MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

INTERNATIONAL FISHERY INVESTIGATIONS.



P74

THIRD REPORT (SOUTHERN AREA)

ON

FISHERY AND HYDROGRAPHICAL INVESTIGATIONS IN THE NORTH SEA AND ADJACENT WATERS.

CONDUCTED

FOR HIS MAJESTY'S GOVERNMENT

BY THE

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM.

1906—1908.

(*In continuation of* [Cd. 4641].)

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THIRD REPORT of the COUNCIL of the MARINE BIOLOGICAL ASSOCIATION of the UNITED KINGDOM on work carried out in connection with the INTERNATIONAL FISHERY INVESTIGATIONS.

TO THE NORTH SEA FISHERIES INVESTIGATION COMMITTEE.

GENTLEMEN,

I AM instructed by the Council of the Marine Biological Association to submit for your information their Third Report on work done in connection with the International Investigation of North Sea Fisheries. The report deals chiefly with work carried out in the years 1906–08, but includes also observations made in 1909.

I.—GENERAL.

The following is a list of members who have served on the Council since 1906 :—

President.—Sir Ray Lankester, K.C.B., F.R.S.

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Governors.—Mr. G. P. Bidder, the Prime Warden of the Worshipful Company of Fishmongers, the late Mr. E. L. Beckwith, Sir Richard Martin, Bart., the late Mr. Bryan Durant, Mr. W. L. Birch (representing the Fishmongers' Company), Prof. G. C. Bourne, F.R.S. (representing the University of Oxford), Dr. A. E. Shipley, F.R.S. (representing the University of Cambridge), Prof. W. A. Herdman, F.R.S. (representing the British Association for the Advancement of Science).

Chairman of Council.—Dr. A. E. Shipley, F.R.S.

Hon. Treasurer.—Major J. A. Travers (late Prime Warden of the Worshipful Company of Fishmongers).

Secretary.—Dr. E. J. Allen.

The following is a list of the scientific staff employed by the Council to carry out the investigations :—

Director and Secretary to the Council.—E. J. Allen, D.Sc.

Naturalist in charge of Fishery Investigations until September, 1907, who was also in charge of the North Sea Work.—Walter Garstang, M.A., D.Sc.

Assistant Director of the Lowestoft Laboratory.—J. O. Borley, M.A.

Naturalists.—W. Wallace, D.Sc., R. A. Todd, B.Sc.

Hydrographer.—D. J. Matthews.

Statistical Assistant.—Miss R. M. Lee, M.A.

Assistant Naturalists.—W. Bygrave, B.A., A. J. Mason-Jones, M.Sc., G. T. Atkinson, H. J. Buchanan-Wollaston.

Assistants.—J. Potter, A. J. Arrowsmith, F. Cooper.

The Council have pleasure in stating that in their opinion the different members of the staff carried out the duties entrusted to them in an efficient manner.

The Council desire to draw attention to the following points in the special memoirs, which in their opinion seem worthy of particular consideration.

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II.—FISHERY INVESTIGATIONS IN THE NORTH SEA.

Grimsby Steam Trawler Records.

In the last Report issued by the Council (Report II., Part II.) the results obtained by the tabulation of individual hauls of the trawl from records which had been furnished by the masters of certain Lowestoft sailing trawlers, were presented and discussed. These records gave information as to the general and seasonal distribution of the more important marketable fishes in the southern bight of the North Sea. In the present Report similar records of individual hauls of the trawl supplied by the masters of a number of Grimsby steam trawlers are tabulated and discussed. The principal records were obtained during the years 1904 to 1907, and give particulars of 13,246 trawl hauls, representing 49,025 hours' fishing. In addition to these the records of 1,297 hauls, representing 4,971 hours' fishing carried out in 1908 are dealt with separately. The area fished over by these steam trawlers lies for the most part to the northward of that worked by the Lowestoft sailing vessels, and comprises the whole of the central and eastern portions of the North Sea, as far north as Aberdeen on the one side and the northern extremity of Denmark on the other.

The thanks of the Association are due to the owners of the trawlers for having allowed these records to be utilised, and also to the captains of the vessels for the care and attention which they have devoted to making the returns reliable and accurate.

In the memoir in the present Report dealing with the subject, the fish treated of are the plaice, the sole, the turbot, and the brill among flat fishes, and the cod, the haddock and the whiting among round fishes. The general distribution of these fishes in the North Sea, so far as it is shown by the present records, is described, as well as their yearly fluctuations. The changes in the fish population on the different fishing grounds from season to season throughout the year are discussed, and inferences as to the migrations of the fishes based upon these changes are suggested.

With regard to the general features of distribution of the fish population, the records show that in the region dealt with, cod and haddock increase in quantity in the deeper waters the further north one proceeds, whilst in the southern areas they almost disappear, whereas the flat fishes, plaice, sole, turbot and brill are most abundant in the southern parts of the district and in the shallow waters on the eastern side of the North Sea. Small cod and haddock are most numerous on the western or British side, whilst small plaice and other flat fishes occur in vast numbers off the continental coasts.

So far as these records indicate, there was on the whole a diminution in the average catch of plaice during the years 1904 to 1907, the fall being greatest between 1905 and 1906. The figures for soles on the other hand show no decline. There was a marked fall in the average number of turbot, but the number of brill increased during the later years. Cod and codling both showed decreases. Haddock also decreased in the average total catch, but the proportion of small haddock showed great variation during the period. In 1906 the small haddock formed a very large proportion of the total catch.

The evidence which the figures yield as to seasonal fluctuations and as to migrations is of some importance as a contribution to the general study of these questions. Thus, for plaice there is shown a spring maximum and again an autumn maximum on some of the eastern grounds. The summer minimum on these grounds is accompanied by increased catches in the offshore areas of the central, southern and northern parts of the North Sea, a result which confirms the existence of a summer migration of plaice from the shallow coastal grounds to the deeper water, which marking experiments and special trawling investigations have already indicated. The accumulation of large plaice on the spawning grounds in winter is also shown by the figures.

The spawning migration of cod and haddock is made evident by the accumulation of large fish about February on the northern grounds.

The Age and Growth-Rate of Plaice.

A further contribution, in continuation of previous studies of this subject, is made to the questions of the age of plaice of different sizes and the growth-rate of these fishes in different parts of the North Sea and English Channel. During the course of the investigations the age of some 20,000 individual plaice has been determined by an examination of the otoliths and in each case the length and sex of the fish and the position of its capture have been recorded. All this material is now brought together and subjected to detailed analysis. The composition of the plaice population on different fishing grounds and at different seasons of the year has in this way been determined, the percentage of fish at each particular age being ascertained, together with the average size

of the fish of each age. The composition of the samples on particular fishing grounds has been found to vary at different seasons of the year. Thus, on the off-shore grounds, such as Flamborough Off, Leman and Brown Banks, and the Southern Deep Water, there is a greater proportion of young plaice of from one to four years old (Age-Groups I.—III.) in autumn and winter than is found in spring and summer. Plaice of the second year (Group I.), which are confined to grounds near the coast in spring and summer, appear on these offshore grounds in autumn and winter.

Such investigations of the age of the plaice population on the fishing grounds are also capable of yielding evidence as to the migrations of plaice, and by means of series of samples taken along a line proceeding radially from the coast of Holland to the deeper water of the central part of the North Sea the migration of the small fish from shallow to deep water has been traced. The mass of each age group was found to move seawards to the extent of several miles between May and September, plaice in their third year taking in September the position which had been occupied in May by those in their fourth year, those in their fourth year in September that of those in their fifth year in May, and so on for the higher ages.

By means of these investigations of the age of plaice the average annual growth of the fish both in length and weight has been determined. Previous researches have indicated, and it may now be regarded as placed beyond doubt, that this average growth is very different in different regions. A study of the two tables on p. 148 will make this clear. When the growth in the Southern Bight of the North Sea is compared with that in the English Channel off the Devon and Dorset coasts (Great West Bay) it is stated that while plaice grow more rapidly in the Great West Bay than in the Southern Bight of the North Sea during the first three years of their lives, they grow less rapidly after that period. In the case of the older fishes, therefore, in the Great West Bay, the effect of the more rapid initial growth is masked by the earlier retardation of the rate of growth.

Experiments with covered Trawl nets.

In order to find out what fishes escape through the meshes of the net when fishing is carried on with ordinary commercial trawls, a number of experiments have been made in which various parts of the trawl have been enclosed in an outer bag of fine meshed netting. After each experiment all the fishes in the trawl itself and all those in the outer covering, which have passed through the meshes of the trawl, were measured and the measurements recorded. Both the commercial otter trawl and the commercial beam trawl were tested in this way.

It was found by experiment that most of the fishes escaping through the trawl do so after reaching the "cod-end," that is to say, the fine meshed terminal portion of the net, where the fishes congregate after they are caught. Relatively few escape through the more open-meshed forward portions of the trawl ("square" and "batings"). As an instance of the kind of information which the experiments yielded, it may be stated that the average sizes at which 75 per cent. of the fishes, which having reached the cod end of the trawl were retained by the trawl whilst the remaining 25 per cent. escaped through it, are in the case of the Beam trawl as follows :—Plaice 12 cm. (4·7 inches), Dab 13·5 cm. (5·3 inches), Cod 17 cm. (6·7 inches), Whiting 19·9 cm. (7·8 inches). These sizes show a remarkable uniformity in all the experiments, such variations as exist being probably due to (1) the condition of the sea, whether rough or smooth, and (2) the weight of the catch in the cod end. When more data as to the effect of these two factors have been obtained, it ought to be possible to calculate with a considerable degree of certainty the number and size of the fish escaping through the trawl, when the number and size of those retained by the trawl are known.

The distribution of Fish-Eggs in the Southern North Sea in June, 1909.

The results of a cruise carried out in the southern part of the North Sea in the summer of 1909 for the purpose of determining the distribution and abundance of pelagic eggs of fishes are included in the present report. The collections were made with Hensen's quantitative egg net and with Petersen's Young-fish Trawl. The number of eggs of each species of fish per square metre of sea surface has been calculated for each of the stations at which collections were made. The eggs that occurred in considerable quantities were those of the mackerel, horse-mackerel, sprat and solenette. The memoir on the subject concludes with an account of some mathematical methods for distinguishing, by means of measurements, between eggs of certain species, which closely resemble each other in the majority of their characters.

III.—HYDROGRAPHICAL AND PLANKTON INVESTIGATIONS IN THE ENGLISH CHANNEL.

English Channel Plankton in 1906.

The most important features of the Plankton collected on the four quarterly cruises made in 1906, the details of which have already been published in the Bulletin of the International Council for the Study of the Sea, are discussed in the present report, whilst the full results of collections made weekly throughout the year at Plymouth and fortnightly at Cardigan Bay, Sevenstones and Varne Light Vessels are recorded.

The conclusions arrived at as to the general distribution of the plankton organisms in the Channel in previous reports, based on collections made in 1903, 1904, and 1905, were confirmed by the observations made in 1906. A first attempt has been made to correlate the number of Oceanic species in the Plankton with the salinity of the water as ascertained by the hydrographical investigations. Curves representing the average number of oceanic species per station and the average salinity per station respectively show a considerable measure of agreement. The report also discusses the seasonal changes which take place in the composition of the plankton, and the chief factors which cause the periodical appearance and disappearance of the plankton diatoms.

Physical Conditions in English Channel in 1906, *and the Mean Conditions for* 1903–1909.

In the memoir on the Physical Conditions in the English Channel which concludes this report, a more satisfactory determination than was previously possible has been made of the mean conditions from month to month, based on observations extending over a number of years, namely, over the seven years from 1903 to 1909. As is pointed out in the memoir, it is a knowledge of the variations from the mean, which occur from year to year at each season of the year, that is chiefly required in considering the relation between fluctuations in the hydrographical conditions and fluctuations in the supply of fish upon the fishing grounds.

The progressive changes in salinity and temperature during the year 1906 are described in detail. It is shown that the monthly salinities of the water in the Channel exhibit a two-year period. From the beginning of 1904 to the end of 1909, the "even" years (1904, 1906, 1908) showed a wide range of salinity, whereas the "odd" years (1905, 1907, 1909) showed a low range of salinity. The year 1906 was a typical "even" year. During January, February and March the salinities were slightly below the average in the central area. They then fell rapidly to a minimum in July. The range for the whole year was abnormally great and both the January maximum and the July minimum were well marked.

I am,

Gentlemen,

Your obedient Servant,

E. J. ALLEN,

Director and Secretary to the Council.

Marine Biological Laboratory,

Plymouth,

15th February, 1911.

REPORT

ON THE

GRIMSBY STEAM TRAWLER RECORDS

1904-1907.

BY

ROSA M. LEE, M.A.

WITH FIGURES 1–98; TABLES I.–XXXIII.; APPENDIX I. AND II. AND ONE CHART.

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REPORT

ON THE

GRIMSBY STEAM TRAWLER RECORDS.

1904-1907.

BY

ROSA M. LEE, M.A.

INTRODUCTION.

The Material.

These statistics are the reduction of the material obtained from the masters of certain of the Grimsby Steam Trawlers. They were supplied by the Marine Biological Association with Record Books, containing the same forms as those used by the Lowestoft Skippers,* and these, giving the date, duration, position and quantity of fish caught in each haul, have been continuously filled up by them since May, 1904.

The number of men engaged in supplying the information is as follows :—1904, seven ; 1905, nine ; 1906, six ; 1907, three ; and of these, two in 1904, two in 1905, two in 1906, only continued their records for a few voyages, extending over one or two months. In the ordinary course they fill in from 30 to 45 record forms in a voyage of eight or nine days, so that from them we have obtained detailed particulars of a very large number of hauls.

The total number of hauls and of hours fishing up to the end of 1907 are given in the following table :—

Table I.—Showing for the Grimsby Trawlers, the total number of hauls and hours fishing, 1904–1907.

Year.	No. of hauls.	No. of hours.
1904	2,669	10,144¾
1905	5,111	18,953¾
1906	3,312	11,704
1907	2,154	8,222¼
1904–1907...	13,246	49,024¾

The men who keep these records were chosen with special reference to their ability to do so, and in working through their books I have been exceedingly struck by their clearness, neatness and reliability, as well as by their readiness to make note of any unusual features and to give any information which they might think valuable. I should like to acknowledge the interest they have shown in this way, and the help it has been to me in dealing with their work.

The records may be taken as a very representative sample of the work of the Grimsby fisheries, as far as the North Sea is concerned. The skippers employ the ordinary commercial steam trawler and extend their fishing operations over the whole of the central part of the North Sea.

* Lee.—Report on the Lowestoft Sailing Trawler Records, 1903–1906. *Internat. Invest. Mar. Biol. Ass. Report II., Part II., Cd. 4641.* Appendix, p. 111.

In examining the results of my statistical analysis of these records I have been greatly helped by some valuable hints from my colleague, Mr. G. T. Atkinson, whose practical knowledge of the fisheries served to elucidate and explain many points suggested by the figures. I take this opportunity of expressing my indebtedness to him. My thanks are also due to Mr. J. Potter for his careful preparation of my figures and charts accompanying this report.

The Region Investigated.

These Grimsby fishermen work mainly in the belt of the North Sea lying between Lat. 52° 30′ and Lat. 57°. No hauls are recorded from further north than Lat. 57° 25′. They generally avoid the deepest parts of this region (over 40 fathoms) and confine their fishing principally to the central and eastern grounds in depths of from 10 to 30 fathoms.

Nearly all the skippers give their positions according to the latitude and longitude of the place where the trawl is shot, and there is no reason to think that there is any error in their determinations, for they were generally found to be consistent with the depths and the nature of the bottom, the name of the ground, and also with their subsequent positions. The only cases where there was any doubt were those in which the position was given by the bearings and distance from Spurn. In long distances there would be some doubt as to the exact position, and as sometimes the name of the ground was not given, the depth of the water had to be taken as the best guide to the position. Even in some of the nearer grounds there would be some uncertainty as to the position, as there is reason to believe that the bearings given were not quite correct. All the hauls for each year have been plotted out on charts in their appropriate positions and these have been very useful, by showing the difference of distribution in the different years, in the interpretation of the statistics and the explanation of the somewhat anomalous features of some of the curves.

This whole region contains fishing grounds of exceedingly diverse characters—diverse as regards depths, bottom, and nearness to the coast—and the catches of fish on these different grounds are just as diverse. For instance, enormous catches of small plaice and soles are made on the eastern grounds, while at the same time the yield of these fish on the western or central areas is many times smaller.

Division into Areas.*

The whole region is divided into a number of "areas," the sub-division being based primarily on the areas adopted by Professor Garstang in his Report as Convener of Committee B†. But these areas proved to be too many and too small for our purpose, and so several areas were combined (*e.g.* the Dogger Bank is made into one area); in other areas the bounding lines were slightly shifted, so as to coincide with the 20-fathom line instead of the 40-metre line. The final arrangement is given in the appended chart. The areas themselves are as follows, and they fall naturally into certain groups.

North-Eastern Areas.

Area A. This ground lies off the western coast of northern Denmark. It contains the Jutland Bank, and is bounded on the south by the Ringkjobing Ground. It ranges in depth from 13–22 fathoms. This ground was not much fished by these men. The August hauls of 1904 were made in the extreme north of the area, and the July hauls of 1905 on the west, outside the 20-fathom line.

Area B contains the West Bank and part of the Little Fisher Bank. It lies offshore and north-west from A. In depth it ranges from 20 to 40 fathoms.

Area C lies adjacent to B, but still further offshore. It has a bottom of fine sand and an average depth of 35 fathoms.

Area F.—This is a small area lying next to and west of area A. It contains two well-known fishing banks, the Tarbot Bank and the Monkey Bank. Most of the fishing here is confined to these banks (depths less than 20 fathoms), and but a small proportion takes place in the deeper water (about 24 fathoms) between them.

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* Note.—The depths given in these areas are generally taken from the fishermen's soundings, but the limiting values are from charts.

† Garstang.—The Distribution of the Plaice in the North Sea, Skagerak and Kattegat. Chart II. *Rapports et Procès-Verbaux.* Vol. XI., 1907–1908.

Area G is situated west of F and south of B and C. On its eastern side it is just under 30 fathoms, but over the greater part of the area it is between 30 and 40 fathoms. The fishing in this area comes more in the eastern than in the western half.

None of these areas were fished to any great extent. The statistics we have are the result of a few occasional and intermittent voyages. In character and depths the offshore areas are much alike and show in the resulting statistics much similarity in their catches.

The more offshore areas of this group coincide with Garstang's Fisher Bank group of areas.

Eastern Areas.

Area H.—This lies directly south of area A and includes the grounds from the western coast of Denmark to the 20-fathom line. It contains Ringkjobing ground and the Horn Reef North ground, but we find that the majority of the hauls are clustered together in the central part of this area (the Horn Reef North ground) within a radius of ten miles from Lat. 55° 55′ N., Long. 7° 24′ E. The depths in this part are from 12-16 fathoms and the bottom is of sand and shells, although there are patches of rough gravel in other parts of the area. This ground was much fished in 1905 throughout the year, but in the other years most of the fishing took place from October to December.

Area M.—This area, situated directly south of area H, contains the Horn Reef South grounds, Sylt Rough, Sylt Outer and Inner and Amrum grounds. Most of the fishing, but not quite all, took place outside the 10-fathom line, and between it and the 20-fathom line in depths of 10-13 fathoms. The majority of the summer hauls were made slightly more inshore, in less depths—from 8 to 11 fathoms. The rough ground in this area is mostly in the western half, and we find that with a few exceptions the hauls were taken over a bottom of fine sand. The April to June hauls are very numerous and these months constitute what the fishermen call "the season."

Area Q.—This area includes the strip of sea between the 10 and 20-fathom lines, running parallel to the German coast. It extends in a southwesterly direction from Heligoland to Vlieland, and embraces Heligoland Rough, Heligoland ground, Norderney, Borkum, Ameland and Terschelling grounds. There is an area of deeper water coming into this area about the north-eastern part as far as Heligoland, but for the most part the depths are under 20 fathoms. We find that in the Terschelling grounds the men fish a good deal on the edge of the 20-fathom line which does not here form a natural barrier to the fishing ground, so that the outer part of Q and inner part of the adjacent area N, are very much alike. The bottoms in this area are composed of sand and mud, and in some places stones and gravel are abundant, as in Borkum Rough.

Area W.—A few hauls were made on the Texel and Vlieland grounds, and to include them, area W, a continuation of area Q was formed. The majority of the soundings are 15 and 16 fathoms.

These "Eastern grounds" all lie about the same distance from the continental coast, and in regard to depth and bottom are very similar. Three of them are regularly fished by the Grimsby Skippers, and the resulting statistics are on the whole fairly complete and satisfactory. Areas H and M together correspond to Garstang's Eastern offshore and inshore grounds, and the rest to the Terschelling and Borkum grounds.

Central Areas.

Area J.—This area is roughly triangular in shape, the apex being at the Tail end of the Dogger and the base the 20-fathom line bordering on the outer part of areas H and M, *i.e.*, the Horn Reef and Sylt grounds. It contains no well-defined fishing grounds—the greater part of it being known by the fishermen as "The Mud" or "Outside the Mud." It also borders on the White Bank, Oyster Ground and Lower Scruff whose outer limits are somewhat variable. The most inshore part of the area has a bottom of fine sand; further out it is of mud. The depth on an average is about 26 fathoms. This is comparable with Garstang's Eastern Deep ground.

Area N.—This is an offshore area running parallel to area Q and divided from it by the 20-fathom line (except near Heligoland, where the deep water penetrates into area Q). It contains the White Bank in the north-eastern part, the Oyster ground, Terschelling Mud and parts of Clay Deep and Upper Scruff. The depth varies between 20 and 27 fathoms and is generally about 24 and 25 fathoms. In most parts the bottom is a mixture of sand and mud. The area has been well fished over all parts and throughout the year.

Area I.—This ground is enclosed between area N and area O (the Dogger Bank). Except for the south-east side of the Dogger where hauls were made in 20–21 fathoms the

prevailing depths are 24–27 fathoms. The grounds included are "Above the Dogger," Clay Deep and The Scruff. The hauls made are scattered over the whole area. Very few were taken in the spring months.

Area O.—This includes the whole of the Dogger Bank lying within the 20-fathom contour line.

Northern Areas, "Below the Dogger."

Area D.—This comprises the deep water (greater than 40 fathoms) west of Long. 3° E. and extending from the 40-fathom line north of the Dogger to about Lat. 57° 20′ N.

Most of the hauls were made in depths between 40 and 50 fathoms in the southern and eastern parts. The bottom is of fine sand.

Area K.—This lies between G and O. All the depths in it are greater than 20 fathoms and less than 40 fathoms.

Area L.—This lies between D (Deep water) and the Dogger, and is continued southwards and ranges in depth from 20 to 40 fathoms. For the most part the bottom is of sand but there are some rough patches of ground in it.

In all these areas a great deal of the fishing took place in the first three months of the year. Areas D and L are the south-eastern parts of the "Middle Deep."

Southern Grounds.

Area S.—This is the most southern ground of our region and it includes the ground situated about half way between the Norfolk and Lincolnshire and the northern Dutch coasts. It includes the "northern areas" of the Lowestoft Sailing Trawler Statistics, *i.e.* The Leman ground, Brown Bank, and the Brown Ridges, as well as some grounds lying to the north of these, such as Botney ground and New Zealand ground. The hauls are made mostly in depths of 15–18 fathoms and in sandy ground.

This area is much frequented in the summer time.

Area T.—This is a small area lying north of area S and south-east of the Silver Pits. It includes Markam's Hole and the shallower ground just around it, and the deeper water over 20 fathoms, wherein are the Western Mud Hole (greater than 20 fathoms) and the Botney Gut (greater than 30 fathoms).

Area V.—This small area includes all the Silver Pits. It is bounded on the north by the Dogger Bank and on the south by the Well Bank Flat and area T, from all of which it is separated by the 20-fathom line. In the Pits themselves the depths reach to over 40 fathoms, but a good many of the hauls were made on the borders of this area, *i.e.*, just over the 20-fathom line separating it from Well Bank.

Western Areas.

Area E.—This is an inshore ground off the Norfolk and Lincolnshire coast. A few hauls were made here during the course of 1906, most of them at a distance of 20 or 30 miles from Cromer and the Norfolk coast, the depths in which they were made being about 9–11 fathoms.

Area R.—This area includes the Well Bank Flat and grounds, the shallower parts of the "Off Grounds," the Dowsing grounds and the Haddock Bank, all of which are shallow water, generally from 11–14 fathoms. But there are also in it small deep holes, where the soundings are often over 30 and sometimes more than 40 fathoms.

These are known as the Sole Pit, and the Coal Pit or N.E. Hole, and are especially visited by the fishermen for the large catches of soles that are to be made there. In 1906 this area was well fished by one or two fishermen who came constantly here throughout the year. In the other years this was very little worked.

Area X.—Is formed by the Deep Water (between 20 and 30 fathoms) west of the Dogger and Silver Pits. Its southern boundary is the 20-fathom line which divides it from area R. The Dogger Bight, Flamborough Off and Eastermost grounds are in this area.

There was hardly any fishing in the western part of this area. It is rather a rough ground, and is worked by a special class of Grimsby steam trawlers.

Area P.—This is an area of very deep water situated north of area X and abreast of the Yorkshire coast. There are very few hauls here, nearly all of them are in the south-eastern region of it where the bottom is of fine sand and the depths about 35–38 fathoms.

These grounds correspond, roughly, to the Western Deep and Flamborough Off Grounds of Garstang's chart.

TABLE II., showing the total number of hours fishing in each area in each year.

——	1904.	1905.	1906.	1907.	1904–07.
A	22	44½	—	—	66½
B	287¾	226	—	152¼	666
C	—	16½	—	—	16½
F	334	318½	37½	—	690
G	198¾	140	98½	96½	533¾
H	733¼	1,624	16	70½	2,443¾
M	860	2,318¼	1,833¾	1,177	6,252
Q	336	996¾	294	729½	2,356¼
W	77	6	12	16	111
J	767	451¾	769	151¾	2,139½
N	944¾	1,610¾	1,907½	2,084	6,547
I	1,431¼	1,379½	261	258½	3,330¼
O	1,461	2,829¾	64½	429	4,784¼
D	37½	1,563	497¼	28	2,125¾
K	209½	559¼	119½	540	1,428¼
L	379	1,263¼	1,329¼	73	3,044½
S	1,218	1,437	647¼	1,095¾	4,398
T	85½	1,143	1,017½	625	2,871
V	277	189¾	368¼	238½	1,073½
E	—	—	45¼	—	45¼
R	13½	487½	1,693¾	66	2,260¾
X	250½	269¾	659¼	391	1,570½
P	221½	16	33	—	270½
Total	10,144¾	18,953¾	11,704	8,222¼	49,024¾

This table shows the distribution of the fishing operations. The grounds most favoured by these men are N and M, including the most important of the "small fish" grounds off the Danish and Dutch coasts. Next in importance are the Dogger Bank, which was very extensively fished in 1905, and the southern ground S, which includes the Leman and Botney Ground, &c. I and L come next, with over 3,000 hours fishing, and T, H, Q, R, J, D have all between two and three thousand hours fishing. The grounds least frequented are the north-eastern areas and E and P. In 1906 some of the men who worked regularly on the Dogger Bank ceased sending in records.

TREATMENT OF THE RECORDS.

Tabulation.—The Grimsby records have been treated in the same way as the Lowestoft statistics*, *i.e.*, the hauls have been grouped according to areas and months and a series of monthly totals and averages calculated for each area. The results for seven of the most important species, *viz.*, plaice, soles, turbot, brill, cod, haddock and whiting, are discussed in the present report.

Conversion of measurements into weight.—For four of these species, plaice, cod, haddock and whiting, which are measured by the skippers in baskets, it has been necessary to calculate a scale whereby the amount in a basket may be converted into weight. The methods adopted to determine this are given in detail for each species later in the report. It might be objected that I have used a single value for each species, when it is clearly shown by the tables that there is distinctly a bias on the part of some of the skippers, and that it might have been better to convert their amounts by using different ratios for different men, or different ratios for different years.

My answer to this objection is, that very little accuracy would be gained to balance the additional labour this would entail, for in the monthly catches the actual ratio for any one man is likely to vary about as much from *his* yearly ratio as does the actual ratio chosen, and furthermore, as the men's catches are combined, the use of the single average ratio is a close enough approximation to the true weights, for material measured in as rough a way as this is. I have tested the difference caused by using varying ratios in one or two areas and find that it is quite unimportant. The curves thus derived show the *same* trend and facts as the ones obtained in the ordinary way, *i.e.*, by using a constant ratio, and differ only slightly in the heights of a few ordinates, and I conclude that any error introduced by this method is but a small proportion of the errors due to roughness of material or any other causes, and has no significant effect on the conclusions drawn from the curves.

* LEE.—Report on the Lowestoft Sailing Trawler Records 1903–06. *Internat. Inves. Mar Biol. Ass. Report II. Part II, Cd.* 4641, p. 92.

Investigation of the yearly fluctuations.—The method employed in my report on the Lowestoft Trawler Records to determine the variations in the yearly abundance, was in the case of the Grimsby Records not admissible. That method was the simple one of combining all the catches from the whole region for the year, and determining the average catch for each year by dividing by the number of hours fishing.

The range of variation over the whole region was far too great, and the catches from the different areas so diverse, while at the same time the distribution of the fishing differed exceedingly year by year, that a combined average over the whole sea would be greatly affected by the distribution, and so would be valueless for comparing one year with another. Nor was it feasible to work out the yearly averages for each area separately, for there were too many gaps in the statistics and it seldom happened that there was a complete series of monthly averages for any area.

It therefore became necessary to use several methods in studying this question, so that each, though inadequate and uncertain in itself, becomes more decisive when its results are corroborated by those of other methods. These have been chiefly :—a comparison of the monthly averages in the same area, to determine whether they more generally show an increase or decrease throughout the period when comparing the averages with the corresponding months in the later years ; secondly, a comparison of the mean values of the monthly averages in each year, excluding those which are untrustworthy, and including only the same months in each year of comparison ; and thirdly, where groups of areas showing some similarity in their total yield could be formed, the method of lumping together all the catches from these areas was employed.

Investigation of the quantitative Distribution in Time and Space.

The only way in which the fish population from a certain area can be compared with that from another, or with itself at different times, by such statistics as these, is to assume that the average catch per uniform time, represents proportionally the population of that area. This of course involves certain assumptions, the chief being that there is a considerable homogeneity of conditions over the area chosen, and that the fishing is well distributed in time and space. We find, generally speaking, that the method is justified by experience, and that it is only where the fishing has been very limited in amount or space that the deductions drawn from such figures reach such a measure of unreliability as to become worthless. By studying the figures giving the amount of fishing, which the average represents, the reader will be able to judge how approximate the averages may be.

There are several ways of representing the quantitative distribution according to time and space. The simplest is to plot out the monthly averages as a continuous series of points varying with time, but we find that the material is too incomplete, rough and variable, for this to be done without a certain amount of interpolation and smoothing. The smoothed curves given in the diagrams are obtained by averaging the average of each month with the one before and after it, the averages of the first and last month in the series being left as they are. These diagrams are rendered more complete by gaps in the curves being joined by a thin line following the general trend of the thick continuous line. This method, although not representing the actual averages, gives a general picture of the seasonal trend, which when combined with a study of the actual figures enables us to determine more or less approximately the real nature of the fluctuations. The index figures given in the tables represent the number of hours fishing in each month, and by these we can judge of the reliability of the average.

When further statistics are to hand we can arrive at a closer approximation of the actual abundance and investigate in more detail the periods of maximum and minimum abundance. Another method, which I also use to smooth the figures and obtain a general measure of the comparative abundance, is to calculate " general averages " for each month, that is, the combined catches of all the years in any particular month, divided by the total number of hours fishing. This method too has its drawbacks, owing to the varying amount of fishing in the different years, but I regard it as the most reliable average obtainable from these figures, to represent the catch in the particular months of the year. It is for this reason that I have used these " general " monthly averages in calculating the *mean values* for the different areas. In this case, it is assumed that the general monthly averages represent, as closely as such figures can, the actual population of the area, and in taking the arithmetic mean of the monthly averages we are not biased in our estimate of the abundance by taking into account the number of hours fishing in the different months, for this might be especially large or small in the month of greatest abundance.

Size distinctions.—The size distinctions have been retained in all cases. It is true that the groups of large, medium and small fish have a very wide range of length and overlap each other to some extent, and that they may be somewhat differently classed by the several men. But we are taking *average* values in all cases so this error is minimised. The proportions in each area are obtained from the mean monthly value, *i.e.*, the average of the monthly general averages. Here we assume that the general average is the nearest we can get to the true state of things, and the method is equivalent to taking samples, as nearly as possible of equal value, during each month of the year, and finding by totalling up for the whole year, what are the proportions of large and small in the long run. This method gives a better picture of the conditions than would be obtained by calculating the percentage proportions from the total catch, or by taking the averages of the percentages in each month.

The results thus obtained are found to be in close agreement with the statistics of the Board of Agriculture and Fisheries, where they are comparable with these. Wherever a definite bias has been found in the classification of the size-groups, attention has been called to it in the discussion of the statistics.

In speaking of the seasons, I have used the terms "winter" for the months December to February, "spring" for the months March to May; "summer," June to August; and "Autumn," September to November.

The average duration of a haul is between three and four hours. All averages are calculated on ten hours fishing, as being the most convenient unit to take.

II.—ACCOUNT OF SEPARATE SPECIES.

A.—Plaice.

Introduction.—Some of the most important fishing grounds for plaice are to be found in this region. This species is to be taken in all areas but in exceedingly varying amounts, some grounds yielding several hundredweights of fish in a haul and others only three or four fish.

The catch is grouped by the fishermen into three classes large, medium and small, and it is according to their classification that they are discussed in the report. The market group "large" varies about a modal value of 17–18 ins.; medium fish vary about a mean of 13 inches, and small about a mean of 10 inches.

The Conversion of the Different Measures into Weight.

The first consideration that presented itself in the reduction of the plaice statistics was the conversion of the quantities measured by different methods to the same unit. In the record forms, either the number of fish of each size-group or the number of baskets was given, generally the latter. In grounds where few fish were caught and then only large ones, their numbers were mostly given.

Their weight was estimated by the following average scale:—

One large plaice weighs ·02 cwt.
One medium plaice weighs ·007 cwt.
One small plaice weighs ·003 cwt.

With regard to the conversion of the baskets into weight there was more uncertainty. It was found that the Grimsby "baskets" were larger than those in use at Lowestoft, which had been ascertained to contain an average amount of half a hundredweight of fish.

Enquiries at Grimsby elicited the information that one "basket" of plaice, irrespective of size, weighs about six stone, with a considerable range of weight due to packing. A "box" averages eight stone* and a "basket" may therefore be estimated at ·75 cwt. or ·75 of a box.

This relation was confirmed by the skippers own records. By summing up the total quantities of the individual hauls, for each skipper throughout each year, and also the sum of the numbers of boxes of plaice given in the summaries of the voyages, and comparing these two measures of the same quantity, we have a means of obtaining a ratio between a basket and a box.

* The recently published report of the Board of Agriculture and Fisheries on the Plaice fisheries of the North Sea, Cd. 4,738 (p. 53), shows that the weight of a "box" is slightly greater than eight stone, averaging 54·8 kilos at Grimsby. This is equivalent to 1·02 cwts.

These ratios have been calculated in each case and are given in the following table :—

TABLE III.—Showing for each skipper in each year, the ratio of a BASKET to a BOX, as estimated from the total number of baskets in the hauls, compared with the total number of boxes in the summaries.

Skipper.	1904.	1905.	1906.	1907.	Average.
i	·77	·77	(·83)	—	·77
ii	—	·80	—	—	·80
iii	·67	·76	·75	·81	·75
iv	—	·64	·68	—	·66
v	·76	·74	·78	·73	·75
vi	(·64)	·73	·73	·67	·71
vii	·72	·68	—	—	·70
viii	·65	(·51)	—	—	·65
Average ...	·71	·73	·75	·74	·73

The ratios in brackets are calculated on the summaries from but a few voyages. These are omitted in calculating the averages.

The last column in this table gives a good measure of each man's bias, and the last line shows whether the tendency in each year has been to estimate above or below the average. Omitting the doubtful averages in brackets, we find that these figures have a very small deviation from the average ·73.

This figure (·73 cwt.) has been chosen as the average weight of a basket for this set of statistics. The choice is further confirmed by measurements made on board the s.s. "Huxley," when the contents of a Grimsby basket were found to weigh 82 lbs. (or ·73 cwt.).

Total Quantities of Plaice and the Proportions formed by the Three Trade Categories.

Using the above determined scale for conversion into weight and putting together the catches from all areas, we find that the total catches by these men during the years 1904 to 1907 are as follows :—

TABLE IV.—Showing the total weight of PLAICE in cwts., and the percentage formed by each of the three trade groups.

Year.	Total weight in cwts.				Percentage of Total.		
	Large.	Medium.	Small.	All sizes.	Large.	Medium.	Small.
1904 ...	354·73	1,046·99	3,351·20	4,752·92	7·5	22	70·5
1905 ...	739·09	3,127·76	6,233·66	10,098·51	7	31	62
1906 ...	534·70	1,236·58	1,290·07	3,061·35	17·5	40·5	42
1907 ...	298·77	697·98	1,383·49	2,380·24	13	29	58
Total ...	1,925·29	6,109·31	12,258·42	20,293·02	9·5	30	60·5

The average catch per ten hours fishing for the whole time is 4·14 cwts., of which only 9·5 per cent. by weight are large fish. Over nine-tenths of the total are medium and small fish, and as but very few of the medium fish can be mature, this table shows the enormous destruction of immature fish. But if we consider the proportions by *numbers*, which we roughly estimate as 2 per cent. large, 17 per cent. medium, and 81 per cent. small, this feature becomes still more striking.

The proportions of "small" in each year are really not comparable with one another. It is necessary to bear in mind that in 1904 there was no fishing before May, and it is in the first four months of the year that the small fish are least abundant. Thus there is an unduly high proportion of small in that year. Moreover in 1906 and 1907 a smaller proportion of fishing took place on the eastern small plaice grounds than in the other years. Further detailed analysis of these figures for the "Eastern grounds," shows that although the proportion of "small" was greatest in 1904, yet in the next three years it did not vary significantly from 80 per cent. In at least one area, N, the proportion is greatest in 1907 and least in 1905.

TABLE V.—SHOWING for each area the Monthly Average Weight of PLAICE in cwts. per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July.				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
North-Eastern Areas.	A	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·50	0·00	$0·50^{22}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·45	0·00	0·00	$0·45^{44}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·45**	**0·00**	**0·00**	$\mathbf{0·45^{44}}$	**0·00**	**0·50**	**0·00**	$\mathbf{0·50^{22}}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	B	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·61	0·61	0·00	$1·22^{18}$	1·05	0·00	0·00	$1·05^{38}$	1·73	0·00	0·00	$1·73^{117}$	0·60	0·00	0·00	$0·60^{64}$	...	...	...	...	B
		1905	...	...	...	...	...	...	...	...	...	...	...	...	1·52	0·00	0·00	$1·52^{30}$	0·58	0·00	0·00	$0·58^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	2·26	0·08	0·00	$2·34^{169}$	2·56	0·37	0·00	$2·92^{20}$	1·83	1·83	0·00	$3·65^{4}$	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·64	0·00	0·00	$1·64^{113}$	1·18	0·00	0·00	$1·18^{32}$	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	**1·52**	**0·00**	**0·00**	$\mathbf{1·52^{30}}$	**0·58**	**0·00**	**0·00**	$\mathbf{0·58^{12}}$	...	...	...	...	...	...	...	...	**0·61**	**0·61**	**0·00**	$\mathbf{1·22^{18}}$	**1·83**	**0·05**	**0·00**	$\mathbf{1·88^{245}}$	**1·75**	**0·03**	**0·00**	$\mathbf{1·78^{260}}$	**0·86**	**0·07**	**0·00**	$\mathbf{0·93^{107}}$	..	...	...	...	
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1905	...	...	...	...	...	...	...	...	0·05	0·00	0·00	$0·05^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	0·00	0·00	$0·20^{4}$	...	...	...	...	0·00	0·00	0·00	$0·00^{4}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	**0·05**	**0·00**	**0·00**	$\mathbf{0·05^{8}}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·20**	**0·00**	**0·00**	$\mathbf{0·20^{4}}$	...	...	...	...	**0·00**	**0·00**	**0·00**	$\mathbf{0·00^{4}}$	
	F	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·48	0·00	0·00	$0·48^{68}$	0·00	0·91	0·00	$0·91^{8}$	0·00	0·91	0·00	$0·91^{8}$	0·24	1·00	0·10	$1·33^{45}$	...	...	...	...	0·11	0·61	0·00	$0·72^{64}$	0·15	0·34	0·00	$0·48^{120}$	F
		1905	...	...	...	...	...	...	...	...	0·10	0·18	0·00	$0·27^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	0·45	0·00	0·00	$0·45^{52}$	0·00	0·62	0·00	$0·62^{35}$	0·10	1·61	0·03	$1·75^{109}$	0·30	1·37	0·00	$1·67^{94}$	0·00	1·83	1·38	$3·20^{8}$	0·23	1·14	0·00	$1·36^{3}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·05	0·83	0·00	$0·87^{38}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	**0·10**	**0·18**	**0·00**	$\mathbf{0·27^{12}}$	...	...	...	...	...	...	...	...	**0·48**	**0·00**	**0·00**	$\mathbf{0·48^{68}}$	**0·39**	**0·12**	**0·00**	$\mathbf{0·52^{60}}$	**0·02**	**0·74**	**0·00**	$\mathbf{0·77^{81}}$	**0·15**	**1·38**	**0·06**	$\mathbf{1·59^{174}}$	**0·30**	**1·37**	**0·00**	$\mathbf{1·67^{94}}$	**0·10**	**0·74**	**0·15**	$\mathbf{0·99^{72}}$	**0·15**	**0·39**	**0·00**	$\mathbf{0·54^{126}}$	
	G	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·33	0·00	0·00	$0·33^{29}$	...	...	...	...	1·01	0·00	0·00	$1·01^{32}$	0·20	0·73	0·06	$0·99^{88}$	0·93	0·87	0·02	$1·81^{44}$	0·00	0·10	0·00	$0·10^{4}$	...	...	...	...	G
		1905	0·27	0·12	0·00	$0·39^{108}$	1·26	0·08	0·00	$1·34^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·93	0·00	0·00	$0·93^{4}$	...	...	...	...	0·63	0·00	0·00	$0·63^{15}$	...	...	...	...	0·36	0·36	0·00	$0·72^{5}$	
		1906	0·00	0·36	0·00	$0·36^{21}$	0·07	0·12	0·00	$0·19^{78}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·63	0·00	0·00	$0·63^{96}$	...	...	...	...	
		1904–7	**0·23**	**0·15**	**0·00**	$\mathbf{0·38^{129}}$	**0·18**	**0·12**	**0·00**	$\mathbf{0·30^{56}}$	...	...	...	...	...	...	...	...	...	...	...	...	**0·33**	**0·00**	**0·00**	$\mathbf{0·33^{29}}$	...	...	...	...	**1·00**	**0·00**	**0·00**	$\mathbf{1·00^{36}}$	**0·20**	**0·73**	**0·06**	$\mathbf{0·99^{88}}$	**0·85**	**0·65**	**0·02**	$\mathbf{1·52^{50}}$	**0·61**	+	**0·00**	$\mathbf{0·62^{100}}$	**0·36**	**0·36**	**0·00**	$\mathbf{0·72^{5}}$	
Eastern Areas.	H	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	0·00	0·00	$0·20^{52}$	...	...	...	...	...	...	...	...	0·00	2·74	13·69	$16·43^{16}$	0·00	0·25	7·79	$8·03^{15}$	0·00	0·84	7·82	$8·67^{73}$	+	2·19	23·35	$25·54^{385}$	+	1·72	4·97	$6·70^{191}$	H
		1905	0·01	2·99	0·49	$3·48^{247}$	...	...	...	...	0·00	0·94	0·00	$0·94^{9}$	0·00	0·49	0·00	$0·49^{133}$	0·03	0·24	0·00	$0·26^{170}$	...	...	...	...	0·10	1·14	0·00	$1·24^{16}$	...	...	...	...	0·00	8·79	41·10	$49·88^{40}$	0·00	8·40	22·62	$31·03^{565}$	+	5·71	8·45	$14·16^{257}$	0·00	0·26	0·23	$0·49^{34}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	2·76	$2·76^{16}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·46	5·77	$6·23^{79}$	...	...	...	...	
		1904–7	**0·01**	**2·99**	**0·49**	$\mathbf{3·48^{247}}$	...	...	...	...	**0·00**	**0·94**	**0·00**	$\mathbf{0·94^{9}}$	**0·00**	**0·49**	**0·00**	$\mathbf{0·49^{135}}$	**0·07**	**0·18**	**0·00**	$\mathbf{0·25^{222}}$	...	...	...	...	**0·10**	**1·14**	**0·00**	$\mathbf{1·24^{16}}$	**0·00**	**2·74**	**13·69**	$\mathbf{16·43^{16}}$	**0·00**	**6·48**	**32·09**	$\mathbf{38·57^{55}}$	**0·00**	**7·35**	**20·48**	$\mathbf{27·83^{654}}$	+	**3·28**	**16·25**	$\mathbf{19·53^{712}}$	+	**1·28**	**3·53**	$\mathbf{4·81^{275}}$	
	M	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·05	0·63	3·84	$4·52^{76}$	0·00	0·36	2·57	$2·93^{262}$	0·00	0·00	0·98	$0·98^{114}$	0·00	1·20	6·77	$7·98^{48}$	...	...	...	...	...	...	...	...	0·01	0·02	1·85	$1·87^{30}$	0·01	1·41	28·92	$30·34^{329}$	M
		1905	0·00	0·65	5·92	$6·57^{53}$	...	...	...	...	+	0·00	2·57	$2·57^{49}$	0·00	4·87	9·66	$14·53^{338}$	+	2·35	5·80	$8·15^{310}$	0·00	2·31	7·79	$10·10^{661}$	...	...	...	...	...	...	...	...	0·00	0·17	3·86	$4·03^{61}$	0·00	1·08	0·27	$1·36^{13}$	0·00	0·97	18·28	$19·25^{284}$	0·00	0·39	0·26	$0·66^{91}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	0·17	2·52	5·59	$8·28^{287}$	0·00	2·72	5·43	$8·15^{423}$	0·00	0·68	3·35	$4·04^{451}$	0·00	0·00	0·05	$0·05^{286}$	0·00	+	0·25	$0·25^{76}$	...	...	...	...	0·06	1·57	20·11	$21·74^{28}$	0·00	2·04	7·98	$10·02^{31}$	+	0·55	1·06	$1·61^{202}$	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·00	1·11	5·56	$6·67^{155}$	0·00	1·30	4·48	$5·77^{442}$	0·00	0·68	2·35	$3·03^{333}$	0·00	0·00	0·56	$0·56^{80}$	...	...	...	...	...	...	...	...	0·00	0·00	1·30	$1·30^{7}$	0·00	0·54	0·78	$1·32^{169}$	
		1904–7	**0·00**	**0·65**	**5·92**	$\mathbf{6·57^{53}}$	...	...	...	...	+	**0·00**	**2·57**	$\mathbf{2·57^{49}}$	**0·06**	**3·30**	**7·40**	$\mathbf{16·76^{830}}$	+	**2·10**	**5·29**	$\mathbf{7·38^{1731}}$	**0·00**	**1·26**	**4·76**	$\mathbf{6·02^{1767}}$	**0·00**	**0·00**	**0·36**	$\mathbf{0·36^{480}}$	**0·00**	**0·47**	**2·79**	$\mathbf{3·26^{124}}$	**0·00**	**0·17**	**3·86**	$\mathbf{4·03^{61}}$	**0·04**	**1·41**	**13·58**	$\mathbf{15·03^{41}}$	+	**1·10**	**14·69**	$\mathbf{15·78^{402}}$	+	**0·89**	**12·63**	$\mathbf{13·53^{782}}$	
	Q	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	3·24	0·00	$3·24^{4}$	0·00	0·42	4·34	$4·75^{48}$	0·00	0·90	6·62	$7·51^{112}$	0·01	0·36	2·28	$2·66^{48}$	0·00	4·50	28·60	$33·10^{115}$	0·00	3·20	6·39	$9·59^{8}$	...	...	...	...	...	...	...	...	Q
		1905	...	...	...	...	...	...	...	...	0·05	7·47	27·52	$35·04^{322}$	0·00	2·86	9·03	$11·89^{99}$	0·00	2·41	18·91	$21·32^{140}$	0·00	0·09	2·14	$2·22^{20}$	0·00	0·37	25·43	$25·80^{73}$	0·00	0·37	5·56	$5·92^{290}$	0·00	0·41	1·39	$1·80^{34}$	...	...	...	...	0·00	0·31	2·15	$2·46^{8}$	0·16	0·18	0·81	$1·14^{9}$	
		1906	...	...	...	...	...	...	...	...	0·20	0·64	0·00	$0·84^{43}$	...	...	...	...	0·03	0·46	0·80	$1·29^{67}$	0·00	0·85	5·38	$6·23^{106}$	0·00	1·38	2·74	$4·11^{8}$	0·00	0·00	1·80	$1·80^{35}$	...	...	...	...	0·00	0·28	4·22	$4·50^{35}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	0·00	0·04	3·41	$3·45^{15}$	0·00	0·86	4·44	$5·31^{118}$	0·02	0·49	5·73	$6·24^{57}$	0·01	0·56	0·99	$1·56^{184}$	0·04	0·74	2·13	$2·92^{40}$	0·00	1·26	2·76	$4·01^{47}$	0·00	2·09	7·15	$9·25^{113}$	0·00	3·56	6·14	$9·70^{120}$	0·00	0·98	6·06	$7·04^{25}$	0·00	0·00	3·91	$3·91^{7}$	...	...	...	...	
		1904–7	...	...	...	...	**0·00**	**0·04**	**3·41**	$\mathbf{3·45^{15}}$	**0·05**	**5·26**	**19·46**	$\mathbf{24·77^{853}}$	**0·01**	**1·99**	**7·83**	$\mathbf{9·83^{166}}$	**0·61**	**1·23**	**7·29**	$\mathbf{8·53^{393}}$	**0·01**	**0·66**	**4·22**	$\mathbf{4·88^{214}}$	**0·00**	**0·82**	**11·48**	$\mathbf{12·36^{240}}$	+	**0·74**	**5·33**	$\mathbf{6·07^{456}}$	**0·00**	**3·57**	**15·17**	$\mathbf{18·74^{269}}$	**0·00**	**0·88**	**5·18**	$\mathbf{6·06^{71}}$	**0·00**	**0·17**	**2·95**	$\mathbf{3·12^{15}}$	**0·16**	**0·18**	**0·81**	$\mathbf{1·14^{9}}$	
	W	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	2·36	5·03	$7·39^{61}$	0·00	0·31	3·35	$3·66^{12}$	...	...	...	...	0·00	1·83	1·83	$3·65^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	W
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·50	3·05	$3·55^{6}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	1·53	3·04	$4·57^{12}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·01	0·69	1·14	$1·84^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·00**	**0·50**	**3·05**	$\mathbf{3·55^{6}}$	**0·00**	**2·36**	**5·03**	$\mathbf{7·39^{61}}$	**0·01**	**0·52**	**2·09**	$\mathbf{2·62^{28}}$	...	...	...	...	**0·00**	**1·83**	**1·83**	$\mathbf{3·65^{4}}$	**0·00**	**1·53**	**3·04**	$\mathbf{4·57^{12}}$	...	...	...	...	...	...	...	...	

TABLE V. (*continued*)—SHOWING for each area the Monthly Average Weight of PLAICE in cwts. per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July.				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
CENTRAL AREAS.	J	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·23	0·00	0·23[9]	...	...	...	...	...	...	...	...	0·04	1·32	0·58	1·94[75]	0·13	1·33	0·72	2·17[205]	...	...	...	...	0·00	0·90	0·00	0·90[77]	0·29	0·66	0·04	0·99[401]	J
		1905	0·09	0·12	0·00	0·20[105]	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·46	0·00	0·46[20]	...	...	...	...	...	...	...	...	...	...	...	...	0·19	1·06	0·35	1·60[98]	0·07	0·73	0·05	0·86[78]	0·15	0·46	0·23	0·84[64]	0·23	0·87	0·12	1·22[88]	
		1906	0·04	0·40	0·00	0·44[28]	0·02	0·37	0·00	0·39[30]	...	...	...	...	...	...	...	...	0·02	0·26	0·00	0·28[77]	...	...	...	...	...	...	...	...	0·15	0·71	0·40	1·26[92]	0·02	0·57	0·19	0·78[90]	0·25	0·25	0·58	1·08[254]	0·21	0·51	+	0·72[130]	0·00	0·17	0·07	0·24[38]	
		1907	...	...	...	...	...	...	...	...	0·03	0·24	0·02	0·29[67]	0·07	0·05	0·02	0·14[68]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·80	0·23	0·46	1·49[16]	...	...	...	...	
		1904–7	**0·08**	**0·18**	**0·00**	**0·25[133]**	**0·02**	**0·37**	**0·00**	**0·38[30]**	**0·03**	**0·24**	**0·02**	**0·28[67]**	**0·07**	**0·05**	**0·02**	**0·14[68]**	**0·02**	**0·29**	**0·00**	**0·31[106]**	...	...	...	...	...	...	...	...	**0·10**	**0·99**	**0·48**	**1·57[167]**	**0·12**	**1·09**	**0·51**	**1·71[299]**	**0·21**	**0·36**	**0·47**	**1·03[362]**	**0·17**	**0·59**	**0·08**	**0·84[287]**	**0·26**	**0·66**	**0·05**	**0·97[527]**	
	N	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·39	0·32	0·71[28]	0·03	0·41	0·91	1·36[40]	+	0·49	3·01	3·50[205]	0·06	1·07	1·45	2·58[109]	0·01	1·18	3·19	4·38[98]	0·11	2·01	2·36	4·48[144]	1·25	1·22	0·06	2·52[182]	0·09	0·63	0·03	0·75[136]	N
		1905	0·86	0·86	0·00	1·72[8]	0·40	0·23	0·00	0·63[40]	0·84	0·84	0·39	2·07[52]	0·11	0·17	0·03	0·31[60]	0·17	0·99	0·05	1·21[39]	0·12	0·99	0·75	1·86[139]	0·02	1·73	1·18	2·92[76]	0·05	2·03	3·91	5·99[272]	0·00	4·03	7·43	11·47[274]	...	...	...	...	0·22	0·96	1·03	2·21[219]	0·17	1·06	0·36	1·59[112]	
		1906	0·15	0·41	0·00	0·56[121]	0·81	0·37	0·00	1·18[310]	1·04	0·40	0·00	1·44[283]	0·00	1·76	0·00	1·76[14]	+	0·45	0·25	0·70[90]	0·05	0·58	1·76	2·39[83]	0·17	0·73	0·93	1·82[76]	0·01	2·37	4·52	6·90[197]	0·04	0·18	2·36	2·58[31]	0·01	0·17	1·76	1·95[168]	0·55	0·37	0·43	1·35[191]	0·05	0·48	0·31	0·84[74]	
		1907	0·13	0·20	0·13	0·46[306]	0·08	0·10	0·20	0·38[125]	0·69	0·67	0·08	1·44[228]	0·09	0·23	0·11	0·43[132]	0·00	0·78	0·48	1·26[74]	0·06	0·87	1·65	2·58[71]	0·02	0·09	0·30	1·41[118]	0·00	3·49	3·69	7·18[45]	0·06	2·23	6·09	8·38[235]	0·01	0·89	2·28	3·18[299]	0·35	0·99	2·60	3·94[354]	0·06	0·72	4·07	4·85[96]	
		1904–7	**0·15**	**0·32**	**0·05**	**0·53[735]**	**0·59**	**0·29**	**0·05**	**0·93[475]**	**0·88**	**0·55**	**0·07**	**1·50[563]**	**0·09**	**0·31**	**0·08**	**0·48[306]**	**0·04**	**0·67**	**0·28**	**0·98[231]**	**0·08**	**0·79**	**1·21**	**2·08[333]**	**0·04**	**0·63**	**1·96**	**2·62[475]**	**0·03**	**2·08**	**3·66**	**5·77[623]**	**0·03**	**2·66**	**5·93**	**8·62[585]**	**0·04**	**1·04**	**2·20**	**3·28[551]**	**0·53**	**0·90**	**1·30**	**2·73[356]**	**0·13**	**0·87**	**0·79**	**1·76[718]**	
	I	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·71	0·00	0·00	1·71[101]	2·57	0·00	0·00	2·57[18]	1·06	1·16	0·23	2·45[319]	+	1·45	0·01	1·46[229]	0·19	1·30	0·09	1·59[218]	0·76	1·54	0·53	2·83[199]	0·01	1·29	0·10	1·40[359]	I
		1905	0·03	0·60	0·00	0·62[87]	0·17	0·25	0·00	0·42[17]	...	...	...	...	...	...	...	...	...	...	...	...	0·10	1·58	1·23	2·90[52]	0·88	0·93	0·47	2·28[121]	1·86	0·92	0·85	3·63[263]	1·62	2·69	1·15	5·45[52]	...	...	...	...	0·43	0·87	0·00	1·30[139]	0·19	0·85	0·00	1·04[47]	
		1906	0·06	0·49	0·00	0·55[79]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·60	0·09	0·00	0·69[74]	...	...	...	...	0·21	0·38	0·00	0·59[31]	1·18	0·46	0·00	1·64[11]	0·81	0·29	0·39	1·49[65]	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·36	1·40	1·64	3·40[169]	0·91	1·31	0·65	2·87[71]	0·95	0·04	0·57	1·56[77]	...	...	...	...	
		1904–7	**0·04**	**0·55**	**0·00**	**0·59[166]**	**0·17**	**0·25**	**0·00**	**0·42[17]**	...	...	...	...	...	...	...	...	...	...	...	...	**1·16**	**0·54**	**0·42**	**2·12[153]**	**0·93**	**0·56**	**0·26**	**1·75[213]**	**1·42**	**1·05**	**0·51**	**2·98[582]**	**1·05**	**2·16**	**0·95**	**4·16[1068]**	**0·40**	**1·27**	**0·22**	**1·89[360]**	**0·67**	**1·03**	**0·34**	**2·03[421]**	**0·03**	**1·24**	**0·09**	**1·36[456]**	
	O	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·58	0·00	0·00	1·58[10]	0·67	0·00	0·00	0·67[100]	0·53	0·00	0·00	0·53[149]	0·39	0·52	0·00	0·91[254]	0·44	0·08	0·00	0·52[216]	0·19	0·06	0·00	0·25[356]	0·20	0·06	0·00	0·26[278]	0·02	0·27	0·00	0·29[97]	O
		1905	0·15	0·08	0·00	0·23[100]	0·15	0·06	0·00	0·21[56]	0·54	0·11	0·00	0·65[156]	0·24	0·02	+	0·26[613]	0·11	0·18	0·01	0·30[395]	0·15	0·09	+	0·24[121]	0·59	0·40	+	1·00[255]	1·07	0·12	0·02	1·21[99]	...	...	...	...	2·51	0·69	0·48	3·68[327]	1·29	0·72	0·28	2·29[175]	0·11	0·28	0·00	0·39[328]	
		1906	...	...	...	...	0·00	1·05	0·00	1·05[11]	0·00	0·43	0·22	0·65[9]	0·81	0·11	0·00	0·93[14]	0·32	0·55	0·00	0·87[10]	...	...	...	...	...	...	...	...	...	...	...	...	1·06	0·00	0·00	1·06[4]	0·41	0·13	0·00	0·54[14]	0·45	0·00	0·00	0·45[4]	...	...	...	...	
		1907	0·20	0·00	0·00	0·20[281]	...	...	...	...	1·28	0·00	0·00	1·28[80]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·26	0·00	0·00	0·26[68]	...	...	...	...	
		1904–7	**0·19**	**0·02**	**0·00**	**0·21[381]**	**0·13**	**0·22**	**0·00**	**0·34[67]**	**0·77**	**0·09**	**0·01**	**0·86[239]**	**0·25**	**0·03**	+	**0·28[67]**	**0·15**	**0·19**	**0·01**	**0·34[115]**	**0·38**	**0·05**	+	**0·43[221]**	**0·57**	**0·25**	+	**0·82[104]**	**0·58**	**0·41**	**0·01**	**1·00[353]**	**0·45**	**0·08**	**0·00**	**0·53[220]**	**1·29**	**0·35**	**0·23**	**1·86[107]**	**0·57**	**0·27**	**0·09**	**0·94[125]**	**0·10**	**0·28**	**0·00**	**0·38[135]**	
NORTHERN AREAS.	D	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·10	0·00	0·00	0·10[37]	...	...	...	...	D
		1905	0·31	0·07	0·00	0·38[21]	0·21	+	+	0·21[760]	0·08	0·01	+	0·09[647]	0·00	0·00	0·00	0·00[24]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00	0·00[69]	
		1906	...	...	...	...	0·21	0·00	0·00	0·21[85]	0·11	0·00	0·00	0·11[57]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·87	0·00	0·00	2·87[131]	1·52	0·00	0·00	1·52[24]	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	0·20	0·00	0·00	0·20[28]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·31**	**0·07**	**0·00**	**0·38[61]**	**0·21**	**0·00**	**0·00**	**0·21[845]**	**0·10**	+	**0·00**	**0·10[332]**	**0·00**	**0·00**	**0·00**	**0·00[24]**	...	...	...	...	...	...	...	...	...	...	...	...	**2·87**	**0·00**	**0·00**	**2·87[131]**	**1·52**	**0·00**	**0·00**	**1·52[24]**	...	...	...	...	**0·10**	**0·00**	**0·00**	**0·10[32]**	**0·00**	**0·00**	**0·00**	**0·00[69]**	
	K	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	0·00	0·00	0·20[4]	0·42	0·00	0·00	0·42[38]	...	...	...	...	0·43	0·00	0·00	0·43[7]	0·09	0·50	0·01	0·60[43]	0·33	0·00	0·00	0·33[26]	0·51	0·00	0·00	0·51[21]	...	...	...	...	K
		1905	0·20	0·19	0·00	0·39[211]	0·27	+	0·00	0·27[39]	0·03	0·23	0·00	0·27[9]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00	0·00[4]	0·95	0·08	0·00	1·02[71]	0·00	0·00	0·00	0·00[4]	...	...	...	...	...	...	...	...	
		1906	0·19	0·00	0·00	0·19[31]	0·10	0·00	0·00	0·10[24]	0·18	0·00	0·00	0·18[44]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·32	0·37	0·00	2·69[21]	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	0·19	0·00	0·00	0·19[55]	0·20	0·00	0·00	0·20[232]	0·20	0·00	0·00	0·20[235]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·16	0·00	0·00	1·16[11]	0·15	0·00	0·00	0·15[5]	...	...	...	...	
		1904–7	**0·20**	**0·14**	**0·00**	**0·33[279]**	**0·23**	+	**0·00**	**0·23[495]**	**0·18**	**0·02**	**0·00**	**0·20[308]**	...	...	...	...	**0·20**	**0·00**	**0·00**	**0·26[4]**	**0·42**	**0·00**	**0·00**	**0·42[38]**	...	...	...	...	**0·27**	**0·00**	**0 00**	**0·27[11]**	**0·88**	**0·26**	+	**1·14[135]**	**0·40**	**0·00**	**0·00**	**0·40[110]**	**0·41**	**0·00**	**0·00**	**0·41[29]**	...	...	...	...	
	L	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·29	0·00	+	0·29[21]	2·43	0·00	0·00	2·43[6]	0·45	0·00	0·00	0·45[84]	0·55	0·01	0·00	0·56[195]	0·23	0·02	0·00	0·25[63]	0·31	0·00	0·00	0·31[8]	...	...	...	...	L
		1905	0·14	0·09	0·00	0·23[84]	0·21	+	0·00	0·21[63]	0·23	+	0·00	0·23[102]	0·26	0·01	0·00	0·27[111]	1·03	0·00	0·00	1·03[30]	0·40	0·00	0·00	0·40[7]	0·48	0·03	0·00	0·50[79]	0·27	0·00	0·00	0·27[18]	1·10	0·09	0·00	1·19[81]	...	...	...	...	...	...	...	...	0·03	0·27	0·00	0·30[26]	
		1906	0·11	0·00	0·00	0·11[132]	0·23	0·00	0·00	0·23[247]	...	...	...	...	...	...	...	...	1·89	0·11	0·00	2·00[199]	1·74	0·00	0·00	1·74[105]	2·90	0·00	0·00	2·90[97]	2·05	0·00	0·00	2·05[101]	1·89	0·04	0·00	1·93[208]	1·28	0·00	0·00	1·28[136]	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	0·20	0·00	0·00	0·20[60]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·88	0·00	0·00	0·88[13]	...	...	...	...	
		1904–7	**0·12**	**0·04**	**0·00**	**0·16[716]**	**0·22**	+	**0·00**	**0·22[872]**	**0·22**	+	**0·00**	**0·23[252]**	**0·26**	**0·01**	**0·00**	**0·27[111]**	**1·78**	**0·09**	**0·00**	**1·87[229]**	**1·44**	**0·00**	+	**1·44[136]**	**1·83**	**0·01**	**0·00**	**1·84[152]**	**1·23**	**0·00**	**0·00**	**1·23[203]**	**1·33**	**0·04**	**0·00**	**1·37[584]**	**0·99**	**0·01**	**0·00**	**1·00[212]**	**0·31**	**0·00**	**0·00**	**0·31[8]**	**0·03**	**0·27**	**0·00**	**0·30[56]**	

TABLE V. (*continued*)—SHOWING for each area the Monthly Average Weight of PLAICE in cwts. per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July.				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
SOUTHERN AREAS.	S	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·43	3·12	1·46	5·01^{216}	0·21	2·77	3·30	6·28^{345}	0·02	2·26	6·74	9·63^{454}	0·00	2·56	2·15	4·71^{100}	0·51	1·83	1·67	4·00^{103}	...	...	...	...	...	...	...	...	S
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	4·07	3·04	7·30^{617}	0·57	4·70	2·61	7·88^{749}	0·81	3·08	3·65	7·54^{45}	0·45	0·93	0·45	1·83^{4}	0·65	0·65	0·86	2·15^{8}	0·86	0·29	0·00	1·15^{13}	
		1906	...	...	...	...	0·00	1·65	2·33	3·98^{5}	1·11	1·61	0·82	3·54^{92}	0·51	0·81	0·89	2·21^{22}	0·16	1·47	0·49	2·12^{7}	0·33	1·56	1·44	3·33^{55}	0·20	1·76	1·51	3·46^{63}	0·06	1·51	1·55	3·12^{106}	0·04	1·24	2·56	3·84^{220}	0·03	1·55	2·36	3·94^{56}	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·17	1·68	1·29	3·14^{461}	0·80	1·59	2·01	4·41^{348}	0·34	1·41	1·74	3·49^{271}	...	...	...	...	...	...	...	...	...	...	...	...	0·78	1·14	0·23	2·15^{16}	...	...	...	...	
		1904–7	...	...	...	...	**0·00**	**1·65**	**2·33**	**3·98^{5}**	**1·11**	**1·61**	**0·82**	**3·54^{92}**	**0·51**	**0·81**	**0·89**	**2·21^{22}**	**0·17**	**1·68**	**1·28**	**3·12^{468}**	**0·63**	**2·12**	**1·77**	**4·52^{619}**	**0·23**	**3·04**	**2·74**	**6·01^{1316}**	**0·34**	**3·59**	**3·96**	**7·90^{1309}**	**0·12**	**1·83**	**2·59**	**4·54^{365}**	**0·35**	**1·71**	**1·88**	**3·93^{163}**	**0·73**	**0·97**	**0·45**	**2·15^{24}**	**0·86**	**0·29**	**0·00**	**1·15^{13}**	
	T	1904	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·98	0·00	0·98^{13}	0·46	2·28	1·14	3·88^{24}	0·00	1·64	0·91	2·55^{10}	0·00	1·38	1·38	2·75^{8}	0·00	1·38	1·38	2·75^{8}	...	...	...	...	1·14	0·57	0·08	1·79^{22}	...	...	...	...	T
		1905	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	0·80	1·15	0·06	2·01^{55}	...	...	...	...	0·45	2·75	1·32	4·52^{48}	0·05	0·70	1·09	1·84^{79}	1·41	1·39	0·93	3·73^{100}	1·07	1·24	1·28	3·59^{177}	1·05	0·67	1·66	3·38^{243}	0·83	0·23	0·17	1·23^{349}	
		1906	...	...	...	...	0·84	1·27	0·23	2·33^{96}	0·71	0·63	0·28	1·63^{52}	1·31	0·84	0·11	2·27^{112}	0·10	1·45	0·46	2·02^{33}	0·45	1·67	0·68	2·81^{97}	0·41	2·04	0·53	2·98^{131}	0·19	1·33	0·87	2·39^{30}	0·78	1·03	0·95	2·76^{83}	0·59	0·85	0·55	1·99^{225}	0·27	0·60	0·00	0·86^{27}	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·78	0·62	0·21	1·61^{39}	0·09	0·66	0·48	1·22^{25}	0·27	0·83	2·14	3·25^{143}	1·16	1·68	0·35	3·20^{91}	...	...	...	...	0·22	1·55	0·28	2·04^{70}	0·52	1·22	0·39	2·14^{84}	1·35	1·02	0·24	2·61^{212}	0·22	1·53	0·38	2·13^{12}	
		1904–7	...	...	...	...	**0·84**	**1·27**	**0·23**	**2·33^{96}**	**0·71**	**0·63**	**0·28**	**1·62^{52}**	**1·18**	**0·79**	**0·14**	**2·16^{151}**	**0·35**	**1·16**	**0·27**	**1·78^{146}**	**0·36**	**1·27**	**1·52**	**3·14^{264}**	**0·61**	**2·03**	**0·61**	**3·25^{330}**	**0·12**	**1·05**	**0·99**	**2·16^{177}**	**1·00**	**1·26**	**0·89**	**3·15^{211}**	**0·75**	**1·06**	**0·79**	**2·66^{456}**	**1·12**	**0·78**	**1·03**	**2·93^{604}**	**0·81**	**0·28**	**0·17**	**1·26^{352}**	
	V	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	0·08	1·62	0·00	1·71^{131}	0·19	1·77	0·00	1·96^{36}	1·03	1·76	0·00	2·80^{45}	...	...	...	...	1·49	0·00	0·00	1·49^{13}	...	...	...	...	V
		1905	...	...	...	...	...	...	...	...	0·15	0·80	0·00	0·95^{25}	...	...	...	...	...	...	...	...	...	...	...	...	1·74	0·24	0·00	1·98^{108}	1·91	0·00	0·00	1·91^{29}	...	...	...	...	0·91	0·65	0·00	1·57^{28}	...	...	...	...	...	...	...	...	
		1906	0·05	0·22	0·72	1·00^{39}	0·40	0·00	0·00	0·40^{4}	0·41	0·24	0·01	0·66^{60}	0·64	0·29	0·00	0·94^{35}	...	...	...	...	1·68	0·61	0·00	2·28^{12}	1·04	0·83	0·06	1·93^{53}	0·51	0·81	0·00	1·32^{49}	0·59	0·24	0·00	0·83^{47}	0·78	0·19	0·00	0·97^{16}	0·63	0·00	0·00	0·63^{12}	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·44	0·82	0·00	3·27^{4}	1·14	0·46	0·00	1·60^{8}	0·99	0·45	0·00	1·44^{55}	...	...	...	...	...	...	...	...	1·05	0·05	0·00	1·10^{24}	1·30	0·06	0·00	1·37^{28}	0·79	0·11	+	0·91^{48}	
		1904–7	**0·05**	**0·22**	**0·72**	**1·06^{39}**	**[0·40**	**0·00**	**0·00**	**0·46^{4}]**	**0·34**	**0·37**	**0·01**	**0·75^{105}**	**0·64**	**0·29**	**0·00**	**0·94^{38}**	**[2·44**	**0·82**	**0·00**	**3·27^{4}]**	**1·46**	**0·55**	**0·00**	**2·01^{20}**	**0·89**	**0·89**	**0·01**	**1·78^{247}**	**0·59**	**1·18**	**0·00**	**1·76^{164}**	**0·81**	**0·99**	**0·00**	**1·80^{32}**	**0·99**	**0·19**	**0·00**	**1·18^{135}**	**1·21**	**0·03**	**0·00**	**1·24^{43}**	**0·79**	**0·11**	**+**	**0·91^{48}**	
WESTERN AREAS.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	E
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	0·00	0·03	0·06	0·09^{8}	...	...	...	...	0·00	0·03	0·03	0·05^{7}	...	...	...	...	...	...	...	...	0·00	2·27	3·45	5·72^{13}	0·00	0·48	0·32	0·80^{11}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·00**	**0·03**	**0·06**	**0·09^{8}**	...	...	...	...	**0·00**	**0·03**	**0·03**	**0·05^{7}**	...	...	...	...	...	...	...	...	**0·00**	**2·27**	**3·45**	**5·72^{13}**	**0·00**	**0·48**	**0·32**	**0·80^{11}**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	R	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·62	0·41	0·00	2·03^{9}	1·62	0·40	0·00	2·02^{4}	R
		1905	...	...	...	...	...	...	...	...	0·00	2·35	0·00	2·35^{14}	...	...	...	...	1·85	2·17	0·00	4·02^{76}	...	...	...	...	...	...	...	...	...	...	...	...	1·12	2·23	0·00	3·35^{18}	...	...	...	...	0·23	1·72	0·29	2·24^{168}	0·03	1·50	0·33	1·86^{212}	
		1906	0·63	1·92	0·83	3·38^{139}	0·00	2·83	1·14	3·96^{236}	0·05	2·47	1·23	3·75^{280}	0·47	2·98	0·73	4·19^{266}	0·20	3·14	0·23	3·57^{176}	0·02	3·95	0·98	4·95^{338}	0·03	3·49	0·76	4·28^{322}	0·03	3·01	0·98	4·02^{113}	1·47	1·95	0·00	3·41^{7}	0·88	1·01	0·00	1·89^{14}	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·85	1·38	0·00	2·25^{6}	1·55	1·40	0·00	2·95^{23}	0·77	0·66	0·37	1·80^{32}	0·45	1·38	0·00	1·83^{4}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·63**	**1·92**	**0·83**	**3·38^{139}**	**0·00**	**2·83**	**1·14**	**3·96^{236}**	**0·05**	**2·46**	**1·18**	**3·68^{294}**	**0·48**	**2·95**	**0·71**	**4·14^{372}**	**0·77**	**2·72**	**0·15**	**3·64^{275}**	**0·11**	**3·56**	**0·90**	**4·57^{279}**	**0·04**	**3·45**	**0·75**	**4·24^{226}**	**0·03**	**3·01**	**0·98**	**4·02^{113}**	**1·22**	**2·15**	**0·00**	**3·37^{25}**	**0·88**	**1·01**	**0·00**	**1·89^{14}**	**0·30**	**1·65**	**0·28**	**2·23^{127}**	**0·06**	**1·48**	**0·32**	**1·86^{216}**	
	X	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·50	0·27	0·03	1·80^{109}	1·25	0·25	0·00	1·50^{60}	1·64	0·42	0·00	2·06^{30}	...	...	...	...	0·93	0·03	0·00	0·96^{33}	1·15	0·31	0·00	1·46^{17}	X
		1905	0·93	0·00	0·00	0·93^{4}	0·80	0·00	0·00	0·80^{3}	0·27	0·58	0·01	0·86^{63}	0·32	0·00	0·00	0·32^{12}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·03	0·71	0·00	1·74^{31}	0·45	0·75	0·02	1·23^{107}	0·03	0·62	0·00	0·64^{15}	0·06	0·24	0·09	0·30^{44}	
		1906	...	...	...	...	0·41	0·41	0·00	0·82^{9}	0·71	0·15	+	0·86^{60}	0·21	1·54	0·16	1·91^{77}	0·14	0·97	0·04	1·16^{53}	1·15	0·35	0·02	1·52^{156}	0·88	1·61	+	2·49^{112}	1·00	1·00	0·02	2·02^{93}	1·03	0·47	0·00	1·49^{64}	0·73	0·24	0·00	0·97^{29}	0·57	0·00	0·00	0·57^{16}	...	...	...	...	
		1907	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·76	0·65	0·02	2·43^{32}	1·60	0·69	0·00	2·29^{5}	0·89	0·73	0·00	1·63^{96}	...	...	...	...	...	...	...	...	1·72	0·62	0·00	2·34^{183}	0·85	0·39	0·00	1·24^{28}	0·52	0·45	0·00	0·97^{25}	
		1904–7	**0·93**	**0·00**	**0·00**	**0·93^{4}**	**0·51**	**0·31**	**0·00**	**0·82^{12}**	**0·50**	**0·35**	**0·01**	**0·86^{113}**	**0·23**	**1·33**	**0·14**	**1·70^{39}**	**0·94**	**0·81**	**0·03**	**1·79^{104}**	**1·17**	**0·36**	**0·62**	**1·55^{164}**	**1·09**	**0·88**	**0·01**	**1·98^{317}**	**1·10**	**0·70**	**0·01**	**1·82^{153}**	**1·18**	**0·51**	**0·00**	**1·69^{125}**	**1·22**	**0·64**	**0·01**	**1·87^{310}**	**0·70**	**0·23**	**0·00**	**0·93^{32}**	**0·42**	**0·32**	**0·00**	**0·73^{36}**	
	P	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·79	0·03	0·00	1·82^{213}	...	...	...	...	1·83	0·00	0·00	1·83^{8}	...	...	...	...	...	...	...	...	...	...	...	...	P
		1905	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·50	0·01	0·00	0·51^{16}	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	0·82	0·00	0·00	0·82^{4}	1·22	0·00	0·00	1·22^{4}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·15	0·08	0·00	1·52^{24}	...	...	...	...	...	..	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**...**	...	...	...	...	...	...	...	**0·82**	**0·00**	**0·00**	**0·82^{4}**	**1·22**	**0·00**	**0·00**	**1·22^{4}**	...	...	...	...	...	...	...	...	**1·70**	**0·03**	**0·00**	**1·73^{220}**	...	...	...	...	**1·54**	**0·06**	**0·00**	**1·66^{32}**	...	...	...	...	...	...	...	...	...	...	...	...	

Discussion of the Seasonal Fluctuations in each Area.

Table V. gives the average monthly catch of plaice in each area, together with the combined monthly averages.

North-Eastern Areas.

Area A.—Only two months' catches are represented, giving averages 0·45 cwt., and 0·50 cwt. of large and medium fish, in July and August respectively.

Area B.—The stock of plaice seems to be fairly good, the averages reaching a maximum of 1·88 cwts. and comparing favourably with those of a more southern area J. Large fish form the chief stock, a very small proportion of the catch being medium. Only six months averages are present, so we cannot compare the winter and summer catches, but there is a great similarity in the shape of the curve as far as it goes, to that of F, where there are indications of at least an autumn maximum. It was noticeable in October in tabulation that the fish were more plentiful on the "West Bank" than in the deeper water.

Area C.—The three or four hauls that were made in this area show a very small yield of plaice. The October average is higher than the March one, while in December there were no fish caught. Large fish only were taken.

Area F.—There is a small catch in March. From June the averages increase till September or October and then fall away to December. Small fish are almost entirely absent. Both large and medium plaice are present, the medium predominating and forming 72 per cent. of the catch.

Area G.—The winter averages are low, compared with those of the autumn, when there appears to be a distinct maximum, culminating about October. Large and medium fish are present, being about 64 per cent. and 34 per cent. of the total catch respectively. Small fish are seldom found.

Although there has been very little fishing in these areas, and the curves are very incomplete and disconnected, yet we have indications that these north-eastern areas are very much alike in their total yield of plaice. B, F, and G have similar curves of very much the same direction, shape and height, reaching a maximum of just over 1·5 cwts. They are combined into the smoothed curve of Fig. 1.

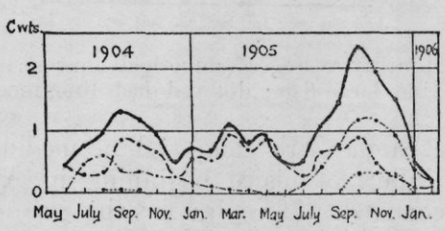

FIG. 1.—PLAICE. North-Eastern areas combined. Monthly averages (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dot and dash line, medium; dotted line, small.

The winter averages and the early summer averages, when present, are considerably lower than the autumn ones. September and October are months of maximum. In B and C which are the most offshore areas, large fish are entirely predominant. In G the population is more mixed, but large still preponderate. In F which is nearer inshore and where there are banks, medium fish predominate.

Eastern Areas.

Area H.—This ground is characterised by enormous catches of plaice at certain seasons of the year. These occur in the early autumn, and by contrast, the spring and early summer catches are so low as to be almost inappreciable. The maximum catches on these grounds *far* exceed those of any other area, the highest average reached in any month being 49·88 cwts. per ten hours fishing (September 1905). The October and November averages too, are extraordinarily high, the lowest catches are made in May, when only 0·25 cwts. are taken. The February and June averages are missing. The curve (Fig. 2) illustrates the comparatively low catches made in the beginning of the year, the minimum in spring, and the sudden and enormous influx of fish in the autumn with a fall almost as sudden to December and January.

The curve (Fig. 2) shows also the constitution of the fish population in this area. Large plaice are generally absent altogether or are caught in very rare instances. In one case (November, 1904) a skipper records a fish 2 ft. 3 ins. long, 1 ft. 2½ ins. wide, but this is very exceptional, though again in November, 1905 one *very* large fish is noticed.*

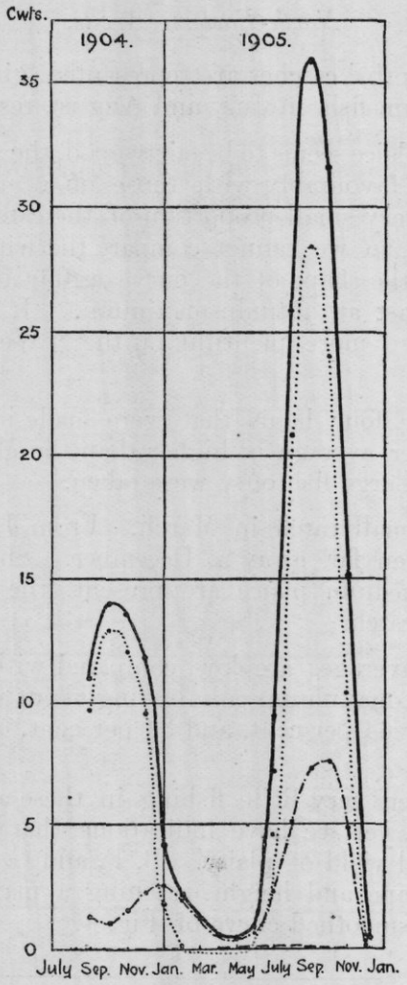

FIG. 2.—PLAICE. Area H. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

From January to May the catches are composed of medium and small plaice, medium preponderating. With the influx of plaice beginning in August, the character of the population appears to be changed. Here by far the greater portion are *small* fish ; medium fish become fairly numerous, but the really large catches are formed by the enormous quantities of small fish. We find that these catches fluctuate very much and that for a few days the fishermen will take about 20 baskets or more in each haul, and then suddenly the quantity caught drops to one basket or less. It is remarkable that these small fish disappear entirely in the winter months and do not seem to be caught anywhere.

In November medium fish appear in the catch of one man only after the middle of the month (November, 1904). The small fish at this time become exceedingly numerous for several days. In 1905 these large shoals appeared earlier, as September and October both had very large catches of small fish. By December we find that the medium fish are more numerous relatively to the small than in the previous months, showing that though they are disappearing they do not do so as rapidly as the small fish. The stock of small fish in this ground is affected both by immigration during August and September of fish from the very shallow coastal grounds near Esbjerg to the S.E., and by a still further offshore movement of the stock of plaice already present. For comparison of the catches year by year, we have really only two years to go upon. Comparing the averages of the months from September to December we find that the largest catches are made in 1905 in the first two of these months, but 1904 exceeds 1905 in the latter two. The

* Johansen (Contributions to the Biology of the Plaice, No. 1., p. 41) has found that the large plaice used formerly to be very numerous on the Horn Reef grounds and have diminished exceedingly in recent years.

autumn catches of 1906 and 1907 are considerably less than those of the corresponding months of 1904 and 1905.

Area M.—A skipper who fishes regularly in these grounds from year to year remarks—"Plenty of plaice and no soles up to March, then the soles occupy the ground till the end of May." Later in the year in July he says—"Fish is getting very scarce here now. The majority of the plaice are very small, averaging from 4-8 ins. The season generally extends from the latter part of March till the end of June, then it is done." In comparing this statement with the facts brought out by observation we see that they correspond. The curve for area M (Fig. 3) is incomplete from January to March as there are no February records, but the figures show that there are considerable

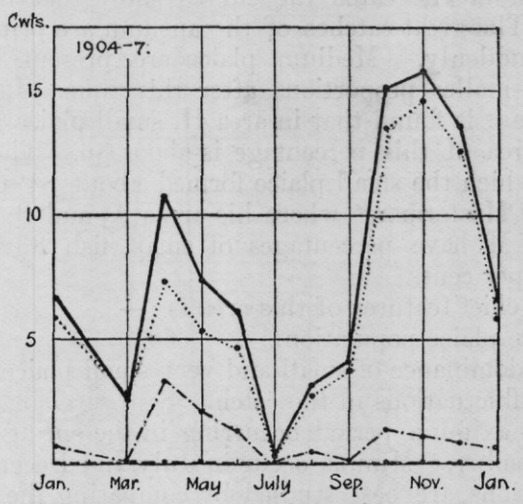

FIG. 3.—PLAICE. Area M. Monthly averages. 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dot and dash line, medium; dotted line, small.

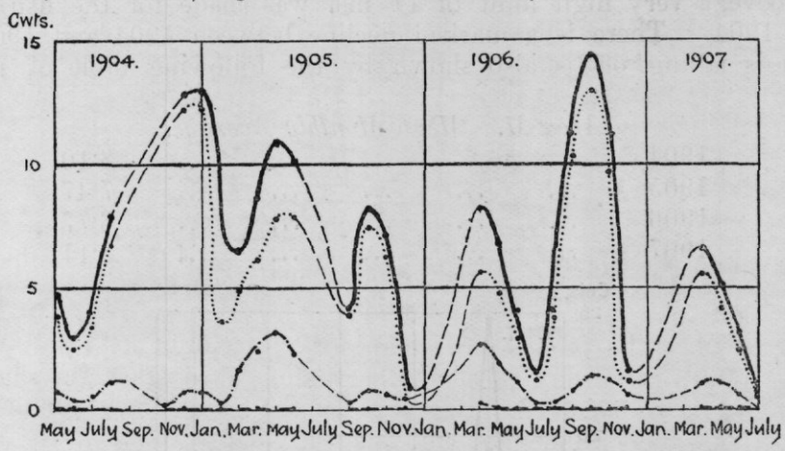

FIG. 4.—PLAICE. Area M. Monthly averages, smoothed curves. Continuous line represents all sizes combined; dashed line, large fish; dot and dash line, medium; dotted line, small.

quantities of plaice reaching a maximum of 10·76 cwts. in April, and the catches afterwards, though good, fall off till, in July, the average is 0·36 cwts., showing that "plaice are getting very scarce." Of the fishery here in the autumn and winter he says nothing, but the averages and the curve show that plaice are increasing after July in the same way as they do in the adjacent area H. There is a sudden and great rise to November (15·78 cwts.) and then a sudden fall. Except for the large catches (30·34 cwts.) in December, 1904, all the December averages are very low and indicate the sudden and almost complete disappearance of the fish. It seems probable that the exceptional case of December 1904 may be a continuation of the phenomenon exhibited in November 1904 in area H, when especially large catches were made. Perhaps some of these great shoals migrated southwards and made their appearance in area M in the following month. Further confirmation of this hypothesis is present in the fact that the high averages of September and October, 1905, in H are followed by a very high average in November, 1905 in M. These large shoals, some of them yielding 40 or 50 baskets in a haul last till about the 22nd of the month and then disappear.

Large quantities of small plaice are thrown away on this ground. In May, June and July of 1904, a skipper reports that he throws away all small plaice under 11 ins. The total quantity disposed of in this way varies considerably. Sometimes there are none, and sometimes as many as 20 baskets or so in a haul. In July he finds that there

are very few plaice except tiny ones of 4 to 8 ins., which are thrown away. This fact has made the 1904 averages for these months less than they would otherwise have been. In April, 1905, this same skipper remarks :—" There are less small plaice over here than I have known for the last 15 years. I think it is owing to the cold weather."

The trend of the curves (Figs. 3 and 4) is also shown in the trend of the figures throughout the course of each month. In 1906 and 1907 we notice that throughout June the catches are appreciably decreasing on the Sylt Inner grounds, and after the 20th the fish disappear altogether. In July there is a continued absence of plaice and it is not till after the beginning of August that they appear even in small quantities.

In the composition of the catch the curves show that the small plaice form the dominant population. The great catches of the autumn are principally of small fish, and these disappear very suddenly. Medium plaice are present in large quantities from March to June, but in smaller proportions after this time. Large plaice are practically absent. On the average it is found that in area H, small plaice form about 76 per cent. of the total catch, in area M this percentage is about 86. The two areas together then would yield catches of which the small plaice formed about 81 per cent., a result which confirms that found by Masterman* where his areas A_3 and B_4 which together cover the same grounds as H and M have percentages of small fish 83·5 and 76·6 respectively, *i.e.*, on the average, 80 per cent.

A summary of the chief features of this area is :—

i. A very large plaice population.
ii. A great predominance of small and very small plaice.
iii. Very great fluctuations in the catch.
iv. A double maximum period occurring in the spring and autumn about April and November. Minima occur in July and December.

The yearly fluctuations are best studied by comparing the averages in each year for the months April to August. May and June are less in 1904 than in 1905, but, as pointed out above, a very high limit of 11 ins. was made for the fish to be thrown overboard in 1904. There is a marked decline between 1904 and 1907. That the average catch is falling off is also shown by the following table of mean monthly averages †:—

	Area M. Mean Monthly Average.
1904	8·10
1905	7·47
1906	6·77
1907	3·11

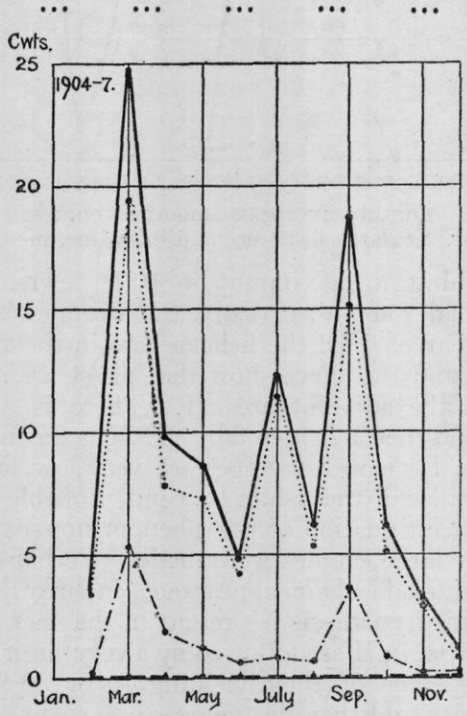

FIG. 5.—PLAICE. Area Q. Monthly averages, 1904–07. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted, small.

* Report of Research work of the Board of Agriculture and Fisheries. Vol. I. Special Statistics.

† Compare also the yield of the Sylt ground in March, 1895 ; 275 and 230 boxes of plaice from two voyages, thus averaging 20 cwts. per 10 hours. CUNNINGHAM. North Sea Investigations. *Journ. Mar. Biol. Assoc. Vol. IV.* 1895. p. 13.

Area Q.—This ground with regard to plaice is very similar in its characteristics to area M. Good catches of plaice are to be made here at nearly all times, the average only once falls below 3·12 cwts. But extraordinary large catches are taken in some months, as in March and July of 1905, and in September, 1904 (33·1 cwts.). Without these exceptional catches the trend of the figures appears to be a gradual rise from the beginning of the year to March or April, a fall to May, a rise to August or September, after which as far as we can tell from the incomplete figures there is a decided falling off.

In March, 1907, we notice a sudden appearance of shoals of small plaice on the Borkum Inner ground, as many as ten baskets being sometimes taken in one haul. But these hauls, though large, are nothing like those of the same month in 1905, when about seven times the quantity was caught. Most of the large catches were made on the Borkum Inner ground. Other parts of the same area did not show such a large population. The average of 25·8 cwts. in July, 1905, is obtained from hauls made by a skipper on the Heligoland ground. His catches in August on the same place are also greater than those of the other skippers who fished about Borkum and Terschelling. It is probable that the fish have come here out of the shallower waters off the Danish coast (area M). The large hauls of September, 1904, were made on the Norderney and Borkum grounds.

Like the other eastern areas the plaice population is essentially a small fish one. This class forms 84 per cent. of the total. Medium plaice are present in large quantities in the exceptionally large catches (March, July and September), but they are in smaller proportions of the whole than in the other months. The number of large fish in this area is negligible.

A comparison of the monthly averages year by year shows on the whole a decline in the average catch, between 1905 and 1907, and also between 1904 and 1907 sometimes, although it is very seldom that the 1904 averages are reliable enough for comparison. This decline is noticeable in March, April, May, and July. In August, 1907 is the best year. The last four months of the year do not give figures sufficient for comparison of the yearly catches. 1907 was, on the whole, a somewhat better year than 1906, but the mean averages of these two years are considerably less than those of 1904 and 1905.

Area W.—The averages of hauls in this area show the presence of a large quantity of plaice, all medium and small, the small being about 69 per cent. of the catch. We cannot ascertain the seasonal fluctuations from these figures as very little fishing took place. The highest average obtained is 7·39 cwts. in June, about which time of the year a large quantity of unmarketable plaice was thrown overboard.

All these eastern areas are very well stocked with plaice, and exceptionally large catches are sometimes made. The catches fluctuate exceedingly, the maximum quantities in the autumn being very large and the minimum very low, sometimes amounting to almost complete absence. Two maximum periods are evident in areas M and Q, and one in area H, where the spring maximum is not marked. The summer minimum in M is probably due to an offshore migration of all sizes of fish present, the larger ones not returning again when the small ones appear to form the autumn maximum. The predominant population is of small fish, but the character of the catch changes in the course of the year.

In the winter and early part of the year, the small fish seem to disappear as in H, or be less abundant in proportion ; medium fish are more plentiful than they are in the autumn when the small fish are exceedingly numerous. Large fish are generally absent, but their appearance in the spring is probably due to an immigration of these fish towards the coasts after the spawning season. A large number of small plaice are thrown overboard and lost count of in the total. There is no doubt that some men retain much smaller fish than others, and their catches are thereby considerably augmented. One of the men states that he keeps none under 11 ins., and that it pays him to throw them away.

Where it has been possible to make comparisons between one year's catch and another, we find that the averages decline between 1904 and 1907 on the whole.

Central Areas.

Area J.—The amount of plaice in this area is very small compared with that obtained from the shallower water between it and the coast ; indeed, the catches are quite of a different order. Whereas enormous quantities of plaice are taken on the inshore grounds, sometimes amounting to 20 or 30 cwts. in 10 hours fishing, no average catch in area J exceeds 2·17 cwts., while most of the general averages are below 1 cwt.

This is possibly partly caused by the enormous destruction of plaice on the inshore grounds. Marked fish experiments (Danish) show that sometimes the intensity of fishing is about 70 per cent.

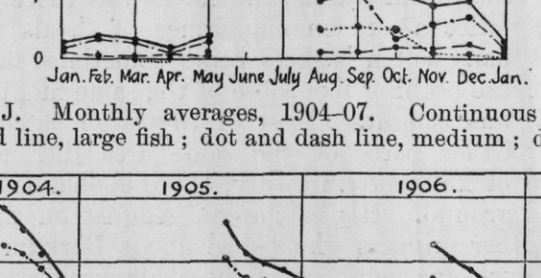

FIG. 6.—PLAICE. Area J. Monthly averages, 1904–07. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

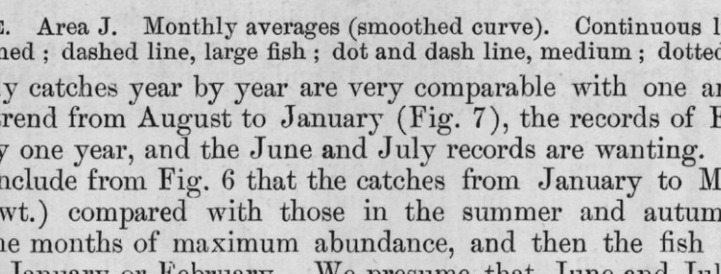

FIG. 7.—PLAICE. Area J. Monthly averages (smoothed curve). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

The monthly catches year by year are very comparable with one another and show much the same trend from August to January (Fig. 7), the records of February to April are those of only one year, and the June and July records are wanting.

We may conclude from Fig. 6 that the catches from January to May are very low (less than ·4 cwt.) compared with those in the summer and autumn. August and September are the months of maximum abundance, and then the fish depart gradually and decrease till January or February. We presume that June and July would not have higher averages than August, by comparing the trend of the curve with those of N and I, which are very similar in respect to depth and distance from the shore, and are likely to be affected at about the same time by immigration from the inshore waters.

The average proportions formed by the large, medium, and small fish are 14 per cent., 64 per cent., and 22 per cent. respectively. We see, therefore, that the predominant population is of medium fish. Small fish are generally absent, and it is only in the months of August, September, and October, when the whole catches are larger, that they appear in any numbers and exceed in bulk the quantity of large fish.

The yearly fluctuations in area J are best studied by comparing the averages in each year of the months from August to December. With the exception of October the averages become smaller between 1904 and 1906 (there are no figures for 1907, except in November, which is unreliable).

The chief features of this area are :—

i. A small population of plaice, with medium sized fish predominating.

ii. An annual wave of immigration, the late summer catches being higher than those of the winter and spring. In this immigration a number of *small* fish partake.

iii. A decline in the average catch between 1904 and 1906.

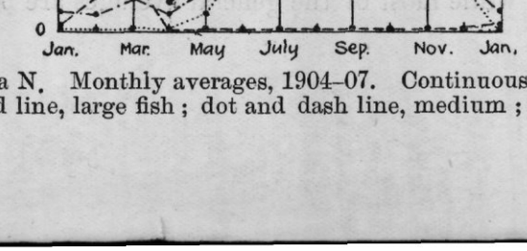

FIG. 8.—PLAICE. Area N. Monthly averages, 1904–07. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

Area N.—The curve, Fig. 8, illustrating the fluctuations of the general monthly averages in this area is complete and fairly smooth. It is a very good plaice ground and shows, for the seasonal fluctuations, two cusps giving maxima in March and September, but the autumn maximum is far larger than that of the spring, the difference being 7·12 cwts. The averages increase from 0·53 cwts. in January to 1·50 cwts. for the March maximum. After the minimum in April the amounts increase steadily and rapidly to an average of 8·62 cwts. in September and then fall off to the January minimum at about the same rate. The smoothed curve in Fig. 9 shows the seasonal fluctuations of each group year by year.

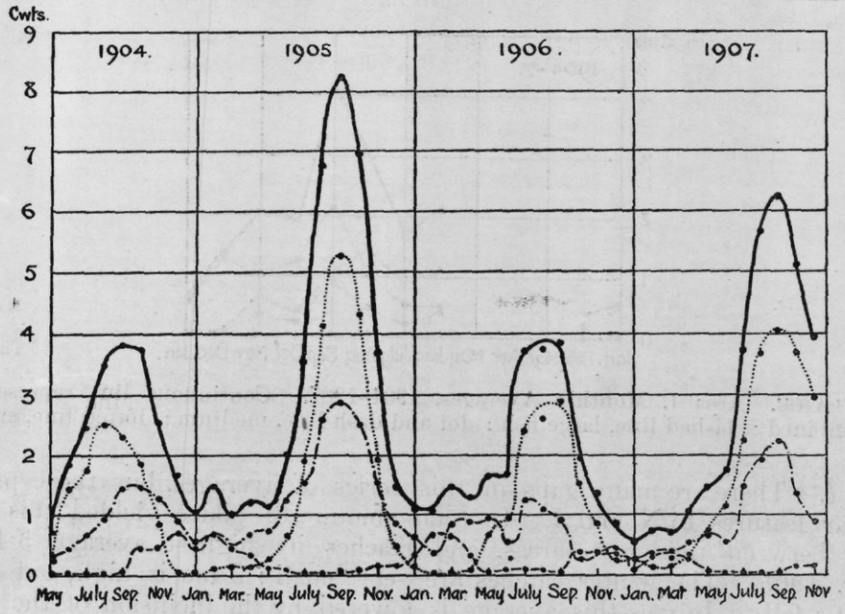

FIG. 9.—PLAICE. Area N. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

The features of the curve of combined averages are all present in each year on this curve, namely, a large wave culminating in a maximum in the late summer and early autumn, and a minimum in January, with a very much smaller wave of increase in February or March. This secondary maximum is formed entirely by the increase in large fish alone, for these are found in their greatest numbers in winter and spring. But this curve (Fig. 9.) also brings out the differences in the four years. 1904 and 1906 are very similar from June to December, though in the latter the high values begin earlier and fall off a month earlier. 1905 and 1907, especially the former, have larger maxima in the autumn than 1904 and 1906. The spring values of 1907 are considerably lower than those of 1905 and 1906. From this curve, 1905 is undoubtedly the best year, 1907 comes next and 1906 is the worst. The comparison is also shown by the following table, giving the quarterly and monthly averages for each year.

Months.	1904.	1905.	1906.	1907.
January–March	—	(1·47)	1·06	0·76
April–June	1·04	1·13	1·62	1·42
July–September	3·49	6·79	3·77	5·66
October–December	2·58	3·55	1·38	3·99
Average of all months ...	2·53	3·24	1·96	2·96

Small fish are found to be 56 per cent. of the total catch in the mean monthly average, but there is a distinct change in the composition of the catch during the course of the year. Large fish predominate up to March, and they are closely followed in amount by medium fish, while small are hardly present at all (*see* Fig. 8). During the summer and throughout the autumn, the large fish disappear and their place is taken by a small fish population, medium fish being also fairly plentiful. The following figures show this change very clearly.

	Average Percentage of Total.		
	Large.	Medium.	Small.
January–March	55	39	6
June–October	1	32	67

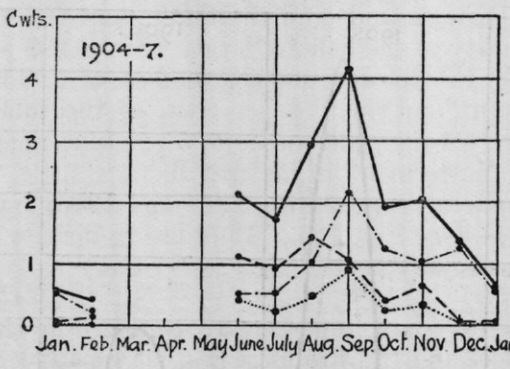

FIG. 10.—PLAICE. Area I. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

Area I.—There are many gaps in this series of averages, but those present show very similar features to N and J. In total amount of plaice yielded this area comes some way between these two areas, and reaches its highest average 5·45 cwts. in September, 1905. The winter catches are very small ; June is high, but there is no evidence of a fall to July as this average is lowered by the inclusion of the 1906 figure, which is absent in June. August and September are both high and then the curve falls straight to January (November is higher than October in only one year).

In the first two months of the year large and medium fish only are present, medium fish preponderating, but the proportion of "large" increases between January and February. During the summer small fish appear. The large fish preponderate at first but they begin to disappear earlier than the medium and small fish, and from September medium fish have the first place. The average proportions of the three classes are as follows :—Large 34 per cent., medium 50 per cent., small 16 per cent.

We have seven months at our disposal for comparison of the yearly fluctuations, but the figures are so incomplete, and many months are missing, while several of those that are present are based on an amount of fishing too small for purposes of a yearly comparison, so that we cannot venture to draw many definite conclusions. 1905 has the highest average in the months of January, June, August, and September. In July there is a fall between 1904 and 1906, and in September between 1905 and 1907.

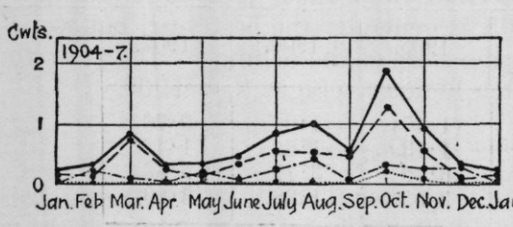

FIG. 11.—PLAICE. Area O. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

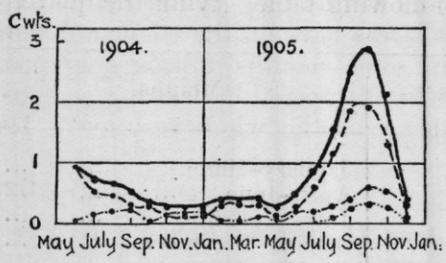

FIG. 12.—PLAICE. Area O. Monthly Averages, (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

Area O.—This curve, Fig. 11, is mainly derived from the 1905 figures when there was a great deal of fishing on the Dogger Bank. In 1906 and 1907 there were very few records, for some of the men ceased recording their catches in those years.

The curve (Fig. 11) shows that plaice are appearing on the Dogger between January and March, when there is a very small maximum. There is a minimum about May or June, and then the curve rises till the secondary and much greater maximum in October. The fall in September on the curve of combined averages (Fig. 11) is probably a chance

occurrence as the average is based on the fishing of 1904, when very small quantities were taken in all months of the year. The catches decline in amount after October throughout the succeeding months to January or February. A sudden appearance of large plaice on the Bank is noted in March, 1907, when, about the 21st of the month, the catches increased from four fish to about $1\frac{3}{4}$ baskets in a haul.

The total amount of fish taken from this area is not large. The greatest average catch obtained is that of 3·68 cwts. in October 1905, and the smallest that of 0·20 cwts. in January 1907.

Although this is a shallow area (less than 20 fathoms) it is divided from the coastal ground by surrounding deep water, and for this reason and also because of the intense fishing between the small fish grounds and the Bank, very few small fish find their way on to the Bank. The majority of the fish are large. Small fish seem to have appeared in appreciable quantities only in October and November of 1905. Large fish form 68 per cent., medium 28 per cent. and small 4 per cent. of the total. Compare this result with the $69\frac{1}{2}$ per cent. large, 24 per cent. medium, 3 per cent. small and $3\frac{1}{2}$ per cent. not distinguished, obtained by Masterman* in his area B_1.

The only two years we can compare are 1904 and 1905, and the latter year yielded undoubtedly the best catches (see Fig. 12). 1904 has uniformly very low averages, and, by contrast, those of 1905 are very large.

These four central areas show together by comparison that the quantity of fish decreases as we move offshore and the size increases, for we have found that in regard to the yield of plaice, N comes first with very good catches, I a very good second, but the areas J and O seldom yield more than an average of 1 cwt. (per 10 hours), while in N the predominant size of the fish is small, in I and J it is medium, and in O it is large.

An early autumn or late summer maximum is apparent in all areas, and where the figures are sufficient to show it, there is another maximum but one of much smaller extent, which occurs about March.

It is a fact worthy of notice that the stock of fish on these grounds begins to increase in May and June, at the time when on the adjacent grounds M and Q, the stock is decreasing. It has been noticed how the constitution of the population in some of these areas changes about April. It is probable that the two maxima on the curve are caused by two quite different sets of fish, the spring one by an immigration of large and medium fish about the time of the spawning season (these being less numerous than the small fish would only cause a small maximum), and the summer increase by an offshore movement of the stock of all sizes of fish including small fish, from the coastal areas M, Q and W.† The majority of the fish probably move in a westerly direction from the Danish and Dutch coasts, while in N and the grounds to south-west they are found in great quantities in the summer. The maximum in O and I is formed mainly by large fish, the small plaice not generally migrating so far. Perhaps the larger fish and some of the medium remain offshore and ultimately make their way northwards to the Dogger Bank and the grounds beyond it, while the small fish remain abundant on the central grounds till August or September and on the inshore grounds till October and November, after which they seem to disappear altogether during the winter. They are supposed at this time to hibernate and so escape capture. The yearly variations in these central areas have on the whole a downward trend from 1905, (also from 1904 in area J) but in some months this is not apparent. 1905 is generally the best year, but we are somewhat hampered in drawing conclusions as to the state of the fishing in 1904, as the records are on the whole very few. 1907 has often higher averages than 1906.

Northern Areas.—"Below the Dogger."

Area D.—In this area we have very deep water (greater than 40 fathoms) and here only large fish are found, and those in very small quantities. There is a downward trend in the averages from 0·38 cwts. in January to 0·0 in April. There are no records in May, June and July. In August, the catch is really very large, 2·87 cwts., but this is based in the fishing in the year 1906 which took place on the Edge of the Deep water, just over the line dividing it from area L. The large catches made here in this month as well as in September are a reflection of the phenomenon observed in areas L and K at the same

* Report on the Research work of the Board of Agriculture and Fisheries, Vol. I, Table IV.

† Note.—The detailed tables of the report on plaice investigations published by the Board of Agriculture and Fisheries confirm the fact that it is during the summer and autumn maximum period that the proportion of small fish is the greatest. See Report on Research work of Board of Agriculture and Fisheries on Plaice Fisheries of the North Sea, Vol. II, 1906–07, 1907–08. p. 65.

time when the summer averages are exceptionally high compared with those of the other years. The November and December catches are very low.

Area K.—This again is another area where plaice are very scarce, the averages being generally about 0·3 or 0·4 cwts. There is a continuous fall from September 1904 to February and March 1905, but it is one small extent. The averages do not change much, either month by month in the same year or in the same month of different years, and they only show any great increase in the month of September, when, especially in 1906 the catches become large. There are many gaps in this series of figures, so much cannot be said about the seasonal or yearly changes. The population is formed almost entirely by large fish, the only important exception being that of September 1906, when medium fish appeared.

Area L.—A first glance at the averages makes it appear that the catches from May to October are comparatively large (greater than 1·0 cwt.) while those from November to April are very small (less than ·40 cwts.). But to some extent this appearance is perhaps exaggerated, as the averages are affected by the predominance of the 1906 figures. We find that the summer catches of 1906 are exceptionally large compared with those of 1904 and 1905. (For 1907 we have no figures in the summer.) It is however probable that the trend indicated by these figures is correct and that the summer catches, beginning in May, are higher than the winter ones, but not generally to such a great extent as is indicated by the general averages. The main bulk of the catch is of large fish.

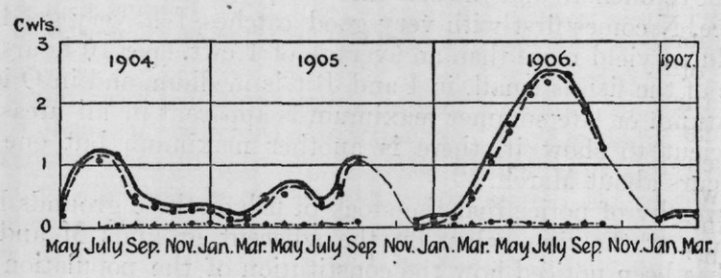

FIG. 13.—PLAICE. Northern Areas D, K and L combined. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium fish.

These three areas (see Fig. 13 for a representation of the averages of the combined catches of the areas) are frequented mainly by large plaice which are never numerous, most often only three or four fish being taken in a haul. The catches do not fluctuate much, but are somewhat greater in the spring and summer than in the winter. 1906 seems to have been an exceptional year with regard to its summer hauls, which gave many more plaice than usual in this region (averaging between two and three cwts.).

Had the averages been more complete for the surrounding areas than they are, we might have been able to trace the course of these extra abundant fish towards these areas. A point which suggests itself, but wants confirmation, is that in 1906 the plaice penetrated the deep water and further north to a greater extent than usual, because of the exceptionally fine and hot summer that was experienced in that year.* It is noticeable, too, that in the more coastal areas, at least on the eastern side, 1906 was a very poor year.

Southern Areas.

Area S.—This area corresponds in position to a part of the northern areas discussed in my paper on the Lowestoft trawlers.† As far as concerns the seasonal fluctuations, the curve (Fig. 14) may be said to corroborate the conclusions there found. There is an annual immigration into this area giving maximum catches in the summer, and the curve falls away smoothly on either side of this maximum, showing that the fish are leaving this ground in the autumn and winter. We found in the Lowestoft trawling statistics that the fish migrated into this area and formed a maximum in the summer, and left it after this season, some of them to migrate southwards in the winter towards the spawning grounds. With regard to the February and March values, which are higher than April, it should be explained that neither of these are reliable, as the February average is based on two hauls only, and nearly all the March hauls were made on the "Well Bank" on the borders of areas S and R, and might even belong to R rather than S (see p. 8). The hauls made away from this border line give a much lower average (about ·8 cwt.).

* See p. 25. † Loc. cit.

The bulk of the fish that migrate on to these grounds in the summer probably come both from the southern grounds of the Flemish Bight (after the spawning season) and also from the Dutch coasts (areas W and Q), where we find a summer minimum.

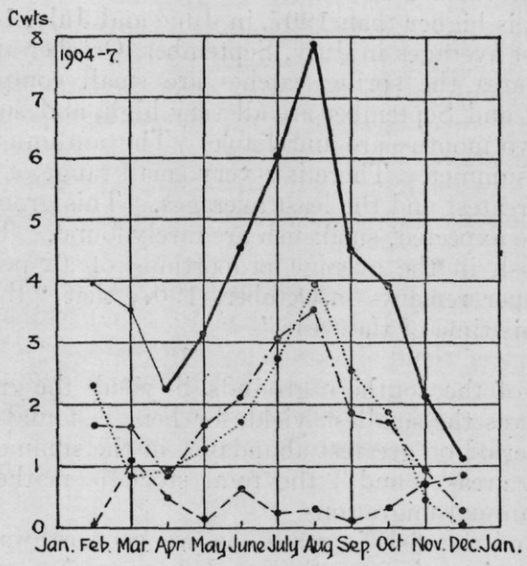

FIG. 14.—PLAICE. Area S. Monthly averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dot and dash line, medium; dotted line, small.

Fish of all sizes are found in this area, but large fish form but a small proportion of the total. The hauls in April, November and December are made by one man, who is evidently biased in his judgment of size. Neglecting these months and the averages of February and March, we obtain from the average of the remaining six months the following proportions during the summer:—Large, 6 per cent., medium, 47 per cent., small, 47 per cent., so that the bulk of the population is seen to consist of medium and small fish in equal proportions.

A comparison of the catches in the different years made of the averages of June to October, which are the most reliable, shows that there is sensibly a decline in the average catch between 1904 and 1906. 1904 is always better than 1906, and it has larger catches than 1905 in two of the four months July to October. The few 1907 averages present compare favourably with those of 1906.

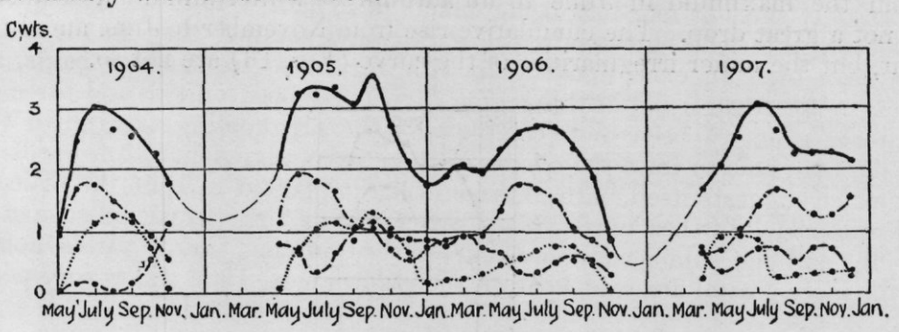

FIG. 15.—PLAICE. Area T. Monthly averages (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dot and dash line, medium; dotted line, small.

Area T.—The somewhat irregular fluctuations of the general monthly averages for this area are eliminated in the smoothed curve of Fig. 15, which shows that the stock of plaice fluctuates between one and three and a half cwts. (per 10 hours) and maintains a higher level in the summer than in the spring and winter. There is a minimum about January, 1906, and the trend of the curve points to the existence of similar minima at about the same time in the other winters.

The plaice population is very mixed in character, all sizes being found, and in the general averages they appear to fluctuate irregularly and independently of one another. How far this may be due to the fact that the groups of fish migrate through this area from the surrounding areas at very different times, or to personal errors on the part of the fishermen in classifying the fish, it is impossible to say. Most probably the latter reason has a good deal to do with this irregular appearance. The average proportions are as follows:—Large, 30 per cent., medium, 44 per cent., small, 26 per cent.

There is no evidence of any great increase or decrease throughout the period, but the smoothed curve suggests that 1905 was the best of the three years, 1905–1907 (we leave 1904 out of account, as all the averages are based on too few hours' fishing to be reliable). In April and May, 1906 is higher than 1907, in June and July, 1907 is better than 1906, but 1905 had the highest averages in July, September, October and November.

Area V.—In this area the spring catches are small compared with those of the summer. July, August and September are all very high, and so are May and June, but the averages for these two months are unreliable. The autumn and winter averages are lower than those of the summer. There is a very small range of difference (a little over one cwt.) between the greatest and the least averages. This ground has in it some very deep pits, and, as may be expected, small fish are rarely found. The catch mostly consists of large and medium fish in the average proportions of 62 per cent. and 33 per cent. respectively. One skipper remarks in October, 1907, that "the plaice we get in the Pits are very large at this time of the year."

The most shallow of the southern grounds, S, yields the greatest amount of plaice. T comes next, and V gives the smallest yield, for here is found the deepest water. All three areas have their period of greatest abundance in the summer and their least in the winter and spring. In areas V and T the total stock is neither greatly increased nor much decreased by the annual migrations.

The average size of the fish increases as we go northwards through these areas. Medium and small predominate in area S (the shallow area), medium in T, followed by large, and the large fish in V (the deepest).

These proportions are not, however, by any means constant. The variation may be caused by different stocks of fish migrating into these areas from the Flemish Bight and the eastern and western coastal areas at different times.

In one of these areas we have found the annual average yield is declining, in the other two the evidence is by no means conclusive.

Western Areas.

Area E.—The few averages present are not really representative of this area Apparently exceedingly small quantities are found in the early months of the year. Eight hauls in June give very good quantities, but out of four in July only one yielded any fish. Only small and medium fish were found.

Area R.—This ground gives a fairly good yield of plaice, the general averages for the first eight months of the year fluctuating between $3\frac{1}{2}$ and $4\frac{1}{2}$ cwts. There is a downward trend from the maximum in June to an autumn or winter minimum of about 2 cwts., which is not a great drop. The cumulative rise from November to June and July is quite significant, but the minor irregularities of the curve (Fig. 16) are not so.

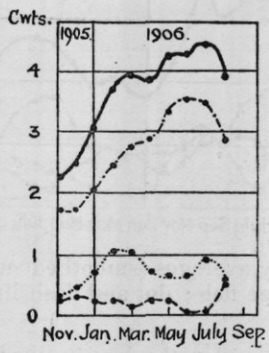

FIG. 16.—PLAICE. Area R. Monthly averages, smoothed curves. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

The majority of the fish are medium sized, but both large and small are present. It can safely be said that the peculiar appearance of the curves, where the maxima and minima of the large fish appear to alternate with those of the small fish, is an unnatural one. It is brought about by the fact that nearly all the hauls in this area were made by two men who were biased in opposite directions, one to classify the greater part of his catch as "large" and the other, to have but few "large" and many more small. When the hauls of the former preponderate, as they do in September and October, we have a maximum of large fish. When the hauls of the latter preponderate as in February, March, June, July and August we have a maximum for small fish.

We cannot say much about the yearly fluctuations. In the month of May, when it is possible to compare three years, we find a distinct decline in the average catch between 1904 and 1907.

Area X.—The December to March averages are all based on the result of very little fishing, and we do not know that they are really representative. From April to July the quantities maintain a fairly high level, after which there is a slight decrease. On the whole a fairly steady level of population seems to be maintained throughout the greater part of the year. The stock consists almost entirely of large and medium fish, small fish seldom averaging more than 0·03 cwts. Large fish are considerably in excess of the medium and form 60 per cent. of the total. Medium are 39 per cent. and small 1 per cent.

Area P.—The few odd hauls made in this area yield averages which are nearly equal to those of the adjacent area X in the same month. Large fish preponderate even more than they do in that area. Small fish are altogether wanting.

In investigating the western areas we are much hampered by the many gaps in the series of monthly averages, and any attempt to draw conclusions from such figures as are present must be regarded as merely provisional. However, the following ideas suggest themselves and await corroboration. The stock of plaice is *very* much smaller than on the eastern grounds off the continental coast and by contrast with these is subject to a very small range of variation. Areas X and P give an average yield of under 2 cwts. R is the best ground, and, like X, keeps up a high level for a considerable number of months. The proportion of large fish increases and that of the small decreases as we move outwards from E to R and thence into the deeper waters of X and P.

Spawning.

We have observations on the maturation and spawning of plaice for the three spawning seasons 1904–5, 1905–6 and 1906–7. These were recorded by the skippers on the ordinary record forms, and were kept very consistently during the first two seasons. But a few of the skippers failed to give any spawning records at all, and some of those who made observations in the first season omitted in the others to note the spawning fish at the same place and time. For this reason it was found impossible to summarise the results numerically, more than has been done in the table (Table VI.). In this, for each area, the total number of hauls where spawning or maturing plaice were recorded, are given as the numerator of a fraction, whose denominator is the total number of hauls made in that month in the area, by the skippers who record spawning fish. In addition to these, there are notes made by one particular skipper in his summary of the voyages, that the fish are maturing or nearly ripe, without specifying the number of hauls in which they occur. These observations are entered in the table at the appropriate areas by significant signs.

TABLE VI.—Showing the number of hauls in each area in which maturing or spawning plaice are recorded.

——		B.	C.	D.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	Q.	R.	T.	X.
September	1904	—	—	—	—	—	—	—	—	—	—	—	—	1/22	—	—	—	—
November	„	—	—	—	—	—	—	*	—	—	—	—	*	4/25	—	—	—	5/8
December	„	—	—	—	—	—	—	35/53	3/86	—	—	—	—	—	—	—	—	—
January	1905	—	—	†	—	11/26	—	5/9	4/25	29/30†	—	—	—	18/25	—	—	—	—
February	„	—	—	52/132†	—	2/2	—	—	—	20/38†	35/146†	—	†	2/14	—	—	—	—
March	„	—	—	21/152	—	—	—	—	—	—	24/47	—	—	10/37	5/21	—	—	2/6
September	1905	13/22	—	—	7/24	—	—	2/2	2/11	5/21	11/17	—	—	—	—	—	—	—
October	„	5/5	1/1	—	4/10	2/3	2/17	—	18/18	—	—	2/3	—	8/8	—	—	1/4	—
November	„	—	—	—	—	—	—	7/9	1/1	—	—	—	15/17	—	—	—	—	—
December	„	—	—	—	2/2	1/1	—	4/5*	14/14	—	5/7	—	2*/2	28/119	—	†	—	7/8
January	1906	—	—	—	—	—	—	—	†	—	—	—	†	—	—	—	—	—
February	„	—	—	—	—	—	—	—	†	—	—	—	†	—	—	—	—	—
March	„	—	—	—	—	—	—	—	—	—	—	—	†	—	†	—	—	—
January	1907	—	—	—	—	—	—	—	—	—	—	—	28/74	—	†	—	—	—
February	„	—	—	—	—	—	—	—	—	—	—	—	†	—	—	—	—	—

Maturing plaice are present in hauls from areas marked thus,* and plaice which are described as full of roes or spawn are present in hauls in areas marked thus †. The number of hauls is not specified. The numerator of the fractions denotes the number of hauls when records of the presence of spawning or maturing plaice were made and the denominator, which is given as a means of comparison, is the total number of hauls in the area for each month which are made by those men who record the spawning fish.

The season of maturation begins in September. In this month and the following the fish are described as "beginning to have roes in them" and "spawn forming." In November and December they are full or "getting ripe," and in many cases actually spawning. In March they are generally spawning, and then the season seems to end.

With regard to the distribution, the table shows that they are present in a greater or less degree in most of the areas, the occurrences being greatest in the deep water areas. They are hardly ever present on the shallow eastern areas H, M, Q and W, nor in the southern areas S, T and V, although we cannot speak with any certainty about these last two areas, as the hauls of January to March were made by men who seldom record spawning fish at all. However, the large fish are never numerous in this region at this time. In area R there were some plaice mentioned as being heavy with spawn at the end of December 1905, but there are no records of spawning fish. Of the other western areas, X, Flamborough Off, &c., seems to be a spawning area, for large numbers of spawning fish are recorded there in a few hauls taken during the spawning season. In the north-eastern areas, A, C, B and also area P, there is either none, or very little, fishing at the spawning time. On the Dogger Bank both maturing and spawning fish were present in the first season. In the second season only full fish were found, none actually spawning, and in the third, when there was a good amount of fishing on the Bank, none were recorded. It was the same case on the adjacent grounds lying to the north of the Bank. In January and February maturing fish were present, and in March a considerable proportion were spawning. In the second season fish "with spawn forming" were present in September and December. After that, and in the next season, none were noticed, although these grounds were well sampled during the winter months. Both maturing and spawning fish are present regularly on the central areas J, N and I. In these the depths are all over 20 fathoms.

These records are generally entered as "few large spawning," and it is only in the deep water areas (over 30 fathoms) that they form any large proportion of the catch. Only in a very few cases do they mention medium plaice as being "full of spawn."

One of the most important of the spawning areas of plaice in the North Sea, that in the southern region*, lies altogether outside the region fished by these Grimsby trawlers, and this shows a more definite accumulation of spawning plaice than any of the areas in the central region.

Summary.—Plaice.

a. Distribution—The distribution of the plaice over the central part of the North Sea, according to the abundance in the average catches, is shown in Fig. 17.

Exceedingly great amounts of plaice are taken on the eastern grounds, off the coasts of Denmark, Germany and Holland (areas H, M, Q and W), and the grounds adjacent to these give also a fairly good yield. The western grounds off the English coast are much more poorly supplied than the eastern inshore grounds, and here we find the conditions are very different. The shallow coastal waters are not of such a large extent, as the deep water off Flamborough Head comes almost to the coast. The ground is very much rougher and is unfit for trawling in some places, and these conditions are probably more unsuitable for the growth of the young plaice. The off-shore grounds have a less abundance, the quantities decreasing as we move off-shore, in a northerly direction and into deeper water. Thus S, I, J, K, G and C form a rough series, as do also S, R, T, V, L and D, in a descending scale.

The Dogger Bank (area O) is unique. It is a shallow area lying in a central position offshore, and quite surrounded by deep water. Its yield corresponds more to that of the offshore areas J or L than to that of any of the shallow waters.

In some of the northern grounds plaice are very scarce, and are often absent in many hauls.

These figures also show the known law of distribution according to size. The average size increases in the more offshore and deeper waters. The areas with very large catches have a predominant small plaice population. The central areas with the intermediate quantities have a mixed population. The northern areas with deep water, and also the Dogger Bank, have almost entirely only large fish.

The proportion of "small" is much greater on the eastern than on the western side of the North Sea.

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* LEE.—Report on the Lowestoft Sailing Trawler Records 1903–06. *Internat. Inves. Mar. Biol. Assoc. Report II.*, Part V., Cd. 4641, p. 104.

cf. also REDEKE and VAN BREEMEN. Distribution of eggs and larvae in the southerly N. Sea, Verhandelingen uit het Rijksiustituut voor het Onderzoek der Zee, p. 34 and Chart III.

"Small" form the largest bulk of the fish landed and with "medium" are 90 per cent. of the total. Thus a small proportion only of the plaice captured in the central part of the North Sea have attained maturity.

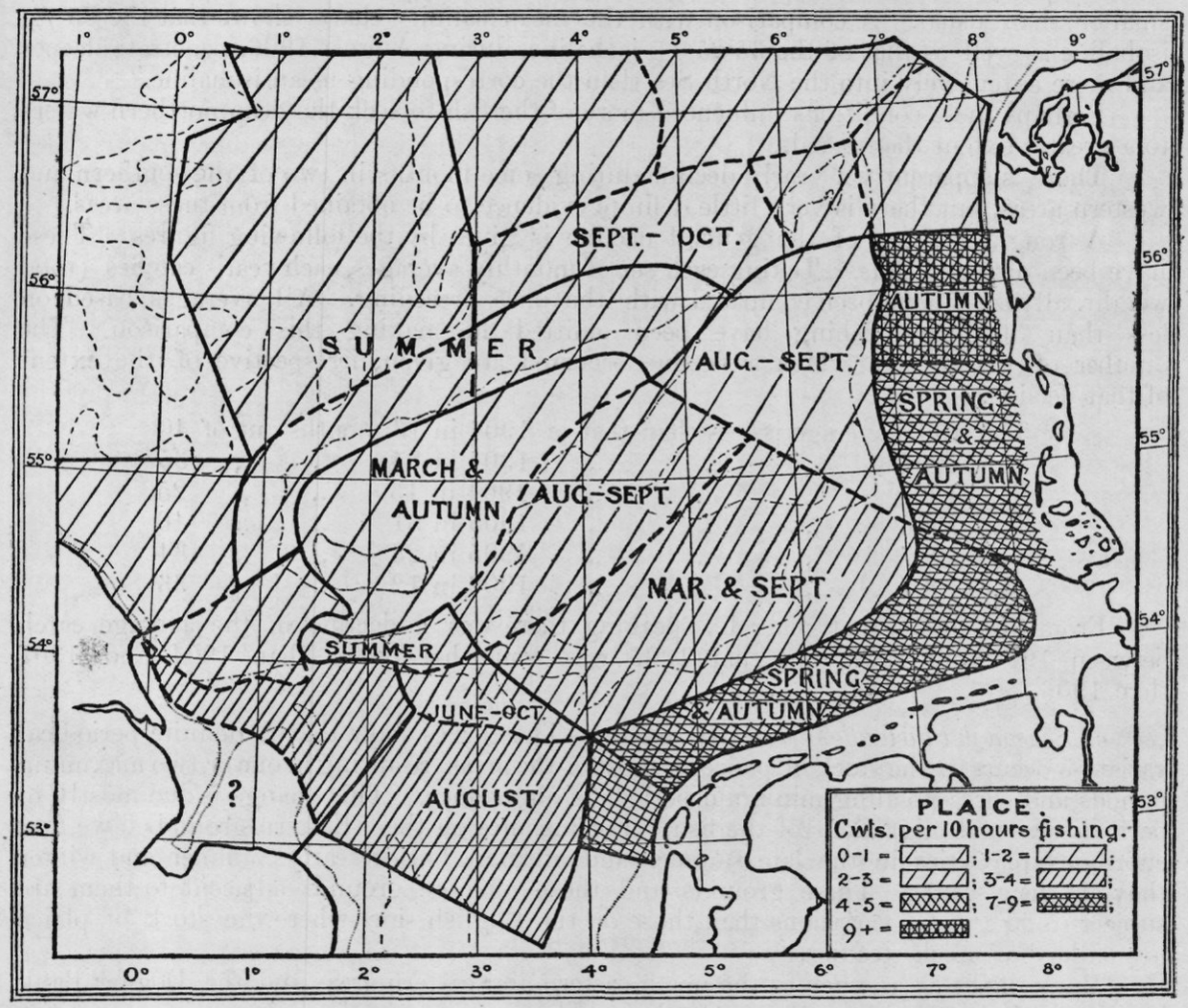

FIG. 17.—CHART showing the distribution of PLAICE according to the mean monthly average catch in various areas, and the periods of maximum abundance in the different regions.

b. Yearly variations.—These have been studied as far as possible by a comparison of the average catches in the corresponding months of each year, but the resulting variations are by no means uniform over the whole of the region investigated. In many cases it was impossible to draw conclusions owing to lack of data.

On the eastern grounds we find a decline in the average catch between 1904 and 1907 ; sometimes 1905 was the best year. In most of the central areas we have a downward trend from 1905 and sometimes from 1904, but there is evidence in some of a recovery to larger catches in 1907 after minimum quantities in 1906.*

About the north-eastern areas we are not able to draw any conclusions as to the yearly fluctuations.

In the grounds north of the Dogger there is a marked increase in the summer of 1906, the catches being two and a-half times those of the two previous years. This may, perhaps, be explained by the somewhat unusual conditions of temperature and salinity. A study of the temperature and salinity charts of the Quarterly Bulletins of the International Council shows that on the whole the surface temperature of the sea was somewhat higher in 1906 than in the other years of this period,† and on p. 32 of No. 1,

* *Cf.* The Dutch Statistics. Jaarverslag omtrent het beheer vande Visscherhaven te Ijmuiden, 1908 (Table IV.). The trend shown by the average catch of plaice for these years is the same as this.

† See also *Conseil Perm. Internat. pour l'Explor. de la Mer.* Bulletin Trimestriel. 1906-7. Partie Supplementaire, p. 64.

NOTE.—Since the writing of this paper, more detailed and summarised information as to the surface temperatures of the North Sea is to hand in a paper by Mr. F. G. Young, B.Sc., in the Fourth Report (Northern Area) of the North Sea Fisheries Investigation Committee. He shows that in 1907 the mean surface temperature was much lower than in 1906, this fact being attributable mainly to the severe winter experienced over Western Europe in 1907 (p. 76) and that the yearly differences were greater and more extreme in the southerly parts of the North Sea.

1906–1907, August 1906, we have the following remark :—" Salinity is remarkably low in the eastern and southern parts of the North Sea. The 34°/$_{oo}$ line has an extraordinary westerly position. The 35°/$_{oo}$ water in the north-west part of the North Sea is not smaller than usual. A comparison with the mean salinity charts shows that the 35°/$_{oo}$ isohaline as well as that of the 35·25°/$_{oo}$ isohaline, during August 1906, penetrate deeper and more extensively into the North Sea than the corresponding mean isohaline."

Perhaps these conditions influenced more of the fish to seek the deep northern waters to a greater extent than usual.

There is apparently a yearly decline during some months in two of the southern and western areas, but there is very little definite evidence to be obtained from these areas.

A rough measure of the general decline is given by the following figures. These have been obtained thus. Taking each set of monthly averages, each year's catches (total weight, all sizes) have been compared with the ones preceding. All averages based on less than 30 hours fishing have been omitted in making this comparison. The number of averages in which a decline occurred are given, irrespective of the extent of that decline.

The	1905	average	is less	than	that of 1904 in	13	months out of 40
,,	1906	,,	,,	,,	1904 in	24	,, ,, 35
,,	1907	,,	,,	,,	1904 in	13	,, ,, 25
,,	1906	,,	,,	,,	1905 in	31	,, ,, 46
,,	1907	,,	,,	,,	1905 in	23	,, ,, 34
,,	1907	,,	,,	,,	1906 in	12	,, ,, 33

From this we see that generally speaking there was a decline in the average catch between 1904 and 1907, but that 1905 was somewhat better than 1904 and 1907 than 1906.

c. Seasonal Fluctuations and Migrations.—The curves show that a definite periodical variation occurs in the stock of plaice in most of the areas, resulting in one or two maximum periods and corresponding minimum periods of abundance. This change is due mostly to periodic seasonal migrations of the fish. For instance on the " Eastern grounds " we find enormous quantities in the late summer and autumn, but in early summer and winter they are very scarce. These grounds and those offshore grounds adjacent to them are subject to far greater variations than those on the English side, where the stock of plaice is smaller but much steadier.

Many of the areas, such as the north-eastern and eastern areas and the Dogger Bank have a maximum in September or October. The central areas have increasing quantities in the summer; the southern and northern areas throughout the greater part of the summer maintain their highest level. Some of the eastern grounds have a spring maximum as well. The most obvious migration observed is that of a spring and summer offshore movement from the Danish and Dutch coasts, commencing about April or May when the central, southern and offshore grounds begin to increase their stock.

A change is found to take place in the constitution of the catch during the course of the year. Large and medium fish are in greater proportions in the spring than in the summer and autumn, and this is probably due to two definite migrations of different sets of fish. Large and medium fish are present in the shallow grounds about April, just after the winter spawning season. They are scattered all over the offshore grounds during the summer, some probably remaining and ultimately making their way to the more distant grounds, while the smaller ones migrate back towards the coast for the autumn, reinforced by the growing small plaice population of the Dutch and Danish nursery grounds which have been hitherto too small for capture or have migrated from still shallower waters more inshore. In most areas (except R and X) the winter catches are low. Small fish do not seem to be caught at all, and they are probably hibernating at this time,* and we know that for some of the large fish there is a definite southward migration for the purposes of spawning which takes them altogether out of this region. In the western areas the winter maximum is probably also connected with the spawning habits. There is some evidence of a southward or south-eastward movement through the eastern areas at the approach of winter, October to December, especially of the great shoals of small plaice before they settle for their winter rest.

d. Spawning.—There is no direct evidence of any accumulations of plaice in this region for spawning purposes, but a good deal of material is lacking in the winter spawning months in those areas (such as X) which are known from other sources† to be spawning

* HEINCKE & HENKING. Schollen and Schollenfischerei, p. 17.

† WALLACE. Maturity of Plaice. *Internat. Invest. Mar. Biol. Ass., Report II., Part II.* Cd. 4641.

areas. They are found maturing in all the deep water areas and offshore grounds in the months of December and January. Spawning fish are found in most of the same areas and are observed in the months of December to March, most of them being in January to February. Most of the fish recorded as spawning are large, and these form a very small proportion of the total.

B.—Soles.

Introduction.

The numbers of soles caught are recorded in pairs on the record forms supplied to the fishermen, who always keep the size distinctions of "large," "medium," and "slips" or "small." These were tabulated according to the areas on the chart corresponding to their place of capture, and totals and averages calculated for each area for each month, the *numbers* of fish (not pairs) in each size group and in the total catch being given.

Although the total yield of soles never amounts in bulk to anything like that found for plaice, for they are always few enough to be counted individually, while plaice are caught in basketfuls numbering hundreds, yet there is as much variation proportionally in the yield of the different grounds as there is for the more abundant plaice. For instance, the highest average obtained is 311 per ten hours fishing, in July, 1906, in area M, while on the Dogger and some of the northern grounds we get as a maximum two or three fish in the same time. Therefore, when we speak of "very large catches" or "abundant shoals," it must be understood that these are but comparative terms used in relation to other more normal catches of soles on the same ground.

In some areas soles seem to become very localised and will congregate in some parts of them in large numbers, leaving the rest of the area very sparsely populated. We find this in areas where there are deep pits, or ground specially suited to them. Moreover, they are limited in this region, as they are never found very far north and their limits of relatively great abundance are readily definable.

The total quantities of Soles and proportions of Large, Medium and Small.

Table VII.—Showing the total numbers of large, medium and small Soles, taken by certain skippers in each year, and the percentage of the total formed by each category.

Year.	Total Number of Soles.				Percentage of Total.		
	Large.	Medium.	Small.	All sizes.	Large.	Medium.	Small.
1904 ...	2,178	12,703	9,916	24,797	9	51	40
1905 ...	12,589	23,992	16,693	53,274	24	45	31
1906 ...	9,728	34,651	11,872	56,251	17	62	21
1907 ...	6,052	16,468	9,492	32,012	19	51	30
Total ...	30,547	87,814	47,973	166,334	18	53	29

This table shows that the greatest proportion by number are medium sized soles, which are over one-half of the total number caught. The large fish are not quite so numerous as the small fish, but their bulk in weight would be considerably greater.

The monthly averages are arranged in the same way as for plaice, and are discussed in the manner employed for that species, each area being taken separately and then afterwards discussed in its relation to other areas of the same group.

Yearly Fluctuations.

For the reasons set forth in the first section, we cannot obtain a single yearly average for each year of the period, but by the same methods of comparison used for plaice we have discovered no evidence of a general decline. Where it has been possible to discuss this question in the single areas it has been done, and also a general idea of the yearly changes, is obtained from the following table, which has been prepared in the same way as the

corresponding one in the section on plaice, all averages based on less than 30 hours fishing being omitted :—

1905 is 16 times less than, and 19 times greater than, 1904 out of 40 months.
1906 is 16 times less than, and 16 times greater than, 1904 out of 35 months.
1907 is 13 times less than, and 10 times greater than, 1904 out of 25 months.
1906 is 17 times less than, and 24 times greater than, 1905 out of 46 months.
1907 is 20 times less than, and 12 times greater than, 1905 out of 34 months.
1907 is 16 times less than, and 15 times greater than, 1906 out of 33 months.

Nothing very definite can be concluded from this table as the number of excesses and defects are nearly equal. But this takes no account of the extent of the difference nor of the years when observations were lacking in some months. The year 1906 is more often greater than 1905, than less than it, and is in some areas at any rate, rather exceptional for its catches of soles. Apparently, however, there is no continued decline or increase in the catch over the whole area. Variations of considerable extent are noticeable in certain areas.

The fluctuations in each area.

The monthly average catch of soles is given in Table VIII, and the variations in these averages are shown in the following discussion.

North-Eastern Areas.

Areas A, B, and C.—No soles are recorded in any of the months in which we have records of fishing in these areas. We may therefore conclude, that if not entirely absent, they must be very rare on these grounds.

Area F.—Most of the hauls in this area were taken on the Tarbot Bank (16–20 fathoms). Soles were found, but only occasionally, and in very small quantities. One large fish was found in March, 1905. The records of June, July and August show complete absence. From September to December they were found in small numbers, the argest catch being made in December, 1904, when they were taken at the rate of 3·17 per 10 hours.

Area G.—There are records of fishing in eight months of the year. January is the only one of these in which any soles were caught. This was in 1905, when one man reported four soles in 61 hours, and another three soles in 32½ hours fishing. None were caught in the following January.

The quantity of soles found in these areas is almost inappreciable. They are taken occasionally in the autumn and winter, but never in the summer.

Eastern Areas.

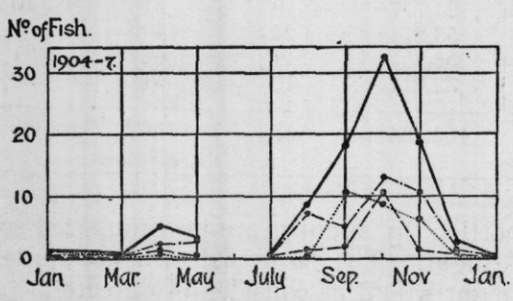

FIG. 18.—SOLES. Area H. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

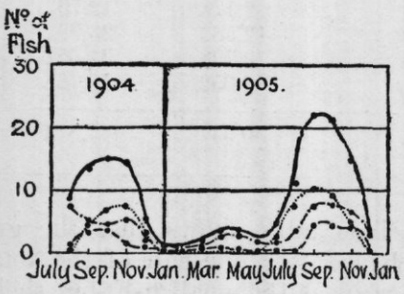

FIG. 19.—SOLES. Area H. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

Area H.—In this area soles are extremely scarce or altogether absent in the winter and spring ; in the summer their numbers are considerably increased and they become comparatively numerous in the autumn. The quantities caught from January to March are almost negligible. There appears to be a small maximum in April (averaging 5·3 soles (Fig. 18). After July there is a sharp, regular and definite increase to a maximum in October in which month the averages are as much as 32. There is a decided drop to November and December, although in one instance (1907) the November catch is very high (82). Most of these figures are based on the fishing of 1904 and 1905, and in some

TABLE VIII. (*continued*)—SHOWING for each area the Monthly Average Number of SOLES caught per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
SOUTHERN AREAS.	S	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·9	17·0	22·2	$41·1^{216}$	4·6	15·0	16·3	$35·9^{345}$	0·1	21·1	20·3	$41·5^{454}$	0·0	38·4	29·2	$67·6^{100}$	0·0	43·3	25·4	$68·7^{103}$	...	...	...	...	...	...	...	...	S
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·6	5·7	6·0	$14·3^{617}$	1·5	8·2	3·6	$13·4^{749}$	0·0	54·4	7·1	$61·6^{45}$	30·0	5·0	0·0	$35·0^{4}$	4·7	4·7	2·4	$11·8^{8}$	19·3	7·4	0·0	$26·7^{13}$	
		1906	...	...	...	...	0·0	32·7	18·2	$50·9^{5}$	5·7	2·8	1·1	$9·6^{22}$	0·9	3·6	1·8	$6·2^{22}$	0·0	0·0	0·0	$0·0^{7}$	5·8	2·7	0·4	$8·9^{55}$	1·0	4·1	0·2	$5·3^{33}$	7·0	7·2	1·1	$15·4^{106}$	0·0	12·2	5·1	$17·3^{220}$	3·2	9·0	2·1	$14·3^{36}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·1	17·7	11·3	$30·1^{461}$	1·5	7·6	6·0	$15·1^{348}$	0·0	7·7	4·5	$12·1^{271}$	...	...	...	...	...	...	...	...	...	...	...	...	16·3	8·8	5·0	$30·0^{16}$	...	...	...	...	
		1904–7	...	...	...	...	[**0·0**	**32·7**	**18·2**	**50·9**^{5}]	**5·7**	**2·8**	**1·1**	**9·6**^{22}	**0·9**	**3·6**	**1·8**	**6·2**^{22}	**1·1**	**17·4**	**11·1**	**29·6**^{465}	**2·0**	**10·4**	**11·1**	**23·6**^{619}	**2·5**	**8·4**	**8·0**	**19·0**^{1316}	**1·5**	**12·6**	**9·2**	**23·3**^{1309}	**0·0**	**24·6**	**12·0**	**36·5**^{365}	**1·8**	**30·5**	**16·8**	**49·1**^{163}	**12·2**	**7·3**	**4·1**	**23·7**^{24}	**19·3**	**7·4**	**0·0**	**26·7**^{13}	
	T	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·5	0·0	10·8	$12·3^{13}$	0·0	10·0	3·3	$13·3^{24}$	10·0	10·0	0·0	$20·0^{10}$	0·0	15·0	10·0	$25·0^{8}$	0·0	72·5	42·5	$115·0^{8}$	...	...	...	...	8·0	16·0	1·8	$25·8^{22}$	...	...	...	...	T
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·2	2·5	0·4	$5·0^{55}$	...	...	...	...	0·0	3·7	4·9	$8·7^{48}$	0·0	38·6	1·8	$40·4^{79}$	34·2	13·0	0·0	$47·2^{100}$	27·8	7·8	0·6	$36·2^{177}$	24·5	8·9	2·0	$35·4^{343}$	33·0	11·8	3·2	$48·0^{349}$	
		1906	...	...	...	...	10·8	6·2	1·9	$18·9^{96}$	4·4	4·2	0·8	$9·4^{52}$	2·3	1·7	0·2	$4·2^{112}$	1·9	1·9	0·4	$4·2^{53}$	7·0	1·9	0·6	$9·5^{97}$	9·8	1·3	0·2	$11·4^{181}$	16·1	3·8	1·5	$21·4^{90}$	15·9	5·3	0·5	$21·7^{93}$	22·3	6·1	0·2	$28·6^{225}$	(10·2 | 0·0 | 0·0 | $10·2^{27}$)	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	4·7	1·6	2·6	$8·8^{39}$	0·8	1·6	2·4	$4·8^{25}$	5·9	0·7	3·5	$10·1^{143}$	3·5	0·0	1·1	$4·6^{91}$	...	...	...	...	11·0	7·0	5·0	$23·0^{20}$	18·2	0·0	3·8	$22·0^{84}$	27·9	7·5	8·9	$44·3^{312}$	(13·3 | 8·3 | 6·7 | $28·3^{12}$)	
		1904–7	...	...	...	...	**10·8**	**6·2**	**1·9**	**18·9**^{96}	**4·4**	**4·2**	**0·8**	**9·4**^{52}	**2·9**	**1·7**	**0·8**	**5·4**^{151}	**1·8**	**1·9**	**1·6**	**5·3**^{146}	**5·8**	**2·0**	**2·4**	**10·2**^{264}	**6·7**	**1·6**	**1·1**	**9·4**^{330}	**8·2**	**19·8**	**2·0**	**30·0**^{177}	**23·5**	**11·7**	**2·3**	**37·4**^{211}	**23·6**	**5·7**	**0·9**	**30·2**^{485}	**24·4**	**8·3**	**4·3**	**37·6**^{604}	**32·3**	**11·6**	**3·4**	**47·3**^{352}	
	V	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·7	3·1	0·3	$5·2^{131}$	1·7	4·4	0·1	$6·2^{86}$	34·9	2·6	0·0	$37·6^{45}$	...	...	...	...	7·4	0·0	0·0	$7·4^{13}$	...	...	...	...	V
		1905	...	...	..	...	...	...	...	...	9·6	0·0	3·2	$12·8^{25}$	...	...	...	...	...	...	...	...	...	...	...	...	1·5	0·2	0·0	$1·7^{108}$	12·5	14·6	0·0	$27·1^{29}$	...	...	...	...	0·7	0·0	0·0	$0·7^{28}$	...	...	...	...	...	...	...	...	
		1906	1·5	9·4	6·0	$16·9^{39}$	4·4	0·0	0·0	$4·4^{4}$	2·5	7·3	3·5	$13·3^{80}$	1·6	2·9	1·1	$5·6^{38}$	...	...	...	...	0·0	1·7	0·0	$1·7^{12}$	1·1	1·3	0·0	$2·5^{53}$	19·8	0·4	0·0	$20·2^{49}$	22·8	0·9	0·0	$23·7^{47}$	6·1	0·0	0·0	$6·1^{16}$	7·0	0·0	0·0	$7·0^{12}$	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	5·0	2·5	0·0	$7·5^{8}$	3·6	0·3	0·0	$4·0^{55}$	...	...	...	...	...	...	...	...	27·9	1·9	0·6	$30·4^{94}$	19·3	0·7	0·0	$20·0^{28}$	9·1	1·6	0·0	$10·7^{48}$	
		1904–7	**1·5**	**9·4**	**6·0**	**16·9**^{39}	**4·4**	**0·0**	**0·0**	**4·4**^{4}	**4·2**	**5·5**	**3·4**	**13·2**^{105}	**1·6**	**2·9**	**1·1**	**5·6**^{38}	**0·0**	**0·0**	**0·0**	**0·0**^{4}	**2·0**	**2·0**	**0·0**	**4·0**^{30}	**1·9**	**1·5**	**0·1**	**3·5**^{347}	**9·0**	**5·0**	**0·1**	**14·0**^{164}	**28·8**	**1·7**	**0·0**	**30·5**^{52}	**19·8**	**1·3**	**0·4**	**21·5**^{138}	**13·6**	**0·4**	**0·0**	**14·6**^{53}	**9·1**	**1·6**	**0·0**	**10·7**^{45}	
WESTERN AREAS.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	E
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	0·0	12·9	33·5	$46·5^{5}$	...	...	...	...	0·0	53·3	66·7	$120·0^{7}$	...	...	...	...	...	...	...	...	0·0	45·4	8·6	$54·1^{18}$	0·0	17·4	115·7	$133·0^{11}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	..	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·0**	**12·9**	**33·5**	**46·5**^{5}	...	...	...	...	**0·0**	**53·3**	**66·7**	**120·0**^{7}	...	...	...	...	...	...	...	...	**0·0**	**45·4**	**8·6**	**54·1**^{18}	**0·0**	**17·4**	**115·7**	**133·0**^{11}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	R	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11·1	31·1	2·2	$44·4^{9}$	8·9	26·7	8·9	$44·4^{4}$	R
		1905	...	...	...	...	...	...	...	...	7·1	1·4	0·0	$8·6^{14}$	...	...	...	...	1·1	0·0	0·5	$1·6^{76}$	...	...	...	...	...	...	...	...	...	...	...	...	7·8	4·4	0·0	$12·2^{18}$	...	...	...	...	6·6	19·6	13·7	$39·8^{168}$	5·6	65·8	14·3	$85·7^{212}$	
		1906	1·2	31·3	19·3	$51·7^{139}$	2·0	54·5	25·2	$81·7^{236}$	0·9	29·6	17·2	$47·8^{280}$	0·5	5·5	3·4	$9·4^{266}$	0·1	1·6	1·1	$2·8^{176}$	0·13	5·0	1·8	$6·8^{238}$	0·0	18·7	3·1	$21·8^{222}$	0·4	42·8	4·1	$47·2^{113}$	5·3	0·0	0·0	$5·3^{7}$	2·8	2·8	0·0	$5·5^{14}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	3·1	3·1	3·1	$9·2^{6}$	4·3	3·4	0·0	$7·7^{23}$	5·0	0·6	0·0	$5·6^{32}$	0·0	5·0	0·0	$5·0^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**1·2**	**31·3**	**19·3**	**51·7**^{139}	**2·0**	**54·5**	**25·2**	**81·7**^{236}	**1·2**	**28·3**	**16·4**	**45·9**^{294}	**0·5**	**5·5**	**3·4**	**9·4**^{272}	**0·7**	**1·3**	**0·9**	**2·6**^{275}	**0·7**	**4·4**	**1·6**	**6·7**^{219}	**0·0**	**18·5**	**3·0**	**21·5**^{226}	**0·4**	**42·8**	**4·1**	**47·2**^{113}	**7·1**	**3·1**	**0·0**	**10·2**^{25}	**2·8**	**2·8**	**0·0**	**5·5**^{14}	**6·8**	**20·1**	**13·1**	**40·1**^{177}	**5·6**	**64·9**	**14·2**	**84·8**^{216}	
	X	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·2	0·2	0·0	$2·4^{109}$	0·8	0·0	0·0	$0·8^{60}$	4·9	0·0	0·0	$4·9^{30}$	...	...	...	...	1·5	0·0	0·0	$1·5^{33}$	17·1	22·9	5·7	$45·7^{17}$	X
		1905	0·0	0·0	0·0	$0·0^{4}$	0·0	0·0	0·0	$0·0^{3}$	4·9	1·1	0·4	$6·4^{33}$	0·0	3·3	3·3	$6·7^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	24·8	5·8	0·0	$30·6^{21}$	47·0	14·3	1·5	$62·8^{107}$	5·4	14·9	4·1	$24·4^{15}$	0·2	0·0	0·0	$0·2^{44}$	
		1906	...	...	...	...	0·0	6·7	0·0	$6·7^{9}$	7·1	4·0	0·3	$11·4^{60}$	1·0	6·0	1·3	$8·3^{77}$	0·6	5·7	0·0	$6·3^{32}$	0·0	3·1	0·4	$3·5^{156}$	4·3	5·2	0·0	$9·4^{112}$	24·5	4·3	0·0	$28·8^{93}$	25·6	1·9	0·0	$27·5^{64}$	15·0	0·0	0·0	$15·0^{20}$	3·8	0·0	0·0	$3·8^{16}$	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·5	1·9	1·5	$5·0^{52}$	2·5	2·5	0·0	$5·0^{8}$	11·3	2·7	0·8	$14·8^{96}$	...	...	...	...	...	...	...	...	40·7	3·6	3·4	$47·7^{152}$	27·9	7·9	0·7	$36·4^{28}$	28·6	4·9	4·1	$37·6^{75}$	
		1904–7	[**0·0**	**0·0**	**0·0**	**0·0**^{4}]	[**0·0**	**5·0**	**0·0**	**5·0**^{12}]	**6·0**	**2·7**	**0·4**	**9·0**^{113}	**0·9**	**5·6**	**1·6**	**8·1**^{89}	**1·1**	**3·8**	**0·8**	**5·6**^{104}	**0·1**	**3·1**	**0·4**	**3·5**^{164}	**5·7**	**2·7**	**0·3**	**8·7**^{317}	**15·2**	**2·6**	**0·0**	**17·8**^{153}	**20·4**	**2·4**	**0·0**	**22·8**^{125}	**41·2**	**7·1**	**2·5**	**50·8**^{318}	**10·5**	**4·8**	**0·9**	**16·2**^{92}	**11·7**	**6·0**	**2·3**	**20·1**^{86}	
	P	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	1·3	0·0	0·0	$1·3^{213}$	...	...	...	...	5·0	0·0	0·0	$5·0^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	P
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	0·0	0·0	0·0	$0·0^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	4·4	0·0	0·0	$4·4^{4}$	0·0	4·4	0·0	$4·4^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19·2	2·5	0·0	$21·7^{24}$	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	**4·4**	**0·0**	**0·0**	**4·4**^{4}	**0·0**	**4·4**	**0·0**	**4·4**^{4}	...	...	...	...	...	...	...	...	**1·2**	**0·0**	**0·0**	**1·2**^{229}	...	...	...	...	**15·6**	**1·9**	**0·6**	**17·5**^{32}	...	...	...	...	...	...	...	...	...	...	...	...	

TABLE VIII. (*continued*)—SHOWING for each area the Monthly Average Number of SOLES caught per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July.				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
CENTRAL AREAS.	J	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{0}$	...	...	...	...	...	...	...	...	0·3	1·1	0·0	$1·3^{75}$	1·5	0·4	0·0	$1·9^{205}$	...	...	...	...	0·8	6·1	9·7	$16·6^{77}$	2·2	21·7	39·6	$63·6^{401}$	J
		1905	10·7	2·8	11·2	$24·7^{165}$	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{39}$	...	...	...	...	...	...	...	...	...	...	...	...	0·2	0·3	0·0	$0·5^{95}$	0·0	0·0	0·0	$0·0^{78}$	1·6	38·3	12·8	$52·7^{64}$	6·3	55·1	4·1	$65·5^{58}$	
		1906	8·7	36·4	3·6	$48·7^{28}$	14·0	84·0	16·7	$114·7^{30}$	...	...	...	...	...	...	...	...	0·5	0·5	0·0	$1·0^{77}$	...	...	...	...	...	...	...	...	0·7	1·1	0·2	$2·0^{92}$	0·0	0·0	0·0	$0·0^{99}$	0·0	34·2	11·4	$45·6^{284}$	0·8	155·9	10·4	$167·2^{130}$	35·3	119·5	30·3	$185·0^{98}$	
		1907	...	...	...	...	...	..	...	...	4·1	56·6	17·2	$77·9^{67}$	3·8	31·1	16·7	$51·6^{85}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	15·0	0·0	$15·0^{16}$	...	...	...	...	
		1904–7	**10·3**	**9·8**	**9·6**	$29·7^{133}$	**14·0**	**84·0**	**16·7**	$114·7^{30}$	**4·1**	**56·6**	**17·2**	$77·9^{67}$	**3·3**	**31·1**	**16·7**	$51·6^{85}$	**0·4**	**0·4**	**0·0**	$0·8^{106}$	...	...	...	...	...	...	...	...	**0·5**	**1·1**	**0·1**	$1·8^{167}$	**0·8**	**0·3**	**0·0**	$1·1^{390}$	**0·0**	**26·8**	**8·9**	$35·7^{362}$	**0·9**	**81·8**	**10·2**	$92·9^{257}$	**5·3**	**34·4**	**33·0**	$72·6^{337}$	
	N	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·8	0·0	12·4	$15·2^{28}$	0·0	15·3	2·0	$17·3^{40}$	7·8	51·6	27·2	$86·6^{265}$	7·8	24·7	10·8	$43·2^{109}$	1·9	21·8	8·1	$31·9^{98}$	0·0	20·3	16·0	$36·3^{144}$	1·9	17·1	10·1	$29·0^{182}$	3·4	31·4	31·9	$66·7^{136}$	N
		1905	—	11·8	—	$11·8^{9}$]	17·0	15·5	8·5	$41·0^{40}$	27·7	43·1	69·2	$140·0^{52}$	12·0	16·7	5·0	$33·7^{60}$	3·1	4·7	1·0	$8·8^{69}$	1·4	10·6	3·0	$15·1^{139}$	0·8	7·0	2·2	$10·0^{76}$	2·4	7·6	0·3	$10·4^{272}$	1·6	22·9	3·7	$28·1^{274}$	...	...	...	...	13·3	72·8	30·0	$116·1^{219}$	8·9	48·7	15·6	$73·3^{412}$	
		1906	9·5	46·1	8·5	$64·1^{421}$	12·3	66·0	11·1	$89·4^{310}$	5·0	48·7	1·1	$54·8^{283}$	0·0	29·6	0·0	$29·6^{14}$	11·1	6·7	0·4	$18·2^{99}$	28·8	3·9	0·5	$33·2^{93}$	24·2	4·7	1·8	$30·8^{76}$	9·6	4·8	0·7	$15·1^{197}$	4·7	21·4	5·5	$31·6^{51}$	7·8	29·5	8·6	$45·9^{108}$	0·5	61·7	8·4	$70·7^{201}$	0·0	12·6	3·4	$16·0^{74}$	
		1907	4·8	45·5	13·4	$63·6^{306}$	7·0	75·8	18·9	$101·8^{123}$	9·1	60·3	21·0	$90·4^{228}$	7·7	18·0	8·6	$34·3^{132}$	5·7	3·5	1·9	$11·2^{74}$	6·4	2·2	0·8	$9·5^{71}$	0·0	5·9	0·8	$6·8^{113}$	0·0	33·8	16·4	$50·2^{45}$	2·6	29·0	19·1	$50·7^{235}$	7·5	22·9	35·5	$65·9^{299}$	2·6	29·1	15·4	$47·1^{354}$	0·0	34·9	22·1	$57·0^{96}$	
		1904–7	**7·4**	**45·5**	**10·4**	$63·3^{735}$	**11·3**	**64·3**	**12·9**	$88·6^{475}$	**8·8**	**52·9**	**15·4**	$77·1^{463}$	**8·4**	**18·4**	**7·0**	$33·8^{206}$	**6·7**	**4·5**	**2·4**	$13·6^{251}$	**9·1**	**7·7**	**1·8**	$18·7^{333}$	**7·4**	**25·6**	**12·6**	$45·6^{475}$	**5·4**	**11·6**	**3·4**	$20·5^{623}$	**2·2**	**24·8**	**10·0**	$37·0^{638}$	**5·6**	**23·6**	**25·1**	$54·3^{551}$	**4·5**	**43·7**	**16·2**	$64·4^{956}$	**5·8**	**39·8**	**18·3**	$63·6^{718}$	
	I	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	0·5	0·0	0·0	$0·5^{101}$	0·0	0·0	0·0	$0·0^{18}$	+	0·6	0·0	$0·7^{319}$	+	0·0	0·0	$0·4^{225}$	0·0	0·7	0·0	$0·7^{218}$	0·2	17·4	6·9	$24·5^{190}$	0·2	3·7	3·6	$7·5^{359}$	I
		1905	0·0	0·5	0·6	$1·0^{87}$	0·0	1·1	0·0	$1·1^{17}$	...	...	...	...	...	...	...	...	...	...	...	..	4·6	·0·8	0·0	$5·4^{52}$	0·3	0·3	0·0	$0·7^{121}$	0·0	1·9	0·0	$1·9^{263}$	0·4	3·8	0·0	$4·2^{252}$	...	...	...	...	0·9	24·4	0·0	$25·3^{139}$	6·3	28·6	5·5	$40·4^{47}$	
		1906	9·9	32·9	11·6	$54·4^{79}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	0·0	0·0	0·0	$0·0^{74}$	...	...	...	...	0·0	0·3	0·0	$0·3^{31}$	0·0	6·1	0·0	$6·1^{11}$	0·0	14·2	6·7	$20·9^{65}$	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	0·0	10·4	0·0	$10·4^{160}$	0·0	1·1	0·0	$1·1^{71}$	3·7	1·5	1·5	$6·7^{27}$	...	...	...	...	
		1904–7	**4·7**	**15·9**	**5·8**	$26·4^{166}$	**0·0**	**1·1**	**0·0**	$1·1^{17}$	...	...	...	...	...	...	...	...	...	...	...	..	**1·9**	**0·3**	**0·0**	$2·2^{152}$	**0·2**	**0·2**	**0·0**	$0·4^{213}$	+	**1·2**	**0·0**	$1·2^{582}$	**0·3**	**3·9**	**0·0**	$4·1^{1068}$	**0·0**	**1·0**	**0·0**	$1·0^{300}$	**0·6**	**18·2**	**4·2**	$23·1^{421}$	**0·9**	**6·6**	**3·8**	$11·4^{406}$	
	O	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{19}$	0·0	0·0	0·0	$0·0^{109}$	0·1	0·0	0·0	$0·1^{149}$	0·5	0·2	0·0	$0·7^{254}$	0·4	·0·0	0·0	$0·4^{216}$	0·0	0·1	0·0	$0·1^{256}$	0·0	+	0·0	$+^{278}$	0·0	0·0	0·3	$0·3^{97}$	O
		1905	0·0	0·6	0·4	$1·0^{100}$	0·0	0·7	0·0	$0·7^{56}$	0·0	0·0	0·1	$0·1^{150}$	0·1	0·1	0·1	$0·2^{213}$	+	0·1	+	$0·1^{285}$	0·0	0·0	0·0	$0·0^{121}$	0·0	0·0	0·0	$0·0^{255}$	0·5	0·1	0·0	$0·6^{99}$	...	...	...	...	0·1	2·2	0·0	$2·3^{227}$	0·0	1·9	0·0	$1·9^{175}$	+	0·1	0·1	$0·2^{338}$	
		1906	...	...	...	...	0·0	0·0	0·0	$0·0^{11}$	0·0	1·1	0·0	$1·1^{9}$	1·5	0·0	0·0	$1·5^{14}$	0·0	0·0	0·0	$0·0^{10}$	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	0·0	0·0	0·0	$0·0^{14}$	0·0	0·0	0·0	$0·0^{4}$	...	..	...	...	
		1907	0·0	0·0	0·0	$0·0^{281}$	...	...	...	...	0·1	0·4	0·0	$0·5^{59}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{68}$	...	...	...	...	
		1904–7	**0·0**	**0·2**	**0·1**	$0·3^{281}$	**0·0**	**0·6**	**0·0**	$0·6^{97}$	+	**0·2**	+	$0·3^{239}$	**0·1**	**0·1**	**0·1**	$0·2^{637}$	+	**0·1**	+	$0·1^{415}$	**0·0**	**0·0**	**0·0**	$0·0^{271}$	+	**0·0**	**0·0**	$+^{404}$	**0·5**	**0·1**	**0·0**	$0·6^{353}$	**0·4**	**0·0**	**0·0**	$0·4^{239}$	+	**1·1**	**0·0**	$1·2^{697}$	—	**0·6**	—	$0·6^{525}$	+	**0·1**	**0·1**	$0·2^{635}$	
NORTHERN AREAS.	D	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{37}$	...	...	...	...	D
		1905	0·65	0·0	0·0	$0·65^{61}$	0·03	0·04	0·0	$0·07^{769}$	0·0	0.0	0·0	$0·0^{647}$	0·0	0·0	0·0	$0·0^{24}$	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{69}$	
		1906	...	...	...	...	0·0	0·0	0·0	$0·0^{85}$	0·04	0·0	0·0	$0·0^{257}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{131}$	0·0	0·0	0·0	$0·0^{24}$	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{28}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·65**	**0·0**	**0·0**	$0·65^{61}$	**0·02**	**0·04**	**0·0**	$0·06^{845}$	**0·01**	**0·0**	**0·0**	$0·01^{932}$	**0·0**	**0·0**	**0·0**	$0·0^{24}$	...	...	...	...	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{121}$	**0·0**	**0·0**	**0·0**	$0·0^{24}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{37}$	**0·0**	**0·0**	**0·0**	$0·0^{69}$	
	K	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	0·0	0·0	0·0	$0·0^{38}$	...	...	...	...	0·0	0·0	0·0	$0·0^{7}$	0·0	0·0	0·0	$0·0^{43}$	0·0	0·0	0·0	$0·0^{85}$	0·0	0·0	0·0	$0·0^{21}$	...	...	...	...	K
		1905	0·0	0·0	0·0	$0·0^{211}$	0·0	0·0	0·0	$0·0^{239}$	0·34	0·0	0·0	$0·34^{29}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	0·0	0·0	0·0	$0·0^{71}$	0·0	0·0	0·0	$0·0^{4}$	...	...	...	...	...	...	...	...	
		1906	0·0	0·0	0·0	$0·0^{31}$	0·0	0·0	0·0	$0·0^{84}$	0·0	0·0	0·0	$0·0^{44}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{71}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	0·0	0·0	0·0	$0·0^{55}$	0·0	0·0	0·0	$0·0^{232}$	0·0	0·0	0·0	$0·0^{285}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{11}$	0·0	0·0	0·0	$0·0^{8}$	...	...	...	...	
		1904–7	**0·0**	**0·0**	**0·0**	$0·0^{297}$	**0·0**	**0·0**	**0·0**	$0·0^{625}$	**0·03**	**0·0**	**0·0**	$0·03^{208}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{64}$	**0·0**	**0·0**	**0·0**	$0·0^{38}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{11}$	**0·0**	**0·0**	**0·0**	$0·0^{135}$	**0·0**	**0·0**	**0·0**	$0·0^{110}$	**0·0**	**0·0**	**0·0**	$0·0^{79}$	...	...	...	...	
	L	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{21}$	0·0	0·0	0·0	$0·0^{6}$	0·0	0·0	0·0	$0·0^{84}$	0·0	0·0	0·0	$0·0^{195}$	0·0	0·0	0·0	$0·0^{63}$	0·0	0·0	0·0	$0·0^{8}$	...	...	...	...	L
		1905	0·0	0·48	0·24	$0·72^{94}$	0·02	0·10	0·0	$0·11^{625}$	0·37	0·10	0·10	$0·57^{192}$	0·0	0·0	0·0	$0·0^{111}$	0·0	0·0	0·0	$0·0^{30}$	0·0	0·0	0·0	$0·0^{7}$	0·0	0·0	0·0	$0·0^{79}$	0·0	0·0	0·0	$0·0^{18}$	0·0	0·0	0·0	$0·0^{81}$	...	...	...	...	...	...	...	...	1·64	1·64	0·0	$3·29^{36}$	
		1906	0·0	0·0	0·0	$0·0^{132}$	0·0	0·44	0·0	$0·44^{247}$	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{199}$	0·0	0·0	0·0	$0·0^{106}$	0·0	0·0	0·0	$0·0^{97}$	0·0	0·0	0·0	$0·0^{161}$	0·0	0·0	0·0	$0·0^{308}$	0·0	0·0	0·0	$0·0^{136}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{69}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{13}$	...	...	...	...	...	...	...	...	
		1904–7	**0·0**	**0·19**	**0·09**	$0·28^{216}$	**0·01**	**0·19**	**0·0**	$0·21^{872}$	**0·28**	**0·08**	**0·08**	$0·44^{252}$	**0·0**	**0·0**	**0·0**	$0·0^{111}$	**0·0**	**0·0**	**0·0**	$0·0^{229}$	**0·0**	**0·0**	**0·0**	$0·0^{136}$	**0·0**	**0·0**	**0·0**	$0·0^{132}$	**0·0**	**0·0**	**0·0**	$0·0^{302}$	**0·0**	**0·0**	...	$0·0^{884}$	**0·0**	**0·0**	**0·0**	$0·0^{312}$	**0·0**	**0·0**	**0·0**	$0·0^{98}$	**1·64**	**1·64**	**0·0**	**3·29**36	

TABLE VIII.—SHOWING for each area the Monthly Average Number of SOLES caught per 10 hours' fishing; large (L.), medium (M.), and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.				February.				March.				April.				May.				June.				July.				August.				September.				October.				November.				December.				Area.
			L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	L.	M.	S.	All Sizes.	
North-Eastern Areas.	A	1904	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{22}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	A
		1905	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{44}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{44}$	**0·0**	**0·0**	**0·0**	$0·0^{22}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	B	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{18}$	0·0	0·0	0·0	$0·0^{88}$	0·0	0·0	0·0	$0·0^{117}$	0·0	0·0	0·0	$0·0^{64}$	...	...	...	...	B
		1905	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{39}$	0·0	0·0	0·0	$0·0^{12}$	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{169}$	0·0	0·0	0·0	$0·0^{20}$	0·0	0·0	0·0	$0·0^{4}$	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{113}$	0·0	0·0	0·0	$0·0^{39}$	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{20}$	**0·0**	**0·0**	**0·0**	$0·0^{12}$	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{18}$	**0·0**	**0·0**	**0·0**	$0·0^{248}$	**0·0**	**0·0**	**0·0**	$0·0^{250}$	**0·0**	**0·0**	**0·0**	$0·0^{107}$	...	...	...	...	
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
		1905	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{4}$	...	...	...	...	
	F	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{68}$	0·0	0·0	0·0	$0·0^{8}$	0·0	0·0	0·0	$0·0^{8}$	0·0	0·0	0·0	$0·0^{65}$	...	...	...	...	0·0	0·63	0·31	$0·94^{64}$	0·67	2·23	0·17	$3·17^{129}$	F
		1905	...	...	...	...	...	...	...	...	0·80	0·0	0·0	$0·80^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{52}$	0·0	0·0	0·0	$0·0^{35}$	0·37	0·0	0·0	$0·37^{109}$	0·11	0·0	0·0	$0·11^{94}$	0·0	0·0	0·0	$0·0^{8}$	0·0	0·0	0·0	$0·0^{8}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{38}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	**0·80**	**0·0**	**0·0**	$0·80^{12}$	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{68}$	**0·0**	**0·0**	**0·0**	$0·0^{60}$	**0·0**	**0·0**	**0·0**	$0·0^{81}$	**0·23**	**0·0**	**0·0**	$0·23^{174}$	**0·11**	**0·0**	**0·0**	$0·11^{94}$	**0·0**	**0·56**	**0·28**	$0·83^{72}$	**0·63**	**2·19**	**0·16**	$2·97^{138}$	
	G	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{29}$	...	...	...	...	0·0	0·0	0·0	$0·0^{32}$	0·0	0·0	0·0	$0·0^{88}$	0·0	0·0	0·0	$0·0^{44}$	0·0	0·0	0·0	$0·0^{4}$	...	...	...	...	G
		1905	0·65	0·0	0·0	$0·65^{108}$	0·0	0·0	0·0	$0·0^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{4}$	...	...	...	...	0·0	0·0	0·0	$0·0^{15}$	...	...	...	...	0·0	0·0	0·0	$0·0^{5}$	
		1906	0·0	0·0	0·0	$0·0^{21}$	0·0	0·0	0·0	$0·0^{78}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·0	0·0	$0·0^{96}$	...	...	...	...	...	...	...	...	
		1904–7	**0·54**	**0·0**	**0·0**	$0·54^{129}$	**0·0**	**0·0**	**0·0**	$0·0^{86}$	...	...	...	...	...	...	...	...	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{29}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{36}$	**0·0**	**0·0**	**0·0**	$0·0^{88}$	**0·0**	**0·0**	**0·0**	$0·0^{100}$	**0·0**	**0·0**	**0·0**	$0·0^{5}$	
Eastern Areas.	H	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·4	0·0	0·0	$0·4^{52}$	...	...	...	...	...	...	...	...	1·3	7·5	0·0	$8·8^{16}$	6·7	0·0	0·0	$6·7^{15}$	2·0	10·3	14·1	$26·5^{73}$	2·7	4·5	6·0	$13·2^{385}$	0·4	1·3	1·2	$2·9^{191}$	H
		1905	0·0	0·2	0·8	$0·9^{347}$	...	...	...	...	0·0	0·0	0·0	$0·0^{9}$	1·8	2·4	1·2	$5·3^{135}$	0·0	3·8	0·0	$3·8^{170}$	...	...	...	...	0·0	0·0	0·0	$0·0^{16}$	...	...	...	...	0·2	7·2	14·8	$22·2^{40}$	12·1	12·7	7·9	$32·7^{365}$	+	3·9	5·3	$9·3^{257}$	0·0	2·7	0·0	$2·7^{84}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	26·9	11·3	$38·1^{16}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	71·1	10·6	$81·7^{70}$	...	...	...	...	
		1904–7	**0·0**	**0·2**	**0·8**	$0·9^{347}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{9}$	**1·8**	**2·4**	**1·2**	$5·3^{135}$	**0·1**	**2·9**	**0·0**	$3·0^{722}$	...	...	...	...	**0·0**	**0·0**	**0·0**	$0·0^{16}$	**1·3**	**7·5**	**0·0**	$8·8^{16}$	**2·0**	**5·2**	**10·8**	$18·0^{55}$	**10·7**	**12·8**	**8·7**	$32·1^{654}$	**1·5**	**10·9**	**6·2**	$18·6^{712}$	**0·3**	**1·7**	**0·8**	$2·8^{275}$	
	M	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	23·9	122·6	61·6	$208·2^{26}$	10·1	60·5	23·2	$93·7^{262}$	9·3	75·8	28·2	$113·3^{114}$	0·0	21·6	1·2	$22·9^{48}$	...	...	...	...	...	...	...	...	6·0	2·7	7·0	$15·7^{39}$	0·7	1·9	4·0	$6·6^{329}$	M
		1905	0·0	0·0	4·5	$4·5^{53}$	...	...	...	...	0·4	0·2	0·6	$1·2^{49}$	8·2	15·0	16·0	$39·2^{258}$	40·2	63·2	54·4	$157·8^{310}$	29·7	45·8	56·6	$132·0^{661}$	...	...	...	...	...	...	...	...	0·7	38·4	67·6	$106·7^{61}$	0·0	13·3	32·6	$45·9^{13}$	1·6	5·4	4·7	$11·7^{284}$	0·0	5·5	0·0	$5·5^{91}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	7·7	34·7	5·5	$47·8^{257}$	36·8	106·0	46·3	$189·1^{423}$	43·5	106·2	36·8	$186·4^{451}$	20·9	186·8	103·5	$311·2^{286}$	13·7	75·0	55·0	$143·7^{76}$	...	...	...	...	0·0	44·7	1·1	$45·8^{38}$	0·2	50·1	31·9	$82·2^{81}$	0·0	23·0	5·2	$28·3^{202}$	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	1·4	8·8	3·7	$13·9^{155}$	19·7	61·9	37·9	$119·5^{442}$	16·5	57·7	36·8	$111·0^{333}$	10·8	69·4	27·4	$107·7^{80}$	...	...	...	...	...	...	...	...	...	...	...	...	0·0	22·9	45·7	$68·6^{7}$	0·0	3·5	2·4	$5·9^{169}$	
		1904–7	**0·0**	**0·0**	**4·5**	$4·5^{53}$	...	...	...	...	**0·4**	**0·2**	**0·6**	$1·2^{49}$	**6·7**	**20·9**	**9·8**	$37·4^{880}$	**33·5**	**75·8**	**48·6**	$157·9^{1751}$	**27·7**	**66·3**	**42·4**	$136·4^{1707}$	**16·5**	**141·0**	**73·0**	$230·5^{480}$	**8·4**	**54·2**	**34·1**	$96·6^{124}$	**0·7**	**38·4**	**67·6**	$106·7^{61}$	**0·0**	**34·4**	**11·5**	$45·9^{41}$	**1·6**	**14·5**	**11·1**	$27·2^{402}$	**0·3**	**8·1**	**3·5**	$11·9^{782}$	
	Q	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	4·4	26·7	$31·1^{4}$	2·1	75·0	62·9	$140·0^{45}$	19·6	72·0	85·0	$176·5^{113}$	12·5	46·3	49·2	$107·9^{48}$	0·2	15·1	12·9	$28·1^{115}$	0·0	12·5	10·0	$22·5^{8}$	...	...	...	...	...	...	...	...	Q
		1905	...	...	...	...	...	...	...	...	4·2	6·5	2·5	$13·1^{322}$	12·5	10·5	11·9	$34·9^{99}$	18·4	10·9	14·9	$44·1^{140}$	13·7	32·2	43·9	$89·8^{39}$	1·4	24·2	25·0	$50·6^{73}$	7·8	56·1	69·7	$133·7^{290}$	1·2	71·2	85·3	$157·6^{34}$	...	...	...	...	7·1	0·0	0·0	$7·1^{8}$	6·7	26·7	11·1	$44·4^{9}$	
		1906	...	...	...	...	...	...	...	...	1·4	34·8	0·0	$36·2^{43}$	...	...	...	...	34·9	10·1	5·4	$50·4^{67}$	48·0	24·3	10·0	$82·3^{106}$	57·5	15·0	7·5	$80·0^{8}$	21·4	5·1	10·7	$37·2^{35}$	...	...	...	...	0·0	39·2	36·1	$75·2^{35}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	0·0	1·3	0·0	$1·3^{15}$	0·0	4·4	0·3	$4·7^{118}$	5·3	12·1	3·5	$20·9^{37}$	48·3	10·3	10·9	$69·5^{134}$	15·3	20·2	16·8	$52·3^{40}$	0·0	9·4	14·9	$24·3^{47}$	0·4	25·8	30·0	$56·2^{112}$	0·0	24·9	12·8	$37·8^{139}$	0·0	20·7	60·7	$81·4^{28}$	0·0	14·3	14·3	$28·6^{7}$	...	...	...	...	
		1904–7	...	...	...	...	**0·0**	**1·3**	**0·0**	$1·3^{15}$	**2·9**	**8·5**	**1·8**	$13·1^{483}$	**9·9**	**11·1**	**8·8**	$29·8^{156}$	**34·9**	**10·4**	**11·5**	$56·8^{295}$	**28·3**	**35·6**	**26·4**	$90·3^{214}$	**11·4**	**43·2**	**50·4**	$105·1^{240}$	**7·5**	**44·4**	**54·2**	$106·1^{486}$	**0·2**	**26·5**	**22·0**	$48·8^{269}$	**0·0**	**29·0**	**42·8**	$71·7^{71}$	**3·9**	**6·5**	**6·5**	$16·8^{15}$	**6·7**	**26·7**	**11 1**	$44·4^{9}$	
	W	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·9	24·9	17·0	$49·8^{61}$	8·3	16·7	35·0	$60·0^{12}$	...	...	...	...	0·0	35·0	30·0	$65·0^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	W
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26·7	6·7	13·3	$46·7^{6}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	6·7	13·3	$20·0^{12}$	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	6·3	12·5	$18·8^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**26·7**	**6·7**	**13·3**	$46·7^{6}$	**7·9**	**24·9**	**17·0**	$49·8^{61}$	**3·6**	**10·7**	**22·1**	$36·4^{23}$	...	...	...	...	**0·0**	**35·0**	**30·0**	$65·0^{4}$	**0·0**	**6·7**	**13·3**	$20·0^{12}$	...	...	...	...	...	...	...	...	

months of 1905 alone (Fig. 19). The average catch per month is 1·77 large, 4·36 medium, and 2·85 small, whence we see that medium fish form the largest proportion, or 48 per cent. of the total, while small form 32 per cent., and large, 20 per cent. of the whole.

During tabulation, some points were noticed which either confirm the general features of the curve or help to explain anomalous ones. In December, 1904, and January, 1905, there were scarcely any soles. In April there were few, but they were more numerous in the shallower parts (about ten fathoms) of this area. This probably explains the small maximum on the curve.

In October, 1904, there were large numbers (from 8 to 10 pairs in each haul) which decreased regularly and steadily throughout November to one or two in each haul. This decrease continued till the 8th December, after which, scarcely any were taken. In October, 1905, they appeared in good numbers in the beginning of the month, and about the middle of the month became much more numerous, and very large catches were made.

Area M.—The grounds contained in this area (Sylt, Amrum, Horn Reef South, &c.) are pre-eminently sole-fishing grounds in the summer and stand first and foremost amongst the areas in this region for their yield of soles. The large catches of soles made here, together with an abundance of plaice no doubt well justify the large proportion of the fishing time that is spent here by some fishermen, including the time spent in voyaging across the North Sea from Grimsby to the distant eastern fishing grounds. The catches are so large that the curves for this area, Figs. 20 and 21, are drawn on a much smaller scale than the others. The average of the 11 months is 68·8.

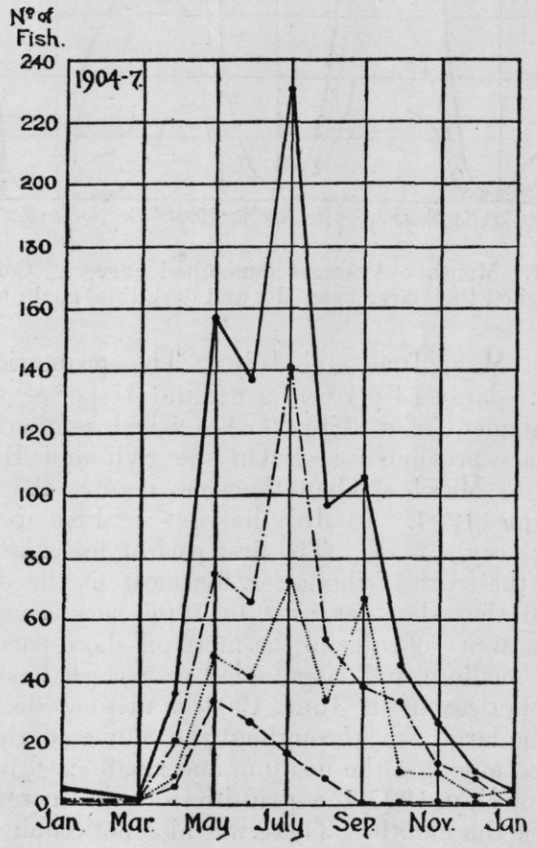

FIG. 20.—SOLES. Area M. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line, small.

This area is characterised by the great difference that exists between the abundance at the maximum and minimum periods. In the early months of the year the catches are exceedingly small—being little more than one in ten hours fishing—then after March a great influx of soles occurs suddenly and this continues till July, when the total catch of all sizes reaches 230, a number which is not exceeded at any other time or in any other area. This sudden rise is checked by a slight fall from May to June, which occurs in each year though it is of but a small extent. After July there is an extremely sudden fall to August and then the curve descends gradually to December, after which the catches, as stated above, become insignificantly small.

Large fish are not comparatively abundant in this area. They are absent from September to March. They reach their greatest number in May, when there are 33 large

out of a total of 158. At this period a large number of soles are spawning on this very ground and it is the height of the season. They then decline steadily till September. For the rest, small soles considerably exceed the large, and medium are still more

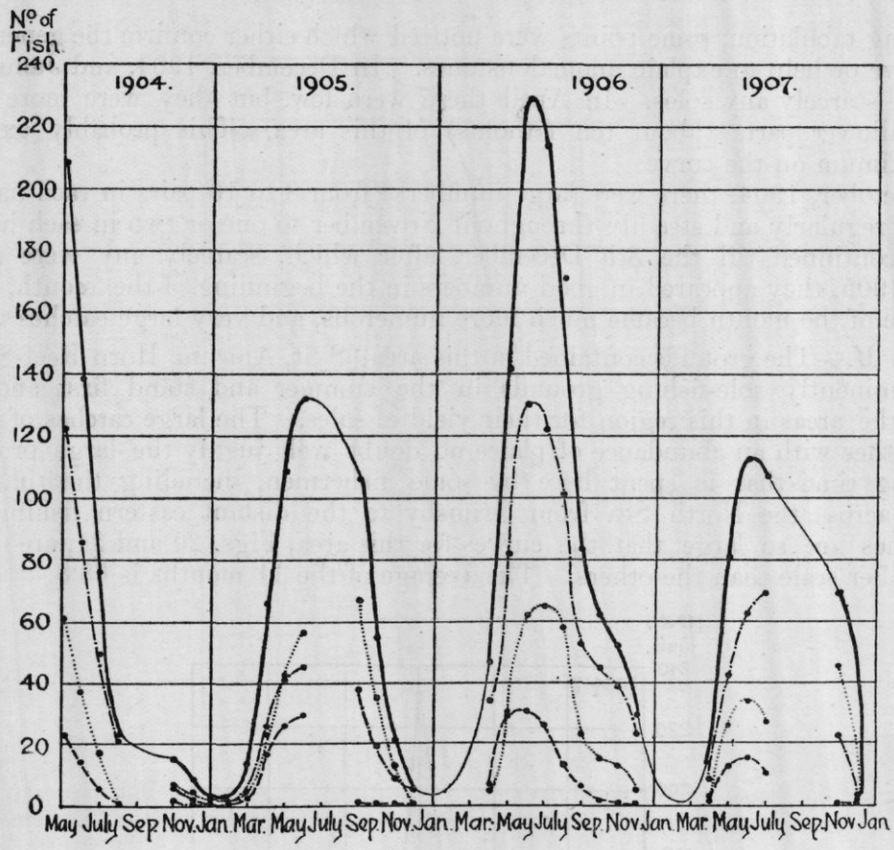

FIG. 21.—SOLES. Area M. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line small.

numerous, especially in May, June and July. The proportions calculated from the averages are as follows :—large 13 per cent., medium 47 per cent., and small 40 per cent. The following is the statement of a skipper who fished regularly on this ground each year, and for many years previously :—" On the Sylt and Horn Reef grounds there are no soles there up to March. Then the soles occupy the ground until the end of May." This was in June, 1904. In July he says : " Fish are getting very scarce here now. Soles are getting very scarce." The first part of his statement is correct but his own figures tell against the truth of the latter, for most of the July records are those of this particular man and they show, at least in 1906, *very* large catches. Probably the statement referred to a scarcity of soles in the more off-shore parts of this area.

Large numbers of medium and large soles are recorded as spawning in April, May and June. There was noticeable in June, 1904, a distinct decrease in the number of soles, mostly amongst the large fish, throughout the course of the month. In July, this trend was not maintained amongst the medium and small sized fish.

During the course of May, 1905, the quantities of soles increased enormously between the beginning and end of the month. There was also noticeable in another set of records a difference in the catches from various depths. On the Horn Reef South ground where the depths are 14–17 fathoms, few soles were found and these were mostly medium, but in 9–12 fathoms a little later on, all sizes of fish were present in great numbers, and of these, the large and medium ones were spawning. Exactly the same phenomenon was observed in another man's records of fishing at the same time. In June, 1905, the number of soles had increased and again it was especially in the shallower water (10–11 fathoms), that there was a large number of spawning fish. In all depths the numbers decreased in the latter part of the month. In several hauls in July, 1907, and in a few in June, a skipper took a large number of " very small soles." There would be about 15 or 20 pairs in each haul, and these have not been included in the figures, as there is a great probability of their being, not small soles, but solenettes (*Solea lutea*).

To judge of the fluctuations in the catch year by year, we have a very good number of months for comparison. A first glance at Figure 21 and at the corresponding averages shows us that 1906 has very much larger catches than most of the other years, and the following

figures are also telling. 1906 is greater than 1904, four times out of five ; than 1905, five times out of five ; and than 1907, six times out of six. 1907 is less than 1904 and also less than 1905 in three times out of five.

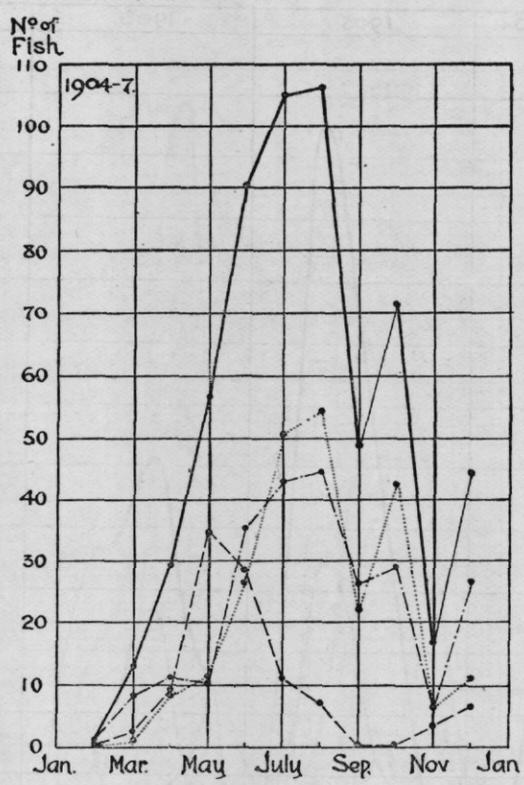

FIG. 22.—SOLES. Area Q. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

Area Q.—It presents in regard to the catches of soles, many similar features to the area M, to which it is also comparable in respect to its depth and relation to the coast. The main feature of the curve (Fig. 22) as in the previous area, is a single annual ebb and flow in the stock of soles with the maximum abundance occurring somewhat later in the summer.

The numbers caught, though large, by no means equal those of M, the average of the five months May to September, being a little over one-half that of the corresponding months in M. The average of the 11 months is 53·1. The rise from 1·3 in February to 106·1 in August is very steady and regular. After this month the curve descends to the winter minimum irregularly, the amount of fishing in the last three months being very small and the averages therefore unreliable.

Medium and small soles are of about equal frequency (41·6 per cent., and 40·3 per cent., respectively) and their fluctuations agree with each other and with those of the general curve, but large soles (18·1 per cent. of the total) behave differently. In common with the other sizes, they partake of the general movement into this area until May, when their numbers form the largest part of the catch ; then, instead of continuing in the general rise till August, they diminish in numbers by degrees till, in September, they are absent altogether. In May, 1907 this departure is particularly noticed to take place just at the beginning of the month. In August, 1905, a series of hauls was made on the Eider ground. The catches here were large, but consisted entirely of medium and small soles.

The numbers increased considerably between July and August 1905 on the Heligoland ground. Most of the 1907 fishing took place on the Terschelling ground, as did also the fishing during October, 1906, which as well as October, 1907, yields a high average.

In a comparison of the yearly averages we find that 1907 is perhaps the worst year of the four.

Area W.—The few hauls made during the spring and summer in this area can show us no more than that very fair numbers of soles were to be taken on this ground and that large fish are present during the spring months only, decreasing from May onwards ; the catch in the later months consisted entirely of small and medium. The highest number in any month is 26 in one haul in September. The other averages are under 50 per ten hours.

These areas are characterised by one large wave of immigration of soles during the year, culminating in very large catches, in summer for two of them, and in October for

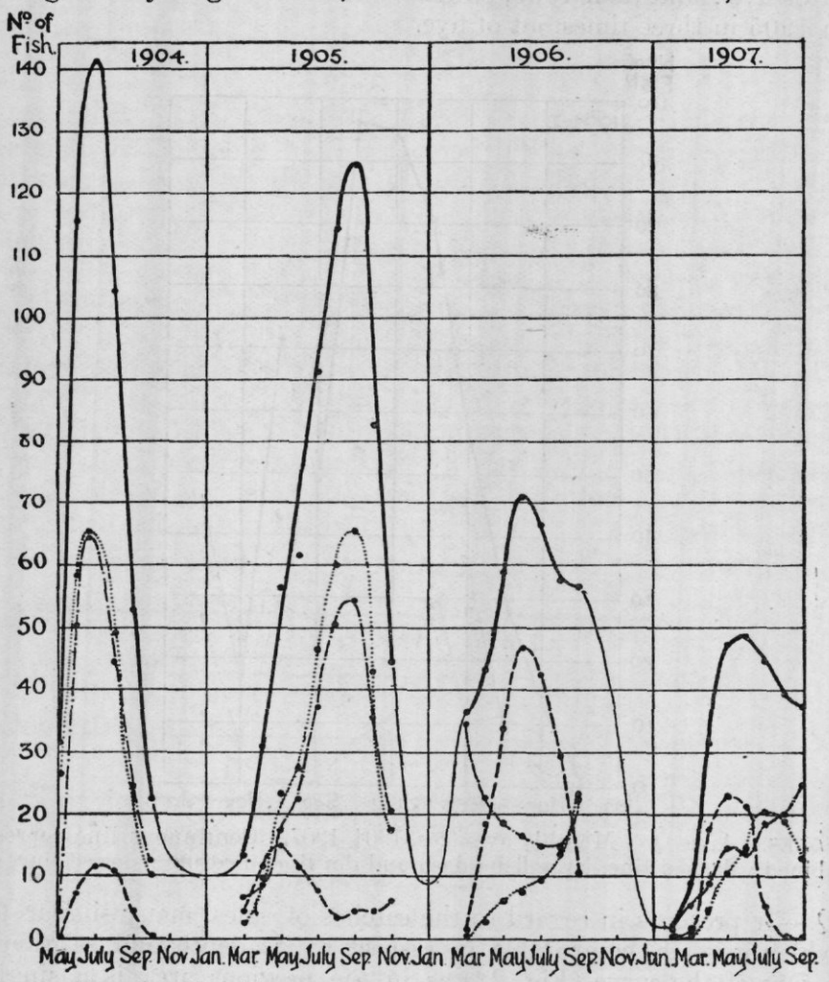

FIG. 23.—SOLES. Area Q. Monthly averages (smoothed curves). Continuous line represents all sizes; dashed line, large fish; dash and dot line, medium; dotted line, small.

the third (Horn Reef North). In order of importance M comes first, then Q and then W and H. In the winter, soles are practically absent from these grounds. Medium and

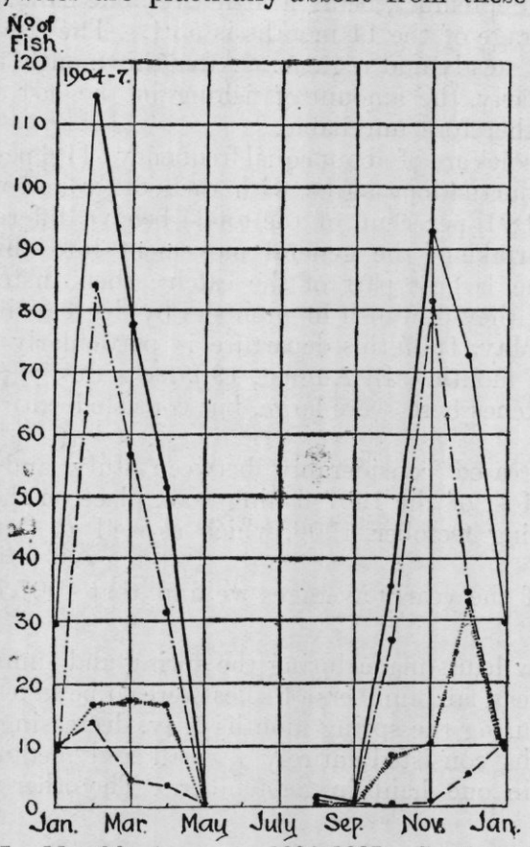

FIG. 24.—SOLES. Area J. Monthly Averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dash and dot line, medium; dotted line, small.

small fish predominate in the catches. Large fish appear more during the spring spawning season and their departure commences earlier, about June, just after the spawning period. Where we could make reliable comparisons it was found that 1906 had much larger catches than the other years—1904 and 1905 were fairly alike—and 1907 was the worst.

Central Areas.

Area J.—Soles are very plentiful here at certain times of the year and absent at others, and like the adjacent inshore areas, H and M, the area is characterised by the great difference in its maximum and minimum catches, and by the annual ebb and flow in its stock of fish. The average catches of May, August and September are all very low, and presumably too, those of June and July also, though there are no records in these two months. But we might expect it to be so, as the coastal areas are at this time so well stocked with fish, and the trend of the curve (Fig. 24) points to absence in the summer. The curve ascends rapidly from October onwards, showing that soles are quickly appearing in these waters as the cold weather approaches. They probably come from M through area H, for the maximum in H comes later than in M and about November they begin to disappear rapidly in H and to appear quickly in J. December should be the maximum month and not November, as one would suppose from the curve (Fig. 24). These irregularities are smoothed out in the smoothed curve (Fig. 25).

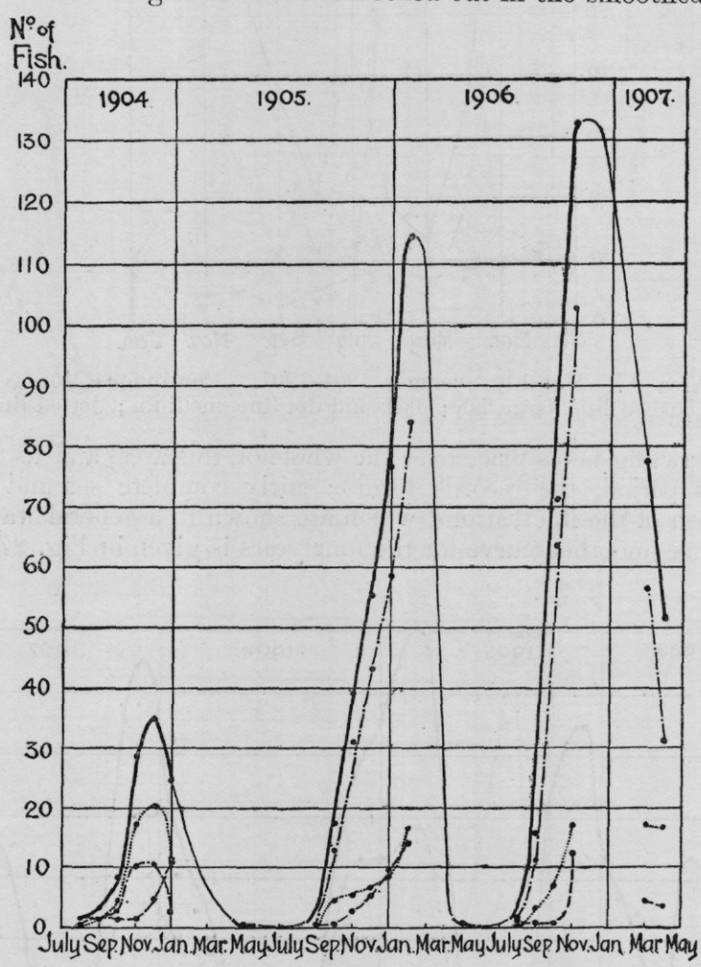

FIG. 25.—SOLES. Area J. Monthly averages (smoothed curves.) Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

Following the course of the figures for each year separately, one finds that December is really greater than November, while the fact that there was a greater amount of fishing in November, 1906, and less in December, 1906, compared with the other years, and the catches in this year were extraordinarily large, makes the November general average appear considerably higher than that of December.

The January catches are low, but they are based on the fishing in only two years and may not be altogether representative. The very high value for February represents the average catch of ten hauls in February, 1906, on the edge of the Oyster ground. The averages in the succeeding months show that soles leave these grounds at the approach of spring and summer, so that, when May arrives, they are almost all gone.

Soles of a medium size predominate in the catches and form 68·1 per cent. of the total. Large soles (8·4 per cent.) are numerically less than slips (23·5 per cent.).

In December, 1904, we find from the individual records that soles appear relatively numerous about the 21st of the month, "Outside the Mud." The shoals include large soles, which were absent in hauls made "In the Mud." In December, 1905, we notice the same feature in another set of records.

We have only three years for a comparison of the yearly fluctuations. The 1905 monthly averages are a little greater than those of 1904. 1906 had much higher averages than the other two years, and was by far the best of the three. The ground was not fished much in 1907, so this year cannot be compared with the others.

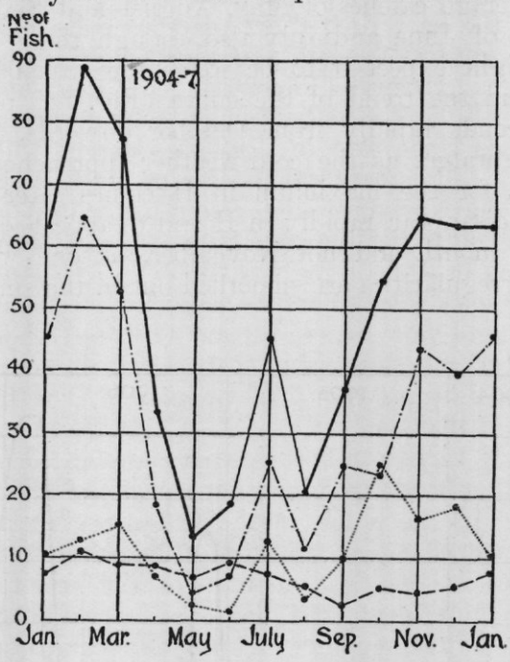

FIG. 26.—SOLES. Area N. Monthly averages 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dash and dot line, medium; dotted line, small.

Area N.—Trawling takes place over the whole of this area, and as it has been well fished during this period, the records form a fairly complete set and allow of a very detailed examination of the fluctuations, which are shown in a general way in Fig. 26.

The continuous smoothed curve for the four years is given in Fig. 27.

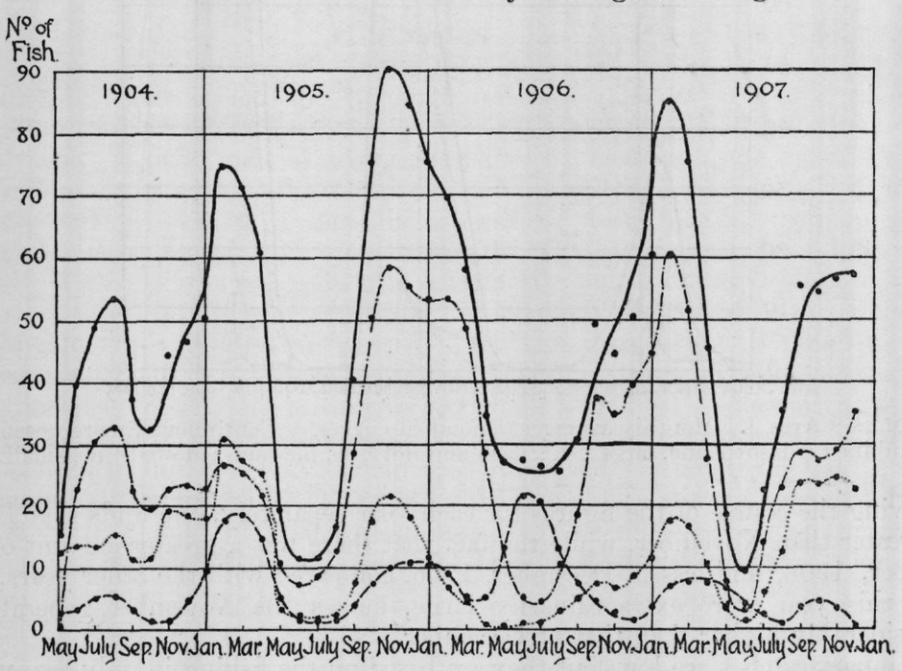

FIG. 27.—SOLES. Area N. Monthly averages (smoothed curves.) Continuous line represents all sizes combined; dashed line, large fish; dash and dot line, medium; dotted line, small.

At a glance we gather that with the exception of 1904, the summer averages in each year are very low while the winter and autumn averages are high. In fact the phenomena

are very similar to those described for area J, with the difference that the averages never get quite so large, nor do they decrease to such a great extent as do those of that area.

The June, July and August catches are generally small in the greater part of this area, but in July 1904 there is a high average of 86·6 based on 205 hours fishing. An examination of the individual records shows that most of this took place in the Terschelling Mud ground, just over the 20-fathom line. This is during the period of greatest abundance in area Q, and this ground which is but a continuation of that in area Q into slightly deeper water (20–21 fathoms), partakes of this abundance.

The August hauls of 1904 and 1907 were also made in the same place, so that the fact that these are so high compared with the other years is thus explained. Hauls made further out in this area at the same time yield very few soles. Now the July catches of 1904 predominate in the general average and thus form the apparent maximum and the cusp that appears on the general curve (Fig. 26). And also some of the hauls in July, 1906, were made in Terschelling Mud, a fact which helps to bring about the same result.

The maximum periods come late in 1904–5 (March, 1905) and early in winter 1905–6 (November, 1905), and late in the winter of 1906–7 (February, 1907). There is a slight fall between the November and December values and a secondary rise in February. The catches begin to decline after February and March and there is a rapid fall to the minimum in May or June.

The number of large soles is small and remains fairly constant throughout the year. The monthly general averages vary between 2 and 11 (per 10 hours). Slips are slightly more numerous, the averages fluctuating between 2 in June and 25 in October. Medium soles, as in area J, form the chief population, but they are not so numerous proportionally as they are in that area.

The question of yearly variations is somewhat complicated by the presence of hauls in grounds (*e.g.*, Terschelling Mud) which do not partake of the general character of the whole, and show decrease in the stock in the summer. The curves in Fig. 27 do not show any evidence of a distinct change in the stock of fish between each year. 1907 seems to have had larger catches in the early months of the year than either 1905 or 1906. This may be because the movement into deeper water was retarded till this time as we find that the October to December averages of 1906 were comparatively low.

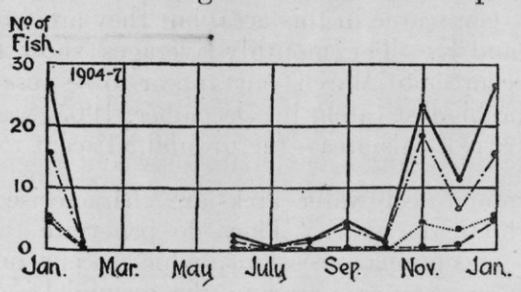

FIG. 28.—SOLES. Area I. Monthly averages 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

Area I.—Soles do not seem to penetrate much further offshore than the outer boundary of N, for we find a striking difference in the abundance in these two adjacent areas. The quantities found in I are *very* small, and it is only in the winter that appreciable catches are made (Fig. 28). Unfortunately we have no records from March to May, but we may presume that the catches are small, as at this time the shoals are moving rapidly out of N towards the inshore spawning areas (M and Q).

Soles approach this area and are found more plentifully in the winter when they appear to become localised and not distributed at all evenly over the whole area. The large catches in December, 1905, and the next month (January, 1906) were all made in the Clay Deeps. The December hauls of 1904 sometimes contain very few soles, and at other times a very fair number. They seem to avoid the Lower Scruff in this month, and also the " Hard ground at the east end of the Pits." They are generally absent in the summer, but in September, 1907, several pairs were taken in each haul in the Lower Scruff. In each year they become comparatively abundant in November.

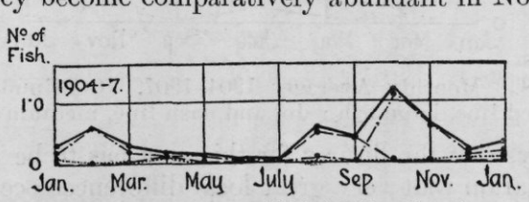

FIG. 29.—SOLES. Area O. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

The relative abundance of large, medium, and small fish is very similar to that of N, *i.e.*, medium come first—then small, and then large.

Area O.—The occurrence of soles on the Dogger Bank is very rare. From the table (Table VIII.) we see that 2·3 per ten hours in October, 1905, is the highest average catch obtained. More often they are wholly absent or almost so. They appear in greater numbers in 1905 than in 1904, and also than in 1906 and 1907 in the months in which we can compare them. Evidence as to seasonal fluctuations can be obtained from the 1905 averages. There is a direct fall from January to June and July, and increasing quantities till October, after which they diminish again, see Fig. 29. Small fish occur only as exceptions. Most of the fish present are classed as medium.

Of these central areas those lying next to the coastal grounds have large quantities of soles, sometimes averaging over ten per hour. In contrast to these, the more central grounds, I and O, are very ill-stocked, especially O. All areas show a definite seasonal fluctuation—broadly speaking, it is that of absence in summer and abundance in winter, with decreasing and increasing quantities in the spring and autumn respectively. The minor fluctuations on the curves, due to some extent to local differences in each area, are not sufficient to hide the main features of these areas in respect of the movement of soles. The summer minimum lasts a shorter time in N, nearest the coastal grounds, than in the other areas, and the complementary period of greater abundance lasts much longer in this area, showing that the fish do not stay in the more offshore areas for any length of time.

Northern Areas.—Below the Dogger.

Area D.—Soles are practically absent from this ground, the only records being of a few isolated ones caught in the early months of the year (January to March). These are mostly large fish, and are so few, numbering only 10 fish caught during over 1,800 hours' fishing, that they may be regarded as exceptions to the general rule that soles are not to be found in this region of deep water.

Area K.—This area too is devoid of soles. One fish only was caught, and that in March, 1905.

Area L.—Soles are very scarce in this area, but they are found more frequently than in the adjacent areas D and K. The monthly averages show that they are present in small quantities from December to March, but appear to be absent during the remaining months of the year. The biggest catch, in December, 1905, was derived from fishing in the extreme south-west part of this area—the ground adjacent to areas P and O.

These three northern and deep-water areas are characterised by an almost complete absence of soles throughout the year. They do penetrate this region, however, and are found on rare and exceptional occasions, which occur only in the winter. The greatest proportion of these instances occur in the ground L, which is in proximity to the Dogger Bank, and the nearest of the three to the English coast.

Southern Areas.

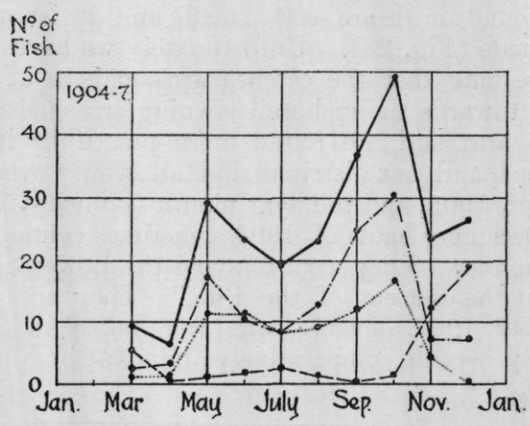

FIG. 30. SOLES. Area S. Monthly Averages 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dot and dash line, medium ; dotted line small.

Area S.—The analysis of the figures for this area has to be made with especial care, for it was found in tabulation that very great local differences occur in the abundance of soles.

The general curve (Fig. 30) for the whole area shows maxima in May and October, the latter being the greatest, and the summer depression being only slight. This area as a whole gives only a moderate yield of soles which consists for the most part of medium and small fish.

Since considerable difference exists in the nature of the catches from the northern part of this area (New Zealand Ground and Tea Kettle Hole) and the south-eastern part (Brown Bank and Brown Ridges) it became advisable to retabulate the hauls from this area and group them according to the actual fishing grounds. Accordingly the area was subdivided into four regions, viz., (*a*) The Leman ground and the banks to the west of it, (*b*) The Botney Ground, New Zealand ground and Tea Kettle Hole, (*c*) The Brown Bank and Brown Ridges, (*d*) Winterton Twenties and Smith's Knoll. The monthly averages for these areas are given in table IX. From this we see that in 1904

TABLE IX.—Showing the monthly average number of SOLES per 10 hours fishing in the different fishing grounds of Area S. Large (L.), medium (M.), and small fish (S.), are distinguished. The number of hours fishing is given as an index number.

Years.	Leman Ground.				Botney, New Zealand Ground, Tea Kettle Hole.				Brown Bank, Brown Ridges.				Smith's Knoll, Winterton Twenties.			
	L.	M.	S.	All.	L.	M.	S.	All.	L.	M.	S.	All.	L.	M.	S.	All.
1904.																
June... ...	1·3	8·2	5·2	$14·7^{46}$	2·0	22·2	29·1	$53·3^{129}$	2·5	10·5	19·5	$32·5^{40}$	—	—	—	—
July	7·5	15·5	18·5	$41·5^{80}$	2·7	19·2	30·2	$52·1^{90}$	4·3	12·7	8·8	$25·2^{175}$	—	—	—	—
August ...	0·0	15·0	7·5	$22·5^{8}$	0·2	29·2	38·2	$67·6^{200}$	0·0	14·3	5·5	$19·8^{177}$	0·0	15·7	7·8	$23·5^{69}$
September ...	—	—	—	—	0·0	46·9	35·3	$82·2^{72}$	(0·0	30·0	30·0	$60·0^{4}$)	0·0	14·2	10·8	$25·0^{24}$
October ...	(0·0	20·0	15·0	$35·0^{4}$)	0·0	44·2	25·9	$70·1^{99}$	—	—	—	—	—	—	—	—
1905.																
July	2·0	6·5	5·7	$14·3^{168}$	0·6	14·4	17·8	$32·8^{100}$	3·5	2·7	2·8	$9·0^{309}$	3·5	3·0	2·5	$8·9^{40}$
August ...	2·7	9·0	2·7	$14·5^{197}$	0·0	13·5	22·8	$36·3^{33}$	1·0	8·8	2·4	$12·3^{347}$	1·5	5·1	3·5	$10·1^{172}$
September ...	—	—	—	—	0·0	54·4	7·1	$61·5^{45}$	—	—	—	—	—	—	—	—
1906.																
March ...	5·7	2·8	1·1	$9·6^{92}$	—	—	—	—	—	—	—	—	—	—	—	—
April ...	0·9	3·6	1·1	$6·2^{22}$	—	—	—	—	—	—	—	—	—	—	—	—
May	0·0	0·0	0·0	$0·0^{7}$	—	—	—	—	—	—	—	—	—	—	—	—
June... ...	1·5	0·0	3·0	$4·4^{14}$	7·2	3·4	0·0	$10·6^{41}$	—	—	—	—	—	—	—	—
July	0·0	3·7	0·3	$4·0^{75}$	10·0	8·0	0·0	$18·0^{8}$	—	—	—	—	—	—	—	—
August ...	6·9	7·3	1·2	$15·4^{102}$	(10·0	5·0	0·0	$15·0^{4}$)	—	—	—	—	—	—	—	—
September ...	0·0	15·3	3·5	$18·8^{120}$	0·0	11·7	27·1	$38·8^{24}$	(0·0	10·0	0·0	$10·0^{4}$)	0·0	7·4	0·8	$8·3^{72}$
October ...	21·2	18·8	4·7	$44·7^{8}$	0·0	8·4	1·3	$9·7^{32}$	0·0	5·0	2·5	$7·5^{16}$	—	—	—	—
1907.																
May	—	—	—	—	1·2	1·2	2·4	$4·8^{17}$	0·3	12·2	9·9	$22·3^{288}$	2·6	29·6	14·7	$47·0^{156}$
June... ...	5·0	2·5	2·5	$10·0^{8}$	8·6	0·4	5·0	$13·9^{56}$	0·0	8·2	9·9	$18·1^{179}$	0·0	11·0	0·0	$11·0^{105}$
July	0·0	8·2	5·1	$13·2^{191}$	0·0	7·5	0·0	$7·5^{12}$	0·0	4·4	6·7	$11·1^{36}$	0·0	8·4	0·0	$8·4^{32}$
November ...	16·2	8·8	5·0	$30·0^{16}$	—	—	—	—	—	—	—	—	—	—	—	—

and 1905, quite large numbers were taken in the north-eastern part of this area, the mean of the numbers in the five months June to October, 1904, being 65·1, of the 3 months July to September, 1905, being 43·5, while none of the other grounds yielded even half this amount. The differences between the other three sub-regions are not so significant, but when we compare the averages of corresponding months, we find that those of the Leman Ground are the highest. Between the Brown Bank region and Winterton Ground there is very little difference.

The differences in the catch of the corresponding months year by year are significant. In all cases those of 1904 are the highest, but there are too many gaps in the observations for us to be able to measure the decline, and to determine whether the catches for the whole year would show the same trend throughout the period as do those for the corresponding months.

The seasonal fluctuations are determinable only from the spring to autumn, as there is no winter fishing. In the Leman Ground, the spring and early summer catches (1906) are very low, but increased quantities are found in the summer and there is a maximum in the autumn. In 1904 there is a considerable increase between June and July. In the region consisting of the Botney Ground, New Zealand Ground and Tea Kettle Hole there is a maximum in September in three out of the four years, but the trend in the spring is not determinate. On the Brown Bank and Brown Ridges there is a decline from June to August in 1904, and from May to July in 1907. This May maximum is also shown in the averages in the adjacent southern sub-area, Winterton

Twenties, etc., where an average of 47·0 is attained, while the June and July averages are much lower. The statistics of the Lowestoft sailing trawlers show the fluctuations in the neighbourhood of the Brown Ridges, much more fully.* There we find a summer minimum, as is also indictated by these figures, and an autumn or early winter maximum.

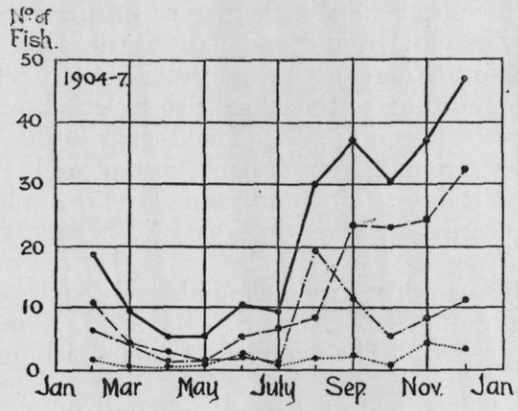

FIG. 31.—SOLES. Area T. Monthly averages 1904–1907.

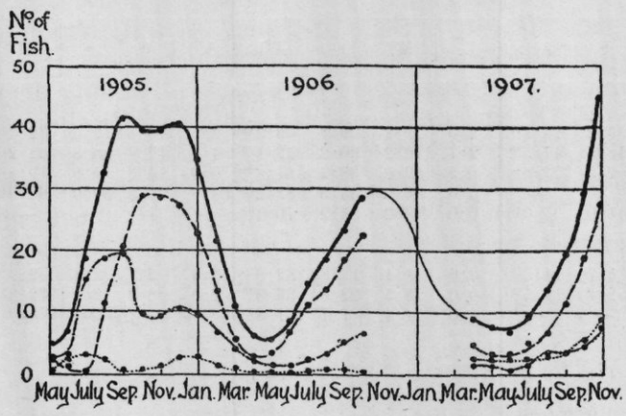

FIG. 32.—SOLES. Area T. Monthly averages (smoothed curve.)

Continuous line represents all sizes combined ; dashed line, large fish ; dash and dot line, medium ; dotted line, small.

Area T.—Although in this area the depths are not uniform, the catches from the various localities are very comparable with one another. The monthly averages show a close resemblance in trend in all the years. (Fig. 32.)

The number of soles caught are of the same order as those of area S, i.e., they rise at their greatest to a maximum of about 40 or 50, and at the minimum they are 5·3 per 10 hours. The curve resulting from the combined averages (Fig. 31) is fairly smooth, and shows distinctly that there is a definite immigration into and emigration from this area, the immigration taking place in the summer and autumn, and the emigration in the spring. There is a regular decline in the average catch from February to April and May. The increase begins in June, is slow at first, but is very sudden between July and August, after which the curve continues to ascend till December. The months, September to December, are all high, the month of maximum not being exactly determined, but the trend of the smoothed curve in Fig. 32 indicates that it occurs in November or December. In this area large soles are apparently the most numerous class, especially after the time when the summer immigration begins. In the autumn and winter they from a large proportion of the catch. The number of small soles is quite insignificant. We have reason to suppose that this appearance on the curve, as well as that in area V, is to be explained to some extent by there being a personal bias in the judgment of the size. Most of the hauls are made by a certain skipper, who calls the majority of his soles large, while at the same time other skippers fishing in this area find a much smaller proportion of large soles, and many more medium and small. The figures for August, 1904 and and 1905, are those in which this man's records do not appear, nor do the large soles. The number of times in which any of the other skippers fish in this area is very small,

* LEE.—Report on Lowestoft Sailing Trawler Records. *Internat. Inves. Mar. Biol. Ass. Report II., Part II.* Cd. 4641. p. 107.

so that the averages, especially those of the later months of the year, are based on his returns, and are influenced in regard to the relative proportions of the sizes by his judgment. For this reason we cannot arrive even at the approximate proportions of the three groups.

With regard to the yearly fluctuations we find 1906 to be a little less than 1907, while both years are on the whole somewhat less than 1905. 1904 cannot be compared with them.

Area V.—This area, including chiefly the Silver Pits, is not at present a good ground for soles when compared with the eastern areas, although some years ago it had the reputation of being well populated with this fish.* Only for two months in the year does the average exceed 15 (per ten hours).

The trend of the averages throughout the year, shows that there is a gradual decline from January to about July. There appears to be a great influx in August and a still greater one in September, but the fishing is very unrepresentative. The decline apparently begins in October, but it is doubtful whether this is the case as in 1907 a skipper made a few hauls in that month and got large catches about which he stated: "Soles are extra large in the Pits, their market value is not so good." His catches for November too are better than those of 1904 and 1906, but the number of hauls is so few that the averages for the last three months are most uncertain.

These southern grounds yield fairly good catches of soles. There are far more fish than in the northern grounds, but at their best they are only about half as productive as the eastern grounds. All three areas show seasonal fluctuations. A period of maximum abundance occurs in the autumn and winter with a corresponding depression in the spring and early summer. Area S has also a smaller secondary maximum about May or June, but here the phenomena are rather ill defined as great local differences are found to exist. Probably there is a northward movement of the soles from midsummer throughout area S, which is continued into T, for here the maximum comes somewhat later (about V we have no certain information for the winter). There is a considerable difference between the catches in the maximum and the minimum months (about 40 per 10 hours). Of the proportion of large, medium and small we have no reliable knowledge.

Western Areas.

Areas E.—The averages of hauls in this area, few as they are, show that very large catches of soles are to be found here. They approximate somewhat to the numbers caught on the continental side of the North Sea. The inshore parts of this ground are known to be one of the English nursery grounds for soles. No large fish were taken, all being medium and small. It is a curious fact that these hauls were all made by the same man, yet his proportions of medium and small vary greatly.

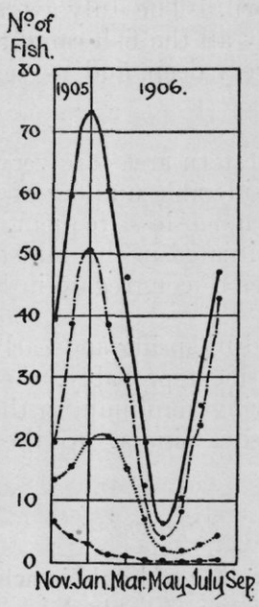

FIG. 33.—SOLES. Area R. Monthly Averages (smoothed curves). Continuous line represents all sizes; dashed line, large fish; dash and dot line, medium; dotted line, small.

Area R.—Seeing that this area is adjacent to an English nursery ground for soles, it

* *Cf.* Cunningham's Investigations in 1895, when from 3 to 10 boxes of soles was the usual quantity landed from the Silver Pits.

is not surprising to learn from the curves that it gives a good yield of soles. The catches are sometimes very high, the highest being over 80 in December and February, and the lowest about 3 (per 10 hours). There is indeed a period of comparative scarcity in April, May and June, but this minimum is of short duration. The September and October averages too are low, but they are calculated from so few records that they are probably more chance occurrences than representatives of the actual stock. This is very likely to be the case as they were taken in the extreme north-east part of this area, the Well Bank Flat. If we omit these two months' averages, the quantities would seem to rise till December. The course of the curve relies almost entirely upon the figures for 1906, when this area in particular was fished regularly by a single fisherman (Fig. 33). But the November and December averages are based on those of 1904 and 1905 (the latter mainly), and they call for more examination. Many hauls were made in and around the deep holes (Coal Pit and Sole Pit, &c.) which are to be found in this area, and the soles were found to be exceptionally numerous in them. In the deep pits from 40 to 50 pairs would sometimes be taken in one haul, while in the shallower water the number caught is generally under 10 pairs per haul. These very large catches appeared oftener in December than in November.

The same great variation is noticeable in the January and February catches of 1906. By April the numbers had diminished greatly, and in several hauls no soles were found. In May they were fewer still. Throughout June they increase slightly. In July and August still more.

The main features of the curve are the spring minimum of short duration and the winter maximum.

Area X.—The average catches of soles from January to June and July are comparatively low (< 9 per 10 hours). They increase rapidly to a very high maximum in October (50 per 10 hours). In this area as in some others there are considerable local differences, and it is difficult to determine the true course of the curve after October, for in November and December some averages are high and some low. The December average of 1905 is the average of hauls made in the Dogger Bight, where there are apparently few fish at this time of year. The relatively small catches of October and November, 1906, were also mostly from the Dogger Bight. On the January and February averages no reliance can be placed. One other fact is noticeable. In October, 1905, there were some exceptionally large catches. After getting an ordinary number of about 10 or 12 pairs in one haul, the skipper suddenly came across a large number, of say 40 pairs in one haul. These extraordinary catches which were all made on the Eastermost and Off grounds have raised the average for this month considerably. Large fish predominate in the catches except in April, May and June, the spawning season, but this may be explained by the fact that the greater number of these hauls were recorded by the fisherman, who as was mentioned above, seemed to be biased.

Area P.—Here we have very few hauls. One pair of soles was present in each of the single hauls taken in March and April. The July average is very low ; that of September relatively much higher. Apparently all the fish caught were large. This is very likely to be the case as the water is here very deep, and as several skippers participated in the hauls there is probably no bias.

The records in some of these western areas are very incomplete, but they indicate as far as they go the presence of a considerable number of soles on the inshore and shallow grounds. In deeper water they are much less frequent, with the exception of those very deep holes, such as the N.E. Hole, situated in the midst of comparatively shallow water. The tendency is shown for the soles to congregate in large numbers in these deep holes, especially in the winter.

The minimum catches are found in spring and early summer in two of these areas (R and X), and the autumn and, most probably, the winter catches are high. It is possible and probable that the spring minimum in these areas is caused by a migration shorewards for the spawning season, similar to the one that occurs on the eastern grounds.

Spawning.

From the table showing the number of hauls in which spawning soles were recorded we obtain some very definite information (Table X). Obviously, the period April, May and June is the real spawning season, the maximum proportion of occurrences coming in May. The season in 1906 and 1907 may have been a little later than in 1904 and 1905, as we have in both years " Large and Medium Soles beginning to have roes " in April, and

* CUNNINGHAM. North Sea Investigations. *Journ. Mar. Biol. Ass.*, Vol. IV., 1895, p. 13.

in May the "Large and Medium Soles are full and nearly ripe for spawning." Occasionally, but rarely, a few slips are recorded as spawning.

TABLE X.—Showing number of hauls in which spawning SOLES are recorded.

Area.	I.	J.	L.	M.	N.	O.	Q.	X.
May 1904	—	—	—	$\frac{10}{18}$	—	—	—	—
June „	—	—	—	$\frac{2}{71}$	—	—	—	—
December „	$\frac{7}{53}$	—	—	—	—	—	—	—
January 1905	$\frac{1}{5}$	$\frac{3}{4}$	—	—	—	—	—	—
February „	—	—	$\frac{3}{13}$	—	—	—	—	—
March „	—	—	$\frac{4}{25}$	—	—	—	$\frac{2}{21}$	$\frac{1}{12}$
April „	—	—	—	$\frac{44}{51}$	$\frac{1}{14}$	$\frac{2}{105}$	—	—
May „	—	—	—	$\frac{177}{208}$	—	—	—	—
June „	—	—	—	$\frac{66}{81}$	—	—	—	—
April 1906	—	—	—	*	—	—	—	—
May „	—	—	—	§	—	—	—	—
June „	—	—	—	$\frac{15}{22}$	$\frac{1}{19}$	—	$\frac{7}{26}$	—
April 1907	—	—	—	*	—	—	—	—
May „	—	—	—	§	—	—	—	—
June „	—	—	—	$\frac{3}{9}$	—	—	—	—

* "Large and medium soles beginning to have roes."
§ "Very full of spawn."
The number of hauls in which spawning soles are recorded is given as the numerator of a fraction of which the denominator is the total number of hauls in the area during the month.

Undoubtedly the most important spawning grounds of the soles are found in area M, where not only are most of the hauls with spawning soles made, but also the fish are here very numerous and a great portion of the catch, at least of the large and medium fish, are recorded as spawning. A few are also found in area Q. The soles are thus found to seek shallow water at their spawning season.

These figures yield no information as to the spawning grounds on the English coast, as hardly any fishing took place in the shallow waters off the Lincolnshire coast, but we know that spawning soles are found in large numbers in the shallow flats off Lowestoft.*

We have in 1905 a few instances of spawning fish in some of the more offshore areas. These cases are in January to April and are in all probability of fish not spawning but "maturing" and making their way towards the shallow water for the purpose of spawning.

Summary.—Soles.

a. Distribution.—The general comparative abundance of soles is displayed by the chart in Fig. 34, which also shows in what season the fish were most abundant in the various areas.

This shows that the inshore grounds off the coasts of Denmark and Germany are very well stocked with soles and supply much the greatest average catch. With the exception of area J, which has in some parts, more especially in the south-east, much larger catches than its adjacent inshore area H, though less than M to which it is also adjacent, the quantities diminish as we proceed further and further offshore into deeper water. On the western side there are indications of large quantities in the shallow grounds off the English coast, but the material does not supply us with sufficient information to enable us to examine the conditions of distribution in that part very precisely. However, area R is found to compare well with N on the eastern side in regard to its maximum yield. The coastal waters off the north-east coast of England are not investigated, so they are not included in the following statement.

An imaginary line drawn from the north-west corner of area H to the end of the line dividing I and N, and continued along this line through areas V and X to Flamborough Head, affords a rough boundary for the occurrence of soles. South of this line, generally speaking, they are plentiful, north of it they are very scarce and almost entirely absent in the summer. The further offshore we proceed the scarcer they get, and they do so, so rapidly, that they are only found on rare occasions on the Dogger Bank and in the grounds north of it. In the southern central grounds they are not so numerous as nearer

**cf.* LEE.—Report on Lowestoft Sailing Trawler Records 1903–1906. *Internat. Invest. Mar. Biol. Assoc. Report II., Part II.* Cd. 4641, p. 109.

the coasts, and in the most southern part of this region investigated, in the neighbourhood of the Brown Ridges, they are comparatively scarce.

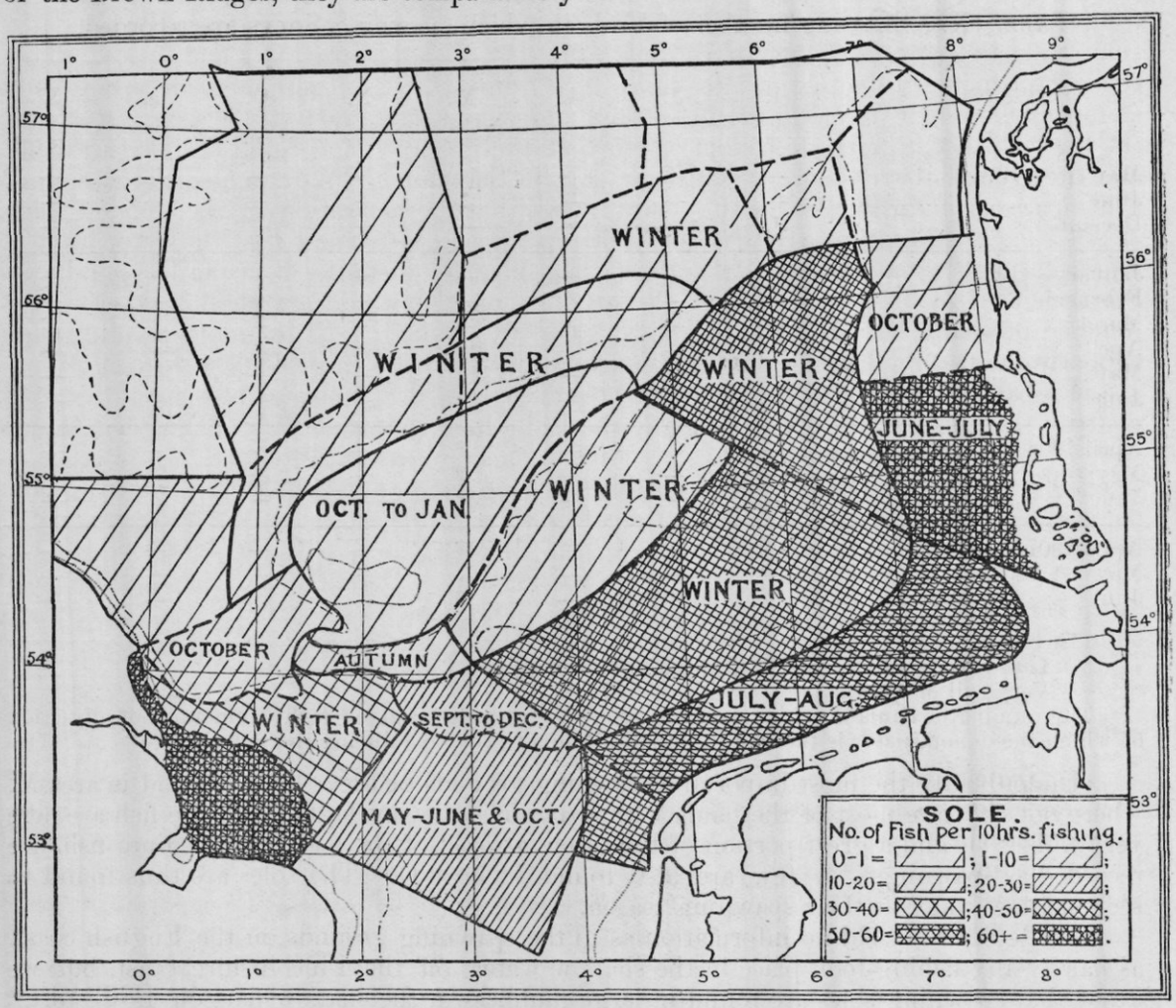

FIG. 34.—*Chart* showing the distribution of SOLES according to the mean monthly catch in each area, and the periods of maximum abundance in the different regions.

With regard to size, we find that over one-half of the total number caught are classed as medium. Small fish do not appear in the northern grounds, or on the Dogger, but they are found to be relatively numerous and nearly equal to the medium on the eastern grounds and in area S. They become relatively less numerous in the central grounds adjacent to these. Large fish generally form under 20 per cent. of the total, but in the deep-water areas and the western areas they appear to predominate. However, the proportions in these latter areas are somewhat unreliable.

b. Yearly variations.—There does not appear to be any regular decrease or increase in the average catch over the whole region. 1906 seems to have been in some respects an exceptional year. In the eastern and some of the central areas it had much larger catches than the other years. 1904 and 1905 were fairly alike, and 1907 was the worst year.

The conditions of salinity and temperature were also somewhat unusual this year (1906). In August, 1906, in the waters off the Danish coast, the salinity was much lower than usual,* while the sea temperatures were somewhat higher than normal. In 1907 they were lower.

Complementary fluctuations appear in the more offshore and the southern areas, when 1906 appears to be a very poor year relatively to the others, and 1907 a little better than it. These facts give great support to a theory that soles are influenced greatly by changes of temperature, and that they seek the shallow water in hot weather, and to a greater extent than usual in hot years. Similarly in 1893 an improvement in the Terschelling sole fishery was attributed to the warm summer.†

c. Seasonal Fluctuations and Migrations.—There appears to be a definite seasonal migration between the inshore and offshore areas, and this may be described as an inshore immigration in the spring, culminating in a maximum stock on the shallow inshore waters in the summer. The offshore migration takes place in the autumn and winter,

* *Cf.* p. 25 of present report.

† HOLT. North Sea Investigations. *Jour. Mar. Biol. Ass.* Vol. 3, p. 127.

and leaves the shallow waters entirely devoid of soles. This fact is suggested, more than proved, for the western areas by the spring and early summer minima that occur on the curves, followed by an influx in the latter part of the year. On the eastern side the figures are much more conclusive. That the fish move into deeper water after the summer is apparent from the curves illustrating the offshore areas N, I and J, &c., where the complementary fluctuations to those in M and Q, *i.e.*, a minimum in spring and summer followed by a maximum in autumn and winter, are clearly to be seen. Moreover the few fish that do migrate farther north than the majority, and reach the Dogger Bank and the grounds beyond, are found there only in the winter. We can also suppose, after a comparison of the curves for the central areas, that the migration of the general mass of soles from the eastern coasts is not of a very great extent, and that the outer limit of migration of the majority stops short some considerable distance from the Dogger Bank. Such an area as R, where, though the grounds on the whole are shallow, there are a number of small but deep holes, where soles are found in large numbers, still more supports the theory that soles have a tendency to seek the deep pits in the winter.

Probably these movements are connected directly with the change of temperature. A study of the temperature charts issued in the Bulletin Trimestriel shows phenomena which vary in much the same way as the stock of fish on these eastern grounds. In October to December, 1905, there was a sudden cooling of the surface waters and at the same time the fish are found to disappear quickly from area M. The winter maximum comes very early in the season in area N—*i.e.*, in November—on the smoothed curve. In the winter of 1906 to 1907, the sea temperatures continued higher than usual up to December and then fell suddenly in the early months of 1907 to very low values. Simultaneously, we find that the migration from area M is delayed in 1906, the averages being fairly high up to December, while the winter maximum in N is late and is protracted beyond the usual time.

All sizes of fish participate in the migrations. Large fish leave the shallow coastal waters earlier than the medium and small, in fact directly after the spawning season.

d. Spawning.—Soles are found to spawn always in shallow water under 20 fathoms. The season for spawning occurs in spring and early summer, April, May and June being the months when most of the spawning fish are found. Nearly all the large fish and many of the medium ones are recorded as spawning. On the western side we have no fishing in the spawning grounds, but on the eastern side we find that area M (Sylt, Amrum, &c.) is the chief ground on which the spawning soles congregate. A few occur in area Q, but none so far north as area H.

C.—Turbot.

Introduction.

These fish are found sparsely scattered over the whole of this region. The numbers of large and small fish caught are recorded by the fishermen, but they seldom amount to more than two or three fish per haul, and it often happens that none are taken at all. The grounds in the south and eastern parts are the most prolific in this fish, and there is definite evidence of regular seasonal fluctuations in these areas. Many of the curves however, especially for the grounds north and west of the Dogger bank, are of a most irregular character, and for this reason several have not been reproduced. The figures need to be studied with especial caution and many reservations in drawing conclusions. The numbers of fish taken are so very small that a difference of one or two makes a great difference in the average, and the variations in these are therefore very great.

The total numbers caught are given in the following table, together with the proportions formed by the large and small fish.

Table XI.—Showing the total numbers of Turbot caught by certain skippers in each year, and the percentage of the total formed by the two categories "large" and "small."

—	Total number of Turbot.			Percentage of total.	
	Large.	Small.	All sizes.	Large.	Small.
1904	2,438	6,873	9,311	26	74
1905	3,662	6,570	10,232	36	64
1906	2,200	4,209	6,409	34	66
1907	1,717	3,299	5,016	34	66
Total	10,017	20,951	30,968	32	68

Here we see that in 1904 a large number of *small* fish were taken. In the other three years the proportions were fairly constant; the large fish forming about one-half the number of small. We find in corroboration of this fact that the catches in the small fish grounds (the eastern areas chiefly) were exceptionally large in 1904.

A study of the curves reveals the fact that turbot have a much more even distribution than we found for either plaice or soles. There are, of course, local differences, and we find much the same law of bathymetric distribution, *i.e.* a decrease in the quantities as we proceed off-shore and northwards into deeper water, but there is nothing like the contrast in numbers, such as was found for soles between the different areas such as M or Q and I or O; they are present even in the most northern grounds of this region in quite appreciable numbers compared with the eastern grounds.

Yearly fluctuations.

In studying the curves of monthly averages, we find in some that that there is a distinct downward trend, indicating continuously decreasing catches. Those areas where this is not shown, are mostly those which have not a sufficient number of reliable monthly averages to determine the yearly trend with anything like a close approximation. The trend of the yearly variation is also shown by the following figures obtained by comparing the averages in the corresponding months of the successive years. (All averages based on less than 30 hours' fishing are omitted.)

The 1905 average is 22 times less than that of 1904 out of 40 months.
The 1906 average is 25 times less than that of 1904 out of 35 months.
The 1907 average is 20 times less than that of 1904 out of 25 months.

The 1906 average is 26 times less than that of 1905 out of 46 months.
The 1907 average is 23 times less than that of 1905 out of 34 months.

The 1907 average is 19 times less than that of 1906 out of 33 months.

From this it appears that there is, on the whole, a decline throughout the period in the average catch, for each year was more often less than the preceding ones than greater than them. Moreover, the proportion increases as time goes on, for 1907 is less than 1904 in a greater proportion of the total months of comparison, than are either 1906 or 1905. In the same way it is greater than 1905, more often proportionally than is 1906. And further, not only is 1904 the best year in the greatest number of time, but there is often a great difference between its averages and those of the subsequent years.*

The Fluctuations in each Area.

The monthly average catch of turbot for each area is given in Table XII., and the nature of the variations are described below.

North-eastern Areas.

Area A.—The averages 4·72 and 8·64 for July and August indicate the presence of appreciable numbers of turbot, at least in the summer.

Area B.—The averages fluctuate between 0 and 4 per 10 hours. It is impossible to determine the seasonal fluctuations from these averages as the trend is not the same in each of the years.

Area C.—Only one fish was taken in the few hauls made in this area.

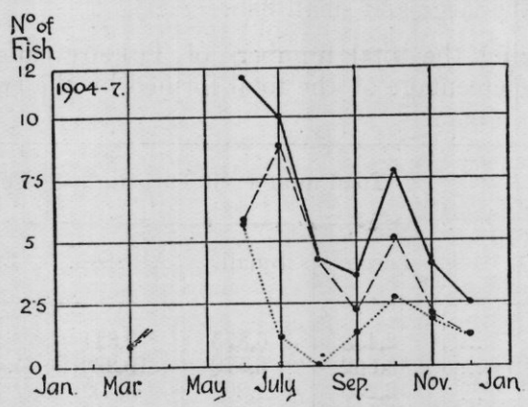

FIG. 35.—TURBOT. Area F. Monthly averages, 1904–1907. Continuous line represents all sizes; dashed line, large fish; dotted line, small.

* With this continued decline we may compare the same phenomenon evidenced by the Dutch statistics. *Jaarverslag omtrent het beheer van de Visschershaven te IJmuiden.* 1908. Table IV., p. 72.

TABLE XII. (*continued*)—SHOWING for each area the Monthly Average Number of TURBOT caught per 10 hours' fishing; large (L.) and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
CENTRAL AREAS.	J	1904	...	...	...	...	...	...	...	...	...	...	...	...	3·33	17·78	21·11[9]	...	...	...	...	...	...	1·59	3·97	5·56[75]	2·15	0·73	2·89[205]	...	...	...	3·25	4·68	7·92[77]	3·37	8·95	12·32[401]	J
		1905	0·57	3·32	3·89[105]	...	...	...	...	...	...	...	...	...	0·50	7·00	7·50[89]	...	...	...	...	...	...	...	...	...	1·99	1·15	3·15[95]	3·31	2·55	5·86[78]	4·22	7·19	11·41[64]	4·41	5·20	9·60[88]	
		1906	1·82	5·09	6·91[28]	4·67	13·33	18·00[30]	...	...	...	...	...	...	0·77	0·52	1·29[77]	...	...	...	...	...	...	1·20	0·77	1·97[92]	0·22	0·00	0·22[90]	5·63	8·59	14·23[254]	10·11	10·27	20·38[130]	2·11	5·26	7·37[38]	
		1907	...	...	...	...	...	...	0·15	2·37	2·52[67]	2·34	6·01	8·35[68]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·00	3·13	8·13[16]	...	...	...	
		1904–7	**0·83**	**3·68**	**4·51[133]**	**4·67**	**13·33**	**18·00[30]**	**0·15**	**2·37**	**2·52[67]**	**2·34**	**6·01**	**8·35[68]**	**0·94**	**3·19**	**4·13[106]**	...	...	...	...	...	...	**1·38**	**2·22**	**3·59[167]**	**1·67**	**0·67**	**2·33[90]**	**5·13**	**7·28**	**12·41[362]**	**6·68**	**7·69**	**14·37[237]**	**3·45**	**8·06**	**11·51[337]**	
	N	1904	..	...	...	...	...	...	...	...	...	...	...	...	6·37	14·51	20·88[78]	8·15	12·59	20·74[40]	13·12	27·17	40·29[205]	15·89	21·74	37·63[109]	4·16	20·10	24·26[98]	1·81	17·15	18·96[144]	4·49	9·70	14·19[182]	10·40	19·56	29·96[136]	N
		1905	1·18	10·59	11·76[8]	0·25	5·25	5·50[40]	9·62	16·92	26·54[52]	3·67	2·83	6·50[60]	6·78	18·14	24·92[49]	8·06	16·19	24·24[139]	4·61	8·82	13·42[76]	5·18	9·92	15·10[77]	4·94	9·84	14·77[174]	...	...	...	8·45	15·75	24·20[219]	4·59	9·79	14·39[112]	
		1906	3·23	6·32	9·55[121]	1·51	5·93	7·45[10]	1·59	4·49	6·08[283]	0·00	2·96	2·96[14]	4·22	8·22	12·44[99]	5·33	7·88	13·21[83]	2·89	11·31	14·21[76]	4·22	4·17	8·40[197]	3·73	6·47	10·20[51]	4·35	7·31	11·67[108]	8·35	7·25	15·60[201]	2·15	4·03	6·17[74]	
		1907	3·13	5·29	8·42[206]	3·04	5·68	8·72[125]	1·10	1·97	3·07[228]	3·40	5·81	9·21[132]	4·49	5·99	10·48[74]	5·31	8·95	14·27[71]	7·63	8·64	16·27[118]	3·33	8·00	11·33[45]	1·70	5·91	7·62[235]	3·74	8·15	11·89[239]	4·30	7·15	11·45[254]	2·29	5·52	7·81[96]	
		1904–7	**3·17**	**5·94**	**9·11[235]**	**1·81**	**5·80**	**7·61[175]**	**2·13**	**4·62**	**6·75[563]**	**3·25**	**4·76**	**8·01[206]**	**5·14**	**10·61**	**15·75[251]**	**6·81**	**12·14**	**18·95[333]**	**3·76**	**17·09**	**25·85[475]**	**6·63**	**10·04**	**16·67[223]**	**3·57**	**9·71**	**13·28[455]**	**3·35**	**10·34**	**13·69[251]**	**6·14**	**9·63**	**15·77[256]**	**5·14**	**10·48**	**15·62[218]**	
	I	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·37	3·75	6·12[101]	0·54	4·86	5·41[18]	0·82	5·89	6·71[219]	0·84	1·06	1·91[225]	0·83	3·03	3·85[218]	4·95	10·32	15·26[190]	2·12	7·80	9·92[359]	I
		1905	0·91	4·91	5·83[37]	1·14	2·29	3·43[17]	...	...	...	...	...	...	...	...	...	2·50	5·00	7·50[52]	3·14	6·28	9·42[121]	3·30	5·47	8·77[263]	3·70	6·68	10·38[252]	...	...	...	3·88	7·19	11·08[139]	4·42	9·68	14·11[47]	
		1906	6·08	8·23	14·30[79]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8·92	0·00	8·92[74]	...	...	...	5·81	0·00	5·81[31]	9·57	2·61	12·17[11]	3·97	4·12	8·09[65]	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·85	3·80	11·65[160]	4·51	1·13	5·63[71]	7·04	4·07	11·11[27]	...	...	...	
		1904–7	**3·36**	**6·49**	**9·85[166]**	**1·14**	**2·29**	**3·43[17]**	...	...	...	...	...	...	...	...	...	**2·41**	**4·18**	**6·59[183]**	**4·92**	**3·98**	**8·90[213]**	**1·94**	**5·70**	**7·64[253]**	**3·75**	**4·87**	**8·65[1068]**	**2·03**	**2·56**	**4·59[200]**	**4·58**	**7·92**	**12·50[421]**	**2·39**	**8·02**	**10·41[406]**	
	O	1904	...	...	...	...	...	...	...	...	...	...	...	...	1·00	0·00	1·00[19]	2·29	0·70	2·99[100]	2·96	0·27	3·23[149]	1·93	2·01	3·94[254]	1·66	1·43	3·09[216]	0·79	0·51	1·29[256]	0·68	1·18	1·87[278]	0·21	2·47	2·68[97]	O
		1905	0·80	1·70	2·50[100]	0·88	1·06	1·95[56]	1·73	1·33	3·07[150]	1·09	0·99	2·09[613]	1·09	1·34	2·43[95]	0·75	1·33	2·07[121]	2·86	3·17	6·03[255]	3·65	2·73	6·38[99]	...	...	...	5·10	1·86	6·97[327]	3·44	3·04	6·48[175]	2·06	0·50	2·56[538]	
		1906	...	...	...	0·00	0·00	0·00[11]	0·00	1·05	1·05[9]	0·00	2·96	2·96[14]	0·00	3·00	3·00[10]	...	...	...	...	...	...	...	...	..	2·86	0·00	2·86[4]	0·74	0·74	1·48[14]	0·00	0·00	0·00[4]	...	...	...	
		1907	2·92	0·00	2·92[281]	...	...	...	0·88	0·00	0·88[59]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·44	0·00	0·44[68]	...	...	...	
		1904–7	**2·36**	**0·45**	**2·81[381]**	**0·75**	**0·90**	**1·64[67]**	**1·38**	**0·88**	**2·25[239]**	**1·07**	**1·04**	**2·11[627]**	**1·06**	**1·35**	**2·41[415]**	**1·45**	**1·04**	**2·49[221]**	**2·90**	**2·11**	**5·00[404]**	**2·41**	**2·21**	**4·62[253]**	**1·68**	**1·41**	**3·09[220]**	**2·81**	**1·15**	**3·96[697]**	**0·56**	**1·64**	**3·20[525]**	**1·78**	**0·80**	**2·58[535]**	
NORTHERN AREAS.	D	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·53	0·00	0·53[37]	...	...	...	D
		1905	0·33	0 65	0·98[61]	0·09	0·39	0·49[760]	0·05	0·06	0·11[647]	0·00	0·00	0·00[24]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00[69]	
		1906	...	...	...	0·82	0·00	0·82[85]	0·90	0·00	0·90[257]	...	...	...	...	...	...	...	...	...	...	...	...	0·31	0·00	0·31[131]	0·00	0·00	0·00[24]	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	0·00	0·00	0·00[28]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·33**	**0·65**	**0·98[61]**	**0·17**	**0·35**	**0·52[244]**	**0·28**	**0·04**	**0·32[232]**	**0·00**	**0·00**	**0·00[24]**	...	...	...	...	...	...	...	...	...	**0·31**	**0·00**	**0·31[131]**	**0·00**	**0·00**	**0·00[24]**	...	...	...	**0·53**	**0·00**	**0·53[37]**	**0·00**	**0·00**	**0·00[69]**	
	K	1904	...	...	...	...	...	...	...	...	...	...	...	...	5·00	0·00	5·00[4]	0·52	1·56	2·08[38]	...	...	...	0·00	1·43	1·43[7]	2·53	0·92	3·45[43]	1·47	0·63	2·11[35]	1·40	2·79	4·19[21]	...	...	...	K
		1905	0·99	1·61	2·60[211]	1·00	0·84	1·84[239]	1·37	0·00	1·37[29]	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00[4]	0·85	1·55	2·39[71]	0·00	0·00	0·00[4]	...	...	...	...	...	...	
		1906	1·29	0·32	1·61[31]	0·00	0·00	0·00[24]	3·64	0·00	3·64[44]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·46	1·46	2·93[21]	...	...	...	...	...	...	...	...	...	
		1907	2·02	0·00	2·02[55]	1·34	0·04	1·38[232]	0·43	0·00	0·43[235]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·82	0·00	1·82[11]	0·00	0·00	0·00[8]	...	...	...	
		1904–7	**1·21**	**1·18**	**2·39[297]**	**1·11**	**0·42**	**1·54[402]**	**0·97**	**0·00**	**0·97[308]**	...	...	...	**5·00**	**0·00**	**5·00[4]**	**0·52**	**1·56**	**2·08[38]**	...	...	...	**0·00**	**0·91**	**0·91[11]**	**1·48**	**1·33**	**2·81[135]**	**1·45**	**0·55**	**2·00[110]**	**1·02**	**2·03**	**3·05[29]**	...	...	...	
	L	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·40	0·00	1·40[21]	0·00	0·00	0·00[6]	0·95	0·36	1·31[84]	0·36	0·26	0·62[195]	0·79	0·32	1·10[68]	2·35	0·00	2·35[8]	...	...	...	L
		1905	0·48	1·55	2·02[84]	0·91	0·66	1·57[625]	3·23	2·92	6·15[192]	0·99	0·36	1·35[111]	4·67	0·00	4·67[30]	2·86	0·00	2·86[7]	2·41	0·25	2·66[79]	1·67	0·00	1·67[18]	1·48	1·36	2·84[81]	...	...	...	...	...	...	1·92	1·10	3·01[36]	
		1906	1·97	0·00	1·97[132]	3·64	0·00	3·64[247]	...	...	...	...	...	...	2·21	2·56	4·77[199]	0·65	0·00	0·65[108]	1·65	0·00	1·65[97]	0·59	0·00	0·59[101]	3·40	0·58	3·99[208]	1·76	0·00	1·76[136]	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	1·00	0·00	1·00[92]	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00[13]	...	...	...	...	...	...	
		1904–7	**1·39**	**0·60**	**1·99[216]**	**1·68**	**0·47**	**2·15[672]**	**2·70**	**2·22**	**4·93[252]**	**0·99**	**0·36**	**1·35[111]**	**2·53**	**2·22**	**4·75[229]**	**0·88**	**0·00**	**0·88[136]**	**1·92**	**0·11**	**2·03[182]**	**0·84**	**0·15**	**0·98[203]**	**2·12**	**0·58**	**2·76[354]**	**1·36**	**0·09**	**1·46[212]**	**2·35**	**0·00**	**2·35[8]**	**1·92**	**1·10**	**3·01[36]**	

TABLE XII.—SHOWING for each area the Monthly Average Number of TURBOT caught per 10 hours' fishing; large (L.) and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
NORTH-EASTERN AREAS.	A	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·27	6·36	$8·64^{22}$	...	...	...	..	...	...	...	...	...	...	...	...	A
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4·72	0·00	$4·72^{44}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**4·72**	**0·00**	**$4·72^{44}$**	**2·27**	**6·36**	**$8·64^{22}$**	...	...	...	...	...	...	...	...	...	...	...	...	
	B	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·67	1·67	$3·33^{18}$	3·62	0·00	$3·62^{38}$	0·26	0·34	$0·60^{117}$	0·00	0·00	$0·00^{64}$	...	...	...	B
		1905	...	...	...	...	...	...	...	...	...	0·67	0·00	$0·67^{30}$	1·60	0·00	$1·60^{12}$	...	...	...	...	...	...	...	...	...	0·31	0·38	$0·69^{160}$	3·00	0·00	$3·00^{20}$	5·00	0·00	$5·00^{4}$	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·09	0·00	$0·09^{113}$	0·26	0·00	$0·26^{39}$	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	**0·67**	**0·00**	**$0·67^{30}$**	**1·60**	**0·00**	**$1·60^{12}$**	...	...	...	...	...	...	**1·67**	**1·67**	**$3·33^{18}$**	**1·49**	**0·24**	**$1·73^{248}$**	**0·40**	**0·16**	**$0·56^{260}$**	**0·28**	**0·00**	**$0·28^{107}$**	...	...	...	
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
		1905	...	...	...	...	...	...	1·25	0·00	$1·25^{3}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{4}$	...	...	...	0·00	0·00	$0·00^{4}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**1·25**	**0·00**	**$1·25^{3}$**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**0·00**	**0·00**	**$0·00^{4}$**	...	...	...	**0·00**	**0·00**	**$0·00^{4}$**	
	F	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·99	5·69	$11·68^{88}$	7·50	1·25	$8·75^{8}$	2·50	0·00	$2·50^{8}$	2·14	0·00	$2·14^{65}$	...	...	...	1·72	2·19	$3·91^{64}$	1·25	1·33	$2·58^{120}$	F
		1905	...	...	...	...	...	...	0·80	0·00	$0·80^{12}$	...	...	...	...	...	...	...	...	...	9·04	1·15	$10·19^{52}$	8·73	0·00	$8·73^{35}$	2·30	2·12	$4·42^{109}$	5·11	2·77	$7·87^{94}$	5·00	0·00	$5·00^{8}$	1·25	0·00	$1·25^{3}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·53	0·00	$0·53^{38}$	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**0·80**	**0·00**	**$0·80^{12}$**	...	...	...	...	...	...	**5·99**	**5·69**	**$11·68^{88}$**	**8·83**	**1·17**	**$10·00^{60}$**	**4·32**	**0·00**	**$4·32^{61}$**	**2·24**	**1·32**	**$3·56^{174}$**	**5·11**	**2·77**	**$7·87^{94}$**	**2·08**	**1·94**	**$4·02^{72}$**	**1·25**	**1·25**	**$2·50^{128}$**	
	G	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4·41	2·37	$6·78^{29}$	...	...	...	0·31	1·54	$1·85^{32}$	0·56	1·36	$1·92^{88}$	1·36	1·36	$2·71^{44}$	0·00	0·00	$0·00^{4}$	...	...	...	G
		1905	0·28	0·92	$1·20^{108}$	0·00	0·00	$0·00^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{4}$	...	...	...	0·00	1·38	$1·38^{15}$	...	...	...	0·00	2·00	$2·00^{5}$	
		1906	0·49	0·00	$0·49^{21}$	0·13	0·00	$0·13^{78}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·21	0·00	$0·21^{96}$	...	...	...	
		1904–7	**0·31**	**0·78**	**1 08^{129}**	**0·12**	**0·00**	**$0·12^{86}$**	...	...	...	...	...	...	...	...	...	**4·41**	**2·37**	**$6·78^{29}$**	...	...	...	**0·27**	**1·37**	**$1·64^{36}$**	**0·56**	**1·36**	**$1·92^{88}$**	**1·02**	**1·36**	**$2·38^{59}$**	**0·20**	**0·00**	**$0·20^{100}$**	**0·00**	**2·00**	**$2·00^{5}$**	
EASTERN AREAS.	H	1904	...	...	...	...	...	...	...	...	...	...	...	...	3·08	2·31	$5·38^{52}$	...	...	...	...	...	...	1·25	1·25	$2·50^{16}$	3·33	5·33	$8·67^{15}$	0·82	3·13	$3·95^{78}$	1·04	1·17	$2·21^{385}$	0·63	0·68	$1·31^{191}$	H
		1905	0·09	0·14	$0·23^{347}$	...	...	...	0·00	0·00	$0·00^{9}$	0·30	0·15	$0·44^{135}$	3·46	0·65	$4·11^{170}$	...	...	...	2·50	2·50	$5·00^{16}$	...	...	...	0·25	0·00	$0·25^{40}$	0·97	0·74	$1·72^{263}$	0·00	1·72	$1·72^{257}$	0·00	0·71	$0·71^{84}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	1·25	$1·25^{16}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·41	4·96	$7·38^{70}$	...	...	...	
		1904–7	**0·09**	**0·14**	**$0·23^{347}$**	...	...	...	**0·00**	**0·00**	**$0·00^{9}$**	**0·30**	**0·15**	**$0·44^{135}$**	**3·37**	**1·03**	**$4·40^{222}$**	...	...	...	**2·50**	**2·50**	**$5·00^{16}$**	**1·25**	**1·25**	**$2·50^{16}$**	**1·08**	**1·44**	**$2·52^{55}$**	**0·93**	**1·02**	**$1·96^{654}$**	**0·80**	**1·74**	**$2·54^{712}$**	**0·44**	**0·69**	**$1·13^{275}$**	
	M	1904	...	...	...	...	...	...	...	...	...	...	...	...	1·97	17·11	$19·08^{76}$	1·18	13·41	$14·59^{282}$	0·70	12·11	$12·81^{114}$	0·62	5·36	$5·98^{48}$	...	...	...	...	...	...	2·33	1·67	$4·00^{30}$	0·40	1·31	$1·70^{329}$	M
		1905	0·38	0·57	$0·94^{53}$	...	...	...	0·00	0·00	$0·00^{49}$	0·03	1·96	$1·98^{358}$	1·98	3·63	$5·61^{510}$	2·66	5·37	$8·03^{861}$	...	...	...	...	...	...	0·00	5·04	$5·04^{81}$	1·48	2·22	$3·70^{13}$	0·18	2·95	$3·13^{284}$	0·22	1·54	$1·76^{91}$	
		1906	...	...	...	...	...	...	...	...	...	0·00	0·42	$0·42^{287}$	0·61	5·22	$5·83^{423}$	1·49	6·61	$8·10^{451}$	0·00	16·96	$16·96^{286}$	0·00	21·18	$21·18^{76}$	...	...	...	0·00	15·27	$15·27^{38}$	0·62	3·83	$4·44^{81}$	0·94	2·48	$3·42^{202}$	
		1907	...	...	...	...	...	...	...	...	...	0·00	0·96	$0·96^{155}$	0·05	3·92	$3·96^{442}$	0·24	5·76	$6·00^{333}$	0·13	7·17	$7·30^{80}$	...	...	...	...	...	...	...	...	...	0·00	41·43	$41·43^{7}$	0·31	3·06	$3·38^{160}$	
		1904–7	**0·38**	**0·57**	**$0·94^{53}$**	...	...	...	**0·00**	**0·00**	**$0·00^{49}$**	**0·01**	**1·21**	**$1·22^{360}$**	**1·16**	**4·67**	**$5·83^{1731}$**	**1·65**	**7·01**	**$8·66^{1707}$**	**0·19**	**14·19**	**$14·38^{480}$**	**0·24**	**15·02**	**$15·26^{124}$**	**0·00**	**5·04**	**$5·04^{61}$**	**0·49**	**10·98**	**$11·46^{41}$**	**0·42**	**3·70**	**$4·12^{402}$**	**0·50**	**2·00**	**$2·56^{782}$**	
	Q	1904	...	...	...	...	...	...	...	...	...	...	...	...	11·11	13·33	$24·44^{4}$	1·67	27·92	$29·58^{48}$	5·63	35·09	$40·71^{112}$	11·25	33·54	$44·79^{48}$	2·25	18·79	$21·04^{115}$	0·00	17·50	$17·50^{8}$	...	...	...	...	...	...	Q
		1905	...	...	...	...	...	...	0·50	1·21	$1·71^{322}$	1·11	2·42	$3·54^{99}$	0·79	3·43	$4·21^{140}$	5·37	13·17	$18·54^{20}$	0·54	2·04	$2·59^{73}$	0·66	4·38	$5·04^{290}$	0·59	10·59	$11·18^{34}$	...	...	...	1·18	5·88	$7·06^{8}$	0·00	3·33	$3·33^{9}$	
		1906	...	...	...	...	...	...	0·24	1·41	$1·65^{43}$	...	...	...	1·64	6·87	$8·51^{67}$	3·32	9·29	$12·61^{106}$	2·50	5·00	$7·50^{8}$	5·07	8·45	$13·52^{35}$	...	...	...	0·56	11·27	$11·83^{35}$	...	...	...	...	...	...	
		1907	...	...	...	0·00	0·00	$0·00^{15}$	0·08	1·19	$1·27^{118}$	0·35	12·28	$12·63^{37}$	2·01	5·82	$7·83^{184}$	3·21	10·37	$13·58^{40}$	2·98	6·81	$9·79^{47}$	1·87	13·24	$15·11^{113}$	0·50	8·08	$8·58^{120}$	0·00	11·79	$11·79^{28}$	[0·00	10·00	$10·00^{7}$]	...	...	...	
		1904–7	...	...	...	**0·00**	**0·00**	**$0·00^{15}$**	**0·37**	**1·22**	**$1·59^{483}$**	**0·83**	**6·03**	**$6·86^{156}$**	**1·62**	**5·23**	**$6·85^{395}$**	**3·12**	**14·03**	**$17·16^{214}$**	**3·45**	**18·46**	**$21·91^{240}$**	**2·31**	**9·61**	**$11·92^{486}$**	**1·26**	**12·99**	**$14·25^{269}$**	**0·28**	**12·17**	**$12·45^{71}$**	**0·65**	**7·74**	**$8·39^{15}$**	**0·00**	**3·33**	**$3·33^{9}$**	
	W	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·97	13·28	$15·25^{61}$	1·67	25·00	$26·67^{12}$	...	...	...	5·00	25·00	$30·00^{4}$	...	...	...	...	...	...	...	...	...	W
		1905	...	...	...	...	...	...	...	...	...	...	...	...	6·67	5·00	$11·67^{6}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·83	4·17	$5·00^{12}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·00	5·00	$10·00^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	**6·67**	**5·00**	**$11·67^{6}$**	**1·97**	**13·28**	**$15·25^{61}$**	**3·57**	**13·57**	**$17·14^{28}$**	...	...	...	**5·00**	**25·00**	**$30·00^{4}$**	**0·83**	**4·17**	**$5·00^{12}$**	...	...	...	...	...	...	

TABLE XII. (*continued*)—SHOWING for each area the Monthly Average number of TURBOT caught per 10 hours' fishing ; large (L.) and small (S.) being distinguished. The monthly total number of hours' fishing in each area, to the nearest hour, is given as an index number.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
SOUTHERN AREAS.	S	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·97	9·84	$12·81^{216}$	2·78	12·90	$15·68^{345}$	1·52	10·25	$11·77^{454}$	2·70	16·40	$19·10^{100}$	2·91	17·96	$20·87^{103}$	...	...	...	...	...	...	S
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·75	6·06	$7·81^{617}$	1·66	2·32	$3·98^{749}$	8·00	15·78	$23·78^{45}$	5·00	10·00	$15·00^{4}$	0·00	2·35	$2·35^{5}$	1·48	4·44	$5·93^{13}$	
		1906	...	...	...	0·00	0·00	$0·00^{5}$	1·20	1·09	$2·29^{92}$	0·00	0·00	$0·00^{22}$	0·00	6·67	$6·67^{7}$	2·55	2·36	$4·91^{55}$	4·70	1·69	$6·39^{83}$	0·85	3·03	$3·89^{106}$	1·36	3·27	$4·64^{229}$	1·06	2·30	$3·36^{56}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	2·58	2·19	$4·78^{461}$	3·24	4·25	$7·49^{345}$	1·85	3·39	$5·24^{271}$	...	...	...	...	...	...	...	...	...	3·75	3·75	$7·50^{16}$	...	...	...	
		1904–7	**...**	**...**	**...**	**[0·00**	**0·00**	**$0·00^{5}$]**	**1·20**	**1·09**	**$2·29^{92}$**	**0·00**	**0·00**	**$0·00^{22}$**	**2·54**	**2·26**	**$4·81^{463}$**	**3·09**	**6·03**	**$9·12^{619}$**	**2·23**	**7·03**	**$9·25^{1316}$**	**1·54**	**5·13**	**$6·68^{1209}$**	**2·55**	**8·41**	**$10·96^{365}$**	**2·32**	**12·35**	**$14·68^{163}$**	**2·45**	**3·27**	**$5·71^{24}$**	**1·48**	**4·44**	**$5·93^{13}$**	
	T	1904	...	...	...	...	...	...	...	...	...	...	...	...	4·62	10·77	$15·38^{13}$	1·67	15·83	$17·50^{24}$	11·00	17·00	$28·00^{10}$	11·25	17·50	$28·75^{8}$	5·00	23·75	$28·75^{8}$	...	...	...	0·89	6·22	$7·11^{72}$	...	...	...	T
		1905	...	...	...	...	...	...	...	...	...	...	...	...	2·88	7·57	$10·45^{55}$	...	...	...	1·44	6·60	$8·04^{48}$	7·34	14·56	$21·90^{79}$	0·40	6·10	$6·50^{100}$	0·68	6·48	$7·15^{177}$	1·49	8·41	$9·90^{343}$	1·59	7·29	$8·88^{340}$	
		1906	...	...	...	0·31	4·36	$4·68^{96}$	0·58	0·96	$1·54^{52}$	0·53	1·60	$2·13^{112}$	3·02	6·98	$10·00^{53}$	2·58	6·20	$8·79^{97}$	2·82	4·53	$7·35^{181}$	2·32	2·65	$4·97^{90}$	1·45	3·61	$5·06^{83}$	2·40	6·04	$8·44^{225}$	1·45	0·73	$2·18^{27}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	0·26	4·16	$4·42^{39}$	2·80	5·60	$8·40^{25}$	4·76	8·81	$13·57^{143}$	1·54	4·95	$6·48^{91}$	...	...	...	2·00	5·50	$7·50^{39}$	1·80	3·47	$5·27^{84}$	2·83	6·42	$9·25^{212}$	0·83	1·67	$2·50^{12}$	
		1904–7	**...**	**...**	**...**	**0·31**	**4·36**	**$4·68^{96}$**	**0·58**	**0·96**	**$1·54^{52}$**	**0·46**	**2·25**	**$2·72^{131}$**	**3·07**	**7·30**	**$10·38^{146}$**	**3·68**	**8·49**	**$12·17^{264}$**	**2·51**	**5·33**	**$7·84^{330}$**	**4·96**	**8·62**	**$13·58^{177}$**	**1·14**	**5·73**	**$6·87^{211}$**	**1·67**	**5·76**	**$7·43^{466}$**	**1·94**	**7·28**	**$9·21^{604}$**	**1·56**	**7·10**	**$8·66^{352}$**	
	V	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·90	1·44	$3·35^{131}$	1·27	3·12	$4·39^{56}$	3·52	0·88	$4·40^{45}$	...	...	...	1·48	1·48	$2·96^{13}$	...	...	...	V
		1905	...	...	...	...	...	...	0·80	1·20	$2·00^{25}$	...	...	...	...	...	...	...	...	...	2·31	3·70	$6·02^{108}$	2·43	0·35	$2·78^{39}$	...	...	...	0·71	5·71	$6·43^{38}$	...	...	...	...	...	...	
		1906	0·85	3·23	$4·09^{59}$	2·22	4·44	$6·67^{4}$	0·25	1·76	$2·01^{39}$	0·53	0·79	$1·32^{38}$	...	...	...	1·67	0·83	$2·50^{12}$	0·38	0·76	$1·14^{53}$	1·03	0·82	$1·86^{49}$	2·15	1·94	$4·09^{47}$	1·21	0·00	$1·21^{16}$	0·87	0·00	$0·87^{12}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·00	2·22	$2·22^{4}$	1·25	0·00	$1·25^{5}$	0·36	0·00	$0·36^{55}$	...	...	...	...	...	...	2·77	0·43	$3·19^{94}$	2·50	1·79	$4·29^{38}$	1·03	0·21	$1·24^{48}$	
		1904–7	**0·85**	**3·23**	**$4·09^{59}$**	**[2·22**	**4·44**	**$6·67^{4}$]**	**0·38**	**1·62**	**$2·00^{105}$**	**0·53**	**0·79**	**$1·32^{38}$**	**0·00**	**2·22**	**$2·22^{4}$**	**1·50**	**0·50**	**$2·00^{20}$**	**1·55**	**1·81**	**$3·37^{347}$**	**1·40**	**1·95**	**$3·36^{164}$**	**2·83**	**1·41**	**$4·24^{92}$**	**2·17**	**1·44**	**$3·61^{138}$**	**1·89**	**1·32**	**$3·21^{53}$**	**1·03**	**0·21**	**$1·24^{48}$**	
WESTERN AREAS.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	E
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	0·00	0·00	$0·00^{8}$	...	...	...	0·00	0·00	$0·00^{7}$	...	...	...	...	...	...	0·00	0·00	$0·00^{18}$	0·87	0·00	$0·87^{11}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·00**	**0·00**	**$0·00^{8}$**	...	...	...	**0·00**	**0·00**	**$0·00^{7}$**	...	...	...	...	...	...	**0·00**	**0·00**	**$0·00^{18}$**	**0·87**	**0·00**	**$0·87^{11}$**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	R	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	3·33	$3·33^{9}$	0·00	2·22	$2·22^{4}$	R
		1905	...	...	...	...	...	...	0·00	0·71	$0·71^{14}$	...	...	...	0·66	1·19	$1·85^{76}$	...	...	...	...	...	...	...	...	...	0·56	0·56	$1·11^{18}$	...	...	...	0·48	1·43	$1·91^{168}$	0·61	0·94	$1·56^{212}$	
		1906	0·43	0·58	$1·01^{139}$	0·42	0·80	$1·23^{236}$	0·18	0·61	$0·79^{280}$	0·15	0·86	$1·02^{206}$	0·68	1·53	$2·21^{176}$	0·29	1·39	$1·68^{338}$	0·49	0·90	$1·39^{222}$	0·18	0·97	$1·15^{113}$	0·00	1·33	$1·33^{7}$	0·69	3·45	$4·14^{14}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	0·00	3·08	$3·08^{6}$	0·43	0·43	$0·85^{73}$	0·31	0·00	$0·31^{32}$	0·00	0·00	$0·00^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·43**	**0·58**	**$1·01^{139}$**	**0·42**	**0·80**	**$1·23^{236}$**	**0·17**	**0·61**	**$0·78^{294}$**	**0·15**	**0·92**	**$1·06^{272}$**	**0·65**	**1·34**	**$2·00^{275}$**	**0·30**	**1·22**	**$1·52^{270}$**	**0·49**	**0·88**	**$1·37^{226}$**	**0·18**	**0·97**	**$1·15^{113}$**	**0·39**	**0·78**	**$1·18^{23}$**	**0·69**	**3·45**	**$4·14^{14}$**	**0·45**	**1·53**	**$1·98^{177}$**	**0·60**	**0·97**	**$1·57^{216}$**	
	X	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·83	1·01	$1·84^{109}$	1·82	0·66	$2·48^{60}$	0·33	0·33	$0·66^{39}$	...	...	...	0·30	1·49	$1·79^{83}$	1·71	2·86	$4·57^{17}$	X
		1905	0·00	0·00	$0·00^{4}$	0·00	0·00	$0·00^{3}$	0·19	0·93	$1·12^{33}$	3·33	0·00	$3·33^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	0·32	0·32	$0·65^{31}$	0·47	1·58	$2·05^{107}$	0·00	1·36	$1·36^{15}$	1·36	0·91	$2·27^{44}$	
		1906	...	...	...	0·00	1·11	$1·11^{9}$	0·67	0·50	$1·18^{69}$	1·17	1·29	$2·46^{77}$	0·38	1·14	$1·52^{52}$	1·67	0·32	$1·99^{156}$	0·62	0·71	$1·34^{112}$	0·32	0·75	$1·08^{93}$	0·94	0·63	$1·56^{64}$	0·00	0·00	$0·00^{20}$	1·88	0·00	$1·88^{16}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·58	0·19	$0·77^{42}$	2·50	0·00	$2·50^{8}$	0·62	0·52	$1·15^{96}$	...	...	...	...	...	...	0·22	0·49	$0·71^{183}$	0·00	0·71	$0·71^{28}$	0·82	0·00	$0·82^{25}$	
		1904–7	**[0·00**	**0·00**	**$0·00^{4}$]**	**0·00**	**0·83**	**$0·83^{12}$**	**0·44**	**0·71**	**$1·15^{113}$**	**1·46**	**1·12**	**$2·58^{89}$**	**0·48**	**0·67**	**$1·15^{104}$**	**1·71**	**0·31**	**$2·02^{164}$**	**0·69**	**0·76**	**$1·45^{317}$**	**0·91**	**0·72**	**$1·63^{153}$**	**0·64**	**0·48**	**$1·12^{125}$**	**0·29**	**0·84**	**$1·13^{310}$**	**0·43**	**0·98**	**$1·41^{92}$**	**1·28**	**1·05**	**$2·33^{56}$**	
	P	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	1·26	0·23	$1·50^{213}$	...	...	...	0·00	0·00	$0·00^{8}$	...	..	...	...	...	...	...	...	...	P
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	1·25	$1·25^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	4·44	0·00	$4·44^{1}$	0·00	0·00	$0·00^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	1·25	0·83	$2·08^{24}$	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**4·44**	**0·00**	**$4·44^{1}$**	**0·00**	**0·00**	**$0·00^{4}$**	...	...	...	...	...	...	**1·18**	**0·31**	**$1·48^{229}$**	...	...	...	**0·94**	**0·63**	**$1·56^{32}$**	...	...	..	...	...	...	...	...	...	

Area F.—This includes the "Tarbot" or "Turbot" Bank and gives a fairly good yield. The March average is low (·8 per 10 hours), but June and July are high. There is a distinct downward trend in the curve (Fig. 35) till September. In October there is a recovery, showing a probable second maximum period. The November and December averages are lower than those of the summer. Large fish predominate.

Area G.—The maximum average obtained is 6·78 in June, 1904. The autumn catches are lower, but there is a slight increase between August and October. The winter averages are low, being only 0·12 in February.

Of these north-eastern areas F (or A) gives the best yield, though the quantities taken are never very large (numbering at the most four or five fish per haul). The greater proportion of the fish are large.

The seasonal fluctuations cannot be very well determined, but from areas F and G we have indications that the summer catches are higher than the winter ones.

Eastern Areas.

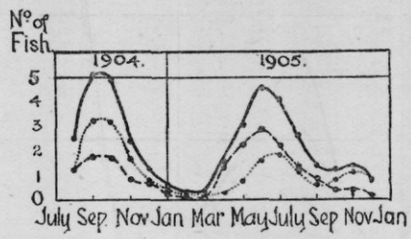

FIG. 36.—TURBOT. Area H. Monthly averages, (smoothed curves). Continuous line represents all sizes; dashed line, large fish; dotted line, small.

Area H.—This area, the most northern of this set, seems to have a very poor yield of turbot compared with the others. The maximum average is about five (per 10 hours). Hardly any fish are caught at the beginning of the year and up to April; in May there is a sudden increase. The summer catches are comparatively large, and then there is a gradual decrease till the winter minimum. (*See* Fig. 36.)

In 1904 we notice the decline in the course of the months October to December by the increasing number of hauls when no turbot were present. They were caught less and less frequently, and after the 8th of December none were taken. In 1905 they were practically absent in the months of January to April. Several were present in each haul in May, and a good many of them were spawning. In October, 1905, very few were caught, and this month was not anything if at all better than November. In one man's records we find none caught up to the 8th of the month, after which they occurred more frequently.

Large and small fish are found in nearly equal numbers, though in May, when the greatest number of fish are taken, large fish predominate; this is at their spawning time.

The 1905 averages are generally lower than those of the corresponding months in 1904.

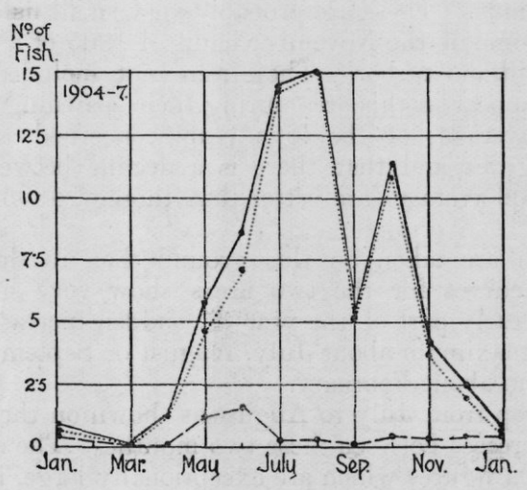

FIG. 37.—TURBOT. Area M. Monthly averages, (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area M.—This is a small fish ground, and it yields a fairly large number of fish, but it does not hold its pre-eminent position amongst the areas, in regard to quantity, that was found for it for plaice and soles.

The maximum averages are from 15 to 20 per 10 hours. The main features of the curves (Fig. 37 and Fig. 38) are the winter and spring minimum and the summer and autumn maximum, showing a considerable migration into this area in the middle of the

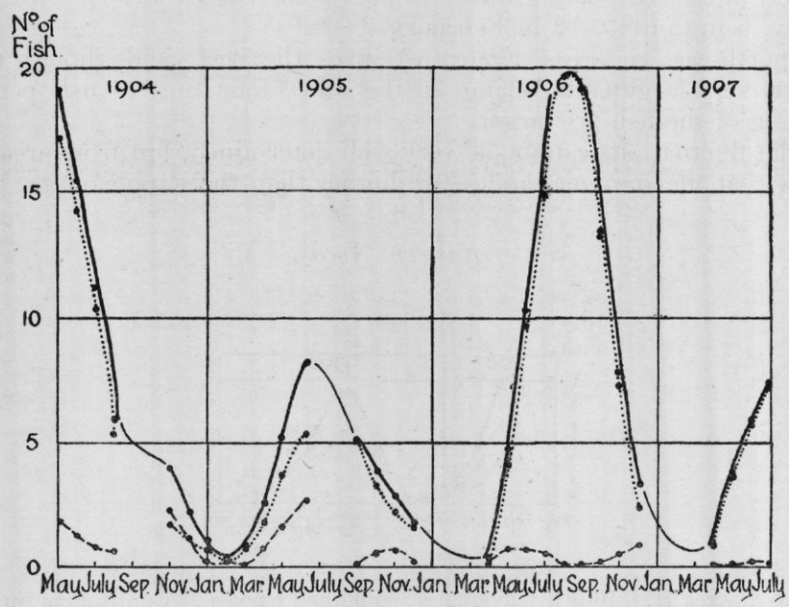

FIG. 38.—TURBOT. Area M. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

year. This maximum occurred in different months in each year. In 1904 it was in May, in 1905, not before June, in 1906 in July or August, and in 1907 not before July. In 1904 there is a distinct decrease during May and June, which is evident throughout the two months. The large fish were caught very much less frequently after the middle of June, and small fish too were noticed to be decreasing.

In 1905 it is noticed that there were very few fish up to April, when from one to four small fish were taken. There were no large fish caught regularly till about the 25th of May. Large turbot were recorded as spawning from the 26th May, and these increased in numbers during June.

In April, 1906, there were very few fish, those present being mostly small. A few more appeared in May and a lot in June, but the large fish were disappearing rapidly towards the end of that month and none were taken in July. The course of the variations is precisely the same in 1907, but the large fish were still more scarce. A skipper remarked in May, 1907, that the turbot are very small—about the size of an ordinary dinner-plate. In November, 1907, there was an exceptionally large number of small turbot, 9 and 20 taken in two successive hauls. These are probably very small fish, for we have a note by one of the fishermen on some of the November hauls of 1905 of a similar occurrence of a large number of tiny brill and turbot. These were not included in the 1905 average. Large fish seem only to appear in this area during their spawning period.

In comparing the averages of the four years concerned, we find that 1904 has generally the highest figures, and that there is a decline between this year and 1907. However, some of the 1906 averages are better than those of 1905.

Area Q.—More fish are taken on this ground than in the shallow waters to the immediate north. The curves for the two areas show very similar fluctuations, *i.e.*, minimum catches in the early part of the year—a sudden increase with the oncoming of the spawning season—a maximum about July, August or September, and then decreasing quantities to the minimum about February.

There is no real drop from July to August as shown on the curve (Fig. 39), for in each year the average increases between these two months. The appearance is due to the preponderance of the 1904 figures which are exceptionally large, in the July average, and of the 1905 figures in August, these being low. Large fish are proportionally and actually

more numerous than in M. They average as high as 3·45 in July, more than double the highest average in M. They are, on the average, 13 per cent. of the total while in M they were only 7 per cent.

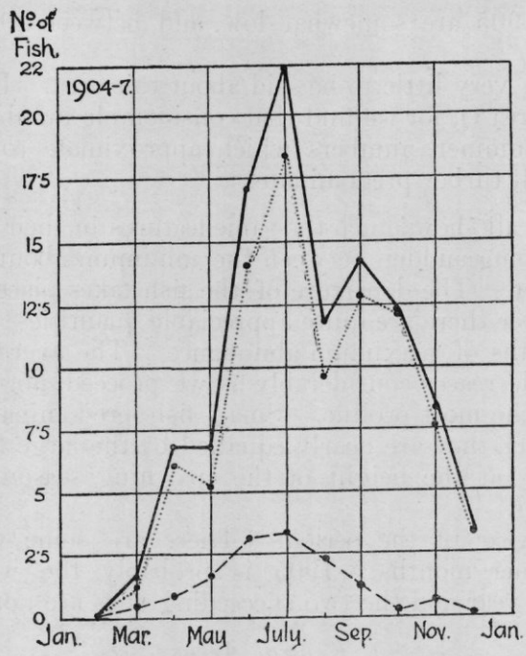

FIG. 39.—TURBOT. Area Q. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

We notice in each year a comparative scarcity of turbot in March, and that soon after the beginning of April they make their appearance much more frequently.

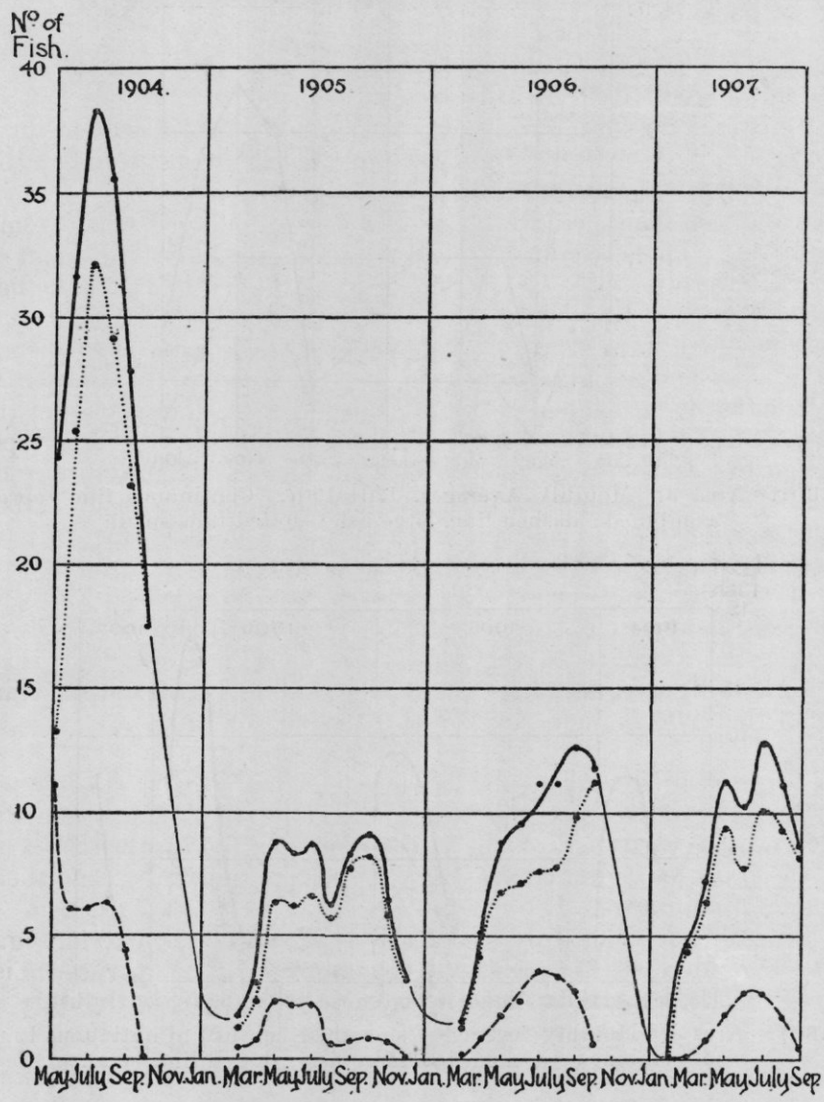

FIG. 40.—TURBOT. Area Q. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

1904 seems to have been an exceptionally good year for turbot in this region. (See Fig. 40.) Its averages are very much higher than those of the other years, and in August it reaches the very high maximum of 44·79 per 10 hours. This maximum comes in July on the smoothed curve.

The averages in 1905 are somewhat low, and between 1906 and 1907 there is but little difference.

Area W.—There is very little to be said about this area. It probably has much the same characteristics as area Q, for we find that considerable numbers were taken in the few hauls made here in the summer, numbers which approximate roughly to those in area Q at the same time. Small turbot predominate.

These eastern areas all show much the same features in their seasonal fluctuations, the appearance of the fish being sudden between the minimum about February or March and the maximum in summer. The departure of the fish takes place more slowly, and up to November and December there are quite appreciable quantities although they are much smaller than in the months of maximum abundance. The average yield is very good for the whole region, but decreases considerably as we proceed northwards, the grounds off the Dutch coasts being the most prolific. Small fish predominate greatly in the catches, except in area H, in which they are nearly equalled by the large fish. Large fish are most abundant in these areas at the height of the spawning season, and quickly take their departure when it is over.

1904 is the best year of the period. There are some very large catches then, especially in the summer months; 1905 is probably the worst year, although the differences between this year and the two succeeding ones are not very great.

Central Areas.

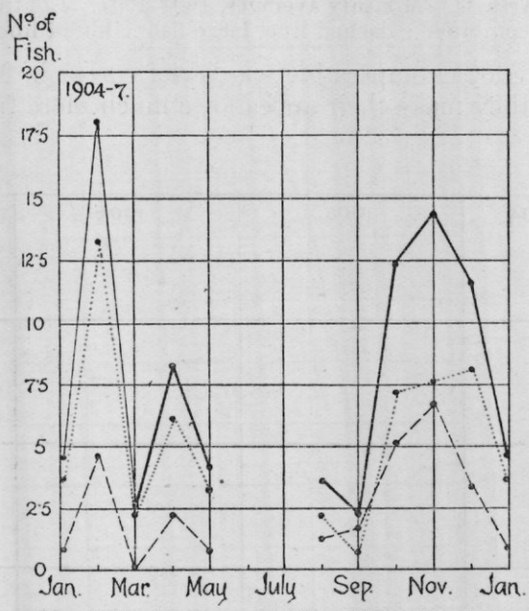

FIG. 41.—TURBOT. Area J. Monthly Averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

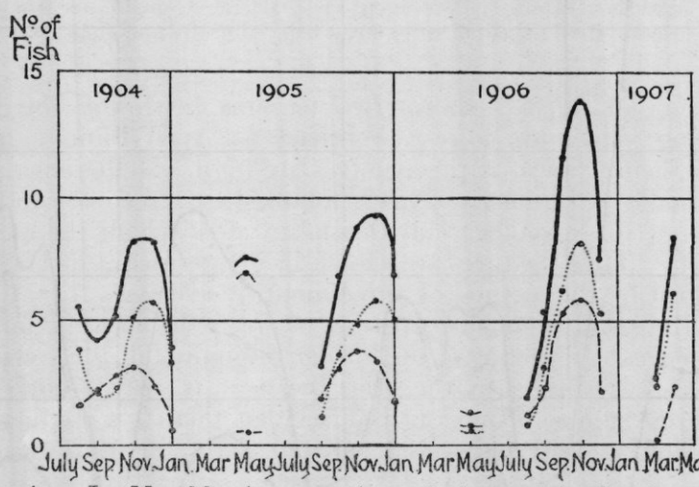

FIG. 42.—TURBOT. Area J. Monthly Averages (smoothed curves.) Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area J.—This curve (Fig. 41), though of a rather indefinite and incomplete nature, indicates that the late summer catches are small, while those in the last three months of the year are very high. The highest general average obtained is 14·37 in November: the maximum catch occurs in December, 1904. The fluctuations are not very well determined for the first half of the year (Fig. 42), but as the March average is very low, there is probably a minimum about this time, followed by a secondary maximum between then and the September minimum. The fish probably migrate into this area to form the autumn and winter maximum after they leave the shallow waters at the approach of the cold season.

Large fish are comparatively abundant, averaging numerically about one-half the small fish. In the months where comparisons can be made, we find a decline in the averages between 1904 and 1906. October and November are exceptions to this. They had very large catches in 1906, a fact which is probably due to local differences in the various parts of this area.

Area N.—This area, including the grounds outside the 20-fathom line off the Dutch and German coasts, give by far the best yield of turbot of any of the areas considered. The lowest averages obtained are about three (per ten hours), but the general average is never below 6·75, while the highest average is 40·29 in July, 1904, and the highest general average is 25·85. Therefore on this ground comparatively good numbers of turbot are to be found at all times of the year, and in nearly all months the general average is higher than that for any other area.

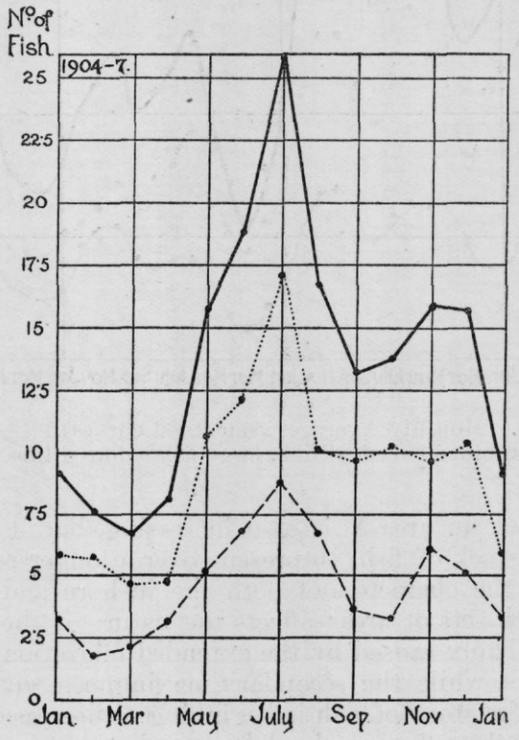

FIG. 43.—TURBOT. Area N. Monthly Averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

The general curve (Fig. 43) shows two maxima, with the corresponding double minima. The spring values are lowest, February to April being months of minimum abundance. From thence onwards the averages are high, but there is a slight depression beginning in the middle of summer. This is followed by a recovery in the numbers and a secondary maximum in November and December, after which the numbers fall off till the spring minimum. These features are shown in greater detail in Fig. 44, showing the fluctuations, smoothed by the method of three-monthly averages, for each year.

In this figure the small summer depression between the two maxima is quite evident as a periodic occurrence. In each case the *spring* minimum is the lowest. In 1904 the summer maximum is very high; in the other years it is only slightly higher than the autumn one. The curve also brings out the fact that there is a distinct downward trend throughout the period, at least between 1904 and 1906, for 1907 does not differ much from 1906.

The fluctuations in this area are such as one would expect to get when there is a stock of fish migrating across it to and from the inshore areas. We found that the stock on the inshore areas was increasing from the spring onwards to the height of summer.

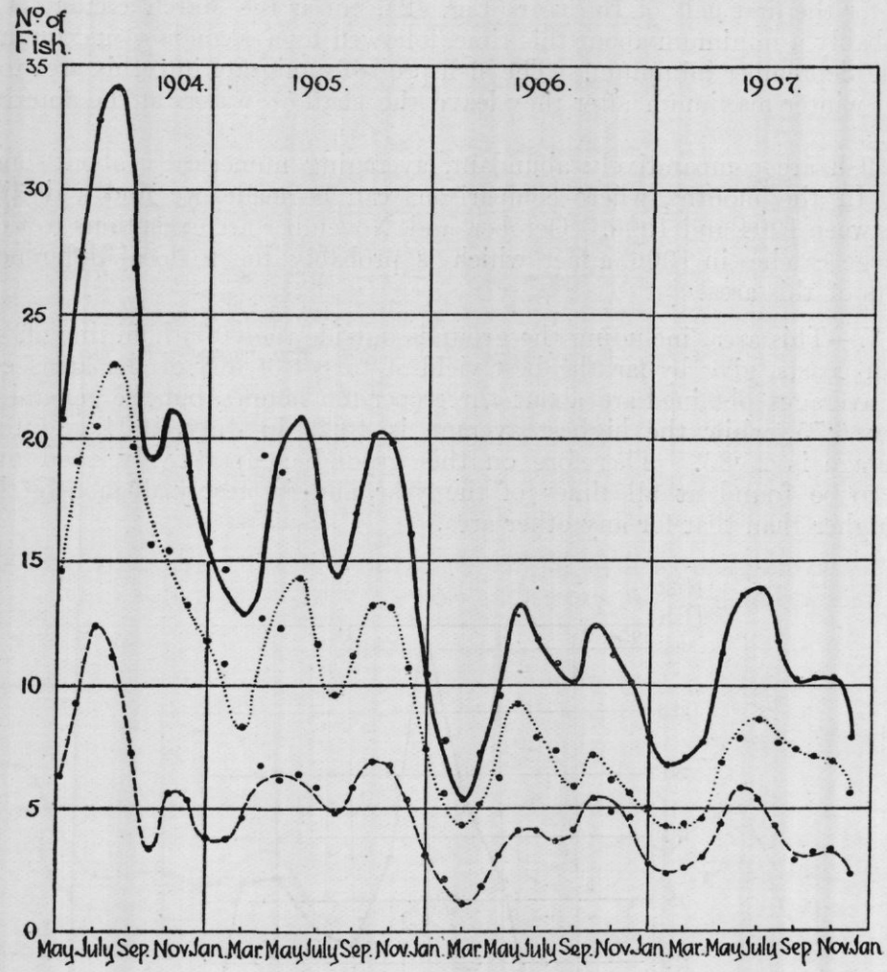

FIG. 44.—TURBOT. Area N. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

At the same time, the stock in area N is also increasing, but it has a somewhat earlier maximum. The large stock of fish is present over a longer period, as this area, being intermediate, partakes of the characters of both the inshore and offshore areas, and the time of abundance of both sets of areas affects the nature of the stock in this one. The summer depression is probably caused by the extended migration of some of the fish into still further inshore waters, while the secondary maximum in autumn and winter, which occurs at the time when the stock of fish is beginning to decrease on the inshore areas, is evidence of the return of the fish towards the somewhat deeper water at the approach of the cold weather.

They are present in considerable numbers even in the middle of winter, and the fact that the numbers are falling off slightly during these months may be explained by some of the turbot passing out of this area into still further offshore areas.

As in the adjacent offshore area J, we find that the large fish are in the minority and form about one-third of the total number. It should, however, be mentioned that several of the fish recorded as " small " are in reality of a medium size, a fact noted by one of the recording skippers.

There were exceptionally large numbers taken in March, 1905. These were all caught on the Oyster ground.

Area I.—The curve of combined averages for this area is not very definite or complete, but if we compare the most reliable averages we may surmise that the seasonal fluctuations are somewhat as follows : The summer averages are fairly high, ranging from six to nine per 10 hours. There is a drop in late summer and early autumn, and a considerable influx in the winter, forming a maximum in November to January, which in the best years reaches the value 14 or 15 per 10 hours, *i.e.* about double the summer

values. There is no fishing in the spring, but there appears to be a downward trend in the curve, and by analogy with the similar area N, we may suppose that there is a minimum at this time.

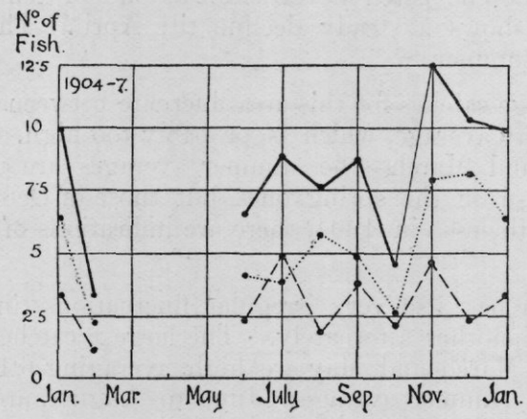

FIG. 45.—TURBOT. Area I. Monthly averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Large fish are still numerically less than the small, but they form a larger proportion (about 37 per cent.) than in the more inshore ground N.

The 1905 averages are a little higher than those of 1904 generally, and there is no evidence of much change in the succeeding years.

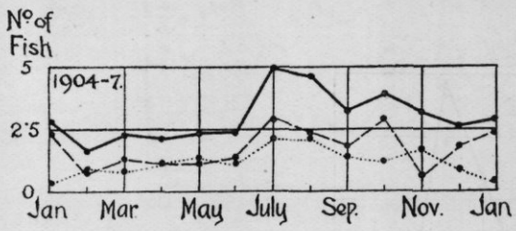

FIG. 46.—TURBOT. Area O. Monthly averages, 1904–1907.

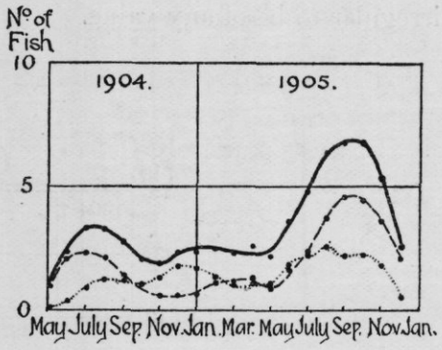

FIG. 47.—TURBOT. Area O. Monthly averages (smoothed curves).

Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area O.—The quantities of turbot taken on this area are very small, and in these the large fish predominate and form 59 per cent. of the total. The general averages (Fig. 46) fluctuate but little. From January to June they are between two and three per 10 hours, in the latter half of the year a little more, but they never exceed five. However, in 1905, the averages from July to November are all between six and seven. 1905 is therefore the best year (*see* Fig. 47), and the 1907 averages that are present indicate very small catches in that year. The seasonal variations, as determined by the smooth curve in Fig. 47, are not very great, but in 1904 we find a slight summer maximum, and in 1905 the catches from July to November are about double those of the previous winter and spring.

These central grounds, with the exception of the Dogger Bank, are some of the best turbot grounds in this region, N especially having a very good supply. Small fish predominate and form about two-thirds of the total number caught, but the proportion decreases relatively to the distance from shore.

Some of the grounds show the features common to intermediate areas, through which the fish migrate periodically, namely a double period of maximum. The first occurs in early summer while the fish are approaching the inshore grounds, and the second maximum in autumn and winter, when they leave those grounds and make their way off-shore and become more scattered and spread out in the deeper parts of the North Sea.

The annual trend is not the same for all four areas. In J and N there is a distinct tendency to decline between 1904 and 1906. In areas I and O the best catches were generally in 1905.

Northern Areas.

Area D.—This area, of all those under our consideration, presents much the smallest yield of turbot. The catch never exceeds one in ten hours' fishing. It is greatest in January and shows a steady decline till April. The winter averages are higher than those of the summer.

Area K.—The average catches for this area fluctuate between one and three (per 10 hours), if we omit the May average, which is probably too high. We find a downward trend between January and March—the summer averages are uncertain—the autumn ones show a slight increase on the spring ones, but those of October and November are rather uncertain. Nevertheless, in 1904, there are indications of increased quantities at this time.

Area L.—This area has also very irregular fluctuations, increased and decreased averages succeeding one another alternately. The largest catches are made in the early part of the year. Both March and May are high, averaging 6·15 in March, 1905, and 4·77 in May, 1906. The summer averages, June to August, are, on the whole, much lower. Large fish are the most numerous.

The quantities of turbot caught in these three areas are very small, especially in D, where the averages never exceed one per 10 hours. In the other two areas the catch fluctuates between one and three, and is seldom more.

The fluctuations are not very regular, and the seasonal variation for this reason are not well marked, but on the whole the summer numbers seem to be the smallest. The curves of monthly variation for these areas are not given, as they are too incomplete and irregular to be of any value.

Southern Areas.

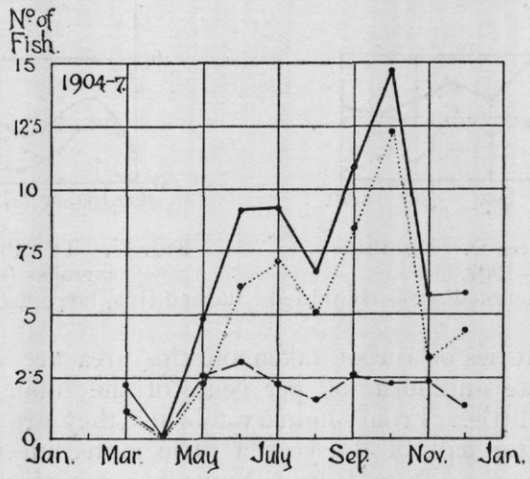

FIG. 48. TURBOT. Area S. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area S.—The numbers of turbot caught are fairly good, for in seven months of the year the general average exceeds five per 10 hours and the catches in September and October sometimes average over 20. There are some local differences in this area, turbot being most abundant in the northern part, just south of the 20-fathom line, dividing it from area T : the largest catches, those of October 1905 (23·78) were taken on the Botney ground. In the southern part of the area they were somewhat less frequent. Except in May, small fish generally outnumber the large by a considerable number.

We can study the seasonal fluctuations only between May and October, the averages for the other months being too uncertain. Large fish are fairly steady, varying during this time between 1·5 and three, the greatest change being the downward trend between June and August. The small fish have much greater fluctuations. In 1904 they have a maximum in July, decrease slightly in August, and become most numerous in October. There is a similar trend in 1905, but the 1906 figures, while showing the decrease in August after the July maximum, show a very small recovery in the early autumn.

Taking all sizes together, we find a rise to June and July, a small decrease during the summer, and a second maximum at the beginning of autumn.

The 1904 averages are the highest by a considerable amount, and we find a decline throughout the period wherever we can make reliable comparisons.

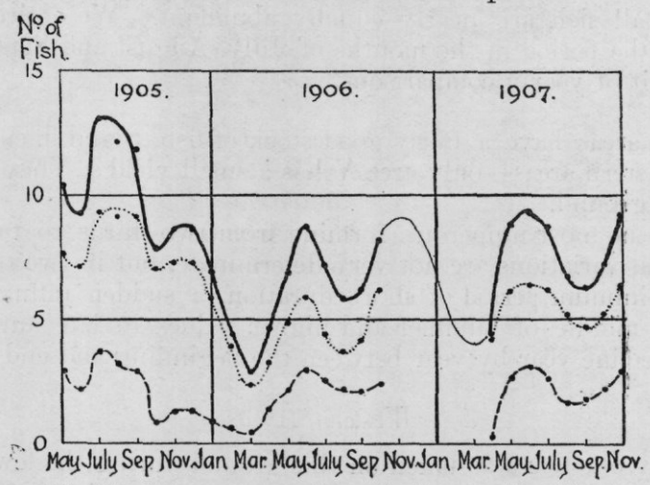

FIG. 49.—TURBOT. Area T. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area T.—The yield of turbot from this area is very similar to that from area S adjacent to it. The maximum general average is 13·58 and the minimum is 1·54, while in eight months of the year the average is over seven per 10 hours.

Spring fishing only took place in 1906, and a little in 1907. The trend is downwards from the beginning of the year till March, then rapidly upwards till June, after which a fairly high level is maintained for the rest of the year. In 1906 and 1907 there is a decline after the maximum in May–June till about August or September. This decline is also shown in 1905 with the exception of the high average of 21·9 in August. The catches increase again till about November, when there is another maximum. (*See* Fig. 49.)

The chief features are : a long period of greatest abundance extending over several months, with a small depression in the middle of this time (about August), and a decided minimum about March which lasts only for a short time.

These fluctuations are very similar to those of area N, and characterise, as in that case, an area across which there is a double annual migration, to and from the inshore grounds. The quantities here are much smaller than in area N.

All the 1904 monthly averages are based on very few hauls, and so are useless for determining the seasonal fluctuations. However, they indicate the presence of very large numbers from May to September in that year, a condition which has been shown to exist in the adjacent areas. The 1906 and 1907 averages are also distinctly smaller than those of 1905.

Small fish predominate, forming, on the whole, nearly three-quarters of the total. Large fish appear to be proportionately less numerous in the latter part of the year than in the first seven or eight months.

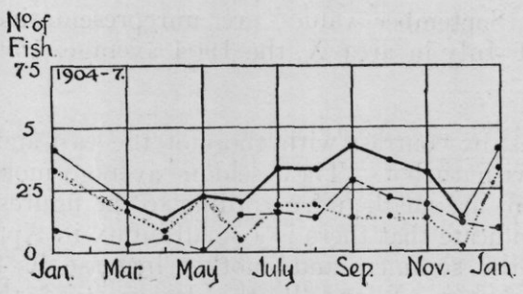

FIG. 50.—TURBOT. Area V. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area V.—The average catches here are small, on the whole being very similar to those on the Dogger Bank. Omitting the February value (only four hours) we find that they vary between 1·32 and 4·24 in the combined average. In 1905 two months have an average of over six per 10 hours, but the majority of the averages are generally less than three.

With this low stock of fish we get very small seasonal fluctuations. The winter values are uncertain, the March to June values are lowest, and the summer and autumn values are highest. September and October are comparatively high compared with other

months of the same years, but it must be admitted that the seasonal fluctuations are not shown with any reliablity by these incomplete figures.

Large and small fish are nearly equally abundant. We notice a continued yearly decline throughout the period in the months of July, August and September. The other months do not admit of yearly comparisons.

The southern areas have a fairly good stock of fish, S and T comparing favourably with some of the eastern areas—only area V has a small yield. They are most abundant around the Botney ground.

Small fish are the most numerous, forming from two-thirds to three-quarters of the catch. The seasonal variations are not very determinate, but in two of the areas we seem to have a spring minimum period of short duration, a sudden influx in early summer, a slight drop in the middle of summer and higher values in late autumn. The average catches generally decline year by year between the beginning and end of this period.

Western Areas.

Area E.—Only one fish was taken on this ground during the few hauls made on it.

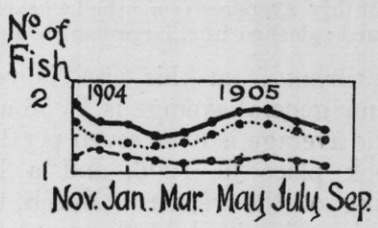

FIG. 51.—TURBOT. Area R. Monthly averages (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area R.—There is a very small stock of turbot here. Most of the averages are under 1·5 per 10 hours. The highest average (omitting the unreliable ones) is 2·21 in May, 1906. The course of the figures in this year, which has the most complete records, is shown in Fig. 51, and is as follows: There is a decline from the comparatively high values of November and December, 1905, to the early spring minimum about March. A maximum occurs in May, and afterwards the quantities very slowly fall off. Small fish always outnumber the large.

Area X.—This is very similar to area R in its average yield, its mean average, however, coming out somewhat higher owing to the inclusion of more fishing in 1904 and 1905, years of comparative plenty.

The maximum appears to come a month earlier (in April). The fluctuations afterwards are small, but they are probably similar to those in R, viz., a slight fall in the summer followed by a recovery in the numbers by November and December. The January and February values are most probably erroneous and much too low. Large and small fish are more nearly equal than in R.

Area P.—The amount of fishing does not result in much satisfactory information. The March, April and September values are unrepresentative, but the July values approximate to those of July in area X, the 1904 average, 1·50, being a little less than that of July 1904 in X.

These western areas, by contrast with those of the east and south of this region are most poorly supplied with turbot. They seldom average more than 1·5 per 10 hours fishing. The fluctuations are small, and, according to the figures, rather irregular, but the most reliable averages indicate that there is a small influx in April and May, a slight and gradual falling off in the summer, and another increase in the autumn. Small fish generally predominate, but in X and P, the deeper areas, they are often equalled or exceeded in numbers by the large fish.

Spawning.

The distribution and frequency of the spawning turbot are shown in Table XIII. It has been prepared by taking the number of hauls in each area in which spawning turbot were recorded, as the numerator of a fraction whose denominator is the number of hauls in the area in which any turbot appeared. Thus we have omitted numerous hauls when no turbot were caught, and also the records of fishermen who did not seem to be recording the spawning fish, for there is reason to believe that the recording of the

spawning fish, especially of the less numerous species, was carried out somewhat spasmodically. At any rate in 1907 we have very little of it, only one man noting the appearance of the spawning turbot.

TABLE XIII.—Showing the number of hauls in each month in which spawning TURBOT are recorded.

The denominators of the fractions are the monthly total number of hauls by the fishermen who have recorded the cases of spawning turbot, those hauls in which no turbot were taken being excluded.

	D.	F.	G.	H.	J.	I.	K.	L.	M.	N.	O.	Q.	R.	S.	T.	X.	All Areas.
1904.																	
May	—	—	—	$\frac{5}{12}$	—	—	—	—	$\frac{8}{19}$	$\frac{4}{6}$	—	$\frac{1}{1}$	—	—	$\frac{3}{3}$	—	21
June	—	$\frac{6}{15}$	$\frac{2}{5}$	—	—	—	—	—	$\frac{9}{65}$	—	$\frac{3}{20}$	—	—	—	—	—	20
July	—	—	—	—	—	—	—	—	—	—	—	$\frac{2}{19}$	—	$\frac{2}{84}$	—	—	4
December ...	—	—	—	$\frac{2}{5}$	—	$\frac{22}{51}$	—	—	—	—	—	—	—	—	—	—	24
1905.																	
January ...	—	—	—	$\frac{2}{4}$	$\frac{1}{4}$	—	$\frac{7}{7}$	—	—	$\frac{2}{5}$	—	—	—	—	—	—	12
February ...	$\frac{1}{1}$	—	—	—	—	—	$\frac{6}{13}$	$\frac{4}{11}$	—	—	—	—	—	—	—	—	11
March	$\frac{2}{6}$	—	—	—	—	—	—	$\frac{3}{3}$	—	—	$\frac{5}{23}$	—	—	—	—	—	10
April	—	—	—	—	—	—	—	$\frac{7}{10}$	—	—	$\frac{15}{31}$	—	—	—	—	$\frac{1}{1}$	23
May	—	—	—	$\frac{18}{33}$	—	—	—	$\frac{7}{8}$	$\frac{58}{154}$	—	$\frac{11}{73}$	—	—	—	—	—	94
June	—	—	—	—	—	†	—	—	$\frac{34}{105}$†	$\frac{10}{11}$†	$\frac{9}{21}$	†	—	—	—	—	53
July	—	—	—	—	—	—	—	$\frac{11}{12}$	—	$\frac{6}{7}$	$\frac{9}{49}$	—	—	—	—	—	26
December ...	—	$\frac{1}{1}$*	—	—	$\frac{14}{14}$*	$\frac{4}{4}$*	—	—	—	—	$\frac{14}{28}$*	—	—	—	—	$\frac{3}{4}$*	36
1906.																	
January ...	—	—	$\frac{1}{1}$*	—	$\frac{1}{2}$*	—	$\frac{3}{4}$*	—	—	—	—	—	—	—	—	—	5
May	—	—	—	—	—	—	—	‡	$\frac{1}{17}$	—	—	—	—	—	—	—	1
June	—	—	—	—	—	—	—	—	$\frac{7}{21}$	$\frac{11}{19}$	—	$\frac{3}{26}$	$\frac{2}{25}$	—	$\frac{3}{15}$	$\frac{1}{7}$	27
July	—	—	—	—	—	—	—	—	—	$\frac{1}{17}$	—	—	—	—	—	$\frac{1}{5}$	2
1907.																	
June	—	—	—	—	—	—	—	—	—	$\frac{1}{16}$‡	—	—	—	$\frac{6}{16}$‡	$\frac{8}{35}$‡	—	15
Total ...	3	7	3	27	16	26	16	32	117	35	66	6	2	8	14	6	—

* "Spawn forming" or "spawn in."
† "All the large turbot are very full of spawn, and several of the small ones have spawn in them."
‡ "Turbot full of spawn, but not quite ripe."

The real spawning period is chiefly during the months of May, June and July. We also have records in the months of December to April, but remembering that the fishermen do not always distinguish between "maturing" and "spawning," we can well believe that these are cases in which the spawn is in process of maturing. They are said to be such in December, 1905, and January, 1906. In May and even in June there are instances of turbot being "very full, but some of them not quite ripe for spawning."

This table does not show any very definite laws with regard to the distribution, for maturing and spawning fish are found in nearly all the areas investigated. Both the Dogger Bank and the region north of it have a good proportion of hauls with spawning fish. Area M, off the Danish coast, has the largest number of these instances, but it so happens that the turbot spawn at a time coinciding with the season on the eastern grounds, when a very large number of hauls were made. In area N also, adjacent to this and area Q, there is a good proportion during June and July.

As an instance of the irregularity in recording, one notices area S which had two cases in 1904, none in 1905 and 1906 and several in 1907, the last being recorded by a man who seldom records any spawning fish.

Each of these observations given in the table, means the appearance of one or two turbot in the haul which are spawning. It is very seldom that more are found.

Summary—Turbot.

a. Distribution.—Turbot are found in all areas in the region investigated, and they are taken at nearly all times of the year. But they are never found in great quantities—from 1 to 3 being the number generally taken in each haul.

A broad line of division between the grounds most abundant and least abundant in this fish may be taken at about the line of longitude 4° East. East and south-east of this line we have comparative abundance, the maximum catches averaging over 25 per ten hours. The general comparative distribution and density of this fish is shown by the chart in Fig. 52.

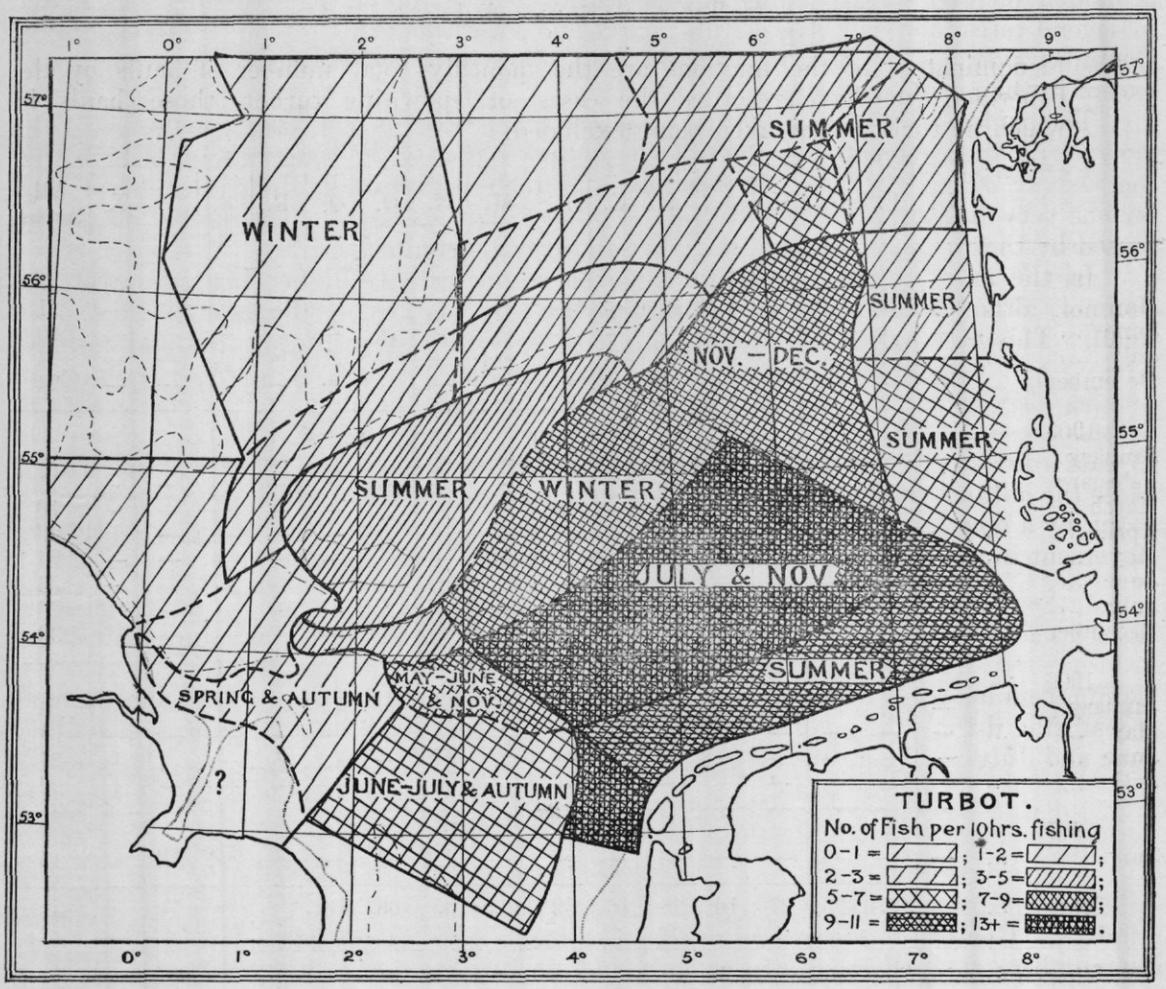

FIG. 52.—*Chart* showing the distribution of TURBOT according to the mean monthly catch in each area, and the periods of maximum abundance in the different regions.

This chart shows that turbot are most numerous in this region, off the coasts of Denmark, Germany and Holland, the largest catches being made in area N (Oyster Ground, deeper parts of Terschelling, &c.), where both the summer and winter catches are large.

The quantities decrease, proceeding northwards and also as we go from east to west. The quantities taken in the northern areas are very small, especially in area D, where they are of very rare occurence. The southern areas S and T have a fairly good yield. In the western grounds we find that turbot are very rare, both in the shallow and deep water areas, the average catch being generally between one and two (per ten hours), that is, after two or three hauls.

Large fish form about one third of the total number of fish caught. They generally outnumber the small fish in the northern and north-eastern areas, those deep-water grounds furthest from the nursery grounds off the Dutch coasts. Small fish predominate in most of the other areas, but they decrease in proportion as we proceed from the coasts, while the large fish proportionally increase.

b. Yearly variations.—There is in very many of the areas a decided decrease in the monthly average catch between 1904 and 1907, and this is, on the whole, continuous. The greatest difference is between the first two years of the period, the last two years not differing so very much from one another.

c. Seasonal Fluctuations and Migrations.—Variations in the catch occur in all areas, and in most these show a regular seasonal periodicity. It is only in such areas as the western and northern groups, where the catches are so small, that chance fluctuations obscure the general law of seasonal variations, that these cannot be determined with certainty.

In the extreme eastern areas the summer catches are the highest and the fish disappear almost entirely in the winter. In the central areas adjacent to these there are two maxima situated at the beginning and end of a lengthy period of maximum abundance and separated by a small depression in the summer. In most areas there is a period of minimum abundance earlier in the year, from February to April, followed by a sudden increase corresponding in time with the oncoming of the spawning season, and in several cases there is a more or less marked decrease when this is over. The October to December averages are often fairly high, those of January and February somewhat lower, except in the northern group.

The evidence with regard to the question of migration is not very conclusive. The most obvious movement suggested by the figures is that of the congregation of turbot on the inshore grounds during the summer, and their departure in the winter, when they become very dispersed over the deeper and more distant grounds. The double maximum caused by their passage through the adjacent areas is definitely marked.

In the most northern areas we find the winter catches higher than those of the summer, although the difference is not particularly marked, as the catches are so very small. This may indicate a departure in the summer, probably southwards and inshore. Areas S and T show two periods of maxima like those in area N, divided by a small summer depression, the autumn maximum being much the higher of the two in area S. In these areas, too, the quantities are very small in early spring. The first maximum appears a little earlier in area T (May and June) than that of area S (June and July), while the autumn maximum arrives later, suggesting a condition which would be brought about by a double annual migration through these two areas, this being a southward movement in the summer and a northward movement in the autumn.

d. Spawning.—Occurrences of spawning and maturing turbot are found in most of the areas considered. In several of the most important turbot areas, including mainly the eastern, south-eastern and southern region between the Dogger and the European coasts, the numbers increase rapidly at the beginning of the spawning season. They are recorded as maturing during the months from December to April and actually spawning in May, June and July which are the chief months.

D.—Brill.

Introduction.

This species is found in nearly all the areas investigated, but in exceedingly small numbers. Generally only one or two fish are taken after several hauls, but in some areas the numbers rise to an average of over 15 per 10 hours (*i.e.*, five or six per haul) at certain times of the year. They are recorded without any distinction of size except in a few cases where the skippers have noted that the brill are very small.

Monthly averages per 10 hours' fishing have been calculated, as for the other species discussed, but the number of fish dealt with is so small that the fortuitous fluctuations in many cases obscure the periodical changes of the catch due to the seasonal influences.

The population on any ground is very variable, not only in comparing one year with another, but also in the course of the year. The trend of the figures throughout the seasons of the different years does not always show the same regular periodicity that was present in the figures of the other species, by which we were justified in combining the figures for the different years to determine general seasonal variations. For this reason the curves of the combined averages appear most irregular and are interpreted with difficulty. Only a few of them are included in the text.

Total numbers caught and the yearly fluctuations.

The following table shows the total number of fish caught :—

Table XIV.—Showing the total number of Brill caught by certain skippers during 1904–1907.

——	Total Number of Fish.
1904	1,603
1905	3,157
1906	3,709
1907	3,232
Total	11,701

This shows the great scarcity of brill, when we consider that it represents the result of over 49,000 hours' fishing. The average per 10 hours' fishing is therefore only 2·4, *i.e.*, under one per haul. They are also, during this period, much scarcer than turbot, totalling a little more than one-third of that species, which is also very rare.

If we compare these totals with the number of hours' fishing in each year (Table I.), we find that brill are extremely scarce in 1904 and 1905, and that there was a comparatively big increase in 1906 and 1907.*

By comparing the averages of each month with those of the corresponding months in the preceding years, we obtain the following figures :—

1905 is 18 times less than, and 20 times greater than 1904, out of 40 months.
1906 is 15 times less than, and 19 times greater than 1904, out of 35 months.
1907 is 8 times less than, and 15 times greater than 1904, out of 25 months.
1906 is 23 times less than, and 20 times greater than 1905, out of 46 months.
1907 is 12 times less than, and 21 times greater than 1905, out of 34 months.
1907 is 7 times less than, and 23 times greater than 1906, out of 33 months.

From this we may conclude that 1905 and 1904 were not markedly different, but that both in 1906 and 1907, especially in the latter year, the amount of brill was more often greater than less than in the two previous years.

Fluctuations in each Area.

Table XV. gives the average numbers of brill taken from each area in each month. These determine the general distribution and the seasonal variations as follows :—

TABLE XV.—SHOWING for each area the Monthly Average Number of BRILL caught per ten hours' fishing.

Grou.	Area.	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
North-Eastern Areas.	A	1904	...	...	...	...	...	...	...	$2\cdot73^{22}$	...	...	...	...
		1905	...	...	...	...	...	...	$0\cdot45^{44}$	...	...	...	...	...
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	...	...	...	...	**$0\cdot45^{44}$**	**$2\cdot73^{22}$**	...	...	...	...
	B	1904	...	...	...	...	...	...	...	$0\cdot00^{18}$	$0\cdot23^{88}$	$0\cdot00^{117}$	$0\cdot00^{64}$	...
		1905	...	...	...	$0\cdot00^{30}$	$0\cdot80^{12}$	...	...	...	$0\cdot00^{160}$	$0\cdot00^{20}$	$0\cdot00^{4}$	...
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	$0\cdot00^{113}$	$0\cdot00^{39}$	...
		1904–7	...	...	...	**$0\cdot00^{30}$**	**$0\cdot80^{12}$**	...	...	**$0\cdot00^{18}$**	**$0\cdot08^{248}$**	**$0\cdot00^{250}$**	**$0\cdot00^{107}$**	...
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...
		1905	...	...	$0\cdot00^{8}$	...	...	...	...	...	...	$0\cdot00^{4}$	...	$0\cdot00^{4}$
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot00^{8}$**	...	...	...	...	...	...	**$0\cdot00^{4}$**	...	**$0\cdot00^{4}$**
	F	1904	...	...	...	...	...	$2\cdot34^{68}$	$0\cdot00^{8}$	$2\cdot50^{8}$	$0\cdot31^{65}$	...	$0\cdot47^{64}$	$1\cdot25^{120}$
		1905	...	...	$0\cdot00^{12}$	...	...	...	$1\cdot35^{52}$	$0\cdot56^{35}$	$0\cdot37^{109}$	$1\cdot60^{94}$	$0\cdot00^{8}$	$2\cdot50^{8}$
		1906	...	...	...	...	...	...	...	$0\cdot00^{38}$	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot00^{12}$**	...	...	**$2\cdot34^{68}$**	**$1\cdot17^{60}$**	**$0\cdot49^{81}$**	**$0\cdot34^{174}$**	**$1\cdot60^{94}$**	**$0\cdot42^{72}$**	**$1\cdot33^{128}$**
	G	1904	...	...	...	...	...	$1\cdot36^{29}$	...	$0\cdot62^{32}$	$0\cdot00^{88}$	$0\cdot45^{44}$	$0\cdot00^{4}$	...
		1905	$0\cdot00^{108}$	$0\cdot00^{8}$	...	...	...	...	...	$0\cdot00^{4}$	...	$0\cdot00^{15}$	...	$0\cdot00^{5}$
		1906	$0\cdot00^{21}$	$0\cdot00^{78}$	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	$0\cdot00^{96}$	...
		1904–7	**$0\cdot00^{129}$**	**$0\cdot00^{86}$**	...	...	...	**$1\cdot36^{29}$**	...	**$0\cdot55^{36}$**	**$0\cdot00^{88}$**	**$0\cdot34^{59}$**	**$0\cdot00^{100}$**	**$0\cdot00^{5}$**
Eastern Areas.	H	1904	...	...	...	...	$1\cdot15^{52}$	...	...	$0\cdot00^{16}$	$3\cdot33^{15}$	$0\cdot68^{73}$	$0\cdot18^{385}$	$0\cdot10^{191}$
		1905	$0\cdot98^{347}$	...	$0\cdot00^{9}$	$1\cdot63^{135}$	$0\cdot70^{170}$	...	$1\cdot25^{16}$	...	$1\cdot98^{40}$	$0\cdot27^{565}$	$0\cdot31^{257}$	$0\cdot12^{84}$
		1906	...	...	...	...	...	...	...	...	...	$0\cdot63^{16}$	...	...
		1907	...	...	...	...	...	...	...	...	...	...	$2\cdot55^{70}$	...
		1904–7	**$0\cdot98^{347}$**	..	**$0\cdot00^{9}$**	**$1\cdot63^{135}$**	**$0\cdot81^{222}$**	...	**$1\cdot25^{16}$**	**$0\cdot00^{16}$**	**$2\cdot34^{55}$**	**$0\cdot32^{654}$**	**$0\cdot46^{712}$**	**$0\cdot11^{275}$**
	M	1904	...	...	...	...	$1\cdot71^{76}$	$1\cdot87^{262}$	$4\cdot82^{114}$	$1\cdot44^{48}$	...	...	$3\cdot33^{30}$	$1\cdot95^{329}$
		1905	$10\cdot75^{53}$	...	$0\cdot82^{49}$	$5\cdot03^{358}$	$7\cdot13^{810}$	$9\cdot24^{661}$	...	...	$5\cdot53^{61}$	$0\cdot00^{13}$	$4\cdot04^{284}$	$0\cdot66^{91}$
		1906	...	...	...	$18\cdot83^{287}$	$12\cdot51^{423}$	$9\cdot32^{451}$	$8\cdot76^{286}$	$3\cdot55^{76}$	...	$18\cdot18^{28}$	$10\cdot49^{81}$	$7\cdot39^{202}$
		1907	...	...	...	$7\cdot85^{155}$	$14\cdot69^{442}$	$10\cdot95^{333}$	$15\cdot09^{80}$	...	...	...	$14\cdot29^{7}$	$4\cdot13^{160}$
		1904–7	**$10\cdot75^{53}$**	...	**$0\cdot82^{49}$**	**$10\cdot52^{800}$**	**$10\cdot10^{1751}$**	**$8\cdot46^{1707}$**	**$8\cdot88^{480}$**	**$2\cdot73^{124}$**	**$5\cdot53^{61}$**	**$12\cdot20^{41}$**	**$5\cdot47^{402}$**	**$3\cdot65^{782}$**
	Q	1904	...	...	...	...	$0\cdot00^{4}$	$3\cdot33^{48}$	$4\cdot64^{112}$	$5\cdot00^{48}$	$2\cdot16^{115}$	$0\cdot00^{8}$	...	...
		1905	...	...	$0\cdot96^{322}$	$2\cdot12^{99}$	$1\cdot79^{140}$	$6\cdot34^{20}$	$5\cdot58^{73}$	$5\cdot49^{290}$	$3\cdot82^{34}$	...	$3\cdot53^{8}$	$5\cdot56^{9}$
		1906	...	...	$2\cdot35^{43}$	...	$4\cdot63^{67}$	$6\cdot54^{106}$	$3\cdot75^{8}$	$4\cdot79^{35}$	...	$16\cdot34^{35}$	...	...
		1907	...	$0\cdot65^{15}$	$4\cdot24^{118}$	$8\cdot77^{57}$	$1\cdot58^{184}$	$11\cdot85^{40}$	$1\cdot70^{47}$	$9\cdot16^{113}$	$2\cdot08^{120}$	$2\cdot50^{28}$	$4\cdot29^{7}$	...
		1904–7	...	**$0\cdot65^{15}$**	**$1\cdot88^{483}$**	**$4\cdot55^{156}$**	**$2\cdot15^{395}$**	**$6\cdot81^{214}$**	**$4\cdot32^{240}$**	**$6\cdot24^{486}$**	**$2\cdot34^{269}$**	**$9\cdot09^{71}$**	**$3\cdot87^{15}$**	**$5\cdot56^{9}$**
	W	1904	...	...	...	...	...	$6\cdot72^{61}$	$5\cdot83^{12}$	...	$2\cdot50^{4}$	...	...	...
		1905	...	...	...	...	$3\cdot33^{6}$	...	...	...	...	...	...	...
		1906	...	...	...	...	...	...	...	...	...	$8\cdot33^{12}$	...	...
		1907	...	...	...	...	...	...	$3\cdot13^{16}$	...	...	...	...	...
		1904–7	...	...	...	...	**$3\cdot33^{6}$**	**$6\cdot72^{61}$**	**$4\cdot29^{28}$**	...	**$2\cdot50^{4}$**	**$8\cdot33^{12}$**	...	...

* This same trend in the yearly averages for brill is shown in the Dutch Statistics, *Jaarverslag omtrent het beheer van de Visscherhaven te IJmuiden*, 1908. Table iv., p. 72.

Group.	Area.	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Central Areas.	J	1904	...	...	...	...	$2\cdot22^{9}$	...	...	$0\cdot40^{75}$	$0\cdot39^{205}$	...	$0\cdot26^{77}$	$2\cdot69^{401}$
		1905	$1\cdot04^{105}$	...	...	...	$2\cdot00^{20}$	...	...	...	$0\cdot00^{95}$	$0\cdot25^{78}$	$1\cdot41^{64}$	$0\cdot56^{88}$
		1906	$1\cdot09^{28}$	$3\cdot67^{30}$	...	...	$0\cdot00^{77}$	...	...	$0\cdot00^{92}$	$0\cdot00^{90}$	$7\cdot50^{284}$	$8\cdot05^{130}$	$5\cdot00^{38}$
		1907	...	...	$1\cdot48^{67}$	$0\cdot59^{68}$	...	...	...	...	...	...	$1\cdot88^{16}$	...
		1904–7	**$1\cdot05^{133}$**	**$3\cdot66^{30}$**	**$1\cdot48^{67}$**	**$0\cdot59^{68}$**	**$0\cdot56^{106}$**	...	...	**$0\cdot18^{167}$**	**$0\cdot21^{390}$**	**$5\cdot93^{362}$**	**$4\cdot14^{287}$**	**$2\cdot50^{527}$**
	N	1904	...	...	...	...	$0\cdot00^{28}$	$2\cdot96^{40}$	$5\cdot17^{205}$	$6\cdot39^{109}$	$3\cdot35^{98}$	$1\cdot25^{144}$	$2\cdot14^{182}$	$1\cdot90^{136}$
		1905	$1\cdot18^{8}$	$0\cdot25^{40}$	$1\cdot73^{52}$	$1\cdot17^{60}$	$2\cdot71^{59}$	$4\cdot03^{139}$	$0\cdot66^{76}$	$1\cdot87^{272}$	$1\cdot35^{274}$	...	$1\cdot37^{219}$	$2\cdot07^{412}$
		1906	$2\cdot47^{421}$	$1\cdot55^{310}$	$117\cdot^{283}$	$2\cdot22^{14}$	$0\cdot56^{90}$	$1\cdot21^{83}$	$2\cdot50^{76}$	$1\cdot78^{197}$	$1\cdot76^{51}$	$2\cdot96^{108}$	$4\cdot47^{201}$	$1\cdot88^{74}$
		1907	$2\cdot64^{306}$	$5\cdot36^{125}$	$2\cdot28^{228}$	$1\cdot21^{132}$	**$0\cdot41^{74}$**	$4\cdot76^{71}$	$0\cdot68^{118}$	$3\cdot56^{45}$	$1\cdot96^{235}$	$3\cdot17^{299}$	$4\cdot30^{354}$	$4\cdot90^{96}$
		1904–7	**$2\cdot53^{735}$**	**$2\cdot44^{475}$**	**$1\cdot67^{563}$**	**$1\cdot26^{206}$**	**$0\cdot96^{251}$**	**$3\cdot36^{333}$**	**$2\cdot91^{475}$**	**$2\cdot76^{623}$**	**$1\cdot90^{658}$**	**$2\cdot63^{557}$**	**$3\cdot25^{956}$**	**$2\cdot39^{718}$**
	I	1904	...	...	...	...	...	$0\cdot00^{101}$	$0\cdot54^{18}$	$0\cdot19^{319}$	$0\cdot04^{225}$	$0\cdot83^{218}$	$2\cdot00^{190}$	$1\cdot09^{359}$
		1905	$1\cdot03^{87}$	$0\cdot00^{17}$	...	...	...	$0\cdot58^{52}$	$0\cdot33^{121}$	$0\cdot19^{263}$	$0\cdot26^{652}$	...	$0\cdot22^{139}$	$1\cdot68^{47}$
		1906	$3\cdot16^{79}$	...	...	...	...	...	$0\cdot00^{74}$	...	$0\cdot00^{31}$	$0\cdot87^{11}$	$0\cdot61^{65}$	...
		1907	...	...	...	...	...	...	...	...	$1\cdot00^{160}$	$0\cdot56^{71}$	$2\cdot22^{27}$	...
		1904–7	**$2\cdot04^{166}$**	**$0\cdot00^{17}$**	...	...	...	**$0\cdot20^{153}$**	**$0\cdot23^{213}$**	**$0\cdot19^{552}$**	**$0\cdot32^{1068}$**	**$0\cdot77^{300}$**	**$1\cdot21^{421}$**	**$1\cdot16^{406}$**
	O	1904	...	...	...	...	$0\cdot00^{10}$	$0\cdot20^{100}$	$0\cdot88^{149}$	$0\cdot16^{254}$	$0\cdot42^{216}$	$0\cdot39^{356}$	$0\cdot18^{278}$	$0\cdot41^{97}$
		1905	$0\cdot50^{100}$	$0\cdot71^{56}$	$0\cdot00^{150}$	$0\cdot08^{613}$	$0\cdot08^{395}$	$0\cdot33^{121}$	$0\cdot51^{255}$	$0\cdot30^{99}$	...	$0\cdot31^{327}$	$0\cdot23^{175}$	$0\cdot07^{538}$
		1906	...	$0\cdot00^{11}$	$0\cdot00^{9}$	$0\cdot00^{14}$	$0\cdot00^{10}$	...	...	...	$0\cdot00^{4}$	$1\cdot48^{14}$	$0\cdot00^{4}$	...
		1907	$0\cdot04^{281}$	...	$0\cdot00^{80}$	...	...	...	...	...	...	...	$0\cdot15^{68}$	...
		1904–7	**$0\cdot16^{381}$**	**$0\cdot60^{67}$**	**$0\cdot00^{239}$**	**$0\cdot08^{627}$**	**$0\cdot07^{415}$**	**$0\cdot27^{221}$**	**$0\cdot64^{404}$**	**$0\cdot20^{353}$**	**$0\cdot41^{220}$**	**$0\cdot37^{697}$**	**$0\cdot19^{525}$**	**$0\cdot13^{635}$**
Northern Areas.	D	1904	...	...	...	...	...	...	...	...	...	...	$0\cdot00^{37}$	...
		1905	$0\cdot16^{61}$	$0\cdot04^{760}$	$0\cdot03^{647}$	$0\cdot00^{24}$	...	...	...	...	...	...	...	$0\cdot00^{69}$
		1906	...	$0\cdot00^{85}$	$0\cdot00^{257}$	...	...	...	...	$0\cdot00^{131}$	$0\cdot00^{24}$	...	...	...
		1907	...	...	$0\cdot00^{28}$	...	...	...	...	...	...	...	...	...
		1904–7	**$0\cdot16^{61}$**	**$0\cdot04^{845}$**	**$0\cdot02^{932}$**	**$0\cdot00^{24}$**	...	...	...	**$0\cdot00^{131}$**	**$0\cdot00^{24}$**	...	**$0\cdot00^{37}$**	**$0\cdot00^{69}$**
	K	1904	...	...	...	...	$0\cdot00^{4}$	$0\cdot26^{38}$	...	$0\cdot00^{7}$	$0\cdot00^{43}$	$0\cdot11^{95}$	$0\cdot47^{21}$	...
		1905	$0\cdot14^{211}$	$0\cdot17^{239}$	$0\cdot34^{29}$	...	...	...	...	$0\cdot00^{4}$	$0\cdot00^{71}$	$0\cdot00^{4}$	...	...
		1906	$0\cdot00^{31}$	$0\cdot00^{24}$	$0\cdot00^{44}$	...	...	...	...	...	$0\cdot00^{21}$	...	...	...
		1907	$0\cdot00^{55}$	$0\cdot09^{232}$	$0\cdot00^{235}$	...	...	...	...	...	...	$0\cdot00^{11}$	$0\cdot00^{8}$	...
		1904–7	**$0\cdot10^{297}$**	**$0\cdot12^{495}$**	**$0\cdot03^{308}$**	...	**$0\cdot00^{4}$**	**$0\cdot26^{38}$**	...	**$0\cdot00^{11}$**	**$0\cdot00^{135}$**	$0\cdot09^{110}$	**$0\cdot34^{29}$**	...
	L	1904	...	...	...	...	...	$0\cdot00^{21}$	$0\cdot00^{6}$	$0\cdot00^{84}$	$0\cdot15^{195}$	$0\cdot00^{63}$	$0\cdot00^{8}$	...
		1905	$0\cdot24^{84}$	$0\cdot18^{625}$	$0\cdot31^{192}$	$0\cdot09^{111}$	$0\cdot00^{30}$	$0\cdot00^{7}$	$0\cdot00^{79}$	$0\cdot00^{18}$	$0\cdot00^{81}$	...	...	$0\cdot55^{36}$
		1906	$0\cdot00^{132}$	$0\cdot08^{247}$	...	...	$0\cdot00^{199}$	$0\cdot00^{108}$	$0\cdot00^{97}$	$0\cdot00^{101}$	$0\cdot16^{308}$	$0\cdot07^{136}$	...	...
		1907	...	...	$0\cdot00^{60}$	...	...	...	...	...	...	$0\cdot00^{13}$	...	...
		1904–7	**$00\cdot8^{216}$**	**$0\cdot15^{872}$**	**$0\cdot24^{252}$**	**$0\cdot09^{111}$**	**$0\cdot00^{229}$**	$0\cdot00^{136}$	$0\cdot00^{182}$	**$0\cdot00^{203}$**	**$0\cdot14^{584}$**	**$0\cdot05^{212}$**	**$0\cdot00^{8}$**	**$0\cdot55^{36}$**
Southern Areas.	S	1904	...	...	...	...	...	$3\cdot20^{216}$	$3\cdot51^{345}$	$4\cdot84^{454}$	$4\cdot60^{100}$	$2\cdot33^{103}$	...	...
		1905	...	...	...	...	...	...	$2\cdot06^{617}$	$1\cdot91^{749}$	$2\cdot00^{45}$	$0\cdot00^{4}$	$0\cdot00^{8}$	$0\cdot74^{13}$
		1906	...	$9\cdot09^{5}$	$0\cdot11^{92}$	$1\cdot38^{22}$	$0\cdot00^{7}$	$2\cdot18^{55}$	$0\cdot72^{83}$	$1\cdot52^{106}$	$1\cdot45^{220}$	$4\cdot07^{56}$	...	...
		1907	...	...	...	...	$6\cdot75^{461}$	$5\cdot77^{348}$	$3\cdot91^{271}$	...	...	...	$3\cdot75^{16}$	...
		1904–7	...	[$9\cdot09^{5}$]	**$0\cdot11^{92}$**	**$1\cdot33^{22}$**	**$6\cdot65^{468}$**	**$4\cdot56^{619}$**	**$2\cdot74^{1316}$**	**$2\cdot90^{1309}$**	**$2\cdot38^{365}$**	**$2\cdot87^{163}$**	**$2\cdot45^{24}$**	**$0\cdot74^{13}$**
	T	1904	...	...	...	...	$2\cdot31^{13}$	$5\cdot00^{24}$	$3\cdot00^{10}$	$5\cdot00^{8}$	$5\cdot00^{8}$	...	$3\cdot56^{22}$	...
		1905	...	...	...	...	$1\cdot98^{55}$	...	$3\cdot30^{48}$	$4\cdot05^{79}$	$2\cdot00^{100}$	$1\cdot80^{177}$	$1\cdot52^{343}$	$0\cdot50^{340}$
		1906	...	$0\cdot42^{96}$	$0\cdot19^{52}$	$1\cdot51^{112}$	$0\cdot94^{53}$	$1\cdot86^{97}$	$2\cdot15^{181}$	$3\cdot32^{90}$	$*2\cdot65^{83}$	$2\cdot53^{225}$	$0\cdot73^{27}$	...
		1907	...	...	...	$4\cdot16^{39}$	$4\cdot00^{25}$	$4\cdot27^{143}$	$2\cdot31^{91}$	...	$2\cdot00^{20}$	$2\cdot75^{84}$	$3\cdot40^{212}$	$2\cdot50^{12}$
		1904–7	...	**$0\cdot42^{96}$**	**$0\cdot18^{52}$**	**$2\cdot19^{151}$**	**$1\cdot98^{146}$**	**$3\cdot45^{264}$**	**$2\cdot39^{330}$**	**$3\cdot72^{177}$**	**$2\cdot37^{211}$**	**$2\cdot30^{486}$**	**$2\cdot22^{604}$**	**$0\cdot57^{352}$**
	V	1904	...	...	...	...	...	...	$0\cdot30^{131}$	$0\cdot35^{86}$	$1\cdot32^{45}$	...	$0\cdot74^{13}$	...
		1905	...	...	$3\cdot20^{25}$	...	...	...	$1\cdot48^{108}$	$0\cdot70^{29}$	...	$1\cdot43^{28}$	...	...
		1906	$0\cdot34^{59}$	$0\cdot00^{4}$	$0\cdot38^{80}$	$0\cdot79^{38}$	...	$0\cdot00^{12}$	$0\cdot76^{53}$	$0\cdot62^{49}$	$1\cdot08^{47}$	$0\cdot00^{16}$	$0\cdot00^{12}$	...
		1907	...	...	...	...	$0\cdot00^{4}$	$0\cdot00^{8}$	$0\cdot00^{55}$	...	...	$2\cdot02^{94}$	$0\cdot71^{28}$	$1\cdot03^{48}$
		1904–7	**$0\cdot34^{59}$**	[$0\cdot00^{4}$]	**$1\cdot05^{105}$**	**$0\cdot79^{38}$**	[$0\cdot00^{4}$]	**$0\cdot00^{20}$**	**$0\cdot69^{347}$**	**$0\cdot49^{164}$**	**$1\cdot20^{92}$**	**$1\cdot66^{138}$**	**$0\cdot57^{53}$**	**$1\cdot03^{48}$**
Western Areas.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...
		1905	...	...	...	...	...	...	...	...	...	...	...	...
		1906	$1\cdot29^{8}$	...	$4\cdot00^{7}$	...	...	$1\cdot08^{18}$	$4\cdot35^{11}$	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	**$1\cdot29^{8}$**	...	**$4\cdot00^{7}$**	...	...	**$1\cdot08^{18}$**	**$4\cdot35^{11}$**	...	...	...	...	...
	R	1904	...	...	...	...	...	...	...	...	...	...	$7\cdot78^{9}$	$4\cdot44^{4}$
		1905	...	...	$0\cdot00^{14}$	...	$0\cdot40^{76}$	...	...	...	$0\cdot56^{18}$	...	$2\cdot80^{168}$	$3\cdot49^{212}$
		1906	$4\cdot11^{139}$	$3\cdot04^{236}$	$2\cdot36^{280}$	$0\cdot75^{266}$	$0\cdot45^{176}$	$0\cdot29^{238}$	$2\cdot16^{222}$	$0\cdot62^{113}$	$1\cdot33^{7}$	$1\cdot38^{14}$	...	...
		1907	...	...	...	$3\cdot08^{6}$	$0\cdot00^{23}$	$1\cdot88^{32}$	$0\cdot00^{4}$	...	...	...	...	...
		1904–7	**$4\cdot11^{139}$**	**$3\cdot04^{236}$**	**$2\cdot24^{294}$**	**$0\cdot81^{272}$**	**$0\cdot40^{275}$**	**$0\cdot48^{270}$**	**$2\cdot12^{226}$**	**$0\cdot62^{113}$**	**$0\cdot78^{25}$**	**$1\cdot38^{14}$**	**$3\cdot05^{177}$**	**$3\cdot51^{216}$**
	X	1904	...	...	...	...	...	...	$0\cdot28^{109}$	$2\cdot15^{60}$	$0\cdot33^{30}$	...	$0\cdot90^{33}$	$9\cdot14^{17}$
		1905	$0\cdot00^{4}$	$0\cdot00^{3}$	$2\cdot99^{53}$	$0\cdot83^{12}$	...	...	...	...	$0\cdot65^{31}$	$2\cdot05^{107}$	$0\cdot00^{15}$	$0\cdot00^{44}$
		1906	...	$0\cdot00^{9}$	$0\cdot84^{60}$	$3\cdot37^{77}$	$0\cdot19^{52}$	$0\cdot45^{156}$	$0\cdot36^{112}$	$0\cdot43^{93}$	$0\cdot47^{64}$	$1\cdot50^{20}$	$0\cdot00^{16}$	...
		1907	...	...	...	...	$0\cdot19^{52}$	$1\cdot25^{8}$	$0\cdot42^{96}$	...	...	$0\cdot44^{183}$	$1\cdot07^{28}$	$1\cdot63^{25}$
		1904–7	[$0\cdot00$]^{4}	[$0\cdot00$]^{12}	**$1\cdot86^{113}$**	**$3\cdot03^{89}$**	**$0\cdot19^{104}$**	**$0\cdot49^{164}$**	**$0\cdot35^{317}$**	**$1\cdot11^{153}$**	**$0\cdot48^{125}$**	**$1\cdot06^{310}$**	**$0\cdot65^{92}$**	**$2\cdot38^{86}$**
	P	1904	...	...	...	...	...	...	$0\cdot00^{213}$	...	$0\cdot00^{8}$	...	...	...
		1905	...	...	...	...	...	...	$0\cdot00^{16}$	...	...	...	...	...
		1906	...	...	$0\cdot00^{4}$	$0\cdot00^{4}$	...	...	...	...	$0\cdot00^{24}$	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot00^{4}$**	**$0\cdot00^{4}$**	...	...	**$0\cdot00^{229}$**	...	**$0\cdot00^{32}$**	...	...	...

North-Eastern Areas.

Brill are found in these areas but very rarely. The biggest catches were taken from areas A and F. In B and C they are almost wholly absent, the only ones reported being one fish in May, 1905, and two in September, 1904, in area B.

In F there is some evidence of a decline in the average from 2·34 in June to 0·34 in September, followed by a slight rise to December. In area G also they are generally absent, and the highest average occurs in June.

Eastern Areas.

Area H.—The averages fluctuate between 0 and 3 per 10 hours, and in 11 cases out of 17 they are less than one.

April and May, and perhaps September, are the best months. November and December are very low, and the numbers of brill decrease appreciably throughout these months.

Area M.—This area gives a greater average number of brill than any of those considered. The general average is never less than 0·82, and it rises to over 10 in four months of the year, while the highest average attained is 18·83 in April, 1906. These years, 1906 and 1907, are throughout the best years of the period in the area, while 1904 has very low values.

From April to July appears to be the season of greatest abundance, while August and September show a period of decreasing abundance before an autumn maximum. It appears that most of the brill on this ground are small, as special note has been made that they are so in May, 1904, and in April and May, 1905. In December, 1904, we notice that brill begin to get more numerous, and at the end of the month and during the first few days of January, 1905, several small fish are recorded. This is paralleled by the occurrence in November, 1905, of large numbers of tiny brill on the Sylt Rough.

Area Q.—The course of the monthly averages in this area is most irregular and fluctuating. They indicate, however, the presence of a fair number of brill in this area, which with area W comes next to area M in its yield. The maximum and minimum general averages are 9·09 and 0·65 respectively, while in five months of the year the general average exceeds five per 10 hours. The maximum averages obtained are 11·85 in June, 1907, and 16·34 in October, 1906.

June seems to be the month of maximum, and there is a rise, although irregular, from February to this time. By September the numbers have decreased, and in the months after this they are indeterminate.

Area W.—The total amount of fishing is very small, but the average numbers of brill taken approximate very closely to those of the adjacent area Q. The maxima are 6·72 in June and 8·33 in October.

These eastern areas give the largest average yield of brill, the grounds in the neighbourhood of Sylt and Amrum being among the most prolific. The population of brill consists apparently mainly of small fish and reaches a maximum about May and June, the spawning period. A secondary maximum appears later in the year, about September in H, and in October and November in the others. Very tiny fish were present on the Sylt grounds at the beginning of winter.

By far the best catches of the period were made in 1906 and 1907.

Central Areas.

Area J.—The average catch here is small, being generally less than 2 per ten hours, and in 4 months no fish at all were caught.

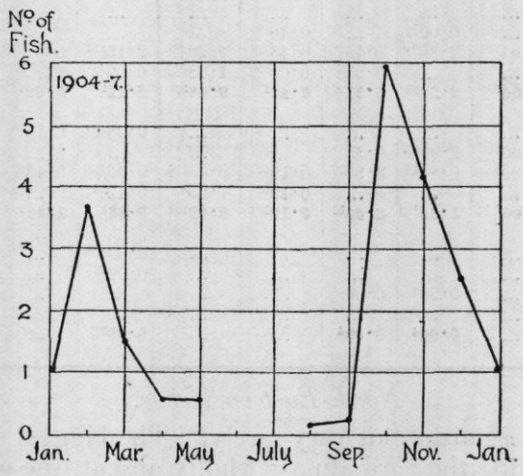

FIG. 53.—BRILL. Area J. Monthly Averages, 1904–1907.

The curve (Fig. 53), is incomplete as the averages for the early summer are missing, but it shows that there is a minimum in summer and a maximum in autumn. Only from October to December of 1906 do we get any large numbers. The highest average reached is 8·05 in November, 1906.

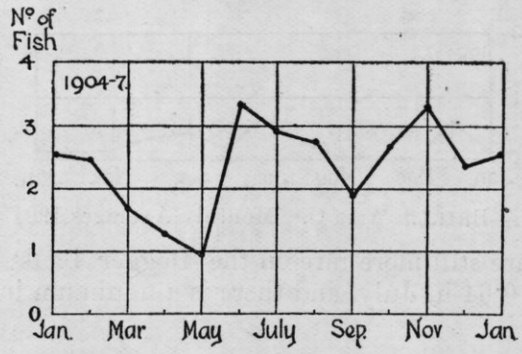

FIG. 54.—BRILL. Area N. Monthly Averages, 1904–1907.

Area N.—The range of variation in the average monthly catch of this area is comparatively small, the general average fluctuating from 0·96 to 3·36, while only four of the twelve general averages are under 2. The highest value obtained is 6·39 in August, 1904. This area, which has through the considerable amount of fishing, yielded very smooth curves for the other species, bringing out periodical fluctuations very definitely, is a good illustration of the great variability in the seasonal movements of the brill. It would be very difficult to interpret the general curve (Fig. 54) as it stands in this respect, and the method of three monthly averages results in a smoothed curve (Fig. 55) which at first sight, serves more to bring out the differences in the trend of the four years, than the similarity in the seasonal fluctuations that generally exists.

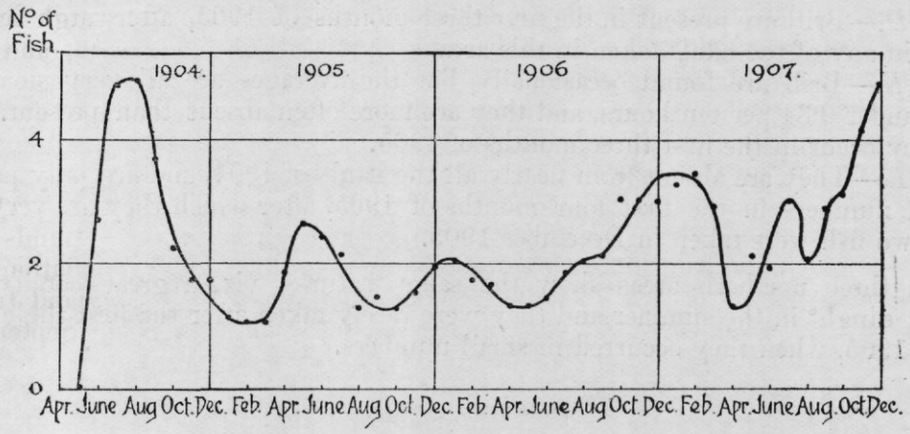

FIG. 55.—Brill. Area N. Monthly Averages, (smoothed curve).

The course of the figures is as follows :—In 1904 we find increasing quantities from May till a maximum of 6·39 in August, and then a sharp and continued decline to a low minimum in February, 1905. After this the curve rises again to a spring maximum, which is only half the maximum in 1904. This is followed by an autumn minimum and a winter maximum culminating in January, 1906. In 1906 we have a minimum about May, and then slowly increased catches till the winter. Both the November and February (1907) averages are very high and there is a decided decrease in the intervening months. There is a sharp drop to a minimum in April or May, and the curve then rises irregularly till the end of the year. It is evident from these figures how very variable is the period of maximum abundance as well as its duration.

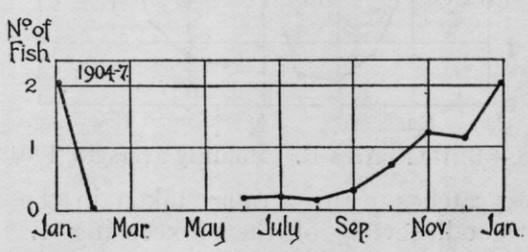

FIG. 56.—BRILL. Area I. Monthly Averages, 1904–1907.

Area I.—The catches are small for the greater part of the year, and considerably less than those in N. November, December and January have the highest general averages, being 2·04 at the maximum. From June to September they are all less than 0·33.

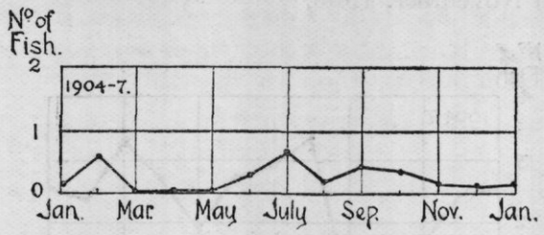

FIG. 57.—BRILL. Area O. Monthly Averages 1904–1907.

Area O.—The brill are still more rare on the Dogger Bank. The highest averages are 0·60 in February and 0·64 in July, and there is a minimum in the spring, for no fish were caught in March.

These central areas show with regard to distribution a marked decrease in the numbers in the more offshore areas. The average yield from areas M, N, I and O forms a rapidly decreasing series, the respective maximum averages attained in these areas being about 12, 3 and 0·6.

The seasonal fluctuations are not always constant for the same area, but as in J we have the highest values from October to December, in N in some years, a maximum in January and February and in I from November to January, it seems that as a rule the autumn and winter catches are the greatest. We may therefore suppose that the fish move offshore into the deeper waters at the approach of the cold weather. The spring and summer catches are generally low, so that an inshore migration, beginning about March and April, may take place.

Northern Areas.

Area D.—Brill are present in the first three months of 1905, afterwards they were not found in any of the hauls taken in this area.

Area K.—Brill are found occasionally, but the averages are all very small, being generally under 0·34 per ten hours, and they are more often absent than present. As in area D, they occur in the first three months of 1905.

Area L.—They are absent from nearly all the hauls of 1904, and are only present in very small numbers in the first four months of 1905, after which they are very seldom found. Two fish were taken in December 1905.

These three northern areas show the same features, viz., a great scarcity of brill. None were caught in the summer and they were rarely taken after the first three or four months of 1905, when they occurred in small numbers.

Southern Areas.

Area S.—This area compares very favourably with some of the eastern areas. The highest average obtained (omitting February 1906), is that of May, 1907, which is 6·75. Most of the other averages vary between 1 and 5. Brill occurred more plentifully in 1907 than in the other years.

Western Areas.

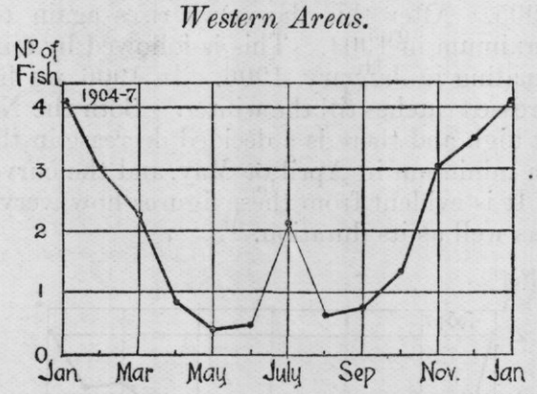

FIG. 58.—BRILL. Area R. Monthly averages, 1904–1907.

Area T.—The greatest catches in this area are taken in the summer, and generally speaking they are fairly good, several of them exceeding 4. 1907 has the highest averages.

Area V.—This has a very poor yield, the highest general average being 1·66, while in several months there were no brill taken. The fluctuations are irregular.

Two of these three areas, S and T give a fairly good yield, but that of the third V, is very poor. The fluctuations are irregular in all cases, but in the neighbourhood of the Leman and Botney grounds, we have some evidence of increased numbers during the spring and summer. The highest averages are those of 1907.

Area R.—The averages in this area vary fairly regularly. We find the numbers increasing from November, 1905 (2·80) to a maximum of 4·11 in January. They steadily decline till June (0·29) ; July is high, and after the small catch in August they steadily increase again.

Area X.—In this area we find the May to September averages very low. Those of March, April and October are higher, the rest more or less indeterminate.

Brill were absent from all hauls taken in area P, but were found in area E in all the months in which fishing took place. Areas R and X together show a probable summer minimum, with a maximum in winter.

Spawning.

The fishermen are not required to note the occurrence of spawning brill on their record forms. However, a few cases were noticed and these are as follows :—

1904, May—one spawning fish in area M out of seven hauls with brill.
1905, April—one fish with spawn in area L out of one haul with brill.
1906, May—two fish spawning in one haul in area Q out of eleven hauls with brill.
1907, May—one fish spawning in area S out of three hauls with brill.

These fish corroborate what we already know about brill, viz., that the height of their spawning season in this region is in May. The specimen that was nearly ripe in April was taken in deep water north of the Dogger ; the other specimens that were spawning were all found in shallow water.

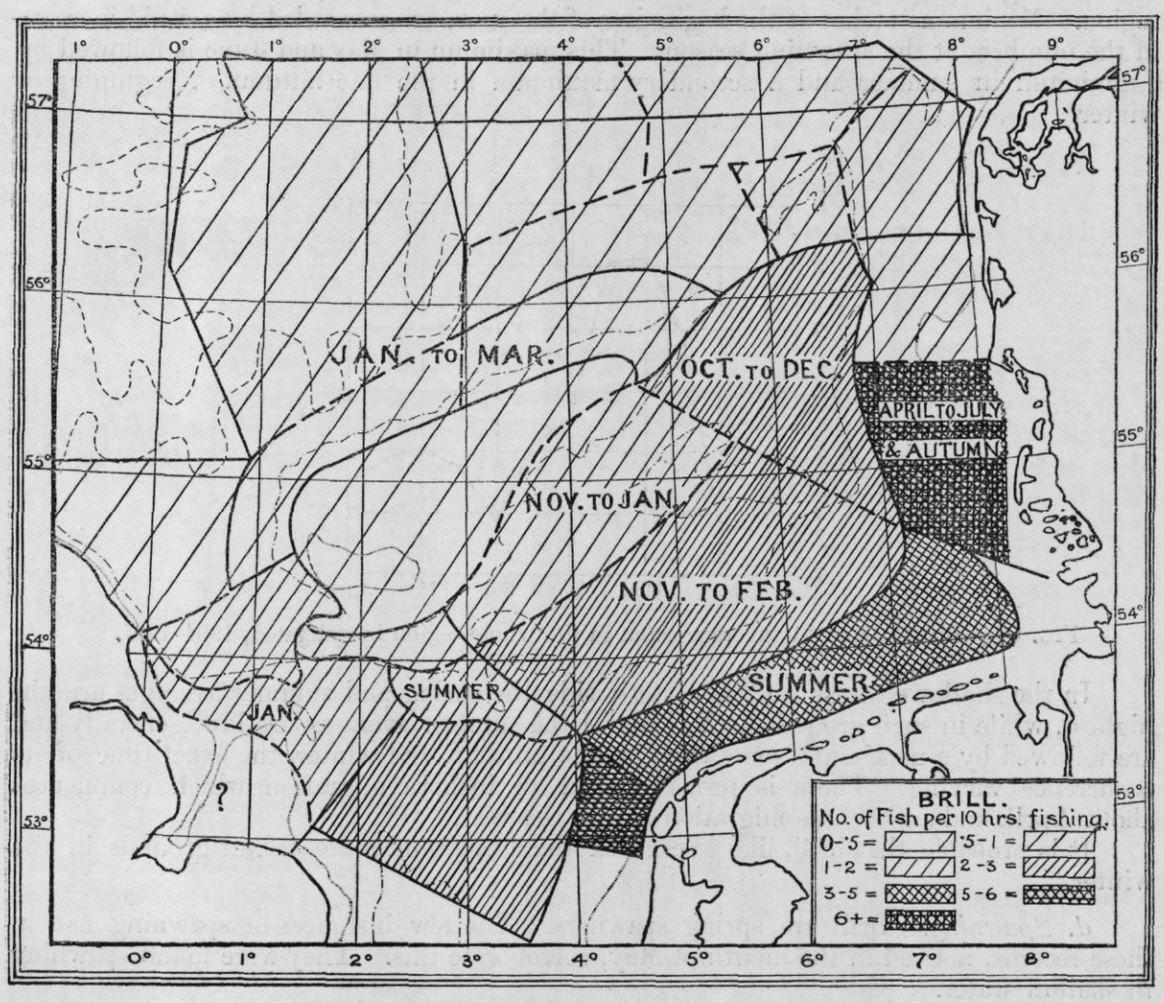

FIG. 59.—*Chart* showing the distribution of BRILL according to the mean monthly catch in each area, and the periods of maximum abundance in the different regions.

Summary—Brill.

a. Distribution.—Brill are found in most parts of this region, but they are nowhere numerous, the average catch being at the rate of 2·4 per 10 hours fishing. In the northern and north-eastern areas they are of very rare occurrence, and in several months they are not taken at all. The comparative abundance in the various areas is shown in Fig. 59 by the mean monthly catch, and also, where it has been possible to determine it, the period of maximum abundance is indicated.

The eastern areas give the greatest yield, which is made up by a large number of small fish. Proceeding seawards from the shore and also northwards from the southern area S, the numbers decrease rapidly. Area S (Leman and Botney, &c.) and area N (the Oyster ground) yield a fair number (averaging from two to three). On the more offshore areas such as V, I and O, the numbers are very small, under one per ten hours. The western area R has good catches in the winter, and there are indications that brill are also comparatively plentiful in area E. From other sources, the Lowestoft trawling records, we find in the results of the catches of brill (unpublished) that they are much more plentiful on the Cromer grounds than in the neighbourhood of the Brown Bank. Although the other western areas X and P are very poorly sampled, it appears that brill are never more numerous than in the eastern and southern areas.

b. Yearly Variations.—We have reason to believe that brill were much more abundant in 1906 and 1907 than in the first two years of the period. There is no marked difference between the catches of 1904 and 1905.

c. Seasonal Fluctuations and Migrations.—The average catches of brill fluctuate considerably, the fluctuations being partly due to seasonal migrations, and partly, and to a great extent, to fortuitous circumstances which have a great effect on the average, since the number of fish is too small to always hide the effect of the chance occurrence of several more or fewer fish. For this reason considerable irregularity is shown, and the true seasonal fluctuations in each area are not definitely determined. Fig. 60 is included, because it shows in a general way the nature of the fluctuations in the average catch over the whole region. Minimum catches at the beginning of the year, are succeeded by a rapid increase in the numbers at the spawning season. This maximum in May and June is followed by a minimum in summer and a secondary maximum in the late autumn or beginning of winter.

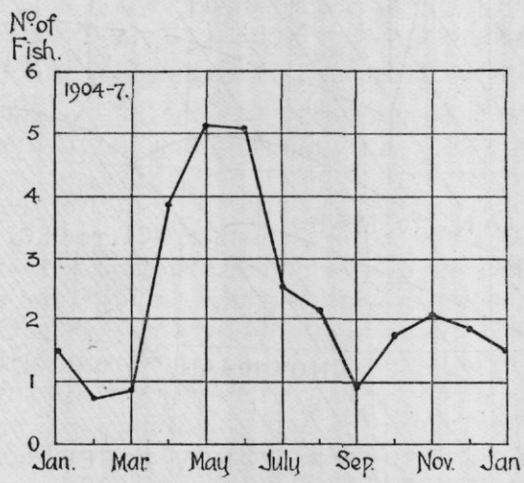

FIG. 60.—BRILL. Monthly average catch in the whole region investigated, 1904–1907.

In the shallower areas on the eastern side the spring and summer averages are the highest, while in such grounds as N, I and J the summer averages are low generally and are followed by a maximum some time in the autumn and winter, the exact time of its occurrence varying. There is probably then an inshore migration which commences about April, and an offshore migration late in the year.

It is probable that brill, like soles, seek the deeper and more distant grounds in the winter.

d. Spawning.—Brill are spring spawners. The few instances of spawning fish in these records, noticed in the month of May, corroborate this. They were found spawning in shallow water.

E. Cod.

Introduction.

Cod, although fairly plentiful in this region, only formed about two-fifths by weight of the total catch of plaice taken during the four years investigated, and of course in numbers this proportion would be much smaller. Nevertheless they were taken in greater or less quantities in all the different areas of this region, the numbers in the northern part being far more numerous than in the southern.

The monthly averages of the catches for each month and area have been worked out as for the other species, but additional care is needed in the interpretation of these averages in the case of cod. This is due to the habit cod have of shoaling, so that the catches may be very unequal. It occasionally happens that the number of cod taken in one or two hauls far outnumber those taken in the rest of the hauls of the month, as for instance, when two or three score large cod are caught at one shot, whereas the usual number is two or three fish. On occasions, ten, eleven or twelve score have been taken on some grounds at one haul. The effect of this is to raise the average considerably, unless the number of hauls is very large, in which case the average is still fairly comparable with those of other occasions or other areas when these extraordinary large catches are not made. It follows that the rate of catching, as determined by the average per ten hours fishing, becomes in such a case, a very poor measure of the fish population. In fact, it is impossible to determine any satisfactory average at all from such figures. The method adopted to deal with these has been to note all cases of such catches as are very large when compared with those made under the same conditions, say 20 to 80 times the usual number, and to mark the averages into which these enter with an asterisk, so that they may be noticed in interpreting the statistics and the curves drawn from them. This difficulty will affect the number of large cod more than the codling.

Conversion of the different Measures into Weight.

Large and medium cod are always counted singly or in scores by the fishermen. Codling are measured in baskets except when only a few are caught, and then their numbers are given. The equivalent weights for these different measures have had to be determined and approximate values have been found from several sources. From the report of Committee A of the International Council* we find that the limit between cod and codling is drawn at about 60 cm. A small calculation from the figures there given,† and the conversion of kilograms to cwts. results in the following average weights :—

1 cod = ·1056 cwt. ; 1 codling = ·013 cwt.

This latter factor is in close agreement with the information supplied by Mr. Olsen, of Grimsby, who states that the average number of codling to a basket of weight 60 lbs. is 40, whence one codling weighs ·013 cwt. For further confirmation I am indebted to Mr. G. T. Atkinson, who has supplied me with the results of some observations made by himself at Hull in March, 1908. He counted the number of Iceland cod, all mature, which went to a "kit" (10 stone), and found that they varied from 12 to 15, and averaged 13·3 in number. From this the average weight of a mature cod is 0·094 cwt.

Medium cod are not distinguished from large cod in the Committee A report. In these Grimsby trawling records this distinction is made on the forms, but is not always kept. The fishermen, some consistently, some only occasionally, divide their fish into "large cod" and "codling," and a few into "medium cod" and "codling." For this reason I have retained only the two classes "cod" and "codling," treating "large" and "medium" as "cod."

In the tabulations I have preferred to give the actual number of "cod" rather than their estimated weight, but for purposes of comparing the two classes, and to give some idea of the total weight, the scale of 1 cod = 0·1 cwt. has been used. In the diagrams the "codling" are always given by their weight in cwts., and so is the estimated weight of the total catch ; "cod" are given in numbers, the scale being one-tenth of that for codling, so that their approximate weight is represented also.

With regard to the weight of a basket of codling, we have several approximations. The fishermen say that with codling (as well as haddock and whiting), it takes nearly two level baskets to make a box (about 1 cwt.). According to Mr. Olsen the weight of a basket of codling is 60 lbs. and this is 0·54 cwt.

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* Hjort : *Rapport sur les Travaux de la Commission A.* General part p. 108. Rapports et Proc.-Verb. Vol. x.

† *Loc. cit.* pp. 110 and 112.

A further method of obtaining the average weight is to compare the skippers' own records of what they catch with the amounts they land at the end of a voyage. The ratio of the total number of boxes of codling landed, to the number of baskets recorded is given in the following table (Table XV.) having been determined for each fisherman for each year. It should be explained that in this table and also in those for haddock and whiting, the figures in the last column and the last row are not the arithmetic average of the ratios determined in each case, but the ratio obtained by summing up all the catches and comparing them with the sum of all the boxes landed. This method gives the greatest weight to the values determined by those fishermen who have caught the most fish.

It has not been possible to compare these totals from every voyage, for in some cases the catches were too small to be measured in baskets, and in others, the records of several hauls were omitted. If only a few hauls had been left out, it was often possible to estimate the number of baskets of fish taken in these and so make the returns complete. This has been done wherever possible. Nevertheless, the resulting figures, though subject to considerable variation, are approximations to the actual average ratio between a basket and a box.

TABLE XVI.—Showing for each of certain skippers the ratio between the numbers of boxes of CODLING landed, and the numbers of baskets caught.

Skipper.	1904.	1905.	1906.	1907.	1904–7.
i	·62	·69	[·59]	—	·65
ii	—	·57	—	—	·57
iii	·48	·40	·53	[·75]	·47
iv	—	·61	·60	—	·60
v	·56	·61	·70	·66	·61
vi	[·57]	·64	·63	·54	·62
vii	·50	·67	—	—	·58
viii	·42	·48	—	—	·46
All men	·51	·57	·62	·64	·57

Since the average weight of a box is about one cwt., the value 0·57 cwt. for the weight of a basket of codling. must be closely approximate to the true average weight. It is calculated from 5,385 baskets. The actual value of this fraction is 0·566, and as the error involved in using 0·56 cwt. as the factor, instead of 0·57 cwt. is very small (the error being ·006 in one case and ·004 in the other), this value, 0·56, has been adopted, as being the same as that determined for haddock.

Total quantities of fish and the proportions of Cod and Codling.

TABLE XVII.—Showing the total quantities of COD and CODLING recorded during the period 1904–1907, and the percentage of the total of each group by weight.

Year.	Number of Cod.	Weight of Codling. Cwts.	Total weight. Cwts.	Percentage of total weight.	
				Cod.	Codling.
1904	9,331	948·24	1881·34	49·6	50·4
1905	24,121	1564·24	3976·34	60·7	39·3
1906	7,498	726·19	1475·99	50·8	49·2
1907	4,453	212·64	657·94	67·7	32·3
Total	45,403	3,451·31	7,991·61	56·8	43·2

It appears from this table that "cod" exceed the "codling" in weight, but not to a very great extent; 43 per cent. of the total weight of cod were small fish. This percentage is much higher than that given in the Bulletin Statistique.* Of the cod from the whole North Sea caught by English steam trawlers, only 21 per cent. in 1904, 19 per cent. in 1905 and 26 per cent. in 1906 were codling.

* Conseil Perm. Inter. pour l'Explor. de la Mer. Bulletin Statistique. Vols. I, II and III Table C. II.

We can make a rough estimate for the total *number* of fish caught, by taking $\cdot\frac{1}{013}$ codling to 1 cwt., whence the total number of codling becomes about 265,485, and the large fish then form 15 per cent., or a little less than one-sixth of the total number of fish.

A measure of the yield of cod from this region is given by the average per 10 hours fishing for the whole period. This is 9·3 cod, 0·70 cwt. codling and 1·63 cwt. total catch, which is equivalent to about 63 fish. The highest average is obtained in 1905 (2·10 cwt.) and the lowest in 1907 when it is 0·79 cwt. This average yield for the south central region of the North Sea is less than one half that found for the northern areas fished by the Aberdeen trawlers.* We also find that codling are more numerous in proportion to the total catch than in the northern region of the North Sea.

Yearly Variations.

For an analysis regarding the proportions of cod and codling and the fluctuations year by year, this method of lumping together the catches from all areas is very unsatisfactory. A better result would be obtained by treating each area separately, but this is impossible owing to the incompleteness of the data. As a closer approximation to the true values than the above, I have calculated the following figures from the catches from groups of areas : —

TABLE XVIII.—Showing for groups of areas, the yearly averages per ten hours fishing, and the percentage of the total weight formed by "Codling."

Group.	North Eastern A. B. C. F. G.				Eastern H. M. Q. W.				Central J. N. I. O.				Northern D. K. L.				Southern S. T.				Western E. R. P. V. X.			
	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.	No. of Cod.	Weight of Codling.	Total Weight.	Per cent.
1904	24·2	1·32	3·74	35	17·6	0·90	2·66	34	4·6	1·01	1·47	69	5·9	1·06	1·65	64	0·5	0·04	0·09	45	15·6	1·56	3·12	50
1905	18·2	1·05	2·87	37	14·3	0·49	1·92	26	5·8	0·94	1·52	62	30·2	0·61	3·63	17	1·1	0·33	0·44	75	15·3	3·69	5·22	71
1906	10·7	0·34	1·41	24	3·2	0·14	0·46	30	4·6	0·34	0·88	42	16·1	0·54	2·15	25	2·7	0·41	0·68	60	6·0	1·48	2·08	71
1907	—	—	—	38	3·2	0·21	0·53	40	4·8	0·28	0·76	37	22·4	0·40	2·64	15	1·5	0·08	0·23	33	5·7	0·43	1·00	50

In this grouping, the catches from area V (the Silver Pits) were included in the western group of areas, as they approximated more in value to these than to the southern group. It must be remembered in drawing conclusions from this table, that the records in 1904 only began in May, so that those groups of areas where cod are very numerous in the winter and early spring, as in the northern areas at the spawning time, result in averages which are relatively too low in that year.

Cod are most numerous and in the largest proportions in the north eastern and northern areas. In the two most northerly (H and M) of the eastern areas, they are also fairly numerous and form the largest portion of the catch. Only about one quarter the number in the most productive areas are found in the central areas, and in the southern areas still less, averaging only one or two. They were found in fair numbers in the deeper parts of the western areas.

The biggest catches of *codling* come from the western areas and the least from the southern. Considering all sizes together, the most productive areas are the north-eastern, northern, and western groups, and the eastern area H. The other eastern areas, and the central group have about one half the quantities taken from these, and in the southernmost areas, S and T, the quantities are very small, and here also the proportion of small fish is large.

The catches of cod seem to be falling off in the north-eastern, eastern and central groups of areas. With regard to the other groups it is more difficult to speak definitely, for the averages are not always representative of the greater part of the year. For instance, in the northern group there are no observations in 1904 in the spring months, which considerably lowers the average, while that of 1907 is raised, because observations from April to September, when the quantities in these areas are low, are lacking.

This yearly decline is further corroborated by the following table, formed by comparing in each area the catches of corresponding months in the different years :—

1905 is 19 times less than, and 20 times greater than 1904, out of 40 months.
1906 is 25 times less than, and 10 times greater than 1904, out of 35 months.
1907 is 18 times less than, and 6 times greater than 1904, out of 25 months.

1906 is 26 times less than, and 19 times greater than 1905, out of 46 months.
1907 is 25 times less than, and 7 times greater than 1905, out of 34 months.

1907 is 24 times less than, and 8 times greater than 1906, out of 33 months.

* D'ARCY THOMPSON. On the Statistics of the Aberdeen Trawl Fishery, 1901–1906, p. 5. Rapports et Proc.-Verb. Vol. X.

Each year, with the exception of 1905, is seen to be considerably more often less than the preceding years than greater than them, and this is still the case, even if we take account of the fact that there are some averages (marked with an asterisk in Table XIX.) which are unduly high.

How far this decline in the averages may be due to chance or to special circumstances connected with this particular region, it is impossible to say. It is, however, a fact that the total quantities taken during the first three years of this period from the whole of the North Sea, do not show the same kind of fluctuation.* The total quantities decreased between 1904 and 1905, but in 1906 there was a considerable increase, mainly in the numbers of small fish. Yet, on the other hand, D'Arcy Thompson† finds declining *averages* for cod in nearly all regions of the North Sea during the three years 1905–1907, so that the rise in the *total* quantities is probably due to there being greater catching power, and to the fishing being extended to more distant grounds where cod are more plentiful.

Discussion of the Fluctuations in each Area.

The monthly average number of "cod" and weight of codling per 10 hours fishing is given in Table XIX. together with the monthly averages of the years combined.

North-Eastern Areas.

The averages for this group of areas are very incomplete and no system of combining or smoothing gives a satisfactory result for the seasonal fluctuations. The catches are large, three or four hundredweight being of fairly common occurrence. The large fish were sometimes found in shoals for a short time, so that their proportions to the total were very irregular. They predominate in weight on nearly every occasion—on the whole forming about twice the bulk of the small. The catches of the winter 1904–1905 made in areas F and G were large compared with those of the summer, when, though codling were present in good quantities "cod" were generally scarce, except in several hauls in September, when they were taken in scores.

Eastern Areas.

Area H.—This is an area which yielded very large amounts of cod during the two years when we have fairly reliable averages. In these two years we find a well marked seasonal fluctuation affecting both the large and small fish alike. This is shown on the two following curves. (Figs. 61 and 62).

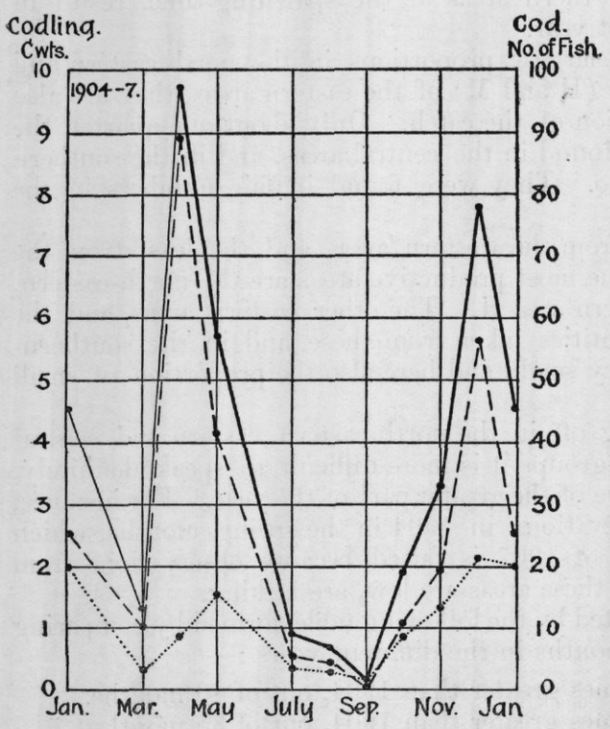

FIG. 61.—COD, Area H. Monthly Averages, 1904–1907.

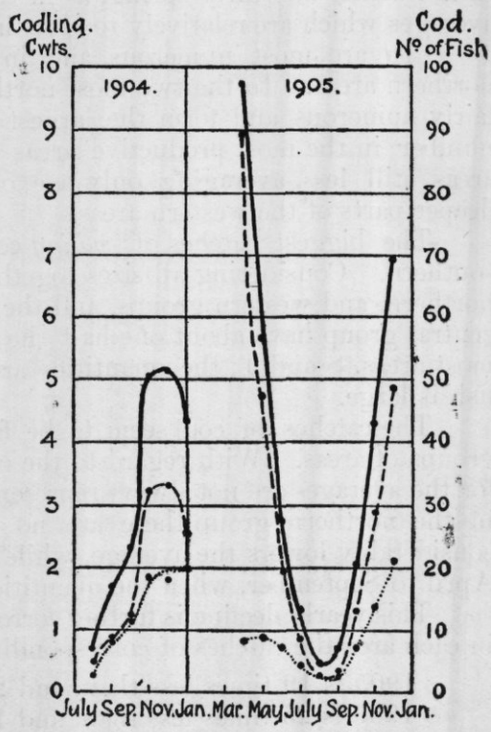

FIG. 62.—COD. Area H. Monthly Averages (smoothed curves).

Continuous line represents all sizes combined; dashed line, "cod;" dotted line, codling.

* Bulletin Statisque. Vol. III., p. 34. *Conseil Perm*; *Internat. pour l'Explor. de la Mer.*

† D'ARCY THOMPSON. Report on Fishery and Hydrographical Investigations in the North Sea. Third Report. Northern Area. *Cd.* 4350. p. v.

To face page 68.

TABLE XIX.—SHOWING for each area the Monthly Average Number of COD, the Average Weight of CODLING, and the total catch of Cod and Codling in cwts. per 10 hours' fishing.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	
NORTH-EASTERN AREAS.	A	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45·5	0·13	$4·68^{22}$	...	...	...	...	...	...	...	...	...	...	...	...	A
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17·5	2·23	$3·98^{44}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**17·5**	**2·23**	**$3·98^{44}$**	**45·5**	**0·13**	**$4·68^{22}$**	...	...	...	...	...	...	...	...	...	...	...	...	
	B	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	30·0*	0·00	$3·00^{18}$	10·4	0·76	$1·80^{88}$	3·6	0·84	$1·20^{117}$	4·8	1·12	$1·60^{64}$	...	...	...	B
		1905	...	...	...	...	...	...	...	...	...	10·7	0·98	$2·05^{30}$	2·4	0·34	$0·58^{17}$	...	...	...	...	...	...	...	...	...	22·3*	1·35	$3·58^{169}$	45·0*	0·56	$5·06^{29}$	15·0	0·00	$1·50^{4}$	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10·7	0·79	$1·86^{113}$	12·3	0·75	$1·98^{39}$	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	**10·7**	**0·98**	**$2·05^{30}$**	**2·4**	**0·34**	**$0·58^{12}$**	...	...	...	...	...	...	**30·0***	**0·00**	**$3·00^{18}$**	**18·0***	**1·14**	**$2·94^{248}$**	**10·1***	**0·80**	**$1·81^{350}$**	**7·9**	**0·94**	**$1·73^{107}$**	...	...	...	
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
		1905	...	...	...	...	...	...	20·0	0·00	$2·00^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10·0	0·70	$1·70^{4}$	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8·9	0·00	$0·89^{4}$	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**20·0**	**0·00**	**$2·00^{8}$**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**10·0**	**0·70**	**$1·70^{4}$**	...	...	...	**8·9**	**0·00**	**$0·89^{4}$**	
	F	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	57·8*	3·02	$8·80^{68}$	0·0	0·70	$0·70^{5}$	0·0	0·35	$0·35^{5}$	39·5*	1·80	$5·75^{65}$	...	...	...	22·0	1·33	$3·53^{94}$	34·5	2·06	$5·51^{139}$	F
		1905	...	...	...	...	...	...	12·0	0·34	$1·54^{12}$	...	...	...	...	...	...	...	...	...	13·7	0·94	$2·31^{52}$	0·0	1·10	$1·10^{25}$	3·2	1·04	$1·36^{109}$	22·0	1·47	$3·67^{94}$	0·0	0·70	$0·70^{5}$	0·0	0·88	$0·88^{5}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26·7*	1·12	$3·79^{35}$	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**12·0**	**0·34**	**$1·54^{12}$**	...	...	...	...	...	...	**57·8***	**3·02**	**$8·80^{68}$**	**11·8**	**0·91**	**$2·05^{50}$**	**12·4***	**1·04**	**$2·28^{31}$**	**16·9***	**1·32**	**$3·01^{174}$**	**22·0**	**1·47**	**$3·67^{94}$**	**19 6**	**1·26**	**$3·22^{72}$**	**32·3**	**1·99**	**$5·22^{128}$**	
	G	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6·8*	1·04	$1·72^{29}$	...	...	...	9·5*	0·09	$1·04^{32}$	45·9*	1·42	$6·01^{88}$	11·1	1·02	$2·13^{44}$	7·5	1·40	$2·15^{4}$	...	...	...	G
		1905	38·1	0·39	$4·20^{108}$	35·0	0·28	$3·78^{8}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	1·40	$1·40^{4}$	...	...	...	0·0	0·77	$0·77^{15}$	...	...	...	0·0	0·28	$0·28^{5}$	
		1906	4·9	0·00	$0·49^{21}$	4·6	0·05	$0·51^{28}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14·8	0·73	$2·21^{36}$	...	...	...	
		1904–7	**32 8**	**0·33**	**$3·61^{129}$**	**7·4**	**0·07**	**$0·81^{36}$**	...	...	...	...	...	...	...	...	...	**6·8***	**1·04**	**$1·72^{29}$**	...	...	...	**8·5***	**0·23**	**$1·08^{36}$**	**45·9***	**1·42**	**$6·01^{88}$**	**8·3**	**0·96**	**$1·78^{59}$**	**14·5**	**0·75**	**$2·20^{100}$**	**0·0**	**0·28**	**$0·28^{5}$**	
EASTERN AREAS.	H	1904	...	...	...	...	...	...	...	...	...	...	...	...	66·0	2·80	$9·40^{59}$	...	...	...	...	...	...	4·4	0·26	$0·70^{16}$	0·0	0·00	$0·00^{15}$	22·6*	2·14	$4·40^{73}$	14·1*	1·25	$2·66^{285}$	59·8*	2·19	$8·17^{191}$	H
		1905	25·9	2·00	$4·59^{347}$	...	...	...	10·0	0·30	$1·30^{9}$	89·1	0·83	$9·74^{135}$	33·6	1·22	$4·58^{179}$	...	...	...	5·6	0·35	$0·91^{16}$	...	...	...	0·3	0·17	$0·20^{10}$	9·3	0·66	$1·59^{265}$	29·5*	1·42	$4·37^{257}$	48·2	2·13	$6·95^{54}$	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·6	1·86	$2·42^{16}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	13·2	1·69	$3·01^{79}$	...	...	...	
		1904–7	**25·9**	**2·00**	**$4·59^{347}$**	...	...	...	[**10·0**	**0·30**	**$1·30^{9}$**]	**89·1**	**0·83**	**$9·74^{135}$**	**41·1**	**1·59**	**$5·76^{229}$**	...	...	...	**5·6**	**0·35**	**$0·91^{16}$**	**4·4**	**0·26**	**$0·70^{16}$**	**0·2**	**0·13**	**$0·15^{55}$**	**10·7***	**0·85**	**$1·92^{454}$**	**19·5***	**1·35**	**$3·36^{712}$**	**56·3***	**2·17**	**$7·59^{275}$**	
	M	1904	...	...	...	...	...	...	...	...	...	...	...	...	6·3	0·15	$0·78^{76}$	7·2	0·05	$0·77^{262}$	0·0	0·00	$0·00^{114}$	3·1	0·06	$0·37^{48}$	...	...	...	...	...	...	68·0*	1·91	$8·71^{30}$	26·5*	1·55	$4·20^{229}$	M
		1905	25·3	0·63	$3·16^{53}$	...	...	...	0·4	0·00	$0·04^{49}$	3·5	0·00	$0·35^{58}$	9·1*	0·08	$0·99^{310}$	2·5	0·03	$0·28^{261}$	...	...	...	...	...	...	0·0	0·00	$0·00^{61}$	7·4	0·62	$1·36^{13}$	25·2*	0·83	$3·35^{254}$	68·5	1·94	$8·79^{91}$	
		1906	...	...	...	...	...	...	...	...	...	5·0	+	$0·50^{87}$	3·5	0·00	$0·35^{423}$	2·0	0·00	$0·20^{451}$	0·4	0·00	$0·04^{286}$	0·0	0·00	$0·00^{76}$	...	...	...	10·6	0·92	$1·98^{78}$	3·3	0·04	$0·37^{81}$	7·8	1·24	$2·02^{202}$	
		1907	...	...	...	...	...	...	...	...	...	2·0	0·01	$0·21^{155}$	1·9	+	$0·19^{442}$	2·0	+	$0·20^{333}$	0·0	0·00	$0·00^{90}$	...	...	...	...	...	...	...	...	...	0·0	0·00	$0·00^{7}$	8·3	1·74	$2·57^{160}$	
		1904–7	**25·3**	**0·63**	**$3·16^{53}$**	...	...	...	**0·4**	**0·00**	**$0·04^{49}$**	**3·8**	+	**$0·38^{109}$**	**5·8***	**0·04**	**$0·62^{1731}$**	**3·0**	**0·02**	**$0·32^{1797}$**	**0·2**	**0·00**	**$0·02^{480}$**	**1·2**	**0·02**	**$0·14^{124}$**	**0·0**	**0·00**	**$0·06^{61}$**	**9·5**	**0·82**	**$1·77^{41}$**	**23·6***	**0·74**	**$3·16^{402}$**	**22·8***	**1·55**	**$3·83^{782}$**	
	Q	1904	...	...	...	...	...	...	...	...	...	...	...	...	2·2	0·00	$0·22^{4}$	0·0	0·00	$0·00^{48}$	0·0	+	$+^{112}$	0·0	0·00	$0·00^{48}$	0·1	0·00	$0·01^{115}$	1·3	0·00	$0·13^{8}$	...	...	...	...	...	...	Q
		1905	...	...	...	...	...	...	5·9	+	$0·59^{222}$	1·2	0·01	$0·13^{99}$	1·5	0·00	$0·15^{149}$	2·4	0·00	$0·24^{99}$	0·5	0·00	$0·05^{73}$	0·1	0·00	$0·01^{290}$	0·0	0·00	$0·00^{24}$	...	...	...	4·7	0·00	$0·47^{8}$	4·4	0·03	$0·47^{9}$	
		1906	...	...	...	...	...	...	11·1	0·00	$1·11^{43}$	...	...	...	4·6	0·02	$0·48^{67}$	0·7	0·00	$0·07^{106}$	0·0	0·00	$0·00^{8}$	0·0	0·01	$0·01^{35}$	...	...	...	0·0	0·00	$0·00^{35}$	...	...	...	...	...	...	
		1907	...	...	...	2·6	0·05	$0·31^{15}$	8·9	0·04	$0·93^{118}$	5·3	+	$0·53^{57}$	4·7	0·02	$0·49^{184}$	1·2	0·00	$0·12^{40}$	0·0	0·00	$0·00^{47}$	0·5	0·00	$0·05^{113}$	0·0	0·00	$0·00^{120}$	0·0	0·00	$0·00^{28}$	0·0	0·00	$0·00^{7}$	...	...	...	
		1904–7	...	...	...	**2·6**	**0·05**	**$0·31^{15}$**	**7·1**	**0·01**	**$0·72^{483}$**	**2·7**	**0·01**	**$0·28^{156}$**	**3·5**	**0·01**	**$0·36^{805}$**	**0·8**	**0·00**	**$0·08^{214}$**	**0·2**	+	**$0·02^{240}$**	**0·2**	+	**$0·02^{486}$**	+	**0·00**	$+^{269}$	**0·1**	**0·00**	**$0·01^{71}$**	**2·6**	**0·00**	**$0·26^{15}$**	**4·4**	**0·03**	**$0·47^{9}$**	
	W	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·01	$0·01^{61}$	0·0	0·00	$0·00^{12}$	...	...	...	0·0	0·00	$0·00^{4}$	...	...	...	...	...	...	...	...	...	W
		1905	...	...	...	...	...	...	...	...	...	...	...	...	1·7	0·00	$0·17^{6}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·00	$0·00^{12}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·00	$0·00^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	**1·7**	**0·00**	**$0·17^{6}$**	**0·0**	**0·01**	**$0·01^{61}$**	**0·0**	**0·00**	**$0·00^{28}$**	...	...	...	**0·0**	**0·00**	**$0·00^{4}$**	**0·0**	**0·00**	**$0·00^{12}$**	...	...	...	...	...	...	

* One or two hauls with an exceptionally large number of Cod included.

TABLE XIX. (*continued*)—SHOWING for each area the Monthly Average Number of COD, the Average Weight of CODLING, and the total catch of Cod and Codling in cwts. per 10 hours' fishing.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	
CENTRAL AREAS.	J	1904	...	...	...	...	...	...	...	...	...	...	...	...	44·4	0·62	5·06^{9}	...	...	...	...	...	...	18·5	0·46	2·31^{75}	5·4	0·72	1·26^{205}	...	...	...	1·8	0·49	0·67^{77}	2·0	1·15	1·35^{491}	J
		1905	5·8	0·90	1·48^{105}	...	...	...	...	...	...	...	...	...	0·0	0·35	0·35^{20}	...	...	...	...	...	...	...	...	...	28·2*	0·87	3·69^{95}	7·1	0·95	1·66^{78}	3·3	0·48	0·81^{64}	2·0	0·59	0·79^{88}	
		1906	4·0	0·14	0·54^{28}	18·0	0·16	1·96^{30}	...	...	...	...	...	...	4·5	0·16	0·61^{77}	...	...	...	...	...	...	11·6	0·43	1·59^{92}	3·6	0·48	0·84^{90}	7·1	0·31	1·02^{284}	9·4	0·43	1·37^{130}	1·1	0·20	0·31^{28}	
		1907	...	...	...	...	...	...	7·3	0·14	0·87^{67}	10·3	0·75	1·78^{68}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3·8	0·27	0·65^{16}	...	...	...	
		1904–7	**5·4**	**0·74**	**1·28^{133}**	**18·0**	**0·16**	**1·96^{30}**	**7·3**	**0·14**	**0·87^{67}**	**10·3**	**0·75**	**1·78^{68}**	**7·0**	**0·24**	**0·94^{106}**	...	...	...	...	...	...	**14·7**	**0·44**	**1·91^{167}**	**10·6***	**0·70**	**1·76^{300}**	**7·1**	**0·45**	**1·16^{382}**	**5·7**	**0·45**	**1·02^{287}**	**2·0**	**0·98**	**1·18^{627}**	
	N	1904	...	...	...	...	...	...	...	...	...	...	...	...	3·2	0·10	0·42^{28}	2·0	0·10	0·30^{40}	0·2	+	0·02^{205}	0·2	0·81	0·83^{109}	3·3	0·60	0·93^{98}	4·7*	0·97	1·44^{144}	3·3	0·55	0·88^{152}	2·2	0·39	0·61^{136}	N
		1905	49·4*	0·00	4·94^{3}	26·3	0·04	2·67^{40}	38·3	0·38	4·21^{52}	18·8	0·07	1·95^{60}	3·6	0·14	0·50^{52}	9·4	0·01	0·95^{130}	4·0	0·07	0·47^{76}	1·6	0·16	0·32^{272}	0·2	0·02	0·04^{274}	...	...	...	1·9	0·31	0·50^{219}	2·8	0·65	0·93^{412}	
		1906	5·9	0·41	1·00^{421}	4·2	0·01	0·43^{310}	7·6	0·18	0·94^{283}	5·2	0·00	0·52^{14}	4·9	0·05	0·54^{99}	0·9	0·01	0·10^{83}	1·1	0·39	0·50^{76}	0·3	0·46	0·49^{197}	0·0	0·11	0·11^{31}	0·7	0·14	0·21^{108}	2·6	0·45	0·71^{201}	0·3	0·28	0·31^{74}	
		1907	2·0	0·68	0·88^{206}	0·3	0·21	0·24^{125}	8·2	0·08	0·90^{223}	5·5	0·03	0·58^{132}	3·3	0·02	0·35^{74}	1·4	0·00	0·14^{71}	0·2	0·03	0·05^{118}	0·4	0·15	0·19^{45}	0·0	+	+^{235}	0·8	0·02	0·10^{299}	4·5	0·07	0·52^{354}	1·2	0·05	0·17^{96}	
		1904–7	**4·8***	**0·52**	**1·00^{735}**	**5·0**	**0·06**	**0·56^{475}**	**10·7**	**0 16**	**1·23^{563}**	**9·4**	**0·04**	**0·88^{706}**	**3·9**	**0·07**	**0·46^{251}**	**4·7**	**0·02**	**0·45^{333}**	**0·9**	**0 08**	**0·17^{475}**	**0·9**	**0·37**	**0·46^{823}**	**0·6**	**0·11**	**0·17^{958}**	**1·8***	**0·29**	**0·47^{551}**	**3·3**	**0·30**	**0·63^{956}**	**2·2**	**0·43**	**0·70^{718}**	
	I	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·3	0·88	0·91^{101}	0·0	0·61	0·61^{18}	1·9	0·65	0·84^{319}	7·7*	1·12	1·89^{225}	35·1*	2·98	6·49^{218}	1·5	0·55	0·70^{199}	2·0	0·99	1·19^{359}	I
		1905	21·4*	0·67	2·81^{87}	8·6	0·17	1·03^{17}	...	...	...	...	...	...	...	...	...	5·6	0·03	0·59^{52}	6·7*	0·59	1·26^{121}	3·1	0·55	0·86^{263}	5·3*	0·33	0·86^{252}	...	...	...	0·4	0·40	0·44^{139}	2·7	0·91	1·18^{47}	
		1906	6·7	0·69	1·36^{79}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·3	0·83	0·86^{74}	...	...	...	2·6	0·77	1·03^{31}	0·0	0·00	0·00^{13}	0·6	0·24	0·30^{65}	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·1*	0·04	0·55^{160}	1·1	0·12	0·23^{71}	0·7	0·00	0·07^{27}	...	...	...	
		1904–7	**14·4***	**0·68**	**2·12^{166}**	**8·6**	**0·17**	**1·03^{17}**	...	...	...	...	...	...	...	...	...	**2·1**	**0·59**	**0·80^{153}**	**3·9***	**0·67**	**1·06^{213}**	**2·4**	**0·61**	**0·85^{582}**	**5·7***	**0·47**	**1.04^{1068}**	**25·8***	**2·19**	**4·72^{200}**	**1·0**	**0·42**	**0·52^{421}**	**2·1**	**0·98**	**1·19^{626}**	
	O	1904	...	...	...	...	...	...	...	...	...	...	...	...	19·0	3·36	5·26^{10}	5·3	2·03	2·56^{100}	1·8	0·76	0·94^{149}	0·6	1·03	1·09^{254}	3·9*	1·30	1·69^{216}	3·0	1·29	1·59^{356}	3·8	1·49	1·87^{278}	1·6	1·00	1·16^{97}	O
		1905	6·7	0·76	1·43^{109}	3·7	1·27	1·64^{56}	5·9	1·36	1·95^{150}	5·5	1·95	2·50^{613}	7·1	2·17	2·88^{395}	7·4	1·70	2·44^{121}	2·8	1·27	1·55^{255}	4·0	2·29	2·69^{99}	...	...	...	4·5	1·33	1·78^{227}	1·4	0·78	0·92^{175}	7·9	1·49	2·28^{538}	
		1906	...	...	...	11·4	9·07	10·21^{11}	0·0	0·33	0·33^{3}	6·7	0·83	1·50^{14}	0·0	1·12	1·12^{10}	...	...	...	...	...	...	...	...	...	0·0	1·60	1·60^{4}	0·0	0·73	0·73^{14}	0·0	0·70	0·70^{4}	...	...	...	
		1907	19·0	1·25	3·15^{231}	...	...	...	6·0	0·23	0·83^{30}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8·0	1·05	1·85^{68}	...	...	...	
		1904–7	**15·8**	**1·12**	**2·70^{381}**	**4·9**	**2·49**	**2·98^{87}**	**5·7**	**0·94**	**1·51^{230}**	**5·6**	**1·92**	**2·48^{627}**	**7·2**	**2·18**	**1·90^{415}**	**6·4**	**1·85**	**2·48^{221}**	**2·4**	**1·08**	**1·32^{494}**	**1·5**	**1·38**	**1·53^{353}**	**3·9***	**1·30**	**1·69^{220}**	**3 7**	**1·30**	**1·67^{697}**	**3·5**	**1·19**	**1·54^{325}**	**6·9**	**1·41**	**2·16^{635}**	
NORTHERN AREAS.	D	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3·7	0·37	0·74^{37}	...	...	...	D
		1905	51·7	0·13	5·30^{61}	31·0	0·45	3·55^{760}	13·1	0·48	1·79^{647}	6·5	0·34	0·99^{24}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8·8	0·30	1·18^{69}	
		1906	...	...	...	25·7	0·92	3·49^{85}	13·2	0·18	1·50^{257}	...	...	...	...	...	...	...	...	...	...	...	...	37·9*	0·51	4·30^{131}	33·8	0·41	3·79^{24}	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	26·1	0·35	2·96^{28}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**51·7**	**0·13**	**5·30^{61}**	**30 4**	**0·50**	**3·54^{945}**	**13·5**	**0·39**	**1·74^{322}**	**6·5**	**0·34**	**0·99^{24}**	...	...	...	...	...	...	...	...	...	**37·9***	**0·51**	**4·30^{131}**	**33·8**	**0·41**	**3·79^{24}**	...	...	...	**3·7**	**0·37**	**0·74^{37}**	**8·8**	**0·30**	**1·18^{69}**	
	K	1904	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·00	0·00^{4}	1·6	0·91	1·07^{38}	...	...	...	1·4	1·00	1·14^{7}	1·2	0·53	0·65^{43}	5·4	1·44	1·98^{95}	4·2	0·78	1·20^{91}	...	...	...	K
		1905	46·7*	0·62	5·29^{211}	50·8	0·70	5·78^{239}	12·0	0·48	1·68^{29}	...	...	...	...	...	...	...	...	...	...	...	...	0·0	1·40	1·40^{4}	20·9	2·37	2·46^{71}	0·0	0·70	0·70^{4}	...	...	...	...	...	...	
		1906	58·1	0·00	5·81^{31}	10·8	0·12	1·20^{24}	17·3	0·00	1·73^{44}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·96	0.96^{21}	...	...	...	...	...	...	...	...	...	
		1907	32·3	0·64	3·87^{55}	24·5	0·51	2·96^{232}	23·6	0·35	2·71^{235}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·00	0·00^{11}	0·0	0·18	0·18^{3}	...	...	...	
		1904–7	**45·2***	**0·56**	**5·08^{297}**	**36·6**	**0·58**	**4·24^{425}**	**21·6**	**0·31**	**2·47^{308}**	...	...	...	**0·0**	**0·00**	**0·00^{4}**	**1·6**	**0·91**	**1·07^{38}**	...	...	...	**0·9**	**1·15**	**1·24^{11}**	**11·3**	**1·56**	**2·69^{125}**	**4·6**	**1·27**	**1·73^{110}**	**3·1**	**0·62**	**0·93^{29}**	...	...	...	
	L	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·9	1·30	2·09^{21}	10·0	0·93	1·93^{6}	2·8	1·14	1·42^{34}	10·8*	1·27	2·35^{195}	4·4	0·76	1·20^{93}	0 0	0·33	0·33^{3}	...	...	...	L
		1905	9·1	0·45	1·36^{34}	43·0	0·41	4·71^{625}	18·3	0·36	2·19^{199}	2·9	1·61	1·90^{111}	11·0	1·21	1·31^{30}	2·9	1·00	1·29^{7}	3·7	0·73	1·10^{79}	109·4*	0·47	11·41^{18}	99·0	2·76	12·66^{31}	...	...	...	...	...	...	14·3	0·75	2·18^{36}	
		1906	25·6	1·25	3·81^{132}	40·8	0·40	4·48^{242}	...	...	...	...	...	...	5·4	0·53	1·07^{199}	11·0*	0·32	1·42^{168}	2·6	0·49	7·57^{2}	1·0	0·51	0·61^{101}	2·8	0·79	1·07^{308}	1·5	0·61	0·76^{136}	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	11·0	0·16	1·26^{60}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·0	0·00	0·00^{13}	...	...	...	...	...	...	
		1904–7	**19·2**	**0·94**	**2·86^{216}**	**42·4**	**0·41**	**4·65^{972}**	**16·6**	**0·31**	**1·97^{252}**	**2·9**	**1·61**	**1·99^{111}**	**6·2**	**0·62**	**1·24^{229}**	**10·1***	**0·51**	**1·52^{126}**	**3·3**	**0·61**	**0·94^{182}**	**11·4***	**0·77**	**1·91^{203}**	**18·8***	**1·22**	**3·16^{884}**	**2·3**	**0·62**	**0·85^{212}**	**0·0**	**0·33**	**0·33^{3}**	**14·3**	**0·75**	**2·18^{36}**	

* One or two hauls with an exceptionally large number of Cod included.

TABLE XIX. (*continued*)—SHOWING for each area the Monthly Average Number of COD, the Average Weight of CODLING, and the total catch of Cod and Codling in cwts. per 10 hours' fishing.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	Number of Cod.	Weight of Codling.	Total Weight.	
SOUTHERN AREAS.	S	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·8	+	$0·08^{216}$	0·6	0·03	$0·09^{345}$	0·0	0·07	$0·07^{454}$	1·0	0·00	$0·10^{100}$	0·2	0·01	$0·03^{103}$	...	...	...	...	...	...	S
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·1	+	$0·01^{617}$	+	0·02	$0·02^{749}$	0·9	0·16	$0·25^{45}$	2·5	0·35	$0·60^{4}$	0·0	1·32	$1·32^{8}$	3·0	0·73	$1·03^{13}$	
		1906	...	...	...	0·0	0·00	$0·00^{5}$	4·3	0·08	$0·51^{92}$	1·3	0·04	$0·17^{22}$	0·0	0·19	$0·19^{7}$	0·4	0·08	$0·12^{55}$	0·0	0·02	$0·02^{83}$	0·0	0·00	$0·00^{106}$	4·5*	0·66	$1·11^{220}$	0·0	0·01	$0·01^{56}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	2·2	+	$0·22^{461}$	0·2	+	$0·02^{348}$	0·0	0·01	$0·01^{271}$	...	...	...	...	...	...	...	...	...	0·0	0·02	$0·02^{16}$	...	...	...	
		1904–7	...	...	...	**[0·0**	**0·00**	**$0·00^{5}$]**	**4·3**	**0·08**	**$0·51^{92}$**	**1·3**	**0·04**	**$0·17^{22}$**	**2·1**	+	**$0·21^{468}$**	**0·4**	**0·01**	**$0·05^{619}$**	**0·2**	**0·01**	**$0·03^{1316}$**	+	**0·03**	**$0·03^{1309}$**	**3·1***	**0·42**	**$0·73^{365}$**	**0·2**	**0·02**	**$0·04^{163}$**	**0·0**	**0·47**	**$0·47^{24}$**	**3·0**	**0·73**	**$1·03^{13}$**	
	T	1904	...	...	...	...	...	...	...	...	...	...	...	...	5·4	0·00	$0·54^{13}$	0·8	0·00	$0·08^{24}$	0·0	0·00	$0·00^{10}$	0·0	0·00	$0·00^{8}$	0·0	0·00	$0·00^{8}$	...	...	...	3·1	0·23	$0·54^{22}$	...	...	...	T
		1905	...	...	...	...	...	...	...	...	...	...	...	...	3·8	0·53	$0·91^{55}$	...	...	...	0·2	0·13	$0·15^{48}$	0·1	0·01	$0·02^{29}$	0·6	1·23	$1·29^{100}$	1·6	0·89	$1·05^{177}$	1·8	0·73	$0·91^{343}$	4·6	0·73	$1·19^{340}$	
		1906	...	...	...	13·8	0·25	$1·63^{96}$	12·3	0·18	$1·41^{52}$	2·4	0·66	$0·90^{112}$	3·6	0·42	$0·78^{53}$	0·6	0·60	$0·66^{97}$	0·8	0·81	$0·89^{181}$	0·0	0·25	$0·25^{90}$	0·1	0·30	$0·31^{83}$	1·6	0·43	$0·59^{225}$	1·5	1·73	$1·88^{27}$	...	...	...	
		1907	...	..	...	...	...	...	...	...	...	13·0	0·11	$1·41^{39}$	3·6	0·21	$0·57^{25}$	0·4	0·08	$0·12^{143}$	0·0	0·02	$0·02^{91}$	...	...	...	0·0	0·35	$0·35^{20}$	0·8	0·52	$0·60^{84}$	3·4	0·28	$0·62^{212}$	10·0	0·70	$1·70^{12}$	
		1904–7	...	...	...	**13·8**	**0·25**	**$1·62^{96}$**	**12·3**	**0·18**	**$1·41^{52}$**	**5·1**	**0·52**	**$1·03^{151}$**	**3·8**	**0·39**	**$0·77^{146}$**	**0·5**	**0·27**	**$0·32^{264}$**	**0·5**	**0·47**	**$0·52^{330}$**	**0·1**	**0·13**	**$0·14^{177}$**	**0·3**	**0·74**	**$0·77^{211}$**	**1·5**	**0·61**	**$0·76^{836}$**	**2·4**	**0·60**	**$0·84^{804}$**	**4·8**	**0·72**	**$1·26^{352}$**	
	V	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	18·3	2·47	$4·30^{131}$	27·9*	2·49	$5·28^{86}$	6·6	0·83	$1·49^{45}$	...	...	...	6·7	0·41	$1·08^{13}$	...	...	...	V
		1905	...	...	...	...	...	...	37·2*	1·90	$5·62^{25}$	...	...	...	...	...	...	...	...	...	38·6	2·97	$6·83^{108}$	27·8*	2·73	$5·51^{29}$	...	..	...	12·5*	12·20*	$13·45^{28}$	...	...	...	...	...	...	
		1906	1·9	2·46	$2·65^{59}$	0·0	1·56	$1·56^{4}$	10·0	1·91	$2·91^{89}$	16·2	1·10	$2·72^{38}$	...	...	...	24·2	1·05	$3·47^{12}$	14·3	1·47	$2·90^{53}$	9·9	2·02	$3·01^{49}$	2·8	1·69	$1·97^{47}$	0·6	0·59	$0·65^{16}$	0·9	0·97	$1·06^{12}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	6·7	0·31	$0·98^{4}$	1·3	0·35	$0·48^{5}$	13·3	1·26	$2·59^{55}$	...	...	...	...	...	...	9·2	0·83	$1·75^{94}$	15·4*	0·50	$2·04^{28}$	4·7	0·26	$0·73^{48}$	
		1904–7	**1·9**	**2·46**	**$2·65^{59}$**	**0·0**	**1·56**	**$1·56^{4}$**	**16·5***	**1·91**	**$3·56^{105}$**	**16·2**	**1·10**	**$2·72^{38}$**	**6·7**	**0·31**	**$0·98^{4}$**	**15·0**	**0·77**	**$2·27^{20}$**	**23·2**	**2·28**	**$4·60^{347}$**	**22·5***	**2·39**	**$4·64^{164}$**	**4·7**	**1·26**	**$1·75^{92}$**	**8·5***	**3·16***	**$3·98^{138}$**	**10·0***	**0·58**	**$1·58^{53}$**	**4·7**	**0·26**	**$0·73^{48}$**	
WESTERN AREAS.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	E
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	0·0	0·09	$0·09^{8}$	...	...	...	0·0	0·21	$0·21^{7}$	...	...	...	...	...	...	0·5	0·97	$1·02^{18}$	0·0	0·17	$0·17^{11}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·0**	**0·09**	**$0·09^{8}$**	...	...	...	**0·0**	**0·21**	**$0·21^{7}$**	...	...	...	...	...	...	**0·5**	**0·97**	**$1·02^{18}$**	**0·0**	**0·17**	**$0·17^{11}$**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	R	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·6	0·47	$1·03^{9}$	4·4	0·62	$1·06^{4}$	R
		1905	...	...	...	...	...	...	85·7*	0·00	$8·57^{14}$	...	...	...	4·5	0·68	$1·13^{76}$	...	...	...	...	...	...	...	...	...	0·6	1·09	$1·15^{18}$	...	...	...	4·4	7·64	$8·08^{168}$	10·6*	5·88	$6·94^{212}$	
		1906	2·3	0·73	$0·96^{139}$	1·3	0·42	$0·55^{236}$	2·2	1·12	$1·34^{280}$	3·4	2·01	$2·35^{266}$	8·9	1·78	$2·67^{176}$	3·9	2·13	$2·52^{238}$	1·1	2·58	$2·69^{222}$	1·2	2·81	$2·93^{113}$	0·0	1·12	$1·12^{27}$	1·4	0·87	$1·01^{14}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	7·7	0·00	$0·77^{6}$	0·4	0·83	$0·87^{23}$	0·6	0·16	$0·22^{32}$	0·0	0·70	$0·70^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**2·3**	**0·73**	**$0·96^{139}$**	**1·3**	**0·42**	**$0·55^{236}$**	**6·2***	**1·06**	**$1·68^{294}$**	**3·5**	**1·96**	**$2·31^{372}$**	**6·9**	**1·40**	**$2·09^{275}$**	**3·5**	**1·89**	**$2·24^{370}$**	**1·1**	**2·55**	**$2·66^{226}$**	**1·2**	**2·81**	**$2·93^{113}$**	**0·4**	**1·10**	**$1·14^{75}$**	**1·4**	**0·87**	**$1·01^{14}$**	**4·4**	**7·28**	**$7·72^{177}$**	**10·4***	**5·77**	**$6·81^{216}$**	
	X	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9·6	1·21	$2·17^{109}$	0·0	1·78	$1·78^{60}$	3·9	0·30	$0·69^{30}$	...	...	...	3·0	2·37	$2·67^{33}$	119·4*	1·28	$13·22^{17}$	X
		1905	0·0	0·23	$0·23^{4}$	0·0	0·93	$0·93^{3}$	36·8	0·49	$4·17^{33}$	43·3*	0·39	$4·63^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	0·7	0·62	$0·69^{31}$	1·6	0·39	$0·55^{107}$	2·0	0·47	$0·67^{15}$	2·3	0·94	$1·17^{44}$	
		1906	...	...	...	12·2	0·31	$1·53^{9}$	18·3	0·62	$2·45^{60}$	10·5	1·12	$2·17^{77}$	17·3	0·76	$2·49^{52}$	28·1	0·85	$3·66^{156}$	8·2	1·86	$2·68^{112}$	1·8	0·72	$0·90^{93}$	1·9	0·94	$1·13^{64}$	0·5	0·77	$0·82^{20}$	0·0	0·96	$0·96^{16}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	9·8	0·41	$1·39^{42}$	2·5	0·35	$0·60^{8}$	7·1	0·49	$1·20^{86}$	...	...	...	...	...	...	1·3	0·05	$0·18^{183}$	0·0	0·19	$0·19^{38}$	4·5	0·29	$0·74^{25}$	
		1904–7	**[0·0**	**0·23**	**$0·23^{4}$]**	**[9·2**	**0·47**	**$1·38^{13}$]**	**27·1**	**0·56**	**$3·27^{113}$**	**14·5***	**1·01**	**$2·50^{89}$**	**13·6**	**0·59**	**$1·95^{104}$**	**26·8**	**0·83**	**$3·51^{164}$**	**8·3**	**1·22**	**$2·05^{317}$**	**1·1**	**1·14**	**$1·25^{153}$**	**2·1**	**0·71**	**$0·92^{125}$**	**1·3**	**0·21**	**$0·34^{310}$**	**1·4**	**1·16**	**$1·30^{92}$**	**26·7***	**0·82**	**$3·48^{96}$**	
	P	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14·9	1·13	$2·62^{13}$	...	...	...	13·8	0·70	$2·08^{8}$	...	...	...	...	...	...	...	...	...	P
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	73·8	1·66	$9·04^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	17·8	0·09	$1·87^{4}$	20·0	0·62	$2·62^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	0·4	1·11	$1·15^{24}$	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**17·8**	**0·09**	**$1·87^{4}$**	**20·0**	**0·62**	**$2·62^{4}$**	...	...	...	...	...	...	**19·0**	**1·17**	**$3·07^{229}$**	...	...	...	**3·8**	**1·01**	**$1·38^{32}$**	...	...	...	...	...	...	...	...	...	

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* One or two hauls with an exceptionally large number of Cod included.

They are present in the spring of 1904 and 1905 in large quantities, the large fish especially being numerous. A rapid emigration takes place in the summer and the quantities taken then are under one hundredweight. In both years they appear again about the middle of October and become still more numerous in November and December. Besides these increased quantities of cod and codling shown on the curve, there is a marked appearance of unmarketable codling towards the end of November. The catches keep fairly high in January, but for February and March we have no information, and it is hardly probable that the quantities decrease so rapidly as shown in Fig. 61.

Horn Reef North appears to be one of the cod spawning areas, and as it is near the coast, they are found already spawning in December and January.

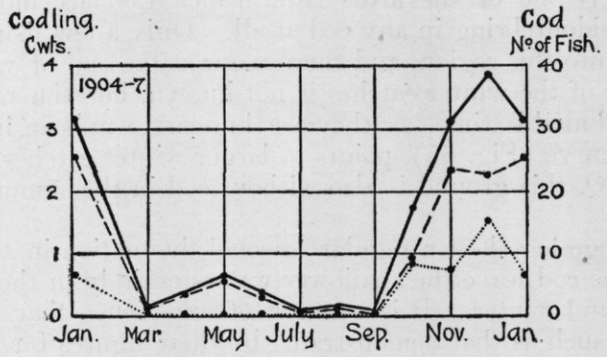

FIG. 63.—COD. Area M. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, "cod" ; dotted line, "codling."

Area M.—The curve of averages (Fig. 63) shows considerable differences between the summer and winter catches of cod. The highest averages, from 2 to 9 cwt., are found in November and December of each year and in January, 1905. The summer catches, July to September, are exceeding small ; those of April to June are a little higher. The February and March averages are uncertain, but we conclude they must be declining as there is a sharp fall from December to April. This winter immigration consists of a large number of "cod" in the first two years, as well as considerable quantities of codling ; in the last two years all are less numerous and the codling exceed the "cod" in bulk (Fig. 64).

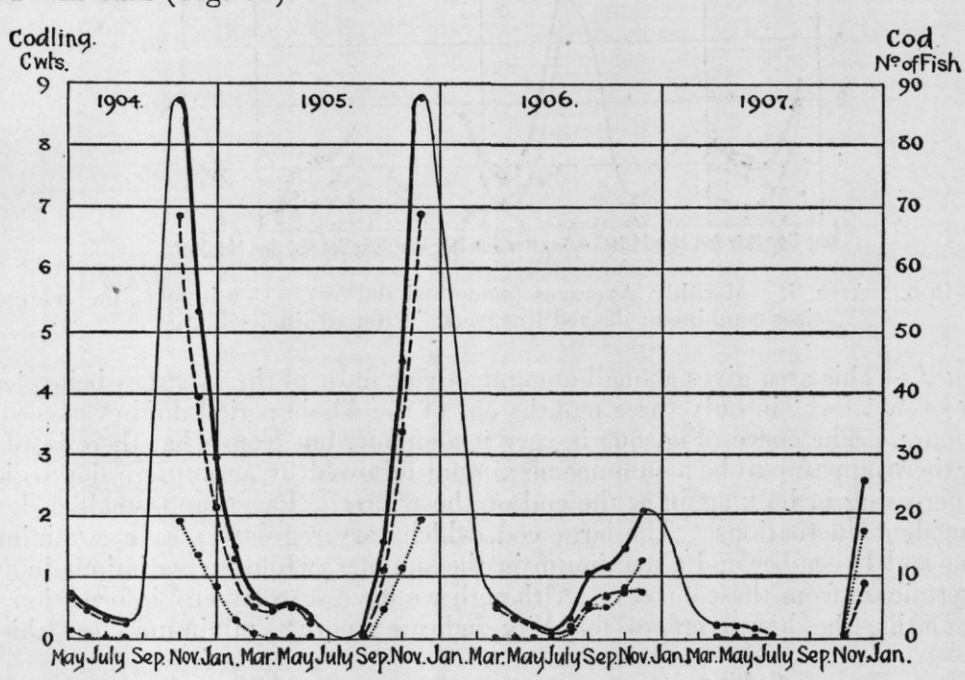

FIG. 64—COD. Area M. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, "cod" ; dotted line, "codling."

The falling off in the catches is evident from the diagrams. In 1904 they are noticed to become rare on the Sylt grounds about the third week in December. In 1905 they are present in November but they do not become at all numerous till the very end of the month. It is interesting to compare these catches with the results of some voyages to the same area in May and June, 1895.* These, worked out as ten-hourly averages,

* CUNNINGHAM.—North Sea Investigations, Loc. cit.

give 12·8 cod in May and 2·9 cod and 0·20 cwt. codling in June, both more than the averages for May and June in these statistics.

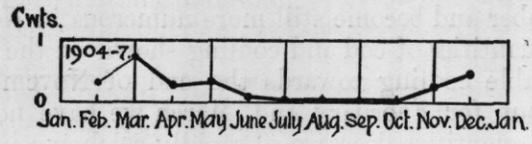

FIG. 65.—COD. Area Q. Monthly Averages, 1904–1907. Continuous line represents all sizes of fish.

Area Q.—This is one of the areas from which Cod are mostly absent. In the summer the hauls seldom bring in any cod at all. Only a few fish, and these nearly all large, find their way into this region, and these occur at the end of winter or beginning of spring. The amount of the winter catches is not known, but the numbers are probably considerably increased at this time, as they are known to appear in the adjacent areas, and the trend of the curve (Fig. 65), points to larger winter catches.

Area W.—Like Q, this ground is also without cod in the summer.

The four areas together show a regular seasonal fluctuation in the cod taken on the eastern grounds. The cod leave the shallower waters entirely in the summer and appear again in the autumn and winter. It is a matter of experience that an *inshore* migration of cod in the autumn, such as that demonstrated by these figures for the eastern grounds, is general on all North Sea coasts—as at Scarborough, Flamborough, Lowestoft and Ymuiden.

The number of Cod in the Horn Reef North ground is large, but in the other areas much smaller, especially in Q where the total catch seldom reaches 1 cwt. Large fish generally predominate in weight, and off the Danish coast in the winter are comparatively numerous.

The four areas also show a decrease in the latter years as compared with the first two.

Central Areas.

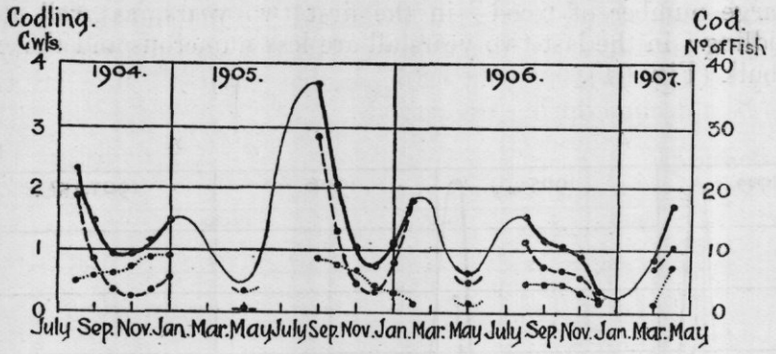

FIG. 66.—COD. Area J. Monthly Averages (smoothed curves). Continuous line represents all sizes combined; dashed line, "cod"; dotted line, codling.

Area J.—This area gives a small amount of cod, most of the averages being less than 2 cwt. or even 1 cwt., in only three months out of the whole period do they exceed 2 cwt. per ten hours. The curve (Fig. 66) is very incomplete, but from what there is of it, we see that there appears to be a summer maximum followed by an autumn depression, the catches increasing in bulk again at the end of the winter. Large and small cod do not have coincident fluctuations. The large cod, which vary regularly, have a minimum in November and December and a maximum in the summer, while the variations in codling are indeterminate from these curves. Although we have scarcely any information for the spring months, the low averages for May indicate another minimum near this time

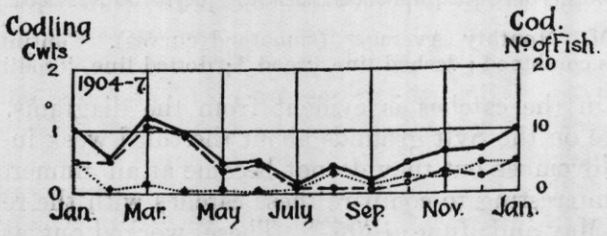

FIG. 67.—COD. Area N. Monthly Averages, 1904–1907. Continuous line represents all sizes combined; dashed line, "cod"; dotted line, codling.

We note the fact that in the grounds to the north of this area, there are, generally speaking, an early summer minimum and a September maximum and a decline in the catch in the autumn between this a winter maximum, which comes earlier than that in in area J. The comparatively large catches in September are in no small way due to some irregularly occurring shoals.

Area N.—This area being more southerly than area J, yields a smaller quantity of cod, the mean monthly value being 0·61 cwt., less than one half that in area J (1·39 cwt.). From Fig. 67 we see that the general average scarcely ever reaches one cwt.

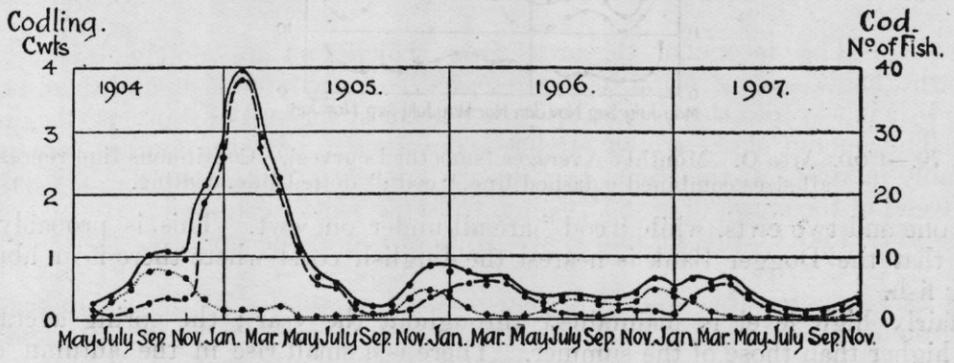

FIG. 68.—COD. Area N. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, "cod"; dotted line, codling.

The population is mixed, consisting of large fish and codling in the proportion of two to one by weight. The smoothed curve (Fig. 68) shows periodic fluctuations for cod and codling, which are, roughly speaking, complementary to one another. Large cod are at a maximum at the beginning of spring and at a very low minimum in the summer and September, when they are at times absent altogether. On the other hand, codling are very scarce in spring and early summer. They begin to increase in July and the maximum comes in the autumn and winter. The total catches are at their greatest in winter and spring and are least in summer.

The average number of cod is greatest at the end of 1904 and the beginning of 1905. The 1906 and 1907 averages are much lower but not very different from one another. Codling appear to be least in 1905 and 1907, so that when all sizes are taken together, there is found to be a decline during the period.

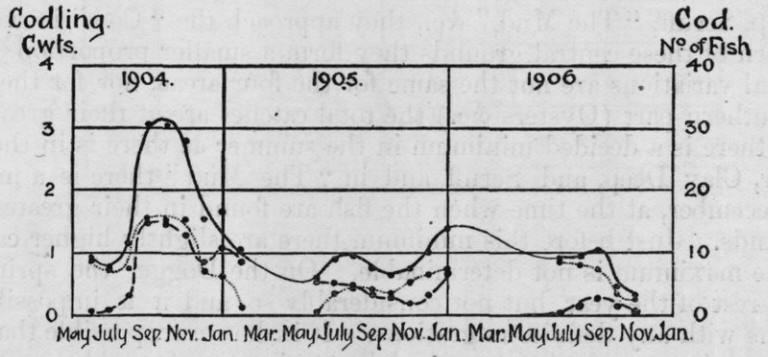

FIG. 69.—COD. Area I. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, "cod ;" dotted line, codling.

Area I.—The average yield from this area is similar to that from area J, and in this case the codling predominate, except in those months when the large cod are found in one or two great shoals.

In 1904 there is a minimum in summer and then a sharp increase to a very high maximum in October—November is low, but there is an increase in December and January. In 1905 the summer and winter averages remain much the same as in 1904, but the October maximum did not appear as there were no observations in that month. In 1906 the summer catches are slightly higher than the autumn ones. In each year the November averages are low. Records for the spring months are entirely wanting so we cannot determine the seasonal fluctuations for the whole year. The outstanding features are a November minimum and slightly increased quantities before and after this.

Herring were present in October, 1904, in the neighbourhood of the hauls made in this area, and their presence may partly explain the large number of cod in that month.

Area O.—Of these four areas, the Dogger Bank has the greatest amount of cod. The large fish are not more abundant than in the adjacent areas, but the difference is

made up in the amount of codling, which in this area are decidedly more numerous than the cod. In the smoothed curve (Fig. 70) the averages for codling alone vary

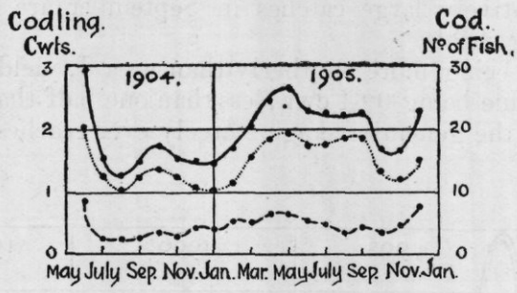

FIG. 70.—COD. Area O. Monthly Averages (smoothed curves). Continuous line represents all sizes combined; dashed line, "cod;" dotted line, codling.

between one and two cwts. while "cod" are all under one cwt. This is probably due to the fact that the Dogger Bank is nearest the English coast where there is an abundance of young fish.

A fairly high level is maintained throughout the year; the spring averages are slightly higher than those of the summer. There is a small rise in the autumn of 1904 and another small fall to December. In 1905 the December value is high and in 1907 there are large numbers in January. In the spring of 1905 an abundance of very small fish was noticed, and amongst these was a number of tiny codlings which were not retained.

The quantities of cod in 1905 are, on the whole, bigger than those in the corresponding months of 1904, and this is wholly due to an exceptional amount of codling. The seasonal variations are small, and one cannot attach much importance to what they seem to indicate.

The four central areas give but a medium amount of cod, averaging between one and two cwts. and this amount, though greater than that from the southern shallow ground (Borkum, Terschelling, &c.) is never half so great as that from the more northerly areas and in the neighbourhood of Horn Reef.

Codling are most abundant on the shallow area of the Dogger Bank, probably owing to its proximity to the western grounds. In the grounds between the bank and the shore, Clay Deep, Scruff, "The Mud," &c., they approach the "Cod" in weight, while in the most southern of these central grounds they form a smaller proportion.

The seasonal variations are not the same for the four areas, nor for the two classes of fish. In the southern part (Oysters &c.) the total catches are at their greatest in winter and spring and there is a decided minimum in the summer as there is in the coastal areas. On the Dogger, Clay Deep, and Scruff and in "The Mud" there is a minimum about November or December, at the time when the fish are found in their greatest numbers in the coastal grounds. Just before this minimum there are slightly higher catches, but the exact time of the maximum is not determinable. On the Dogger the spring catches are higher than the rest of the year, but not considerably so, and it is impossible to connect these fluctuations with any definite migrations. It is, however, possible that the increased quantities in the spring may be partly caused by a migration from the northern grounds to search for food after the spawning season.

Northern Areas.

The grounds north of the Dogger Bank are relatively rich in cod. The three areas, D, K, and L are very much the same as regards total yield and the seasonal fluctuations, so, in order to make as complete a series of monthly averages as possible, the catches from the three areas have been combined and monthly averages for the whole region calculated. These, with a few values interpolated, have been smoothed by the method of three-monthly averages into the curves in Fig. 71.

The seasonal fluctuations are very definite, showing two maxima and minima in each year. The first maximum, occurring in January and February, is wholly due to the appearance of large mature cod in great numbers—most of which are spawning. Only a few codling are present at this time, averaging generally about half a hundredweight. The catches of large cod fall off till their minimum in May and June and they afterwards come to these areas again for a smaller summer maximum. This differs in its nature from that of the winter, which is formed by a *regular* abundance of spawning fish. In the summer the general catches are not remarkably large, but occasionally shoals appear, and

these contribute largely to the total, as, for instance, in one haul in area D in August, 1906, 400 large cod were taken. Such conditions were precisely similar in the other areas

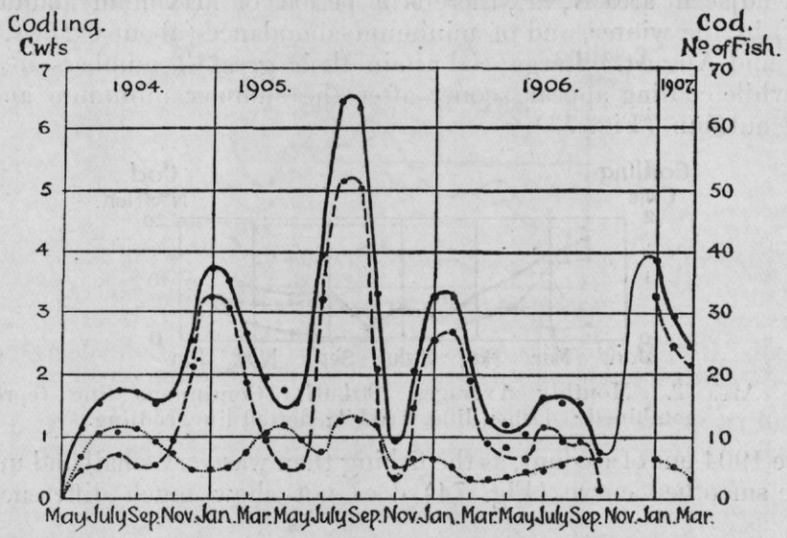

FIG. 71.—COD. Northern areas D, K, L combined. Monthly Averages, (smoothed curves). Continous line represents all sizes combined ; dashed line, " cod " ; dotted line, codling.

where a summer maximum occurred. Several instances of such catches occurred in the summer of 1905 and this makes the maximum part of the curve remarkably high. This is the herring season in this region and these shoals are probably closely connected with the herring shoals.

There is a distinct minimum about November. Codling appear to have a small summer maximum and a winter minimum, but their fluctuations are not very regular and they form but a small proportion of the catch.

These fluctuations can be correlated with the complementary variations in the grounds to the south and east, on the hypothesis that a double seasonal migration takes place. If it exists, the following movements would explain the phenomena observed.

Large cod are congregated for spawning purposes, mainly in the northern part of this region, about February. After spawning they disperse, probably in search of food, and thus form a minimum in the northern grounds, at the same time as the numbers in the central areas, the Dogger and south and east of it, are being augmented. Scarcely any fish are to be found in the summer on the eastern and coastal grounds, but both large and small cod are present on the intermediate areas in summer, and they occur in considerable numbers in the northern areas. We may surmise that this is caused by an offshore migration in the summer. Cod then appear to leave to some extent the offshore northern and central grounds once more in the autumn, October and November, and appear in their greatest numbers on the eastern grounds, where some spawn in December and January, while others return seawards to spawn.*

Southern Areas.

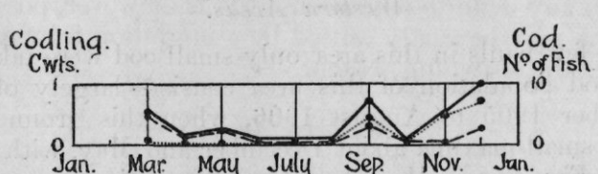

FIG. 72.—COD. Area S. Monthly Averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, " cod," dotted line, " codling."

Area S.—Fig. 72 shows that this southern area has practically no cod at all during the months for which we have statistics, *i.e.*, from March to December. There was no winter fishing so we do not know the conditions then, but the trend is towards increased quantities in the winter as in other shallow and coastal areas. Throughout the greater part of the year they are only taken in very small numbers and on rare occasions. One or two fairly large catches were taken in the month of September on the Leman Ground and on Winterton Twenties amongst many other hauls which were quite barren of cod. These are also possibly connected with herring shoals.

* cf. HJORT.—General report of Committee A. *Loc cit.* p. 116.

Area T.—The Botney grounds and Mud Hole are found to yield more cod than the adjacent more southern area S. The seasonal variations are in their nature very similar to those in the adjacent area N, *i.e.*, there is a period of maximum abundance (between 1 and 2 cwts.) in the winter, and of minimum abundance (about 0·2 cwt. or less) in the summer, July and August. Large cod attain their greatest numbers in late winter or early spring, while codling appear sooner after the summer minimum and are at their greatest in the autumn (Fig. 73).

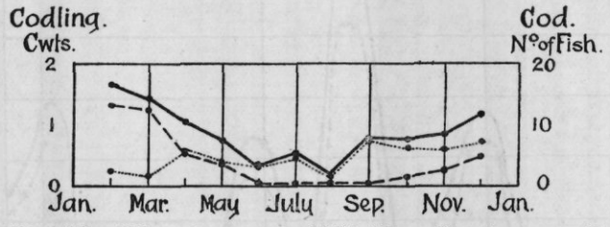

FIG. 73.—COD. Area T. Monthly Averages, 1904–07. Continuous line represents all sizes combined ; dashed line, " cod " ; dotted line, codling.

If we leave 1904 out of account, as the fishing then was very small and unrepresentative in amount, the smoothed curve (Fig. 74) does not show much difference in the total

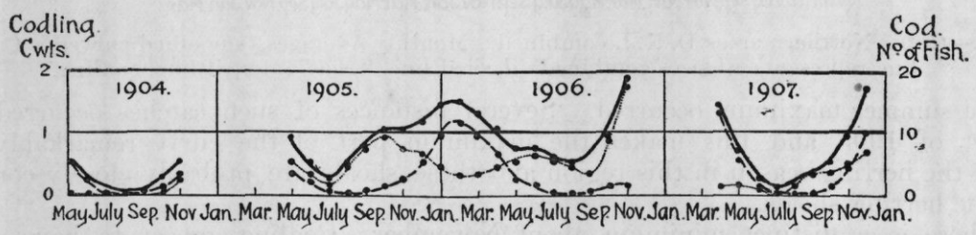

FIG. 74.—COD. Area T. Monthly Averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, " cod " ; dotted line, codling.

abundance in the next three years. However, by a more detailed study of the figures, when only the most reliable averages are considered, a continued decrease of about 20 to 30 per cent. is evinced in the mean values for these years.

Area V.—Very large quantities of cod are taken in the Silver Pits, the averages seldom being less than two cwts. and often considerably more than this. There are so many gaps in the series of monthly averages, and several which are untrustworthy, that it has been impossible to get a reliable curve to represent the seasonal fluctuations. Large cod have been found in large numbers in the middle of summer, and apparently in the autumn and winter they are much lower. Codling are fairly plentiful at all times, and exceedingly numerous in some months, frequently averaging between $1\frac{1}{2}$ and 3 cwts.

The two most southern of these three areas show minimum abundance of cod in the summer and maximum abundance in late winter and early spring. The quantities taken from them are rather small. In V (the Pits) many more cod are present and they are very plentiful in summer. This area partakes more of the nature of the western grounds where the smaller fish are abundant.

Western Areas.

Area E.—In the few hauls in this area only small cod were taken.

Area R.—The cod population of this area consists largely of small fish. In the months from November 1905 to August 1906, when this ground was well fished, we find large cod having small maxima about December and May, with minima in February and in the summer (Fig. 75). However these fluctuations are not very significant. Codling were exceedingly abundant in the autumn of 1905 ; they dropped to a minimum in the winter and then rose steadily till August.

In connection with the large catches of November and December of 1905, a skipper notes in November that the fish were full of herring spawn, and on the 15th of December he notes the same thing, with the addition that it was the latest date on which he remembers having caught any feeding on that kind of food. There is great variation in the catches ; sometimes a great many baskets of codling were taken, sometimes only a few fish.

Area X.—These averages as far as they go show that very fair amounts of cod are taken (mean value nearly two cwts.). Large cod are apparently plentiful in the spring and early summer, and become very scarce in the late summer and autumn. Codling, which show no regular fluctuations, are not so numerous as they were in the adjacent

shallower area R, but still they show very fair amounts, and in the mean monthly average form 43 per cent. of the total. In the first half of the year they are generally exceeded by the cod in weight. In the latter half the reverse is the case. The greatest average catches are four or five cwts. In December of 1904 one haul contained over 200 large cod besides two baskets of codling. In 1895* the principal item of fish taken from the

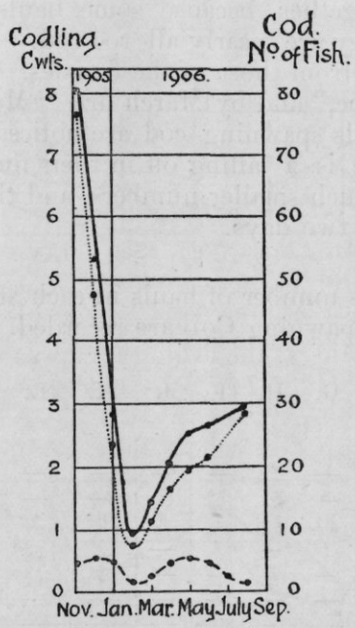

FIG. 75.—COD. Area R. Monthly Averages, (smoothed curves). Continuous line represents all sizes combined ; dashed line, "cod"; dotted line, codling.

Flamborough Head grounds in 35 fathoms was large cod. In one voyage 90 score cod and four boxes of codling were landed in February ; this is roughly equivalent to about 13 cwts. for 10 hours fishing.

Area P.—Cod were numerous in nearly all hauls, and codling averaged in July between one and two cwts.

Taking all the western areas together, we find that they give a large yield of cod, larger than several of the areas on the eastern side. Large fish are few in the southern and shallower parts (E and R), while they are found in good numbers in the deeper waters (over 20 fathoms) to the north between the English coast and the Dogger. On the other hand codling are very numerous in the shallower areas. The appearance of some of the large shoals is definitely connected with the shoals of herring on the spawn of which they were found to be feeding, and probably also on the fish.

Spawning.

The table (Table XX.) gives simply the number of hauls in each area in each month in which observations are made on the spawning and maturation of the cod, and as a means of comparison of the abundance, the total number of hauls made in each month is also given.

The season covered by these occurrences extends from November to April in 1904–1905, from September to March in 1905–1906, and in 1907 from January to March, the difference in the last case being due to a lack of observations in the earlier months of maturation.

Besides, and sometimes instead of these records in each haul there are notes made by some skippers on the maturity of the fish. One man in particular prefers to give a general statement at the end of his voyage regarding the spawning fish, than to indicate them in each haul.

The earliest records of the season are made in September (1905), when, in the most northerly part of this region, areas B, F, K, and L, some cod are recorded as "starting to make spawn." In October, 1905, the condition is "spawn forming." This applies to the cod in the above areas as well as those of G, J, and O. In November and December they are characterised as "full" and "spawn in," while on the Dogger Bank (O) they are "spawning." In November, 1904, a few cod were found spawning in areas H and M (Horn Reef), and they become more numerous here in the next month, while a few isolated

* CUNNINGHAM. North Sea Investigations. *Journ. Mar. Biol. Assoc.* Vol. IV., 1895, p. 12.

cases of spawning cod were found in the more offshore areas I, J and O in December. In the next month (January, 1905) the occurrences of spawning fish become much more numerous. In the most northern areas D and L the fish are plentiful, and many of them are spawning. An observation of some interest made by a man who was fishing in areas D, K and I in January, 1905, is " The majority of the cod are full of spawn. But I believe that the different kinds go together, because some hauls the cod we get are full of chicklings, and another time they are nearly all roe cod." He obviously means that the shoals of male fish are distinct from those of the females. He also observes in February that " roes are getting very ripe," and by March 3rd " Most of the cod have spawned " (northern areas). In all records spawning cod are noticeably numerous in February in these northern areas, and there is a falling off in their numbers in March. They were present on the Dogger, but in much smaller numbers, and the April records were those of some half-dozen fish in the first two days.

TABLE XX.—Showing the number of hauls in each area in which maturing or spawning COD are recorded.

Areas.	B.	C.	D.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	R.	T.	V.	X.
November 1904	—	—	—	—	—	6/82	—	—	—	—	2/2	—	—	—	—	—	—
December „	—	—	—	—	—	24/42	15/53	3/86	—	—	51/72	—	2/25	—	—	—	—
January 1905	—	—	6/14	—	13/26	75/94	7/9	6/25	30*/30	8/17	13/13	*	19/22	—	—	—	—
February „	—	—	112/132	—	2/2	—	2/3	—	35*/38	125*/146	—	*	8/14	—	—	—	—
March „	—	1/2	90/152	3/4	—	2/3	—	—	4/8	32/47	—	—	10/37	—	—	6/8	13/14
April „	—	—	—	—	—	—	—	—	—	—	—	—	4/158	—	—	—	1/3
September 1905	4/22	—	—	8/24	—	—	—	—	5/5	2/2	—	—	—	—	—	—	—
October „	4/5	—	—	5/10	3/3	—	—	16/18	—	—	—	—	5/8	—	—	—	—
November „	1/1	—	—	—	—	—	—	—	—	—	6/11	—	—	—	—	—	—
December „	—	—	12/15	—	—	—	—	4/14	—	7/7	—	—	54/119	—	—	—	2/8
January 1906	—	—	—	—	—	—	—	—	6/6	21/33	—	—	—	—	—	—	—
February „	—	—	15*/23	—	7/15	—	—	*	4*/5	51/63	—	1*/1	2/2	—	19/22	1/1	—
March „	—	—	17/65	—	—	—	—	—	—	—	—	—	—	2/6	3/12	18/14	10/13
January 1907	—	—	—	—	—	—	—	—	13/13	—	—	13/14	—	39/69	—	—	—
February „	—	—	—	—	—	—	—	—	51/58	—	—	—	—	—	—	—	—
March „	—	—	7/7	—	—	—	—	—	28/39	12/15	—	—	—	—	—	—	—

An asterisk denotes that maturing or spawning cod are present in some hauls the number of which is not specified.

The numerator of the fractions denotes the number of hauls when records of spawning fish were made, and the denominator, which is given as a means of comparison, is the total number of hauls in the area for each month, only those being included which are made by men who have recorded *any* spawning cod or haddock.

In January and February, 1906, the cod from the northern and north-eastern areas and the Dogger are fairly numerous and are described as having " spawn in " and spawning. Those from areas N, I, and J are " very near spawning " and " are all full of roes." In the northern areas they were noticed in the first few days of March, after which none were recorded. Observations of a few spawning cod were also made in the western and southern grounds in March. They occur here in this month and not in those preceding, because these grounds were not well sampled by the fishermen in the earlier part of the spawning season, but there is no evidence that they are at any time very numerous in this part of our region.

The season of 1907 was very similar, although much fewer observations were made. In January, of the few fish in area N, a few were spawning. After this, none were noticed in this part.

In the northern areas and on the Dogger they were found spawning in January and February and in the first half of March.

Thus it appears that the process of maturing begins in the autumn and that the cod become more and more " full " till the end of the year, some becoming ripe in December, and a few more as early as November. These cases of early spawning occur mostly on the shallow grounds of the coast of Jutland (H and M) in depths less than 20 fathoms. But in the majority of grounds the cod are still ripening at this time and it is not till January that the actual spawning begins. It continues throughout February when it is apparently at its height, and ceases some time during March, generally in the first half of the month. Only a few cases of spawning cod were found in April.

With regard to the distribution of these spawning fish, it may be said that they occur more or less in all areas of this region. The greatest numbers come from the grounds north of the Dogger in depths of 20 to 40 fathoms. In area G they were also numerous, but we have a very small amount of fishing in the other north-eastern areas (A, B, C, F) during the spawning season, so the conditions there must be left somewhat in doubt. The western and southern areas are very poorly sampled, but as far as can be judged from the few hauls during the first three months of the year, no great abundance of large cod is indicated and only a few are recorded as spawning. Apparently then the cod seek the more central and northerly parts of this region, around the Dogger and Horn Reef, at their spawning time,* and while they occur in the more southerly grounds and off the Dutch coast, as we see more definitely from the Dutch reports,† they are not nearly so numerous in this part.

The first maturity of cod occurs at a size (about 60 cm.) which coincides approximately with the size limit between cod and codling, that is to to say, the group known as "cod" is composed almost entirely of mature individuals.‡

The proportion that these form of the total catch by weight (approximately) is as follows :—1904, 50 per cent., 1905, 61 per cent., 1906, 51 per cent., 1907, 68 per cent., and 1904-7, 57 per cent. On the other hand, if we make an estimate for the *number* of codling from the weight, we find that only 15 per cent of the total number of fish caught are large and therefore mature. Most of the observations refer to the "large" and "medium" cod, but a few, though very few instances occur in which a few of the codling are spawning.

In those parts of our region which have been sufficiently sampled we find that these results are in agreement with those given by Damas in the report of Committee A,§ where it is shown with regard to the spawning of cod that it begins in December in the neighbourhood of the Danish and German coasts, becomes later in the greater depths and northwards where it is at its height from January to March and ceases in March and April. Furthermore that it is most frequent in depths of 40 to 80 metres, and that the biggest catches of eggs have been made in the neighbourhood of the Dogger and towards the coasts of Jutland.

Summary.—Cod.

The main results obtained from the study of the cod statistics can be summarised as follows :—

a. Distribution.—The distribution of cod in the central part of the North Sea, according to the mean monthly average catch is shown in a comparative manner by Fig. 76. The amounts in the western areas are not represented very accurately, as the most northern ones had very little fishing.

Both large and small fish are found over the whole region. They are generally rather sparsely distributed, but on several occasions they were taken in large shoals, many of which appeared to be intimately connected with the occurrence of herring shoals on the spawn of which they feed.

They are relatively plentiful in the northern half and scarce in the southern and south-eastern parts of the region. In more detail, they are very numerous in the Horn Reef grounds in the autumn and winter ; on the northern grounds (below the Dogger) in the winter and summer, and also on the western grounds. In the central areas, Dogger, Clay Deep, &c., they are never actually so abundant, but they are present throughout the year, while in the southern shallow areas and the coastal grounds they are remarkably infrequent, especially in the summer. In respect of their proportions by weight, codling are found to be most abundant on the grounds off the English coasts and on the Dogger. They are also fairly abundant in the autumn and winter on the Horn Reef and Amrum grounds, but there they are exceeded in weight by the larger fish.

b. Yearly Variations.—A decline in the average catch throughout the period is noticeable in some of the areas, while in others there is not enough material to show either increase or decrease in the mean catches. The falling off is most noticeable in the eastern, north-eastern, and central areas, and between 1905 and 1906. In some parts there is a very small recovery in 1907, while in others the decline is continued. This is also shown in the Dutch statistics,‖ in which the amount of large cod is greatest in 1904 and 1905,

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* Cf. Committee A report, p. 48. *Loc. cit.*
† Verhandelingen mit het Rijksinstitut voor het Ondersoek der Zee 1907-1908. Plate I.
‡ HJORT.—Committee A report, p. 110. Loc. cit.
§ DAMAS.—Contribution à la Biologie des Gadides, pp. 64-68. *Loc. cit.*
‖ Jaarverslag ontrent het beheer van de Visschershaven IJmuiden. 1908. Table iv., p. 72.

and in 1906 there is a drop to a little more than one-half the amount in 1905. Codling, on the other hand, show minimum quantities in 1905 and 1907, the same trend as that described in area N.

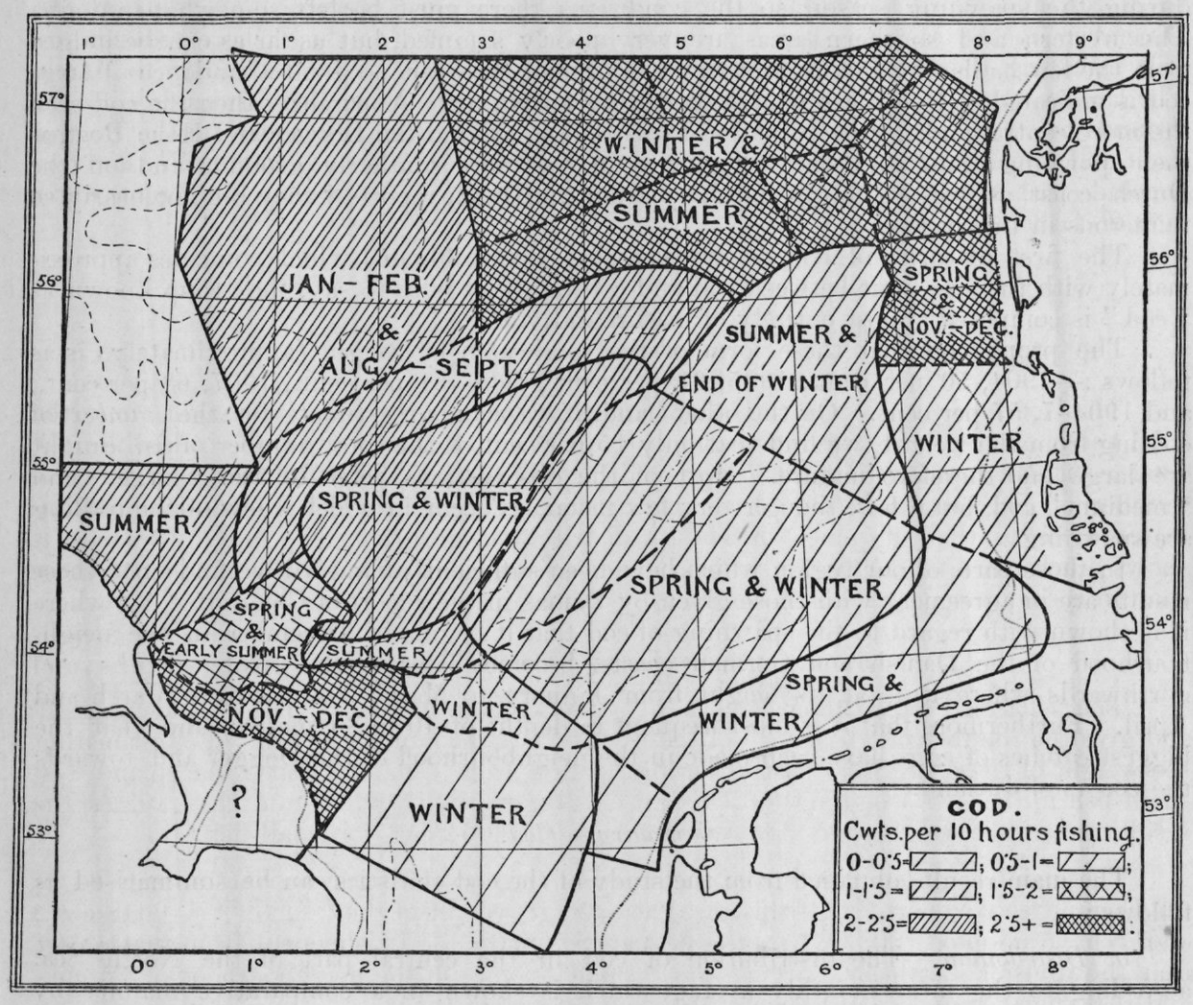

FIG. 76.—Chart showing the distribution of COD according to the mean monthly average catch in various areas, and the periods of maximum abundance in the different regions.

c. Seasonal Fluctuations and Migrations.—The fluctuations in the catches of "cod" are generally definitely periodic, those of codling are not so regular, and they are often found to be of a somewhat different nature. The most noticeable variations are those in the northern areas, where there are two distinct maxima, the first caused by the immigration in the winter of large spawning cod only, and the second in the summer by shoals of fish which apparently are following the herring—and also of the eastern coastal grounds and the southern grounds, where there is found to be a maximum in the late autumn and winter, and a distinct minimum in the summer.

On the central grounds we notice a minimum about November and December, and in some a spring and autumn maximum.

The most probable migrations which can be inferred from these complementary fluctuations, are for "cod" a movement northwards in the late winter towards the spawning grounds, a return migration when this is over, swelling the spring catches to a greater or less degree in most of the areas to the south. From the eastern and southern grounds there is a distinct offshore migration in the summer affecting all sizes, and codling show an inshore migration in the autumn, forming an early winter maximum on the coastal grounds. The autumn increase can also be partly accounted for by the inclusion of the smaller sizes which had before been untrawlable.

In the spring of 1905 a large number of tiny codling were to be taken on the Dogger Bank, and traces of them were still to be found in the autumn of the same year, when very large catches were made on the grounds between the Bank and the English coasts, whither they had probably migrated according to the usual tendency to go inshore in the autumn.

d. Spawning.—Roughly speaking, about 15 per cent. of the total number of cod taken by these fishermen in this region are found to be at or above the size at which they first become mature.

Some of these were recorded as maturing or spawning in the months from September to March and April. The actually spawning fish occur as early as November and December on the eastern coastal grounds, but the majority on the offshore grounds are still maturing then and do not spawn till the height of the season—January to March. The largest number of these spawning fish come from the Horn Reef grounds and the grounds below the Dogger, *i.e.*, the northern areas. They were also found on the Dogger itself and in the grounds south of it, but in considerably smaller numbers. We therefore conclude that in this region they spawn in depths from 15 to 40 fathoms, but prefer water over 20 fathoms in depth.

F.—Haddock.

Introduction.

This species is much more abundant than cod in this region. By weight alone the total catch of the four years was more than twice as much as that of the cod, while the total *estimated* numbers, 798,722 large and 1,088,843 small are more than *six* times the number of cod caught in the corresponding time. The total yield of haddock approximates more to that of plaice, but in its distribution, geographically and by seasons, it shows much more similarity to that of cod, *i.e.* it is more abundant in the northerly rather than in the southerly parts of the region.

Conversion of the different Measures into Weight.

The fishermen record their catches of haddock in two classes "large" and "small," and give the number of "baskets" of these or at times the number of fish. For estimating the weight of these, we have firstly the information from Grimsby that 35 large and 110 small fish fill baskets weighing 60 lbs. and 50 lbs. respectively. From these values the resulting average weights are ·015 cwt. for large and ·004 cwt. for small fish.

These values closely correspond to those found from the figures given on page 94 of the Committee A report.* In this case the average weight of the "small" is ·0048 cwt., and I have adopted ·005 cwt. as the best approximation. It is evident from that report that the division between "large" and "small" comes in the neighbourhood of 35 cm., and that the average size of the small is about 30 cm. (12 in.).

The weight of a basket of haddock has been obtained from the "Huxley" records and also from the Grimsby records by the method of comparing the total catches with the totals landed. The former method gives the average weight of 188 baskets as ·60 cwt., while the latter results in the following table :—

Table XXI.—Showing the ratio between the total number of boxes of Haddock landed by certain skippers and the number of baskets caught.

Skipper.	1904.	1905.	1906.	1907.	1904–7.
i.	·58	·54	(·77)	—	·57
ii.	—	·67	—	—	·67
iii.	·54	·61	·61	·65	·60
iv.	—	·71	·64	—	·66
v.	·57	·51	·61	·55	·56
vi.	(·44)	·70	·58	·61	·63
vii.	·55	·54	—	—	·54
viii.	·54	·47	—	—	·49
All men ...	·56	·54	·61	·58	·56

In the calculation of the last ratio ·56, 28,542 baskets are considered. From this we conclude that the most probable average weight of a basket is ·56, the weight of a box, *i.e.* ·56 cwt., and this value has been adopted for these statistics.

* *Loc. cit.*

Total Quantities of Fish and the Proportion formed by "Large" and "Small."

TABLE XXII.—Showing the total quantities of HADDOCK (in cwts.) recorded by certain skippers during the period 1904–07, and the percentage of the total by weight of the groups "large" and "small."

Year.	Large Haddock.	Small Haddock.	Total Haddock.	Percentage of Total Weight.	
				Large	Small.
1904	4526·84	656·97	5183·81	87·3	12·7
1905	5388·61	1970·86	7359·47	73·2	26·8
1906	1270·06	1747·64	3017·70	42·2	57·8
1907	955·07	742·09	1697·16	56·3	43·7
Total	12140·58	5117·56	17258·14	70·5	29·5

The main features shown by this table are the considerably varying and increasing proportion of small fish, with the greatest proportion in 1906, and a decline in the total catch. The average per 10 hours fishing for the four years are 5·11 cwts. in 1904, 3·88 cwts. in 1905, 2·58 cwts. in 1906 and 2·06 cwts. in 1907, which shows a considerable drop,* but these figures are analysed in more detail in the next table. In 1906 there were large numbers of small haddock, while the average catch of the large was less than in many of the other years. Further analysis of the records shows that small haddock were also very plentiful in the latter half of 1905, most of them being so very small that tons of them were thrown away. These facts fully confirm the results given in the general part of the Committee A report, p. 102, and by Helland Hansen† where it is shown that in 1902 and 1903 very few young haddocks were spawned, while in 1904 there was a large number, so that two years afterwards, when these became of a trawlable size the catches of small fish in 1904 were particularly small, while in 1906 very many "small haddock" were trawled.

Yearly Fluctuations.

TABLE XXIII.—Showing for groups of areas, the yearly average catch of HADDOCK per ten hours fishing, and the percentage of the total weight formed by the class "small."

—	North Eastern. A. B, C. F. G.				Eastern. H. M. Q. W.				Central. J. N. I. O.				Northern. D. K. L.				Southern. S. T.				Western. E. R. X. P. V.			
	L.	S.	All Sizes.	Per cent.	L.	S.	All Sizes.	Per cent.	L.	S.	All Sizes.	Per cent.	L.	S.	All Sizes.	Per cent.	L.	S.	All Sizes.	Per cent.	L.	S.	All Sizes.	Per cent.
1904. May-Dec.	7·20	1·99	9·19	21·7	1·68	0·03	1·71	1·8	6·54	0·58	7·12	8·1	6·40	2·12	8·52	24.9	0·05	0·58	0·05	0·0	2·16	1·10	3·26	33·7
1905.	6·87	1·56	8·43	18·5	1·06	0·23	1·29	17·8	3·28	1·58	4·86	32·5	6·45	1·16	7·61	15.2	0·26	0·68	0·94	72·3	0·38	1·90	2·28	83·3
1906.	4·19	3·53	7·72	45·7	0·81	0·59	1·40	42·1	1·07	2·04	3·11	65·6	3·49	1·92	5·41	35·5	0·13	0·76	0·89	85·4	0·05	1·65	1·70	97·1
1907.	—	—	—	34·6	0·74	0·24	0·98	24·5	1·30	1·05	2·35	44·7	3·11	3·15	6·26	50·3	0·24	0·13	0·37	35·1	0·53	1·20	1·73	69·4

All these groups of areas show a distinct and considerable fall in the catches between the beginning and the end of the period, and in most cases it is continuous. The proportion of "small" fish varies very considerably in the different areas in the different years, but all groups with the exception of the northern areas, are alike in showing a maximum proportion of "small" in 1906 with a minimum in 1904 or 1905. Large fish have their minimum catches in the same year (1906) in most groups.

The class "small" forms the largest proportion of the total in the west and south parts of this region, but they are actually most numerous in the northern and north eastern areas, where the large fish are also most abundant, for, like the cod, haddock show a much more northerly distribution than any of the other species yet dealt with. On the eastern grounds, small haddock are scarce and form less than one fourth of the total. With regard to the total yield, we find the north eastern areas have by far the largest amount, averaging over eight cwts. per 10 hours fishing. In the northern areas we have an average of nearly seven cwts., and in the central areas between four and five cwts. The eastern and western grounds have less, those on the western side being made up by

* *Cf.* HELLAND HANSEN. Statistical Research into the Biology of the Haddock and Cod in the North Sea, p. 43, Report of Committee A.

† *Loc. cit.*, p. 37.

TABLE XXIV. (*continued*)—SHOWING for each area the Monthly Average Catch of HADDOCK in cwts. per 10 hours' fishing; large (L) and small (S) being distinguished.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
SOUTHERN AREAS.	S	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	0·00	$+^{216}$	0·00	0·00	$0·00^{345}$	0·00	0·00	$0·00^{454}$	0·00	0·00	$0·00^{100}$	0·00	0·00	$0·00^{103}$	...	...	...	...	...	...	S
		1905	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{617}$	+	+	$+^{749}$	0·00	0·00	$0·00^{45}$	0·00	0·35	$0·35^{54}$	0·00	3·95	$3·95^{8}$	0·21	2·59	$2·80^{13}$	
		1906	...	...	...	0·00	0·00	$0·00^{5}$	0·00	0·00	$0·00^{22}$	0·00	0·00	$0·00^{22}$	0·00	0·93	$0·93^{7}$	0·00	0·37	$0·37^{35}$	0·00	0·07	$0·07^{83}$	0·00	0·03	$0·03^{186}$	0·00	0·00	$0·00^{220}$	0·00	0·00	$0·00^{36}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·06	0·04	$0·10^{461}$	0·06	0·04	$0·10^{348}$	0·00	0·00	$0·00^{271}$	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{16}$	...	...	...	
		1904–7	...	...	...	**0·00**	**0·00**	**$0·00^{5}$**	**0·00**	**0·00**	**$0·00^{22}$**	**0·00**	**0·00**	**$0·00^{22}$**	**0·03**	**0·03**	**$0·12^{468}$**	**0·03**	**0·05**	**$0·09^{619}$**	**0·00**	+	$+^{1316}$	+	+	$+^{1309}$	**0·00**	**0·00**	**$0·00^{365}$**	**0·00**	**0·01**	**$0·01^{163}$**	**0·00**	**1·37**	**$1·37^{24}$**	**0·21**	**2·59**	**$2·80^{13}$**	
	T	1904	...	...	...	...	...	...	...	...	...	...	...	...	3·02	0·43	$3·45^{13}$	0·00	0·01	$0·01^{24}$	0·00	0·00	$0·00^{10}$	0·00	0·00	$0·00^{8}$	0·00	0·00	$0·00^{8}$	...	...	...	1·00	0·00	$1·00^{22}$	...	...	...	T
		1905	...	...	...	...	...	...	...	...	...	...	...	...	0·44	0·00	$0·44^{55}$	...	...	...	0·00	0·00	$0·00^{48}$	0·00	0·00	$0·00^{79}$	0·01	0·72	$0·73^{100}$	0·05	2·40	$2·44^{177}$	0·22	2·37	$2·59^{343}$	1·64	1·13	$2·76^{340}$	
		1906	...	...	...	0·04	0·76	$0·79^{96}$	0·00	0·19	$0·19^{32}$	0·00	2·02	$2·02^{112}$	0·12	2·48	$2·60^{53}$	0·10	2·72	$2·82^{97}$	0·17	1·61	$1·78^{181}$	0·15	0·70	$0·85^{90}$	0·00	0·34	$0·34^{53}$	0·29	0·38	$0·67^{225}$	3·26	2·04	$5·29^{39}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	0·36	0·65	$1·02^{39}$	1·68	1·57	$3·25^{75}$	0·97	0·64	$1·61^{143}$	0·02	0·05	$0·06^{91}$	...	...	...	0·77	0·35	$1·12^{70}$	0·89	0·32	$1·21^{84}$	0·40	0·00	$0·40^{212}$	0·00	0·00	$0·00^{12}$	
		1904–7	...	...	...	**0·04**	**0·76**	**$0·79^{96}$**	**0·00**	**0·19**	**$0·19^{32}$**	**0·09**	**1·67**	**$1·76^{121}$**	**0·76**	**1·20**	**$1·97^{146}$**	**0·56**	**1·34**	**$1·91^{264}$**	**0·10**	**0·89**	**$0·98^{330}$**	**0·08**	**0·35**	**$0·43^{127}$**	**0·08**	**0·51**	**$0·58^{211}$**	**0·31**	**1·11**	**$1·41^{486}$**	**0·45**	**1·44**	**$1·85^{604}$**	**1·58**	**1·09**	**$2·67^{352}$**	
	V	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·80	0·69	$3·49^{131}$	2·52	0·58	$3·11^{86}$	0·90	0·41	$1·31^{45}$	...	...	...	1·14	0·00	$1·14^{13}$	...	...	...	V
		1905	...	...	...	...	...	...	0·00	0·17	$0·17^{25}$	...	...	...	...	...	...	...	...	...	0·50	0·00	$0·50^{108}$	0·00	2·73	$2·73^{29}$	...	...	...	6·20	10·00	$16·20^{28}$	...	...	...	...	...	...	
		1906	0·38	3·81	$4·19^{39}$	0·31	1·24	$1·56^{4}$	0·07	4·25	$4·32^{30}$	0·00	1·37	$1·37^{28}$	...	...	...	0·00	1·40	$1·40^{12}$	0·06	4·03	$4·09^{53}$	0·12	6·99	$7·10^{49}$	0·48	4·40	$4·88^{47}$	0·51	2·04	$2·55^{16}$	0·73	1·10	$1·83^{12}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{4}$	0·70	2·10	$2·80^{8}$	0·35	4·04	$4·39^{55}$	...	...	...	...	...	...	2·11	2·13	$4·24^{94}$	1·50	0·00	$1·50^{78}$	1·44	1·30	$2·74^{48}$	
		1904–7	**0·38**	**3·81**	**$4·19^{39}$**	**0·31**	**1·24**	**$1·56^{4}$**	**0·05**	**3·27**	**$3·33^{105}$**	**0·00**	**1·37**	**$1·37^{28}$**	**0·00**	**0·00**	**$0·00^{4}$**	**0·28**	**1·68**	**$1·96^{39}$**	**1·28**	**1·51**	**$2·80^{347}$**	**1·37**	**2·86**	**$4·25^{464}$**	**0·69**	**2·43**	**$3·11^{92}$**	**2·75**	**3·71**	**$6·45^{138}$**	**1·24**	**0·24**	**$1·48^{43}$**	**1·44**	**1·30**	**$2·74^{48}$**	
WESTERN AREAS.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	E
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	0·00	0·00	$0·00^{8}$	...	...	...	0·00	0·00	$0·00^{7}$	...	...	...	..	...	...	0·00	0·02	$0·02^{18}$	0·00	0·00	$0·00^{11}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·00**	**0·00**	**$0·00^{8}$**	...	...	...	**0·00**	**0·00**	**$0·00^{7}$**	...	...	...	...	...	...	**0·00**	**0·02**	**$0·02^{18}$**	**0·00**	**0·00**	**$0·00^{11}$**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	R	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{9}$	0·00	0·00	$0·00^{4}$	R
		1905	...	...	...	...	...	...	0·00	0·00	$0·00^{14}$	...	...	...	0·00	0·00	$0·00^{76}$	...	...	...	...	...	...	...	...	...	0·00	1·87	$1·87^{18}$	...	...	...	0·00	3·74	$3·74^{168}$	0·00	1·39	$1·39^{212}$	
		1906	0·00	0·11	$0·11^{139}$	0·00	0·00	$0·00^{236}$	0·00	0·00	$0·00^{280}$	0·00	0·45	$0·45^{266}$	+	2·19	$2·19^{176}$	0·00	2·79	$2·79^{238}$	0·00	2·35	$2·35^{222}$	0·00	2·66	$2·66^{113}$	0·00	3·17	$3·17^{7}$	1·83	1·35	$3·19^{14}$	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	0·00	0·00	$0·00^{6}$	0·00	0·00	$0·00^{23}$	0·04	0·04	$0·09^{33}$	0·35	1·40	$1·75^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**0·00**	**0·11**	**$0·11^{139}$**	**0·00**	**0·00**	**$0·00^{236}$**	**0·00**	**0·00**	**$0·00^{294}$**	**0·00**	**0·44**	**$0·44^{272}$**	+	**1·40**	**$1·40^{275}$**	**0·01**	**2·46**	**$2·47^{270}$**	**0·01**	**2·33**	**$2·34^{226}$**	**0·00**	**2·66**	**$2·66^{113}$**	**0·00**	**2·25**	**$2·25^{75}$**	**1·83**	**1·35**	**$3·19^{14}$**	**0·00**	**3·55**	**$3·55^{177}$**	**0·00**	**1·36**	**$1·36^{216}$**	
	X	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·95	1·23	$2·18^{109}$	6·90	1·78	$8·68^{80}$	0·41	1·84	$2·25^{30}$	...	...	...	2·94	0·98	$3·92^{23}$	0·00	0·00	$0·00^{17}$	X
		1905	0·00	0·03	$0·03^{4}$	0·47	0·47	$0·93^{2}$	0·18	0·04	$0·22^{53}$	0·00	0·00	$0·00^{12}$	...	...	...	...	...	...	...	...	...	...	...	...	0·15	1·24	$1·40^{31}$	0·00	2·10	$2·10^{107}$	0·02	0·85	$0·87^{15}$	1·70	4·52	$6·22^{44}$	
		1906	...	...	...	0·00	0·00	$0·00^{9}$	0·00	0·09	$0·09^{60}$	0·00	0·51	$0·51^{27}$	0·00	1·29	$1·29^{32}$	0·13	1·04	$1·18^{156}$	0·06	2·31	$2·37^{112}$	0·00	2·65	$2·65^{93}$	0·02	3·50	$3·52^{64}$	0·00	1·82	$1·82^{29}$	1·05	2·28	$3·33^{16}$	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·08	$0·08^{32}$	0·00	1·75	$1·75^{8}$	0·04	2·90	$2·95^{96}$	...	...	...	...	...	...	0·12	0·07	$0·19^{183}$	0·05	0·25	$0·30^{38}$	0·00	0·17	$0·17^{25}$	
		1904–7	**[0·00**	**0·03**	**$0·03^{4}$]**	**[0·12**	**0·12**	**$0·23^{12}$]**	**0·09**	**0·07**	**$0·15^{113}$**	**0·00**	**0·44**	**$0·44^{89}$**	**0·00**	**0·69**	**$0·69^{104}$**	**0·13**	**1·08**	**$1·21^{164}$**	**0·36**	**2·12**	**$2·48^{317}$**	**2·72**	**2·31**	**$5·03^{153}$**	**0·15**	**2·54**	**$2·69^{125}$**	**0·07**	**0·89**	**$0·96^{310}$**	**1·27**	**0·96**	**$2·23^{92}$**	**0·87**	**2·36**	**$3·23^{36}$**	
	P	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·73	1·61	$3·34^{213}$	...	...	...	0·70	0·70	$1·40^{8}$	...	...	...	...	...	...	...	...	...	P
		1905	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	2·73	1·93	$4·66^{16}$	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	0·60	0·00	$0·00^{4}$	0·00	0·31	$0·31^{4}$	...	...	...	...	...	...	...	...	...	...	...	...	0·00	1·98	$1·98^{24}$	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**0·00**	**0·00**	**$0·00^{4}$**	**0·00**	**0·31**	**$0·31^{4}$**	...	...	...	...	...	...	**1·80**	**1·63**	**$3·43^{229}$**	...	...	...	**0·18**	**1·66**	**$1·84^{32}$**	...	...	...	...	...	...	...	...	...	

TABLE XXIV. (*continued*)—SHOWING for each area the Monthly Average Catch of HADDOCK in cwts. per 10 hours' fishing; large (L) and small (S) being distinguished.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
CENTRAL AREAS.	J	1904	...	...	...	...	..	...	...	...	...	...	...	...	2·49	1·56	4·04^{9}	...	...	...	...	...	...	8·57	0·07	8·64^{75}	6·40	0·44	6·84^{205}	...	...	...	3·27	0·35	3·62^{27}	5·07	0·95	6·01^{491}	J
		1905	2·68	0·31	2·99^{185}	...	...	...	...	...	...	...	...	...	0·98	0·35	1·33^{30}	...	...	...	...	...	...	...	...	...	4·91	2·53	7·44^{95}	7·56	2·43	9·99^{78}	2·34	0·70	3·04^{64}	1·99	1·96	3·95^{88}	
		1906	2·95	1·63	4·58^{78}	3·55	3·17	6·72^{20}	...	...	...	...	...	...	5·87	0·76	6·63^{77}	...	...	...	...	...	...	5·37	6·49	11·86^{92}	3·66	5·90	9·55^{90}	1·18	2·31	3·49^{284}	1·67	0·78	2·46^{130}	0·17	0·59	0·76^{38}	
		1907	...	...	...	...	...	...	0·48	0·45	0·93^{67}	0·36	2·32	2·67^{68}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·58	0·00	1·58^{16}	...	...	...	
		1904–7	**2·74**	**0·58**	**3·32^{133}**	**3·55**	**3·17**	**6·72^{20}**	**0·48**	**0·45**	**0·93^{67}**	**0·36**	**2·32**	**2·67^{68}**	**4·67**	**0·75**	**5·42^{105}**	...	...	...	...	...	...	**6·82**	**3·59**	**10·40^{167}**	**5·40**	**2·21**	**7·61^{200}**	**2·56**	**2·34**	**4·90^{362}**	**2·24**	**0·60**	**2·85^{287}**	**4·20**	**1·09**	**5·29^{227}**	
	N	1904	...	...	...	...	...	...	...	...	...	...	...	...	4·26	0·79	5·05^{38}	2·50	0·14	2·64^{40}	0·08	0·03	0·11^{205}	0·62	0·04	0·66^{109}	1·96	0·47	2·43^{98}	2·34	0·25	2·59^{144}	4·21	0·03	4·25^{182}	3·44	0·00	3·44^{136}	N
		1905	0·02	0·00	0·02^{8}	0·51	0·07	0·58^{40}	0·37	0·00	0·37^{52}	1·03	0·05	1·08^{60}	0·94	0·01	0·95^{59}	3·62	0·24	3·86^{130}	4·00	0·41	4·40^{76}	0·13	0·01	0·14^{372}	0·00	0·00	0·00^{274}	...	...	...	2·22	1·22	3·44^{219}	1·13	3·74	4·88^{412}	
		1906	0·85	1·75	2·60^{421}	0·12	0·10	0·22^{310}	+	0·00	+^{283}	0·10	1·14	1·24^{14}	0·67	1·46	2·13^{89}	0·27	2·12	2·39^{83}	1·18	3·11	4·29^{76}	0·24	3·34	3·58^{197}	0·00	0·40	0·40^{51}	0·01	0·25	0·26^{108}	0·63	2·18	2·81^{291}	0·22	2·54	2·76^{74}	
		1907	0·34	2·18	2·53^{306}	0·10	0·64	0·74^{125}	0·48	0·49	0·97^{228}	0·98	1·03	2·00^{152}	2·02	1·49	3·50^{74}	2·23	0·94	3·17^{71}	1·83	1·10	2·93^{118}	0·00	0·06	0·06^{45}	0·00	0·00	0·00^{235}	0·28	0·07	0·35^{299}	0·69	+	0·69^{354}	0·49	0·00	0·49^{96}	
		1904–7	**0·63**	**1·91**	**2·54^{735}**	**0·14**	**0·24**	**0·38^{475}**	**0·23**	**0·20**	**0·43^{363}**	**0·93**	**0·75**	**1·68^{206}**	**1·53**	**1·05**	**2·58^{231}**	**2·36**	**0·84**	**3·20^{333}**	**1·32**	**0·85**	**2·17^{475}**	**0·24**	**1·07**	**1·31^{623}**	**0·29**	**0·10**	**0·39^{658}**	**0·76**	**0·15**	**0·91^{551}**	**1·70**	**0·74**	**2·44^{936}**	**1·39**	**2·41**	**3·80^{718}**	
	I	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3·58	0·53	4·11^{101}	3·71	0·68	4·39^{18}	5·84	0·63	6·46^{319}	7·92	0·06	7·98^{225}	15·33	0·87	16·20^{218}	3·04	0·17	3·21^{190}	8·58	0·73	9·31^{359}	I
		1905	4·59	0·33	4·92^{87}	2·24	0·21	2·45^{17}	...	...	...	...	...	...	...	...	...	4·52	0·29	4·81^{52}	3·59	0·38	3·97^{121}	3·33	1·47	4·80^{263}	2·47	0·64	3·11^{652}	...	...	...	2·49	5·12	7·60^{139}	2·18	5·31	7·49^{47}	
		1906	0·62	4·75	5·36^{79}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3·33	6·58	9·91^{74}	...	...	..	1·31	4·06	5·37^{31}	0·97	0·97	1·95^{11}	0·22	3·44	3·66^{65}	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·42	0·95	3·38^{160}	2·43	0·55	2·98^{71}	1·14	0·16	1·30^{97}	...	...	...	
		1904–7	**2·71**	**2·43**	**5·13^{166}**	**2·24**	**0·21**	**2·45^{17}**	...	...	...	...	...	...	...	...	...	**3·90**	**0·45**	**4·35^{153}**	**3·51**	**2·56**	**6·07^{213}**	**4·70**	**1·01**	**5·71^{352}**	**3·58**	**0·66**	**4·25^{1068}**	**11·73**	**0·80**	**12·53^{300}**	**2·29**	**2·31**	**4·60^{421}**	**7·84**	**1·26**	**9·10^{406}**	
	O	1904	...	...	...	...	...	...	...	...	...	...	...	...	8·40	3·08	11·48^{10}	5·80	1·42	7·22^{100}	5·04	0·98	6·02^{149}	5·16	0·97	6·13^{254}	5·59	1·14	6·73^{216}	18·72	0·97	19·68^{356}	4·77	0·37	5·14^{278}	7·88	0·07	7·95^{97}	O
		1905	6·36	0·20	6·55^{100}	1·56	0·06	1·62^{26}	4·23	0·86	5·09^{150}	5·82	0·78	6·60^{613}	6·60	1·03	7·63^{235}	6·20	0·94	7·15^{121}	4·14	0·82	4·97^{255}	5·42	2·28	7·70^{99}	...	...	...	3·08	3·11	6·19^{337}	1·85	3·71	5·57^{175}	3·17	4·11	7·28^{338}	
		1906	...	...	...	2·13	3·73	5·87^{11}	0·21	0·00	0·21^{9}	0·00	1·24	1·24^{14}	1·96	3·92	5·88^{10}	...	...	...	...	...	...	...	...	...	1·60	3·20	4·80^{4}	1·04	0·93	1·97^{14}	2·80	4·20	7·00^{4}	...	...	...	
		1907	4·57	3·97	8·54^{281}	...	...	...	1·89	1·73	3·62^{80}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6·55	1·59	8·14^{68}	...	...	...	
		1904–7	**5·04**	**2·98**	**8·02^{381}**	**1·65**	**0·63**	**2·28^{67}**	**3·29**	**1·12**	**4·40^{239}**	**5·69**	**0·79**	**6·48^{627}**	**6·53**	**1·15**	**7·68^{115}**	**6·02**	**1·16**	**7·18^{221}**	**4·47**	**0·88**	**5·35^{404}**	**5·24**	**1·33**	**6·57^{533}**	**5·53**	**1·18**	**6·70^{220}**	**11·03**	**1·97**	**13·01^{697}**	**4·02**	**1·67**	**5·68^{325}**	**3·89**	**3·49**	**7·38^{633}**	
NORTHERN AREAS.	D	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·95	5·38	8·33^{37}	...	...	...	D
		1905	1·32	0·46	1·78^{61}	9·47	1·27	10·75^{760}	6·73	2·23	8·96^{647}	0·97	1·60	2·57^{24}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4·59	2·01	6·61^{69}	
		1906	...	...	...	6·73	0·82	7·55^{55}	3·16	1·21	4·36^{237}	...	...	...	...	...	...	...	...	...	...	...	...	2·27	0·88	3·14^{131}	1·28	1·23	2·51^{24}	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	3·95	1·55	5·50^{78}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	**1·32**	**0·46**	**1·78^{61}**	**9·20**	**1·23**	**10·42^{345}**	**5·67**	**1·93**	**7·59^{332}**	**0·97**	**1·60**	**2·57^{24}**	...	...	...	...	...	...	...	...	...	**2·27**	**0·88**	**3·14^{131}**	**1·28**	**1·23**	**2·51^{24}**	...	...	...	**2·95**	**5·38**	**8·33^{37}**	**4·59**	**2·01**	**6·61^{69}**	
	K	1904	...	...	...	...	...	..	...	...	...	...	...	...	2·10	5·60	7·70^{4}	3·93	2·33	6·25^{38}	...	...	...	4·80	1·80	6·60^{7}	6·31	2·64	8·95^{43}	8·09	1·58	9·67^{95}	2·02	0·52	2·54^{21}	...	...	...	K
		1905	3·28	0·63	3·91^{211}	6·12	0·69	6·81^{239}	1·72	0·22	1·94^{29}	...	...	...	...	...	...	...	...	...	...	...	...	5·60	1·40	7·00^{4}	9·54	1·85	11·40^{71}	1·40	1·40	2·80^{4}	...	...	...	...	...	...	
		1906	3·25	1·99	5·24^{31}	3·73	2·57	6·30^{24}	2·39	0·45	2·83^{44}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·09	2·32	3·41^{21}	...	...	...	...	...	...	...	...	...	
		1907	2·06	1·00	3·06^{55}	3·79	3·83	7·62^{232}	3·18	3·84	7·02^{235}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·27	1·40	2·67^{11}	0·35	0·35	0·70^{8}	...	...	...	
		1904–7	**3·05**	**0·84**	**3·88^{292}**	**4·91**	**2·25**	**7·16^{495}**	**2·92**	**3·01**	**5·94^{368}**	...	...	...	**2·10**	**5·60**	**7·70^{4}**	**3·93**	**2·33**	**6·25^{38}**	...	...	...	**5·09**	**1·65**	**6·75^{11}**	**7·22**	**2·18**	**9·40^{135}**	**7·17**	**1·55**	**8·72^{110}**	**1·57**	**0·47**	**2·04^{29}**	...	...	...	
	L	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·08	1·24	6·32^{21}	1·87	1·40	3·27^{6}	6·08	1·82	7·90^{84}	7·80	2·05	9·85^{195}	7·14	1·94	9·08^{63}	0·99	1·32	2·31^{8}	...	...	...	L
		1905	4·65	0·48	5·13^{84}	5·97	0·26	6·23^{625}	6·59	0·23	6·82^{122}	4·92	0·62	5·54^{111}	3·97	0·61	4·57^{30}	2·00	2·00	4·00^{7}	2·14	0·83	2·98^{79}	3·11	1·01	4·12^{18}	6·87	2·37	9·23^{81}	...	...	...	...	...	...	2·88	6·52	9·40^{36}	
		1906	5·64	1·42	7·06^{132}	5·40	0·76	6·16^{247}	...	...	...	...	...	...	1·39	0·66	2·05^{199}	3·50	0·76	4·26^{108}	4·39	1·08	5·47^{97}	2·79	0·94	3·73^{101}	3·16	4·83	7·99^{108}	2·53	5·38	7·92^{136}	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	1·87	0·63	2·50^{60}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·62	5·71	7·32^{13}	...	...	...	...	...	...	
		1904–7	**5·25**	**1·06**	**6·31^{218}**	**5·81**	**0·40**	**6·21^{372}**	**5·48**	**0·33**	**5·81^{252}**	**4·92**	**0·62**	**5·54^{111}**	**1·73**	**0·65**	**2·38^{229}**	**3·67**	**0·90**	**4·57^{135}**	**3·33**	**0·98**	**4·32^{252}**	**4·18**	**1·31**	**5·50^{203}**	**5·22**	**3·56**	**8·78^{334}**	**3·85**	**4·37**	**8·23^{212}**	**0·99**	**1·32**	**2·31^{8}**	**2·88**	**6·52**	**9·40^{36}**	

TABLE XXIV.—SHOWING for each area the Monthly Average Catch of HADDOCK in cwts. per 10 hours' fishing; large (L.) and small (S.) being distinguished.

Group.	Area.	Year.	January.			February.			March.			April.			May.			June.			July.			August.			September.			October.			November.			December.			Area.
			L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	L.	S.	All Sizes.	
North-Eastern Areas.	A	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·25	1·40	8·65^{22}	...	...	...	...	...	...	...	...	...	...	...	...	A
		1905	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14·88	1·60	16·49^{44}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**14·88**	**1·60**	**16·46^{44}**	**7·25**	**1·40**	**8·65^{22}**	...	...	...	...	...	...	...	...	...	...	...	...	
	B	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·33	1·40	3·73^{18}	8·99	3·76	12·75^{86}	6·23	4·57	10·81^{117}	5·04	1·49	6·53^{64}	...	...	...	B
		1905	...	...	...	...	...	...	...	...	...	2·33	0·61	2·94^{30}	1·34	0·34	1·68^{12}	...	...	...	...	...	...	...	...	...	10·50	1·28	11·78^{160}	3·92	1·96	5·88^{89}	2·80	1·40	4·20^{4}	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·24	3·84	9·09^{113}	5·17	2·01	7·18^{39}	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	**2·33**	**0·61**	**2·94^{30}**	**1·34**	**0·34**	**1·68^{12}**	...	...	...	...	...	...	**2·33**	**1·40**	**3·73^{18}**	**9·96**	**2·17**	**12·13^{248}**	**5·60**	**4·04**	**9·64^{250}**	**5·00**	**1·68**	**6·68^{107}**	...	...	...	
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	C
		1905	...	...	...	...	...	...	1·05	0·24	1·29^{8}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·40	0·70	2·10^{4}	...	...	...	0·62	0·62	1·24^{4}	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**1·05**	**0·24**	**1·29^{8}**	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	**1·40**	**0·70**	**2·16^{4}**	...	...	...	**0·62**	**0·62**	**1·24^{4}**	
	F	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4·03	2·60	6·62^{68}	5·60	0·00	5·60^{8}	1·05	0·35	1·40^{8}	12·35	1·35	13·70^{65}	...	...	...	6·48	0·00	6·48^{64}	7·61	0·00	7·61^{120}	F
		1905	...	...	...	...	...	...	0·46	0·02	0·48^{12}	...	...	...	...	...	...	...	...	...	6·11	0·51	6·62^{42}	6·94	1·42	8·36^{35}	10·57	2·31	12·88^{109}	4·56	3·66	8·22^{24}	3·50	4·90	8·40^{8}	2·10	3·50	5·60^{8}	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·34	6·38	11·72^{38}	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	**0·46**	**0·02**	**0·48^{12}**	...	...	...	...	...	...	**4·03**	**2·60**	**6·62^{65}**	**6·04**	**0·44**	**6·48^{60}**	**5·62**	**3·61**	**9·23^{81}**	**11·24**	**1·95**	**13·19^{174}**	**4·56**	**3·66**	**8·22^{24}**	**6·14**	**0·54**	**6·65^{72}**	**7·26**	**0·22**	**7·48^{128}**	
	G	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2·47	3·61	6·07^{79}	...	...	...	3·27	3·02	6·29^{33}	10·38	1·46	11·83^{88}	9·81	1·20	11·01^{44}	4·20	0·00	4·20^{4}	...	...	...	G
		1905	3·02	0·38	3·40^{108}	2·45	0·35	2·80^{8}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5·60	2·80	8·40^{4}	...	...	...	1·35	0·97	2·32^{15}	...	...	...	2·24	0·56	2·80^{5}	
		1906	3·82	2·19	6·01^{21}	3·73	2·51	6·25^{78}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7·21	2·83	10·04^{96}	...	...	...	...	...	...	
		1904–7	**3·15**	**0·67**	**3·82^{129}**	**3·61**	**2·31**	**5·93^{86}**	...	...	...	...	...	...	...	...	...	**2·47**	**3·61**	**6·07^{79}**	...	...	...	**3·53**	**2·99**	**6·52^{36}**	**10·38**	**1·46**	**11·83^{88}**	**7·72**	**1·14**	**8·86^{69}**	**7·09**	**2·72**	**9·81^{100}**	**2·24**	**0·56**	**2·80^{5}**	
Eastern Areas.	H	1904	...	...	...	...	...	...	...	...	...	...	...	...	3·12	0·70	3·82^{52}	...	...	...	...	...	...	0·78	0·00	0·78^{16}	0·00	0·00	0·00^{15}	6·53	0·18	6·71^{73}	2·55	0·00	2·55^{385}	2·63	0·00	2·63^{191}	H
		1905	4·02	+	4·02^{347}	...	...	...	0·16	0·00	0·16^{9}	2·95	0·00	2·95^{135}	3·04	0·04	3·08^{170}	...	...	...	2·28	0·53	2·80^{16}	...	...	...	0·00	0·69	0·69^{40}	1·68	1·02	2·70^{365}	1·51	0·64	2·15^{257}	2·87	0·45	3·32^{24}	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1·63	5·25	6·88^{16}	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4·92	0·00	4·92^{70}	...	...	...	
		1904–7	**4·02**	+	**4·02^{347}**	...	...	...	[**0·16**	**0·00**	**0·16^{9}**]	**2·95**	**0·00**	**2·95^{135}**	**3·06**	**0·20**	**3·26^{222}**	...	...	...	**2·28**	**0·53**	**2·80^{16}**	**0·78**	**0·00**	**0·78^{16}**	**0·00**	**0·50**	**0·50^{55}**	**2·22**	**1·03**	**3·25^{534}**	**2·41**	**0·23**	**2·64^{712}**	**2·70**	**0·14**	**2·84^{775}**	
	M	1904	...	...	...	...	...	...	...	...	...	...	...	...	0·34	0·02	0·36^{76}	0·63	0·01	0·64^{262}	0·00	0·00	0·00^{114}	0·18	0·00	0·18^{48}	...	...	...	...	...	...	4·21	0·00	4·21^{30}	2·74	0·00	2·74^{329}	M
		1905	0·34	0·00	0·34^{53}	...	...	...	0·00	0·00	0·00^{19}	0·02	+	0·02^{38}	0·56	0·05	0·61^{130}	0·12	+	0·12^{661}	...	...	...	...	...	...	0·00	0·00	0·00^{61}	4·98	3·32	8·30^{13}	1·09	0·56	1·64^{294}	4·21	0·66	4·87^{91}	
		1906	...	...	...	...	...	...	...	...	...	0·04	0·08	0·11^{287}	0·36	0·70	1·06^{423}	0·03	1·18	1·21^{451}	0·00	0·00	0·00^{286}	0·00	0·00	0·00^{276}	...	...	...	0·00	0·00	0·00^{28}	0·02	0·02	0·01^{81}	7·51	0·96	8·47^{202}	
		1907	...	...	...	...	...	...	...	...	...	0·03	+	0·03^{155}	0·03	0·36	0·39^{442}	0·17	6·24	0·41^{333}	0·00	0·00	0·00^{99}	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00^{7}	4·40	0·00	4·40^{160}	
		1904–7	**0·34**	**0·00**	**0·34^{53}**	...	...	...	**0·00**	**0·00**	**0·00^{49}**	**0·03**	**0·03**	**0·06^{300}**	**0·37**	**0·28**	**0·65^{1751}**	**0·19**	**0·36**	**0·54^{1797}**	**0·00**	**0·00**	**0·00^{480}**	**0·07**	**0·00**	**0·07^{124}**	**0·00**	**0·00**	**0·00^{61}**	**1·64**	**1·09**	**2·73^{41}**	**1·09**	**0·40**	**1·48^{402}**	**4·48**	**0·33**	**4·81^{732}**	
	Q	1904	...	...	...	...	...	...	...	...	...	...	...	...	1·24	0·00	1·24^{4}	0·00	0·00	0·00^{48}	0·01	0·00	0·01^{112}	0·01	0·00	0·01^{48}	+	0·00	+^{115}	0·00	0·00	0·00^{8}	...	...	...	...	...	...	Q
		1905	...	...	...	...	...	...	0·01	0·00	0·01^{222}	0·00	0·00	0·00^{29}	0·18	0·00	0·13^{140}	0·01	0·00	0·01^{20}	0·00	0·00	0·00^{73}	0·00	0·00	0·00^{299}	0·00	0·00	0·00^{34}	...	...	...	0·13	0·00	0·13^{8}	2·18	0·00	2·18^{9}	
		1906	...	...	...	...	...	...	0·00	0·00	0·00^{42}	...	...	...	0·41	0·90	1·31^{67}	0·03	0·64	0·66^{106}	0·00	1·05	1·05^{9}	0·00	0·00	0·00^{25}	...	...	...	0·00	0·00	0·00^{25}	...	...	...	...	...	...	
		1907	...	...	...	0·00	0·00	0·00^{15}	+	0·00	+^{118}	0·25	0·34	0·59^{57}	1·70	1·13	2·83^{184}	0·52	0·45	0·97^{49}	0·00	0·00	0·00^{47}	0·00	0·00	0·00^{113}	0·00	0·00	0·00^{120}	0·00	0·00	0·00^{28}	0·00	0·00	0·00^{7}	...	...	...	
		1904–7	...	...	...	**0·00**	**0·00**	**0·00^{15}**	+	**0·00**	+^{483}	**0·09**	**0·13**	**0·22^{156}**	**0·92**	**0·68**	**1·60^{395}**	**0·11**	**0·40**	**0·51^{214}**	+	**0·03**	**0·04^{240}**	+	**0·00**	+^{486}	+	**0·00**	+^{209}	**0·00**	**0·00**	**0·00^{21}**	**0·07**	**0·00**	**0·07^{15}**	**2·18**	**0·00**	**2·18^{9}**	
	W	1904	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00^{61}	0·00	0·00	0·00^{17}	..	...	...	0·00	0·00	0·00^{4}	...	...	...	...	...	...	...	...	...	W
		1905	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00^{6}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1906	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00^{12}	...	...	...	...	...	...	
		1907	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·00	0·00	0·00^{16}	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
		1904–7	...	...	...	...	...	...	...	...	...	...	...	...	**0·00**	**0·00**	**0·00^{6}**	**0·00**	**0·00**	**0·00^{61}**	**0·00**	**0·00**	**0·00^{28}**	...	...	...	**0·00**	**0·00**	**0·00^{4}**	**0·00**	**0·00**	**0·00^{12}**	...	...	...	...	...	...	

considerable numbers of small fish which appear to be very scarce on the eastern side (where the total average catch varies from one to two cwt.). The southern areas give a very small yield (less than one cwt. per 10 hours in each year).*

Thus there is found to be a great difference in the yield of haddock in the various parts of this region, and while their distribution is somewhat similar to that of cod, in showing increasing quantities towards the north, they exhibit still more marked and decided differences in the various parts. For instance, the average catch of haddock in the north eastern region is about 15 times that in the southern region, while we find that for cod, this proportion is halved.

The yearly catches are compared in another way by the following summary, which is the comparison of the averages of the corresponding months in the various years.

1905 is 24 times less than, and 14 times greater than 1904, out of 40 months.
1906 is 15 times less than, and 17 times greater than 1904, out of 35 months.
1907 is 13 times less than, and 10 times greater than 1904, out of 25 months.

1906 is 20 times less than, and 24 times greater than 1905, out of 46 months.
1907 is 14 times less than, and 15 times greater than 1905, out of 34 months.

1907 is 19 times less than, and 12 times greater than 1906, out of 33 months.

On the whole, this table shows more decline than increase. There was a decided drop in the yield of 1905 compared with 1904, while in 1906 there is a recovery. 1907 is less than 1906.

The Fluctuations in each Area.

The average catch of haddock in each area is given for each month in Table XXIV. The nature of the variations, as far as they can be determined from these figures for each area or group of areas, is as follows :—

The North Eastern Areas.

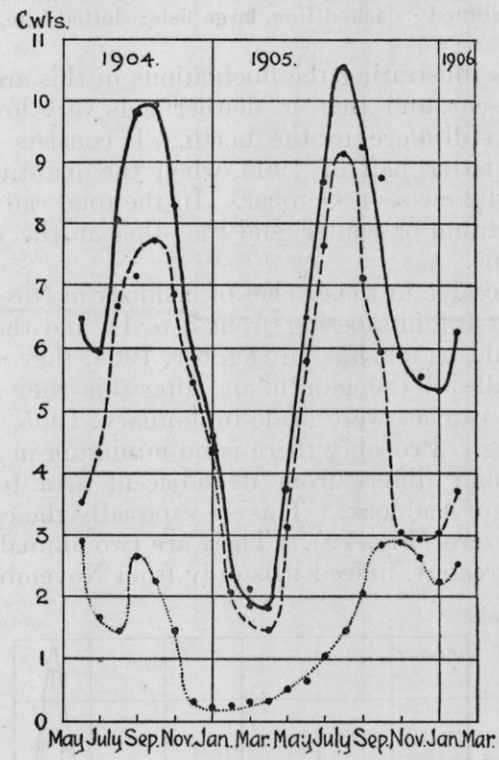

FIG. 77.—HADDOCK. North-eastern areas combined. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

When we compare the averages from the various parts of this group, especially those representing a very fair amount of fishing, we find a certain similarity in amount and trend. Owing to this fact, it is possible to combine the records from all these areas and so obtain a more complete and accurate series of averages than is otherwise possible.

The resulting averages with a few interpolations are smoothed into the curve of Fig. 77, to show approximately the nature of the abundance and the seasonal variations in this region.

* With these facts compare the results given on p. 92, Committee A Report. *Loc. cit.*

The height of the curve is considerable and shows that the stock of haddock is very great. This consists of fish of all sizes, the large fish preponderating and far outweighing the small, although these are not at all inconsiderable in amount. With regard to these small fish it should be mentioned that a number of small unmarketable haddocks were present in area G in January, 1905, but these are thrown away when caught. In area F a lot of tiny haddocks appeared in September, 1905.

Haddocks of all sizes are most abundantly found in the months August to October, in some areas averaging nearly 14 cwt. in September. In some cases, as in F, they appear in unusually large shoals. The averages for the spring months (1905) are based on very few hours fishing, and are possibly erroneous, so we can place no reliance on the position or extent of this minimum.

About ten years before (in 1895) the chief item of fish landed from this region was haddock; vessels would bring in sometimes from two to three hundred boxes of large haddocks as the result of one trip—far more than is now ever taken.*

Eastern Areas.

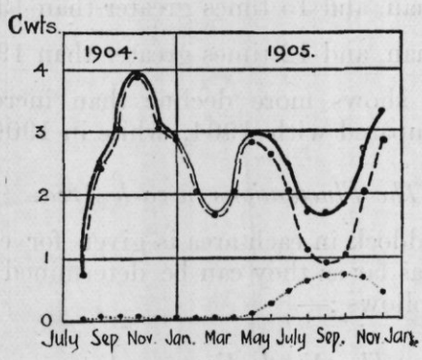

FIG. 78.—Area H. Monthly averages (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area H.—The curves illustrating the fluctuations in this area show that a fair stock of haddock is always present, and that it neither gets very low nor has such a high maximum, as the grounds still more to the north. It consists almost entirely of large haddock alone, until the latter half of 1905, when the quantity of "small" gradually increases to a maximum 1·02 cwts. in October. In the total catch, there appear to be two maxima, as in the late autumn or winter and the other in the spring or early summer. The summer catches are low.

Great variation is noticeable in the catches of haddock in November, 1904—sometimes they are caught in basketsful numbering from 7 to 11 and then for many hauls only a fraction of a basketful would be taken. In October, 1904, they are absent from most of the hauls up to the middle of the month, and after this they are taken in considerably varying quantities. Good catches were made in January, 1905, and nearly all the large fish in these were spawning. Probably there is no minimum in February and March.

Area M.—This ground differs from its adjacent area further north in yielding generally a smaller catch of haddock. This is especially the case in the summer, when the catches are most often zero (Fig. 79). There are two annual maxima, the one in late autumn being by far the greatest, indeed it is only from November to December that the

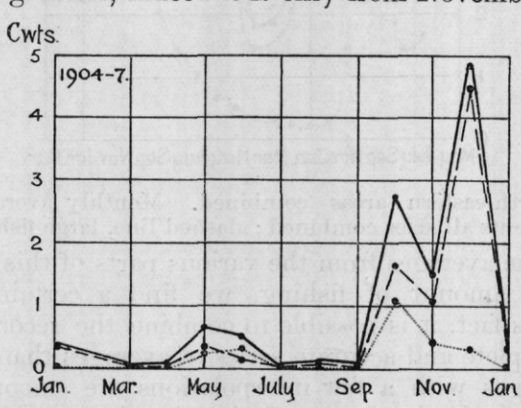

FIG. 79.—HADDOCK. Area M. Monthly averages, 1904–07. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

* CUNNINGHAM. North Sea Investigations. Journ. Mar. Biol. Ass., Vol. IV., 1895, p. 13.

catches are at all large ; for most of the rest of the year they average considerably under one cwt. A secondary maximum occurs about June, but being of such a small extent, it is probably only caused by the spring migration shown clearly in area H extending a little further south into M. It is generally caused by a few very large catches combined with hauls in which none are taken, and is not always indicative of a uniform large abundance.

Small fish are rarely found in the catches till the autumn of 1905. In 1906 they form a still larger proportion of the total, though on the whole throughout the period the large fish exceed the small in weight. (Fig. 80.)

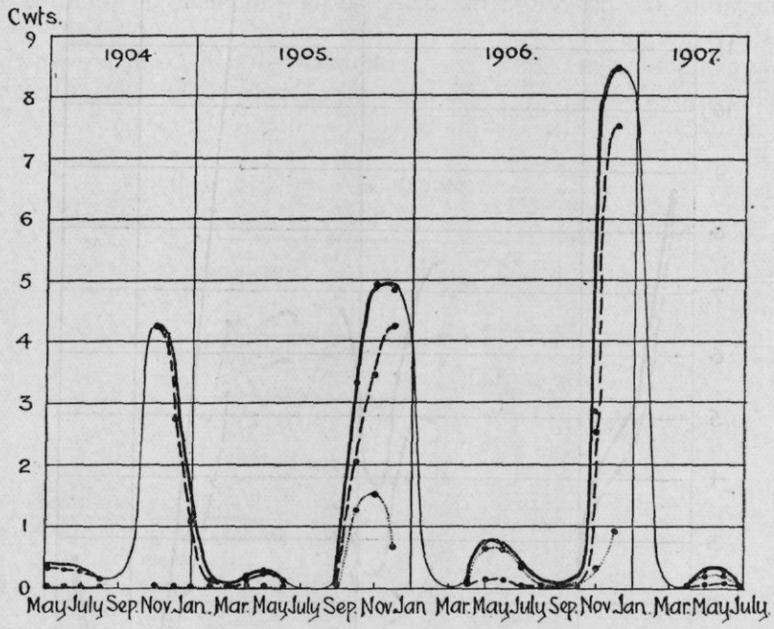

FIG. 80.—HADDOCK. Area M. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

The difference in the yield of the successive years is not determinable from the curves but it is interesting to compare such averages as we have with the conditions that existed here ten years ago. The average catch of haddock in May, 1905, is 0·61 cwt., in June it is 0·12 cwt. In 1895* the results of two voyages in May and June respectively are 11·4 cwt. and 3·1 cwt. per ten hours fishing. It is evident that at one time haddock were much more plentiful on the Sylt grounds than they are now.

In December, 1904, a noticeable diminution in the catches occurs towards the end of the month. This may be caused by an offshore migration of the fish.

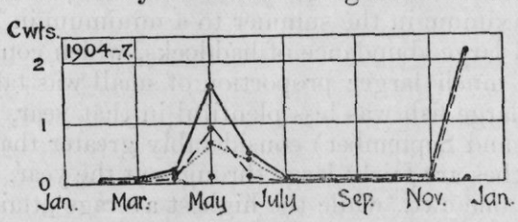

FIG. 81.—HADDOCK. Area Q. Monthly averages, 1904–07. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Areas Q and W.—In the latter of these two areas no haddock were taken at all (in spring and summer), while a similar condition of things was the case in area Q for the greater part of the year. The autumn and winter months are not sampled sufficiently for us to know whether the fish come inshore in this part as they do in the other two inshore areas in the autumn, but this is probably the case. They are certainly entirely absent in early spring and are only found in any appreciable quantities in May and June of the months investigated. In 1906 and 1907 they were more plentiful than in the other years.

The four eastern areas yield small quantities of haddock, the northern Horn Reef area having the largest amount. There are generally two maxima, the greatest immigration taking place in late autumn ; the other one occurs about May or June, just after the

* CUNNINGHAM.—North Sea Investigations. *Loc. cit.*, p. 33, *et seq.*

spawning season. There is an absolute minimum in the summer on the Sylt, Amrum, and Terschelling grounds. Comparison with observations made in 1895 show that the catches in this region have much decreased as compared with that year. Large fish preponderate in this part, but small haddock show increased proportions from the autumn of 1905 onwards.

Central Areas.

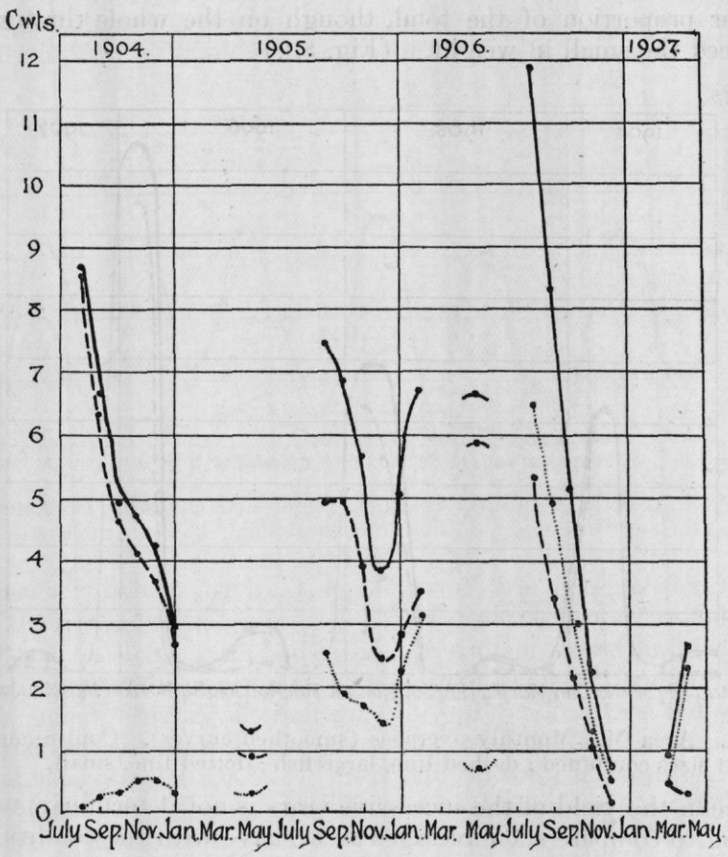

FIG. 82.—HADDOCK. Area J. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area J.—There is great similarity between the total yield and seasonal abundance of the haddock in this area and those immediately to the north (the north eastern areas). Comparing the sections of the curves (Figs. 82 and 77) from 1904 to 1905, we find the same sharp fall from a maximum in the summer to a minimum in November or December, a slightly smaller but still large abundance of haddocks, which consists in these two years, mostly of large fish. A much larger proportion of small was taken in 1906, so that, in spite of the fact that the large fish was less plentiful in that year, the total catches were in some months (August and September) considerably greater than they were in the two previous years. The catches are fairly large throughout the year. Only on two occasions is the average less than one cwt., while the highest average attained is 11·86. Between 1905 and 1906 we find indications, from the few hauls taken in the winter, of increased quantities at the oncoming of the spawning season.

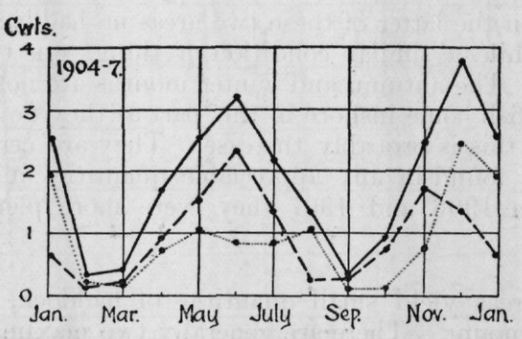

FIG. 83.—HADDOCK. Area N. Monthly averages, 1904–07. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area N.—The total yield of haddock from this region is much less than in any of the other central areas, the maximum catches being about 4 cwt., and the minimum zero. The seasonal variations are very regular and periodic, giving annually two maxima in June and December, while the minima between these two come in the periods February to March, and September to October. (Fig. 83.)

Fig. 84 shows that in the first two years the stock mainly consists of *large* fish, but these become very scarce in 1906 and make a slight recovery in 1907. This decrease in 1906 is *almost* balanced by the greatly increased numbers of small fish which appear first of all at the end of 1905, but which show a considerable falling off in 1907.

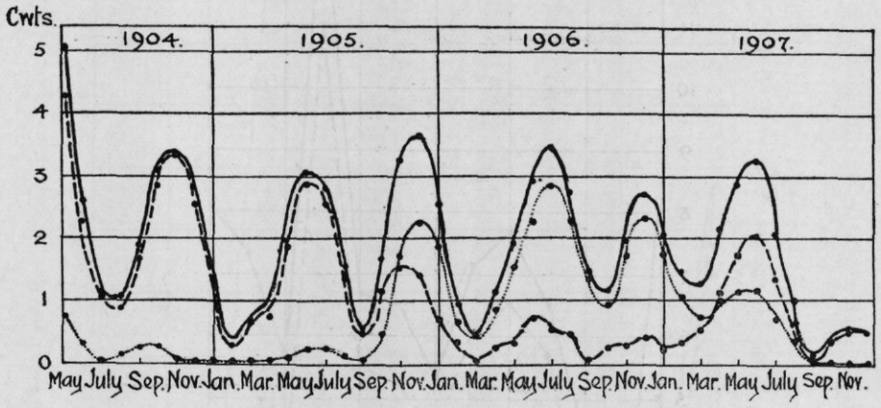

FIG. 84.—HADDOCK. Area N. Monthly averages, (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area I.—This is a good area for haddock, and the average several times exceeds 7 cwt., and on one occasion (October, 1904) it is as much as 16·2 cwt. As in many of the other areas, we find here a majority of large haddock, until the last three months of 1905 and in 1906, when the small fish outweigh them considerably.

For the seasonal fluctuations (Fig. 85) we find the catches rising from the summer of 1904 to a maximum in October, followed by a drop to the following February. In 1905 the large fish show a slow decline from June to January, 1906, but the marked increase in the number of small fish is sufficient to make the total catch rise from a minimum in the summer to a maximum about November. There is a downward trend throughout the summer and autumn of 1906, corroborated by the decreasing averages of September to November, 1907, but the amount of fishing is almost too small to make this conclusion of any value.

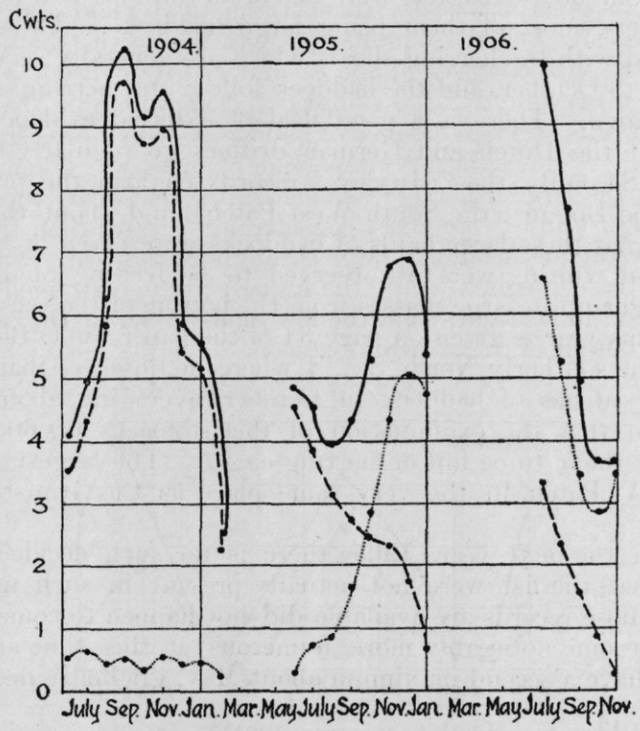

FIG. 85.—HADDOCK. Area I. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area O.—The Dogger Bank appears to be pre-eminently a haddock fishing ground, for it yields a far larger amount of this species than of any of the other important food fishes yet dealt with in this report. In the eight months of 1904 for which we have records, the averages, with one exception, were all over 6 cwt., and in October the total

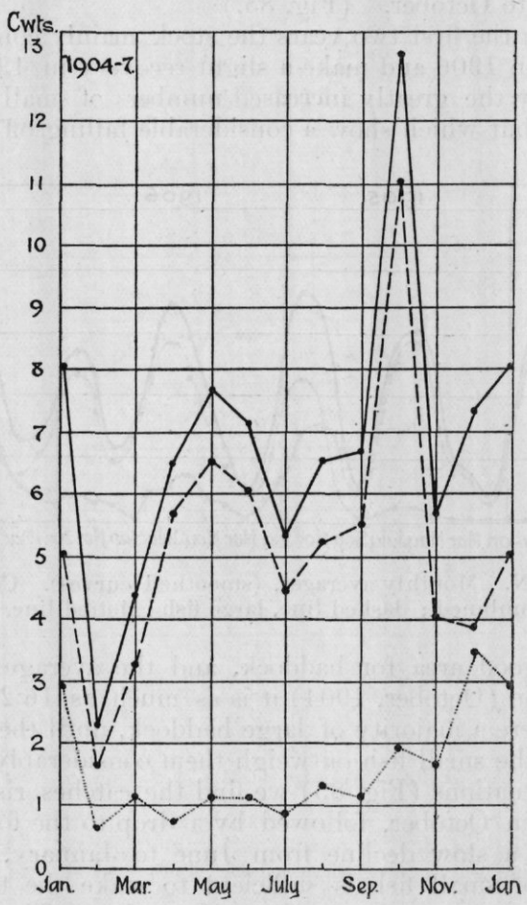

FIG. 86.—HADDOCK. Area O. Monthly averages, 1904–07. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

reached the high amount of 19·68 cwt. The catches in this month were extraordinarily large, several times from 50–80 baskets were taken, and in one haul on the 22nd October there were 147 baskets, most of them being large haddocks. These large shoals are undoubtedly connected with the herring shoals which are generally very numerous on the Dogger in September to October, and the haddock follow the herring in shoals in order to feed on their spawn. There is a good deal of external evidence to confirm this. Firstly, we know that the Dutch and German drifters go regularly to the Dogger for herring in October. Secondly, the "Huxley" records confirm the presence of herrings on the same part of the Dogger (the South West Patch), and about the same time (the 20th October, 1904) that these large hauls of haddocks were taken by the Grimsby men.*

Cod, haddock and whiting were all observed to be feeding on the herring spawn which the trawl brought up in large masses from the bottom of the sea. Further evidence of the conditions in this year is given on page 34 of the paper by J. Boeke, on the "Fish Eggs and Larvæ in the southerly North Sea,"† where he observes that the Dutch fishermen made enormous catches of haddock in October, averaging about 606 kg. per day (about 12 cwt.), and that the examination of the stomachs of 60 haddocks on the 20th October, showed them to be full of herring eggs.‡ The largest catches were made just north of the S.W. Patch, in the very same place as the Grimsby fishermen found them.

The fact that in the next year (1905) there is no such decided maximum about October may mean that the fish were not actually present in such numbers, or, that if they were, the men whose records are available did not happen to come across the shoals.

The small fish become noticeably more numerous at this time and in 1906, while the large fish, which have a second maximum about May, gradually decline in numbers.

* Voyage 41, Station 19.

† Verhandelingen Uit. Het. Rijksinstituut vor Het Onderzoek der Zee. III.–V. 1906.

‡ Cf. *Todd.* Food of Fishes. *Internat. Invest. Mar. Biol. Assoc.* Report II., Part I., 1904–5, p. 127.

Tiny unmarketable haddock were very plentiful on the Dogger in April, 1905, and in the succeeding months. Tons of them were put overboard, and one of the skippers remarked that it was many a year since he had seen so many very small fish on the Dogger. They were mainly haddocks and whitings.*

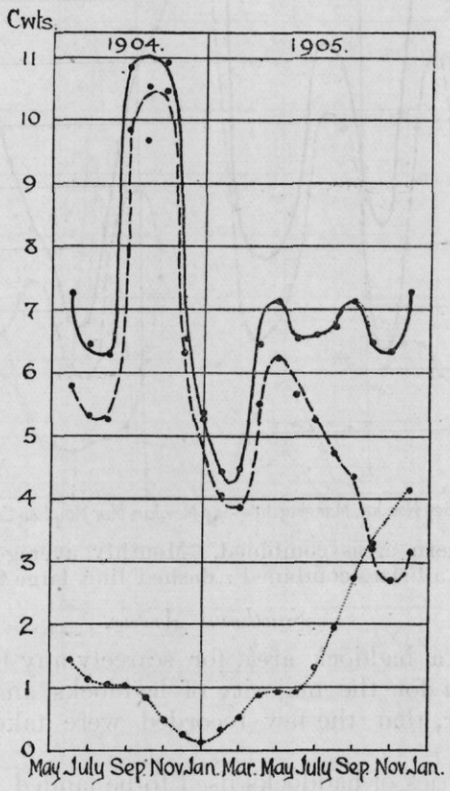

FIG. 87.—HADDOCK. Area O. Monthly averages (smoothed curves). Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

The four central areas, with one exception, yield very large amounts of haddock, the average in many cases exceeded 5 and 6 cwt., and was very seldom less than 2 cwt. The most southern and shallow of these areas show smaller catches with a maximum of about 4 cwt.

In all parts, the small fish were scarce in 1904, and increased significantly at the end of 1905, when they began to exceed the large. The unmarketable fish made their first appearance earlier in the year, when tons of them had to be thrown overboard.

A slight decrease in the total of all sizes together is observed between 1904 and 1907. The periods of maximum abundance appear to be in the summer (and probably at the end of the winter) in the most northerly area J (the Mud Bank, &c.), in spring and autumn on the Dogger Bank (O), and in June and December in area N. In the remaining area the period is not definitely determined by these figures, but there are indications of a maximum some time in the autumn.

Northern Areas.

The catches from these three areas have been combined into the averages which are shown smoothed in Fig. 88. They show that large numbers are present, for they are nearly all over 3 cwt. per 10 hours fishing, and about one half of the averages are over 6 cwt.

Early in the year there is an accumulation of *large* fish which are nearly all spawning, and they generally reach their greatest numbers in February. They diminish again to 2 or 3 cwt. in the early part of the summer, and rise to a maximum in September or October of each year. Small fish generally form a considerably smaller proportion of the total weight than the large, but towards the end of 1906 they are very numerous. Their seasonal fluctuations are not very definite, but there is some evidence for the existence of a late summer or autumn maximum.

* The average catches of haddock in April, 1895, were about double the amount in April, 1905. *See* Cunningham's Investigations. *Loc. cit.*

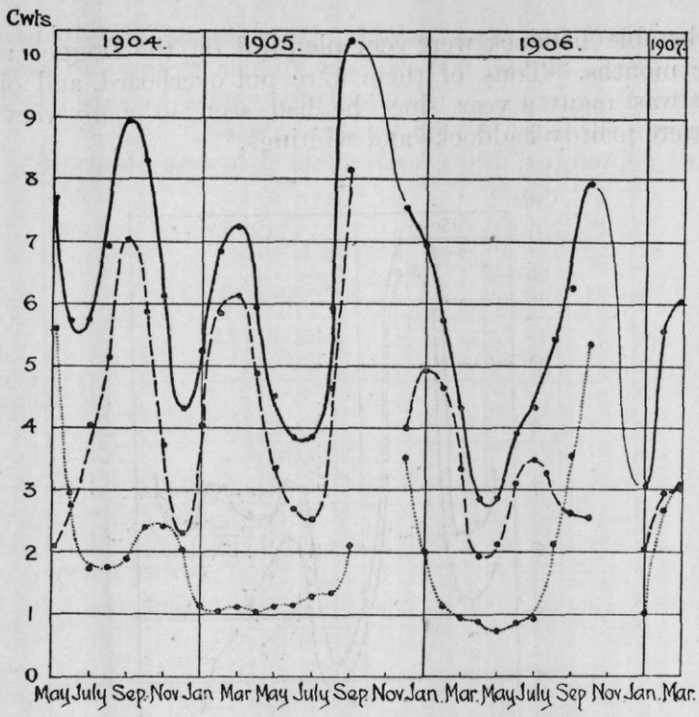

FIG. 88.—HADDOCK. Northern areas combined. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Southern Areas.

Area S.—This is not a haddock area, for scarcely any fish are reported from this region. It is too far south for the majority of haddocks, and it is only in the spring, and perhaps in the winter, that the few recorded were taken. These were nearly all small fish.

In former years quantities of haddocks used to be landed by Lowestoft smacks from Smith's Knoll. Mr. Atkinson tells me, that as the result of persistent enquiry among the fishermen, it was generally observed that the fish, *which were all large*, made their appearance in August and September. They remained there up to Christmas, and then, according to the fishermen, suddenly and rapidly disappeared. Mr. Atkinson states that haddock are now but rarely seen on the Lowestoft market, but that in the autumn of 1905 he observed a few small haddocks packed in boxes with whitings from the Leman.

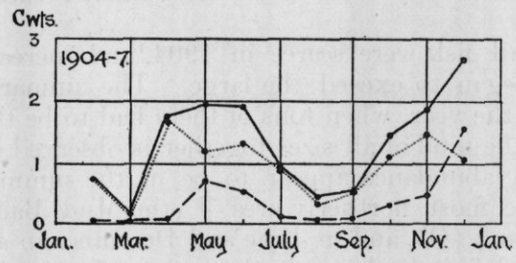

FIG. 89.—HADDOCK. Area T. Monthly averages, 1904–1907. Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

Area T.—Haddocks are found throughout the year in this area, but in small quantities. The maximum monthly catches of the year are 3 cwt. or less, and in 1905

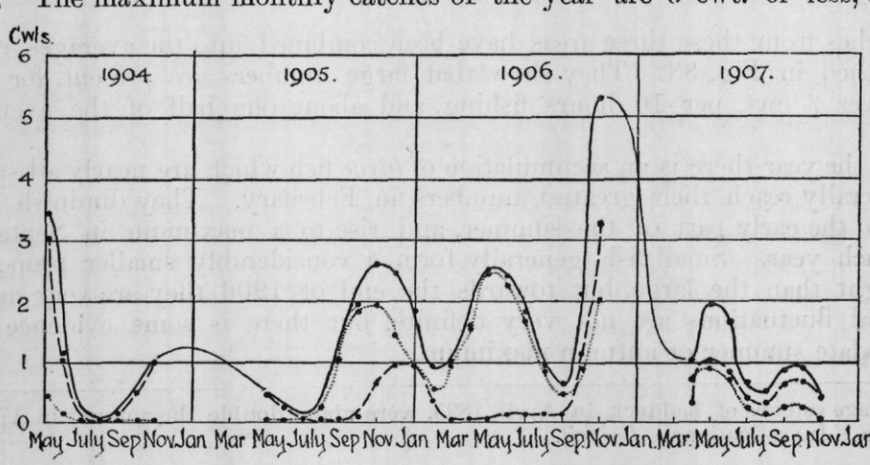

FIG. 90.—HADDOCK. Area T. Monthly averages (smoothed curves). Continuous line represents all sizes combined ; dashed line, large fish ; dotted line, small.

and 1906, when we have the most records, they consist mainly of small fish. The seasonal fluctuations (Figs. 89 and 90) are very similar to those in area N, that is, there are two annual maxima occurring in May to June, and November to December, respectively. In the summer the catch is zero, or almost so.

About the 23rd September, 1905, some of the fish were observed to be full of herring spawn.

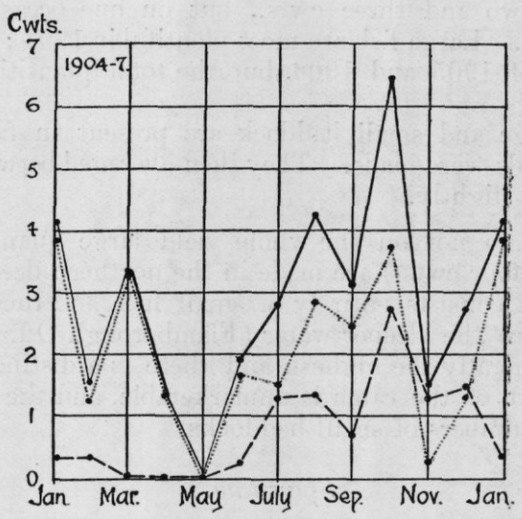

FIG. 91.—HADDOCK. Area V. Monthly averages, 1904–1907. Continuous line represents all sizes combined; dashed line, large fish; dotted line, small.

Area V.—The average catch of haddocks from the Silver Pits compares favourably with the other two southern areas. The maximum catches are between four and five cwts. The hauls of October, 1905, which resulted in particularly large numbers, were all made on the Spit of the Dogger, just over the line bordering the two areas V and O.

The three areas together show rather small quantities of haddock, the most notherly one having the largest abundance. They are absent in the summer in S and T but present, sometimes in their greatest numbers at this time, in V. There are two periods of maximum abundance in T, at the end of spring and autumn, while those present in S indicate the same conditions there. Small fish are mostly predominant.

Western Areas.

Area E.—Only six small haddock were recorded from the few hauls made in this area, in 1906.

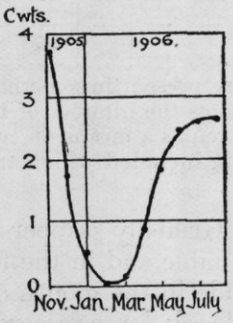

FIG. 92.—HADDOCK. Area R. Monthly averages (smoothed curves). Continuous line represents small fish.

Area R.—The haddock in these grounds, almost without exception, are recorded as small. The curve is shown only for the averages from November, 1905, to August, 1906, as the rest are not reliable. The highest value is in November (3·47 cwts.); it is followed by a sharp drop to a zero minimum in February and March, after which the curve rises to nearly three cwts. in the summer. During this time large quantities of unmarketable haddock were caught in the trawl but not landed. This preponderance of small haddock is probably somewhat exaggerated owing to the fact that 1906 is the year of "small haddocks," and the other years are not allowed sufficient weight in the averages.

The fish caught about 16th November, 1905, when large hauls were taken, were full of herring spawn, and it was noticed that the haddock had eaten only clean spawn. Haddock were seldom taken on this ground after the 22nd November. On the 15th December the skipper remarks on the unusual occurrence of a few haddock still feeding on herring spawn, a "very late date for them to be feeding on that kind of food."

Area X.—The greatest catches appear to be made in the summer; they generally average then between two and three cwts., but on one occasion (August, 1904) the maximum was 8·68 cwts. Large fish are most plentiful in 1904; small occur in increased quantities at the end of 1905 and 1906, but the total quantities on the whole decrease from 1904.

Area P.—Both large and small haddock are present in fair numbers, especially in July, when the most hauls were made. They then averaged between three and four cwts., large fish predominating slightly.

The western areas do not on the whole yield large quantities of haddock. The largest catches (three to four cwts.) are made in the northern deepest part. In the most southern area the catch consists entirely of small fish, and these form no inconsiderable portion of the catch from the deeper water (Flamborough Off, &c.). The summer and autumn catches are generally the highest, and there is a distinct minimum in February and March. A good part of the catch is unmarketable, and the fishermen mention that they throw away large numbers of small haddocks.

Spawning.

Table XXV.—Showing the number of hauls in each area in which maturing or spawning HADDOCK are recorded.

		B.	C.	D.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	T.	V,	X.
October...	1904	—	—	—	—	—	—	13/22 *	—	—	—	—	—	—	—	—	—
November	„	—	—	—	—	—	—	—	—	—	—	2/2	*	19/23	*	*	5/5 *
December	„	—	—	—	—	—	27/42	53/53	3/86	—	—	63/72	—	25/25	—	—	
January	1905	—	—	1/14 *	—	11/26	88/94	7*	9/25	30*/30	9/17	13/13	—	19/25	—	—	—
February	„	—	—	127/132	—	2/2	—	3/3	—	37*/38	133*/146	—	*	14/14	—	—	1/1
March ...	„	—	1/2	145/152	3/4	—	1/3	—	—	7/8	37/47	—	—	22/37	—	—	3/14
April ...	„	—	—	—	—	—	—	—	—	—	—	—	—	10/158	—	—	—
October...	1905	5/5	—	—	5/10	—	2/17	—	1/18	—	—	2/3	—	—	—	—	—
November	„	1/1	—	—	2/2	—	—	9/9	—	—	—	17/19	17/17	1/1	—	—	—
December	„	—	—	15/15	2/2	1/1	11/21	4*/5 *	14/14	—	7/7	11*/11	2*/2 *	97/119	—	—	7/8
January	1906	—	—	—	—	4/4	—	—	44/4 *	6/6	28/33	—	—	—	—	—	—
February	„	—	—	16/23	—	15/15	—	—	—	5/5	54/63	—	1*/1	2/2	13/22	1/1	—
March ...	„	—	—	21/65	—	—	—	—	—	—	—	—	—	—	—	1/14	—
January	1907	—	—	—	—	—	—	—	—	12/13	—	—	48/74	39/69	—	—	—
February	„	—	—	—	—	—	—	—	—	51/58	—	—	8/31	—	—	—	—
March ...	„	—	—	7/7	—	—	—	—	—	28/69	12/15	—	—	—	—	—	—

* Maturing or spawning haddock are present in some hauls, the number of which is not specified. The numerator of the fractions denotes the number of hauls when records of spawning fish were made, and the denominator, which is given as a means of comparison, is the total number of hauls in the area for each month, only those being included which are made by men who record any spawning cod or haddock.

The observations made by the Grimsby skippers on the maturation and spawning of the haddock are summarised in the table and in the following account:—

The first observations were made in the month of October, 1904, when in the central grounds, Clay Deep, &c., "a few haddock" were recorded as spawning (probably maturing), and this condition is continued throughout November and December on the Dogger, the Dogger Bight, the eastern grounds H and M, while in Clay Deep they became numerous. According to another fisherman, in November and December the haddock from areas N, T, V and X are "developing spawn."

Throughout January and February, 1905, we notice that "the roes of the haddock are getting very ripe"—this applies to the northern and central areas. Numerous haddock are found spawning at Horn Reef in January and still more in areas G, J, D, I, K and L, north and east of the Dogger in January, February and March. They are present on the Dogger and Dogger Bight, but never in such quantities as in the grounds north of the Dogger and the eastern grounds, where the spawning fish are sometimes measured in basketsful.

The spawning of haddock is continued till the first week in April, 1905, the few cases recorded at this time being found on the Dogger.

In the next season the observations begin in the same month, October. Here we find "spawn forming in the haddock" in a few cases in the eastern areas (J, M and H) and in the north eastern areas. In November, in these areas, together with the other central areas I, N and O, the large haddock are very full of spawn. In December, in all these groups of areas and in the western area X, we find spawning haddocks and fish which are full of spawn. A skipper states in the first week in December that "the large haddock caught on the Amrum Grounds are full of roes," while later on, in the last week of this month, he notices that the large haddock are beginning to get roes in them. In this case he was working further offshore, in the neighbourhood of Clay Deeps—between the 20-fathom line and the Dogger. According to Damas the individuals inhabiting the regions near the coasts spawn sooner than those farther away.*

During January and February, 1906, the large haddock are reported as "full of spawn" from most of the areas fished over during these months. The northern areas D, K and L have very large numbers of spawning fish, several basketsful being often taken in each haul. In the more southern areas N, T and V spawning fish are present, but they are characterised as "few." Large numbers are spawning in the first week in March in area D, after which none were recorded.

In the next season there are no records till January, 1907 when a few haddock, small and large, from area N were spawning; these records from area N were continued till the first week in February. They were also spawning on the Dogger in January, and from January to about the middle of March in the grounds north of the Dogger.

It is seen that, while a few haddock are found spawning as early as December, the majority are still unripe at this time. The ripe or "full" fish become much more abundant in January, and they are constantly found spawning in this and the two succeeding months, as well as in different stages of ripeness.

Spawning fish are taken over the greater part of this region, but those from the Dogger and the ground south of it are few in number, compared with those from the Horn Reef grounds, and from the areas north of the Dogger.

It seems that the haddock from this region when spawning, seek the central parts of the North Sea where the depths are from 20 to 50 fathoms and congregate in especially large numbers north of the Dogger, avoiding the shallower and more southerly grounds.

If we may judge from the presence of spawning haddock in the Horn Reef area, the Mud Bank and the outside the Tail End of the Dogger, we may infer that they are also to be found abundantly still further north, in the group of north-eastern areas, including part of the little Fisher Bank from which we have, unfortunately, few observations in the winter months.†

Summary.—Haddock.

The comparative distribution of the haddock according to the mean monthly catch in this region is shown in Fig. 93.

a. Distribution.—Haddock are distributed in large quantities over this region. The central grounds are abundantly supplied, and the general tendency is for the quantities to increase as we proceed northwards. They have, however, a southern limit, for they are seldom found south of Latitude 54° N. or in the shallow coastal grounds bordering on the Dutch, German and English coasts. The greatest abundance was found in the group of north-eastern areas, including parts of the Fisher Bank &c., while the Dogger Bank and the Deep Water surrounding it on the north and east were also some of the best grounds in this region (south of 57° N.). The mean monthly catch of these areas was about 6 cwts. per 10 hours fishing for the period 1904–07, while the maximum averages were 12 or 13 cwts. On the other hand we find mean values of only 1 to 2 cwts. on the eastern grounds and in some of the western areas, while the most southern areas yield only occasional fish and for the greater part of the year are absolutely without any haddock.

It was found that small fish form about 30 per cent. of the total weight of fish caught, but this percentage varies for the different regions, and even more for the different years. It is in the western areas that we find the largest percentage of small—on the eastern grounds there are very few. The small are actually the most numerous on the northern and north-eastern grounds.

The abundance of small fish on the western side may be explained by reference to Damas' report on the distribution of eggs and larvae, where we find that the eggs,

* *cf.* DAMAS. Contribution à la Biologie des Gadides, p. 129. Committee A Report. *Loc. cit.*
† *cf.* DAMAS. Contribution a la Biologie des Gadides, p. 132. *Loc. cit.*

spawned in the northerly regions, are carried by the surface currents while they are still in their pelagic state. The current coming down the east coast of Scotland and N.E. England would bring the larval forms to the neighbourhood of the western areas where they develop into small fish. This fact would also account for the comparative scarcity of small fish on the eastern side, for the water here comes in a current from the south part of the North Sea, where no haddock eggs are spawned.

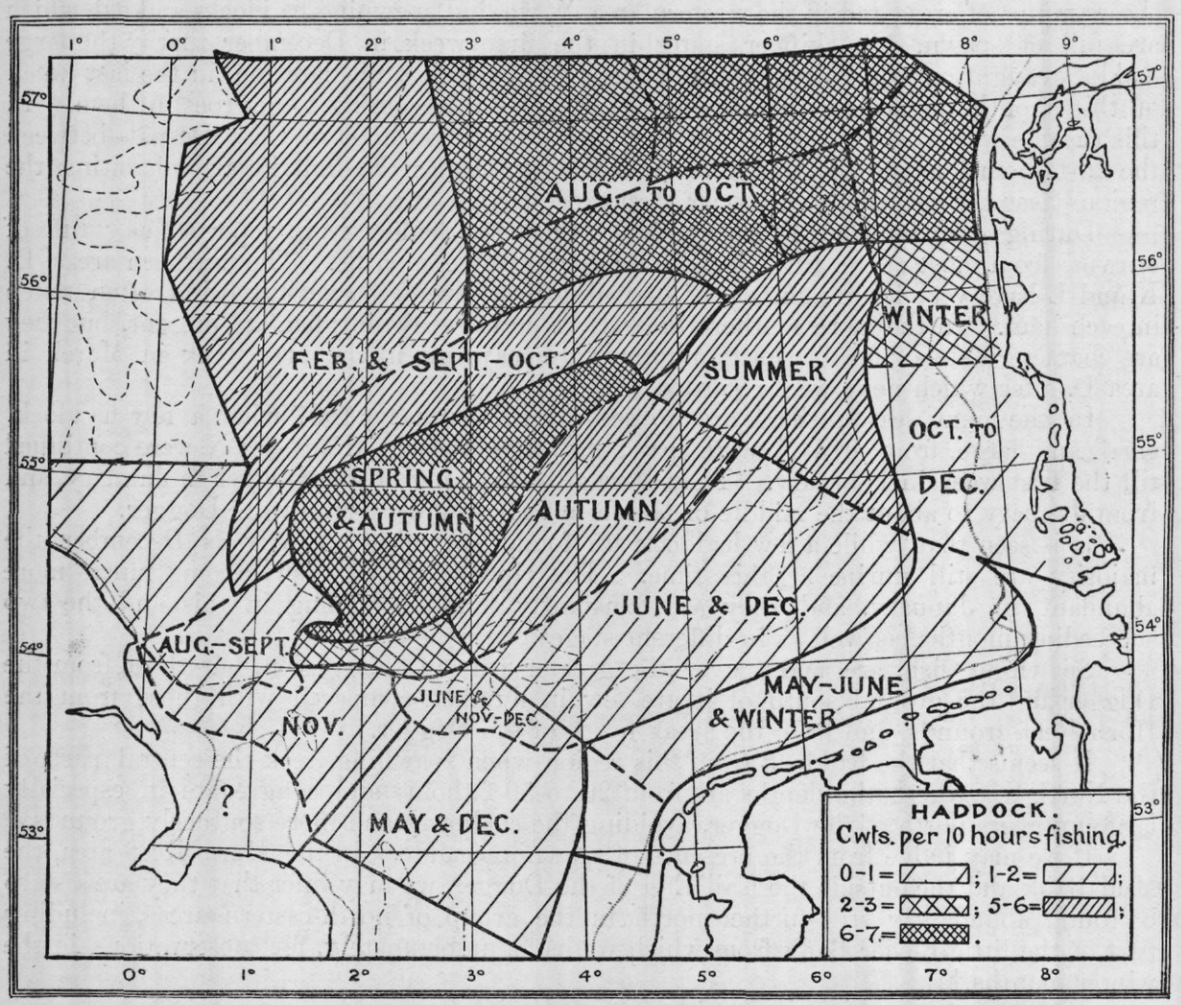

FIG. 93.—*Chart* showing the distribution of HADDOCK according to the mean monthly average catch in various areas and the periods of maximum abundance in the different regions.

b. Yearly Variations.—We have found for nearly all groups of areas considered a fall in the average total catch throughout the period. The year 1906 is not always significantly less or greater than 1904–5, but it is greater than 1907. The nature of the variations is not the same for the two classes "large" and "small." The large fish fall from 1904 to a minimum in 1906. After this there is, on the whole, a recovery in 1907, but one that still keeps the amounts less than they were in 1904 and 1905. The small fish, however, generally increase between 1904 and 1906 and diminish again in numbers in 1907.

The change in the quantity of "small" is very marked—in nearly every case we find but small quantities of small fish in 1904, while in 1905 the tiny haddocks, of course unmarketable, were thrown overboard in enormous numbers. Toward the end of 1905 they became of a marketable size and helped to swell the amounts of marketable small haddocks, which were so much in evidence at this time and during 1906. This condition, viz., the great number of young haddocks spawned in 1904 and the absence of those spawned two years earlier, has been already noted as remarkable by Helland Hansen.* The Grimsby statistics are therefore strongly confirmatory.

c. Seasonal Fluctuations and Migrations.—The majority of the areas show at least one definite period in the year when the stock of fish is considerably augmented: in some, there are two such periods. On the whole, the fish are most abundant in the last four or five months of the year, and this may be explained in two ways, both of which probably

* HELLAND HANSEN.—Statistical Research in the Biology of the Haddock and Cod in the North Sea, p. 37. Committee A Report. *Loc. cit.*

are responsible for the increase. In the first place, some of the small haddock, which were of an unmarketable size earlier in the year, would in the autumn become just large enough to be caught in the trawl* ; secondly, there is a seasonal migration probably between the different areas, and also between this region as a whole and the grounds still further north.

In the northern areas the first maximum occurs about February, and this is undoubtedly a spawning migration, for nearly all the fish that cause the increase are "large" fish and are spawning. It is probable that such is also the case in the north-eastern areas, but the statistics are not complete enough to show it. On the Dogger Bank and in some of the areas to the south and east, we find a spring immigration, culminating in a maximum in May and June, indicating a southerly and coastal migration after the spawning season. A definite offshore migration then takes place, the haddock leaving the southern and south-eastern coastal grounds entirely for a few months in the summer. The catches in the northern and north-eastern areas and the offshore area J are very large in the summer and at the beginning of autumn. An autumn and winter increase is shown on the eastern grounds and southern grounds and it is only at this time of the year (November to December) that these areas show any appreciable numbers of haddocks.

The very large shoals of haddock, which appear on several grounds, such as the Dogger Bank, in the autumn are undoubtedly caused by migration in search of food, chiefly at this time, the spawn of the herring. Haddock have been found in the neighbourhood of the herring shoals, with their stomachs absolutely full of herring spawn.

d. Spawning.—Most of the large haddock and certain of the small were mature. The first observations on their maturity were made in October, but actually spawning fish are seldom seen before January ; after this both maturing and spawning haddocks were taken in large numbers, and February and March seem to be the height of the season. The latest records were made early in April.

The spawning fish were found in nearly all areas, but they seem to prefer the central and northern parts, where the water is deeper, to the shallow grounds, and were found there in much greater abundance than in the southern and inshore areas.

G.—Whiting.

Introduction.

The Grimsby fishermen record on their forms the amount of whiting taken in the trawl, and these records have been averaged in the same way as the other species. soon, however, becomes evident that the resulting figures have not got the same value and importance for elucidating the distribution and fluctuations that the corresponding figures for the other species have. In fact, there is evidence that the amounts are not only roughly measured, but that they are inaccurately given so that there can be very few deductions drawn from the resulting averages, since they cannot with any degree of reliability be said to represent the stock of fish in the various areas. For one thing, it is known that large numbers of whiting escape through the net.† Very often they are recorded, merely as "few fish" which may be a very varying quantity. Then again, the fishermen often neglect to record them at all, when we know that they have been caught from the records of the total quantities landed ; also, it is possible that many more fish are caught than are sometimes recorded, for a good many are thrown away and only a few of the best kept. This results in a remarkable sameness in the catches of whiting from the different areas and a considerable irregularity in the seasonal fluctuations. There is none of that great difference between east and west or north and south, that was so marked in the case of plaice or haddock, nor are the regular inshore and offshore movements that annually took place in the case of some species so clearly displayed by these figures. All that can be done then is to give the figures for what they are worth, and use great reserve in drawing conclusions from them, pointing out the facts they indicate and leaving it to future and more exact investigations to corroborate them.

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* The I Group reaches an average size of 22·5 cm. in October. (Helland Hansen, p. 27.) And Mr. Todd's results from the covered net experiments, show that all haddocks above this size are retained in the nets, while a large percentage of those below it escape.

† Todd.—Covered Net Experiments. These show that the size of the largest fish escaping considerably exceeds that for other species, and in all the hauls examined, nearly one-half the total number of whiting passed through the net.

Conversion of the different Measures into Weight.

Fish of all sizes are measured together. Mr. Olsen gives an average of 220 whiting in a box of 95 lbs. weight, whence one whiting is equal to 0·004 cwt. There are 120 fish to every basket, so that the ratio of the quantity in a basket to that in a box is 0·55. The "Huxley" measurements give similar results. The weight of 24,490 fish measured on board is 3836 kilos., whence 1 fish is equal to 0·003 cwt., a result somewhat lower than that given above, because many very small fish are included in the "Huxley's" catches which would be unmarketable and therefore neglected on a steam trawler. The weight of one basket deduced from that of 44 baskets on the "Huxley" is 0·60 cwt. From the same source we have the number of fish in one basket is 166, whence the average weight of a fish is 0·004 cwt., the value adopted.

The ratio of a basket to a box, obtained from the skippers records, is given in the following table :—

TABLE XXVI. giving the ratio between the total number of boxes of WHITING landed by each skipper in each year, and the number of baskets in the hauls.

Skipper.	1904.	1905.	1906.	1907.	1904–7.
i	·77	·72	·68	—	·74
ii	—	·66	—	—	·66
iii	·59	·49	·56	·61	·53
iv	—	·74	·67	—	·69
v	·79	·62	·62	·57	·69
vi	·69	·74	·66	·71	·71
vii	·66	·66	—	—	·66
viii	·57	·52	—	—	·54
All	·68	·59	·63	·66	·63

In the case of whiting there is a serious objection to using the ratio ·63 obtained in this way, for there is reason to believe that it is somewhat unreliable as the figures on which it is based are subject to such considerable error. In the first place the number of baskets considered is much less than in the case of cod and haddock, in the second place, the quantities caught and the amounts landed are not always the same thing. Whiting are fish which readily decay, and being relatively unimportant are soon thrown away if not in first class condition. Hence it happens that the amounts landed are sometimes not strictly comparable with the amounts caught. Occasionally, note is made of the fact that the whiting of a saleable size from the first few hauls of a voyage are thrown away. This would result in reducing the *real* ratio of a basket to a box.

On the other hand, there is the real error, which occurs without doubt, namely, of neglecting to record in the individual hauls the catches of whiting, while their presence is known by the record in the summary. Of these errors we cannot gauge the extent, and under such conditions it is better to adopt the value for a basket obtained from the "Huxley" records, viz., 0·60 cwt.

Yearly Total and Average Quantities.

TABLE XXVII.—Showing the Yearly Total Catch of WHITING, in cwts., and the average per 10 hours fishing.

Year.	Total Weight.	Average.
1904	647·94	0·64
1905	1049·85	0·55
1906	376·71	0·32
1907	274·98	0·33
1904–1907	2349·48	0·48

It is seen that the catch of whiting is very small, averaging about half a hundredweight per ten hours fishing. The 1904 average is the highest, and there is a decline to an average one-half the amount for that year in 1906 and 1907. The monthly averages when compared also show a decline on the whole, at least till 1906.

Distribution and Seasonal Fluctuations.

TABLE XXVIII.—Showing for each Area the Monthly Average Catch of WHITING, in cwts., per ten hours fishing.

Group.	Area.	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
North Eastern Areas.	A	1904	...	...	...	...	...	...	...	$0\cdot00^{22}$	...	...	...	...
		1905	...	...	...	...	...	...	$0\cdot05^{44}$	...	...	...	...	...
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	...	...	...	...	**$0\cdot05^{44}$**	**$0\cdot00^{22}$**	...	...	...	...
	B	1904	...	...	...	...	...	...	...	$0\cdot00^{18}$	$0\cdot54^{88}$	$0\cdot45^{117}$	$0\cdot52^{64}$	...
		1905	...	...	...	$0\cdot40^{30}$	$0\cdot36^{12}$	...	...	...	$0\cdot52^{160}$	$0\cdot45^{20}$	$0\cdot00^{4}$	...
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	$0\cdot32^{113}$	$0\cdot04^{39}$	...
		1904–7	...	...	...	**$0\cdot40^{30}$**	**$0\cdot36^{12}$**	...	...	**$0\cdot00^{18}$**	**$0\cdot53^{248}$**	**$0\cdot38^{250}$**	**$0\cdot32^{107}$**	...
	C	1904	...	...	...	...	...	...	...	...	...	...	...	...
		1905	...	...	$0\cdot56^{8}$	...	...	...	...	...	...	$0\cdot00^{4}$	...	$0\cdot00^{4}$
		1906	...	...	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot56^{8}$**	...	...	...	...	...	...	**$0\cdot00^{4}$**	...	**$0\cdot00^{4}$**
	F	1904	...	...	...	...	...	$0\cdot46^{68}$	$0\cdot00^{8}$	$0\cdot00^{8}$	$0\cdot50^{65}$	...	$0\cdot14^{64}$	$0\cdot04^{120}$
		1905	...	...	$0\cdot02^{12}$	...	...	...	$0\cdot12^{52}$	$1\cdot27^{35}$	$0\cdot88^{109}$	$0\cdot72^{94}$	$0\cdot38^{8}$	$0\cdot38^{8}$
		1906	...	...	...	...	...	...	...	$0\cdot40^{38}$	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot02^{12}$**	...	...	**$0\cdot46^{68}$**	**$0\cdot10^{60}$**	**$0\cdot74^{81}$**	**$0\cdot74^{174}$**	**$0\cdot72^{94}$**	**$0\cdot16^{72}$**	**$0\cdot06^{128}$**
	G	1904	...	...	...	...	...	$0\cdot10^{29}$	...	$0\cdot09^{32}$	$0\cdot76^{88}$	$0\cdot34^{44}$	$0\cdot00^{4}$	...
		1905	$0\cdot47^{108}$	$0\cdot26^{8}$	...	...	...	...	...	$0\cdot00^{4}$	...	$0\cdot21^{15}$	...	$0\cdot30^{5}$
		1906	$0\cdot51^{21}$	$0\cdot40^{78}$	...	...	...	...	...	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	$0\cdot31^{96}$	...
		1904–7	**$0\cdot48^{129}$**	**$0\cdot39^{86}$**	...	...	...	**$0\cdot16^{29}$**	...	**$0\cdot08^{36}$**	**$0\cdot76^{88}$**	**$0\cdot31^{59}$**	**$0\cdot30^{100}$**	**$0\cdot36^{5}$**
Eastern Areas.	H	1904	...	...	...	...	$0\cdot46^{52}$	...	...	$0\cdot09^{16}$	$0\cdot00^{15}$	$0\cdot21^{73}$	$0\cdot05^{385}$	$0\cdot07^{191}$
		1905	$0\cdot16^{347}$	...	$0\cdot00^{9}$	$0\cdot00^{135}$	$0\cdot28^{170}$	...	$0\cdot00^{16}$	...	$0\cdot00^{30}$	$0\cdot17^{565}$	$0\cdot05^{257}$	$0\cdot32^{84}$
		1906	...	...	...	...	...	...	...	...	...	$0\cdot00^{16}$	...	...
		1907	...	...	...	...	...	...	...	...	...	...	$1\cdot17^{70}$	...
		1904–7	**$0\cdot16^{347}$**	...	**$0\cdot00^{9}$**	**$0\cdot00^{135}$**	**$0\cdot32^{222}$**	...	**$0\cdot00^{16}$**	**$0\cdot09^{16}$**	**$0\cdot00^{55}$**	**$0\cdot17^{654}$**	**$0\cdot16^{712}$**	**$0\cdot15^{275}$**
	M	1904	...	...	...	...	$0\cdot02^{76}$	$0\cdot25^{262}$	$0\cdot00^{114}$	$0\cdot00^{48}$	...	...	$0\cdot20^{30}$	$0\cdot11^{329}$
		1905	$0\cdot01^{53}$	...	$0\cdot00^{49}$	$0\cdot03^{358}$	$0\cdot08^{810}$	$0\cdot64^{661}$	...	...	$0\cdot00^{61}$	$0\cdot67^{13}$	$0\cdot20^{284}$	$0\cdot28^{91}$
		1906	...	...	...	$0\cdot01^{287}$	$0\cdot02^{423}$	$0\cdot00^{451}$	$0\cdot00^{286}$	$0\cdot00^{76}$	...	$0\cdot00^{28}$	$0\cdot02^{81}$	$0\cdot45^{202}$
		1907	...	...	...	$0\cdot00^{155}$	$0\cdot00^{442}$	$0\cdot02^{333}$	$0\cdot00^{80}$	...	...	...	$0\cdot00^{7}$	$0\cdot71^{160}$
		1904–7	**$0\cdot01^{53}$**	...	**$0\cdot00^{49}$**	**$0\cdot02^{800}$**	**$0\cdot04^{1751}$**	**$0\cdot29^{1707}$**	**$0\cdot00^{480}$**	**$0\cdot00^{124}$**	**$0\cdot00^{61}$**	**$0\cdot22^{41}$**	**$0\cdot16^{402}$**	**$0\cdot34^{782}$**
	Q	1904	...	...	...	...	$0\cdot67^{4}$	$0\cdot44^{48}$	$1\cdot02^{112}$	$1\cdot25^{48}$	$0\cdot10^{115}$	$0\cdot00^{8}$	...	...
		1905	...	...	$1\cdot51^{322}$	$0\cdot64^{99}$	$0\cdot11^{140}$	$0\cdot29^{20}$	$0\cdot00^{73}$	$0\cdot00^{290}$	$0\cdot00^{34}$	...	$0\cdot18^{8}$	$0\cdot00^{9}$
		1906	...	...	$0\cdot14^{43}$	...	$0\cdot11^{67}$	$0\cdot10^{106}$	$0\cdot00^{8}$	$0\cdot00^{35}$	...	$0\cdot00^{35}$	...	...
		1907	...	$0\cdot00^{15}$	$0\cdot00^{118}$	$1\cdot59^{57}$	$0\cdot77^{184}$	$0\cdot15^{40}$	$0\cdot00^{47}$	$0\cdot01^{113}$	$0\cdot00^{120}$	$0\cdot05^{28}$	$0\cdot00^{7}$	...
		1904–7	...	**$0\cdot00^{15}$**	**$1\cdot02^{483}$**	**$0\cdot99^{156}$**	**$0\cdot42^{395}$**	**$0\cdot20^{214}$**	**$0\cdot47^{240}$**	**$0\cdot13^{486}$**	**$0\cdot04^{269}$**	**$0\cdot02^{71}$**	**$0\cdot10^{15}$**	**$0\cdot00^{9}$**
	W	1904	...	...	...	...	...	$0\cdot07^{61}$	$0\cdot75^{12}$	...	$0\cdot00^{4}$	...	...	...
		1905	...	...	...	...	$0\cdot00^{6}$	...	...	...	...	...	...	...
		1906	...	...	...	...	...	...	...	...	...	$0\cdot00^{12}$	...	...
		1907	...	...	...	...	...	...	$0\cdot00^{16}$	...	...	...	...	...
		1904–7	...	...	...	...	**$0\cdot00^{6}$**	**$0\cdot07^{61}$**	**$0\cdot32^{28}$**	...	**$0\cdot00^{4}$**	**$0\cdot00^{12}$**	...	...
Central Areas.	J	1904	...	...	...	...	$0\cdot33^{9}$	...	...	$0\cdot72^{75}$	$0\cdot70^{205}$	...	$0\cdot33^{77}$	$1\cdot25^{401}$
		1905	$0\cdot97^{105}$	...	...	...	$0\cdot38^{20}$	...	...	...	$1\cdot53^{95}$	$0\cdot21^{78}$	$0\cdot21^{64}$	$0\cdot73^{88}$
		1906	$0\cdot49^{28}$	$0\cdot75^{30}$	...	...	$0\cdot25^{77}$	...	...	$0\cdot36^{92}$	$0\cdot38^{90}$	$0\cdot00^{284}$	$0\cdot01^{130}$	$0\cdot00^{38}$
		1907	...	...	$0\cdot02^{67}$	$0\cdot41^{68}$	...	...	...	...	...	...	$0\cdot00^{16}$	...
		1904–7	**$0\cdot87^{133}$**	**$0\cdot75^{30}$**	**$0\cdot02^{67}$**	**$0\cdot41^{68}$**	**$0\cdot28^{106}$**	...	...	**$0\cdot52^{167}$**	**$0\cdot83^{390}$**	**$0\cdot05^{362}$**	**$0\cdot14^{287}$**	**$1\cdot07^{527}$**
	N	1904	...	...	...	...	$0\cdot64^{28}$	$0\cdot78^{40}$	$1\cdot95^{205}$	$1\cdot30^{109}$	$1\cdot13^{98}$	$0\cdot41^{144}$	$1\cdot45^{182}$	$0\cdot64^{136}$
		1905	$0\cdot35^{8}$	$0\cdot23^{40}$	$1\cdot48^{52}$	$0\cdot68^{60}$	$0\cdot56^{59}$	$0\cdot99^{139}$	$1\cdot28^{76}$	$1\cdot58^{272}$	$0\cdot01^{274}$	...	$0\cdot47^{219}$	$0\cdot90^{412}$
		1906	$0\cdot41^{421}$	$0\cdot07^{310}$	$1\cdot32^{283}$	$0\cdot67^{14}$	$0\cdot22^{90}$	$0\cdot11^{83}$	$0\cdot58^{76}$	$0\cdot34^{197}$	$0\cdot38^{51}$	$0\cdot11^{108}$	$0\cdot01^{201}$	$0\cdot36^{74}$
		1907	$0\cdot77^{306}$	$0\cdot27^{125}$	$0\cdot20^{228}$	$0\cdot83^{132}$	$0\cdot96^{74}$	$0\cdot34^{71}$	$0\cdot11^{118}$	$0\cdot03^{45}$	$0\cdot05^{235}$	$0\cdot22^{299}$	$0\cdot12^{354}$	$0\cdot12^{96}$
		1904–7	**$0\cdot56^{735}$**	**$0\cdot13^{475}$**	**$0\cdot88^{563}$**	**$0\cdot77^{206}$**	**$0\cdot56^{251}$**	**$0\cdot61^{333}$**	**$1\cdot17^{475}$**	**$1\cdot05^{623}$**	**$0\cdot22^{658}$**	**$0\cdot25^{551}$**	**$0\cdot43^{956}$**	**$0\cdot69^{718}$**
	I	1904	...	...	...	...	...	$0\cdot83^{101}$	$0\cdot00^{18}$	$0\cdot65^{319}$	$0\cdot66^{225}$	$1\cdot18^{218}$	$0\cdot71^{190}$	$1\cdot13^{359}$
		1905	$0\cdot83^{87}$	$0\cdot21^{17}$	...	...	...	$1\cdot30^{52}$	$1\cdot05^{121}$	$1\cdot03^{263}$	$0\cdot85^{652}$	...	$0\cdot57^{139}$	$0\cdot88^{47}$
		1906	$0\cdot81^{79}$	...	...	...	...	...	$0\cdot36^{74}$	...	$0\cdot34^{31}$	$0\cdot13^{11}$	$0\cdot00^{65}$	...
		1907	...	...	...	...	...	...	...	...	$0\cdot36^{160}$	$0\cdot53^{71}$	$0\cdot44^{27}$	...
		1904–7	**$0\cdot82^{166}$**	**$0\cdot21^{17}$**	...	...	...	**$0\cdot99^{153}$**	**$0\cdot72^{213}$**	**$0\cdot82^{582}$**	**$0\cdot72^{1068}$**	**$0\cdot98^{300}$**	**$0\cdot54^{421}$**	**$1\cdot16^{406}$**
	O	1904	...	...	...	...	$0\cdot15^{10}$	$0\cdot48^{100}$	$0\cdot60^{149}$	$0\cdot74^{254}$	$0\cdot80^{216}$	$1\cdot33^{356}$	$0\cdot68^{278}$	$068\cdot97$
		1905	$0\cdot14^{100}$	$0\cdot04^{56}$	$0\cdot31^{150}$	$0\cdot45^{613}$	$1\cdot11^{395}$	$0\cdot52^{121}$	$1\cdot08^{255}$	$1\cdot27^{99}$	...	$0\cdot61^{327}$	$0\cdot57^{175}$	$0\cdot50^{538}$
		1906	...	$0\cdot57^{11}$	$0\cdot00^{9}$	$0\cdot33^{14}$	$0\cdot30^{10}$	...	...	...	$0\cdot43^{4}$	$0\cdot33^{14}$	$0\cdot38^{4}$	...
		1907	$0\cdot15^{281}$	...	$0\cdot19^{80}$	...	...	...	...	...	...	...	$0\cdot80^{68}$	...
		1904–7	**$0\cdot15^{381}$**	**$0\cdot13^{67}$**	**$0\cdot26^{239}$**	**$0\cdot44^{627}$**	**$1\cdot07^{415}$**	**$0\cdot56^{221}$**	**$0\cdot96^{404}$**	**$0\cdot88^{353}$**	**$0\cdot78^{220}$**	**$0\cdot97^{697}$**	**$0\cdot66^{525}$**	**$0\cdot53^{435}$**

Group.	Area.	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Northern Areas.	D	1904	...	...	...	...	...	...	...	...	...	...	$0\cdot56^{37}$	...
		1905	$0\cdot25^{61}$	$1\cdot00^{760}$	$0\cdot99^{647}$	$0\cdot37^{24}$	...	...	...	...	...	...	...	$0\cdot78^{69}$
		1906	...	$0\cdot21^{85}$	$0\cdot17^{257}$	...	...	...	...	$0\cdot48^{131}$	$0\cdot25^{24}$	...	...	...
		1907	...	...	$0\cdot11^{28}$	...	...	...	...	...	...	...	...	...
		1904–7	**$0\cdot25^{61}$**	**$0\cdot92^{845}$**	**$0\cdot74^{932}$**	**$0\cdot37^{24}$**	...	...	...	**$0\cdot48^{131}$**	**$0\cdot25^{24}$**	...	**$0\cdot56^{37}$**	**$0\cdot78^{69}$**
	K	1904	...	...	...	...	$0\cdot00^{4}$	$0\cdot31^{38}$	...	$0\cdot43^{7}$	$0\cdot79^{43}$	$0\cdot62^{95}$	$0\cdot35^{21}$	...
		1905	$0\cdot38^{211}$	$0\cdot36^{239}$	$0\cdot18^{29}$	...	...	...	...	$0\cdot00^{4}$	$0\cdot49^{71}$	$0\cdot75^{4}$	...	...
		1906	$0\cdot34^{31}$	$0\cdot56^{24}$	$0\cdot14^{44}$	...	...	...	...	...	$0\cdot22^{21}$	...	...	...
		1907	$0\cdot11^{55}$	$0\cdot08^{232}$	$0\cdot29^{235}$	...	...	...	...	...	...	$0\cdot41^{11}$	$0\cdot19^{8}$	...
		1904–7	**$0\cdot33^{297}$**	**$0\cdot24^{495}$**	**$0\cdot26^{308}$**	...	**$0\cdot00^{4}$**	**$0\cdot31^{38}$**	...	**$0\cdot27^{11}$**	**$0\cdot54^{135}$**	**$0\cdot60^{110}$**	**$0\cdot31^{29}$**	...
	L	1904	...	...	...	...	...	$0\cdot35^{21}$	$0\cdot50^{6}$	$0\cdot41^{84}$	$0\cdot47^{195}$	$0\cdot78^{63}$	$0\cdot35^{8}$	..
		1905	$0\cdot30^{84}$	$0\cdot26^{625}$	$0\cdot24^{192}$	$0\cdot42^{111}$	$0\cdot46^{30}$	$0\cdot21^{7}$	$0\cdot46^{79}$	$0\cdot25^{18}$	$0\cdot63^{81}$	...	...	$0\cdot62^{36}$
		1906	$0\cdot30^{132}$	$0\cdot11^{247}$	...	...	$0\cdot11^{199}$	$0\cdot38^{108}$	$0\cdot43^{97}$	$0\cdot50^{101}$	$0\cdot47^{308}$	$0\cdot41^{136}$	...	...
		1907	...	...	$0\cdot03^{60}$	...	...	...	...	...	...	$0\cdot35^{13}$	...	...
		1904–7	**$0\cdot30^{216}$**	**$0\cdot22^{872}$**	**$0\cdot19^{252}$**	**$0\cdot42^{111}$**	**$0\cdot16^{229}$**	**$0\cdot36^{136}$**	**$0\cdot45^{182}$**	**$0\cdot44^{203}$**	**$0\cdot48^{584}$**	**$0\cdot52^{212}$**	**$0\cdot35^{8}$**	**$0\cdot62^{36}$**
Southern Areas.	S	1904	...	...	...	...	...	$0\cdot40^{216}$	$0\cdot00^{345}$	$0\cdot03^{454}$	$0\cdot60^{100}$	$1\cdot25^{103}$	...	...
		1905	...	...	...	...	...	...	$0\cdot05^{617}$	$0\cdot10^{749}$	$0\cdot63^{45}$	$0\cdot38^{4}$	$0\cdot88^{8}$	$0\cdot78^{13}$
		1906	...	$0\cdot00^{5}$	$0\cdot58^{92}$	$0\cdot33^{22}$	$0\cdot40^{7}$	$0\cdot27^{55}$	$0\cdot07^{83}$	$0\cdot16^{106}$	$0\cdot22^{220}$	$0\cdot03^{56}$	...	...
		1907	...	...	...	...	$0\cdot28^{461}$	$0\cdot31^{348}$	$0\cdot04^{271}$	...	...	...	$0\cdot47^{16}$	...
		1904–7	...	**[$0\cdot00^{5}$]**	**$0\cdot58^{92}$**	**$0\cdot33^{22}$**	**$0\cdot28^{468}$**	**$0\cdot34^{619}$**	**$0\cdot04^{1316}$**	**$0\cdot08^{1309}$**	**$0\cdot37^{365}$**	**$0\cdot81^{163}$**	**$0\cdot61^{24}$**	**$0\cdot78^{13}$**
	T	1904	..	...	...	...	$0\cdot12^{13}$	$0\cdot94^{24}$	$2\cdot40^{10}$	$5\cdot25^{8}$	$0\cdot00^{8}$	...	$1\cdot07^{22}$	...
		1905	...	...	...	...	$0\cdot78^{55}$	...	$0\cdot28^{48}$	$0\cdot00^{79}$	$0\cdot42^{100}$	$0\cdot47^{177}$	$0\cdot80^{343}$	$0\cdot94^{340}$
		1906	...	$1\cdot19^{96}$	$0\cdot95^{52}$	$0\cdot40^{112}$	$0\cdot40^{53}$	$0\cdot36^{97}$	$0\cdot36^{181}$	$0\cdot30^{90}$	$0\cdot52^{83}$	$0\cdot35^{225}$	$0\cdot71^{27}$	...
		1907	...	...	...	$1\cdot25^{39}$	$0\cdot84^{25}$	$0\cdot41^{143}$	$0\cdot51^{91}$	...	$0\cdot90^{20}$	$1\cdot15^{84}$	$0\cdot58^{212}$	$0\cdot38^{12}$
		1904–7	...	**$1\cdot19^{96}$**	**$0\cdot95^{52}$**	**$0\cdot62^{151}$**	**$0\cdot59^{146}$**	**$0\cdot44^{264}$**	**$0\cdot45^{330}$**	**$0\cdot39^{177}$**	**$0\cdot49^{211}$**	**$0\cdot53^{486}$**	**$0\cdot73^{604}$**	**$0\cdot92^{352}$**
	V	1904	...	...	...	...	...	...	$1\cdot23^{131}$	$0\cdot73^{86}$	$2\cdot11^{45}$	...	$1\cdot11^{13}$	...
		1905	...	...	$1\cdot50^{25}$	...	...	...	$1\cdot89^{108}$	$3\cdot13^{29}$	...	$2\cdot68^{28}$	...	...
		1906	$2\cdot94^{59}$	$0\cdot67^{4}$	$0\cdot54^{80}$	$0\cdot10^{38}$	...	$0\cdot25^{12}$	$2\cdot09^{53}$	$1\cdot08^{49}$	$1\cdot00^{47}$	$0\cdot45^{16}$	$0\cdot52^{12}$	...
		1907	...	...	...	...	$0\cdot33^{4}$	$0\cdot56^{8}$	$1\cdot16^{55}$	...	...	$2\cdot01^{94}$	$0\cdot64^{28}$	$1\cdot11^{48}$
		1904–7	**$2\cdot94^{59}$**	**$0\cdot67^{4}$**	**$0\cdot77^{105}$**	**$0\cdot10^{38}$**	**$0\cdot33^{4}$**	**$0\cdot38^{20}$**	**$1\cdot55^{347}$**	**$1\cdot25^{164}$**	**$1\cdot25^{92}$**	**$1\cdot96^{138}$**	**$0\cdot74^{53}$**	**$1\cdot11^{48}$**
Western Areas.	E	1904	...	...	...	...	...	...	...	...	...	...	...	...
		1905	...	...	...	...	...	...	...	...	...	...	...	...
		1906	$0\cdot00^{8}$	...	$0\cdot00^{7}$	...	...	$0\cdot52^{18}$	$0\cdot52^{11}$	...	...	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	**$0\cdot00^{8}$**	...	**$0\cdot00^{7}$**	...	...	**$0\cdot52^{18}$**	**$0\cdot52^{11}$**	...	...	...	...	...
	R	1904	...	...	...	...	...	...	...	...	...	...	$0\cdot50^{9}$	$0\cdot33^{4}$
		1905	...	...	$0\cdot00^{14}$	...	$1\cdot25^{76}$	...	...	...	$0\cdot52^{18}$	...	$0\cdot88^{168}$	$0\cdot98^{212}$
		1906	$0\cdot01^{139}$	$0\cdot00^{236}$	$0\cdot04^{280}$	$0\cdot14^{266}$	$0\cdot40^{176}$	$0\cdot75^{238}$	$0\cdot89^{222}$	$0\cdot98^{113}$	$0\cdot40^{7}$	$0\cdot21^{14}$	...	...
		1907	...	...	...	$0\cdot69^{6}$	$0\cdot45^{23}$	$0\cdot38^{32}$	$0\cdot75^{4}$	...	...	...	...	...
		1904–7	**$0\cdot01^{139}$**	**$0\cdot00^{236}$**	**$0\cdot03^{294}$**	**$0\cdot15^{272}$**	**$0\cdot64^{275}$**	**$0\cdot71^{270}$**	**$0\cdot88^{226}$**	**$0\cdot98^{113}$**	**$0\cdot48^{25}$**	**$0\cdot21^{14}$**	**$0\cdot86^{177}$**	**$0\cdot97^{216}$**
	X	1904	...	...	...	...	...	...	$0\cdot39^{109}$	$1\cdot93^{60}$	$1\cdot03^{30}$	...	$1\cdot21^{33}$	$0\cdot34^{17}$
		1905	$0\cdot13^{4}$	$0\cdot50^{3}$	$0\cdot28^{53}$	$0\cdot38^{12}$	...	...	...	...	$0\cdot44^{31}$	$0\cdot57^{107}$	$0\cdot10^{15}$	$0\cdot38^{44}$
		1906	...	$0\cdot17^{9}$	$0\cdot23^{60}$	$0\cdot07^{77}$	$0\cdot20^{52}$	$0\cdot44^{156}$	$0\cdot33^{112}$	$0\cdot47^{93}$	$0\cdot61^{64}$	$0\cdot38^{20}$	$0\cdot38^{16}$	...
		1907	...	...	...	...	$0\cdot38^{52}$	$0\cdot38^{8}$	$0\cdot53^{96}$	...	...	$0\cdot49^{153}$	$0\cdot43^{28}$	$0\cdot43^{25}$
		1904–7	**[$0\cdot13$]^{4}**	**[$0\cdot25$]^{12}**	**$0\cdot25^{113}$**	**$0\ 11^{89}$**	**$0\cdot29^{104}$**	**$0\cdot44^{164}$**	**$0\cdot41^{317}$**	**$1\cdot05^{153}$**	**$0\cdot67^{125}$**	**$0\cdot51^{310}$**	**$0\cdot65^{92}$**	**$0\cdot38^{86}$**
	P	1904	...	...	...		...	...	$0\cdot70^{213}$	...	$0\cdot75^{8}$	...	...	...
		1905	...	...	...	...	...	...	$1\cdot03^{16}$	...	...	...	...	...
		1906	...	...	$0\cdot00^{4}$	$0\cdot00^{4}$	...	...	...	...	$0\cdot38^{24}$	...	...	...
		1907	...	...	...	...	...	...	...	...	...	...	...	...
		1904–7	...	...	**$0\cdot00^{4}$**	**$0\cdot00^{4}$**	...	...	**$0\cdot73^{229}$**	...	**$0\cdot47^{32}$**	...	...	...

Table XXVIII. gives the monthly averages of the recorded catches of whiting, but we know from the reasons given above, that they cannot be very exact. The curves drawn from these figures are of a very irregularly fluctuating character, and very few are reproduced in the text. The chief facts indicated by the figures for the groups of areas are as follows.

North Eastern Areas.—These have general monthly averages which vary between 0·0 and 0·76 cwt., with a mean value of about 0·3 cwt. There is probably a summer and early autumn maximum in Area F.

Eastern Areas.—The amounts in the Horn Reef, Sylt and Amrum grounds are very small, smaller than in any other areas, the averages very often being zero, and having mean monthly values of about 0·1 cwt. for both H and M. Maximum values occur about June and December. (See Fig. 94).

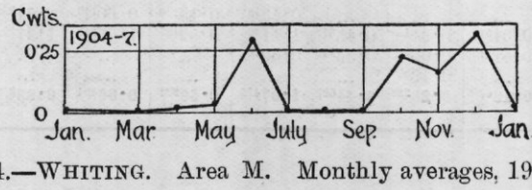

FIG. 94.—WHITING. Area M. Monthly averages, 1904–1907.

In Area Q, much larger numbers were taken. They averaged 1·51 cwt. in March, 1905, and amongst them were many "full of roes." In 1904 they were comparatively abundant in the summer; in the other years there was a spring maximum, and no fish at all in the summer.

The Central Areas show somewhat larger averages, the mean values varying between 0·5 cwt. in area J and 0·8 cwt. in area I. Areas N and O both have mean values of 0·6 cwt. and the maximum monthly value is about 1·1 cwt. in all.

There is some evidence for a summer maximum in area J, about August and September, but on the whole the seasonal fluctuations are not very constant in their occurrence. This is clearly shown in the curves representing the fluctuations in area N (Figs. 95 and 96).

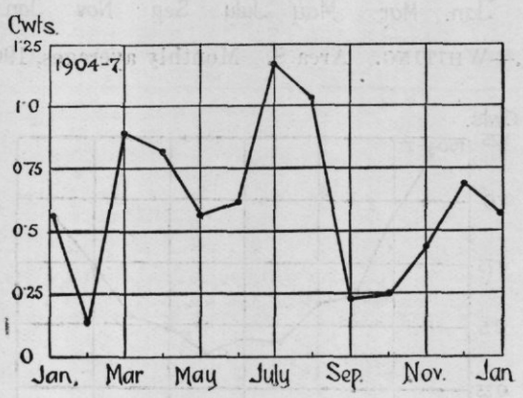

FIG. 95. WHITING. Area N. Monthly averages, 1904–1907.

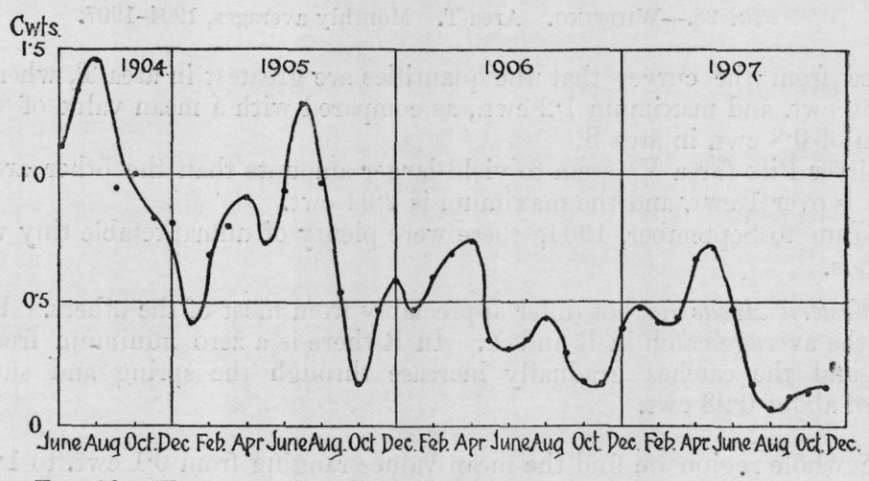

FIG. 96. WHITING. Area N. Monthly averages (smoothed curves).

In Fig. 96 there is a big summer maximum in 1904 and 1905, a very small one in 1906, and a minimum at that time in 1907. Apparently there is also a second maximum in the early spring. Although the seasonal fluctuations are not well brought out, the curve shows plainly the big continuous drop in the catches between 1904 and 1907. This decline is also shown in a greater or less degree in the other areas.

In October, 1904, there were large numbers of whiting congregated on the Dogger Bank and south-east of it, and from other sources we learn that they were feeding on the herring spawn.* In the spring and summer of 1905 large quantities of tiny unmarketable whiting were present on the Dogger Bank.

The Northern Areas.—In area D we have a maximum in February and March, amounting to 1 cwt. in 1905, and this occurs at the spawning season. In the following year the averages are much lower. In K and L the mean monthly average is between 0·3 cwt. and 0·4 cwt., and at their best these areas seldom exceed a yield of 0·6 cwt or 0·7 cwt.

* Huxley Records. Voyage 41. Station 19.

The Southern Areas.—The curves for area S (Fig. 97) and area T (Fig. 98) give definite indications of a summer minimum and an autumn or winter maximum.

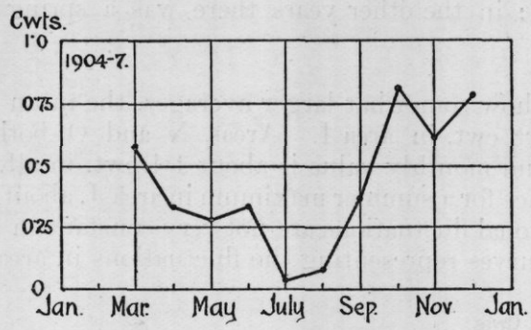

FIG. 97.—WHITING. Area S. Monthly averages, 1904-1907.

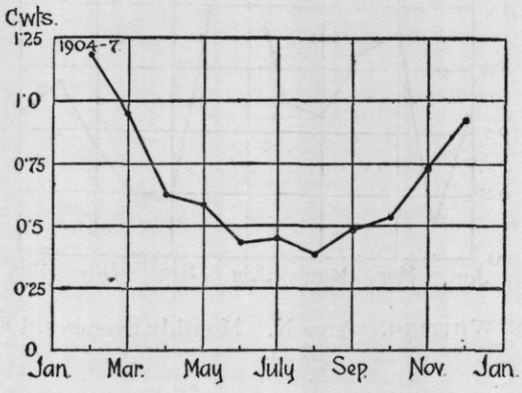

FIG. 98.—WHITING. Area T. Monthly averages, 1904-1907.

We see from the curves that the quantities are greatest in area T, where the mean value is 0·66 cwt. and maximum 1·2 cwt., as compared with a mean value of 0·4 cwt. and a maximum of 0·8 cwt. in area S.

The Silver Pits (area V) seem to yield larger amounts than the other areas, for the mean value is over 1 cwt. and the maximum is 2·94 cwt.

From June to September, 1904, there were plenty of unmarketable tiny whitings on these grounds.

The Western Areas do not differ appreciably from most of the others. From 0·4 to 0·5 cwt. is the average catch in R and X. In R there is a zero minimum from January to March, and the catches gradually increase through the spring and summer to a maximum of about 0·98 cwt.

In the whole region we find the mean values ranging from 0·1 cwt. to 1·0 cwt., and being most often from 0·3 to 0·5 cwt., so that the yield does not vary very much in the different parts of the region, according to these figures, which however cannot be taken to represent the actual population at all closely.

Spawning.

The spawning records of the whiting are by no means satisfactory, and the table appended, Table XXIX., can hardly be considered to give a very true picture of the distribution and comparative abundance of the spawning members of this species. We suffer from a great lack of observation, especially at the end of the spawning season, which, in the case of whiting, is somewhat prolonged. There is reason for this failure on the part of the skippers to note carefully the occurrences of spawning fish. On the one hand, the whiting are not taken in anything like the numbers which are obtained for cod and haddock so the spawning individuals are more likely to be overlooked. As a species, they are not so valuable as some of the other food fishes, and much less attention is paid to them, so that, not only are the spawning fish not always recorded, but the fish themselves are often omitted in the records. Furthermore, since the fish are so easily perishable, it often happens that only a small part of the catch is retained for market, the remainder being shovelled overboard perhaps before their maturity has been noticed. Also it is quite possible that many of the fish, even of the larger mature sizes, escape through the net.

TABLE XXIX.—Showing the number of hauls in each area in which maturing or spawning WHITING are recorded.

Areas.		D.	F.	G.	H.	I.	J.	K.	L.	M.	N.	O.	Q.	R.	S.	T.	V.	X.
November	1904	—	—	—	—	*	—	—	—	—	*	6/23	—	*	—	*	*	5/5
December...	,,	—	—	—	4/5	49/53	—	—	—	6/28	—	13/25	—	—	—	—	—	—
January ...	1905	—	—	3/3	31/38	5/5	4/4	26/27	3/9	—	—	3/18	—	—	—	—	—	—
February ...	,,	82/86	—	—	—	—	—	29/34	27/37	—	—	1/1	—	—	—	—	—	—
March ...	,,	13/114	—	—	—	—	—	—	24/30	—	—	16/33	*	—	—	—	8/8	3/12
April ...	,,	—	—	—	—	—	—	—	6/6	—	—	98/158	—	—	—	—	—	3/3
May ...	,,	—	—	—	—	—	—	—	—	—	—	116/118	—	—	—	—	—	—
June ...	,,	—	—	—	—	—	—	—	—	—	—	33/34	—	—	—	—	—	—
November	1905	—	1/2	—	1/1	—	—	—	—	9/11	—	—	—	—	—	—	—	—
December...	,,	12/15	2/2	—	—	1/5	11/14	—	5/7	—	1/2	96/119	—	—	—	—	—	7/8
January ...	1906	—	—	4/4	—	—	4/4	5/6	26/33	—	—	—	—	—	—	—	—	—
February ...	,,	11/23	—	10/15	—	—	—	5/5	8/63	—	1/1	2/2	—	—	—	19/22	1/1	—
March ...	,,	15/65	—	—	—	—	—	—	—	—	*	—	*	5/6	17/20	10/12	12/14	6/13
January ...	1907	—	—	—	—	—	—	—	—	—	47/74	—	—	—	—	—	—	—
February ...	,,	—	—	—	—	—	—	—	—	—	7/31	—	—	—	—	—	—	—

* indicates the presence of maturing or spawning whiting in hauls, the number of which is not specified.

The numerator of the fractions gives the number of hauls in which spawning whiting occur, and the denominator is the total number of hauls made by the men who record spawning whiting.

The earliest records occur in November (1904) when a few " spawning " whiting are found on the Dogger Bank and the area south-west of it. But these, and the records of " spawning " fish in December in these and other areas, are given by only one man, while the other skippers fishing in the same areas, either fail to notice them altogether, or describe them only as " developing spawn." It is probable then that this man also means " maturing " rather than " spawning."

Spawning whiting are noticed in January, February and March of 1905 by one or two skippers in all the areas they fished in. These were mainly the northern areas, the Dogger Bank and Horn Reef, and in March in the Silver Pits and Flamborough Off grounds. In nearly all these cases with the exception of those in area D, the spawning fish are described as " few." Fish in area Q, which are fairly numerous, were recorded as " full of roes " in March.

Throughout April, May and June, a skipper, fishing on the Dogger Bank, records a few " small " whiting spawning in nearly every haul (some are " large "), and the records cease at the end of June.

In the next season, whiting " with spawn " were taken on the eastern areas as early as November (1905). In December the same skipper describes them as " spawn forming " in the northern, north-eastern and central areas and in area X. A few whiting on the Dogger were " spawning " according to two other skippers. In January they were either " spawning " or " with spawn in." In February and March, most of the whiting from the central, southern and western areas were spawning. Those from areas N and Q were " all very full of spawn and very ripe " from the first to the third week in March.

The spawning of the whiting during the next season (1906–1907) is still more incompletely recorded, a few isolated cases in January and February being the only ones given.

These scanty observations cannot yield many definite results of themselves, but if we compare them with the facts obtained from other sources, we find in them a corroborative value.

It is evident that the spawning begins in January or, at the earliest, in December and continues steadily till March and April, while some are still spawning in June.

Moreover, they are found spawning in all the areas of this region, and, unlike haddock, even in the more shallow southern areas Q and R and S in appreciable quantities.

Summary.—Whiting.

Whiting are found to be very generally distributed over the whole of the central part of the North Sea. The quantities taken are small, being generally under one cwt. per ten hours fishing. They are fairly evenly distributed, although perhaps the central and southern grounds show a slightly greater yield than the northern and eastern.

There is a decline in the average catch between 1904 and 1906, 1907 remaining about the same as 1906.

The seasonal fluctuations are not very regularly marked.

The southern areas and some of the eastern grounds have a summer minimum and an autumn or winter maximum. An annual migration to the coastal grounds takes place in the autumn and winter.

III.—GENERAL SUMMARY.

In the preceding report, I have discussed in detail the distribution and fluctuations of seven of the most important food fishes found in the North Sea, in so far as these are indicated by the records of the vessels examined. These include plaice, soles, turbot, and brill among flat fishes, and cod, haddock and whiting among round fishes. In this summary I propose to compare these species among themselves and to set down shortly and on very general lines the phenomena observed.

a. Distribution.—With regard to the distribution, a glance at the charts showing the mean monthly averages for each species is sufficient to make evident the complementary nature of the abundance of the round fish and the flat fish within this region.

Whereas cod and haddock show a northerly distribution with ever increasing quantities towards the north and almost total absence in the southern region, more especially of haddock, the reverse is the case in regard to flat fish. Here we find that plaice are very scarce in the northern and western regions while soles are almost limited to the part south of a line drawn south of the Dogger Bank from Horn Reef North.

All the flat fish show their greatest abundance in the coastal grounds and are especially numerous in Sylt, Amrum and Terschelling grounds. Turbot and brill show much the same distribution, viz., their greatest abundance in the eastern and south-eastern grounds and a rapid diminution in the numbers as we proceed off-shore in a north-westerly direction.

The grounds off the English coasts are not investigated thoroughly by these records, but there are indications that the catches of flat fishes (with the exception of soles) are never so large as on the eastern side of the North Sea. This great density of flat fishes is made up largely by the small and very small fish of the species. On the other hand, cod and haddock, which are far from being numerous south of Horn Reef North and are found but rarely along the German coasts, show a preponderating amount of large fish in these grounds. It is on the western side that the small fish are relatively numerous for these two species. "Small" fish form 60·5 per cent. of the total catch of plaice (weight), and with "medium" 90·5 per cent. for plaice and 82 per cent. of the soles (by number). Of the turbot, "small" are 68 per cent. by number, and of cod they are 43 per cent., and of haddock, 29·5 per cent. by weight.

This difference in distribution can be understood when we consider the relation of this region to the spawning places. The main spawning region for soles is along these same German and Danish coastal grounds while plaice spawn to some extent further off in the deeper water and in a far greater degree yet further south in the Flemish Bight. The pelagic eggs of these species which are carried by the surface currents in an easterly direction must of necessity develop in the shallow waters off the continental coasts. There are spawning places for soles on the English coasts and there the young fish are also abundant. Cod also spawn in the southern part of the North Sea, but not to nearly such a great extent as in the grounds north of the Dogger, while spawning haddock are very rarely found in the southern region, so that there are naturally no eggs of this species to be carried by the current which runs north and east along the European coast. Although cod and haddock have been found spawning in most of the areas investigated, it is shown that the greatest number of spawning individuals are found in the northerly regions, and it is a probable conclusion that great numbers of the eggs are carried southwards by the surface currents coming from the north down the east coast of Britain, and ultimately develop into the "small fish" found on the western grounds.

Although the same general distribution has been observed for most of the flat fishes examined, yet we find a few differences that are worthy of mention. The chief is that the rate of diminution in the amounts of plaice and soles in the successive areas from the coasts offshore, is very great, while the rate for turbot and brill is much less rapid, not only because the initial greatest density is not so great, but also for the reason that they are more scattered over the whole area. In comparing turbot and soles, it is found that the latter species is about five times as numerous as turbot in the grounds of their greatest density, while the maximum is about ten times as great. When we reach the grounds just south-east of the Dogger Bank we find them about equally numerous, and in the

grounds still further offshore, the turbot occur more frequently than soles. Turbot are very scarce on the western side of the sea ; brill and soles are very numerous there in comparison.

The distribution of these species must also be much influenced by the nature of the bottom. We find cod in rough ground where plaice are scarce, and plaice seem to avoid the somewhat muddy grounds of areas J and N in some parts of which soles and turbot are comparatively plentiful. But this is as yet an unproved hypothesis, and it is difficult to separate the influences of depth, nature of the bottom, latitude, and spawning places, in the resultant distribution.

b. Yearly Fluctuations.—Although it has not been possible to determine a definite general measure of the yearly fluctuations of all these species, yet the data have been sufficient to indicate, in the case of some of them, that a falling off in the amount of the average catch is taking place, and though this is not of a very great extent during the four years investigated, it is seen to be far more important when we compare with the amount taken ten or twelve years before. Another interesting comparison is furnished by the records kept by the skippers of certain *sailing* trawlers from Grimsby in the year 1879.* In that year there were very large numbers of large plaice and haddock on the Dogger Bank. From 50 to 200 baskets of these fish† was a very common result of one haul of 9, 10, or 12 hours, with from four to six score cod as well and smaller numbers of the other species. In May the average was about 26 baskets per haul, in June 16 baskets, in July 15, in September 43, and in October about 78. In that month some of the hauls consisted of from 100 to 200 baskets of large plaice and haddock. Several turbot occurred in each haul in some months, whereas now they are only very occasionally taken in the hauls. In February, 1880, one skipper took from 4 to 18 baskets of plaice in each of a number of hauls on the Great Fisher Bank as well as from 10 to 62 baskets of haddock. Seeing that such enormous catches were made by an old type smack of the kind in use in 1880, and knowing that now the Dogger Bank only yields a mean of about 7 cwt. of haddock and less than 1 cwt. of plaice per 10 hours fishing, while the maximum average for the four years 1904–07 is only 13 cwt. for haddock and 1·9 cwt. for plaice, even when fished by the vastly more effective otter trawl of a modern steam trawler, estimated by Dr. Garstang‡ as about eight times as powerful as a smack, we cannot but realise how very great must have been the diminution of the stock of fish on these grounds.

Evidence of such distinct changes in the state of the fisheries in the course of the years is constantly accumulating. It is only necessary to mention the former well-known quantities of soles in the Silver Pits, the presence of large plaice on the Horn Reef, of haddock in the Haddock Bank and Leman and Smith's Knoll region, and of turbot in the western grounds, to illustrate clearly the very changed conditions of the present day.

The question of yearly decline within the four years investigated by the Grimsby Records is complicated by the fact that the yearly fluctuations in some areas are in a way complementary to one another, as was shown in the case of plaice when the inshore eastern grounds showed minimum quantities in 1906 at the same time as the "northern areas" yielded an unusually large amount ; and also in the case of soles for the same year. Such variations as these would not improbably be due to the unusual conditions of temperature or salinity—perhaps to both.

In the case of plaice, we found on the whole, a downward trend from 1904 to 1907, the fall being greatest between 1905 and 1906 ; in some cases there was a slight recovery between 1904 and 1905, and between 1906 and 1907.

Soles, on the other hand, evinced no decline in this period, but there is a very marked fall in the number of turbot.§

Brill, on the whole, increased in numbers in 1906 and 1907 as compared with the two former years. Cod and codling generally decreased. Haddock also decreased in the average total catch, but were marked by great variation in the abundance of small fish. 1906 was a year when they formed a very large proportion of the total. Whiting were most abundant in 1904 and decreased continuously till 1906 to about one-half the amount in 1904.

c. Seasonal Fluctuations and Migrations.—With the exception of whiting and brill, all these species show well marked seasonal fluctuations, giving one or two annual

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* Issued by Mr. Buckland. Report on Sea Fisheries of England and Wales. London, 1879, p. 225.

† The species are not separated in the records.

‡ GARSTANG. Impoverishment of the Sea. *Journ. Mar. Biol. Ass.*, 1901. Vol. VI., p. 46.

§ NOTE.—The percentages of recaptures of marked turbot are considerably higher than for plaice. They are thus much more liable to capture, and this fact would probably bring about a rapid decrease in the supply.

maximum periods in each area, and from these we have been able to deduce some hypotheses regarding the annual migrations. For the spring and summer spawners, turbot, soles and brill, there is an inshore migration at the time of the spawning season, all sizes of fish partaking of it. The accumulation of fish on the coastal grounds (8–20 fathoms) is continued throughout the summer, but only with respect to the smaller sizes—the larger ones leaving the shallow waters soon after they have spawned. In the winter these species are not found in any quantities on the inshore grounds, but are dispersed over the offshore areas. The soles especially congregated in deep holes.

For plaice there is a spring and autumn maximum on some of the eastern grounds, the summer minimum being caused by an offshore migration at this time. The increased catches in the central, southern and northern areas in the summer prove that they have moved offshore. The large fish accumulate on the spawning grounds at the beginning of the year, while the small fish manage to escape capture owing to their winter rest.

The other winter spawners, cod and haddock, have a spawning migration, shown in the accumulation of large fish about February in the northern grounds. The intermediate areas show a spring maximum, and there are again numbers of fish on some of the offshore and northern grounds in the summer. These are often found in large shoals, many of which have been found to accompany the herring shoals. During this time they avoid the coastal and southern areas and only approach them in the autumn and early winter. Whiting also show a tendency to accumulate in the autumn and winter in the southern and coastal grounds.

We see then, that in some of the areas at least, there are distinct complementary fluctuations between the round and the flatfish. Such areas as S, T and some of the eastern grounds, have an abundance of flat fish, plaice, soles and turbot in the summer months, attaining a maximum between May and October, during which months, cod, haddock and whiting are particularly scarce, and which only appear in considerable numbers from November to February or March.

APPENDIX I.

THE RELATION OF VARIOUS STATISTICAL UNITS OF FISHING.

(*a*) For Steam Trawlers.

Attention has several times been drawn to the necessity of finding equivalents for the conversion of data resulting from the use of various methods of determining the quantitative distribution of fish. The varying methods arise from the use of different standards to represent the amount of fishing. For instance, various groups of fishery statistics give the average catch per month (D'Arcy Thompson, Granton and Montrose Trawling Statistics); per voyage (Fulton); per day's absence (The Board of Agriculture and Fisheries); per 100 hours' fishing for each month (Fulton); per one hour's fishing (Redeke). What we need is a set of factors to connect these various methods, in order that, if necessary, the figures may be compared or combined. The Grimsby Trawler Records supply sufficiently detailed information to enable us to determine these factors to some extent. We are justified, I think, in taking the voyages of these special Grimsby skippers as a fair representation of the actual kind of voyages made by the fishing industry from this most important of our east coast fishing ports.

The region to which the factors will apply is, of course, that shown on the chart, *i.e.*, the North Sea from the English to the continental coasts, southwards to the Brown Ridges and northwards to Fisher Bank. The fishing is distributed all over this area, and we have samples of both long and short voyages from Grimsby.

As has already been found,* the average duration of a voyage bears a distinct relation to the distance from Grimsby of the fishing grounds visited. But before going into this question in detail, I give some figures for the central part of the North Sea as a whole.

The total number of voyages considered is 431, made by a number of men varying from nine in 1905 to three in 1907 over the period 1904 to 1907. It is found that when fishing very regularly the men can make about three voyages in a month. The greatest numbers of voyages made by one man in a year is 34. But as it generally happens that there are several breaks in the course of the fishing and omissions of records for two or three weeks in some of the months, the average number of trips per month is only two and a half.

The dates of departure and return are given for each voyage. From these we obtain directly, the number of days absence which is 3,551 for the period. This gives an average number of 8·2 days per voyage. The number of days in a voyage varies between 3 and 14, but the modal value is 8 or 9, while half the voyages last between 7 and 10 days.

In the records several hauls have been omitted, firstly, because there was no room for them in the books when they had been filled up, and secondly, because several of the hauls were ineffective through the trawl being torn or fouled in some way. In these foul hauls the result was sometimes, though not always, a total absence of fish. The quantities taken would at any rate be much diminished, and these hauls were omitted in my tabulations. The number of hours fishing equivalent to these omitted hauls has been estimated and added to the totals already determined.

For the purpose of comparing the average duration and amount of fishing of voyages made to near and distant grounds, the voyages were grouped according to the distance from the Spurn Light. The sea was divided into four zones or belts, the outer boundaries of which were distant 70, 140, 215 miles from Spurn, the last being any ground fished by these men, more than 215 miles distant. Each voyage was allotted to its proper zone, that being in each case the most distant one visited. Zone I roughly includes the areas E, R, X, P and V; Zone II, the areas S, T, O and L; Zone III, the areas W, Q, N, I, K and D, and Zone IV, the areas M, H, J, G, C, B and A.

The total number of hours fishing corresponding to the 13,246 recorded hauls is 49,024¾, resulting in an average duration of 3·70 hours per haul. But it was found that the duration for each man separately ranged closely round the average 3·7853 hours, with one exception. The average of this man is much lower, 2·578 hours, and as his voyages are made to the near grounds (Zone I), due allowance has had to be made for these different rates. The higher figure, 3·7853 hours, has been used to obtain the equivalent amount of fishing in all zones, except where the hauls of the above fisherman were concerned, when his average 2·578 hours was employed. These estimated numbers of hours fishing are given in the table with the other totals.

Table XXX.—Showing the total number of voyages, days absence and hauls, together with the estimated number of hours fishing, in different zones of fishing, made by the Grimsby fishermen, from whom records were obtained during 1904–1907.

Zone.	Total number of						Estimated number of hours fishing.	
	Voyages.	Days absent.	Hauls given.	Hauls omitted.	Foul hauls.	All hauls.	Foul hauls included.	Foul hauls excluded.
I	44	216	1,103	51	83	1,237	3,649	3,406
II	106	794	3,174	88	217	3,479	13,054	12,240
III...	125	1,049	3,923	213	155	4,291	16,243	15,656
IV...	156	1,492	5,046	142	335	5,523	20,906	19,638
All regions ...	431	3,551	13,246	494	790	14,530	53,849	50,940

* Board of Agriculture and Fisheries. Annual Report, 1906, p. xxxii.

TABLE XXXI.—Showing the average relations between numbers of voyages, hours fishing and hauls.

1	2	3	4	5	6	7	8	9	10
Zone.	Days per voyage.	Hauls per voyage.	Hours fishing per voyage.		Percentage of foul hauls to total hauls.	Percentage number of hours fishing to total number of hours in voyage.	Hauls per day.	Hours fishing per day.	
			All hauls included.	Foul hauls excluded.				All hauls included.	Foul hauls excluded.
I	4·9	28·1	82·88	77·42	6·7	70·45	5·73	16·88	15·77
II	7·5	32·8	123·15	115·47	6·2	68·5	4·38	16·44	15·42
III	8·4	34·3	129·94	125·25	3·6	64·5	4·09	15·48	14·92
IV	9·6	35·4	134·07	125·88	6·1	58·4	3·70	14·01	13·16
All regions...	8·2	33·7	124·94	118·19	5·4	63·2	4·09	15·16	14·35

The average relations deduced from Table XXX are given in Table XXXI. Columns 2, 3 and 4 show that the duration of the trip and the amount of fishing increase with the distance from Grimsby. On the average a voyage lasts 8·2 days, during which the trawl is shot 33·7 times and fishing lasts 124·94 hours. 5·4 per cent. of this fishing is more or less ineffective, owing to the trawl being damaged in some way, so that, excluding these foul hauls, we have on the average 118·19 hours fishing in a voyage, 60 per cent, of the total time spent on it. Column 7 shows the proportion of the voyage which is spent on fishing. It decreases considerably with the distance from Grimsby. Columns 8, 9 and 10 show the same facts in another form relating to the amount of fishing per day. This naturally decreases when the voyage is longer and more time is spent on travelling to and from the distant fishing grounds. About 4 hauls a day and 15 hours fishing is the average amount attained.

The reciprocals of the factors give the following equivalents :—

100 hours fishing, when foul hauls are included = ·80 of a voyage.
Do. do. do. = 6·6 days absence.
Do. do. do. = 27 hauls.
and when the foul hauls are omitted, 100 hours fishing = ·85 of a voyage.
Do. do. do. = 6·9 days absence.

The factors for 10 hours' and one hour's fishing are easily deduced from these.

To convert cwts. per 10 hour's fishing to kilos. per one hours' fishing it is sufficient to multiply by five, or more exactly by 5·08. Conversely, to convert kilos. per one hour's fishing to cwts. per 10 hours' fishing, one can multiply by two and move the decimal one place to the left,

e.g. 6 cwts. per 10 hours is equivalent to 30 kilos. per one hour,
and 15 kilos. per one hour is equivalent to 3·0 cwts. per 10 hours.

(*b.*) FOR SAILING TRAWLERS.

Similar figures to the above for steam trawlers are necessary for application to sailing trawler statistics. These have been compiled in a similar manner and can be used, when necessary, to convert any average amount of fish taken in a given unit of time, say a month, day's absence, haul or hour, to any other unit.

The material from which these factors have been derived is taken from the Lowestoft Trawler Record Books kept by three skippers in the period April, 1904, to December, 1906.* Their records in the year prior to April, 1904, were not of any value for this analysis, as these earlier books did not contain any information as to the dates of departure and arrival for each voyage.

Such figures as we have obtained will be applicable to statistics of fish landed by smacks at Lowestoft from voyages made, as these were, within a distance of 80 miles or so from Lowestoft.

A total of 306 voyages made by three fishermen was considered. These men make about three voyages a month each, each lasting approximately one week, the books containing records of about 15 hauls, except when unfavourable weather or accidents occurred.

There is some diversity among these men as to the duration of the hauls. Especially in the early years of the period we find one skipper who makes hauls of 9, 10 or 12 hours' duration, averaging over eight hours in some years. The general practice was to make hauls lasting about six hours, the duration of the tide, and the other men average between five and six hours.

Later records of the same and other fishermen, give one the impression that this same man still makes fewer hauls in his voyages, each haul being of a longer duration. Others again make very short hauls and can record from 17 to 19 hauls in a week. There seems to be this distinct tendency at the present time to make hauls of a shorter duration, and counteracting this by taking more of them, so that the total amount of fishing, represented by the number of hours the trawl is down, remains nearly the same. The duration of a voyage is also fairly constant for these smacks.

The total number of hauls in the record books, including some whose details had not been given, was 3,874, and of these 180 or 4·6 per cent. were "foul" or had the trawl torn or destroyed.† These latter ones had been omitted in calculating the totals and averages given in the Report.

Table I., p. 93, gives the average duration of each man's hauls for each year. These were applied to the hauls included in this section, both ordinary and foul hauls and the total number of hours' fishing thereby estimated as 25,506, and excluding all "foul" hauls the total is 24,274.

* LEE.—Report on Lowestoft Sailing Trawler Records. 1903–1906.
† *See* p. 92. *Loc. cit.*

Those numbers suffice to determine the necessary factors, which are given as follows :—

For the Lowestoft Smacks fishing within a radius of 80 *miles from port.*

Average number of :

1. Voyages per month	3·12
2. Days per voyage	7·10
3. Hauls per voyage	12·66
4. Percentage of foul hauls to total hauls	4·65
5. Hours fishing per voyage, all hauls included	83·35
6. Hours fishing per voyage, fouls hauls excluded	79·33
7. Percentage number of hours fishing to total number of hours in voyage	48·9
8. Hauls per day	1·78
9. Hours fishing per day	11·74
10. Hours fishing per day, excluding foul hauls	11·17
11. Hours per haul	6·58
12. Number of 6-hour hauls in a voyage, foul hauls excluded	13·22
13. Number of 6-hour hauls in one day's absence	1·96
14. Ditto. with foul hauls excluded	1·86

We see from this that not quite one-half of the time spent on the voyage is devoted to the actual fishing. The hauls are just over six hours in length and about two are obtained per day. The actual ratio is 1·78 through the diminution caused by the time taken in sailing to and from the fishing grounds and in spells of calm when they find it impossible to trawl successfully. In the best times the men can make about 15 6-hour hauls in the week's voyage, that is about three a day, from the time they begin fishing after reaching the ground till the time they leave off to return to port. Those who make shorter hauls can get in even more than this.

The number of hours fishing per day's absence is nearly 12 hours, and neglecting the time spent on foul or inefficient hauls, this is just over 11 hours.

One six-hour haul, as used in the Lowestoft Records Report, is equivalent to ·54 of the fishing in a day's absence from port and conversely one day's absence includes 1·86 of these six-hour hauls.

The value of such figures as these lies in the great opportunity they afford for the direct comparison of fishery statistics accumulated by different methods at the present time, and with isolated records of catches many years ago. For instance, the catch per day's absence by sailing trawlers in area B_3 (of the Board of Agriculture and Fisheries chart) for the year 1906 is given in their report (1906, p. lxix.) as 1·79 cwts. To reduce this to the rate of catching per six-hour haul we multiply by ·54 obtaining ·97 cwt. as the result. This is very comparable with the average catch per six hours' fishing obtained from the Lowestoft Trawler Records, which is ·91 cwt. for 1906. The greater part of the fishing by these Lowestoft smacks was within the B_3 area as we see from Table II.* where the areas B, C, F, J, M and the eastern side of E and H (20–22 fathoms) fall into area B_3.

Or again, Mr. Cunningham in his North Sea Investigations, 1895†, states that a Lowestoft smack, fishing in the neighbourhood of the Brown Ridges, landed in the early part of September, 18 boxes of plaice. Assuming that the voyage was of about a week's duration, we divide 18 by 13·22, obtaining 1·36 cwts. per six hours' fishing in September, 1895, as against 1·14 cwts., the average obtained for this same ground in September, 1903–1906.

Apart from this aspect of the value of the figures we may look upon them also, as a permanent record of certain conditions of the industry at the present time, which in future years will serve as a measure of certain changes that may have taken place.

APPENDIX II.

SUBSEQUENT RETURNS—ANALYSIS OF THE 1908 RECORDS.

During the preparation of the statistics and the writing of the report on the Trawling Records collected in the period 1904–1907, more Record Books accumulated as they were being filled in by the fishermen. In 1908 they were much less numerous than in the previous years, as from one man we have only the result of one voyage, while another recorded a few voyages discontinuously throughout the year. Only one man has recorded a complete set of records for the year. These few records add little or nothing to the information already obtained with regard to the seasonal and geographical distribution of the species examined, but they are of value in corroboration of these results, and more especially in comparison of the yearly yield in showing whether the yearly decline was continued for the species for which it had been demonstrated, or whether this had been succeeded by an increase. The grounds fished were those lying to the south and east of the Dogger, also including the eastern half of the Dogger itself which was fished over by one man in the spring, and one voyage in October to area G, one of the north-eastern areas.

Area N (Oyster Ground, &c.), a ground already well examined, has the most continuous and greatest share of the fishing. All the other areas visited had fishing in only a very few months of the year, as will be seen from Table XXXIII.

These records have been analysed in precisely the same way as the former ones, the only difference being in some of the factors used to convert the amounts in baskets to hundredweights. As nearly all the monthly catches in any area belong to one man alone, and any bias in over or under estimation would not therefore be eliminated in an average with other men's catches, it was necessary to calculate the ratio between a basket and a box for each man, and apply it separately to his catches. Any bias in the nature of the size classification of the fish is also not measurable by a comparative method, and on this account it has not been possible to detect any changes in the comparative abundance of the different size groups. That such a bias is present we know, for the one man who contributed over

* *Loc. cit.*, p. 94.

† CUNNINGHAM.—North Sea Investigations. Loc. cit., p. 126.

three-quarters of the total number of hauls in 1908, always showed a tendency to maintain very high size limits for plaice. In the early part of the period, although he fished regularly on the "Eastern small plaice grounds," he made a point of not keeping any plaice under 11 inches. In 1908 he adopted a fourth class which he calls "very small plaice," including those from 10 to 8 inches in length, while his "best small" plaice are from 10 to 12 inches in length. Part of the increase in the catches of plaice displayed by the 1908 figures must be due to this tendency to include much smaller fish than formerly. This cannot, however, explain the greatly increased catches on the Dogger in the spring. The probability that such a tendency, namely to retain fish which would formerly have been rejected on account of their small size, is very common amongst the fishermen of to-day, suggests that the decline in the yield is really more marked than it appears.

The following table shows the total and average amounts of fish caught, and the number of hauls and hours of fishing :—

TABLE XXXII.—Showing the Total Amount of Fishing and the Total and Average Quantities of Seven Species of Fish caught by certain Skippers in 1908.

	Total Quantities.		Average per 10 hours' fishing.
Plaice ... ... (Cwts.)	L	79·21	0·16
	M	487·69	0·98
	S	1319·43	2 65
	All	**1886·33**	**3·80**
Soles... ... ... (Number)	L	1,335	2·7
	M	12,448	25·0
	S	6,998	14·1
	All	**20,781**	**41·8**
Turbot ... ... (Number)	L	994	2·00
	S	2,727	5·49
	All	**3,721**	**7·49**
Brill ... ... (Number)	—	**2,246**	**4·52**
Cod ... ... (Cwts)	No. of Cod	1,469	3·0
	Weight of Codling	83·03	0·17
	Total Weight	**229·93**	**0·47**
Haddock ... ... (Cwts.)	L	404·14	0·81
	S	127·27	0·26
	All	**531·41**	**1·07**
Whiting ... ... (Cwts.)	—	**95·22**	**0·19**
Number of hauls	—	1,297	—
Number of hours' fishing... ...	—	4,971¼	—

We can compare these averages with the yearly average catch obtained by the one fisherman, whose fishing is mainly represented in this year, in the four previous years, for, although the distribution of fishing is not precisely the same, yet he always had a tendency to visit the same grounds at the same time of year, and roughly they are comparable. His average total catches of plaice for the four years 1904 to 1907 are 4·23, 5·23, 2·98, 3·99 cwts. respectively.

A comparison of the monthly averages shows that in the eastern areas and in the most inshore of the central areas the average monthly catches of 1908 were well up to the averages of the four preceding years, while on the offshore areas they greatly exceeded these, so that the decline is not marked in this year.

Soles, (averaging 42) are slightly less than in the previous years, the fisherman's averages for this region being 1904, 42 ; 1905, 61 ; 1906, 101 ; 1907, 65. The changes in 1908 are in no case at all marked.

Turbot still show very small numbers, even though most of the fishing took place in the grounds where they are most abundant. The average 7·49 compares unfavourably with 13·49 in 1904, 9·95 in 1905, 8·16 in 1906, and 7·55 in 1907, attained by this man. In 1870, we have by contrast, a record* of a catch of 1,500 turbot by a smack in one night's fishing about 40 miles from Heligoland in June, an almost incredible number when compared with what is taken now when a fisherman working regularly, even with a steamer, can only catch about twice as many during the year as were taken in that one night.

Brill show very small numbers, but there is no decrease on the previous years—if anything there is an increase.

Cod, haddock and whiting all show a considerable decrease on the previous years. We have only to compare the averages given here in Table XXXII. with those for the eastern and central areas in Tables XVIII. and XXIII.

* BUCKLAND and SPENCER WALPOLE.—Report on the Sea Fisheries of England and Wales. 1879, p. 200.

Table XXXIII. includes the monthly averages of the seven species of fish for each area examined, and while it is seen to be very incomplete in many areas, all the averages that are present tend to confirm the nature of the seasonal fluctuations as already determined, and the general comparative distribution of these species.

TABLE XXXIII.—Showing for each of the seven species of FOOD FISHES the monthly average catch per ten hours' fishing for each area and month investigated in 1908.*

Area.	Month.	Number of hours fishing.	Plaice (cwts,).				Number of Soles.				Number of Turbot.			Number of Brill.	Cod.			Haddock (cwts.).			Whiting (cwts.).
			L.	M.	S.	All.	L.	M.	S.	All.	L.	S.	All.		Number of Cod.	Weight of Codling.	Total weight (cwts.).	L.	S.	All.	
G.	October ..	147	0·39	0·00	0·00	0·39	0·0	0·0	0·0	0·0	0·00	0·00	0·00	0·00	10·1	0·95	1·96	4·72	1·45	6·17	0·34
M.	January ..	56	0·00	0·35	0·41	0·77	0·0	1·4	3·6	5·0	0·36	4·64	5·00	3·57	15·7	0·80	2·37	2·93	0·03	2·96	0·11
	April ..	280¾	0·00	3·10	7·30	10·41	0·0	16·1	6·9	23·0	0·00	2·71	2·71	12·79	1·4	+	0·14	0·03	0·00	0·03	0·00
	May ..	155½	0·00	1·72	5·27	7·00	1·7	33·0	13·8	48·5	0·06	5·49	5·54	9·02	3·3	0·01	0·34	0·61	0·00	0·61	0·00
	June ..	243½	0·00	0·34	3·26	3·60	22·6	75·3	43·9	141·8	0·57	7·27	7·84	12·11	0·4	0·00	0·04	0·06	0·00	0·06	0·00
	July ..	38½	0·00	0·00	0·00	0·00	24·9	91·4	54·5	170·9	0·00	6·97	5·97	18·18	0·0	0·00	0·00	0·00	0·00	0·00	0·00
	October ..	40	0·00	0·15	3·85	4·00	0·0	13·5	4·5	18·0	0·00	6·50	6·50	0·50	0·0	0·00	0·00	0·00	6·00	0·00	0·00
Q.	January ..	14½	0·23	0·44	0·32	0·99	0·0	49·7	24·8	74·5	1·38	11·72	13·10	6·21	11·7	0·19	1·36	0·78	0·00	0·78	0·00
	February..	4	0·50	1·00	0·50	2·00	0·0	15·0	30·0	45·0	0·00	5·00	5·00	25·00	0·0	0·00	0·00	0·00	0·00	0·00	0·00
	March ..	171½	0·00	1·27	7·92	9·19	0·0	12·5	11·6	24·1	0·17	2·45	2·62	2·57	2·6	0·01	0·27	0·00	0·00	0·00	0·16
	April ..	31½	0·00	0·83	5·71	6·54	0·0	19·0	13·0	32·1	0·32	2·86	3·17	4·76	0·3	0·00	0·03	+	0·00	+	0·02
	August ..	8	0·00	0·13	1·50	1·63	0·0	7·5	13·8	21·3	7·50	26·25	33·75	6·25	0·0	0·00	0·00	0·00	0·00	0·00	0·00
	October ..	20	0·00	0·28	1·90	2·18	0·0	32·0	17·0	49·0	3·50	14·50	18·00	3·00	0·0	0·00	0·00	0·00	0·00	0·00	0·03
	November.	20	0·00	0·16	1·80	1·96	0·0	64·0	43·0	107·0	7·50	29·00	36·50	23·50	1·0	0·29	0·39	0·03	0·00	0·03	0·00
W.	August ..	4	0·00	1·50	4·50	6·00	0·0	10·0	10·0	20·0	0·00	15·00	15·00	15·00	0·0	0·00	0·00	0·00	0·00	0·00	0·00
	October ..	28	0·00	1·29	1·36	2·64	0·0	37·5	23·2	60·7	4·64	10·00	14·64	3·93	0·4	0·00	0·04	0·00	0·00	0·00	0·04
J.	January ..	119	0·04	0·06	0·20	0·30	7·7	33·4	4·9	46·0	3·36	6·72	10·08	3·28	3·2	0·40	0·72	2·23	0·69	2·91	0·55
	February..	94½	0·00	0·10	0·02	0·12	0·1	12·0	3·6	15·7	0·21	2·33	2·54	0·74	1·3	0·26	0·39	0·51	0·13	0·64	0·33
	December.	31	0·00	0·28	0·19	0·47	0·0	30·0	10·6	40·6	4·84	8·71	13·55	0·97	1·0	0·36	0·46	1·63	0·16	1·78	0·50
N.	January ..	151	0·18	0·24	0·16	0·57	8·2	47·3	40·0	95·5	2·78	12·91	15·69	4·77	7·0	0·17	0·87	1·48	6·06	1·54	0·13
	February..	284½	0·51	0·73	0·23	1·47	1·5	36·6	31·0	69·0	1·65	5·98	7·63	7·77	3·2	0·02	0·34	0·05	0·01	0·06	0·02
	March ..	92½	0·25	0·55	0·17	0·96	0·2	37·6	27·0	64·9	0·86	4·54	5·41	5·19	4·0	0·02	0·42	0·01	0·00	0·01	0·00
	April ..	49	0·00	0·20	0·07	0·27	1·6	37·1	18·8	57·6	1·02	2·86	3·88	2·65	7·1	0·07	0·78	0·09	0·00	0·09	0·00
	July ..	3½	0·00	1·14	1·14	2·29	0·0	0·0	0·0	0·0	0·00	2·85	2·85	0·00	2·9	0·23	0·52	0·29	0·11	0·40	0·86
	August ..	180	0·00	1·30	3·30	4·61	0·0	11·6	4·7	16·2	3·06	3·78	6·83	2·11	0·4	0·19	0·23	0·28	0·13	0·41	0·48
	September	72	0·00	2·09	6·34	8·43	0·0	5·1	0·3	5·4	0·42	0·56	0·97	2·50	0·8	0·20	0·28	0·20	0·01	0·21	0·05
	October ..	87½	0·00	0·13	1·72	1·86	0·0	22·6	7·5	30·2	2·86	12·34	15·20	4·80	0·6	0·04	0·10	0·02	0·00	0·02	0·07
	November.	393½	0·05	0·70	5·73	6·48	0·4	38·7	15·7	54·7	5·41	10·70	16·11	4·80	1·7	0·06	0·23	0·09	+	0·09	0·02
	December.	349	0·10	0·54	0·81	1·45	3·4	51·1	20·7	75·2	4·44	9·08	13·52	4·36	2·8	0·30	0·58	0·65	0·00	0·65	0·25
I.	February..	75	0·00	0·24	0·02	0·25	0·0	5·5	0·7	6·1	0·53	1·20	1·73	0·21	17·9	0·25	2·04	3·92	2·35	6·26	1·08
	May ..	63½	0·46	0·42	0·00	0·88	0·0	0·0	0·0	0·0	1·26	0·63	1·89	0·16	2·0	0·43	0·63	3·07	0·82	3·89	0·99
	July ..	16	0·00	2·87	1·38	4·25	0·0	0·0	0·0	0·0	1·25	0·00	1·25	0·00	1·9	0·31	0·50	0·71	0·19	0·91	1·06
	August ..	179	0·00	2·89	4·39	7·28	0·0	1·5	0·9	1·5	1·17	0·67	1·84	0·11	3·5	0·32	0·67	0·12	0·08	0·20	0·46
	September.	143½	0·02	2·40	5·24	7·66	0·0	2·9	0·6	3·5	0·77	0·84	1·61	0·91	3·7	0·24	0·61	0·12	+	0·12	0·11
	December.	4	0·50	0·50	1·10	2·10	25·0	50·0	15·0	90·0	2·50	12·50	15·00	5·00	2·5	0·33	0·58	0·13	0·00	0·13	0·15
O.	April ..	164	0·27	1·01	0·48	1·76	0·1	0·2	0·0	0·3	0·79	0·85	1·65	0·06	2·0	0·25	0·45	1·84	0·38	2·21	0·58
	May ..	376¾	0·50	0·49	0·01	1·00	0·0	0·0	+	+	1·65	1·06	2·71	0·03	0·8	0·26	0·34	3·13	1·50	4·63	0·37
	June ..	43	0·66	0·66	0·00	1·32	0·0	0·0	0·0	0·0	1·63	1·40	3·02	0·00	0·0	0·16	0·16	2·23	1·13	3·37	0·56
S.	February..	24½	0·40	0·71	0·27	1·38	4·9	3·3	4·9	13·1	0·41	4·90	5·31	0·00	14·3	0·00	1·43	0·00	0·00	0·00	0·13
	July ..	147½	0·29	1·08	6·19	7·56	1·2	11·6	6·3	19·1	1·49	3·32	4·81	4·14	0·3	0·15	0·18	0·00	0·00	0·00	0·00
	August ..	80½	0·00	1·01	1·74	2·75	0·0	9·8	4·2	14·0	1·12	3·60	4·72	2·98	2·5	0·18	0·43	0·00	0·00	0·00	0·00
	September.	96½	0·28	1·25	2·49	4·02	1·5	49·2	34·7	85·4	5·71	13·61	19·32	7·90	0·0	0·00	0·00	0·00	0·00	0·00	0·00
	October .	316½	0·14	1·12	2·53	3·80	4·8	32·6	25·9	63·3	3·22	9·00	12·23	5·53	0·0	+	+	0·00	0·00	0·00	0·02
T.	February..	52	0·94	1·00	0·19	2·13	8·1	3·8	2·7	14·6	0·19	3·27	3·46	0·58	30·6	0·09	3·15	0·03	0·00	0·03	+
	September.	7¾	0·15	1·29	3·10	4·54	0·0	23·2	12·9	36·1	1·29	9·03	10·32	5·16	0·0	0·00	0·00	0·00	0·00	0·00	0·00
V.	February..	8	0·38	0·02	0·00	0·40	10·0	7·5	0·0	17·5	0·00	1·25	1·25	0·00	11·3	0·35	1·48	0·28	0·00	0·28	0·94
X.	February..	4	0·40	0·40	0·00	0·80	10·0	0·0	0·0	10·0	0·00	0·00	0·00	0·00	5·0	0·00	0·50	0·00	0·00	0·00	0·00

The following points in the averages of each species are of interest :—

Plaice.—The only observations made in the north-eastern areas were in area G in October, when the average, 0·39 cwts., is considerably less than that determined in other years.

The amounts in the eastern areas, M and Q, show much the same trend as has been determined in other years, viz., a maximum in March and April in Q, and in April–May and again about October in M. The minimum in the winter and that caused by an offshore migration in the summer is also marked. The quantities are generally very slightly greater than in 1907, but less than those of the previous years.

In the central areas, we find the same very small catches in area J, while in area N (Oysters, &c.) they are very near the averages for the four previous years. The seasonal trend in the latter area is similar to that determined in the general curve (Fig. 8), but in 1908 the first maximum comes in February instead of March.

The unusually high average in November, 6·48 cwts., is due to large catches made in the first week of the month in 20 fathoms at the very border of this area (about 54° 12′ N., 6° 50′ E.). On the more offshore areas, I and O, much larger numbers than in the previous years were taken. The spring catches on the Dogger are about three times those in 1904–06, and the summer averages on the Clay Deep Grounds are also considerably greater than in previous years. These particular hauls are,

* + indicates the presence of very small quantities of the species, averaging less than 0·005.

however, not representative of the whole area but lie near the dividing line between N and I. We find the usual trend maintained in the southern areas, viz., a summer maximum. The drop here in August is due to the fact that the hauls were made in a different and more southern part of the region from the others in this area, viz., around Smith's Knoll and Winterton Twenties, where they are not generally so plentiful.

Soles.—In 1908 soles were entirely absent from hauls made in area G, and were as rare on the Dogger Bank as they were shown to be in the previous years. The largest numbers in any area were taken from area M (Sylt Amrum) where the catches increase regularly from the minimum in the winter to their maximum about July. The complementary fluctuations of a winter maximum and a summer minimum are maintained in the offshore areas J, N and I, but the amounts taken average on the whole slightly less than in the period 1904–1907.

The southern areas show no great change in their yield of soles, but the autumn maximum is considerable in S. This is made more distinct because all the September and October hauls were taken on the Botney and New Zealand Ground regions, which have been shown to be much more productive of soles than the Leman ground and Brown Bank parts of this area.

Turbot.—Area N still maintains its reputation of yielding the largest number of turbot. The spring minimum appears somewhat later and the summer values are not so high as usual, but the autumn and winter maxima are quite decided and come well up to the average of the previous years. The other areas do not show any marked or unusual features. The winter averages in area J are high and all averages, with the exception of December, in area I are very low (less than two per 10 hours' fishing). In M we find indications of the summer maximum (7·84), and here also the January catches are much larger than usual. No great changes are seen to occur in S (southern area) : the autumn maximum is emphasised by the distribution of the fishing (mainly in the northern part at this time and in the southern part in July and August).

Brill.—This species seems to maintain in 1908 the rise in numbers indicated in 1907. In some cases the averages are considerably higher than the average of the four previous years. The seasonal variations are not very regular, but in the cases where the averages are numerous and reliable enough to show them they seem to agree roughly with those already determined. In area N we have a definite winter maximum and summer minimum, the trend of the figures agreeing with that which they showed in 1906 and 1907.

Cod.—We find the average catch of cod is considerably reduced in 1908. Many of the averages are only from one-third to one-half of the corresponding averages for the previous years. The quantities on the Dogger Bank especially show a great reduction, most especially in the large fish. The average of the three spring months of 1908 is only 0·32 cwt. whereas the general average in 1904–1907 was 2·62 cwts. or over eight times as much. In area N the average of all the months examined (except July) is 0·43 cwts. ; in the other four years it is 0·80 cwts. In this area the period of maximum abundance occurs in the winter and spring, and there is a minimum in the summer and early autumn as in the other years.

There are no hauls in which very exceptionally large catches of cod were taken. The large fish are generally caught in numbers under 10, while in very few hauls do they reach a score in number.

Haddock.—In all cases considered in 1908, the catch of haddock is found to be decreased by a considerable amount. The only times when the averages appear at all large is in October in area G (6·17 cwts. as compared with 8·85 cwts. in 1901–05) and in area I in February (6·26 cwts.) and at all other times and areas the catches come far below the normal. For instance, in area N the average of the nine months with reliable averages is 0·34 cwt., only a little more than one-fifth of the average of the same months in the previous years. The seasonal variations and the periods of maximum abundance follow the same course as usual and no remarkable feature occurs. The large fish form a very large percentage of the catch.

Whiting.—Very small quantities of whiting were taken from these areas in 1908, for the decline evidenced throughout the former period is continued, and the average amount taken is about one-half or a little more that in 1907.

It is thus apparent that in this region of the sea the seasonal fluctuations, as far as they can be inferred from these few figures, remained fairly constant in 1908, and that the yearly variation determined for these species were, broadly speaking, a tendency for flat fish—to remain nearly the average, some like plaice and brill being slightly greater, and other like soles and turbot slightly less than the years immediately preceding—and for round fish—to be considerably diminished. How far this may apply to the western and northern half of the sea it is, of course, impossible to imagine as complementary fluctuations may possibly take place there.

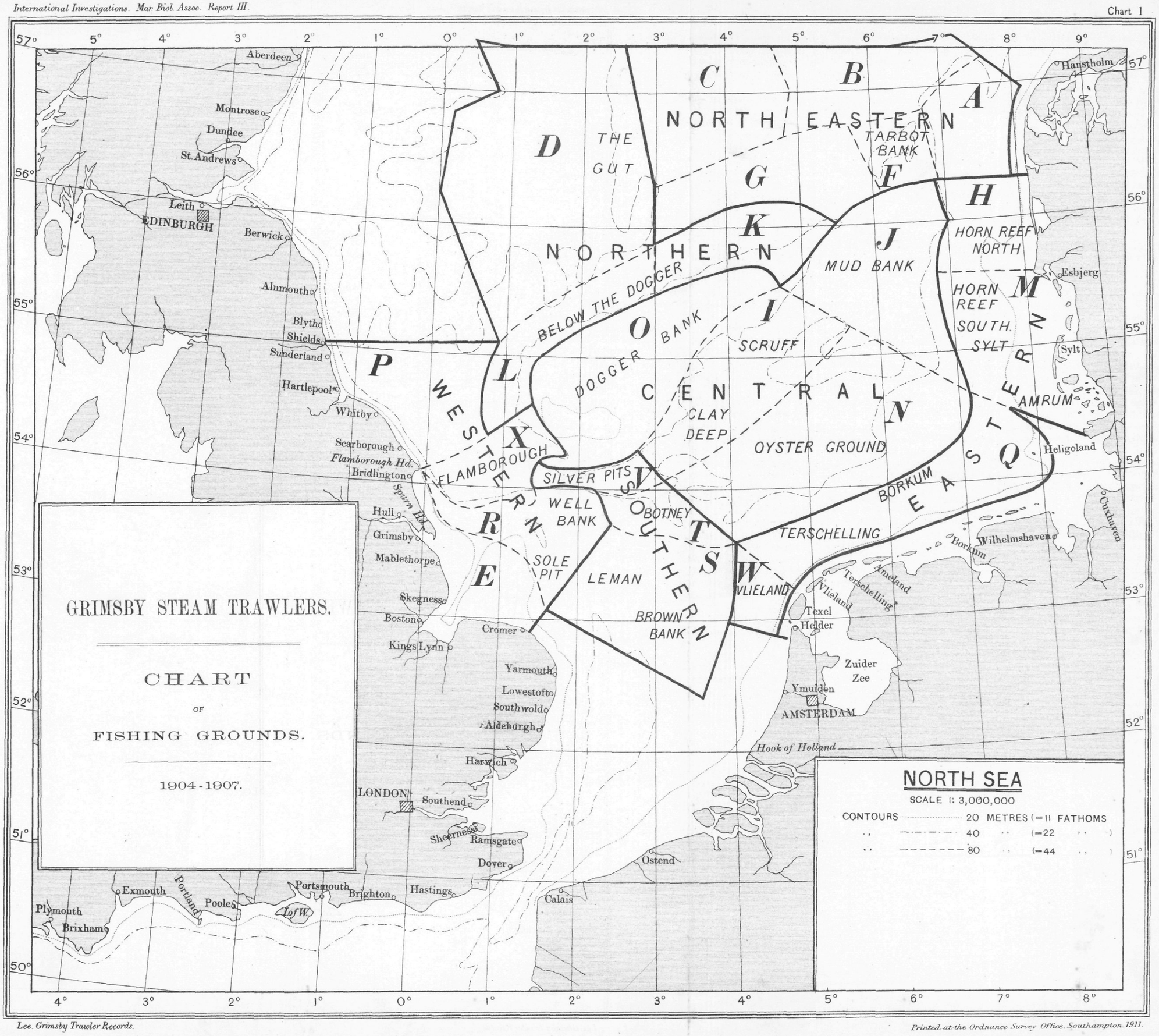
GRIMSBY STEAM TRAWLERS.

CHART

OF

FISHING GROUNDS.

1904-1907.



Lee. Grimsby Trawler Records.

Printed at the Ordnance Survey Office, Southampton. 1911.

FURTHER REPORT

ON THE

AGE AND GROWTH-RATE OF PLAICE IN THE NORTH SEA AND ENGLISH CHANNEL,

AS DETERMINED BY THE

INVESTIGATION OF OTOLITHS.

BY

WILLIAM WALLACE, D.Sc.,

With Tables 1–21 and Figures 1–10 in the Text; Tables I. and I*a*., II. and II*a*., III. and III*a*., IV. and IV*a*., V. and V*a*., VI. and VI*a*., and VII. to IX., and One Chart (Plate I.) at the end.

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I.—Introduction.

1. *Scope of Report.*

In writing this Report the object has been to record as concisely as possible the chief results of an analysis of all the material concerning the Age of Plaice* in the North Sea and English Channel, which has been collected by the Marine Biological Association in connection with the International Investigations.

The principal subjects dealt with, and the sections and tables in which information concerning them will be found, are the following :—

1.—The Age Composition of the Plaice population on various fishing grounds and seasonal changes therein.

Section II. Tables 2 *and* 3.

Table 2 also gives the extreme range of length, range of 50 per cent. and average length of each age-group (irrespective of sex), in each sample.

2.—Evidence of Summer Off-shore Migration in the Texel-Leman region from a comparison of the quantitative distribution of the age-groups in this region in May and September respectively.

Section III. Table 4. *Figs.* 1 *to* 5.

3.—Local variations in the average length of Plaice of a given age in the North Sea and English Channel.

Section IV. Tables 5 *to* 10.

4.—Estimation of the average yearly growth of Plaice in length and weight in the following regions :—

a. Southern Bight of the North Sea (including the Leman region).
b. South Dogger region (including the Flamborough Off ground).
c. Western part of the English Channel.

Section V. Tables 11 *to* 19. *Figs.* 6, 7, *and* 8.

5.—The proportions of the sexes at different ages in the North Sea and English Channel respectively.

Section VI. Tables 20 *to* 22. *Figs.* 9 *and* 10.

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* Not including the Ages of Marked Plaice.

TABLE 1.—Numbers of PLAICE belonging to Different Age Groups (M. = male; F. = Female) in samples from various Fishing Grounds in the North Sea and English Channel, collected during the period, 1906–09, with Particulars of Samples.

Sample No.	Voyage and Station.	Gear and Haul No.	Date.	Name of Fishing Ground.	Central Position. Long. N.	Central Position. Lat.	Depth. Fathoms.	Sex.	Age Groups. O.	I.	II.	III.	IV.	V.	VI.	VII.	VIII	IX+.	Age Doubtful.	Sample total.	Total Catch.	Number of Hours Fishing.
29	—	Shrimp	June, 1906	The Wash	—	—	—	M. + F.	—	*934*	*632*	*69*	*8*	—	—	—	—	—	*116*	*1759*	—	—
30	LXXVII 14	B 500	26 June, 1906	Bridlington Bay	53 59	0 3 W.	10¼–10½	M. ...	—	—	1	9	9	1	1	1	—	—	—	22	43	43	2
								F. ...	—	—	2	**11**	**6**	—	—	1	—	—	1	**21**			
31[1]	LXXX 1	B (c) 508	10 Sept., 1906	,, ,, ...	54 1	0 9 W.	5½–6	M. ...	—	—	46	24	6	2	1	—	—	—	5	84	146	149	2⅝
								F. ..	—	4	**44**	**10**	**4**	—	—	—	—	—	—	**62**			
31[2]	,, 2	,, 509	10 ,,	,, ,, ...	54 3	0 10 W.	5-5½	M. ...	—	—	21	13	3	—	—	—	—	—	—	37	79	79	1
								F. ...	—	1	**15**	**20**	**5**	—	—	—	—	—	1	**42**			
31[3]	,, 3	,, 510	11 ,,	,, ,, ...	54 3	0 9 W.	6	M. ...	—	—	29	20	7	—	—	—	—	—	—	56	85	85	1⅛
								F. ...	—	—	**14**	**10**	**4**	—	—	—	—	—	1	**23**			
32[1]	LXX 1	O 375	22 Mar., 1906	Flamborough Off Ground	54 4	0 55 E.	26–29	M. ...	—	—	5	5	3	2	—	—	—	—	—	15	33	5	—
								F. ...	—	—	2	**9**	**3**	**2**	—	—	—	—	—	**18**			
32[2]	,, 2	,, 376	23 ,,	,, ,, ,, ...	54 3	0 56 E.	26	M. ...	—	—	1	6	2	—	1	—	—	—	—	10	23	23	5
								F. ...	—	—	1	—	**6**	**2**	**2**	1	—	1	—	**13**			
32[3]	,, 3	,, 397	23 ,,	,, ,, ,, ...	54 7	0 51 E.	26–29	M. ...	—	—	3	1	12	**1**	—	—	—	—	—	17	69	69	5
								F. ...	—	—	—	**4**	**32**	**10**	**4**	**1**	—	**1**	—	**52**			
32[4]	,, 5	B 415	23 ,,	,, ,, ,, ...	54 7	0 55 E.	29	M. ...	—	—	1	—	—	1	1	—	—	—	—	**3**	9	9	3
								F. ...	—	—	2	—	3	—	1	—	—	—	—	**6**			
32[5]	,, 9	,, 416	28 ,,	,, ,, ,, ...	54 7	0 54 E.	24–30	M. ...	—	1	—	1	1	1	—	—	—	—	—	4	15	15	5
								F. ...	—	—	1	**2**	**5**	**2**	1	—	—	—	—	**11**			
33[1]	LXXXII 4	O (c) 417	20 Oct., 1906	,, ,, ,, ...	54 12	0 37 E.	29–31	M. ...	—	—	—	—	—	1	—	—	—	—	—	1	5	5	4
								F. ...	—	—	—	**1**	**1**	—	—	1	—	1	—	**4**			
33[2]	,, 5	,, 418	20 ,,	,, ,, ,, ...	54 15	0 42 E.	29–32	M. ...	—	—	—	1	—	2	1	—	—	—	—	4	10	10	5
								F. ...	—	—	—	1	**2**	**1**	—	—	—	**2**	—	**6**			
33[3]	,, 6	,, 419	21 ,,	,, ,, ,, ...	54 21	0 31 E.	32	M. ...	—	—	—	—	—	—	—	—	—	—	—	—	5	5	5
								F. ...	—	—	—	**1**	—	**1**	—	1	—	**2**	—	**5**			
33[4]	,, 7	,, 420	21 ,,	,, ,, ,, ...	54 16	0 24 E.	29–32	M. ...	—	—	—	—	1	1	—	—	—	—	—	2	8	8	3½
								F. ...	—	—	—	—	—	—	1	1	1	3	—	**6**			
33[5]	,, 8	B 522	21 ,,	,, ,, ,, ...	54 6	0 40 E.	29	M. ...	—	—	—	1	—	—	—	—	—	—	—	1	9	9	4
								F. ...	—	—	—	—	—	**3**	**1**	—	—	**4**	—	**8**			
33[6]	,, 9	,, 523	21 ,,	,, ,, ,, ...	54 0	0 45 E.	26–29	M. ...	—	—	—	2	3	2	—	—	—	—	—	7	12	12	5
								F. ...	—	—	—	—	—	3	1	—	—	1	—	**5**			
33[7]	,, 10	,, 524	22 ,,	,, ,, ,, ...	54 0	0 52 E.	26–28	M. ...	—	—	—	—	4	4	—	—	—	—	—	8	18	18	5
								F. ...	—	—	—	—	5	**3**	**2**	—	—	—	—	**10**			
33[8]	,, 11	,, 525	22 ,,	,, ,, ,, ...	53 57	0 54 E.	26	M. ...	—	—	1	5	6	2	**2**	—	—	—	—	16	26	26	5
								F. ...	—	—	**1**	**5**	**1**	—	—	2	—	1	—	**10**			
33[9]	,, 12	,, 526	22 ,,	,, ,, ,, ...	54 3	0 54 E.	26	M. ...	—	—	—	—	—	4	—	1	—	—	—	5	21	21	5
								F. ...	—	—	—	—	4	**6**	**2**	**2**	2	—	—	**16**			
33[10]	,, 13	,, 527	22 ,,	,, ,, ,, ...	54 6	0 51 E.	26–29	M. ...	—	—	—	—	1	1	1	—	—	—	—	3	16	16	5
								F. ...	—	—	—	—	4	**4**	**2**	**2**	—	1	—	**13**			
33[11]	,, 14	,, 528	23 ,,	,, ,, ,, ...	54 11	0 42 E.	29–33	M. ...	—	—	—	—	1	—	1	—	—	—	—	2	4	4	5
								F. ...	—	—	—	—	—	1	—	1	—	—	—	2			
33[12]	,, 15	,, 529	23 ,,	,, ,, ,, ...	54 14	0 34 E.	30–33	M. ...	—	—	—	—	1	—	—	—	—	—	—	1	6	6	5
								F. ...	—	—	—	—	—	2	—	2	—	1	—	5			

33[13]	„	16	„	530	23	„	„ „ „	54	12	0	26 E.	30	M. ...	—	—	—	—	—	—	—	—	—	—	—	8	8	8	1½
													F. ...	—	—	—	—	3	1	—	—	2	2	—				
33[14]	„	17	„	531	23	„	„ „ „	54	25	0	28 E.	33–37	M. ...	—	—	—	—	—	—	1	—	—	—	—	2	2	2	1
													F. ...	—	—	—	—	—	—	—	—	1	—	—				
34	C	1–21	B 721–723 B(c)724–727 O 525–529		2–5 June, 1908		Flamborough Off Ground	54	5	0	56 E.	24–25	M. ...	—	—	—	2	4	3	2	—	—	—	—	40	41	34
													F. ...	—	—	—	1	11	11	1	1	2	2	—				
35	CIV	1–24	B 781–783 B(c)784–787 O 547–554		18-22 Aug., 1908		„ „ „	54	5	0	56 E.	24–25	M. ...	—	—	1	5	37	6	2	3	2	—	—	171	214	45
													F. ...	—	—	—	11	68	25	4	5	2	—	—				
36[1]	LXXXII	1	O (c)	414	16 Oct., 1906		Dogger Bank—South Part... ...	54	38	1	46 E.	10–15	M. ...	—	—	—	—	—	—	—	—	—	—	—	3	3	4
													F. ...	—	—	—	1	1	—	—	—	—	1	—				
36[2]	„	2	„	415	16	„	„ „	54	42	2	1 E.	13–15	M. ...	—	—	1	—	—	1	—	—	—	—	—	5	5	4
													F. ...	—	—	—	—	1	1	—	—	—	1	—				
36[3]	„	3	„	416	16	„	„ „	54	49	1	47 E.	10–15	M. ...	—	—	—	1	—	—	—	—	—	—	—	21	21	5
													F. ...	—	—	—	1	3	2	3	1	3	7	—				
37[1]	LXXXI	1	B (c)	511	25 Sept., 1906		Horn Reef Outer Ground	55	18	6	0 E.	24–25	M. ...	—	—	—	4	1	—	1	—	—	—	—	20	20	2
													F. ...	—	—	—	3	4	3	2	2	—	—	—				
37[2]	„	5	„	515	25	„	„ „ „	55	39	6	15 E.	23–25	M. ...	—	—	—	7	4	—	—	—	—	—	—	24	24	3⅝
													F. ...	—	—	1	8	1	1	1	—	—	1	—				
37[3]	„	6	„	516	26	„	„ „ „	55	38	6	15 E.	21–25	M. ...	—	—	—	19	7	—	—	—	—	—	—	49	49	4
													F. ...	—	—	2	17	1	2	—	—	—	1	—				
37[4]	„	8	„	518	26	„	„ „ „	55	35	6	19 E.	22–23	M. ...	—	—	—	—	—	—	—	—	—	—	—	2	30	2
													F. ...	—	—	—	—	—	—	1	1	—	—	—				
37[5]	„	9	„	519	26	„	„ „ „	55	33	6	17 E.	23–24	M. ...	—	—	1	29	5	—	1	—	—	—	—	67	67	4
													F. ...	—	—	—	24	3	4	—	—	—	—	—				
38[1]	„	10	B	520	27	„	Clay Deep edge of Dogger... ...	55	15	4	4 E.	15–22	M. ...	—	—	—	3	—	2	—	—	—	—	—	11	11	4
													F. ...	—	—	—	—	2	1	—	—	1	2	—				
38[2]	„	11	„	521	27	„	„ „ „	55	13	3	55 E.	17–22	M. ...	—	—	—	—	—	—	—	—	—	—	—	6	6	4
													F. ...	—	—	—	1	1	1	2	1	—	—	—				
39[1]	LXIX	11	B	407	14 Mar., 1906		Off Smith's Knoll Light Vessel ...	52	51	2	27 E.	21–25	M. ...	—	—	1	—	—	—	—	—	—	—	—	3	3	5
													F. ...	—	—	—	1	—	1	—	—	—	—	—				
39[2]	„	12	„	408	14	„	East of South end of Well Bank ...	53	1	2	39 E.	18½–21	M. ...	—	1	1	1	—	—	—	—	—	—	—	5	5	5
													F. ...	—	—	2	—	—	—	—	—	—	—	—				
39[3]	„	14	„	409	14	„	Between South ends of Well and Swarte Banks.	53	10	2	32 E.	16½–19	M. ...	—	—	1	—	—	1	—	—	—	—	—	4	4	5
													F. ...	—	—	2	—	—	—	—	—	—	—	—				
39[4]	„	16	„	410	14	„	Leman Ground	53	16	2	34 E.	16–16½	M. ...	—	1	2	1	2	—	—	—	—	—	—	15	15	4
													F. ...	—	3	1	3	1	1	—	—	—	—	—				
39[5]	„	17	„	411	15	„	„ „	53	22	2	32 E.	15–16	M. ...	—	5	7	9	3	2	—	—	—	—	—	52	52	4
													F. ...	—	1	8	7	7	3	—	—	—	—	—				
39[6]	„	18	„	412	16	„	„ „	53	26	2	15 E.	14 16	M. ...	—	6	26	24	4	—	—	—	—	—	—	102	104	5½
													F. ...	—	9	14	10	5	2	—	—	—	2	—				
39[7]	„	19	„	413	16	„	East side of Swarte Bank... ...	53	24	2	17 E.	14–17	M. ...	—	3	16	4	6	1	—	—	—	—	—	70	72	4½
													F. ...	—	3	14	17	4	1	—	—	—	1	—				
39[8]	„	20	„	414	17	„	N.E. of Smith's Knoll Light Vessel	52	54	2	15 E.	22–25	M. ...	—	—	3	2	—	1	—	—	—	—	—	11	11	6
													F. ...	—	—	1	1	1	1	—	—	—	1	—				
40[1]	LXXIV	1	B (c)	466	10 May, 1906		Between Broken Bank & Swarte Bank.	53	21	2	2 E.	17	M. ...	—	1	8	29	26	15	1	—	—	—	—	162	168	4
													F. ...	—	—	10	32	31	7	2	—	—	—	—				
40[2]	„	2	„	467	11	„	Leman Ground	53	23	2	12 E.	13–17	M. ...	—	—	6	23	26	9	1	—	—	—	—	128	130	5
													F. ...	—	—	9	27	19	6	1	—	—	1	—				
40[3]	„	3	„	468	11	„	„ „	53	25	2	22 E.	13–15	M. ...	—	2	58	54	41	3	1	—	—	—	—	326	326	5
													F. ...	—	—	69	62	25	11	—	—	—	—	—				

TABLE 1—*continued.*

Sample No.	Voyage and Station.	Gear and Haul No.	Date.	Name of Fishing Ground.	Central Position. Long. N.	Central Position. Lat.	Depth. Fathoms.	Sex.	Age Groups. O.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX+.	Age Doubtful.	Sample Total.	Total Catch.	Number of Hours Fishing.
					° ′	° ′																
40^4	LXXIV 4	B (c) 469	11 May, 1906	Leman Ground	53 23	2 37 E.	15–17	M. ...	—	—	4	13	5	5	—	—	1	—	—	28	44	44	5
								F. ...	—	—	—	8	5	1	1	1	—	—	—	16			
40^5	„ 5	„ 470	11 „	„ „	53 19	2 53 E.	17	M. ...	—	—	12	3	1	—	—	—	—	—	—	16	24	24	5
								F. ...	—	—	1	2	1	3	1	—	—	—	—	8			
41^1	„ 6	„ 471	12 „	Brown Bank	53 14	3 10 E.	$16\frac{1}{2}$–17	M. ...	—	—	9	3	—	—	—	—	—	—	—	12	31	32	5
								F. ...	—	—	6	6	1	2	2	1	—	1	—	19			
41^2	„ 7	„ 472	12 „	„	53 10	3 26 E.	$15\frac{1}{2}$–$16\frac{1}{2}$	M. ...	—	—	5	3	2	5	—	—	—	—	—	15	37	37	5
								F. ...	—	—	2	6	3	8	2	—	—	1	—	22			
41^3	„ 8	„ 473	12 „	„	53 6	3 38 E.	$15\frac{1}{2}$–$16\frac{1}{2}$	M. ...	—	—	25	41	40	16	2	—	—	—	—	124	220	228	5
								F. ...	—	—	14	38	26	15	2	1	—	—	—	96			
41^4	„ 9	„ 474	13 „	Between Brown Bank and Texel Ground.	53 1	4 0 E.	$15\frac{1}{2}$–$16\frac{1}{2}$	M. ...	—	—	28	47	16	5	1	—	—	—	—	97	182	184	5
								F. ...	—	—	21	28	27	9	—	—	—	—	—	85			
42^1	„ 10	„ 475	13 „	„ „ „	52 57	4 14 E.	13–$15\frac{1}{2}$	M. ...	—	7	190	76	9	—	—	—	—	—	—	282	468	468	5
								F. ...	—	5	109	57	11	4	—	—	—	—	—	186			
42^2	„ 11	„ 476	13 „	„ „ „	52 51	4 26 E.	12–13	M. ...	—	43	447	132	8	—	—	—	—	—	—	630	1217	1231	5
								F. ...	—	24	413	135	15	—	—	—	—	—	—	587			
43	C 24–47	B 728–730, B(c)731–735, O 530–534	9–12 June, 08	Leman Ground	53 33	2 34 E.	15–18	M. ...	—	—	92	113	100	19	4	2	—	1	—	331	576	647	41
								F. ...	—	1	62	67	80	21	9	3	2	—	—	245			
44	CIV 27–46	B 788–790, B(c)791–793, O 555–559	22–24 Aug., 08	„ „	53 33	2 31 E.	15–17	M. ...	—	—	162	216	109	18	3	2	2	3	—	515	913	1018	33
								F. ...	—	—	132	168	75	8	4	5	1	5	—	398			
45^1	LXIX 1	B 400	6 Mar., 1906	Eastern Deep Water	52 6	2 41 E.	23–24	M. ...	—	4	9	5	9	—	—	—	—	—	—	27	38	38	$4\frac{1}{2}$
								F. ...	—	—	5	4	1	1	—	—	—	—	—	11			
45^2	„ 2	„ 401	7 „	„ „	52 11	2 59 E.	$18\frac{1}{2}$–23	M. ...	—	1	4	2	2	—	—	—	—	—	—	9	15	15	5
								F. ...	—	—	4	2	—	—	—	—	—	—	—	6			
45^3	„ 3	„ 402	7 „	„ „	52 19	3 4 E.	19–20	M. ...	—	—	6	3	—	—	—	—	—	—	—	9	18	18	$5\frac{1}{4}$
								F. ...	—	1	4	2	1	—	—	—	1	—	—	9			
45^4	„ 4	„ 403	7 „	„ „	52 33	3 6 E.	$18\frac{1}{2}$–20	M. ...	—	—	2	1	5	—	—	—	—	—	—	8	15	15	5
								F. ...	—	—	6	—	1	—	—	—	—	—	—	7			
45^5	„ 6	„ 405	10 „	„ „	52 22	2 40 E.	23–25	M. ...	—	—	2	7	2	1	2	1	—	—	—	15	18	18	5
								F. ...	—	—	—	—	1	—	—	1	—	1	—	3			
45^6	„ 7	„ 406	11 „	Between Middle and Winterton Shoals.	52 30	2 50 E.	22–25	M. ...	—	2	1	4	5	1	—	—	—	—	—	13	14	14	5
								F. ...	—	—	—	1	—	—	—	—	—	—	—	1			
46^1	LXXIV 17	B (c) 480	18 May, 1906	Brielle Ground	52 11	3 51 E.	12–$14\frac{1}{2}$	M. ...	—	5	128	54	12	—	—	—	—	—	—	199	393	1167	5
								F. ...	—	3	110	69	9	3	—	—	—	—	—	194			
46^2	„ 19	„ 481	18 „	Between Brielle Ground and Eastern Deep Water.	52 15	3 36 E.	$14\frac{1}{2}$–15	M. ...	—	5	202	112	21	7	—	—	—	—	—	347	631	633	5
								F. ...	—	6	132	121	21	4	—	—	—	—	—	284			
47	„ 21	„ 482	18 „	S. of Brown Ridges	52 19	3 21 E.	15–19	M. ...	—	1	17	25	14	2	—	—	—	—	—	59	93	97	5
								F. ...	—	—	8	15	8	3	—	—	—	—	—	34			
48^1	„ 23	„ 483	18 „	S.E. part of Eastern Deep Water	52 21	3 5 E.	19–20	M. ...	—	—	9	25	26	27	1	—	—	—	—	88	148	150	5
								F. ...	—	—	3	12	26	19	—	—	—	—	—	60			
48^2	„ 24	„ 484	19 „	Eastern Deep Water	52 22	2 50 E.	20–23	M ...	—	—	1	9	12	15	—	—	—	—	—	37	58	58	5
								F. ...	—	—	4	5	2	9	1	—	—	—	—	21			
49^1	LXXXIII 1	B 543	29 Nov. 1906	Off Sandettie Light Vessel ...	51 9	1 52 E.	20–22	M. ...	—	—	—	4	1	—	1	—	—	—	—	6	13	13	2
								F. ...	—	—	—	6	1	—	—	—	—	—	—	7			

49[2]	„	2	„	544	29	„	„	„	51	13	2	1 E.	17–20	M ...	—	—	4	4	1	—	—	—	—	—	—	9	12	12	2
														F. ...	—	—	—	2	—	—	—	1	—	—	—	—	3			
49[3]	„	4	„	545	29	„	„	„	51	14	1	46 E.	16–21	M. ...	—	—	2	2	1	1	—	—	—	—	—	6	7	7	1¾
														F. ...	—	—	—	—	1	—	—	—	—	—	—	1			
50	Lowestoft trawler "Ena."		...	...	2 Dec., 1907	West Kapelle Ground			ca51	50	ca3	14 E.	15–17	M. ...	—	8	68	147	21	—	—	—	—	—	—	244	400	?	—
														F. ...	—	4	70	79	3	—	—	—	—	—	—	156			
51	Lowestoft trawler "Forward."		...	...	1 Jan., 1908	Gabbard Deep Water			ca51	58	ca2	30 E.	23–25	M. ...	—	97	240	376	91	42	23	7	3	2	—	881	1108	1108	14
														F. ...	—	13	38	127	14	9	11	5	4	6	—	227			
52	XCVIII	63	B.c.	679	29 Apr., 1908	Schouwen Ground			51	48	3	11 E.	15–17	M. ...	—	1	97	20	19	2	—	—	—	—	—	139	248	294	3½
														F. ...	—	2	72	25	7	3	—	—	—	—	—	109			
53[1]	LXVIII	1	O	371	12 Feb., 1906	"Spion Kop" Ground			50	30	3	5 W.	26–28	M. ...	—	2	2	2	2	—	—	—	—	—	—	8	26	26	3½
														F. ..	—	3	5	7	2	—	—	—	—	1	—	18			
53[2]	„	3, 4	O	373, 374	27 „	Between Beer Head and Berry Head			50	28	3	5 W.	20–29	M. ...	—	13	24	12	5	—	—	—	—	—	—	54	84	84	7⅚
														F. ...	—	1	12	6	8	1	1	—	—	1	—	30			
54[1]	LXXXIV	1	O	421	28 „	Inside "Eastern Scruff"			50	26	2	57 W.	21–30	M. ...	—	—	9	5	3	—	—	—	—	—	—	17	33	33	5
														F. ..	—	2	8	4	1	—	1	—	—	—	—	16			
54[2]	„	2	„	422	1 Mar., 1907	„ „			50	25	2	49 W.	21–30	M. ...	—	6	8	8	2	1	—	—	—	—	—	25	64	64	5
														F. ...	—	1	13	19	4	—	2	—	—	—	—	39			
54[3]	„	3	„	423	1 „	„ „			50	25	2	51 W.	26–30	M. ...	—	2	3	—	—	—	—	—	—	—	—	5	26	26	5
														F. ...	—	1	6	8	3	1	1	1	—	—	—	21			
54[4]	„	4	„	424	1 „	„ „			50	34	2	45 W.	19–26	M. ...	—	—	1	1	—	—	—	—	—	—	—	2	6	6	5
														F. ...	—	3	—	1	—	—	—	—	—	—	—	4			
55[1]	Brixam Trawler.		Beam trawl		27 Nov., 1907	Teignmouth Bay			50	30	3	30 W.	3–4	M. ...	22	13	—	1	—	—	—	—	—	—	—	36	73	73	1¼
														F. ...	17	18	1	—	—	1	—	—	—	—	—	37			
55[2]	„	„	„	„	27 „	„ „			50	33	3	29 W.	4–4½	M. ...	3	14	4	2	1	—	—	—	—	—	—	24	53	53	1¼
														F. ...	4	19	1	1	1	3	—	—	—	—	—	29			
55[3]	„	„	„	„	28 „	„ „			50	34	3	27 W.	5½–6	M. ...	—	34	14	8	—	—	—	—	—	—	—	56	118	118	1
														F. ...	—	28	22	10	2	—	—	—	—	—	—	62			
56	...	...	...	...	27, 28 Nov., 1908.	„ „			50	34	3	30 W.	3½–4½	M. ...	—	16	207	20	12	3	—	—	—	—	48	306	533	533	10½
														F. ...	—	13	140	8	15	4	1	—	—	—	46	227			
57[1]	CXII	4	B	912	6 Aug., 1909	Tor Bay			50	26	3	31 W.	7–7	M. ...	—	123	7	1	—	—	—	—	—	—	1	132	225	233	2
														F. ...	—	83	4	5	1	—	—	—	—	—	—	93			
57[2]	„	5	„	913	6 „	„			50	26	3	31 W.	6–7	M. ..	—	39	3	2	1	—	—	—	—	—	—	45	69	69	2
														F. ...	—	22	2	—	—	—	—	—	—	—	—	24			
57[3]	„	7	„	915	6 „	„			50	25	3	32 W.	3–5	M. ...	—	20	2	—	—	—	—	—	—	—	—	22	42	42	1
														F. ...	—	15	3	1	—	1	—	—	—	—	—	20			
57[4]	„	8	„	916	7 „	„			50	26	3	31 W.	5–7	M. ...	—	81	4	3	—	—	—	1	—	—	—	89	170	170	2
														F. ...	—	66	11	—	3	1	—	—	—	—	—	81			
58[1]	„	9	„	917	9 „	Start Bay			50	19	3	34 W.	7–13	M. ...	—	2	2	—	—	—	—	—	—	—	—	4	18	18	1
														F. ...	—	3	3	3	2	2	—	—	—	1	—	14			
58[2]	„	10	„	918	9 „	„			50	18	3	37 W.	7–8	M. ...	—	21	6	2	3	2	—	1	—	—	—	35	70	70	3
														F. ...	—	13	2	5	4	5	3	1	1	1	—	35			
58[3]	„	11	„	919	9 „	„			50	18	3	36 W.	8	M. ...	—	4	6	4	—	1	—	—	—	—	—	15	37	37	2
														F. ..	—	4	3	9	3	2	—	1	—	—	—	22			
58[4]	„	12	„	920	9 „	„			50	18	3	37 W.	8	M. ...	—	7	7	6	2	—	—	—	—	—	—	22	48	48	3⅚
														F. ...	—	8	3	9	4	2	—	—	—	—	—	26			

The principal results of each part of the investigation will be found summarised at the end of each section.

Assistance.—The final drafting of Figs. 1 to 5 and 8, and the plotting of the sample numbers in their proper positions on the Chart, Plate I., were the careful work of Mr. J. Potter, of the Lowestoft Laboratory, who also helped me with certain calculations and tables. I wish to record here my thanks to Mr. Potter for his valuable assistance. I have also received useful clerical assistance from Mr. D. Cooper; and I am much obliged to Mr. H. H. Goodchild for his excellent photographs of otoliths reproduced on p. 142A, (Figs. 6 and 7). Finally, I have to thank my colleagues, Mr. G. T. Atkinson, and Miss R. M. Lee, for information and opinion on one or more points relating to their particular studies.

2. *Material.*

My Report for 1907 (*see* full reference p. 152), dealt with the ages of 7,863 plaice, this being the number of otoliths which had been collected up to the end of 1905. Since then, during the period 1906–09, the otoliths of 12,343 plaice have been collected and examined ; thus making *a total of* 20,206 *separate age-determinations for plaice collected* over a wide area of the North Sea and from the Western part of the Channel.

Material Collected during period 1906–09.—In Synoptic Table 1 (at the beginning), are recorded the numbers, and in Tables I.–IX.* (at the end), the individual length measurements, of plaice of different ages collected during 1906–09. The Synoptic Tables contains precise data regarding locality, depth of water, date, number of hours fishing, kind of fishing gear and other essential particulars concerning each sample.

The samples are numbered so as to follow the reference numbers in my 1907 Report, beginning with No. 29 and ending with No. 584. The primary arrangement of the data in these tables is according to the geographical relations of the fishing grounds on which the samples were taken, the secondary arrangement being chronological.

Plate I.—The approximate position of the "stations" (more precisely the central position between the shooting and hauling of the trawl) on which the 1906–09 samples were taken, are indicated on the *Chart, Plate I.*, by means of the appropriate reference numbers enclosed in squares and circles. On this Chart also the positions of the principal fishing grounds are roughly indicated by their ordinary names (as used by fishermen).

The following short synopsis shows from what region the 1906–09 material was obtained, the number of otoliths from each region, the months and years of collection, and the reference numbers of the samples.

Region.	Sample Reference Nos.	Month and Year of Collection, 1906–1909.	No. of Otoliths = No. of Age Determinations.
English East Coast (Bridlington, Wash)	29–31	June, Sept., 1906 ...	2,112
Flamborough Off Ground	32–35	Mar. and Oct., 1906, June and Aug., 1908.	510
Dogger, Clay Deep, &c.	36–38	Sept. and Oct., 1906	208
Texel—Leman Region	39–44	Mar. and May, 1906, June and Aug., 1908.	4,590
Southern Bight (Middle and Southern parts) ...	45–52	Mar. and May, 1906, November, 1906, December, 1907, Jan. and Apr., 1908.	3,229
Great West Bay (English Channel)	53–58	Feb.,1906,Mar.,1907, November, 1907–08, August, 1909.	1,694
Total (1906–09)			12,343
Total to end of 1905			7,863
Grand Total			20,206

* It will be noticed that I have included all plaice of nine years and over nine years of age in one group (IX+). This has been done partly for the sake of compactness (on account of small numbers), and partly because of the uncertainty as to the exact number of annual rings in the otoliths of many of the older fishes.

II.—General Summary of the Age-Composition of the Plaice Population on Various Fishing Grounds.

Tables 2 and 3.

Table 2.—Showing Age-Composition of Samples of Plaice from different Fishing Grounds (1904–09) together with the Extreme Range of Length, Range of Fifty per cent. and Average Length of each Age Group (sexes combined).

Note.—The Range of Fifty per cent. and Average Length are omitted in certain cases in which the number of specimens is too small to give sufficiently accurate results.

Name of Ground.	Sample Reference Nos.	Depth in Fathoms.	Month and Year.	Age Groups.	No. of Fish—Index Figures =Males.	Percentage of Total Sample	Extreme Range. cm.	Range of fifty per cent. cm.	Calculated Average Length. cm.	Amended Average Length. cm.
Bridlington Bay	4	3½–5	vii/05	II	94	51	12–22	14–17	15·7	16·2
				III	74	40	12–26	17–20	18·1	18·6
				IV	12	7	19–26	—	21·8	22·3
				V	1	+	—	—	—	—
				VI	2	1+	—	—	—	—
„ „	31	5–6	ix/06	I	5^{0}	1	12–13	—	—	—
				II	169^{96}	56	12–21	15–16	15·8	16·3
				III	97^{57}	32	15–25	18–20	19·0	19·5
				IV	29^{16}	10	16–27	19–22	20·7	21·2
				V	2^{2}	+	—	—	—	—
				VI	1^{1}	+	—	—	—	—
Mablethorpe	6	3½–9	viii/05	I	68	41	7–17	10–13	11·5	12·0
				II	70	42	11–22	15–18	16·6	17·1
				III	27	16	14–25	17–22	19·8	20·3
The Wash	5	1½–7	viii/05	0	10	3+	3–6	—	4·2	4·7
				I	183	65	7–18	8–10	9·2	9·7
				II	86	30	9–19	12–16	14·2	14·7
				III	6	1	14–19	—	—	—
„ „	29	?	vi/06	I	934	—	4–12	6–7	6·8	7·3
				II	632	—	6–19	9–13	10·7	11·2
				III	69	—	10–21	13–16	14·4	14·9
				IV	8	—	13–18	—	—	—
				Age ?	116	—	9–21	—	—	—
Lowestoft	1	3–5	v/05	I	96	21	5–10	6–8	7·1	7·6
				II	272	61	8–18	10–14	11·9	12·4
				III	75	17	9–21	13–16	14·7	15·2
				IV	3	+	—	—	—	—
Flamborough Off	34	24–25	vi/08	III	3^{2}	7	—	—	—	—
				IV	15^{4}	37	30–43	33–35	34·7	35·2
				V	14^{3}	35	30–43	35–39	37·0	37·5
				VI+	8^{2}	20	34–49	—	—	—
„ „	35	24–25	viii/08	II	1^{1}	+	—	—	—	—
				III	16^{5}	9	25–34	29–32	30·5	31·0
				IV	105^{37}	61	26–38	31–34	32·4	32·9
				V	31^{6}	18	29–41	34–38	36·1	36·6
				VI+	18^{7}	11	33–45	36–42	39·6	40·1
„ „	17	25–30	x/05	II	10^{8}	5	18–31	—	22·7	23·2
				III	37^{18}	18	21–36	25–32	28·9	29·4
				IV	87^{25}	44	25–44	33–37	35·2	35·7
				V	38^{19}	19	30–49	36–41	38·4	38·9
				VI+	30^{12}	14	31–58	38–48	44·0	44·5
„ „	33	29–31	x/06	II	2^{1}	+	—	—	—	—
				III	17^{9}	11	20–38	24–28	27·6	28·1
				IV	37^{17}	25	23–41	33–36	34·3	34·8
				V	42^{17}	28	29–44	37–41	38·2	38·7
				VI+	52^{7}	36	36–64	42–52	47·9	48·4

TABLE 2—*continued.*

Name of Ground.	Sample Reference Nos.	Depth in Fathoms.	Month and Year.	Age Groups.	No. of Fish—Index Figures =Males.	Percentage of Total Sample.	Extreme Range. cm.	Range of fifty per cent. cm.	Calculated Average Length. cm.	Amended Average Length. cm.
Flamborough Off	18, 19	25–31	i/05	I	3^{3}	1+	18–20	—	—	—
				II	3^{3}	1+	22–25	—	—	—
				III	30^{16}	21	24–36	27–32	29·8	30·3
				IV	44^{37}	31	25–41	32–36	34·0	34·5
				V	41^{36}	28	23–43	36–40	37·1	37·6
				VI+	24^{16}	17	33–44	—	38·8	39·3
„ „	32	24–30	iii/06	I	1^{1}	+	—	—	—	—
				II	16^{10}	11	16–34	19–27	22·8	23·3
				III	21^{13}	14	15–38	24–33	29·2	29·7
				IV	73^{18}	49	23–43	35–39	36·7	37·2
				V	22^{5}	15	26–46	33–41	37·4	37·9
				VI+	16^{2}	10	28–55	—	43·4	43·9
Dogger : South Part ...	14	$10\frac{1}{2}$–14	x/05	II	5^{2}	9	25–30	—	—	—
				III	6^{2}	11	25–33	—	—	—
				IV	23^{10}	42	28–46	31–36	34·3	34·8
				V	13^{3}	24	30–48	—	41·9	42·4
				VI+	8^{0}	14	44–58	—	—	—
„ „ „ ...	36	10–15	x/06	II	1^{1}	3	29–	—	—	—
				III	3^{1}	10	33–41	—	—	—
				IV	5^{0}	17	39–41	—	—	—
				V	4^{1}	14	40–48	—	—	—
				VI+	16^{0}	56	45-66	—	56·7	57·2
„ „ „ ...	15	$11\frac{1}{2}$–17	i/05	III	22^{8}	40	25–34	27–31	29·1	29·6
				IV	31^{6}	56	29–44	32–36	34·3	34·8
				V	3^{1}	4	—	—	—	—
„ „ „ ...	16	9–17	iii/04	II	2^{0}	+	21–24	—	—	—
				III	62^{12}	38	22–37	27–32	29·8	30·3
				IV	50^{17}	30	29–41	33–38	35·3	35·8
				V	26^{2}	15+	34–48	38–43	41·1	41·6
				VI+	26^{0}	15+	41–64	45–50	48·0	48·5
Clay Deep, edge of Dogger	13	20–24	x/05	III	17^{7}	13	24–32	26–30	27·8	28·3
				IV	86^{32}	67	24–39	30–34	31·8	32·3
				V	18^{8}	14	31–47	34–40	37·7	38·2
				VI+	7^{0}	5	45–53	—	—	—
Horn Reef, Outer	37	21–35	ix/06	II	4^{1}	1	—	—	—	—
				III	111^{59}	69	22–32	24–27	25·8	26·3
				IV	26^{17}	16	24–34	28–31	29·3	29·8
				V	11^{0}	7	28–46	30–39	35·2	35·7
				VI+	11^{2}	7	42–61	—	46·1	46·6
Leman Ground and Swarte Bank.	40	13-17	v/06	I	3^{3}	+	12–15	—	—	—
				II	177^{88}	26	9–26	14–19	16·5	17·0
				III	253^{122}	37	12–31	20–25	22·6	23·1
				IV	180^{99}	26	19–36	25–30	27·8	28·3
				V	60^{32}	9	20–42	29–34	31·4	31·9
				VI+	11^{4}	1	32–42	—	37·3	37·8
Leman Ground	43	15–18	vi/08	I	1^{0}	+	—	—	—	—
				II.	154^{92}	27	13–27	16–19	17·9	18·4
				III	180^{113}	31	16–32	22–25	23·5	24·0
				IV	180^{100}	31	19–37	26–30	28·3	28·8
				V	40^{19}	7	23–39	31–35	32·3	32·8
				VI+	21^{7}	3	30–41	35–40	36·8	37·3
„ „	44	15–17	viii/08	II	294^{162}	32	16–28	20–23	21·5	22·0
				III	384^{216}	43	19–32	24–27	25·1	25·6
				IV	184^{109}	20	22–38	26–29	27·8	28·3
				V	26^{18}	3	28–37	30–33	31·7	32·2
				VI+	14^{10}	1	31–39	—	35·1	35·6

TABLE 2—*continued.*

Name of Ground.	Sample Reference Nos.	Depth in Fathoms.	Month and Year.	Age Groups.	No. of Fish—Index Figures =Males.	Percentage of Total Sample.	Extreme Range. cm.	Range of fifty per cent. cm.	Calculated Average Length. cm.	Amended Average Length. cm.
Leman Ground	9	15½–17	ix/05	I	34^{14}	10	12–20	14–17	15·6	16·1
				II	66^{35}	20	17–29	22–25	23·4	23·9
				III	119^{64}	36	17–33	25–28	26·2	26·7
				IV	82^{44}	25	24–41	29–33	31·1	31·6
				V	11^{4}	3	32–41	—	37·3	37·8
				VI+	17^{5}	6	35–50	—	41·6	42·1
„ „	21	12–17	x/05	I	18^{8}	8	17–22	—	—	—
				II	65^{32}	29	19–31	23–26	24·6	25·1
				III	50^{25}	22	23–35	28–31	28·8	29·3
				IV	64^{21}	28	24–40	31–34	32·7	33·2
				V	17^{7}	7	33–40	35–39	36·6	37·1
				VI+	12^{1}	6	35–53	—	44·6	45·1
South Botney (E. of Leman) Ground.	20	17½–20	i/05	I	1^{0}	1+	16 —	—	—	—
				II	4^{2}	6+	23–29	—	—	—
				III	38^{12}	62	23–37	26–29	28·0	28·5
				IV	10^{3}	16	28–37	—	32·4	32·9
				V	4^{1}	6+	40–47	—	—	—
				VI+	5^{0}	8	39–54	—	—	—
Leman Ground and Smith's Knoll.	39	14–25	iii/06	I	32^{16}	12	12–24	15–18	16·6	17·1
				II	99^{57}	39	16–28	21–25	22·9	23·4
				III	80^{41}	30	19–34	24–29	26·2	26·7
				IV	33^{15}	13	20–39	27–33	30·4	30·9
				V	14^{5}	5	27–41	—	36·2	36·7
Brown Bank	41	15½–17	v/06	II	110^{67}	23	11–24	14–18	16·2	16·7
				III	171^{93}	37	14–23	21–27	24·0	24·5
				IV	115^{58}	24	18–35	26–30	27·9	28·4
				V	60^{26}	13	22–28	29–34	31·7	32·2
				VI+	13^{3}	3	33–62	—	38·3	38·8
„ „	10	14–16	ix/05	I	9^{5}	1+	14–21	—	—	—
				II	208^{96}	37	17–29	20–23	21·7	22·2
				III	228^{115}	40	20–34	24–28	25·8	26·3
				IV	107^{50}	19	22–36	28–31	29·4	29·9
				V	7^{4}	1+	—	—	—	—
				VI+	4^{1}	1+	—	—	—	—
The Texel	42	12–15½	v/06	I	79^{50}	5	8–15	10–12	10·7	11·2
				II	1159^{637}	69	9–22	12–15	13·7	14·2
				III	400^{208}	24	12–28	18–22	20·0	20·5
				IV	43^{17}	2	17–32	23–28	25·4	25·9
				V	4^{0}	+	23–37	—	—	—
„	$11^{1,2}$	12–14	ix/05	I	10^{6}	1+	—	—	17	—
				II	403^{236}	65	16–28	19–21	20·1	20·6
				III	170^{86}	27	19–30	22–26	24·1	24·6
				IV	37^{23}	6	21–34	26–30	27·9	28·4
Off Petten	$11^{3,4}$	7–12	ix/05	I	149^{86}	33	11–18	13–15	13·8	14·3
				II	252^{120}	57	13–25	16–19	17·4	17·9
				III	38^{11}	8	14–28	19–25	21·9	22·4
				IV	9^{5}	2	21–30	—	—	—
Brielle Ground	46	12–15	v/06	I	19^{10}	2	9–15	11–13	12·4	12·9
				II	572^{330}	56	9–25	14–18	16·4	16·9
				III	356^{166}	35	13–31	19–23	21·3	21·8
				IV	63^{33}	6	20–33	25–28	26·4	26·9
				V	14^{7}	+	23–34	—	28·4	28·9
South of Brown Ridges ...	47	15–19	v/06	I	1^{1}	1+	—	—	—	—
				II	25^{17}	27	13–24	15–19	17·4	17·9
				III	40^{25}	43	18–36	21–25	23·4	23·9
				IV	22^{14}	24	22–33	26–28	28·6	29·1
				V	5^{2}	5+	25–30	—	—	—

TABLE 2—*continued.*

Name of Ground.	Sample Reference Nos.	Depth in Fathoms.	Month and Year.	Age Groups.	No of Fish—Index Figures =Males.	Percentage of Total Sample.	Extreme Range. cm.	Range of fifty per cent cm.	Calculated Average Length. cm.	Amended Average Length. cm.
Eastern Deep Water ...	48	19–23	v/06	II	17^{10}	8	13–23	17–21	18·9	19·4
				III	51^{34}	25	16–34	22–27	24·5	25·0
				IV	66^{38}	32	20–38	26–31	28·9	29·4
				V	70^{42}	34	24–39	30–34	31·9	32·4
				VI+	2^{1}	1	—	—	—	—
„ „ ...	45	18½-25	iii/06	I	8^{7}	7	14–19	—	—	—
				II	43^{24}	36	16–31	19–23	21·7	22·2
				III	31^{22}	26	20–36	24–29	27·2	27·7
				IV	27^{23}	23	22–37	28–34	30·8	31·3
				V	3^{2}	2+	33–38	—	—	—
				VI+	5^{3}	5	37–47	—	—	—
Gabbard Deep Water ...	51	23–25	i/08	I	110^{97}	10	14–23	16–19	17·4	17·9
				II	278^{240}	25	15–31	19–22	21·0	21·5
				III	503^{376}	45	16–34	23–26	24·6	25·1
				IV	105^{91}	9	21–40	27–32	29·6	30·1
				V	51^{42}	5	23–43	31–37	34·0	34·5
				VI+	61^{35}	6	27–64	35–45	—	—
Schouwen Ground	52	15–17	iv/08	I	3^{1}	1	—	—	—	—
				II	169^{97}	68	12–23	15–18	16·5	17·0
				III	45^{20}	18	16–25	19–21	20·5	21·0
				IV	26^{19}	10	19–27	22–24	22·9	23·4
				V	5^{2}	2	—	—	—	—
„ „	50	15–17	xii/07	I	12^{8}	3	18–21	—	19·0	19·5
				II	138^{68}	34	18–28	21–23	21·8	22·3
				III	226^{147}	57	20–31	22–25	23·8	24·3
				IV	24^{21}	6	23–29	26–28	26·4	26·9
Sandettie	26	19–20	xi/04	I	4^{4}	2	20–22	—	—	—
				II	15^{15}	11	20–27	—	24·6	25·1
				III	44^{39}	31	21–35	27–31	28·4	28·9
				IV	63^{54}	46	27–42	30–34	32·2	32·7
				V	13^{12}	9	30–40	—	34·0	34·5
				VI+	2^{1}	1	38–42	—	—	—
Great West Bay	28	17–23	ii/04	I	22^{14}	25	12–23	17–20	18·4	18·9
				II	45^{17}	52	19–33	23–27	25·4	25·9
				III	18^{6}	21	22–37	30–32	30·8	31·3
				IV	2^{2}	2	33–35	—	—	—
„ „	53	20–29	ii/06	I	19^{15}	18	16–28	22–25	23·2	23·7
				II	43^{26}	40	19–37	24–30	27·3	27·8
				III	27^{14}	25	23–38	30–34	31·4	31·9
				IV	14^{4}	13	30–41	33–36	35·2	35·7
				V	1	1	43	—	—	—
				VI+	3	2+	48–56	—	—	—
„ „	54	19–30	ii, iii/07	I	15^{8}	12	15–29	19–24	22·0	22·5
				II	48^{21}	37	17–34	23–26	25·0	25·5
				III	46^{14}	36	22–40	26–31	28·9	29·4
				IV	13^{5}	10	23–37	—	32·6	33·1
				V	2^{1}	1	36–38	—	—	—
				VI+	5^{0}	4	40–51	—	—	—
Teignmouth Bay	27	4½–7	xi/04	I	5^{3}	8	20–25	—	—	—
				II	31^{18}	50	22–32	26–28	27·1	27·6
				III	18^{4}	29	28–36	31–34	32·3	32·8
				IV	5^{2}	8	30–35	—	—	—
				VI+	3^{0}	5	41–51	—	—	—
„ „	55	3–6	xi/07	0	46^{25}	19	9–12	10–11	10·3	10·8
				I	126^{61}	52	13–28	15–22	19·4	19·9
				II	42^{18}	17	21–35	26–30	28·2	28·7
				III	22^{11}	9	27–40	30–33	32·3	32·8
				IV	4^{1}	1+	29–40	—	—	—
				V	4^{0}	1+	40–43	—	—	—

TABLE 2—*continued.*

Name of Ground.	Sample Reference Nos.	Depth in Fathoms.	Month and Year.	Age Groups.	No. of Fish—Index Figures =Males.	Percentage of Total Sample.	Extreme Range. cm.	Range of fifty per cent. cm.	Calculated Average Length. cm.	Amended Average Length. cm.
Teignmouth Bay	56	3½–4½	xi/08	I	29^{16}	—	15–26	21–23	22·0	22·5
				II	347^{207}	—	17–35	26–29	27·5	28·0
				III	28^{20}	—	25–39	30–34	31·8	32·3
				IV	27^{12}	—	28–40	32–36	34·2	34·7
				V	7^{3}	—	30–39	—	—	—
				VI+	1^{0}	—	—	—	—	—
				Age ?	94^{48}	—	8–13	—	—	—
Tor Bay	57	3–7	viii/09	I	449^{263}	89	12–26	16–19	17·8	18·3
				II	37^{16}	7	20–33	25–29	27·4	27·9
				III	12^{6}	2	24–43	—	32·5	33·0
				IV	5^{1}	1	30–45	—	—	—
				V	2^{0}	+	43–45	—	—	—
				VI+	1^{1}	+	39–	—	—	—
Start Bay	58	7–13	viii/09	I	62^{34}	37	12–24	17–19	18·4	18·9
				II	32^{21}	19	20–33	26–30	28·2	28·7
				III	37^{11}	21	24–38	31–34	32·2	32·7
				IV	18^{5}	10	31–47	—	35·8	36·3
				V	14^{3}	8	33–48	—	38·8	39·3
				VI+	9^{1}	5	37–61	—	—	—

From the data given in Tables 2 and 3 a broad classification of the fishing grounds according to the percentage of different ages in our samples of plaice taken thereon is possible and should be useful (in spite of the fact that only approximate representative value can be attached to the percentages in question) as showing the kind of knowledge aimed at and the method by which more accurate information might be obtained if a sufficient number of samples from each ground were procurable.

The following classification into three groups of grounds, which accords well with geographical and bathymetrical relations, takes account of :—

1. The percentage of fish less than three years of age.
2. The percentage of fish less than four years of age.
3. The percentage of fish over six years of age.*
4. The dominant age group.

TABLE 3.—Percentage of fish less than three years old, and less than four years old respectively, in samples of PLAICE from various grounds, with the Predominant Age Group in each sample.

Name of Fishing Ground.	Depth (fms.).	Month and Year.	Predominant Age Groups.	Per cent. of Total Sample.	
				< 3 years old.	< 4 years old.
Bridlington Bay	3–5	vii/05	II	51	91
,, ,, ...	1–3	ix/06	II	57	89
Mablethorpe	3–9	viii/05	I, II	83	100
Lowestoft	3–5	v/04	II	82	99
Flamborough Off Ground	24–25	vi/08	IV	0	7
,, ,, ,, ...	24–28	viii/08	IV	+	9
,, ,, ,, ...	25–30	x/05	IV	5	23
,, ,, ,, ...	26–37	x/06	V	+	11
,, ,, ,, ...	23–31	i/05	IV	2	23
,, ,, ,, ...	24–30	iii/06	IV	11	25
Dogger	10–18	x/05	IV	9	20
,, ...	10–15	x/06	IV	3	13
,, ...	11–17	i/05	IV	0	40
,, ...	9–17	iii/04	III	+	38
Clay Deep, edge of Dogger	20–24	x/05	IV	0	13
Horn Reef Outer Ground	21–25	ix/06	III	1	70

* One may call these "adult" plaice since all, with few exceptions, must have spawned at least *once*. *See* Wallace, 1909, pp. 67–69.

TABLE 3—*continued.*

Name of Fishing Ground.	Depth (fms.).	Month and Year.	Predominant Age Groups.	Per cent. of Total Sample.	
				< 3 years old.	< 4 years old.
Leman Ground, &c.	13–17	v/06	III	26	63
„ „	15–18	vi/08	III	27	58
„ „	15–17	viii/08	III	32	75
„ „	14–17	ix/05	III	30	66
„ „	15½–17	x/05	II–IV	37	59
„ „	14–25	iii/06	II	51	81
South Botney Ground	17½–20	i/05	III	7	69
Brown Bank „	15½–17	v/06	III	23	60
„ „ „	14–16½	ix/05	III	38	78
Texel Ground	12–15½	v/06	II	74	98
„ „	12–14	ix/05	II	66	93
Off Petten (Dutch Coast)	7–12	„	II	89	97
Brielle Ground	12–15	v/06	II	58	93
South of Brown Ridges	15–19	„	III	28	71
Eastern Deep Water	19–23	„	V	8	33
„ „ „	18½–23	iii/06	II	43	69
Gabbard Deep Water	23–25	i/08	III	35	80
Schouwen Ground	15–17	iv/08	II	69	87
„ „	15–17	xii/07	III	37	93
Sandettie	19–21	xi/04	IV	12	43
Great West Bay, Offshore	17–23	ii/04	II	77	98
„ „ „ „	20–29	ii/06	II	58	83
„ „ „ „	19–30	ii/07	II	49	85
Teignmouth Bay	4½–7	xi/04	II	58	87
„ „	3–6	xi/07	I	88	97
Tor Bay	3–7	viii/09	I	96	98
Start Bay	7–13	„	I	55	76

A. Central Grounds.—With less than 15 per cent. under three years ; less than 50 per cent. under four years ; and more than 10 per cent. over six years of age. Plaice of the fifth year (IV. group) generally predominate.

Examples :—Dogger (South part) ... ... 9–20 fathoms.
Flamborough Off Ground ... ... 20–40 „
Clay Deep, edge of Dogger, ... 20–24 „

The single sample from the last-named ground (October, 1905) had, however, only 5 per cent. over six years of age.

The population of the Deep Water of the Southern Bight of the North Sea in winter appears to be intermediate in character between the A and the following B grounds. Our samples from this region had all less than 10 per cent. of fish over six years (Sample Nos. 26, 45, 48, 49, 51), but the predominant age group varied from II. to V. in the five samples.

B. Intermediate Grounds.—With not more than 50 per cent. under three years ; 50 per cent. to 75 per cent. under four years ; and less than 10 per cent. over six years.

Plaice of the fourth year (III. group) generally preponderate on these grounds.

Examples :—Leman Ground and Bank ... ... 15–17 fathoms.
Brown Bank Ground and Brown Ridges ... 15–17 „
South Botney Ground ... ... 17–20 „
Horn Reef Outer Ground ... ... 21–25 „

C. Young Fish Grounds.—With more than 50 per cent. under three years ; more than 75 per cent. under four years ; and not more than about 5 per cent. over six years.

Plaice of the third year (II. group) and second year (I. group) predominate on these grounds.

a. Depth less than 10 fathoms.

Examples :—Bridlington Bay ... ... With about 1 per cent. over six years of age.
The Wash ... ... With none over six years of age.
Off Mablethorpe ... ... „ „ „
Off Lowestoft ... ... „ „ „
Off Petten (Dutch coast) ... ... „ „ „
Teignmouth, Tor, and Start Bays (Devon). With up to 5 per cent. over six years of age.

b. Depth more than 10 fathoms.

Examples:—Texel Ground, 12–15 fathoms ... With none over six years.
Brielle Ground, 12–15 fathoms ... ,, ,, ,,
Schouven Ground, 15–17 fathoms... ,, ,, ,,
Great West Bay Offshore, 17–30 fathoms. With up to 5 per cent. over six years of age.

The predominance of the II. group and the presence of considerable numbers (12–25 per cent.) of the I. group on the *offshore* grounds of Great West Bay is a noteworthy feature as contrasted with similarly situated grounds in the North Sea, such as the Flamborough Off Ground, especially when the depth of water is taken into account. Now it is known from other evidence* that these offshore grounds in Great West Bay are spawning grounds for plaice. We also know that the plaice in this region are decidedly larger for their age than in the North Sea,† and that they come to maturity at an earlier average age.‡ It is, therefore, not surprising that the spawning shoals in this region contain a larger proportion of young fish than in the North Sea (cf. Flamborough Off Ground and Southern Deep Water in winter).

According to our samples, Bridlington Bay and the South Devon Bays§ are distinguished from other sampled inshore grounds within the 10 fathom line, either on the Dutch or English sides of the North Sea, by the presence (though in small numbers) of fishes over six years of age. These amounted to about 1 per cent. in our samples from Bridlington Bay, and about 5 per cent. in the case of the Devon Bays.

Perhaps the main cause of the absence or rare occurrence of older plaice close inshore on the Dutch coast of the North Sea and on parts of the English coast‖ is to be found either in the absence of suitable food for the older fish, or, in the annual production of a large "head" of young plaice, which must tend to enforce emigration at early age. In Bridlington Bay and the South Devon Bays it is evident, from our investigations, that the annual production of young plaice is small compared with that on the Dutch coast of the North Sea, and on the other parts of the English East coast investigated where (on the grounds nearest the coast) no plaice older than four years of age have been found in our samples.

Seasonal Changes.—On various offshore grounds in the North Sea we found a greater proportion of the younger age-groups in autumn and winter than in the spring and summer.

Thus, on the Flamborough Off Ground the percentages of fish less than three years old, and less than four years old, respectively, on different occasions were as follows :—

—	June, 1908.	Aug. 1908.	Oct. 1908.	Oct. 1906.	Jan. 1905.	March, 1906.
Less than three years old (per cent.) ...	0	<1	5	<1	2	11
Less than four years old (per cent.) ...	7	9	23	11	23	25

So far as it goes this series indicates a rise in the proportion of the younger age groups in autumn and winter (I.-III.) as compared with summer.

If we take the 1 group above we find that it was present only in our samples taken in January and March, and not at all in June, August or October. In January (1905) and March (1906) the few examples of this group caught on the ground were ripe males.

These few results are in complete agreement with Garstang's investigations¶ which show that the maximum density of small plaice (*i.e.* under 30 cm.) on the Flamborough Off Ground occurred in winter, while the seasonal variations in the density of large plaice were very slight.

On the South part of the Dogger also we found a larger percentage of the younger age groups (chiefly III) in January (1905) and March (1906) than in October (1905 and 1906).

Thus :—

—	Oct. 1905.	Oct. 1906.	Jan. 1905.	March 1906.
Less than four years old (per cent.) ...	20	13	40	38

* Kyle, quoted in Garstang, 1903, p. 494.
† See Tables 15 and 16 and I.–IX., in present report.
‡ Wallace, 1909, p. 67 and *seq.*
§ Teignmouth, Tor, and Start (*see* chart, Plate I.).
‖ *e.g.* The Wash and the Lincolnshire and Suffolk coast.
¶ Garstang, 1909, p. 133, &c.

This agrees with Garstang's observation* that the maximum density of small plaice occurs on this part of the Bank in winter (I–III).

Again our six samples from the Leman region indicate a more or less gradual rise in the percentage of young fish from spring to winter ; thus :—

—	May 1906.	June 1908.	Aug. 1908.	Sept. 1905.	Oct. 1905.	March 1906.
Less than three years old (per cent.) ...	26	27	32	30	37	51

The seasonal differences in the percentage of the I group *alone* are still greater :—

—	May 1906.	June 1908.	Aug. 1908.	Sept. 1905.	March 1906.	Oct. 1905.
I. group (per cent.)	<1	<1	0	10	8	12

The seasonal changes in the age-composition of the population in the Leman region, indicated by these results, may be fairly attributed to the offshore migration of young plaice from the Dutch coast, which takes place in the course of the summer and to which reference will be made in the next section ; combined with an autumn emigration from this region of older fishes to more Southern regions for Spawning purposes.†

Finally to be noted is the presence in the central and southernmost parts of the Southern Bight *in winter* of the I group, consisting chiefly of ripe males.

Thus on the Eastern edge of the Southern Deep Water the I group was present in March 1906, when the fishes of this group would be nearly two years old. In May 1906, however, the I. group (then just over one year old) was not present in our catches from the edge of the Deep Water. On the former occasion seven out of the eight fish belonging to the I. group were males, of which at least three were certainly ripe.‡ Again, the I. group formed about 10 per cent. of the sample from the Deep Water near the Gabbard Light Vessel in January 1908 : and 97 out of 110 were males of which at least 88 were ripe.§ Finally, near Sandettie Light Vessel in November 1904 the only fish (four in number) belonging to the I. group were males, all probably ripening.‖

Summary.—(1) The Seasonal changes in the age-composition of our samples from the Flamborough Off, Leman and Brown Bank grounds, and the Southern Deep Water indicate that there is a greater proportion of young plaice on these grounds in autumn and winter (I.-III.) than in spring and summer.

(2.) Plaice of the second year (I group) which are confined to grounds near the Coast in spring and summer appear on the above mentioned offshore grounds in autumn and winter. (*See also* next section, p. 126).

III. Evidence of Summer Offshore Migration in the Texel-Leman Region.

Table 4 *and Charts, Figs.* 1 *to* 5.

That the region that lies between the North West Coast of Holland and the Leman Banks (*see* Chart, Plate 1) is one of two main tracks¶ along which young plaice emigrate in summer from the Continental coast of the North Sea, was first demonstrated by Garstang in 1905 by means of marking experiments and a study of the seasonal changes in the density-distribution of small plaice.** These earlier conclusions have been amply confirmed by later English marking experiments (as yet unpublished) and size distribution data.††

In Garstang's report of 1909 on the quantitative distribution of plaice in the North Sea, based upon the trawling data furnished by the various International Research Steamers, the seasonal changes in the density-distribution of *small* plaice are graphically displayed on two charts, on which contour lines are drawn representing the seaward limit of particular grades of density in the first half year and second half year respectively.

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* Garstang, 1909, p. 128.
† *See* Section III.
‡ Wallace, 1909, p. 88, Table IIa., Sample No. 28.
§ Wallace, 1909, Table IIa., Sample No. 26.
‖ Wallace, 1909, Table IIa., Sample No. 31.
¶ The other is off Horn Reef on the Danish coast.
** Garstang, 1905, A., pp. 20, &c.; 1905, B., pp. 87–93, &c.; 1905, C., p. 21, 22.
†† Garstang, 1909, Plates V. and VI., &c.

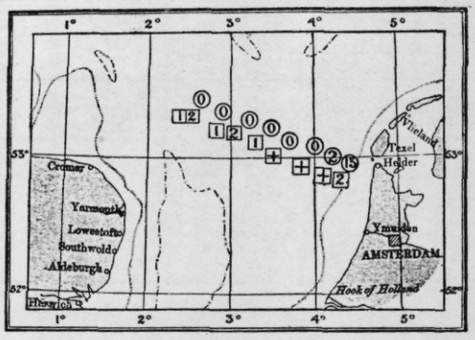


FIG. 1.—Catch per hour of the I group,
○ = May, 1906 (Covered Beam Trawl),
□ = September, 1905 (Otter Trawl).

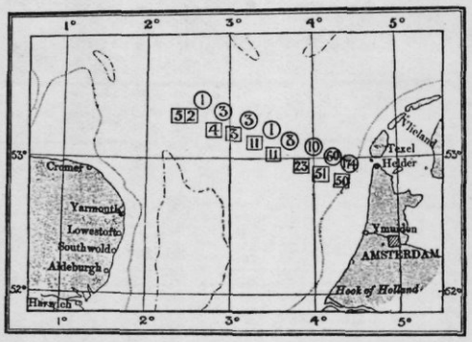


FIG. 2.—Catch per hour of the II group,
○ = May, 1906 (Covered Beam Trawl),
□ = September, 1905 (Otter Trawl).

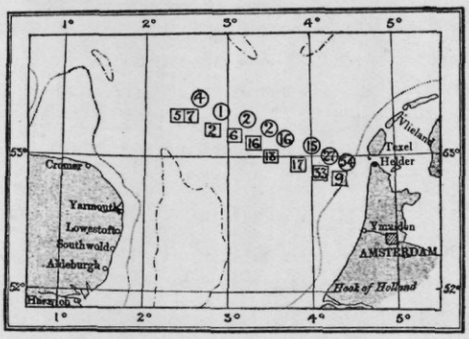


FIG. 3.—Catch per hour of the III group,
○ = May, 1906 (Covered Beam Trawl),
□ = September, 1905 (Otter Trawl).

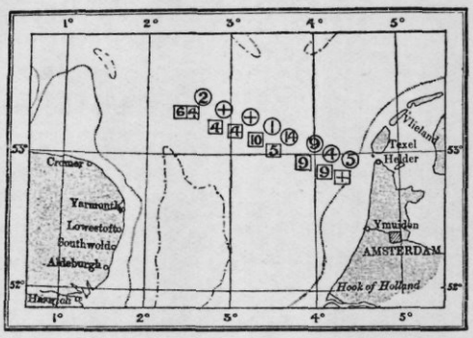


FIG. 4.—Catch per hour of the IV group,
○ = May, 1906 (Covered Beam Trawl),
□ = September, 1905 (Otter Trawl).

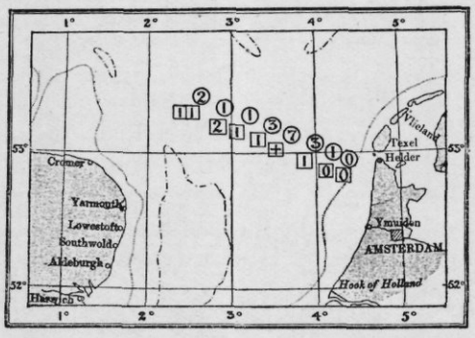


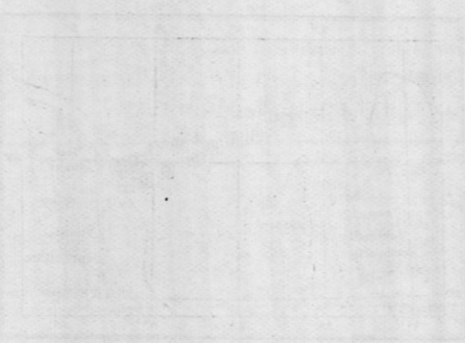
FIG. 5.—Catch per hour of the V group,
○ = May, 1906 (Covered Beam Trawl),
□ = September, 1905 (Otter Trawl),











The seasonal change in the positions of the density contour-line to be seen on comparing these two charts is thus described by Garstang :—" If we take the limit of 50 per hour as approximately separating the areas of low and high density of small fish, we see that in the first half year the limit runs nearly parallel with the Island belt at a distance of about 30–40 miles along the whole extent from Horn Reef to Texel " . . . . . " In the second half year (VII-XII) the dense bands off Horn Reef-Sylt and Texel-Ymuiden are seen to have broken up, and the line of low density has been pushed far seawards especially off these two points as centres. The two areas Horn Reef-Sylt and Texel-Ymuiden may fitly be described as the chief centres of the summer expansion and the lines running north-westwards from them as the main axes of emigration."*

Redeke† speaking of the Dutch coast generally, draws attention to an " annual migration of young fish in summer and autumn from the coastal zone to deeper waters, where they supplant the older plaice which by degrees begin to seek the spawning places " (translation). Redeke also refers to a migration in winter and spring in the opposite direction of fishes " awakened from hibernation " and plaice which have recently spawned (" aus der Winterruhe erwachten und ausgelaichten Schollen "). This, he says, is also to be looked upon as a feeding migration (" nahrungswanderung "). As evidence of this shorewards-directed spring migration Redeke mentions results obtained by marking and liberating plaice on the Brown Bank Ground in January and March. " In the first two or three months the recaptured plaice were, with few exceptions, caught nearer the Dutch coast than where they were set out " (translation).

In the present section a third and distinct class of facts will be brought forward as confirmatory evidence of the Texel-Leman summer migration. Having in September, 1905, and, again in May, 1906, determined (by means of otolith examination) the ages of all the plaice caught in continuous series of hauls extending in a straight line from " inside " the Haaks (Texel) Light Vessel to the Leman Ground (near the Banks), we are able to state fo each haul the number of a particular age-group caught per hour at various distances from the Dutch Coast along this track. These data will form the basis of our comparison of the density-distribution of the different age groups in spring and autumn ; and attention will be directed to the comparison as evidence of offshore migration.

The data to which reference is intended are recorded in the accompanying table (Table 4) and are graphically displayed in the five small charts (Figs. 1–5).

The use of different fishing gears on the two occasions, viz., the small-mesh-covered beam trawl in May 1906 and the commercial otter trawl (without small-mesh covering) in September 1905 should not affect the validity of the comparison contemplated ; since to determine whether there is evidence of a shifting seawards of the mass of each age-group in the interval between May and September, it is only necessary that the catches per hour of the different hauls of the May line be comparable *inter se* ; and the same with the September series. The important point, therefore, so far as fishing gear is concerned, is that the same net was consistently used throughout in trawling over the track on each occasion.

TABLE 4.—Catch-per-hour of Different Age Groups of PLAICE in May (1906) and September (1905), at different Distances from the Dutch Coast, from the " Texel " to the Leman Ground.

May, 1906. (Covered Beam Trawl.)								September, 1905. (Otter Trawl.)							
Sample No.	Central Position of Haul.	No. of Miles from Dutch Coast.	Age Groups. Catch per hours' Fishing. I.	II.	III.	IV.	V.+	Sample No.	Central Position of Haul.	No. of Miles from Dutch Coast.	Age Groups. Catch per hours' Fishing. I.	II.	III.	IV.	V.+
	° ′ ° ′								° ′ ° ′						
42^2	52 51—4 26 E.	10	13·5	174·0	54·0	4·6	—	11^2	52 52—4 25 E.	10	2·0	50·1	9·3	0·2	—
42^1	52 57—4 14 E.	18	2·4	59·8	26·6	4·0	0·8	11^1	52 55—4 11 E.	19	0·5	51·3	33·4	9·0	—
41^4	53 1—4 0 E.	27	—	9·9	15·2	8·7	3·0	10^3	53 0—3 53 E.	32	0·5	22·8	17·4	8·6	1·0
41^3	53 6—3 38 E.	42	—	8·1	16·4	13·7	7·5	10^2	53 4—3 33 E.	44	0·4	11·0	17·8	5·4	0·2
41^2	53 10—3 26 E.	50	—	1·4	1·8	1·0	3·2	10^1	53 8—3 17 E.	54	1·3	11·4	15·7	10·1	1·3
41^1	53 14—3 10 E.	61	—	3·1	1·7	0·2	1·2	9^3	53 12—3 2 E.	64	2·2	3·2	6·2	3·7	1·2
40^5	53 19—2 53 E.	73	—	2·6	1·0	0·4	0·8	9^2	53 16—2 48 E.	73	1·2	3·7	2·5	3·7	2·5
40^4	53 23—2 37 E.	83	—	0·8	4·2	2·0	1·8	9^1	53 19—2 32 E.	84	1·5	3·5	6·0	5·3	1·1

Even a slight examination of the catch per hour data given in Table 4 and plotted on the small charts (Figs. 1 to 5) gives a distinct impression of the greater seaward

* Garstang, 1909, p. 94. † Redeke, 1909, pp. 49–52.

spread of the mass of each age group in September than in May. This is particularly noticeable in the case of the I group. Referring to Fig. I. we see that *in May plaice belonging to this group were caught only in the neighbourhood of the Dutch coast, and not at all on the offshore grounds (Brown Bank and Leman) ; whereas in September the I. group was taken in all the hauls of the series from the nearest inshore to the furthest offshore station.* The seasonal difference in the distribution of the I. group is therefore well marked. As has been said, the beam trawl with small mesh was employed throughout in May, so that if any fishes of the I. group had been present on the offshore stations they would certainly have been caught. On the other hand, if this net, instead of the otter trawl (with no small mesh covering net) had been used in September, greater numbers of the I. group would have been caught on this occasion than actually were ; and the difference in density-distribution as compared with May would have been emphasised still more.

To obtain an approximate quantitative measure of the *spread* of each age group in May and September respectively, I have calculated from the data given in Table 4 the approximate position, with reference to the Dutch coast, of what may be called the *Centre of Density* of each age group* in May and September, respectively. This position was found by multiplying the catch per hour of each age group in each haul of the May or September series by the number of miles (of the central position) from the Dutch coast, adding up the products thus obtained, and dividing their sum by the sum of the individual catches per hour.

Thus the approximate position of the *Centre of Density* of the III. group in May, 1906, was found by means of the calculation indicated in the following scheme :—

Example :—III. Group. Centre of Density in May, 1906.

Mean No. of Miles from Dutch Coast.		Catch per hour.		Products.
10	×	54·0	=	540·0
18	×	26·6	=	478·8
27	×	15·2	=	410·4
42	×	16 4	=	688·8
50	×	1·8	=	90·0
61	×	1·7	=	103·7
73	×	1·0	=	73·0
83	×	4·2	=	348·6
		120·9		2,733·3

$$\frac{2,733·3}{120·9} = 24·2 \text{ miles from Dutch Coast.}$$

Below are given the approximate distances from the Dutch Coast of the *Centres of Density* of age groups II.–IV. and V.+ (taken collectively) in May and September, as calculated in the way that has just been described.

Groups.	——	II.	III.	IV.	V.+.
Mean Number of Miles from Dutch Coast.	May	15	24	35	46
	September ..	26	37	47	63
Differences ...	... ...	11	13	12	17

We see from these data :—

(1.) That the centre of density of the II.-group in September (26 miles) approximately equals the centre of density of the III.-group in May (24 miles).

(2.) That the centre of density of the III.-group in September (37 miles) approximately equals the centre of density of the IV.-group in May (35 miles).

(3.) That the centre of density of the IV.-group in September (47 miles) approximately equals the centre of density of the V.+-group in May (46 miles).

* By this is meant not the centre of density of the *whole* mass of each age group, but of that portion of each age group which is distributed between the two extremities of the section trawled over. A considerable portion of Group II. (especially) remains "inside" the 10-fathom line ; and of this portion no account can be taken owing to the lack of samples for comparison.

These results clearly point to a movement seawards of the mass of each age group to the extent of several miles in the interval between May and September, the II.-group taking the place of the III.-group, the III.-group that of the IV.-group, and the IV.-group that of the V.+-groups.

On referring again to Fig. 5 or Table 4, we see that the older fishes (V.+) were caught in considerably greater numbers per hour in May than in September on the Texel-Leman track. In May, the mean catch-per-hour for the series of hauls was 2·6; in September it was 1·2. This marked difference between the numbers of the V.+-groups caught on those two occasions would doubtless have been still greater if the otter trawl had been used in May as well as in September, so that we pretty safely conclude that the V.+-groups were actually more abundant in this region in May (1906) than in September (1905). The presence of these fishes (which from their age would practically all be mature)* in greater quantities and nearer the coast in May than in September is probably to be explained as the result of recent immigration from the southern deeper part of the Southern Bight of fishes which had spawned two or three months previously. That the principal spawning grounds for plaice are in this region has been clearly demonstrated;† as has also a spring migration of these fishes in a northerly direction‡ and partly towards the Dutch coast,§ *i.e.*, towards the Leman-Texel region.

Summary.—From the density-distribution of the age groups of Plaice in the region between the Texel and Leman Grounds in May and September, respectively, there is evidence of a seaward movement of the mass of each age group in the course of the intervening summer. These results confirm the indications of marking experiments and size distribution data.

IV.—Relation of Size to Age on Different Grounds.

1. *Notes on Tables* 5–10.

In *Table* 5 are recorded, for males and females separately, the average lengths (to the nearest tenth of a centimetre) of age-groups I.–V. in our various samples collected during the period 1904–09; the primary grouping of the records being according to the geographical relations of the fishing grounds, the secondary arrangement being in the order of the months (April to March).

In *Tables* 6 to 10 the records are grouped in months and whole centimetres (the *nearest* whole centimetre) and the averages are for the two sexes combined. These tables show at a glance the more prominent local variations apart from sexual differences (except in the case of the V. group), and averages based on only a few specimens (< 30) are omitted from these tables.

In *Tables* 6–8 I have incorporated the values given by Johansen‖ (marked J) for the average lengths of age groups I.–III. in September 1905 at the Vyl Light Vessel (Horn Reef) for the sake of comparison with my own determinations of the average lengths of the same groups off the Dutch and English coasts. Johansen's results, like mine, are based on otolith examination.

Since the spawning of plaice in the North Sea and English Channel occurs mainly during the months of January, February and March¶, a convenient arbitrary date to take

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* Wallace, 1909, p. 67, &c.

† Redeke, 1906 and 1909, pp. 53, 54, &c.; Boeke, 1906, p. 26, &c.; Lee, 1909, pp. 102–104; Wallace, 1909, pp. 57–58.

‡ Garstang, 1905, A., pp. 21–23 and Chart 2.

§ Redeke, 1909, p. 52.

‖ Johansen, 1906, p. 104.

¶ See Cunningham's "Marketable Marine Fishes" (London, 1896), pp. 215, &c.; also Publication de Circonstance du Conseil Permanent International pour l'Exploration de la Mer, No. 3, p. 72.

as the starting point of each age group or yearly period is April 1st, since this virtually covers the termination of the spawning period and by this time practically all the season's ova have been spawned and fertilised and the young fishes have started their development. April 1st is the starting point adopted in my reports of 1907, 1909 and the present one.

In the Western part of the English Channel the average spawning period is somewhat earlier than in the North Sea, the maximum, according to Kyle *, occurring between the third week in January and the second week in February ; whereas in the Central † and Northern ‡ parts of the North Sea the maximum appears to occur in the latter part of February and the first part of March. It follows that in any given month plaice of a given age group, defined as commencing on April 1st, will be slightly older in the Channel than in the North Sea ; but the allowance to be made for the slight difference of age in comparing the average length of the same age group in the same month in the two regions probably constitutes a very small proportion of the relatively considerable differences with which we have to deal. One has only to examine the otoliths of Channel and North Sea plaice and to compare the relative breadth of the periodic rings in the two cases to be convinced by "internal evidence" of the considerably greater yearly growth-increments in the *earlier* years in the one case than in the other (see Figs. 6 and 7) and that these are of themselves sufficient to account for the difference in the average length of the same age group in the two localities.

The rest of this section consists of notes on Tables 6 to 10 in which attention will be directed to facts illustrating the following *general conclusions :—*

1.—Judging from a comparison of the average length of plaice of the same age caught at different distances from the Danish (Horn Reef) and Dutch (Texel) coasts respectively, *plaice would appear to be smaller for their age off Horn Reef than at the same distance off Texel.*

The difference observed if proved to be constant (apart from yearly fluctuations) appears susceptible of two explanations, viz. :

(*a*) Migration off shore at a smaller size (irrespective of age) at Horn Reef than at Texel, owing to the pressure of the population which is denser than at Texel.§

(*b*) Slower average growth-rate at Horn Reef than at Texel, due to greater intensity of competition for food induced by greater density of population.

It may be said that the *latter* explanation is in harmony with the results of researches by Johansen indicating a relation between growth-rate and density of population at different places ‖ and in different years ¶ on the coast of Denmark.

2.—The average length of a plaice at a given age was found to be approximately uniform and constant throughout the *central* parts of the *Southern Bight*, from the Leman Ground in the North to near the straits of Dover in the South.

3.—On the South Dogger and Flamborough Off Grounds plaice of the fourth, fifth and sixth years (age Groups III.–V.) are (on an average) larger for their age than in the central parts of the Southern Bight, the average differences increasing with age (being least for the III. Group).

4.—Plaice of the second and third years of life (I. and II. Groups) in West Bay (English Channel) were found to be considerably larger (on an average) than plaice of (approximately) the same age anywhere off the coasts of Holland, England or Denmark.

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* See Kyle in report by Garstang, 1903, pp. 490–493.
† Wallace, 1909, p. 59.
‡ Fulton, 1892, p. 242.
§ Garstang, 1909, pp. 73–77, &c.
‖ Johansen, 1906, pp. 86 (foot) and 90–108 ; Johansen, 1907, p. 60, 7c.
¶ Johansen, 1908, p. 47. "In 1903 when an unusually rich stock of undersized plaice occurred in the Horn Reef area the growth-rate of marked plaice of 20–30 cm. was very slow (ca. 4cm.) In 1904, 1905, 1906, and 1907 when the stock of undersized plaice in the Horn Reef area was less, the growth of the marked plaice was far more rapid, viz., 6·0–7·5 cm. annually.

TABLE 5.—Average Length (cm.) of Age Groups I.–V. in samples from various localities (1903–1909).

Index figures give the numbers of fish on which the Averages are based.

Averages based on less than 20 fish in brackets.

Locality.	Sample Reference Nos.	Depth in fathoms.	Month and Year.	I.—Group.		II.—Group.		III.—Group.		IV.—Group.		V.—Group.	
				Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Bridlington Bay	4	3½–5	vii./05	—	—	$16 \cdot 2^{94}$		$18 \cdot 6^{74}$		$(22 \cdot 3^{12})$		—	—
,, ,,	31	5–6	ix./06	—	$(12 \cdot 9^{5})$	$16 \cdot 3^{96}$	$16 \cdot 3^{73}$	$19 \cdot 4^{57}$	$19 \cdot 6^{40}$	$(20 \cdot 5^{16})$	$(22 \cdot 2^{13})$	$(24 \cdot 5^{2})$	—
Wash	29	?	vi./06		$7 \cdot 3^{934}$		$11 \cdot 2^{632}$		$14 \cdot 9^{69}$		$(15 \cdot 9^{8})$	—	—
,, ...	5	1½–7	viii./05		$9 \cdot 6^{183}$		$14 \cdot 6^{86}$		$16 \cdot 6^{6}$	—	—	—	—
Mablethorpe ...	6	3½–9	viii./05		$12 \cdot 0^{68}$		$17 \cdot 1^{70}$		$20 \cdot 3^{7}$	—	—	—	—
Lowestoft ...	1	3–5	v./05		$7 \cdot 6^{96}$		$12 \cdot 4^{272}$		$15 \cdot 2^{75}$		$(20 \cdot 8^{3})$	—	—
Flamborough Off	34	24–25	vi./08	—	—	—	—	$(23 \cdot 5^{2})$	$(30 \cdot 5^{1})$	$(34 \cdot 0^{4})$	$(35\ 6^{11})$	$(35 \cdot 5^{3})$	$(38 \cdot 1^{11})$
,, ,,	35	24–28	viii./08	—	—	$(27 \cdot 5^{1})$	—	$(30 \cdot 3^{5})$	$(31 \cdot 3^{11})$	$31 \cdot 9^{37}$	$33 \cdot 4^{68}$	$(33 \cdot 7^{6})$	$37 \cdot 3^{25}$
,, ,,	17	25–30	x./05	—	—	$(21 \cdot 7^{8})$	$(28 \cdot 5^{2})$	$(28 \cdot 2^{19})$	$(30 \cdot 2^{18})$	$33 \cdot 3^{25}$	$36 \cdot 6^{62}$	$(36 \cdot 0^{19})$	$(41 \cdot 2^{19})$
,, ,,	33	26–37	x./06	—	—	$(20 \cdot 5^{1})$	$(24 \cdot 5^{1})$	$(25 \cdot 6^{9})$	$(31 \cdot 0^{8})$	$(32 \cdot 8^{17})$	$37 \cdot 0^{20}$	$(36 \cdot 7^{17})$	$40 \cdot 1^{25}$
,, ,,	18, 19	23–31	i./05	$(19 \cdot 5^{3})$	—	$(24 \cdot 1^{3})$	—	$(29 \cdot 7^{16})$	$(31 \cdot 0^{14})$	$34 \cdot 3^{37}$	$(35 \cdot 8^{7})$	$37 \cdot 8^{36}$	$(36 \cdot 3^{5})$
,, ,,	32	24–30	iii./06	$(13 \cdot 5^{1})$	—	$(21 \cdot 6^{10})$	$(26 \cdot 2^{6})$	$(29 \cdot 6^{13})$	$(29 \cdot 7^{8})$	$(36 \cdot 2^{18})$	$37 \cdot 5^{55}$	$(33 \cdot 7^{5})$	$(39 \cdot 1^{17})$
,, ,,	—	—	**x.–iii.**	—	—	—	—	**$28 \cdot 3^{57}$**	**$30 \cdot 5^{45}$**	**$34 \cdot 1^{97}$**	**$36 \cdot 9^{144}$**	**$37 \cdot 8^{77}$**	**$40 \cdot 1^{66}$**
Dogger, S. ...	14	10½–18	x./05	—	—	$(29 \cdot 0^{2})$	$(28 \cdot 5^{2})$	$(32 \cdot 0^{2})$	$(28 \cdot 0^{4})$	$(33 \cdot 1^{10})$	$(36 \cdot 2^{13})$	$(37 \cdot 8^{3})$	$(43 \cdot 8^{10})$
,, ...	36	10–15	x./06	—	—	$(29 \cdot 5^{1})$	—	$(41 \cdot 5^{1})$	$(37 \cdot 0^{2})$	—	$(40 \cdot 3^{15})$	$(44 \cdot 5^{1})$	$(43 \cdot 5^{3})$
,, ...	15	11½–17	i./05	—	—	—	—	$(29 \cdot 5^{8})$	$(29 \cdot 6^{14})$	$(32 \cdot 6^{8})$	$35 \cdot 3^{23}$	—	$(45 \cdot 0^{2})$
,, ...	16	9–17	iii./04	—	—	—	$(23 \cdot 0^{2})$	$(30 \cdot 1^{12})$	$30 \cdot 4^{50}$	$(35 \cdot 3^{17})$	$36 \cdot 9^{33}$	$(38 \cdot 0^{2})$	$41 \cdot 9^{24}$
,, ...	—	—	**x.–xii.**	—	—	—	—	**$30 \cdot 5^{23}$**	**$30 \cdot 3^{70}$**	**$34 \cdot 0^{35}$**	**$36 \cdot 1^{74}$**	—	**$42 \cdot 6^{39}$**
Clay Deep ...	13	20–24	x./05	—	—	—	—	$(27 \cdot 3^{7})$	$(28 \cdot 9^{10})$	$31 \cdot 6^{32}$	$32 \cdot 7^{54}$	$(35 \cdot 6^{8})$	$(40 \cdot 1^{10})$
Horn Reef Outer	37	21–25	ix./06	—	—	$(23 \cdot 5^{1})$	$(24 \cdot 8^{3})$	$25 \cdot 9^{59}$	$26 \cdot 7^{52}$	$(29 \cdot 4^{17})$	$(30 \cdot 6^{9})$	—	$(35 \cdot 6^{11})$
Leman Region ...	40	13–17	v./06	—	$(11 \cdot 5^{1})$	$16 \cdot 8^{88}$	$17 \cdot 3^{89}$	$22 \cdot 3^{122}$	$23 \cdot 8^{131}$	$27 \cdot 6^{99}$	$29 \cdot 0^{81}$	$30 \cdot 7^{32}$	$33 \cdot 2^{28}$
,, ,, ...	43	15–18	vi./08	—	—	$18 \cdot 5^{92}$	$18 \cdot 2^{62}$	$23 \cdot 4^{113}$	$25 \cdot 1^{67}$	$28 \cdot 1^{100}$	$29 \cdot 6^{80}$	$(31 \cdot 3^{19})$	$34 \cdot 3^{21}$
,, ,, ...	44	15–17	viii./08	—	—	$21 \cdot 8^{162}$	$22 \cdot 4^{132}$	$25 \cdot 2^{216}$	$26 \cdot 2^{168}$	$27 \cdot 7^{109}$	$29 \cdot 1^{75}$	$(31 \cdot 5^{18})$	$(33 \cdot 7^{8})$
,, ,, ...	9	15½–17	ix./05	$(16 \cdot 7^{14})$	$15 \cdot 9^{20}$	$23 \cdot 2^{34}$	$24 \cdot 5^{31}$	$26 \cdot 8^{61}$	$26 \cdot 6^{58}$	$30 \cdot 9^{44}$	$32 \cdot 4^{38}$	$35 \cdot 2^{4}$	$(39 \cdot 2^{7})$
,, ,, ...	21	12–17	x./05	$(19 \cdot 4^{5})$	$(20 \cdot 0^{10})$	$24 \cdot 9^{32}$	$25 \cdot 3^{33}$	$28 \cdot 4^{25}$	$30 \cdot 3^{25}$	$31 \cdot 7^{21}$	$33 \cdot 9^{43}$	$(36 \cdot 2^{7})$	$(37 \cdot 8^{10})$
,, ,, ...	20	17½–20	i./05	—	$(16 \cdot 5^{1})$	$(26 \cdot 5^{2})$	$(27 \cdot 0^{2})$	$(27 \cdot 9^{2})$	$28 \cdot 7^{26}$	$(33 \cdot 8^{3})$	$(32 \cdot 7^{7})$	—	$(43 \cdot 8^{3})$
,, ,, ...	39	14–25	iii./06	$(16 \cdot 7^{16})$	$(17 \cdot 5^{16})$	$23 \cdot 1^{57}$	$24 \cdot 2^{42}$	$27 \cdot 1^{41}$	$26 \cdot 3^{39}$	$(29 \cdot 8^{15})$	$(32 \cdot 8^{18})$	$(34 \cdot 1^{5})$	$(38 \cdot 4^{9})$
,, ,, ...	—	—	**x.–iii.**	—	—	**$23 \cdot 6^{91}$**	**$24 \cdot 8^{77}$**	**$27 \cdot 6^{78}$**	**$28 \cdot 1^{90}$**	**$31 \cdot 1^{39}$**	**$33 \cdot 2^{68}$**	—	—
Brown Bank Ground.	41	15½–17	v./06	—	—	$16 \cdot 8^{67}$	$16 \cdot 4^{43}$	$24 \cdot 7^{93}$	$24 \cdot 2^{78}$	$27 \cdot 4^{58}$	$29 \cdot 4^{57}$	$31 \cdot 2^{26}$	$33 \cdot 0^{34}$
,, ,,	10	14–16½	ix./05	$(18 \cdot 5^{5})$	$(19 \cdot 2^{4})$	$21 \cdot 6^{96}$	$22 \cdot 8^{112}$	$26 \cdot 1^{115}$	$26 \cdot 5^{113}$	$29 \cdot 1^{50}$	$30 \cdot 6^{57}$	$(32 \cdot 2^{4})$	$(34 \cdot 1^{3})$
Texel Ground ... (Off Haaks Light Vessel.)	42	12–15½	v./06	$11 \cdot 1^{50}$	$11 \cdot 5^{29}$	$14 \cdot 0^{637}$	$14 \cdot 4^{522}$	$20 \cdot 2^{208}$	$20 \cdot 9^{192}$	$(24\ 4^{17})$	$26 \cdot 8^{26}$	—	$(29 \cdot 7^{4})$
,, ,,	$11^{1,2}$	12–14	ix./05	$(18 \cdot 2^{6})$	$(18 \cdot 0^{4})$	$20 \cdot 2^{206}$	$21 \cdot 0^{197}$	$24 \cdot 1^{86}$	$25 \cdot 0^{84}$	$28 \cdot 0^{23}$	$(29\ 2^{14})$	—	—
Off Petten ...	11^{3}	8–12	ix./05	$(15 \cdot 4^{15})$	$(15 \cdot 5^{13})$	$17 \cdot 3^{67}$	$18 \cdot 3^{68}$	$(21 \cdot 9^{5})$	$(23 \cdot 3^{14})$	$(25 \cdot 0^{2})$	$(30 \cdot 2^{3})$	—	—
,, ...	11^{4}	7–12	ix./05	$13 \cdot 9^{67}$	$14 \cdot 1^{50}$	$17 \cdot 0^{53}$	$18 \cdot 3^{64}$	$(18 \cdot 5^{6})$	$(23 \cdot 6^{13})$	$(23 \cdot 8^{3})$	$(25 \cdot 5^{1})$	—	—
N. of Brown Ridges.	22	14–17	xi./03	—	—	$(23 \cdot 9^{15})$		$(27 \cdot 9^{16})$		$31 \cdot 7^{5}$		—	—
Off Ymuiden and Egmond.	23–25	8–11	xi.–xii./03.	$14 \cdot 2^{111}$		$18 \cdot 3^{244}$		$(26 \cdot 1^{9})$		—	—	—	—
Brielle Ground ...	46	12–15	v./06	$(12 \cdot 3^{10})$	$(13 \cdot 5^{9})$	$16 \cdot 3^{331}$	$17 \cdot 7^{242}$	$21 \cdot 3^{166}$	$22 \cdot 1^{190}$	$26 \cdot 7^{33}$	$27 \cdot 1^{30}$	$(29 \cdot 3^{7})$	$(28 \cdot 5^{7})$
S. of Brown Ridges	47	15–19	v./06	$(14 \cdot 5^{1})$	—	$(17 \cdot 9^{17})$	$(17 \cdot 9^{8})$	$22 \cdot 9^{25}$	$(25\ 5^{15})$	$(28 \cdot 4^{14})$	$(30 \cdot 4^{8})$	$(26 \cdot 5^{2})$	$(29 \cdot 8^{3})$
Eastern Deep Water.	48	19–23	v./06	—	—	$(18 \cdot 6^{10})$	$(20 \cdot 5^{7})$	$24 \cdot 1^{34}$	$(26 \cdot 9^{17})$	$28 \cdot 4^{38}$	$30 \cdot 8^{28}$	$31 \cdot 6^{42}$	$33 \cdot 7^{28}$
,, ,,	45	18½–23	iii./06	$(17 \cdot 3^{7})$	$(18 \cdot 5^{1})$	$20 \cdot 9^{24}$	$(24 \cdot 9^{19})$	$27 \cdot 7^{22}$	$(27 \cdot 6^{9})$	$31 \cdot 3^{23}$	$(31 \cdot 5^{4})$	$(35 \cdot 5^{2})$	$(38 \cdot 5^{1})$
Gabbard Deep Water.	51	23–25	i./08	$17 \cdot 8^{97}$	$(18 \cdot 7^{13})$	$21 \cdot 2^{240}$	$24 \cdot 2^{38}$	$24 \cdot 8^{376}$	$26 \cdot 2^{127}$	$29 \cdot 8^{91}$	$(32 \cdot 1^{14})$	$33 \cdot 3^{42}$	$(39 \cdot 9^{9})$
Schouwen Ground.	52	15–17	iv./08	$(13 \cdot 5^{1})$	$(13 \cdot 5^{2})$	$16 \cdot 7^{97}$	$17 \cdot 5^{72}$	$21 \cdot 2^{20}$	$20 \cdot 9^{25}$	$(22 \cdot 8^{19})$	$(25 \cdot 1^{7})$	$(29 \cdot 5^{2})$	$(27 \cdot 1^{3})$
,, ,,	50	15–17	xii./07	$(19 \cdot 1^{5})$	$(20 \cdot 2^{4})$	$22 \cdot 3^{68}$	$22 \cdot 4^{70}$	$24 \cdot 0^{147}$	$24 \cdot 8^{79}$	$26 \cdot 9^{21}$	$(27 \cdot 5^{3})$	—	—
Off Sandettie Bank.	26	19–21	xi./04	$(21 \cdot 5^{4})$	—	$(25 \cdot 1^{15})$	—	$28 \cdot 5^{39}$	$(32 \cdot 1^{5})$	$32 \cdot 0^{54}$	$(36 \cdot 5^{9})$	$34 \cdot 3^{12}$	$(36 \cdot 5^{1})$
West Bay, Off Shore.	28	17–23	ii./04	$(19 \cdot 2^{14})$	$(18 \cdot 5^{8})$	$(25 \cdot 1^{17})$	$26 \cdot 7^{28}$	$(30 \cdot 0^{6})$	$(32 \cdot 0^{12})$	$(34 \cdot 5^{2})$	—	—	—
,, ,,	53	20–29	ii./06	$(23 \cdot 0^{15})$	$(26 \cdot 5^{4})$	$26 \cdot 5^{26}$	$(30 \cdot 7^{17})$	$(31 \cdot 4^{14})$	$(32 \cdot 3^{13})$	$(34 \cdot 0^{4})$	$(36 \cdot 4^{10})$	—	$(43 \cdot 5^{1})$
,, ,,	54	19–30	ii.–iii./07	$(20 \cdot 1^{8})$	$(25 \cdot 2^{7})$	$24 \cdot 0^{21}$	$26 \cdot 6^{27}$	$(29 \cdot 1^{14})$	$29 \cdot 6^{32}$	$(32 \cdot 9^{5})$	$(33 \cdot 2^{8})$	$(36 \cdot 5^{1})$	$(38 \cdot 5^{1})$
Teignmouth Bay	27	4½–7	xi./04	$(22 \cdot 2^{3})$	$(23 \cdot 0^{2})$	$(27 \cdot 3^{8})$	$(28 \cdot 0^{13})$	$(32 \cdot 0^{4})$	$(33 \cdot 1^{14})$	$(33 \cdot 0^{2})$	$(33 \cdot 2^{3})$	—	—
,, ,,	55	3–6	xi./07	$19 \cdot 4^{61}$	$19 \cdot 2^{65}$	$(28 \cdot 5^{18})$	$28 \cdot 9^{24}$	$(31 \cdot 3^{11})$	$(34 \cdot 2^{11})$	$(29 \cdot 5^{1})$	$(36 \cdot 1^{3})$	—	$(41 \cdot 5^{4})$
,, ,,	56	3¼–5	xi./08	$(22 \cdot 2^{16})$	$(22 \cdot 9^{13})$	$27 \cdot 6^{207}$	$28 \cdot 6^{140}$	$31 \cdot 8^{20}$	$(33 \cdot 6^{8})$	$(32 \cdot 5^{12})$	$(36 \cdot 4^{15})$	$(35 \cdot 8^{3})$	$(34 \cdot 5^{4})$
,, ,,	—	—	xi./04, 07, 08	**$20 \cdot 1^{80}$**	**$20 \cdot 9^{80}$**	**$27 \cdot 6^{243}$**	**$28 \cdot 6^{177}$**	**$31 \cdot 7^{35}$**	**$33 \cdot 6^{33}$**	**$(32 \cdot 4^{15})$**	**$(35 \cdot 8^{21})$**	—	—
Tor Bay	57	3–7	viii./09	$18 \cdot 3^{263}$	$18 \cdot 3^{186}$	$(27 \cdot 0^{16})$	$27 \cdot 1^{20}$	$(29 \cdot 3^{6})$	$(36 \cdot 7^{6})$	$(30 \cdot 5^{1})$	$(38 \cdot 5^{4})$	$(39 \cdot 5^{1})$	$(44 \cdot 5^{4})$
Start Bay ...	58	7–13	viii./09	$18 \cdot 6^{34}$	$19 \cdot 2^{28}$	$28 \cdot 6^{21}$	$(28 \cdot 9^{11})$	$(32 \cdot 3^{11})$	$32 \cdot 8^{26}$	$(34 \cdot 1^{5})$	$(37 \cdot 1^{13})$	$(34 \cdot 5^{3})$	$(40 \cdot 7^{11})$
,,	57, 58	—	viii./09	**$18 \cdot 3^{297}$**	**$18 \cdot 4^{214}$**	**$27 \cdot 8^{37}$**	**$27 \cdot 7^{31}$**	**$(31 \cdot 3^{17})$**	**$33 \cdot 5^{32}$**	**$(33 \cdot 5^{6})$**	**$(37 \cdot 4^{17})$**	—	**$(41 \cdot 3^{13})$**

TABLE 6.—Average Length of I. Group on various Grounds in different Months.

cm.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	cm.
22	—	—	—	—	—	—	—	—	—	—	West Bay (Offshore) (1904, 1906, 1907).	—	22
21	—	—	—	—	—	—	—	—	—	—	—	—	21
20	—	—	—	—	—	—	—	Teignmouth (1904, 1907, 1908).	—	—	—	—	20
19	—	—	—	—	—	—	—	—	—	—	—	—	19
18	—	—	—	—	Tor Bay, 1909. Start Bay, 1909.	—	—	—	—	Gabbard L.V., 1908.	—	—	18
17	—	—	—	—	—	—	—	—	—	—	—	Leman, 1906.	17
16	—	—	—	—	—	Leman, 1905.	—	—	—	—	—	—	16
15	—	—	—	—	—	—	—	—	—	—	—	—	15
14	—	—	—	—	—	Off Petten, 1905.	—	Ymuiden, 1903.	—	—	—	—	14
13	—	—	—	—	—	Horn Reef, off Vyl L.V., 1905 (J).	—	—	—	—	—	—	13
12	—	—	—	—	Mablethorpe, 1905.	—	—	—	—	—	—	—	12
11	—	Off Haak's (Texel) L.V., 1906.	—	—	—	—	—	—	—	—	—	—	11
10	—	—	—	—	Wash, 1905.	—	—	—	—	—	—	—	10
9	—	—	—	—	—	—	—	—	—	—	—	—	9
8	—	Lowestoft, 1904.	—	—	—	—	—	—	—	—	—	—	8
7	—	—	Wash, 1906.	—	—	—	—	—	—	—	—	—	7
6	—	—	—	—	—	—	—	—	—	—	—	—	6

TABLE 7.—Average Length of II. Group on various Grounds in different Months.

28	—	—	—	—	Tor Bay, 1909. Start Bay, 1909.	—	—	Teignmouth (1904, 1907, 1908).	—	—	—	—	28
27	—	—	—	—	—	—	—	—	—	—	—	—	27
26	—	—	—	—	—	—	—	—	—	—	West Bay (Offshore) (1904, 1906, 1907).	—	26
25	—	—	—	—	—	—	Leman, 1905.	—	—	—	—	—	25
24	—	—	—	—	—	Leman, 1905.	—	—	—	—	—	—	24
23	—	—	—	—	—	—	—	—	—	—	—	Leman, 1906.	23
22	—	—	—	—	Leman, 1908.	Brown Bank, 1905.	—	—	Schouwen, 1907.	—	—	Eastern Edge of Southern Deep Water, 1906.	22

21	—	—	—	—	—	Off Haak's (Texel) L.V., 1905.	—	—	—	Gabbard L.V. 1908.	—	—	21
20	—	—	—	—	—	—	—	—	—	—	—	—	20
19	—	Eastern Edge of Southern Deep Water, 1906.	—	—	—	—	—	—	—	—	—	—	19
18	—	South of Brown Ridges, 1906.	Leman, 1908.	—	—	Off Petten, 1905. Horn Reef, off Vyl L.V., 1905 (J).	—	—	—	—	—	—	18
17	Schouwen, 1908.	Leman, 1906. Brown Bank, 1906. Brielle, 1906.	—	—	Mablethorpe, 1905.	—	—	—	—	—	—	—	17
16	—	—	—	Bridlington, 1905.	—	Bridlington, 1906.	—	—	—	—	—	—	16
15	—	—	—	—	Wash, 1905.	—	—	—	—	—	—	—	15
14	—	Off Haak's (Texel) L.V. 1906.	—	—	—	—	—	—	—	—	—	—	14
13	—	—	—	—	—	—	—	—	—	—	—	—	13
12	—	Lowestoft, 1904.	—	—	—	—	—	—	—	—	—	—	12
11	—	—	—	—	—	—	—	—	—	—	—	—	11

TABLE 8.—Average Length of III. Group on various Grounds in different Months.

33	—	—	—	—	Tor Bay, 1909, Start Bay, 1909.	—	—	—	—	—	—	—	33
32	—	—	—	—	—	—	—	Teignmouth, (1904, 1907, 1908).	—	—	—	—	32
31	—	—	—	—	—	—	—	—	—	—	—	—	31
30	—	—	—	—	—	—	—	—	—	Dogger, 1905 Flamborough, 1905.	West Bay (Offshore) (1904, 1906, 1907).	Dogger, 1904 ... Flamborough, 1906.	30
29	—	—	—	—	—	—	Flamborough, 1905. Leman, 1905.	Sandettie, 1904.	—	—	—	—	29
28	—	—	—	—	—	—	—	—	—	S. Botney, 1905.	—	Eastern edge of Southern Deep Water, 1906.	28
27	—	—	—	—	—	Leman, 1905 ...	—	—	—	—	—	Leman, 1906 ...	27
26	—	—	—	—	Leman, 1908 ...	Brown Bank, 1905. Horn Reef Outer, 1906.	—	—	—	—	—	—	26

TABLE 8.—Average Length of III. Group on various Grounds in different Months—*continued*.

cm.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	cm.
25	—	Eastern edge of Southern Deep Water, 1906.	—	—	—	Off Haak's (Texel) L.V., 1905.	—	—	—	—	—	—	25
24	—	South of Brown Ridges, 1906. Brown Bank, 1906.	Leman, 1908...	—	—	Horn Reef, off Vyl L.V., 1905 (J).	—	—	Schouwen, 1907.	—	—	—	24
23	—	Leman, 1906 ...	—	—	—	—	—	—	—	—	—	—	23
22	—	Brielle, 1906 ...	—	—	—	Off Petten, 1905	—	—	—	—	—	—	22
21	Schouwen, 1908.	—	—	—	—	—	—	—	—	—	—	—	21
20	—	Off Haak's (Texel) L.V., 1906.	—	—	Mablethorpe, 1905.	—	—	—	—	—	—	—	20
19	—	—	—	Bridlington, 1905.	—	Bridlington, 1906.	—	—	—	—	—	—	19
18	—	—	—	—	—	—	—	—	—	—	—	—	18
17	—	—	—	—	—	—	—	—	—	—	—	—	17
16	—	—	—	—	—	—	—	—	—	—	—	—	16
15	—	Lowestoft, 1904	Wash, 1906 ...	—	—	—	—	—	—	—	—	—	15
14	—	—	—	—	—	—	—	—	—	—	—	—	14

TABLE 9.—Average Length of IV. Group on various Grounds in different Months.

37	—	—	—	—	—	—	—	—	—	—	—	Flamborough, 1906.	37
36	—	—	—	—	—	—	Flamborough, 1905.	—	—	—	—	Dogger, 1904.	36
35	—	—	—	—	—	—	Dogger, 1905. Flamborough, 1906.	—	—	—	—	—	35
34	—	—	—	—	—	—	—	Teignmouth (1904. 1907, 1908)	—	Dogger, 1905. Flamborough, 1905.	West Bay (off-shore) (1904, 1906, 1907).	—	34
33	—	—	—	—	Flamborough, 1908.	—	Leman, 1905.	Sandettie, 1904.	—	—	—	—	33
32	—	—	—	—	—	Leman, 1905.	Clay Deep, edge of Dogger, 1905.	—	—	—	—	—	32
31	—	—	—	—	—	—	—	—	—	—	—	Leman, 1906. Eastern edge, of Southern Deep Water, 1906.	31

30	—	—	—	—	—	Brown Bank, 1905. Horn Reef, Outer, 1906.	—	—	—	Gabbard, 1908.	—	—	30
29	—	Eastern edge of Southern Deep Water, 1906. South of Brown Ridges, 1906.	Leman, 1908.	—	—	—	—	—	—	—	—	—	29
28	—	Leman, 1906. Brown Bank, 1906.	—	—	Leman, 1908.	Off Haak's (Texel) Light Vessel, 1905.	—	—	—	—	—	—	28
27	—	Brielle, 1906.	—	—	—	—	—	—	Schouwen, 1907.	—	—	—	27
26	—	Off Haak's (Texel) Light Vessel, 1906.	—	—	—	—	—	—	—	—	—	—	26
25	—	—	—	—	—	—	—	—	—	—	—	—	25
24	—	—	—	—	—	—	—	—	—	—	—	—	24
23	Schouwen, 1908.	—	—	—	—	—	—	—	—	—	—	—	23
22	—	—	—	—	—	—	—	—	—	—	—	—	22
21	—	—	—	—	—	Bridlington, 1906.	—	—	—	—	—	—	21

TABLE 10.—Average Length of V. Group (Males only) on various Grounds in different Months.

42	—	—	—	—	—	—	—	—	—	—	—	—	42
41	—	—	—	—	—	—	—	—	—	—	—	—	41
40	—	—	—	—	—	—	—	—	—	—	—	—	40
39	—	—	—	—	—	—	—	—	—	—	—	—	39
38	—	—	—	—	—	—	—	—	—	Flamborough, 1905.	—	—	38
37	—	—	—	—	—	—	Flamborough, 1906.	—	—	—	—	—	37
36	—	—	—	—	—	—	Flamborough, 1905.	—	—	—	—	—	36
35	—	—	—	—	—	—	—	—	—	—	—	—	35
34	—	—	—	—	—	—	—	—	—	—	—	—	34
33	—	—	—	—	—	—	—	—	—	Gabbard L.V., 1908.	—	—	33
32	—	Eastern Edge of Southern Deep Water, 1906.	—	—	—	—	—	—	—	—	—	—	32
31	—	Leman, 1906. Brown Bank, 1906.	Leman, 1908.	—	Leman, 1908.	—	—	—	—	—	—	—	31
30	—	—	—	—	—	—	—	—	—	—	—	—	30
29	—	—	—	—	—	—	—	—	—	—	—	—	29
28	—	—	—	—	—	—	—	—	—	—	—	—	28
27	—	—	—	—	—	—	—	—	—	—	—	—	27

Notes on Table 6.

I. Group—Second Year of Life.

1.—Comparing the records of average length for the month of August we see the second-year plaice averaged about 6 centimetres larger in the South Devon Bays* (< 10 fathoms) than off the Lincolnshire coast (Mablethorpe), although the depth of water and distance from shore were much the same for the two localities. In the Wash in the same month the average length of this group was 8 centimetres less than in the Devon Bays.

2.—Our records for November show that the average length of the I. Group was 6 centimetres higher in Teignmouth Bay (< 10 fathoms) than off Ymuiden (< 10 fathoms) on the Dutch Coast.

3.—In winter (January to March) the age group we are considering averaged 4 to 5 centimetres larger on the offshore grounds of West Bay (17–30 fathoms) than in the central parts of the Southern Bight of the North Sea (Gabbard, Leman).

4.—The average length of the group in winter (*i.e.* when practically two years old) was approximately the same on the Leman Ground, in the Northern part, as off the Gabbard Light Vessel in the Southern part of the Central region of the Southern Bight, viz., 17–18 cm.

5.—In September, 1905, at Vyl Light Vessel, about twenty miles from the Danish coast, the average length of the I. group was found to be about 1 centimetre lower than at a distance of about five miles from the Dutch coast (off Petten).

Notes on Table 7.

II. Group—Third Year of Life.

1.—The average length of this group in May (*i.e.* when just over two years old) in the central parts of the Southern Bight (Leman, Brown Bank and Ridges, Eastern Deep Water) was 17–19 cm. This is practically identical with the average length of the I. Group in winter (*i.e.* when just under two years old) on the Leman Ground and at the Gabbard Light Vessel (*see* Table 6).

2.—In our samples taken in August, plaice of the third year averaged 6 centimetres longer in the Devon Bays (< 10 fathoms) than on the Leman Ground and as much as 11 centimetres longer than at Mablethorpe (< 10 fathoms).

3.—In winter the average size of this group on the offshore grounds (17–30 fathoms) of West Bay was found to be 3–5 centimetres higher than in the central part of the Southern Bight.

4.—In autumn–winter the average length of the II. Group (practically three years old) in the central region of the Southern Bight (Leman, Sandettie, Gabbard, Eastern Deep Water) ranged from 21–25 centimetres.

5.—In September, 1905, the II. Group averaged about the same length at Vyl Light Vessel, some twenty miles from the Danish coast, as at a distance of about five miles from the Dutch coast (off Petten).

Notes on Table 8.

III. Group—Fourth Year of Life.

1.—The average length of this group in May (*i.e.* when just over three years of age) in the central part of the Southern Bight, we found to be 23–25 cm. This agrees very well with the average length of the II. Group in winter (*i.e.* when just under three years old) in the same region (*see* Table 7).

2.—In autumn–winter the average length of this group (when practically four years old) was 27–29 cm. in our samples from the central region of the Southern Bight.

3.—On the South Dogger and Flamborough Off Grounds the average length of the III. Group in winter was slightly higher (viz., 30 cm.) than in the central parts of the Southern Bight.

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* Tor Bay and Start Bay.

4.—The November records for Teignmouth Bay (< 10 fathoms) and near Sandettie Light Vessel, at the Southern extremity of the North Sea, show a difference of 3 centimetres in the average length of the III. Group, to the advantage of Teignmouth (South Devon).

5.—On the offshore grounds of West Bay the average length of this group in winter was found to be approximately the same as on the South Dogger and Flamborough Off Grounds, viz., 30 cm.

6.—In September, 1905, at Vyl Light Vessel, about 20 miles from the Danish coast, the III. Group averaged about 1 centimetre smaller than at an average distance of about fifteen miles from the Dutch coast (*i.e.* "Inside" Haaks (Texel) Light Vessel).

7.—In September the average size of this group was the same on the Horn Reef Outer Ground (in 1906), at a distance of sixty-five miles from the Danish coast, as on the Brown Bank Ground (in 1905), at an average distance of about forty-five miles from the Dutch coast.

Notes on Table 9.

IV. Group—Fifth Year of Life.

1.—In the central part of the Southern Bight (Leman, Brown Bank, Brown Ridges, Eastern Deep Water) the average length of this group in May (*i.e.* when just over four years of age), we found to be 28–29 cm; practically identical, therefore, with the average length of the III. Group in winter in the same region (*see* Table 8) March: Leman and Eastern Deep Water).

2.—In autumn-winter the average length of this group (now nearly four years old) in our samples from the central parts of the Southern Bight was 30–33 cm. On the South Dogger and Flamborough Off Grounds it was 34–37 cm.

3.—On the offshore grounds of West Bay (17–30 fathoms) in February the average length of the group was approximately the same as on the South Dogger and Flamborough Off Grounds in January and about 2 centimetres lower than on these same grounds in March (different years compared).

4.—In September the IV. Group averaged about the same size on the Horn Reef Outer Ground (in 1906) at a distance of about sixty-five miles off the Danish coast as on the Brown Bank Ground (in 1905) at an average distance of about forty-five miles from the Dutch coast.

5.—In October, 1905, the average length of this group was the same on the Leman Ground, eighty to ninety miles from the Dutch coast, as on the Clay Deep edge of the Dogger, about one hundred and fifty miles from the Danish coast.

Notes on Table 10.

V. Group (Males)—Sixth Year of Life.

1.—31–32 cm. was the average length of this group in May (*i.e.* when just over five years of age) in our samples from the central parts of the Southern Bight. This agrees very well with the average length of the IV. Group in winter, which was (for males only) 30 cm. on the Leman in March, the same at the Gabbard in January, and 31 cm. in the Eastern Deep Water in March (*see* Table 5).

2.—That male plaice of the sixth year grow very slowly in the Leman region is indicated by the fact that this group had the same average size in May, June, and August, according to our samples, viz., 31 cm.

3.—Another centimetre allowed for growth by the month of October gives 32 cm. as the probable average length of this group (males) on the Leman, as compared with 36–37 cm. on the Flamborough Off Ground. Again, in our records for January, we find 38 cm. as the average length of this group on the Flamborough Off Ground as against 33 cm. at the Gabbard Light Vessel. We may say then that plaice of the sixth year appear to average 4–5 centimetres larger on the Flamborough Off Ground than in the central parts of the Southern Bight.

TABLE 11.—Principal Age Groups in the region between the **Texel and the Leman Banks** in September, 1905. Depth 7–17 fathoms.

Sample No. 12.

—	Males.				Females.				
Age Groups.	I.	II.	III.	IV.	I.	II.	III.	IV.	
Approximate Age : Years, Months.	1, 6.	2, 6.	3, 6.	4, 6.	1, 6.	2, 6.	3, 6.	4, 6.	
Length in cm.									Length in cm.
11	1	—	—	—	3	—	—	—	11
12	18	—	—	—	11	—	—	—	12
13	24	1	—	—	13	—	—	—	13
14	20	11	2	—	24	9	1	—	14
15	22	18	—	—	13	15	1	—	15
16	9	27	—	—	13	29	—	—	16
17	6	37	2	—	6	27	—	—	17
18	8	63	—	—	3	46	2	—	18
19	—	74	6	—	2	64	3	—	19
20	3	77	11	—	2	59	8	—	20
21	—	46	19	2	1	60	19	—	21
22	—	38	22	1	—	48	16	1	22
23	—	32	21	1	—	42	16	—	23
24	—	16	33	4	—	28	38	1	24
25	—	11	40	5	—	22	37	7	25
26	—	5	41	8	—	10	39	3	26
27	—	1	30	13	—	8	33	9	27
28	—	—	18	21	—	2	27	7	28
29	—	—	13	18	—	3	17	15	29
30	—	—	6	14	—	—	12	22	30
31	—	—	10	15	—	—	7	9	31
32	—	—	1	10	—	—	2	13	32
33	—	—	1	4	—	—	—	7	33
34	—	—	—	4	—	—	1	6	34
35	—	—	—	2	—	—	—	4	35
36	—	—	—	—	—	—	—	4	36
37	—	—	—	—	—	—	—	1	37
38	—	—	—	—	—	—	—	2	38
39	—	—	—	—	—	—	—	1	39
40	—	—	—	—	—	—	—	—	40
41	—	—	—	—	—	—	—	1	41
Totals ...	111	457	276	122	91	472	279	113	
Range of fifty per cent. (cm.)	13–15	18–21	23–27	27–31	13–16	18–22	24–27	29–32	
Average Length (cm.) ...	14·4	19·5	24·9	28·8	14·6	20·4	25·3	30·4	
Amended Average (cm.)...	14·9	20·0	25·4	29·3	15·1	20·9	25·8	30·9	
Probable Error of Average (cm.)	0·13	0·08	0·18	0·17	0·15	0·09	0·12	0·21	

TABLE 12.—Principal Age Groups in the region between the **Texel and the Leman Banks** in May, 1906. Depth 13–17 fathoms.

Sample Nos. 40–42 combined.

—	Males.				Females.				—
Age Groups.	II.	III.	IV.	V.	II.	III.	IV.	V.	—
Approximate Age: Years, months.	2, 2.	3, 2.	4, 2.	5, 2.	2, 2.	3, 2.	4, 2.	5, 2.	
Length in cm.									Length in cm.
9	5	—	—	—	4	—	—	—	9
10	28	—	—	—	14	—	—	—	10
11	92	—	—	—	61	—	—	—	11
12	113	3	—	—	79	2	—	—	12
13	128	—	—	—	116	1	—	—	13
14	115	3	—	—	118	1	—	—	14
15	116	12	—	—	78	10	—	—	15
16	58	11	—	—	58	18	—	—	16
17	54	30	—	—	36	18	1	—	17
18	33	42	1	—	26	18	—	—	18
19	18	44	1	—	24	41	—	—	19
20	12	60	2	—	14	40	1	1	20
21	10	46	11	—	11	26	3	—	21
22	6	51	5	2	5	52	5	—	22
23	1	36	11	—	4	32	2	1	23
24	3	31	19	2	2	45	9	—	24
25	—	20	12	4	3	36	12	1	25
26	—	18	17	2	1	14	14	1	26
27	—	5	21	3	—	14	18	3	27
28	—	3	16	3	—	12	21	3	28
29	—	4	16	4	—	5	17	8	29
30	—	2	14	4	—	11	17	3	30
31	—	2	14	11	—	5	15	2	31
32	—	—	10	7	—	—	9	6	32
33	—	—	3	7	—	—	9	8	33
34	—	—	1	1	—	—	5	8	34
35	—	—	—	4	—	—	5	5	35
36	—	—	—	1	—	—	1	6	36
37	—	—	—	1	—	—	—	6	37
38	—	—	—	2	—	—	—	3	38
42	—	—	—	—	—	—	—	1	42
Totals ...	792	423	174	58	654	401	164	66	
Range of fifty per cent. (cm.)	12–15	19–23	24–29	28–33	13–16	19–24	26–31	29–35	
Average Length (cm.) ...	14·1	20·8	26·7	30·4	14·4	22·0	28·3	32·4	
Amended Average (cm.)...	14·6	21·3	27·3	30·9	14·9	22·5	28·8	32·9	
Probable Error of Average (cm.).	0·06	0·10	0·17	0·33	0·07	0·06	0·18	0·33	

TABLE 13.—Principal Age Groups between **Scheveningen and Southern Deep Water** in May, 1906. Depth 12–23 fathoms.

Sample Nos. 46–48 combined.

—	Males.				Females.				—
Age Groups.	II.	III.	IV.	V.	II.	III.	IV.	V.	
Approximate Age : Years, months.	2, 2.	3, 2.	4, 2.	5, 2.	2, 2.	3, 2.	4, 2.	5, 2.	
Length in cm.									Length in cm.
9	—	—	—	—	1	—	—	—	9
10	3	—	—	—	1	—	—	—	10
11	8	—	—	—	5	—	—	—	11
12	18	—	—	—	11	—	—	—	12
13	36	—	—	—	18	1	—	—	13
14	42	—	—	—	23	2	—	—	14
15	53	1	—	—	28	1	—	—	15
16	41	9	—	—	22	4	—	—	16
17	45	9	—	—	25	9	—	—	17
18	42	21	—	—	33	13	—	—	18
19	35	24	—	—	22	17	—	—	19
20	20	25	3	—	19	28	—	—	20
21	9	31	—	—	20	25	—	—	21
22	5	29	4	—	16	25	1	—	22
23	—	20	2	—	4	22	3	1	23
24	—	19	8	1	7	20	3	—	24
25	—	16	10	1	2	14	7	1	25
26	—	8	12	2	—	17	7	1	26
27	—	6	11	2	—	7	8	—	27
28	—	4	8	7	—	8	3	2	28
29	—	1	3	6	—	3	6	2	29
30	—	2	6	5	—	1	4	6	30
31	—	—	3	8	—	1	9	5	31
32	—	—	10	6	—	2	6	1	32
33	—	—	4	4	—	—	8	5	33
34	—	—	1	4	—	1	—	6	34
35	—	—	—	3	—	—	—	4	35
36	—	—	—	2	—	1	—	2	36
37	—	—	—	—	—	—	—	—	37
38	—	—	—	—	—	—	1	1	38
39	—	—	—	—	—	—	—	1	39
40	—	—	—	—	—	—	—	—	40
41	—	—	—	—	—	—	—	—	41
42	—	—	—	—	—	—	—	—	42
Totals ...	357	225	85	51	257	222	66	38	
Range of fifty per cent. (cm.)	14–18	19–23	25–30	28–33	15–20	20–24	26–31	30–34	
Average Length (cm.) ...	16·0	21·4	27·2	30·6	17·2	22·4	28·6	31·9	
Amended Average (cm.)...	16·5	21·9	27·7	31·1	17·7	22·7	29·1	32·4	
Probable Error of Average (cm.)	0·09	0·14	0·25	0·27	0·14	0·16	0·28	0·37	

TABLE 14.—Principal Age Groups on the **South Dogger** and **Flamborough Off** Grounds in Winter (October–March).

Samples, Nos. 14–19 and 32–36 combined.

—	Males.				Females.					—
Age Groups.	III.	IV.	V.	VI.	III.	IV.	V.	VI.	VII.	
Approximate Age : Years, months.	3, 7 to 4.	4, 7 to 5.	5, 7 to 6.	6, 7 to 7.	3, 7 to 4.	4, 7 to 5.	5, 7 to 6.	6, 7 to 7.	7, 7 to 8.	
Length in cm.										Length in cm.
15	1	—	—	—	—	—	—	—	—	15
16	—	—	—	—	—	—	—	—	—	16
17	—	—	—	—	—	—	—	—	—	17
18	—	—	—	—	—	—	—	—	—	18
19	—	—	—	—	—	—	—	—	—	19
20	2	—	—	—	—	—	—	—	—	20
21	1	—	—	—	3	—	—	—	—	21
22	—	—	—	—	3	—	—	—	—	22
23	5	2	—	—	4	—	1	—	—	23
24	5	—	—	—	6	—	—	—	—	24
25	1	2	—	—	8	—	—	—	—	25
26	6	—	—	—	7	2	1	—	—	26
27	8	5	—	—	4	—	—	—	—	27
28	9	6	1	1	7	2	1	—	—	28
29	12	2	1	—	7	8	—	—	—	29
30	4	9	3	—	14	3	—	—	—	30
31	5	5	1	1	7	5	1	—	—	31
32	5	14	7	—	9	11	—	—	—	32
33	7	16	3	1	13	12	—	—	—	33
34	5	13	5	1	9	28	2	1	—	34
35	3	20	7	2	6	17	3	—	—	35
36	—	12	12	3	5	24	9	1	—	36
37	—	4	11	2	3	30	7	3	—	37
38	—	9	11	3	2	18	5	1	—	38
39	—	8	3	4	—	20	4	2	—	39
40	—	3	4	5	1	16	11	4	2	40
41	1	1	8	3	—	13	17	6	—	41
42	—	1	4	—	—	4	12	6	—	42
43	—	—	1	—	—	2	7	2	—	43
44	—	—	1	1	—	2	7	3	3	44
45	—	—	—	—	—	—	2	6	2	45
46	—	—	—	—	—	1	6	5	3	46
47	—	—	—	—	—	—	3	3	4	47
48	—	—	—	—	—	—	5	8	3	48
49	—	—	—	—	—	—	1	1	3	49
50	—	—	—	—	—	—	—	1	1	50
51	—	—	—	—	—	—	—	—	1	51
52	—	—	—	—	—	—	—	2	1	52
56	—	—	—	—	—	—	—	—	1	56
Totals ...	80	132	83	27	118	218	105	55	24	
Range of fifty per cent. (cm.) ...	26–32	32–36	34–38	36–40	26–33	34–39	38–43	41–47	45–49	
Average Length (cm.)	28·6	33·6	36·5	37·6	29·9	36·1	40·5	43·6	47·0	
Amended Average (cm.)	**29·1**	**34·1**	**37·0**	**38·1**	**30·4**	**36·6**	**41·0**	**44·1**	**47·5**	
Probable Error of Average ...	0·32	0·22	0·26	0·44	0·27	0·16	0·30	0·37	0·48	

TABLE 15.—Principal Age Groups in the **Great West Bay** (English Channel) in Winter (November and February). Depth 3–7 and 17–30 fathoms.

Samples, Nos. 27, 28 and 53–56 combined.

—	Males.				Females.				—
Age Groups.	I.	II.	III.	IV.	I.	II.	III.	IV.	
Approximate Age : Years, months.	1, 9 to 2.	2, 9 to 3.	3, 9 to 4.	4, 9 to 5.	1, 9 to 2.	2, 9 to 3.	3, 9 to 4.	4, 9 to 5.	
Length in cm.									Length in cm.
12	1	—	—	—	—	—	—	—	12
13	3	—	—	—	2	—	—	—	13
14	3	—	—	—	6	—	—	—	14
15	11	—	—	—	12	—	—	—	15
16	11	—	—	—	11	—	—	—	16
17	7	2	—	—	6	—	—	—	17
18	9	—	—	—	3	—	—	—	18
19	8	3	—	—	6	—	—	—	19
20	8	10	—	—	6	2	—	—	20
21	12	8	—	—	7	4	—	—	21
22	11	7	2	—	12	3	—	—	22
23	14	10	3	—	4	8	1	—	23
24	8	20	3	1	6	13	3	—	24
25	6	21	2	—	8	23	2	—	25
26	2	45	—	—	6	24	4	—	26
27	1	57	3	—	1	38	4	—	27
28	2	50	2	2	2	33	4	1	28
29	—	36	6	1	1	37	5	—	29
30	—	21	7	4	—	24	12	1	30
31	—	9	10	2	—	18	14	2	31
32	—	2	12	—	—	10	10	6	32
33	—	3	6	5	—	5	7	3	33
34	—	2	6	2	—	4	11	6	34
35	—	1	3	6	—	2	2	6	35
36	—	—	3	2	—	—	4	2	36
37	—	—	1	1	—	1	2	3	37
38	—	—	—	—	—	—	2	—	38
39	—	—	—	—	—	—	1	4	39
40	—	—	—	—	—	—	2	4	40
41	—	—	—	—	—	—	—	1	41
Totals ...	117	307	69	26	99	249	90	39	
Range of fifty per cent. (cm.)	17–23	25–28	29–33	30–35	16–23	26–29	29–33	32–37	
Average Length (cm.) ...	19·8	26·6	30·5	32·4	19·9	27·8	31·3	35·0	
Amended Average (cm.)...	20·3	27·1	31·0	32·9	20·4	28·3	31·8	35·5	
Probable Error of Average (cm.)	0·23	0·11	0·29	0·41	0·28	0·12	0·26	0·35	

TABLE 16.—Principal Age Groups in **Tor Bay** and **Start Bay** in August, 1909. Depth 3–8 fathoms.

Samples Nos. 57 and 58 combined.

—	Males.			Females.					—
Age Groups.	I.	II.	III.	I.	II.	III.	IV.	V.	—
Approximate Age : Years, Months.	1, 6.	2, 6.	3, 6.	1, 6.	2 6.	3, 6.	4, 6.	5, 6.	
Length in cm.									Length in cm.
12	2	—	—	—	—	—	—	—	12
13	—	—	—	—	—	—	—	—	13
14	12	—	—	6	—	—	—	—	14
15	19	—	—	19	—	—	—	—	15
16	41	—	—	31	—	—	—	—	16
17	58	—	—	33	—	—	—	—	17
18	64	—	—	46	—	—	—	—	18
19	40	—	—	33	1	—	—	—	19
20	30	1	—	27	1	—	—	—	20
21	20	—	—	8	5	—	—	—	21
22	5	—	—	6	1	—	—	—	22
23	5	1	—	3	—	—	—	—	23
24	1	3	1	1	—	1	—	—	24
25	—	6	—	—	—	1	—	—	25
26	—	3	—	1	2	1	—	—	26
27	—	4	—	—	—	1	—	—	27
28	—	4	2	—	5	1	—	—	28
29	—	7	1	—	4	1	—	—	29
30	—	4	3	—	5	1	—	—	30
31	—	1	5	—	5	2	2	—	31
32	—	2	1	—	1	2	1	—	32
33	—	1	1	—	—	5	—	—	33
34	—	—	2	—	1	6	3	—	34
35	—	—	—	—	—	2	2	1	35
36	—	—	1	—	—	3	—	—	36
37	—	—	—	—	—	2	1	—	37
38	—	—	—	—	—	1	4	3	38
39	—	—	—	—	—	—	1	3	39
40	—	—	—	—	—	1	—	—	40
41	—	—	—	—	—	—	—	1	41
42	—	—	—	—	—	—	1	1	42
43	—	—	—	—	—	1	—	1	43
44	—	—	—	—	—	—	—	—	44
45	—	—	—	—	—	—	1	2	45
46	—	—	—	—	—	—	—	—	46
47	—	—	—	—	—	—	1	—	47
48	—	—	—	—	—	—	—	1	48
Totals ...	297	37	17	214	31	32	17	13	
Range of 50 per cent. (cm.)	17–19	25–29	30–32	16–19	22–30	31–35	34–38	38–43	
Average Length (cm.) ...	17·8	27·4	30·8	17·9	27·2	33·0	6·	40·8	
Amended Average (cm.)...	**18·3**	**27·9**	**31·3**	**18·4**	**27·7**	**33·5**	**37·4**	**41·3**	
Probable Error of Average (cm.).	0·08	0·31	0·45	0·09	0·51	0·50	0·74	0·68	

V.—The Average Annual Growth of Plaice in Length and Weight.

1. *Material and Method.*

Tables 11–19, *and Figs.* 6 *and* 7.

The determination as accurately as possible of the average annual growth of Plaice in length and weight has a direct bearing on certain practical questions and has, therefore, been made one of the chief tasks in connection with the present research.

My report of 1907* contained an estimate, which the results of later and fuller investigations (detailed below) have confirmed, of the average annual growth in *length* in the Southern North Sea as a whole, based on the otolith analysis of the material collected up to the end of 1905. In the following pages will be found a considerable amount of further material for an estimate of the growth of plaice, not only in the North Sea, but also in the Western part of the English Channel.

The directions in which progress has been made since the publication of my 1907 report on the subject are indicated in the next four paragraphs.

1.—On the basis of the more abundant material now available we are able to estimate the average yearly growth of plaice in certain regions with a closer approximation to accuracy than has hitherto been possible. Especial efforts have been made to obtain as correct an estimate as possible of the average annual growth during the first five years in the Southern Bight of the North Sea (South of the Dogger), between the English and Dutch coasts.

2.—In my report of 1907 only the growth in *length* was dealt with. I am now able to give figures for an approximate estimate of the average annual growth in *weight* in the North Sea, deduced by means of Heincke's formula from the average lengths of successive age-groups.

3.—Our further collections from the Western part of the English Channel have afforded material for an estimate of the average annual growth in length during the first five years in this region.

4.—The probable errors of the averages on which the estimates of growth-rate are based have been calculated. Their effect in determining the degree of accuracy of the weight estimated is indicated in Fig. 8.

The most important conclusions regarding the average yearly growth of plaice in different regions, as ascertained by means of the material and methods described in the next few pages, are summarised at the end of the section (pp. 148, 149).

In the present section estimates will be adduced of the annual average growth of plaice during certain life years in the following three regions :—

A.—The Southern Bight of the North Sea, between the Dutch and English Coasts, and including the region of the Leman Banks.

B.—The South Dogger region ; including the Flamborough Off Ground.

C.—The Western part of the English Channel (Great West Bay).

Tables 11–16. The materials for our estimate of average yearly growth in the Texel-Leman, South Dogger, and West Channel regions respectively, are contained in these tables.

At the foot of each column appropriated to each age group are recorded :—

1.—The range-in-length of fifty per cent. of the group, as defined by the two "Quartiles."

* Wallace 1907, p. 33.

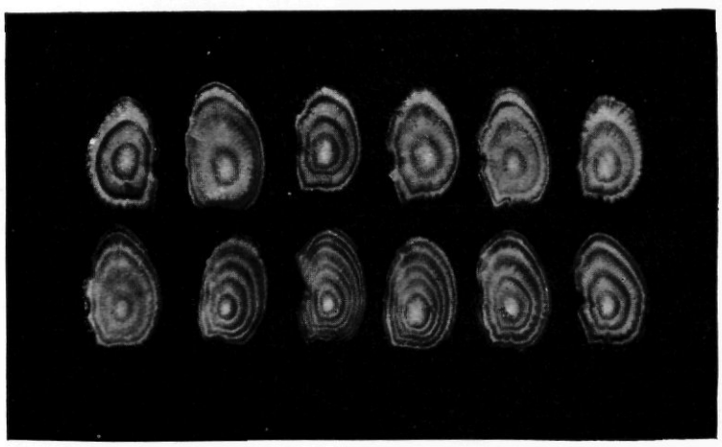

FIG. 6.—Otoliths of mature male plaice.—Upper row—Otoliths of plaice from the West Bay (English Channel); Lower row—Otoliths of plaice taken in the Southern Deep Water of the North Sea, near the Gabbard Light Vessel.

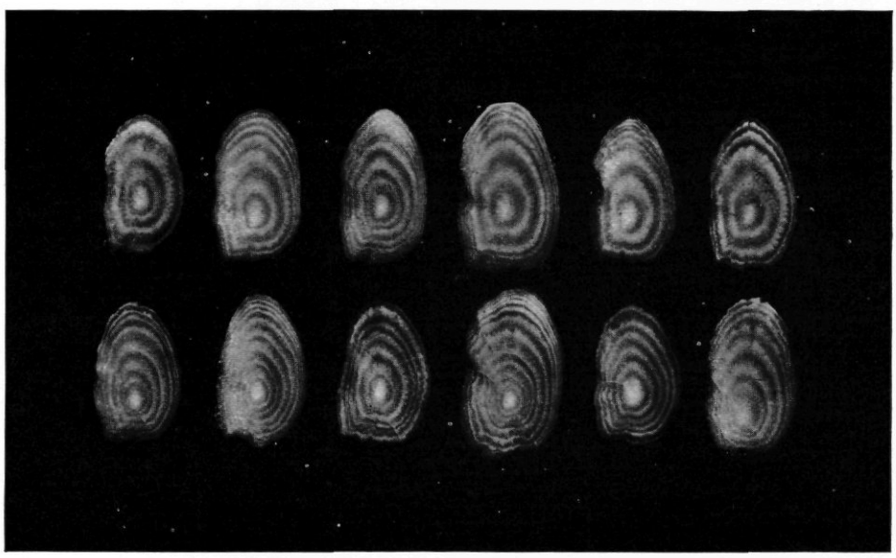

FIG. 7.—Otoliths of mature female plaice.—Upper row—Otoliths of plaice from West Bay (English Channel); Lower row—Otoliths of plaice taken in the region of the Leman Banks (North Sea).

2.—The average length as calculated from the original measurements in centimetres and amended by the addition of 0·5 cm. This addition to the calculated average is necessary owing to the method of measuring the fishes according to which fractions of a centimetre are neglected, so that, for instance, a fish measuring 20·9 cm. is regarded as 20 cm. It follows that an average based on measurements grouped in this way must be 0·5 cm. too low: hence the necessary addition.

3.—The probable error of the average as calculated by means of the formula $\pm 0{\cdot}6745 \frac{\sigma}{\sqrt{n}}$ in which σ = the standard deviation and n = the number of fishes in the age group.

As will be seen from a reference to Tables 11–16, the "probable errors" of the averages are very small in the cases of well-represented age groups, and are never too high to invalidate the approximate estimates of yearly growth required for our present purpose, or the general inferences drawn from them, and stated at the end of this section.

The validity of *separate* estimates of the average annual growth for the Southern Bight, South of Dogger region, and Great West Bay respectively, based on the average lengths of successive age-groups in our separate collections from these three regions, depends on the extent to which the stock of plaice (of the ages involved in each separate estimate) is confined to each region. How far the stock of plaice in each of the regions A, B, and C is independent of that in the other two regions cannot be precisely stated at present; but the results of marking experiments* prove that there is a certain amount of interchange between the plaice population of the first two regions, A and B.

Pending further information from the marking experiments we shall assume that the *main mass* of plaice *up to five years of age* found in the Southern Bight (including the Leman region) is bred in and mainly confined its cycle of movements to this region; and that this is the case also with the plaice in the West Channel region,† *the otoliths of which may be generally easily distinguished from those of North Sea plaice by the relatively great breadth of the first one or two rings white* (outside the nucleus), indicating relatively rapid growth during the *earlier* years in this region.

Figs. 6 & 7 clearly show the relatively great breadth of the first or first and second white rings in the otoliths of plaice from West Bay as compared with the breadth of the corresponding rings in otoliths of plaice from the Southern North Sea. For these excellent photographs I am indebted to Mr. H. H. Goodchild, of the Lowestoft Laboratory. The otoliths were not selected in any way, but taken at random from our collections.

With regard to plaice of four to seven years of age in the South Dogger region it will be noticed (*see* Table 14) that I have combined samples from the Flamborough Off Ground with samples from the South part of the Dogger to form one large collection. This combination appears justified by the following considerations:—

(1.) The average length of plaice of a given age is approximately the same on the Flamborough Off Ground as on the South part of the Dogger (*see* Tables 8 and 9).

(2.) The results of English marking and transplantation experiments show that mature plaice emigrate from the South part of the Dogger to the Flamborough Off Ground in winter. (I refer particularly to the results of the 1906–08 experiments, not yet published.)

(3.) Garstang‡ has shown that there are complementary seasonal changes on the two grounds as regards the density-distribution of the larger fishes, pointing to a spawning migration from the South Dogger to the Flamborough Off Ground in winter.

We know, however, from the results of English marking experiments that certain numbers of plaice (especially males) emigrate from the Flamborough Off Ground to the Southern Bight in winter and, conversely, cases of migration from the latter to the former region have been noted.

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* I refer especially to the results of the more recent English marking and transplantation experiments of 1906–08, reports on which are (at the time of writing this) in course of preparation.

† At the time of writing I am aware of only two instances on record of English marked plaice migrating into this region from the North Sea; one liberated on the Flamborough Off Ground, the other on the Leman Ground. I owe this information to my colleague, Mr. G. T. Atkinson.

‡ Garstang, 1909, p. 87, &c.

We cannot, therefore, at present state to what extent the plaice of four to seven years of age found in the South Dogger region belong to a separate stock from that in the Southern Bight ; neither can we definitely assert that the main mass of plaice which arrive on the South part of the Dogger when four years old perform the whole, or at least the bulk of their growth during the next three years in this region, as the requirements of a separate estimate of growth-rate for this region would imply. All that can be claimed as highly probable is that the effect of growth actually performed on the Dogger is mainly instrumental in determining the relatively high values of the average lengths of plaice of four to seven years of age in this region and that subsequently the estimates based on these data and the curves derived therefrom (Fig. 8) are mainly the expression of growth on the Dogger itself.

Southern Bight.—Especial efforts have been made to obtain sufficiently correct estimates of the average annual growth of plaice during the first five years of their lives in this region *as a whole*. As shown by marking experiments and other data, the Southern Bight of the North Sea derives its chief supplies of plaice from the adjacent Dutch coast* ; and there is a gradual movement offshore with increase in size, independently of age, so that the average length of plaice of a given age becomes greater and greater as the distance from the coast of Holland increases.† From this follows the necessity of making collections embracing as far as possible the entire range of distribution of each age group, by trawling in continuous radial lines from the near neighbourhood of the shore as far as the central parts of the region.

Four such continuous radial series of hauls have been carried out for this purpose across the Southern Bight, viz.,

A.—Across the Northern part ; from the "Texel" to the Leman Banks. This track coincides with the main axis of summer offshore migration as demonstrated by Garstang.‡

Three continuous series of hauls have been made along this track, viz., in May, 1905 (Sample No. 2) ; in September, 1905 (Sample No. 12), and, finally in May, 1905 (Samples Nos. 40–42).

The results of otolith-analysis of the plaice collected along this track in May, 1905, and September, 1905, were recorded and discussed in my report of 1907,§ and on the resulting figures estimates were based of the average annual growth which are confirmed by the more recent investigations in the same region recorded below.

B.—Across the *middle* part of the Southern Bight ; from the inner part of the Brielle Ground (Off Scheveningen) to the Southern Deep Water in May, 1906 (Sample Nos. 46–48).

Here we need only consider the collections of September, 1905, and May, 1906, made along the Texel-Leman track and the collection of May, 1906, between Scheveningen and the Eastern Deep Water (Tables 12 and 13). From the average lengths of the *principal* age-groups in these three collections from the Southern Bight we shall obtain our new estimates of the average annual growth in this region.

Unfortunately we are unable to determine from the otolith-analysis of these collections, the average growth for each of the first three years *separately*, because the I. Group in September, 1905, and both the I. Group and II. Group in May, 1906, are inadequately represented in these collections, owing to the fact that a large proportion of these groups (the main mass in the case of the I. Group) remains in shallower water, further inshore than the Eastern extremities of the lines trawled over in making these collections. Accordingly we are obliged to start with the average length of the II. Group in September and that of the III. Group in May, and to take the mean of these two values as representing the average length at the end of the third year (*i.e.*, when just three years of age). This quantity divided by three, gives us the average annual growth during the first three years.

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* See Section III.
† Wallace, 1907, p. 22, &c., and Fig. 7.
‡ Garstang, see especially, 1909, p. 94. and charts, Plates V. and VI.
§ Wallace, 1907, pp. 24, 25, 31, 32. Figs. 8–11 and 13.

TABLE 17.—Average Length of Principal Age Groups of PLAICE trawled between the Texel and the Leman Banks and between Scheveningen and the Southern Deep Water respectively.

Age Groups.	Males.		Females.	
	Texel to Leman.	Scheveningen to Southern Deep Water.	Texel to Leman.	Scheveningen to Southern Deep Water.
II. Group.—September, 1905 ...	20·0	—	20·9	—
III. Group.—May, 1906 ...	21·3 } 20·6[3]	21·9	22·5 } 21·7[3]	22·7
III. Group.—September, 1905 ...	25·4	—	25·8	—
IV. Group.—May, 1906 ...	27·2 } 26·3[4]	27·7	28·8 } 27·3[4]	29·1
IV. Group.—September, 1905 ...	29·3	—	30·9	—
V. Group.—May, 1906	30·9 } 30·1[5]	31·1	32·9 } 31·9[5]	32·4

[3] = Average length when 3 years old = mean of II. Group (September) and III. Group (May).
[4] = " " 4 " " III. " " IV. " "
[5] = " " 5 " " IV. " " V. " "

Inference from Table 17.—Comparing age group with age group in our collections of May, 1906, from the Texel-Leman and Scheveningen Deep Water regions respectively, we see that the average lengths of plaice of the same age do not differ significantly (0·2–0·6 cm.) in the two collections. The somewhat higher values (except in the case of the V. Group, females) for Scheveningen-Deep Water are probably to be explained by the circumstance that only about one-third of the total number of plaice caught in the most inshore haul (Sample No. 46[1]) of the series is included (together with *all* the plaice caught in the other hauls) in the collection ; whereas the Texel-Leman collection includes all the plaice caught on the most inshore station (Sample No. 42[2]) as well as as on the other stations of the line. The Texel-Leman averages are, therefore, likely to be more accurate, the Scheveningen-Deep Water averages being *slightly* too high, owing to the fact that they are based on samples containing an insufficient proportion of the smaller inshore representatives of each age group. *The small differences between the two series of averages are, however of trifling account for our present purpose.*

The close approximation in value of the average lengths of the same age groups in the Northern and Middle sections respectively of the Southern Bight, as determined by means of the material and methods just described, may be said to establish on a satisfactory basis our estimates of the average yearly growth in this region as a whole.

2. *Method of Estimating Average Annual Growth in Weight.*

If we are given the length of a plaice in centimetres (l) we can find its weight in grammes (g) by means of the formula

$$g = \frac{l^3}{100} \times K.$$

The ratio K, called by Heincke* "the Length-Weight Coefficient," varies from about 0·8 – 1·2 cm., according to the "condition" of the fish. The value of K., therefore varies according to season and place of capture, and also with size (if not with sex).

From abundant records of the average weight (in grammes) of plaice of different centimetre lengths, recently published by the English Board of Agriculture and Fisheries† and by the Dutch Marine Station at Helder‡ respectively, the value of K. has been calculated§ for different months for various large regions (based on depth contours) into which the North Sea has been divided for statistical purposes. The values of K. thus obtained are of great value for (among other things) the purpose of converting statistics of length into statistics of weight, and have been made use of in connection with the present

* Heincke and Henking, 1907, p. 27.
† Masterman, W., 1908 and 1909, Cd. 4227 and Cd. 4738. Tables (for full reference, see p. 152).
‡ Redeke, 1909. Verhandelungen, u.h. Ryksinstituut, v.h. onderzoek der Zee, 2nd. Deel, Nos. 4–5. Anhang. Tabellen I.–IV. "Messungen und Waegungen von Kleinen Marktschollen aus der Nordsee gelandet in Ijmuiden und Helder, 1904–06.
§ By Mr. J. Potter, of the Lowestoft Laboratory.

research to obtain estimates of the average weights of different age groups in the North Sea from the length data given in Tables 11–16.

In using the formula $g = \frac{l^3}{100} \times K$. for the conversion of the average length of an age group into the average weight of the same, it is necessary to take account of the difference (pointed out by Heincke) between the average of the cubes of the individual lengths (a) and the cube of the average length (b). In the case of a varying series such as an age group, these two quantities are not identical, but *a* is somewhat larger than *b* ; the ratio $\frac{a}{b}$ ranging from 1·02—1·13, according to our calculations, being smaller for the older than for the younger age groups, as shown in the following table :—

VALUES of the Ratio $\frac{a}{b}$ for different age groups calculated for the data recorded in Tables 11–14.

Region.	Period of Year.	Sex.	Age Groups.				
			II.	III.	IV.	V.	VI.
South Dogger–Flamborough Off ...	October–March	M.	—	1·06	1·04	1·03	1·02
		F.	—	1·07	1·03	1·04	1·03
Texel–Leman	May, 1906	M.	1·11	1·08	1·05	1·04	—
		F.	1·13	1·08	1·05	1·05	—
Texel–Leman	September, 1905	M.	1·06	1·04	1·03	—	—
		F.	1·06	1·05	1·04	—	—

a = average of cubes of individual lengths.
b = cube of average length.

The values of the ratio $\frac{a}{b}$ used by Heincke as a general factor in converting the average lengths of his age groups into their average weights was 1·1 (*see* Heincke, 1907, p. 28).

$$Gm = \frac{Lm^3}{100} K \frac{a}{b}.$$

This is Heincke's formula* by means of which the average weight of an age group in grammes (Gm) may be calculated, provided we are given the average length in centimetres Lm) and the appropriate values of the ratios K and $\frac{a}{b}$.

We may illustrate the method of calculation generalised in the above formula by two concrete examples, showing how we have obtained our estimates of the average weights in different age groups in two regions of the North Sea from the length-data recorded in Tables 11, 12 and 14.

First Example.—To determine the average weight of five year old female plaice in the South Dogger region. In this case the values of the three factors Lm, K, and $\frac{a}{b}$ required by the formula are as follows :—

(1.) Lm. The average length of the IV. Group (females) in winter (practically five years of age) in our collection from this region (Table 14) is 36·6 cm.

* Heincke and Henking, 1907, p. 28.

(2.) K. The mean value of K for the statistical area B_1 (the Dogger as a whole) for the months of October, January and March (the months in which our samples from this region were obtained) is approximately 1·1. This is obviously the most appropriate value of K to use as our factor in this case.

(3.) $\frac{a}{b}$. The value of this ratio for the IV. Group (females) in our South Dogger collection is 1·03.

The range of probable error of the average length of the IV. Group (females) in our South Dogger collection (Table 14), is approximately 36·4–36·8 cm. The weights corresponding to these two limiting values were calculated in the same way as the average weight (*see* below).

Giving to the factors Lm, K, and $\frac{a}{b}$ their appropriate values and combining them according to the formula, we obtain the following scheme for calculation :—

$$\frac{(36{\cdot}8)^3}{100} \times 1{\cdot}1 \times 1{\cdot}03 = 564{\cdot}6 \text{ gr.} = \text{upper limit of probable error.}$$

$$\frac{(36{\cdot}6)^3}{100} \times 1{\cdot}1 \times 1{\cdot}03 = 555{\cdot}5 \text{ gr.} = \text{average weight.}$$

$$\frac{(36{\cdot}4)^3}{100} \times 1{\cdot}1 \times 1{\cdot}03 = 546{\cdot}4 \text{ gr.} = \text{lower limit of probable error.}$$

Result.—The above calculation give us 555 grammes as the approximate average weight of five-year-old female plaice in the South Dogger region and 546–565 grammes as the range of probable error of the average.

Second Example.—To determine the average weight of four-year-old male plaice in the Texel-Leman region (*see* Tables 11 and 12).

In this case the separate calculations necessary to obtain appropriate values for the individual factors Lm, K, and $\frac{a}{b}$ are as under :—

(1.) Lm. The average length of the III. Group (males) in the September collection is 25·4 cm.; that of the IV. Group in the May collection is 27·2 cm. The *mean* of these two values is 26·3 cm. This gives approximately the average length at the *end* of the fourth year; which is the value of Lm required.

(2.) K. The average length of the length-weight coefficient for the statistical area B_3 (which *includes* the Texel-Leman region) is about 0·95 for May, and 1·11 for September. The mean of these two figures, viz., 1·03, is evidently the most appropriate value of K for our present purpose.

(3.) $\frac{a}{b}$. The value of this ratio for the III. Group (males) in the September collection is 1·04, that for the IV. Group in the May collection, 1·05, that is to say they are practically identical.

The range of probable error of the average length of the III. Group (males) in the September collection (viz., 25·4 cm.) is approximately 25·3–25·5 cm. The range of probable error of the average length of the IV. Group in the May collection (viz., 27·2 cm.) is about 27·0–27·4 cm. The mean range of probable error of the average length of four-year-old males is therefore about 26·1-26·5 cm. The foregoing calculations are combined in the following scheme :—

$$\frac{(26{\cdot}5)^3}{100} \times 1{\cdot}03 \times 1{\cdot}04 = 199{\cdot}3 \text{ gr.} = \text{upper limit of probable error.}$$

$$\frac{(26{\cdot}3)^3}{100} \times 1{\cdot}03 \times 1{\cdot}04 = 194{\cdot}9 \text{ gr.} = \text{average weight.}$$

$$\frac{(26{\cdot}1)^3}{100} \times 1{\cdot}03 \times 1{\cdot}04 = 190{\cdot}5 \text{ gr.} = \text{lower limit of probable error.}$$

TABLE 18.—Average Length and approximate Weight of PLAICE of Different Ages in the Texel–Leman region, South Dogger region, and Great West Bay (length only) respectively.

The averages are printed in thick type. The two figures in ordinary type above and below each average show the range of Probable Error of the average.

Age. Years.	Males.					Females.				
	Texel to Leman.		South Dogger and Flamborough Off.		Great West Bay.	Texel to Leman.		South Dogger and Flamborough Off.		Great West Bay.
	Average Length. cm.	Average Weight. gr.	Average Length. cm.	Average Weight. gr.	Average Length. cm.	Average Length. cm.	Average Weight. gr.	Average Length. cm.	Average Weight. gr.	Average Length. cm.
3	20·7	98	—	—	27·2	21·8	114	—	—	28·4
	20·6	**96**	—	—	**27·1**	**21·7**	**113**	—	—	**28·3**
	20·5	95	—	—	27·0	21·6	111	—	—	28·2
4	26·5	199	29·4	296	31·3	27·5	225	30·7	340	32·1
	26·3	**195**	**29·1**	**287**	**31·0**	**27·3**	**220**	**30·4**	**331**	**31·8**
	26·1	190	28·8	278	30·7	27·1	215	30·1	321	31·5
5	30·4	298	34·3	462	33·3	32·2	358	36·8	565	35·8
	30·1	**289**	**34·1**	**454**	**32·9**	**31·9**	**348**	**36·6**	**555**	**35·5**
	29·8	281	33·9	446	32·5	31·6	338	36·4	546	35·2
6	—	—	37·3	588	—	—	—	41·3	806	—
	—	—	**37·0**	**574**	—	—	—	**41·0**	**788**	—
	—	—	36·7	560	—	—	—	40·7	771	—
7	—	—	38·5	640	—	—	—	44·5	998	—
	—	—	**38·1**	**620**	—	—	—	**44·1**	**972**	—
	—	—	37·7	601	—	—	—	43·7	945	—

TABLE 19.—Average Annual Increase in Length (cm.) and Weight (gr.) in three Regions, viz., Texel–Leman, South Dogger, and Great West Bay.

Growth Period.	Males.					Females.				
	Texel–Leman.		Dogger-Flamborough Off.		Great West Bay.	Texel–Leman.		Dogger–Flamborough Off.		reat West Bay.
	Length Increase. cm.	Weight Increase. gr.	Length Increase. cm.	Weight Increase. gr.	Length Increase. cm.	Length Increase. cm.	Weight Increase. gr.	Length Increase. cm.	Weight Increase. gr.	Length Increase. cm.
First Three Years	20·6	96	—	—	27·1	21·7	113	—	—	28·3
	M*=6·9	M*= 32			M*=9·0	M*=7·2	M*= 38			M*=9·4
Fourth Year ...	5·7	99	—	—	3·9	5·6	107	—	—	3·5
Fifth „ ...	3·8	94	5·0	167	1·9	4·6	128	6·2	224	3·7
Sixth „ ...	—	—	2·9	120	—	—	—	4·4	233	—
Seventh „ ...	—	—	1·1	46	—	—	—	3·1	184	—

M* = Mean Annual Increment for first three years.

Result.—The above calculations give us 195 grammes as the approximate average weight of four-year-old male plaice in the Texel-Leman region and 190–199 grammes as the approximate range of probable error of the average.

§ 3. *Chief Inferences from Tables* 18 *and* 19 *and Fig.* 8.

1.—In the Southern North Sea, according to these investigations, a plaice normally adds as much to its weight in the fourth year of its life as it does in the three previous years taken together.

2.—The greatest absolute average increase in weight apparently occurs in the fifth and sixth years of life.

3.—The results of otolith-analysis of samples taken in the South Dogger region indicate a marked diminution in the yearly average weight-increment after the fifth year in the case of the males, whereas in that of females there is apparently no diminution in the sixth and little if any in the seventh year.

4.—In the *Southern Bight* of the North Sea the average length of three-year-old plaice is about 21 cm. for males and 22 cm. for females, *i.e.*, about 8½ inches for the two sexes combined.

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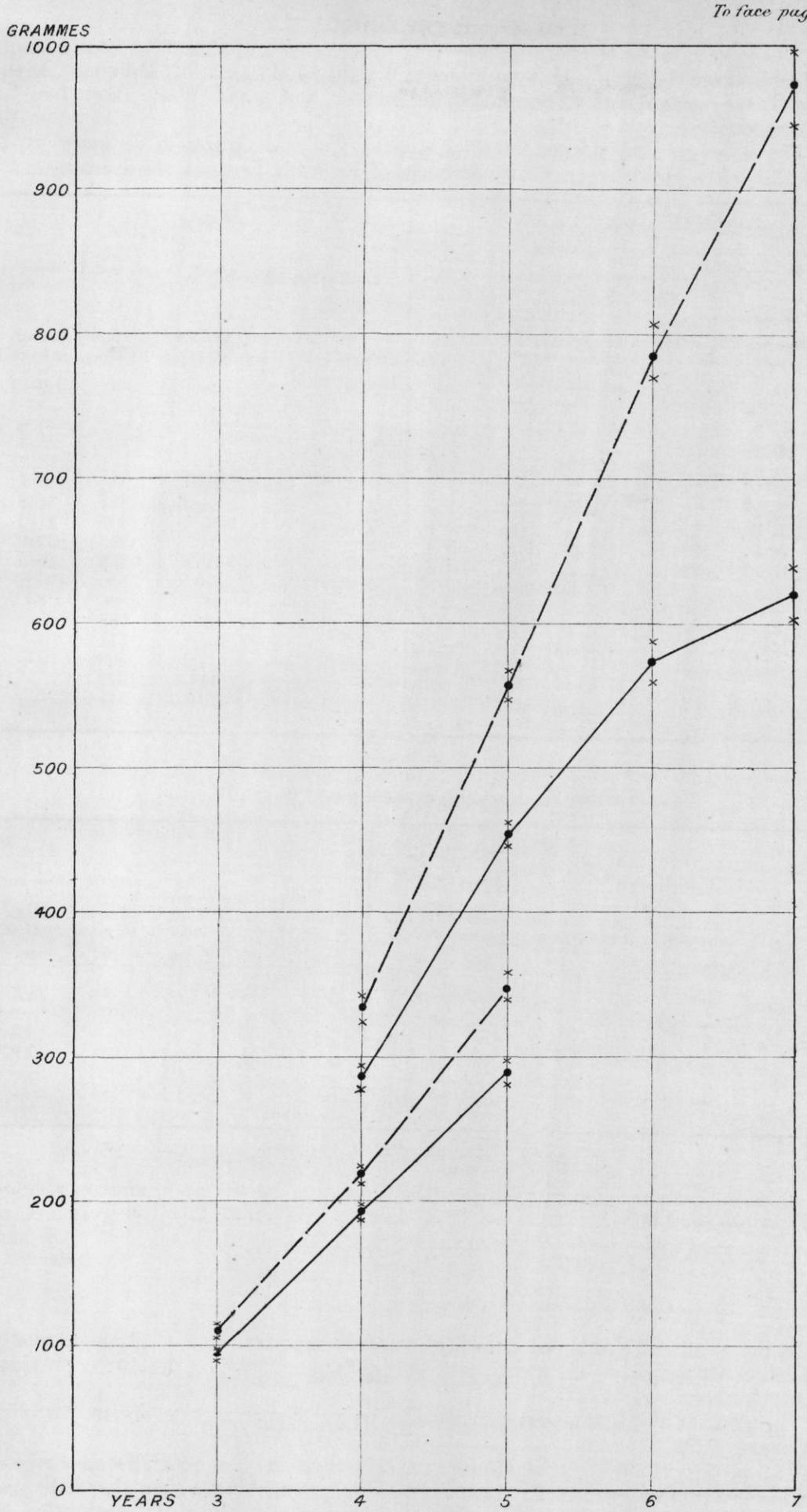

FIG. 8. *Showing approximate Average Annual Growth in Weight of Plaice in the North Sea.*
Upper pair of curves refer to the South Dogger region.
Lower " " " " " " Texel-Leman region.
Continuous Line = Males, Broken Line = Females.
Crosses × indicate range of Probable Error of the Averages. (See Table 18.)

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In the *Great West Bay* the average length of plaice of the same age is about 27 cm. for males and 28 cm. for females, *i.e.*, about $10\frac{3}{4}$ inches for both sexes.

These results give an average annual increment during the first three years of about 7 cm. in the Southern Bight of the North Sea, and 9–9·5 cm. in the Western part of the Channel.

In the fourth year the absolute average increase in length is apparently about 5·5 cm. in the Southern Bight and about 3·5–4 cm. in the Great West Bay.

In the fifth year the absolute average increase in length, according to our results, is about 4 cm. (males) and 4·5 cm. (females) in the Southern Bight and about 2 cm. (males) and 3·5 cm. (females) in the Great West Bay.

These results indicate that while plaice grow considerably more rapidly in the Great West Bay than in the Southern Bight of the North Sea during the first three years of their lives, they grow less rapidly after that period, the earlier retardation of growth counteracting the effect of more rapid initial growth.

APPENDIX.

Comparison with Heincke's Estimates of the Yearly Growth of Plaice in the German Bight.

From an otolith-analysis of samples of plaice collected in the German Bight, off the islands of Heligoland, Borkum, Juist, and Sylt, Heincke* obtained the following values† for the average lengths of fishes of the ages of three to five years respectively :—

------	Three-Years Old.	Four-Years Old.	Five-Years Old.
	cm.	cm.	cm.
Males	19·6	23·5	26·2
Females	20·2	25·0	27·2

The corresponding averages obtained as a result of my otolith-analysis of collections made by trawling continuously in a line extending from the near neighbourhood of the Dutch Coast (" the Texel ") to that of the Leman Banks (*see* Table 17) are as under :—

——	Three-Years Old.	Four-Years Old.	Five-Years Old.
	cm.	cm.	cm.
Males	20·6	26·3	30·1
Females	21·7	27·3	31·9

Comparing the two series of figures we see that the average lengths of plaice in Heincke's samples from the German Bight are smaller than ours for the Texel-Leman region (and Southern Bight generally) ; the difference between his and my values amounting to as much as 4–5 cm. in the case of the fifth year.

It will be interesting now to compare the average annual increments in length and weight based on the two series of averages.

The following figures represent the average yearly growth-increments in the German Bight, according to Heincke.

——	First Three Years (mean).		Fourth Year.		Fifth Year.	
	cm.	gr.	cm.	gr.	cm.	gr.
Males	6·6	25	3·8	52	3·0	58
Females	6·7	27	4·8	72	2·8	60

* Heincke and Henking—" Uber Schollen und Schollenfischerei in der sudostlichen Nordsee " 1907, pp. 18–30, Tables II.–VIII.

† These are the means of the averages for three different collections, viz., (1) Heligoland : September to November ; (2) Sylt, Borkum u. Juist : March ; (3) Sylt : May.

According to my calculations based on the Texel-Leman material the average yearly growth-increments are as follows :—

—	First Three Years (mean).		Fourth Year.		Fifth Year.	
	cm.	gr.	cm.	gr.	cm.	gr.
Males	6·9	32	5·7	99	3·8	94
Females	7·2	38	5·6	107	4·6	128

Comparison between these two series of data might appear to indicate considerably slower average growth, especially during the fourth and fifth years, in the German Bight than in the Southern Bight. *The two series of values are not, however, strictly comparable*, as may be gathered from what has been said above regarding the necessity of allowing for the selective migration according to size of fishes of a given age by extending the area of collection to considerable distance from land in the direction of migration, thereby obtaining as far as possible a representative sample of each age group *as a whole*, in which the length-frequencies occur in approximately their true proportions. It seems reasonable, therefore, to suspect that Heincke's values for the average lengths of plaice of three to five years of age, as determined by the analysis of isolated samples obtained not far from the German Coast, involve an insufficient proportion of the largest fishes of each age group and consequently lead to an under-estimate of the true average yearly growth in the German Bight as a whole.

VI.—The Proportion of the Sexes at Different Ages in the North Sea and English Channel.

Tables 20 *and* 21. *Figs.* 9 *and* 10.

In my 1907 report* I gave some data to show the proportion of the sexes in successive years of life in a collection of plaice from the North Sea, consisting of all fishes of which the sex *and* age had been recorded (by us) up to the end of 1905. To the numbers given in Table 6 of that report have been added the new records of age and sex for plaice taken in the North Sea *since* 1905 ; and the result is Table 20 below. Table 21 contains all the age-and-sex determinations for plaice collected in the Western part of the English Channel during the whole period 1904–09.

In both these collections, viz., from the North Sea and from the Western part of the English Channel respectively, we find a small majority of males in the earlier years gradually giving place to a rapidly increasing preponderance of females in the later years ; but *the age at which the change in the proportions of the sexes occurs is about two years earlier in the collection from the Channel than in that from the North Sea.*

This is shown in Figs. 9 and 10 by x, the foot of the perpendicular from the point y where the curves of male and female percentage cross one another. This is the age at which the proportion of the sexes are equal.

Now in the Western part of the English Channel, as was shown in my 1909 report, the majority of males first become mature when they are three years old (II. Group in winter), whereas in the more central parts of the North Sea (including the Leman region) the average age of males at first maturity is five years (IV. Group in winter).

Table 20.—Numbers and **Percentages** of Males and Females at different Ages in collection from the North Sea.

Age Groups		I.	II.	III.	IV.	V.	VI.	VII.	VIII. +	Total.
Year of Life		2.	3.	4.	5.	6.	7.	8.	9. +	
Males	Number	357	3,074	2,635	1,393	394	86	29	20	7,988
	Per cent.	63	56	55	51	50	42	27	13	—
Females ...	Number	207	2,429	2,142	1,333	388	120	78	135	6,832
	Per cent.	37	44	45	49	50	58	73	87	—

* Wallace, 1907, p. 34, Table 6.

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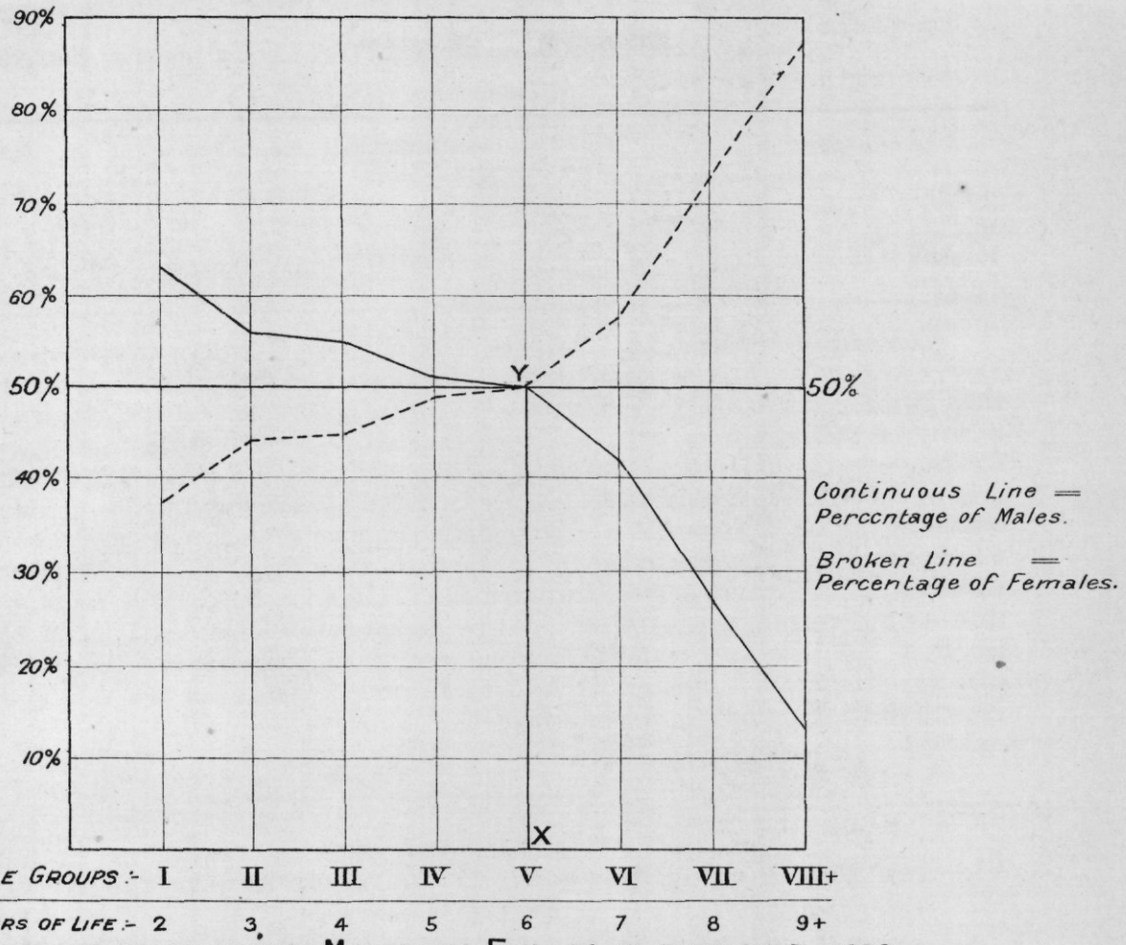

FIG. 9. SHOWING PERCENTAGE OF MALES AND FEMALES AT DIFFERENT AGES, IN A COLLECTION OF 14,820 PLAICE FROM THE NORTH SEA.
TO ILLUSTRATE TABLE 20.

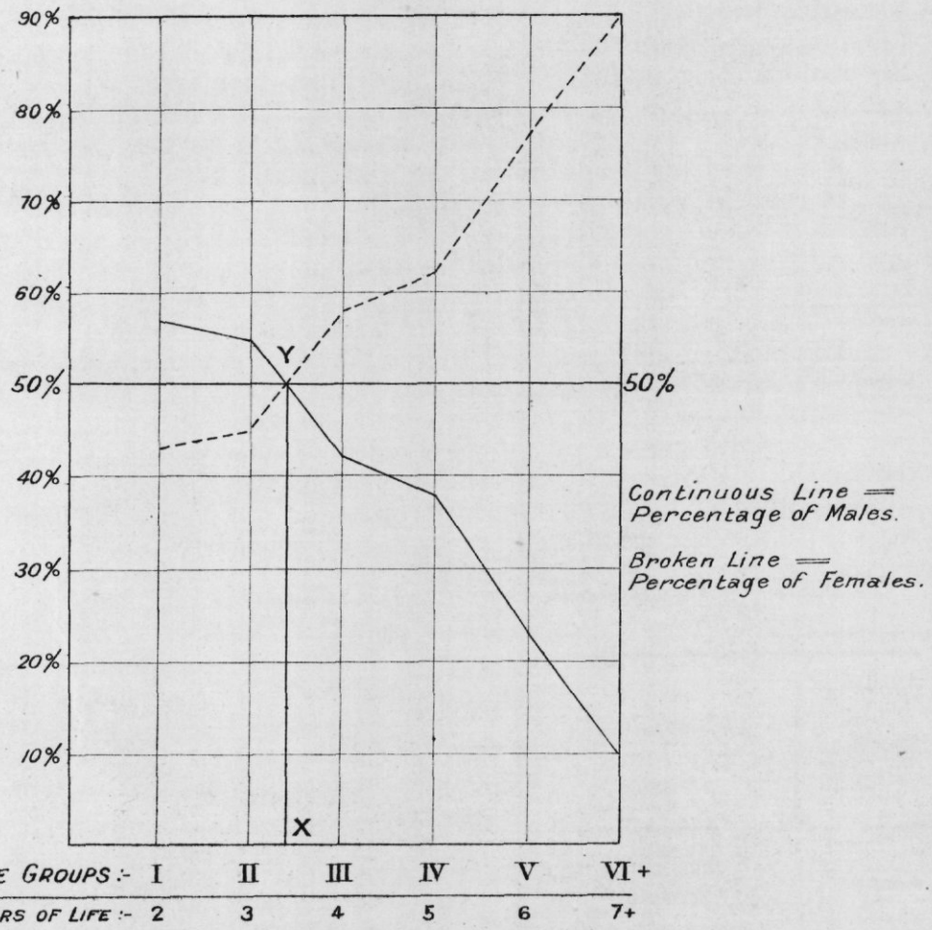

FIG. 10. SHOWING PERCENTAGE OF MALES AND FEMALES AT DIFFERENT AGES IN A COLLECTION OF 1.703 PLAICE FROM WEST BAY (ENGLISH CHANNEL.)
TO ILLUSTRATE TABLE 21.

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TABLE 21.—Numbers and **Percentages** of Males and Females at different Ages in collection from the West Bay (English Channel).

Age Group		I.	II.	III.	IV.	V.	VI. +	Total.
Year of Life		2.	3.	4.	5.	6.	7. +	
Males	Number	414	344	87	35	7	2	889
	Per cent.	57	55	42	38	23	10	—
Females	Number	313	280	122	56	23	20	814
	Per cent.	43	45	58	62	77	90	—

The connection between the advent of maturity and the decline in male preponderance would appear to be as follows :—*In each region, males are more numerous than females up to the age at which the majority of males become mature for the first time, after which, or soon after which, females begin to preponderate, the number of males diminishing somewhat rapidly.*

The reason for the *rapid* decline in the relative number of males after, or soon after, the average age at first maturity, as shown by the wide angle of divergence of the pairs of curves in Figs. 9 and 10 to the *right* of the crossing point, might be somewhat obscure, if *only* "natural" causes were at work. We know, however, that in the breeding season the catch of *ripe* males by trawlers greatly exceeds that of females on the spawning grounds, and it is possible, as Hefford* suggests, that this factor may be the cause of the *rapid* decline in the proportionate numbers of this sex after maturity is reached.

It is interesting to compare with Table 20 the German results† based on the determination of age and sex in 7,564 plaice from the South-Eastern part of the North Sea (neighbourhood of the Frisian Islands). These show a cessation of male preponderance as early as the fifth year (IV. Group) which accords well with Maier's‡ observation that the average age of males at first maturity in this region is four years (III. Group in winter), *i.e.*, about a year earlier than in the central and Northern parts of the North Sea.

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* Hefford, 1909, pp. 162–167, &c.
† Franz, 1908, p. 126, Tabelle VIII.
‡ Maier, 1907, p. 99.

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TABLE I.—Length Measurements of FEMALE PLAICE of the I. Group (second year of life) in samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	Totals.
29	The Wash	vi/06	—	1	32	378	348	133	26	8	6	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	934
31	Bridlington Bay	10/ix/06	5½–6	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
31[2]	„ „	10/ix/06	5–5½	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	3
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	1	—	2	1	4	—	—	—	—	—	1	—	—	—	—	—	—	—	9
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	1	—	—	—	—	—	3
42[1]	Off Haak's Light Vessel	13/v/06	13–15½	—	—	—	—	—	—	1	—	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
42[2]	„ „	13/v/06	12–13	—	—	—	—	1	2	6	7	6	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
45[3]	Eastern Deep Water	7/iii/06	19–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
46[2]	Between Brielle Ground and Eastern Deep Water	18/v/06	14½–15	—	—	—	—	—	—	—	1	1	1	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	—	—	—	—	—	—	—	4
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	—	—	—	—	—	—	—	1	4	3	2	2	1	—	—	—	—	—	—	—	—	13
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
53[1]	Great West Bay : "Spion Kop" Ground	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	—	3
53[2]	„ „ „ Beer Head—Berry Head	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
54[1]	„ „ „ Inside "Eastern Scruff"	28/ii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	2
54[2]	„ „ „ „ „ „	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
54[3]	„ „ „ „ „ „	1/iii/07	26–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
54[4]	„ „ „ „ „ „	1/iii/07	19–26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	1	—	—	—	3
55[1]	„ „ „ Teignmouth Bay	27/xi/07	3–4	—	—	—	—	—	—	—	—	—	2	3	5	3	3	1	—	—	1	—	—	—	—	—	—	—	—	18
55[2]	„ „ „ „ „	27/xi/07	4–4½	—	—	—	—	—	—	—	—	—	—	3	6	6	—	1	1	—	—	1	—	1	—	—	—	—	—	19
55[3]	„ „ „ „ „	28/xi/07	5½–6	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	2	3	4	7	1	1	5	2	—	1	—	28
56	„ „ „ „ „	27–28/xi/08	3½–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	3	3	2	—	2	—	—	—	13
57[1]	„ „ „ Tor Bay	6/viii/09	7–7	—	—	—	—	—	—	—	—	—	—	2	12	18	13	11	14	8	3	1	1	—	—	—	—	—	—	83
57[2]	„ „ „ „	6/viii/09	6–7	—	—	—	—	—	—	—	—	—	—	—	1	4	2	6	5	—	1	2	1	—	—	—	—	—	—	22
57[3]	„ „ „ „	6/viii/09	3–5	—	—	—	—	—	—	—	—	—	—	—	—	2	1	6	—	3	1	—	1	—	—	1	—	—	—	15
57[4]	„ „ „ „	7/viii/09	5–7	—	—	—	—	—	—	—	—	—	—	4	5	6	11	15	12	11	—	2	—	—	—	—	—	—	—	66
58[1]	„ „ „ Start Bay	9/viii/09	7–13	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	3
58[2]	„ „ „ „	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	1	5	5	—	2	—	—	—	—	—	—	—	—	—	13
58[3]	„ „ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	—	—	1	—	—	—	—	—	4
58[4]	„ „ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	3	1	1	—	—	—	—	—	—	—	8

TABLE Ia.—Length Measurements of MALE PLAICE of the I. Group (second year of life) in Samples collected during the period 1906–09.

N.B.—New Age-groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.)	Centimetres. 7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	7.	28.	Totals
32^{5}	Flamborough Off	28/iii/06	24–30	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39^{2}	East of South end of Well Bank	14/iii/06	$18\frac{1}{2}$–21	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
39^{4}	Leman Ground	14/iii/06	16–$16\frac{1}{2}$	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39^{5}	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	1	2	2	—	—	—	—	—	—	—	—	—	—	—	—	5
39^{6}	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	1	—	4	1	—	—	—	—	—	—	—	—	—	6
39^{7}	Along E. side of Swart Bank	16/iii/06	14–17	—	—	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	3
40^{1}	Between Broken and Swart Banks	10/v/06	17	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
40^{3}	Leman Ground	11/v/06	13–15	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
42^{1}	Off Haaks Light Vessel	13/v/06	13–$15\frac{1}{2}$	—	—	—	2	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
42^{2}	„ „	13/v/06	12–13	—	1	9	13	12	4	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	43
45^{1}	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	1	1	—	—	2	—	—	—	—	—	—	—	—	—	4
45^{3}	„ „	7/iii/06	$18\frac{1}{2}$–23	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
45^{6}	Between Middle and Winterton Shoals	11/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2
46^{1}	Brielle Ground	18/v/06	12–$14\frac{1}{2}$	—	—	1	1	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
46^{2}	Between Brielle Ground and Eastern Deep Water	18/v/06	$14\frac{1}{2}$–15	—	—	—	—	2	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	—	—	—	5	1	2	—	—	—	—	—	—	—	—	8
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	—	—	1	11	21	29	10	14	7	2	1	1	—	—	—	—	—	97
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
53^{1}	Great West Bay: "Spion Kop" Ground	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	2
53^{2}	„ „ Between Beer Head and Berry Head	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	2	3	2	2	—	1	1	13
54^{2}	„ „ Inside "Eastern Scruff"	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	1	1	1	—	1	—	2	—	—	—	—	—	6
54^{3}	„ „ „ „ „	1/iii/07	26–30	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	2
55^{1}	„ „ Teignmouth Bay	27/xi/07	3–4	—	—	—	—	—	—	—	1	5	5	1	1	—	—	—	—	—	—	—	—	—	—	13
55^{2}	„ „ „ „	27/xi/07	4–$4\frac{1}{2}$	—	—	—	—	—	—	3	1	3	2	3	2	—	—	—	—	—	—	—	—	—	—	14
55^{3}	„ „ „ „	28/xi/07	$5\frac{1}{2}$–6	—	—	—	—	—	—	—	—	1	1	1	2	4	4	4	4	3	4	3	2	—	1	34
56	„ „ „ „	27–28/xi/08	$3\frac{1}{2}$–$4\frac{1}{2}$	—	—	—	—	—	—	—	—	1	—	—	—	1	1	3	3	4	2	1	—	—	—	16
57^{1}	„ „ Tor Bay	6/viii/09	7	—	—	—	—	—	1	—	9	8	15	26	20	17	14	10	2	1	—	—	—	—	—	123
57^{2}	„ „ „	6/viii/09	6–7	—	—	—	—	—	—	—	—	1	5	8	10	5	6	4	—	—	—	—	—	—	—	39
57^{3}	„ „ „	6/viii/09	3–5	—	—	—	—	—	—	—	1	—	1	4	4	5	—	4	1	—	—	—	—	—	—	20
57^{4}	„ „ „	7/viii/09	5–7	—	—	—	—	—	—	—	2	8	13	14	19	11	9	2	1	1	1	—	—	—	—	81
58^{1}	„ „ Start Bay	9/viii/09	7–13	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	2
58^{2}	„ „ „	9/viii/09	7–8	—	—	—	—	—	1	—	—	1	4	3	7	5	—	—	—	—	—	—	—	—	—	21
58^{3}	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	1	—	—	—	—	—	4
58^{4}	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	1	2	—	—	—	—	—	7

TABLE II.—Length Measurements of FEMALE PLAICE of the II. Group (third year of life) in Samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth. (fms.)	Centimetres. 6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36	37.	Totals.
29	The Wash	vi/06	—	17	56	83	64	79	74	87	94	44	15	7	11	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	632
30	Bridlington Bay	26/vi/06	10½–10½	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
31[1]	„ „	10/ix/06	5½–6	—	—	—	—	—	—	3	—	3	14	15	7	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	44
31[2]	„ „	10/ix/06	5–5½	—	—	—	—	—	—	—	—	3	4	1	5	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15
31[3]	„ „	11/ix/06	6	—	—	—	—	—	—	—	1	1	3	1	6	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
32[1]	Flamborough Off Ground	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	2
32[2]	„ „	23/iii/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
32[4]	„ „	23/iii/06	29	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
32[5]	„ „	28/iii/06	24–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[8]	„ „	22/x/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
37[2]	Horn Reef Outer Ground	25/ix/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
37[3]	„ „	26/ix/06	21–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2
39[2]	East of South end of Well Bank ...	14/iii/06	18½–21	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2
39[3]	Between South ends of Well and Swarte Banks.	—	16½–19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
39[4]	Leman Ground	—	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	1	1	2	—	1	—	—	—	—	—	—	—	—	—	—	8
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	2	—	2	1	4	—	1	1	—	—	—	—	—	—	—	—	—	—	14
39[7]	Along East side of Swarte Bank ...	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	1	2	—	2	2	2	3	—	—	—	—	—	—	—	—	—	—	14
39[8]	North-East of Smith's Knoll Light Vessel	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
40[1]	Between Broken and Swarte Banks ...	10/v/06	17	—	—	—	—	—	1	—	1	—	2	—	—	1	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	—	3	1	—	—	1	1	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
40[3]	„ „	11/v/06	13–15	—	—	—	2	—	4	4	2	8	8	12	7	4	4	3	3	1	3	—	3	1	—	—	—	—	—	—	—	—	—	—	—	69
40[5]	Between Leman Ground and middle of Brown Ridges.	11/v/06	17	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[1]	Brown Bank Ground	12/v/06	16½–17	—	—	—	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6
41[2]	„ „	12/v/06	15½–16½	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	—	—	—	1	4	4	1	—	2	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	—	—	—	—	1	2	2	6	4	1	—	3	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
42[1]	„ „ „	13/v/06	13–15½	—	—	—	—	3	6	12	23	21	17	6	6	7	7	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	109
42[2]	„ „ „	13/v/06	12–13	—	—	—	2	11	50	62	87	77	37	33	22	11	7	7	5	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	413
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	—	—	1	8	7	6	7	8	8	9	4	1	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	62
44	„ „	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	—	1	—	4	12	18	23	19	24	22	7	1	—	1	—	—	—	—	—	—	—	—	—	—	132

TABLE II.—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth. (fms.)	Centimetres. 6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	Totals.
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	5
45[2]	„ „	7/iii/06	18½–23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	—	1	—	—	—	—	—	—	—	—	4
45[3]	„ „	7/iii/06	19–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
45[4]	„ „	7/iii/06	18½–20	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	2	—	1	—	—	—	—	—	1	—	—	—	—	—	—	6
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	1	1	3	7	8	9	16	12	7	16	10	7	5	4	1	2	1	—	—	—	—	—	—	—	—	—	—	—	—	110
46[2]	Between Brielle Ground and Eastern Deep Water.	18/v/06	14½–15	—	—	—	—	—	2	4	8	14	12	9	16	15	9	12	12	12	2	4	1	—	—	—	—	—	—	—	—	—	—	—	—	132
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	—	2	—	—	1	1	1	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	8
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	—	—	—	—	2	5	6	11	17	21	5	2	1	—	—	—	—	—	—	—	—	—	—	—	70
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	—	—	—	—	—	—	—	1	1	4	4	1	5	6	7	4	3	2	—	—	—	—	—	—	—	—	—	38
52	Schouwen Ground	29/iv/09	15–17	—	—	—	—	—	—	2	3	15	10	15	11	6	5	3	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	72
53[1]	Great West Bay : "Spion Kop" Ground	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	1	1	—	—	—	—	—	—	5
53[2]	„ „ Beer Head—Berry Head.	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	1	—	2	2	—	2	—	1	—	—	1	12
54[1]	„ „ Inside "Eastern Scruff."	28/ii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	2	—	—	1	—	1	1	—	—	—	8
54[2]	„ „ „ „ „	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	4	2	—	—	1	—	1	—	—	—	—	—	—	13
54[3]	„ „ „ „ „	1/iii/07	26–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	—	—	1	1	—	—	—	—	—	6
55[1]	„ „ Teignmouth Bay ...	27/xi/07	3–4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
55[2]	„ „ „ „ ...	27/xi/07	4–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
55[3]	„ „ „ „ ...	28/xi/07	5½–6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	2	2	3	6	3	1	—	—	1	1	—	—	22
56	„ „ „ „ ...	27–28/xi/08	3½–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	6	8	15	28	21	20	17	11	6	3	1	1	—	—	140
57[1]	„ „ Tor Bay	6/viii/09	7–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	—	—	1	—	—	—	4
57[2]	„ „ „	6/viii/09	6–7	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	2
57[3]	„ „ „	6/viii/09	3–5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	3
57[4]	„ „ „	7/viii/09	5–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	1	2	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	11
58[1]	„ „ Start Bay	9/viii/09	7–13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	3
58[2]	„ „ „	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	2
58[3]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	—	—	—	—	—	3
58[4]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	—	—	—	—	—	—	3

TABLE II.*a*.—Length Measurements of MALE PLAICE of the II. Group (third year of life) in samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	Totals.
30	Bridlington Bay	26/vi/06	10¼–10½	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
31[1]	„ „	10/ix/06	5½–6	—	—	—	—	2	8	13	14	5	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	46
31[2]	„ „	10/ix/06	5–5½	—	—	—	—	1	3	4	3	3	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
31[3]	„ „	11/ix/06	6	—	—	—	—	—	2	7	13	6	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	29
32[1]	Flamborough Off Ground	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	1	1	1	1	—	—	—	—	1	—	—	—	—	—	—	—	—	5
32[2]	„ „	23/iii/06	26	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
32[3]	„ „	23/iii/06	26–29	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3
32[4]	„ „	23/iii/06	29	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[8]	„ „	22/x/06	26	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
35	„ „	18–22/viii/06	24–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
36[2]	Dogger Bank—South part	16/x/06	13–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
37[5]	Horn Reef Outer Ground	26/ix/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
39[1]	Off Smith's Knoll Light Vessel	14/iii/06	12–17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
39[2]	East of South end of Well Bank	14/iii/06	18½–21	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[3]	Between South ends of Well and Swarte Banks... ...	14/iii/06	16½–19	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	2	—	1	1	2	—	—	—	1	—	—	—	—	—	—	—	—	7
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	1	1	4	6	1	6	2	2	3	—	—	—	—	—	—	—	26
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	2	—	2	3	2	—	2	—	3	—	1	1	—	—	—	—	—	—	16
39[8]	North-east of Smith's Knoll Light Vessel...	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	3
40[1]	Between Broken and Swarte Banks	10/v/06	17	—	1	—	—	—	—	—	1	—	2	1	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	8
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	2	—	—	2	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	6
40[3]	„ „	11/v/06	13–15	—	1	8	4	2	4	4	8	8	5	3	3	3	3	1	1	—	—	—	—	—	—	—	—	—	—	58
40[4]	„ „	11/v/06	15–17	—	—	—	—	—	1	—	1	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	4
40[5]	Between Leman Ground and middle of Brown Ridges...	11/v/06	17	—	—	1	2	1	2	4	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
41[1]	Brown Bank Ground...	12/v/06	16½–17	—	—	—	1	1	3	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9
41[2]	„ „	12/v/06	15½–16½	—	—	—	—	—	1	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	2	1	4	1	8	2	2	1	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	25
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	1	2	3	2	6	1	1	5	4	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	28
42[1]	„ „ „	13/v/06	13–15½	—	—	7	26	31	41	47	14	14	5	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	190
42[2]	„ „ „	13/v/06	12–13	5	26	75	78	88	60	49	24	22	13	4	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	447
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	1	4	7	7	16	23	17	9	4	—	3	—	—	—	1	—	—	—	—	—	—	—	—	92
44	„ „	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	4	20	25	49	36	13	6	7	1	—	1	—	—	—	—	—	—	—	162

TABLE II.*a*—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	Totals.
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	1	—	2	2	—	2	1	—	—	—	—	1	—	—	—	—	—	—	—	—	9
45[2]	„ „	7/iii/06	18½–23	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	—	—	—	—	—	—	—	—	—	—	4
45[3]	„ „	7/iii/06	19–20	—	—	—	—	—	—	—	1	1	—	1	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	6
45[4]	„ „	7/iii/06	18½–20	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2
45[5]	„ „	10/iii/06	23–25	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2
45[6]	Between Middle and Winterton Shoals	11/iii/06	22–25	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
46[1]	Brielle Ground	18/v/06	12–14½	—	2	7	11	21	17	20	8	11	11	10	6	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	128
46[2]	Between Brielle Ground and Eastern Deep Water ...	18/v/06	14½–15	—	1	1	7	14	22	30	32	32	24	21	11	4	3	—	—	—	—	—	—	—	—	—	—	—	—	—	202
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	3	2	1	1	4	3	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	17
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	1	—	1	—	1	2	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	9
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
49[2]	Off Sandette Light Vessel	29/xi/06	17–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—	—	—	4
49[3]	„ „ „	29/xi/06	16–21	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	—	—	4	11	15	20	11	3	2	—	1	1	—	—	—	—	—	—	—	68
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	—	1	4	14	17	42	42	34	45	18	10	7	2	2	—	1	—	1	—	—	—	—	240
52	Schowen Ground	29/iv/08	15–17	—	—	—	2	8	10	19	21	15	4	10	5	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	97
53[1]	Great West Bay: "Spion Kop" Ground	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	2
53[2]	„ „ Beer Head—Berry Head	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	1	—	2	2	3	1	—	4	4	—	1	3	—	1	1	—	1	24
54[1]	„ „ Inside "Eastern Scruff"	28/ii/07	21–30	—	—	—	—	—	—	—	—	1	—	1	—	2	—	—	3	1	1	—	—	—	—	—	—	—	—	—	9
54[2]	„ „ „ „ „	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	1	1	—	—	—	—	1	—	—	—	1	—	8
54[3]	„ „ „ „ „	1/iii/07	26–30	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	3
54[4]	„ „ „ „ „	1/iii/07	19–26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
55[2]	„ „ Teignmouth Bay	27/xi/07	4–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2	—	—	—	—	—	—	4
55[3]	„ „ „ „	28/xi/07	5½–6	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	1	1	—	—	3	2	1	—	2	1	—	14
56	„ „ „ „	27–28/xi/08	3½–4½	—	—	—	—	—	—	—	—	1	—	—	6	1	2	3	5	14	29	50	48	27	14	7	—	—	—	—	207
57[1]	„ „ Tor Bay	6/viii/09	7–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	2	—	—	—	—	—	—	7
57[2]	„ „ „	6/viii/09	6–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—	3
57[3]	„ „ „	6/viii/09	3–5	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2
57[4]	„ „ „	7/viii/09	5–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	—	—	—	—	—	—	4
58[1]	„ „ Start Bay	9/viii/09	7–13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	2
58[2]	„ „ „	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	1	—	1	—	—	6
58[3]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	2	—	1	—	—	—	6
58[4]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	1	1	1	—	—	—	—	—	7

TABLE III.—Length Measurements of FEMALE PLAICE of the III. Group (fourth year of life) in Samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date	Depth (fms.).	Centimetres. 10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38	39.	40.	41.	42	43.	Totals.
29	The Wash	vi/06	—	2	—	10	13	15	11	7	4	3	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	69
30	Bridlington Bay	26/vi/06	10¼–10½	—	—	—	—	—	—	—	—	5	1	3	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	11
31[1]	,, ,, ...	10/ix/06	5½–6	—	—	—	—	—	—	2	3	—	—	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
31[2]	,, ,, ...	10/ix/06	5–5½	—	—	—	—	—	—	2	—	4	2	3	5	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
31[3]	,, ,, ...	11/ix/06	6	—	—	—	—	—	—	2	1	1	4	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10
32[1]	Flamborough Off Ground ...	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
32[3]	,, ,, ...	23/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—	—	—	—	4
32[5]	,, ,, ...	28/iii/06	24–30	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
33[1]	,, ,, ...	20/x/06	29–31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[2]	,, ,, ...	20/x/06	29–32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
33[3]	,, ,, ...	21/x/06	32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[8]	,, ,, ...	22/x/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	5
34	,, ,, ...	2–5/vi/08	24–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
35	,, ,, ...	18–22/viii/08	24–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	3	1	1	2	1	—	—	—	—	—	—	—	—	—	11
36[1]	South-west Patch of Dogger Bank	16/x/06	10–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
36[3]	Dogger Bank—South part ...	17/x/06	10–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
37[1]	Horn Reef Outer Ground ...	25/ix/06	24–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	3
37[2]	,, ,, ...	25/ix/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
37[3]	,, ,, ...	26/ix/06	21–25	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	4	3	4	1	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	17
37[5]	,, ,, ...	26/ix/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	2	7	2	5	1	3	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	24
38[2]	Clay Deep, edge of Dogger ...	27/ix/06	17–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
39[1]	Off Smith's Knoll Light Vessel ...	14/iii/06	21–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
39[5]	,, ,, ...	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
39[6]	,, ,, ...	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	1	1	—	2	1	—	1	—	—	—	—	—	—	—	—	—	—	10
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	2	1	—	1	1	1	4	1	2	1	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	17
39[8]	North-east of Smith's Knoll Light Vessel.	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
40[1]	Between Broken and Swarte Banks.	10/v/06	17	—	—	—	—	—	—	—	—	1	3	4	4	2	2	2	2	2	2	4	1	3	—	—	—	—	—	—	—	—	—	—	—	—	—	32
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	1	—	1	2	2	2	2	3	6	—	2	1	1	3	1	—	—	—	—	—	—	—	—	—	—	—	—	27
40[3]	,, ,, ...	11/v/06	13–15	—	—	1	—	—	—	3	—	3	5	5	2	6	9	8	8	3	5	1	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	62
40[4]	,, ,, ...	11/v/06	15–17	—	—	—	—	—	—	—	—	2	—	1	—	2	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8

TABLE III—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	Totals.
40[5]	Between Leman Ground and Middle of Brown Ridges.	11/v/06	17	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[1]	Brown Bank Ground	12/v/06	16½–17	—	—	—	—	1	1	—	—	—	—	1	—	1	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6
41[2]	„ „	12/v/06	15½–16½	—	—	—	—	—	—	—	—	—	1	—	—	2	—	1	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	6
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	—	1	1	—	1	1	3	1	3	3	6	5	3	3	2	2	2	1	—	—	—	—	—	—	—	—	—	—	—	38
41[4]	Off Haak's Light Vessel... ..	13/v/06	15½–16½	—	—	—	—	—	—	—	1	—	—	1	2	6	3	7	3	1	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	28
42[1]	„ „ „	13/v/06	13–15½	—	—	—	—	—	2	—	3	2	10	4	6	9	5	9	4	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	57
42[2]	„ „ „	13/v/06	12–13	—	—	1	1	—	6	13	13	9	20	18	9	19	7	8	7	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	135
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	—	—	—	1	—	1	5	7	7	10	10	13	7	2	2	1	1	—	—	—	—	—	—	—	—	—	—	—	67
44	„ „	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	1	—	1	3	13	30	30	40	23	17	6	1	1	2	—	—	—	—	—	—	—	—	—	—	168
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	4
45[2]	„ „	7/iii/06	18½–23	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
45[3]	„ „	7/iii/06	19–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
45[6]	Between Middle and Winterton Shoals.	11/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	2	1	3	2	4	5	14	13	9	7	2	2	—	1	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	69
46[2]	Between Brielle Ground and Eastern Deep Water.	18/v/06	14½–15	—	—	—	1	—	—	1	7	8	11	14	11	13	11	15	9	13	2	4	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	121
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	—	—	1	—	—	1	1	2	2	1	3	3	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	15
48[1]	Edge of Eastern Deep Water ...	18/v/06	19–20	—	—	—	—	—	—	—	—	—	1	—	—	2	1	1	1	1	1	2	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	12
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	1	—	—	1	—	1	—	—	—	—	—	—	—	—	—	5
49[1]	Off Sandette Light Vessel ...	29/v/06	20–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2	1	1	1	—	—	—	—	—	—	—	—	—	6
49[2]	„ „ ...	29/v/06	17–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	—	—	2	2	9	17	16	10	12	9	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	79
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	—	—	—	—	—	1	5	2	11	23	26	24	8	9	6	6	2	1	2	1	—	—	—	—	—	—	—	—	—	127
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	—	—	1	—	3	4	4	7	3	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
53[1]	Great West Bay : "Spion Kop" Ground.	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	—	—	3	—	—	—	—	—	—	—	—	—	7
53[2]	„ „ „ Beer Head—Berry Head.	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	1	—	1	—	—	—	—	1	—	—	—	—	—	6
54[1]	„ „ „ "Inside Eastern Scruff."	28/ii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	4
54[2]	„ „ „ „ „	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	2	—	1	2	4	3	1	—	2	—	—	—	—	—	—	—	—	—	19
54[3]	„ „ „ „ „	1/iii/07	26–30	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	2	—	1	—	—	1	—	1	—	—	—	1	—	—	—	—	—	8
54[4]	„ „ „ „ „	1/iii/07	19–26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

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TABLE IIIa—*continued*.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	Totals.
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	3	1	1	—	1	—	—	—	—	—	—	—	—	—	9
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	1	1	4	2	1	4	1	2	2	2	2	1	—	1	—	—	—	—	—	—	—	24
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	4
39[8]	North-east of Smith's Knoll	17/iii/06	22–25	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
40[1]	Between Broken Bank and Swarte Bank ...	10/v/06	17	1	—	—	1	—	1	2	4	3	4	2	3	2	—	4	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	29
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	2	—	1	—	6	3	3	3	3	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	23
40[3]	„ „	11/v/06	13–15	1	—	1	3	1	2	2	4	11	2	5	5	6	4	3	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	54
40[4]	„ „	11/v/06	15–17	—	—	—	—	—	—	1	1	2	—	2	3	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
40[5]	Between Leman Ground and Middle of Brown Ridges.	11/v/06	17	1	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
41[1]	Brown Bank Ground	12/v/06	16½–17	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
41[2]	„ „ „	12/v/06	15½–16½	—	—	—	—	—	—	—	1	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
41[3]	„ „ „	12/v/06	15½–16½	—	—	—	1	—	—	2	2	3	3	8	6	3	8	2	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	41
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	—	1	—	4	3	5	5	5	6	3	3	4	3	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	47
42[1]	„ „	13/v/06	13–15½	—	—	—	1	1	8	7	4	13	16	8	11	6	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	76
42[2]	„ „	13/v/06	12–13	—	—	2	5	8	15	22	22	21	15	14	2	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	132
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	2	1	6	9	4	16	13	13	12	18	8	3	3	3	—	1	1	—	—	—	—	—	—	—	—	—	113
44	„ „	22–24/vii/08	15–17	—	—	—	—	—	—	—	2	5	9	15	25	49	36	23	30	16	4	2	—	—	—	—	—	—	—	—	—	—	—	216
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	1	—	1	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	5
45[2]	„ „ „	7/iii/06	18½–23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	2
45[3]	„ „ „	7/iii/06	19–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	1	—	—	—	—	—	—	3
45[4]	„ „ „	7/iii/06	18½–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
45[5]	„ „ „	10/iii/06	23–25	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	1	1	—	—	—	1	1	—	1	—	—	—	—	—	—	7
45[6]	Between Middle and Winterton Shoals ...	11/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	4	5	10	7	7	7	8	3	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	54
46[2]	Between Brielle Ground and Eastern Deep Water	18/v/06	14½–15	—	—	—	1	4	4	10	13	15	18	9	8	9	11	5	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	112
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	1	1	3	5	5	2	3	2	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	25
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	1	—	—	3	—	—	5	6	2	3	—	2	1	—	2	—	—	—	—	—	—	—	—	—	—	—	25
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	1	2	1	2	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	9
49[1]	Off Sandette Light Vessel	29/xi/06	20–22	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1	—	1	—	—	—	—	—	—	—	—	—	4
49[2]	„ „	29/xi/06	17–20	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	4
49[3]	„ „	29/xi/06	16–21	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	—	—	9	13	22	36	22	24	8	7	5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	147
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	1	—	2	12	22	30	47	49	52	35	39	21	36	9	7	7	6	1	—	—	—	—	—	—	—	—	—	376
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	1	—	2	3	5	1	3	2	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20
53[1]	Great West Bay: "Spion Kop" Ground ...	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	2

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TABLE IV—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38	39.	40.	41.	42.	43.	44.	45.	46.	47.	Totals.
35	Flamborough Off Ground ...	18–22/viii/08	24–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	5	10	10	10	12	10	2	4	1	—	—	—	—	—	—	—	—	—	68
36[1]	S.W. Patch of Dogger Bank...	16/x/06	10–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
36[2]	Dogger Bank—South part ...	16/x/06	13–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
36[3]	,, ,, ,, ...	17/x/06	10–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	3
37[1]	Horn Reef Outer Ground ...	25/ix/06	24–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
37[2]	,, ,, ,, ...	25/ix/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
37[3]	,, ,, ,, ...	26/ix/06	21–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
37[5]	,, ,, ,, ...	26/ix/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	3
38[1]	Clay Deep, edge of Dogger ...	27/ix/06	15–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	2
38[2]	,, ,, ,, ...	27/ix/06	17–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
39[5]	,, ,, ...	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	1	—	—	1	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	7
39[6]	,, ,, ...	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	5
39[7]	Along East side of Swarte Bank.	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	4
39[8]	North-east of Smith's Knoll Light Vessel.	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
40[1]	Between Broken and Swarte Banks.	10/v/06	17	—	—	—	—	—	—	—	—	1	1	—	—	6	3	2	—	1	5	6	1	2	2	1	—	—	—	—	—	—	—	—	—	—	—	—	31
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	—	—	—	—	—	—	1	4	4	2	3	2	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	19
40[3]	,, ,, ...	11/v/06	13–15	—	—	—	—	—	—	—	—	—	1	2	2	1	4	2	6	4	2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25
40[4]	,, ,, ...	11/v/06	15–17	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	5
40[5]	Between Leman Ground and middle of Brown Ridges.	11/v/06	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
41[1]	Brown Bank Ground	12/v/06	16½–17	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[2]	,, ,, ...	12/v/06	15½–16½	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	3
41[3]	,, ,, ...	12/v/06	15½–16½	—	—	—	—	—	—	—	—	—	—	—	—	2	1	4	3	3	3	3	4	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	26
41[4]	Off Haak's Light Vessel ...	13/v/06	15½–16½	—	—	—	—	—	—	—	—	1	—	—	1	2	2	3	5	4	3	1	1	3	1	—	—	—	—	—	—	—	—	—	—	—	—	—	27
42[1]	,, ,, ,, ...	13/v/06	13–15½	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	2	1	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11
42[2]	,, ,, ,, ...	13/v/06	12–13	—	—	—	—	1	—	—	—	1	2	—	5	—	1	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	—	—	—	—	—	2	3	3	8	12	9	9	7	6	12	2	4	1	2	—	—	—	—	—	—	—	—	—	—	—	80
44	,, ,, ...	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	—	1	3	6	11	7	12	9	8	5	6	1	1	4	—	—	1	—	—	—	—	—	—	—	—	—	75
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
45[3]	,, ,, ...	7/iii/06	19–20	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
45[4]	,, ,, ...	7/iii/06	18½–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
45[5]	,, ,, ...	10/iii/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	—	—	—	—	—	—	1	1	2	1	1	1	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	9

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TABLE IV.*a*.—*continued*.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	28.	39.	40.	41.	42.	Totals.
32[1]	Flamborough Off Ground	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	3
32[2]	„ „	23/iii/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
32[3]	„ „	23/iii/06	26–29	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	2	—	2	2	1	2	—	1	—	1	12
32[5]	„ „	28/iii/06	24–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
33[4]	„ „	21/x/06	29–32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
33[6]	„ „	21/x/06	29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	1	—	—	—	3
33[7]	„ „	22/x/06	26–28	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	4
33[8]	„ „	22/x/06	26	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	1	1	2	—	—	—	—	—	—	—	—	6
33[10]	„ „	22/x/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
33[11]	„ „	23/x/06	29–33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[12]	„ „	23/x/06	30–33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
34	„ „	2–5/vi/08	24–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	1	—	—	—	—	—	—	4
35	„ „	18–22/viii/08	24–28	—	—	—	—	—	—	—	—	—	—	1	—	1	2	4	12	7	6	2	2	—	—	—	—	—	—	—	37
37[1]	Horn Reef Outer Ground	25/ix/06	24–25	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
37[2]	„ „	25/ix/06	23–25	—	—	—	—	—	—	—	—	1	—	1	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	4
37[3]	„ „	26/ix/06	21–25	—	—	—	—	—	—	—	—	—	—	—	3	—	2	—	1	1	—	—	—	—	—	—	—	—	—	—	7
37[5]	„ „	26/ix/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	1	1	—	—	—	—	—	—	—	—	—	5
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	2
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	1	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	3
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	2	—	—	—	—	—	—	—	—	—	—	—	4
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	1	—	—	—	—	—	—	2	1	—	1	—	—	—	1	—	—	—	—	—	—	—	—	6
40[1]	Between Broken Bank and Swarte Bank	10/v/06	17	—	—	—	—	—	1	—	4	1	1	2	4	3	4	—	3	2	—	1	—	—	—	—	—	—	—	—	26
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	1	—	5	3	3	1	2	1	4	1	5	—	—	—	—	—	—	—	—	—	—	26
40[3]	„ „	11/v/06	13–15	—	—	—	1	1	2	1	4	7	2	4	4	4	3	3	2	2	1	—	—	—	—	—	—	—	—	—	41
40[4]	„ „	11/v/06	15–17	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	1	1	—	—	—	—	—	—	—	—	—	—	5
40[5]	Between Leman Ground and Middle of Brown Ridges	11/v/06	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
41[2]	Brown Bank Ground	12/v/06	15½–17	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	—	2	1	1	3	2	1	8	6	5	4	6	—	1	—	—	—	—	—	—	—	—	—	40
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	1	—	—	1	1	—	1	3	2	3	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	16
42[1]	„ „	13/v/06	13–15½	—	—	—	—	1	2	—	—	1	—	3	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	9
42[2]	„ „	13/v/06	12–13	—	—	—	—	—	2	1	2	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
43	Leman Ground	9–12/vi/08	15–18	—	—	—	2	1	—	3	2	2	7	14	17	13	16	10	6	4	—	1	—	1	1	—	—	—	—	—	100
44	„ „	22–24/viii/08	15–17	—	—	—	—	—	—	2	5	2	16	15	21	19	14	9	4	1	—	1	—	—	—	—	—	—	—	—	109
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	1	—	1	2	—	1	1	—	—	—	—	—	9
45[2]	„ „	7/iii/06	18½–23	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2
45[4]	„ „	7/iii/06	18½–20	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—	—	1	1	—	—	—	—	—	—	—	5
45[5]	„ „	10/iii/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	2

45[6]	Between Middle and Winterton Shoals	11/iii/06	22–25	—	—	—	—	—	—	1	—	—	—	—	—	2	1	—	—	—	1	—	—	—	—	—	—	—	—	—	5
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	1	—	1	1	2	1	2	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	12
46[2]	Between Brielle Ground and Eastern Deep Water ...	18/v/06	14½–15	—	—	—	—	—	—	2	—	1	4	4	3	4	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	21
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	1	1	1	1	2	2	1	—	—	—	2	3	—	—	—	—	—	—	—	—	—	—	14
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	1	—	—	—	1	2	4	4	2	3	4	2	3	—	—	—	—	—	—	—	—	—	—	—	26
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	1	—	—	—	3	2	—	—	—	—	1	1	3	—	1	—	—	—	—	—	—	—	—	—	12
49[1]	Off Sandette Light Vessel	29/xi/06	20–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
49[2]	„ „	29/xi/06	17–20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
49[3]	„ „	29/xi/06	16–21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
50	Schouwen Ground	2/xii/07	15–17	—	—	—	—	—	—	1	1	3	7	4	3	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	2	—	3	1	6	8	7	23	3	8	6	7	5	2	1	5	1	1	1	1	—	—	—	—	91
52	Schouwen Ground	29/iv/08	15–17	—	—	—	1	1	3	8	2	1	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19
53[1]	Great West Bay : "Spion Kop" Ground...	12/ii/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	2
53[2]	„ „ Beer Head—Berry Head	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	5
54[1]	„ „ Inside "Eastern Scruff"	28/ii/07	21–30	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	3
54[2]	„ „ „ „ „	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	2
55[2]	„ „ Teignmouth Bay	27/xi/07	4–4½	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
56	„ „ „ „	27–28/xi/08	3½–4½	—	—	—	—	—	—	—	—	—	—	—	2	—	2	1	—	3	2	2	—	—	—	—	—	—	—	—	—	12
57[2]	„ „ Tor Bay	6/viii/09	6–7	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
58[2]	„ „ Start Bay	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	3
58[4]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	2

TABLE V.—Length Measurements of FEMALE PLAICE of the V. Group (sixth year of life) in Samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres.																												Totals.
				20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	
32[1]	Flamborough Off Ground	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	3
32[2]	„ „ „	23/iii/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	2
32[3]	„ „ „	23/iii/06	26–29	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	1	1	1	—	—	1	1	2	—	—	—	—	10
32[5]	„ „ „	28/iii/06	24–30	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2
33[2]	„ „ „	20/x/06	29–32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
33[3]	„ „ „	21/x/06	32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
33[5]	„ „ „	21/x/06	29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—	—	—	3
33[6]	„ „ „	21/x/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	1	—	—	—	—	—	—	—	3
33[7]	„ „ „	22/x/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—	—	—	—	3
33[9]	„ „ „	22/x/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	1	2	—	—	1	—	—	—	—	6
33[10]	„ „ „	22/x/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	—	1	—	—	—	—	—	4

TABLE V.—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres.																										Totals.
				20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47	48.	
33[11]	Flamborough Off Ground	23/x/06	29–33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
33[12]	„ „ „	23/x/06	30–33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	2
33[13]	„ „ „	23/x/06	30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
34	„ „ „	2–5/vi/08	24–25	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2	1	4	1	1	—	—	1	—	—	—	—	11
35	„ „ „	18–22/viii/08	24–28	—	—	—	—	—	—	—	—	—	—	—	—	2	—	3	3	2	6	3	2	2	2	—	—	—	—	—	—	25
36[2]	Dogger Bank—South part	16/x/06	13–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
36[3]	„ „ „	17/x/06	10–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	2
37[1]	Horn Reef Outer Ground	25/ix/06	24–25	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	3
37[2]	„ „ „	25/ix/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
37[3]	„ „ „	26/ix/06	21–25	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
37[5]	„ „ „	26/ix/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	1	—	—	1	—	—	4
38[1]	Clay Deep, edge of Dogger	27/ix/06	15–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
38[2]	„ „ „	27/ix/06	17–22	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[1]	Off Smith's Knoll Light Vessel	14/iii/06	21–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[4]	Leman Ground	14/iii/06	16–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
39[5]	„ „	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	3
39[6]	„ „	16/iii/06	14–16	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
39[8]	North-east of Smith's Knoll Light Vessel ...	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
40[1]	Between Broken and Swarte Banks	10/v/06	17	1	—	—	—	—	1	—	—	—	1	—	—	—	1	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	7
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	—	—	2	—	—	—	—	1	2	1	—	—	—	—	—	—	—	—	—	—	—	—	6
40[3]	„ „	11/v/06	13–15	—	—	—	—	—	—	—	—	1	2	1	—	1	2	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	11
40[4]	„ „	11/v/06	15–17	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
40[5]	Between Leman Ground and Middle of Brown Ridges.	11/v/06	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	1	—	—	—	—	—	—	3
41[1]	Brown Bank Ground	12/v/06	16½–17	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[2]	„ „	12/v/06	15½–16½	—	—	—	—	—	—	1	—	1	—	1	—	—	—	2	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	8
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	—	—	—	2	1	2	—	1	2	1	2	—	2	1	1	—	—	—	—	—	—	—	—	—	—	—	15
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	—	—	—	—	—	—	—	1	—	1	2	3	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	9
42[1]	„ „	13/v/06	15–15½	—	—	—	1	—	—	—	1	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	4
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	—	—	—	—	1	—	4	3	4	1	4	—	1	—	3	—	—	—	—	—	—	—	—	—	—	21
44	„ „	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	1	1	1	1	1	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	8
45[1]	Eastern Deep Water	6/iii/06	23–24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
46[1]	Brielle Ground	18/v/06	12–14½	—	—	—	—	—	—	1	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
46[2]	Between Brielle Ground and Eastern Deep Water	18/v/06	14½–15	—	—	—	1	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	—	—	—	—	1	—	2	4	1	2	3	3	2	—	1	—	—	—	—	—	—	—	—	—	—	—	19

48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	—	1	1	—	3	2	1	—	—	—	1	—	—	—	2	—	—	—	—	9
51	Gabbard Deep Water...	15/i/08	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	1	3	—	—	—	—	—	—	—	9
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
53[2]	Great West Bay : Beer Head—Berry Head ...	27/ii/06	20–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
54[2]	„ „ Inside "Eastern Scruff" ...	1/iii/07	26–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
55[1]	„ „ Teignmouth Bay	27/xi/07	3–4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
55[2]	„ „ „ „	27/xi/07	4–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	—	—	—	—	3
56	„ „ „ „	27–28/xi/08	3½–4½	—	—	—	—	—	—	—	—	—	1	—	1	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	4
57[3]	„ „ Tor Bay	6/viii/09	3–5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
57[4]	„ „ „	7/viii/09	5–7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
58[1]	„ „ Start Bay...	9/viii/09	7–13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	2
58[2]	„ „ „	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	1	—	—	1	—	—	5
58[3]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	2
58[4]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	2

TABLE V.*a*.—Length Measurements of MALE PLAICE of the V. Group (sixth year of life) in samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth. (fms.).	Centimetres 18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	Totals.
30	Bridlington Bay	26/vi/06	10¼–10½	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
31	„ „	10/ix/06	5½–6	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
32[1]	Flamborough Off Ground	22/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	2
32[3]	„ „	23/iii/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
32[4]	„ „	23/iii/06	29	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
32[5]	„ „	28/iii/06	24–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[1]	„ „	20/x/06	29–31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
33[2]	„ „	20/x/06	29–32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	2
33[4]	„ „	20/x/06	29–32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
33[6]	„ „	20/x/06	26–29	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2
33[7]	„ „	20/x/06	26–28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	1	1	—	—	—	—	—	4
33[8]	„ „	20/x/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	2
33[9]	„ „	20/x/06	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	—	—	—	1	—	—	4
33[10]	„ „	20/x/06	26–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1

TABLE V.*a.*—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Centimetres. 18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	Totals.
34	Flamborough Off Ground	2–5/vi/08	24–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	1	—	—	—	—	3
35	„ „	18–22/viii/08	24–28	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	1	2	—	—	—	—	—	—	—	—	6
36[2]	Dogger Bank—South part	16/x/06	13–15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
38[1]	Clay Deep, edge of Dogger Bank	27/ix/06	15–22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
39[3]	Between South ends of Well and Swarte Banks	14/iii/06	16½–19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
39[5]	Leman Ground	15/iii/06	15–16	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
39[8]	North-east of Smith's Knoll Light Vessel	17/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
40[1]	Between Broken and Swarte Banks	10/v/06	17	—	—	—	—	—	—	1	2	1	1	1	1	1	3	1	1	1	1	—	—	—	—	—	—	—	—	15
40[2]	Leman Ground	11/v/06	13–17	—	—	—	—	—	—	—	1	—	2	—	—	—	2	1	—	—	1	—	1	1	—	—	—	—	—	9
40[3]	„	11/v/06	13–15	—	—	—	—	1	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	3
40[4]	„	11/v/06	15–17	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	2	—	—	—	—	—	—	—	—	5
41[2]	Brown Bank Ground	12/v/06	15½–16½	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	3	—	—	—	—	—	—	—	—	—	—	5
41[3]	„ „	12/v/06	15½–16½	—	—	—	—	1	—	1	1	—	—	1	2	3	4	2	1	—	—	—	—	—	—	—	—	—	—	16
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	—	—	1	—	1	—	—	—	—	—	5
43	Leman Ground	9–12/vi/08	15–18	—	—	—	—	—	1	—	—	1	—	2	3	—	3	4	1	1	3	—	—	—	—	—	—	—	—	19
44	„	22–24/viii/08	15–17	—	—	—	—	—	—	—	—	—	—	1	3	4	3	1	5	1	—	—	—	—	—	—	—	—	—	18
45[5]	Eastern Deep Water	10/iii/06	23–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
45[6]	Between Middle and Winterton Shoals	11/iii/06	22–25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
46[2]	Between Brielle Ground and Eastern Deep Water	18/v/06	12–14½	—	—	—	—	—	—	—	—	1	—	1	3	1	1	—	—	—	—	—	—	—	—	—	—	—	—	7
47	South of Brown Ridges	18/v/06	15–19	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	—	—	—	—	—	—	1	—	1	—	2	2	4	4	3	4	3	2	1	—	—	—	—	—	—	—	27
48[2]	Eastern Deep Water	19/v/06	20–23	—	—	—	—	—	—	—	—	—	1	4	1	—	3	3	—	1	1	1	—	—	—	—	—	—	—	15
49[3]	Off Sandette Light Vessel	29/xi/06	16–21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
51	Gabbard Deep Water	15/i/08	23–25	—	—	—	—	—	1	—	—	—	1	2	2	6	2	7	4	4	4	3	1	2	—	3	—	—	—	42
52	Schouwen Ground	29/iv/08	15–17	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
54[2]	Great West Bay: Inside "Eastern Scruff"	1/iii/07	21–30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
56	„ „ Teignmouth Bay	27/xi/08	3½–4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	—	—	—	—	3
58[2]	„ „ Start Bay	9/viii/09	7–8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	2
58[3]	„ „ „	9/viii/09	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1

TABLE VI.—Length Measurements of PLAICE of the VI. Group (seventh year of life) in Samples collected during the period 1906–09.
N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Sex.	Centimetres. 27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	Totals.
30	Bridlington Bay	26/vi/06	10¼–10½	M.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
31	„ „	10/ix/06	5½–6	M.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
32[1]	Flamborough Off Ground	22/iii/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	2
32[2]	„ „	23/iii/06	26	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	2
32[3]	„ „	23/iii/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	2	—	—	—	—	—	—	—	4
32[4]	„ „	23/iii/06	29	M.	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
32[5]	„ „	28/iii/06	24–30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
33[2]	„ „	20/x/06	29–32	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
33[4]	„ „	21/x/06	29–32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
33[5]	„ „	21/x/06	29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
33[6]	„ „	21/x/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
33[7]	„ „	22/x/06	26–28	F.	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
33[8]	„ „	22/x/06	26	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	2
33[9]	„ „	22/x/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2
33[10]	„ „	22/x/06	26–29	M.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2
33[11]	„ „	23/x/06	29–33	M.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[14]	„ „	23/x/06	33–37	M.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
34	„ „	2–5/vi/08	24–25	M.	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
35	„ „	18–22/viii/08	24–28	M.	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	2	4
36[3]	Dogger Bank—South part	17/x/06	10–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	2	3
37[1]	Horn Reef Outer Ground	25/ix/06	24–25	M.	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	2
37[2]	„ „	25/ix/06	23–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
37[4]	„ „	26/ix/06	22–23	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
37[5]	„ „	26/ix/06	23–24	M.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
38[2]	Clay Deep, edge of the Dogger	27/ix/06	15–22	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	2
40[1]	Between Broken Bank and Swarte Bank	10/v/06	17	M.	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
40[2]	Leman Ground	11/v/06	13–17	M.	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
40[3]	„ „	11/v/06	13–15	M.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

TABLE VI.—*continued.*

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Sex.	Centimetres. 27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	Totals.
40[4]	Leman Ground	11/v/06	15–17	F.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
40[5]	Between Leman Ground and middle of Brown Ridges	11/v/06	17	F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[1]	Brown Bank Ground	12/v/06	16½–17	F.	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
41[2]	„ „	12/v/06	15½–16½	F.	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[3]	„ „	12/v/06	15½–16½	M.	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
41[4]	Off Haak's Light Vessel	13/v/06	15½–16½	M.	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
43	Leman Ground	9–12/vi/08	15–18	M.	—	—	—	—	1	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
				F.	—	—	—	1	—	—	—	—	1	1	1	3	—	2	—	—	—	—	—	—	—	—	—	—	—	9
44	„ „	22–24/viii/08	15–17	M.	—	—	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
				F.	—	—	—	—	1	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	4
45[5]	Eastern Deep Water	10/iii/06	23–25	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	2
48[1]	Edge of Eastern Deep Water	18/v/06	19–20	M.	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
48[2]	Eastern Deep Water	19/v/06	20–23	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
49[1]	Off Sandette Light Vessel	29/xi/06	20–22	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
51	Gabbard Deep Water	15/i/08	23–25	M.	—	3	—	—	1	2	2	2	4	3	2	1	1	1	1	—	—	—	—	—	—	—	—	—	—	23
				F.	1	—	—	—	—	—	—	—	—	—	2	1	—	1	1	1	1	1	1	—	1	—	—	—	—	—	11
53[2]	Great West Bay: Beer Head—Berry Head	27/ii/06	20–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1
54[1]	„ „ Inside "Eastern Scruff"	28/ii/07	21–30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
54[2]	„ „ „ „ „	1/iii/07	21–30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	2
54[3]	„ „ „ „ „	1/iii/07	26–30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
56	„ „ Teignmouth Bay	27–28/xi/08	3½–4½	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
58[2]	„ „ Start Bay	9/viii/09	7–8	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	3

Table VII.—Length Measurements of Plaice of the VII. Group (eighth year of life) in samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Date (fms.).	Sex.	Centimetres. 24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50	51.	52.	53.	54.	55.	56	Totals.
30	Bridlington Bay	26/vi/06	10¼–10½	M.	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
32[2]	Flamborough Off Ground ...	23/iii/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1

32[3]	„ „ „ ...	23/iii/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
33[1]	„ „ „ ...	20/x/06	29–31	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
33[3]	„ „ „ ...	21/x/06	32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
33[4]	„ „ „ ...	21/x/06	29–32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
33[8]	„ „ „ ...	22/x/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	2
33[9]	„ „ „ ...	22/x/06	26	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
33[10]	„ „ „ ...	22/x/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	2
33[11]	„ „ „ ...	23/x/06	29–33	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[12]	„ „ „ ...	23/x/06	30–33	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	2
34	„ „ „ ...	2–5/vi/08	24–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
35	„ „ „ ...	18–22/viii/08	24–28	M.	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
36[2]	Dogger Bank—South part ...	17/x/06	10–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
37[1]	Horn Reef Outer Ground ...	25/ix/06	24–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	2
37[4]	„ „ „ ...	26/ix/06	22–23	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
38[2]	Clay Deep, edge of Dogger ...	27/ix/06	17–22	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
40[4]	Leman Ground	11/v/06	15–17	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[1]	Brown Bank Ground... ...	12/v/06	16½–17	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[3]	„ „	12/v/06	15½–16½	F.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
43	Leman Ground	9–12/vi/08	15–18	M.	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
44	„ „	22–24/viii/08	15–17	M.	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	5
45[5]	Eastern Deep Water	10/iii/06	23–25	M.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
49[2]	Off Sandette Light Vessel ...	29/xi/06	17–20	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
51	Gabbard Deep Water	15/i/08	23–25	M.	—	—	—	—	—	—	—	—	1	—	—	1	—	2	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	7
				F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	5
54[3]	Great West Bay: "Inside Eastern Scruff."	1/iii/07	26–30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
57[4]	„ „ Tor Bay ...	7/viii/09	5–7	M.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
58[2]	„ „ Start Bay ...	9/viii/09	7–8	M.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
58[3]	„ „ „ ...	9/viii/09	8	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

TABLE VIII.—Length Measurements of PLAICE of the VIII. Group (ninth year of life) in samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Sex.	Centimetres. 34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.	Totals.
33[4]	Flamborough Off Ground	21/x/06	29–32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
33[9]	„ „	22/x/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	2
33[13]	„ „	23/x/06	30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	2
33[14]	„ „	23/x/06	33–37	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
34	„ „	2–5/vi/08	24–25	F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	2
35	„ „	18–22/viii/08	24–28	M.	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	2
36[3]	Dogger Bank—South part	17/x/06	10–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	—	—	—	3
38[1]	Clay Deep, edge of Dogger	27/ix/06	15–22	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
40[4]	Leman Ground	11/v/06	15–17	M.	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
43	„ „	9–12/vi/08	15–18	F.	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
44	„ „	22–24/viii/08	15–17	M.	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
45[3]	Eastern Deep Water	7/iii/06	19–20	F.	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
51	Gabbard Deep Water	15/i/05	23–25	M.	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	1	4
58[2]	Start Bay	9/viii/09	7–8	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1

TABLE IX.—Length Measurements of PLAICE of the IX.+ Groups combined (tenth and subsequent years of life) in Samples collected during the period 1906–09.

N.B.—New Age Groups are taken to start from the beginning of April.

Sample No.	Name of Fishing Ground.	Date.	Depth (fms.).	Sex.	Centimetres. 34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.	66.	Totals.
32[2]	Flamborough Off Ground	23/iii/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
32[3]	„ „ „	23/iii/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[1]	„ „ „	20/x/06	29–31	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1

33[2]	„ „ „ ...	20/x/06	29–32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	2
33[3]	„ „ „ ...	21/x/06	32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
33[4]	„ „ „ ...	21/x/06	29–32	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	3
33[5]	„ „ „ ...	21/x/06	29	F.	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	4
33[6]	„ „ „ ...	21/x/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
33[8]	„ „ „ ...	22/x/06	26	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[10]	„ „ „ ...	22/x/06	26–29	F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
33[12]	„ „ „ ...	23/x/06	30–33	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
33[13]	„ „ „ ...	23/x/06	30	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	2
34	„ „ „ ...	2–5/vi/08	24–25	F.	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
36[1]	Dogger Bank—South part ...	16/x/06	10–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
36[2]	„ „ „ ...	16/x/06	13–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
36[3]	„ „ „ ...	17/x/06	10–15	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	2	—	1	—	1	1	—	—	7
37[2]	Horn Reef Outer Ground ...	25/x/06	23–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
37[3]	„ „ „ ...	26/x/06	21–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
38[1]	Clay Deep, edge of Dogger ...	27/x/06	15–22	F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
39[6]	Leman Ground	16/iii/06	14–16	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	2
39[7]	Along East side of Swarte Bank	16/iii/06	14–17	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
39[8]	North-east of Smith's Knoll Light Vessel.	17/iii/06	22–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
40[2]	Leman Ground	11/v/06	13–17	F.	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[1]	Brown Bank Ground	12/v/06	16½–17	F.	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
41[2]	„ „	12/v/06	15½–16½	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
43	Leman Ground	9–12/vi/08	15–18	M.	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
44	„ „	22–24/viii/08	15–17	M.	—	1	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
				F.	—	—	—	—	—	1	—	—	—	—	1	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
45[5]	Eastern Deep Water	10/iii/06	23–25	F.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
51	Gabbard Deep Water	15/i/08	23–25	M.	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
				F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	2	1	—	—	1	—	—	—	—	—	1	—	—	—	—	6
53[1]	Great West Bay: "Spion Kop" Ground.	12/ii/06	26–28	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
53[2]	„ „ Beer Head—Berry Head.	27/ii/06	20–29	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
58[1]	„ „ Start Bay ...	9/viii/09	7–13	F.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
58[2]	„ „ „ ...	9/viii/09	7–8	F.	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1

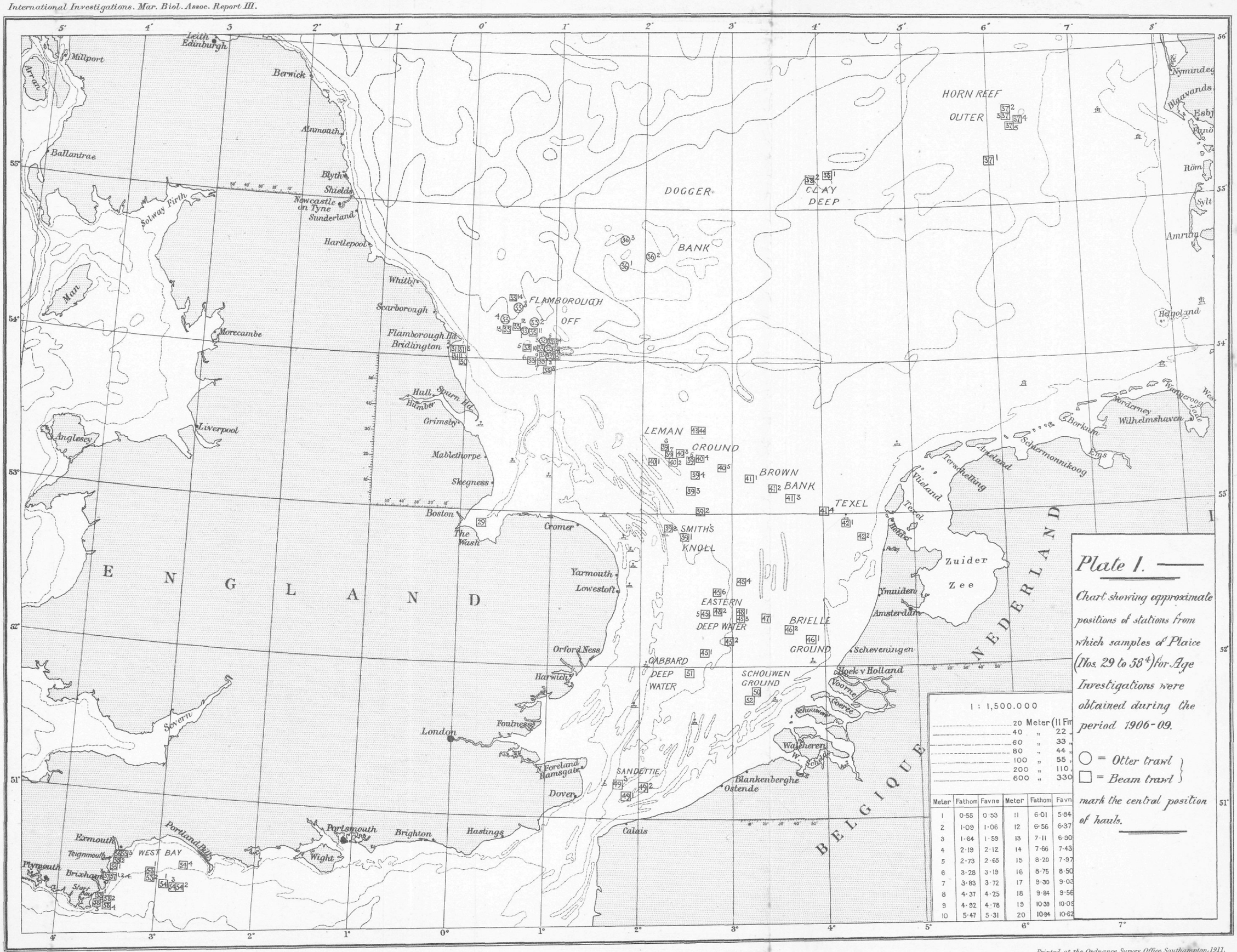

Plate I.

Chart showing approximate positions of stations from which samples of Plaice (Nos. 29 to 58⁴) for Age Investigations were obtained during the period 1906-09.

○ = Otter trawl
□ = Beam trawl
mark the central position of hauls.

1 : 1,500.000

20 Meter	(11 Fm	
40 „	22 „	
60 „	33 „	
80 „	44 „	
100 „	55 „	
200 „	110 „	
600 „	330 „	

Meter	Fathom	Favne	Meter	Fathom	Favn
1	0·55	0·53	11	6·01	5·84
2	1·09	1·06	12	6·56	6·37
3	1·64	1·59	13	7·11	6·90
4	2·19	2·12	14	7·66	7·43
5	2·73	2·65	15	8·20	7·97
6	3·28	3·19	16	8·75	8·50
7	3·83	3·72	17	9·30	9·03
8	4·37	4·25	18	9·84	9·56
9	4·92	4·78	19	10·39	10·09
10	5·47	5·31	20	10·94	10·62

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COVERED NET EXPERIMENTS.

BY

R. A. TODD, B.Sc.

WITH DIAGRAMS (FIGS 1–4) IN TEXT AND TABLES I–VIII. IN TEXT AND A–H IN APPENDIX.

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COVERED NET EXPERIMENTS.

BY

R. A. TODD, B.Sc.

Object of the Experiments.

It is a well-known fact that a certain proportion of the smaller fish, which enter the mouth of a trawl, ultimately escape through the meshes, and it is obvious that the proportion so doing will vary with the size of the mesh, more especially of the cod end. The experiments about to be described have been made in order to determine as far as possible the actual proportion of fishes at each size (in cm.) which escape through the meshes of the ordinary commercial trawls (beam and otter), and also how far, if at all, conditions of weather and catch affect the proportion escaping.

Previous Work.

Fulton* describes a number of experiments with a 25 foot beam trawl designed to show the proportion of fish which escape through the meshes of the cod end. For this purpose the latter was covered with fine net ($\frac{1}{2}$-inch knot to knot) which retained any fish which escaped from the cod end excepting, of course, the very small individuals. At the same time he varied the proceedings by using cod ends of different mesh, *i.e.*, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 inches double twine, and $1\frac{1}{2}$ inch single twine. For each series of experiments (*i.e.*, with different cod ends) he gives the actual number of fish of each species taken both in the inner and in the outer nets, whilst for the more important fish he also gives tables showing the number at each size (in inches) which were retained in the cod end and also those which escaped.

Gilson† gives tables showing the percentage of fish at each size which were retained in the cod end in 50 hauls with an 8–10 m. beam trawl, having a mesh of 2–2·5 cm.

Redeke‡ describes 19 experiments with the otter trawl having a cod end of 3 cm. mesh covered with fine mesh netting, and gives a summary table showing the total number of fish (Plaice, Dabs and Whiting) at each size which were found in the inner and outer nets.

Heincke§ gives the data for plaice and dabs caught in a few hauls with a 90 foot otter trawl, having a cod end mesh of 3–3·5 cm.

The following table collates, for certain species, the size at which 50 per cent. of those reaching the cod end are retained, as shown by the above investigators, together with those shown by the present report.

Table I.—Showing for certain species the size at which 50 per cent. of those reaching the cod end are retained, as shown by the above investigators and the present report. The size of mesh used is given in each case.

Investigator.	Fulton.		Gilson.	Redeke.	Heincke.	Present Report.	
Number of Hauls.	43	6	50	19	—	20	78
Gear used.	25 ft. Beam.		8-10 m Beam.	Otter.	90 ft. Otter.	90 ft. Otter.	45 ft. Beam.
Mesh of cod end, cm. (length of side).	3·8	3·8 (single).	2–2·5	3	3–3·5	3·5	2·8
	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Plaice	<12·7*	—	10–11	15–16	14–15	?	10–11
Dab	15·2–17·8	15·2–17·8	8–9	15–16	16–17	13–14	12–13
Sole	—	—	11–12	—	—	—	—
Cod	20·3–22·8	22·8–25·4	—	—	—	—	15
Haddock	17·8–20·3	17·8–20·3	—	—	—	18–19	—
Whiting	25·4–27·9	25·4–27·9	10–11	25–26	—	19–20	17–18

* All the original measurements were in inches, and have been reduced to cm. for the sake of comparison.

* 12th Annual Report. Fishery Board for Scotland, 1893. Scientific Investigations.
† Rapports et Procès-verbeaux. Vol. IV., July, 1904–July, 1905.
‡ Verhandelingen uit het ryksinstituut voor het onderzoek der Zee, I.–II., 1906.
§ Internationale Meeresforschung Jahresbericht IV./V., 1905–7.

It will be seen from the above table that the results of the various investigators do not invariably correspond. Redeke, for instance, using a cod end of 3 cm. mesh, finds that 50 per cent. of the plaice are retained at 15–16 cm., and 50 per cent. of the dabs at the same size. Heincke's figures, using a 3–3·5 cm. mesh, show that the size for plaice was smaller (14–15 cm.), whilst that for dabs was larger (16–17 cm.), whilst in the present report, using a 3·5 cm. mesh, the size for dabs is shown to be 13–14 cm. It is thus obvious that many more hauls are needed with cod ends of different mesh before the relation between size of mesh and the proportion of fish escaping can be definitely stated.

Description of Experiments.

As it was usually supposed that a very fair proportion of the fish, more especially round fish, which escaped after entering the trawl, went through the meshes of the square, this portion of the net, as well as the batings and cod end were covered in some experiments at the beginning of the series. It was found, however, that the fish escaping through the square were practically a negligible quantity, the great majority of those escaping going through the meshes of the cod end, whilst the greater part of the remainder escaped through the batings. As a result of this finding, the square was left uncovered, the majority of the hauls being made with the batings and cod end, or the latter only, covered.

Otter Trawl.

The trawl used in these experiments was the commercial otter trawl (90 foot headline) in which the size of the meshes in the various parts of the net was as follows, the dimensions given (the average of 10 adjacent meshes) being that of one side of a mesh :— Wings, 7·4 cm. ; square, 7·1 cm.; belly and batings, 6·3 cm., decreasing to 4·1 at the hinder end ; cod end (of double twine), 3·5 cm.

Otter I.—In this, the only series of experiments with a covered otter trawl, the cod end was the only part of the net which was covered. This was done with fine mesh netting (1 cm. mesh) in such a manner that the whole of the cod end excepting the under side (belly part) was enclosed in an outer covering. The under side was omitted as this portion has the "rubbers" of old net attached to it which prevent the net chafing on the sea bottom, and it is obvious that fine mesh net fixed outside the rubbers would in the majority of cases soon be destroyed.

With this form of covered net 28 hauls were made, of which eight have been omitted, owing to various accidents to the trawl or the outer covering. The number of fish which were taken in these hauls was over 41,800.

Beam Trawl.

The trawl used in these experiments was the commercial 45 foot beam trawl. The dimensions (as length of side) of the meshes of the various parts of the net were as follows :—Wings, 5·6 cm. ; square, 5·6 cm. ; belly and batings, 5·3 cm., decreasing to 3·8 cm. ; cod end, 2·8 cm.

The experiments with this gear fall into various series according to the parts of the net which were covered. They are :—

Beam i.—Cod end only covered (as in Otter I.).

In this series 37 hauls were made, of which 34 are considered, the remaining three having been omitted owing to accidents. The number of fish caught was over 69,800.

Beam ii.—Cod end and half the batings covered.

In this series the cod end was covered in the usual manner, and in addition fine mesh net was fixed over half the surface of the batings, the two coverings, of course being separate.

Six hauls were made with the net covered in this manner, the number of fish taken being 7,955.

Beam iii.—Cod end and all the batings covered.

Thirty-eight hauls of which 34 are used, were made in this series, the number of fish taken being 36,851.

Beam iv.—Cod end, batings and square covered.

In this series practically the whole trawl, excepting the under surface, was covered.

With the beam trawl covered in this manner five hauls were made, of which four, representing 3,051 fish, are used.

Beam v.—Cod end, batings and square covered.

This series corresponds to Beam IV, except with regard to the cod end. This part of the net was covered in three parts, the upper and lower surfaces being covered separately, whilst the hinder end of the cod end was stretched on an oval hoop (139 × 88 cm.), to which was fastened a bag of fine mesh netting. With this modification, 14 hauls were made, in three of which the fine mesh netting was torn. The number of fish taken by the 11 successful hauls was 9,066.

General.

In the various hauls (109) made in the above experiments the number of species of fish taken was 56, represented by 168,500 individuals together with about six baskets (ca. 190 kg.) of fish (chiefly gurnards, whiting, and dabs), which were neither measured nor counted.

The species taken in greatest numbers were, in order of abundance, Dabs (57,000 +), Lesser Weever (30,900 +), Haddock (21,673), Whiting (18,800 +), Gurnard (12,900 +), and Plaice (12,555). None of the remaining species were represented by more than 2,500 fish, whilst 20 species were each represented by less than 20 individuals. It is interesting, although not agreeable, to note, that of the 168,500 fish actually measured or counted no less than 88,100 (over one half) were either dabs or lesser weevers, which, although they certainly constitute food for turbot and cod, are themselves of no market value, with the exception of the larger dabs.

Dabs, of course, are almost ubiquitous in their distribution in the S. North Sea, whereas lesser weevers are more or less restricted to certain regions. Thus, of the 30,900 specimens of the latter species which were taken, no less than 21,500 were taken in the small mesh net in nine consecutive hauls in Series B i. (B 467–475), made on the Leman and Brown Bank grounds and off the Haaks LV., an average of nearly 2,400 per haul, the largest number in a haul being 5,960 (in five hours). In these nine hauls lesser weevers were absent from the cod end in all but two, the total number found in that portion of the net being 160. In this connection it may be noted that of the total number of weevers taken in all the hauls less than two per cent. were found in the cod end.

Besides the lesser weever (*Trachinus vipera*) certain other fish were taken more abundantly in the covering nets than in the cod end. These were mostly unmarketable species, the principal ones being " father-lasher " (*Cottus* sp.), pogge (*Agonus cataphractus*), suckers (*Liparis* sp.), gobies (*Gobius minutus*), dragonet (*Callionymus lyra*), sandeels (*Ammodytes* sp.), scaldbacks (*Arnoglossus laterna*), solenettes (*Solea lutea*), and sprats (*Clupea sprattus*), but none of these occurred in any great numbers.

All the species of *Raia* which were taken were almost invariably found in the cod end, the only individuals escaping being one thornback and one homelyn.

Owing to the fact that practically no hauls were made on grounds frequented by small turbot, brill, and soles, the data regarding the size at which these species escape is *nil* for the two first named and extremely poor as regards the last named fish. Only six soles escaped through the cod end, the sizes in the various series being ; O i, one of 24 cm., B i.–iv. two, one of which measured 14 cm., and in B v. three of 16, 22, and 28 cm. respectively, whilst one sole (17 cm.) escaped *viâ* the batings in B v. The soles (≤ 25 cm.) retained in the cod end were O i none, B i.–iv. 12 (19–24 cm.), B v. 16 (10–24 cm.)

The actual number of each species of fish taken in the cod end and the various parts of the covering net is shown in Table A. in the appendix, the following table showing similar data for certain of the more important species :—

TABLE II.—Showing for Plaice, Dab, Cod, Haddock and Whiting, the number of fish taken in each part of the net in each series of experiments, omitting from consideration those hauls in which the fish from any part of the net were neither counted nor measured.

Species.	Series.	Number of Fish in Cod end.	Number of Fish in Net Covering.			Total.
			Square.	Batings.	Cod end.	
Plaice	O i.	345	—*	—	2	347
	B i.	6,370	—	—	336	6,706
	B ii.	189	—	0	0	189
	B iii.	3,465	—	5	21	3,491
	B iv.	53	2	0	0	55
	B v.	968	1	13	785	1,767
Dabs	O i.	6,262	—	—	3,031	9,293
	B i.	12,183	—	—	7,251	19,434
	B ii.	3,637	—	218	2,520	6,375
	B iii.	11,739	—	766	5,274	17,779
	B iv.	189	30	1,082	37	1,338
	B v.	1,313	0	505	941	2,759
Cod	O i.	443	—	—	27	470
	B i.	96	—	—	0	96
	B ii.	81	—	0	3	84
	B iii.	302	—	5	32	339
	B iv.	24	0	8	15	47
	B v.	42	0	20	52	114
Haddock	O i.	18,057	—	—	1,083	19,140
	B i.	1,307	—	—	0	1,307
	B ii.	39	—	3	0	42
	B iii.	57	—	0	0	57
	B iv.	31	8	7	0	46
	B v.	79	0	8	391	478
Whiting	O i.	3,276	—	—	2,915	6,191
	B i.	4,177	—	—	1,874	6,051
	B ii.	150	—	16	44	210
	B iii.	2,959	—	250	1,798	5,007
	B iv.	119	29	171	1	320
	B v.	227	4	37	566	834

* A dash (—) shows that in the experiments the corresponding part of the net was not covered.

PROPORTION AND SIZE OF FISH OF CERTAIN SPECIES FOUND IN VARIOUS PARTS OF THE COVERING NET.

PLAICE. (*Pleuronectes platessa.*)

The actual number of fish at each size taken in the various parts of the net in each series will be found in Table B. in the Appendix, whilst the details of each haul are given in Tables E. to H. (appendix) and are summarised in Table III. (text).

Beam Trawl.

Square.—Of the 801 fish which escaped in the hauls in which all the net was covered, only two (14 and 40 cm.) did so through the square. The larger of these two fish, obviously too large to get through the meshes of the trawl in the ordinary course of events, apparently escaped through an unnoticed split.

*Batings.**—In Series B iii. 5 plaice (12–15 cm.) out of 26, and in Series B v. 13 plaice (7–17 cm.) out of 798, which escaped after passing the square, went through the meshes of the batings. In Series Beam ii. and iv. only two plaice escaped, one doing so through the batings.

Cod end.†—*Beam i.–iv.*—Plaice were retained in the cod end in 75 hauls in this group, some escaping in 13 hauls.

The size of the smallest fish retained in each haul ranged from 6 cm. upwards, and was from 9 to 13 cm. in 25 hauls, and 14 cm. or over in 49. The size of the largest fish escaping in each haul ranged from 11 to 13 cm. in 7 hauls, the total range in the 13 hauls in which some escaped being 7 to 18 cm. The number, however, (eight fish) over 13 cm. in length which escaped was almost negligible.

In the hauls in which it could be determined the size at which at least 75 per cent. were retained ranged from 12 to 13 cm. in 9 out of 10 hauls, and was 11 cm. in the remaining one, 50 per cent. were retained in nine hauls at sizes ranging from 11 to 12 cm., and at 10 cm. in one haul, whilst 25 per cent. were retained in six hauls at 10 to 11 cm., the extreme range being 9 to 12 cm. The average sizes at which these proportions were retained, as shown by the curve (Fig. 1) derived from the combined figures of all the hauls, with the addition of ·5 cm., the necessary correction for averages due to the method of measuring, are 75 per cent. at 12·0 cm., 50 per cent. at 11·1 cm., and 25 per cent. at 9·7 cm.

Beam v.—Small plaice were taken in the cod end and the net surrounding it, in two hauls in this series. No fish of over 19 cm. escaped in these hauls, whilst only six fish of 16 cm. or over were found in the covering net. 75 per cent. were retained at 15 cm. in both hauls, 50 per cent. at 14 and 15 cm. and 25 per cent. at 13 and 14 cm. respectively, the average sizes at which these proportions were retained as shown by the curve (Fig. 1) plus the necessary ·5 cm. correction‡ being 15·2, 14·3, and 13·2 cm. respectively. The larger size at which the above proportions were retained, compared with series B i.–iv. is due to the fact that the supporting hoop tends to keep the meshes open, thereby allowing more fish to escape.

The number of fish escaping through the various portions of the cod end was as follows :—upper (bating) part 618 (7–16 cm.), lower (belly) part 45 (8–19 cm.), behind the hoop 122 (7–14 cm.).

Otter Trawl.

Cod end.—The data regarding the retaining power of the cod end of the otter trawl, as far as this species is concerned, are practically nil, none of the hauls having been made on small plaice ground. In the hauls made, all the plaice of 15 cm. and over were retained, whilst only two fish of less length (12 and 14 cm.) were taken, both of which escaped into the outer covering.

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* In the majority of the hauls in which the batings and cod end were covered, the greater portion of the fish which escaped did so through the cod end. In all the hauls in Series B. iv., and two of those in B. v., however, the proportions were reversed, and many more escaped through the batings than through the cod end. From a study of all the data, it seems probable that this is only apparent, in other words, the majority of those which escaped into the net covering the cod end, found their way out again through an unnoticed hole. The chief fact in favour of this assumption apart from the abnormality of the occurrence, is that the six hauls mentioned were consecutive hauls with the covered beam trawl. The hauls, however, have been treated with the others in default of actual evidence that they were not comparable.

† *Otter I., Beam I.–IV., and Beam V.*—The hauls in each of the above groups of series showed so great a uniformity with regard to the size at which various proportions of the fish reaching the cod end, escaped, that it has been found possible to treat each group collectively.

In determining the proportion which escape through the cod end at different sizes, no note has been taken of any fish which escaped through the batings or square, as it is obvious that, as they do not reach the cod end, they cannot have any influence on the proportions which escape through that part. In each haul, where the number of fish was sufficient, the size at which at least 75 per cent., 50 per cent., and 25 per cent., were retained was noted for each species, and also the size of the largest fish which escaped from, and the smallest fish retained in the cod end. It will be seen from the following account that in flatfish (plaice and dabs) these sizes are very uniform in the different groups, but tend to be less so with roundfish, more especially whiting.

‡ Owing to the fact that no note is taken of fractions of a cm. in recording length, *i.e.*, a length of 13·9 cm. for example being recorded as 13 cm.

TABLE III.—Showing for Plaice and Dabs the number of hauls in which the smallest fish retained in the cod end and the largest fish escaping through each of the various portions of the net were of the sizes given, and also the number of hauls in which certain proportions were retained in the cod end at given sizes :—

Size	Plaice.												Dabs.											
	Minimum size in Cod end.		25 per cent. in Cod end.		50 per cent. in Cod end.		75 per cent. in Cod end.		Maximum size escaping.				Minimum size in Cod end.		25 per cent. in Cod end.		50 per cent. in Cod end.		75 per cent. in Cod end.		Maximum size escaping.			
									Cod end.		Btngs.	Sq.									Cod end.		Btngs.	Sq.
cm.	O.	B.	O.	B.	O.	B.	O.	B.	O.	B.	B.	B.	O.	B.	O.	B.	O.	B.	O.	B.	O.	B.	B.	B.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
4	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
6	—	1	—	—	—	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	1	—	—	1	7	—	—	—	—	—	—	—	—	1	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	12	—	1	—	—	—	—	—	—	1	—
9	—	1	—	1	—	—	—	—	—	2	—	—	4	5	—	3	—	2	—	—	—	—	—	—
10	—	4	—	2	—	1	—	—	—	—	—	—	4	16	1	2	—	2	—	1	—	—	—	—
11	—	5	—	4	—	4	—	1	—	1	—	—	3	10	1	6	—	1	—	1	—	1	1	—
12	—	8	—	2	—	5	—	5	1	5	—	—	6	6	4	32	—	15	—	3	—	—	1	—
13	—	7	—	—	—	—	—	4	—	1	1	—	—	2	5	13	3	35	—	22	—	8	5	—
14	—	8	—	—	—	—	—	—	1	1	2	—	2	1	7	1	5	5	4	29	—	25	5	—
15	2	5	—	—	—	—	—	—	—	—	2	—	—	—	1	—	9	—	2	3	1	18	3	—
16	1	5	—	—	—	—	—	—	—	1	—	1	—	—	—	—	2	—	10	—	7	5	9	—
17	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	7	3	7	1
18	1	4	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	2	3	3	—
19	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	1	3	1
20	16	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1

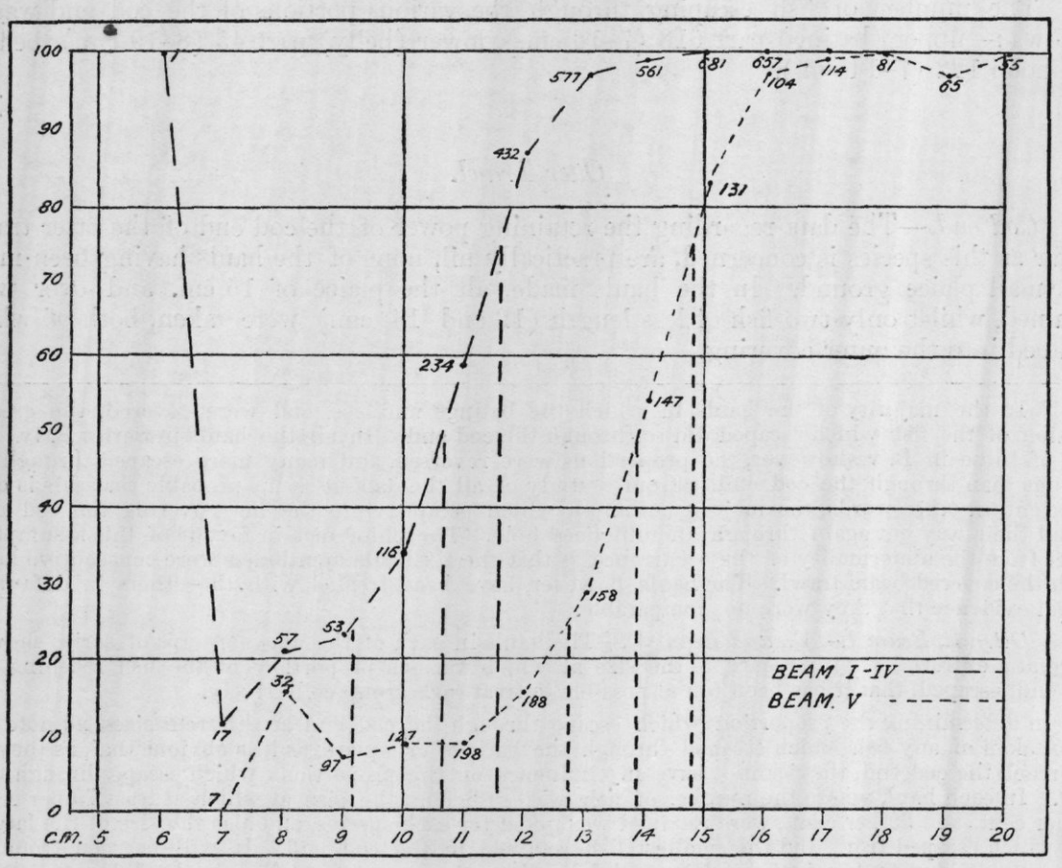

FIG. 1.—PLAICE.—Curve showing for the fish which reached the cod end the percentage at each size which are retained. The index figures show the number reaching the cod end at each size, whilst the vertical lines indicate the size at which 25 per cent., 50 per cent., and 75 per cent. are retained.

DAB. (*Pleuronectes limanda.*)

The actual number of fish at each size taken in the various parts of the net in each series will be found in Table B in the appendix, whilst details of each haul are given in Tables E to H (appendix) and are summarised in Table III (text).

Beam Trawl.

Square.—2,595 dabs escaped through various portions of the net in these hauls, but of these, only 30 fish got through the meshes of the square, all in four hauls of Series B iv. The size of the fish escaping ranged from 10 to 19 cm., the majority (23) being from 13 to 17 cm. in length.

Batings.—In Series Beam ii. 218 fish (8–14 cm.) out of 2,738 (eight per cent.) which were found in the covering nets, had escaped through this part of the net, the proportion at various sizes falling from 14 per cent. at 8 cm. to four per cent. at 12 cm., and then rising again to 19 per cent. at 14 cm. In Series B iii., 766 (5–22 cm.) out of 6,040 (13 per cent.) escaped through the batings, the proportion falling from 100 per cent. at five cm. to eight per cent. at 11 cm., and then rising regularly to 93 per cent. at 16 cm. and varying between 67 and 100 per cent. above that size. In Series B iv. no less than 1,082 fish (6–19 cm.) out of 1,119 (96 per cent.) fish which escaped after passing the square were found in the net covering the batings. The proportion at each size varied in this series from 94 to 100 per cent., whilst compared with all the dabs taken the proportion which escaped through the batings fell gradually from 100 per cent. at six cm. to 62 per cent. at 15 cm., and then more rapidly from 32 per cent. at 16 cm. to 11 per cent. at 19 cm., above which size only one escaped. In Series B v., 505 fish (4–23 cm.) escaped through the batings out of 1,446 (35 per cent.) The proportion at each size escaping through the batings fell from 91 per cent. at four cm. to ten per cent. at 15 cm., and then rose to 37 per cent. at 17 cm., with 33 per cent. at 19 cm., 67 per cent. at 23 cm., and 0 per cent. at the intervening sizes, *i.e.*, 18, 20 and 21 cm.

Cod end.—Beam i.–iv.—Small dabs were taken in 77 out of the 78 hauls in this group and were measured in nearly all. The size of the smallest fish retained in the cod end in each haul ranged from 7 to 11 cm. in 50 hauls, the range in 69 hauls being 4 to 14 cm. The size of the largest escaping in each case ranged from 14 to 15 cm. in 43 hauls, the total range in 65 hauls being 11 to 20 cm. Of the dabs reaching the cod end practically all those of over 15 cm. were retained, only 25 fish of 16 cm. or more escaping. Seventy-five per cent. were retained in 51 hauls at 13 to 14 cm., the total range in 59 hauls being 10 to 15 cm. Fifty per cent. were retained in 50 hauls at sizes ranging from 12 to 13 cm., the latter being the size in 35 hauls, the total range being 9 to 14 cm., whilst 25 per cent. were retained in 45 hauls also at 12 to 13 cm., 32 being at the former size, whilst the extreme range was 8–14 cm.

The curve (Fig. 2.) shows the average sizes after correction at which these proportions were retained to be 75 per cent. at 13·5 cm., 50 per cent. at 12·7 cm., and 25 per cent. at 11·7 cm. It may be noted here that the sizes at which the various proportions are retained, as derived from a study of the individual hauls, tend to be greater than the average sizes as deduced from the curve drawn from the combined figures. The reason for this apparent discrepancy is that the size as found for each individual haul is that at which *at least* 75, 50 or 25 per cent. are retained. For example, if at 13 cm. 74 per cent. and at 14 cm. 100 per cent are retained, the latter size would be given as that at which 75 per cent. were retained, although the size as interpollated from the curve would be 13·04 + ·5 cm. correction = 13·54.

As in the otter trawl (q. v.) there are indications that weight of catch and condition of sea have some influence on proportions of fish escaping through the cod end at different sizes, the effect being the same as with that gear.

Series B v.—Dabs were taken in all the hauls in this series and in the small mesh net over the cod end in ten hauls. The size of the smallest fish retained in the cod end in each haul ranged from 7 to 13 cm. in eight hauls, and was 3 and 18 cm. respectively in two others, whilst the size of the largest escaping through the cod end ranged from 16 to 19 cm. in six hauls, the total range in the ten hauls being 14 to 24 cm.

Of the fish which escaped from the cod end very few were over 20 cm. in length, the fish above this size all escaped in one haul and numbered six in all. The size at which 75 per cent. were retained at each haul ranged from 15 to 17 cm. in seven hauls out of eight, the size in the remaining haul being 10 cm., whilst 50 per cent. were

retained in five hauls at 13 to 15 cm. the total range being 10 to 16 cm. and 25 per cent. were retained in four hauls at 12 to 13 cm., the extreme range being 10 to 15 cm. The average size (corrected) at which these proportions were retained (see Fig. ii.) was 75 per cent. at 16·3 cm., 50 per cent. at 14·3 cm., and 25 per cent. at 12·1 cm.

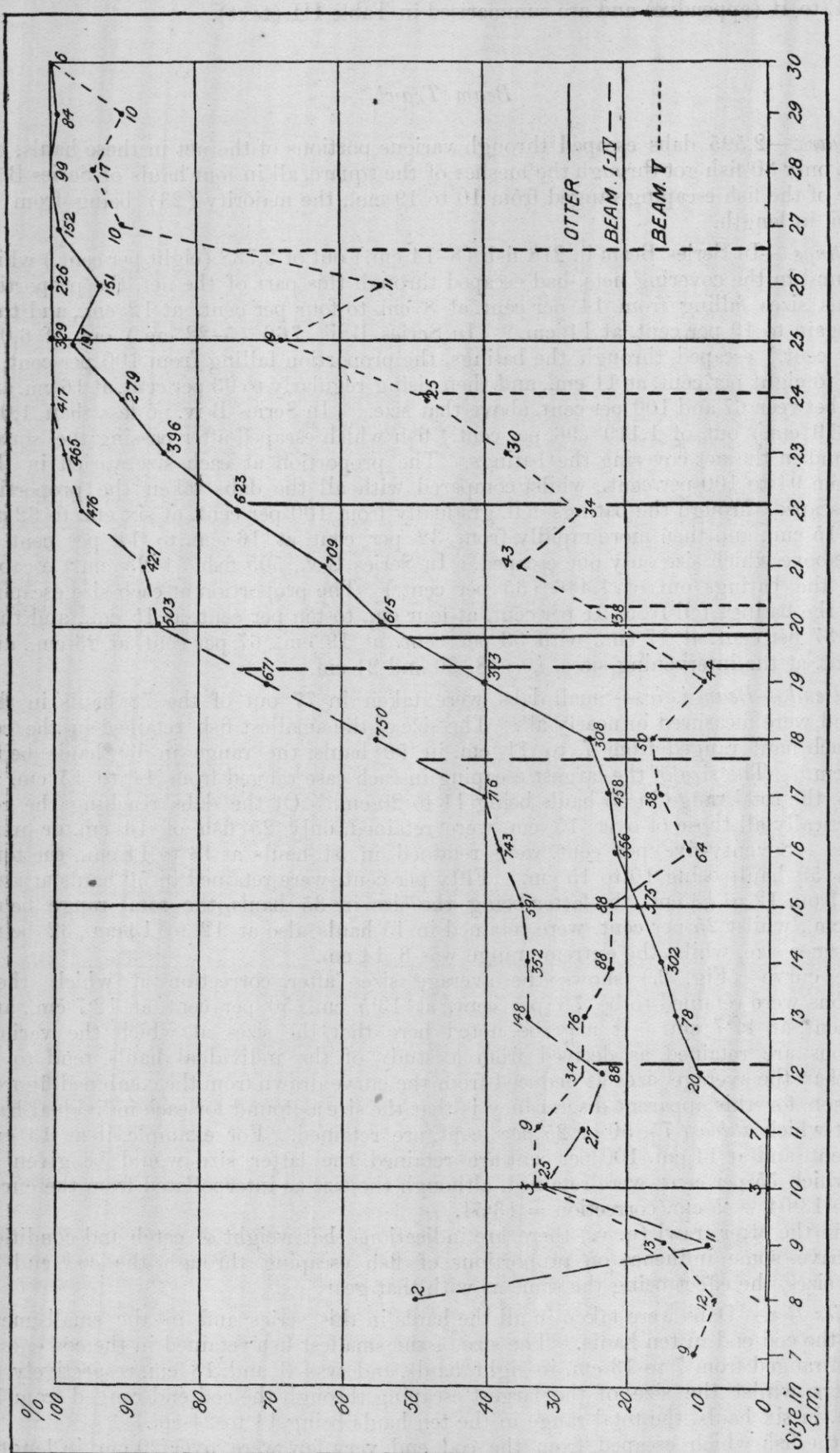

FIG 2.—DABS.—Curves showing for the fish, which reach the cod end, the percentage at each size which are retained. The index figures show the number reaching the cod end at each size, whilst the vertical lines indicate the size at which 25 per cent., 50 per cent., and 75 per cent. are retained.

Of the 941 fish which escaped through the cod end, 447 (2–19 cm.) did so through the hinder part, 392 (7–20 cm.) through the upper (bating) part, and the remaining 102 (9–24 cm.) through the lower (belly) part.

Otter Trawl.

Cod end.—Small dabs were taken in all the hauls with this gear, both in the cod end and in the net surrounding it, and except in one case, when the range in size only of those escaping was noted, all were measured.

The size of the smallest fish retained in the cod end in each haul ranged from 9 to 12 cm. in 17 hauls the extreme range in 20 hauls being 7 to 14 cm., whilst the size of the largest fish escaping ranged from 16 to 17 cm., in 14 hauls, the total range being 15 to 19 cm.

Of the fish which reached the cod end very few of 17 cm. or over escaped, only 21 fish of that size and over succeeding in doing so. At least 75 per cent. were retained in 12 hauls at sizes ranging from 15 to 16 cm., the total range in 19 hauls being 14 to 18 cm. 50 per cent. were retained in 14 hauls at sizes ranging from 14 to 15 cm., the range in all the hauls (19) being 13 to 16 cm., whilst 25 per cent. were retained in 16 hauls at from 12 to 14 cm., the extreme range being 10 to 15 cm.

The curve (Fig. 2) shows the average corrected size at which the above proportions were retained to be 15·3, 14·4, and 13·0 cm. respectively. It seems probable, from an examination of the data for each individual haul, that the weight or bulk of the catch, and also the condition of the sea have some influence on the above sizes, namely, a large catch, or a calm sea tending to raise the sizes at which the various proportions are retained, while a rough sea or light catch have an opposite effect. Taking a single proportion, 50 per cent. for example, it is interesting to note that of the eight hauls in which the size was 13 or 14 cm., the catch of fish (in the ordinary cod end) exceeded 500 kg. in two hauls, whilst in two the catch of invertebrates was recorded as exceedingly abundant, and in one as very common, the latter haul giving also 300 kg. of fish. In the remaining three hauls the fish did not exceed 400 kg., and the invertebrates were either recorded as common or few. In all these hauls the sea was either moderate or smooth. In the nine hauls in which the size at which 50 per cent. were retained was 15 cm., only three hauls had a large catch of invertebrates or fish, the condition of the sea being moderate or smooth, whilst in the two hauls in which the size was 16 cm. the catch of fish was poor ($<$75 kg. in each case), invertebrates were not common, and the sea was rough.

Cod. (*Gadus morrhua.*)

The actual number of fish taken at each size in the various portions of the net in each series will be found in Table C of the Appendix, whilst details of each haul are given in Tables E to H (Appendix), and are summarised in Table IV. (Text).

Beam Trawl.

Square.—Only two cod, both of 23 cm., were found in the net covering this portion of the net, out of 25 which escaped in Series B iv., whilst of the 72 which escaped in Series B v. none did so through the square.

Batings.—In all the experiments in which the batings were covered, only 33 cod escaped through them out of 135, and of these 33 only nine were from 14 cm. to 21 cm. in length, the remaining 24 being all less than 9 cm. The proportion of cod escaping through the batings in the various series was B ii. none out of 3, B iii. 5 out of 37, B iv. 8 out of 23, and B v. 20 out of 72.

Cod end.—Beam i–iv.—Of the cod which reached the cod end in this group none of more than 19 cm. escaped, the range in size of the largest taken in the outer net, in each haul, being from 13 to 19 cm. in nine hauls and 7 cm. in one. Of those retained in the inner net, the smallest ranged from 12 cm. upwards, with one exception, when the smallest measured 4 cm. only.

The size at which 75, 50, and 25 per cent. were retained in individual hauls could only be determined even approximately in two cases, when they were 17 cm., 17 cm., and 16 cm. respectively in each. The average sizes (corrected) for the above proportions, as given by the figures for all the hauls, are 75 per cent. at 17 cm. and 50 per cent. at 15 cm.

Beam v.—Of the 95 cod which reached the cod end 52 escaped. Of these four (21-26 cm.) were more than 20 cm. in length, whilst with the exception of two fish of 5 and 6 cm. respectively none were retained below 22 cm.

From the combined figures for all the hauls it seems probable that 50 per cent. would be retained between 24 and 26 cm., but the number of fish is too small to allow of any definite statement. Of the 52 fish which escaped through the cod end, the majority (40) did so through the hinder end, only eight and four fish escaping through the bating and belly parts respectively.

Otter Trawl.

Cod end.—Cod were taken in all the hauls but one made with this gear, some escaping through the cod end in nine hauls.

The size of the largest escaping in each case ranged from 15 to 22 cm., whilst the smallest retained ranged from 15 cm. upwards. In only one haul was the size of the largest which escaped equal to that of the smallest retained, and in no case was it greater. In the seven hauls in which small cod were taken in both the inner and outer net, the smallest in the inner net in each haul ranged from 19 to 23 cm., whilst the largest in the outer net ranged from 19 to 22 cm. in six hauls, and was 16 cm. in the seventh, in which haul no cod were taken between 16 and 20 cm. in length. From the very meagre data provided by the hauls mentioned above no definite conclusions can be drawn. It seems probable, however, that the cod end would retain practically all cod of 23 cm. and upwards, about 50 per cent. of those from 20 to 21 cm., and very few below 18 cm. in length.

TABLE IV.—Showing for cod the number of hauls in which the smallest fish retained in the cod end and the largest fish escaping through each of the various portions of the net were of the sizes given, and also the number of hauls in which certain proportions were retained in the cod end at given sizes.

Size.	Cod (Gadus morrhua).											
	Minimum size in Cod end.		25 per cent. in Cod end.		50 per cent. in Cod end.		75 per cent. in Cod end.		Maximum size escaping.			
									Cod end.		Btngs	Sq.
Cm.	O.	B.	O.	B.	O.	B.	O.	B.	O.	B.	B.	B.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
≤ 8	—	1	—	—	—	—	—	—	—	1	—	—
12	—	2	—	—	—	—	—	—	—	—	—	—
13	—	1	—	—	—	—	—	—	—	2	—	—
14	—	4	—	—	—	—	—	—	—	—	1	—
15	1	—	—	—	—	—	—	—	1	1	—	—
16	—	3	—	2	—	—	—	—	1	1	—	—
17	—	5	—	—	—	2	—	2	—	2	1	—
18	1	3	—	—	—	—	—	—	—	2	—	—
19	1	3	1	—	1	—	—	—	3	1	1	—
20	4	3	1	—	1	—	1	—	1	—	3	—
21	—	2	1	—	1	—	1	—	2	—	1	—
22	2	—	2	—	2	—	2	—	1	—	—	—
23	2	3	1	—	1	—	1	—	—	—	—	2
24	2	1	—	—	—	—	—	—	—	—	—	—
≤ 25	6	9	—	—	—	—	—	—	—	—	—	—

HADDOCK. (*Gadus æglefinus.*)

The actual number of fish at each size found in the various portions of the net in each series will be found in Table D of the Appendix, whilst details of each haul are given in Tables E to H (Appendix) and are summarised in Table V. (text).

Beam Trawl.

Square.—Eight fish of 22 to 28 cm., out of 15 which escaped in series B. iv. were found in the net covering the square, whereas in series B. v., none escaped through this part of the net, although nearly 400 were found in the fine net covering other parts of the trawl.

Batings.—Practically no haddock were found in the covering nets in series B. ii. and iii., whilst in series B. iv., only 7 (21-24 cm.) escaped after passing the square, all of which went through the meshes of the batings. In series B. v. only 8 haddock (7-23 cm.) escaped through the batings, although 391 were found in the net covering the cod end.

Cod end.—Beam i.–iv.—Haddock were taken in 30 hauls in this group, but of the 1,437 fish which reached the cod end only three fish (12–13 cm.) escaped into the outer net. The size of the smallest fish retained in the cod end in each haul, ranged from 12 cm. upwards, and was less than 18 cm. in only three hauls.

From these data it is obvious that all that can be said is that the cod end of the beam trawl probably retains all haddock of 18 cm. and over.

Beam v.—Haddock were taken in six hauls in this series, both in the cod end and the net surrounding it.

The size of the largest fish escaping ranged from 18 to 26 cm. in five hauls, and was 9 cm. in the sixth, in which case no fish were taken between 9 and 33 cm., whilst the size of the smallest retained in each haul ranged from 16 to 22 cm. in five hauls.

Of the 470 fish reaching the cod end in these hauls, only one fish out of 32 over 24 cm. in length escaped, whilst 50 per cent. were retained at 24 cm., below which size the percentage which escaped ranged from 71 to 100 per cent.

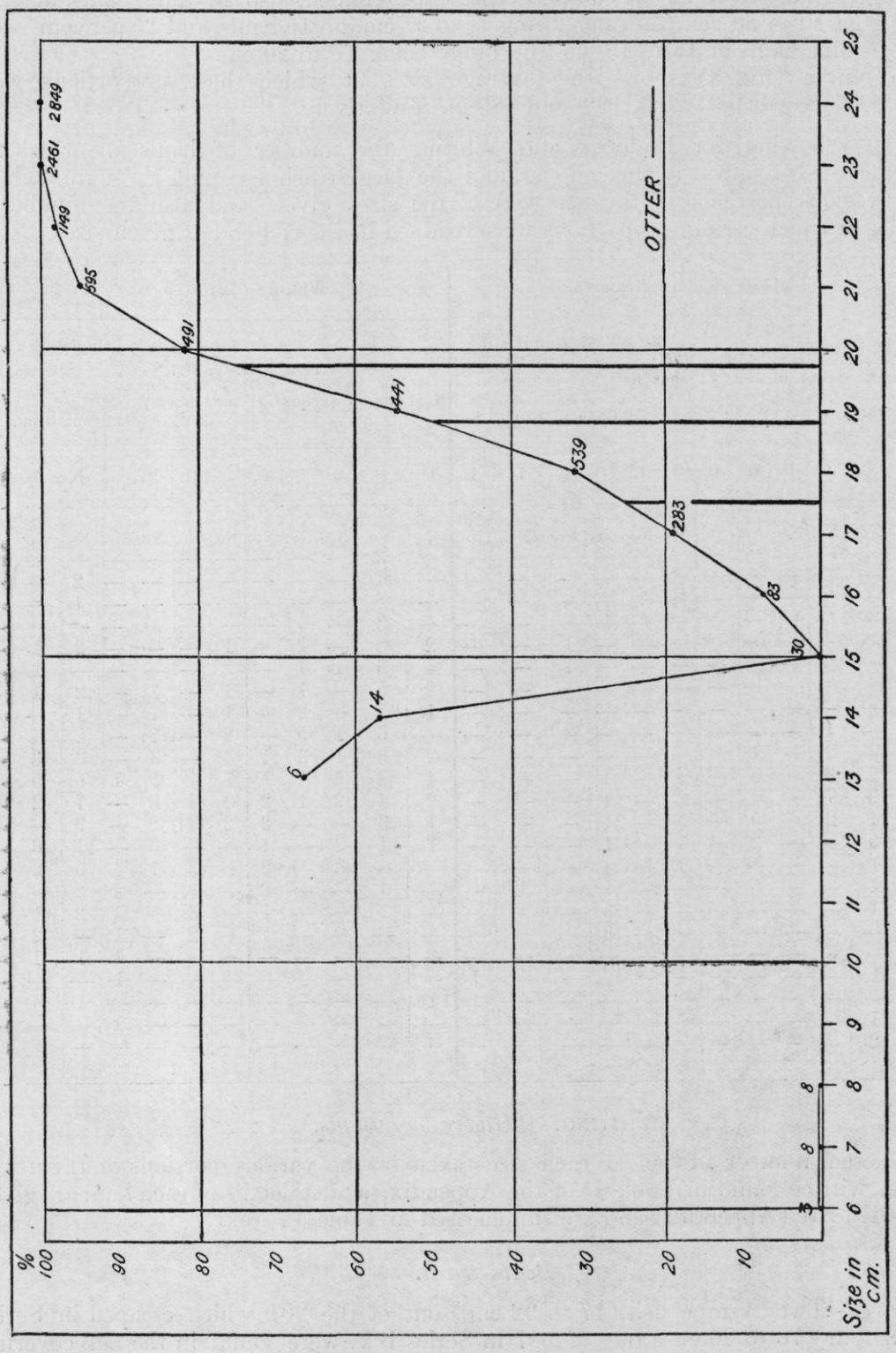

FIG. 3.—HADDOCK. Curve showing for the fish which enter the cod end, the percentage at each size which are retained. The index figures show the number entering the cod end at each size, whilst the vertical lines indicate the size at which 25 per cent., 50 per cent. and 75 per cent. were retained.

The great majority (372) of the fish escaping through the cod end were found in the net covering the hinder part, only 17 escaping through the batings and two through the belly portions.

Otter Trawl.

Cod end.—Haddock were taken in the cod end in all the hauls in this series, and in the net covering this portion of the trawl in 15 hauls.

The size of the smallest fish retained in each case ranged from 16 to 19 cm. in 12 of the 15 hauls in which some escaped, the total range being 13 to 21 cm., whilst in the five hauls in which none escaped, the range was 20 to 29 cm.

The size of the largest fish escaping ranged from 22 to 24 cm. in eight cases, the range in 15 hauls being 18 to 25 cm.

Only 11 fish (23–25 cm.) of over 22 cm. escaped out of nearly 8,000 of those sizes, whilst 75 per cent. were retained in nine hauls at sizes ranging from 20 to 21 cm., the total range being 18 to 22 cm., 50 per cent. were retained, also in nine hauls, at sizes ranging from 19 to 20 cm., the range being 17 to 21 cm., in 15 hauls, and 25 per cent. were retained in nine hauls at 18 to 19 cm. the range being 16 to 20 cm.

The curve (fig. 3) shows the average sizes at which these proportions were retained to be (corrected) 20·3, 19·4 and 18 cm. respectively.

TABLE V.—Showing for Haddock and Whiting the number of hauls in which the smallest fish retained in the cod end, and the largest fish escaping through each of the various portions of the net were of the sizes given, and also the number of hauls in which certain proportions were retained in the cod end at given sizes.

	Haddock (Gadus æglefinus).												Whiting (Gadus merlangus).											
	Minimum size in Cod end.		25 per cent. in Cod end.		50 per cent. in Cod end.		75 per cent in Cod end.		Maximum size escaping.				Minimum size in Cod end.		25 per cent in Cod end.		50 per cent. in Cod end.		75 per cent. in Cod end.		Maximum size escaping.			
									Cod end.		Btngs.	Sq.									Cod end.		Btng.	Sq.
Size																								
cm.	O.	B.	O.	B.	O	B.	O.	B.	O.	B	B.	B.	O.	B.	O.	B.	O.	B.	O.	B.	O.	B.	B.	B.
	No.	No.	No.	No	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No·	No.
8	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	2	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	1	—	—
11	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	1	—	—	—	—	—	—	—	—
12	—	2	—	—	—	—	—	—	—	1	—	—	2	8	—	2	—	1	—	—	—	2	1	—
13	1	—	—	—	—	—	—	—	—	1	—	—	4	6	1	1	—	2	—	—	—	—	1	—
14	1	1	—	—	—	—	—	—	—	—	—	—	2	5	—	1	—	1	—	1	—	2	1	—
15	—	—	—	—	—	—	—	—	—	—	—	—	1	5	—	2	—	1	—	1	—	1	—	—
16	2	—	1	—	—	—	—	—	—	—	—	—	—	6	1	5	—	2	—	2	—	2	4	—
17	4	—	2	—	1	—	—	—	—	—	—	—	2	9	1	3	1	3	—	3	—	3	3	—
18	3	2	3	—	3	—	3	—	1	—	—	—	4	4	2	4	1	7	—	5	1	6	5	—
19	3	3	7	—	4	—	2	—	1	—	—	—	2	4	2	1	2	2	1	3	—	7	2	—
20	1	4	2	—	5	—	5	—	1	—	—	—	1	3	—	—	2	2	1	2	—	3	—	—
21	2	9	—	—	2	—	4	—	1	—	—	—	1	1	2	—	1	—	—	3	—	11	6	—
22	—	1	—	—	—	—	1	—	4	—	—	—	—	—	3	—	2	—	3	1	4	9	2	—
23	—	1	—	—	—	—	—	—	1	—	1	—	—	1	—	—	2	—	3	—	4	2	—	—
24	1	1	—	—	—	—	—	—	3	—	1	—	—	1	—	—	1	—	3	—	4	2	1	—
25	1	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	1	—	2	—	1	—	2	—
26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	1	1	—
27	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—
28	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1	3	1
29	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
>30	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1

WHITING. (*Gadus merlangus.*)

The actual number of fish at each size taken in the various portions of the net in each series will be found in Table D of the Appendix, whilst details of each haul are given in Tables E to H (Appendix) and are summarised in Table V. (text).

Beam trawl.

Square.—Twenty-nine fish (17 to 32 cm.) out of the 201 which escaped in Series B iv., and four (16 to 26 cm.) out of 607 in Series B v. were found in the net covering the square.

Batings.—The proportion of those whiting which escaped, which were found in the net covering the batings, varied very considerably in the different series, being 27 per

cent. (16–22 cm.) in B ii., 10 per cent. (9–31 cm.) in B iii., 99 per cent. (16–28 cm.) in B iv., and 6 per cent. (10–29 cm.) in B v. The proportion at different sizes in B iii. fell from 26 per cent. at 12 cm. to 9 per cent. at 16 cm., and then rose to 100 per cent. at 31 cm. In B iv. the proportion was uniformly 100 per cent., except at 18 cm., at which size one fish escaped through the cod end.

Cod end.—Beam i.–iv.— Of the whiting which escaped from the cod end in this group the size of the largest in each haul ranged from 18 to 22 cm. in 36 hauls, the range in 55 hauls being 9 to 28 cm. The smallest retained in each haul ranged from 12 to 18 cm. in 43 cases, the range in 65 hauls being 8 to 24 cm.

Very few whiting of 23 cm. or over escaped, whilst 75 per cent. were retained at sizes ranging from 17 to 20 cm. in 13 hauls, the range in all the hauls in which the size could be determined (21) being 14 to 22 cm. 50 per cent. were retained at from 16 to 19 cm. in 12 hauls, the extreme range being 12 to 20 cm., whilst 25 per cent. were retained at 15 to 18 cm. in 13 hauls, the extreme range being 11 to 19 cm. The average sizes (corrected) at which these proportions were retained, as shown by the curve (Fig. 4), were 75 per cent. at 19·9 cm., 50 per cent. at 18·2 cm., and 25 per cent. at 12·7 cm.

It will be noticed that the average size, at 25 per cent., is considerably less than that which would appear probable from a study of the size in the individual hauls in which it could be determined. Apart from the fact that the average size is found from the figures for all the hauls, the chief cause of this discrepancy is to be found in the great irregularity of the proportion of whiting retained at consecutive centimetres in the smaller fish. In B 668, for example, the percentage retained at 10 cm. and the following centimetres was 100, 100, 33, 50, 25, 67, 50, 100, whilst in B 565 the percentages at 10 cm. and onwards were 50, 50, 0, 33, 75, 50, 0, 33, 100, the number of fish being small. These irregularities are also the cause of the flatness of the curve (Fig. 4), between 13 and 17 cm. compared with the curve from 18 to 20 cm. Some of the curves for other species show something similar, although not to the same degree, namely, that below a certain size, varying, of course, with the species, the chance of escape tends to increase less rapidly, and, in fact, in the very small fish rather tends to decrease. This may, however, be due to the fact that the very small fish which escape from the cod end can also do so from the net surrounding it, thereby leaving no record of their escape from the cod end.

Beam v.—Whiting were taken in the net covering the cod end in all the hauls, some being retained in the cod end itself in all but one.

The size of the largest escaping in each haul ranged from 21 to 25 cm. in six hauls., the total range being 18 to 28 cm., with one case at 13 cm., whilst the size of the smallest retained ranged from 11 to 15 cm. in five hauls, the total range being 7 to 20 cm. in eight hauls, with one instance at 35 cm.

The sizes at which 75, 50, and 25 per cent. respectively were retained could only be determined satisfactorily in one haul, and were 25, 24, and 21 cm. respectively ; in the remaining hauls the percentages at successive centimetres were too irregular.

The curve from the combined figures of all the hauls is very irregular (Fig. 4), and seems to show that below 22 cm. the tendency is for approximately $\frac{1}{2}$ to $\frac{1}{3}$ of the fish to be retained at each centimetre size. Above this size the rise is fairly regular, 50 per cent. being retained at 24·5 cm. and 75 per cent. at 27·1 cm.

Otter Trawl.

Cod end.—Whiting were taken in both the cod end and in the outer net in every haul in this series.

The size of the largest escaping from the cod end ranged from 22 to 26 cm. in 17 hauls, the total range being 18 to 29 cm. (in the instance of 18 cm. no fish were taken between 19 and 27 cm. inclusive). The size of the smallest retained ranged from 12 to 21 cm. in 19 hauls, with one instance at 28 cm. Practically all the fish of 27 cm. and over were retained, only two escaping, whilst 75 per cent. were retained at sizes ranging from 22 to 24 cm. in nine of the 13 hauls in which this could be determined, the total range being 19 to 25 cm., 50 per cent. were retained in nine hauls at 19 to 23 cm., the extreme range being 17 to 25 cm., whilst 25 per cent. were retained at 18 to 22 cm. also in nine hauls, the range being 13 to 22 cm. in 12 hauls.

The average sizes (corrected) at which the above proportions were retained, as shown by the curve (Fig. 4) were 22·6, 20·3, and 18·8 cm. respectively.

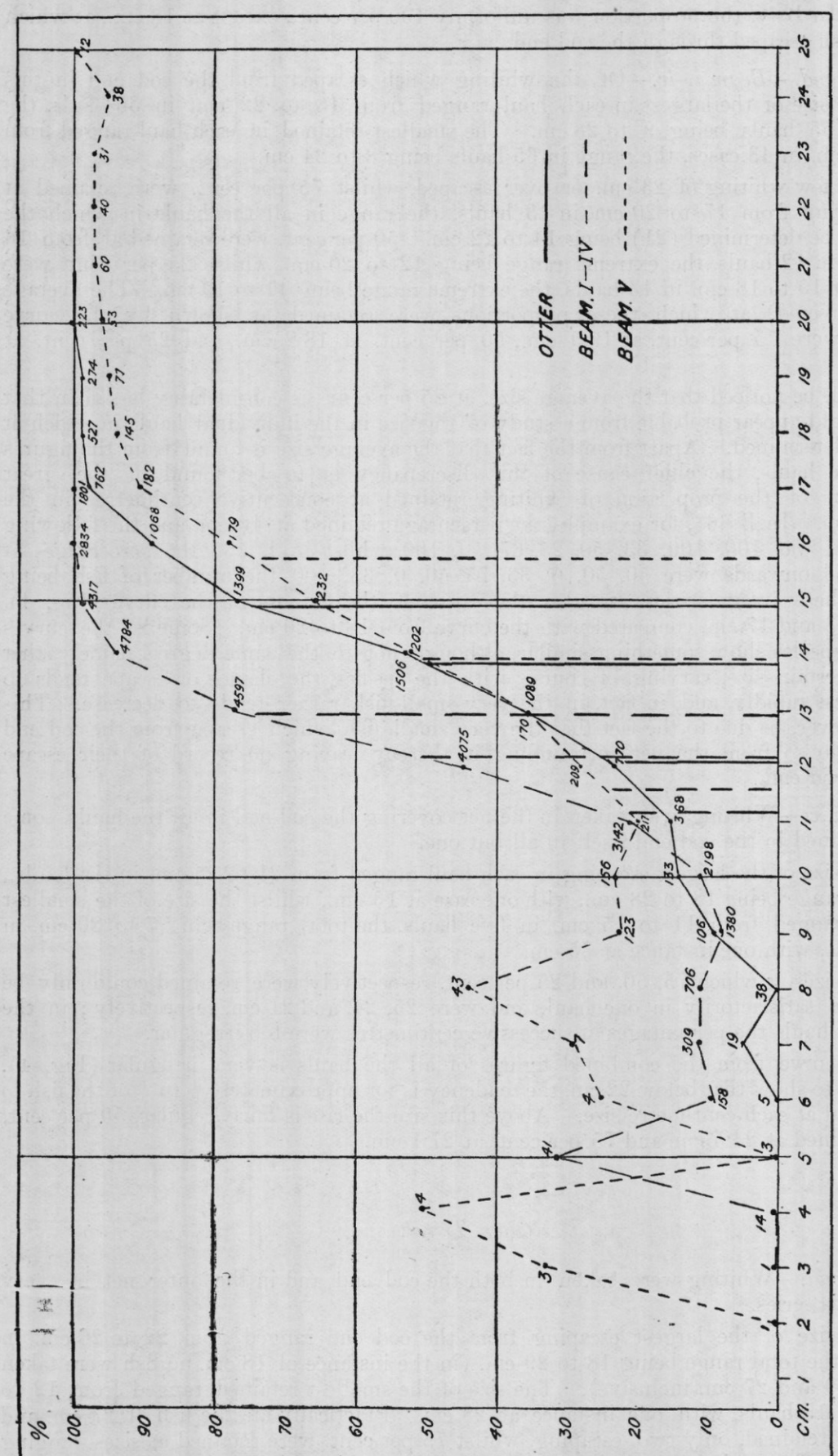

FIG. 4.—WHITING.—Curve showing for the fish which enter the cod end the percentage at each size which are retained. The index figures show the number of fish entering the cod end at each size, whilst the vertical lines indicate the size at which 25 per cent., 50 per cent., and 75 per cent. are retained.

Summary and Conclusions.

(I.)—Proportion of fish escaping through the various portions of the net :—

(*a.*) Square.—A few experiments were made with the beam trawl having the square as well as the batings and cod end covered with fine mesh netting. Contrary to expectations the number of fish found in the net covering the square did not form a fair proportion of those escaping, being only a trifle over ·5 per cent. of the plaice and dabs (33 out of nearly 6,000) and about 2·5 per cent. of the haddock and whiting (41 out of over 1,600).

(*b.*) Batings.—In the hauls in which the batings of the beam trawl were covered, the evidence in the majority of cases shows that the proportion of fish escaping through them is not large. In six hauls, however, more escaped through this part of the net than through the cod end. Although these hauls have been included in default of actual evidence of there having been anything wrong in the working of the net, it appeared probable that the net covering the cod end was torn so that the fish escaping were not retained in the covering net.

It will be seen from the table (VI.) that the proportion of fish escaping through the batings only exceeded 11 per cent., even if the fish which are too large to escape are omitted, in the case of haddock (B ii.) and cod and dabs (B v.). In these instances cod and haddock were represented by small numbers of fish whilst the hauls from which the records of dabs were taken included two of the abnormal ones mentioned above.

(*c.*) Cod end.—Compared with the batings and square the percentage of fish escaping from the cod end is very large. In half the cases, *i.e.*, plaice (O i. and B v.), cod (O i. and B v.), haddock (B v.), and whiting (O i. and B v.), the percentage escaping was 50 per cent. or over, whilst in only one case, plaice (B i.-iv.), was it less than 25 per cent.

Table VI.—Showing the proportion of those fish of certain species which, having passed the square, escape through the batings, and also the proportion of those entering the cod end which escape from it. Two percentages are given in each case, i. irrespective of size, and ii. omitting fish above a certain size, *i.e.*, those which are in all probability too large to escape.

——	Fish escaping through.											
Gear.	Otter I.		Beam I–IV.		Beam V.		Beam II.		Beam III., IV.		Beam V.	
Part of Net.	Cod end.		Cod end.		Cod end.		½ Batings.		All Batings.		All Batings.	
Specie .	Size.	Per cent.	Size.	Per cent.	Size.	Per cent.	Size.	Per cent.	Size.	Per cent.	Size.	Per cent.
Plaice	all	1	all	3	all	45	all	0	all	+	all	1
	<15	100	<16	13	<17	66	<16	0	<16	2	<16	1
Dab	all	33	all	35	all	42	all	3	all	10	all	19
	<20	38	<16	41	<25	43	<14	5	<20	10	<20	21
Cod	all	6	all	9	all	55	all	0	all	3	all	18
	<23	57	<20	26	<27	88	—	—	<22	5	< 9	80
Haddock ...	all	6	all	0	all	83	all	7	all	7	all	2
	<23	29	—	—	<27	88	<14	50	<25	11	<24	2
Whiting ...	all	47	all	27	all	71	all	8	all	8	all	4
	<27	52	<24	40	<30	73	<23	9	<29	8	<30	5

II.—Size of the fish escaping.

In regard to the size of fish escaping through the various parts of the net, it is obvious that the maximum size possible tends to decrease from the square to the cod end owing to the decrease in the size of the mesh.

The following table (VII.) shows the average size of the largest fish escaping in each haul through the various portions of the net.

TABLE VII.

	Otter I.	Beam I.–IV.	Beam II.–V.	Beam IV.–V.
	Cod end.	Cod end.	Batings.	Square.
	cm.	cm.	cm.	cm.
Plaice	13·0	12·1	14·6*	16·0†
Dab	16·9	14·8	15·5	19·5
Cod	19·1	14·6	17·5	23·0
Haddock	22·4	12·5	19·7	27·5
Whiting	23·9	19·2	20·2	26·4

* Omitting one of 7 cm.
† Omitting one of 45 cm.

It will be noticed that in all cases the average size of the largest fish escaping decreases from the square to the cod end of the beam, whilst the average size for the cod end of the otter is in every case greater than that for the beam cod end.

In regard to the proportion of fish escaping at different sizes so few fish escape through the square that nothing need be said about them.

Although the proportion of fish escaping through the batings is not great there seems to be a tendency for the proportion of the fish escaping, which are found in the net covering the batings, to at first decrease and then increase in size. For example, the proportion of whiting escaping through the batings in B iii. fell from 26 per cent. at 12 cm. to 9 per cent. at 16 cm., others rose to 100 per cent. at 31 cm., whilst dabs in Series B ii., iii. and v. showed exactly the same. B iv., however, does not show this fall and rise, but this series is in all probability not comparable.

The fish escaping from the cod end are not only considerable in number, but the size at which certain arbitrary proportions, 25, 50 and 75 per cent. to wit, were retained showed a remarkable uniformity.

Taking a single proportion only, for example 50 per cent., it will be seen from the table (VIII.) that the extreme range was : plaice (beam) 3 cm. ; dab (otter) 4 cm., (beam) 6 cm. ; cod (otter) 5 cm., (beam) 1 cm. ; haddock (otter) 5 cm. ; whiting (otter) 9 cm., (beam) 7 cm.

If, however, instead of taking the extreme range we take the predominant range,* these figures are considerably reduced, becoming ; plaice (beam) 2 cm. ; dab (otter) 2 cm., (beam) 2 cm. ; cod (otter) 3 cm., (beam) 1 cm. ; haddock (otter) 3 cm. ; whiting (otter) 5 cm., (beam) 3 cm.

The actual number of occurrences within the predominant range constituted two-thirds of the total in 17 out of the 24 cases, and was less than three-fifths in four cases only.

As is to be expected, the range both extreme and predominant is on the whole less in the case of flat fish than of round fish.†

* *i.e.*, the range excluding 25 per cent. of the occurrences at each end of the extreme range (*cf.* Garstang. The Distribution of the Plaice in the North Sea, Skagerak and Kattegat, according to Size, Age, and Frequency. Rap. et Proc.-Verb., Vol. XI., p. 74).

† From the fact that round fish both increase in girth less rapidly with increase in length than do flat fish, and also show more variability in the former dimension owing to the greater effect distension of the abdomen has upon it.

TABLE VIII.—Showing for Otter I. and Beam I.–IV.—(i.) the extreme and predominant size at which 25, 50 and 75 per cent. respectively of certain species which reach the cod end are retained, and the total number of instances in each case, and (ii.) the corrected average size at which the above proportions are retained :—

Species.	Proportion retained. %	Otter I.					Beam I.–IV.				
		Extreme Range.	Number of instances.	Predominant Range.	Number of instances.	Average Size.	Extreme Range.	Number of instances.	Predominant Range.	Number of instances.	Average Size.
Plaice ...	25	—	—	—	—	—	9–12 cm. 3·6–4·7 in.	9	10–12 cm. 3·9–4·7 in.	8	9·7 cm. 3·8 in.
	50	—	—	—	—	—	10–12 cm. 3·9–4·7 in.	10	11–12 cm. 4·3–4·7 in.	9	11·1 cm. 4·4 in.
	75	—	—	—	—	—	11–13 cm. 4·3–5·1 in.	10	12–13 cm. 4·7–5·1 in.	9	12·0 cm. 4·7 in.
Dab ...	25	10–15 cm. 3·9–5·9 in.	19	12–14 cm. 4·7–5·5 in.	16	13·0 cm. 5·1 in.	8–14 cm. 3·1–5·5 in.	58	12 cm. 4·7 in.	32	11·7 cm. 4·6 in.
	50	13–16 cm. 5·1–6·3 in.	19	14–15 cm. 5·5–5·9 in.	14	14·4 cm. 5·7 in.	9–14 cm. 3·5–5·5 in.	60	12–13 cm. 4·7–5·1 in.	50	12·7 cm. 5·0 in.
	75	14–18 cm. 5·5–7·1 in.	19	15–16 cm. 5·9–6·3 in.	12	15·3 cm. 6·0 in.	10–15 cm. 3·9–5·9 in.	59	13–14 cm. 5·1–5·5 in.	51	13·5 cm. 5·3 in.
Cod ...	25	19–23 cm. 7·5–9·1 in.	6	20–22 cm. 7·9–8·7 in.	4	—	16 cm. 6·3 in.	2	16 cm. 6·3 in.	2	—
	50	19–23 cm. 7·5–9·1 in.	6	20–22 cm. 7·9–8·7 in.	4	—	17 cm. 6·7 in.	2	17 cm. 6·7 in.	2	15·0 cm. 5·9 in.
	75	20–23 cm. 7·9–9·1 in.	5	21–22 cm. 8·3–8·7 in.	3	—	17 cm. 6·7 in.	2	17 cm. 6·7 in.	2	17·0 cm. 6·7 in.
Haddock...	25	16–20 cm. 6·3–7·9 in.	15	18–19 cm. 7·1–7·5 in.	10	18·0 cm. 7·1 in.	—	—	—	—	—
	50	17–21 cm. 6·7–8·3 in.	15	18–20 cm. 7·1–7·9 in.	12	19·4 cm. 7·6 in.	—	—	—	—	—
	75	18–22 cm. 7·1–8·7 in.	15	19–21 cm. 7·5–8·3 in.	11	20·3 cm. 8·0 in.	—	—	—	—	—
Whiting ...	25	13–22 cm. 5·1–8·7 in.	12	18–21 cm. 7·1–8·3 in.	6	18·8 cm. 6·9 in.	11–19 cm. 4·3–7·5 in.	20	15–17 cm. 5·9–6·7 in.	10	12·7 cm. 5·0 in.
	50	17–25 cm. 6·7–9·8 in.	13	19–23 cm. 7·5–9·1 in.	9	20·3 cm. 8·0 in.	12–20 cm. 4·7–7·9 in.	21	16–18 cm. 6·3–7·1 in.	12	18·2 cm. 7·2 in.
	75	19–25 cm. 7·5–9·8 in.	13	22–24 cm. 8·7–9·4 in.	9	22·6 cm. 8·9 in.	14–22 cm. 5·5–8·7 in.	21	17–20 cm. 6·7–7·9 in.	13	19·9 cm. 7·8 in.

In Beam v. which is not included in the above table the sizes at the given proportions could not be determined for cod and haddock in any haul, and in the case of whiting could only be determined in one haul when they were 21, 24 and 25 cm. respectively. The sizes for plaice could be determined in two hauls, and were 13, 14 and 15 cm. in one and 14, 15 and 15 cm. in the other. In the case of dabs the sizes could be determined in eight hauls and were as follows :—extreme range 10–15, 10–16 and 10–17 cm. respectively, predominant range and the number of instances within it, 12–13 cm. (4), 13–15 cm. (5) and 15–17 cm. (7).

There is very good ground for believing that these sizes are influenced by (i.) condition of the sea, *i.e.*, rough or smooth, and (ii.) the weight of catch in the cod end. The effect of a heavy sea or a small catch is to increase the size at which the various proportions are retained, whilst a calm sea or heavy catch have an opposite effect.

In hauling in a rough sea the trawl, especially when it comes alongside the vessel, and still more when the footrope is inboard, is raised and lowered in the water through fairly considerable distances owing to the roll of the vessel. This has a certain sifting action on the contents of the cod end, tending to sieve out the small fish. In a calm sea when the vessel is almost motionless this action is reduced to a minimum.

The action of a heavy catch is obvious, it simply tends to block the meshes of the trawl in actual contact with the catch, although opening them to their fullest extent, whilst the strain on the meshes above the catch (in front when trawling) being almost entirely along one diagonal practically closes them, thereby preventing the escape of small fish to some extent. With a small catch these actions still continue, but to nothing like the same degree.

It will be seen from the above that, given similar conditions of sea and catch, the size at which certain proportions of fish escape from the cod end is remarkably uniform, in other words, with more data regarding the effect of sea and catch one could almost calculate the number escaping at each size if given the number caught and the conditions.

TABLE A.—Showing the actual number of each species taken in the

Species.	Otter trawl.		Beam trawl.					
	I.—Cod end covered.		I.—Cod end covered.		II.—Cod end and half Batings covered.			
	Cod end.	Net covering cod end.	Cod end.	Net covering cod end.	Cod end.	Net covering. Batings.	Net covering. Cod end.	
	No.	No.	No.	No.	No.	No.	No.	
Tope. *Galeus vulgaris.* Flem. ...	...	...	2	...	...	...	...	1
Lesser spotted Dogfish. *Scyllium caniculus.* (L.)	...	...	...	...	...	...	...	2
Spurdog. *Acanthias vulgaris.* Risso	10	1	24	...	...	...	...	3
Greenland Shark. *Laemargus microcephalus.* (Blesch.)	1	...	...	...	...	...	...	4
Skate. *Raia batis.* L.	13	...	16	...	...	...	...	5
Thornback. *R. clavata.* L. ...	3	...	41	...	1	...	...	6
Homelyn. *R. maculata.* Mont. ...	...	...	...	...	...	...	...	7
Blonde. *R. blanda.* Holt	...	...	...	...	...	...	...	8
Starry Ray. *R. radiata.* Don ...	270	...	18	...	1	...	...	9
Horse Mackerel. *Caranx trachurus.* (L.)	9	...	...	...	...	...	...	10
John Dory. *Zeus faber.* L. ...	...	...	...	...	...	...	...	11
Mackerel. *Scomber scomber.* L. ...	118	4	62	2	...	...	...	12
Greater Weever. *Trachinus draco.* L.	18	13	336	57	4	...	...	13
Lesser Weever. *T. vipera.* C. & V.	Few	787	198+many	26,142	6	2	39	14
Angler. *Lophius piscatorius.* L. ...	15	...	...	...	3	...	...	15
Father Lasher. *Cottus scorpius.* L.	...	...	...	...	...	...	...	16
Red Gurnard. *Trigla cuculus.* L....	...	...	...	...	...	...	...	17
Latchet. *T. hirundo.* Bloch. ...	1	...	86	11	...	...	...	18
Grey Gurnard. *T. gurnardus.* L. ...	1,606+ ¾ basket	222	4,967+ 1 basket.	515	480	3	32	19
Pogge. *Agonus cataphractus.* (L.)	...	...	5	35+few	9	2	12	20
Lumpsucker. *Cyclopterus lumpus.* L.	...	...	...	...	...	...	...	21
Seasnail. *Liparis lineatus.* (Lepech.)	...	...	...	...	...	...	...	22
Spotted Goby. *Gobius minutus.* Gmel	...	...	1	4	...	...	...	23
Dragonet. *Callionymus lyra.* (L.)	3+few	62	45	254+few	141	50	149	24
Catfish. *Anarrhichas lupus.* L. ...	11	...	...	...	...	...	...	25
Haddock. *Gadus æglefinus.* L. ...	18,057	1,083	1,910	...	39	3	...	26
Cod. *G. morrhua.* L.	443	27	96	...	81	...	3	27
Pout. *G. luscus.* L....	5	1	2	...	...	...	...	28
Poor Cod. *G. minutus.* L.	2	25	1	24	...	...	...	29
Whiting. *G. merlangus.* L. ...	3,276	2,915	4,177+ 33 Kg.	2,005	150	16	44	30
Norway Pout. *G. esmarki.* Nilss ...	6	302	...	...	...	...	...	31
Coalfish. *G. virens.* L.	8	...	...	2	...	...	...	32
Hake. *Merluccius vulgaris.* Flem....	...	...	4	...	...	...	...	33
Ling. *Molva vulgaris.* Flem. ...	13	...	2	...	...	...	...	34
Five-bearded Rockling. *Motella mustela.* (L.)	...	...	...	...	...	...	...	35
Four-bearded Rockling. *M. cimbria.* (L.)	...	...	6	17	...	...	...	36
Three-bearded Rockling. *M. tricirrata.* (Bloch.)	...	...	...	...	...	...	...	37
Greater Sand-eel. *Ammodytes lanceolatus.* Lesauvage.	...	155	1	1	...	...	...	38
Lesser Sand-eel. *A. tobianus.* L. ...	...		...	9	...	...	...	39
Halibut. *Hippoglossus vulgaris.* Flem.	2	...	...	...	...	...	...	40
Long Rough Dab. *Hippoglossoides platessoides.* (O. Fabr.)	1,031	1,040	178	104	3	...	2	41
Turbot. *Rhombus maximus.* (L.)...	13	...	12	...	3	...	...	42
Brill. *R. lævis.* Rondel	1	...	8	...	...	...	...	43
Megrim. *Zeugopterus megastoma* ...	27	...	...	...	...	...	...	44
Scaldback. *Arnoglossus laterna.* (Walb.)	...	...	11+few	227 +few.	8	6	54	45
Plaice. *Pleuronectes platessa.* L. ...	345	2	6,370	336	189	...	...	46
Lemon Sole. *P. microcephalus.* Don	94	...	14	...	17	...	...	47
Dab. *P. limanda.* L.	6,262	3,031	12,183 +42 Kg.	7,301	3,637	218	2,520	48
Flounder. *P. flesus.* L.	1	...	4	...	...	...	...	49
Sole. *Solea vulgaris.* Quensel ...	4	1	39	1	1	...	...	50
Solenette. *S. lutea.* Risso	1	10	119 + few	1,314 + few.	1	8	15	51
Anchovy. *Engraulis encrasicola.* (L.)	...	...	...	1	...	...	...	52
Herring. *Clupea harengus.* L. ...	56	134	12	68	...	...	...	53
Sprat. *C. sprattus.* L.	17	58 216	14	389	1	1	1	54
Conger. *Conger vulgaris.* Cuv. ...	...	...	1	...	...	...	...	55
Greater Pipefish. *Syngnathus acus.* L.	...	...	...	...	...	...	...	56
Total	31,742+	10,089	30,978+	38,819+	4,775	309	2,871	

cod end and in the various parts of the covering net in each series.

	Beam trawl.													
	III.—Cod end and Batings covered.			IV.—Cod end, Batings and Square covered.				V.—All trawl except Belly covered. Cod end supported by a hoop.						Total.
	Cod end.	Net covering.		Cod end.	Net covering.			Cod end.	Covering net.					
		Batings.	Cod end.		Square.	Batings.	Cod end.		Over Square.	Over Batings.	Above Cod end.	Below Cod end.	Behind Cod end.	
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
1	2	...	...	2	...	...	...	...	...	...	...	...	...	6
2	40	...	...	...	...	...	...	...	...	...	...	...	4	44
3	9	...	...	...	...	...	...	12	...	2	...	...	3	61
4	...	...	...	...	...	...	...	...	...	...	...	...	...	1
5	...	...	...	...	...	...	...	...	...	...	...	...	...	29
6	19	1	...	...	...	...	...	17	...	...	...	...	...	82
7	...	...	...	...	...	...	...	...	...	...	...	...	1	1
8	1	...	...	...	...	...	...	...	...	...	...	...	...	1
9	...	...	...	1	...	...	...	16	...	...	...	...	...	306
10	...	...	...	...	...	19	12	...	...	3	...	...	...	43
11	1	...	...	...	...	...	...	...	...	...	...	...	...	1
12	6	...	3	...	...	...	...	...	1	...	...	...	...	196
13	194	20	39	8	...	28	33	75	...	6	10	30	34	905
14	316	136	2,420	2	...	562	4	5	...	156	39	4	103	30,921+
15	6	...	...	...	...	...	...	6	...	...	...	...	...	30
16	2	...	...	...	...	...	...	31	...	1	1	10	30	75
17	1	...	...	...	...	...	...	...	...	...	...	...	...	1
18	29	...	1	1	...	...	...	2	...	...	4	1	4	140
19	3,446	92	1,126	68	17	35	...	132	1	32	30	5	91	12,900+
20	3	1	6	4	...	10	2	6	...	3	13	2	37	150+
21	1	...	...	...	...	...	...	...	...	...	...	...	...	1
22	...	...	...	...	...	...	...	...	...	...	...	...	12	12
23	...	...	1	...	...	...	...	...	1	19	...	...	...	26
24	200	78	314	7	...	191	4	12	...	11	7	1	26	1,555+
25	...	...	...	...	...	...	...	...	...	...	...	...	...	11
26	57	...	...	31	8	7	...	79	...	8	17	2	372	21,673
27	302	5	32	24	2	8	15	42	...	20	8	4	40	1,152
28	383	...	21	5	...	5	...	9	...	2	8	...	44	485
29	25	9	23	...	...	...	...	...	...	...	...	...	...	122
30	2,959	250	1,798	119	29	171	1	227+ 32 Kg.	4	44	308	28	307	18,828+
31	...	...	...	...	...	...	...	1	...	...	...	...	...	309
32	...	...	...	...	...	...	...	...	...	...	...	...	...	10
33	...	...	...	...	...	...	...	...	...	...	...	...	...	4
34	...	...	...	...	...	...	...	...	...	...	...	...	...	15
35	...	...	...	...	...	...	...	...	...	...	...	...	2	2
36	...	...	...	...	...	...	...	...	...	...	...	...	...	23
37	2	...	...	...	...	...	...	...	...	...	...	...	...	2
38	...	...	...	...	...	...	1	...	6	18	1	...	...	27 } 156
39	...	...	...	...	...	...		1	4	17	15	...	6	52 }
40	...	...	...	...	...	...	...	...	...	...	...	...	...	2
41	4	1	2	...	...	2	...	32	...	2	17	...	17	2,435
42	16	...	...	...	...	...	...	2	...	...	...	...	...	46
43	7	...	...	...	...	...	...	1	...	...	...	...	...	17
44	...	...	...	...	...	...	...	...	...	...	...	...	...	27
45	120	18	362	6	1	50	2	6	...	18	7	...	7	903+
46	3,465	5	21	53	1	1	...	968	1	13	618	45	122	12,555
47	8	...	...	3	...	...	...	6	...	...	...	...	...	142
48	11,739	766	5,274	189	30	1,082	37	1,313+ 32 Kg.	1	515	508	111	495	57,212+
49	7	...	...	...	...	...	...	2	...	...	...	2	...	16
50	15	...	1	...	...	...	...	46	...	1	...	1	2	111
51	31	64	429	1	...	149	8	2	...	42	4	3	36	2,237+
52	...	...	...	...	...	...	...	...	...	...	...	...	...	1
53	9	9	40	...	...	...	...	1	...	4	...	...	...	333 } 216
54	14	41	2	...	...	...	...	28	38	1,098	106	25	98	1,931 }
55	1	...	...	...	...	...	...	1	...	...	...	...	2	5
56	...	...	...	...	...	...	...	...	...	...	...	...	3	3
	23,440	1,496	11,915	524	88	2,320	119	3,081+	57	2,035	1,721	274	1,898	168,551+

TABLES B to D.—Showing for certain species the number of fish at each

TABLE B.—PLAICE (*Pleuronectes platessa*)

	Size.	Otter Trawl. I. Cod end covered. Cod end. No.	%	Net covering Cod end. No.	%	Beam I. Cod end covered. Cod end. No.	%	Net covering Cod end. No.	%	II. Cod end and Half Batings covered. Cod end. No.	%	Net covering. Half Batings. No.	%	Cod end. No.	%	III. Cod end Batings. Cod end. No.	%	Net Batings. No.	%	
PLAICE (*Pleuronectes platessa*).	Cm.																					
	6 ...	—	—	—	—	1	**100**	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
	7 ...	—	—	—	—	2	**12**	15	**88**	—	—	—	—	—	—	—	—	—	—	—	—	2
	8 ...	—	—	—	—	12	**22**	43	**78**	—	—	—	—	—	—	—	—	—	—	—	—	3
	9 ...	—	—	—	—	12	**26**	35	**74**	—	—	—	—	—	—	—	—	—	—	—	—	4
	10 ...	—	—	—	—	38	**35**	70	**65**	—	—	—	—	—	—	1	**12**	—	—	—	—	5
	11 ...	—	—	—	—	135	**59**	94	**41**	—	—	—	—	—	—	2	**40**	—	—	—	—	6
	12 ..	—	—	1	—	367	**87**	53	**13**	—	—	—	—	—	—	9	**69**	1	**8**	—	—	7
	13 ...	—	—	—	—	521	**97**	18	**3**	—	—	—	—	—	—	38	**97**	1	**3**	—	—	8
	14 ...	—	—	1	—	483	**99**	5	**1**	—	—	—	—	—	—	67	**99**	1	**1**	—	—	9
	15 ...	3	—	—	—	542	**100**	—	—	1	—	—	—	—	—	131	**99**	2	**1**	—	—	10
	16 ...	4	—	—	—	418	—	1	+	—	—	—	—	—	—	229	**100**	—	—	—	—	11
	17 ...	2	—	—	—	400	—	1	+	—	—	—	—	—	—	276	—	—	—	—	—	12
	18 ...	11	—	—	—	400	—	1	+	1	—	—	—	—	—	371	—	—	—	—	—	13
	19 ...	3	—	—	—	342	—	—	—	9	—	—	—	—	—	417	—	—	—	—	—	14
	20+ ...	322	—	—	—	2,697	—	—	—	178	—	—	—	—	—	1,924	—	—	—	—	—	15
	Total ...	345	—	2	—	6,370	—	336	—	189	—	—	—	—	—	3,465	—	5	—	—	—	16
DAB (*Pleuronectes limanda*).																						
	2 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	17
	3 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18
	4 ...	—	—	—	—	—	—	14	**100**	—	—	—	—	—	—	—	—	—	—	—	—	19
	5 ...	—	—	—	—	12	**30**	28	**70**	—	—	—	—	—	—	1	**20**	4	**80**	—	—	20
	6 ...	—	—	5	**100**	12	**8**	131	**92**	—	—	—	—	—	—	2	**8**	11	**42**	—	—	21
	7 ...	1	**5**	18	**95**	22	**11**	171	**89**	—	—	—	—	7	**100**	5	**4**	28	**22**	—	—	22
	8 ...	—	—	38	**100**	55	**20**	217	**80**	12	**19**	7	**11**	43	**69**	6	**1**	61	**14**	—	—	23
	9 ...	10	**9**	96	**91**	48	**14**	284	**86**	35	**6**	69	**13**	442	**81**	15	**2**	55	**9**	—	—	24
	10 ...	19	**14**	114	**86**	70	**19**	292	**81**	109	**9**	87	**8**	952	**83**	66	**8**	72	**9**	—	—	25
	11 ...	54	**15**	314	**85**	202	**26**	577	**74**	201	**21**	26	**3**	608	**73**	252	**15**	109	**7**	—	—	26
	12 ...	176	**23**	594	**77**	521	**48**	555	**52**	438	**56**	13	**2**	326	**42**	853	**36**	148	**6**	—	—	27
	13 ...	396	**36**	693	**64**	875	**78**	248	**22**	798	**85**	10	**1**	115	**12**	1,841	**70**	96	**4**	—	—	28
	14 ...	800	**53**	706	**47**	1,070	**94**	66	**6**	825	**96**	6	**1**	25	**3**	2,595	**91**	80	**3**	—	—	29
	15 ...	1,083	**77**	316	**23**	1,202	**97**	23	**3**	641	**100**	—	—	2	+	2,385	**97**	55	**2**	—	—	30
	16 ...	952	**89**	116	**11**	963	**99**	8	**1**	328	—	—	—	—	—	1,511	**98**	26	**2**	—	—	31
	17 ...	748	**98**	14	**2**	692	**99**	7	**1**	137	—	—	—	—	—	941	**98**	15	**2**	—	—	32
	18 ...	524	**99**	3	**1**	388	**99**	3	**1**	58	—	—	—	—	—	517	**100**	2	+	—	—	33
	19 ...	270	**99**	4	**1**	338	**100**	—	—	22	—	—	—	—	—	260	**99**	2	**1**	—	—	34
	20 ...	223	**100**	—	—	183	**99**	1	**1**	16	—	—	—	—	—	187	**100**	—	—	—	—	35
	21 ...	194	—	—	—	132	**100**	—	—	10	—	—	—	—	—	96	**100**	—	—	—	—	36
	22 ...	96	—	—	—	95	—	—	—	1	—	—	—	—	—	72	**97**	2	3	—	—	37
	23 ...	78	—	—	—	72	—	—	—	2	—	—	—	—	—	41	**100**	—	—	—	—	38
	24 ...	114	—	—	—	35	—	—	—	—	—	—	—	—	—	23	—	—	—	—	—	39
	25 ...	85	—	—	—	37	—	—	—	—	—	—	—	—	—	19	—	—	—	—	—	40
	26 ...	67	—	—	—	52	—	—	—	1	—	—	—	—	—	14	—	—	—	—	—	41
	27+ ...	372	—	—	—	93	—	—	—	3	—	—	—	—	—	37	—	—	—	—	—	42
	Counted	—	—	—	—	5,014	—	4,626	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Total ...	6,262	—	3,031	—	12,183	—	7,251	—	3,637	—	218	—	2,520	—	11,739	—	766	—	—	—	

size taken in the cod end and various parts of the covering net in each series.

and DAB (*Pleuronectes limanda*).

Trawl.

	and covered.		IV. Cod end, Square and Batings covered.								V. All Trawl, except Belly, covered. Cod end supported by a hoop.											
	covering.		Cod end.		Net covering.						Cod end.		Covering net.									
	Cod end.				Square.		Batings.		Cod end.				Over-Square.		Over-Batings.		Above Cod end.		Below Cod end.		Behind Cod end.	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	12	4	50	—	—	3	37
3	2	100	—	—	—	—	—	—	—	—	5	16	—	—	—	—	17	53	1	3	9	28
4	6	100	—	—	—	—	—	—	—	—	7	7	—	—	2	2	49	50	9	9	32	32
5	7	87	—	—	—	—	—	—	—	—	12	9	—	—	1	1	89	70	6	5	20	16
6	3	60	—	—	—	—	—	—	—	—	17	8	—	—	2	1	140	70	10	5	31	15
7	3	23	—	—	—	—	—	—	—	—	30	16	—	—	3	2	134	70	9	5	15	8
8	—	—	—	—	—	—	—	—	—	—	46	29	—	—	1	1	95	60	6	4	11	7
9	—	—	6	—	1	—	—	—	—	—	80	54	—	—	1	1	65	44	1	1	1	1
10	—	—	7	—	—	—	—	—	—	—	109	83	—	—	1	1	22	17	—	—	—	—
11	—	—	9	—	—	—	1	—	—	—	101	97	—	—	—	—	3	3	—	—	—	—
12	—	—	4	—	—	—	—	—	—	—	113	98	—	—	1	1	—	—	1	1	—	—
13	—	—	4	—	—	—	—	—	—	—	81	100	—	—	—	—	—	—	—	—	—	—
14	—	—	2	—	—	—	—	—	—	—	63	97	—	—	—	—	—	—	2	3	—	—
15	—	—	21	—	—	—	—	—	—	—	304	—	1	—	—	—	—	—	—	—	—	—
16	21	—	53	—	1	—	1	—	—	—	968	—	1	—	13	—	618	—	45	—	122	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	100
18	—	—	—	—	—	—	—	—	1	100	1	33	—	—	—	—	—	—	—	—	2	67
19	—	—	—	—	—	—	—	—	—	—	2	8	—	—	20	83	—	—	—	—	2	8
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23	88	—	—	—	—	3	12
21	13	50	—	—	—	—	5	100	—	—	1	11	—	—	5	56	—	—	—	—	3	33
22	96	74	6	23	—	—	18	69	2	8	2	10	—	—	13	65	1	5	—	—	4	20
23	367	84	3	3	—	—	92	94	3	3	19	18	—	—	64	60	7	7	—	—	17	16
24	542	89	6	3	—	—	213	94	8	4	27	14	—	—	67	35	27	14	6	3	63	33
25	694	83	5	2	1	+	220	93	10	4	36	15	—	—	77	33	36	15	9	4	75	32
26	1,291	78	7	3	—	—	232	95	4	2	43	14	—	—	82	27	58	19	24	8	92	31
27	1,369	58	9	10	2	2	79	84	4	4	58	21	—	—	65	24	47	17	22	8	82	30
28	696	26	21	29	4	5	45	62	3	4	62	30	—	—	33	16	56	27	6	3	46	23
29	172	6	31	25	5	4	89	71	—	—	105	47	—	—	22	10	61	27	9	4	27	12
30	28	1	34	31	6	5	68	62	2	2	154	64	—	—	10	4	55	23	9	4	14	6
31	2	+	22	59	3	8	12	32	—	—	139	74	—	—	10	5	29	15	1	1	10	5
32	3	+	21	64	5	15	7	21	—	—	165	86	—	—	10	5	12	6	1	1	4	2
33	1	+	11	85	1	8	1	8	—	—	137	95	—	—	—	—	1	1	6	4	1	1
34	—	—	6	67	2	22	1	11	—	—	73	92	—	—	2	3	1	1	2	3	1	1
35	—	—	5	100	—	—	—	—	—	—	51	96	—	—	—	—	1	2	1	2	—	—
36	—	—	1	100	—	—	—	—	—	—	58	97	—	—	—	—	—	—	2	3	—	—
37	—	—	1	100	—	—	—	—	—	—	39	98	—	—	—	—	—	—	1	2	—	—
38	—	—	—	—	—	—	—	—	—	—	30	91	—	—	2	6	—	—	1	3	—	—
39	—	—	—	—	—	—	—	—	—	—	36	95	—	—	—	—	—	—	2	5	—	—
40	—	—	—	—	—	—	—	—	—	—	12	100	—	—	—	—	—	—	—	—	—	—
41	—	—	—	—	1	—	—	—	—	—	16	—	—	—	—	—	—	—	—	—	—	—
42	—	—	—	—	—	—	—	—	—	—	47	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	5,274	—	189	—	30	—	1,082	—	37	—	1,313	—	—	—	505	—	392	—	102	—	447	—

TABLE C.—WHITING (*Gadus merlangus*)

	Size.	Otter Trawl. I. Cod end covered. Cod end. No.	%	Otter Trawl. I. Cod end covered. Net covering Cod end. No.	%	Beam I. Cod end covered. Cod end. No.	%	Beam I. Cod end covered. Net covering Cod end. No.	%	Beam II. Cod end and Half Batings covered. Cod end. No.	%	Beam II. Net covering. Half Batings. No.	%	Beam II. Net covering. Cod end. No.	%	Beam III. Cod end Batings. Cod end. No.	%	Beam III. Net Batings. No.	%	
WHITING (*Gadus merlangus*).	cm.																			
	7 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
	8 ...	—	—	1	100	1	50	1	50	—	—	—	—	—	—	—	—	—	—	2
	9 ...	—	—	—	—	1	10	9	90	—	—	—	—	—	—	—	—	1	50	3
	10 ...	—	—	3	100	6	26	17	74	—	—	—	—	—	—	2	100	—	—	4
	11 ...	—	—	7	100	6	24	19	76	—	—	—	—	—	—	1	50	—	—	5
	12 ...	2	10	18	90	14	21	54	79	—	—	—	—	—	—	6	24	5	20	6
	13 ...	10	13	68	87	36	35	68	65	—	—	—	—	—	—	14	27	7	14	7
	14 ...	44	15	258	85	85	44	108	56	—	—	—	—	1	100	36	21	14	8	8
	15 ...	106	18	469	82	136	55	112	45	—	—	—	—	1	100	67	18	34	9	9
	16 ...	114	21	442	79	142	64	79	36	1	20	2	40	2	40	134	24	36	7	10
	17 ...	101	22	357	78	124	73	46	27	5	29	2	12	10	59	154	27	47	8	11
	18 ...	76	25	232	75	149	84	29	16	17	49	7	20	11	31	225	40	33	6	12
	19 ...	148	40	225	60	174	90	19	10	37	71	3	6	12	23	237	55	23	5	13
	20 ...	329	54	286	46	184	96	8	4	36	90	1	2	3	7	195	72	13	5	14
	21 ...	436	62	273	38	166	94	10	6	11	73	—	—	4	27	183	78	13	6	15
	22 ...	458	74	165	26	146	97	5	3	13	93	1	7	—	—	290	93	8	3	16
	23 ...	332	84	64	16	116	100	—	—	4	100	—	—	—	—	330	98	1	+	17
	24 ...	250	90	29	10	73	—	—	—	11	—	—	—	—	—	326	98	6	2	18
	25 ...	191	97	6	3	46	—	—	—	5	—	—	—	—	—	273	99	3	1	19
	26 ...	141	93	10	6	28	—	—	—	4	—	—	—	—	—	188	98	2	2	20
	27 ...	151	99	1	1	31	—	—	—	2	—	—	—	—	—	111	99	1	1	21
	28 ...	99	100	—	—	21	—	—	—	2	—	—	—	—	—	85	98	2	2	22
	29 ...	83	99	1	1	13	—	—	—	—	—	—	—	—	—	34	100	—	—	23
	30 ...	68	100	—	—	8	—	—	—	2	—	—	—	—	—	29	100	—	—	24
	31 ...	36	—	—	—	10	—	—	—	—	—	—	—	—	—	12	92	1	8	25
	32 ...	40	—	—	—	5	—	—	—	—	—	—	—	—	—	12	100	—	—	26
	33+ ...	61	—	—	—	12	—	—	—	—	—	—	—	—	—	15	—	—	—	27
	Counted only.	—	—	—	—	2,444	—	1,290	—	—	—	—	—	—	—	—	—	—	—	28
	Total ...	3,276	—	2,915	—	4,177	—	1,874	—	150	—	16	—	44	—	2,959	—	250	—	29
HADDOCK (*Gadus æglefinus*).	6 ...	—	—	3	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
	7 ...	—	—	8	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	31
	8 ...	—	—	8	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	32
	9 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	33
	10 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	34
	11 ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	35
	12 ...	—	—	—	—	—	—	—	—	2	—	2	—	—	—	—	—	—	—	36
	13 ...	4	67	2	33	—	—	—	—	1	—	1	—	—	—	—	—	—	—	37
	14 ...	8	57	6	43	1	—	—	—	—	—	—	—	—	—	—	—	—	—	38
	15 ...	—	—	30	100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	39
	16 ...	6	7	77	93	—	—	—	—	—	—	—	—	—	—	—	—	—	—	40
	17 ...	53	19	230	81	—	—	—	—	—	—	—	—	—	—	—	—	—	—	41
	18 ...	173	32	366	68	2	—	—	—	—	—	—	—	—	—	4	—	—	—	42
	19 ...	240	55	201	45	4	—	—	—	—	—	—	—	—	—	3	—	—	—	43
	20 ...	403	82	88	18	14	—	—	—	—	—	—	—	—	—	4	—	—	—	44
	21 ...	564	95	31	5	32	—	—	—	1	—	—	—	—	—	8	—	—	—	45
	22 ...	1,127	98	22	2	58	—	—	—	3	—	—	—	—	—	8	—	—	—	46
	23 ...	2,458	100	3	+	84	—	—	—	2	—	—	—	—	—	5	—	—	—	47
	24 ...	2,844	100	5	+	83	—	—	—	3	—	—	—	—	—	5	—	—	—	48
	25 ...	2,510	100	3	+	86	—	—	—	6	—	—	—	—	—	3	—	—	—	49
	26 ...	1,802	—	—	—	100	—	—	—	4	—	—	—	—	—	8	—	—	—	50
	27 ...	1,271	—	—	—	109	—	—	—	6	—	—	—	—	—	4	—	—	—	51
	28 ...	934	—	—	—	120	—	—	—	3	—	—	—	—	—	3	—	—	—	52
	29+ ...	3,660	—	—	—	614	—	—	—	8	—	—	—	—	—	2	—	—	—	53
	Total ...	18,057	—	1,083	—	1,307	—	—	—	39	—	3	—	—	—	57	—	—	—	

AND HADDOCK (*Gadus æglefinus*).

Trawl.

	and covered.		IV. Cod end, Batings and Square covered.								V. All Trawl, except Belly, covered. Cod end supported by a hoop.											
	covering.		Cod end.		Net covering.						Cod end.		Covering net.									
	Cod end.				Square.		Batings.		Cod end.				Over Square.		Over Batings.		Above Cod end.		Below Cod end.		Behind Cod end.	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	—	—	—	—	—	—	—	—	—	—	1	11	—	—	—	—	—	—	—	—	8	89
2	—	—	—	—	—	—	—	—	—	—	1	8	—	—	—	—	—	—	—	—	11	92
3	1	50	—	—	—	—	—	—	—	—	2	15	—	—	—	—	—	—	—	—	11	85
4	—	—	—	—	—	—	—	—	—	—	1	17	—	—	3	50	—	—	—	—	2	33
5	1	50	—	—	—	—	—	—	—	—	3	30	—	—	1	10	5	50	—	—	1	10
6	14	56	—	—	—	—	—	—	—	—	9	26	—	—	—	—	15	44	1	3	9	26
7	30	59	—	—	—	—	—	—	—	—	20	25	—	—	3	4	28	35	6	8	22	28
8	122	71	—	—	—	—	—	—	—	—	19	20	—	—	5	5	47	51	5	5	17	18
9	274	73	1	—	—	—	—	—	—	—	19	20	—	—	8	8	36	38	5	5	28	29
10	382	69	3	—	—	—	1	—	—	—	7	10	1	1	3	4	24	35	3	4	30	44
11	374	65	3	—	2	—	23	—	—	—	7	14	1	2	2	4	16	32	2	4	23	45
12	299	54	19	—	5	—	48	—	1	—	8	15	1	2	1	2	21	40	—	—	21	40
13	173	40	19	—	1	—	43	—	—	—	4	9	—	—	1	2	22	49	2	4	16	36
14	63	23	14	—	3	—	21	—	—	—	8	21	—	—	1	3	11	28	1	3	18	46
15	40	17	13	—	1	—	15	—	—	—	15	34	—	—	1	2	15	34	—	—	13	30
16	15	5	7	—	4	—	6	—	—	—	9	25	—	—	2	6	10	28	—	—	15	42
17	7	2	8	—	3	—	—	—	—	—	11	33	—	—	3	9	6	18	—	—	13	39
18	2	1	5	—	—	—	5	—	—	—	12	46	—	—	1	4	2	8	—	—	11	42
19	—	—	5	—	3	—	4	—	—	—	13	68	—	—	—	—	2	11	—	—	4	21
20	1	1	5	—	2	—	2	—	—	—	6	50	1	17	—	—	1	17	—	—	4	33
21	—	—	7	—	1	—	—	—	—	—	9	82	—	—	1	9	—	—	—	—	1	9
22	—	—	4	—	3	—	3	—	—	—	16	94	—	—	—	—	1	6	—	—	—	—
23	—	—	1	—	—	—	—	—	—	—	9	82	—	—	1	9	—	—	—	—	1	9
24	—	—	3	—	—	—	—	—	—	—	6	100	—	—	—	—	—	—	—	—	—	—
25	—	—	1	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—
26	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
27	—	—	1	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	1,798	—	119	—	29	—	171	—	1	—	227	—	4	—	37	—	262	—	25	—	279	—
30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	1	—
32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—
33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	3	—
34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
37	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
38	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—
39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—
40	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	16	—
41	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	2	—	1	—	41	—
42	—	—	—	—	—	—	—	—	—	—	5	—	—	—	—	—	2	—	—	—	98	—
43	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	5	—	—	—	76	—
44	—	—	1	—	—	—	—	—	—	—	8	—	—	—	1	—	4	—	—	—	60	—
45	—	—	1	—	—	—	2	—	—	—	4	—	—	—	—	—	—	—	—	—	37	—
46	—	—	8	—	1	—	1	—	—	—	10	—	—	—	—	—	2	—	—	—	22	—
47	—	—	7	—	1	—	2	—	—	—	2	—	—	—	1	—	2	—	—	—	8	—
48	—	—	4	—	1	—	2	—	—	—	3	—	—	—	—	—	—	—	—	—	3	—
49	—	—	1	—	2	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—
50	—	—	1	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—
51	—	—	2	—	1	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
52	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53	—	—	5	—	—	—	—	—	—	—	24	—	—	—	—	—	—	—	—	—	—	—
	—	—	31	—	8	—	7	—	—	—	79	—	—	—	8	—	17	—	2	—	372	—

TABLE D.—COD (*Gadus morrhua*).

Size.	Otter Trawl.		Beam Trawl.																	
	I. Cod end covered.		I. Cod end covered.		II. Cod end & Half Batings covered.			III. Cod end & Batings covered.			IV. Cod end, Batings & Square covered.				V. All Trawl except Belly covered. Cod end supported by a hoop.					
						Net covering.			Net covering.			Net covering.				Covering net.				
	Cod end.	Net covering Cod end.	Cod end.	Net covering Cod end.	Cod end.	Batings.	Cod end.	Cod end.	Batings.	Cod end.	Cod end.	Square.	Batings.	Cod end.	Cod end.	Over square.	Over Batings.	Above Cod end.	Below Cod end.	Behind Cod end.
Cm.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
3	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	1	—	—	4	—	—	1	—	—	1
5	—	—	—	—	—	—	—	—	—	—	1	—	1	4	1	—	3	—	—	—
6	—	—	—	—	—	—	—	—	—	—	3	—	2	1	1	—	6	1	—	—
7	—	—	—	—	—	—	—	—	—	—	3	—	1	4	—	—	6	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	3	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
12	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	1	—	3
13	—	—	—	—	—	—	—	2	—	5	—	—	—	—	—	—	—	—	1	2
14	—	2	—	—	—	—	—	6	2	11	—	—	—	—	—	—	—	1	1	4
15	2	1	—	—	—	—	—	6	—	3	—	—	—	—	—	—	—	3	1	2
16	—	2	—	—	1	—	2	11	—	5	—	—	—	—	—	—	—	2	1	1
17	—	2	—	—	11	—	1	17	1	3	1	—	1	—	—	—	—	—	—	2
18	1	4	1	—	7	—	—	26	—	3	2	—	—	—	—	—	—	—	—	3
19	2	6	—	—	12	—	—	28	—	2	1	—	—	—	—	—	—	—	—	5
20	7	5	2	—	12	—	—	31	1	—	1	—	3	—	—	—	—	—	—	6
21	3	3	2	—	10	—	—	38	1	—	2	—	—	—	—	—	—	—	—	3
22	5	2	1	—	6	—	—	34	—	—	4	—	—	—	1	—	—	—	—	—
23	11	—	5	—	6	—	—	23	—	—	—	2	—	—	—	—	—	—	—	—
24	14	—	4	—	3	—	—	19	—	—	1	—	—	—	1	—	—	—	—	1
25	16	—	3	—	3	—	—	13	—	—	—	—	—	—	2	—	—	—	—	2
26	16	—	5	—	2	—	—	13	—	—	1	—	—	—	1	—	—	—	—	1
27	20	—	3	—	2	—	—	13	—	—	—	—	—	—	3	—	—	—	—	—
28+	346	—	70	—	6	—	—	20	—	—	3	—	—	—	32	—	—	—	—	—
Total	443	27	96	—	81	—	3	302	5	32	24	2	8	15	42	—	20	8	4	40

15360

TABLES E. to H.—Showing for each haul—(i.) Condition of sea ; (ii.) Weight of fish in cod end and amount of invertebrates ; and(iii.) for certain speci of fish : *a*. Length of smallest fish in the cod end ; *b*. Length at which given percentages were retained in the cod end ; and *c*. Length of the la fish in each portion of the covering net.

TABLE E.—BEAM I.

No. of Haul.	Condition of Sea.	Weight of Fish in Cod end.	Amount of invertebrates in Cod end.	PLAICE.					DAB.					COD.	HADDOCK.	WHITING.				
				Length of smallest Fish in Cod end.	Length of Fish at which given percentages were retained in the Cod end.			Length of largest Fish in covering net.	Length of smallest Fish in Cod end.	Length of Fish at which given percentages were retained in the Cod end.			Length of largest Fish in covering net.	Length of smallest Fish in Cod end.	Length of smallest Fish in Cod end.	Length of smallest Fish in Cod end.	Length of Fish at which given percentages were retained in the Cod end.			Length of largest Fish in covering net.
					25 °/₀.	50 °/₀.	75 °/₀.			25 °/₀.	50 °/₀.	75 °/₀.								
		Kg.		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm	cm.	cm.	cm.	cm.
B. 2	s.*	20	?	12	...	...	...	...	10	?	(11–12)	?	11	...	29	20	...	...	...	...
3	s.	250	?	6	9–10	9–10	10–11	13	?	...	...	...	?	...	...	?	...	...	...	...
466	ms.	93	f.†	10	(9–10)	(10–11)	(11–12)	11	8	9–10	11–12	13–14	15	18	19	?	...	...	...	22
467	ms.	189	c.	14	...	...	...	...	8	12–13	12–13	13–14	14	20	18	?	...	...	...	28
468	ms.	236	c.	11	10–11	11–12	12–13	12	?	...	...	...	?	...	?	?	...	...	...	?
469	ms.	145	f.	14	...	...	...	...	7	11–12	12–13	13	15	...	19	12	15–16	17–18	17–18	21
470	s.	52	?	11	...	...	...	...	?	...	...	...	?	>45	21	12	...	...	...	?
471	s.	67	f.	12	...	...	...	...	6	...	...	...	?	...	24	11	...	...	...	?
472	s.	33	f.	14	...	...	...	...	8	12–13	12–13	13–14	16	...	22	10	15–16	17–18	17–18	22
473	s.	137	?	13	...	...	...	7	6	...	...	...	?	20	19	12	...	...	...	?
474	ms.	110	fc.	12	...	...	...	...	?	...	...	...	?	34	...	?	...	...	...	?
475	ms.	78	?	11	10–11	10–11	11–12	12	?	...	...	...	?	...	>45	?	...	...	...	?
476	ms.	69	ec.	9	8–9	10–11	11–12	18	8	...	...	...	?	...	...	16	...	...	...	...
479	ms.	18	?	10	...	(11–12)	(12)	12	11	12–13	12–13	13–14	15	...	...	19	(18)	(18)	(18)	17
480	ms.	162	?	10	11–12	11–12	12–13	14	?	...	...	...	?	...	...	?	...	...	...	...
481	s.	97	?	11	(10–11)	(11)	(11–12)	16	10	12–13	13	14–15	18	...	...	17	...	...	...	?
483	ms.	84	?	13	...	...	...	...	10	...	...	...	?	23	...	...	...	...	...	?
484	ms.	71	f.	18	...	...	...	...	11	...	...	...	?	21	...	17	...	...	...	?
508	s.	32	c.	12	...	...	...	...	4	10–11	11–12	11–12	16	43	...	...	...	...	...	10
510	s.	22	fc.	13	...	...	...	...	9	10–11	11–12	12–13	13	...	...	...	...	...	...	9
511	s.	38	?	24	...	...	...	...	9	11–12	11–12	12–13	16	30	20	17	(16–17)	(16–17)	(16–17)	22
512	s.	67	?	21	...	...	...	...	?	...	...	...	14	21	21	8	...	...	...	21
513	s.	78	?	23	...	...	...	...	8	10–11	11–12	12–13	14	23	21	9	...	...	...	21
514	s	246	?	20	...	...	...	...	?	...	...	...	15	24	?	?	...	...	...	23
561	s.	17	f.	29	...	...	...	...	10	12–13	13–14	14–15	14	...	...	11	...	...	...	21
562	s.	18	f.	24	...	...	...	...	6	11–12	12–13	13–14	14	...	27	18	...	...	...	12
563	m.	16	f.	21	...	...	...	...	6	12	13	13–14	13	...	...	11	...	...	...	22
564	r.	18	fc.	24	...	...	...	...	12	11–12	12–13	13–14	13	...	...	10	...	...	...	12
565	swell	121	vc.	19	...	...	...	...	6	(9–10)	(9–10)	(9–10)	13	33	14	10	...	...	...	21
566	m.	50	fc.	16	...	...	...	...	6	11–12	12–13	13–14	14	...	20	10	...	...	...	18
567	r.	23	fc.	16	...	...	...	...	7	11–12	12–13	13–14	19	...	23	12	...	...	...	19
568	r. heavy	90	fc.	20	...	...	...	...	10	11–12	11–12	12–13	17	37	21	13	(12–13)	(13)	16–17	21
569	r.	168	fc.	21	...	...	...	...	12	11–12	12–13	12–13	18	43	21	12	(11–12)	(12)	15–16	18
570	r.	181	fc.	17	...	...	...	...	5	9	9–10	10–11	20	>45	20	8	10–11	13–14	16–17	22

* m=moderate. s.=smooth. r=rough.
† f=few. c=common. fc=fairly common. vc=very common. ec=extremely common.

TABLE F.—BEAM II. AND III.

—	No. of Haul.	Condition of Sea.	Weight of Fish in cod end.	Amount of invertebrates in cod end.	PLAICE. Length of Smallest Fish in cod end.	PLAICE. Length of Largest Fish in net covering: Cod end.	PLAICE. Length of Largest Fish in net covering: Batings.	DAB. Length of smallest Fish in cod end.	DAB. Length of Fish at which given percentages were retained in the cod end.: 25 %	50 %	75 %	DAB. Length of largest Fish in net covering: Cod end.	DAB. Length of largest Fish in net covering: Batings.	COD. Length of Smallest Fish in cod end.	COD. Length of Largest Fish in net covering: Cod end.	COD. Length of Largest Fish in net covering: Batings.	HADDOCK. Length of Smallest Fish in cod end.	HADDOCK. Length of Largest Fish in net covering: Cod end.	HADDOCK. Length of Largest Fish in net covering: Batings.	WHITING. Length of smallest Fish in cod end.	WHITING. Length of Fish at which given percentages were retained in the cod end.: 25 %	50 %	75 %	WHITING. Length of largest Fish in net covering: Cod end.	WHITING. Length of largest Fish in net covering: Batings.
			Kg.		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
B II. Cod end and ½ Batings covered.	B785	m.	66	f.	29	...	...	8	9	10–11	11–12	15	14	17	...	...	12	...	...	17	...	...	...	21	18
	786	m.	38	vf.	34	...	...	10	11–12	12–13	13–14	14	...	16	17	...	21	13	...	17	(17)	17–18	19–20	21	22
	787	s.	27	f.	29	...	...	8	7–8	11–12	12–13	14	13	17	...	...	12	12	...	16	(17–18)	18	18–19	19	19
	791	m.	30	f.	15	...	...	9	11–12	12–13	12–13	14	14	...	...	...	...	...	...	18	...	...	...	19	18
	792	m.	38	vf.	19	...	...	8	11–12	11–12	12–13	14	14	...	...	...	...	...	...	17	...	...	...	17	16
	793	m.	26	f.	18	...	...	8	11–12	12–13	12–13	14	13	...	...	...	...	...	...	19	...	...	...	19	18
B. III. Cod end and all Batings covered.	657	m.	21	vf.	...	...	...	10	12–13	13–14	14–15	15	15	12	13	...	...	...	...	12	...	...	...	9	...
	658	s.	<10	vf.	...	...	...	13	?	?	?	14	13	...	...	...	...	...	...	24	...	...	...	16	25
	659	m.	18	f.	26	...	...	10	12–13	13–14	13–14	18	19	25	...	...	...	...	...	13	...	...	...	15	...
	660	r.	21	m.	23	...	...	11	12–13	13–14	13–14	14	19	...	...	...	...	...	...	15	...	...	...	14	...
	664	r.	17	f.	18	...	...	11	10–11	12–13	13–14	16	16	...	...	...	...	...	...	23	...	...	...	...	13
	665	m.	98	vf.	15	...	...	10	11–12	12–13	13–14	15	17	17	...	21	>45	...	...	14	15–16	16	18–19	26	25
	666	m.	56	f.	12	12	...	11	11–12	12–13	13–14	15	16	...	...	...	...	...	...	16	...	...	...	23	18
	667	s.	37	vf.	14	9	...	10	11–12	12–13	12–13	15	17	23	...	...	...	...	...	13	...	...	...	14	...
	668	s.	37	vf.	18	...	...	5	10–11	11–12	12–13	14	22	20	...	...	...	...	...	10	...	...	...	16	16
	669	s.	25	vf.	14	...	...	10	11–12	12–13	13–14	16	16	19	...	...	...	...	...	10	...	...	...	18	17
	673	r.	37	vf.	14	...	...	13	(12–13)	13	(13–14)	13	13	...	...	...	...	...	...	16	15–16	16–17	19–20	22	24
	674	r.	189	vf.	13	...	15	10	12–13	12–13	13–14	15	18	...	...	...	...	...	...	14	18–19	19–20	20–21	24	28
	676	m.	32	vf.	12	...	14	11	(11)	(11–12)	(13–14)	14	14	16	16	...	...	...	...	13	(15)	15–16	15–16	21	28
	677	m.	14	vf.	10	12	15	11	12–13	12–13	13–14	15	17	13	...	...	...	...	...	17	...	...	...	...	12
	679	s.	46	f.	12	...	13	12	12–13	12–13	13–14	14	18	14	19	...	...	...	...	14	16–17	18–19	20–21	20	21
	680	s.	206	f.	24	...	...	14	...	...	...	...	...	14	18	19	...	...	...	18	...	...	...	...	21
	724	s.	19	f.	34	...	...	8	11–12	12–13	13–14	15	17	18	13	14	21	...	...	21	...	...	...	...	17
	725	s.	48	m.	43	...	...	9	11–12	12–13	13–14	15	16	14	18	...	18	...	...	18	(17–18)	(18)	(18–19)	18	16
	726	s.	7	vf	...	...	...	10	11–12	12–13	13	14	13	12	15	20	21	...	...	15	...	...	...	24	21
	727	m.	41	m.	30	...	...	6	11–12	12–13	13–14	14	16	14	...	...	...	...	...	12	(11–12)	(12–13)	13–14	17	16
	731	s.	50	m.	13	...	...	7	11–12	12	12–13	14	14	16	...	...	...	...	...	13	(13–14)	14–15	14–15	19	21
	732	s.	36	m.	14	...	...	7	11–12	12–13	13–14	15	17	19	...	17	...	...	...	15	...	...	...	22	17
	733	m.	37	fc.	16	...	...	8	11–12	12–13	12–13	14	16	17	...	...	...	...	...	15	...	...	...	19	18
	734	s.	56	m.	12	9	...	9	11–12	12–13	12–13	15	16	18	...	...	...	...	...	14	14–15	16–17	17–18	20	21
	735	s.	120	fc.	11	...	...	7	11–12	12–13	12–13	17	15	17	...	...	...	...	...	13	17–18	19–20	21–22	22	31
	736	m.	73	f.	13	...	...	11	11–12	12–13	13–14	15	16	19	17	...	...	...	...	14	15–16	17–18	17–18	20	21
	740	swell	8	vf.	15	...	...	11	(13–14)	(13–14)	(13–14)	13	8	...	...	...	...	...	...	17	...	...	...	...	19
	741	swell	46	vf.	13	...	...	10	11–12	12	13–14	14	17	...	...	...	...	...	...	16	...	...	...	19	...
	742	m.	9	f.	15	...	...	12	?	?	?	14	7	...	...	...	...	...	...	19	...	...	...	...	...
	743	m.	20	m.	16	...	...	12	(11–12)	(11–12)	(12–13)	13	17	...	...	...	...	...	...	20	...	...	...	...	...
	794	r.	16	f.	19	...	...	10	11–12	12–13	12–13	14	11	...	...	...	...	...	...	16	...	...	...	21	22
	795	r.	56	f.	17	...	...	12	(11–12)	(12–13)	(12–13)	17	12	...	...	...	...	...	...	20	...	...	...	18	...
	800	r.	21	f.	16	...	...	11	12–13	12–13	13–14	14	...	...	...	...	...	...	...	17	...	...	...	22	14
	801	r.	89	f.	15	...	...	10	11–12	11–12	12–13	14	16	...	...	...	...	...	...	12	?	(18–19)	20–21	21	...

Table G.—Beam V and IV.

	No. of Haul	Condition of Sea.	Weight of fish in Cod end.	Amount of invertebrates in Cod end.	Plaice. Length of: Smallest fish in Cod end.	Plaice. Largest fish in covering net: Behind Cod end.	Below Cod end.	Above Cod end.	Over Batings.	Over Square.	Dab. Length of smallest fish in Cod end.	Dab. Length of fish at which given percentages were retained in the Cod end: 25 per cent.	50 per cent.	75 per cent.	Dab. Length of largest fish in covering net: Behind Cod end.	Below Cod end.	Above Cod end.	Over Batings.	Over Square.
			Kg.		cm.	cm.	cm	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Beam V.	B 188	s.	< 20	vc.	37	—	—	—	—	—	3	(9–10)	9–10	9–10	12	12	14	19	—
	203	m.	50	c.	17	—	—	—	7	45	10	11–12	12–13	14–15	18	15	15	17	—
	299	mr.	< 10	vc.	—	—	—	—	—	—	18	—	—	—	—	—	—	—	—
	300	ms.	194	nr.	8	14	19	15	14	—	?	?	?	?	15	17	16	17	16
	301	ms.	100	fc.	8	13	19	16	17	—	8	13–14	15–16	16–17	14	24	19	23	—
	313	ms.	< 20	fc.	39	—	—	—	—	—	13	—	(16)	—	16	—	17	—	—
	319	s.	10	f.	38	—	—	—	—	—	11	(12–13)	13–14	(16–17)	16	—	15	—	—
	320	s.	10	vc.	38	—	—	—	—	—	7	(14–15)	14–15	(17)	19	14	15	—	—
	344	s.	< 20	nr.	43	—	—	—	—	—	8	11–12	14–15	14–15	14	12	15	12	—
	346	s.	—	c.	39	—	—	—	—	—	12	12–13	13–14	16–17	17	—	17	12	—
	398	s.	70	c.	> 45	—	—	—	—	—	9	(10–11)	(11)	(14–15)	14	—	20	—	—
Beam IV.	155	s.	ca. 15	nr.	36		—		—	—	7	(8–9)	(9)	11–12		13		15	17
	156	s.	ca. 45	nr.	29		—		—	—	7	?	(9)	12–13		15		18	26
	162	s.	< 5	f.	14		—		14	16	—	—	—	—		—		—	—
	163	s.	ca. 5	fc.	20		—		—	—	8	—	—	—		15		19	19

	No. of Haul	Cod. Length of: Smallest fish in Cod end.	Cod. Largest fish in covering net: Behind Cod end.	Below Cod end.	Above Cod end.	Over Batings.	Over Square.	Haddock. Length of: Smallest fish in Cod end.	Haddock. Largest fish in covering net: Behind Cod end.	Below Cod end.	Above Cod end.	Over Batings.	Over Square.	Whiting. Length of: Smallest fish in Cod end.	Whiting. Largest fish in covering net: Behind Cod end.	Below Cod end.	Above Cod end.	Over Batings.	Over Square.
		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
Beam V.	B 188	5	9	—	6	9	—	33	9	9	—	9	—	7	21	10	8	26	29
	203	—	—	—	—	—	—	—	—	—	—	—	—	20	21	19	—	23	—
	299	—	—	—	—	—	—	—	—	—	—	—	—	11	13	—	11	—	—
	300	—	18	14	16	—	—	—	—	—	—	—	—	?	18	14	17	14	—
	301	22	—	16	15	—	—	—	—	—	—	—	—	11	16	17	22	16	—
	313	24	26	—	—	—	—	16	24	—	23	23	—	13	25	—	22	17	26
	319	28	21	—	—	—	—	18	18	17	—	—	—	—	19	—	—	—	—
	320	—	24	—	16	—	—	16	22	—	22	—	—	15	25	—	—	—	—
	344	27	19	—	—	—	—	22	22	—	—	—	—	35	24	—	—	—	—
	346	25	21	—	—	—	—	16	26	—	23	—	—	15	27	—	28	17	—
	398	25	—	—	—	—	—	—	—	—	—	—	—	9	26	20	26	29	17
Beam IV.	155	—		—		20	23	22		—		23	27	19		—		26	28
	156	4		7		20	23	20		—		24	28	15		18		28	32
	162	—		—		—	—	—		—		—	—	—		—		—	—
	163	—		—		—	—	—		—		—	—	—		—		—	—

TABLE H.—OTTER I.

No. of Haul.	Condition of Sea.	Weight of fish in Cod end.	Amount of invertebrates in Cod end.	PLAICE.		DAB.					COD.					HADDOCK.					WHITING.				
				Length of		Length of smallest fish in Cod end.	Length of fish at which given percentages were retained in the Cod end.			Length of largest fish in covering net.	Length of smallest fish in Cod end.	Length of fish at which given percentages were retained in the Cod end.			Length of largest fish in covering net.	Length of smallest fish in Cod end.	Length of fish at which given percentages were retained in the Cod end.			Length of largest fish in covering net.	Length of smallest fish in Cod end.	Length of fish at which given percentages were retained in the Cod end.			Length of largest fish in covering net.
				Smallest fish in Cod end.	Largest fish in covering net.		25 per cent.	50 per cent.	75 per cent.			25 per cent.	50 per cent.	75 per cent.			25 per cent.	50 per cent.	75 per cent.			25 per cent.	50 per cent.	75 per cent.	
		Kg.		cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.	cm.
O 398	m.	267	c.	24	—	12	12–13	13–14	13–14	16	—	—	—	—	—	19	18–19	18–19	18–19	25	14	15–16	17–18	19–20	22
399	m.	437	ec.	27	—	9	12–13	12–13	13–14	16	36	—	—	—	—	19	18–19	18–19	18–19	21	13	(12–13)	16–17	18–19	23
400	m.	982	f.	29	—	12	11–12	12–13	13–14	16	24	—	—	—	—	18	<18	<18	<18	20	13	17–18	20–21	23–24	26
401	s.	325	vc.	31	—	9	10	14–15	15–16	19	18	—	—	—	—	17	<17	<17	17–18	19	12	16–17	19–20	22–23	22
404	m.	649	c.	27	—	10	13–14	14–15	15–16	17	22	(21)	(21)	(21)	20	17	16–17	19–20	20–21	23	17	21–22	22–23	22 23	22
405	s.	368	c.	31	—	10	13–14	13–14	15–16	18	19	(18–19)	(19)	?	19	13	18–19	19–20	19–20	22	15	18–19	19–20	21–22	24
406	s.	390	fc.	37	—	9	12–13	14–15	15–16	16	20	—	—	—	—	16	18–19	19–20	20–21	22	13	?	?	?	23
407	s.	325	fc.	29	—	9	13	14–15	(17–18)	17	26	—	—	—	—	14	19–20	20–21	20–21	24	28	—	—	—	18
408	s.	298	fc.	33	—	11	11–12	14–15	15–16	17	23	(22–23)	(22–23)	(22–23)	22	17	18–19	18–19	19–20	22	19	?	23–24	24–25	24
409	m.	127	vc.	34	—	11	13–14	14–15	15–16	17	23	(22)	(22)	(22)	21	17	19	19–20	21–22	25	18	21	21–22	23–24	26
410	m.	558	fc.	38	—	11	12–13	13–14	15–16	17	20	(19–20)	(19–20)	(19–20)	19	19	18–19	18–19	19–20	24	18	?	?	?	23
411	m.	129	ec.	31	—	7	11–12	13–14	14–15	17	24	—	—	—	—	16	<16	17–18	19–20	25	17	?	?	?	27
412	m.	307	vc.	29	—	10	11	13–14	14–15	19	20	—	—	—	—	18	<18	<18	<18	24	12	18–19	18 19	22–23	24
413	m.	143	fc.	27	—	10	13–14	14–15	15–16	16	22	(21–22)	(21–22)	(21–22)	21	18	<18	20–21	20–21	22	14	21–22	22–23	23–24	26
414	r.	86	f.	33	—	14	?	?	?	18	30	—	—	—	—	24	—	—	—	—	20	21–22	24–25	24–25	29
461	r.	41	f.	>45	—	14	13–14	15–16	16–17	19	>45	—	—	—	—	21	(19–20)	(19–20)	(19–20)	18	18	?	?	?	23
462	s.	207	fc.	15	—	12	13–14	14–15	15–16	17	38	—	—	—	15	21	—	—	—	—	13	?	?	?	26
464	m.	156	fc.	16	14	12	14–15	14–15	16–17	16	20	—	—	—	16	25	—	—	—	—	21	20–21	21–22	21–22	25
465	m.	74	f.	18	—	12	11–12	12–13	13–14	16	41	—	—	—	19	20	—	—	—	—	18	(17–18)	18–19	21–22	24
467	r.	74	fc.	15	12	12	(13–14)	15–16	15–16	15	15	—	—	—	—	29	—	—	—	—	19	?	?	?	22

REPORT

ON THE

RESULTS OF THE FISH-EGG CRUISE MADE BY THE S.S. "HUXLEY" IN JUNE, 1909,

BY

H. J. BUCHANAN-WOLLASTON.

With Tables I. to III.; Figures 1.–13. in the Text; Plates I. and II., and Two Appendices.

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REPORT

ON THE

RESULTS OF THE FISH-EGG CRUISE MADE BY THE S.S. "HUXLEY" IN JUNE, 1909,

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H. J. BUCHANAN-WOLLASTON.

The cruise of the "Huxley" in June, 1909, (voyage 109) was the first to be made by an English ship with the express purpose of making observations on the spawning of fishes by means of samples of eggs taken with a "quantitative" net. Hauls were also made with the Petersen Young Fish-Trawl at most of the stations, in order to catch larval and post-larval stages of fishes, but the examination of these has had to be postponed for a while. The present paper deals only with the results of the Hensen-Net hauls, the large catches of eggs made by the Petersen-Net being occasionally made use of in order to explain methods of obtaining standard sizes, &c., for different species of eggs. It is most important in examining Hensen-Net catches to have access to larger catches of eggs taken at nearly the same time.

With the exception of the samples taken on the voyage at present under discussion, those of voyage 110, and those taken in June, 1904 (voyage 32), all the collections we have are too much scattered over different years and various localities to be of much help in forming conclusions. The catches made in June, 1904, were examined and reported upon by Boeke (1). Where it seemed useful references have been made to these catches and others taken by the Dutch and German workers.

Appendix I. is a short discussion on the question of the constant for the Hensen-Net, and in Appendix II. are described methods for separating species of eggs which overlap as regards size. These should prove useful, as the methods at present in use for separating compound groups into their constituents are either somewhat rough, as Heincke's method ((2) pp. 194 et seq. and p. 201) or, very laborious, as that of Karl Pearson. That it is often extremely important to be able to separate one species of egg from another, which overlaps it in size, is obvious, when it is remembered in how many cases one of the overlapping species is of great value to the fisheries, while the other is comparatively unimportant. Such overlapping occurs, for instance, between the eggs of brill and gurnard, mackerel and gurnard, turbot and greater weever, and greater weever and mackerel, to mention those only which have come under our own observation in dealing with one month's catches. There has not been time to test the above methods except in one case, a somewhat difficult one, given as an example in Appendix II., but it was thought advisable to give a full description thereof in order that other workers might test them in practice.

Methods of Research.

The collections discussed here were made by vertical hauls from bottom to surface, with a large conical net constructed on the pattern of Hensen's quantitative Egg-net. The dimensions are given in Appendix I. The catches were preserved at once in one per cent. Formaldehyde solution in sea water (one part 40 per cent. Formaldehyde to 39 parts sea water), and examined ashore. A chart of standard sizes of eggs was made for reference, from large numbers of eggs caught by the Petersen Trawl on the same voyage, and another chart was made in the same way for the oil-globules of the eggs. These proved most useful for identifying eggs in the Hensen gatherings in stages before the development of pigment in the embryos. However, better charts could probably be formed by combining the sizes of eggs and oil-globules in the manner described in Appendix II., as has been done in the charts given for brill, mackerel and gurnard. The numbers of the various species of eggs taken were found by the use of the microscope, and tabulated for the stations. At all the stations two hauls were made, one immediately after the other. The numbers of eggs "per square metre surface" is therefore found by mutiplying the sum of the eggs in the two catches by $\frac{3}{2}$ (See Appendix I.). It was found that a most useful method for showing the pigment in difficult cases was

to clear the eggs in Carbolic acid (saturated solution in absolute Alcohol). All that is necessary is to transfer them direct from the Formalin solution to 80 per cent. Alcohol, leave them in the Alcohol for two or three hours, then transfer them to the Carbolic acid. They very often collapse in the Alcohol, and also at first in the acid, but after a few hours in the latter, they regain their normal shape and *more than their normal size*. On the latter account, measurements, if wanted, must be made before clearing. By this method, the eggs become almost as clear as when living, the pigment stands out sharp and intense, that in the oil-globule appearing particularly clear. The difficulty of distinguishing turbot's from greater weever's eggs, or grey gurnard's from those of mackerel, disappears, except in the case of very young stages.

Photographs are given at the end of this report of different stages of various eggs as they appear after clearing. They were taken with a $\frac{1}{2}$-inch objective without using an eyepiece. Using Imperial Ordinary plates, the correct exposure was found to be about three minutes, by the light of an incandescent gas burner placed about a foot from the mirror of the miscroscope. The concave side of the latter was used, and in order to obtain sufficient depth of focus, the aperture of the objective was decreased to an eighth of its ordinary diameter, by means of a Davis shutter.

As the slide used for counting and measuring the eggs was of a somewhat novel form, a description may be of use. The slide was designed by Mr. Todd, of the Lowestoft Laboratory, and the one actually used was made by the writer. The construction is very simple (Fig. 1). On an ordinary 3 in. by 1 in. microscope slide (*a*) a rim is made, either by

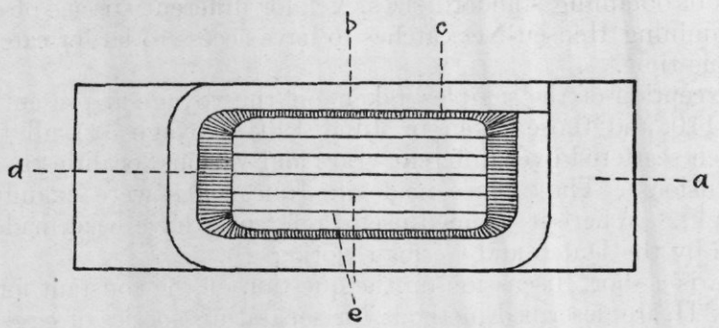

FIG. 1.—The slide used at Lowestoft Laboratory for measuring and counting Fish eggs.

pieces of glass cemented on, or by bending a glass rod (*b*) in a flame, so as to enclose a rectangular space, and cementing this to the slide with balsam. The spaces under the rod are filled in with paraffin-wax (*c*), in order to make smooth walls to the centre space. Two small pieces of paraffin-wax (*d*) are warmed and pressed on to the slide at the ends of this space, and in these are imbedded fine glass rods (*e*) about $\frac{1}{2}$ mm. in diameter, made by drawing out ordinary rod in a flame. It was found more serviceable to have two $\frac{1}{2}$ mm. rods cemented one above the other than a single 1 mm. rod. These pairs of rods are placed at such a distance apart that eggs put on to the slide form rows and cannot pass each other. This slide does away with the chance of an egg being accidentally measured or counted twice, and allows of a large number of eggs being examined at a time. The rods do not interfere with measurement of the eggs, as the diameters to be measured can be taken at an angle of 45° to the direction of the rods.

In most cases the eggs and oil-globules were measured twice each, the measurements being taken approximately at right angles, as advised by Prof. Ehrenbaum. This does away to a certain extent with the error due to the lack of symmetry of the egg. The following tables show the actual numbers of eggs taken at the stations with the Hensen-Net, as well as the "number per square metre surface of water," the latter being printed in heavy type. After the tables follows a systematic discussion of the species of eggs taken. I must here take the opportunity of thanking Prof. Ehrenbaum for his most kind help during my stay at Heligoland, and Miss Lee, of Lowestoft Laboratory, who most kindly put her mathematical knowledge at my service, and without whose help I should have found considerable difficulty in developing the methods given in Appendix 2. My thanks are due also to Mr. Todd and Mr. Goodchild for kindly lending me the necessary photographic apparatus, and for other valuable help, and finally to Mr. Potter, who has spared no pains in preparing the plates and charts for press. The skill and dispatch with which these were made from my rough drawings has saved much time, and added greatly to the pleasure of the work.

TABLE I.—Showing NUMBER and SPECIES of FISH-EGGS and FISH-LARVÆ caught by the HENSEN-NET (Voyage 109).

Number of Eggs "per Square Metre" is given in heavy type.

Date.	No. of Station.	Position of Station.	Depth (Fathoms).	Species of Eggs.								Larvæ.
				Mackerel.	Horse Mackerel.	Sole.	Solenette.	Rockling and Scaldback.	Dragonet.	Sprat.	Other Species.	All Species.
6/6/09	5 (1)	52° 57′ N. 2° 56′ E.	22	0 **0**	0 **0**	0 **0**	20 **76**	1 **1**	2 **16**	10 **31**	Dab, 1; Brill or Gurnard, 1.	None.
	5 (2)	„	„	0	0	1	31	0	9	11	Dab, 2; Whiting, 2	None.
6/6/09	6 (1)	52° 56′ N. 3° 17′ E.	16	1 **1**	0 **0**	0 **0**	8 **46**	1 **9**	0 **3**	1 **7**	Turbot, 1	None.
	6 (2)	„	„	0	0	0	23	5	2	4	Lemon-sole, 1; Grey Gurnard, 1.	Dab, 1.
7/6/09	7 (1)	52° 57′ N. 3° 37′ E.	16	4 **6**	1 **1**	1 **1**	33 **79**	1 **3**	5 **10**	2 **18**	None	Solenette, 1; Gobius sp., 1; Unknown, 1.
	7 (2)	„	„	0	0	0	20	1	2	10	Dab, 1; Brill or Gurnard, 1.	None.
7/6/09	8 (1) *	52° 58′ N. 3° 56½′ E.	15	10 **30**	10 **30**	0 **0**	25 **75**	1 **3**	1 **3**	36 **108**	Whiting, 2; Dab, 1	Dab, 3.
7/6/09	9 (1)	52° 58′ N. 4° 16′ E.	13	81 **214**	15 **42**	3 **7**	21 **43**	1 **1**	3 **4**	0 **1**	Dab, 1	Dab, 1.
	9 (2)	„	„	62	13	2	8	0	0	1	Gurnard, 1 ...	Solea sp., 1; Dab, 1; Herring, 1; Gobius sp., 2.
8/6/09	10 (1)	52° 55′ N. 4° 2′ E.	15	0 **4**	1 **3**	1 **3**	22 **66**	1 **1**	1 **3**	44 **118**	Dab, 1; Turbot, 1; Brill, 1; Lesser Weever, 1; Whiting, 3; Raniceps ?, 1; Lemon-sole ?, 1; Flounder ?, 1.	Dab, 5; Globius sp., 3; Solenette, 2; Dragonet, 2; Unknown, 1.
	10 (2)	„	„	3	1	1	22	0	1	35	None	None.
8/6/09	11 (1)	52° 51¾′ N. 3° 47′ E.	14	3 **6**	0 **0**	5 **7**	59 **166**	1 **4**	9 **25**	2 **10**	Turbot, 2; Dab, 2...	Sole, 1; Solenette, 4; Dab, 1; Solea sp., 1; Dragonet, 4; Gobius sp., 1.
	11 (2)	„	„	1	0	0	52	2	8	5	Dab, 1; Turbot, 1; Whiting, 1.	Solenette, 2; Sole, 1; Solea sp., 3; Dab, 1; Caranx, 1; Dragonet, 2; Gobius sp., 1.
8/6/09	12 (1) *	52° 48¼′ N. 3° 31½′ E.	15	0 **0**	0 **0**	0 **0**	30 **90**	0 **0**	4 **12**	6 **18**	Lemon-sole, 1 ...	Clupea sp., 2; Dab, 2; Dragonet, 6; Gobius sp., 1; Solea sp., 1; Solenette, 2.
8/6/09	13 (1)	52° 44½′ N. 3° 15¾′ E.	16	0 **0**	0 **0**	1 **1**	40 **94**	4 **6**	1 **7**	13 **30**	Brill, 1	Solenette, 1; Dab, 3; Dragonet, 2.
	13 (2)	„	„	0	0	0	23	0	4	7	Brill, 1; Turbot, 1	Dab, 6; Solenette, 1; Clupea sp., 2; Scaldback, 1; Dragonet, 1.
8/6/09	14 (1)	52° 41′ N. 3° 0′ E.	20	0 **0**	0 **0**	2 **3**	6 **22**	0 **0**	10 **27**	27 **60**	Dab, 2; Turbot, 1; Brill, 2.	Whiting, 1; Dab, 1.
	14 (2)	„	„	0	0	0	9	0	8	13	Gurnard, 1; Turbot, 1.	None.
8/6/09	15 (1)	52° 37½′ N. 2° 44′ E.	23	1 **3**	0 **0**	0 **0**	4 **10**	0 **0**	5 **9**	145 **333**	Brill or Gurnard, 1; Turbot, 1; Dab, 1; Whiting, 1.	None.
	15 (2)	„	„	1	0	0	3	0	1	77	None	Whiting, 1.
8/6/09	16 (1)	52° 34′ N. 2° 29′ E.	26	1 **4**	0 **0**	0 **0**	0 **1**	0 **0**	0 **0**	18 **48**	None	None.
	16 (2)	„	„	2	0	0	1	0	0	14	None	None.
8/6/09	17 (1)	52° 30½′ N. 2° 13′ E.	22	0 **3**	0 **0**	0 **0**	0 **1**	1 **1**	0 **0**	13 **40**	Dead, 3	None.
	17 (2)	„	„	2	0	0	1	0	0	14	None	None.
8/6/09	18 (1)	52° 27′ N. 1° 58′ E.	18	0 **0**	0 **0**	0 **0**	0 **0**	0 **0**	0 **0**	0 **4**	None	None.
	18 (2)	„	„	0	0	0	0	0	0	3	None	None.
8/6/09	19 (1)	52° 30½′ N. 1° 53′ E.	16	1 **1**	0 **0**	0 **0**	0 **0**	0 **0**	0 **0**	2 **7**	Brill or Gurnard, 1	None.
	19 (2)	„	„	0	0	0	0	0	0	3	None	None.
11/6/09	20 (1) *	52° 19½′ N. 1° 48′ E.	12	1 **3**	0 **0**	0 **0**	0 **0**	0 **0**	0 **0**	0 **0**	Turbot, 1	None.

* No. 2 haul lost.

Date.	No. of Station.	Position of Station.	Depth (Fathoms).	Species of Eggs.								Larvæ.
				Mackerel.	Horse Mackerel.	Sole.	Solenette.	Rockling and Scaldback.	Dragonet.	Sprat.	Other Species.	All Species
11/6/09	21 (1)	52° 17′ N. 2° 4¾′ E.	20	1	0	0	0	0	0	14	None	None.
				1	0	0	0	0	0	39		
	21 (2)	„	„	0	0	0	0	0	0	12	None	None.
11/6/09	22 (1)	52° 15′ N. 2° 20¾′ E.	27	0	0	0	0	0	0	2	None	None.
				0	0	0	0	0	0	16		
	22 (2)	„	„	0	0	0	0	0	0	9	Dab, 1	Motella sp., 1; Clupea sp., 5.
11/6/09	23 (1)	52° 13′ N. 2° 37′ E.	22	0	0	0	0	0	1	0	None	Sole, 1; Clupea sp., 2.
				0	0	0	0	0	3	1		
	23 (2)	„	„	0	0	0	0	0	1	1	Turbot, 1; Whiting, 1; Lesser Weever, 1.	Clupea sp., 1.
11/6/09	24 (1)	52° 10½′ N. 2° 53′ E.	23	1	0	0	2	3	4	2	Dab, 1; Lesser Weever, 1.	Clupea sp., 5; Dragonet, 5; Whiting, 1; Dab, 2.
				1	0	1	6	9	12	7		
	24 (2)	„	„	0	0	1	2	3	4	3	Lesser Weever, 1; Flounder, 1.	Clupea sp., 5; Dragonet, 2; Solea sp., 1; Dab, 1; Pout, 1.
12/6/09	26 (1)	52° 9′ N. 3° 7′ E.	20	1	0	0	4	1	5	1	Gurnard, 2 (1?); Lesser Weever, 1; Whiting, 1.	Clupea sp., 2; Solea sp., 2; Dragonet, 2.
				6	1	6	10	4	16	1		
	26 (2)	„	„	3	1	4	3	2	6	0	Turbot, 1; Gurnard, 1.	Sandlaunce, 1; Solea sp., 3; Solenette, 1; Scaldback, 1; Dab, 2; Dragonet, 8.
12/6/09	27 (1)	52° 6½′ N. 3° 23′ E.	17	5	16	0	4	0	0	0	Turbot, 1; Mackerel or Gurnard, 1; Brill, 1; Whiting, 1.	Solea sp., 2; Solenette, 1.
				10	63	0	34	3	3	0		
	27 (2)	„	„	2	26	0	19	2	2	0	Gurnard, 1; Whiting, 1; Turbot, 2; Lemon-Sole, 1; Dab, 1; Lesser Weever, 1; Unknown, 1.	Gurnard, 1; Horse-Mackerel, 1; Solea sp., 5.
12/6/09	28 (1)	52° 4′ N. 3° 39′ E.	14	12	79	4	37	7	5	12	Gurnard, 1; Turbot, 2; Dab, 2; Whiting, 1.	Whiting, 1; Dragonet, 1; Solea sp., 2.
				37	217	9	97	15	15	40		
	28 (2)	„	„	13	66	2	28	3	5	15	Whiting, 1; Turbot, 1.	Solea sp., 2; Whiting, 1; Dragonet, 1; Horse-mackerel, 10; Unknown, 1.
15/6/09	29 (1)	52° 2½′ N. 3° 53′ E.	13	0	0	0	20	9	5	16	Turbot, 1; Dab, 3.	Whiting, 1; Solea sp., 2; Solenette, 1; Gobius sp., 2; Dragonet, 1; Unknown, 1.
				0	0	0	73	37	12	70		
	29 (2)	„	„	0	0	0	29	16	3	31	Brill, 1; Turbot, 1; Whiting ?, 1.	Dab, 1; Scaldback, 1; Horse-mackerel, 1; Dragonet, 2; Gobius sp., 2; Unknown, 2.
15/6/09	30 (1)	51° 49′ N. 3° 38′ E.	15	2	130	0	28	9	8	10	Brill, 1; Turbot, 1; Mackerel or Gurnard, 1; Gurnard, 1; Brill or Gurnard, 1; Dab, 1.	Solenette, 1; Horse-mackerel, 1.
				9	406	3	64	21	18	28		
	30 (2)	„	„	4	141	2	15	5	4	9	Anchovy, 1 ...	Horse-mackerel, 17; Solea sp.,* 1; Solea sp., 1; Whiting, 1.
15/6/09	31 (1)	51° 56′ N. 3° 22′ E.	16	3	35	0	9	7	6	0	Scomber or caranx, 1; Lesser Weever, 1.	Horse-mackerel, 4; Dragonet, 2; Solea sp., 3.
				10	99	0	13	15	10	0		
	31 (2)	„	„	4	31	0	0	3	1	0	Brill, 1; Gurnard, 1; Turbot, 1; Mackerel or Gurnard, 1.	Solenette, 1; Whiting or Poor-cod, 1; Clupea sp., 2; Gobius sp., 1.

* Apparently *Solea variegata* or *S. lascaris*.

Date.	No. of Station.	Position of Station.	Depth (Fathoms).	Species of Eggs.								Larvæ.
				Mackerel.	Horse Mackerel.	Sole.	Solenette.	Rockling and Scaldback.	Dragonet.	Sprat.	Other Species.	All Species.
16/6/09	33 (1)	51° 53′ N. 3° 7′ E.	17	4 13	23 43	0 0	4 10	2 4	2 7	0 0	Turbot, 1; Gurnard, 1; Lesser Weever, 1; Whiting, 4.	Horse - mackerel, 28; Dragonet, 5; Mackerel, 1; Solea lutea (?), 6.
	33 (2)	„	„	5	6	0	3	1	3	0	Turbot, 1; Gurnard, 1; Brill or Gurnard, 1; Lesser Weever, 2; Whiting, 1.	Horse - mackerel, 38; Dragonet, 4; Mackerel, 1; Solea sp., 2; Solenette, 1; Scaldback, 1; Sandlaunce, 1; Whiting, 1.
16/6/09	34 (1)	51° 49′ N. 2° 52′ E.	17	8 21	46 157	0 0	0 1	3 6	5 9	0 0	Whiting, 1; Lesser Weever, 1.	Horse-mackerel, 9; Dragonet, 3; Sole, 1; Solenette, 1; Sandlaunce, 1.
	34 (2)	„	„	6	59	0	1	1	1	0	Brill, 1, Dab, 1 ...	Caranx, 7; Dragonet, 2; Sandlaunce, 1.
16/6/09	35 (1)	51° 48′ N. 2° 35′ E.	23	3 7	0 0	0 0	0 0	0 3	7 21	2 10	Turbot, 1; Lesser Weever, 1; Gurnard, 1.	Dragonet, 5; Clupea sp., 18; Solea sp., 1; Scaldback, 1; Sandlaunce, 1.
	35 (2)	„	„	2	0	0	0	2	7	5	Lesser Weever, 1...	Dragonet, 5; Clupea sp., 14; Solea sp., 1; Mackerel, 1; Horse-mackerel, 1; Gobius sp., 1; Unknown, 1.
16/6/09	36 (1)	51° 47′ N. 2° 18½′ E.	23	0 0	0 0	0 0	0 0	0 0	0 0	1 1	Whiting, 1; Dab, 1	Clupea sp., 5.
	36 (2)	„	„	0	0	0	0	0	0	0	Whiting (?), 1 ...	Clupea sp., 3.
17/6/09	37 (1)	51° 45¾′ N. 2° 0′ E.	18	0 0	0 0	0 0	0 0	0 1	0 1	6 18	Lesser Weever, 2...	Solea sp., 1; Gobius sp., 1; Onos mustela, 1; Clupea sp., 1; Sandlaunce, 1.
	37 (2)	„	„	0	0	0	0	1	1	6	Gurnard, 1 ...	Solea sp., 1; Onos mustela, 1; Gobius sp., 2; Clupea sp., 2.
17/6/09	38 (1)	51° 37′ N. 2° 9′ E.	27	0 0	0 0	0 0	0 0	1 3	4 6	2 4	Unknown, 1 ...	Dragonet, 2; Clupea sp., 1.
	38 (2)	„	„	0	0	0	0	1	0	1	None	Dragonet, 2; Dab, 1; Gobius sp., 1.
17/6/09	39 (1)	51° 29½′ N. 2° 18′ E.	19	4 7	2 9	0 0	0 1	4 9	7 24	0 0	Lesser Leever, 1; Brill, 1; Greater Weever (?), 1.	Dragonet, 2; Horse-mackerel, 2; Clupea sp., 1; Pout, 1; Whiting, 1.
	39 (2)	„	„	1	4	0	1	2	9	0	Lesser Weever, 1; Turbot, 1.	Dragonet, 4; Horse-Mackerel, 3; Sandlaunce, 2; Gobius sp., 2.
17/6/09	40 (1)	51° 22′ N. 2° 27′ E.	17	1 9	115 459	0 0	0 1	2 9	1 13	0 0	Brill or Gurnard, 1; Mackerel or Gurnard, 1.	None.
	40 (2)	„	„	5	191	0	1	4	8	0	Brill or Gurnard, 2; Brill, 1; Unknown, 1.	None.
17/6/09	43 (1)	51° 18½′ N. 2° 8′ E.	17	1 6	41 103	0 0	0 0	3 6	5 15	0 0	Pilchard, 2; Lesser Weever, 3; Gurnard, 1.	Horse-mackerel, 1; Dragonet, 4; Sandlaunce, 1.
	43 (2)	„	„	3	28	0	0	1	5	0	Pilchard, 2; Brill, 1; Turbot 1.	None.
17/6/09	44 (1 & 2)	51° 13½′ N. 1° 51′ E.	21	4 6	25 37	0 0	0 0	3 4	1 1	0 0	Pilchard, 6; Lesser Weever, 1; Turbot, 1; Whiting, 1.	Dragonet, 1; Solea sp., 1; Horse-mackerel, 1; Gobius sp., 1.

It will be seen from the tables that the only species of eggs occurring in considerable quantities were those of Mackerel, Horse-mackerel, Sprat, and Solenette. The hauls with the Petersen Young Fish-Trawl, indeed, sometimes contained fairly large numbers of other species, such as Pilchard, Red Gurnard, Whiting, Grey Gurnard, Sole, Greater and Lesser Weaver, &c., but these hauls have not as yet been systematically examined and, even had they been, the value of the results from a quantitative point of view would be open to question. One useful result has come from them, however : they have afforded an excellent opportunity of obtaining a clear view of the differences between similar species, both as regards pigment and size, which would have been impossible with the very limited numbers of eggs caught by the Hensen-Net. It is hoped that the notes on these differences, in the case of Brill and Gurnard and Mackerel, and Turbot and *Trachinus draco*, together with the photographs, will render the identification of preserved eggs of these species somewhat easier. The identification and distribution of the eggs may be now systematically treated. The species are taken in the order of Boulenger's classification ; Fig. 2 is a chart showing the stations of voyage 109 at which the Hensen-Net and Petersen-Trawl were used, with the exception of Stations 1, 3, and 4, at which the sea was too rough for the former net to be employed.

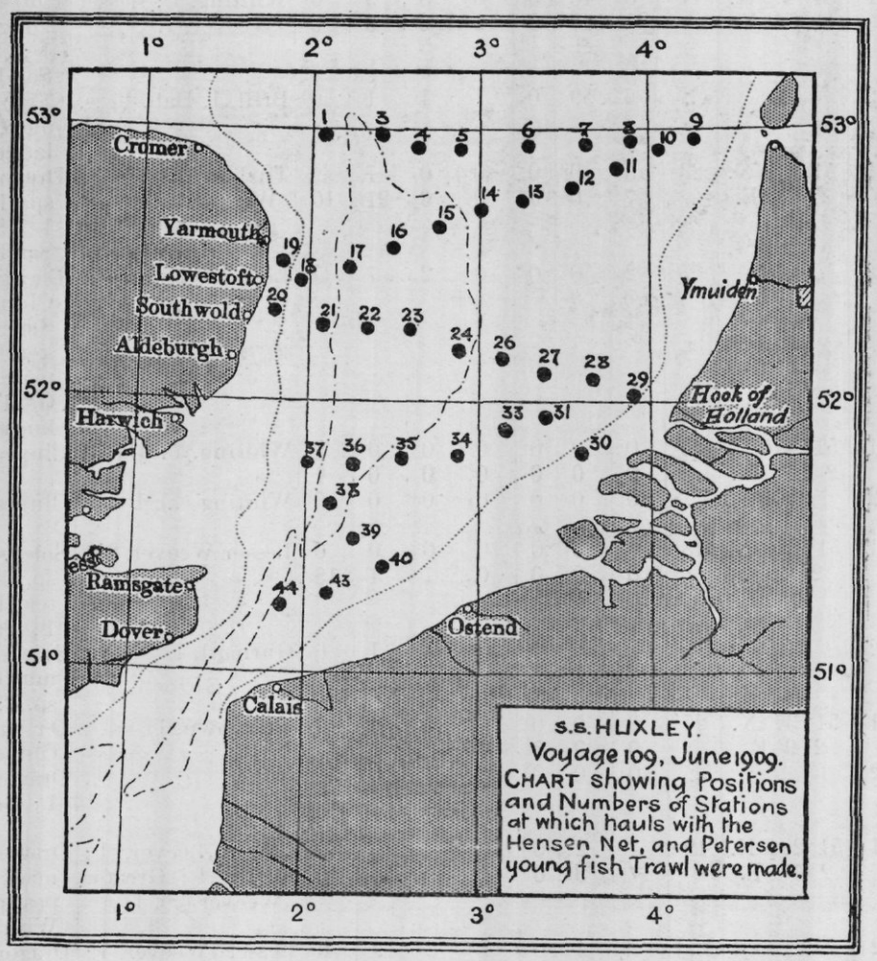

FIG. 2.

WHITING. (*Gadus merlangus.*)

One or two gadoid eggs occurred in a great many of the hauls. They possessed a curiously dark, vacuolated yolk, which, as Dr. Ehrenbaum informs me, is characteristic of whiting eggs. The following are measurements of a group of these eggs taken by the Petersen-Trawl at Station 28 :—

Eggs.

Micro-Divisions ...	31	32	33	34	35	36	37	38	39	Total
No. of eggs	1	1	2	9	23	23	14	2	1	76

Mean size 35·54 = 1·084 mm.

Ehrenbaum (2) gives 1·1 mm. as the average size of 36 Whiting eggs taken in the Plankton in May, and in (3) he gives two groups of measurements of 52 and 26 eggs

respectively, with means of 1·048 and 1·043. The average size of the group given above is considerably greater, but probably within the range of annual variation. As June is very near the end of the spawning season for whiting, great numbers of eggs are not to be expected in the catches. The greatest number occurred at Station 33, off the Dutch coast, at about the middle of the 20–40 metre zone, where seven eggs per square metre were present. One or two eggs occurred at most of the stations. This is quite in accordance with what has been found by other workers, viz., that the spawning region of whiting in the North Sea is very extensive, and not limited to any particular part of the sea.

Sprat. (*Clupea sprattus.*)

The eggs of the Sprat can be recognised in nearly all cases by the segmentation of the yolk, by the size (which, however, I have never found it necessary to measure), and by the fact that they usually show a somewhat marked deviation from the truly spherical form.

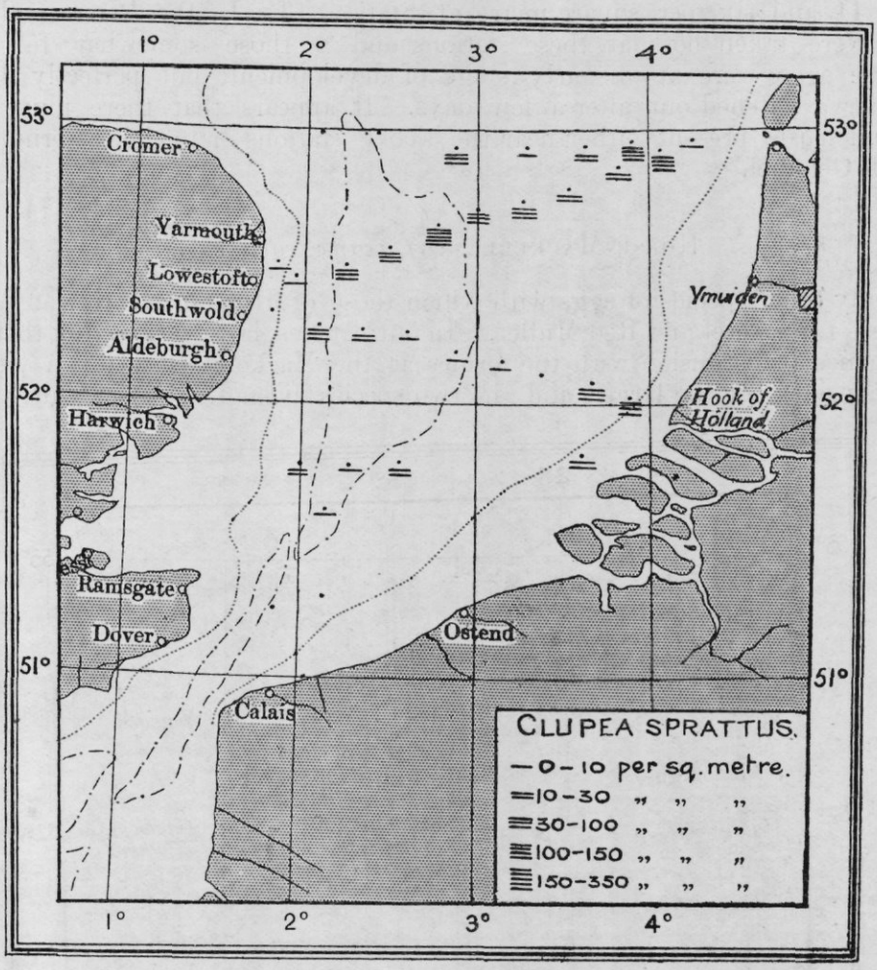

Fig. 3.

Sprat eggs occurred at nearly all the more northerly stations, even where the depth of water was great. The greatest number of eggs (viz. 333 per square metre) was taken at Station 15, where the depth was 22 fathoms (40 metres), and the next two greatest, 118 and 108 per square metre, at Stations 10 and 8 respectively, the depth at each being 15 fathoms (27 metres). However, at the three shallow stations, 28, 29 and 30, sprats' eggs also occurred in considerable quantities, so that we are not justified in saying that the sprat, at least in this part of the North Sea, prefers the deeper water to the shallower for spawning, or the reverse. Boeke (1) found great numbers of Sprats' eggs in the samples collected by the "Huxley," in June, 1904, in the neighbourhood of the Wash and off the coasts of Norfolk and Lincoln, and also in catches made far out to sea. Our observations, then, confirm the conclusions of Boeke and the other Dutch workers, that in the southern part at least of the North Sea, excepting perhaps the most southerly part—that south of the Mouth of the Thames—the Sprat is a ubiquitous spawner. Further north, off the East Friesian Islands, the eggs of the Sprat are also very

abundant—indeed Ehrenbaum states (Ehrenbaum (3)), that in June, the eggs of the sprat are overshot by no other species in that region, as regards abundance. The absence of this species of egg from the catches made at Stations 27, 31, 33 and 34, while so abundant at neighbouring stations, is curious. It does not appear, however, from an examination of the salinities of the water samples taken, that this is due to the presence of a tongue of water of high salinity, extending from the mouth of the Channel over this region, as would at first sight be supposed.

Pilchard. (*Clupea pilchardus.*)

The eggs of the Pilchard are very easy to identify. They are very large, the yolk is segmented, the oil-globule minute, and the perivitelline space of extraordinary size, so that there is no other species of egg with which they can possibly be confused.

Pilchard eggs must have been present in considerable quantities in the most southerly part of the Flemish Bight in June, 1909, as nine per square metre were taken at Station 44, and six per square metre at Station 43. In the Petersen Trawl, large quantities were taken both at these stations and at those somewhat further north. Most of the eggs were at an early stage of development, but perfectly healthy, as numerous larvæ hatched out after a few days. It appears that there must have been spawning pilchards present either near the above stations or in the easternmost part of the English Channel.

Horse-Mackerel. (*Caranx trachurus.*)

The only other species of eggs with which those of Horse-mackerel can be confused, are the eggs of Mackerel and Red Mullet. In our catches, however, I think there is practically no chance of confusion with the former as the Mackerel eggs taken were without exception considerably the larger, and the two species did not, when measured in groups,

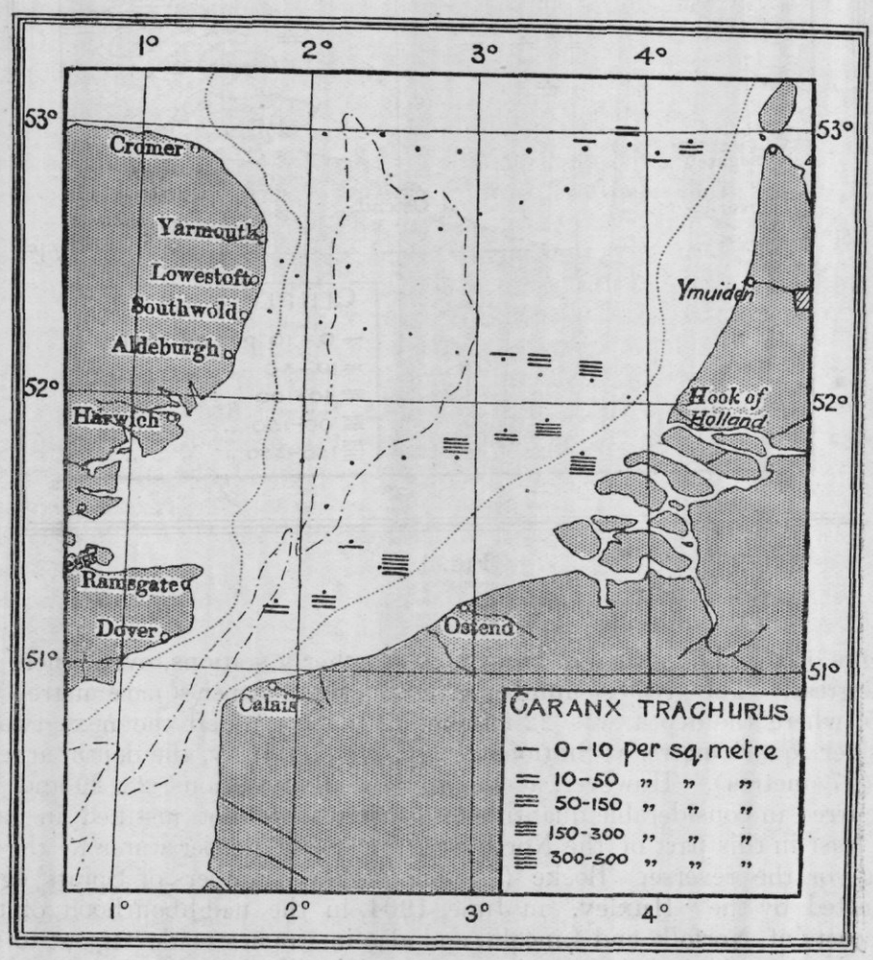

Fig. 4.

overlap at all. Horse-mackerel eggs, too, very often show a very marked segmentation of the yolk, even in preserved material, but not invariably. The measurements, when grouped, fitted the normal curve of error so closely, that it is not possible that any other species, even differing only slightly in size, can be mixed with the horse-mackerel eggs. Were those of *Mullus* present in any but insignificant numbers, this could not fail to be indicated by the skewness, or bimodal form of the resulting curve of measurements.

The following are series of measurements of *Caranx* eggs and the contained oil-globules. The eggs were taken in the Petersen Trawl at Station 28. The corresponding areas of the Curve of Error ($\sigma = \cdot 91$) for eggs, and that for oil-globules ($\sigma = \cdot 508$) are also given :—

Eggs.

Micro-Divisions ...	26	27	28	29	30	31	32	33	34	Total.
No. of Eggs	0	2	2	13	72	101	42	4	0	236
By Curve of Error ...	0	0	1	17	75	99	39	5	0	236

Oil-Globules.

Micro-Divisions ...	7	8	9	10	11	Total.
No. of Eggs	0	12	25	1	0	38
By Curve of Error ...	0+...	11+...	25+...	1+...	0+...	38+

The eggs of *Caranx* occurred abundantly at all the eastern stations, particularly at those nearest to the Southern Dutch and the Belgian coasts. The greatest quantities taken were 406 per square metre at Station 30, and 459 per square metre at Station 40. They were quite absent from the catches at all the western and central stations.

We may say quite definitely from these results that the spawning ground of the Horse-mackerel in this part of the North Sea is off the Dutch and Belgian coasts, in shallowish water (20 to 40 metres).

The absence of *Caranx* eggs from the hauls at Station 29 is most extraordinary. They occurred in great abundance at the two nearest stations, at which the depth was only slightly greater. Other species of eggs, such as those of Solenette, Rockling and Scaldback, Dragonet and Sprat, were present at Station 29 in proportions approximating to those at Stations 30 and 28. It will be noticed that Mackerel eggs are also absent from the hauls at Station 29. Is it possible that this is caused by a heavy outflow of fresh water from the Maas and Rhine, which is avoided by these fish ?

On examination of the table of salinities of water-samples taken on the voyage, it was found that that from Station 29 had remarkably low salinity, namely $32 \cdot 23^{\circ}/_{\circ\circ}$; this is more than $1 \cdot 0^{\circ}/_{\circ\circ}$ lower than any other sample taken. The salinity at Station 28 was 33·49, and that at Station 30, 33·28, so that the difference is probably sufficient to account for the absence of horse-mackerel and mackerel eggs from Station 29.

Our results as to the depth of water preferred by the Horse-mackerel for spawning do not quite agree with those of the German and Dutch researches. Both Tesch (4) and Ehrenbaum (3) lay stress on the almost complete absence of *Caranx* eggs at stations where the water is more than 30 metres deep, and the preference of this fish for even much shallower water, down to 10 metres deep, for spawning. In our case, at the eleven stations at which more than 50 eggs were present per square metre, the depths were as follows, taken in numerical order :—Metres : 27, 24, 31, 38, 31, 31, 26, 29, 31, 27, 31, and the greatest catch of all, that at Station 40, was with a depth of 31 metres. True, *Caranx* eggs are absent from stations with a depth of over 40 metres, but we cannot be certain that this is not due to the preference of the fish for the easterly regions of the Southern North Sea. The fact that the south-eastern stations nearest the coast yielded the greatest numbers of this species of eggs, proves, however, the preference of this fish for coastal waters as spawning grounds, but it appears that the spawning region is not so limited as regards depth as has been previously supposed.

MACKEREL. (*Scomber scomber.*)

Mackerel-eggs are somewhat troublesome to identify. In our catches, their size was found quite sufficient in every case to separate them from the rather similar eggs of Horse-mackerel, but this does not hold as regards Gurnard-eggs. In the later stages of Mackerel the pigment is very characteristic, particularly that on the head, and that on the sides of the body of the embryo ; and the pigment over the oil-globule may be included. In intermediate stages the body-pigment is in the form of two double rows of chromatophores, which later coalesce to form diagonal lateral bars. (Plate II., Fig. 2.) These may be the

beginnings of the bars of the adult fish. The head-pigment consists of a continuous ring of anastomosing chromatophores, which completely surround the optic region, and two

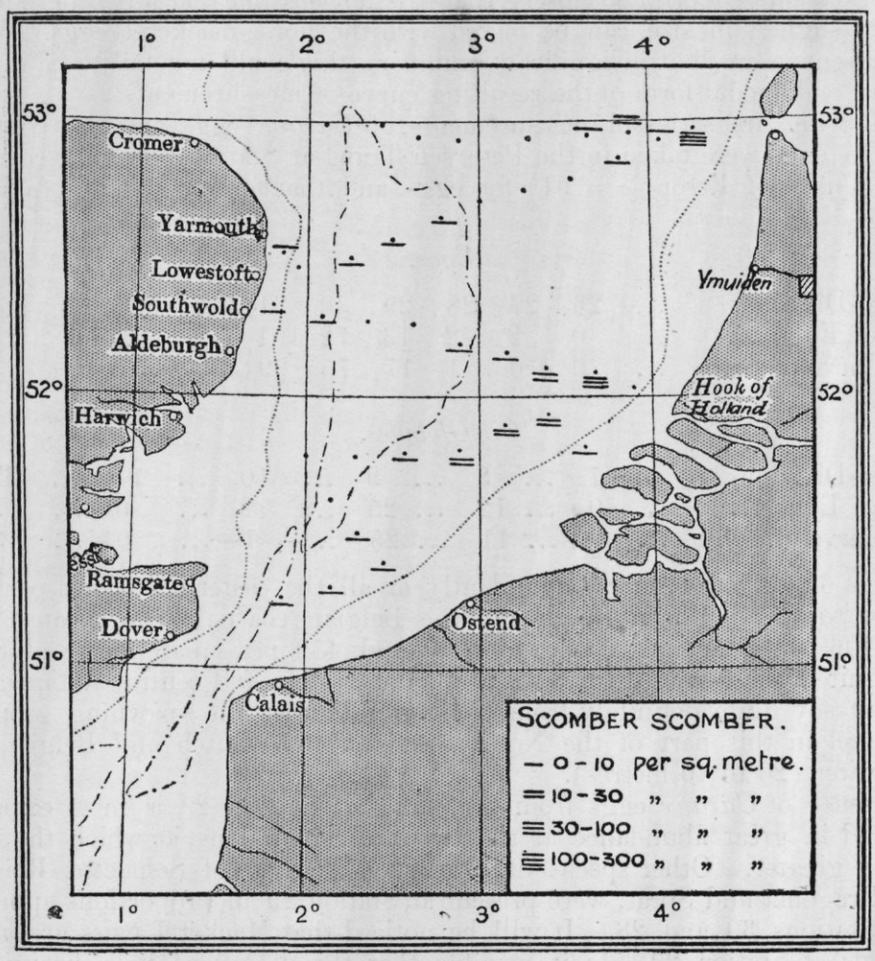

FIG. 5.

rows of similar chromatophores which extend down the sides of the occipital region and almost enclose it. The centre of the occipital region is practically free from pigment. (Plate II., Fig. 1.) The pigment-spots over the oil-globule are usually limited to one half. (Plate II., Fig. 2.)

Mackerel and Gurnard eggs in the earlier stages may be separated by the methods given in Appendix 2. I tested the methods on a mixed group of these two species—84 Mackerel and 36 Gurnard, and found that they gave a result very near the truth.

The average diameter of 200 Mackerel eggs from Station 9 was found to be 38·88 Micro-Divisions (1·1857 mm.) and that of the oil-globules 10·4575 Micro-Divisions (·319 mm.). The co-efficient of correlation between diameters of the eggs and oil-globules was ·58. In Appendix 2 is given an elliptical chart (Fig. 9) of these measurements, as well as another chart (Fig. 12) showing the amount of overlapping between Mackerel and Gurnard eggs measured. The distribution of Mackerel eggs in June 1909 is shown in the chart, Fig. 5. It appears that, as regards the Flemish Bight, the region between the 20 and 40 metre lines on the eastern side is preferred as a spawning-ground by this fish. The most southerly stations as well as those with deep water, and those on the English side, yielded but few Mackerel eggs. The Dutch and German workers obtained their greatest catches of these eggs further north, Ehrenbaum (*see* 3) north-west of Heligoland, and Tesch (*see* 4) near the Great Fisher Bank. The numbers, however, are considerably less than in our greatest, namely, that from Station 9, near the Haaks Lightship, where 214 per square metre were present. The spawning-region is thus shown to extend further south than has been previously supposed.

SOLE. (*Solea vulgaris.*)

Sole-eggs are easily recognisable from their size, the segmentation of the yolk surface and the arrangement of the oil-globules, which are very numerous and minute, and distributed in "clumps" throughout the yolk. After preservation the oil-globules

sometimes coalesce to form larger globules, but in nearly all cases some minute ones remain, which serve to distinguish the eggs from those of Lesser Weever, when the segmentation of the yolk is not easily visible.

The following is a group of measurements of Sole-eggs taken at Station 30 in the Petersen Trawl.

Micro-Divisions ...	34	35	36	37	38	39	40	41	Total
No. of Eggs ...	1	1	3	8	8·5	5·5	1·5	·5	29

Mean = 37·621 = 1·147 mm.

Very few Sole-eggs were taken on voyage 109. The only stations at which they occurred in the Hensen-net, are the following, the "number per square metre" being given in brackets, namely, Station 9 (7) ; 10 (3) ; 11 (7) ; 13 (1) ; 14 (3) ; 24 (1) ; 26 (6) ; 28 (9) ; 30 (3). All these stations lie between the 20-metre and 40-metre lines on the eastern side of the Flemish Bight. The small size of the eggs, and the great quantity of postlarval stages taken in the Petersen Trawl, combine to show that the time of most intensive spawning had passed when the voyage was undertaken.

It was suggested to me by a passage in Boeke (1) (p. 31), that a comparison of the hauls made from the "Huxley," in June, 1904, in the neighbourhood of the Wash, with tow-nets —those hauls examined by Boeke—and of neighbouring hauls with large gear, would be instructive. Table 2 is a list of these. Unfortunately there are many hauls with the tow-nets with which there are none made with the shrimp and beam trawls to compare, but even the scanty records we have clearly indicate the Wash and neighbourhood as a spawning-ground for Soles. A cruise undertaken on a larger scale than the above in April, May or June, in this neighbourhood, on which parallel hauls with the large and small gear were made, would probably give very interesting results.

It will be seen from Table 2 that, on all occasions on which more than two Sole-eggs were taken in the tow-nets, except one, ripe or nearly ripe Soles also occurred in neighbouring hauls with the large gear.

In Table 2 the following abbreviations are used :—

Small Gear.	Large Gear.
Hor. Cl. N. (2) = Two Horizontal Closing Nets.	S.T. = Shrimp Trawl.
F. & C.S.T. = Fine and Coarse Surface Tow-nets.	B.T. = Beam-Trawl.
F.S.T. = Fine Surface Tow-net.	
C.S.T. = Coarse Surface Tow-net.	

Table 2.—Spawning of Soles in the Wash and neighbourhood. Showing the Hauls made with Tow-nets in June, 1904, in which Sole-Eggs were taken, compared with Neighbouring Hauls with the Shrimp-Trawl and Beam-Trawl.

Hauls with Tow-nets in which more than Two Sole-Eggs were taken.					Neighbouring Hauls with Shrimp-Trawl and Beam-Trawl.				
Date.	Gear.	Position.	Depth (Metres).	No. of Sole-Eggs.	Date.	Gear.	Position.	Depth (Metres).	Soles.
8/6/04	Hor. Cl. N.(2).	52° 59′ N. 0° 19′ E.	21	4	10/6/04	B.T.	53° 0⅛′ N. 0° 22′ E.	27	3 nearly ripe.
8/6/04	F. & C.S.T.	52° 54½′ N. 0° 16¾′ E.	13	5	10/6/04	S.T.	52° 54⅜′ N. 0° 16⅜′ E.	13	1 nearly ripe.
					„	S.T.	52° 56⅜′ N. 0° 18′ E.	13	2 nearly ripe.
					„	S.T.	52° 55⅝′ N. 0° 17¼′ E.	13	2 nearly ripe.
					„	S.T.	52° 55¼′ N. 0° 17⅛′ E.	13	1 nearly ripe, 1 spent.
8/6/04	F.S.T.	52° 59¼′ N. 0° 16′ E.	8	3	9/6/04	S.T.	52° 58′ N. 0° 18⅜′ E.	18	3 nearly ripe, 2 spent.
8/6/04	F. & C.S.T.	52° 59¾′ N. 0° 12⅜′ E.	9	3	8/6/04	S.T.	52° 59¼′ N. 0° 11¼′ E.	13	No Soles.
10/6/04	F. & C.S.T.	53° 1¾′ N. 0° 26¼′ E.	29	3	10/6/04	B.T.	53° 0⅛′ N. 0° 22′ E.	26	3 nearly ripe.
17/6/04	C.S.T.	53° 19½′ N. 0° 27′ E.	15	11	17/6/04	B.T.	53° 22½′ N. 0° 23¼′ E.	17	4 nearly ripe, 5 ripe, 7 spent.

Solenette. (*Solea lutea.*)

The eggs of the Solenette are very easily recognized.

They were found to be very generally distributed over the eastern region of the Flemish Bight, being more abundant, however, at the more northerly stations. On the western side of the deep water they did not occur. The greatest number, 166 per square

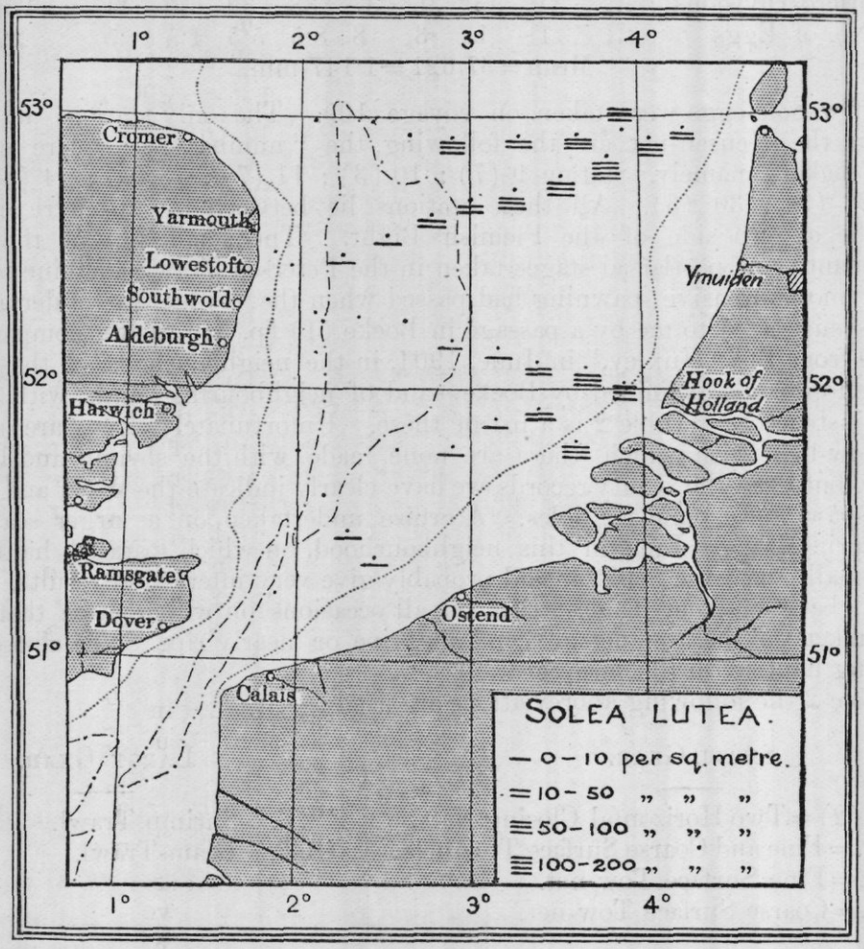

Fig. 6.

metre, was found at Station 11. It will be noticed that these eggs occurred plentifully at Station 29, proving that water of low salinity is not avoided by the Solenette for spawning. Our results agree well with those of the German and Dutch researches on the spawning of this fish.

Dab. (*Pleuronectes limanda.*)

The egg of the Dab is recognized by its being the smallest of those without oil-globules. Though overlapped in size by the Flounder's egg, the spawning time of the latter fish is probably quite past by June, so that all of these very small eggs found in that month, can be fairly safely ascribed to the Dab.

It will be seen from Table 1 that Dabs' eggs occurred in ones and twos at a great many of the stations, but it is obvious that the culminating point of the spawning-season of this species was long past when the voyage was undertaken. It is, of course, useless to attempt to draw conclusions from such small catches.

Lemon-Sole or Lemon-Dab. (*Pleuronectes microcephalus.*)

Very few eggs of the Lemon-Sole occurred in the tow-nettings. The spawning-season had probably hardly begun as early as June, since, later on, in August, enormous numbers of Lemon-Soles were taken by the Lowestoft smacks on the Leman Banks and neighbouring region, most of them either ripe or spent.

Turbot. (*Bothus maximus*) and Greater Weever. (*Trachinus draco.*)

Though the eggs of the Turbot were taken in but small numbers in the Hensen-net—the greatest number being four per square metre—yet they occurred in greater

quantity in many of the hauls with the Petersen trawl. Sufficient numbers were taken in the latter, in all stages of development, to render it possible to do something towards clearing up the important question—how to distinguish between Turbot eggs and Greater Weever eggs in different stages, when dealing with preserved material. Photographs are given (Plate I.) showing the differences between the pigmentation of the two species, beginning with that stage of development at which the first signs of dark pigment appear. In living eggs it is probable that pigment may be discerned in still earlier stages. The following are notes on the pigmentation, drawn up with the view of emphasizing the differences.

Stage 1.

Turbot (Fig. 1, Plate I.).—The whole of the dorsal surface, except the fore-part of the head and hinder part of the tail, is dotted with small circular dark-brown chromatophores.

T. draco.—No pigment is discernible.

Stage 2.

Turbot (Fig. 2, Plate I.).—The pigment is very similar to that of the first stage, but more intense, and extending now over the head and tail of the embryo.

T. draco.—The first signs of pigment begin to appear, in the form of two rows of irregular black chromatophores, extending, one along each side of the dorsal surface of the body from the eyes to a point nearly midway between the snout and the tail (as in Fig. 5, but more faint).

Stage 3.

Turbot.—As in Stage 2, but the chromatophores are now larger and less numerous, and have extended over the sides of the embryo.

T. draco (Fig. 5, Plate I.).—As in 2nd Stage, but some chromatophores are also present between the two rows, about midway between snout and tail.

Stage 4.

Turbot.—Form of pigment intermediate between that of Stages 3 and 5. The pigment-cells are now somewhat branched, particularly on the head.

T. draco (Fig. 6, Plate I.).—The lateral rows have broken up. A few scattered black chromatophores are now present on the head and gill-region and others form an irregular bar midway between snout and tail. One or two spots—one in photograph—are visible on the tail.

Stage 5 (probably shortly before hatching).

Turbot (Figs. 3 and 4, Plate I.).—Pigment is generally distributed over the embryo in the form of anastomosing stellate chromatophores, those on the head being larger and more markedly stellate. On the tail they are smaller and less intense.

T. draco (Figs. 7 and 8, Plate I.).—Scattered pigment-spots are present on the body from the snout to a point distant from the end of the tail about one-third of the length of the embryo. The remainder of the tail-region is free from pigment with the exception of one or two spots at the base of the embryonic fin near the caudal extremity. The head-pigment consists of two large irregular chromatophores *behind* and one or two *between* the eyes, also a group of large ones on the snout. The pigment over the oil-globule is very characteristic. All the chromatophores are intensely black.

The differences in pigment may be summarised for all stages as follows:—

Turbot.—Pigment in the form of *numerous almost radially symmetrical chromatophores* covering nearly the whole dorsal surface of the embryo and *extending over the tail region*, except in very young stages. In the oil-globule the chromatophores are of a fairly regular *stellate* form.

T. draco.—Pigment in the form of a *few scattered irregular chromatophores*—in the youngest stages forming a single row on each side of the body—*not extending beyond a point distant from the caudal extremity about one-third of the length of the embryo*, with the exception of one or two chromatophores at the base of the embryonic fin-membrane: Tail free from pigment with the exception of these last. Pigment in oil-globule consisting of *irregularly shaped chromatophores*, resembling the spots on the eggs of some birds—the Buntings, for instance.

As will be seen from the above notes, there is no difficulty in distinguishing by means of the pigmentation between the species in question, from that stage of development in which the tail of the embryo is almost free from the yolk, until hatching. In advanced stages neither the diameter of the egg nor that of the oil-globule are criteria, *since the oil-globule in Greater Weevers' eggs is gradually absorbed during development*, as in the eggs of the Lesser Weever. This renders it impossible, in the absence of a pure group of the

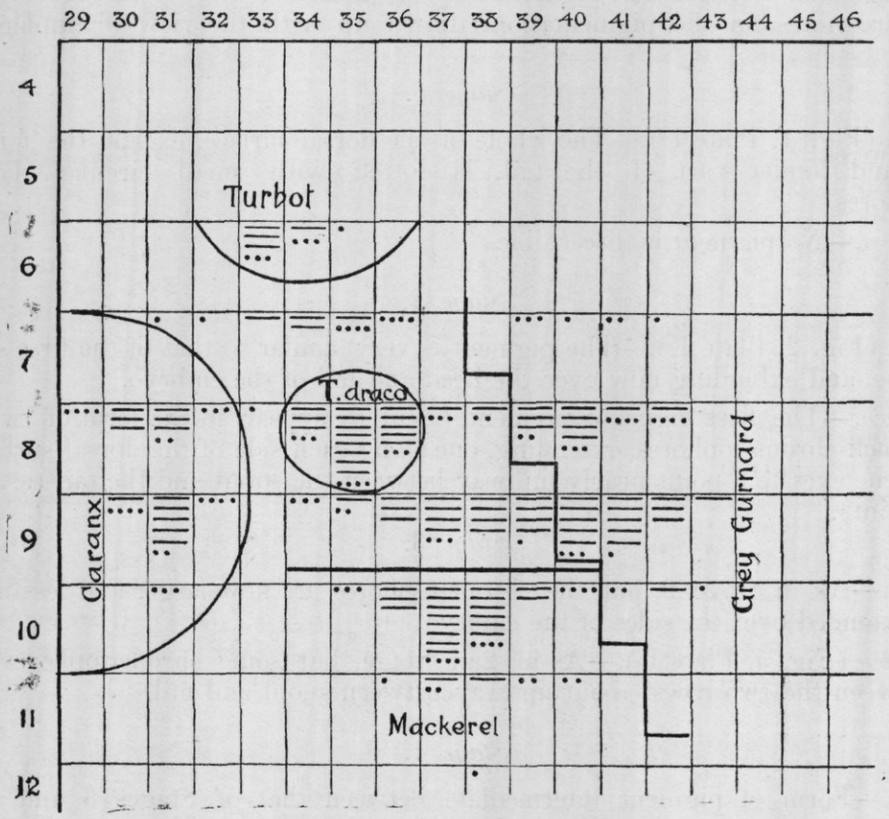

FIG. 7.

species, ever to obtain an absolutely correct standard size for the oil-globule. The average diameters of the two species of egg are not very different, though that of Weever eggs is slightly greater. In all our catches in which a considerable number of Greater Weever eggs occurred, they were overlapped in size on all sides, namely, by groups of Turbot, Mackerel, and Grey Gurnards' eggs, both as regards egg-diameter and O.-G. diameter.* The only way possible to disentangle the group in question would be to complete the other three by some mathematical method, such as those given in Appendix II. This is somewhat laborious, as it necessitates the evaluation of four or five curves of error. These evaluations have not been attempted in the case of our catches, as it is very probable that a purer group will be obtained in the future from which a better standard can be derived.

Tesch (4) gives 1·060 mm. as the mean diameter of a group of 37 *T. draco* eggs taken in July, 1908, and states that the oil-globules had diameters of from ·20 to ·23 mm. The stage of development is not noted.

The following are the measurements of a group of these eggs in advanced stages of development, taken in the Petersen trawl at Station 18, Voyage 110 (near the Haaks Lightship, 28/6/09).

Egg Diameters.

Micro-Divisions	33	34	35	36	37	Total
Eggs	0	3·5	10·5	5·0	0	19

Mean = 35·08 M.D. = 1·07 mm.

O.-G. Diameters.

Micro-Divisions	5	6	7	8	9	10	Total
Eggs	0	1·5	7·5	9·5	·5	0	19

Mean = 7·47 M.D. = ·22 mm.

* *See* Fig. 7, which is a Table of measurements showing this overlapping. For an explanation of the way in which the figure is constructed, compare the account of Fig. 13 on p. 231.

It will be noticed that diameters of 7 M.D. and 8 M.D. are here about equally common among the oil-globules. But in the case of little-developed eggs from the same catch there is a very distinct mode at 8·0 M.D. (*see* Fig. 7), and the frequencies at 7 M.D. are small ; it is obvious that the oil-globules have been gradually absorbed during development. This question needs further treatment. An elliptical chart was drawn up for a group of Turbot eggs from Stations 27, 30, 31, and 40 of Voyage 109, but it was found that the micro-divisions were too large for the method to give a satisfactory picture in the case of a group of eggs with such slight variability as those of Turbot. The measurements, taken separately for egg-diameter and O-G diameter, are as follows :—

Egg-Diameter.

Micro-Divisions	32	33	34	35	36	37	Total
Eggs	0	16	20·5	6·5	1	0	44

Mean = 33·83 M.D. = 1·03 mm.

OG-Diameter.

Micro-Divisions	4	5	6	7	8	Total
Eggs	0	2	27	15	0	44

Mean = 6·3 M.D. = ·19 mm.

A group of 27 certainly identified eggs from a haul with the Petersen Trawl at Station 18, Voyage 110,—the haul for which Fig. 7 shows the measurements of unidentified eggs—gives a mean egg-diameter of 33·63 M.D., and a mean OG-diameter of 6·185, both being thus slightly smaller than in the case of eggs taken on Voyage 109.

Finally another difference, between the two species dealt with, may be noticed—that in the colour of the yolk. Turbot eggs, that is of course preserved ones, usually have a very clear and colourless yolk, while Weever eggs possess a yolk of a distinct yellow colour. In some Turbot eggs the yolk is also yellowish, but I have never seen Weever eggs with the other character.

Brill (*Rhombus laevis*) and Grey Gurnard (*Trigla gurnardus*).

Though the eggs of the Brill and Grey Gurnard were very rarely taken in the quantitative hauls they occurred in considerable numbers in the qualitative ones. At Station 29, for instance, over 100 Brill eggs were taken in the Petersen Trawl. An elliptical chart of the measurements of these eggs (Fig. 10) is given in Appendix 2. The mean diameter of the eggs was 43·525 M.D. (1·227 mm.) and that of oil-globules 7·22 M.D. (·22 mm.). Though in many cases the large size of the egg and the small size of the O.G. is sufficient to distinguish them from those of Grey Gurnard, yet the overlap is considerable (*see* Fig 12). The pigment, too, is in some stages very similar, in the two species. In advanced stages of development, there are characteristic differences. The Brill egg is much the more intensely pigmented on the head, and on the yolk near the gill-region, and the chromatophores are much smaller, more numerous, and less branched (Fig. 7, Plate II.). The pigment on the yolk in the Gurnard egg appears very early, and is at first intense, but it soon becomes faint, the chromatophores send off long processes (Fig. 3, Plate II.), and finally become almost invisible. The opposite is the case with the egg of Brill, that is to say, the pigment becomes continually more intense with development of the embryo. Figs. 4, 5, and 6 of Plate II., show well the pigmentation of a Gurnard egg in an advanced stage of development. The following characteristics may be noticed, (1) the large branched chromatophores on the head, (2) the faint pigmentation of the yolk, and (3) a very distinct row of pigment-spots on the dorsal fin-membrane, quite absent from the Brill-embryo. In still further advanced stages, just before hatching, all the pigment is almost invisible, and the pectoral-fins become very conspicuous ; they are quite separate from the yolk and somewhat curled upwards. From the characteristics here noticed, it is usually possible in the case of a moderate number of eggs, to obtain a standard size for distinguishing eggs of this species in a less-developed state, from those of Mackerel and Brill. It will be seen that the curves formed from the Gurnard group in Appendix 2 have not the appearance of compound curves, and thus probably belong, mainly at least, to one species only. That this species is Grey Gurnard is highly probable, as the other species of *Trigla* are not nearly so common in the North Sea.

The mean diameters in the *Trigla* eggs measured were 40·86 M.D. (1·24 mm.) and 8·863 M.D. (·26 mm.) for eggs and O.G.'s respectively. These eggs, used to form the ellipse for Gurnards (Fig. 11), were taken at Stations 27, 28, 30, 31, 33, 35, and 40 of Voyage 109 in the Petersen Trawl.

Scaldback (*Platophrys laterna*) and Rockling (*Onos sp.*).

The eggs of the above species are difficult to distinguish except in advanced stages. They have therefore been entered in the same column in Table (1), though, in some cases, separation was possible by means of pigmentation. In cases where this was possible, it appeared that the groups consisted mostly of Scaldback eggs, since, as a rule, no pigment was visible. (*See* Ehrenbaum (3), pp. 237 *et seq.*) Scaldback and Rockling eggs occurred in nearly all the Hensen-Nettings taken between the 20 and 40 metre lines on the Dutch Coast ; the two stations nearest shore, namely, 29 and 30, yielded the largest numbers, 37 and 21 per square metre respectively, the next largest being given by the neighbouring stations, 28 and 31. It is useless, however, to attempt to draw conclusions from such small catches, in the case of eggs which are not certainly identified.

As a rule, none of these little eggs were taken in the Petersen-Trawl, probably owing to the coarseness of the material of which it is made. It would be useful to obtain large catches by means of a finer-meshed Petersen-Trawl in order to obtain good standards, which might then be applied to the separation of the groups taken in the Hensen-Net.

Red Gurnard. (*Trigla cuculus.*)

Some large eggs very similar in pigmentation and general appearance to those of Grey Gurnard occurred in the Petersen-Trawl, four at Station 38 and five at Station 36, of Voyage 109 ; also 27 at Station 10 of Voyage 110 (between Stations 15 and 16, Voyage 109). The measurements were as follows :—

Egg-Diameters.

M.D.	·46	47	48	49	50	51	52	Total
Eggs	1	5·5	8	8	7	3·5	3	36

Mean = 48·86 M.D. = 1·49 mm.

O.G.-Diameters (*omitting very irregular O.G.'s*).

M.D.	10	11	12	13	Total
Eggs	5	18·5	7	·5	31

Mean = 11·097 M.D. = ·339 mm.

The large size and coppery colour of the oil-globule render it probable that these eggs belong to Red Gurnard (*see* McIntosh and Masterman (5), pp. 134 and 462). The embryos, where present, show peculiar lobes, one on each side of the snout (Fig. 8, Plate II.), and the chromatophores on the yolk are large, faint and much branched, as in Grey Gurnard eggs, but to a greater degree. No pigment is visible on the embryo itself, but it is probable that, even if faint pigment had been present in the living egg, this would have become invisible after preservation. Though the above measurements showed distinct correlation between egg-diameter and O.G.-diameter, the number of specimens is not sufficient to warrant quantitative treatment.

Greater Weever. *Trachinus draco* (*see* under Turbot).

Lesser Weever. (*Trachinus vipera.*)

The spawning season of this fish fell rather later than the first half of June in 1909. The Petersen-Trawl catches at some of the stations of voyage 110 (latter half of June 1909), and two or three hauls taken on the Knoll Flat on July 22, 1909, contain enormous numbers of Lesser Weever eggs.

Dragonet. (*Callionymus lyra.*)

The eggs of the Dragonet are the most easily recognizable of all fish-eggs, by their peculiar honey-comb-like markings. These eggs may be divided into two groups as a rule—those with "cells" of large diameter on the capsule, and those with small "cells." It was formerly supposed that the small-celled eggs belonged to *C. maculatus*, but Prof. Ehrenbaum* informs me that this is very doubtful, if not improbable. Eggs with

* For possible explanation, *see* Ehrenbaum (3).

both sorts of markings were about equally common in our catches, and it seems probable that they both belong to *C. lyra*, as *C. maculatus* is a very rare fish in the Southern North Sea.

Dragonet eggs were taken at all the more easterly stations, though not in great quantities, the greatest catch being 35 per square metre at station (11), voyage 109. There is not apparently any preference shown by this fish for coastal waters. If a straight line is drawn from a point half-way between stations 4 and 5 to a point half-way between the Sandettie and Bergues Lightships, it will be seen that these eggs are fairly common at all stations to the Eastward of the line, and absent or rare at those to the Westward. These results agree, as to the depth of water preferred, with those of the German and Dutch workers.

APPENDIX I.

Note on the Constant of the Hensen Net used by the "Huxley" in June, 1909.

Two hauls were made with the above net at each station. The speed of hauling of the second differed somewhat in most cases from that of the first. Except in three cases only, viz., Stations 6, 29 and 40, it was found that the greater number of eggs was caught either (1) by the first haul, whether the quicker or slower, or (2) by the second haul when this was the quicker.

Omitting Stations 6, 29 and 40 and Station 22 as an extreme case (the greater catch was here four times as great as the lesser), also Station 9 at which the hauls were made at the same speed and Station 17 in which the numbers of eggs in the two catches were equal; finally omitting those hauls in which the total number of eggs caught was too small to give reliable results, there remain 18 pairs of hauls for comparison. The results are as follows :—

In 12 cases out of 18 the first haul gives the greater catch by an average excess of 37 per cent.
In 12 cases out of 18 the quicker haul gives the greater catch by an average excess of 44 per cent.
In 6 cases the first haul is the quicker and gives the greater catch by an average excess of 51 per cent.
In 6 cases the first haul is the slower and gives the greater catch by an average excess of 23·5 per cent.
In 6 cases the second haul is the quicker and gives the greater catch by an average excess of 37 per cent.

From these figures it is obvious that too much reliance must not be placed on the constant for the net as calculated from the speed of hauling. It is probable that the fact of the first haul's being often greater than the second, even when the latter is hauled more quickly, is due to the net's becoming somewhat shrunk and clogged by organisms such as *Phaeocystis* or *Noctiluca*. These organisms were present in great abundance at some of the stations, but unfortunately the estimation of the comparative numbers present is a matter of great difficulty, particularly as regards *Phaeocystis*.

I have thought it best in the circumstances to calculate a constant for the net from the *average* speed of hauling and to use this for all the catches. The calculation was carried out by means of Hensen's Tables (6) with the help of Dakin's paper (Dakin (7)).

The average speed of hauling was found to be ·3 metres per second; and the constant is therefore 1·182.

To reduce to "amount per square metre" the number of eggs must be multiplied by the above constant and by the factor $= \frac{\text{Area of net opening}}{\text{1 square metre}}$, *i.e.*, by $1{\cdot}182 \times 2{\cdot}598 = 3{\cdot}07$. As the net is made of material with 22 meshes per cm. instead of 23 per cm., as in No. 3 Müllergaze (the material used by Hensen in his calculation), the constant will be somewhat lower than 1·182, and the number of eggs per square metre will be given to a sufficient approximation by simply multiplying the catch by 3. This has accordingly been done to form the row in dark type in the Tables of Eggs in the present paper.

I append a list of measurements of the egg-net used at Lowestoft Laboratory. The measurements are of internal dimensions.

MEASUREMENTS OF THE HENSEN FISH-EGG NET USED AT LOWESTOFT LABORATORY.

Diameter of opening	70 cm.
„ of upper ring to which the net is attached	97 cm.
„ of lower ring joining net and bucket	19 cm.
Length of side of net (frustum of cone)	136 cm.
Half-angle at apex of net-cone (α)	16° 40′
Area of net opening	3848·5 q. cm.
Area of silk in net (N′)	26152·2 q. cm.
Area of silk in bucket (C.)	944 q. cm.
Total conical area of silk (N′ + C. cos. α)	=27056·5 q. cm.
No. of bolting-cloth ... ... Staniar's Quality I., No. 2.	
No. of meshes in silk per cm.	22

TABLE III.—Showing VALUE in MILLIMETRES of DIVISIONS of the MICROMETER EYEPIECE, by which the Eggs were Measured.

Number of Divisions.	Millimetres.	Number of Divisions.	Millimetres.
1	·030497	31	·945407
2	·060994	32	·975904
3	·091491	33	1·00640
4	·121988	34	1·03690
5	·152485	35	1·06739
6	·182982	36	1·09789
7	·213479	37	1·12839
8	·243976	38	1·15889
9	·274473	39	1·18938
10	·304970	40	1·21988
11	·335467	41	1·25038
12	·365964	42	1·28087
13	·396461	43	1·31137
14	·426958	44	1·34187
15	·457455	45	1·37236
16	·487952	46	1·40286
17	·518449	47	1·43336
18	·548946	48	1·46386
19	·579443	49	1·49435
20	·609940	50	1·52485
21	·640437	51	1·55535
22	·670934	52	1·58584
23	·701431	53	1·61634
24	·731928	54	1·64684
25	·762425	55	1·67733
26	·792922	56	1·70783
27	·823419	57	1·73833
28	·853916	58	1·76883
29	·884413	59	1·79932
30	·914910	60	1·82982

Value of Fractions of a Division.

Divisions.	Millimetres.
·05	·00152
·10	·00305
·15	·00457
·20	·00610
·25	·00762
·30	·00915
·35	·01067
·40	·01220
·45	·01372
·50	·01525
·55	·01677
·60	·01830
·65	·01982
·70	·02135
·75	·02287
·80	·02440
·85	·02592
·90	02745
·95	·02897

NOTE.—Where no unit is mentioned in the measurements, the unit is the Micro-Division (M-D), or ·030497 mm.

APPENDIX II.

On Mathematical Methods of representing groups of Fish Eggs and of separating compound groups into their Constituent Species.

It is often of very great importance, in the case of a catch of fish eggs, to be able to separate out two or more species of eggs which overlap in size. As a rule there are no morphological characters which enable us to do this before the embryos are far developed, and the pigment has begun to show specific characters. In the case of early stages we have to depend solely on mathematical methods applied to measurements taken under the microscope.

Heincke and Ehrenbaum (1. pp. 194 *et seq.*) give methods for roughly determining the positions of the *maxima* or modes for overlapping species and also a method (loc. cit. p. 201) for showing how many of each species are present in a compound group. The latter method was applied by the authors mentioned to distinguish between the eggs of Dab and Flounder, and in other cases, and has done very useful work; it obviously, however, only gives correct results in cases where the component species are present in equal or nearly equal quantities, and where the modes are quite distinct. This is indeed pointed out by the above authors themselves. It is proposed here to give an account of a method which should give more exact results, and which may often be applied in cases where the maxima fall close together. It is, in the form in which it is developed here, only applicable to species of eggs with oil-globules, but the fundamental idea can be easily applied to the other case, though, possibly, with not quite such correct results.

In the case of eggs with oil-globules, the method depends on the assumption that the numbers of eggs measured with regard to their diameters and that of the contained oil-globules fit approximately

a normal correlation surface. As the cases dealt with are purely biometrical, there is surely justification for the use of biometrical methods, and the above assumption is made by all biometricians who make use of the coefficient of correlation. The following method takes into consideration all the measurable characters of the eggs, that is to say, not only the actual diameters of eggs and oil-globules, but the relation between them. As an instance, consider an egg of 41 divisions, with an oil-globule of 9 divisions. Now an egg of 41 divisions may belong to either Grey Gurnard or Mackerel; similarly with an oil-globule of 9 divisions. But an egg of 41 divisions *with an oil-globule of 9 divisions* is most unlikely to be a Mackerel egg, or anything but a Gurnard egg. This, of course, only applies to eggs taken at the same time of year as those here considered, but the idea may easily be extended to fit other cases.

In the development of the methods the following symbols are used :—

$x_0\ y_0$=centre of correlation surface, *i.e.* centre also of all horizontal sections of the surface.
σ_1=standard deviation of all x's (egg-diameters) from mean of whole surface.
σ_2=standard deviation of all y's (O.G. diameters) from mean of whole surface.
r=coefficient of correlation between x's and y's.
k=any constant.

Method for representing Groups.

A good picture of a species of fish-egg as regards measurable characters (diameters of eggs and oil-globules) is given by a horizontal section of the correlation surface from which the frequencies at different measurements arise with least improbability. The values of σ_1, σ_2, and r are obtained in the usual way from the measurements, and these values, together with N, the total number of eggs in the group, fix the form and size of the correlation surface. The position of the centre is fixed by the positions of the means of the two characters measured. We must decide on a horizontal section of this surface, within which fall very nearly all the frequencies. As an example may be taken a horizontal section of the surface extending from $x_0\ y_0$ to $x_0\ y_0 \pm 3\ \sigma_1$, and from $x_0\ y_0$ to $x_0\ y_0 \pm 3\ \sigma_2$. This will probably contain the great majority of frequencies, but the limits may easily be extended if necessary. Nothing, however, would be gained in a case such as those considered here by including all extreme frequencies. The equation to the correlation surface is

$$Z=\frac{N}{2\pi\sigma_1\sigma_2\sqrt{1-r^2}}\cdot e^{-\frac{1}{2}\left\{\frac{x^2}{\sigma_1^2(1-r^2)}-\frac{2xyr}{\sigma_1\sigma_2(1-r^2)}+\frac{y^2}{\sigma_2^2(1-r^2)}\right\}} \quad \ldots \quad \ldots \quad (a.)$$

where N is the total frequency ;
so that the equation of any horizontal section is :—

$$\frac{x^2}{\sigma_1^2}-\frac{2xyr}{\sigma_1\sigma_2}+\frac{y^2}{\sigma_2^2}+2k(1-r^2)=o, \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (b.)$$

which is the equation of an ellipse with centre $x_0\ y_0$. Equation (b) is obtained by putting Z = a constant in (a).

The problem to be solved then is as follows :—"To draw an ellipse of the form of equation (b), touching the straight lines $x = \pm 3\ \sigma_1$ and $y = \pm 3\ \sigma_2$." Substituting $3\ \sigma_1$ for x, equation (b) becomes

$$\frac{1}{\sigma_2^2}(y^2)-\frac{6r}{\sigma_2}(y)+\left\{2k(1-r^2)+9\right\}=o. \quad \ldots \quad \ldots \quad \ldots \quad (c.)$$

For the condition that the ellipse given by equation (c) touches but does not cut the straight line $x = 3\ \sigma_1$, the roots of equation (c) must be equal, that is :—

$$\frac{36r^2}{\sigma_2^2}-\frac{4}{\sigma_2^2}\left\{2k(1-r^2)+9\right\}=o \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (d.)$$

$$\therefore 2\quad (1-r^2)=9\,(r^2-1)$$

$$\therefore k=-\frac{9}{2}$$

Equation (b) then becomes

$$\frac{x^2}{\sigma_1^2}-\frac{2rxy}{\sigma_1\sigma_2}+\frac{y^2}{\sigma_2^2}+9\,(r^2-1)=o. \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (e.)$$

Substituting the values $\pm 3\ \sigma_1$ for x, or $\pm 3\ \sigma_2$ for y, the points of contact are found to be

$$x=\pm 3\ \sigma_1,\ y=\pm 3\ r\sigma_2 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (f.)$$
$$y=\pm 3\ \sigma_2,\ x=\pm 3\ r\sigma_1.$$

These points lie on the "Regression Lines"

$$y=\frac{\sigma_2}{\sigma_1}.\ r.\ x.$$

$$x=\frac{\sigma_1}{\sigma_2}.\ r.\ y.$$

that is, the Regression Lines pass through the points of contact between the ellipse and the straight lines $x = \pm 3\ \sigma_1$ and $y = \pm 3\ \sigma_2$.

In general, if the limiting values for x and y are taken as $\pm t\ \sigma_1$ and $\pm t\ \sigma_2$ respectively, the points of contact are

$$x=\pm t\ \sigma_1,\ y=\pm tr\ \sigma_2$$
$$y=\pm t\ \sigma_2,\ x=\pm tr\ \sigma_1$$

and the equation (e) becomes

$$\frac{x^2}{\sigma_1^2}-\frac{2rxy}{\sigma_1\sigma_2}+\frac{y^2}{\sigma_2^2}+t^2(r^2-1)=o \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (g.)$$

In Fig. 8 are given the equations of all the straight lines mentioned, as well as the co-ordinates of the points of contact and points obtained by putting $x = o$, $y = o$ in equation (e) in the particular

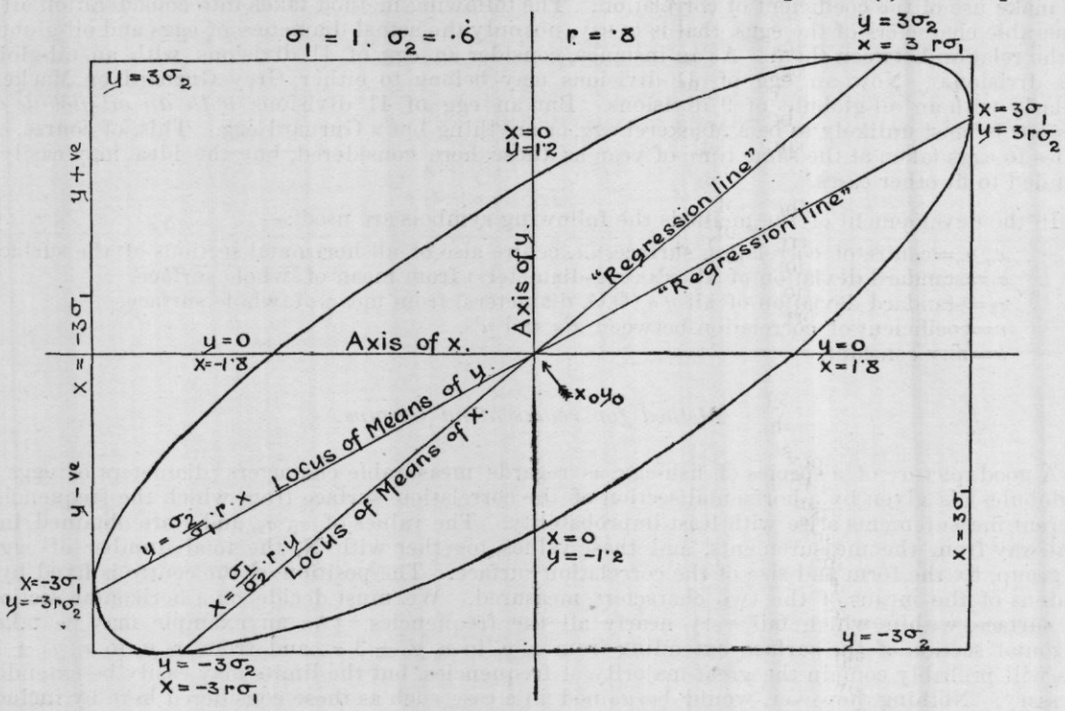

FIG. 8.

case when $\sigma_1 = 1$, $\sigma_3 = \cdot 6$, $r = \cdot 8$, and the limiting values for x and y have been taken respectively as $\pm 3\ \sigma_1$, and $\pm 3\ \sigma_2$. From these eight points the ellipse is easily drawn freehand.

The following shows the calculation needed to draw the ellipse for mackerel (Fig. 9). It will be noticed that the smaller ellipse, obtained by putting $x = \pm 3\ \sigma_1$, &c., includes nearly all the frequencies, while the larger, obtained by putting $x = \pm 4\ \sigma_1$, &c., includes them all.

Now

$$\sigma_1 = 1{\cdot}085,\ \sigma_2 = \cdot 612,\ r = \cdot 58.$$

All measurements are from the means (38·88 and 10·4575)

If

$$x = \pm 3\sigma_1,\ y = \pm 3\ r\ \sigma_2$$
$$x = \pm 3{\cdot}255,\ y = \pm 1{\cdot}065$$

2 points of contact are at $\dfrac{38{\cdot}88 + 3{\cdot}255}{10{\cdot}4575 + 1{\cdot}065}$ or $\dfrac{42{\cdot}135}{11{\cdot}522}$ *

and $\dfrac{38{\cdot}88 - 3{\cdot}255}{10{\cdot}4575 - 1{\cdot}026}$ or $\dfrac{35{\cdot}625}{9{\cdot}392}$

If

$$y = \pm 3\ \sigma_2,\ x = \pm 3\ r\ \sigma_1$$

2 points of contact are at $\dfrac{40{\cdot}77}{12{\cdot}2935}$ and $\dfrac{36{\cdot}99}{8{\cdot}6215}$.

Putting $x = o$ in equation (e) on page (227)

Then

$$\frac{y^2}{\sigma_2^2} = -9\ (r^2 - 1) = 9\ (1 - r^2)$$

$$\frac{y}{\sigma} = \sqrt{9\ (1 - r^2)} = 3\ \sqrt{1 - r^2}$$

$$\therefore\ y = 3\ \sigma_2\ \sqrt{1 - r^2}$$

$$= 3 \times \cdot 612 \times \sqrt{\cdot 6636} = \pm 1{\cdot}49.$$

$\therefore$ Two points on ellipse are at mean of x's and at distances $\pm$ 1·49 from mean of y's or at $\dfrac{38{\cdot}88}{11{\cdot}95}$ and $\dfrac{38{\cdot}88}{8{\cdot}97}$.

Putting $y = o$ in equation (e)

$$x = 3\ \sigma_1\ \sqrt{1 - r^2} = \pm 2{\cdot}65$$

$\therefore$ 2 points on ellipse are at $\dfrac{41{\cdot}53}{10{\cdot}4575}$ and $\dfrac{36{\cdot}23}{10{\cdot}4575}$.

---

* This expression and similar ones below are not fractions ; the upper numbers indicate the values of x, and the lower those of y, at which the points in question fell.

From these eight points the ellipse was drawn freehand.
The points on the larger ellipse are given by

$$x = \pm 4\,\sigma_1,\ y = \pm 4\,r\,\sigma_2 \text{ (two points)};\quad y = \pm 4\,\sigma_2,\ x = \pm 4\,r\,\sigma_1 \text{ (2 points)}$$
$$x = 0,\ y = 4\,\sigma_2\sqrt{1 - r^2} \text{ (2 points)};\quad y = 0,\ x = 4\,\sigma_1\sqrt{1 - r^2} \text{ (2 points)}.$$

Figs. 10 and 11 are similar ellipses for brill and grey gurnard, while Fig. 12 is a chart, showing the amount of overlap in the three species considered.

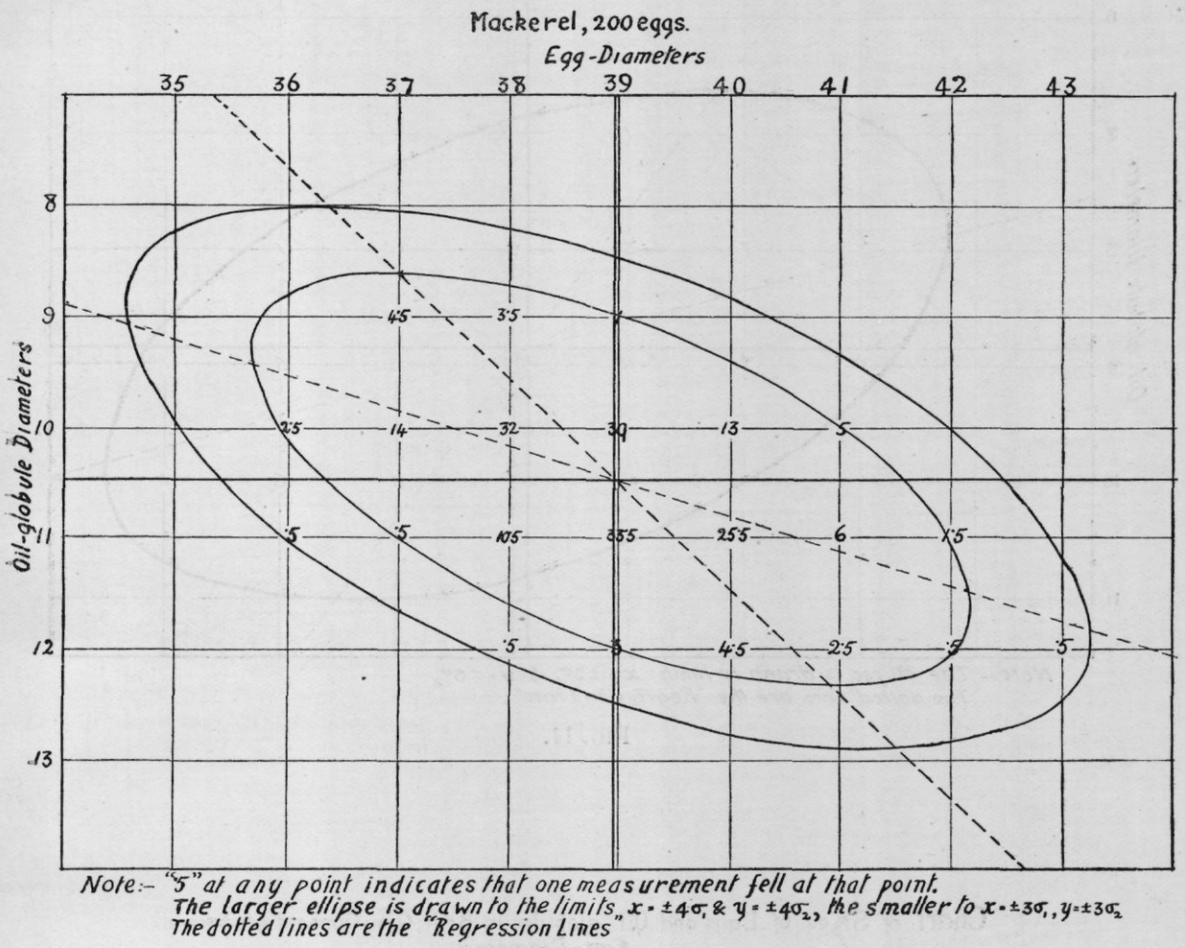

FIG. 9.

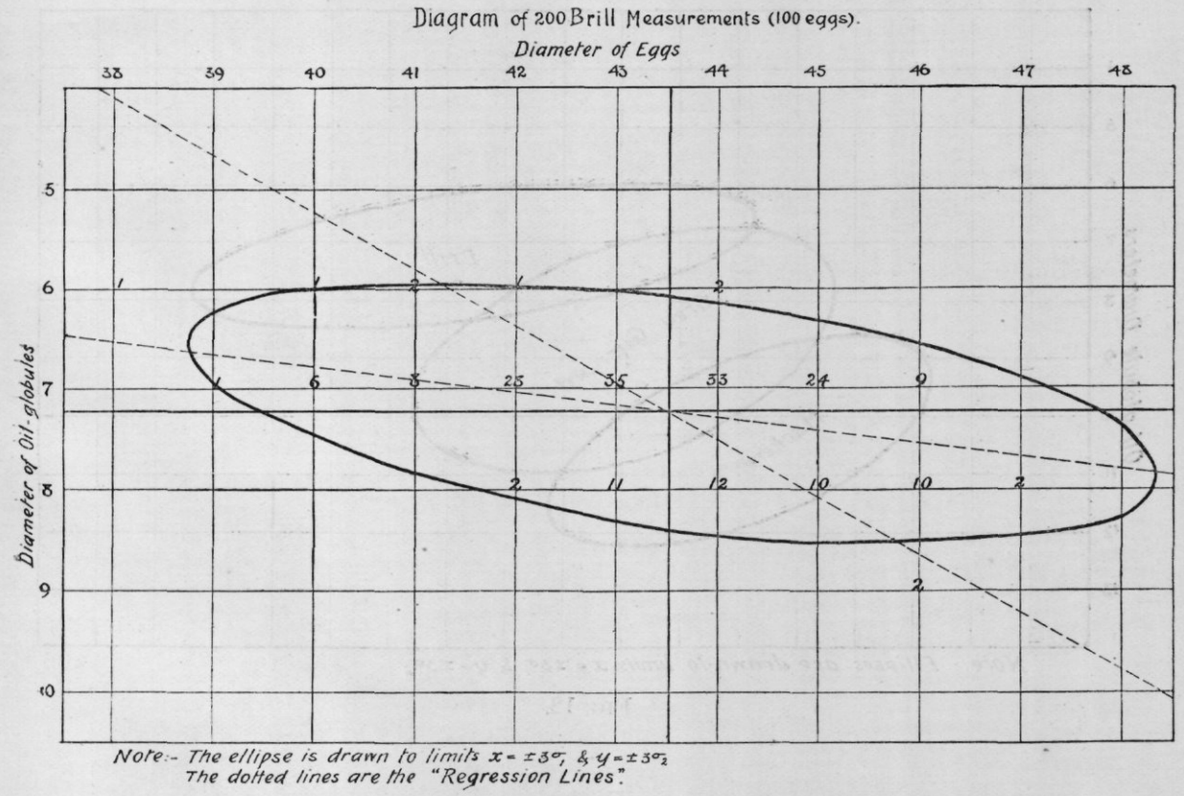

FIG. 10.

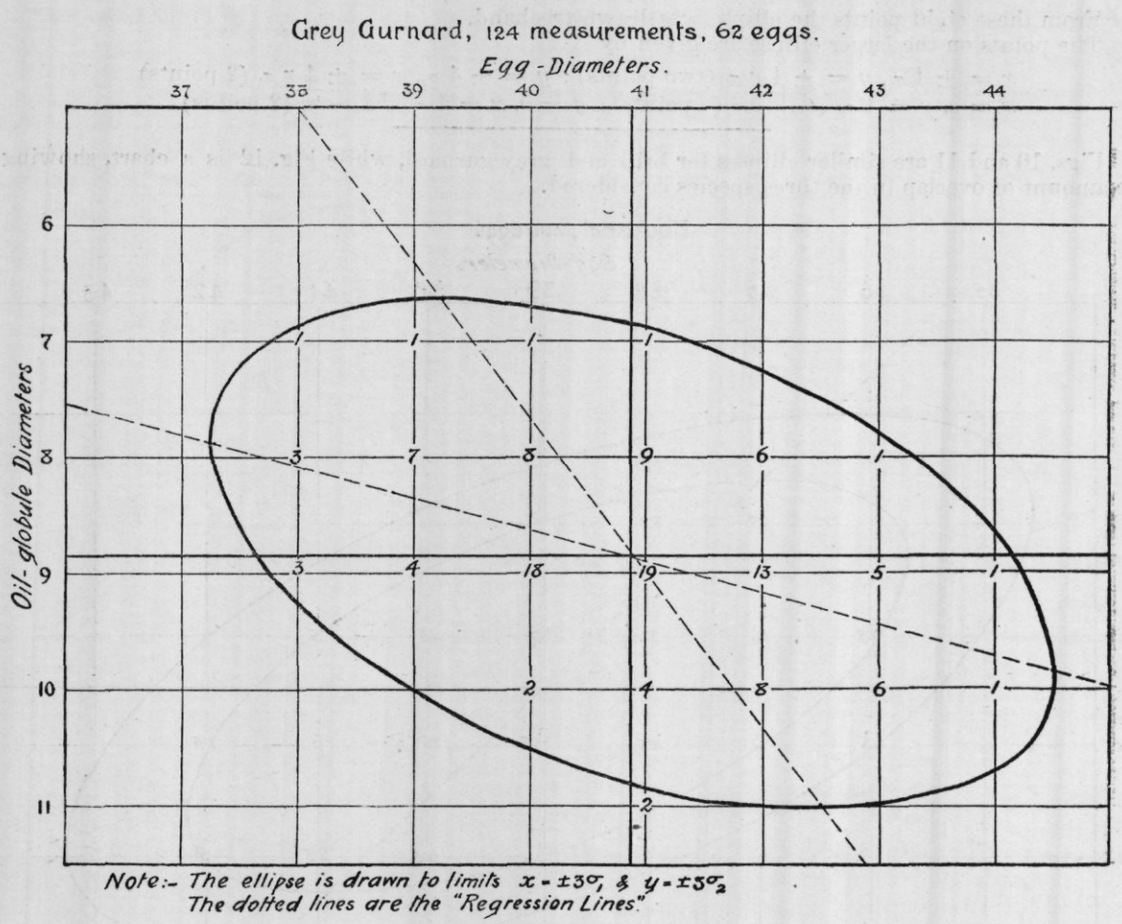
Grey Gurnard, 124 measurements, 62 eggs.
Egg-Diameters.
37
38
39
40
41
42
43
44
Oil-globule Diameters
6
7
8
9
10
11
1 1 1 1
3 7 8 9 6 1
3 4 18 19 13 5 1
2 4 8 6 1
2
Note:- The ellipse is drawn to limits x = ±3σ1 & y = ±3σ2
The dotted lines are the "Regression Lines."

FIG. 11.

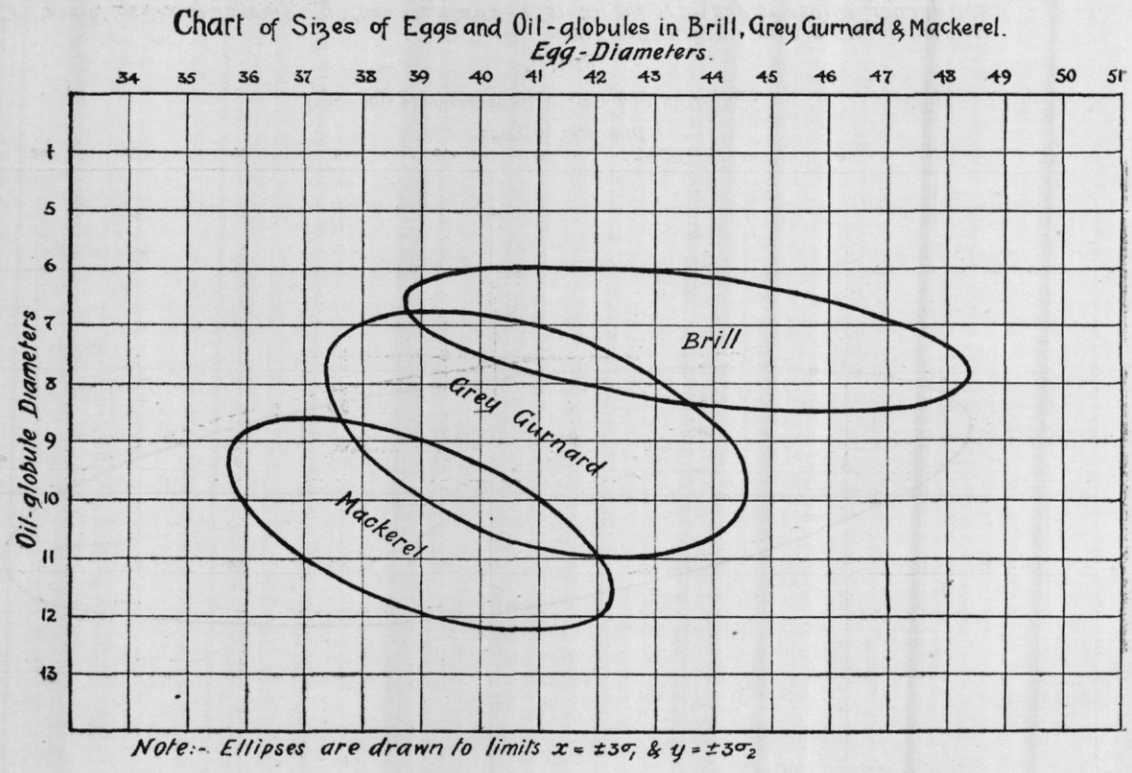
Chart of Sizes of Eggs and Oil-globules in Brill, Grey Gurnard & Mackerel.
Egg-Diameters.
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
Oil-globule Diameters
4
5
6
7
8
9
10
11
12
13
Brill
Grey Gurnard
Mackerel
Note:- Ellipses are drawn to limits x = ±3σ1 & y = ±3σ2

FIG. 12.

Methods of separating Compound Groups of Eggs into the True Numbers of their Constituent Species.

The methods may be most easily explained by means of an example.

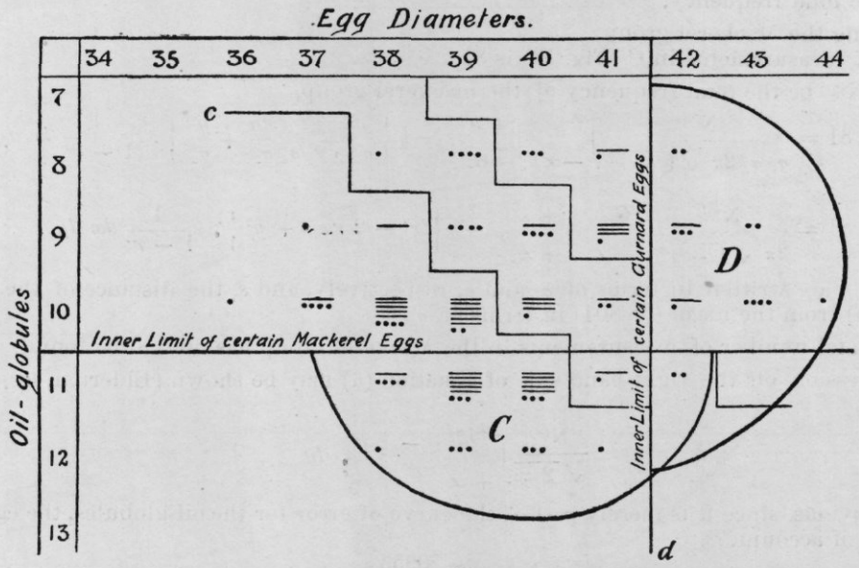

FIG. 13.

Fig. 13 is a table of measurements of 84 certainly identified eggs of Mackerel, mixed with 36 certain Grey Gurnards' eggs, all taken on voyage 109. The eggs are entered in the squares corresponding to their own diameter and that of the contained oil-globule. Each egg is measured twice, the measurements being taken as nearly as possible at right angles to each other, and a dot is placed in the table for each measurement; a line is drawn through each set of five dots. Where the pairs of measurements are found to differ both for egg-diameter and O.G.-diameter, *four* dots are entered in the table. For instance, in an egg whose measurements are $\frac{41-2}{9-10}$, dots are placed opposite $\frac{41}{9}$, $\frac{42}{9}$, $\frac{41}{10}$, and $\frac{42}{10}$, and these eggs are noted as they must be subtracted from the total of the whole group of measurements in the final calculation. We will now attempt to separate the two groups again mathematically.

The *means* of the two groups may be found (1) from any eggs of the same catch which can be certainly identified by means of the pigment or other non-measurable characters, or (2) from certainly identified eggs collected at neighbouring stations on the same voyage, or, if both of these methods are impracticable, (3) from eggs taken in another year, but at the same time of year; this last method would not be very reliable.

The standard deviations (σ_1, σ_2) of eggs and oil-globules are found either (1) in a similar way to the means, or (2) by finding the standard deviation of any pure row or column in the table, *i.e.*, any row or column all the entries in which are practically certain to belong to one species. This follows from the fact that in a normal correlation surface, the standard deviations of all the x-arrays are equal to each other and to that of the whole surface; similarly with the y-arrays (*vide* Elderton (8) pp. 113 *et seq.*). The coefficients of correlation (r) between egg-diameter and O.G.-diameter are probably sufficiently accurate if found once and for all for each species from fairly large series of measurements. "r" must be found for drawing the elliptical charts described above, but it need not be found for the separation method, as the expression obtained is independent of correlation.

In the example given, the means* as found from 115 other eggs taken on voyage 109 at the same station are for Mackerel 38·804 and 10·439 for egg-diameter and O.G.-diameter respectively, and the standard deviations, σ_1 and σ_2, are 1·16 and ·64 respectively. The coefficient of correlation (r) is found from the same group to be ·619±·039. In the case of Gurnard eggs, the means are 40·765 and 8·687, as found from 29 certainly identified eggs taken at various stations on voyage 109; the standard deviations are 1·4 and ·73 and r = ·395 ± ·1. The large Probable Error of "r" is due to the small number of eggs measured.

We may now separate the given compound group into its constituents, with a fair degree of accuracy. The method is as follows:—

We may say, with fair justification, that *by reason of their measurements*, all eggs with O.G's of over 10·5 are Mackerel eggs; similarly, that all eggs of more than 41·5 in diameter are Gurnards'. In the example, the number of measurements (dots) of these certain Mackerel eggs is 81, and of gurnard 25. The straight lines in Fig. (13) are drawn through the limits mentioned. The number "2" in the square $\frac{\text{"42"}}{11}$ is included in both groups ("C" and "D" in Fig. (13)).

The whole compound group is considered as made up of two overlapping correlation surfaces.

* NOTE.—The means and standard deviations are most conveniently found by Mr. Hardy's summation method (*vide* Elderton (8) pp. 19 *et seq.*), but "r" is better obtained in the usual manner (*loc. cit.* pp. 107 and 119).

The equation to the correlation surface is :—

$$z = \frac{N}{2\pi\,\sigma_1\,\sigma_2\,\sqrt{1-r^2}}\,e = \tfrac{1}{2}\left\{\frac{x^2}{\sigma_1^2} - \frac{2\,xyr}{\sigma_1\,\sigma_2} + \frac{y^2}{\sigma_2^2}\right\}\cdot\ \frac{1}{1-r^2},$$

where N is the total frequency.

Considering the Mackerel group ;
the number of measurements in C (Fig. 13) is 81.

Then, if $N^{(a)}$ be the total frequency of the mackerel group,

$$81 = \frac{N^{(a)}}{\sigma_1\,\sigma_2\,2\pi\,\sqrt{1-r^2}}\int_{-\infty}^{\infty}\int_{+\infty}^{+s} e^{-\frac{1}{2}\left\{\frac{x^2}{\sigma_1^2} - \frac{2\,rxy}{\sigma_1\,\sigma_2} + \frac{y^2}{\sigma_2^2}\right\}\cdot\ \frac{1}{1-r^2}}\,dx\,dy,$$

or

$$81 = \frac{N^{(a)}}{2\pi\,\sqrt{1-r^2}}\int_{-\infty}^{\infty}\int_{+\infty}^{+s} e^{-\frac{1}{2}\left\{x^2 - 2\,rxy + y^2\right\}\cdot\ \frac{1}{1-r^2}}\,dx\,dy \quad \ldots \quad \ldots \quad (\alpha)$$

where x and y are written in terms of σ_1 and σ_2 respectively, and s, the distance of the inner limit of c (*viz.*, 10·5) from the mean (38·804) in terms of σ_2.

$N^{(a)}$, the total number of measurements in the Mackerel group has now to be found.

The expression on the right-hand side of equation (α) may be shown (Elderton, *loc. cit.*, p. 127) to be equal to

$$\frac{N^{(a)}}{\sqrt{2\pi}}\int_{+\infty}^{+s} e^{-\frac{1}{2}y^2}\cdot\,dy$$

This is obvious, since it is merely part of the curve of error for the oil-globules, the egg-diameters being left out of account.

Then

$$81 = \frac{N^{(a)}}{\sqrt{2\pi}}\int_{+\infty}^{+\cdot0953} e^{-\frac{1}{2}y^2}\cdot\,dy$$

replacing s by its numerical value in the present case (*viz.*, ·061), divided by σ_2 (·64).

$$\therefore\ N^{(a)} = \frac{81}{\frac{1}{\sqrt{2\pi}}\int_{+\infty}^{+\cdot0953} e^{-\frac{1}{2}y^2}\cdot dy}$$

The denominator is equal to

$$\frac{1}{\sqrt{2\pi}}\int_{+\infty}^{o} e^{-\frac{1}{2}\cdot y^2}\cdot dy - \frac{1}{\sqrt{2\pi}}\int_{+\cdot0953}^{o} e^{-\frac{1}{2}y^2}\cdot dy$$

and

$$\frac{1}{\sqrt{2\pi}}\int_{+\infty}^{o} e^{-\frac{1}{2}y^2}\cdot\,dy = \cdot5$$

The second expression may be found from Davenport's Tables (Davenport (9), pp. 119 *et seq.*). It is equal to ·03784.

$$\therefore\ N^{(a)} = \frac{81}{\cdot5 - \cdot03784} = \frac{81}{\cdot46216} = 175\cdot2$$

The number of eggs in the group is thus found to be $\frac{175\cdot2}{2}$ or 88, since each egg was measured twice.

In the case of the Gurnards' eggs, $N^{(b)}$ the total number of measurements in the group is given by

$$N^{(b)} = \frac{25}{\frac{1}{\sqrt{2\pi}}\int_{+\infty}^{+\cdot525} e^{-\frac{1}{2}x^2}\cdot\,dx}$$

where the distance, from the mean, of the inner limit of D is written in terms of σ_1

$$N^{(b)} = \frac{25}{\cdot5 - \cdot2002} = \frac{25}{\cdot2998} = 83\cdot3$$

or the number of Gurnards' eggs present is 42.

Now the total number of eggs actually measured is seen to be 84 + 36 or 120.

This total should be divided in the proportions given by the above method.

viz., $\frac{88}{88+42} \times \frac{120}{1}$, or 81 *Mackerel eggs*.

and $\frac{42}{88+42} \times \frac{120}{1}$, or 39 *Gurnards' eggs*.

Thus the method in this case gives results very near the truth, *although the groups overlap very much, and the number of Gurnards' eggs is less than half that of Mackerel eggs.*

As a rule the standard deviations would not have to be specially calculated for each separation, but would probably already have been obtained from good pure groups taken at some neighbouring stations. They could then be applied to separate any compound groups taken on the same voyage.

Apart from the actual measuring of the eggs and oil-globules, the time required for the method is very short, and no mathematical knowledge is required *for its use* beyond that necessary to obtain the means and one of the standard deviations of each of the groups.

It will be seen that the problem here solved is really this :—"To complete two normal curves of error, when the centres, σ's, and parts of the curves between infinity and known distances from the centres are given." The problem might also be solved by tabulating the egg-diameters and O.G.-diameters separately and completing the O.G.-curve for Mackerel, and the egg-curve for Gurnards. The advantages in treating and tabulating the measurements as has been done here are (1) only half the number of entries are required ; (2) it is much more easily seen *which* eggs are practically certain to belong to one species or the other ; (3) these certain eggs often bear a larger proportion to the whole than would be the case if tabulated separately for egg-diameters and O.G.-diameters ; this is due to the correlation between the two sets of measurements. For instance there may sometimes be eggs with O.G.'s of 10 Divs., belonging to both Gurnard and Mackerel ; but, owing to correlation, nearly all the Gurnard eggs with so large an O.G. would fall some distance beyond the limit for Mackerel eggs with an O.G. of the same size, and therefore the 10-array would be seen to consist of two complete groups, one practically certain to be Gurnard, the other Mackerel.

Another quicker and more simple method is the following :—

Tabulate as before.

Tabulate in a separate correlation-table the diameters of eggs, and oil-globules in eggs, which may be certainly identified by means of pigment or other characters *not measurable.*

In the compound group divide off those eggs which *by reason of their measurements* are practically certain to belong to one species or the other.

In the separately noted eggs, if sufficient in number, find for each species what proportion the eggs of size corresponding to those divided off in the compound group bear to the whole group separately noted.

Consider the whole unknown groups for each species as made up in the same proportions, that is to say, to obtain the number in each unknown group, multiply the eggs "divided off" by $\frac{a}{b}$, where a=total number of "separately noted" eggs, and b=number of those of size corresponding to the eggs "divided off."

If an insufficient number of eggs have been "separately noted," the proportions must be obtained from catches taken elsewhere on the same voyage, as was done in the case of Gurnard in the example used in describing the longer method.

In this example, the measurements "divided off" for Mackerel numbered 81, and those for Gurnard 25.

In the group of 115 eggs used for separation of the Mackerel, the number of eggs with O.G.'s of over 10·5 was 49·5. The proportion of these in the complete group is then $\frac{49{\cdot}5}{115{\cdot}0}$. The total number of measurements in the unknown Mackerel group is then given by $\frac{81}{1} \times \frac{115}{49{\cdot}5}$ or 188.

The number of Mackerel eggs is therefore 94.

The number of Gurnard eggs is similarly found to be 35.

$$35 + 94 = 129.$$

This total must be divided, in the proportions given, to form the total of 120.

The number of Mackerel eggs is $94 \times \frac{120}{129}$ or 87.

The number of Gurnard eggs is $35 \times \frac{120}{129}$ or 33.

This result is as nearly accurate as that given by the longer method.

We are, however, justified in taking a larger number of measurements than 81 and 25, as being certainly of one species and the other respectively. The measurements divided off by the zigzag lines in Fig. 13 may be so taken.

The eggs in the standard group used, corresponding to those below the line "cd" in Fig. 13, number 102·5 ; therefore, to obtain the total number of Mackerel measurements in Fig. 13, the number below the line "cd" (viz., 148) must be multiplied by $\frac{115}{102{\cdot}5}$. This gives 166 measurements, or 83 eggs.

The Gurnard measurements are similarly found to number 77 or the eggs 38·5.

Dividing the total proportionately as before, these become 82 and 38, or each within two of the true number.

This result is quite sufficiently accurate for all practical purposes.

Though only one example of the methods has been given, it was not chosen as being in any way likely to give good results, and even had it been chosen to suit one method, that is no reason, *ipso facto*, why it should suit the other.

It may be asked why, seeing that the short method is sufficiently accurate, the long method should have been described here. In answer to this it may be said, that, where the groups are rough, and the numbers in them small, the long method might give superior results, as it is probable that the standard deviations obtained from small frequencies would show less chance variation than the number of instances in a particular part of the group. It has also another application, and that is as a method for completing the rows and columns of measurements of overlapping species, on the sides on which they overlap. In this capacity it might be useful for obtaining the measurements of a group overlapped on all sides by other species, and for which a standard could not be obtained, owing to an insufficient number of identifiable eggs being present, or other causes. The group, in this case, could be considered as composed of the remainder after the elimination of all the other groups by completion. The catch of eggs in the Petersen Trawl at Station 18 of Voyage 110 (Fig. 7), offers an instance of this, where the *Trachinus draco* eggs are overlapped in size by the groups of Mackerel, Gurnard, and Turbot, and it is impossible to obtain a standard size for the oil-globules in the first species, owing to their shrinkage in the course of development of the embryo.

LIST OF LITERATURE REFERRED TO IN THIS REPORT (IN ORDER OF REFERENCE).

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(2.) *Heincke and Ehrenbaum.*—Eier und Larven von Fischen der deutschen Bucht. II. Die Bestimmung der schwimmenden Eier und die Methodik der Eimessungen. Wissenschaftliche Meeresuntersuchungen. Abteilung Helgoland. N.F. Band III. 1900.

(3.) *Ehrenbaum, E.*—Ueber Eier und Jugendformen der Seezunge und anderer im Frühjahr laichender Fische der Nordsee. Wissenschaftliche Meeresuntersuchungen. Abteilung Helgoland. N.F. Band VIII. Heft 2. 1907.

(4.) *Tesch, J. J.*—Eier und Larven einiger im Frühjahr laichender Fische besonders der Südlichen Nordsee. Verhandelingen uit het Rijksinstituut voor het Onderzoek der Zee. Tweede Deel. 1909.

(5.) *McIntosh and Masterman.*—British Marine Food Fishes. Cambridge University Press. 1897.

(6.) *Hensen, V.*—Methodik der Untersuchungen der Plankton Expedition der Humboldt-Stiftung. Kiel. 1895.

(7.) *Dakin, W. J.*—The Filtration-Coefficients of Plankton nets. Lancs. Sea Fisheries Laboratory Report. 1908.

(8.) *Elderton, W. Palin.*—Frequency Curves and Correlation. London. 1906.

(9.) *Davenport, C. B.*—Statistical Methods. 2nd Edition. New York. 1904.

The most up-to-date and complete general treatise on the subject of Fish-eggs and Larvæ is the following, in which numerous references to other works may be found :—

Ehrenbaum, E.—Nordisches Plankton. Zehnte Lieferung. I. Eier und Larven von Fischen (2 parts). Kiel und Leipzig. 1908 & 1909.

EXPLANATION OF PLATES.

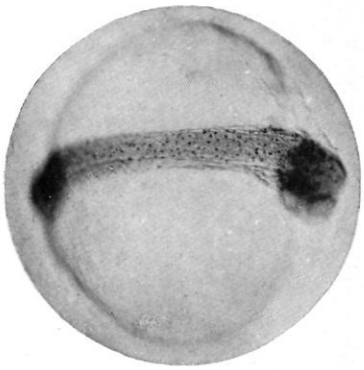
PLATE I.

Fig. 1. Egg of Turbot. Stage 1.
„ 2. „ „ „ 2.
„ 3 & 4 „ „ „ 5.
Fig. 5. Egg of Greater Weever. Stage 3.
„ 6. „ „ „ „ 4.
„ 7 & 8 „ „ „ „ 5.

N.B.—For explanation of Stages *see* page 221.

PLATE II.

Figs. 1 & 2. Egg of Mackerel (*see* pages 217 & 218).
„ 3, 4, 5, 6. Eggs of Grey Gurnard (*see* page 223).
Fig. 7. Egg of Brill (*see* page 223).
„ 8. Egg of Red Gurnard (*see* page 224).



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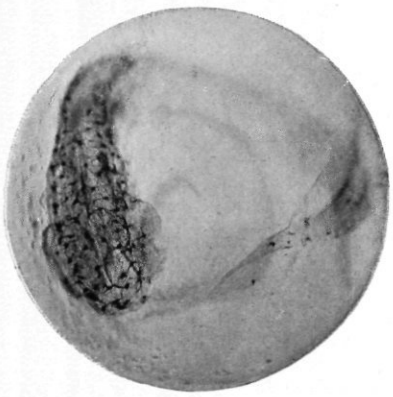

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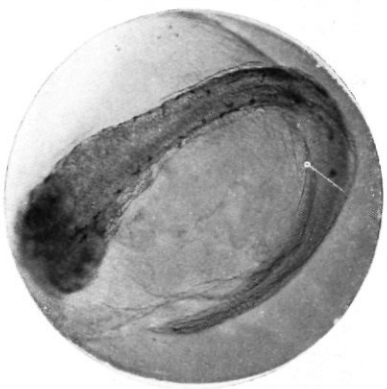

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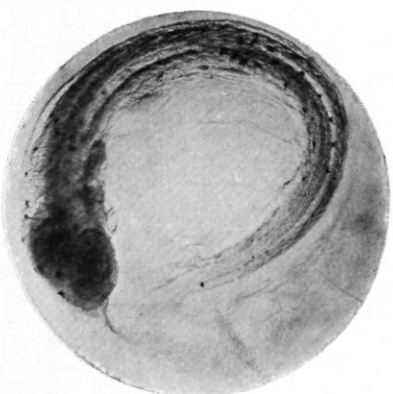

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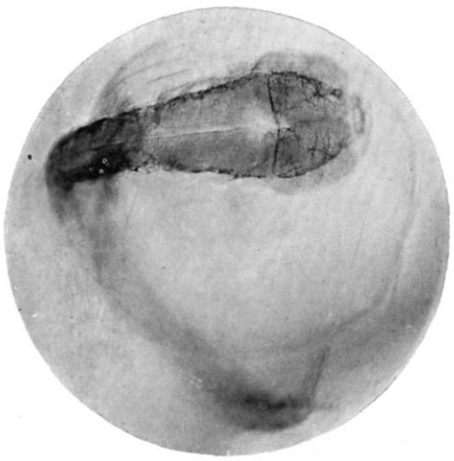
8.

Wollaston Fish Egg Cruise.



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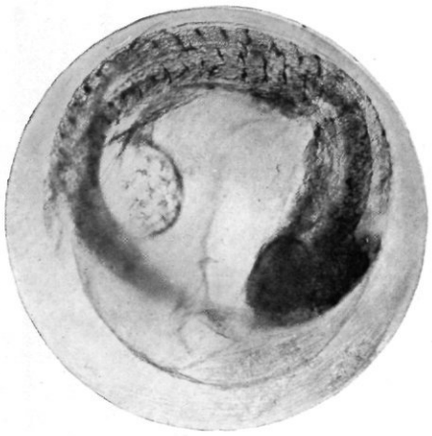

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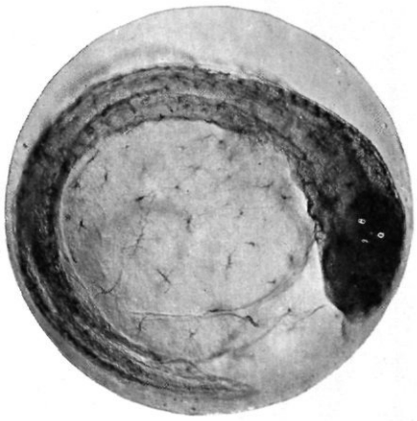

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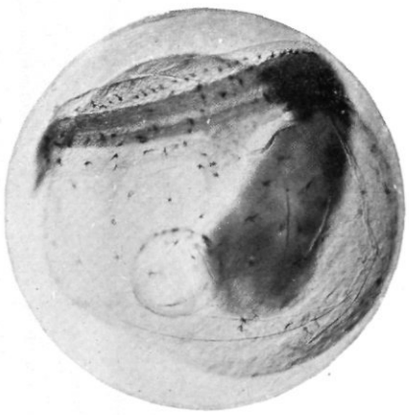

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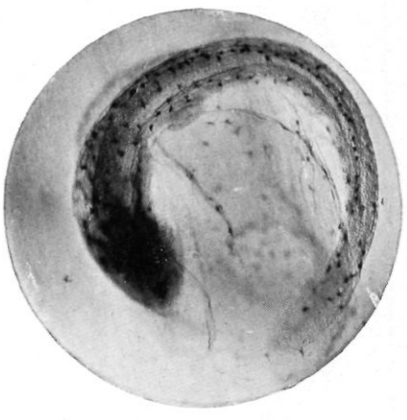

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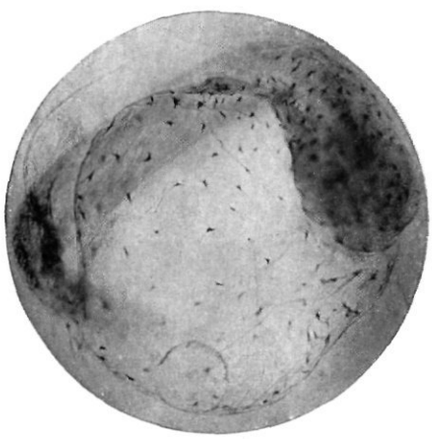

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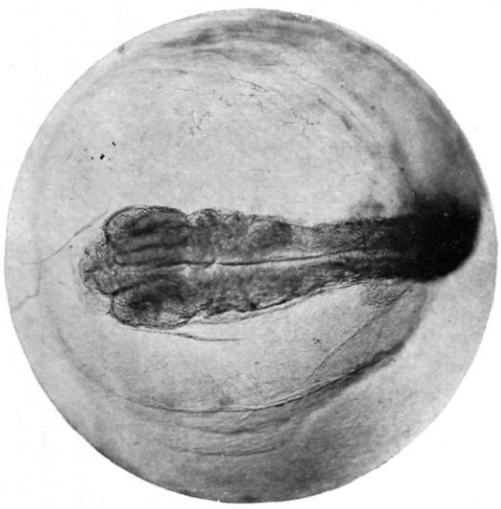

8.

Wollaston Fish Egg Cruise.

REPORT

ON

THE PLANKTON OF THE ENGLISH CHANNEL IN 1906.

BY

W. BYGRAVE, B.A.

With Tables I.–VI., Table A., and Plates I. to III.

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Plate III. Percentages of Oceanic Species, &c.

REPORT

ON

THE PLANKTON OF THE ENGLISH CHANNEL IN 1906.

BY

W. BYGRAVE, B.A.

I.—Introduction and Summary of Results.

During the year 1906 Plankton samples were taken on the four quarterly cruises in the same way as in previous years. Station E 15 off Anvil Point was abandoned, and a new station E 25 was added, the position of this station being 49° 46½′ N., 6° 34′ W.

The complete record of the Plankton taken on these cruises will be found in the Bulletin of the International Council.

In addition to the samples taken on the quarterly cruises, Plankton was taken at regular intervals throughout the year—weekly at Plymouth, and fortnightly at Bahama Bank, Cardigan Bay, Sevenstones, and Varne Light-ships. Fortnightly samples were also taken approximately half-way between Plymouth and the Channel Islands from the S.S. "Devonia" by means of a full-speed townet.

In August. 1906, an experiment was made at station E 17 in order to find whether the Plankton taken by means of a full-speed net differs from that taken at the same time and place by means of an ordinary townet made of the same silk as the full-speed net.

The townet was used in the ordinary way at the station, being towed horizontally at the surface for 10 minutes, and then the full-speed net was towed for one mile whilst the "Huxley" was steaming on a circular course round the station. On examination the composition of the two catches thus obtained was found to be practically identical, though the total volume of Plankton taken by the townet was slightly greater than that taken by the full-speed net.

The general results of the year's work agree very well with those of the three previous years. Thus the percentage of Oceanic species in the Plankton is greatest at the most westerly stations, diminishing fairly regularly as one passes eastwards, and rising again slightly in the Eastern area of the Channel. These percentages have been worked out in the same manner as in 1903–4–5 and are shown on Charts 1–4.

On comparing the salinity of the water with the number of Oceanic species occurring in the Plankton it is found that as a general rule an increase in the salinity is accompanied by a corresponding increase in the number of Oceanic species. This comparison has been made for a period of three years including all the stations in the English Channel, and will be found more fully explained on p. 247 and illustrated by Chart 5.

On studying the distribution of individual species an interesting fact is to be observed in the case of certain Oceanic forms such as *Rhizosolenia alata* and *Metridia lucens*. These forms are usually found only in the extreme west of the English Channel, and do not reach eastward beyond Portland. Although common in both the South-west and North-west, it is noticeable that when they are found well within the mouth of the channel, they keep to the northern shore and are consequently more abundant in the Great West Bay area than in the Channel Islands area. This is in agreement with the fact that Oceanic Water on entering the Channel always keeps nearer to the English than to the French coast, and moreover the general surface drift, which may have some influence on the way in which such forms enter the Channel, is from the South-west.

The Plankton taken in the summer of 1906 was characterised by the presence of vast swarms of Pteropods at certain of the western stations. This is of especial interest as these Pteropods have been identified by Professor Pelseneer as *Limacina lesueuri* (d'Orb), a tropical form usually found in warm water of high salinity.

II.—Changes in the Composition of the Plankton.

On studying the records of the Plankton taken in the English Channel area since 1903, it is found that well-marked changes occur during each year, certain of these bearing a close resemblance to one another in different years ; whilst on the other hand there are well-marked differences to be observed from year to year in the composition of the Plankton taken at the same place and at the same season of the year.

The causes which bring about these changes in the Plankton are, like the changes themselves, partly of an irregular nature, and also such as recur with considerable regularity each year. They include the life histories of the various Plankton animals and plants, and the changes in the environment of these organisms. This influence of the life histories on the changes in the Plankton must, from its nature, be the same from year to year, excepting in so far as it itself may be modified by changes in the external conditions.

As regards the seasonal changes in the composition of the Plankton, their comparative regularity indicates that they are chiefly due to the life histories of the animals and plants as affected by the change of season. The way in which these influences bring about changes in the Diatom Plankton is discussed more fully elsewhere (pp. 240–241).

Unfortunately little is known of the life history of many of the Plankton organisms, but in the case of certain groups of animals the influence of the change of season on the life history is very clearly shown. Thus the Cladocera always make their appearance in the spring, and during the summer play a very important part in the Plankton, disappearing again in the autumn when they form winter eggs, and are thus able to survive the cold season of the year. The Hydro-Medusae also, as a group, are decidedly summer forms, but owing to the different seasonal range of the various species their appearance and disappearance is not so sharply defined as that of the Cladocera. Amongst the Protophyta, *Phaeocystis globosa* has a well-defined period of abundance in the spring, and is usually entirely absent from the Plankton during the remainder of the year.

The changes in the environment of the Plankton organisms are partly regular ones which occur in the same sequence each year, and partly irregular ones due to varying causes. The regular changes are entirely dependent upon the seasonal climatic changes, and include the variations of temperature and intensity of light. These changes affect the composition of the Plankton indirectly by modifying the life histories of the animals and plants.

It is the irregular changes in the composition of the Plankton which are of the greatest interest, and whose study is most likely to be of service to Hydrography. As such changes must have a cause, it is necessary to consider the ways in which they may be brought about. The action of currents and the movements of large volumes of water from place to place must exert an important influence on the Plankton. Thus the composition of the Plankton at any place may be modified in this way firstly by the direct introduction of species brought by the new water, and also by the carrying away of indigenous forms. The latter is possibly not so very important as unless a very rapid change of water takes place, a sufficient number of the native forms will be left to preserve the composition of the Plankton at that place.

Within the area of the English Channel the rate of change of the water is not so very rapid that the character of the Plankton at any place can be very greatly changed by this means alone. In addition to this direct action, currents may modify the Plankton at any place in several more indirect ways.

For example, a change of water will usually mean a change in salinity, and possibly in temperature, thus altering the conditions under which the indigenous species are living.

The changes in the composition of the Plankton may be better understood if we consider the different elements of which the Plankton, found at any particular place, is composed. Then, by studying the causes which are chiefly instrumental in bringing about changes in each of these components, we shall be better able to understand the changes of the composition of the Plankton as a whole.

For this purpose we may roughly divide the Plankton elements at any station into two groups, namely :—

i. Periodic Plankton elements,
ii. Permanent Plankton elements.

The term "Permanent" as applied to any animal or plant occurring in the Plankton is perhaps open to criticism, but at many stations certain species are found to appear with such regularity that there is some justification for the use of this term.

Whenever a Plankton organism is constantly found at any particular place it naturally follows that this place is situated well within the area of distribution of this species. On

the other hand, however, a form may have its centre of distribution at a given place and yet, by reason of its life history, be decidedly periodic in its appearance in the Plankton.

It is obvious that no sharp line can be drawn between these two groups, as any particular form may be a permanent constituent of the Plankton in one part of the English Channel and yet be irregular in its appearance at another. Each of the above-mentioned groups of Plankton elements may be still further divided into Oceanic and Neritic forms. As regards the meaning of the terms Oceanic and Neritic, I agree with the definitions suggested by Gough (Report on the Plankton of the English Channel in 1903), namely, "Neritic Plankton includes all species whose centres of distribution lie in shallow (coastal) waters, the species becoming rarer, and finally dying out as the open ocean is approached. Neritic Plankton can under certain circumstances be carried out into the open ocean, but it cannot propagate indefinitely there, and must eventually die out unless it can reach shallow water again. Oceanic Plankton includes all species usually found in the ocean whether also found in abundance near the coast or not."

In the case of many Neritic species, the reason why they are confined to inshore waters is probably due chiefly to the increase in the depth of the water, and not so much to changes in the salinity. Thus in the case of the Diatoms, many of the Neritic forms are known to form resting spores when the conditions of life become unfavourable. These spores then sink to the bottom of the sea and there await a return of more favourable conditions. On the other hand, none of the Oceanic Diatoms are known to form such spores which would be useless in deep water, where they would sink down far out of reach of the sunlight which is essential for their germination.

In the case of the distribution of Oceanic species, the depth of the water has probably no such significance, though its influence may be felt in another way as suggested by Van Breemen, namely, that some Oceanic species are poisoned by substances present in the water, which have been dissolved out of the sea-bed.

The salinity of the water may have an important influence on the distribution of many Oceanic species, though some forms can endure very great changes in the salinity of the water. Thus *Pleurobrachia pileus* is to be found alike in the open ocean and in brackish estuarine waters. Consequently, the distribution of Oceanic species differs essentially from that of Neritic species, as the range of the former depends largely upon the power possessed by each individual of adapting itself to changes in the composition of the dissolved matter present in the water, whereas in the case of Neritic forms there is the definite factor of depth of water to be considered.

The group of Periodic Oceanic Plankton Elements includes all Oceanic forms which have their centre of distribution outside the area under investigation.

In the group may be placed such species as *Chaetoceras peruvianum*, *Rhizosolenia hebetata*, *Muggiaea atlantica*, *Euchaeta hebes*, and *Limacina retroversa*, forms which are usually only observed in the western part of the English Channel, and which occur with no regularity. The occurrence of these Periodic Oceanic forms in the English Channel is probably greatly influenced by purely Hydrographic causes, such as the Ocean Currents and the inflow of Atlantic water into the Channel, which directly affect the composition of the Plankton by the introduction of new species.

It is to such species therefore that one must look for information which will be of direct assistance in aiding and checking the results of the Hydrographic observations. As a rule these forms appear so rarely, and in such small numbers, that no information of any value can be obtained from a study of their distribution. Occasionally, however, a large shoal of some strange form suddenly makes its appearance and its movements can be clearly traced, thus giving a clue as to the movement of the influx of Oceanic water by which the species was introduced into the Channel.

In the central portion of the English Channel, the number of Periodic Oceanic Species is greater than in the extreme west, as many Oceanic forms which occur with great regularity at the western stations become sporadic in their appearance in the central area, whilst in the eastern part of the Channel the number of Oceanic species is very much reduced and consists chiefly of permanent Oceanic forms.

The group of Permanent Oceanic Plankton Elements is intended to include those forms such as *Pleurobrachia pileus*, which are found with considerable regularity even at the most Neritic stations. Other species belonging to this group are *Calanus finmarchicus*, *Pseudocalanus elongatus*, *Coscinodiscus radiatus*, *Oikopleura dioica*, and *Sagitta bipunctata*.

The group of Periodic Neritic Plankton Elements includes most of the Neritic species found in the English Channel. The periodicity of these Neritic forms is in many cases due to their life history, and in consequence many of them show distinct seasonal variations, as for example the Cladocera and Medusae.

The Neritic Diatoms also show, as a rule, decided periodic changes, the causes of which are discussed below. At some of the stations certain Neritic species are to be found throughout the year, these stations being always well within the area of the Channel (Central and Eastern areas) and near to the coast. Here the changes in the Hydrographic conditions take place more slowly than in the Western areas, thus favouring the growth of a more stable Plankton.

Possibly also the continuous abundance of food material in the water at such stations has an important influence on the growth of the Permanent Neritic Species. Amongst the chief species of this section of the Plankton are *Biddulphia mobiliensis*, *Tintinnopsis beroidea*, *Temora longicornis*, and *Centropages hamatus*.

By considering together these four groups of Plankton Elements we see that the greatest seasonal changes in the Plankton are to be expected in the central portion of the English Channel. Thus the permanent Oceanic and Neritic forms are most abundant in the extreme West and extreme East respectively, whereas the greatest number of periodic forms is to be found in the intermediate areas. In the Eastern areas the least changes are to be observed, whilst it is in the extreme West that the irregular changes are most likely to occur. Consequently it is in this region that the Plankton observations are most likely to be of value in their relation to the Hydrographic work.

III.—The chief Factors which cause the Periodicity of the Plankton Diatoms, and their Influence within the Area of the English Channel.

As pointed out by Gran,* it is apparently a general rule that along the coasts of the North-west of Europe the Plankton Diatoms form two well-defined maxima during the year, the first in March–April, and a second one in September–November. This regular periodicity is brought about by the combined influences of several factors, which from their nature are on the whole fairly constant from year to year. Of such factors probably the most important are the influences of light and temperature, the supply of food material in solution in the water, and the power possessed by certain marine bacteria of decomposing the nitrogen compounds, which form an important constituent of the food of most of the Protophyta.

In the winter, owing to the diminished intensity of the light, the conditions are not favourable for the development of the Diatoms, many of which are then present in the coastal regions in the resting stage as "dauersporen." During this period of rest the food material in the water is steadily accumulating, so that as soon as the conditions of light and temperature become favourable for the germination of the spores a rich Diatom-Plankton comes into existence. As a consequence of this, the supply of food material in the water rapidly becomes exhausted unless it can be constantly replenished, and the competition amongst the Diatoms becomes so severe that many forms are compelled to form spores and await a return of conditions favourable to their growth.

As many of the forms which first appear in the Plankton are northern forms, their disappearance is probably also largely due to the increase in the temperature of the water during the spring. As the maximum abundance of the Peridinidae occurs during the summer months, the Diatoms bave then to endure the competition of these Protophyta which require similar food to themselves. Also at this period of the year when the maximum temperature is reached, the denitrifying bacteria are most active, and they, by decomposing the nitrogen compounds present in the water, still further reduce the supply of food available for the Diatoms as the latter are unable to assimilate the free nitrogen.

Then in the autumn when the Peridinidae are less abundant and the activity of the denitrifying bacteria is diminished owing to the decrease of temperature, the supply of food material again commences to accumulate, and the Diatoms, which have been resting as spores, again appear in the Plankton, forming the second maximum which persists until the diminished intensity of the light causes most of the Diatoms to re-form spores, which lie dormant at the bottom of the sea until the time of the next spring maximum.

Within the area of the English Channel the influence of some of these factors is considerably modified, with the result that the maxima and minima are less sharply defined. For example, there is always sufficient light even through the winter to enable a fairly rich Diatom-Plankton to flourish, this Plankton consisting chiefly of forms such as *Coscinodiscus excentricus*, *radiatus*, and *Grani*, *Biddulphia mobiliensis* and species of Thalassiosira. Probably, however, the chief reason why the maxima and minima are not so sharply marked in the Plankton of the English Channel is that within this area there

* "Das Plankton des Norwegischen Nordmeeres." 1902.

is little possibility of the food supply of the Diatoms becoming exhausted. Thus the area comprises a long and comparatively narrow arm of the sea, no parts of which are very far from land. In consequence of this the water must contain a considerable amount of nitrogenous material resulting from the decomposition products of littoral organisms. Then again the numerous rivers which flow into the English Channel must add considerably to the amount of food-stuff in the water.

Another important fact in this connection is that, over most of the area investigated, the depth of water is so small that the action of the waves is felt at the bottom of the sea, as shown by the presence of sand and mud in the surface waters. In consequence of this the organic matter which is thrown off by the sea bottom is brought up to the surface waters where it can be used as food by the Diatoms. Again, the velocity of the change of water in the English Channel is much less than it would be along a coast directly exposed to the open ocean, and as the main drift of water passes eastwards along the centre of the Channel the water in the bays and along the coasts probably changes very slowly, thus enabling the holo-planktonic forms at any place to persist, and in this way increase the stability of the Plankton at that place.

As a consequence of all this it is found that many species of Diatoms are able to exist throughout the year at places favourable to their development. Thus many Neritic Diatoms are found at certain stations on every quarterly cruise. At those places where Plankton samples are taken at frequent regular intervals, such as at various lightships and at Plymouth, this fact is well shown. Thus at the Varne (and Cardigan Bay) light-stations several Neritic species are to be found at all seasons of the year, *e.g.*, *Rhizosolenia shrubsolei*, *Stroptotheca thamensis*, *Coscinodiscus radiatus*, *Paralia sulcata*.

At places near the open sea, such as Sevenstones, certain, Oceanic Diatoms, such as *Coscinodiscus radiatus* and *Rhizosolenia alata*, are found to be practically permanent forms.

No samples are taken at frequent intervals at any place in the extreme west of the English Channel and far from land, but from the records of the quarterly cruises there appears to be a decided falling off of the Diatoms during the summer. This is possibly due to the fact that in this portion of the Channel the depth of water is greater and the supply of food not so plentiful as further east.

Moreover, it is at the most westerly stations that the Peridinidae are found in the greatest numbers.

It is possible that within the area of the English Channel the temperature plays an important part in determining the character of the Diatom-Plankton. Thus, during the winter, the forms which are most abundant are those whose centre of distribution lies in a more northern latitude, as, for example, various species of Coscinodiscus and Thalassiosira, *Coscinosira polychorda*, *Skeletonema costatum*, *Thalassiothrix nitzschioides*. All of these are included by Cleve in his type of Tricho-Plankton, which is the Plankton characteristic of the Arctic waters.

During the summer the above forms are usually absent from the Plankton, or, if present, are found in very small numbers, and the forms which are then dominant have a more southerly distribution than above, *e.g.*, *Guinardia flaccida*, *Rhizosolenia shrubsolei*, *Rhizosolenia stolterfothii*. These species belong to Cleve's type of Didymus-Plankton, a Neritic type of Styli-Plankton, which is found along the west coasts of Africa and Europe as far north as the Faeroes.

In the extreme west of the Channel the dominant species are *Rhizosolenia alata* and *styliformis*. These forms belong to the type of Oceanic Styli-Plankton of the temperate waters of the Atlantic Ocean.

The second Diatom maximum, which occurs in the autumn, is brought about by the reappearance of many of the winter forms, which are found in the Plankton more or less regularly until the following spring.

IV.—Notes on the Distribution of certain Species.

In the following pages the distribution of some of the more important species occurring in the Plankton will be given in detail. The list is intended to be as far as possible representative of the different Plankton elements, in order that a comparison may be made of the changes shown by these elements during the same period.

The data here given are drawn from the records of the Plankton taken on the four quarterly cruises in 1906, and from Tables I to VI.

In order to facilitate the descriptions of the distribution of the various species as found on the quarterly cruises during 1906, the stations in the English Channel have been divided into the following areas, which are indicated by broken lines on Chart I :—

(1.) *North-west Area*	including	Stations	...	...	1, 6, 7, (25)*
(2.) *South-west Area*	,,	,,	...	...	2, 3, 4, 5
(3.) *Great west Bay Area*	,,	,,	...	...	16, 17, 18, 19, 20
(4.) *Channel Islands Area*	,,	,,	...	...	8, 9, 10
(5.) *Central Area*	,,	,,	...	...	11, 12, 13, 14
(6.) *Eastern Area*	,,	,,	...	...	21, 22, 24

Biddulphia mobiliensis (Bail) was found at Plymouth in 1906 from January to the end of March, occurring in large numbers. A few individuals were observed at intervals during the summer, and from September 7th Biddulphia was continuously present until the end of the year, being common during October, November, and December. At Varne in 1905 it was only absent from the Plankton during June and July, and in 1906 it was not observed on May 23rd, from June 21st to August 4th, and on August 21st. At Cardigan Bay in 1905 it was present throughout the year excepting on July 2nd. At Sevenstones in 1905 it was absent from June 3rd until September 30th, and in 1906 it was absent from May 10th until September 20th.

Biddulphia mobiliensis was observed on each quarterly cruise in 1906. In February it was present at every station, usually in considerable numbers. In May it was not observed in the north-west area, and was rare in the other areas. In August it was observed in small numbers in the Great West Bay, Central, and Eastern areas. In November it occurred in every area, being very abundant in the Great West Bay area.

Biddulphia mobiliensis is a Neritic Diatom and is an important element in the winter Plankton of the Channel.

At the more Neritic stations its period of vegetation is so long that Biddulphia is practically a perennial form at such stations. The records of the quarterly cruises show that its range of distribution extends much further west in winter than during the summer.

Chaetoceras danicum (Cleve) occurred at Plymouth in 1906 on January 1st, during March and April, on July 20th and 27th, and during October, November, and December. At Varne in 1905 it occurred only on October 28th, and in 1906 from July 21st to October 2nd, being common on August 4th. At Cardigan Bay in 1905 it occurred on February 7th, from March 7th to June 4th, on July 17th, August 15th, September 14th and 29th, and on November 12th. At Sevenstones in 1905 it occurred from January 7th to April 20th and from October 30th to December 27th. At Sevenstones in 1906 it was present from January 12th to April 10th, and on September 20th, October 3rd and December 17th.

In February, 1906, *Chaetoceras danicum* was abundant in the Great West Bay area, at E 2 and E 10. In May it was not observed at any station. In August it was abundant in the Great West Bay area, and rare at E 14 and in the eastern area. In November it was common in the Great West Bay area and also present in the North-west and Channel Islands areas.

Chaetoceras danicum is a Neritic species whose centre of distribution lies in the Great West Bay area. It is apparently a winter form in the western part of the Channel, but differs from the preceding species in being a summer form only in the more Neritic eastern portion of the Channel.

Coscinodiscus radiatus (Ehbg.) was generally present in the Plankton taken at Plymouth during 1906, being only absent during May and the first half of September. It was continuously present at Varne in 1905 until June 6th, and again from August 21st until the end of the year. In 1906 it was only absent on July 17th. At Cardigan Bay in 1905 it occurred in every sample. At Sevenstones in 1905 *Coscinodiscus* was absent from June 17th to August 3rd, and in 1906 it was not observed on May 23rd and from July 7th to August 22nd.

In February, 1906, *Coscinodiscus radiatus* occurred in every area, and was common in all areas but the two western ones. In May it was still present in every area but only in small numbers. In August it was absent from the North-west area and was generally rare wherever observed. In November it occurred in every area, being common in the Great West Bay, Central, and Channel Islands areas.

* Station E 25 $\left\{\begin{matrix}49^\circ\ 46\frac{1}{2}'\ \text{N.}\\ 6^\circ\ 34'\ \text{W.}\end{matrix}\right\}$ was worked as an extra station on the quarterly cruises in 1906, but is now one of the regular stations.

Coscinodiscus radiatus is remarkable in its distribution. It is an oceanic species and yet is almost continuously present even at the most neritic stations. Moreover, it is always more abundant in the Central and Eastern parts of the Channel than in the extreme West. Although practically a permanent Plankton element *Coscinodiscus* has a well-marked seasonal variation in abundance, being much more common from October until May, than during the summer.

Guinardia flaccida was observed at Plymouth in 1906 from the beginning of March to October 4th, being very abundant during the first half of June. At Varne in 1905 it occurred at irregular intervals until the end of June, and was then continuously present until the end of the year. During 1906 it was generally present at Varne, but in small numbers. At Cardigan Bay in 1905 *Guinardia* was only absent on January 6th and September 29th, and was very common during July and August. At Sevenstones in 1905 it was only found on July 4th, September 16th and September 30th. In 1906 it occurred at Sevenstones from the end of April to the beginning of October.

In February 1906 *Guinardia flaccida* was found in small numbers in the Eastern, Central, Channel Islands and Great West Bay areas, and also at E 2. In May it occurred in every area, and was common at all stations in the Great West Bay area. In August it was still found in each area, but was rare in the extreme west, being most abundant in the Channel Islands area and station E 12. In November it was not observed in the south-west and eastern areas, and was very rare excepting at station E 13.

Guinardia flaccida is one of the most important neritic summer forms of the Plankton of the Channel, occurring sometimes in great numbers. During the summer it spreads over the whole area of the Channel, including even the most oceanic stations, and thus differing from such neritic winter forms as *Biddulphia mobiliensis*, which retreat eastward during the summer. This spreading is well shown by the dates upon which it occurred at Sevenstones in 1905 and 1906.

Rhizosolenia alata (Btw.) was found at Plymouth in 1906 at intervals during January and February ; it was continuously present from March 17th until September 7th, and also occurred on November 20th and December 22nd. It was never seen at Varne during 1905 and 1906, nor at Cardigan Bay in 1905. At Sevenstones in 1905 it occurred in small numbers during January and February, and was continuously present from June 17th until the end of the year, being very abundant in July. In 1906 it was only absent at Sevenstones on November 19th, and was common from May until September.

Rhizosolenia alata was found in the Great West Bay, Channel Islands, and the two western areas on each cruise in 1906. In February it was common in the Great West Bay and at station E 1. In May it was common in the two western areas and at stations 18 and 20 in the Great West Bay area. A few individuals were also found at station E 21 in the eastern area. In August it was common at all stations in the north-west area. In November *Rhizosolenia* was not common at any station, its maximum abundance being at station E 5.

Rhizosolenia alata is an oceanic species which is very rarely found further east than Portland. In the west of the Channel it is generally present throughout the year, but forms a decided maximum during the summer. When found within the mouth of the Channel, *Rhizosolenia* is more abundant at the northern than at the southern stations.

Rhizosolenia semispina (Hensen) occurred at Plymouth in 1906 almost continuously from the middle of March until the end of September. At Varne it was only observed as very rare on May 23rd, 1906. At Cardigan Bay in 1905 it was present from July 2nd to November 12th, being common in July and August. At Sevenstones in 1905 it was observed at irregular intervals from April to October, and in 1906 was present from February 12th to July 7th, on August 6th, September 20th, and October 3rd, being very common during April and May. In February, 1906, *Rhizosolenia semispina* was present in small numbers at all stations near the coast in the western portion of the Channel. In May it was abundant in the North-West, South-West and Great West Bay areas. In August it was confined to the Great West Bay area, being common at station 18. In November it was common in the South-West area and in rare the Great West Bay area.

Rhizosolenia semispina is an oceanic species and does not penetrate further east than Portland. It attains its maximum abundance at the most oceanic stations in May, but at stations intermediate in character between oceanic and neritic, this maximum is not reached

until August, and at such stations moreover, *Rhizosolenia* has a longer period of vegetation. In 1906 its distribution was remarkable as it remained abundant in the Great West Bay area when it had disappeared from all the stations in the Western area.

Rhizosolenia stolterfothii (Perag.) was almost continuously present at Plymouth in 1906 from the end of March until the end of September, and was also observed during December. During the early part of July, *Rhizosolenia stolterfothii* and *Guinardia flaccida* formed the bulk of the Phytoplankton. In 1905, *Rhizosolenia stolterfothii* was observed in nearly every sample taken at the Varne, and in 1906 it was but little less regular in its appearances. At Cardigan Bay in 1905 it was observed on March 22nd, from June 18th to August 15th, and on December 12th. In 1905 it was only seen at Sevenstones during the latter part of September, and in 1906 was continuously present from April 26th until August 6th. In February, 1906, *Rhizosolenia stolterfothii* occurred in small numbers in the Eastern, Central, and Great West Bay areas. In May it was found in every area and was common at most stations excepting those in the South-West area. In August it was still present in every area but was generally less abundant, being common only in the Channel Islands area. In November it was present in small numbers in all areas but the South-West.

Rhizosolenia stolterfothii is a neritic species and an important element of the summer Plankton of the Channel. Its distribution is almost identical with that of *Guinardia flaccida*, also a neritic summer form, and what has been said of Guinardia will apply equally well to *Rhizosolenia stolterfothii*.

Ceratium tripos (O. F. Müll.) was found at Plymouth, in 1906, in small numbers, on March 29th, April 12th, May 4th, and almost continuously from August 4th until the end of December. At Varne it was not observed during 1905 and 1906. At Cardigan Bay in 1905 it was taken in very small numbers on February 21st, September 1st, and December 12th. At Sevenstones in 1905 it was present until the end of April, and from July 4th until the end of the year, being common during August. In 1906 it occurred at Sevenstones until April 10th, and from May 23rd to December 17th, being common during August and September.

In February, 1906, *Ceratium tripos* was present in small numbers at all stations west of Portland, and also at E 12. In May it had penetrated eastwards as far as station E 24, and was also present in the Great West Bay area and in the extreme west of the Channel. In August it was common at most stations west of Portland, and was also found south of station E 22. In November Ceratium was found in every area, being observed as far east as Dungeness.

Like most of the Peridinidae found in the English Channel, *Ceratium tripos* is an oceanic species which attains its maximum abundance in the summer. As was observed in 1903 (Gough, Report on the Plankton of the English Channel for 1903) this species shows a distinct eastward movement during the year.

Phaeocystis globosa (Scherffel) was observed at Plymouth in 1906 from March 22nd until June 8th, being very abundant during April and May. At Varne it was not observed during 1905, and in 1906 was present from May 9th until June 21st. At Cardigan Bay in 1905 it occurred from June 18th to July 17th. At Sevenstones in 1905 it was present on September 1st, and in 1906 from May 23rd to June 8th. *Phaeocystis globosa* was found in May in large quantities in the Great West Bay and Channel Islands areas, and was also present at stations E 2 and E 14.

Phaeocystis globosa is a neritic species which belongs to the periodic Plankton of the English Channel and Irish Sea. Its absence from certain areas during May is possibly due to the fact that its period of vegetation is comparatively short, and does not occur simultaneously in all parts of the Channel.

Nitzschia closterium and a smaller species of Nitzschia were frequently found associated with Phaeocystis.

Tintinnopsis beroidea (Stein) was observed in every Plankton sample taken at Plymouth in 1906, excepting on January 1st and April 5th. At Varne in 1905 it was present in every sample, and in 1906 was only absent on May 9th, June 21st and September 4th. At Cardigan Bay it was found throughout the year except on June 18th. At Sevenstones in 1905 it was present on April 6th, 20th, May 19th, August 3rd, and from September 1st to the end of the year. At Sevenstones in 1906 it occurred from January 12th to May 23rd, from September 20th to November 3rd, and on December 17th.

Tintinnopsis beroidea was found at every station on the February and November cruises. In May it was found in all areas excepting the Eastern and in August it was present in the Great West Bay, Central and Eastern areas.

Tintinnopsis beroidea is a neritic species which is a permanent constituent of the Plankton of all parts of the Channel excepting the extreme west where it was not observed in August. It is a winter form as shown by the changes in its abundance at different seasons, but it does not show such marked seasonal variations as many of the neritic diatoms.

Centropages hamatus (Lillj.) was observed at Plymouth in 1906 at irregular intervals from May to August. At Varne it occurred continuously throughout 1905 and 1906. At Cardigan Bay in 1905 it occurred on February 7th and 21st, and from March 22nd until the end of the year. At Sevenstones it was not seen at all during 1905 and 1906.

Centropages hamatus was observed on each of the quarterly cruises in 1906. In February it was confined to the Central and Eastern areas. In May it had become much more abundant, and was found in all areas but the South-West. In August it was common in the Eastern, Central, and Great West Bay areas. In November its distribution was similar to that in August, but *Centropages* was then less abundant.

Centropages hamatus is a neritic species, and is a permanent Plankton element in the Eastern area of the Channel. It is most abundant during the summer, and is then found much further west, though it is still most abundant in the Central and Eastern areas.

Centropages typicus (Kröyer) was present at Plymouth in 1906 at frequent intervals until the middle of June, occurring in small numbers. It was then continuously present until December 22nd, attaining its maximum abundance during September and October. At Varne in 1905 it was observed on March 5th, and was present in every sample from the end of April to the end of August. In 1906 it occurred at Varne on January 24th, August 4th and 21st, and October 20th. At Cardigan Bay in 1905 it was present from June 4th until the end of the year, excepting October 30th. At Sevenstones in 1905 it was only absent on February 21st, and was very common during August, September, and October. In 1906 it was generally present at Sevenstones, excepting on February 24th, March 12th, November 19th, and December 2nd, being most common from July until the end of October.

Centropages typicus was taken on each cruise in 1906. In February it was present in small numbers in the South-West, Great West Bay, and Channel Islands areas, and also fairly abundant at station E 1. In May it occurred in small numbers at all stations west of Portland, excepting E 2. In August it was found in all areas but the Eastern, being most common at stations between the Portland–Barfleur and Land's End–Ushant lines. In November it had the same distribution as in August, but was generally less abundant.

Centropages typicus is an oceanic species and a permanent Plankton element in the western half of the English Channel. Its distribution is interesting when compared with that of *Centropages hamatus*, a neritic species whose centre of distribution lies in the Eastern area of the Channel. *Centropages typicus* attains its maximum abundance during September and October, and it is worthy of note that it is generally more abundant at stations just within the mouth of the Channel than at the most westerly stations. The fact of its frequent occurrence at Varne, although it is not observed in the Eastern area of the Channel, may be accounted for by the fact that it is found at many of the stations in the southern part of the North Sea (Belgian area), including B 12,* which lies close to the Varne Bank.

Metridia lucens (Boeck) appeared at Plymouth in 1906 at irregular intervals from January until June. At Varne it was never observed during 1905 and 1906. At Cardigan Bay in 1905 it occurred only on December 12th.

At Sevenstones in 1905 it was present on January 23rd, March 23rd, and from October 30th to December 27th. At Sevenstones in 1906 it was only observed on March 12th, April 10th, October 20th, and November 3rd.

On each quarterly cruises in 1906 *Metridia lucens* was found in both the North-West and South-West areas. In February and May it also occurred in the Great West Bay area.

* B 12 is situated 51° 04′ N., 1° 21′ E.

Metridia lucens is one of the periodic elements of the Plankton of the western part of the Channel. It is an oceanic species whose range is very similar to that of *Rhizosolenia semispina*. Thus both these species are most commonly found in the North-West and South-West areas. When however they are observed further East they are both much more abundant in the Great West Bay area than in the Channel Islands area which adjoins it on the southern side. *Metridia* is irregular in its appearances during different years, but on the whole is most abundant in the spring.

Temora longicornis, (O. F. Müll.) was almost continuously present at Plymouth during 1906, the dates on which it was not observed being January 1st, 26th, February 12th, 16th and March 3rd. At Varne it occurred in every sample taken during 1905 and 1906. At Cardigan Bay in 1905 it was found from the beginning of the year until September 14th, and on October 14th and December 12th. At Sevenstones in 1905 it occurred on March 7th, September 1st, and from September 30th to December 27th. At Sevenstone in 1906 it was present from April 26th until the end of the year.

Temora longicornis was abundant in the Eastern and Central areas in February, 1906, and was also present in the Great West Bay and Channel Islands areas and at E 3. In May it was observed in every area, being rare in the extreme west, and abundant elsewhere. In August it was common in every area excepting the South-West. In November it was absent from the South-West area, and was generally less abundant than in August.

Temora longicornis is one of the most abundant Copepods found in the English Channel. It is a neritic species and appears to be a permanent constituent of the Plankton in all areas but the two western ones. During the summer it is very abundant, and its range of distribution then extends further west than in winter, thus resembling that of *Centropages hamatus*, also a neritic summer form.

Evadne Nordmanni (Lovén) was continuously present at Plymouth in 1906, from March 22nd until the end of September. It was not seen at Varne during 1905 and 1906, nor at Cardigan Bay in 1905. At Sevenstones in 1906 it occurred in small numbers on July 18th, August 3rd, and September 30th. In 1906 it was present at Sevenstones continuously from April 26th to October 3rd.

In February, 1906, *Evadne Nordmanni* was only observed in small numbers at station E 17 in the Great West Bay area. In May it was present in the North-West, Great West Bay and Channel Islands areas, being fairly common at station E 1, and abundant in a sample taken mid-way between stations E 1 and E 2. In August its distribution was very similar to that in May. In November *Evadne* was not observed at any station.

Evadne Nordmanni is one of the periodic neritic species of the Plankton of the English Channel. It is only present during the warmer part of the year and has a limited distribution whose centre lies near station E 1. *Evadne* was generally much less abundant in 1905 than in 1906. This may possibly have some connection with the fact that during the summer of 1905 a patch of high salinity water was present for a considerable time near station E 1.

Oikopleura dioica (Fol) was rarely absent from the Plankton taken at Plymouth during 1906. At Varne it was generally present throughout 1905 and 1906. At Cardigan Bay in 1905 it occurred from February 7th until September 1st, and during November and December. At Sevenstones in 1905 it was observed at intervals from February until July, and then almost continuously until the end of the year. At Sevenstones in 1906 it was present from February 24th until October 20th.

Oikopleura dioica was found in every area, on each of the quarterly cruises in 1906. In February it was most common in the Great West Bay and Channel Islands areas. In May it was most abundant at station E 8 and in the South-West area. In August it was generally more abundant than in May, and was common at stations E 1 and E 24. In November it was found in small numbers at almost every station.

Oikopleura dioica is an oceanic species which is found throughout the year even at many of the most neritic stations. It does not have any well-marked seasonal changes in abundance such as are shown by most of the Plankton organisms.

V.—The Distribution of Oceanic and Neritic Species in the English Channel during 1906.

The distribution of the Oceanic and Neritic species occurring in the Plankton taken on the four quarterly cruises during the year 1906, has been worked out in the same manner as for previous years. Charts 1–4 show the percentage of the number of Oceanic species to the total number of species found at each station, and also the total numbers of both Oceanic and Neritic species at each station. The results obtained in this way agree very well with those of previous years in showing that the greatest percentage of Oceanic species occurs at stations in the extreme west of the Channel, this percentage diminishing fairly regularly towards the east, and rising again in the eastern basin of the Channel. This change in the percentage of Oceanic species is possibly due in part to the decrease in the salinity of the water passing from west to east, but no direct connection can be traced between the changes in this percentage and the changes in salinity from station to station.

One exception to this statement is perhaps worthy of notice. Thus in February, 1906, a sample taken midway between stations E 12* and E 13 contained 50 per cent. of Oceanic species, whilst at stations 12 and 13 the percentages were respectively 35 and 20. This seems to have some significance, as the hydrographic observations showed that a narrow strip of water of high salinity (35·34 per thousand) was present midway between stations 12 and 13, whereas at the stations themselves the salinity was E. 12, 35·01 ; E. 13, 34·81 per thousand.

It will be observed that the percentages at any station vary during the year, but these variations may be brought about by the combined influence of many causes including others as well as hydrographic ones. Thus the seasonal variations shown by the Plankton diatoms will have the effect of disturbing these percentages, especially as most of the diatoms found in the English Channel are neritic species. For example the high percentage of Oceanic species usually found at the most westerly stations and especially in August, is largely due to the absence of neritic diatoms at these stations. Also the occurrence at many stations of neritic summer forms such as the Hydromedusae, and the Cladocera has the effect of modifying the percentage of Oceanic species.

An attempt to establish a direct connection between changes in the hydrographic conditions and the varying percentages of Oceanic species, by comparing the conditions at corresponding seasons of different years, has also proved fruitless. As the Oceanic species in general have much less clearly marked seasonal variations than the neritic species, it is probably a better plan to consider only the actual numbers of Oceanic forms and not percentages, as in this way the influence of the seasonal changes in the Neritic Plankton elements may be eliminated. On doing this it is found that the number of Oceanic species at any station generally increases as the salinity of the water at that station rises. If the average number of Oceanic species and the average salinity of the water per station be compared, it is found that the fluctuations of the two averages generally agree very well with one another. These averages have been calculated for all cruises during 1904, 1905, and 1906, and will be found plotted in Chart 5. The dotted line indicates the variations of the average salinity, at intervals of three months during the three years, and the continuous line indicates the corresponding variations in the average number of Oceanic species per station. In calculating these averages the salinities at each station worked have been added together, and the sum divided by the number of stations.

The same method was also adopted in calculating the average number of Oceanic species. As all the 22 stations were not worked on every cruise this method is not strictly accurate but the error thus introduced is very small and not likely to affect the general agreement of the curves, for out of 22 stations, only 2 were omitted in February, 1904, one in November, 1904, and 3 in November, 1906. The scale according to which the two curves are drawn is so arranged that each has approximately the same maximum variation.

It will be seen that the curves are in least agreement during the latter part of 1905, when the number of Oceanic species was lower in comparison with the salinity than at any other period of the three years. This may perhaps be explained as follows.† In the early part of 1905 there was an inflow into the Channel from the west of water of comparatively high salinity (35·5 per thousand). During the remainder of 1905 this

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* The positions of these stations are :—E 12, 49° 55′ N., 1° 09′ W.; E 13, 50° 20′ N., 1° 15 W.

† *See* Matthews' "Report on the Physical Conditions of the English Channel in 1904 and 1905."

water was present in the western part of the Channel as a large isolated patch, which was still of high saliinity (35·4 per thousand). In February this patch of water was disturbed by a fresh inflow of Atlantic water and was driven eastwards out of the Channel.

As Gough has suggested, when water of high salinity remains long over a shallow bottom, the number of Oceanic species present in this water will decrease, even though the salinity of the water may change very little. Consequently it seems not improbable that the unusual Hydrographic conditions were chiefly responsible for the high salinity and small number of Oceanic species during the latter part of 1905.

It may also be observed that the minima of both curves occur in August each year and that there is a decided rise between August and November. It is during this period of the year that the inflow of Atlantic water into the English Channel reaches its maximum, and also the surface drift from the South-west is then greatest, owing to the prevalent south-westerly autumnal gales.

It will be observed that as in previous years the number of Oceanic Species found at the most westerly stations is almost always less than at the stations just within the mouth of the Channel, and that the actual number of Oceanic species found at each station bears no constant relation to the salinity of the water. This agrees with what Ostenfeldt has pointed out, namely that many oceanic species seem to thrive best at places near to land. As in 1904 and 1905, the largest total number of species was usually found at stations where a considerable mixing of waters of different origin takes places, such stations being situated near Start Point, Ushant, and Land's End. Similarly the smallest number of species was always found in the Eastern and Central Areas, and also at the most westerly stations where such mixing is very slight.

VI.—Plankton taken at Plymouth in 1906, and at various Light-Stations in 1905 and 1906.

The Plankton taken at Plymouth during the year 1906 will be found recorded in Table I. The samples were taken under exactly the same conditions as during the two previous years, in order that the results of the three years may be comparable with one another. Tables II. to VI. contain the records of the fortnightly samples of Plankton taken at the Varne and Sevenstones Light-ships during 1905 and 1906, and at Cardigan Bay Light-ship in 1905. As these stations are situated well apart from one another, and as the conditions of life for the Plankton are likely to differ considerably at the various stations owing to their different geographical positions, a comparison of the Plankton taken at each place may be of interest.

The Varne Light-vessel is situated in the middle of the Straits of Dover and is far removed from the direct influence of Atlantic water. It lies in the path of the water passing out from the English Channel into the North Sea, and the water in its vicinity always contains large quantities of chalk in suspension.

Cardigan Bay Light-vessel lies in the middle of Cardigan Bay, and like the Varne, is well removed from any direct influence of Oceanic water.

Sevenstones Light-ship lies in close proximity to land (between the Scilly Islands and the mainland) but is much nearer to the open Atlantic than any of the other stations. The currents and tides run very strongly here, and there is probably a considerable mixing of Oceanic and inshore waters.

Plymouth may be regarded as intermediate in character between Sevenstones and the two other stations. It lies open to the south-west and is thus in the line of the prevalent surface drift from the south-west of the English Channel. Moreover, the water there probably contains a large amount of organic matter in solution.

On calculating the average percentage of Oceanic species at these stations we find that the numbers are :—Sevenstones, 55 per cent. ; Plymouth, 44 per cent. ; Cardigan Bay, 37 per cent. ; Varne, 36 per cent., thus agreeing with the relative proximity of the stations to the open sea.

If we consider the number of species present in the Plankton, we find that the number of Oceanic forms is always more constant than that of neritic forms, even at Sevenstones where the greatest variation of Oceanic species might be expected. Moreover, the variations in the number of Oceanic species are more irregular than those of the neritic species and show no seasonal periodicity, whereas the number of neritic species has in all cases a fairly distinct minimum in the summer, and a smaller one in the winter.

The greatest variation in the number of Oceanic species is found at Sevenstones, whilst the number is most constant at Varne, the order of the stations being—Sevenstones, Plymouth, Cardigan Bay, Varne.

The variation in the number of neritic species is practically equal at Sevenstones, Varne and Plymouth, but is considerably less at Cardigan Bay. The fact of this variation being so much greater at Varne than at Cardigan Bay is possibly due to the fact that there is a considerable flow of water through the Straits of Dover and that the entire Plankton may be continually being replaced, whereas at Cardigan Bay it is possible for the local forms to persist, and thus preserve the character of the Plankton.

The number of neritic species was never less than 22 in any sample taken at Cardigan Bay, whereas this minimum was 14 at Plymouth, 9 at Varne, and 5 at Sevenstones. The Plankton taken at Cardigan Bay was remarkable on account of the very few species of Hydromedusae found in it. The average volume of the Plankton was always much less at the Varne than at the other stations, being greatest at Plymouth, and at these three latter places the bulk of the Plankton was often very great owing to the presence of dense swarms of Copepods, a state of affairs which is very seldom met with at the eastern end of the English Channel (approximately equal at Cardigan Bay and Sevenstones).

VII.—The Occurrence of *Limacina retroversa* (Fleming) and *Limacina lesueuri* (d'Orb) in the English Channel during 1905 and 1906.

As recorded in the "Report on the Plankton of the English Channel in 1904 and 1905" (Gough), *Limacina retroversa* (Fleming) was first observed in the Channel in August, 1905, when it was present in large numbers in the South-West area, and more sparingly in the North-West and Great West Bay areas. In November, 1905, it was still abundant in the west and south-west of the Channel, and was rare in the Great West Bay and Channel Islands areas. In February, 1906, it was only observed in very small numbers at stations E 1 (50° 02′ N., 4° 22′ W.). In May, 1906, small numbers of Limacina were found at all stations west of Start Point, and a sample taken mid-way between stations E 4 (48° 27′ N., 6° 35′ W.) and E 5 (49° 06′ N., 6° 32′ W.) contained a considerable number of Spiralis larvae. In August, 1906, a considerable number of young Limacinae were present at every station in the North-West area, and at stations E 2 (49° 27′ N., 4° 42′ W.) and E 6 (50° 24′ N., 6° 05′ W.) enormous shoals of these young Pteropods were found in the surface waters. In November, 1906, Limacina was found at all stations west of Portland, usually in small numbers, but moderately numerous at station E 1.

The young Pteropods which appeared in such large numbers in August, 1906, were identified by me as *Limacina retroversa* (Flem.), but Professor Pelseneer is of the opinion that they belong to a different species, *Limacina lesueuri* (d'Orb), a form which has not been found north of the Bay of Biscay, whereas the Pteropods found from August, 1905, to February, 1906, are certainly *Limacina retroversa* (Flem.). In consequence of this it will be necessary to re-examine all the Pteropods found during 1906, from May until the end of the year, as possibly some of the individuals found during this part of the year may be remnants of the shoal which appeared in 1905. As there is not time for such examination before the publication of this report, it is my intention to deal with the distribution of the two species of Limacina, during the years 1905 and 1906, in a separate paper.

All that can be said at present is that a shoal of *Limacina retroversa* entered the English Channel in 1905, between May and August, and that its distribution in August appears to indicate that it came from the south-west, passing close to Ushant. After passing station E 2 it spread out on both sides, part going eastwards into the Great West Bay area, and the other branch rounding Land's End and entering the Bristol Channel. In November, 1905, the denser part of the shoal had moved further north, reaching station E I, the north-west branch had disappeared, and the eastern branch had extended into the Channel Islands area. In February, 1906, the shoal had almost entirely disappeared. In May the new shoal of *Limacina lesueuri* made its appearance, probably entering the Channel from the south-west. It was then carried northwards in a similar manner to the 1905 shoal of *Limacina retroversa* and spread out over the north-western part of the Channel. In November, 1906, the boundary of the shoal had spread out so as to include all stations west of Portland, but the number of individuals had very greatly decreased.

The records of the Plankton taken during 1905 and 1906 at Plymouth and at Sevenstones Lightship show clearly when the two shoals of Limacina reached these stations. At Plymouth, Limacina was first observed in 1905, at the beginning of September, and was continuously present until the end of the year. During the early part of 1906 no Pteropods were found at Plymouth, but at the end of June Limacina again appeared, and was continuously observed until the beginning of November. At Sevenstones in 1905, Limacina was present from the end of August until the end of October ; it was also observed in 1906 on May 10th, and from July 23rd until November 3rd.

VIII.—Notes on a Series of Plankton Samples taken in August, 1906.

In August, 1906, a series of Plankton samples were taken at 47° 48′ N., 7° 24·8′ W., and 48° 7′ N., 8° 13′ W. A list of the species occurring in these samples will be found in Table A, from which, however, all larval forms have been omitted. Of the 53 species present in this list only three are neritic forms namely *Coscinodiscus excentricus*, *Gonyaulax polygramma*, and *Trochiscia Clevei*, all the Metazoa being Oceanic forms.

Thus the percentage of Oceanic species is 94 as compared with 90 per cent. at station E 4 earlier in the same month (Chart 3).

The list of species is remarkable on account of the few species of diatoms, the only forms which occurred in any abundance being *Rhizosolenia alata* and *Rhizosolenia styliformis*. The Plankton contained several species which had not previously been found at any of the regular stations in the English Channel, namely *Collozum sp.*, *Tintinnus inquilinus*, *Aetidius armatus*, *Sagitta furcata*, *Cymbulia peronii*, *Dexiobranchea ciliata*.

On August 24th a single sample was taken at 47° 35·6′ N., 7° 30′ W., just on the edge of the La Chapelle Bank, by letting down a tow-net to a depth of 750 metres, and towing it horizontally at this depth for one mile. This sample has not yet been fully examined, but several interesting species have already been found in it, *e.g.* *Copepoda*, *Euchirella curticauda* (Giesbr), *Gaetanus longispinus* (Wolfenden), *Lucicutia atlantica* (Wolfenden). *Lucicutia flavicornis* (Claus), *Oncaea venusta* (Philippi), *Pleuromamma robusta* (Dahl).

Schizopoda, *Boreomysis arctica* (Kröyer), *Gnathophausia Zoaea* (Suhm), *Nematoscelis megalops* (G. O. Sars).

TABLE A.—August, 1906.

Species Number.	—	Aug. 23 47° 48′ N. 7° 24·8′ W.			Aug. 25 48° 7′ N. 8° 13′ W.		Species Number.	—	Aug. 23 47° 48′ N. 7° 24·8 W.			Aug. 25 48° 7′ N. 8° 13′ W.	
		247—Om.	Om.	Om.	Om.	Om.			247—Om.	Om.	Om.	Om.	Om.
	Diatomaceae.							**Copepoda.**					
1	Chaetoceras peruvianum	...	...	...	...	rr	24	Acartia Clausi	rr	...	...	rr	rr
2	Coscinodiscus excentricus	...	...	...	...	rr	25	Aetidius armatus	rr	...	...	...	...
3	Fragilaria oceanica	...	...	...	rr	...	26	Anomalocera Pattersoni	rr	...	rr	...	rr
4	Rhizosolenia alata	r	c	+	c	r	27	Calanus finmarchicus	cc	rr	+	...	rr
5	— semispina	...	...	...	rr	rr	28	Candacia pectinata	r	...	...	...	...
6	— styliformis	+	...	rr	...	r	29	Centropages typicus	+	r	+	+	cc
							30	Clausocalanus arcuicornis	rr	...	rr	rr	r
							31	Corycaeus anglicus	...	rr	...	...	...
	Peridiniales.						32	Ctenocalanus vanus	r	...	...	...	rr
							33	Euchaeta hebes	rr	...	...	...	...
7	Ceratium bucephalum	...	...	...	r	...	34	Metridia lucens	c	...	r	...	rr
8	— furca	...	rr	...	r	...	35	Microsetella atlantica	...	...	...	rr	...
9	— fusus	...	...	...	r	...	36	Monstrilla sp.	rr	...	...	...	...
10	— longipes	rr	...	rr	...		37	Oithona similis	rr	c	r	c	...
11	— macroceras	...	...	...	r	...	38	— plumifera	+	...	rr	rr	...
12	— tripos	...	+	rr	c	...	39	Oncaea mediterranea	rr	...	...	...	...
13	Dinophysis acuta	rr	rr	rr	rr	...	40	Paracalanus parvus	+	+	c	c	+
14	Diplopsalis lenticula	...	r	...	...	...	41	Pseudocalanus elongatus	cc	rr	+	c	c
15	Gonyaulaux polygramma	...	rr	...	...	...	42	Rhincalanus nasutus	r	...	...	...	...
16	Peridinium divergens	...	...	...	rr	...							
	Protophyta Cetera.							**Metazoa cetera.**					
17	Halosphaera viridis	rr	+	...	+	...	43	Beroe ovata	rr	...	..	...	...
18	Trochiscia Clevei	...	...	..	r	...	44	Sagitta bipunctata	c	...	r	...	...
							45	— furcata	rr	...	...	...	...
							46	Tomopteris helgolandica	rr	..	rr	...	...
	Protozoa.						47	Apherusa Clevei	rr	...	...	...	...
							48	Euthemisto gracilipes	+	...	...	...	...
19	Collozoum sp.	...	...	...	r	c	49	Nyctiphanes Couchi	rr	...	rr	...	...
20	Dictyocysta templum	...	...	...	r	...	50	Cymbulia Peronii	rr	...	rr	...	...
21	Lithomelissa sp.	...	rr	...	...	...	51	Dexiobranchea ciliata	+	...	...	..	...
22	Tintinnus acuminatus	...	...	...	rr	...	52	Limacina retroversa	r	r	rr	...	...
23	— inquilinus ?	...	...	...	r	...	53	Oikopleura dioica	...	rr	rr	rr	...

TABLE I.

West Channel, Plymouth, 1906.

	January.				February.				March.				April.				May.				
	1	4	10	26	2	12	16	24	3	17	22	29	5	12	20	27	4	9	17	25	
Diatomaceae.																					
Actinoptychus undulatus ...	r	r	r	r	r	r	r	rr	rr	r	rr	...	...	...	...	...	..	...	...	...	1
Asterionella japonica ...	rr	...	rr	...	...	rr	...	...	...	...	rr	rr	c	r	r	...	...	...	...	rr	2
Bacillaria paradoxa ...	+	+	c	c	r	+	+	+	+	r	rr	rr	...	...	...	...	...	..	...	...	3
Bellerochea malleus ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4
Biddulphia alternans ...	rr	rr	r	r	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5
— granulata ...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	6
— mobiliensis ...	+	+	c	c	c	+	c	c	c	c	c	+	...	r	...	...	...	...	...	rr	7
Cerataulina Bergonii ...	...	...	...	...	...	...	...	...	...	...	...	rr	r	r	...	...	...	...	...	...	8
Chaetoceras boreale ...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	r	r	...	...	...	...	9
— constrictum ...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	r	...	...	...	...	...	10
— contortum ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11
— crinitum ...	...	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	12
— curvisetum ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	13
— danicum ...	r	...	...	...	...	...	...	...	rr	r	...	r	r	r	rr	rr	...	...	...	...	14
— debile ...	...	...	...	...	...	...	...	rr	r	r	+	+	+	r	rr	r	r	rr	r	r	15
— decipiens ...	...	...	rr	...	...	rr	rr	...	r	r	rr	+	r	rr	...	rr	rr	...	...	...	16
— densum ...	...	...	...	...	...	...	...	...	...	...	rr	+	r	+	r	r	r	rr	rr	...	17
— diadema ...	...	...	...	...	...	...	...	...	rr	r	r	...	...	...	...	...	...	...	...	...	18
— didymum ...	...	...	...	...	...	...	...	...	...	...	+	...	r	r	r	...	...	...	...	...	19
— laciniosum ...	...	...	...	...	...	...	...	...	...	...	r	r	+	r	r	rr	...	...	...	...	20
— Schüttii ...	...	...	rr	...	...	...	...	...	...	...	...	rr	r	rr	rr	rr	...	...	rr	...	21
— sociale ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22
— teres ...	...	...	...	...	..	...	...	...	...	...	rr	rr	r	r	r	...	...	...	...	...	23
— Willei ...	...	...	...	...	...	rr	...	...	...	...	...	rr	r	rr	rr	...	rr	...	...	...	24
Corethron hystrix ...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	25
Coscinodiscus concinnus ...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	26
— excentricus ...	r	+	c	c	c	c	c	c	c	c	c	c	r	r	rr	...	rr	...	...	...	27
— Grani ...	...	...	rr	r	r	...	rr	rr	+	r	r	rr	...	...	...	...	...	...	...	...	28
— oculus iridis ...	rr	...	r	rr	+	r	rr	rr	r	...	...	rr	rr	..	rr	...	rr	rr	..	...	29
— radiatus ...	rr	rr	+	+	c	c	c	+	c	c	c	c	+	r	rr	rr	...	...	...	...	30
Ditylium Brightwellii ...	...	...	...	...	...	...	...	...	...	rr	...	rr	+	r	...	...	...	...	...	...	31
Eucampia zoodiacus ...	...	...	...	...	...	...	...	...	rr	...	...	rr	r	r	rr	rr	rr	...	...	...	32
Fragilaria oceanica ...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33
Guinardia flaccida ...	...	...	...	...	...	...	...	...	r	r	r	+	+	c	c	+	+	+	c	c	34
Hyalodiscus stelliger ...	r	+	c	c	c	c	c	c	+	+	r	rr	...	...	...	...	rr	...	...	...	35
Isthmia enervis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	36
Lauderia borealis ...	...	...	...	rr	...	r	r	r	r	+	c	cc	c	+	rr	rr	...	...	...	...	37
Leptocylindrus danicus ...	...	...	...	...	...	...	...	..	...	...	...	rr	...	rr	...	rr	...	...	..	...	38
Lithodesmium undulatum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39
Melosira sp.	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...	...	...	...	...	40
Navicula membranacea ...	...	...	...	...	...	...	...	...	...	...	..	...	rr	rr	rr	rr	...	rr	rr	rr	41
— vanhoffeni ...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	42
Nitzschia closterium ...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...	43
— seriata ...	rr	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	44
Paralia sulcata	r	+	c	c	c	c	+	r	r	r	r	rr	...	rr	...	rr	...	rr	...	rr	45
Pleurosigma sp.	rr	rr	rr	rr	rr	r	r	rr	...	...	...	rr	...	rr	rr	...	rr	...	...	...	46
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16	...	...	...	...	...	...	...	...	...	...	...	...	r	rr	r	rr	rr	r	...	rr	rr	...	...	rr	...	rr	r	...	...	rr	rr
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18	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...
19	...	...	...	...	...	...	...	...	..	...	...	rr	...	...	rr	rr	rr	rr	...	rr	...	rr	...	...	...	r	r	rr	...	rr	...
20	rr	r	rr	...	...	...	...	rr	rr	...	r	rr	...	rr	+	r	+	r	...	...	...	...	...	rr	...	rr	rr	...	...	..	...
21	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	rr	...	...	...	...
22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
23	...	rr	...	..	r	...	...	r	r	rr	rr	rr	...	...	r	...	r	r	..	rr	...	...	...	rr	...	...	...	...	...	...	...
24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	rr	rr	...	...	rr	rr	rr	...	...	...	...	...	...	...	...
26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...
27	rr	...	...	rr	rr	rr	...	rr	...	rr	...	...	...	...	...	rr	rr	rr	rr	rr	r	r	+	+	+	+	+	c	+	c	c
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	rr	...	...	r	rr	rr	r	rr	r	rr	...	rr
29	...	...	...	...	...	rr	...	...	...	rr	...	...	rr	...	rr	rr	r	rr	r	r	rr	rr	rr	rr	...	r	r	r	rr	rr	rr
30	..	rr	rr	r	rr	r	r	+	rr	...	rr	r	rr	...	..	...	rr	r	...	rr	rr	r	+	c	+	+	c	c	+	+	r
31	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	c	r	+	c	r	r	r	rr	rr	r	r	r	r	r	rr	r	r
32	rr	rr	...	...	...	...	...	...	...	...	...	...	...	rr	+	+	rr	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...
33	...	...	...	rr	...	...	...	...	..	rr	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
34	cc	cc	+	r	c	rr	rr	rr	rr	rr	...	rr	r	r	+	r	...	r	rr	...	...	...	...	...	...	...	...	...	...	...	...
35	...	...	...	rr	rr	rr	rr	rr	rr	r	...	rr	rr	...	rr	rr	rr	...	r	rr	rr	r	rr	rr	r	+	+	r	r	r	r
36	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
37	...	...	...	rr	...	...	...	rr	...	...	...	r	rr	...	rr	rr	...	rr	rr	...	...	..	...	...	rr	...	...	...	...	...	...
38	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	r	...	...	...	...	...	...	...	...	...	..	...	...	..
39	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	rr	...	...	rr	...	rr	...	...	...
40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	rr	...	rr	rr	rr	...	...	...	rr
41	rr	r	rr	...	rr	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	..
42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...	...	...	...	...	...
43	...	...	...	...	...	...	...	...	rr	...	...	r	...	r	rr	rr	...	...	rr	...	...	...	...	rr	rr	rr	...	...	...	rr	...
44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	c	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr
45	rr	...	rr	rr	rr	rr	r	rr	r	r	...	rr	rr	rr	...	rr	rr	rr	+	r	r	r	r	+	r	+	r	r	rr	rr	rr
46	rr	rr	...	...	rr	rr	rr	rr	rr	rr	rr	r	rr	rr	...	rr	rr	rr	rr	...	rr	rr	rr	rr	rr	rr	rr	...	rr	rr	r
47	...	...	...	...	...	...	rr	rr	...	rr	rr	rr	rr	rr	rr	rr	rr	rr	r	rr	rr	r	rr	...	rr	rr	rr	rr	...	rr	rr
48	r	c	r	+	c	r	r	+	rr	r	r	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...
49	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
50	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..
51	rr	rr	+	rr	+	...	...	...	rr	r	r	rr	...	...	rr	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...
52	...	...	...	...	...	...	...	+	r	rr	r	rr	rr	r	+	+	r	+	r	c	r	r	r	+	+	+	+	+	+	r	r
53	rr	+	r	...	rr	...	rr	...	...	...	rr	...	rr	rr	r	r	r	r	rr	rr	rr	rr	...	rr	rr	...	...	rr	...	...	...
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56	...	...	...	...	...	...	...	+	+	r	rr	c	c	c	+	c	rr	r	rr	c	rr	r	rr	+	r	+	r	rr	r	+	+
57	...	...	r	rr	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	+	+	c	+	+	+	+	+	+	r	r	r
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65	r	r	rr	+	+	...	...	r	...	rr	rr	rr	rr	rr	rr	rr	r	r	r	r	rr	r	r	+	r	+	r	r	r	r	r
66	...	...	...	...	...	...	...	...	...	r	r	rr	rr	rr	rr	...	rr	...	...	rr	rr	rr	rr	rr	rr	rr	rr	rr	...	r	rr
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76	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
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	June.					July.				August.				September.					October.				November.					December.			
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1	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	..
2	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
3	rr	r	rr	rr	rr	r	r	rr	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	r	r	+	+	r	r	...	r	r	...	rr	rr	r	rr	r	r	rr	r	...	rr	...	r	...	rr	...	rr	r	rr	...	rr	rr
5	...	...	...	rr	...	...	...	...	...	...	...	...	..	...	...	...	...	...	.	rr	...	...	rr	...	...	...	...	...	...	...	...
6	rr	rr	+	r	+	+	+	r	...	rr	rr	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	rr	...	...	...	...	...
7	...	...	rr	...	rr	...	rr	...	rr	rr	...	rr	rr	rr	rr	r	rr	rr	rr	r	...	...	...	...	...	...	...	...	...	...	...
8	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	..	...	...	...
9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	...	...	...	...	...	rr	...	...	...	...	...	rr	rr
10	...	...	...	..	..	...	...	...	...	...	...	rr	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	..	...
11	r	rr	rr	r	r	rr	...	rr	rr	r	r	rr	r	r	...	rr	rr	rr	r	rr	r	r	r	r	r	r	r	rr	r	rr	rr
12	r	rr	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...
13	...	...	...	...	...	...	...	..	...	...	rr	...	...	...	...	...	...	rr	...	rr	...	...	...	rr	...	...	rr	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
16	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...
17	...	...	..	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...
19	r	+	+	rr	+	rr	rr	r	r	+	r	+	+	r	r	+	+	c	+	+	r	+	c	+	+	c	+	r	r	rr	+
20	...	...	...	...	...	...	...	r	rr	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...
21	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...
22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	c	+	+	...	rr	..	...	rr	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	...	rr	...	...	rr	rr	...	...	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
26	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
29	...	...	...	...	r r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...
33	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
34	...	...	...	...	...	...	...	...	rr	...	r	...	rr	...	rr	r	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...
35	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
36	+	c	c	...	r	...	r	r	...	rr	r	r	rr	rr	...	r	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
37	+	cc	c	rr	+	r	+	rr	rr	r	r	+	r	rr	rr	c	...	c	r	r	r	...	+	r	rr	rr	...	rr	rr	...	...
38	rr	rr	r	...	rr	rr	r	rr	rr	r	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	rr	...	...	...	...	...
39	rr	r	rr	...	r	rr	rr	rr	rr	rr	rr	...	...	...	...	...	...	rr	...	r	rr	...	r	...	rr	r	...	...	...	rr	...
40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
42	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
43	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
44	...	...	...	...	cc	...	..	...	...	rr	rr	...	...	rr	rr	rr	rr	...	rr	rr	rr	...	...	...	...	c	rr	...	...	...	...
45	rr	r	c	...	r	rr	rr	c	rr	r	rr	r	r	rr	rr	rr	rr	rr	r	r	c	r	c	c	c	c	+	+	c	+	r
46	...	...	...	...	r	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	rr	rr	...	...
47	rr	rr	rr	...	rr	r	rr	rr	rr	r	rr	rr	rr	rr	rr	r	r	rr	rr	c	r	rr	rr	r	rr	r	r	rr	...	rr	rr
48	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	rr	...	...	...	rr
49	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
50	r	...	...	rr	+	rr	rr	r	rr	rr	...	...	...	...	...	rr	rr	rr	...	+	...	...	+	+	r	c	+	+	r	rr	rr

TABLE I—*continued.*

WEST CHANNEL, PLYMOUTH, 1906—*continued.*

	January.				February.				March.				April.				May.				
	1	4	10	26	2	12	16	24	3	17	22	29	5	12	20	27	4	9	17	25	
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Acartia Clausi	r	rr	+	+	c	c	r	+	+	c	c	c	c	+	+	+	r	r	+	+	1
— discaudata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Calanus finmarchicus	rr	r	r	r	r	r	rr	r	r	r	r	+	+	r	rr	r	r	r	r	+	3
Caligus rapax	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4
Candacia pectinata	...	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	5
Centropages hamatus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	6
— typicus	r	r	rr	r	...	...	rr	rr	...	...	...	r	r	r	...	rr	...	...	...	rr	7
Clytemnestra rostrata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8
Corycaeus anglicus	c	+	+	+	r	+	+	r	+	r	...	r	...	r	rr	rr	rr	rr	...	rr	9
Euterpe acutifrons	...	...	...	rr	r	r	...	...	...	...	...	...	...	...	...	rr	rr	...	...	rr	10
Harpacticus chelifer	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	11
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— similis	...	...	...	...	rr	r	r	r	+	+	+	rr	r	r	+	r	r	rr	rr	rr	20
Paracalanus parvus	rr	rr	rr	rr	rr	rr	r	r	r	r	r	r	r	r	r	r	r	r	rr	...	21
Parapontella brevicornis ...	...	...	...	...	rr	r	r	r	rr	r	+	r	r	r	r	...	rr	rr	...	rr	22
Pseudocalanus elongatus ...	+	+	+	+	c	c	c	c	c	c	cc	cc	cc	cc	c	c	+	+	+	+	23
Temora longicornis	...	rr	r	...	rr	..	...	rr	...	r	r	+	+	r	+	+	r	+	+	c	24
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WEST CHANNEL, PLYMOUTH, 1906—*continued.*

	June.					July.				August.				September.					October.				November.					December.			
	1	8	15	22	29	9	13	20	27	4	10	17	24	1	7	14	24	28	4	11	18	26	5	10	20	24	30	8	15	22	29
1	c	c	+	c	c	+	+	+	r	+	r	+	+	r	r	+	r	r	+	+	c	r	+	c	+	+	+	+	+	+	+
2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
3	r	+	r	r	r	cc	c	r	+	rr	r	r	r	rr	rr	r	r	rr	rr	r	rr	+	r	r	r	r	rr	rr	r	rr	rr
4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	rr	..	...	rr	...	...	...
5	...	...	...	...	...	rr	...	...	...	rr	rr	rr	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...	...	...	...	...
6	...	...	...	rr	rr	...	...	rr	...	..	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
7	rr	...	r	r	rr	rr	rr	r	r	rr	r	r	c	c	c	+	+	+	c	c	c	c	r	r	r	+	r	rr	rr	rr	...
8	..	...	...	...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
9	rr	rr	...	r	rr	rr	rr	r	rr	rr	rr	rr	rr	rr	r	rr	r	r	+	+	+	+	+	+	+	c	+	+	+	r	rr
10	rr	rr	...	...	rr	...	...	rr	...	rr	...	...	...	...	rr	rr	...	rr	rr	+	r	rr	r	rr	rr	rr	rr	+	rr	rr	rr
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
12	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	rr	...	...	...	...	...	...	rr	...	...	...	...	...	..	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...
15	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...
16	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
17	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
18	...	...	...	...	...	...	...	rr	...	. .	...	rr	rr	rr	rr	...	rr	rr	...	rr	...	...	...	rr	...	...	...	r	...	...	...
19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...
20	r	r	r	rr	rr	rr	rr	r	...	+	...	r	r	rr	r	rr	+	r	rr	+	+	r	r	r	r	+	r	r	r	rr	rr
21	rr	...	rr	rr	rr	rr	rr	rr	rr	r	rr	r	rr	rr	rr	rr	r	r	rr	r	rr	r	...	...	rr	rr	rr	r	r	r	rr
22	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	..	...
23	+	+	+	+	r	r	r	+	r	r	+	+	+	+	r	r	+	+	+	r	r	+	+	c	+	+	+	c	c	c	c
24	c	c	c	cc	c	c	c	c	r	c	c	c	+	+	+	+	r	r	+	+	+	+	r	rr	r	r	r	r	r	r	+
25	rr	rr	+	+	+	r	r	+	rr	r	c	c	+	c	+	+	r	r	...	...	...	...	...	...	...	...	...	...	...	...	...
26	r	rr	+	rr	rr	rr	rr	r	rr	r	+	c	c	c	c	+	r	rr	r	rr	...	...	...	...	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...
31	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...
32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	. .	...	...	...	...	rr	...	...	rr	...	...	...	...
33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...
34	r	...	r	+	r	r	...	r	rr	rr	rr	rr	r	rr	rr	rr	...	rr	rr	rr	...	rr	r	rr	...	...	rr	rr	...	...	rr
35	...	rr	...	rr	rr	...	...	rr	rr	rr	rr	r	r	+	c	c	+	+	r	rr	...	...	...	...	rr	rr	...	...	...	...	rr
36	rr	rr	...	...	...	...	...	...	...	rr	...	...	rr	...	...	rr	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...
37	rr	rr	...	...	rr	..	...	rr	rr	...	...	...	rr	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
38	...	...	...	...	rr	rr	...	...	...	rr	rr	...	...	...	...	..	...	rr	rr	rr	rr	rr	r	r	rr	...	rr	rr	rr	rr	rr
39	rr	r	+	+	r	r	rr	+	rr	+	r	r	r	r	r	r	+	r	rr	r	r	rr	r	+	r	+	+	r	r	r	r
40	r	+	rr	r	r	r	rr	r	rr	rr	r	+	r	rr	rr	rr	r	rr	r	rr	r	r	rr	rr	rr	...	rr	rr	r	r	+
41	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	..	...
42	...	...	...	...	+	rr	...	+	rr	rr	rr	r	rr	r	rr	rr	rr	rr	rr	rr	rr	rr	r	+	rr	rr	...	rr	...	...	...
43	rr	...	rr	rr	rr	...	rr	rr	rr	rr	rr	...	...	...	rr	...	...	...	rr	rr	...	...	...	rr	...	rr	...	rr	...	...	rr
44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.	...	...	...	...	...	...	...	rr	r	rr	+	...	rr	...	rr	rr
45	...	rr	rr	rr	+	...	...	+	r	c	+	+	rr	rr	r	r	r	r	rr	r	r	rr	...	+	r	r	rr	rr	r	r	r
46	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
47	r	+	r	r	r	r	rr	rr	rr	rr	rr	rr	...	rr	rr	rr	rr	...	...	rr	rr	...	...	...	...	...	...	...	..	rr	...

TABLE II.

Cardigan Bay Lightship, 1905.

—	Jan.		Feb.		Mar.		April.		May.	June.		July.		Aug.		Sept.			Oct.		Nov.	Dec.
	6	24	7	21	7	22	6	21	19	4	18	2	17	3	15	1	14	29	14	30	12	12
Diatomaceae.																						
Actinoptychus splendens ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	..	...	...
— undulatus ...	+	c	+	c	c	c	+	+	+	r	...	...	rr	r	...	r	r	r	r	r	+	+
Asterionella japonica ...	rr	...	rr	rr	r	r	rr	rr	...	c	rr	...	...	...	rr	...	+	+	+	r	+	r
Bacillaria paradoxa... ...	c	c	c	c	c	c	c	+	r	r	rr	rr	r	r	...	r	c	c	+	+	+	+
Bellerochea malleus ...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Biddulphia alternans ...	rr	rr	rr	...	rr	rr	...	...	rr	...	...	...	...	rr	...	rr	rr	rr	r	rr	r	rr
— aurita	...	...	...	rr	...	...	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...
— favus	...	...	...	...	...	...	rr	rr	rr	...	...	...	...	...	...	rr	rr	rr	...	...	...	...
— granulata ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...
— mobiliensis ...	r	+	c	+	+	c	+	+	r	r	r	..	rr	rr	rr	+	+	c	+	+	+	+
Cerataulina Bergonii ...	...	...	...	...	...	...	...	rr	rr	r	+	+	rr	rr	rr	...	...	...	...	...	...	...
Chaetoceras boreale... ...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
— convolutum ...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	...	...	...	...	..	...	...
— crinitum ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...
— curvisetum ...	...	...	...	...	...	rr	r	...	...	...	rr	rr	...	..	...	...	rr	...	rr	...	...	...
— danicum ...	...	...	rr	...	rr	+	r	rr	rr	rr	...	...	rr	...	rr	...	rr	r	...	...	rr	...
— debile	...	...	...	...	...	...	r	rr	rr	c	...	...	...		...	...	...	...	..	...	...	...
— decipiens ...	...	r	r	rr	+	+	+	r	r	cc	rr	...	...	rr	rr	...	rr	rr	r	r	r	r
— densum ...	...	rr	...	...	...	...	...	...	rr	rr	rr	rr	...	+	rr	...	...	...	...	...	...	...
— Schüttii ...	...	...	rr	...	r	rr	...	...	...	rr	...	+	r	rr	c	r	+	+	r	...	r	rr
— sociale... ...	...	...	...	...	...	...	...	...	...	...	+	r	...	...	...	...	...	...	...	...	...	...
— teres	...	...	...	rr	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...
— Willei	...	...	...	...	...	...	rr	...	...	...	r	rr	r	r	rr	...	...	..	...	...	...	...
Corethron hystrix	...	...	rr	...	...	...	..	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...
Coscinodiscus concinnus ...	rr	r	+	r	r	+	+	r	rr	r	r	rr	...	rr	...	...	...	...	...	rr	r	rr
— excentricus ...	c	cc	cc	cc	c	c	c	c	+	r	rr	...	r	r	rr	+	c	c	c	c	c	c
— Grani ...	...	...	...	r	r	+	c	+	r	rr	...	...	...	...	...	rr	rr	rr	...	...	r	rr
— oculus iridis	...	...	...	...	...	...	rr	r	r	rr	rr	...	...	.	..	...	...	...	...	...	rr	...
— radiatus ...	+	c	c	c	c	c	cc	cc	cc	c	+	rr	r	+	r	c	+	+	+	+	+	+
Coscinosira polychorda ...	...	...	rr	...	...	r	...	...	...	r	rr	...	...	...	...	...	...	...	...	...	...	...
Ditylium Brightwellii ...	rr	rr	rr	rr	r	+	+	r	r	+	r	rr	...	...	...	...	rr	...	rr	rr	r	r
Eucampia zoodiacus ...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...
Fragilaria oceanica	...	...	...	...	...	...	...	...	r	rr	...	...	...	...	.	...	...	...	...	...	...	...
Guinardia flaccida	...	rr	rr	r	r	+	r	r	r	c	+	+	c	cc	c	r	r	...	rr	rr	rr	rr
Hyalodiscus stelliger ...	+	r	+	+	+	c	+.	+	+	r	...	...	rr	r	r	r	r	r	r	r	r	r
Lauderia borealis	rr	r	r	r	r	c	r	rr	...	+	+	r	...	...	...	...	...	rr	...	r	r	r
Leptocylindrus danicus ...	...	...	...	...	...	...	rr	...	...	rr	r	...	...	+	r	...	...	rr	...	...	...	...
Lithodesmium undulatum...	...	rr	rr	rr	rr	r	rr	rr	rr	...	...	...	...		..	...	rr	rr	rr	rr	r	rr
Navicula membranacea ...	...	rr	rr	...	...	rr	rr	...	...	r	r	r	...	rr	+	rr	...	...	rr	rr	rr	...
Nitzschia closterium ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	rr	...
— seriata	...	...	...	...	...	rr	r	...	...	..	...	...	...	...	...	...	...	...	...	...	..	...
— sp....	...	...	...	...	...	...	...	...	...	...	cc	cc	c	...	...	...	...	...	...	...	...	...
Paralia sulcata	+	+	+	+	+	c	r	+	+	r	rr	...	rr	r	r	r	rr	rr	r	rr	r	r
Pleurosigma sp.	...	rr	...	rr	rr	r	rr	..	...	...	...	rr	rr	rr	rr	rr	rr	rr	rr	rr	rr	...
Rhizosolenia semispina ...	...	...	...	...	...	...	...	...	...	rr	...	rr	c	c	c	+	rr	rr	rr	rr	rr	...
— setigera ...	...	rr	...	...	...	rr	...	...	rr	r	...	...	...	...	...	...	rr	...	rr	...	...	...
— Shrubsolei ...	r	r	r	rr	r	c	+	r	r	c	c	c	c	cc	c	rr	rr	rr	rr	rr	r	r
— Stolterfothii	...	...	...	...	...	r	...	...	...	..	r	+	r	+	+	...	...	...	..	...	...	rr
Skeletonema costatum ...	rr	r	rr	rr	r	c	r	rr	...	...	...	...	...	rr	rr	...	...	...	rr	rr	...	...
Stephanopyxis turris ...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	rr	...	...	...
Streptotheca thamensis ...	rr	+	c	+	c	c	c	+	+	+	r	rr	rr	+	+	c	c	+	+	+	c	+
Thalassiosira decipiens ...	...	...	rr	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— gravida ...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
— Nordenskioldii	...	...	...	..	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
— sp.	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Thalassiothrix nitzschioides	rr	rr	rr	r	+	+	+	r	rr	+	+	...	...	...	...	rr	r	rr	+	r	+	r
Perediniales.																						
Ceratium furca	rr	rr	r	r	r	+	rr	rr	r	r	r	rr	r	+	c	+	r	r	r	r	r	r
— fusus	rr	...	...	...	rr	r	...	...	rr	rr	rr	...	rr	c	cc	+	+	r	r	r	rr	rr
— longipes	...	rr	...	rr	r	r	rr	rr	...	rr	...	rr	r	c	c	c	+	r	r	r	r	r
— tripos	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	..	...	...	rr
Dinophysis acuminata ...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...
— acuta	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
Diplopsalis lenticula ...	...	...	...	...	...	...	...	...	...	...	?	...	rr	c	c	+	rr	r	rr	...	...	...
Gonyaulax polygramma ...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...
Peridinium conicum ...	...	rr	rr	r	rr	r	r	r	r	+	r	rr	rr	+	c	r	...	rr	rr	r	r	r
— depressum ...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	c	rr	r	rr	...	rr	...	...	...
— divergens ...	...	...	...	...	...	...	rr	...	...	...	rr	...	r	r	...	...	...	...	...	...	...	...
— ovatum... ...	...	...	...	...	...	...	...	rr	...	r	r	+	+	c	+	r	rr	rr	rr	...	...	...
— pallidum ...	...	...	...	rr	...	...	rr	...	...	r	r	rr	+	c	c	+	r	rr	rr	...	...	rr
— Steinii	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
Prorocentrum micans ...	...	...	...	...	...	...	...	...	...	..	...	...	rr	...	rr	rr	...	...	...	...	...	...
Photophyta Cetera.																						
Dictyocha fibula	...	rr	rr	rr	rr	r	rr	rr	...	...	...	...	..	...	...	rr	...	...	rr	...	rr	rr
Distephanus speculum ...	...	...	...	...	rr	...	...	...	...	...	rr	...	...	...	...	rr	rr	...	...	rr	...	rr
Halosphaera viridis... ...	r	r	+	+	+	c	c	c	c	c	rr	rr	r	+	c	c	+	+	+	+	+	r
Hexasterias problematica ...	...	rr	rr	rr	...	rr	...	rr	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	rr
Phaeocystis globosa ...	...	...	...	...	...	...	...	...	...	...	cc	cc	c	...	...	...	...	...	...	...	...	...
Trochiscia brachiolata ...	...	rr	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	..
— Clevei	...	...	rr	...	...	rr	...	rr	rr	...	...	...	rr	r	rr	rr	rr	...	rr	...	...	...

TABLE II.—*continued.*

CARDIGAN BAY LIGHTSHIP, 1905—*continued.*

	Jan.		Feb.		Mar.		April.		May.	June.		July.		Aug.		Sept.			Oct.		Nov.	Dec.
	6	24	7	21	7	22	6	21	19	4	18	2	17	3	15	1	14	29	14	30	12	12
PROTOZOA.																						
Cyttarocylis serrata... ...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	r	...	rr	...	...	...	...	...	rr
Noctiluca miliaris	rr	...	rr	...	rr	...	r	rr	rr	...	r	r	...	rr	rr	...	...	...	...	...	...	...
Tintinnopsis beroidea ...	r	r	rr	r	r	+	r	r	rr	r	...	rr	rr	c	c	c	c	c	+	+	+	rr
— campanula ...	...	...	rr	rr	...	...	rr	...	...	...	...	...	...	+	c	rr	+	r	rr	r	r	r
COELENTERATA.																						
Pleurobrachia pileus ...	...	...	...	...	...	rr	rr	...	r	rr	...	rr	...	...	rr	...	...	...	...	...	...	...
Obelia sp.	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Phialidium cymbaloideum...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	rr	...	rr	...	...	...	...	...
— temporarium ...	...	...	...	...	...	...	...	...	...	...	...	rr	r	r	rr	rr	+	r	rr	...	rr	rr
ECHINODERMATA.																						
Auricularia	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...
Ophiopluteus	...	...	...	...	...	...	...	...	...	...	rr	rr	...	rr	...	rr	rr	...	...	...	...	...
VERMES.																						
Autolytus sp.	...	rr	rr	r	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sagitta bipunctata	+	r	r	r	rr	...	r	...	r	r	...	...	...	...	rr	c	+	r	r	r	r	r
Tomopteris helgolandica ...	rr	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...
Polychaete larvae	...	rr	r	r	r	r	rr	rr	rr	...	...	...	...	r	...	r	+	r	rr	rr	rr	rr
Terebellid larvae	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BRYOZOA.																						
Cyphonautes	rr	rr	rr	...	...	...	rr	rr	rr	...	rr	...	...	...	...	rr	...	...	...	rr	...	rr
COPEPODA.																						
Acartia Clausi	c	c	c	r	r	+	c	cc	cc	c	+	rr	...	+	+	cc	cc	c	c	+	c	+
— discaudata	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Alteutha bopyroides ...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...
Anomalocera Pattersoni ...	...	...	...	...	...	...	rr	c	r	rr	...	...	...	...	r	...	rr	r	rr	...	rr	...
Calanus finmarchicus ...	r	r	r	rr	rr	...	...	...	+	rr	...	...	...	...	rr	+	r	r	r	r	rr	r
Centropages hamatus ...	...	...	r	rr	...	r	+	+	c	+	r	rr	rr	+	+	c	c	+	c	rr	+	r
— typicus ...	...	...	...	...	...	...	...	...	...	rr	rr	...	rr	+	+	cc	c	+	c	...	c	r
Corycaeus anglicus	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	rr	...	...	...	...	...
Echinosoma sp.	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Euterpe acutifrons	rr	r	+	rr	rr	+	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	rr	...
Harpacticus chelifer ...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
Isias clavipes	...	...	...	...	...	...	...	...	r	r	...	...	...	+	c	cc	+	rr	rr	...	...	...
Longipedia Scotti	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Metridia lucens	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
Oithona nana	rr	rr	r	...	...	rr	rr	...	...	...	...	...	...	r	rr	r	rr	...	...	rr	rr	rr
— similis	...	...	rr	...	rr	...	rr	...	rr	...	...	rr	...	rr	r	r	r	rr	rr	...	...	rr
Paracalanus parvus... ...	r	rr	r	...	...	rr	r	...	...	...	...	...	...	...	rr	+	+	+	+	r	+	r
Parapontella brevicornis ...	...	...	...	...	...	...	rr	rr	rr	...	...	...	...	...	r	rr	r	rr	rr	rr	rr	...
Pseudocalanus elongatus ...	c	c	c	+	+	rr	c	+	+	...	...	...	...	...	...	r	r	+	+	+	+	+
Temora longicornis... ...	rr	rr	r	rr	rr	rr	+	+	cc	r	rr	...	rr	rr	rr	+	+	...	rr	...	...	rr
Thalestris Croni	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...
CRUSTACEA CETERA.																						
Podon intermedius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...
Metopa sp. juv.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	r	...	...	...	...	...
Podocerus falcatus	rr	...	rr	...	...	...	...	...	...	...	r	rr	...	r	rr	...	rr	...	...	rr	rr	...
Eurydice inermis	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pseudocuma cercaria ...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...
Cumacea juv.	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Megalopa	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	rr	...	...	...	...	...	...
Micronisсus	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	...	rr	...	rr
Nauplius and metanauplius	r	r	rr	r	r	+	+	+	+	+	r	r	rr	c	c	c	+	r	r	r	r	r
Zoaea	...	...	rr	rr	r	...	c	r	+	...	...	...	...	...	+	r	r	rr	...	...	rr	rr
Caridid larvae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...
Cirripede larvae	...	...	...	...	...	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— (cypris) larvae ...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
MOLLUSCA.																						
Limacina retroversa ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	?	...	...	...	...	...
Gasteropod larvae	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Lamellibranch larvae ...	rr	...	...	...	c	r	...	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...
TUNICATA.																						
Oikopleura dioica	...	...	r	rr	rr	r	r	rr	+	r	rr	rr	...	r	rr	r	...	...	...	...	rr	rr
VERTEBRATA.																						
Fish ova	...	...	rr	rr	rr	c	c	+	r	r	...	...	...	...	rr	...	...	...	...	...	...	...
— larvae	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	...

TABLE III.

Sevenstones Lightship, 1905.

	Jan.		Feb.		Mar.		April.		May.		June.		July.		Aug.		Sept.			Oct.		Nov.		Dec.	
	7	23	6	21	7	23	6	20	6	19	3	17	4	18	3	17	1	16	30	14	30	14	28	13	27
Diatomaceae.																									
Achnanthes sp....	rr	rr	...	rr	rr	r	r	rr	rr	+	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Actinoptychus undulatus	rr	+	r	r	r	r	r	r	r	+	rr	...	...	...	...	...	...	rr	rr	rr	+	r	+	c	+
Asterionella japonica	rr	rr	r	rr	rr	rr	r	r	+	rr	...	...	...	...	...	...	...	rr	...	rr	rr	rr	r	r	rr
Bacillaria paradoxa	rr	r	+	rr	rr	rr	r	+	rr	rr	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	rr	r
Biddulphia alternans	r	r	r	rr	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	...	rr	...	...	rr	r	+	r
— granulata	...	...	...	...	...	rr	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	rr
— mobiliensis	+	+	+	r	rr	+	+	r	rr	r	rr	...	...	...	...	...	...	...	rr	rr	r	r	+	+	c
Cerataulina Beyonii	...	...	...	...	...	..	...	...	...	...	...	...	...	..	...	...	...	...	...	rr	...	...	..	...	...
Chaetoceras boreale	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
— contortum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
— curvisetum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...	...	...
— danicum	rr	rr	r	rr	r	r	+	r	...	...	...	...	...	...	...	...	...	...	...	...	r	rr	rr	r	rr
— debile	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
— decipiens	r	rr	rr	rr	rr	...	r	+	rr	rr	...	...	...	r	...	...	...	rr	rr	r	r	rr	rr	r	
— densum	...	...	...	rr	rr	...	...	...	...	...	...	...	+	+	...	...	...	rr	+	r	r	rr	rr	...	...
— didymum	rr	rr	r	...	...	rr	r	rr	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...
— laciniosum	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	rr	rr	...	...	...	...
— Peruvianum	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— teres	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	...	...	...	...
— Schüttii	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	rr	rr	+	+	r	...	...	...	...
Corethron hystrix	r	r	r	r	rr	rr	rr	rr	...	...	...	...	...	...	...	...	rr	r	+	c	+	+	r	rr	
Coscinodiscus concinnus ...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— excentricus ...	+	+	c	+	+	+	c	+	+	+	r	...	...	...	rr	rr	...	rr	r	r	c	c	c	c	c
— Grani	rr	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— oculus iridis ...	rr	...	...	rr	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— radiatus ...	+	+	r	r	+	+	c	c	+	c	r	...	...	...	rr	r	rr	r	r	r	c	+	c	c	+
Ditylium Brightwellii	r	rr	r	r	rr	r	+	r	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
Guinardia flaccida	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	r	...	...	...	...	...	...
Hyalodiscus stelliger	c	+	+	r	r	c	+	+	r	+	r	rr	...	...	r	...	rr	r	+	+	cc	c	c	c	c
Isthmia enervis	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lauderia borealis	...	...	...	...	...	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr
Lithodesmium undulatum ...	...	...	...	...	...	...	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Navicula membranacea ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...	...	...	...
Nitzschia closterium	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	r	rr	...
— seriata	rr	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Paralia sulcata	+	+	+	r	r	r	r	r	r	+	r	rr	...	...	rr	...	rr	r	r	r	c	c	c	c	c
Pleurosigma sp.	rr	rr	rr	r	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	...	rr	rr	rr	rr	rr	r	r
Rhizosolenia alata	rr	rr	rr	rr	...	...	...	...	...	...	...	rr	r	cc	cc	cc	cc	c	+	+	c	c	+	c	+
— semispina	...	...	...	...	...	...	...	rr	...	...	...	rr	rr	...	...	...	...	+	...	rr	...	...	...	...	...
— setigera	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	rr	rr	...	...
— Shrubsolei	rr	rr	...	...	...	...	rr	...	...	...	...	rr	rr	c	+	...	...	r	+	+	+	rr	r	...	...
— Stolterfothii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...
— styliformis	...	...	...	...	...	...	...	...	...	...	...	+	c	cc	c	r	rr	rr	rr	rr	r	rr	rr	rr	...
Streptotheca thamensis ...	rr	rr	rr	rr	r	+	r	+	r	+	rr	...	...	...	...	...	...	...	...	rr	rr	rr	rr	...	r
Thalassiosira gravida	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— decipiens ...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— sp.	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...
Thalassiothrix nitzschioides ...	+	+	c	rr	rr	r	c	+	r	+	r	...	...	...	...	...	rr	rr	...	rr	+	+	c	c	c
Peridiniales.																									
Ceratium furca	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— fusus	...	...	rr	...	...	rr	rr	rr	...	...	...	...	...	rr	+	...	r	r	rr	...	...	...	rr	...	rr
— hexacanthum ...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— longipes	rr	rr	rr	...	rr	rr	r	r	rr	rr	...	rr	...	...	r	...	r	rr	r	r	r	rr	rr	rr	rr
— tripos	rr	rr	rr	rr	...	rr	rr	rr	...	...	...	...	rr	rr	c	c	c	r	+	r	r	rr	r	r	r
Dinophysis acuta	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...
— ovum	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	...	rr	...	...	...	...	...	...	...
— rotundata	..	...	...	...	..	..	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...
Diplopsalis lenticula	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	r	+	+	r	rr	r	...	...	...	...	...
Gonyaulax polygramma ...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	...	...	r	...	...	...	...	...	...	...
Peridinium conicum	...	...	...	...	...	...	rr	r	rr	rr	...	...	...	...	...	...	...	...	rr	rr	...	...	...	rr	...
— depressum	...	...	...	...	...	rr	...	rr	rr	r	rr	rr	...	...	r	...	rr	rr	rr	rr	...	...	...	...	...
— divergens	rr	...	...	..	...	rr	rr	...	...	...	...	..	...	...	rr	...	...	...	...	...	...	...	...	...	...
— ovatum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
— pallidum	...	..	...	...	rr	rr	...	rr	...	rr	...	...	...	rr	r	...	...	...	...	...	...	...	...	...	rr
— pentagonum	..	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Prorocentrum micans	...	...	...	...	...	...	...	...	...	..	...	...	...	...	rr	rr	...	rr	...	...	...	...	...	...	...
Protophyta cetera.																									
Coccosphaera atlantica	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
Dictyocha fibula	...	rr	rr	rr	...	...	rr	rr	rr	...	...	...	...	...	rr	...	rr	rr	rr	rr	r	rr	r	r	rr
Distephanus speculum	...	...	...	..	...	...	...	rr	...	...	...	..	...	...	...	...	...	...	rr	rr	...	...	rr	rr	...
Halosphaera viridis	+	+	r	r	r	+	+	c	+	+	+	r	...	+	r	rr	c	r	c	c	+	+	+	r	+
Phaeocystis globosa	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	r	...	...	...	...	...	...	...	...
Trochiscia Clevei	...	...	...	...	rr	rr	...	...	...	...	...	...	...	rr	rr	...	...	...	rr	...	rr	...	...	...	...
— multispinosa	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Protozoa.																									
Lithomelissa sp.	...	...	rr	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...	r	rr	rr
Tintinnopsis beroidea	...	...	...	...	...	...	rr	rr	...	rr	...	...	...	...	rr	...	r	r	+	c	+	r	+	r	+

TABLE III.—*cont.*

SEVENSTONES LIGHTSHIP, 1905—*continued.*

	Jan.		Feb.		Mar.		April.		May.		June.		July.		Aug.		Sept.			Oct.		Nov.		Dec.	
	7	23	6	21	7	23	6	20	6	19	3	17	4	18	3	17	1	16	30	14	30	14	28	13	27
COELENTERATA.																									
Muggiaea atlantica	...	...	...	...	..	...	...	...	..	...	...	...	...	...	...	...	...	...	...	c	+	c	+	r	...	...
Beroe ovata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...
Pleurobrachia pileus	...	...	...	. .	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	r	r	rr	...	...	...	...
Gemmaria implexa	...	...	...	...	...	...	..	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Laodice calcarata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...
Lizzia blondina	...	...	...	...	...	...	...	...	...	...	...	...	+	+	r	...	...	...	...	...	...	...	...	...	...	...
Obelia nigra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...
— sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	rr	rr	r	rr	r	...	...	...	...	...
Phialidium cymbaloideum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...
— temporarium	...	..	...	...	...	...	..	...	...	...	...	...	...	...	...	+	r	...	rr	...	r	rr	rr	...	...	...
Sarsia gemmifera	...	...	...	...	...	...	...	...	...	...	...	rr	r	c	r	...	...	...	...	...	...	...	...	...	...	...
— prolifera	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...
Actinula (Tubularia)	...	...	...	...	...	...	...	...	...	...	rr	r	r	r	...	...	...	rr	...	...	...	rr	rr	...	...	...
ECHINODERMATA.																										
Ophiopluteus	...	...	...	...	...	...	...	..	...	...	...	...	...	...	rr	+	r	...	...	c	rr	...	...	...	...	...
Auricularia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...
VERMES.																										
Sagitta bipunctata	...	...	...	r	r	r	r	rr	...	...	...	...	...	...	...	...	. .	r	+	rr	+	r	c	c	c	+	c
Tomopteris helgolandica	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr
Polychaete larvae	...	...	...	...	...	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	rr	rr	rr	rr	...	rr	rr	
BRYOZOA.																										
Cyphonautes	...	...	...	...	rr	rr	rr	...	...	...	...	r	...	...	c	+	+	rr	c	r	r	...	r	rr	rr	
COPEPODA.																										
Acartia Clausi	...	...	...	...	r	rr	r	r	+	+	+	c	r	c	r	+	+	r	c	c	+	r	r	r	rr	
Anomalocera Pattersoni	...	...	...	...	...	...	...	...	...	...	+	r	...	rr	+	rr	rr	r	+	r	rr	rr	r	...	rr	
Calanus finmarchicus	...	...	...	r	+	+	+	c	r	rr	+	r	c	r	c	r	cc	c	cc	r	c	c	c	c	c	
Candacia pectinata	...	...	...	..	..	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
Centropages typicus	...	...	...	+	r	r	...	rr	rr	r	r	rr	+	r	cc	c	cc	c	cc	cc	c	+	r	r	r	
Corycaeus anglicus	...	...	...	rr	rr	rr	...	rr	...	...	...	...	...	r	+	+	c	r	+	+	r	+	+	+	r	rr
Isias clavipes	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	rr	...	...	...	...	rr	rr	...	...	...	
Longipedia coronata	. .	...	...	...	...	...	...	...	rr	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...
Metridia lucens	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	r	r	r	rr	r	
Oithona nana	..	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	..	...	...	...	...	...	...	...	...	...	...
— similis	...	...	...	rr	r	r	r	r	rr	r	+	rr	+	r	+	c	c	r	r	rr	rr	rr	rr	rr	r	
— plumifera	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...
Paracalanus parvus	...	...	..	rr	rr	r	r	+	+	r	+	r	+	r	+	+	+	c	r	c	+	+	+	+	r	r
Parapontella brevicornis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Pseudocanalus elongatus	...	..	r	r	r	r	+	+	rr	c	rr	r	+	+	r	rr	c	+	c	+	c	+	c	c	c	c
Temora longicornis	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	+	...	rr	rr	r	rr	rr	rr	rr	
Thalestris Croni	...	...	...	rr	...	...	...	...	...	...	rr	rr	...	..	...	...	...	...	...	...	...	...	...	...	...	...
CRUSTACEA CETERA.																										
Evadne Nordmanni	...	...	...	...	...	...	...	...	...	...	...	..	...	r	r	...	...	...	rr	...	...	...	...	...	...	...
Podon intermedius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	cc	r	...	...	+	...	...	...	...	...	...	...
Nyctiphanes Couchi	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...
Apherusa Clevei	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Podocerus falcatus	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
Megalopa	...	..	...	...	...	...	...	...	...	...	...	rr	...	r	rr	rr	...	rr	rr	...	...	...	...	...	...	...
Microniscus	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nauplius	...	...	...	rr	rr	rr	rr	r	r	r	r	r	r	+	cc	c	cc	r	+	r	r	r	rr	r	rr	
Zoaea	...	...	...	...	rr	rr	rr	r	...	+	rr	r	+	rr	c	c	+	c	rr	+	rr	r	+	r	rr	rr
Caridid larvae	...	...	...	...	...	...	rr	...	...	...	...	..	...	rr	...	rr	rr	...	...	...	rr	rr	...	...	...	...
Cirripede larvae	...	...	...	...	...	...	...	rr	rr	c	rr	...	...	...	...	rr	...	...	...	.	..	...	...	...	...	...
— (Cypris) larvae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	rr
Hyperiid juv	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	..	..	rr	rr	...
Squillidae larvae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...
MOLLUSCA.																										
Limacina retroversa	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	r	c	r	cc	...	r	...	...	...	...	
Gasteropod larvae	...	...	...	...	rr	rr	...	...	...	...	rr	...	...	...	r	+	r	...	...	...	...	...	...	...	...	...
Lamellibranch larvae	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	r	...	...	rr	
TUNICATA.																										
Oikopleura dioica	...	...	...	...	...	...	r	r	...	rr	..	...	...	rr	...	r	+	+	rr	r	rr	r	...	rr	rr	...
Ascidian tadpole	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr
VERTEBRATA.																										
Fish ova	...	...	...	...	...	...	...	rr	r	rr	+	r	r	+	+	+	+	+	r	...	...	...	...	...	...	...
— larvae	...	...	...	...	...	...	...	...	rr	...	...	rr	...	...	rr	rr	...	...	...	rr	...	...	...	...	...	...
INCERTAE SEDIS.																										
Umrindete cyste	...	...	...	...	rr	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...

TABLE IV.

Sevenstones Lightship, 1906.

	Jan.		Feb		Mar.		April		May		June.		July.		Aug.		Sept.		Oct		Nov.		Dec.	
	12	26	12	24	12	26	10	26	10	23	8	23	7	23	6	22	4	20	3	20	3	19	2	17
Diatomaceae.																								
Achnanthes sp.	...	...	rr	...	rr	rr	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr
Actinoptychus undulatus	c	c	c	+	+	r	r	rr	r	...	...	...	...	...	...	...	...	rr	rr	rr	...	...	...	rr
Asterionella japonica	rr	r	+	c	+	+	rr	rr	...	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	...
Bacillaria paradoxa	rr	rr	+	c	c	r	r	rr	...	...	..	...	...	...	...	...	...	...	...	rr	...	...	...	...
Biddulphia alternans	r	r	r	+	rr	...	rr	...	..	...	...	...	...	...	...	..	...	...	...	...	...	...	...	rr
— granulata	rr	rr	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...
— mobiliensis	c	+	+	c	+	+	+	...	rr	...	...	...	...	...	...	...	...	rr	rr	rr	rr	...	...	rr
Cerataulina Beyonii	...	...	...	...	...	...	...	+	+	+	+	rr	...	...	...	...	...	...	...	...	...	...	...	...
Chaetoceras boreale	...	...	...	...	...	...	...	c	c	r	r	...	...	...	...	...	...	...	...	...	...	...	...	...
— constrictum	...	...	...	...	...	...	...	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
— curvisetum	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...
— danicum	rr	rr	rr	c	+	r	+	...	...	...	...	...	...	...	...	...	...	rr	r	...	...	...	...	rr
— debile	...	...	...	...	...	...	rr	r	...	...	...	...	...	...	rr	...	..	...	...	...	...	...	...	...
— decipiens	...	rr	rr	rr	r	rr	+	...	...	...	...	..	...	...	r	...	rr	...	+	rr	rr	...	...	...
— densum	...	...	...	...	rr	...	r	c	cc	r	r	rr	...	rr	...	...	...	...	r	...	rr	...	...	...
— didymum	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
— laciniosum	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...
— convolutum	...	rr	rr	rr	r	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— teres	..	...	...	rr	rr	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...	...	...	...	...	...
— Schüttii	...	rr	...	rr	rr	...	rr	rr	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...
Corethron hystrix	rr	rr	r	r	r	rr	rr	...	...	...	...	...	...	...	rr	...	...	+	c	r	r	rr	...	rr
Coscinodiscus excentricus	c	c	c	c	+	+	+	rr	rr	...	...	rr	...	...	...	...	rr	+	c	r	r	rr	rr	r
— Grani	...	...	...	...	r	r	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— oculus iridis	...	...	...	...	...	...	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— radiatus	c	c	+	+	+	+	c	r	r	...	r	rr	...	..	..	rr	rr	...	+	r	r	rr	r	+
Ditylium Brightwellii	...	...	...	...	r	r	r	+	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr
Eucampia zoodiacus	...	...	...	...	...	...	...	...	r	+	+	+	r	...	...	rr	...	...	...	...	...	...	...	...
Guinardia flaccida	...	...	...	...	..	...	...	...	c	c	c	c	+	r	r	+	rr	rr	...	r	...	...	...	...
Hyalodiscus stelliger	c	c	+	+	+	+	+	r	r	...	...	rr	rr	...	...	...	...	r	r	+	+	rr	r	+
Isthmia enervis	...	...	rr	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lauderia borealis	...	...	rr	r	r	rr	rr	+	r	c	+	rr	...	...	...	...	...	...	...	...	...	...	rr	rr
Leptocylindrus danicus	...	...	...	...	...	...	...	...	...	...	...	...	..	...	+	...	rr	...	...	...	...	...	...	...
Lithodesmium undulatum	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Navicula membranacea	...	...	...	...	...	...	...	rr	+	c	cc	c	r	...	rr	r	...	...	...	...	...	...	...	...
Nitzschia closterium	...	...	rr	r	...	rr	...	rr	...	rr	..	...	rr	rr	...	...	...	...	rr	rr	...	...	...	..
— seriata	...	rr	...	r	...	...	rr	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...
Paralia sulcata	c	c	c	+	+	+	r	rr	r	rr	r	rr	...	rr	rr	rr	...	r	r	r	r	r	rr	+
Pleurosigma sp.	r	r	r	r	rr	rr	rr	rr	rr	rr	rr	...	...	...	...	...	...	rr	rr	rr	rr	rr	rr	rr
Rhizosolenia alata	r	rr	r	rr	rr	rr	r	c	c	c	c	c	c	c	c	cc	c	+	r	rr	rr	...	rr	r
— hebetata	...	...	...	...	...	...	...	r	+	r	r	...	...	...	...	...	...	...	...	...	...	...	...	...
— semispina	...	...	rr	rr	rr	r	+	cc	cc	c	c	rr	r	...	rr	...	...	rr	+	...	...	...	...	...
— setigera	...	rr	r	r	r	r	+	...	...	...	...	...	...	...	...	..	...	...	c	...	r	...	...	rr
— Shrubsolei	...	rr	...	rr	rr	rr	r	c	c	c	+	r	r	rr	+	...	rr	r	+	rr	...	...	...	...
— Stolterfothii	...	...	...	...	...	...	...	c	cc	cc	cc	c	rr	r	rr	...	...	...	...	...	...	...	...	...
— styliformis	...	...	...	...	...	...	...	rr	r		+	+	r	r	rr	...	...	...	...	...	...	...	...	...
Streptotheca thamensis	rr	rr	+	+	c	+	c	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	..	rr
Thalassiosira decipiens	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— Nordenskiold	...	..	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	rr
— sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
Thalassiothrix nitzschioides	c	cc	c	c	c	r	+	rr	rr	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	rr
Peridiniales.																								
Ceratium furca	...	...	...	rr	rr	...	r	...	..	...	...	...	...	...	rr	rr	...	rr	...	...	...	...	..	...
— fusus	...	rr	rr	rr	rr	r	+	rr	r	r	r	r	r	r	+	c	+	r	+	...	rr	rr	...	...
— hexacanthum	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— lineatum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	rr	...	...	...	...
— longipes	rr	rr	rr	r	rr	...	rr	rr	rr	rr	rr	rr	rr	...	r	rr	r	r	+	r	rr	...	...	...
— tripos	rr	rr	rr	rr	...	rr	rr	...	...	rr	rr	rr	+	c	c	c	c	c	+	+	r	rr	rr	rr
Dinophysis acuminata	...	...	...	...	...	...	...	...	...	rr	rr	rr	+	r	r	rr	rr	rr	r	...	...	...	...	...
— acuta	...	...	...	...	...	...	...	rr	rr	...	rr	...	rr	r	rr	...	...	...	...	...	...	...	...	...
— ovum	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— rotundata	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr
Diplopsalis lenticula	...	...	...	...	...	...	...	rr	r	c	c	+	r	r	rr	rr	r	r	rr	...	...	...	...	rr
Gonyaulax polygramma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	c	rr	rr	rr	r	...	...	...	...	...
Gymnodinium lunula	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
Peridinium conicum	rr	rr	rr	r	rr	rr	rr	rr	+	+	+	r	rr	...	rr	..	...	...	...	...	...	...	...	rr
— decipiens	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— depressum	rr	...	...	...	...	...	...	...	+	+	+	+	r	rr	rr	...	rr	rr	...	rr	..	...	...	...
— divergens	...	...	...	...	...	...	...	...	rr	..	...	rr	...	...	...	...	...	...	..	...	...	...	...	...
— ovatum	...	...	...	...	...	...	rr	+	rr	r	+	rr	...	...	...	...	...	...	...	...	...	...	...	...
— pallidum	...	...	...	...	...	rr	r	+	rr	rr	r	r	r	rr	...	...	...	...	rr	rr	rr	...	...	rr
— pentagonum	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...
— Steinii	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	...
Prorocentrum micans	...	...	...	...	...	...	...	rr	...	...	...	rr	rr	rr	c	r	r	+	+	rr	...	...	rr	...
Protophyta cetera.																								
Coccosphaera atlantica (coccolith)	...	...	...	..	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...	rr	...
Dictyocha fibula	r	r	rr	r	rr	rr	r	rr	rr	rr	...	...	rr	...	rr	rr	rr	rr	+	rr	rr	rr	...	rr
Distephanus speculum	...	rr	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...
Halosphaera viridis	+	r	+	r	+	+	+	r	+	rr	r	...	...	+	c	+	r	+	c	+	+	rr	r	r
Phaeocystis globosa	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	...	...	...	...	...	...	...	...	...	...
Trochiscia Clevei	...	rr	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	r	...	...	...	...	...	...	...	...

TABLE IV.—*cont.*

SEVENSTONES LIGHTSHIP, 1906—*continued.*

	Jan.		Feb		Mar		April.		May.		June.		July		Aug.		Sept		Oct,		Nov		Dec.	
	12	26	12	24	12	26	10	26	10	23	8	23	7	23	6	22	4	20	3	20	3	19	2	17
PROTOZOA.																								
Lithomelissa sp....	...	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Noctiluca miliaris	...	...	...	...	...	...	...	...	...	+	rr	rr	r	+	rr	...	...	...	...	...	...	...	...	...
Tintinnopsis beroidea	...	r	r	r	r	rr	rr	rr	...	rr	r	...	...	...	...	...	...	rr	+	r	rr	...	...	rr
COELENTERATA.																								
Beroe ovata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...
Pleurobrachia pileus	...	...	...	...	...	...	...	...	...	*r	*rr	...	...	...	rr	...	...	...	...	...	...	...	...	rr
Actinula (Tubularia)	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	...	..	...	rr	rr	...	...	...	...
Arachnactis Bournei	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Euphysa aurata...	...	...	...	...	...	...	...	..	...	r	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gossea corynetes	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
Hybocodon prolifer	...	...	...	rr	...	...	...	r	r	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Laodice calcarata	...	...	...	...	...	..	...	rr	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
Lizzia blondina...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	+	rr	...	...	...	...	...	...	...	...	...
Margellium octopunctatum	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Obelia nigra ..	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	rr	rr	rr	...	..	...	...
— sp....	...	...	...	...	...	...	...	r	+	r	...	...	...	rr	rr	...	rr	rr	...	rr	...	...	...	...
Phialidium cymbaloideum	...	...	...	...	...	...	...	r	...	rr	rr	...	rr	rr	...	...	...	...	...	...	...	...	...	...
— temporarium	...	...	...	...	..	...	...	rr	r	rr	...	rr	rr	r	rr	...	rr	+	rr	...	...	...	..	...
Sarsia prolifera	...	...	...	...	...	...	..	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ECHINODERMATA.																								
Auricularia	...	...	...	...	...	...	rr	...	...	...	...	rr	rr	...	...	...	rr	...	...	...	...	...	...	...
Bipinnaria	...	...	...	...	...	...	...	...	...	...	...	..	rr	rr	...	...	...	...	...	...	...	...	...	...
Echinopluteus	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	..	...	...	...	...	...	...	...	...	...
Ophiopluteus	...	...	...	...	...	...	rr	...	...	rr	rr	r	r	r	...	rr	r	r	...	...	...	...	...	...
VERMES.																								
Sagitta bipunctata	...	r	+	r	...	...	...	r	...	...	...	r	r	r	rr	...	rr	rr	...	+	+	r	c	+
Tomopteris helgolandica	..	...	...	...	...	...	..	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Polychaete larvae	...	...	rr	...	...	rr	rr	rr	rr	r	rr	...	rr	...	...	...	...	...	rr	...	...	...	...	...
BRYOZOA.																								
Cyphonautes	...	...	...	...	...	rr	...	...	...	rr	rr	...	+	c	c	+	r	+	r	rr	r	r	...	rr	rr
COPEPODA.																								
Acartia Clausi	...	...	...	rr	rr	rr	+	c	c	c	c	r	+	c	+	rr	rr	r	c	r	rr	...	...	rr
Anomalocera Pattersoni	...	...	...	...	...	*r	rr	+	...	...	rr	*rr	...	rr	...	r	+	...	rr	r	rr	...	..	...
Calanus finmarchicus	...	...	c	r	c	+	r	c	r	c	cc	c	r	c	c	c	+	+	c	+	r	+	+	r
Candacia pectinata	...	...	...	...	...	...	...	...	...	...	...	...	*rr	...	rr	...	...	*r	...	...	...	...	...	...
Centropages typicus	...	...	rr	rr	rr	...	...	rr	r	+	r	c	+	c	c	c	c	cc	cc	cc	c	+	...	...	r
Corycaeus anglicus	...	...	..	...	...	...	...	rr	r	...	...	r	r	+	c	+	r	+	+	c	+	+	rr	r	r
Isias clavipes	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	+	rr	...	...	...	...
Metridia lucens	...	...	...	...	...	rr	...	...	...	r	...	...	...	...	...	...	...	...	...	rr	rr	..	...	...
Oithona plumifera	...	...	rr	...	...	...	..	...	...	rr	..	...	...	...	...	...	...	...	...	...	...	...	...	...
— similis	...	...	r	r	rr	r	rr	r	r	+	+	r	+	+	r	+	+	+	+	...	rr	rr	rr	rr	rr
Paracalanus parvus	...	...	r	rr	r	+	+	+	rr	c	+	r	...	+	+	+	r	+	+	c	c	+	+	rr	rr
Parapontella brevicornis	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	rr	...	r	..	...	...	...	...
Pseudocalanus elongatus	...	...	+	r	+	+	+	+	...	c	cc	c	...	+	r	+	c	+	+	r	r	c	c	rr	rr	r
Temora longicornis	...	...	...	...	...	...	...	...	...	rr	rr	c	rr	rr	...	r	c	r	+	rr	rr	r	r	rr	rr	rr
Thalestris Croni...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
CRUSTACEA CETERA.																								
Evadne Nordmanni	...	...	...	...	...	...	...	...	...	...	r	rr	+	rr	+	r	c	+	+	...	...	...	...	...
Podon intermedius	...	...	...	...	...	...	...	...	...	...	...	r	r	rr	r	rr	r	...	...	...	...	...	...	...
Nyctiphanes Couchi	...	...	...	...	...	...	rr	+	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Apherusa Clevei	...	...	...	...	...	...	...	..	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...
Podocerus falcatus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	+	...
Megalopa	...	...	...	...	...	...	...	...	...	..	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...
Micronisc us	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	rr	...	...	...	rr	...	...	...	...	...
Nauplius	...	...	...	...	rr	rr	r	rr	+	r	+	+	rr	+	+	+	c	+	+	r	r	rr	r	...
Zoaea	...	...	...	...	...	rr	rr	r	...	rr	+	+	...	rr	rr	...	r	+	rr	...	r	rr	. .	rr	...
Caridid larvae	...	...	...	...	...	...	...	...	rr	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...
Cirripede larvae	...	...	...	...	..	...	...	...	rr	rr	rr	r	rr	rr	...	...	...	...	...	...	...	...	...	...
— (Cypris)	...	...	...	...	...	...	...	...	...	. .	rr	...	...	...	...	rr	...	...	...	...	rr	...	...	...
Hyperiid juv.	...	...	...	...	...	rr	...	...	..	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Harpacticidae juv.	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...
MOLLUSCA.																								
Limacina retroversa	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	rr	rr	+	+	r	r	r	rr	...	...	...
Gasteropod larvae	...	...	...	...	...	...	rr	..	...	...	rr	...	r	...	..	...	...	...	...	rr	..	...	..	...	...
Lamellibranch larvae	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr	.	rr	r	rr	...	rr	...
TUNICATA.																								
Oikopleura dioica	...	...	...	...	...	rr	rr	c	+	c	c	c	r	r	+	r	rr	r	r	r	r	rr	r	rr	...	...	...
VERTEBRATA.																								
Fish ova	...	...	...	...	...	...	...	rr	rr	+	+	r	rr	rr	...	rr	+	rr	r	rr	rr	rr	...	rr	rr	...	...	...	...
— larvae	...	...	...	...	...	...	...	...	r	...	rr	rr	rr	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...

Aug. 6th.—Evadne with winter eggs.
Aug. 22nd.—Many young Copepods, *e.g.*, Calanus, Centropages, and Anomalocera.

TABLE V.

VARNE LIGHTSHIP, 1905.

	Jan.		Feb.		Mar.		April.		May		June.		July.			Aug.		Sept.		Oct.		Nov.	Dec.	
	4	21	5	18	5	21	5	19	8	26	3	17	3	17	24	9	30	14	28	13	28	16	12	26
DIATOMACEAE.																								
Actinocyclus Ehrenbergii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Actinoptychus splendens	...	...	...	rr	rr	rr	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	rr	...	rr
— undulatus	...	...	rr	...	rr	+	r	rr	...	...	rr	...	...	...	...	...	...	rr	rr	...	+	+	r	rr	rr
Asterionella japonica	...	...	...	r	rr	r	r	rr	...	r	+	r	...	...	...	...	...	rr	...	...	...	rr	...	...	...
Bacillaria paradoxa	...	...	c	+	+	+	r	+	...	rr	...	...	...	...	...	rr	rr	r	+	rr	...	+	rr	r	r
Bellerochea malleus	...	...	rr	r	rr	rr	rr	rr	...	rr	...	rr	...	...	...	...	...	...	...	rr	...	r	r	rr	...	rr
Biddulphia alternans	...	...	rr	r	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	+	r	r	r
— aurita	...	...	...	rr	rr	r	rr	rr	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
— granulata	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...
— mobiliensis	...	...	+	+	+	+	+	+	r	rr	rr	rr	...	...	...	rr	rr	rr	rr	+	+	r	r	r
Cerataulina Bergonii	...	...	...	...	...	...	...	...	cc	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	...	...
Chaetoceras boreale	...	...	...	...	...	...	rr	...	c	rr	...	...	...	...	...	...	...	rr	+	rr	...	...	...	...
— danicum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
— debile	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...	...	...	...	...	+	rr	rr	...	...	...
— decipiens	...	...	rr	...	...	rr	rr	...	rr	...	...	...	...	...	...	r	+	+	rr	rr	...	...	...	...
— densum	...	...	...	...	...	...	...	+	...	...	...	rr	rr	...	...	rr	...	...	...	...	...	...	...	...
— didymum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	rr	rr	...	...	...
— Schuttii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
— teres	...	...	...	...	...	...	rr	...	...	...	...	...	...	rr	...	...	...	...	...	rr	...	...	...	...
Coscinodiscus concinnus	...	...	r	r	r	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	...	...
— excentricus	...	...	c	c	+	+	+	c	rr	r	rr	rr	rr	...	rr	rr	r	r	r	+	+	+	+	+
— Grani	...	...	r	r	r	...	rr	r	rr	...	rr	...	...	...	...	...	rr	...	r	+	r	rr	rr	r
— radiatus	...	...	c	c	c	+	+	c	+	+	r	r	rr	rr	...	rr	rr	rr	rr	+	+	+	+	c
Ditylium Brightwellii	...	...	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	...	...	...	rr	r	rr	r	...	...
Eucampia zoodiacus	...	...	rr	...	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Guinardia flaccida	...	...	r	...	rr	...	...	rr	+	...	rr	...	...	r	+	rr	rr	r	+	r	rr	rr	rr	rr
Hyalodiscus stelliger	...	...	rr	rr	r	rr	rr	rr	...	rr	rr	rr	...	...	...	rr	rr	rr	rr	..	rr	rr	rr	rr
Lauderia borealis	...	...	r	rr	...	rr	rr	rr	...	...	...	...	...	...	...	...	...	..	rr	rr	rr	rr	r	rr
Lithodesmium undulatum	...	...	rr	rr	rr	rr	...	rr	...	...	...	...	...	...	...	...	...	...	rr	r	r	rr	rr	rr
Navicula membranacea	...	...	rr	rr	rr	rr	rr	r	...	...	...	rr	...	...	r	rr	rr	r	rr	rr	...	...	rr	...
Nitzschia closterium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...
Paralia sulcata	...	...	r	r	r	rr	rr	rr	rr	rr	rr	rr	rr	r	r	r	r	r	...	rr	r	r	rr	rr
Pleurosigma sp.	...	...	rr	rr	rr	rr	rr	...	...	...	rr	rr	...	...	rr	rr	rr	rr	rr	rr	rr	...	rr	...
Rhizosolenia setigera	...	...	...	r	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— Shrubsolei	...	...	rr	rr	rr	...	rr	rr	c	rr	...	r	...	rr	rr	...	...	...	r	...	...	rr	rr	...
— Stolterfothii	...	...	rr	...	rr	rr	rr	...	c	...	rr	rr	r	c	cc	cc	c	+	rr	r	rr	...	rr	rr	rr	rr
Skeletonema costatum	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streptotheca thamensis	...	...	+	r	r	r	+	+	rr	+	+	+	rr	...	...	...	rr	rr	r	rr	r	rr	r	rr	+
Thalassiosira gravida	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
Thalassiothrix nitzschioides	...	...	...	rr	...	...	...	rr	...	...	...	rr	...	...	...	...	...	rr	rr	...	...	rr	...	...	...
PERIDINIALES.																								
Ceratium furca	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	...	...
— fusus	...	...	r	r	rr	rr	r	...	r	r	...	rr	rr	rr	r	r	r	+	r	r	r	r	rr	rr	...	rr
— lineatum	...	...	..	...	...	...	rr	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...
— longipes	...	...	rr	rr	...	rr	rr	rr	r	r	r	r	+	+	r	r	r	+	rr	+	+	+	+	rr	rr	rr
Dinophysis acuminata	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...
Diplopsalis lenticula	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	r	+	+	rr	r	+	rr	...	rr	...	rr	rr
Gonyaulax polygramma	...	...	...	...	..	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...
Gymnodinium lunula	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Peridinium conicum	...	...	rr	rr	rr	rr	...	r	+	rr	rr	rr	rr	rr	...	rr	rr	rr	rr	+	r	r	r	rr	r	r
— divergens	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	...	...	...	...
— ovatum	...	...	...	rr	...	rr	r	r	+	rr	...	...	...	rr	rr	rr	...	rr	rr	rr	rr	...	rr	...	...	...
— pallidum	...	...	...	rr	rr	...	rr	...	rr	...	...	rr	rr	...	...	rr	...	...	...	...	...	rr	...	rr	...	rr
— pentagonum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...
— Steinii	...	...	...	...	...	...	...	...	r	rr	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Prorocentrum micans	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	...	...	...
PROTOPHYTA CETERA.																								
Dictyocha fibula	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...
Distephanus speculum	...	...	...	rr	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...
Halosphaera viridis	...	...	r	r	r	rr	rr	+	rr	r	rr	+	r	r	r	rr	rr	r	rr	rr	rr	rr	r	...	r	...
Hexasterias problematica	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
PROTOZOA.																								
Noctiluca miliaris	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	...	...	...	...	...	...	rr	+	rr	...	rr	rr
Tintinnopsis beroidea	...	...	r	rr	r	r	rr	+	rr	rr	rr	r	rr	r	rr	rr	rr	r	rr	rr	rr	r	r	r	r	r
— campanula	...	...	rr	r	rr	rr	rr	r	...	...	...	...	...	rr	rr	rr	...	rr	...	rr	...	rr	rr	rr	rr	rr
COELENTERATA.																								
Pleurobrachia pileus	...	...	...	...	...	...	rr	...	rr	...	...	+	+	c	rr	...	rr	rr	r	...	...	...	...	...	...	rr
Hybocodon prolifer	...	...	...	...	...	...	rr	...	rr	...	...	..	...	r	...	...	...	...	...	...	...	...	...	...	...	...
Laodice calcarata	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...	...	rr	...	...	...	...	...	..	...
Obelia nigra	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
— sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...	rr	rr	rr	...	...	...	...	...	...

TABLE V.—*cont.*

VARNE LIGHTSHIP, 1905—*continued.*

	Jan.		Feb.		Mar.		April.		May.		June.		July.			Aug.		Sept.		Oct.		Nov.	Dec.	
	4	21	5	18	5	21	5	19	8	26	3	17	3	17	24	9	30	14	28	13	28	16	12	26
COELENTERATA—*cont.*																								
Philalidium temporarium	...	...	...	...	...	...	...	...	...	...	...	+	rr	...	r	r	r	rr	rr	+	+	rr	...	rr
Sarsia tubulosa	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aurelia aurita	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
ECHINODERMATA.																								
Ophiopluteus	..	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	rr	...	rr	...	...	...	...
VERMES.																								
Autolytus sp.	...	...	...	...	rr	...	...	...	...	...	...	rr	...	..	...	...	...	...	...	...	...	...	rr	...
Sagitta bipunctata	...	...	...	...	rr	r	...	...	...	...	...	c	r	r	c	+	+	+	rr	rr	rr	+	r	r
Polychaete larvae	...	...	...	...	...	+	...	...	...	...	rr	rr	...	...	r	...	rr	rr	rr	rr	...	...	rr	rr
Terebellid larvae	...	...	...	...	...	...	...	...	...	...	...	r	rr	...	...	...	...	...	...	...	...	...	...	...
BRYOZOA.																								
Cyphonautes	...	...	...	...	r	...	...	rr	...	rr	..	...	..	...	...	...	...	...	...	...	...	...	...	...
COPEPODA.																								
Acartia Clausi	...	...	+	+	+	r	+	+	c	c	c	+	cc	+		c	c	c	+	+	+	+	+	+
— discaudata	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Alteutha bopyroides	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr
Anomalocera Pattersoni	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	rr	rr	...	rr	...	...	...	...	...
Calanus finmarchicus	...	...	...	rr	r	...	rr	rr	+	rr	rr	...	r	+	+	rr	r	+	...	rr	...	...	...	rr
Centropages hamatus	...	...	r	r	+	r	+	c	r	+	+	r	c	+	r	c	+	+	c	+	r	+	rr	r
— typicus	...	...	...	...	...	...	rr	...	...	+	+	rr	rr	r	r	r	r	rr	rr	r	...	r	...	...
Corycaeus anglicus	...	...	...	...	...	..	...	...	rr	rr	...	...	...	rr	...	rr	rr	rr	rr	r	rr	rr	rr	...
Cyclopina littoralis	...	...	...	...	...	...	...	..	..	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
Euterpe acutifrons	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Isias clavipes	...	...	rr	...	...	...	rr	rr	...	...	...	...	rr	...	...	rr	...	rr	rr	rr	...	r	...	rr
Labidocera Wollastoni	...	...	...	...	...	...	...	...	...	r	rr	r	...	...		+	rr	r	rr	...	...	...	...	...
Oithona nana	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	rr	...	+	r	rr	...	...	...	...
Paracalanus parvus	...	...	r	rr	rr	...	...	rr	...	...	...	...	...	...	rr	rr	rr	...	rr	rr	...	rr	...	. .
Parapontella brevicornis	...	...	c	c	c	r	+	+	c	r	+	r	rr	...	...	+	+	r	r	r	+	c	c	+
Pseudocalanus elongatus	...	...	...	...	rr	rr	rr	...	...	rr	rr	rr	rr	...	...	+	r	r	r	r	r	r	r	r
Rynchothalestris rufocincta	...	...	r	+	+	r	r	+	+	r	r	+	cc	rr	...	rr	r	rr	rr	rr	rr	rr	+	+
Temora longicornis	...	...	...	rr	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...
	...	...	+	+	c	r	+	r	c	c	c	c	...	cc	r	rr	c	c	+	+	+	+	+	+
CRUSTACEA.																								
Podon intermedius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	...	...	...	...	...	...
Macropsis Slabberi	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...
Podocerus falcatus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Proto pedata	...	...	rr	...	...	...	...	...	rr	rr	rr	rr	..	...	...	...	...	...	...	rr	...	...	...	...
Idothea linearis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...
— sp. juv.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cuma Edwardsii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	..	...
Megalopa	...	...	...	...	...	...	...	rr	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...
Microniscus	...	...	...	...	...	...	...	...	r	r	r	rr	...	...	rr	r	...	...	...	...	...	...	...	...
Nauplius and Metanauplius	...	...	...	rr	...	...	...	rr	r	r	rr	...	...	...	rr	rr	rr	...	...	...	rr	rr	...	rr
Zoaea	...	...	r	r	rr	r	r	r	r	r	+	rr	r	r	r	+	r	r	+	r	rr	r	r	r
Caridid larvae	...	...	...	...	r	rr	rr	+	r	rr	r	r	...	...	+	+	+	...	rr	r	r	...	rr	...
Cirripede larvae	...	...	...	...	r	rr	rr	+	r	rr	rr	r	rr	rr	+	+	...	rr	rr	rr	...	...	...	...
— (cypris) larvae	...	...	rr	...	...	rr	...	+	rr	rr	..	...	...	...	..	...	...	...	rr	...	...	...	...	...
Squillidae larvae	...	...	..	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
MOLLUSCA.																								
Gasteropod larvae	..	...	...	rr	...	...	...	...	rr	rr	...	...	rr	...	rr	rr	...	...	rr	...	...	rr	...	...
Lamellibranch larvae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...
TUNICATA.																								
Oikopleura dioica	...	...	...	+	r	rr	rr	rr	r	cc	+	r	r	r	rr	rr	...	rr	...	r	rr	rr	rr	rr	rr
VERTEBRATA.																								
Teleostei ova	...	...	...	r	r	+	r	+	+	+	+	+	...	rr	rr	...	...	...	...	...	...	...	rr	...	r
— larvae	...	...	...	rr	...	r	r	rr	rr	rr	...	rr	rr	rr	...	...	..	rr	...	...	...	...	...	...	rr

TABLE VI.

Varne Lightship, 1906.

—	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.	Dec.
	10	24	9	23	10	24	9	23	9	23	6	21	6	21	4	21	4	18	2	20	30	15
Diatomaceae.																						
Actinocyclus Ehrenbergii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...
Actinoptychus splendens	...	rr	rr	...	...	...	rr	...	...	...	...	..	...	...	...	...	...	...	r	...	rr	rr
— undulatus	rr	r	rr	r	rr	r	r	+	rr	...	...	...	rr	...	..	rr	...	...	rr	rr	r	+
Asterionella japonica	...	...	rr	rr	+	r	r	r	...	+	rr	rr	...	...	...	...	r	+	+	rr	...	...
Bacillaria paradoxa	rr	rr	+	c	c	c	r	r	...	...	rr	...	rr	r	r	rr	r	rr	+	rr	r	r
Bacteriastrum varians	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
Bellerochea malleus	rr	r	rr	rr	...	...	rr	rr	...	...	rr	...	...	rr	rr	rr	rr	r	+	rr	rr	+
Biddulphia alternans	r	r	r	...	rr	rr	...	rr	...	...	...	...	...	...	...	...	...	rr	r	rr	+	rr
— aurita	...	...	rr	rr	...	...	rr	rr	r	...	...	...	...	...	...	...	...	...	...	...	...	...
— favus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
— granulata	rr	rr	rr	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr
— mobiliensis	r	r	r	r	r	+	r	r	rr	...	rr	...	...	...	rr	...	rr	rr	+	r	r	c
Cerataulina Bergonii	..	...	rr	r	+	r	...	...	...	...	...	...	...	...	...	...	..	...	...	rr	rr	...
Chaetoceras boreale	...	...	...	rr	rr	rr	rr	...	rr	rr	...	...	...	...	rr	...	rr	rr	rr	rr	...	...
— curvisetum	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	rr	r	..	...
— danicum	...	...	...	...	...	...	...	...	...	...	..	...	...	rr	c	rr	rr	r	rr	...	...	...
— debile	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	...
— decipiens	...	...	...	..	...	...	...	...	...	rr	...	...	...	rr	rr	...	r	+	+	...	...	...
— didymum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+	+	..	...	...
— laciniosum	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	rr	rr	...	...	...	...
— Schuttii	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	r	r	...	...	...
— simplex	...	...	...	...	rr	rr	...	...	...	..	...	...	...	...	...	rr	...	rr	...	...	...	...
— Willei	...	..	...	...	...	...	...	...	...	...	...	...	...	r	r	...	...	...	rr	...	...	...
Coscinodiscus concinnus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...
— excentricus	c	c	c	c	+	c	+	+	rr	rr	rr	...	...	rr	r	rr	rr	r	...	...	+	c
— Grani	r	r	rr	r	rr	rr	...	...	...	...	...	...	...	...	...	...	...	r	r	rr	r	+
— oculus iridis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r
— radiatus	c	+	c	c	c	+	+	r	r	rr	rr	...	...	...	...	rr	rr	rr	rr	rr	+	+
Ditylium Brightwellii	rr	rr	rr	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	rr	r	...	r	r
Guinardia flaccida	...	rr	rr	rr	rr	...	rr	...	rr	r	r	r	...	...	rr	...	rr	rr	rr	r	r	rr
Hyalodiscus stelliger	r	rr	rr	rr	rr	rr	rr	rr	...	rr	rr	...	rr	rr	rr	rr	rr	...	rr	rr	r	rr
Lauderia borealis	rr	rr	r	r	+	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr
Leptocylindrus danicus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
Lithodesmium undulatum	rr	rr	rr	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	rr	r	rr	rr	r
Navicula membranacea	...	...	...	rr	...	...	...	...	r	rr	...	...	...	...	...	...	...	...	...	+	...	rr
Nitzschia closterium	...	.	...	...	...	rr	...	...	r	r	rr	rr	...	rr	...	...	rr	...	...	rr	...	...
— sp.	...	...	...	...	...	...	...	...	c	r	cc	r	...	...	...	...	...	...	...	...	...	...
Paralia sulcata	r	r	r	rr	rr	r	rr	r	rr	rr	rr	...	r	rr	r	r	r	rr	rr	rr	r	rr
Pleurosigma sp.	rr	rr	rr	...	...	...	...	rr	rr	...	...	...	...	rr	rr	rr	rr	rr	rr	...	rr	rr
Rhizosolenia semispina	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
— setigera	rr	rr	rr	rr	rr	...	...	rr	...	rr	...	...	...	rr	r	...	r	...	r	...	rr	...
— Shrubsolei	...	rr	rr	rr	rr	rr	r	...	+	+	rr	...	...	rr	+	rr	...	...	...	rr	...	...
— Stolterfothii	...	rr	rr	...	...	...	rr	...	+	c	c	c	c	rr	rr	...	...	rr	r	rr	rr	...
Skeletonema costatum	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Streptotheca thamensis	+	r	r	+	+	r	r	r	rr	rr	r	...	...	...	rr	...	rr	rr	r	rr	r	+
Thalassiosira decipiens	...	...	rr	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Thalassiothrix nitzschioides	...	rr	...	...	rr	rr	rr	...	...	rr	...	...	...	...	...	...	rr	rr	rr	...	...	...
Peridiniales.																						
Ceratium furca	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	r	...	...	...
— fusus	rr	rr	...	...	...	...	rr	rr	...	...	...	rr	rr	...	rr	rr	rr	r	+	+	r	rr
— longipes	rr	...	...	...	...	...	...	...	...	...	...	...	rr	...	rr	...	rr	rr	rr	rr	rr	r
Dinophysis acuminata	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...
— ovum	...	...	...	...	rr	...	...	...	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...
— rotundata	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...
Diplopsalis lenticula	...	...	rr	...	rr	...	r	..	...	r	rr	r	rr	...	rr	...	...	...	rr	...	rr	...
Gonyaulax polygramma	...	...	...	...	...	...	...	...	...	...	...	...	..	...	rr	...	...	rr	...	...	...	...
Gymnodinium lunula	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	rr	...	...	...	...	...	...	...
Peridinium conicum	rr	rr	rr	r	r	rr	c	+	r	rr	rr	...	...	...	...	...	...	rr	r	r	r	...
— depressum	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	rr	rr	rr	...	...	...	...	...	...
— divergens	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...
— globulus	..	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...
— ovatum	...	...	rr	r	+	r	+	r	+	+	+	rr	rr	r	rr	...	...	...	...	...	...	...
— pallidium	rr	rr	...	..	rr	...	...	rr	r	rr	rr	...	...	...	rr	...	...	rr	r	...	rr	...
— Steinii	...	...	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	rr	...	...	..
Prorocentrum micans	...	...	...	...	rr	rr	rr	...	rr	...	...	...	...	...	rr	...	...	rr	rr	r	...	...
Protophyta cetera.																						
Dictyocha fibula	...	rr	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...
Distephanus speculum	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	rr	r	+	r	rr	...
Halosphaera viridis	rr	rr	rr	rr	rr	rr	r	rr	r	r	r	rr	r	rr	+	rr	r	...	r	rr	r	r
Hexasterias problematica	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr
Phaeocystis globosa	...	...	...	...	...	...	...	...	cc	+	cc	r	...	...	...	...	...	...	...	...	...	...
Protozoa.																						
Noctiluca miliaris	...	...	...	...	...	...	rr	...	rr	rr	+	+	+	rr	rr	rr	...	...	rr	rr	rr	+
Tintinnopsis beroidea	rr	r	rr	r	r	r	r	rr	...	rr	rr	..	rr	rr	rr	rr	...	rr	r	rr	rr	+
— campanula	rr	rr	rr	rr	...	..	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	rr	rr	r

TABLE VI.—*continued.*

VARNE LIGHTSHIP, 1906—*continued.*

—	Jan.		Feb.		Mar.		Apr.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.	Dec.
	10	24	9	23	10	24	9	23	9	23	6	21	6	21	4	21	4	18	2	20	30	15
COELENTERATA.																						
Pleurobrachia pileus	rr	...	rr	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	rr	...	rr	...	...
Hybocodon prolifer	...	...	...	...	...	rr	rr	...	rr	...	...	rr	...	...	...	...	...	...	...	...	...	...
Obelia sp.	...	...	...	...	...	..	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	..	...
Phialidium cymbaloideum	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	..	...	...	...	...
— temporarium	...	...	...	...	...	...	...	...	...	...	rr	...	...	r	+	...	...	rr	rr	rr	rr	rr
Actinula (Tubularia)	...	...	..	...	...	...	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	...
ECHINODERMATA.																						
Asteroid Juv.	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ophiopluteus	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	rr	...	r	...	...
VERMES.																						
Autolytus sp.	...	r	rr	...	...	rr	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
Sagitta bipunctata	+	+	+	rr	rr	rr	...	...	...	...	...	rr	...	rr	r	rr	r	rr	rr	+	r	+
Polychaete larvae	...	rr	...	rr	rr	rr	rr	rr	...	...	rr	...	...	...	...	rr	...	...	rr	rr	...	rr
Terebellid larvae	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	..	...	...
BRYOZOA.																						
Cyphonautes	...	...	...	rr		r	rr	rr	rr	rr	rr	...	...	...	...	...	...	...	rr	...	...	rr
COPEPODA.																						
Acartia Clausi	+		+	rr	rr	+	c	r	+	+	c	r	rr	+	c	c	+	+	+	+	+	
Alteutha bopyroides	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	rr	...	...	...	...	...
Anomalocera Pattersoni	...	...	...	...	...	...	...	...	..	...	...	...	...	...	rr	rr	...	...	...	...	...	...
Calanus finmarchicus	rr	...	rr	r	rr	rr	rr	...	rr	rr	...	rr	...	rr	r	...	rr	rr	...	...	...	...
Caligus rapax	...	...	rr	...	..	...	...	...	...	...	...	...	.	...	...	...	...	...	...	...	...	...
Centropages hamatus	rr	rr	rr	r	rr	+	+	rr	rr	...	r	rr	rr	+	+	r	r	rr	r	+	r	rr
— typicus	...	rr	...	...	...	..	...	...	...	...	...	...	...	...	rr	rr	...	...	...	rr	...	...
Corycaeus anglicus	.	...	...	...	...	...	...	...	...	...	...	...	...	..	...	r	...	rr	...	...	...	rr
Cyclopina littoralis	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	..	...	rr
Eurytemora hirundoides	...	...	...	...	...	rr	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...
Euterpe acutifrons	rr	...	...	...	..	..	.	..	...	...	...	...	...	...	...	...	rr	...	rr	rr	...	+
Isias clavipes	...	...	...	...	...	..	...	...	...	...	...	...	...	rr	rr	r	+	...	r	...	...	...
Labidocera Wollastoni	...	...	.	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...
Oithona nana	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	rr	rr	...	+
Paracalanus parvus	rr	r	r	+	+	r	+	rr	r	rr	rr	rr	rr	r	rr	rr	...	rr	r	r	c	r
Parapontella brevicornis	...	...	...	...	...	rr	...	...	rr	rr	rr	...	...	rr	...	...	...	rr	rr	rr	rr	rr
Pseudocalanus elongatus	+	+	c	+	+	c	+	rr	+	+	+	r	...	+	r	...	rr	...	r	r	rr	r
Temora longicornis	r	r	r	+	+	+	+	rr	r	rr	r	r	rr	+	+	+	+	r	+	rr	+	+
CRUSTACEA CETERA.																						
Podon intermedius	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...
Podocerus falcatus	...	...	rr	...	...	...	rr	...	rr	...	...	...	...	...	...	...	...	...	rr	...	...	...
Pseudocuma cercaria	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...
Megalopa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...
Micronisсus	...	...	rr	...	...	...	...	...	...	...	...	...	..	...	...	...	rr	...	...	...	...	...
Nauplius and Metanauplius	rr	rr	rr	rr	rr	r	r	rr	rr	r	r	rr	rr	rr	+	r	r	r	+	r	r	r
Zoaea	...	...	r	rr	rr	rr	r	...	rr	...	rr	rr	...	rr	r	rr	rr	r	rr	...	rr	rr
Caridid larvae	...	...	rr	rr	rr	rr	rr	...	...	...	rr	...	...	...	rr	rr	rr	...	rr	rr	...	...
Cirripede larvae	...	...	...	...	rr	rr	c	rr	rr	...	rr	...	...	...	...	...	...	...	rr	...	...	...
— (cypris) larvae	...	...	...	...	...	...	...	...	...	rr	...	...	...	...	...	...	...	...	...	...	...	...
Cumacea sp. Juv.	...	...	...	...	rr	rr	...	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...
MOLLUSCA.																						
Gasteropod larvae	...	...	...	...	...	rr	...	...	rr	...	...	...	...	rr	rr	...	...	rr	rr	...	rr	...
Lamellibranch larvae	...	...	...	...	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	rr	...
TUNICATA.																						
Oikopleura dioica	...	...	...	...	rr	r	rr	rr	r	...	rr	r	+	rr	...	rr	r	rr	...	rr	rr	r	...	r
VERTEBRATA.																						
Teleostei ova	+	r	r	r	+	r	+	+	r	+	rr	rr	...	rr	...	rr	...	...	...	...	rr	rr
— larvae	rr	...	+	r	rr	rr	rr	...	...	...	...	...	...	...	...	...	...	...	...	...	...	+

CHART 1.

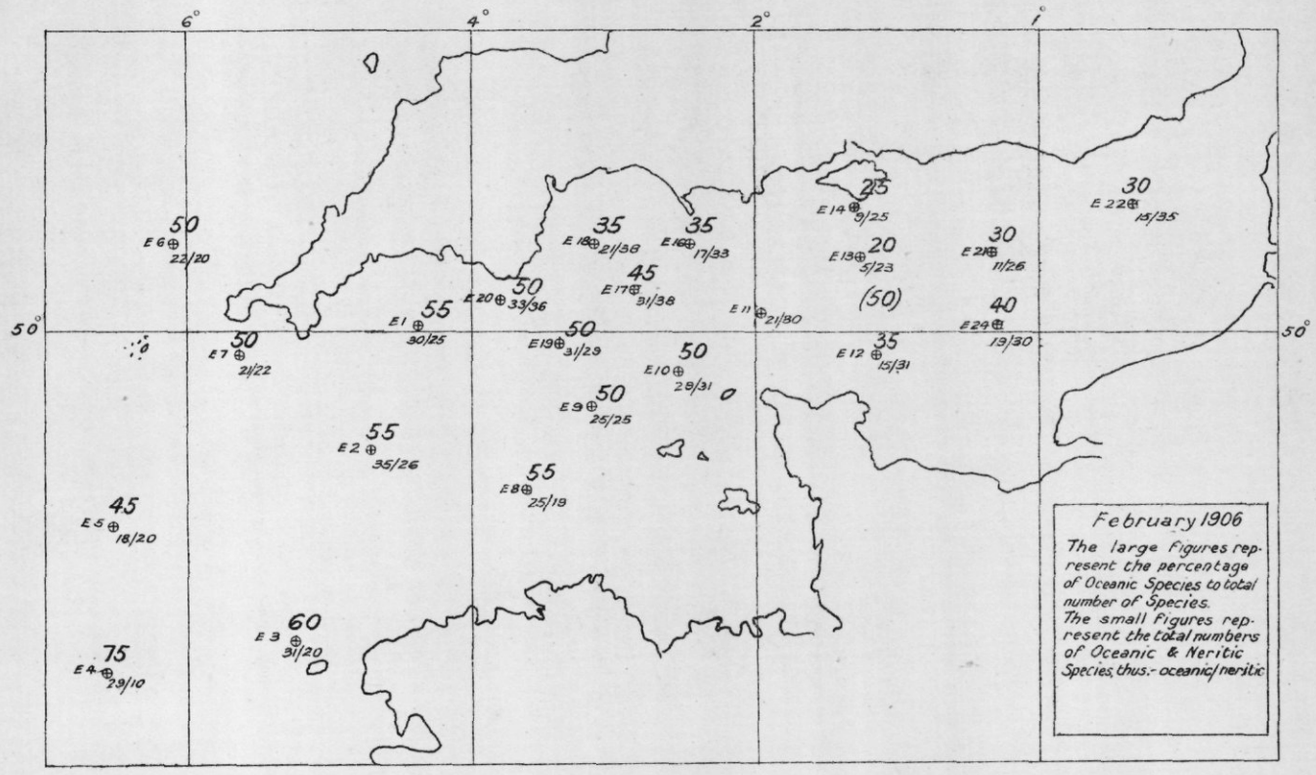
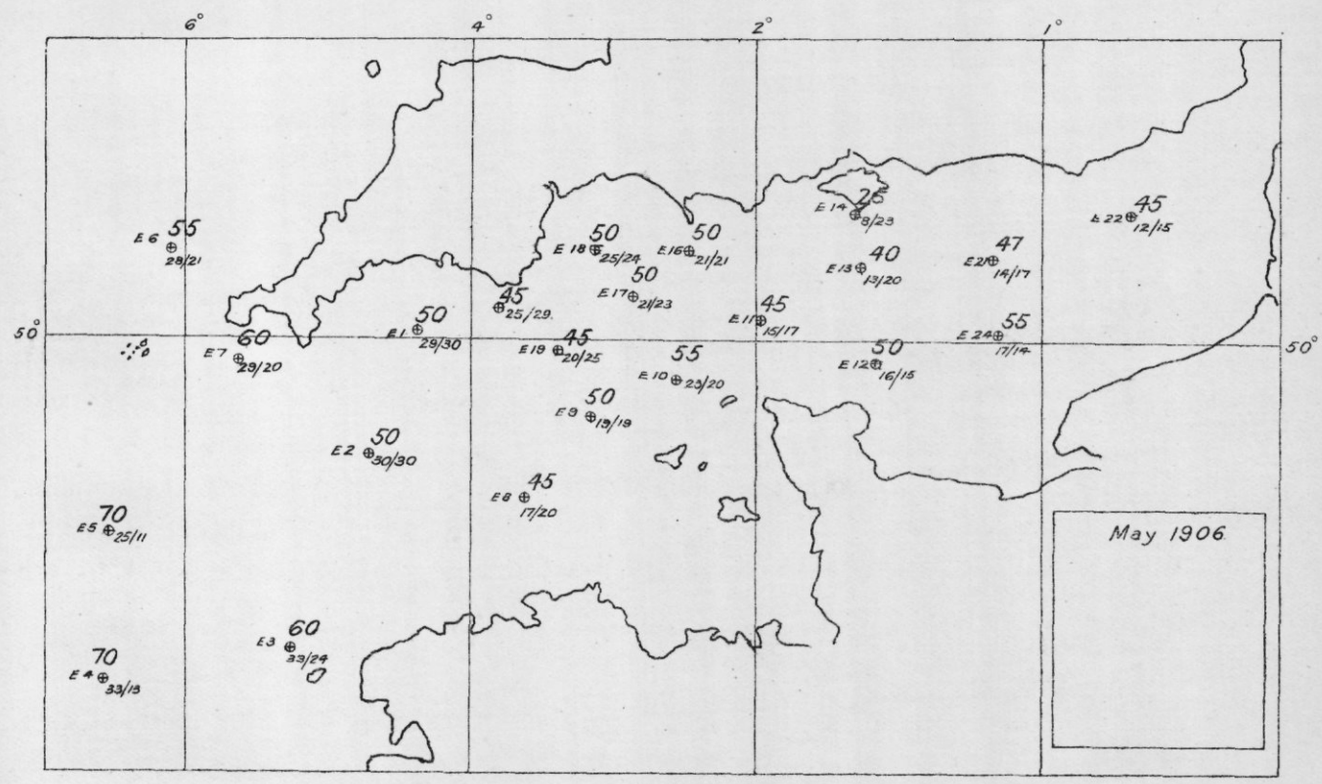


CHART 2.



Bygrave. Plankton of English Channel

Weller & Graham, Ltd. Litho. London.

CHART 3.

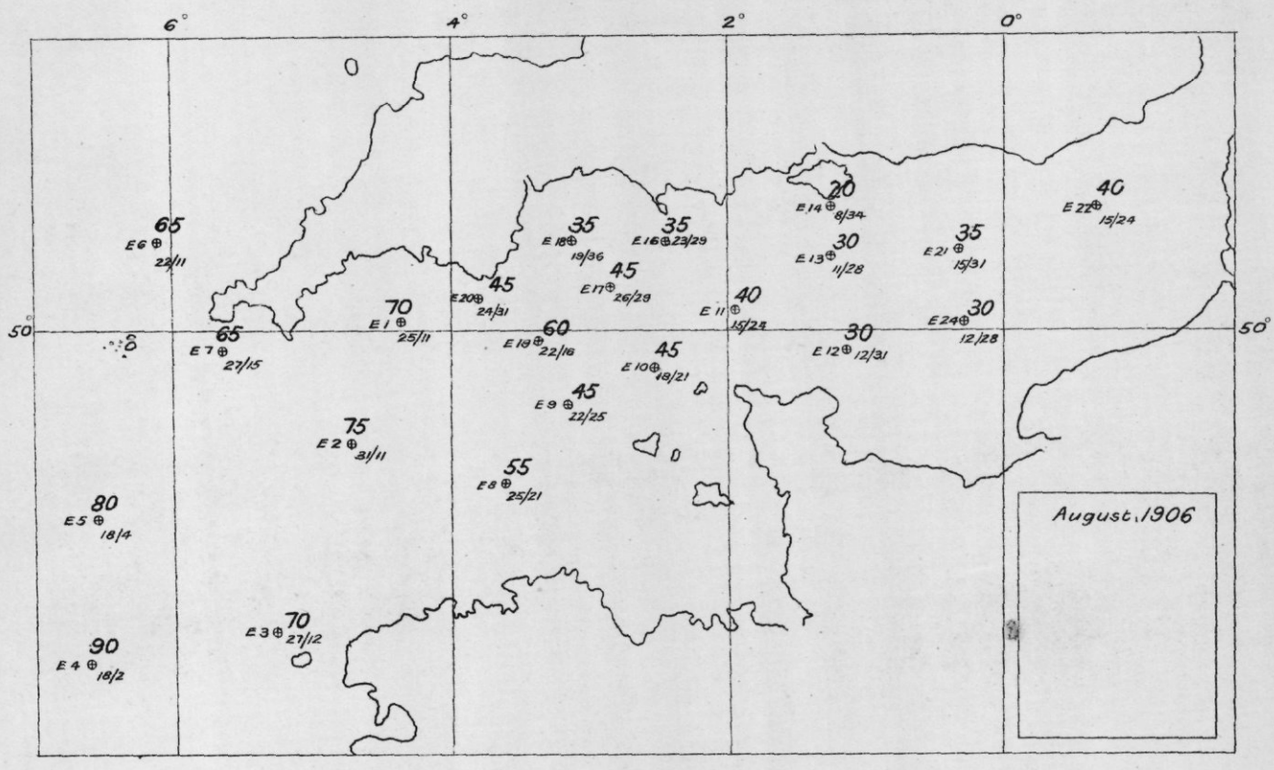
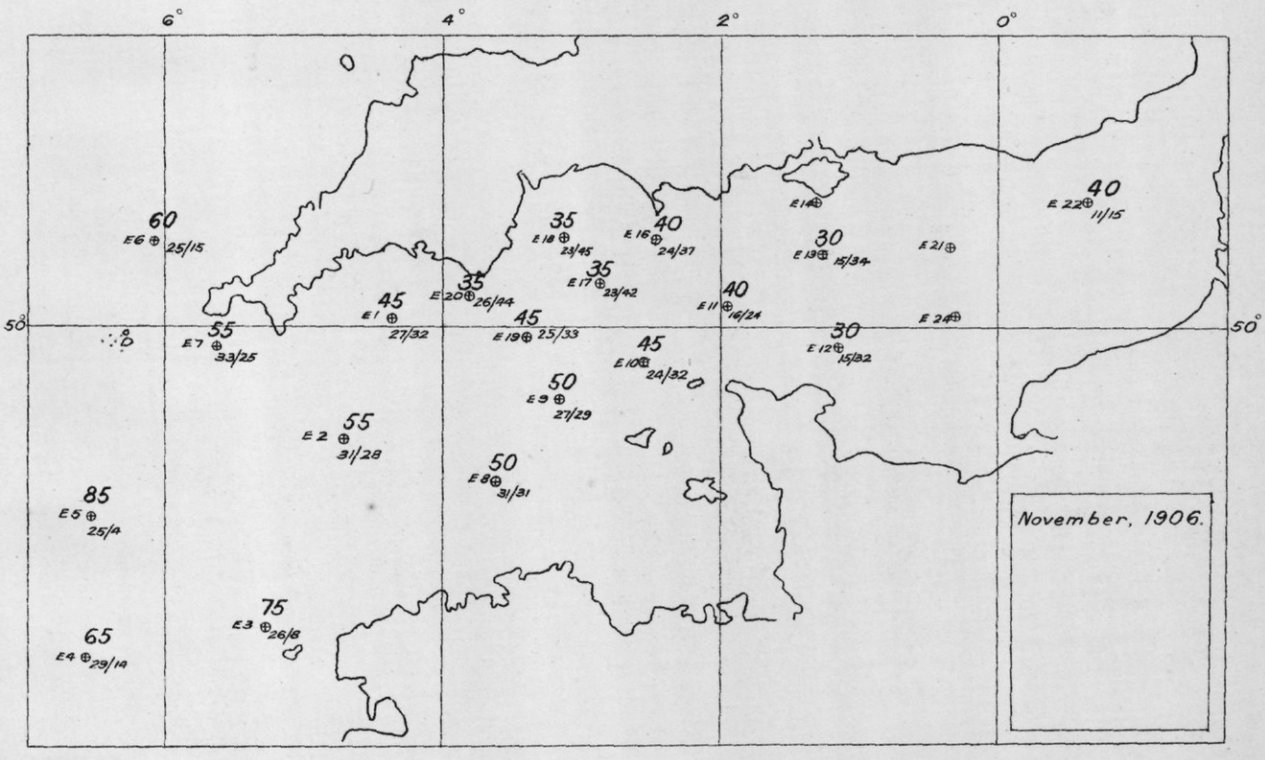


CHART 4.



Bygrave. Plankton of English Channel.

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Weller & Graham, Ltd. Litho, London.

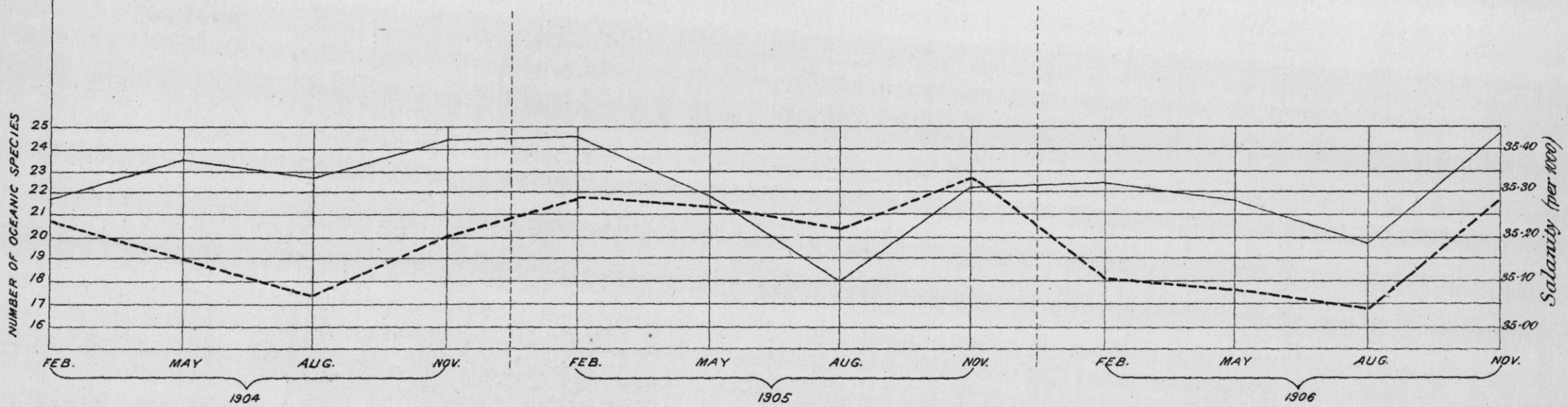
1904				1905				1906			
FEB.	MAY	AUG.	NOV.	FEB.	MAY	AUG.	NOV.	FEB.	MAY	AUG.	NOV.
21·7	23·5	22·7	24·3	24·5	21·9	18·0	22·2	22·4	21·6	19·8	24·7
35·23	35·15	35·07	35·20	35·29	35·27	35·22	35·33	35·11	35·08	35·04	35·28

AVERAGE NUMBER OF OCEANIC SPECIES PER STATION.
Average Salinity per Station.

CHART 5.

CHART SHOWING VARIATIONS OF SALINITY AND OF NUMBER OF OCEANIC SPECIES.

Salinity ..... shown thus ------
Number of Species " " ——



Bygrave. Plankton of English Channel.

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REPORT ON THE

PHYSICAL CONDITIONS

IN THE

ENGLISH CHANNEL AND ADJACENT WATERS, 1906,

WITH A NOTE ON THE MEAN CONDITIONS FOR 1903–1909.

BY

DONALD J. MATTHEWS.

With Figures 1–3 and Plates 1–4.

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ENGLISH CHANNEL AND ADJACENT WATERS, 1906, WITH A NOTE ON THE MEAN CONDITIONS FOR 1903-1909.

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INTRODUCTORY.

The hydrographic investigations in the English Channel were carried out during the year 1906 according to the programme of the previous year,* on board the Marine Biological Association's steamers *Oithona* and *Huxley*.

In addition to the observations made on the four quarterly cruises, surface samples were collected and temperatures recorded every fortnight on board four cross-channel steamers, and every week on five lightships.

As in previous years, the Nansen-Pettersson small model insulating water bottle was used, except on the three extra stations worked in August in the deep water of the Bay of Biscay, where the reversing water bottle and thermometer were employed.

The analyses of the water were made by Mohr's method against standard water supplied by the Central Laboratory at Christiania, and I take this opportunity of expressing my thanks to Mr. D. O. Mitchell for the care and accuracy with which he carried them out.

The observations on which this report is founded have already been published,† and are therefore not reprinted here.

It may be accepted as an axiom that for the purposes of fishery investigation it is not so much the mean hydrographic conditions as the deviations from this mean which are of primary importance, and this holds with special force in areas of which the fish fauna is fairly well known. The mean conditions have of course a bearing on such problems, and one would not expect to find a warm water fish in regions where the mean temperature is near freezing point; but it is only in comparatively unknown seas which have not been fished commercially that a knowledge of the mean conditions alone could be of much use, by suggesting, for instance, the possibility of fishing grounds hitherto untouched. In the British area, or at any rate in the English area, such conditions are not found. The kinds of fish present in sufficient quantity to make fishing a commercial possibility are a matter of common knowledge, and fishery investigation must be directed to determining the factors which influence the catch from year to year, to increasing this catch, and finally to furnishing, if possible, some forecast which will minimise the losses resulting from bad years, and enable those engaged in the industry to take advantage of a good year.

If the hydrographic conditions vary *irregularly* about a fixed mean and have done so for a long period of time, the fish population will have arrived at a state of equilibrium with this mean in the various regions, and in so far as it is affected by hydrographic conditions it will also vary irregularly about its own mean condition.

If on the other hand the hydrographic conditions undergo on the average a regular periodic change and have done so for a long period, we may suppose that the fish have reached a state of equilibrium with such periodic changes, and if abnormal deviations occur in the salinity or temperature or in the strength of the currents of the sea, they will

* Internat. Invest. Mar. Biol. Assoc. Report II., Part II. [Cd. 4641] 1904-1905. Matthews, Physical Conditions in the English Channel, &c., 1904 and 1905.

† Cons. Perm. Internat. pour l'Explor. de la Mer: Bulletin Trimestriel, année 1905-1906, Nos. 3 and 4, année 1906-1907, Nos. 1 and 2.

be affected abnormally only by such deviations, just as the land flora follows the course of the seasons every year, and is affected by abnormal spells of high or low temperature, of drought or of heavy rain.

We know that there is a regular seasonal variation in the temperature of the sea, and in the movements and conditions (*e.g.* spawning) of some fish ; and if we wish to look for any connection between the two we must not consider the deviations from the mean temperature of the year, but rather the deviations from the mean temperature for each period of the year.

With regard to salinity the problem is more complex. If there is a regular seasonal change here also, and the fish are affected by the changes in the salinity, or, more probably by other factors such as food supply which may change with the salinity or be influenced by it, then we must fix our attention on the deviations from the weekly or monthly mean salinity ; and if superimposed on the seasonal change there are also changes of longer period which affect but do not obliterate the seasonal change we must endeavour to trace these also. The difficulty increases rapidly with the length of the period because changes which require years for their completion demand a great increase of the length of time over which regular observations must be carried out.

The question then arises, is the salinity subject to any periodic change ? Such changes with a period of one year have been clearly demonstrated in other regions, and the author of the present paper considers that he will be able to prove beyond dispute that a similar change takes place in the whole of the water of the English Channel on the surface, and at all depths in the part lying to the eastward of Start Point, and that it is also probable that there is superimposed on this yearly change another change which is completed every two years, though of course the evidence for this has less than half the weight of that for the yearly change. There also seem to be signs of a much slower change with a period of perhaps twelve years, but this would require investigations carried on for at least fifty years more for its elucidation. So far the only evidence for it is in a fairly regular fall in the salinity of the western part of the English Channel from the beginning of the international investigations in 1903 up to the date of the present paper (November, 1909). More complete analysis of the curves may show that this long period variation is really composed of others of very different lengths.

If we consider the bottom waters of the western area as a whole, the evidence in favour of a yearly period is unconvincing, and there is so little difference between the means for the various months that it does not matter greatly whether we take as a basis of comparison the average for corresponding cruises or for the whole year. On the other hand the variations from time to time are often considerable, and it is extremely probable that further investigations would show that the salinity here also changes according to definite laws. The problem is one of considerable importance, because the bulk of the oceanic water in the English Channel is probably derived from this source ; the high salinity surface water which is sometimes found near Parsons Bank is confined to a very thin layer and appears to be too small in quantity to have any great influence on the general conditions.

Assuming then that there are regular periodic changes in temperature and in the salinity, it is clear that we ought to compare the conditions at any one epoch with the mean for the same epoch. In the case of changes which are completed in one year we compare the salinity or temperature with the means for the same date ; when the longer periods are considered, we take the mean for the corresponding phase.

The question then arises, what are the mean values for the various epochs. Knudsen has published a series of charts and sections of the mean conditions, and in the case of the temperature he gives the average values for the times of the four quarterly cruises. These averages are all that is required for the purpose, and only suffer from the disadvantage of having been founded on a comparatively short period. For salinity, however, he only gives a mean of the whole year, and this is clearly insufficient for the present purpose.

The author has in preparation a series of charts and sections showing the mean salinities, as far as possible, for every month in the year, and also for the "odd" and "even" years. The calculations are not yet complete, as it is intended to include all observations up to the end of 1909, but the following description of the chief points brought out will be of assistance in the discussion of the conditions during 1906.

THE MEAN CONDITIONS.

According to the programme arranged in 1903 the western boundary of the English hydrographic investigations was a line drawn north and south in about $6\frac{1}{2}^{\circ}$ W. longitude from the western side of the Scilly Islands to Parsons Bank, and though the cruises have

been extended of late years, it is only within the narrower limits that we have as yet sufficient observations to make it possible to draw reliable charts of the average distribution of temperature and salinity.

From the point of view of physical oceanography this area is divided naturally into two parts by a line drawn from Start Point to Guernsey. To the westward there is a broad and unbroken stretch of relatively deep water, at least half of which shows soundings of fifty fathoms and upwards, and if we except the coastal shallows the depths are not less than thirty-six fathoms. The eastern part is more irregular ; the soundings are less, and fall to twenty-five fathoms near the Straits of Dover, and this progressive decrease in the depth, combined with the influence of the constriction between the Isle of Wight and the Cotentin Peninsula, gives rise to much swifter tidal movements than are found to the westward.

The observations made in the English Channel fall into two series. We have in the first place the investigations of the four quarterly cruises of February, May, August and November, which are made at all depths and under the most favourable conditions for accuracy over the whole of the English Channel ; and secondly, observations made regularly every fortnight since June, 1904, on board four cross-channel steamers in what may be called for convenience the " Central Area," between lines drawn from Start Point to Guernsey and thence to St. Brieuc, and from Newhaven to the mouth of the Seine. These latter observations are necessarily confined to the surface, and it might be supposed that for various reasons they would not be so reliable as those made on the special research steamers. The quarterly cruises have shown however that, at least at the times at which the latter are made, the tidal mixing of this central area is so complete that the water is nearly always of the same salinity at all depths, so that we are justified in considering that surface observations are all that is required here ; and the general regularity of the curves drawn from the analyses of the samples collected on the cross-channel steamers speaks well for their accuracy. Remarkable variations of course occur at times, but similar irregularities, on a somewhat smaller scale, have been found occasionally on the cruises, and it has been thought best under the circumstances to use all the material available, while drawing attention to any doubtful points.

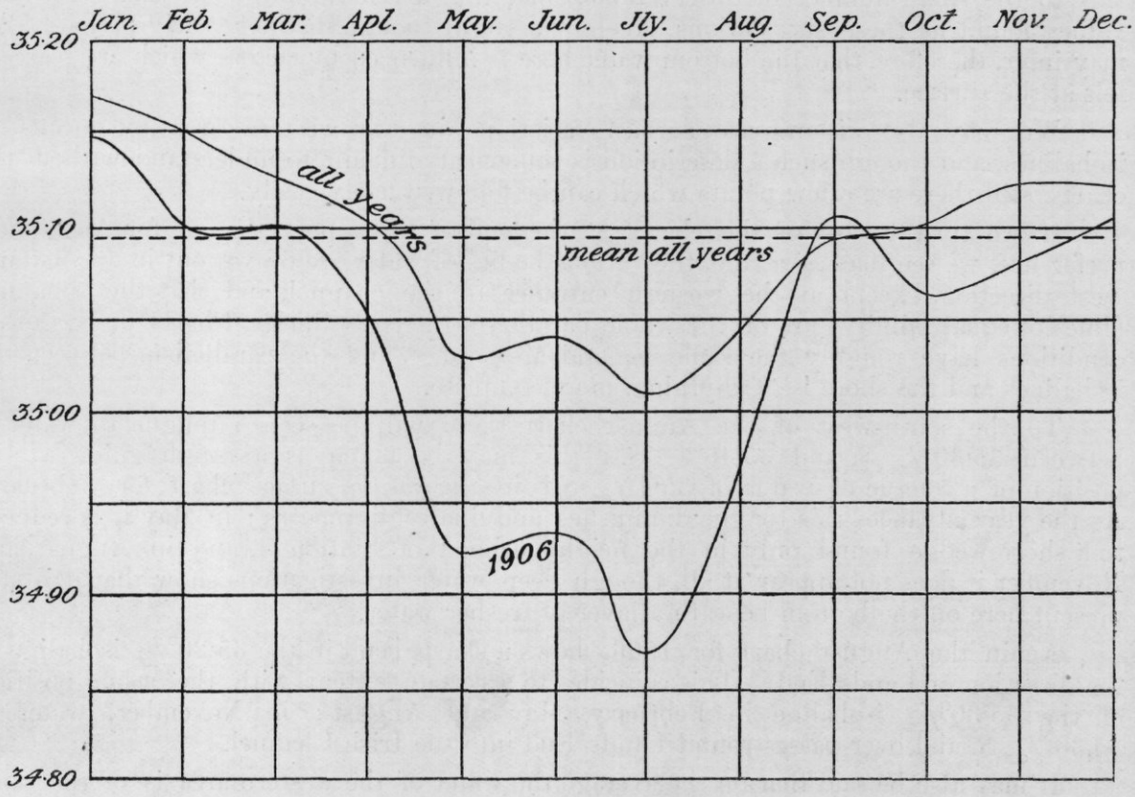

FIG. 1.—Curves of monthly salinities in the Central area. The curve marked " all years " is the mean of all observations made on the four cross-channel steamers from October, 1903, to September, 1909. The horizontal broken line marked " mean " is the mean of all observations irrespective of date.

Finally there are the observations made at the East Goodwin, Varne and Seven Stones Lightships. These are somewhat less useful than the others and show very irregular changes. The explanation is not far to seek ; the salter stream which is found in the central line of the channel not only advances and retreats in an approximately east and west direction, but also oscillates from side to side of the central line, and so it

happens that a slight retreat from the shore may give the appearance of falling salinities when as a matter of fact the salter water is actually pushing further eastwards.

It will be seen from what has been said above that our knowledge is most complete in the central area, and it is summarised in the curve marked "all years" in Fig. 1. This curve shows the average monthly value of the salinities of all the samples collected on board the four cross-channel steamers from June, 1904, to September, 1909, with the exception of a few taken so close to the mouth of the Seine as to be unduly influenced by river water. There is a well marked change during the course of the year; the salinities are at a maximum in January, and fall regularly, if we neglect a slight check in June, to a minimum in July, and then increase again to the end of the year, and as has been pointed out, we may assume that this change extends to all depths. The difference between the highest and lowest values is about $0{\cdot}16°/_{oo}$.

In the western area we have only the observations made at the times of the four quarterly cruises and at the Seven Stones Lightship. It is therefore somewhat difficult to express the changes by means of curves, and the charts of average salinity are not yet complete.

There are three lines on which surface salinities have been observed at ten mile intervals on every cruise, *i.e.*, from Plymouth to Ushant, from Ushant to Parsons Bank, and from Parsons Bank to Station 5.* If we treat these as representing or rather varying proportionately to the surface salinity of the western area, as has been done in the case of the fortnightly observations in the central area, we find that the highest values occur on the average in February and the lowest in August, and that the range is about $0{\cdot}07°/_{oo}$, or less than half that of the central area. There appears to be no doubt that here also there is a yearly period in the salinity of the surface, but it is not possible to say that the minimum falls in August; it may occur in July as in the central area, and the same doubt arises as to the date of the maximum.

It has already been mentioned that on the basis of the six stations in the western area the *mean* bottom salinity hardly varies throughout the year though, at any one time, there may be and often are large deviations from this mean. We can hardly attribute this to the small number of observations, since the surface salinities, calculated from the values found at these six stations, do show a slight though distinct yearly period. We may infer, therefore, that the bottom water here is influenced by factors which are scarcely felt at the surface.

We may also discuss the surface variations in the western area by means of isohalines, and though such a description is somewhat difficult to understand without the charts, still there are a few points which can be followed fairly easily.

If we turn to any of the charts at the end of this report, the one for August for preference, we see that, as a rule, the various bodies of water are drawn out in an east and west direction, except at the western entrance to the channel, and that the isohalines (lines of equal salinity) are on the whole parallel to the coast lines. Charts of the mean conditions have roughly the same general appearance, and the parallelism between the isohalines and the shore is, if anything, more complete.

To the south-west of the August chart there will be seen a tongue of water of between $35{\cdot}30°/_{oo}$ *S.* and $35{\cdot}40°/_{oo}$ *S.*; this may be taken as a rough guide to the position of a tongue of water of $35{\cdot}4°/_{oo}$ *S.*† in the *mean* surface chart for February. As the year advances this tongue diminishes and finally disappears; in May it is reduced to a short wedge found only in the neighbourhood of Station 4, and in August and November it does not appear at all, though deep water investigations show that it is still present here on the bottom beneath a layer of fresher water.

Again the August chart for 1906 shows a sharp bend in the $35{\cdot}20°/_{oo}$ isohaline in the direction of Lands End. This coincides to a certain extent with the *mean* position of the $35{\cdot}30°/_{oo}$ isohaline in February, May and August; in November, water of $35.30°/_{oo}$ *S.* and over passes round Lands End into the Irish Channel.

It may also be said that on the average the water of the western area is of the same composition from surface to bottom in February and May; in August and November it is divided into layers of different salinity, and it is only the upper and fresher layer which shows a well marked seasonal change.

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* The positions of these points can be found in the larger charts at the end of this report.

† $35{\cdot}4$ $°/_{oo}$, giving only one decimal place, is to be understood as including all values from $35{\cdot}40$ $°/_{oo}$ to $35{\cdot}49$ $°/_{oo}$; and so with other figures.

THE CONDITIONS DURING THE YEAR 1906.

The curves of Fig. 1 give a general idea of the course of the changes in the central area considered as a whole. The salinity was below the general mean during the larger part of the year, and the average defect for the whole of the period was about 0·054 $^{\circ}/_{\circ\circ}$; it was also below the monthly mean at all times except in September. The yearly period was well marked, with a maximum in January and an abnormally low minimum in July.

The surface salinity of the western area does not lend itself readily to such treatment, but we can get a general idea of the conditions by comparing the surface observations on the line from Plymouth to Ushant, Parsons Bank and Station 5. The average value on this track irrespective of year or month, is 35·331$^{\circ}/_{\circ\circ}$, and the figures in the accompanying table show that in 1906 there was a defect in August only and that the maximum occurred in May.

Average for all cruises and years ...	35·331	35·331	35·331	35·331
	February	May	August	November
1906	35·363	35·371	35·309	35·339
	+0·032	+0·040	−0·022	+0·008

Comparing the figures for the four cruises with the corresponding means for the same months,

	February	May	August	November
Mean salinity in	35·370	35·331	35·299	35·326
1906	35·363	35·371	35·309	35·339
	−0·007	+0·040	+0·010	+0·013

we find that the salinities were nearly normal except in May, when they were somewhat above the monthly mean, so that the maximum occurred in that month instead of in February. If we compare the mean salinity for the whole of 1906 with the mean of all the years we find that there was an excess of 0·014$^{\circ}/_{\circ\circ}$.

The mean *bottom* salinity of the western area, calculated from the observations on stations only, is 35·327$^{\circ}/_{\circ\circ}$, the corresponding value for 1906 was 35·344$^{\circ}/_{\circ\circ}$, showing an excess of 0·017$^{\circ}/_{\circ\circ}$, about equal to that found at the surface.

Comparing the separate cruises with the general mean, one sees that there was a defect in February only, and that the excess was greatest in May.

Average of all years and months ...	35·327	35·327	35·327	35·327
	February	May	August	November
1906	35·308	35·370	35·347	35·352
	−0·019	+0·043	+0·020	+0·025

The values for 1906 were alternately high and low, and there seems to be no regular change.

If one uses the mean bottom salinities for each of the four months as a basis of comparison

	February	May	August	November
Mean for all years	35·345	35·329	35·318	35·315
1906	35·308	35·370	35·347	35·352
	−0·037	+0·041	+0·029	+0·037

we again find a defect in February, but there is still no regular change or distribution of excess and defect such as was found in the central area, and for the present all we can say is that the observations at present available are insufficient for such a method of treatment.

In *January* the observations were confined to the surface of the central area, where the salinity was at its maximum for the year, and a fairly extensive body of water of $35{\cdot}4^{\circ}/_{\circ\circ}$ *S.* is shown on the chart off Start Point. The average salinity of the whole area was above the annual mean, but less than that for the month.

The *February* cruise showed that the general distribution of salinity agreed fairly well with monthly mean, the chief points of difference shown on the surface chart being the break in the $35{\cdot}3^{\circ}/_{\circ\circ}$ water southward of Start Point and its northerly extension past Lands End, combined with an unusually strong southerly flow of lower salinity to the westward of the meridian of the Scilly Isles.

If we compute the average surface salinity we see that in the central area it had fallen since January, and now agreed almost exactly with the annual mean, but was about $0{\cdot}05^{\circ}/_{\circ\circ}$ lower than the mean for the corresponding monthly period. In the western area the surface salinity was both actually and relatively higher, even if we neglect the north western part of it, and showed an excess of $0{\cdot}032^{\circ}/_{\circ\circ}$ over the annual mean and a defect of only $0{\cdot}007^{\circ}/_{\circ\circ}$ when compared with the average for the month.

As is normally the case in February, the isohalines were generally vertical, if we neglect the thin surface layers at Stations 5 and 2. If we calculate the bottom salinity in the western area from the bottom samples at the six stations we find that it fell short of the annual and monthly means by $0{\cdot}019^{\circ}/_{\circ\circ}$ and $0{\cdot}037^{\circ}/_{\circ\circ}$ respectively. Such calculations are never satisfactory when founded on a small number of observations, and in the present instance are probably misleading ; for we find that the average surface salinity at these stations was $35{\cdot}325^{\circ}/_{\circ\circ}$, exactly equal to the yearly mean and $0{\cdot}047^{\circ}/_{\circ\circ}$ less than the mean for the month. The mean of all the surface observations at ten mile intervals on the runs between Plymouth and Station 5 showed an excess over the annual mean of $0{\cdot}032^{\circ}/_{\circ\circ}$, and on account of their much larger number they are more reliable. If we increase the bottom salinity by this amount we get an excess over the annual mean of $0{\cdot}013^{\circ}/_{\circ\circ}$, and a defect of only $0{\cdot}005^{\circ}/_{\circ\circ}$ from the monthly value. We are probably justified in doing so because the $35{\cdot}4^{\circ}/_{\circ\circ}$ surface water was present in about normal quantity, but was so distributed as to avoid the stations almost entirely. On the whole, we may say that the water was below the average salinity for the month everywhere, but only very slightly so in the western area, while it was equal to the annual mean in the central area and above it to the westward.

For *March* and *April* there are only the observations of the cross-channel steamers. In March a break appeared in the $35{\cdot}3^{\circ}/_{\circ\circ}$ water to the north-west of the Cotentin Peninsula, and became more pronounced in the following month ; the curve shows no fall from March to April, and the change must have been due at first to mixing only, but later to dilution also. In both months the salinity was lower than the average for the corresponding epochs, but a defect from the annual mean occurred in April only.

At the time of the *May* cruise the salinity of the central area was very low, though it had not yet reached its minimum. Water of $35{\cdot}3^{\circ}/_{\circ\circ}$ *S.* was no longer found eastward of Start Point, and the isohalines of $35{\cdot}20^{\circ}/_{\circ\circ}$ and $35{\cdot}10^{\circ}/_{\circ\circ}$ were broken to the southward of the Isle of Wight, while the salinity of the area, as a whole, was much less than the average either for the year or for the month.

In the western area the conditions were entirely different, and the chart shows abnormally high salinity. The $35{\cdot}30^{\circ}/_{\circ\circ}$ isohaline passed far to the northward of its mean position round Lands End, and the area enclosed by that for $35{\cdot}40^{\circ}/_{\circ\circ}$ was greater than normally is the case in May ; and finally to the extreme south-west was found an area of water with a salinity as high as $35{\cdot}5^{\circ}/_{\circ\circ}$ which does not appear on any of the charts of mean conditions.

On the lines from Plymouth to Station 5 the surface salinity, calculated from the observations made at intervals of ten miles, was higher than the mean for either the year or the month by $0{\cdot}40^{\circ}/_{\circ\circ}$, and the average bottom salinity showed an excess of almost exactly the same amount over the corresponding monthly and yearly values.

The sections show that the isohalines were still approximately vertical except between Plymouth and Ushant ; near the latter position the difference between surface and bottom was as much as $0{\cdot}13^{\circ}/_{\circ\circ}$, a decidedly unusual condition to find in an area of such strong tidal mixing.

The difference between the general characters of the distribution in the two areas which showed itself in February was accentuated in May. In the central area the defect from the monthly mean had increased, while the almost negligible deficiency of the western area had been replaced by a decided excess.

In *June* the salinity of the central area was very slightly higher than in May ; the chart shows a rather unusual condition, even for the time of the minimum, with no water as high as $35{\cdot}00^{\circ}/_{\circ\circ}$ between Newhaven and the mouth of the Seine.

July was the month of lowest salinities for the year, in the central area at any rate, where there was a defect of about 0·14°/$_{oo}$ below the average July value and as much as 0·22°/$_{oo}$ below the yearly mean.

In *August* the salinity of the central area showed a considerable rise though it was still much less than the monthly or yearly averages. The salinity of the western area was lower now than at the times of the other cruises, but the date of the actual minimum is uncertain. The observations made at the Seven Stones Lightship put it in this month, but owing to their position the evidence is inconclusive.

The chart shows a considerable change since May. The isohaline for 35·30°/$_{oo}$ had been driven westwards and southwards by an increased southerly current from the Irish Channel, and water of 35·4°/$_{oo}$ was found at two positions only, on the surface, where it probably formed a thin layer not extending to any depth. In spite of this the salinity on the lines between Plymouth and Station 5 was still slightly above the average for the month, but it is unfortunately impossible to include in the calculation the area where the change was most marked as the course followed here has been altered from time to time. Compared with the annual mean there was a defect of 0·022°/$_{oo}$. The water of 35·5°/$_{oo}$ shown on the chart lies outside the usual area of investigation and will be discussed later.

The sections show that the water in the western area was divided into layers of varying composition as is normally the case during the latter half of the year and particularly at the time of the August cruise. The average salinity on the bottom at the six stations was higher than the monthly and yearly means by 0·029°/$_{oo}$ and 0·020°/$_{oo}$ respectively.

The transverse section from Station 4 to Station 6 presents several points of interest. Water of 35·4°/$_{oo}$ was still present at Station 4, but was now confined to the lower layers. The surface salinities at Stations 5 and 6 were unusually low owing to the influence of the Irish Channel, and at Station 5 the highest values were found between the depths of 20 and 40 metres, an arrangement which appears to be normal.

In *September* the salinity of the central area underwent a sudden increase and was slightly above the monthly and yearly averages. The cause of this change is doubtful and the abnormally high value (35·88°/$_{oo}$) found at one position on the Southampton—St. Malo line might be considered as pointing to some inaccuracy ; but on the other hand the average salinity on the line from Newhaven to Caen also showed a sudden rise.

There is another consideration which tends to confirm the general accuracy of the curve. As has been mentioned already and will be explained more fully later, there appear to be two distinct types of annual change in the central area, which occur in alternate years. The curves of Fig. 3 show that the general course of the changes during 1906 followed the type of the "even" years to which it belongs with remarkable fidelity, but with decidedly lower values, until August, when the two curves almost coincide. In September the curve for 1906 was above the monthly mean, but in October it returned to the "even" year curve and followed it for the rest of the year, but now on the side of excess. One might imagine in fact that the changes had followed the "even" year type throughout, but that a sudden increase in the salinity had spread quickly over the whole of the surface of the Channel and had brought the curve permanently from the side of defect to that of excess.

In *October** the salinity of the central area was lower than in September, but in other respects it showed the general autumn rise, and water of 35·3°/$_{oo}$ *S.* is marked on the chart between Start Point and the Channel Islands. The average was still below the monthly and yearly means.

At the time of the *November* cruise the salinity had nearly reached the mean value in the central area, but it was still somewhat low for the time of the year.

In the western area the surface salinities were abnormally high for this month. The chart shows a considerable area of 35·4°/$_{oo}$ water, which on the average is not found now on the surface, and 35·3°/$_{oo}$ water again passed round Lands End. Between Plymouth and Station 5 there was an excess of 0·008°/$_{oo}$ over the yearly average and of 0·013°/$_{oo}$ over that for the month. Unfortunately this high salinity water was not found on any of the stations and there is some doubt as to how it should be represented in the sections. The author has taken the view that it was continuous to the bottom in most places, spreading out somewhat on the surface near its edges, a view which is confirmed to a certain extent by the average bottom salinity at the stations, which was 0·037°/$_{oo}$ above the monthly values, and 0·025°/$_{oo}$ above that for the year.

The sections show that the western water was still divided into layers of varying salinity at Stations 4 and 5, but not at 6 and 7 as in August.

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* The charts for October and December have been accidently misplaced on Plate 4.

Finally in *December* the salinity of the central area rose to above the yearly mean value, though it still fell short of the average for the month. The chart shows the presence of the isohaline of 35·40°/$_{oo}$ for the first time since December 1905, if we neglect the abnormal conditions of September.

TEMPERATURE.

The author's calculation of the mean temperatures in the depths has been completed up to May, 1909, but the surface charts are not yet ready, and for purposes of comparison it will therefore be necessary to use Knudsen's surface values, founded in the shorter period from February, 1903, to May, 1906.

The surface temperatures in the central area observed by the cross-channel steamers do not appear to be so reliable as the salinities, and the following discussion will therefore be confined to the months of the four quarterly cruises.

February.—In February the temperatures were the same or nearly so at all depths on any station, and were normally distributed in that the coldest water was found under the shores and in the eastern part of the Channel. They were decidedly lower than the mean for the month and ranged from 10° C. down to less than 6° C. ; according to Knudsen's charts the mean only falls below 7° in the coastal waters of northeastern France. The chief defect from the mean was in the area of water of 10° C., which was found only in the neighbourhood of Station 4 instead of reaching the meridian of Ushant.

The following table gives the mean bottom temperatures for the month on the western stations, calculated on seven years' observations, and those observed in 1906.

Bottom Temperatures for February.

——	Station 4.	Station 5.	Station 7.	Station 6.
	C.°	C.°	C.°	C.°
Mean of seven years	10·20	9·64	9·15	8·89
1906	10·07	9·19	8·70	8·45
	−0·13	−0·45	−0·45	−0·44

May.—In May the surface temperatures were again below the normal. Water of a temperature as high as 11° C. was only found as a thin surface layer round Station 7 south of Lands End ; Knudsen draws the 11° C. isotherm in the neighbourhood of Ushant. The 10° C. isotherm ran northwards from Ushant towards the English coast and then turned northwestward with the 35·3°/$_{oo}$ water into the Irish Channel. That for 9° C. followed an irregular north and south course from Start Point, and coincided roughly with Knudsen's 10° C. line. To the eastward the temperature was between 8° C. and 9° C., about 1° below the mean.

Bottom Temperatures for May.

——	Station 4.	Station 5.	Station 7.	Station 6.
	C.°	C.°	C.°	C.°
Mean of seven years	10·30	9·81	9·78	9·55
1906	10·28	9·53	9·57	9·32
	−0·02	−0·28	−0·21	−0·23

The western bottom temperatures were still below the mean, but less so than in February, and the isotherms were nearly vertical, though the surface layer showed some signs of seasonal warming.

August.—In this month the temperature distribution undergoes a complete change in comparison with the two previous cruises of February and May. The surface water is strongly heated by the sun, and this heating reaches progressively greater depths as the water becomes shallower and the tidal mixing stronger. The general course of the isotherms tends to become horizontal.

The warmest water, 18° C. and over, was found stretching northeastward on the surface from Station 4. It was surrounded by a broad band of water of between 17° and 18° C., and outside this by narrow bands of water with temperatures down to less than 16° C. In the central and eastern areas the temperatures lay in the reverse order; under the English coast they were above 16° C. and fell to less than 15° C. in the central line of the Channel. The surface chart shows two minor points of interest; one is the sharpness of the dividing line between the hot and cold currents westward of Ushant, where the temperature changes by 4° in the course of a few miles; the other the peculiar kink in the 17° C. line in the neighbourhood of Station 2, where it follows the isohaline of $35{\cdot}30°/_{\infty}S$.

A comparison with Knudsen's charts shows that the surface temperature was above the mean in the western part of the Channel and below it in the eastern part.

The sections show that on the western stations the seasonal heating had little influence below 30 metres, at which depth or near it, there was a sudden change. Following the longitudinal section from Station 5 eastwards to Stations 2 and 19 we see the isotherms dipping to the bottom as the effect of the sun's rays penetrates more deeply into the shallower and more quickly moving waters. Eastwards of Station 19 the mixing was so complete that only the surface could be heated to a temperature appreciably above that of the bottom.

In the transverse western section, from Station 4 to Station 6, the conditions were similar and the isotherms were nearly horizontal, with the exception of that for 10° C., which followed the course of the low salinity current entering on the bottom from the Irish Channel.

BOTTOM TEMPERATURES FOR AUGUST.

——	Station 4.	Station 5.	Station 7.	Station 6.
	C.°	C.°	C.°	C.°
Mean of six years	10·72	10·16	11·83	11·59
1906	10·56	9·85	10·91	10·53
	−0·16	−0·31	−0·92	−1·06

The western temperatures were therefore slightly below the mean on the bottom in the southern half of the Channel and about 1° below it in the neighbourhood of the southwest coast of England.

November.—The surface temperatures in November were distributed in a somewhat peculiar way, which showed the broad features of Knudsen's mean chart. Between Start Point and the Cotentin peninsula lay an area of water with a temperature above 13° C., which was surrounded on all sides by slightly cooler water. The lowest temperature recorded was above 11° C. so that the total range was very small.

The temperatures were now fairly uniform from surface to bottom except at Stations 4 and 5, where the deviation of the isotherms from the vertical still showed some trace of the summer conditions. On Station 5 the 11° C. isotherm followed the course of the 10° C. isotherm for August.

BOTTOM TEMPERATURES FOR NOVEMBER.

——	Station 4.	Station 5.	Station 7.	Station 6.
	C.°	C.°	C.°	C.°
Mean of six years	11·84	10·78	12·45	12·47
1906	11·32	10·38	12·34	12·52
	− 0·52	− 0·40	− 0·11	+ 0·05

The bottom temperatures were still below the mean on the western stations except Station 6, but no defects approaching those of August were recorded.

DEEP WATER INVESTIGATIONS.

After the completion of the August cruise the *Huxley* made a five days trawling and dredging cruise along the edge of the deep water in the neighbourhood of La

Chappelle Bank. She was not at that time fitted with gear suitable for hydrographic work in such great depths, and it was not possible to work more than three stations or to make many observations on them. The observations are not sufficient to enable one to draw a section.

The only point of particular interest brought out was the salinity and temperature on Station C, in 820 metres (448 fathoms). The salinity rose steadily from the surface downwards and reached 35·62°/$_{oo}$ on the bottom, in the stratum which is generally supposed to have its source in the Mediterranean. The temperature, 16·10° C., was so high as to be open to grave doubt though it was perhaps not quite impossible considering the origin of the water. Similar abnormally high readings have been made since, in May and November 1909, at the same position and depth. On the two first occasions a single Richter reversing thermometer was used ; in November 1909, this was supplemented by a Negretti and Zambra reversing thermometer which showed a perfectly regular rise from bottom to surface, and it is therefore almost certain that the high readings were due to an error. The Richter instrument was only used for great depths, and accordingly very few opportunities had offered for testing its accuracy. When comparative readings had been made with it and with the Nansen-Pettersson insulating waterbottle it had always given excellent results, and it is possible that its failure in the deep water may have been due in some way to pressure.

THE TWO YEAR PERIOD.

Reference has been made in this paper and also in the report on the investigations of 1904 and 1905 to a two year period in the English Channel. This will be fully discussed in a later report on the general results of the hydrographic work during the years 1903 to 1909, which is now in preparation, but a few words on the question may not be out of place here.

The curves below, (Fig. 2) give the mean monthly salinities of the central area in the "odd" years 1903 (October to December only), 1905, 1907, and January to September 1909, in the "even" years 1904, 1906 and 1908, and also the mean of all years from 1903 onwards to September 1909.*

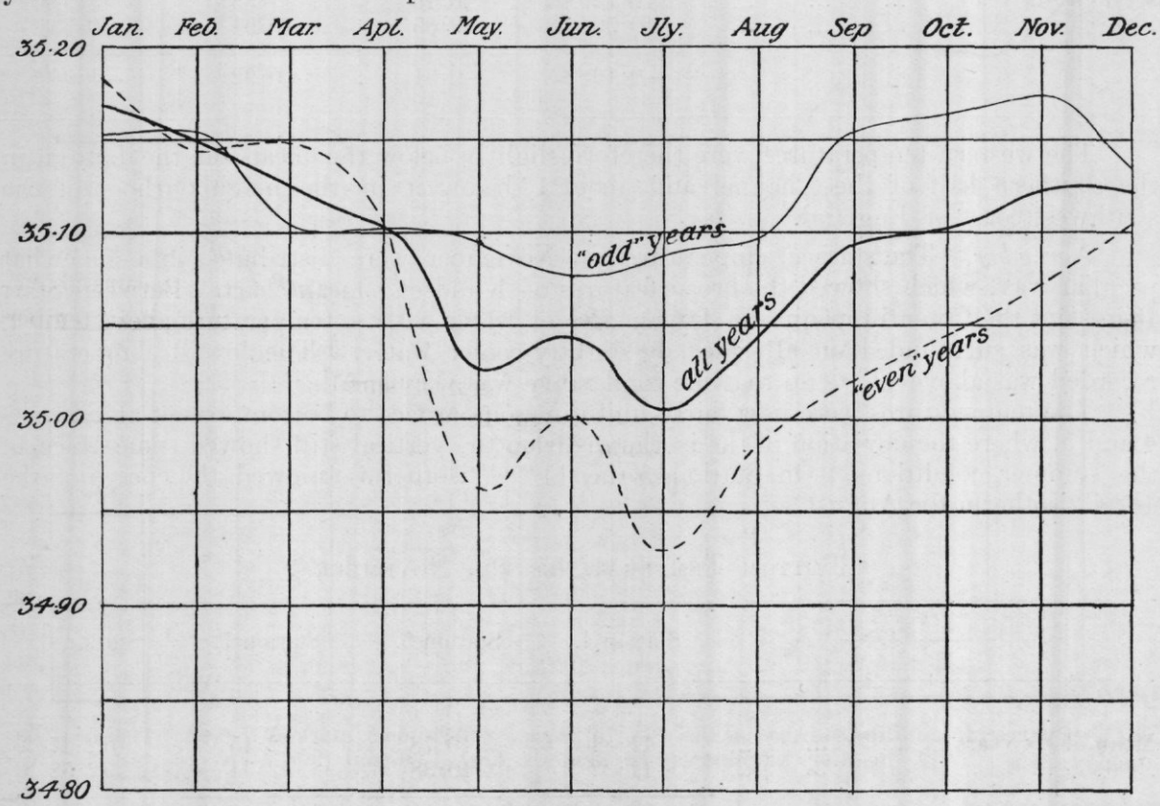

FIG. 2.—Curves of monthly salinities in the Central Area. Heavy curve : the mean of the observations made in all years from October 1903 to September 1909. Light curve : mean of the observations made in 1903, 1905, 1907 and 1909—"odd" years. Broken curve : mean of the observations made in 1904, 1906 and 1908—"even" years.

* The terms "odd" and "even" have been used for convenience, but it will probably be better to use the expressions "low range" and "high range." It is extremely probable that unperiodic changes, or changes of very long period, may give rise at times to accelerations or retardations which would result in the "even" years taking on the characteristics which in this paper have been described as belonging to an "odd" year. It is possible that such a change took place in the abnormal period 1902–1903.

The observations of 1903 have little effect on the result as there were only a small number of them. It is probable that they would have shown wide deviations from the curves, as 1903 was abnormal over the whole of the northern European area.

Neglecting the observations of 1903, we find that since then there have been alternately years of high and low range of salinity. In the "even" years there is a well marked maximum in January, a rapid fall from March to May, a slight rise in June and then a slower fall to a definite minimum in July, followed by a nearly uniform rise to the end of the year. The salinities are below the "all years" monthly mean except at the January maximum and in March.

The "odd" years show a lower and less definite maximum in January and February and also in November. The minimum is in June, but there is so little change that it might almost be said to last from May to August. The salinity is above the monthly mean except in January and March.

The mean range in all years is $0{\cdot}16^{\circ}/_{\circ\circ}$, in the "odd" years $0{\cdot}08^{\circ}/_{\circ\circ}$, and in the "even" years $0{\cdot}25^{\circ}/_{\circ\circ}$, three times that of an "odd" year.

In the western area it is not possible to show the difference by means of curves, as we have here only four sets of observations in each year. On the whole it seems probable that in the "odd" years the current of high salinity water from the Bay of Biscay sets in somewhat earlier than in the "even" years, and extends further up Channel. This appears particularly in the course of the $35{\cdot}40^{\circ}/_{\circ\circ}$ isohaline. In the "odd" years, in February, it encloses an island of high salinity, covering Stations 2 and 19, but cut off from the west by fresher water. In the "even" years it takes the form of a broad-based wedge which does not reach even Station 2. The subject will be treated more fully in the report on the general results of the investigations.

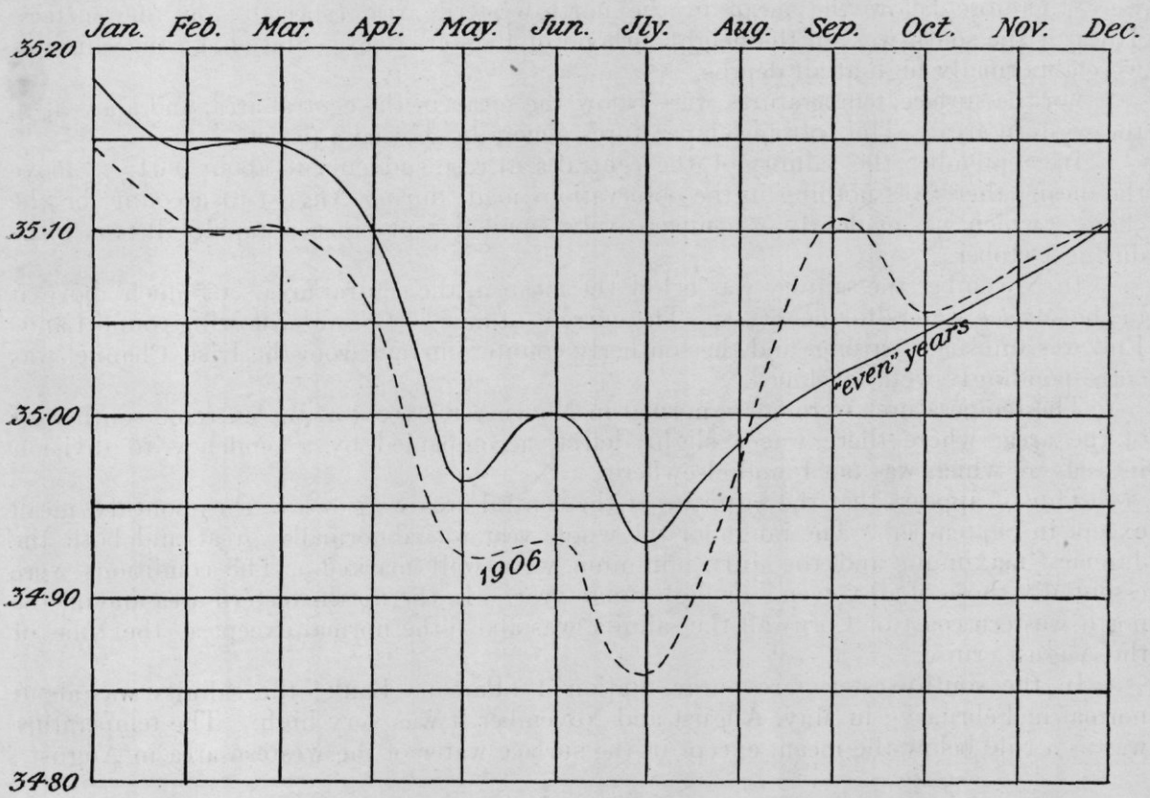

FIG. 3.—Curves of monthly salinity in the Central Area. The curve marked "even" years is the mean of the observations made in 1904, 1906 and 1908.

In Fig. 3* we have the central area curve for 1906 and for the mean of the "even" years. The agreement is remarkably good as to the general shape of the curve except in the month of September (see page). Before September the salinities of 1906 were below the "even" year mean, and slightly above it afterwards.

In the western area the conditions at the beginning of the year also approximated more nearly to the "even" type than to that of an "odd" year.

* There is a slight error in the broken curve in July and October. Compare Fig. 1.

SUMMARY.

During the first half of the year 1906 the water was of approximately the same salinity and temperature from surface to bottom.

At the beginning of the year the salinities in the Central Area were somewhat below the average ; in the western area they were nearly normal except in the north-western region, north and south of the Scilly Isles and Lands End. The current of water flowing from the English Channel round Lands End was of higher salinity than usual, and was accompanied by, and probably connected with an abnormal southerly set of low salinity from the Irish Channel.

The temperatures were below the average in February both at the surface and on the bottom.

The salinity of the central area continued to fall during March and April and was about as much below the monthly means as in January and February.

The May salinities were abnormally low in the central area, and also in the eastern half of the western region.

In the Scilly area the current passing northwards round Lands End was much salter than the average, while on Station 4 the salinities were very high, reaching $35{\cdot}50°/_{oo}$. The temperatures were still below the normal, but only very slightly so in the bottom water to the extreme south-west.

The minimum salinity of the central area was reached in July and was $0{\cdot}15°/_{oo}$ below the average for the month.

In August it rose rapidly but was still below the mean. In the western area the salinity was the lowest recorded during the year ; the minimum probably occurred during the preceding month.

The southerly flow from the Irish Channel was unusually strong, and the salinities were therefore below the mean in the north-western area, especially on the surface. Towards the south-west in the neighbourhood of Parsons Bank (Station 4) the salinities were abnormally high at all depths.

On the surface, temperatures were below the mean in the central area, and above it in the western area. The bottom temperatures generally showed a defect.

In September the salinity of the central area rose suddenly to about $0{\cdot}01°/_{oo}$ above the mean ; there was nothing in the observations made during August to account for the change, which was evidently of comparatively small extent since a rapid fall took place during October.

In November the salinity was below the mean in the central area, but much above it in the surface waters further west. The current of $35{\cdot}3°/_{oo}$ *S.* water flowing round Lands End was unusually strong, and the southerly counter current from the Irish Channel was correspondingly well developed.

The temperatures were fairly normal in November, except at the extreme south-west of the area, where there was a slight defect, accompanied by a tendency to division into layers which was not found elsewhere.

Thus it appears that the salinities of the central area were below the monthly mean except in September. The range for the whole year was abnormally great and both the January maximum and the July minimum were well marked. The conditions were essentially those of an " even " or high range year. In the north-western area and off the north-western coast of Cornwall the salinity was above the normal except at the time of the August cruise.

In the south-western area near Station 4 (Parsons Bank) the salinity was about normal in February ; in May, August and November it was very high. The temperature was as a rule below the mean, except in the surface water of the western area in August.

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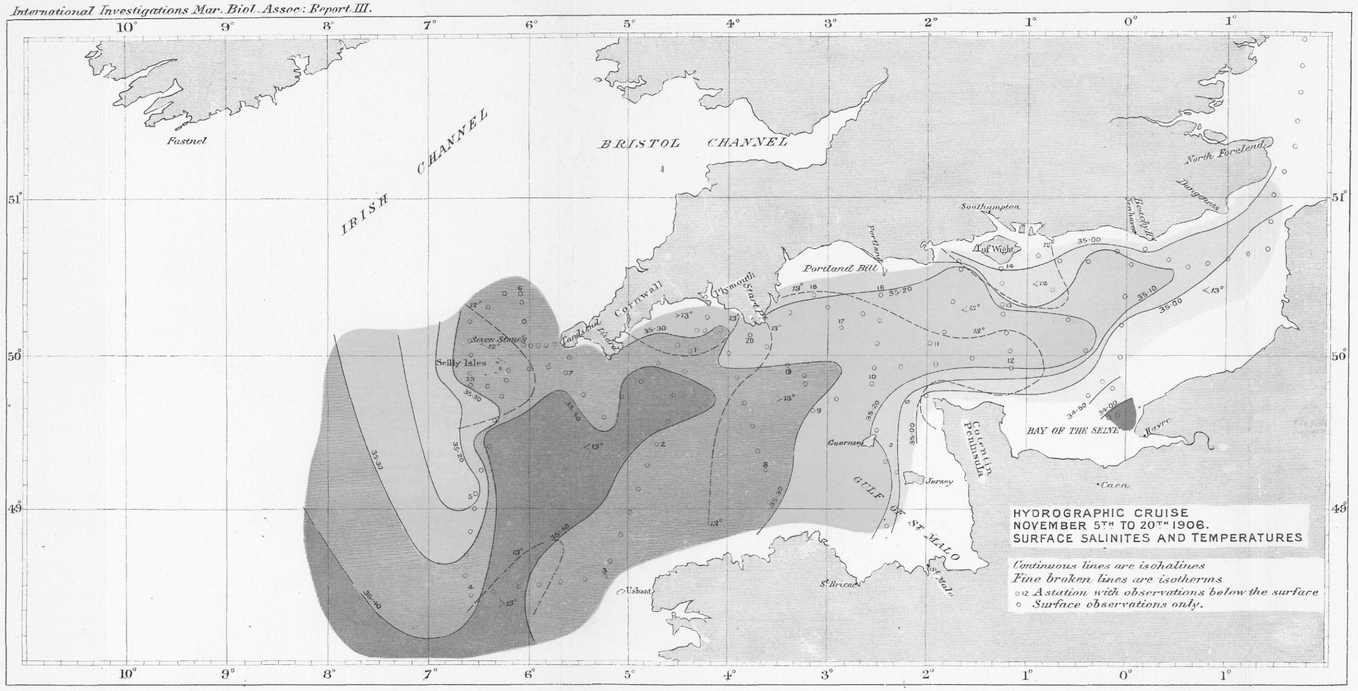
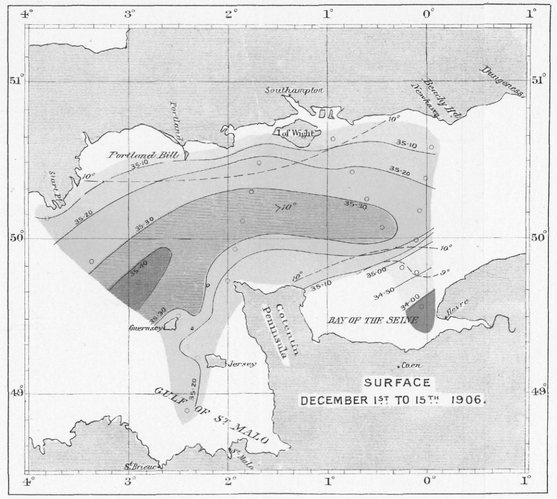
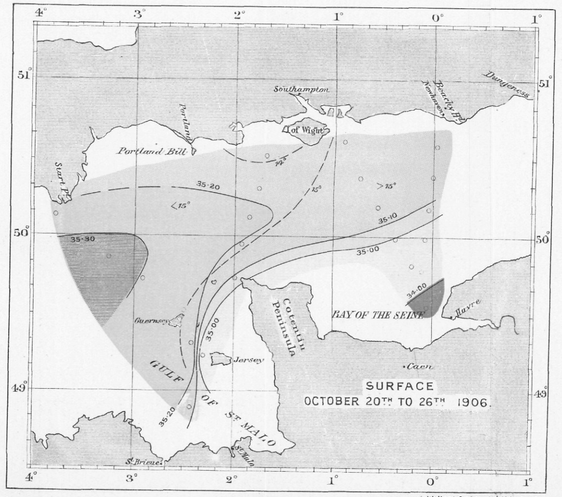
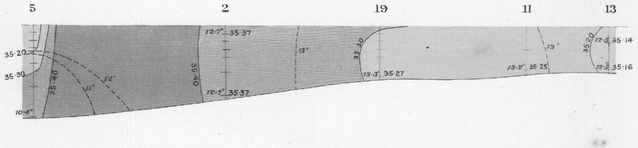


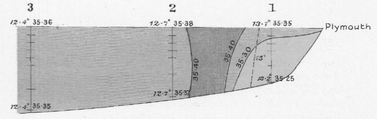


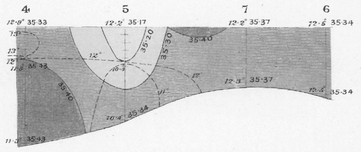


SCALE OF SALINITY COLOURING

BELOW 33·00
34·00
35·00
35·10
35·20
35·30
35·40
35·50 AND OVER







Fathoms Metres
50
50
100
150
100
200

SECTIONS NOVEMBER 1906.

Stations are shown by vertical lines with the number of the station above.
Observations below the surface are shown by short horizontal lines.
Isohalines are shown by continuous lines. Isotherms by broken lines.
The horizontal scale is the same as that of the charts.

Matthews. Physical Conditions in English Channel.

3314.

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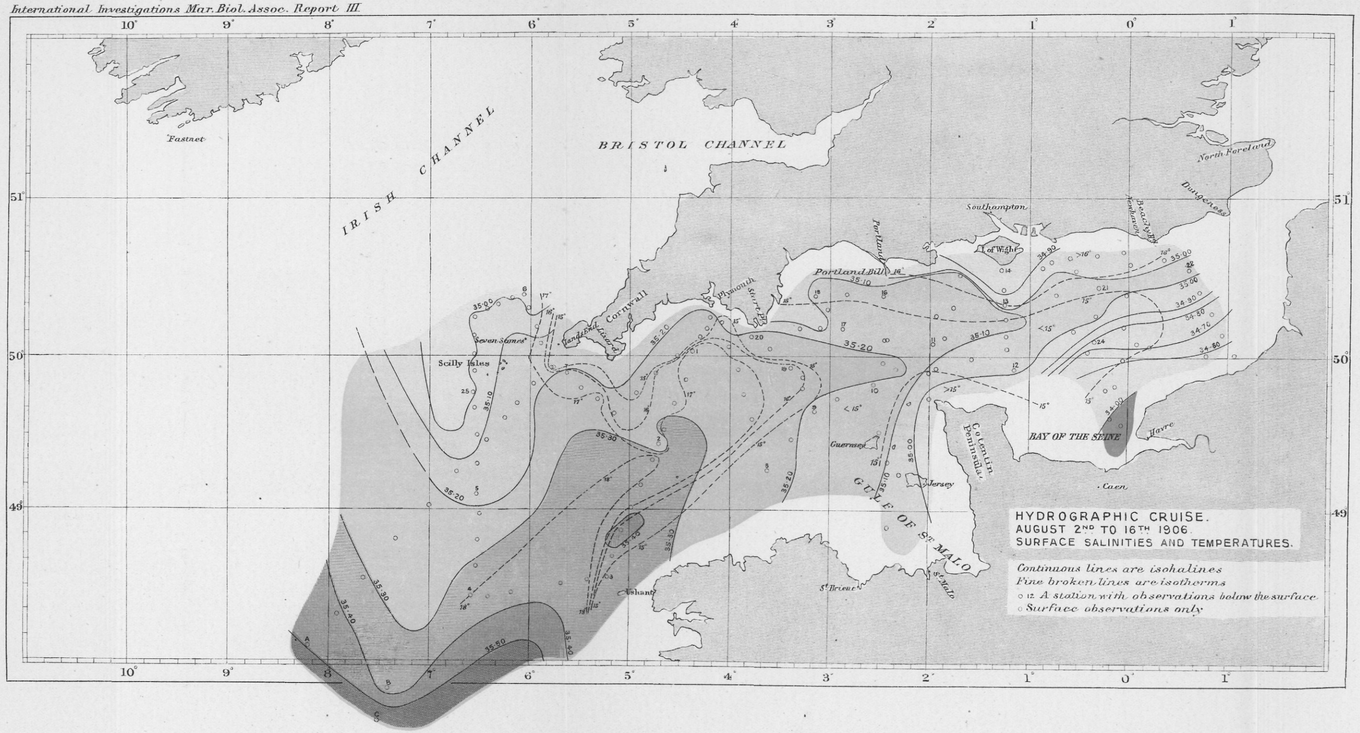

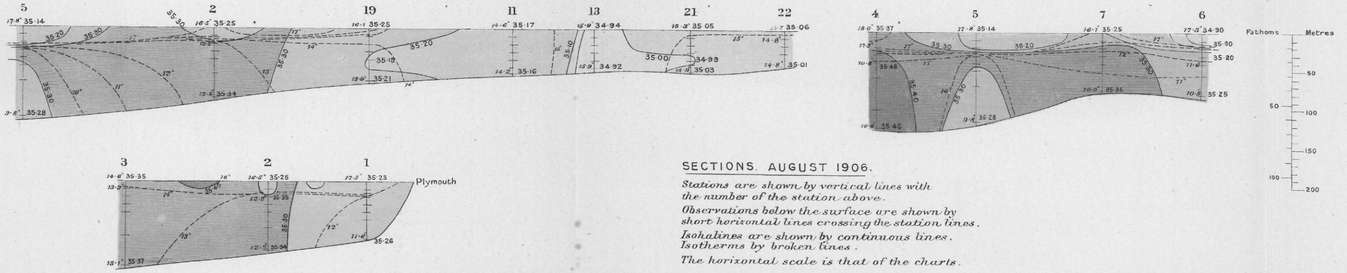

SECTIONS. AUGUST 1906.

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Isohalines are shown by continuous lines. Isotherms by broken lines.
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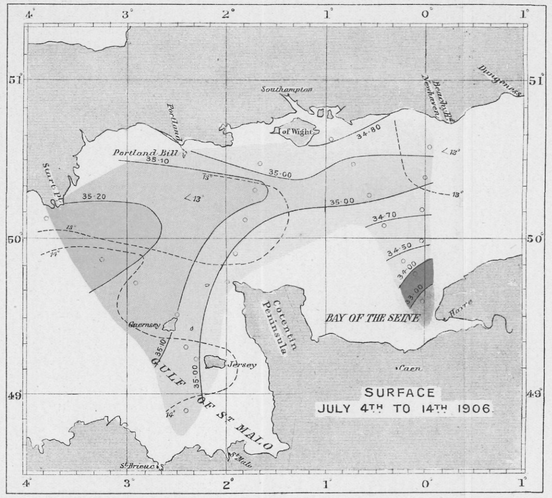

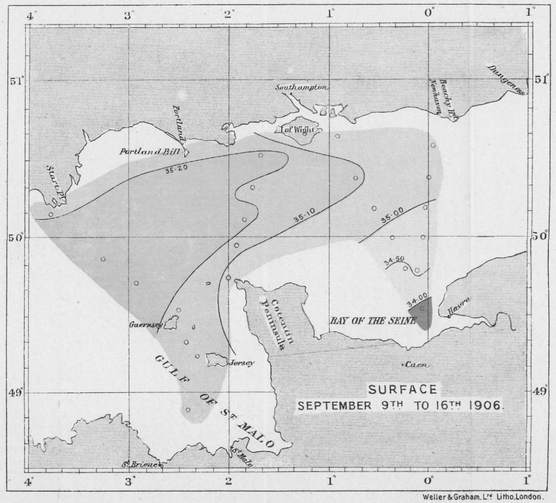

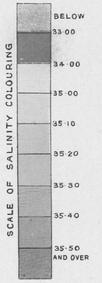

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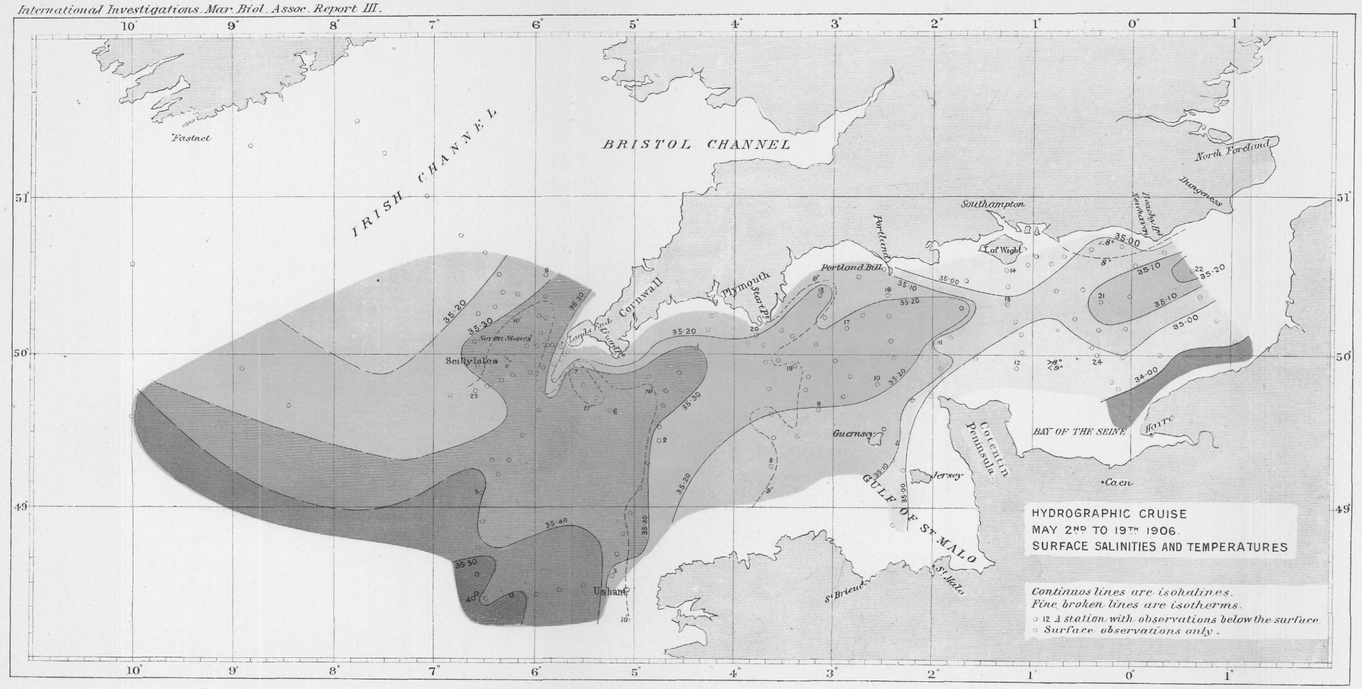

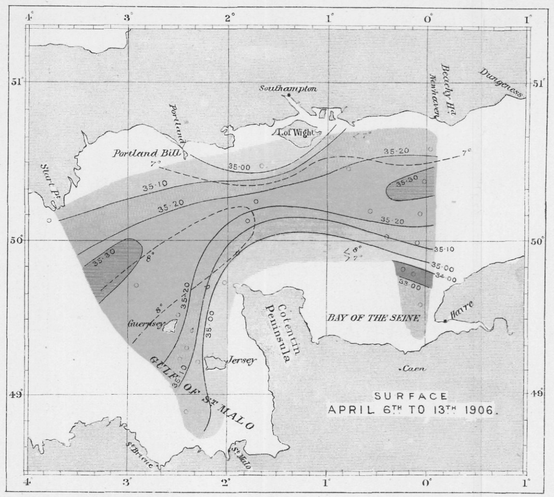

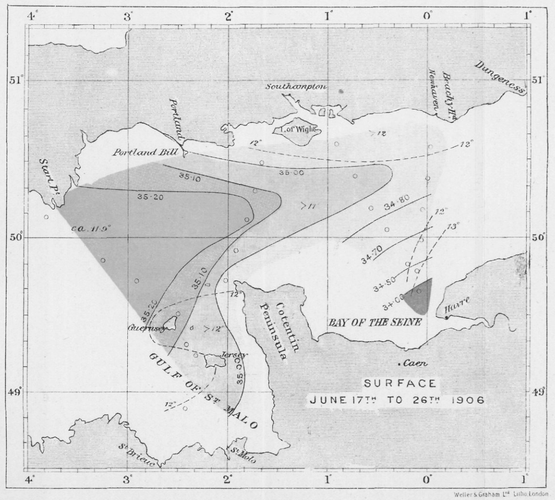

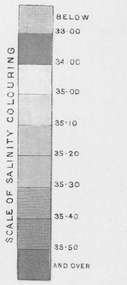

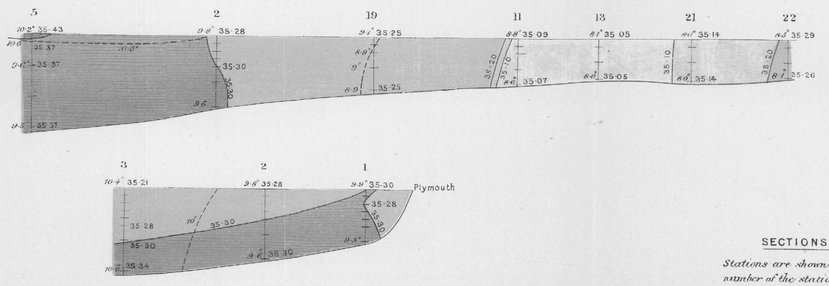

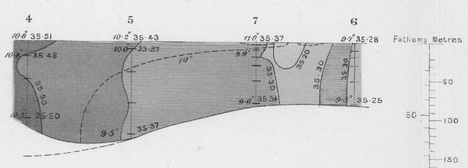

Matthews Physical Conditions in English Channel.

3534.

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Stations are shown by vertical lines with the number of the station above.
Observations below the surface are shown by short horizontal lines crossing the station lines.
Isohalines are shown by continuous lines.
Isotherms are shown by broken lines.

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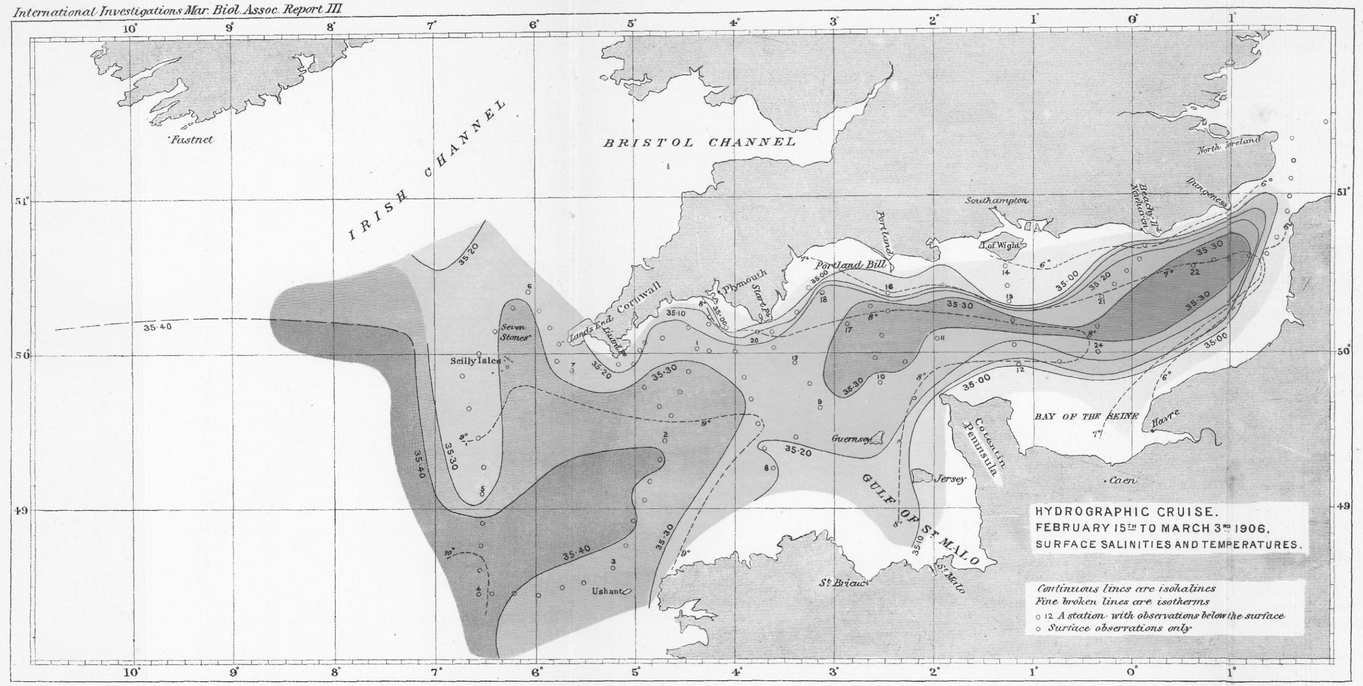

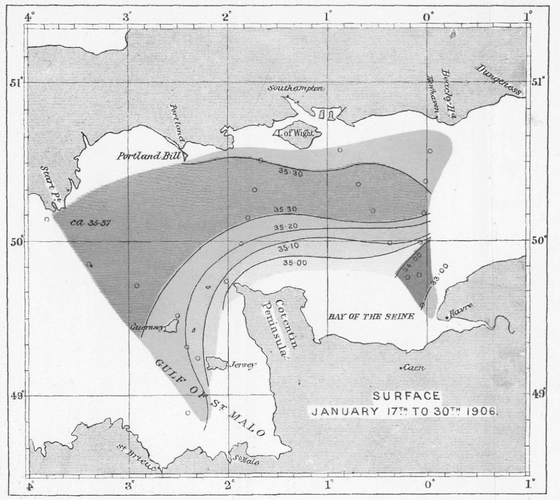

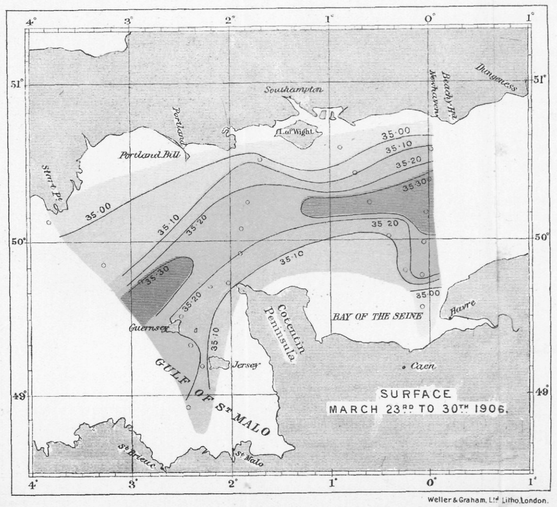

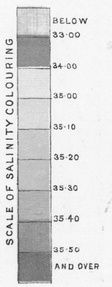

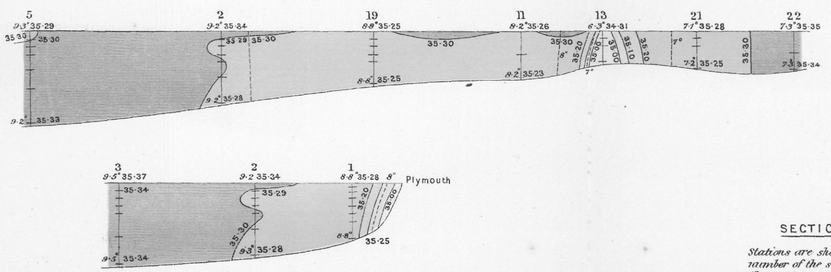

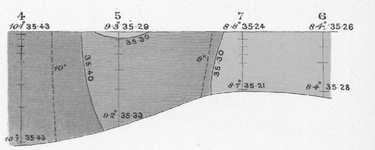

Matthews Physical Conditions in English Channel.

3334

SECTIONS. FEBRUARY, 1906.

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Isohalines are shown by continuous lines
Isotherms by broken lines

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