.	.	.	.	.	.	.	.	25	.	4	.	15	5	1	10	.	5	.	.	1	4	3	.	.	2	1	.	.	.
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7/5	10 a. m.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	14	1	1	.	8	2	2	4	1	.	.	2	.	1	.	.	.	.	.	.	.	.
8/5	9^{30} a. m.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3	.	.	1	.	.	.	1	.	.	1	.	.	.	1	.	.	.
9/5	9^{20} a. m.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	6	2	.	5	.	.	.	5	.	.	.	.	.	.	.	.	.	.
10/5	9^{20} a. m.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	21	.	1	.	16	3	1	4	.	1	.	.	.	3	.	.	.	.	.	.	2?	1
11/5	9^{30} a. m.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	27	.	2	1	9	12	3	1	.	.	.	.	.	1	.	.	.	.	.	.	1	.
12/5	9^{30} a. m.	1	.	.	.	1	.	.	.	2	.	.	.	.	.	2[1]	43	.	2	1	22	10	8	2	.	.	1	1	.	.	1	.	.	1	.	.	1	.
13/5	9^{30} a. m.	7	.	.	1	6	.	.	.	.	.	.	.	.	.	.	108	3	4	.	65	18	18	4	.	.	.	3	.	1	.	.	.	.	.	.	1	.
14/5	9^{30} a. m.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	36	1	2	2	17	8	6	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.
15/5	9^{30} a. m.	1?	.	.	.	1	.	.	.	.	.	.	.	.	.	.	7	.	.	.	2	.	5	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
16/5	9^{30} a. m.	1	.	.	.	.	.	1	.	2	.	.	.	2	.	.	45	.	3	.	20	9	13	4	1	.	.	3	.	.	.	.	.	.	.	.	1	.

[1] The one with pigmented eyes, undoubtedly cimbrius.

Clupea sprattus							Ova sp. indet.						undeterminable	Larvæ		Hour	Depth	Gadus callarias								Onos sp.				Pl. limanda							Pl. flesus							Pl. limanda or flesus	Clupea sprattus							Ova sp. indet	Larvæ		
Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	pE	d	Gadus callarias	Pleur. limanda			Total	?	d	nE	G	yE	pE	pO	Total	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	G	Total	?	d	nE	G	yE	pE	G	Gadus callarias	Pleur. limanda	sp. indet.
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(Table III continued).

Date		HYDROGRAPHICAL OBSERVATIONS								Hour	Depth m	Gadus callarias								Onos sp.						Pl. limanda						
		Meters below the surface																														
		35	30	25	20	15	10	5	0			Total	?	d	nE	G	yE	pE	pO	Total	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE
17/5	Sal.	25.5	26.4	29.0	22.4	20.9	16·4	16.0	16.0			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	5.9	5.7	5.4	6.2	7.0	7.4	7.4	7.3			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current																															
18/5	Sal.	27.8	27.2	26.5	22.1	19.1	17.7	16.9	16.9	9^{30} a. m.	35 – 0	1	1	.	.	.	.	.	.	1	.	.	.	.	1	18	.	2	.	7	2	7
	Temp.	5.6	5.7	5.8	6.3	6 8	7.1	7.2	7.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-26	-34	-46	-47	-30	-30	-19	13																							
19/5	Sal.	29.2	28.0	27.2	23.1	19.5	18.8	18.1	18.1	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	5	1	.	1	2	1[1]	68	1	.	.	36	16	15
	Temp.	5.7	5.7	5.8	6.5	7.1	7.2	7.2	7.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-30	-43	-43	-63	-48	-39	-50	-55																							
20/5	Sal.	28.2	28.0	27.4	24.5	20.2	20.0	19.8	19.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	5.8	5.8	5.9	6·1	7.2	7.2	7.3	7.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-19	-28	-29	-44	-31	-23	-34	-30																							
21/5	Sal.	28.5	28.4	27.9	26.0	22.1	20.5	20.0	16.7	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	3	.	.	1	.	2	66	.	2	.	26	13	25
	Temp.	5.8	5.8	5.9	6.2	7.0	7.5	7.8	8.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-4	-7	-9	-10	9	17	22	41																							
22/5	Sal.	28.1	28.0	27.4	24.7	21.0	19.7	17.4	15.6	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	1	.	.	1	.	.	38	3	2	.	14	3	16
	Temp.	5.9	5.9	6.0	6.2	7.1	7.4	8.4	9.2	11 p. m.	35 – 0	.	.	.	.	.	.	.	.	1	1	.	.	.	.	13	1	.	.	5	2	5
	Current	1	-4	-9	10	52	57	75	118																							
23/5	Sal.	28.0	28.0	25.6	24.0	20.0	17.0	14.8	13.3	9^{30} a. m.	35 – 0	1	.	.	.	1	.	.	.	.	.	.	.	.	.	36	1	2	21	5	4	3
	Temp.	5.9	5.9	6.0	6.4	7.0	7.8	8.6	8.5			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current																															
24/5	Sal.	28.0	27.8	27.7	25.1	20.3	15.9	13.5	13.1	9^{30} a. m.	35 – 0	1	.	.	.	1	.	.	.	1	.	.	.	.	1	58	.	.	4	25	10	19
	Temp.	6.0	6.0	6.0	6.4	7.2	8.0	8.5	8.9			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-11	-17	-19	-22	-2	35	69	81																							
25/5	Sal.	28.0	27.6	27.4	26.1	18.6	16.2	14.8	13.6	9^{80} a. m.	35 – 0	1	.	.	.	1	.	.	.	1	.	.	1	.	.	68	1	3	16	21	17	10
	Temp.	6.0	6.2	6.2	6.8	8.4	8.9	9.2	9.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-5	-10	-7	-18	-15	-25	-33	-36																							
26/5	Sal.	29.4	28.9	29.0	27.6	22.2	16.0	14.3	14.0	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35	.	1	.	19	1	14
	Temp.	6.0	6.0	6.1	6.3	7.4	9.0	9.7	9.7			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-1	-3	-5	3	38	65	81	122																							
27/5	Sal.	29.9	28.4	27.3	18.0	14.9	13.4	12.8	13.0			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.0	6.2	6.4	8.4	9.1	9.2	9.2	9.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-14	-25	-36	128	170	147	162	168																							
28/5	Sal.	28.8	27.0	21.1	16.7	13.0	12.9	12.4	11.7	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13	1	1	1	5	2	3
	Temp.	6.2	6.4	7.5	8.4	9.2	9.2	9.2	9.3			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-7	-20		103	94	80	108	98																							
29/5	Sal.	29.0	29.0	27.9	23.2	15.1	12.8	12.3	11.0	9^{30} a. m.	35 – 0	1	.	.	.	.	1	.	.	.	.	.	.	.	.	36	1	1	3	25	3	3
	Temp.	6.3	6.2	6.5	7.2	8.8	9.2	9.2	9.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-8	-16	-17	1	48	50	56	63																							
30/5	Sal.	29.2	29.2	28.8	26.8	19.9	12.4	10.7	10.0	9^{30} a. m.	35 – 0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	30	.	.	.	19	.	11
	Temp.	6.4	6.2	6.4	6.7	7.8	9 2	9.6	9.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-12	-10	-8	-6	36	90		106																							

[1] cimbrius.

Pl. flesus							Pl. limanda or flesus			Clupea sprattus							undeterminable	Larvæ	Hour	Depth m.	Onos sp.				Pl. limanda							Pl. flesus							Pl. limanda or flesus	Clupea sprattus						
Total	?	d	nE	G	yE	pE	Total	G	yE	Total	?	d	nE	G	yE	pE	d	Liparis liparis			Total	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	?	d	nE	G	yE	pE	G	Total	?	d	nE	G	yE	pE
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3	1	.	.	2	.	.	.	.	.	6	.	.	.	3	1	2	.	.	9^{40} a. m.	15—0	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	4	.	.	.	4	.	.
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(Table III continued).

Date		HYDROGRAPHICAL OBSERVATIONS: Meters below the surface 35	30	25	20	15	10	5	0	Hour	Depth m.	Onos sp. Total	Onos sp. G	Onos sp. yE	Onos sp. pE	Pl. limanda Total	Pl. limanda ?	Pl. limanda d	Pl. limanda nE	Pl. limanda G	Pl. limanda yE	Pl. limanda pE	Pl. flesus Total	Pl. flesus ?	Pl. flesus d	Pl. flesus nE	Pl. flesus G	Pl. flesus yE	Pl. flesus pE	Pl. limanda or flesus Total	Pl. limanda or flesus ?	Pl. limanda or flesus nE	Pl. limanda or flesus G	Rhombus laevis G
1/6	Sal.	30.4	30.4	30.3	30.1	26.6	18.4	12.1	11.0	9^{30} a. m.	35—0	.	.	.	.	28	.	.	3	14	6	5	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.4	6.2	6.2	6.4	7.0	8.6	9.8	11.1			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—12	—6	—7	—17	—32	—10	23	32																									
2/6	Sal.	30.2	30.2	30.2	29.6	25.4	17.8	12.5	11.1	9^{30} a. m.	35—0	.	.	.	.	45	1	1	5	25	5	8	1	.	.	.	1	.	.	.	.	.	.	.
	Temp.	6.3	6.3	6.4	6.6	7.4	9.1	10.4	10.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—11	—18	—21	—28	—23	—36	—28	—33																									
3/6	Sal.	30.0	29.9	29.8	28.9	24.4	16.5	13.5	12.9	9^{30} a. m.	35—0	2	1	.	1	76	1	.	6	29	14	26	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.4	6.4	6.4	6.7	7.7	10.0	11.0	11.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—9	—20	—25	—32	—25	—40	—43	—43																									
4/6	Sal.	30.0	29.9	29.7	29.2	24.7	16.2	14.8	14.3	9^{30} a. m.	35—0	3	2	.	1	59	.	.	.	29	10	20	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.3	6.4	6.5	6.7	7.8	10.7	11.1	11.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—8	—14	—20	—27	—18	—21	—18	—13																									
5/6	Sal.	29.9	29.8	29.7	28,2	24.4	19.1	15.1	14.9	9^{30} a. m.	35—0	.	.	.	.	60	1	3	.	24	7	25	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.4	6.4	6.5	6.9	8.2	10.0	11.4	11.9			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—11	—18	—24	—34	—30	—28	—13	—12																									
6/6	Sal.	30.4	30.2	30.0	29.5	25.0	21.2	15.3	15.0	9^{30} a. m.	35—0	2	2	.	.	65	3	1	.	32	5	24	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.4	6.4	6.5	6.7	8.2	9.4	11.8	11.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current																																	
7/6	Sal.	30.4	30.3	30.1	28.3	24.5	20.0	16.1	16.0	9^{30} a. m.	35—0	1	1	.	.	93	1	.	.	37	19	36	.	.	.	.	.	.	.	2	.	1	1	.
	Temp.	6.5	6.6	6.6	7.2	8.6	10.4	12.3	12.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—15	—17	—19	—32	—25	—33	—35	—35																									
8/6	Sal.	30.4	30.4	30.2	28.4	25.0	20.1	17.5	17.5	9^{30} a. m.	35—0	.	.	.	.	68	1	.	1	38	8	20	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.6	6.6	6.7	7.3	8.6	10.7	11.8	11.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—12	—19	—20	—26	—25	—38	—33	—36																									
9/6	Sal.	30.8	30.7	30.5	29.6	24.0	20.8	19.2	19.2	9^{30} a. m.	35—0	2	1	1	.	73	1	2	.	52	3	15	.	.	.	.	.	.	.	.	.	.	.	1
	Temp.	6.6	6.6	6.6	6.9	9.2	10.6	11.2	11.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—22	—23	—30	—46	—53	—54	—60	—61																									
10/6	Sal.	31.2	31.0	30.9	29.3	22.4	21.2	20.8	20.6	9^{30} a. m.	35—0	1	1	.	.	35	.	.	3	14	5	13	.	.	.	.	.	.	.	1	1	.	.	.
	Temp.	6.6	6.6	6.7	7.2	10.1	10.7	10.8	10.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—9	—15	—19	—38	—28	—35	—44	—45																									
11/6	Sal.	31.2	31.1	30.7	29.5	24.9	21.5	20.6	20.2	9^{40} a. m.	35—0	1	.	1	.	37	.	1	1	19	6	10	.	.	.	.	.	.	.	1	.	.	1	.
	Temp.	6.6	6.7	6.8	7.1	8.7	10.5	11.1	11.3			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	7	0	4	10	25	26	23	28																									
12/6	Sal.	30.7	30.4	29.5	26.5	21.9	20.7	18.0	14.9	9^{30} a. m.	35—0	.	.	.	.	18	.	.	1	6	5	6	.	.	.	.	.	.	.	3	.	.	3	.
	Temp.	6.8	6.8	7.1	7.9	9.6	10.0	11.2	11.7			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—8	—9	—7	12	28	57	78	92																									
13/6	Sal.	30.6	30.4	29.7	26.9	22.5	20.2	16.6	13.9	10^{30} a. m.	35—0	.	.	.	.	27	.	.	.	11	7	9	3?	.	.	.	3	.	.	.	.	.	.	.
	Temp.	6.8	6.8	7.0	7.8	9.0	10.1	11.4	11.5			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current																																	
14/6	Sal.	40.5	30.4	30.0	27.5	22.8	19.0	16.2	12.0	9^{30} a. m.	35—0	3	2	1	.	16	.	.	.	10	2	4	.	.	.	.	.	.	.	.	.	.	.	.
	Temp.	6.8	6.8	7.0	7.7	9.0	10.6	11.5	12.7			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—10	—20	—7	13	38	75	110	123																									
15/6	Sal.	30.2	30.0	28.8	26.7	18.6	16.5	14.0	11.0																									
	Temp.	6.9	7.0	7.3	7.9	10.4	11.2	12.8	12.9			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	—6	—8	—2	12	63	72	109	138			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Clupea sprattus							Ova sp. indet.				undeterminable	Larvæ: Pleur. limanda	Larvæ: Rhombus maximus	Larvæ: Clupea harengus	Larvæ: Clupea sprattus	Hour	Depth	Onos sp.				Pl. limanda							Pl. flesus				Pl. limanda or flesus				Clupea sprattus							undeterminable	Larvæ: Ammodytes sp.	Larvæ: Pleur. limanda	Larvæ: Clupea sprattus
Total	?	d	nE	G	yE	pE	Total	?	G	yE	d							Total	G	yE	pE	Total	?	d	nE	G	yE	pE	Total	G	yE	pE	Total	G	yE	pE	Total	?	d	nE	G	yE	pE	d			
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9^{40} a. m.	10—0	.	.	.	.	6	.	.	.	3	.	3	.	.	.	.	.	.	.	.	3	.	.	.	3	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	10—0	.	.	.	.	2	.	.	.	2	.	.	.	.	.	.	.	.	.	.	6	.	.	.	5	.	1	.	.	.	.
5	.	.	.	4	.	1	1	.	1	.	.	.	.	.	.	9^{40} a. m.	10—0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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16	.	.	.	6	6	4	.	.	.	.	.	4	.	.	.	9^{40} a. m.	10—0	.	.	.	.	2	.	.	.	.	1	1	.	.	.	.	.	.	.	.	5	.	.	.	1	3	1	.	.	2	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	10—0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.
9	.	.	.	4	.		.	.	.	.	.	.	.	.	.	9^{40} a. m.	10—0	1	.	.	1	3	.	.	.	1	1	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	10—0	.	.	.	.	9	.	.	.	3	3	3	.	.	.	.	.	.	.	.	6	.	1	.	2	1	2	.	.	1	1
15	.	.	.	6	4	5	.	.	.	.	.	2	.	.	1	9^{40} a. m.	10—0	.	.	.	.	20	.	.	.	9	3	8	.	.	.	.	.	.	.	.	13	1	.	.	3	3	6	.	.	1	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	10—0	.	.	.	.	1	.	.	.	.	.	1	1	.	1	.	.	.	.	.	3	.	.	.	1	.	2	.	.	.	.
22	.	.	.	10	4	8	.	.	.	.	3	2	.	.	.	9^{40} a. m	7—0	.	.	.	.	6	.	.	.	1	2	3	.	.	.	.	.	.	.	.	2	.	.	.	2	.	.	.	.	.	.
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25	.	.	.	12	7	6	1	1	.	.	.	8	.	.	.	9^{40} a. m.	10—0	1	1	.	.	41	2	.	.	16	10	13	.	.	.	.	.	.	.	.	9	.	.	.	1	4	4	.	.	1	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	10—0	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	4	.	.	.	.	.	4	.	.	.	.
3	2	.	2	12	8	9	.	.	.	.	.	4	.	.	2	9^{40} a. m.	7—0	.	.	.	.	8	.	.	.	5	.	3	1	1	.	.	.	.	.	.	7	.	.	2	3	1	1	2	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	7—0	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	5	1	.	.	2	1	1	.	.	1	.
1	.	3	3	18	7	10	.	.	.	.	.	3	.	.	.	9^{40} a. m.	5—0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	1	.	.	2	.	.	1	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11 p. m.	5—0	.	.	.	.	4	.	.	.	2	.	2	.	.	.	.	.	.	.	.	11	.	.	.	3	5	3	.	1	2	.
1	2	.	3	9	4	3	.	.	.	.	.	6	.	.	.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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7	.	3	.	15	2	7	.	.	.	.	.	1	.	.	.	10^{40} a. m.	10—0	.	.	.	.	2	.	.	.	1	.	1	.	.	.	.	1	1	.	.	1	.	.	.	1	.	.	.	.	.	.
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[1] Gad. callarias?

(Table III continued).

Date		HYDROGRAPHICAL OBSERVATIONS								Hour	Depth m.	Onos sp.	Pl. limanda							Pl. limanda or flesus			Clupea sprattus							Ammodytes sp.
		meters below the surface																												
		35	30	25	20	15	10	5	0			G	Total	?	d	nE	G	yE	pE	Total	G	yE	Total	?	d	nE	G	yE	pE	
16/6	Sal.	30.1	30.1	29.4	26.7	19.3	15.4	12.6	10.1	9^{40} a. m.	35-0	.	1	.	.	1	.	.	.	.	.	.	36	.	.	.	28	3	5	.
	Temp.	6.9	6.9	7.2	8.0	10.4	11.2	12.4	12.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-10	-12	-10	-1	29	53	69	95																					
17/6	Sal.	30.1	30.1		27.3		15.6	13.2	10.2	9^{30} a. m.	35-0	.	11	.	.	.	9	1	1	.	.	.	32	.	.	.	29	2	1	.
	Temp.	6.9	7.0		7.8		11.3	12.9	13.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-11	-20	-24	-11	13	40	48	51																					
18/6	Sal.	30.0	30.0		28.8	22.2	15.9		10.5	9^{30} a. m.	35-0	.	27	.	.	1	17	5	4	.	.	.	21	.	.	.	8	1	12	.
	Temp.	7.0	7.0		7.6	9.7	11.0		12.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-11	-12	-11	-30	-12	-14	14	-7																					
19/6	Sal.	30.1	30.0	29.9	29.2	22.9	18.2	12.8	12.3	9^{30} a. m.	35-0	.	21	.	.	3	11	3	4	.	.	.	8	.	.	.	4	3	1	.
	Temp.	6.9	7.0	7.1	7.4	9.7	11.0	12.8	13.0			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-19	-24	-21	-29	-17	-15	-8	-11																					
20/6	Sal.	30.4	30.3	30.1	28.7	21.6	15.6	13.6	13.2	10 a. m.	35-0	1	25	.	1	.	19	2	3	1	1	.	7	.	.	.	3	1	3	.
	Temp.	6.9	6.9	7.1	7.7	10.4	12.7	12.8	13.0			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current																													
21/6	Sal.	30.7	30.6	30.3	29.5	22.8	17.8	14.8	13.9	9^{30} a. m.	35-0	.	16	.	.	.	6	5	5	1	1	.	5	.	.	.	4	1	.	.
	Temp.	6.9	6.9	7.0	7.6	10.0	12.1	13.1	13.5			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-8	-10	-12	-21	-2	-3	17	24																					
22/6	Sal.	30.8	30.7	30.4	28.8	23.5	17.7	14.4	13.0	9^{30} a. m.	35-0	.	28	1	.	.	9	7	11	.	.	.	9	.	.	.	6	.	3	.
	Temp.	6.9	6.9	7.1	7.8	9.5	10.9	13.2	14.4			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-7	-7	-6	-6	12	52	74	91																					
23/6	Sal.	30.7	30.7	30.3	28.2	22.3	15.6	13.0	11.9	9^{30} a. m.	35-0	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.	15	.	.	.
	Temp.	6.9	6.9	7.2	8.0	9.6	11.8	13.4	14.2			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-5	-9	-7	-2	33	64	86	89																					
24/6	Sal.	30.6	30.6	30.1	28.5	22.2	14.4	12.0	9.8	9^{30} a. m.	35-0	.	34	.	1	12	10	3	8	1	1	.	15	.	.	.	11	2	2	.
	Temp.	6.9	7.0	7.3	7.9	9.9	12.1	13.4	14.3			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-2	-5	-3	0	7	53	83	95																					
25/6	Sal.	30.5	30.5	30.1	28.6	22.1	15.6	10.6	10.2	9^{30} a. m.	35-0	.	31	.	.	.	12	10	9	2	1	1	15	.	.	.	11	2	2	.
	Temp.	7.0	7.0	7.3	7.9	9.7	11.6	14.6	14.8			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	Current	-4	-9	-12	-6	12	57	102	116																					
26/6	Sal.	30.6	30.5		28.8		14.1		9.0	9^{30} a. m.	35-0	.	5	.	1	1	1	1	1	2	1	1	4	.	.	.	4	.	.	.
	Temp.	7.0	7.1		7.9		12.2		14.6	10^{30} p. m.	35-0	.	2	.	.	.	2	.	.	.	.	.	3	.	.	.	3	.	.	1
	Current	-6	-6	-4	2	22	72	109	131																					
27/6	Sal.	30.5	30.3		28.7		13.1		9.4	9^{30} a. m.	35-0	.	2	.	.	.	.	.	2	1	1	.	3	.	.	.	3	.	.	.
	Temp.	7.0	7.1		7.8		13.6		14.7	10^{40} p. m.	35-0	.	1	.	.	.	1	.	.	.	.	.	4	.	.	.	3	.	1	.
	Current	-10	-10	-8	-2	17	59	97	102																					

Larvæ			Hour	Depth m.	Onos sp.	Pleur. limanda							Pl. flesus				Pl. limanda or flesus	Clupea sprattus							Larvæ				
Ammodytes sp.	Pleur. limanda	Clupea harengus			G	Total	?	d	nE	G	yE	pE	Total	G	yE	pE	G	Total	?	d	nE	G	yE	pE	Ammodytes sp.	Pleur. limanda	Gobius sp.	Clupea harengus	Clupea sprattus
.	1	.	9^{50} a. m.	15—0	.	.	.	.	.	.	.	.	.	.	.	.	.	25	.	.	.	25	.	.	.	.	.	.	.
.	.	.	10^{40} p. m.	15—0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	9^{40} a. m.	14—0	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3	.	.	.	.	.	.	.
.	.	.	10^{40} p. m.	14—0	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.	.	.	7	2	2	.	.	.	.	.
.	1	.	9^{40} a. m.	14—0	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	2	.	7	3	4	.	.	1	.	.
.	.	.	10^{50} p. m.	14—0	.	6	.	.	.	5	.	1	.	.	.	.	.	3	.	.	.	1	1	1	.	.	.	.	.
.	1	.	9^{40} a. m.	10—0	.	3	.	.	.	3	.	.	.	.	.	.	.	6	.	.	.	6	.	.	.	1	.	.	.
.	.	.	11 p. m.	10—0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
.	2	.	10^{10} a. m.	12—0	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2	.	1	.	.	.
.	.	.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	9^{40} a. m.	13—0	.	2	.	.	.	1	1	.	.	.	.	.	.	8	.	.	.	5	2	1	.	.	.	.	.
.	.	.	11 p. m.	13—0	1	.	.	.	.	.	.	.	1	.	.	1	.	1	.	.	.	.	.	1	.	.	.	.	.
.	1	.	9^{40} a. m.	12—0	.	1	.	.	.	.	.	1	.	.	.	.	.	9	.	.	.	9	.	.	1	.	.	.	.
.	.	.	11 p. m.	12—0	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	3	.	.	.	.	.	.	1
.	.	.	9^{40} a. m.	13—0	.	8	.	.	1	1	1	5	.	.	.	.	.	13	.	1	.	11	.	1	.	.	.	4	.
.	.	.			.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	.	9^{40} a. m.	13—0	.	.	.	.	.	.	.	.	.	.	.	.	1	6	.	.	.	5	.	1	.	.	.	.	.
.	.	.	10^{40} p. m.	13—0	.	.	.	.	.	.	.	.	1	.	.	1	.	4	.	.	.	4	.	.	.	.	2	.	.
.	1	.	9^{10} a. m.	13—0	.	1	.	.	.	.	.	1	.	.	.	.	.	4	.	.	.	4	.	.	.	.	.	.	.
.	.	.	11 p. m.	13—0	.	1	.	.	.	.	.	1	3	2	.	1	1	2	.	.	.	1	.	1	.	.	.	.	.
.	6	.	9^{40} a. m.	13—0	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	7	.	1	.	.	1	.	.
1	.	.	10^{40} p. m.	14—0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	1	.	.	.	.
.	.	.	9^{40} a. m.	14—0	.	1	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.
.	.	3	10^{15} p. m.	13—0	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	1	.	.

One of the eggs of 62 is a certain *flesus*, identified by the embryo; thus only 4 eggs in this great sample are undeterminable. 8 is also an example, where only two classes of size have to be excluded, but one of these classes contains 5 specimens. In samples with fewer specimens there will usually be less regularity in the grouping of the variates; in such cases the separation of the species must be effected by comparison with what is known about the average size and the probable limits of variation of the species from the greater samples within the same shorter space of time (exp. 9 and 10). When the one species is rare, the other abundant, we have to use the same method, since an egg so much divergent in size as to fall outside the probable limit of variation of the abundant species, can be referred without doubt to the other species. The outermost individuals of the larger group ought, strictly speaking, to be indicated as uncertain, but the most deviating variates, which are rare when the material is large, can, as a rule, safely be supposed to be quite absent when the material is small. Thus, in the case in question, the probability that any of the dubitable variates belong to the rare species is very slight; in such cases (exp. 2) I have usually referred them to the common species, except in the case mentioned above and represented by exp. 4, 5 and 6, when traces of a secondary top appear near the limit of variation.

These methods I have used in the determination of the *Pleuronectes* eggs, and I have found, that the cases of doubt were comparatively few; wrong identifications are, I believe, so rare as to be of no importance to the general conclusions drawn from the material.

If we want to state the number of individuals and the average size of the two species without regard to the stages of development, we must be allowed to go somewhat further in determinating with probability as one thinks proper in every single case; the error will only be small. In calculating the average size such method is even nescessary, because the exclusion of the outermost variates at the one side of the range would displace the average to no inconsiderable degree.

The determination of the stages of development of the eggs I have carried out with the aid of the drawings of Apstein 1909 and 1911, using, however, somewhat different limits for the stages. Thus my »young embryo« is reckoned from a somewhat earlier point of development than Apstein's, viz. from the moment when a denser mass begins to concentrate itself on the one side of the germinative disc, and this ceases to be a disc. Similarly, the stage »pigmented embryo« I have reckoned from the moment, when any pigmentation at all is visible, not as Apstein did, from the time of presence of »distinct pigment«, which will always be a vague and arbitrary limitation. Thus the durations of the stages as defined by me differ from those given by Apstein (see later p. 31).

Explanation of the signs used in the general view:

d = dead eggs.
nE = eggs containing no embryo, but probably living.
G = - — germinative disc.
yE = - — young embryo.
pE = - — pigmented embryo.
pO = - — embryo with pigmented eyes.

Spawning time.

Table IV represents the average number of living eggs per one haul from bottom to surface within periods of 10 days. I have worked out this table for the purpose of determinating the summit of the spawning time of each species. The results are represented graphically in fig. 3. In the table no notice has been taken of the developmental stages of the eggs; the eggs included in the table are, for the most part, some days old, so that the summits of the curves do not really respresent the time of the maximal spawning itself, which must be sought some days earlier than the time of maxima-occurrence of the eggs.

HEINEN (1912) has worked out a very practical table (Tabelle 2, p. 140), showing the spawning times of the fishes, especially in the Belt Sea. According to his table, the summits of the spawning times are as follows: *Pleuronectes platessa* in February (eggs still present in May), *Gadus callarias* and *Pleur. flesus* in March (eggs still present in June), *Onos cimbrius* in April (spawning time from February to August), *Pleur. limanda* and *Clupea sprattus* in June. APSTEIN (1911) has worked out a figure (Fig. 4, p. 245) similar to mine, showing the average of eggs pr. m^2 surface in the Belt Sea in the various seasons; as to *Pleur. limanda* and *Clupea sprattus* his results agree with HEINEN'S; as to *Pl. platessa*, *Pl. flesus* and *Gadus callarias* the summit of the spawning time as found by APSTEIN has a somewhat later position than is the case according to HEINEN'S statements, for *Pl. flesus* and *Gadus callarias* between April and May; in the case of *Pl. platessa* the spawning has nearly the same intensity during all the four first months of the year, though increasing slowly to a maximum in April. *Onos cimbrius* is not included in APSTEIN'S figure. As will be seen from table IV and fig. 3, the facts of the material from Spodsbjerg agree more with APSTEIN'S statements than with those of HEINEN.

Tabel IV. Average number of living eggs pr. one haul from the bottom to the surface, within periods of 10 days.

	Gad. call.	Onos sp.	Pl. limanda	Pl. flesus	Cl. sprattus
10—20 April	5.6	0.4	4	18.2	—
21—30 —	7.2	3.2	10.5	39.5	—
1—10 May	0.9	1.3	13.5	6.2	—
11—20 —	1.4	1.25	41.5	1.6	2.0
21—31 —	0.3	0.5	37.3	0.7	6.0
1—10 June	—	1.1	58.6	0.1	18.0
11—20 —	—	0.6	21.1	—	27.7
21—27 —	—	—	12.9	—	8.1

Pleuronectes platessa has not been included in table IV; only 16 eggs of this species are to hand, all from April.

Gadus callarias. The maximum falls late in April, the eggs being somewhat less common in the middle of the month. Just after the time of the maximal occurrence the number decreases suddenly (from 7.2 to 0.9 pr. haul), some few eggs being found during the month of May, none in June. The slight increase between May 10th and 20th is due to one single haul, that of May 13th, when the net contained enormous quantities of planceton (*Chaetoceras*, medusæ, fish eggs), having undoubtedly filtered much more water than the column of 35 m from the bottom to the surface (the current was very strong).

Onos has a very extended spawning time. For the present material we may point out a somewhat vaguely marked maximum late in April, from which time the number decreases slowly and somewhat irregularly; the last eggs were found in the surface water on June 21st. According to HEINEN, *Onos* eggs can also be found in July and August.

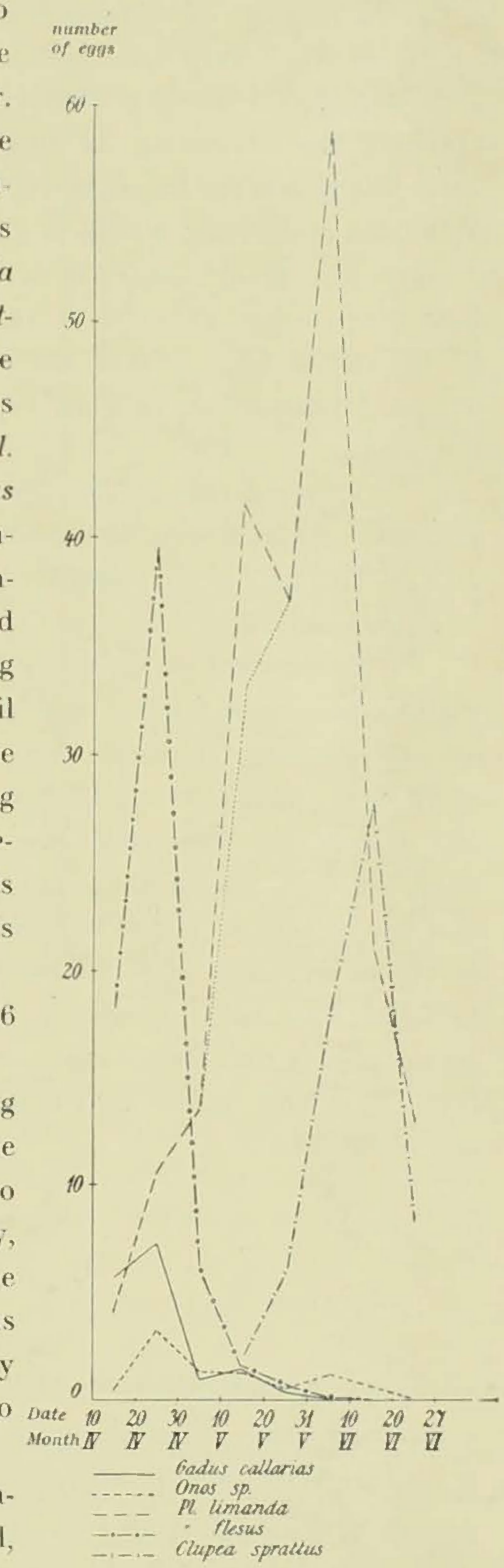

Fig. 3. Average number of living eggs pr. one haul from the bottom to the surface within periods of 10 days.

Also *Pleuronectes flesus* had its maximal occurrence late in April, when, on an average, 39.5 eggs were brought up by every haul from the bottom; the greatest number was 134 in one haul, on April 28th. But from the beginning of May the flounder eggs almost disappeared from the plancton, the number suddenly decreasing very much and continuing to decrease until June. The last indubitable flounder egg from the bottom—surface hauls was taken on June 2nd., but in the surface layers of the water some few flounder eggs were found as late as June 25th, and during the whole of June some doubtful *Pleuronectes* eggs were found also in the hauls from the bottom.

The eggs of *Pleuronectes limanda* were by far the most numerous in the material. During the month of April they were comparatively scarce, though more abundant than the cod eggs. From April 30th the eggs of the dab were more numerous than the flounder eggs, the number increasing very much, reaching the maximum in the beginning of June (average 58.6 eggs pr. haul, 93 eggs in one haul June 7th). As in the case of *Gadus callarias*, we observe a secondary summit in the middle of May, also here exclusively owing to the haul of May 13th, when the net contained 108 dab eggs, more than in any one of the hauls from the time of the maximal occurrence. If we exclude the material of this haul, the average contents of the remaining 7 hauls of the period would be 33.0 eggs, indicated in fig. 3 by the dotted line. From the point of culmination the number of dab eggs decreases very much, the average contents pr. haul in the latter part of the month being 75 $^0/_0$ smaller than in the beginning of the month.

Clupea sprattus. The first indubitable egg was taken on May 11th; during the following time the number increases very considerably, culminating in the middle of June (average 27.7 eggs pr. haul, 53 eggs in one bottom—surface haul June 12th). Between June 20th and 27th the average number pr. haul was only 8.1.

In the case of the three last named species, *Pleur. flesus, Pl. limanda* and *Clupea sprattus*, there exists a very well marked maximum of spawning within a short space of time. The figures of Apstein and Heinen only show the facts for every whole month; my figures, on the other hand, refer to periods of 10 days, thus showing with considerable distinctness how strongly marked the summit of the spawning can be, in any case when the whole material has been collected at the same locality. It will also be observed that the decrease after the culmination takes place much more rapidly than the increase; the number of eggs increases continually during one or two months to the culminating point and thereafter decreases suddenly to a comparatively very small number. For *Pl. limanda* and *Cl. sprattus* the material in hand does not display the further progress of the decrease; in the case of *Pl. flesus,* on the other hand, we see that the number of eggs falls at once very much, further on decreasing more slowly for a fairly long time, a few eggs being found now and then as late as two months after the time of maximal spawning.

Occurrence of the eggs in the different layers of the water.

The 67 bottom—surface hauls have fished through 2340 m, filtering 780 m^3 water; thus the average density of eggs in the whole water column is n : 780 eggs pr. m^3, n being the number of eggs of the species in question caught by all the bottom—surface hauls during the whole time of investigation. The hauls through the upper water-layers have fished through 1110 m, filtering 370 m^3 water; thus the average density of eggs in the upper water layers is n : 370, n being the number of eggs caught by all the hauls of the upper strata. (In table V I have preferred to put down the number of eggs pr. 100 m^3, as we should otherwise get very small fractions with several decimals).

Naturally it would be more practical, if we could obtain proportionate figures for the density of eggs in the lower strata compared with that in the upper strata; but the manner in which this material has been collected renders it impossible to calculate such figures exactly. It will not be permissible to calculate such proportions by means of a simple subtraction, because the bottom—surface hauls have fished through the lower strata, the boundary stratum and the upper strata, and the hauls through the upper water layers have been kept clear of the boundary stratum, beginning on an average 3.5 m above the boundary stratum, as determined by the hydrographical observations. If the hauls had begun exactly

Table V. Showing the density of living eggs in the whole water column, compared with the density in the upper strata.

		Gad. callarias	Onos	Pl. limanda	Pl. flesus	Cl. sprattus
Number of living eggs, caught	by the bottom—surface hauls	94	68	1806	412	590
	in the upper strata	7	27	197	78	261
Number of eggs pr. 100 m^3	in the whole water column	12.1	8.7	231.5	52.8	75.6
	in the upper strata	1.9	7.3	53.2	21.1	70.5
Relative density of eggs in the whole water column and in the upper strata (approximative fractions)		$\frac{13}{2}$	$\frac{7}{6}$	$\frac{9}{2}$	$\frac{5}{2}$	$\frac{15}{14}$
Calculated number of living eggs	in the bottom + boundary water	85	32	1543	308	242
	in the whole of the upper water layer	9	36	263	104	348
Number of eggs pr. 100 m^3	in the bottom + boundary water	18.9	7.1	342.9	66.2	53.8
	in the upper strata	1.9	7.3	53.2	21.1	70.5
Relative density of eggs in the bottom + boundary water and in the whole of the upper water layer		$\frac{10}{1}$	$\frac{1}{1}$	$\frac{13}{2}$	$\frac{3}{1}$	$\frac{3}{4}$

at the boundary they would have fished through on an average 11.3 + 3.5 m water, or about $^1/_3$ more than was actually the case. If we calculate the density of eggs to be the same through the whole of the upper water-layers (above the boundary) we have to add one third of the number of eggs caught by the hauls in order to obtain the number of eggs contained in a water column with the same diameter, but going through the whole of the upper strata. If we now subtract these figures from the number of eggs taken by the bottom—surface hauls we have the number of eggs belonging to the lower strata plus the boundary stratum (the bottom- and boundary-water, see the table). Of the whole water column on an average 20.2 m belong to the lower strata + the boundary stratum, so that the 67 bottom—surface hauls will have fished through 1350 m, filtering 450 m^3 bottom- and boundary-water. Thus the density of eggs in the bottom- and boundary-water is n : 450 eggs pr. m^3 (n being the number of eggs in the water-layers in question, as calculated above). By means of this calculation we obtain some new fractions, somewhat different from the above. But these new figures must not be considered as exactly representing the real facts, partly because it seems very doubtful whether the upper water-layers have the same quantity of eggs right through, partly because the limit between the upper and the lower strata is never sharp, the figure we have used above, 450 m³, being thus very inaccurately determined. But the two ranges of proportions, the upper strata compared with the whole water column and with the lower strata, show altogether with sufficient evidence that the eggs of *Gadus callarias*, *Pleuronectes limanda* and (to a smaller extent) *Pl. flesus* are more abundant in the lower than in the upper strata, while, on the other hand, the eggs of *Onos* and *Clupea sprattus* have nearly the same frequency in the upper strata as in deep water; the last named species seems even to be more common in the upper water-layers.

Table VI. Density of living eggs in the different water-layers within periods of 20 days.

Period	Number of living eggs caught	Gad. callarias	Onos	Pl. limanda	Pl. flesus	Cl. sprattus
I. 10—30 April	by the bottom—surface hauls	71	23	83	328	·
	in the upper strata	5	13	13	62	·
II. 1—20 May	by the bottom—surface hauls	19	23	467	75	16
	in the upper strata	2	9	50	8	4
III. 21 May—10 June	by the bottom—surface hauls	4	17	959	9	252
	in the upper strata	·	4	107	3	102
IV. 11—27 June	by the bottom—surface hauls	·	5	297	·	322
	in the upper strata	·	1	27	5	155
	Average number of living eggs pr. m³					
I. 10—30 April	in the whole water column	0.55	0.18	0.65	2.50	·
	» » upper strata	0.07	0.19	0.19	0.92	·
II. 1—20 May	» » whole water column	0.091	0.26	2.22	0.36	0.076
	» » upper strata	0.021	0.10	0.56	0.09	0.045
III. 21 May—10 June	» » whole water column	0.02	0.073	4.11	0.039	1.08
	» » upper strata	·	0.037	0.98	0.027	0.94
IV. 11—27 June	» » whole water column	·	0.024	1.98	·	1.51
	» » upper strata	·	0.008	0.26	0.05	1.48
	Relative density of eggs in the whole water column and in the upper strata (approximative fractions)					
I. 10—30 April		$\frac{8}{1}$	$\frac{1}{1}$	$\frac{3.5}{1}$	$\frac{2.7}{1}$	·
II. 1—20 May		$\frac{4.3}{1}$	$\frac{2.6}{1}$	$\frac{4}{1}$	$\frac{4}{1}$	$\frac{1.7}{1}$
III. 21 May—10 June		$\left(\frac{1}{0}\right)$	$\frac{2}{1}$	$\frac{4.2}{1}$	$\frac{1.4}{1}$	$\frac{1.1}{1}$
IV. 11—27 June		·	$\frac{3}{1}$	$\frac{7.6}{1}$	$\left(\frac{0}{1}\right)$	$\frac{1}{1}$

In table VI I have calculated the relative density of eggs in the whole water column and in the upper strata within periods of 20 days, to see whether the proportion was the same at the different times and, if not, to see whether any regularity could be found in the variation. It will be seen, that for every one of the species the proportion varies rather considerably. Unfortunately the investigations do not embrace the whole of the spawning time for any of the species in hand; nevertheless I think we can get some information from the figures.

Table VII.

Species	Maximum of predominance in the deeper strata	Maximal spawning time	Proportion in the whole time of investigation
Onos	Period IV	I	$^{7}/_{6}$
Clupea sprattus	— II	IV	$^{15}/_{14}$
Gad. callarias	— I	I	$^{18}/_{2}$
Pl. limanda	— IV	III	$^{9}/_{2}$
Pl. flesus	— II	I	$^{5}/_{2}$

In the case of *Onos* and *Clupea sprattus*, the eggs of which have about the same density in the upper and in the deeper strata, and of which the one (*Onos*) is early spawning, the other (*Cl. sprattus*) late spawning, there are proportionately more eggs in the upper strata in the time of maximal spawning, proportionately more eggs in the deeper strata outside this time (for *Onos* the predominance of eggs in the deeper strata increases from the maximal spawning time onwards, for *Cl. sprattus* it decreases from the time of the species' first appearance towards the time of maximal spawning).

In the case of *Gadus callarias* and *Pleuronectes limanda*, the eggs of which are much more numerous in the deeper strata than in the surface water, and of which the one (*G. callarias*) is early spawning, the other (*Pl. limanda*) late spawning, the predominance of eggs in the deeper strata has its maximum contemporaneously, or nearly contemporaneously with the time of maximal spawning. For these species the salinity has probably also some influence on the bathymetrical occurrence of the eggs; thus the salinity in the upper strata was comparatively high in period III, comparatively low in period IV. This is possibly the reason why the maximal predominance of dab eggs in the deeper water did not coincide with the maximal spawning of the species, but took place in the next period, when the salinity of the surface water was low.

The eggs of *Pleuronectes flesus* are somewhat more numerous in the lower than in the upper water layers; the maximum of spawning took place (in 1909) in the last days of April, and at about this time the predominance of eggs in the deeper strata was most considerable, decreasing with the advancing season.

How far these results agree with the real facts must be decided by further investigations, carried out during the whole of the spawning time of the species and embracing a sufficiently large material to eliminate the influence of accidental circumstances.

Influence of the hydrographical conditions on the occurrence of the fish eggs.

The influence of the temperature on the occurrence of the fish eggs cannot be studied within one and the same year. During the whole period of investigation the temperature of the different water

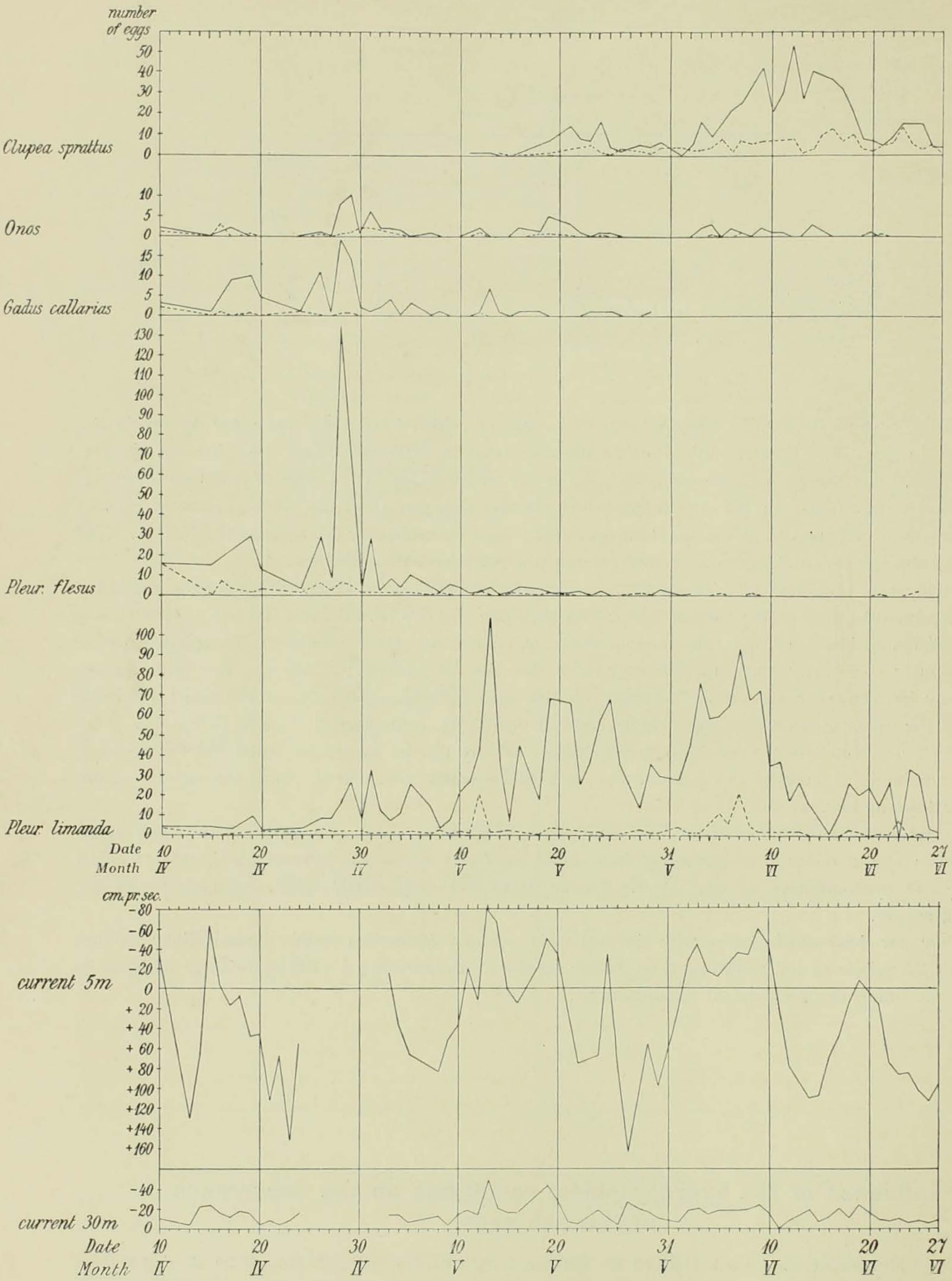

Fig. 4. Daily number of fish eggs caught, compared with the daily observations of the current (comp. fig. 2). The curves for the fish eggs: the dotted curves represent the eggs caught by the hauls through the upper water layers. The fully drawn curves represent the eggs caught by the bottom—surface hauls. When two hauls have been made at the same day, I have used the mean of the number ofeggs caught.

The curves for the current: the figures represent the speed in cm pr. sec. ÷ = N—S, + = S—N.

ayers was constantly increasing without great oscillations. On the other hand, investigations carried out at the same localities during several years would undoubtedly give valuable information as to the influence of the temperature on the time of spawning of the fishes, and the vitality, mortality and development of the eggs. The temperatures at the surface and at the bottom in the time of maximal occurrence of the eggs in 1909 were:

Species	Surface	Bottom
Gadus callarias	5°	4°.3
Onos	5°.5	4°.4
Pleur. limanda	11°.5	6°.4
— flesus	5°.5	4°.4
Clupea sprattus	11°.5	6°.7

As mentioned above, the variations of the salinity in the different water layers follow in the main the changings and oscillations of the current; accordingly the influence of the current and the salinity on the occurrence of the eggs is naturally discussed at the same time. Owing to the great daily variations this influence can only be discussed by comparing the daily hydrographical conditions with the daily appearance of the eggs; for this purpose I have worked out the curves on fig. 4, which are to be compared with the hydrographical curves figs. 1—2, (in order to facilitate the comparison the curves for the current have been reprinted in fig. 4). When discussing the influence of the current we must distinguish between the influence of the speed and of the direction of the current. It seems, that when the current has been very strong, the net has usually filtered too much water; accordingly the results are inexact; when a large number of eggs are taken within a period of strong current, this does not necessarily mean that the water has contained an especially large number of eggs. It is probable, however, that the speed of the current has nevertheless some indirect influence on the occurrence of the eggs, inasmuch as a strong current will effect a larger transportation of water from the one or the other direction with different degree of salinity; thus the speed is of importance as increasing or reducing the influence of the direction. If we compare the curves of the occurrence of the fish eggs with the curves of the hydrographical conditions, and take into consideration what is said about the latter, we shall have the following results:

Onos. There is no evident connection between the content of eggs in the whole water-column and the salinity at the bottom, but a fairly distinct agreement with the salinity at 10—15 m depth, the boundary stratum, inasmuch as there is a larger number of eggs when the current comes from the north and when the salinity is comparatively high. There also seems to exist a similar connection between the occurrence of eggs and the salinity and current in the surface layers, but owing to the small material nothing can be stated with certainty about the matter. These facts seem to show, that most of the eggs of *Onos* are imported from the north, but owing to their great floating power (their little weight), possibly due to the oil-globule, they only sink a little on entering regions with lower salinity, and remain floating in the boundary-stratum, and also, when the surface current comes from the north, in considerable numbers in the surface water.

The variations of the hydrographical conditions within the limits observed at Spodsbjerg during the time of investigation, do not seem to have any influence on the occurrence of the eggs of *Clupea sprattus.*

Pleuronectes flesus. The investigations embrace only a little part of the time before the culmination of the spawning; during the time of maximal occurrence of the eggs no information of the current is present, and immediately after the culmination of occurrence the flounder eggs almost entirely disappear, so that the material is not sufficient to show the possible relation to the hydrographical condition. But it is probable that most of the flounder eggs come from the south or from the neighbouring coastal areas.

Pleuronectes limanda shows a considerable dependence on the salinity, even comparatively small oscillations of the salinity in the lower strata (10—15—20 m) being followed by corresponding variations of the number of eggs. The higher the salinity, the more dab eggs we find in the bottom—surface hauls. There is a more distinct agreement with the salinity at 10—15 m than at 20—30 m depth; for example there is a great number of eggs in the time from ca. May 12th to ca. May 24th, although just at this time the bottom-layers have a very low salinity. The number of dab eggs in the upper strata is so small, that no conclusions as to their connection with the hydrographical conditions can be drawn. Only during the time of maximal spawning does any considerable number of eggs occur here; at the same time the current in the surface layers was N—S, and the salinity was comparatively high; it is possible, that this is the cause of the comparatively large number of dab eggs in the upper strata during this time. The bulk of dab eggs are therefore undoubtedly imported from the north with the bottom current, possibly however they are able to accommodate their specific gravity to a such degree, that they do not sink into the deepest layers of the water, but keep themselves in the neighbourhood of the boundary

Table VIII. Summary of the stages of development and their occur-

			Gadus callarias									Onos sp.							
			Total	?	d	Total living	nE	G	yE	pE	pO	Total	?	d	Total living	nE	G	yE	pE
April 10—30	from bottom to surface	total number of each stage	76	3	2	71	1	47	11	11	1	24	1	.	23	1	16	3	3
		per cent of living eggs . .				100	1.4	66.2	15.5	15.5	1.4				100	4.3	69.6	13	13
	upper water-layers . . .	total number of each stage	7	.	2	5	1	2	1	1	.	14	1	.	13	.	10	1	2
		per cent of living eggs . .									.				100	.	77	8	15
May 1—20	from bottom to surface	total number of each stage	23	1	3	19	1	17	.	1	.	25	1	1	23	.	11	5	7
		per cent of living eggs . .				100	5.3	89.5	.	5.3	.				100	.	47.9	21.7	30.4
	upper water-layers . . .	total number of each stage	2	.	.	2	.	2	.	.	.	9	.	.	9	.	6	1	2
		per cent of living eggs . .					.		.	.	.				100	.	67	11	22
May 21—June 10 . .	from bottom to surface	total number of each stage	4	.	.	4	.	3	1	.	.	18	.	1	17	.	11	1	5
		per cent of living eggs . .					.			.	.				100	.	65	6	29
	upper water-layers . . .	total number of each stage	.	.	.	.	.	.	.	.	.	4	.	.	4	.	1	1	2
		per cent of living eggs . .				.	.	.	.	.	.					.			
June 11—27	from bottom to surface	total number of each stage	.	.	.	.	.	.	.	.	.	5	.	.	5	.	3	2	.
		per cent of living eggs . .				.	.	.	.	.	.					.			.
	upper water-layers . . .	total number of each stage	.	.	.	.	.	.	.	.	.	1	.	.	1	.	1	.	.
		per cent of living eggs . .				.	.	.	.	.	.					.		.	.
Total . .	from bottom to surface	total number of each stage	103	4	5	94	2	67	12	12	1	72	2	2	68	1	41	11	15
		per cent of living eggs . .				100	2.1	71.3	12.8	12.8	1.0				100	1.5	60.3	16.2	22.1
	upper water-layers . . .	total number of each stage	9	.	2	7	1	4	1	1	.	28	1	.	27	.	18	3	6
		per cent of living eggs . .				100	14	57	14	14	.				100	.	66.7	11.1	22.2
Grand Total . . .		total number of each stage	112	4	7	101	3	71	13	13	1	100	3	2	95	1	59	14	21
		per cent of living eggs . .				100	3.0	70.3	12.9	12.9	1.0				100	1.1	62.1	14.7	22.1

stratum, and may even be found above this, when the surface-current comes from the north. It would be highly desirable to obtain collections, carried out in such manner, that it could be determined more distinctly, in which layers of the water the eggs mostly abound.

As to *Gadus callarias* the material is too small for obtaining certain results in regard to the relation of the eggs to the hydrographical conditions. During the first part of the time the number of eggs in the bottom—surface hauls seems to follow the variations of the salinity at 15 m depth fairly well, but after the culmination of the spawning about April 28th the number suddenly decreases very much, while the salinity at 15 m is still increasing. On the other hand, as the cod eggs are much more abundant in the lower strata than in the upper water layers, there can be no doubt but that they are for the very most part imported from the north with the salt water. The cause of the peak on the 13th of May has earlier been mentioned.

As a main result we can state as follows: eggs of *Gadus callarias* and *Pl. limanda* are imported from the north, they possibly keep mainly near the boundary stratum. Also the eggs of *Onos* are imported from the north, but they have a lower specific gravity and reside in and above the boundary stratum. As to *Pl. flesus* nothing definite can be stated. *Clupea sprattus*, though a large material is to hand, does not show any dependence on the hydrographical conditions within the limits observed at Spodsbjerg.

rence in the different water-layers and within periods of 20 days.

Pleuronectes platessa								Pleuronectes limanda								Pleuronectes flesus								Clupea sprattus							
Total	d	Total living	nE	G	yE	pE	pO	Total	?	d	Total living	nE	G	yE	pE	Total	?	d	Total living	nE	G	yE	pE	Total	?	d	Total living	nE	G	yE	pE
12	1	11	.	3	.	3	5	91	5	3	83	3	56	7	17	353	10	15	328	6	166	61	95	.	.	.	.	.	.	.	.
		100	.	27	.	27	46				100	3.6	67.5	8.4	20.5				100	1.8	50.6	18.6	29.0				.	.	.	.	.
4	.	4	.	.	2	2	.	14	1	.	13	.	8	3	2	68	3	3	62	1	27	12	22	.	.	.	.	.	.	.	.
			.	.			.				100	.	62	23	15				100	1.6	43.5	19.4	35.5				.	.	.	.	.
.	.	.	.	.	.	.	.	496	8	21	467	7	270	100	90	85	3	7	75	1	42	7	25	16	.	.	16	2	12	1	1
		.	.	.	.	.	.				100	1.5	57.8	21.4	19.3				100	1.3	56.0	9.3	33.3				100	13	75	6	6
.	.	.	.	.	.	.	.	56	3	3	50	.	23	14	13	10	.	2	8	.	4	2	2	4	.	.	4	1	1	.	2
		.	.	.	.	.	.				100	.	46	28	26				100	.	50	25	25							.	
.	.	.	.	.	.	.	.	995	17	19	959	63	458	137	301	10	1	.	9	.	5	1	3	260	4	4	252	9	139	45	59
		.	.	.	.	.	.				100	6.6	47.8	14.3	31.4				100	.	56	11	33				100	3.6	55.2	17.8	23.4
.	.	.	.	.	.	.	.	112	4	1	107	.	47	20	40	3	.	.	3	.	2	1	.	108	5	1	102	3	49	19	31
		.	.	.	.	.	.				100	.	43.9	18.7	37.3					.			.				100	3.0	48.0	18.6	30.4
.	.	.	.	.	.	.	.	302	1	4	297	20	143	57	77	.	.	.	.	.	.	.	.	327	2	3	322	.	242	28	52
		.	.	.	.	.	.				100	6.7	48.1	19.2	25.9				.	.	.	.	.				100	.	75.2	8.7	16.1
.	.	.	.	.	.	.	.	29	.	2	27	1	12	2	12	5	.	..	5	.	2	.	3	159	1	3	155	.	128	9	18
		.	.	.	.	.	.				100	3.7	44.4	7.4	44.4					.		.					100	.	82.6	5.8	11.6
12	1	11	.	3	.	3	5	1884	31	47	1806	93	927	301	485	448	14	22	412	7	213	69	123	603	6	7	590	11	393	74	112
		100	.	27.3	.	27.3	45.4				100	5.2	51.3	16.7	26.8				100	1.7	51.7	16.7	29.9				100	1.9	66.6	12.5	19.0
4	.	4	.	.	2	2	.	211	8	6	197	1	90	39	67	86	3	5	78	1	35	15	27	271	6	4	261	4	178	28	51
		100	.	.	50	50	.				100	0.5	45.7	19.8	34.0				100	1.3	44.9	19.2	34.6				100	1.5	68.2	10.7	19.5
16	1	15	.	3	2	5	5	2095	39	53	2003	94	1017	340	552	534	17	27	490	8	248	84	150	874	12	11	851	15	571	102	163
		100	.	20	13.3	33.3	33.3				100	4.7	50.8	16.9	27.6				100	1.6	50.6	17.1	30.6				100	1.8	67.1	12.0	19.1

Frequency of the various stages of development.

Table VIII represents the occurrence of the stages of development of the eggs in the bottom—surface hauls and in the upper water-layers, summed up within every twenty days; besides which the numerical percentage of the different stages in relation to the number of living eggs has been put down in the table.

I have earlier mentioned (p. 20), how I have limited the stages. As to the reliability of the determinations I may state as follows: Now and then I found some difficulty in deciding, whether an egg contained a young embryo or did not contain any embryo at all; I think that a great deal of the eggs marked ? ought belong to the group yE, but as these eggs on the whole are not numerous, they have, I think, no decisive importance in regard to the numerical relations of the stages. I have never put any egg in column pE without being quite sure that pigment was really present; in some cases, especially in bad lights, it was difficult to discover the pigment. It is possible, therefore, that in a few cases I have overlooked a pigment just developing, and placed individuals with incipient pigmentation among the eggs with »young embryo«, but I am sure these cases are very few. On account of these sources of inexactness, and owing to the arbitrariness existing in the practical limitation of the stages, besides the variation of the development according to the temperature, and the individual variability, the figures presented in this and the following tables cannot be regarded as being completely correct. I have therefore not based further calculations on the figures, but will restrict myself to a short discussion of the conclusions which can be drawn from the material in hand.

Apstein (1911) states, that a remarkable sinking of the older stages takes place; the present material does not confirm this statement, as will be seen from the percentage figures in the table. On the contrary, in each species the percentage of eggs with pigmented embryo is larger in the upper water layers than in the bottom—surface hauls.

In the same paper (1911, p. 241) Apstein points out, that the presence of a large number of fish eggs at a certain spot does not necessarily indicate a spawning place, except when several dead undeveloped and very young eggs are present; I think he is right in this respect; the eggs just spawned are very exposed to destruction; after fecundation however and especially after beginning their development, they are more capable of resistance and may be carried long distances with the current. Now it is a fact worthy of note, that in the material from Spodsbjerg there are very few dead and undeveloped eggs; this indicates, I think, that no spawning takes place in the locality where the material has been collected (in the deep channel); all the eggs have been imported by the current from other places. The unfecundated eggs are destroyed at or near the spawning places; the fecundated eggs have already passed through the first stages of development, before being transported by the current to the anchoring place of the ship. In a few cases (May 23rd and 25th, June 24th) the bottom—surface haul contained an unusually large number of undeveloped, living eggs of *Pl. limanda*; these cases, I think, are due to the exceptional spawning of single female dabs in the channel near the place, where the hauls were made. The material is too small to show whether the upper or the lower water-layers contained the comparatively larger number of dead eggs.

For investigating the mortality of the different stages of development, we must take into consideration the duration of the single stages. Apstein (1911) states, that according to his method of limiting the stages, all have about the same duration. As I have defined the stages (after Apstein's figures), this does not hold good (see above, p. 20). The relative duration of the stages calculated by means of Apstein's tables according to the limitation used by me, will be seen from the table IX.

It will be seen that the duration of the stage yE is always much shorter than pE, in the case of *Pleur. limanda* and *flesus* also shorter than G. Owing to the unavoidable inaccuracy already mentioned, it will not be advisable to construct a numerical expression for the mortality of the eggs from the figures above. I refer rather to the graphical presentation (fig. 5), which has been constructed in the following manner: the number of eggs caught within each stage is divided by the average duration of the stage (within certain limits of temperature), and then the older stages are expressed in relation to G; these figures are set up on the vertical axis; on the horizontal axis the durations of the stages are set up; accordingly the area of the rectangles expresses the relative number of eggs of each stage, the different heights of the rectangles give a picture of the mortality. It will be seen that a relatively very large number of eggs are destroyed in the young stages, but the eggs having passed through the stage of germinative disc are more resistant and for the most part succeed in attaining further development.

Table IX.

Gadus callarias	G	yE	pE+pO		
limits of the stages	0	31	68	150	Tagesgraden
average duration by 1—5° C	5	6	14		days
number of eggs caught	71	13	14		
divided by the average duration	14	2.2	1		
in relation to G	100	15.7	7.1		

Pleur. limanda	G	yE	pE		
limits of the stages	0	16	28	59	Tagesgraden
average duration by 2—6° C	4½	3½	9½		days
number of eggs caught	1017	340	552		
divided by the average duration	226	97	58		
in relation to G	100	43	26		

Pleur. flesus	G	yE	pE		
limits of the stages	0	17	30	56	Tagesgraden
average duration by 1—5° C	4	3	6½		days
number of eggs caught	248	84	150		
divided by the average duration	62	26	23		
in relation to G	100	42	37		

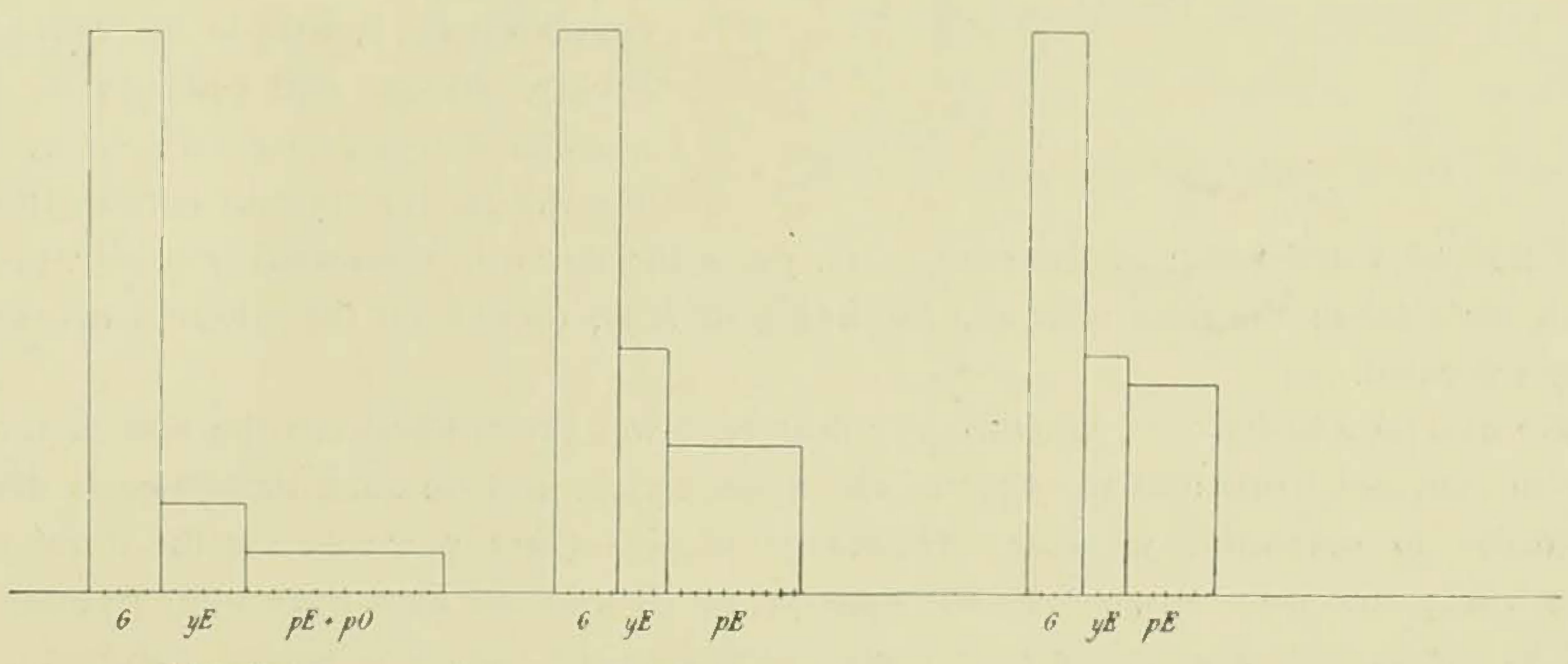

Fig. 5. Relative occurrence of the various stages of development of the eggs (as to the explanation of the figure, see the text p. 31).

Size of the eggs at different times.

It is a well known fact, that the average size of the eggs, in any case of certain species, decreases during the spawning period. The tables X and XI and fig. 6 have been worked out in order to illustrate this fact in the case of *Onos* and *Pleuronectes limanda* and *flesus* from Spodsbjerg. The material of cod eggs does not show any decrease in the average size; it was in April 1321.5 μ (88.1 divisions), in May 1326 μ (88.4 divisions); this is possibly due to the comparatively small material. In the case of *Onos* (table X) the decrease is very obvious, the average size decreasing from 935 to 905 μ during the time of investigation (see the table and the curve on fig. 6). In the two species of *Pleuronectes* the average sizes can only be determinated approximately. I have earlier mentioned (p. 8 ff) how I have distinguished the two species in the case, when a high degree of exactness was necessary; I also pointed out, that when it is a case of determining the average size of the two species without regard to the stages of development, we may carry our estimate somewhat further; in reality, it is necessary in such case to include all the variates, because the exclusion of the outermost variates of the one side would displace the average, and when regarding the material within shorter periods it is possible to judge the probable number of eggs belonging to each species with an exactness sufficient for the purpose. It will be seen from table XI and the corresponding curves on fig. 6, that in the case of *Pl. limanda* a very obvious and constant decrease of the average size can be stated, the average decreasing during the time of investigation from 886.5 to 814.5 μ (59.1—54.3 divisions); in the case of *Pl. flesus* the curve is somewhat irregular, probably owing to the small material in the time after the beginning of May, though on the whole a decrease also here seems to be indicated.

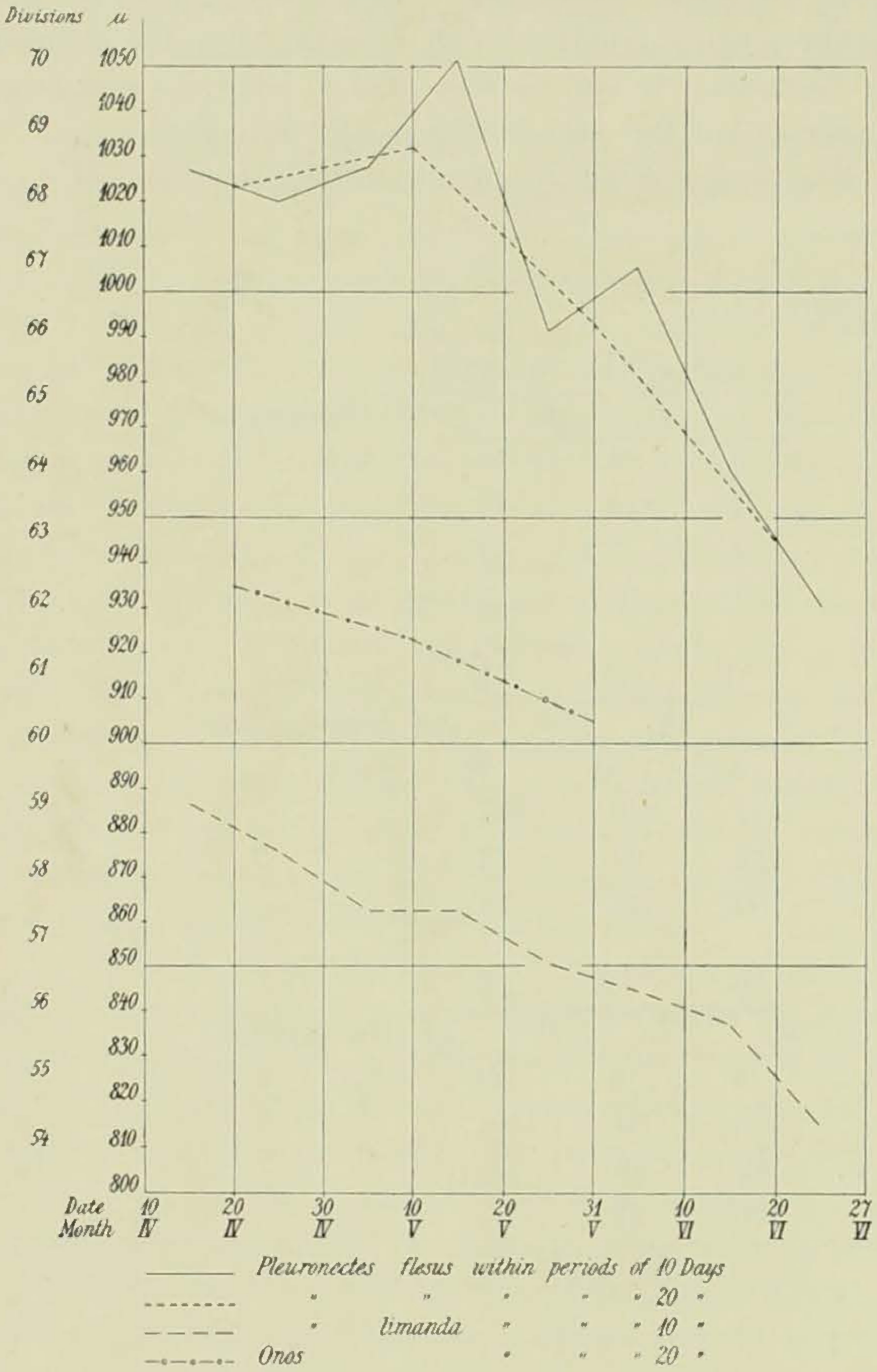

Fig. 6. Average size of the eggs at different times.

I have also tried to discover, whether any difference was present between the size of the eggs caught by the bottom—surface hauls and the eggs of the upper strata, but no such difference is distinguishable.

In order to determine whether any change of size takes place during the development of the eggs, I have worked out table XII, where the material of *Pleuronectes* eggs have been put down in periods of 10 days, as the average size of the eggs decreases during the spawning period. Moreover the proportionate number of the different stages is not the same during the whole time of investigation. It will be seen, that in some cases the eggs of the older stages are a little smaller than the young stages, and in the summary a slight decrease during the development seems to be indicated, but there is a great deal of irregularity, so that it seems very doubtful whether any such decrease really takes place.

Table X. Size of eggs of Onos within periods of 20 days.

μ	Divisions	April 10—30	May 1—20	May 21—June 10	June 21—27	Total
810	54	.	1	.	.	1
	55	.	.	1	.	1
840	56	.	1	1	1	3
	57	.	1	2	.	3
870	58	3	4	2	.	9
	59	6	1	4	.	11
900	60	6	4	2		12
	61	3	5	2	1	11
930	62	3	4	3	.	10
	63	2	4	1	.	7
960	64	5	2	.	.	7
	65	3	5	1	.	9
990	66	3	1	1	1	6
	67	1	.	1	.	2
1020	68	2	.	.	.	2
	69	.	.	.	1	1
1050	70	1	1	.	.	2
	71	.	.	.	.	.
1080	72	.	.	.	.	.
	73	.	.	.	1	1
Summary		38	34	21	5	98
Average size	Divisions	62.3	61.5	60.3	—	61.8
	μ	935	923	905	—	927

Table XI. Size of eggs of Pleuronectes limanda + flesus within periods of 10 days.

μ	Divisions	April		May			June		
		10—20	21—30	1—10	11—20	21—31	1—10	11—20	21—27
	49	.	.	.	.	.	1	.	.
750	50	.	.	.	.	.	1	3	2
	51	.	.	.	.	1	4	4	5
780	52	.	.	.	2	6	17	9	12
	53	.	1	2	15	20	33	21	27
810	54	.	3	7	17	32	74	27	26
	55	.	2	11	34	60	114	32	25
840	56	4	7	22	59	55	124	31	15
	57	1	12	30	80	75	108	27	4
870	58	3	13	27	80	59	79	16	4
	59	5	16	20	49	41	50	15	5
900	60	8	17	11	24	13	29	10	4
	61	4	8	7	18	11	19	5	3
930	62	1	9	5	10	9	7	6	2
	63	3	13	7	7	2	8	5	3
960	64	8	12	4	5	7	2	4	2
	65	4	29	6	1	3	.	2	.
990	66	7	30	7	2	2	.	1	.
	67	16	38	7	5	1	3	.	1
1020	68	13	42	4	1	1	.	.	.
	69	16	36	7	2	.	.	.	.
1050	70	11	29	10	2	1	.	.	.
	71	14	19	5	1	.	.	.	.
1080	72	4	19	4	.	.	.	.	.
	73	7	5	5	1	.	.	.	.
1110	74	9	3	3	2	.	.	.	.
	75	2	3	1	1	.	.	.	.
1140	76	2	3	.	.	1	.	.	.
	77	1	1	1	1	.	.	.	.
1170	78	.	1	.	1	.	.	.	.
	79	.	.	.	1	.	.	.	.
1200	80	1	.	.	.	.	.	.	.
	number	144	371	213	421	400	673	218	140
probable average size	limanda	59.1	58.4	57.5	57.5	56.7	56.3	55.8	54.3
	flesus	68.5	68.0	68.5	70.1	66.1	(67)	ca. 64	ca. 62
		68.2		68.8		66.2		ca. 63	

Table XII. Size of eggs of Pleuronectes limanda +

μ	Divisions à 15 μ	10—20 April				21—30 April				1—10 May				11—20 May			
		nE	G	yE	pE	nE	G	yE	pE	nE	G	yE	pE	nE	G	yE	pE
	49	.	.	.	.	.	.	.	.	.	.	.	.	.	.		.
750	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	51	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
780	52	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
	53	.	.	.	.	.	1	.	.	.	2	.	.	.	8	4	1
810	54	.	.	.	.	.	1	.	1	.	4	.	3	.	9	2	5
	55	.	.	.	.	.	2	.	.	.	9	3	.	.	18	6	8
840	56	.	2	.	1	.	4	.	3	.	16	4	2	1	30	12	13
	57	.	1	.	.	.	6	1	4	1	19	10	.	.	36	25	17
870	58	.	3	.	.	.	11	1	1	2	18	4	3	.	36	16	22
	59	.	3	.	2	.	9	3	2	.	11	3	4	.	30	8	8
900	60	3	4	.	1	.	11	2	2	.	9	1	.	1	12	5	5
	61	.	3	1	.	.	4	1	1	.	4	1	1	1	8	3	5
930	62	.	.	.	1	.	7	1	1	.	3	2	.	1	7	1	1
	63	.	2	.	1	.	4	3	4	.	4	1	2	.	4	3	.
960	64	1	2	2	3	.	4	3	5	.	1	1	2	.	2	2	.
	65	.	2	2	.	.	14	6	5	.	4	1	1	.	1	.	.
990	66	1	3	2	1	1	18	7	4	.	3	2	1	.	1	.	.
	67	1	12	.	2	.	13	6	16	.	4	1	1	.	3	.	2
1020	68	.	8	2	3	.	15	11	12	.	2	1	1	.	.	.	1
	69	1	11	2	2	.	20	5	8	.	5	.	2	.	2	.	.
1050	70	.	7	2	2	.	13	6	9	.	7	.	3	.	.	1	.
	71	2	8	1	3	.	4	2	12	.	3	.	2	.	.	.	.
1080	72	1	3	.	.	.	8	3	6	.	1	.	3	.	.	.	.
	73	.	5	2	.	.	5	.	.	.	2	1	2	.	.	1	.
1110	74	1	4	2	2	.	1	.	2	.	1	.	2	.	2	.	.
	75	.	.	1	.	.	.	1	2	.	1	.	.	.	.	1	.
1140	76	.	2	.	.	.	3	.	.	.	.	.	.	.	.	.	.
	77	.	.	1	.	.	1	.	.	.	.	.	1	.	1	.	.
1170	78	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.
	79	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
1200	80	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
probably limanda	number	3	16	1	4	.	52	8	14	3	96	28	13	4	200	87	85
probably limanda	average size	(60)	58.9	(61)	(58.5)	.	58.5	(59.1)	57.7	(57.7)	57.5	57.6	57.3	(59.5)	57.5	57.4	57.4
probably flesus	number	8	69	19	21	1	128	54	86	.	37	8	23	1	12	4	3
probably flesus	average size	(67.3)	69.2	69.7	68.6	(66)	68.1	67.5	68.3	.	68.3	(66.5)	69.4	(78)	69.9	(70.8)	(67.3)

flesus in the different stages, within periods of 10 days.

21—31 May				1—10 June				11—20 June				21—27 June				Total			
nE	G	yE	pE	nE	G	yE	pE	nE	G	yE	pE	nE	G	yE	pE	nE	G	yE	pE
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	1	.	.	.	2	.	1	.	.	1	1	.	3	1	2
.	1	.	.	.	2	2	.	.	3	1	.	.	2	1	2	.	8	4	2
.	2	2	2	2	9	1	6	.	6	3	.	2	3	1	6	4	21	8	14
2	8	3	5	1	15	2	17	1	14	3	3	4	9	6	8	8	57	18	34
.	19	5	5	.	39	11	24	.	15	3	8	6	9	4	7	6	96	25	53
5	27	10	15	4	53	18	38	.	14	6	12	1	12	7	5	10	135	50	78
3	27	10	13	6	59	17	45	2	17	6	6	1	5	4	5	13	160	53	88
9	36	6	20	1	53	9	43	1	16	1	9	.	1	1	2	12	168	53	95
15	16	9	18	.	46	15	14	1	9	4	2	.	.	.	3	18	139	49	63
9	13	7	11	2	25	10	12	1	8	2	3	.	1	2	2	12	100	35	44
1	8	.	4	1	15	6	7	1	7	2	.	.	2	2	.	7	68	18	19
.	3	1	5	1	7	5	8	.	5	.	.	.	3	.	.	2	37	12	20
1	4	1	3	.	7	1	.	.	5	.	1	.	1	1	.	2	34	7	7
.	1	.	1	.	3	3	2	.	4	.	1	.	2	.	1	.	24	10	12
.	5	.	1	1	.	.	.	.	3	.	1	.	1	.	.	2	18	8	12
.	2	.	1	.	.	.	.	.	1	1	.	.	.	.	.	.	24	10	7
.	2	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	27	11	7
.	.	1	.	.	2	1	.	.	.	.	.	.	.	.	1	1	34	9	22
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	26	14	17
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	38	7	12
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	9	14
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	15	3	17
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	12	3	9
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	4	2
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	8	2	6
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	2
.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
45	165	54	102	19	334	100	217	7	ca. 118	31	45	14	ca. 44	ca. 27	41	95	1025	336	521
57.6	56.5	56.3	57.0	56.5	56.4	56.8	56.1	(57.1)	56	55.5	55.7	53.7	54.5	54.5	54.2	56.8	56.8	56.6	56.4
.	11	1	3[1]	.	2	1	.	.	?	1	3	.	ca. 7	ca. 3	2	10	277	91	141
.	65.4	(67)	(68.3)	.	(67)	(67)	.	.	(ca. 63)	(65)	(ca. 64)	.	(ca. 62)	(ca. 61)	(65)	69.8	68.0	67.5	68.3

[1] certain.

Summary of each species of fish eggs and larvæ.

Liparis liparis.

One larva of this species was captured in the bottom—surface haul of May 25th; size: 9 mm.

Agonus cataphractus.

One larva, April 28th, 10—0 m; size: 7 mm.

Gadus callarias.

112 eggs were found, average size 1323 μ. Most of the eegs were taken during the period April 21st—30th (7.2 living eggs pr. bottom—surface haul = 21.6 pr. m² surface); the last cod egg was found on May 29th. By far the greater part of the eggs were caught in the bottom—surface hauls; the relative density of eggs in the whole water column and in the upper strata was $^{13}/_{2}$; the predominance of eggs in the deeper strata had its maximum contemporaneously with the time of maximal spawning. Owing to the comparatively small material it is impossible to state with certainty the dependence of the cod eggs on the hydrographical conditions; the bulk of the cod eggs of the Langelandsbelt are probably imported from the north by the inflowing salt water in the lower strata. 70.3 % of the living cod eggs were in the stage of germinative disc; a great deal seem to have been destroyed before reaching the older stages. No decrease in the average size of the eggs during the spawning time can be distinguished. Only 3 larvæ were captured: April 16th, 15—0 m, size 4 mm; May 3rd, 35—0 m, size 4 mm; May 15th, $7^{1}/_{2}$—0 m, size 4 mm.

Table XIII. Occurrence of fish larvæ, within periods of 10 days.

	April 10—20		April 21—30		May 1—10		May 11—20		May 21—31		June 1—10		June 11—20		June 21—27		Total
	bottom—surface	upper strata	bottom—surface	upper strata	bottom—surface	upper strata	bottom—surface	upper strata	bottom—surface	udper strata	bottom—surface	upper strata	bottom—surface	upper strata	bottom—surface	upper strata	
Liparis liparis	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
Agonus cataphractus	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Gadus callarias	.	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	3
Ammodytes sp.	10	7	2	2	.	.	.	.	.	.	.	1	.	.	1	2	25
Rhombus maximus	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Pleur. limanda	.	.	1	1	1	.	.	5	.	.	29	9	8	2	9	.	65
Gobius sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	4	5
Clupea harengus	.	.	.	.	.	.	.	.	.	.	.	.	1	.	3	4	8
— sprattus		.	.	.	.	.	.	.	.	.	3	4	.	1	.	1	9
— sp.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Undeterminated larva	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1

Onos cimbrius.

Nearly all the *Onos* eggs belong undoubtedly to *O. cimbrius*. 100 eggs were found; average size 927 μ. *Onos* eggs were taken during almost the whole time of investigation, being most numerous during the period from April 21st—30th (3.2 living eggs pr. bottom—surface haul = 9.6 pr. m² surface). Density was nearly the same in the upper and the lower water layers during the time of maximal spawning;

outside this time more eggs were taken in the bottom—surface hauls than in the surface water hauls. There seems to be a fairly high dependence on the hydrographical conditions; probably the *Onos* eggs are for the most part imported from the north with the inflowing salt water, but owing to their small specific gravity they keep mainly in and above the boundary stratum. 62.1 % of the living eggs belong to the stage of germinative disc. A fairly well marked decrease of the average size has taken place during the time of investigation. No larvæ were found.

Ammodytes sp.

25 Ammodytes larvæ were captured, mostly in April (see table XIII).

Rhombus maximus.

One larva, June 12th, 35—0 m, size 2.3 mm.

Rhombus laevis.

One egg has been referred to this species. It was caught in a bottom—surface haul of June 9th, and contained a germinative disc; size 1365 μ.

Pleuronectes platessa.

16 eggs of the plaice were found, all in April. Average size 1750 μ. 12 eggs were taken in the bottom—surface hauls, 4 in the upper strata. No larvæ.

Pleuronectes limanda.

2095 eggs are considered without great doubt to belong to *Pl. limanda*. Average size ca. 850 μ. The greatest number of eggs was taken during the period June 1st—10th (58.6 living eggs pr. bottom—surface haul = 175.8 pr. m^2 surface). Most of the dab eggs were taken by the bottom—surface hauls; the relative density of eggs in the whole water column compared with the upper water layers as $^9/_2$; the maximal predominance of eggs in the deeper strata took place somewhat later than the time of maximal spawning. The occurrence of the dab eggs is greatly dependent on the hydrographical conditions; most of the eggs are undoubtedly imported from the north, they seem to keep mainly in or near the boundary stratum. 50.8 % of the living eggs belong to the stage of germinative disc; a great deal of the eggs are destroyed in the young stages, but the mortality is not so large as in the case of *Gadus callarias*. The average size of the dab eggs decreases very obviously during the spawning time. 65 larvæ have been captured, the most of them in the beginning of June (see table XIII).

Pleuronectes flesus.

534 eggs have been referred to *Pl. flesus*. Average size ca. 1020 μ. During the period April 21st —30th the flounder eggs had their maximal occurrence (39.5 living eggs pr. bottom—surface haul = 118.5 pr. m^2 surface); after the beginning of May the eggs were very rare, though a few were taken as late as June 25th in a haul 13—0 m. The predominance of flounder eggs in the bottom—surface hauls is not very large: $^5/_2$. As to dependence on the hydrographical conditions nothing can be stated with certainty. 50.6 % of the living eggs belong to the stage of germinative disc. A decrease of the average size during the time of investigation seems to be indicated. No larvæ have been captured.

Pleuronectes limanda + flesus.

68 eggs could not be referred to the one or the other of the two species.

Gobius sp.

5 larvæ of *Gobius*, 3—5 mm were taken in the month of June, all in the upper strata.

Clupea harengus.

8 larvæ are referred to this species; they were taken late in June.

Clupea sprattus.

874 eggs were found; the first undubitable sprat egg was taken in a bottom—surface haul May 11th. The greatest number was taken during the period June 11th—20th (27.7 living eggs pr. bottom—surface haul = 83.1 pr. m^2 surface). There seem to be somewhat more sprat eggs in the surface water than in the deeper strata; the relative density of eggs in the whole water column compared with the upper water layers was $^{15}/_{14}$; there are proportionately more eggs in the upper strata during the time of maximal spawning. The changes of salinity and current observed do not seem to have any influence on the occurrence of the sprat eggs. 67.1 ‰ of the living eggs belong to the stage of germinative disc. The sprat eggs have not been measured. 9 larvæ were taken, all in June, 3 in the bottom—surface hauls, 6 in the upper strata.

Clupea sp.

2 *Clupea* larvæ could not be referred with certainty to any of the species.

Species indeterminata.

30 eggs could not be identified, partly because dead and empty. One larva is undeterminated.

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