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Fishery Board for Scotland.

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REPORT
ON
THE DISTRIBUTION AND SEASONAL ABUNDANCE
OF
FLATFISHES (PLEURONECTIDAE)
IN
THE NORTH SEA AND THE FLUCTUATIONS
IN
THEIR ABUNDANCE DURING THE YEARS 1901-1910.
BY
T. WEMYSS FULTON, M.D., F.R.S.E.
(Scientific Superintendent of the Fishery Board for Scotland).
WITH FIFTEEN PLATES.

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I.—INTRODUCTION.

The following report is based upon a study of the special statistics collected from the Aberdeen steam trawling fleet during the years 1901-10, and is the third report which I have prepared on the subject. The first was published in the Twentieth Annual Report of the Fishery Board for Scotland for the year 1901.*

It described the system which I devised and which began to be put into operation in April, 1901, for ascertaining in a definite way the fluctuations in the abundance of the food fishes on the fishing-grounds, by obtaining and recording for each vessel (1) the place where the fish were captured; (2) the duration or extent of the fishing operations by which they were taken; (3) the date; (4) the particulars as to the kinds and quantities of the various fishes caught or landed. The necessity of taking the operations of the individual vessels as a unit was emphasised, and that throughout the manipulation and condensation of the statistics referring to a large number of vessels the various factors alluded to should be kept separate and distinct—the method of fishing, the quantities of the various species and classes of fish, the place of fishing, the duration or extent of fishing, and the season.

These statistics were collected under my direction, for publication in the Annual Reports of the Fishery Board, from April, 1901, until February, 1903, when it was decided that they should be handed over for the use of the International Committee, and since then they have been continued in connection with the international investigations, and gradually statistics from almost all the trawling fleet operating from Aberdeen have been included.

My second report was confined to the flatfishes, and was published in the first Report on the International Investigations (North Sea Investigation Committee. Report on the Fishery and Hydrographical Investigations in the North Sea and adjacent Waters, 1902-1903 (Cd. 2612), p. 471, 1905).

* Part III., Scientific Investigations, pp. 73-227 ("North Sea Investigations," 1902).

The present report is also confined to the flatfishes, and it deals with the statistics concerning them from the commencement in 1901 to the end of 1910. It has been prepared from tables and curves sent to me by Professor Thompson, the work of tabulating and calculating the averages having been done at Dundee. So far as was possible (from the published tables giving the particulars as to quantities, hours' fishing, &c.), I have had all the averages for the years 1901-1907 re-calculated, and any small discrepancies that were discovered adjusted.

THE METHODS OF THE INVESTIGATION.

In the former papers above referred to the methods and objects have been described, but a few words will not be out of place here. For the presentation of the results in relation to the fishing grounds or places of fishing, the North Sea was divided into imaginary square areas, formed by the intersection of each degree of latitude with every second degree of longitude, and each of these "squares" was numbered on the chart, from I to XLVIII, the catches and particulars from each being dealt with separately. The extent of the areas differs to some degree in different parts of the North Sea, but it is approximately for each about 3,600 square, Geographical, miles. This system has considerable disadvantages, inasmuch as in many of the squares the grounds included are of very different character and depth, and have consequently a different predominant fish-fauna, and unless one knows the part of the square where the fishing was carried on to the greatest extent in each month and each year, comparison between the various months and years may be inaccurate. For the interpretation of the statistics in an intelligent way it would be necessary to have charts showing the position where, in the various squares, each vessel fished in each month of each year, such as those for 1905 published by Professor D'Arcy Thompson in his paper dealing with the distribution of the Cod, Haddock, and Other Round Fishes for the period 1901-1906.* In these charts the place of fishing of each vessel was represented by a dot, and one could thus compare the positions in successive months in each of the squares. I venture to hope that a similar series of charts may be prepared for the whole period; the importance of the work fully justifies the cost.

I formerly expressed the opinion that it would be better to arrange the areas in a different way, according to the different fishing grounds, or "banks," so that one would be able to include in each of them grounds of more nearly similar character and depth, and this may yet be done. The important thing is to have the exact place of fishing of each vessel charted and recorded, so that it will be possible to re-arrange the statistics under a different system, either for the whole of the areas, for particular areas, or for certain parts of them, when it is desired to do so. This may become important with reference to a particular species of fish with reference to proposed regulations.

The question of the areas in the North Sea which should be selected for the best treatment of the statistics is one of great difficulty. If they are made too large then the disadvantages of different grounds, &c., above adverted to, come into operation. If they are made too small, the number of observations for comparison in different months or even years may become fragmentary and inadequate. At present there are at least four different systems of areas for statistical purposes adopted by one or other of the countries engaged in the international investigations, and it would be of much advantage if they were replaced by a uniform system, so that the records of all the different series could be readily compared. At the meeting of the International Council at Copenhagen, in 1909, I suggested that a more natural system would be to deal with each fish separately: to mark on the chart the mean or average catch of the particular species at the place where the vessel fished, and to collate these in the different months and years, and the Council remitted to me to report as to the best areas for statistical purposes. Considering the volume of the statistics already collected, especially in relation to the English trawl fishery, the work of re-casting the figures would be enormous and perhaps now impossible. But it is probable that it would not be necessary to do so, except for some species which appears to require legislative protection.

The region of the North Sea covered by these statistics of the Aberdeen trawlers is large, extending northwards from about the 56th degree of latitude, N.; but the amount of fishing in different parts varied much. In the extreme eastern and south-eastern parts

* North Sea Fisheries Investigation Committee. Third Report (Northern Area), 1904-1907, Cd. 4350, p. 317 (1908).

the fishing was less, and less regular, than on the western side, in particular from about the Shetlands to south of Aberdeen. The average catch in the various squares, so far as flatfish are concerned, for the whole period of 10 years is shown in table (p.); but in some of the squares where the fishing was confined to a short period of the year, and sometimes to the month or months when a particular fish was to be obtained in chief abundance, the figure does not give a true representation. An examination of the tables also shows that occasionally in the less frequented squares an odd and exceptional catch may disturb the averages unduly. But on the greater part of the grounds the figures may be taken as fairly representing the changes that have occurred and the yearly and monthly fluctuations. The total figures and those for each year are very large and represent an enormous amount of fishing and a vast quantity of fish landed. They may indeed be taken as representing from 80 to over 90 per cent. of the fishing of the whole fleet of Aberdeen steam trawlers.

The method of dealing with the figures is simply to divide the quantity, in cwts., by the number of hours fishing, the term taken being the number of cwts. per hundred hours, which in most cases is easier for the mind to grasp. The averages so obtained have been submitted to the process of "smoothing," by the method of three-monthly averages taken monthly. This undoubtedly has many advantages, particularly when the observations are not very numerous, but it has also, in my opinion, undoubted disadvantages in many cases, by tending to smooth away and obliterate the smaller changes or those which last for only a comparatively brief time, but which may be normal and significant. In the tables the smoothed and the smoothed averages are both given.

THE OBJECTS OF THE INVESTIGATION.

As I stated in my previous reports, the chief object of these statistical investigations was to endeavour to solve the great problem as to the impoverishment of the fishing grounds; to ascertain whether or not the fluctuations or variations due to the operations of fishing could be separated from the natural fluctuations which occur, and whether evidence could be obtained that the relative abundance of any of the species of food fishes was changing from year to year or remaining stationary. That was the chief object. But it was also pointed out that these statistics would enable important information to be acquired as to the limits of the fishing grounds from which the fish supply is drawn, and the extent to which they are fished over in different months and years—and every part of the North Sea is not productive—as to the distribution of the various species and classes of the food fishes on the different grounds, their variations in abundance with the changes of the seasons, and the relation of these to the great phases in the natural history of the fishes, their reproduction and migrations in particular.

In the preceding reports, above referred to, sufficient time had not elapsed to make it profitable to discuss the first object, the question of overfishing or impoverishment of the grounds, but the other objects were discussed in some detail, and especially the distribution of the fishes and their seasonal fluctuations. They are again discussed in this report, on the basis of the 10 years' observations (*see p.*), but I feel it is of much greater importance, from the point of view of the fisheries in the immediate future, to ascertain as far as possible what the 10 years' statistics tell us as to the fluctuations in the abundance of the fish. Ten years is a fairly long period, and since the investigation has been carried on in the same way and on the same lines from the beginning until now, and since it has covered a large area of the North Sea and dealt with the fishing operations of a large number of steam trawlers, it ought to furnish us with a certain amount of trustworthy information on the subject. First of all, then, I consider this aspect of the investigation.

II.—THE QUESTION OF THE IMPOVERISHMENT OF THE FISHING GROUNDS.

From the tables of the flatfishes (pp.) it will be seen that the average catch in each square is calculated for each month for each species of fish and for each class of such species, as large and small, that is to say, the quantity in cwts. per 100 hours' fishing. The mean for each year for each of the squares has been calculated in the same way, and the information so obtained has been arranged in the following manner:—

- (1.) The period of 10 years, 1901–1910, has been divided into two quinquennial periods, viz., 1901–1905 and 1906–1910, and the average annual mean for each square for each fish and class calculated for these two periods, so that comparison can be made between the relative abundance of the fish in the two periods.
- (2.) The average monthly means for each square for the two quinquennial periods have also been calculated, so that comparison can be made between the average catch of each kind of fish in each month in one period and the other.
- (3.) For each fish the number of squares in which an increase has occurred in the last of the two periods is contrasted with the number in which a decrease has taken place, and also the number of months in which an increase or decrease has occurred, in the same way.
- (4.) In the more important squares and for the more important fishes comparison is made between the means for the successive years.
- (5.) Comparison is made between the proportion of the large and the small fish of the species where there are separate size-classes in the two periods.

It is obvious from what has been said above as to the statistics that certain of the squares will have much greater value than others in this comparison or series of comparisons. In some, the fishing throughout the entire period of 10 years has been quite representative or almost quite representative, that is to say, it has been large in extent and well distributed over the months. In some of the other squares, particularly on the margin of the region covered by the Aberdeen vessels, the fishing was irregular and small in amount. Moreover the value of the squares differs for the different fish, or for certain classes of these fish. That may be seen from the tables, and still more from the subsequent discussion as to the distribution of the fish in the region.

It will be most convenient to begin with those fishes which are not separated into classes at the market according to their size, viz., turbot, brill and halibut—all of which are of some considerable value.

THE TURBOT (*Rhombus maximus*).

In Table A, p. are given the averages of the total means for the two quinquennial periods for all the squares for which there is information. It will be seen that comparing the first quinquennial period with the second the mean catch of turbot increased in six of the squares and decreased in ten. These squares and the amounts of the increase or decrease in each are as follows:—

Increase.				Decrease.			
—				—			
XI	...	...	0·03	X	...	...	0·22
XII	...	...	0·23	XVI	...	...	0·16
XIII	...	...	0·70	XVII	...	...	0·28
XIV	...	...	0·11	XVIII	...	...	0·03
XV	...	...	0·01	XX	...	...	0·19
XIX	...	...	0·4	XXIII	...	...	0·41
				XXIV	...	...	0·20
				XXV	...	...	0·14
				XXVIII	...	...	0·37
				XXIX	...	...	0·04
			1·17				2·04

The net increase was thus somewhat smaller than the net decrease, the figure showing an average mean decrease of 0·87 cwts., but when the difference is reduced to terms of cwts. per 100 hours' fishing, it does not appear to be great, viz. the average increase is

0.195 cwts. per 100 hours, and the average decrease is 0.204 cwts. per 100 hours. The effect is of course cumulative.

By looking at the chart it will be seen that the areas where an increase has taken place are on the distant grounds, east of the Shetlands, and on the three extending from between the Shetlands and the Orkneys to 2° E. longitude (XIII, XIV, XV), and in the offshore one, XIX, containing the Fladen Ground. Those which show a decrease are nearer the coast—around the Shetlands, off the Moray Firth and down the east coast of Scotland.

The areas in which the largest decreases occurred were XXIII, XXVIII, XVII, X and XXIV, as follows:—

—		XXIII.	XXVIII.	XVII.	X.	XXIV.
1901-1905 ...	...	1.65	1.10	0.74	0.53	0.90
1906-1910 ...	...	1.24	0.73	0.46	0.31	0.70

Squares XXIII and XXIX are areas where the fishing was quite regular and representative; in X it was almost regular, as it was also in XVII; in XXVIII it was not so regular.

(2.) When the monthly means are compared for the two quinquennial periods (Table B, p.) it is found that in the second period there were increases in 83 cases and decreases in 98, instances where the averages were equal being omitted. The figures are these, the first line showing the number of months in which there was an increase in the second period and the second line the number of months in which there was a decrease:—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XVIII.	XXIX.
Increase in ...	3	6	10	11	10	3	4	2	5	7	3	3	4	4	3	5
Decrease in ...	9	4	2	1	2	7	4	10	7	5	8	9	8	8	7	7

The months in which increases and decreases occurred in the second period compared with the first were as follows, the figures in the first line representing the number of months in which increases took place, and the second line the number of months in which decreases took place:—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
8	6	10	5	8	9	5	6	8	7	5	6
7	10	6	10	8	6	10	8	6	8	10	9

In all these squares treated in this way it may happen that one year is of greater value than another, and it is desirable to look at the successive yearly means for one year after another in order to see the order of the changes. These means for the turbot are given in the subjoined table. It will be seen that the fluctuation of the mean catch in the

TURBOT. Showing Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.91	0.05	0.71	0.55	0.41	0.37	0.24	0.34	0.44	0.18
XI ...	0.11	0.06	0.03	0.27	0.03	0.17	0.04	0.09	0.19	0.12
XII ...	0.25	0.04	0.07	0.22	0.21	0.99	0.32	0.50	0.35	0.04
XIII ...	0.00	0.23	0.31	0.48	0.70	1.22	1.34	0.94	1.27	0.57
XIV ...	—	—	—	—	—	—	—	—	—	—
XV ...	—	—	—	—	—	—	—	—	—	—
XVI ...	—	—	—	—	—	—	—	—	—	—
XVII ...	0.80	0.73	0.78	0.74	0.65	0.44	0.66	0.48	0.43	0.31
XVIII ...	0.28	0.48	0.57	0.26	0.48	0.34	0.38	0.35	0.39	0.42
XIX ...	0.25	0.07	0.16	0.17	0.12	0.24	0.17	0.13	0.29	0.09
XX ...	0.55	0.28	0.22	0.34	0.32	0.38	0.2	0.17	0.08	0.00
XXIII ...	1.49	1.29	1.79	1.56	2.11	1.36	1.51	1.27	1.27	0.77
XXIV ...	0.97	0.86	1.31	0.61	0.76	0.90	0.80	0.67	0.61	0.52
XXV ...	0.82	0.43	0.60	0.45	0.42	0.60	0.39	0.60	0.42	0.00
XXVIII ...	1.73	0.91	0.85	1.16	0.85	1.12	0.58	0.62	0.63	0.72
XXIX ...	1.66	1.76	1.28	1.41	1.12	1.23	0.82	2.06	1.48	1.06

different years may be considerable, and that is, of course, especially the case where the fishing was relatively small in amount and irregular. But in the more important areas in the home grounds curves of the means for the successive years bring out the feature above adverted to, namely, a decline in the abundance of turbot in the later years.

THE BRILL (*Rhombus laevis*).

As is pointed out in describing the distribution of the brill (p.) there are several of the squares in which very few brill were taken, but in ten of the squares comparison can be instituted between the average mean catch in the two quinquennial periods. These squares are as follows, the figures showing the extent of the increase or the decrease in the second quinquennial period, as compared with the first :—

Increase.				Decrease.			
XX	...	...	0.02	XIII	...	...	0.34
XXIV	...	...	0.12	XVII	...	...	0.59
XXV	...	...	0.09	XXIII	...	...	0.20
XXVI	...	...	0.08	XXVII	...	...	0.54
				XXVIII	...	...	0.46
				XXIX	...	...	0.11
			<hr/> 0.31 <hr/>				<hr/> 2.24 <hr/>

The net decrease was thus considerably greater than the net increase. The average increase was 0.08 cwts. per 100 hours' trawling and the net decrease 0.37 cwts. All the squares in which there was a decrease in the second period are, with one exception, those along the east coast of Scotland, namely from XIII to XXVIII and XXIX. The exception is square XXVII, on the other side of the North Sea, where the fishing was almost limited to the last months and the first month in each of the years. The areas in which increases were indicated are the middle grounds in the central portion of the North Sea.

(2.) Comparison of the number of months in which the means in the second period were greater or less than those in the first period shows that there were 28 months in which the average catch was greater, and 60 months in which the average catch was less. In four of the squares the number of months in the second period in which the mean catch was greater exceeded, and in six was less than in the first period; the following figures show the relation :—

—	XIII.	XVII.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXVII.	XXVIII.	XXIX.
Increase in ...	6	2	4	0	2	5	6	0	3	0
Decrease in ...	5	10	2	12	2	1	3	6	7	12

Taking the distribution of the differences according to the months for all the squares together, the following is the result, the first line indicating the number of increases, and the second the number of decreases in the second period as compared with the first :—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
3	3	5	2	3	3	2	3	3	0	1	0
4	5	4	5	5	5	6	3	4	6	7	6

In some of the squares in which fair averages of turbot were taken brill were practically absent, as in X, XI and XII, but as already indicated in some of the others the quantity was moderately good. The yearly mean catch for each of the squares throughout the ten years are given in the subjoined table.

BRILL. Showing the Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
XIII	1.87	0.08	0.14	0.14	0.16	0.19	0.09	0.05	0.14	0.12
XVII	1.59	0.65	0.93	0.45	0.21	0.22	0.33	0.12	0.10	0.11
XX	0.12	0.02	0.08	0.08	0.02	0.23	0.07	0.04	0.02	0.02
XXIII	0.28	0.25	0.41	0.18	0.15	0.13	0.07	0.02	0.02	0.01
XXIV	0.00	0.00	0.015	0.00	0.00	0.00	0.00	0.00	0.05	0.00
XXV	0.03	0.04	0.07	0.00	0.00	0.17	0.12	0.36	0.00	0.00
XXVI	0.08	0.06	0.14	0.07	0.50	0.27	0.34	0.50	0.03	0.05
XXVII	—	—	0.07	0.75	0.61	0.00	0.18	0.00	0.03	0.00
XXVIII	0.55	1.43	0.10	1.26	1.14	0.65	0.98	0.22	0.22	0.12
XXIX	0.01	0.33	0.07	0.17	0.15	0.02	0.12	0.00	0.02	0.04

The squares with the most representative fishing and a good mean catch were XIII, XVII, XXIII, and XXIX. The table shows that in these squares there has been on the whole over the period a fairly regular fall in the average catch, the last two or three years contrasting with the years at the beginning.

THE HALIBUT (*Hippoglossus vulgaris*).

The grounds frequented in greatest abundance by the halibut differ from those for the turbot and brill, and the statistics show that while the two former species are getting rather scarcer on the whole in the region under consideration, the halibut appears to be increasing in numbers, or at least is being caught in greater proportional quantity than was the case a few years ago.

There are seventeen of the squares in which comparison can be made as to the relative catches of this fish in the two periods, though they are of course of different value. They are as follows, the increase or decrease in the second period as compared with the first being also indicated.

Increase.				Decrease.			
X ... ..	...	...	0.98	XV ... ..	...	...	0.04
XI... ..	...	...	0.31	XVIII ... ..	...	...	0.03
XII ... ..	...	...	0.45	XX ... ..	...	...	0.15
XIII ... ..	...	...	0.88	XXIV ... ..	...	...	0.12
XIV ... ..	...	...	0.40	XXVIII ... ..	...	...	0.21
XVII ... ..	...	...	0.10	XXIX ... ..	...	...	0.01
XIX ... ..	...	...	0.14				
XXIII ... ..	...	...	0.09				
XXX ... ..	...	...	0.07				
XXXI ... ..	...	...	0.18				
			3.60				0.56

There are thus ten squares in which an increase in the years 1906–1910 took place compared with the years 1901–1905, and six squares in which there was a decrease in the average catch. In some instances, notably in square X and square XIII, the increase is noteworthy, and much above the figure of the increase in any of the other class of squares. Even in the intensely fished area XXIII, off the Aberdeenshire coast, there was an increase, though a small one. None of the increases, on the other hand, are of any large extent. The average net increase works out at 0.27 cwts. of halibut per 100 hours' fishing.

It will be observed that the areas in which the largest increase in the average catch has occurred are the northern and north-western squares in relation to the deep water, the Shetlands and the Orkneys. The mean increase per 100 hours' fishing in these areas (X–XIV) amounts to 0.6 cwts.

(2.) Comparing the number of cases where the monthly average catch in the second period is greater or less than in the first period, we have the following figures for the

various squares, the first line, as before, referring to the cases of increase and the second line to cases of decrease :—

X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVIII.	XXIX.	XXX.	XXXI.
11	8	9	9	8	6	9	9	8	5	11	5	4	6	4	3	4
1	3	3	3	4	6	3	3	4	6	1	7	8	4	6	6	6

Thus in 119 cases an increase in the average catch took place, and in 74 cases a decrease ; just the contrary of what occurred with the turbot and the brill.

Comparing now the means for the separate months in the two groups of years and for all the squares together we have the following, the first line showing the increases in the second period and the second line the decreases :—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	12	13	12	11	14	8	8	7	6	8	9
5	5	3	2	5	2	9	7	10	10	9	7

It will be observed that, as in some other cases, the months in which the greatest increase occurred are the earlier months of the year covering the spawning season.

The average catch in the separate months for each period is shown in Table B, p. , and the yearly mean catch for each of the squares is given in the table subjoined here. It shows the increases in the later years in the squares where the halibut is principally found.

HALIBUT. Showing the Yearly Mean Catch.

Squares.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.65	0.94	1.52	3.72	2.80	3.05	2.97	2.30	3.52	2.73
XI ...	2.10	1.37	1.32	2.00	2.51	2.43	3.06	2.09	1.59	1.67
XII ...	2.41	1.09	1.82	2.57	2.41	3.50	2.99	2.41	2.11	1.60
XIII ...	0.37	0.54	1.95	2.22	1.61	1.62	1.83	2.21	2.37	3.07
XIV ...	1.53	1.17	1.50	1.60	1.82	1.63	1.95	1.67	2.14	2.22
XV ...	1.93	1.67	1.45	1.92	2.04	2.43	2.21	1.47	1.12	1.55
XVII ...	0.33	0.75	0.47	0.96	0.75	0.68	0.76	0.69	0.71	0.95
XVIII ...	1.57	0.81	0.90	1.28	1.25	1.38	1.21	1.02	0.94	1.08
XIX ...	1.34	1.40	1.56	1.44	1.39	2.10	1.72	1.64	1.38	1.00
XX ...	1.85	1.44	1.36	1.51	1.54	1.57	1.56	1.25	1.04	1.36
XXIII ...	0.20	0.20	0.34	0.61	0.44	0.53	0.48	0.47	0.35	0.43
XXIV ...	0.84	0.65	0.76	1.14	1.79	1.20	1.05	0.82	0.74	0.78
XXV ...	1.43	1.17	1.17	1.58	1.28	1.51	1.67	1.40	0.82	1.24
XXVI ...	2.21	2.16	1.58	1.51	2.10	2.17	1.94	—	—	—
XXVIII ...	0.30	0.00	0.67	1.36	0.32	0.18	0.38	0.37	0.31	0.36
XXIX ...	0.15	0.10	0.14	0.43	0.28	0.15	0.21	0.22	0.25	0.23
XXX ...	0.91	0.46	0.61	1.06	0.65	0.48	1.54	0.88	0.65	0.51
XXXI ...	0.55	0.77	0.62	0.79	1.27	1.23	1.75	0.75	0.25	0.90
XXXII ...	1.13	0.37	1.17	1.28	0.90	1.37	—	—	—	—

THE WITCH (*Pleuronectes cynoglossus*).

The witch, like the halibut and the megrim, is a fish of the deeper water, but the centre of its distribution is not in the greater depths outwith the North Sea, but rather as is explained later (p.) in the northern part of the North Sea itself.

In this case, as with the plaice, the lemon dab, and the megrim, the fish are divided into classes according to size. First of all we may consider the nature of the fluctuations that have taken place in the 10 years with respect to the totals, the large and the small fish together.

The statistics with regard to this fish show that a remarkable change has taken place in the period which they cover, and that there has occurred a noteworthy decrease in the average catch in most of the squares. It may be that owing to the nature of its distribution, probably not being materially recruited from the outside waters, and living

in a region within which (as the marking experiments show) trawling has been intense, it has suffered more than most fishes.

The following are the particulars, with reference to the various squares, in which an increase or a decrease in the average catch occurred in the second period (1906-1910), compared with the first period, 1901-1905.

Increase.				Decrease.			
XVII	...	...	0.07	X	...	...	2.86
XX	...	...	0.54	XI	...	...	2.35
XXIII	...	...	0.08	XII	...	...	1.30
XXV	...	...	0.33	XIII	...	...	1.25
				XIV	...	...	7.13
				XV	...	...	2.78
				XVI	...	...	4.85
				XVIII	...	...	2.56
				XIX	...	...	5.28
				XXIV	...	...	4.13
				XXVI	...	...	0.09
				XXVII	...	...	0.97
				XXVIII	...	...	1.36
				XXIX	...	...	0.04
				XXX	...	...	0.42
				XXXI	...	...	0.73
			<u>1.02</u>				<u>38.10</u>

Thus an increase occurred in only four of the squares, and none of them areas of importance with regard to this fish, and the increments were moreover small. On the other hand decreases occurred in sixteen squares, including those comprising the headquarters of the fish, and in many cases the diminution is very large. The net increase was 1.02, while the net decrease was 38.10, showing a diminution of about 1.8 cwts. per 100 hours' fishing.

A look at the chart will show how extensive is the region over which this decline in the average catch of the witch stretches, and the table indicates how great it is in the chief areas. The mean reduction in the average catch in the second period in the seven principal squares for the fish amounts to 4.15 cwts. per 100 hours' fishing. Here are the average monthly means in the two periods for a few of the chief squares:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
X—1st ...	7.97	2.19	7.20	1.82	0.39	0.10	3.00	0.07	2.52	4.62	4.05	6.70
„ 2nd...	2.10	2.08	0.80	1.06	0.18	0.05	0.05	0.06	0.44	0.58	1.62	1.94
XIV—1st ...	10.39	10.34	4.76	8.57	21.41	9.67	15.08	5.15	6.89	6.08	8.70	9.48
„ 2nd ...	6.78	4.42	3.42	2.92	0.13	0.56	0.02	0.30	1.16	1.72	2.44	4.60
XVIII—1st ...	22.05	15.65	9.74	6.33	24.42	13.25	15.15	11.08	14.30	18.07	16.80	14.58
„ 2nd ...	12.36	13.08	6.44	4.70	16.76	16.12	12.06	10.54	11.62	11.02	14.86	14.26
XIX—1st ...	14.88	13.31	11.70	24.12	29.41	28.90	25.20	22.48	16.18	13.50	11.71	14.86
„ 2nd ...	14.10	10.18	3.34	8.40	27.08	23.06	20.08	18.15	12.83	7.87	10.72	10.20

In all these months in those areas, only one in the second period shows an increase, and a slight one, over the corresponding month in the first period, and in some cases the reduction in the average catch is startling. In the other leading squares, it is only in one or a few months that the average catch in the period, 1906-1910 exceeds that of the period 1901-1905 (one in XI and XIII, three in XV, four in XII) and they are swamped by the enormous reductions in other months.

In addition to the reasons advanced above as to the possible explanation of the great reductions in the average catch, it must also be borne in mind that the use of the very effective otter trawl, enabling fishing to be extended into the deeper areas, was introduced

only four or five years before these statistics begin ; that the fishing grounds in the deeper water areas (those in question) were actually what are termed "virgin" grounds until that time, the extension of the trawling previously with the beam trawl having taken place to the east and south-east of Aberdeen, and only later to the north and north-east.*

(2.) With regard to the months and the squares, the following represent the changes when the second period is compared with the first :—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXIX.	XXX.	XXXI.
Increase	0	1	4	1	0	3	6	1	0	3	5	4	3	4	4	2	3
Decrease	12	10	8	11	12	9	6	11	12	8	7	8	9	7	8	7	7

The lesson is the same here. The catch was greater in 44 cases and less in 152.

The particulars arranged according to the separate months in the two quinquennial periods are as follows :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Increase	...	2	3	2	3	2	8	5	4	4	2	6	3
Decrease	...	15	13	14	12	14	8	12	12	13	14	11	14

(3.) In the adjoining table I give the annual mean catch for the various squares in the separate years, and as will be seen they bear out the figures above quoted :—

TOTAL WITCHES. Showing the Annual Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	2.35	4.40	6.46	3.29	2.38	1.46	0.92	1.23	0.41	0.58
XI ...	9.51	7.24	5.46	7.52	10.17	6.65	5.26	7.14	6.04	3.07
XII ...	7.48	0.62	2.58	4.60	6.06	3.01	2.58	4.27	2.27	2.71
XIII ...	0.00	4.16	3.04	3.21	3.30	1.18	1.45	2.67	1.07	1.10
XIV ...	12.97	8.71	8.29	10.30	7.63	2.92	2.30	3.42	2.03	1.59
XV ...	15.64	12.00	8.56	10.80	11.10	6.76	7.06	11.75	10.52	8.11
XVI ...	10.64	7.92	5.44	6.80	6.80	4.70	3.16	2.80	5.60	4.59
XVII ...	0.78	0.41	0.73	0.55	1.94	1.01	0.67	1.29	0.84	0.93
XVIII ...	16.53	9.07	13.69	16.48	17.03	13.85	14.51	12.22	9.64	9.78
XIX ...	17.44	19.01	21.26	23.50	14.08	15.59	15.31	16.09	9.22	12.67
XX ...	2.45	5.07	2.96	3.55	2.94	2.36	2.62	5.66	4.68	4.40
XXIII ...	1.07	0.98	0.89	1.65	1.31	1.19	1.16	1.93	1.24	0.79
XXIV ...	7.39	11.18	4.63	11.88	7.18	5.53	6.09	5.38	2.50	2.11
XXV ...	2.76	2.04	1.87	2.74	1.50	2.25	2.30	1.07	3.22	3.70
XXVI ...	0.19	1.47	0.71	0.95	0.60	0.81	0.59	1.23	0.60	0.20
XXVII ...	—	—	2.56	0.45	0.89	0.00	0.48	0.07	0.13	0.10
XXVIII ...	3.99	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.02
XXIX ...	0.12	0.05	0.08	0.03	0.16	0.07	0.03	0.02	0.09	0.02
XXX ...	2.41	2.59	3.74	4.01	2.97	1.70	2.40	5.82	1.50	2.16
XXXI ...	2.14	1.48	1.88	2.28	1.97	1.00	0.25	0.95	3.15	0.75

There is evidence that the most effective fishing was in the years 1904 and 1905, and partly 1906, for many of the northern squares, but earlier for the areas nearer or in water of less depth. Sometimes the average monthly catch in the more productive areas in those years was very large, and even exceeded 50 cwts. per 100 hours' fishing.

The average mean catch in each month in the two periods and for each square are contrasted in Table B on page .

* See my first paper, 20th Ann. Rep. Fishery Board for Scotland, Part III., pp. 119, 127, 140 ; and compare the charts there given as to the grounds fished over by trawlers in 1891 and 1901.

The Large Witches.—In the case of the large witches, as might have been expected, the decrease is more marked. In the second period, 1906–1910, seventeen of the squares showed diminution in the average catch and only three increases as compared with the first period. The particulars are as follows:—

Increase.				Decrease.			
XX	...	...	0.25	X	...	...	1.79
XXIII	...	...	0.01	XI	...	...	2.29
XXV	...	...	0.06	XII	...	...	1.13
				XIII	...	...	0.74
				XIV	...	...	4.78
				XV	...	...	2.34
				XVI	...	...	2.95
				XVII	...	...	0.22
				XVIII	...	...	2.52
				XIX	...	...	3.62
				XXIV	...	...	3.13
				XXVI	...	...	0.21
				XXVII	...	...	0.07
				XXVIII	...	...	0.74
				XXIX	...	...	0.04
				XXX	...	...	0.66
				XXXI	...	...	0.63
			0.32				27.86

The mean increase was thus 0.106 in the three squares, while the mean decrease was 1.64 in the 17 squares, the average net decrease being about 1.5 cwts. per 100 hours' fishing. In all the squares in which an increase occurred, the total, as indicated on a former page, also increased; but with regard to the large witches, square XVII, which indicated an increase in the totals, showed a small decrease.

(2.) The tabulation according to the separate months and squares (Table B, p.) shows that on 153 occasions the change in the abundance in the second period compared with the first was by way of decrease, while on 42 occasions it was an increase.

The particulars are as follows:—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXIX.	XXX.	XXXI.
Increase	1	1	2	2	0	3	6	1	1	3	5	3	2	3	4	2	3
Decrease	11	10	10	10	12	9	6	11	11	7	7	9	10	8	8	7	7

The same figures tabulated according to the months gives the results indicated in the adjoining table, viz.:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase	...	2	4	2	3	2	8	4	4	2	5	2
Decrease	...	15	12	14	12	14	8	13	12	12	14	15

What has been said above in regard to the total witches applies generally also to the large fish. The greatest reductions have taken place in what may be termed the principal witch squares, on the grounds which form the headquarters of the distribution of the species, and in some of them, as above shown, the decrease amounts to nearly 5.0 cwts. per 100 hours' fishing. In some months in former years the average catch of the large fish in some of the squares approached, or exceeded, 20 cwts. per 100 hours' fishing, occasionally indeed it was over 30 cwts. In the last two or three years the decrease has been at a greater rate than in the few years before, as may be seen from the

subjoined table showing the average catch in each month in each square for the two quinquennial periods :—

LARGE WITCHES. Showing the Annual Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	1.63	2.74	3.99	1.98	1.08	0.70	0.60	0.67	0.20	0.26
XI ...	6.98	5.15	4.14	5.17	6.62	3.98	3.16	4.47	3.19	1.79
XII ...	5.80	0.61	2.19	3.36	3.89	2.19	1.96	3.34	1.29	1.43
XIII ...	0.00	2.49	1.15	2.27	1.64	0.62	0.65	1.27	0.66	0.63
XIV ...	8.80	5.55	5.15	6.72	5.00	1.89	1.45	2.07	1.07	0.83
XV ...	10.63	8.13	6.04	7.70	7.45	4.78	4.70	7.81	6.92	4.03
XVI ...	8.16	5.62	4.17	4.80	5.11	3.37	2.37	1.94	3.34	2.74
XVII ...	0.69	0.42	0.48	0.45	1.48	0.76	0.54	0.73	0.52	0.54
XVIII ...	10.96	6.12	9.62	10.60	11.08	9.30	9.04	6.79	5.70	4.92
XIX ...	11.71	11.49	14.70	14.87	9.09	10.86	10.48	10.37	5.48	6.58
XX ...	2.10	3.81	2.66	2.73	2.32	1.75	2.22	4.56	3.50	2.90
XXIII ...	0.85	0.70	0.74	1.15	0.96	0.90	0.88	1.32	0.87	0.49
XXIV ...	5.45	6.97	3.34	9.44	5.80	4.16	4.47	3.67	1.54	1.59
XXV ...	2.21	1.75	1.79	2.60	1.38	1.78	1.76	0.97	2.62	2.92
XXVI ...	0.19	1.44	0.75	0.77	0.50	0.68	0.59	0.57	0.60	0.15
XXVII ...	—	—	2.30	0.45	0.90	0.00	0.42	0.05	0.13	0.10
XXIX ...	0.12	0.04	0.08	0.03	0.14	0.07	0.02	0.03	0.07	0.02
XXX ...	2.38	2.48	3.59	3.66	2.86	1.63	2.24	4.42	1.48	1.90
XXXI ...	2.03	1.44	1.85	2.11	1.83	1.00	0.25	0.95	3.15	0.75

The Small Witches.—On the whole, the change in the comparative abundance of the small witches in the two periods has not been so marked as in the case of the large fish. They have not diminished to the same extent either in the squares considered by themselves or considered collectively, *i.e.* over the whole region. In the second period, compared with the first increases took place in seven squares and decreases in twelve, as follows :—

Increase.				Decrease.			
XVII ...	...	...	0.15	X ...	...	...	1.08
XX ...	...	...	0.35	XI ...	...	...	0.11
XXIII ...	...	...	0.07	XII ...	...	...	0.18
XXV ...	...	...	0.25	XIII ...	...	...	0.18
XXVI ...	...	...	0.13	XIV ...	...	...	2.35
XXIX ...	...	...	0.01	XV ...	...	...	0.40
XXX ...	...	...	0.25	XVI ...	...	...	0.81
				XIX ...	...	...	1.46
				XXIV ...	...	...	1.21
				XXVII ...	...	...	0.93
				XXVIII ...	...	...	0.60
				XXXI ...	...	...	0.10
			1.21				9.41

The principal decreases occurred in the principal witch squares in the deeper water, and in a few of the cases the decrease was considerable. The net increase amounted to 0.17 cwts. per 100 hours' fishing and the net decrease to 0.78 cwts. in the same time, the result being a decrease on the whole of about 0.6 cwts. in the 100 hours.

(2.) With regard to the squares and the months in which decreases or increases occurred, the figures are these :—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXIX.	XXX.	XXXI.
Increase	3	4	6	4	0	6	9	6	2	5	7	5	6	1	2	2	0
Decrease	9	7	5	8	12	6	3	5	10	4	4	7	6	3	6	6	8

There were increases, therefore, on 68 occasions and decreases on 109 occasions, as compared with increases of the large fish on 42 occasions and decreases on 153.

The particulars arranged according to the months in the two periods show the following for the second period as compared with the first :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	4	6	6	7	6	8	3	7	4	3	9	5
Decrease ...	12	9	10	7	9	7	9	8	12	10	6	10

As with the large fish, the proportional decrease was rather greater in the autumn and winter months.

The particulars as to the annual mean catch in the various areas and in the successive years are as follows :—

SMALL WITCHES.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.70	1.66	2.46	1.30	1.31	0.76	0.33	0.54	0.22	0.13
XI ...	2.51	2.08	1.33	2.32	3.53	2.21	2.08	2.67	2.83	1.29
XII ...	1.65	0.00	0.39	1.26	2.15	0.85	0.61	0.97	0.84	1.30
XIII ...	0.00	1.66	0.33	0.94	1.68	0.55	0.82	1.39	0.47	0.46
XIV ...	4.16	3.17	3.15	3.55	2.64	1.02	0.85	1.36	0.95	0.74
XV ...	4.98	3.89	2.51	3.06	3.63	1.96	2.36	4.06	3.59	4.09
XVI ...	2.31	2.30	1.26	1.34	1.68	1.34	0.74	0.70	2.25	1.84
XVII ...	0.09	0.02	0.25	0.10	0.44	0.24	0.14	0.58	0.32	0.38
XVIII ...	5.56	2.95	4.58	5.85	5.93	4.55	5.44	5.42	3.87	5.05
XIX ...	5.73	7.52	6.55	7.45	4.86	4.72	4.82	5.63	3.73	5.92
XX ...	0.36	1.19	0.31	0.80	0.60	0.40	0.42	1.09	1.30	1.78
XXIII ...	0.23	0.27	0.14	0.49	0.35	0.28	0.28	0.60	0.39	0.28
XXIV ...	1.94	4.20	1.29	3.33	1.38	1.37	1.65	1.72	0.85	0.51
XXV ...	0.55	0.28	0.07	0.14	0.09	0.48	0.56	0.01	0.60	0.74
XXVI ...	0.00	0.00	0.00	0.17	0.03	0.11	0.00	0.67	0.00	0.05
XXVII ...	—	—	0.26	0.00	0.07	0.00	0.04	0.02	0.00	0.00
XXIX ...	0.01	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.03	0.05
XXX ...	0.02	0.11	0.16	0.24	0.11	0.06	0.16	1.39	0.02	0.29
XXXI ...	0.11	0.05	0.06	0.17	0.10	0.00	0.00	0.00	0.00	0.00

THE MEGRIM (*Lepidorhombus whiff* (Penn) Walb.).

This fish is an inhabitant of the deeper water, and is chiefly obtained by the Aberdeen trawlers from the northern and north-western areas of the North Sea, in the region where the halibut is also mainly taken. Like the witch, it only began to be caught in anything like large quantities after the introduction of the otter-trawl enabled trawling operations to be carried on in considerable depths. Like the witch also the statistics show that in recent years the average catch of this fish has diminished.

The market classes are two, large and small, but it may be desirable to consider first of all the totals in relation to the different squares and the two periods.

In this case, owing to delay in getting the tables for 1909 and 1910, the two periods are divided into four years each, viz., 1901-1904 and 1905-1908 respectively.

The following shows the changes that have taken place in the average catch of the total witches in the latter of these periods :—

Squares showing Increase.				Squares showing Decrease.			
XVI	...	...	3.33	X	...	...	4.01
XX	...	...	0.02	XI	...	...	0.80
XXIX	...	...	0.09	XII	...	...	2.89
				XIII	...	...	0.81
				XIV	...	...	1.17
				XV	...	...	0.42
				XVII	...	...	0.28
				XVIII	...	...	2.88
				XIX	...	...	0.68
				XXIII	...	...	0.90
				XXIV	...	...	0.97
				XXV	...	...	0.09
				XXVIII	...	...	1.79
			3.44				17.67

It is thus seen that in the years 1905-1908 decreased catches per unit of fishing were got in twelve squares and increased catches were got in three squares.

The average decrease for the various squares was about 1.5 cwts. per 100 hours' fishing while the increase is indicated as about 1.1 cwts. in the same time. The figures for square XVI are not, however, representative and depend on a small basis.

The further particulars regarding the small and the large megrims show that with this fish the decrease was not confined to the large individuals. The small fish decreased likewise, and over a wider area.

The figures for the large fish, showing the increases and decreases in the mean average catch in the second of the two periods are as follows :—

Increase.				Decrease.			
XX	...	...	0.06	X	...	...	2.96
XXIX	...	...	0.08	XI...	...	...	0.50
				XII	...	...	2.46
				XIII	...	...	0.61
				XIV	...	...	0.85
				XV	...	...	0.32
				XVII	...	...	0.11
				XVIII	...	...	1.76
				XIX	...	...	0.60
				XXIII	...	...	0.71
				XXIV	...	...	0.76
			<hr/> 0.14 <hr/>				<hr/> 11.64 <hr/>

The diminution in the large megrims thus extended over a large area, the decrease in those referred to amounting to about 1.1 cwt. per 100 hours' fishing.

The decrease in the second period among the small fish was still more extensive, affecting fourteen squares, while in only two squares were there any increases. The squares and the extent of the changes in the second period in each of them are shown as follows :—

Increase.				Decrease.			
XVI	...	...	1.63	X	...	...	0.96
XXIX	...	...	0.01	XI...	...	...	0.33
				XII	...	...	0.40
				XIII	...	...	0.23
				XIV	...	...	0.29
				XV	...	...	0.11
				XVII	...	...	0.21
				XVIII	...	...	1.36
				XIX	...	...	0.07
				XX	...	...	0.04
				XXIII	...	...	0.18
				XXIV	...	...	0.23
				XXV	...	...	0.07
				XXVIII	...	...	0.25

It may be concluded from the figures that this fish, like the witch and the plaice, has diminished in abundance in recent years.

THE LEMON DAB (*Pleuronectes microcephalus*).

This fish, like the witch, is classed as large and small, but it will be better to consider first of all the facts referring to the totals, that is to the fish as a species.

It will be found that this fish, unlike the witch and the plaice, and resembling the halibut, has increased in abundance to a noteworthy extent over the period covered by the statistics.

It is not improbable that its increase is in large measure due to the diminution in the numbers of the witch. It comes into competition with that fish on many of the

grounds, and it lives upon much the same sort of food,* chiefly annelids, as shown by the following percentage proportions :—

—	Annelids.	Crustacea.	Molluscs.	Echinoderms.
Witch	72	20	14	3
Lemon Dab	78	24	6	2

Some of the fish, of course, contained more than one class of organisms.

Taking first the totals, the large and the small together, it is found that in 13 squares an increase occurred in the period 1906–1910 as compared with the period 1901–1905, while in five of the squares there was a decrease. The figures are as follows :—

Increase.				Decrease.			
X ...	...	...	1.04	XII	...	...	0.07
XI	...	...	0.13	XVII	...	...	0.20
XIII	...	...	0.80	XX	...	...	0.41
XIV	...	...	2.88	XXVII	...	...	0.15
XV	...	...	0.37	XXVIII	...	...	1.35
XIX	...	...	0.06				
XXIII	...	...	2.53				
XXIV	...	...	0.11				
XXV	...	...	0.02				
XXVI	...	...	0.26				
XXIX	...	...	1.07				
XXX	...	...	1.52				
XXXI	...	...	0.37				
			<u>11.16</u>				<u>2.18</u>

The average increase was at the rate of 0.86 cwts. per 100 hours' fishing, and the average decrease is represented by 0.44 cwts. per 100 hours' trawling.

The largest increases it will be noted occurred in squares XIV (south of the Shetlands) where the largest decrease of witches took place; in XXIII, where witches slightly increased, in XXIX and XXX, where witches also diminished. The proportional increases and decreases of the large and the small varied in different areas, as will presently appear.

(2.) The comparison of the monthly means for the two periods and for each square brings out the fact that there was an increase in the total lemon dabs in the second period as compared with the first in 149 cases and decreases in 55 cases. The figure for each of the squares are as follows :—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXVIII.	XXIX.	XXX.	XXXI.
Increase ...	11	8	8	9	11	10	6	7	9	5	12	8	4	10	7	11	6	7
Decrease ..	1	3	4	3	1	2	5	5	2	6	0	4	8	1	3	1	3	3

It will be noted that in each month of the year the average catch in the second period in square XXIII, on the coast of Aberdeenshire, was greater than in the first period.

The particulars distributed over the months of the two periods show the following changes in the second as compared with the first :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	12	11	14	8	13	12	10	12	13	14	16	14
Decrease ...	5	6	3	7	4	4	8	4	5	3	2	4

* See my Second Report [Cd. 2612], pp. 547, 574.

(3.) The particulars for each square in each month of the two quinquennial periods are compared in Table B on page . I give here the average catches monthly for the coast squares XXIII and XXIX :—

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XIII—1901-05	4.70	6.32	8.69	9.49	8.96	7.70	10.00	11.71	9.71	7.52	6.81	5.75
„ 1906-10	8.34	8.88	11.08	12.58	11.50	11.64	12.96	12.66	12.02	10.20	9.06	7.34
XXIX—1901-05	5.72	7.43	6.29	7.06	9.35	90.2	8.66	8.69	8.16	7.65	6.00	5.95
„ 1906-10	8.34	6.67	8.08	8.44	10.02	12.14	13.04	12.56	11.00	11.08	10.78	8.52

There were of course variations in the averages in the same months in the successive years, but, in contrast to what we found with the witches and some others, the later years of the period show in several of the areas a fairly general increase in almost every month.

The average mean catch for each square in each of the ten years is given in the subjoined table :—

TOTAL LEMON DABS. Showing the Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.26	0.93	0.92	1.68	1.64	2.12	1.82	1.68	2.52	2.60
XI ...	0.13	0.82	0.31	0.36	0.19	0.40	0.46	1.01	0.25	0.32
XII ...	0.00	1.64	0.36	0.37	0.36	0.47	0.29	0.68	0.65	0.30
XIII ...	3.55	4.06	2.53	2.65	1.90	1.97	4.96	3.01	4.08	4.68
XIV ...	0.49	0.52	1.19	1.57	1.57	2.10	3.04	2.80	4.87	5.04
XV ...	0.30	0.18	0.29	0.37	0.47	1.54	0.33	0.55	0.39	0.63
XVI ...	0.46	0.21	0.25	0.18	0.27	0.20	0.42	0.48	0.30	0.24
XVII ...	7.31	4.92	10.25	6.37	5.70	4.95	6.19	6.85	7.87	7.67
XVIII ...	1.63	2.16	3.89	1.50	2.34	1.92	1.40	1.11	3.46	3.61
XIX ...	0.63	0.37	0.81	0.47	1.05	0.54	0.60	0.78	0.73	0.97
XX ...	0.76	1.34	0.76	1.32	1.23	0.71	0.94	0.89	0.40	0.40
XXIII ...	7.62	7.82	8.01	8.07	9.30	11.02	10.49	10.72	9.91	11.29
XXIV ...	6.40	4.70	9.16	3.34	4.74	7.79	4.94	4.82	4.88	6.47
XXV ...	1.82	1.78	1.43	1.50	1.51	1.13	1.19	2.20	2.50	1.12
XXVI ...	0.65	0.54	1.40	0.56	1.46	1.31	1.22	1.35	1.13	0.90
XXVIII ...	9.17	6.27	13.21	8.73	9.77	10.01	9.27	10.91	10.87	10.52
XXIX ...	7.86	8.01	7.83	7.00	7.38	8.29	9.74	10.53	10.61	10.55
XXX ...	3.78	2.32	2.80	2.99	2.83	3.71	6.52	3.59	6.67	4.67
XXXI ...	2.78	2.23	1.69	1.34	1.47	2.52	4.20	3.55	0.65	1.72

The Large Lemon Dabs.—Comparing in the same way the means for the large fish, it is found that in ten of the squares in the second period the catch increased, while in eight squares it diminished. This contrasts with the proportion for the totals. The particulars in regard to each of the squares in the two categories are as follows :—

Increase.				Decrease.			
X ...	...	...	0.25	XIII	...	...	0.15
XI ...	...	...	0.10	XVII	...	...	0.96
XII ...	...	...	0.03	XVIII	...	...	0.29
XIV ...	...	...	1.08	XX	...	...	0.43
XV ...	...	...	0.32	XXIV	...	...	0.12
XXIII	...	...	0.74	XXV	...	...	0.09
XXVI	...	...	0.25	XXVII	...	...	0.15
XXIX	...	...	1.07	XXVIII	...	...	1.35
XXX	...	...	1.52				
XXXI	...	...	0.37				
			<hr/> 5.73				<hr/> 3.54

The average for the squares showing an increase is 0.573 and for those showing a decrease 0.44, the net increase in the large fish being at the rate of about 0.13 cwts. per 100 hours' fishing. Squares XIII, XXIV and XXV, which exhibited increases in the totals show decreases in the large fish.

(2.) The comparison of each of the squares according to the various months of the year in the two periods, shows that in 131 cases there was an increase among the large in the second period, and in 72 cases a decrease, as follows:—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVI.	XXVIII.	XXIX.	XXX.	XXXI.
Increase ...	8	8	7	7	10	9	4	7	7	5	10	7	4	9	6	10	6	7
Decrease ...	4	3	4	5	2	3	8	5	3	6	2	5	8	2	4	2	3	3

And when the information is arranged according to the months, the following appears:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	12	9	14	7	12	11	10	11	9	10	14	12
Decrease ...	5	8	3	8	5	6	8	5	9	7	2	6

(3.) The means for each year for each square in the whole period are given in the accompanying table:—

LARGE LEMON DABS. Showing the Mean Yearly Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.25	0.90	0.86	1.41	1.33	1.52	1.36	0.98	1.16	1.00
XI ...	0.31	0.77	0.31	0.36	0.19	0.39	0.44	0.80	0.25	0.35
XII ...	0.00	0.73	0.36	0.33	0.36	0.47	0.28	0.40	0.53	0.28
XIII ...	2.80	4.06	1.77	2.32	1.68	1.60	3.55	1.92	2.33	2.51
XIV ...	0.48	0.51	1.19	1.44	1.50	1.81	2.41	1.81	2.32	2.13
XV ...	0.29	0.18	0.28	0.37	0.47	1.54	0.31	0.52	0.37	0.46
XVI ...	0.86	0.21	0.25	0.18	0.27	0.20	0.29	0.48	0.30	0.24
XVII ...	6.73	4.85	8.66	5.75	4.84	4.20	5.14	5.46	5.68	5.56
XVIII ...	1.58	1.96	3.71	1.47	2.08	1.69	1.27	1.19	2.47	2.56
XIX ...	0.63	0.36	0.79	0.47	0.80	0.53	0.58	0.55	0.70	0.71
XX ...	0.76	1.33	0.76	1.32	1.22	0.70	0.94	0.82	0.40	0.40
XXIII ...	6.54	6.80	6.85	6.87	7.54	8.53	7.76	7.52	7.19	7.18
XXIV ...	6.31	4.63	8.65	3.34	4.67	7.62	4.54	4.52	4.26	6.08
XXV ...	1.81	1.76	1.42	1.88	1.48	1.13	1.13	2.20	2.32	1.12
XXVI ...	0.65	0.54	1.38	0.56	1.37	1.27	1.12	1.30	1.13	0.90
XXVIII ...	7.80	5.35	11.91	7.56	7.70	7.71	5.94	6.97	6.90	6.04
XIX ...	7.46	7.52	7.31	6.51	6.70	7.18	7.82	9.12	8.51	8.22
XXX ...	3.78	2.30	2.72	2.90	2.80	3.55	5.42	3.12	6.03	4.00
XXXI ...	2.76	2.15	1.69	1.33	1.44	2.42	3.85	3.40	0.45	1.07

The Small Lemon Dabs.—It is among the small fish that the most noteworthy increase took place, and this also occurred with some of the other species. It is not so much the higher means of the large fish as the higher means of the small that increased the totals in the second period, and the proportion and relation of the one class to the other are worthy of attention.

Among the small lemon dabs increases in the second period were shown in 18 of the squares and a decrease only in one. The figures for each square, showing the respective increase or decrease are as follows :—

Increase.				Decrease.			
X ...	...	...	1.04	XII	...	...	0.17
XI...	...	...	0.05				
XIII	...	...	0.98				
XIV	...	...	1.41				
XV	...	...	0.04				
XVII	...	...	0.88				
XVIII	...	...	0.33				
XIX	...	...	0.05				
XX	...	...	0.01				
XXIII	...	...	1.60				
XXIV	...	...	0.21				
XXV	...	...	0.04				
XXVI	...	...	0.02				
XXVII	...	...	0.21				
XXVIII	...	...	2.41				
XXIX	...	...	1.41				
XXX	...	...	0.73				
XXXI	...	...	0.20				

The average increase among the small lemon dabs was thus about 0.6 cwts. per 100 hours' fishing.

It is remarkable how widespread the increase has been among the small class of this species, and, as may be noticed, it is largest in the areas along the coast, where fishing has been intense for comparatively a long period.

A superabundance of small individuals of a species of fish is often associated with a reduction in the numbers of the large adults, and is one of the first signs of the effects of overfishing, the fish not getting a chance of growing to full size and ripe old age.

(2.) Considering now the changes as shown by comparison of the monthly means, we find that out of 167 cases the small lemons diminished in the second period in only 21, or 12.6 per cent., and they increased in 146 cases, or 87.4 per cent. With the large lemon dabs the decrease amounted to 35.5 per cent., on this basis of comparison, and the increase to 64.5 per cent. The particulars are these, the first line showing the increases and the second line the decreases in the second period as compared with the first :—

—	x.	xI.	xII.	xIII.	xIV.	xV.	xVII.	xVIII.	xIX.	xx.	xxIII.	xxIV.	xxv.	xxVI.	xxVIII.	xxIX.	xxx.	xxxI.
Increase ...	12	7	3	12	12	4	11	11	6	4	12	9	4	5	10	12	8	4
Decrease ...	0	1	2	0	0	1	1	1	2	1	0	3	3	2	0	0	0	4

Thus in seven squares there were increases in each of the months and decreases in none, and in some others very nearly the same thing obtained.

Arranging the particulars according to the months, irrespective of any individual squares, we get the following :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	9	12	12	11	10	14	10	12	14	16	15	11
Decrease ...	1	2	1	0	5	0	5	3	1	1	0	2

These contrast forcibly with the corresponding figures for the witch, and indicate how the small lemon dabs have increased in recent years. The adjoining table represents

the mean yearly catch of the small lemon dabs in each of the squares throughout the ten years :—

SMALL LEMON DABS. Showing the Mean Yearly Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X	0·01	0·03	0·06	0·25	0·27	0·60	0·46	0·72	1·37	1·60
XI	0·00	0·06	0·00	0·00	0·00	0·01	0·02	0·22	0·01	0·02
XII	0·00	0·91	0·00	0·04	0·00	0·01	0·01	0·00	0·12	0·00
XIII	0·75	0·00	0·75	0·20	0·22	0·37	1·43	1·07	1·72	3·20
XIV	0·01	0·01	0·01	0·12	0·08	0·30	0·62	0·94	2·55	2·89
XV	0·01	0·00	0·00	0·00	0·00	0·00	0·00	0·01	0·01	0·18
XVI	0·00	0·00	0·00	0·00	0·00	0·00	0·01	0·00	0·00	0·00
XVII	0·58	0·40	1·58	0·60	0·85	0·75	1·07	1·39	2·29	2·81
XVIII	0·05	0·19	0·17	0·01	0·25	0·24	0·13	0·16	0·72	1·05
XIX	0·00	0·00	0·02	0·02	0·00	0·01	0·01	0·00	0·03	0·27
XX	0·00	0·01	0·00	0·00	0·01	0·02	0·00	0·04	0·00	0·00
XXIII	1·08	1·02	1·16	1·21	1·89	2·48	2·73	2·29	2·71	4·12
XXIV	0·10	0·07	0·50	0·10	0·08	0·16	0·44	0·29	0·63	0·41
XXV	0·01	0·02	0·01	0·02	0·02	0·00	0·04	0·00	0·26	0·00
XXVI	0·00	0·00	0·02	0·00	0·09	0·04	0·09	0·08	0·00	0·00
XXVIII	1·37	0·91	1·30	1·13	2·11	2·30	3·33	3·95	4·81	4·45
XXIX	0·40	0·46	0·52	0·49	0·69	1·09	1·92	2·17	2·07	2·34
XXX	0·00	0·02	0·07	0·09	0·04	0·17	1·98	0·47	0·62	0·64
XXXI	0·02	0·08	0·01	0·01	0·03	0·11	0·35	0·10	0·20	0·37

The relative increase of the small fish compared with the large is brought out in the following percentage table for several of the more important squares :—

Square.	1901-1905.		1906-1910.	
	Large.	Small.	Large.	Small.
X	88·5	11·5	55·8	44·2
XIII	87·0	13·0	63·6	36·4
XIV	95·3	4·7	59·0	41·0
XVII	88·5	11·5	75·6	24·4
XVIII	94·2	5·8	80·0	20·0
XXIII... ..	84·4	15·6	72·7	27·3
XXVIII	85·5	14·5	63·9	36·1
XXIX	93·3	6·7	80·9	19·1

These figures are impressive as indicating the changed abundance of the large and small individuals of this fish on the fishing grounds, or at least as landed.

With regard to the distinction hinted at, it may be said that inquiries I have made have led to the conclusion that no change has been carried out in the size of the mesh of the cod-end of the trawl net in recent years. There is an impression that a smaller mesh is employed in the smaller trawlers working on the inshore grounds on the Aberdeenshire coast, but Mr. James Robb, the Board's statistical clerk at the Aberdeen market, who has great experience with regard to such matters, assures me that no change has been made. He also states that more small lemon dabs are now saved for the market than was formerly done ; practically all the lemon dabs caught are brought ashore. He thinks the increased catch of lemon dabs in recent years may be explained by the big-bosomed ground-ropes of the net allowing working on very rough areas, which formerly had been only skirted.

The conclusion that the small lemon dabs are gradually replacing the larger appears to be justified by the above facts and figures. It would, however, have been of much value in considering this and similar cases if a large body of records of the measurements of the different classes of fish at the market had been available, so that comparison could have been made in an accurate way of the sizes of the fish from the various squares in the different years.}

THE PLAICE (*Pleuronectes platessa*).

It is with regard to this fish that most of the energy of investigation has been directed under the international scheme ; and in view of the somewhat contradictory results of the statistical enquiries in England as to whether or not the plaice is diminishing in numbers

on the fishing grounds, these statistics of the Aberdeen trawlers have special value. They refer to a longer period than any of the other statistics of the kind, and though plaice are not so common in Scottish waters as they are on certain parts of the coast of England, they are sufficiently abundant to afford a valuable measure as to any change of importance as a result of overfishing.

There are three market classes of plaice—large, medium and small, each of which will be dealt with separately. First of all the totals, for all the different classes, will be considered.

On the same system as before, I contrast the squares in which a decrease and those in which an increase is exhibited in the last of the two quinquennial periods, viz., the years 1906–1910, and the following is the result:—

Squares Showing Increase.				Squares Showing Decrease.			
XXIII	...	...	0.27	X	...	...	6.39
XXXI	...	...	0.60	XI	...	...	0.15
				XII	...	...	0.08
				XIII	...	...	1.46
				XIV	...	...	0.83
				XV	...	...	0.40
				XVII	...	...	5.83
				XVIII	...	...	0.17
				XIX	...	...	0.11
				XX	...	...	3.23
				XXIV	...	...	0.59
				XXV	...	...	3.13
				XXVIII	...	...	3.53
				XXIX	...	...	0.99
				XXX	...	...	0.52
				XXXII	...	...	2.98

Increases thus occurred in two of the squares and decreases in sixteen. The extent of the diminution in some of them is surprising. In square XVII, where the fishing was regular and representative, the decrease amounted to 5.83 cwts. per 100 hours' fishing. This area is on the north-east coast and comprises the southern portion of the Orkneys. In square X, around the Shetlands, the decrease was even greater, amounting to 6.39 cwts. per 100 hours' fishing. Then, in squares XX and XXV, on the middle grounds, there were decreases of 3.23 and 3.13 cwts. respectively; and in XXVIII, which embraces the mouth of the Firth of Forth and includes the coast to the north of it, there was a decline of 3.53 cwts.

The squares in which an increase occurred are not of equal importance. XXIII is one of the chief trawling areas and the fishing in it was regular and representative; and the increase here, as we have seen, was shared with some other flatfishes.

The monthly means for the two periods may be given in some of these cases:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
X: 1901-05...	14.50	15.18	13.17	16.70	18.23	14.70	8.10	21.96	3.20	6.41	8.74	13.11
1906-10...	6.40	12.04	7.52	5.66	4.64	4.48	3.80	3.00	2.56	2.10	3.70	3.52
XVII 1901-05...	9.25	9.15	24.19	6.74	12.18	12.92	11.34	6.38	9.17	8.24	6.87	11.47
1906-10...	4.62	4.72	4.12	5.08	8.04	6.70	5.50	4.00	4.66	4.64	4.20	6.14
XXV 1901-05...	4.10	2.00	11.83	8.78	9.37	9.44	8.71	10.56	6.81	7.32	6.10	5.60
1906-10...	2.06	4.28	3.02	2.70	6.77	8.70	7.70	10.30	11.45	8.00	2.30	3.05

These will serve as illustrations of the very considerable changes that have taken place in many of the areas, with regard to the total quantity of plaice taken.

(2.) Comparing the different squares in relation to the months we have the following, showing the increase or decrease in the second period:—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVIII.	XXIX.	XXX.	XXXI.	XXXII.
Increase ...	0	6	5	6	7	3	0	4	4	2	4	5	3	3	2	4	4	1
Decrease...	12	5	6	6	5	9	12	7	8	9	8	7	9	7	10	5	5	4

Thus in 63 cases there were increases, and in 134 (or 67 per cent.) decreases, in the second period compared with the first.

Arranged under the months we have the following changes in the second period :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	10	10	8	7	5	6	3	1	4	1	3	5
Decrease ...	6	6	8	7	11	11	14	16	14	16	14	11

(3.) The yearly average catch for all the areas, or the whole region, are given in the adjoining table :—

TOTAL PLAICE. Showing Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	2.92	12.54	7.56	19.09	14.61	8.93	7.68	3.30	2.75	2.08
XI ...	1.16	0.74	0.56	0.86	0.76	0.96	1.17	0.49	0.42	0.29
XII ...	0.00	0.00	1.20	2.23	1.75	1.95	0.86	0.81	0.85	0.27
XIII ...	6.72	11.98	22.72	12.54	11.08	21.69	16.22	9.81	6.94	3.08
XIV ...	1.98	1.90	7.52	3.22	3.20	4.85	3.45	2.11	2.04	1.18
XV ...	0.41	0.23	1.99	0.37	0.91	1.01	0.47	0.15	0.11	0.16
XVI ...	—	—	—	—	—	—	—	—	—	—
XVII ...	10.42	15.71	11.76	10.47	7.74	5.00	6.76	4.08	4.90	5.50
XVIII ...	0.73	0.54	0.98	1.22	1.22	0.61	0.38	0.23	0.85	1.78
XIX ...	0.13	0.23	0.53	0.49	0.51	0.19	0.44	0.12	0.24	0.34
XX ...	5.11	5.58	4.76	6.11	5.48	3.41	4.41	1.95	0.80	0.34
XXIII ...	5.42	4.56	5.48	5.10	3.67	3.55	2.63	4.68	9.05	5.62
XXIV ...	1.72	1.38	1.70	8.05	0.68	0.62	0.74	0.58	0.77	0.67
XXV ...	5.71	5.20	11.41	8.48	7.32	6.62	6.47	6.60	2.06	0.42
XXVI ...	12.06	10.46	18.83	11.53	11.12	11.02	10.21	—	—	—
XXVIII ...	7.16	27.57	10.71	11.33	11.23	12.01	12.25	10.78	6.04	9.27
XXIX ...	4.80	7.54	5.74	6.52	5.45	6.30	4.29	5.67	3.80	5.03
XXX ...	1.51	1.59	3.56	1.52	1.26	0.96	1.74	0.62	1.53	1.50
XXXI ...	3.76	4.45	6.03	5.01	3.74	7.12	12.70	3.75	1.35	1.07
XXXII ...	6.51	9.05	16.22	8.41	5.71	7.44	—	5.55	5.60	—

The Large Plaice.—With the large Plaice there occurred in the second period a decrease in 15 of the squares and an increase in 3. They are as follows :—

Increase.				Decrease.			
XII ...	...	...	0.01	X ...	...	...	1.30
XXX ...	...	...	0.17	XI ...	...	...	1.06
XXXI ...	...	...	0.13	XIII ...	...	...	0.80
				XIV ...	...	...	0.02
				XV ...	...	...	0.10
				XVII ...	...	...	1.51
				XVIII ...	...	...	0.11
				XIX ...	...	...	0.06
				XX ...	...	...	0.20
				XXIII ...	...	...	0.18
				XXIV ...	...	...	0.08
				XXV ...	...	...	0.52
				XXVIII ...	...	...	0.30
				XXIX ...	...	...	0.08
				XXXII ...	...	...	0.03

The average increase amounted to 0.10, and the average decrease to 0.356.

(2.) Considering the squares and the months as before, there were 44 cases in which an increase took place in the second period, and 115 cases in which there was a decrease, the percentages being respectively 27 and 73. The particulars are as follows :—

—	X.	XII.	XIII.	XIV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVIII.	XXIX.	XXX.	XXXI.	XXXII.
Increase	0	5	6	6	0	2	3	3	2	2	3	4	2	1	2	3
Decrease	12	6	6	6	12	10	8	7	10	8	8	6	10	6	8	2

The arrangement according to the months gives the following differences for the second period :—

—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	7	8	5	3	4	4	2	1	4	2	1	3
Decrease ...	6	5	9	8	10	11	3	14	11	13	13	12

The table showing the annual means for the various squares in the ten years is subjoined :—

LARGE PLAICE. Showing the Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.36	2.08	1.63	3.97	3.15	2.32	1.63	0.47	0.22	0.07
XII...	0.00	0.00	0.25	0.78	0.61	0.74	0.24	0.23	0.45	0.03
XIII ...	2.98	1.51	3.39	2.85	1.71	3.36	2.64	1.55	0.82	0.08
XIV ...	0.44	0.32	0.99	0.55	0.65	1.43	0.89	0.36	0.13	0.02
XVII ...	1.76	2.95	2.59	2.30	1.75	1.10	1.26	0.42	0.54	0.46
XVIII ...	0.15	0.06	0.08	0.25	0.15	0.07	0.03	0.02	0.02	0.02
XIX ...	0.03	0.04	0.15	0.21	0.03	0.02	0.07	0.01	0.01	0.02
XX...	0.65	0.54	0.40	0.46	0.41	0.28	0.79	0.17	0.16	0.04
XXIII ...	0.39	0.34	0.33	0.27	0.20	0.15	0.09	0.13	0.13	0.07
XXIV ...	0.21	0.14	0.09	0.10	0.01	0.02	0.05	0.00	0.07	0.03
XXV ...	0.75	0.60	1.45	0.99	0.78	0.65	0.74	0.46	0.08	0.04
XXVI ...	0.80	0.37	1.97	1.60	2.57	1.41	1.51	—	—	—
XXVIII ...	0.43	0.55	0.90	0.67	0.58	0.71	0.26	0.14	0.24	0.27
XXIX ...	0.26	0.56	0.31	0.27	0.14	0.27	0.14	0.30	0.17	0.28
XXX ...	0.35	0.22	0.50	0.18	0.10	0.02	0.00	0.02	0.11	0.07
XXXI ...	0.14	0.55	0.54	0.48	0.40	0.51	1.35	0.85	0.00	0.05
XXXII ...	0.74	0.77	1.84	0.72	0.51	0.98	—	1.05	0.06	—

The distinction made between the various sizes of plaice is not very accurate, or at least it does not enable one to separate those which may be adult and capable of reproduction from those which are immature. As mentioned elsewhere (p.), while the plaice classed as "large" are all adult fishes, a proportion of those classed as medium may be adult, and some even of the "small" may fall into the same category.

The Medium Plaice.—These form the great bulk of the plaice landed by the Aberdeen trawlers, the proportion of the total from the various grounds varying from about 70 to over 90 per cent. The variations in the total plaice are therefore very largely determined by, and dependent on, the variations in the medium fish.

The following are the particulars with reference to the various squares in which an increase or a decrease took place in the average catch, in the second quinquennial period compared with the first :—

Squares showing Increase.

XXXI ... 0.32

Squares showing Decrease.

X ... 5.10
 XI ... 0.09
 XII ... 0.13
 XIII ... 1.28
 XIV ... 0.88
 XV ... 0.32
 XVII ... 4.24
 XVIII ... 0.03
 XIX ... 0.03
 XX ... 4.03
 XXXIII ... 0.95
 XXIV ... 0.61
 XXV ... 2.71
 XXVIII ... 3.51
 XXIX ... 1.11
 XXX ... 0.45
 XXXII ... 2.88

It will thus be seen that the decrease in the years 1906-10 compared with the years 1901-1905 is very widespread among medium plaice, only a single square—and that by no means an important one—showing an increase. As with the total plaice, the decreases are in certain of the areas much more marked than in others, as in X, XVII, XX, XXVIII, XXV, and XIII. The average decrease in the squares as a whole is about 1.7 cwts. per 100 hour's fishing.

(2) With respect to the monthly averages in the two periods in relation to the various squares, the following figures show that in the second period there were 71 cases of increase and 127 cases of decrease, or about 36 per cent. and 64 per cent. respectively:—

—	X.	XI.	XII.	XIII.	XIV.	XV.	XVII.	XVIII.	XIX.	XX.	XXIII.	XXIV.	XXV.	XXVIII.	XXIX.	XXX.	XXXI.	XXXII.
Increase ...	0	8	6	6	7	4	0	6	5	3	2	5	5	2	1	5	5	1
Decrease ...	12	3	5	6	5	7	12	6	7	8	10	7	7	8	11	4	5	4

The same story is told when the particulars are arranged according to the months, as follows, the figures showing the number of increases or decreases under the various months:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	12	10	8	7	5	7	3	3	5	3	2	6
Decrease ...	4	7	7	7	10	10	14	14	13	14	15	12

The period of the year when the largest decrease occurred was in the later months, contrasting with the increases in January, February and March.

The table showing the annual average catch for each of the squares is appended.

MEDIUM PLAICE. Showing Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	2.54	10.26	5.70	14.35	10.57	6.14	5.20	2.49	2.23	1.82
XI ...	0.86	0.54	0.43	0.55	0.48	0.61	0.85	0.38	0.29	0.26
XII ...	0.00	0.00	0.93	1.45	1.20	1.21	0.58	0.45	0.47	0.23
XIII ...	3.73	8.38	18.34	7.53	7.92	15.24	9.91	6.84	4.69	2.80
XIV ...	1.52	1.53	6.36	2.65	2.48	3.30	2.35	1.64	1.73	1.12
XV ...	0.28	0.15	1.75	0.27	0.65	0.81	0.36	0.13	0.08	0.14
XVII ...	8.08	12.28	8.11	7.70	5.50	3.71	4.73	3.30	3.90	4.80
XVIII ...	0.57	0.49	0.88	0.98	1.03	0.51	0.35	0.20	0.72	1.71
XIX ...	0.10	0.19	0.37	0.28	0.45	0.15	0.39	0.15	0.23	0.32
XX ...	4.45	5.03	4.35	5.63	4.95	3.04	3.59	1.66	0.66	0.30
XXIII ...	4.60	3.76	4.51	4.25	3.08	2.95	2.26	3.46	3.38	3.38
XXIV ...	1.50	1.22	1.78	0.74	0.65	0.58	0.67	0.57	0.52	0.53
XXV ...	4.86	4.55	9.50	7.53	6.37	5.82	5.49	5.56	2.20	0.38
XXVI ...	11.24	10.09	16.69	9.63	8.41	9.46	8.36	—	—	—
XXVII ...	—	—	65.60	8.91	8.58	19.65	14.44	—	—	—
XXVIII ...	6.48	21.22	9.80	8.40	9.04	9.50	8.28	8.28	5.21	6.15
XXIX ...	4.53	6.46	5.31	5.74	5.02	5.24	3.95	4.56	3.48	4.29
XXX ...	1.18	1.35	3.02	1.34	1.30	0.95	1.74	0.60	1.23	1.41
XXXI ...	3.60	3.82	5.25	4.39	3.30	6.27	10.45	2.85	1.35	1.02
XXXII ...	5.55	8.28	13.58	7.42	4.30	6.10	—	3.75	5.00	—

The Small Plaice.—As already hinted, the proportion of small plaice which is landed at Aberdeen is much less than that which is landed at some of the English ports, a circumstance due to the fact that the grounds and depths are different in the regions fished over by the respective trawling fleets. It must also be borne in mind that the bays and firths, as the Moray Firth, are closed to the trawlers, as well as all the grounds within the three-mile limit. This makes an enormous difference in the proportion of the small plaice caught, particularly if the depth beyond the restricted area is considerable, as it is on nearly all parts of the Scottish coast. One never gets hauls of the so-called "ivy-leaves," the very small immature plaice which are often caught in great numbers on the shallow grounds off the Continental coasts.

Thus in the statistics of the Aberdeen trawlers the proportion of the small plaice ranges from about 25 per cent.—and that is rare—down to nothing. In some of the squares hardly any plaice distinguished in the market as "small" are taken (See p.).

The small fish present a contrast to the large and medium, inasmuch as they have rather increased in abundance in the second quinquennial period, as the following figures show :—

Squares showing Increase.				Squares showing Decrease.			
XIII	...	...	0.58	X	...	...	0.05
XIV	...	...	0.08	XV	...	...	0.06
XXIII	...	...	1.42	XVII	...	...	0.01
XXVIII	...	...	0.35	XXV	...	...	0.06
XXIX	...	...	0.22				
XXXI	...	...	0.15				
XXXII	...	...	0.09				

They thus increased in seven of the squares and decreased in four. In many of the other squares the small plaice were altogether absent, or present in such small numbers that a comparison between the periods cannot be instituted. The average increase was 0.41 cwts. per 100 hours' fishing, and the average decrease only 0.045 cwts.

The greatest increase took place in square XXIII, which, as we have seen, also showed increases in some of the other species. (2) With regard to the monthly means for the two periods and the various squares, the following table shows that the small plaice increased in the second period on 65 occasions and decreased on 31, presenting a contrast to the variation in the opposite direction of the other classes of the plaice :—

—	X.	XIII.	XVII.	XXIII.	XXV.	XXVIII.	XXIX.	XXXI.	XXXII.	XXXIII.
Increase ...	9	8	6	9	6	8	8	6	3	2
Decrease ...	3	4	6	3	6	2	2	3	2	0

Arranged in the order of the months in the two periods there were increases and decreases in the second period as shown thus :—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Increase ...	5	5	5	4	2	4	7	5	9	7	5	7
Decrease ...	2	3	2	2	5	4	1	4	1	3	3	1

The increases were thus greatest in July, September and December.

The table showing the average annual means for each year and each square throughout the period of ten years is appended.

SMALL PLAICE. Showing the Yearly Mean Catch.

Square.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.
X ...	0.00	0.02	0.23	0.64	0.86	0.47	0.85	0.32	0.30	0.19
XI ...	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
XII ...	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.01
XIII ...	0.00	2.08	0.99	2.25	1.34	2.83	3.68	1.40	1.46	0.19
XIV ...	0.02	0.04	0.14	0.01	0.04	0.12	0.22	0.11	0.15	0.04
XV ...	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00
XVII ...	0.23	0.47	0.36	0.43	0.49	0.17	0.75	0.34	0.43	0.24
XVIII ...	0.00	0.08	0.02	0.02	0.02	0.02	0.00	0.00	0.06	0.07
XIX ...	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
XX ...	0.00	0.00	0.00	0.00	0.04	0.07	0.02	0.10	0.00	0.00
XXIII ...	0.43	0.46	0.47	0.60	0.46	0.47	0.25	1.10	5.53	2.16
XXIV ...	0.00	0.02	0.05	0.08	0.00	0.02	0.01	0.01	0.00	0.00
XXV ...	0.08	0.04	0.46	0.07	0.12	0.12	0.27	0.10	0.00	0.00
XXVI ...	0.00	0.00	0.16	0.31	0.13	0.15	0.35	—	—	—
XXVII ...	—	—	1.69	2.50	1.15	0.47	1.36	—	—	—
XXVIII ...	0.25	5.80	0.00	2.20	1.62	1.78	3.71	2.52	0.59	3.02
XXIX ...	0.03	0.52	0.13	0.41	0.26	0.77	0.18	0.83	0.13	0.47
XXX ...	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.18	0.01
XXXI ...	0.00	0.07	0.23	0.12	0.03	0.31	0.90	0.00	0.00	0.00
XXXII ...	0.22	0.00	0.77	0.24	0.18	0.36	—	0.75	0.00	—
XXXIII ...	0.00	0.00	0.81	2.57	1.40	16.20	0.80	2.95	3.50	4.80

Though there has been as above indicated, on the whole, an increase in the average abundance of the small plaice, the change is nothing like so great as that which occurred in the case of small lemon dabs and small witches.

In the following table I have calculated the percentages of the large, the medium and the small plaice in certain of the more important squares :—

Square.	1901-1905.			1906-1910.		
	Large.	Medium.	Small.	Large.	Medium.	Small.
X	19·7	76·5	4·2	18·9	72·3	8·6
XIII	19·1	70·5	10·2	14·6	68·4	16·5
XIV	16·5	81·7	1·4	20·8	74·4	4·7
XVII	20·5	75·3	3·6	14·5	77·9	7·4
XX	7·7	92·3	—	13·6	86·4	—
XXIII	6·2	83·5	9·9	2·3	60·5	37·2
XXV	12·0	86·1	1·9	8·8	86·9	2·2
XXVIII	4·6	80·8	14·4	3·1	74·3	23·0
XXIX	5·2	90·0	4·5	4·6	85·6	9·8

An examination of these figures shows that, while the large plaice and the medium plaice in almost all the squares referred to have decreased in relation to the other class in the second period compared with the first, the small plaice have increased in proportion in each of them, that which has taken place in square XXIII, off the coast of Aberdeenshire being specially noteworthy.

The statistics above discussed show that the plaice as a species has diminished in abundance, or at all events in weight landed per unit of fishing, during the ten years over which the statistics extend, and this conclusion is in agreement with the opinions so often and strongly expressed by the practical men.

Though the increase in flatfishes in square XXIII is not confined to the plaice, and thus indicates rather the influence of some general cause, it may be that the extensive liberation of the fry of the plaice from the hatchery of the Fishery Board at the Bay of Nigg, Aberdeen, for a number of years past, has not been without effect in raising the increase of this fish so remarkably. On the Aberdeenshire coast, the fishermen at the various fishing villages attribute to the liberation of the plaice fry the greatly improved fishery for that fish which has characterised the later years.

TABLE A.—Showing the Average Catch per 100 hours' in cwts. in each Square in the Two Quinquennial Periods, 1901-1905 and 1906-1910.

Square.	Period.	Turbot.	Brill.	Halibut.	Witches.			Megrims.			Lemons.			Plaice.			
					L.	S.	Total.	L.	S.	Total.	L.	S.	Total.	L.	M.	S.	Total.
X ...	1901-05	0·53	—	1·93	2·28	1·48	3·78	6·53	2·45	9·07	0·95	0·12	1·11	2·24	8·68	0·48	11·34
	1906-10	0·31	—	2·91	0·49	0·40	0·92	3·57	1·49	5·06	1·20	0·95	2·15	0·94	3·58	0·43	4·95
XI ...	1901-05	0·10	—	1·86	5·61	2·35	7·98	4·01	1·51	5·52	0·35	0·01	0·36	0·24	0·57	—	0·82
	1906-10	0·13	—	2·17	3·32	2·24	5·63	3·51	1·18	4·72	0·45	0·06	0·49	0·18	0·48	—	0·67
XII ...	1901-05	0·16	—	2·07	3·17	1·09	4·27	5·68	1·45	7·13	0·36	0·19	0·55	0·33	0·72	—	1·03
	1906-10	0·44	—	2·52	2·04	0·91	2·97	3·22	1·05	4·24	0·39	0·02	0·48	0·34	0·59	—	0·95
XIII ...	1901-05	0·34	0·46	1·34	1·51	0·92	2·74	4·73	1·51	6·22	2·53	0·38	2·94	2·49	9·18	1·33	13·01
	1906-10	1·04	0·12	2·22	0·77	0·74	1·49	4·12	1·28	5·41	2·38	1·36	3·74	1·69	7·90	1·91	11·55
XIV ..	1901-05	0·26	—	1·52	6·24	3·33	9·58	3·02	0·66	3·73	1·02	0·05	1·07	0·59	2·91	0·05	3·56
	1906-10	0·37	—	1·92	1·46	0·98	2·45	2·17	0·37	2·56	2·10	1·46	3·95	0·57	2·03	0·13	2·73
XV ..	1901-05	0·07	—	1·80	7·99	3·61	11·62	1·52	0·31	1·81	0·32	0·00	0·32	0·16	0·62	0·15	0·78
	1906-10	0·08	—	1·76	5·65	3·21	8·84	1·20	0·20	1·39	0·64	0·04	0·69	0·06	0·30	0·09	0·38
XVI ...	1901-05	0·23	—	—	5·75	2·00	8·42	—	0·12	2·28	—	—	—	—	—	—	—
	1906-10	0·07	—	—	2·80	1·19	3·57	—	1·75	5·61	—	—	—	—	—	—	—
XVII ...	1901-05	0·74	0·77	0·65	0·84	0·18	0·88	0·94	0·28	1·22	6·17	0·80	6·91	2·27	8·33	0·40	11·08
	1906-10	0·46	0·18	0·75	0·62	0·33	0·95	0·83	0·07	0·95	5·21	1·68	6·71	0·76	4·09	0·39	5·25

TABLE A.—*continued.*

Squares.	Period.	Turbot.	Brill.	Halibut.	Witches.			Megrims.			Lemons.			Plaice.			
					L.	S.	Total.	L.	S.	Total.	L.	S.	Total.	L.	M.	S.	Total.
XVIII ...	1901-05	0.41	—	1.16	9.67	4.87	14.56	5.79	2.03	7.56	2.13	0.13	2.30	0.14	0.73	0.03	0.94
	1906-10	0.38	—	1.13	7.15	4.87	12.00	4.03	0.67	4.68	1.84	0.46	2.30	0.03	0.70	0.03	0.77
XIX ...	1901-05	0.14	—	1.43	12.37	6.42	19.06	1.66	0.19	1.86	0.61	0.01	0.66	0.09	0.28	—	0.38
	1906-10	0.18	—	1.57	8.75	4.96	13.78	1.06	0.12	1.18	0.61	0.06	0.72	0.03	0.25	—	0.27
XX ...	1901-05	0.36	0.06	1.54	2.74	0.65	3.40	0.27	0.05	0.32	1.08	0.00	1.08	0.49	5.88	—	5.41
	1906-10	0.17	0.08	1.39	2.99	1.00	3.94	0.33	0.01	0.34	0.65	0.01	0.67	0.29	1.85	—	2.18
XXIII ...	1901-05	1.65	0.25	0.36	0.88	0.30	1.18	1.35	0.20	1.56	6.90	1.27	8.16	0.30	4.04	0.48	4.84
	1906-10	1.24	0.05	0.45	0.89	0.37	1.26	0.64	0.02	0.66	7.64	2.87	10.69	0.12	3.09	1.90	5.11
XXIV ...	1901-05	0.90	0.17	1.04	6.20	2.43	8.45	1.34	0.26	1.59	5.52	0.17	5.67	0.11	1.18	—	1.27
	1906-10	0.70	0.29	0.92	3.07	1.22	4.32	0.58	0.03	0.62	5.40	0.38	5.78	0.03	0.57	—	0.68
XXV ...	1901-05	0.54	0.03	1.33	1.95	0.23	2.18	—	0.08	0.16	1.67	0.02	1.61	0.91	6.56	0.15	7.62
	1906-10	0.40	0.12	1.33	2.01	0.48	2.51	—	0.01	0.07	1.58	0.06	1.63	0.39	3.85	0.09	4.43
XXVI ...	1901-05	0.83	0.21	1.91	0.73	0.04	0.78	—	—	—	0.89	0.02	0.92	—	—	—	—
	1906-10	—	0.29	—	0.52	0.17	0.69	—	—	—	1.14	0.04	1.18	—	—	—	—
XXVII...	1901-05	—	0.54	—	0.09	1.09	1.15	—	—	—	1.43	0.03	—	—	—	—	—
	1906-10	—	0.00	—	0.02	0.16	1.18	—	—	—	1.28	0.24	—	—	—	—	—
XXVIII.	1901-05	1.10	0.90	0.53	0.78	0.60	1.36	—	0.25	2.08	8.06	1.36	9.43	0.62	10.99	1.97	13.60
	1906-10	0.73	0.44	0.32	0.00	0.00	0.00	—	0.00	0.29	6.71	3.77	10.32	0.32	7.48	2.32	10.07
XXIX ...	1901-05	1.37	0.15	0.22	0.08	0.01	0.09	0.43	0.01	0.44	7.10	0.51	7.62	0.31	5.41	0.27	6.01
	1906-10	1.33	0.04	0.21	0.04	0.02	0.05	0.51	0.02	0.53	8.17	1.92	9.94	0.23	4.30	0.49	5.02
XXX ...	1901-05	0.24	—	0.74	2.99	0.13	3.14	—	—	—	2.90	0.04	2.94	0.27	1.64	—	1.89
	1906-10	—	—	0.81	2.33	0.38	2.72	—	—	—	4.42	0.77	5.03	0.44	1.19	—	1.37
XXXI ...	1901-05	0.35	—	0.80	1.85	0.10	1.95	—	—	—	1.87	0.03	1.90	0.42	4.07	0.09	4.60
	1906-10	—	—	0.98	1.22	0.00	1.22	—	—	—	2.24	0.23	2.53	0.55	4.39	0.24	5.20
XXXII .	1901-05	—	—	0.97	—	—	—	—	—	—	—	—	—	0.72	7.83	0.28	9.18
	1906-10	—	—	—	—	—	—	—	—	—	—	—	—	0.69	4.95	0.37	6.20

TABLE B.—Showing the Monthly Mean Catch for each Square in the Two Quinquennial Periods 1901-1905 and 1906-1910.

TURBOT.

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
X ...	1901-05	0.22	1.19	0.49	0.19	0.62	0.35	0.40	0.78	0.33	0.25	0.48	1.20
	1906-10	0.54	0.40	0.28	0.20	0.30	0.14	0.34	0.42	0.26	0.28	0.24	0.31
XI ...	1901-05	0.05	0.04	0.07	0.03	0.04	0.19	0.27	0.43	0.17	0.07	0.05	0.00
	1906-10	0.17	0.02	0.08	0.02	0.07	0.27	0.20	—	0.17	0.08	0.28	0.10
XII ...	1901-05	0.00	0.45	0.13	0.02	0.17	0.00	0.10	0.80	0.10	0.32	0.16	0.16
	1906-10	0.57	0.18	0.24	0.16	0.57	2.50	1.30	2.70	1.40	0.10	0.18	0.52
XIII ...	1901-05	0.20	1.90	0.35	0.52	0.75	0.87	0.22	0.20	0.33	0.26	0.00	0.27
	1906-10	0.37	1.04	1.30	1.26	1.64	0.92	0.82	0.72	1.06	1.70	1.26	0.37
XIV ...	1901-05	0.00	0.03	0.09	0.22	0.15	0.23	0.39	0.98	0.15	0.15	0.10	0.06
	1906-10	0.22	0.30	0.14	0.08	0.73	0.48	0.80	0.60	0.30	0.30	0.34	0.20
XV ...	1901-05	0.10	0.06	0.07	0.11	0.10	0.11	0.15	0.16	0.05	0.05	0.00	0.00
	1906-10	0.06	0.04	0.06	0.04	0.15	0.00	0.00	0.60	0.00	0.07	0.00	0.00
XVI ...	1901-05	0.20	0.05	0.05	0.17	0.03	—	—	—	0.00	1.45	0.04	0.07
	1906-10	0.02	0.00	0.08	0.14	0.20	—	—	0.00	—	0.10	0.12	0.10

TABLE B.—TURBOT—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XVII ...	1901-05	0.90	1.17	0.61	0.67	0.56	0.44	0.68	0.83	0.54	0.42	1.00	1.17
	1906-10	0.48	0.48	0.44	0.28	0.64	0.24	0.47	0.35	0.98	0.38	0.52	0.42
XVIII ...	1901-05	0.16	0.41	0.15	0.62	0.47	0.68	1.27	0.60	0.24	0.07	0.18	0.14
	1906-10	0.08	0.14	0.24	0.74	0.44	1.04	0.88	0.32	0.20	0.26	0.08	0.10
XIX ...	1901-05	0.01	0.04	0.09	0.33	0.25	0.34	0.28	0.11	0.04	0.09	0.09	0.03
	1906-10	0.00	0.06	0.16	0.20	0.28	0.44	0.62	0.25	0.03	0.12	0.02	0.02
XX ...	1901-05	0.07	0.30	0.14	0.18	0.63	0.85	1.11	0.26	0.35	0.17	0.09	0.13
	1906-10	0.10	0.14	0.12	0.17	0.33	0.03	0.60	0.10	0.40	—	0.00	0.02
XXIII ...	1901-05	0.70	0.76	1.83	1.86	4.08	0.87	1.49	1.59	2.19	1.42	1.51	1.25
	1906-10	0.84	1.64	2.02	1.80	1.82	0.80	1.20	1.30	0.92	0.88	0.96	0.68
XXIV ...	1901-05	0.30	0.16	0.35	0.20	0.89	2.55	1.99	1.43	0.84	0.86	0.36	0.03
	1906-10	0.20	0.20	0.34	1.20	0.80	1.03	1.74	1.04	1.14	0.60	0.27	0.07
XXV ...	1901-05	0.20	0.10	0.88	0.50	0.91	0.97	0.91	0.51	0.24	0.29	0.17	0.20
	1906-10	0.00	0.32	0.33	0.40	0.90	1.23	0.60	0.60	1.05	0.20	0.03	0.10
XXVIII.	1901-05	—	0.89	0.42	—	0.56	0.27	1.52	1.19	0.00	1.72	2.10	1.40
	1906-10	0.52	0.74	0.68	0.67	0.22	0.50	0.45	0.50	1.12	0.92	1.12	0.82
XXIX ...	1901-10	1.30	0.67	1.43	2.76	2.06	1.45	1.05	1.06	1.03	1.42	1.56	1.95
	1906-10	2.14	0.77	2.16	2.64	1.16	0.78	1.14	1.28	0.92	1.20	1.14	0.74

BRILL.

XIII ...	1901-05	0.0	0.25	0.0	0.15	0.25	0.22	0.49	0.0	0.0	0.47	0.0	0.05
	1906-10	0.7	0.16	0.26	0.02	0.12	0.26	0.10	0.04	0.16	0.02	0.16	0.05
XVII ...	1901-05	0.75	0.25	1.52	1.12	0.36	1.09	0.54	0.04	1.41	0.44	0.43	0.44
	1906-10	0.14	0.28	0.06	0.12	0.14	0.38	0.32	0.05	0.30	0.06	0.06	0.18
XX ...	1901-05	0.0	0.17	0.05	0.14	0.23	0.05	0.0	0.0	0.0	0.0	0.0	0.0
	1906-10	0.04	0.04	0.12	0.10	0.27	0.50	0.0	0.0	0.0	—	0.0	0.0
XXIII ...	1901-05	0.20	0.29	0.57	0.35	0.51	0.29	0.11	0.11	0.18	0.17	0.38	0.14
	1906-10	0.10	0.14	0.16	0.06	0.04	0.02	0.02	0.0	0.0	0.02	0.02	0.04
XXIV ...	1901-05	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1906-10	0.00	0.06	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
XXV ...	1901-05	0.00	0.00	0.14	0.11	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.15
	1906-10	0.00	0.12	0.16	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
XXVI ...	1901-05	0.10	—	0.0	0.0	0.05	0.79	0.0	0.0	0.0	0.0	0.25	0.13
	1906-10	0.40	0.57	0.30	0.53	0.10	0.55	0.90	0.0	0.10	0.0	0.0	0.0
XXVII.	1901-05	4.20	—	—	—	0.57	0.30	0.10	0.06	0.05	0.06	0.45	1.25
	1906-10	0.80	—	0.00	—	—	—	0.00	0.04	0.00	0.00	0.00	—
XXVIII.	1901-05	—	3.42	0.50	—	0.62	0.07	1.20	0.0	0.0	0.40	1.03	1.71
	1906-10	0.46	0.68	0.82	1.13	0.42	0.00	0.12	0.47	0.06	0.14	0.34	0.38
XXIX ...	1901-05	0.12	0.10	0.93	0.14	0.13	0.01	0.16	0.01	0.01	0.10	0.30	0.08
	1906-10	0.04	0.02	0.26	0.08	0.0	0.0	0.0	0.0	0.0	0.0	0.04	0.04

HALIBUT.

X ...	1901-05	1.47	1.59	1.71	2.14	2.88	0.62	2.40	4.73	2.13	1.10	1.35	1.90
	1906-10	2.78	2.96	2.48	2.76	4.54	4.48	3.08	2.66	2.48	2.02	2.04	2.70
XI ...	1901-05	1.39	1.38	2.15	2.08	1.84	1.77	1.79	2.28	1.80	3.15	1.41	1.59
	1906-10	1.87	2.24	2.38	2.32	2.62	3.97	1.30	—	1.73	1.25	1.70	1.90
XII ...	1901-05	0.60	4.55	2.10	2.21	2.52	1.40	0.40	2.70	2.20	2.27	1.94	2.01
	1906-10	2.30	2.44	3.14	2.80	4.43	4.20	3.77	5.40	2.30	1.04	1.74	2.48

TABLE B.—HALIBUT—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XIII ...	1901-05	1.15	0.83	0.25	0.34	4.20	1.55	2.02	4.16	2.21	1.69	1.67	1.43
	1906-10	2.50	1.68	1.14	1.54	3.08	3.38	2.50	2.82	1.34	2.28	2.52	2.57
XIV ...	1901-05	1.07	1.16	1.04	1.95	1.26	1.31	1.76	1.98	1.75	1.81	1.66	1.48
	1906-10	1.70	1.74	1.20	1.66	3.27	2.98	2.92	2.10	1.52	1.46	1.68	1.46
XV ...	1901-05	1.34	1.47	1.65	2.17	2.00	1.16	1.42	2.24	1.82	2.25	2.19	1.54
	1906-10	1.46	1.82	1.76	2.52	0.75	2.20	0.80	1.10	2.02	1.50	1.66	1.52
XVII ...	1901-05	0.50	0.49	0.50	0.31	0.63	1.69	1.37	0.61	0.58	0.22	0.58	0.62
	1906-10	0.92	0.62	0.54	0.50	1.16	1.08	1.40	0.97	0.38	0.38	0.56	0.72
XVIII ...	1901-05	0.95	0.43	0.43	0.29	0.96	0.87	1.27	1.42	1.54	1.92	2.10	1.10
	1906-10	0.66	0.72	0.46	0.56	1.16	1.42	1.42	1.54	1.78	1.18	1.30	1.32
XIX ...	1901-05	1.05	0.98	1.40	1.12	1.33	1.20	1.60	1.93	1.92	1.76	1.40	1.10
	1906-10	1.46	1.22	1.16	2.30	1.80	1.50	2.22	2.30	1.77	1.52	1.14	1.52
XX ...	1901-05	1.55	1.67	1.53	2.10	2.75	1.23	2.46	1.56	1.04	1.12	0.79	0.86
	1906-10	1.30	1.26	2.10	1.87	1.47	1.40	0.40	1.00	1.30	—	1.34	0.98
XXIII ...	1901-05	0.17	0.26	0.21	0.48	0.45	0.41	0.89	0.44	0.37	0.29	0.18	0.14
	1906-10	0.28	0.44	0.52	0.60	0.52	0.60	0.62	0.58	0.42	0.36	0.28	0.22
XXIV ...	1901-05	1.20	1.24	1.07	0.93	1.09	1.65	1.18	0.77	0.97	0.75	1.60	0.87
	1906-10	0.50	1.46	1.30	0.95	1.03	1.13	1.26	0.78	0.60	0.56	0.70	0.77
XXV ...	1901-05	2.70	1.25	2.64	2.21	2.44	1.14	1.23	1.20	0.72	0.73	0.72	0.92
	1906-10	1.10	1.14	2.17	2.45	1.83	1.40	1.10	1.00	1.45	0.70	1.73	0.57
XXVIII.	1901-05	—	0.15	0.00	—	0.25	0.20	0.31	0.00	2.03	0.15	0.22	1.40
	1906-10	0.28	0.34	0.18	0.57	0.50	1.27	0.20	0.35	0.12	0.14	0.26	0.18
XXIX ...	1901-05	0.17	0.13	0.56	0.34	0.30	0.19	0.25	0.18	0.22	0.18	0.15	0.10
	1906-10	0.18	0.12	0.30	0.44	0.42	0.26	0.20	0.18	0.10	0.12	0.10	0.10
XXX ...	1901-05	0.50	2.75	0.70	—	—	—	0.52	0.70	0.69	0.51	0.54	0.81
	1906-10	1.08	1.60	0.80	—	—	1.57	0.30	0.27	0.17	1.04	0.50	0.62
XXXI ...	1901-05	2.80	0.70	1.12	—	1.53	0.91	0.76	0.57	0.60	0.39	0.55	0.47
	1906-10	0.50	2.07	—	2.90	1.90	1.25	0.60	0.30	0.20	0.93	0.37	0.00

TOTAL WITCHES.

X ...	1901-05	7.97	2.19	7.20	1.82	0.39	0.10	3.00	0.07	2.52	4.62	4.05	6.70
	1906-10	2.10	2.08	0.80	1.06	0.18	0.06	0.05	0.06	0.44	0.58	1.62	1.94
XI ...	1901-05	11.21	12.32	5.56	4.17	4.48	9.89	11.87	7.38	10.32	6.25	9.77	12.77
	1906-10	6.70	8.62	5.46	3.94	4.40	13.12	0.60	—	5.03	3.10	4.32	4.95
XII ...	1901-05	5.40	2.70	5.63	4.31	4.07	7.50	26.80	1.90	1.50	3.81	2.64	2.52
	1906-10	3.45	3.74	3.50	3.64	3.37	1.90	1.57	0.90	4.20	2.00	2.68	3.82
XIII ...	1901-05	9.30	4.73	4.80	1.76	0.00	0.10	1.77	1.50	1.77	2.30	3.90	11.20
	1906-10	8.77	1.80	0.54	0.22	0.06	0.04	0.04	0.08	0.26	1.36	2.56	4.32
XIV ...	1901-05	10.39	10.34	4.76	8.75	21.41	9.67	15.08	5.15	6.89	6.08	8.70	9.48
	1906-10	6.78	4.42	3.42	2.92	0.13	0.56	0.02	0.30	1.16	1.72	2.44	4.60
XV ...	1901-05	12.75	14.25	7.77	6.45	12.76	16.92	14.98	11.55	10.11	11.62	11.88	12.90
	1906-10	10.82	8.30	5.94	6.02	20.60	24.70	29.10	4.00	4.07	7.60	8.06	9.02
XVI ...	1901-05	8.45	10.95	4.90	4.74	4.43	—	—	—	11.875	12.48	9.15	8.81
	1906-10	7.60	5.56	4.68	3.34	1.30	—	—	0.00	—	2.10	4.04	3.55
XVII ...	1901-05	3.75	1.17	1.01	0.90	0.67	0.32	0.11	0.55	2.67	0.20	1.42	0.44
	1906-10	1.26	2.06	1.36	0.64	0.30	0.24	0.15	1.32	0.18	0.40	0.82	2.62
XVIII ...	1901-05	22.05	15.65	9.74	6.33	24.42	13.25	15.15	11.08	14.30	18.07	16.80	14.58
	1906-10	12.36	13.08	6.44	4.70	16.76	16.12	12.06	10.54	11.62	11.02	14.86	14.26

TOTAL WITCHES—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XIX ...	1901-05	14.88	13.31	11.70	24.12	29.41	28.90	25.20	22.48	16.18	13.50	11.71	14.86
	1906-10	14.10	10.18	3.34	8.40	27.08	23.06	20.08	18.15	12.83	7.87	10.72	10.20
XX ...	1901-5	10.24	4.13	6.63	1.49	1.89	1.87	1.52	2.79	1.41	5.62	3.36	4.94
	1906-10	4.66	2.98	2.96	3.80	0.77	5.80	0.30	1.50	1.20	—	6.02	3.70
XXIII ...	1901-05	1.37	1.29	0.31	1.00	0.72	0.87	1.13	1.29	1.86	1.80	1.58	0.97
	1906-10	1.14	0.70	0.46	0.54	0.56	1.64	0.94	1.24	1.74	2.80	1.70	1.70
XXIV ...	1901-05	7.75	8.72	4.37	28.71	17.90	4.93	4.82	2.84	5.85	5.25	13.79	6.85
	1906-10	10.22	4.30	1.16	0.90	7.33	6.00	5.86	3.64	2.98	2.48	2.02	5.42
XXV ...	1901-05	5.70	4.40	3.75	1.35	1.54	0.95	0.75	2.59	1.53	1.45	1.96	4.27
	1906-10	6.77	2.64	1.97	3.60	1.43	0.53	0.50	1.20	0.95	0.70	3.47	1.72
XXVI ...	1901-05	0.90	—	1.40	6.20	1.47	0.07	0.10	0.63	0.29	0.77	0.67	1.50
	1906-10	0.63	0.47	1.10	1.52	0.00	0.20	0.60	0.70	0.45	0.47	0.60	0.10
XXIX ...	1901-05	0.13	0.34	0.11	0.07	0.06	0.07	0.09	0.09	0.03	0.14	0.05	0.03
	1906-10	0.10	0.02	0.00	0.08	0.02	0.14	0.02	0.02	0.06	0.10	0.60	0.00
XXX ...	1901-05	5.60	5.00	3.30	—	—	—	1.28	1.55	3.49	3.18	3.07	4.87
	1906-10	2.78	9.85	1.50	—	—	7.07	0.15	1.57	0.50	1.28	2.07	4.56
XXXI ...	1901-05	3.00	3.65	3.60	—	2.10	1.45	0.80	1.03	1.02	1.41	1.87	3.72
	1906-10	0.90	1.93	—	0.20	0.40	0.20	1.00	0.50	1.30	0.70	2.07	0.90

LARGE WITCHES.

X ...	1901-05	4.97	1.66	4.17	1.18	0.36	0.10	1.93	0.07	1.53	2.90	2.91	3.35
	1906-10	1.06	1.02	0.54	0.46	0.10	0.40	0.02	0.06	0.26	0.34	0.92	1.20
XI ...	1901-05	8.10	8.46	3.84	2.82	3.09	2.58	7.54	6.96	6.71	3.87	6.66	5.76
	1906-10	4.02	5.02	3.44	2.06	2.78	7.30	0.60	—	3.20	2.24	2.84	3.25
XII ...	1901-05	3.30	2.05	3.97	2.92	3.10	4.10	15.00	1.90	1.25	3.53	2.27	2.06
	1906-10	1.90	2.62	2.40	2.04	0.90	0.95	1.56	0.80	3.30	1.78	1.92	1.82
XIII ...	1901-05	5.00	0.23	4.15	1.31	0.00	0.06	1.23	1.06	1.23	1.56	1.70	6.75
	1906-10	3.90	1.20	0.38	0.16	0.04	0.05	0.02	0.08	0.20	0.62	1.42	1.85
XIV ...	1901-05	6.71	6.72	3.38	5.51	14.34	6.64	8.48	3.43	4.76	4.09	5.27	6.36
	1906-10	4.00	2.70	2.22	1.62	0.06	0.38	0.02	0.20	0.76	0.84	1.42	2.46
XV ...	1901-05	9.59	9.68	5.70	4.80	8.12	10.32	9.17	7.52	7.12	8.01	8.54	8.97
	1906-10	6.82	5.30	3.82	3.46	14.00	11.20	25.30	2.90	2.08	4.67	4.96	5.36
XVI ...	1901-05	7.25	6.60	3.70	3.50	3.37	—	—	—	8.75	9.98	6.42	6.71
	1906-10	4.97	3.66	3.20	1.92	1.00	—	—	0.00	—	1.80	2.98	2.10
XVII ...	1901-05	2.95	0.96	0.67	0.72	0.60	0.39	0.09	0.39	1.93	0.12	1.05	0.33
	1906-10	0.94	1.42	0.84	0.44	0.18	0.16	0.10	0.50	0.12	0.26	0.50	1.80
XVIII ...	1901-05	13.60	9.62	9.81	4.50	13.67	9.46	7.96	7.08	9.61	11.90	10.96	9.45
	1906-10	7.16	7.54	3.83	2.96	10.42	9.70	7.90	7.02	7.00	6.64	8.60	7.98
XIX ...	1901-05	7.15	8.76	8.62	14.56	19.21	17.53	16.27	15.93	11.45	9.44	8.57	8.68
	1906-10	9.22	7.02	2.40	5.86	16.62	10.68	12.84	13.35	8.03	4.42	6.24	6.66
XX ...	1901-05	7.26	2.60	4.17	1.15	1.47	1.54	1.52	2.78	1.20	4.25	2.82	3.97
	1906-10	3.44	2.32	2.12	2.93	0.67	4.87	0.30	1.50	1.20	—	4.86	2.70
XXIII ...	1901-05	0.97	1.105	0.29	0.66	0.59	0.76	0.91	0.89	1.29	1.33	1.11	0.66
	1906-10	0.78	0.54	0.38	0.40	0.46	1.16	0.64	0.84	1.28	1.92	1.12	1.22
XXIV ...	1901-05	7.15	6.45	3.58	17.84	11.64	3.86	3.84	1.94	4.00	5.78	9.78	5.75
	1906-10	7.58	3.50	1.02	0.90	4.86	3.70	3.98	2.52	2.10	1.80	1.55	3.82
XXV ...	1901-05	5.70	4.35	3.75	1.30	1.42	0.93	0.69	2.03	1.41	1.38	1.75	3.44
	1906-10	4.72	2.44	1.63	2.80	1.36	0.40	0.50	0.80	0.95	0.70	2.86	1.63

LARGE WITCHES—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XXVI ...	1901-05 1906-10	0.70 0.63	— 0.43	1.10 0.95	1.30 1.00	1.37 0.00	0.07 0.20	1.10 0.60	0.43 0.70	0.29 0.45	0.77 0.47	0.67 0.60	1.50 0.10
XXIX ...	1901-05 1906-10	0.13 0.10	0.30 0.02	0.08 0.00	0.07 0.08	0.05 0.02	0.054 0.08	0.079 0.02	0.092 0.02	0.02 0.06	0.12 0.08	0.05 0.06	0.03 0.00
XXX ...	1901-05 1906-10	5.40 2.62	4.85 8.00	3.20 1.50	— —	— —	— 3.93	1.30 0.15	1.38 1.56	3.22 0.47	3.05 1.20	2.81 1.96	4.61 4.36
XXXI ...	1901-05 1906-10	2.50 0.90	3.60 1.93	3.40 —	— 0.20	2.06 0.40	1.37 0.20	0.80 1.00	1.01 0.50	0.99 1.30	1.41 0.70	1.82 2.06	3.32 0.90

SMALL WITCHES.

X ...	1901-05 1906-10	2.97 0.88	0.77 1.06	3.03 0.26	0.64 0.58	0.02 0.04	0.05 0.02	1.07 0.02	0.00 0.02	0.99 0.02	3.38 0.22	1.14 0.70	3.36 0.74
XI ...	1901-05 1906-10	3.13 2.67	3.79 3.60	1.72 2.02	1.35 1.88	1.39 1.60	3.30 5.82	4.30 0.00	1.37 —	3.61 1.83	1.42 0.86	3.09 1.48	1.90 1.70
XII ...	1901-05 1906-10	2.10 1.55	0.65 1.14	1.62 1.12	1.44 1.62	0.93 0.47	3.40 0.00	11.80 0.00	0.00 0.10	0.25 0.90	0.24 0.24	0.34 0.78	0.56 1.04
XIII ...	1901-05 1906-10	4.35 4.77	0.03 0.60	0.60 0.16	0.42 0.06	0.00 0.02	0.03 0.00	0.54 0.00	0.43 0.00	0.69 0.08	0.70 0.72	2.23 1.14	4.45 2.47
XIV ...	1901-05 1906-10	3.65 2.74	3.61 1.76	1.40 1.14	3.09 1.30	7.09 0.03	3.03 0.16	6.57 0.00	1.72 0.10	2.12 0.38	1.97 0.70	3.41 1.02	3.12 2.12
XV ...	1901-05 1906-10	3.16 4.02	4.54 3.00	2.04 2.08	1.65 2.56	4.64 6.60	6.57 13.50	5.30 3.80	3.96 1.10	2.40 1.00	3.55 2.90	3.32 5.12	4.16 3.66
XVI ...	1901-05 1906-10	1.15 2.67	1.87 1.90	1.20 1.50	1.26 1.40	1.06 0.30	— —	— —	— 0.00	3.125 —	3.50 0.30	2.76 1.24	2.08 1.45
XVII ...	1901-05 1906-10	0.80 0.32	0.18 0.46	0.34 0.52	0.15 0.22	0.09 0.04	0.00 0.08	0.02 0.05	0.26 0.82	0.57 0.06	0.05 0.14	0.31 0.32	0.05 0.82
XVIII ...	1901-05 1906-10	8.41 5.20	6.03 5.56	3.16 2.72	1.83 1.74	6.16 6.38	3.73 6.40	4.16 4.15	3.99 4.10	4.66 5.05	6.16 4.56	5.81 6.24	5.11 6.32
XIX ...	1901-05 1906-10	5.41 4.86	4.57 3.18	3.11 0.94	9.58 2.53	9.82 10.26	11.39 8.36	8.94 7.22	6.63 4.80	4.73 4.30	6.07 3.45	3.15 4.48	4.98 3.54
XX ...	1901-05 1906-10	2.90 1.30	1.50 0.66	0.83 0.86	0.32 0.87	0.41 0.10	0.34 0.87	0.00 0.00	0.00 0.00	0.17 2.30	1.37 —	0.50 1.18	0.97 0.74
XXIII ...	1901-05 1906-10	0.39 0.30	0.16 0.16	0.04 0.10	0.36 0.12	0.13 0.06	0.11 0.48	0.22 0.30	0.38 9.40	0.54 0.46	0.45 0.92	0.47 0.62	0.31 0.50
XXIV ...	1901-05 1906-10	0.60 2.68	2.24 0.80	0.79 0.14	10.87 0.00	6.24 2.43	1.07 2.30	0.98 1.92	0.92 1.12	1.85 0.90	1.48 0.70	3.99 9.47	1.09 1.62
XXV ...	1901-05 1906-10	0.00 2.03	0.04 0.21	0.00 0.35	0.04 0.84	0.13 0.06	0.01 0.15	0.04 0.00	0.56 0.36	0.11 0.00	0.05 0.02	0.19 0.61	0.84 0.47
XXVI ...	1901-05 1906-10	0.19 0.00	— 0.02	0.23 0.13	0.89 1.50	0.00 0.00	0.00 0.00	0.00 0.00	0.16 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
XXIX ...	1901-05 1906-10	0.00 0.00	0.04 0.00	0.03 0.00	0.00 0.00	0.01 0.00	0.00 0.06	0.06 0.00	0.06 0.02	0.04 0.12	0.024 0.00	0.00 0.00	0.00 0.00
XXX ...	1901-05 1906-10	0.185 0.16	0.125 1.82	0.075 0.00	— —	— —	— 3.10	0.00 0.00	0.17 0.00	0.27 0.02	0.13 0.10	0.04 0.13	0.25 0.20
XXXI ...	1901-05 1906-10	0.41 0.00	0.07 0.00	0.19 —	— 0.00	0.11 0.00	0.10 0.00	0.00 0.00	0.01 0.00	0.01 0.00	0.00 0.00	0.05 0.00	0.42 0.00

TOTAL LEMONS.

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
X ...	1901-05 1906-10	0.39 0.84	0.88 1.36	0.86 1.26	1.68 1.04	1.50 2.48	3.05 3.74	1.83 3.74	1.58 3.42	1.80 2.00	1.48 1.92	0.53 2.50	0.66 1.50
XI ...	1901-05 1906-10	0.15 0.25	0.06 0.40	0.07 0.16	0.22 0.18	0.21 0.15	0.03 0.56	2.66 0.20	0.57 —	0.44 0.80	0.22 0.60	0.38 0.44	0.25 0.44
XII ...	1901-05 1906-10	0.60 0.32	0.45 0.28	1.36 0.22	0.02 0.32	0.10 0.13	0.00 0.20	0.20 0.60	1.10 1.40	0.45 0.70	0.75 0.48	0.43 0.44	0.16 0.58
XIII ...	1901-05 1906-10	0.00 1.10	1.82 1.46	5.30 8.44	4.06 1.46	2.30 4.06	3.41 6.48	2.75 5.52	1.70 4.84	2.55 3.36	2.40 3.46	1.99 1.42	0.94 1.17
XIV ...	1901-05 1906-10	0.14 0.74	0.26 1.12	0.42 1.42	0.53 0.52	0.86 7.20	1.81 9.02	1.14 7.78	2.06 5.14	2.76 3.74	2.15 3.66	0.58 2.72	0.55 1.90
XV ...	1901-05 1906-10	0.14 0.30	0.18 0.42	0.12 0.32	0.16 0.24	0.17 1.05	0.06 2.20	0.45 0.00	0.52 8.80	0.95 0.55	0.59 1.05	0.23 0.52	0.19 0.34
XVII ...	1901-05 1906-10	5.20 4.88	4.38 4.94	7.58 4.32	7.47 7.08	6.43 10.26	8.66 8.66	8.46 7.25	8.70 11.87	7.63 8.88	4.53 5.48	3.31 4.62	7.92 4.84
XVIII ...	1901-05 1906-10	0.34 0.80	0.39 1.00	0.59 2.06	4.73 3.40	0.68 2.40	3.54 2.60	7.75 4.36	3.69 3.44	2.04 3.20	0.86 2.70	0.60 0.96	1.06 0.68
XIX ...	1901-05 1906-10	0.14 0.28	0.25 0.42	0.31 0.80	0.21 0.53	0.38 0.60	0.24 0.74	0.70 1.32	1.05 1.05	1.59 1.37	1.29 0.80	0.64 0.66	0.26 0.38
XX ...	1901-05 1906-10	0.29 0.40	0.37 0.48	0.37 0.46	0.35 0.57	1.54 0.93	1.49 1.27	2.39 1.50	2.34 0.80	2.36 0.80	1.36 —	0.73 1.44	0.49 0.24
XXIII ...	1901-05 1906-10	4.70 8.34	6.32 8.88	8.69 11.08	9.49 12.58	8.96 11.50	7.70 11.64	10.00 12.96	11.71 12.66	9.71 12.02	7.52 10.20	6.81 9.06	5.75 7.34
XXIV ...	1901-05 1906-10	2.85 0.70	1.61 2.00	2.30 3.10	0.73 2.02	4.01 6.00	7.76 7.47	8.99 9.40	10.47 9.44	10.87 10.50	6.28 8.52	2.33 3.95	1.51 1.55
XXV ...	1901-05 1906-10	1.50 0.62	1.35 0.60	1.39 1.77	1.13 0.90	1.89 1.07	1.33 3.97	1.93 1.70	1.15 1.50	2.02 1.75	1.90 1.10	1.45 3.10	1.22 0.52
XXVI ...	1901-05 1906-10	0.10 0.57	— 0.70	1.10 0.32	0.00 1.00	1.14 1.70	0.63 2.65	1.89 5.80	1.20 1.65	1.29 1.80	1.38 1.42	0.66 0.90	0.84 1.05
XXVIII ...	1901-05 1906-10	— 7.66	7.51 8.38	1.00 7.00	— 8.22	5.57 8.70	14.62 11.27	14.42 12.85	14.88 11.37	0.00 16.78	7.51 12.96	8.97 11.98	6.31 9.64
XXIX ...	1901-05 1906-10	5.72 8.34	7.43 6.67	6.29 8.08	7.06 8.44	9.35 10.02	9.02 12.14	8.66 13.04	8.69 12.56	8.16 11.00	7.65 11.08	6.00 10.78	5.95 8.52
XXX ...	1901-05 1906-10	0.85 3.22	0.85 0.45	0.85 1.20	— —	— —	— 3.20	6.77 3.55	4.67 11.50	5.17 6.52	2.51 6.84	2.01 1.50	1.12 5.14
XXXI ...	1901-05 1906-10	1.05 0.50	1.30 1.20	1.05 —	— 0.80	2.58 1.20	1.53 2.95	1.38 2.80	2.05 2.20	1.98 3.20	2.04 4.33	1.93 3.13	1.20 1.30

LARGE LEMONS.

X ...	1901-05 1906-10	0.39 0.68	0.86 0.94	0.79 0.94	1.59 0.84	1.15 1.18	2.45 1.84	1.37 2.04	1.28 1.76	1.49 1.12	1.29 1.04	0.54 1.18	0.67 0.90
XI ...	1901-05 1906-10	0.15 0.25	0.07 0.38	0.07 0.16	0.22 0.16	0.21 0.15	0.03 1.67	2.44 0.20	0.57 —	0.44 0.57	0.22 0.56	0.39 0.40	0.25 0.47
XII ...	1901-05 1906-10	0.60 0.32	0.45 0.24	0.68 0.22	0.02 0.32	0.10 0.13	0.00 0.20	0.20 0.60	0.80 1.40	0.45 0.70	0.76 0.50	0.44 0.44	0.17 0.94
XIII ...	1901-05 1906-10	0.00 0.70	1.68 1.16	5.10 6.04	3.80 2.04	1.80 2.78	3.02 4.38	2.34 2.60	0.98 2.88	1.82 1.60	2.30 2.08	1.66 1.15	0.13 0.67
XIV ...	1901-05 1906-10	0.14 0.58	0.26 0.84	0.42 0.78	0.53 0.50	0.83 3.30	1.71 5.06	1.07 4.12	1.74 3.18	2.71 2.44	2.13 2.40	0.56 1.64	0.33 1.00

LARGE LEMONS—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XV ...	1901-05	0.13	0.18	0.12	0.26	0.16	0.06	0.45	0.53	0.95	0.59	0.23	0.19
	1906-10	0.30	0.42	0.30	0.24	1.05	1.10	0.00	8.80	0.55	0.97	0.44	0.32
XVII ...	1901-05	5.05	4.05	6.92	7.01	5.66	8.08	7.50	7.65	6.56	4.21	2.88	5.89
	1906-10	3.66	4.00	3.40	5.74	8.18	6.64	5.52	9.62	7.00	3.54	3.08	3.18
XVIII ...	1901-05	0.34	0.37	0.56	4.47	0.68	3.36	7.56	3.36	1.94	0.78	0.56	0.85
	1906-10	0.68	0.88	1.72	2.66	1.76	2.02	3.22	2.90	2.72	2.14	0.76	0.60
XIX ...	1901-05	0.13	0.21	0.31	0.21	0.46	0.24	0.69	1.05	1.59	1.29	0.66	0.62
	1906-10	0.26	0.42	0.79	0.53	0.60	0.70	0.86	1.05	1.33	0.70	0.66	0.38
XX ...	1901-05	0.25	0.36	0.37	0.33	1.54	1.49	2.38	2.34	2.36	1.32	0.73	0.49
	1906-10	0.40	0.46	0.46	0.53	0.46	1.26	1.50	0.70	0.80	—	1.44	0.24
XXIII ...	1901-05	4.09	5.57	7.67	8.29	7.27	6.34	6.62	9.69	8.49	5.79	5.41	4.79
	1906-10	6.42	6.46	8.28	9.42	8.48	8.56	9.72	9.08	7.88	6.90	5.46	4.94
XXIV ...	1901-05	2.80	1.58	2.30	0.73	3.82	7.89	8.48	10.39	10.79	6.19	2.20	1.48
	1906-10	0.68	2.80	3.06	4.35	5.83	6.83	8.98	8.76	9.76	7.98	3.42	1.37
XXV ...	1901-05	1.50	1.35	1.39	1.13	1.86	1.33	1.87	1.13	2.24	1.86	1.44	1.21
	1906-10	0.62	0.60	1.76	0.90	1.00	3.96	1.79	1.50	1.65	1.10	2.36	0.52
XXVI ...	1901-05	0.10	—	1.10	0.00	1.13	0.62	1.66	1.20	1.29	1.37	0.66	0.83
	1906-10	0.56	0.70	0.32	0.90	1.70	2.60	3.25	1.55	1.55	1.32	0.90	1.05
XXVIII ...	1901-05	—	6.76	0.67	—	4.11	12.55	12.06	11.90	0.00	6.58	7.06	5.83
	1906-10	6.02	5.60	4.74	4.92	5.97	7.70	8.17	5.32	10.48	8.06	7.32	6.48
XXIX ...	1901-05	5.71	6.52	5.45	6.49	8.96	8.68	8.42	8.31	7.86	6.59	5.34	5.20
	1906-10	6.20	5.55	5.80	6.96	8.76	10.18	11.54	10.86	8.90	8.76	7.76	6.06
XXX ...	1901-05	0.85	0.85	0.85	—	—	—	6.68	4.47	5.22	2.50	1.97	1.11
	1906-10	2.60	0.45	1.10	—	—	2.93	3.20	10.00	6.17	5.66	1.33	4.70
XXXI ...	1901-05	1.05	1.30	1.05	—	2.48	1.48	1.36	2.05	1.93	2.00	1.91	1.20
	1906-10	0.50	1.16	—	0.80	1.10	2.30	2.80	2.20	3.20	3.93	2.76	1.30

SMALL LEMONS.

X ...	1901-05	0.00	0.00	0.07	0.09	0.32	0.55	0.46	0.27	0.31	0.18	0.00	0.00
	1906-10	0.14	0.44	0.36	0.22	1.26	1.90	1.70	1.70	0.90	0.84	1.34	0.62
XI ...	1901-05	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00
	1906-10	0.00	0.02	0.00	0.02	0.00	0.30	0.00	—	0.23	0.04	0.04	0.07
XII ...	1901-05	0.00	0.00	0.68	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00
	1906-10	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.02
XIII ...	1901-05	0.00	0.15	0.20	0.26	0.50	0.43	0.41	0.75	0.74	0.10	0.34	0.05
	1906-10	0.42	0.32	2.42	0.62	1.34	2.08	2.90	1.96	1.76	1.38	0.44	0.50
XIV ...	1901-05	0.00	0.00	0.00	0.00	0.02	0.15	0.06	0.30	0.04	0.04	0.01	0.00
	1906-10	0.16	0.28	0.58	0.04	3.90	4.00	3.68	1.98	1.18	1.00	1.08	0.94
XV ...	1901-05	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1906-10	00.0	0.00	0.02	0.00	0.00	1.10	0.00	0.00	0.00	0.07	0.06	0.00
XVII ...	1901-05	0.15	0.33	0.66	0.46	0.79	0.61	0.92	1.05	1.00	1.04	0.43	2.03
	1906-10	1.24	0.92	0.94	1.34	2.08	2.04	1.70	2.47	1.86	1.92	1.58	1.68
XVIII ...	1901-05	0.02	0.02	0.02	0.26	0.00	0.17	0.39	0.33	0.10	0.06	0.02	0.18
	1906-10	0.12	0.14	0.32	0.74	0.64	0.56	1.18	0.48	0.46	0.54	0.20	0.08
XIX ...	1901-05	0.00	0.04	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.02	0.00
	1906-10	0.00	0.00	0.01	0.00	0.01	0.04	0.48	0.00	0.03	0.10	0.08	0.00
XX ...	1901-05	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1906-10	0.00	0.02	0.00	0.04	0.13	0.00	0.00	0.10	0.00	—	0.00	0.00

SMALL LEMONS—continued.

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XXIII ...	1901-05 1906-10	0.64 1.90	0.74 2.42	1.04 2.80	1.17 3.14	1.27 3.02	1.27 3.04	1.19 3.24	2.01 3.58	1.46 4.16	1.71 3.28	1.43 3.60	0.99 2.32
XXIV ...	1901-05 1906-10	0.05 0.06	0.03 0.02	0.02 0.06	0.00 0.70	0.24 0.16	0.36 0.63	0.53 0.40	0.09 0.70	0.15 0.76	0.10 0.56	0.12 0.57	0.02 0.17
XXV ...	1901-05 1906-10	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.03 0.06	0.00 0.00	0.06 0.00	0.02 0.00	0.00 0.05	0.04 0.00	0.01 0.40	0.01 0.02
XXVI ...	1901-05 1906-10	0.00 0.00	— 0.00	0.00 0.00	0.00 0.10	0.02 0.00	0.01 0.05	0.23 0.10	0.00 0.10	0.00 0.20	0.01 0.12	0.00 0.00	0.00 0.00
XXVIII ...	1901-05 1906-10	— 2.46	0.75 2.82	0.33 2.24	— 3.30	1.51 2.70	2.06 3.60	2.36 4.87	2.98 6.02	0.00 6.30	1.17 4.86	1.93 4.68	0.48 3.16
XXIX ...	1901-05 1906-10	0.31 2.16	0.92 1.05	0.84 2.28	0.58 1.48	0.41 1.24	0.33 1.94	0.23 1.50	0.44 1.66	0.32 2.12	0.69 2.32	0.66 3.00	0.75 2.46
XXX ...	1901-05 1906-10	0.00 0.62	0.00 0.00	0.00 0.10	— —	— —	— 0.26	0.08 0.35	0.20 1.46	0.06 0.32	0.01 1.76	0.04 0.13	0.01 0.44
XXXI ...	1901-05 1906-10	0.00 0.00	0.00 0.03	0.00 —	— 0.00	0.96 0.10	0.05 0.65	0.01 0.00	0.01 0.00	0.05 0.00	0.03 0.36	0.02 0.36	0.00 0.00

TOTAL PLAICE.

X ...	1901-05 1906-10	14.50 6.40	15.18 12.04	13.17 7.52	16.70 5.66	18.23 4.64	14.70 4.48	8.10 3.80	21.96 3.00	3.20 2.56	6.41 2.10	8.74 3.70	13.11 3.52
XI ...	1901-05 1906-10	0.12 0.85	0.20 1.44	0.15 0.38	0.22 0.24	0.20 0.30	0.36 0.0	3.13 0.20	1.45 —	0.67 1.03	1.84 1.04	1.19 0.86	0.88 0.72
XII ...	1901-05 1906-10	0.0 1.26	3.20 1.42	0.51 0.54	0.14 0.28	0.33 0.27	0.20 2.60	0.70 1.83	3.70 2.70	2.65 2.10	3.28 0.90	2.70 0.94	1.20 1.20
XIII ...	1901-05 1906-10	0.70 5.07	9.92 11.88	3.45 10.98	11.63 15.80	14.90 18.96	22.35 10.06	18.76 13.76	11.16 6.10	14.83 8.14	14.73 13.98	10.64 13.78	3.57 4.37
XIV ...	1901-05 1906-10	0.22 1.50	0.88 1.44	0.86 1.80	10.96 0.98	0.39 4.40	3.85 5.14	1.99 5.16	4.26 2.72	5.37 2.36	6.99 2.98	4.32 2.74	0.89 1.60
XV ...	1901-05 1906-10	0.07 0.06	0.57 0.18	0.29 0.28	0.33 0.76	2.04 0.0	0.4 0.10	0.55 0.00	0.14 1.80	1.39 0.50	2.00 0.50	0.78 0.52	0.37 0.22
XVII ...	1901-05 1906-10	9.25 4.62	9.15 4.72	24.19 4.12	6.74 5.08	12.18 8.04	12.92 6.70	11.34 5.50	6.38 4.00	9.17 4.66	8.24 4.64	6.87 4.20	14.47 6.14
XVIII ...	1901-05 1906-10	0.12 0.34	0.38 0.38	0.42 1.02	1.43 1.78	1.84 0.54	1.55 2.00	1.90 0.82	0.92 0.38	0.84 0.48	0.84 0.80	0.68 0.48	1.10 0.22
XIX ...	1901-05 1906-10	0.21 0.16	0.27 0.54	0.65 0.54	0.15 0.60	0.28 0.22	0.08 0.12	0.14 0.18	0.57 0.05	0.54 0.50	0.58 0.27	1.02 0.12	0.21 0.08
XX ...	1901-05 1906-10	1.83 3.32	3.83 3.24	3.44 1.54	1.38 1.03	5.80 6.43	8.94 3.30	9.36 5.30	5.50 5.20	13.49 3.40	4.40 —	5.22 0.66	3.85 0.82
XXIII ...	1901-05 1906-10	4.09 8.34	4.87 9.02	10.05 6.68	5.54 4.30	5.19 2.80	3.99 2.40	2.73 1.82	2.63 1.82	3.53 3.08	5.59 3.70	5.72 7.58	4.78 9.76
XXIV ...	1901-05 1906-10	0.85 0.08	0.27 0.98	0.34 0.50	0.20 0.50	0.47 0.60	1.63 1.07	3.18 1.10	2.24 0.66	1.41 0.94	1.40 0.80	1.09 0.52	0.14 0.22
XXV ...	1901-05 1906-10	4.10 2.06	2.00 4.28	11.83 3.02	8.78 2.70	9.37 6.77	9.44 8.70	8.71 7.70	10.56 10.30	6.81 11.45	7.32 8.00	6.10 2.30	5.60 3.05
XXVIII ...	1901-05 1906-10	— 12.92	40.05 10.42	10.80 18.42	— 14.97	9.35 6.20	6.50 4.10	8.26 5.45	6.50 5.95	0.0 5.48	16.37 10.96	9.87 10.64	12.61 8.98
XXIX ...	1901-05 1906-10	4.44 7.04	9.83 12.50	19.44 9.72	6.97 6.18	4.05 3.18	4.65 3.20	4.64 3.44	4.82 3.12	4.68 3.22	4.80 4.08	4.16 2.42	3.18 2.12
XXX ...	1901-05 1906-10	0.05 1.32	0.15 0.80	0.40 0.90	— —	— —	— 1.47	4.66 1.25	4.23 1.20	2.42 2.37	2.25 1.85	0.71 0.43	0.23 0.38

TOTAL PLAICE—*continued.*

Square.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XXXI ...	1901-05	0.85	3.30	3.28	—	5.49	6.03	6.87	8.28	5.01	4.31	3.50	0.90
	1906-10	2.70	7.23	—	12.90	12.40	5.25	4.70	4.90	6.35	1.85	3.27	0.90
XXXII .	1901-05	—	4.47	—	—	10.48	9.00	8.72	7.10	11.61	8.09	20.18	9.59
	1906-10	—	—	5.60	8.60	—	12.20	—	4.90	6.30	5.55	—	5.20

LARGE PLAICE.

X ...	1901-05	2.18	4.25	2.85	2.83	3.95	3.75	2.40	4.93	0.45	0.77	1.72	2.04
	1906-10	1.28	2.78	1.68	0.94	0.56	0.94	0.72	0.64	0.42	0.28	0.56	0.52
XII ...	1901-05	0.00	1.00	0.17	0.04	0.06	0.00	0.00	0.80	1.00	1.00	0.82	0.80
	1906-10	0.44	0.50	0.18	0.12	0.03	1.10	0.76	0.80	0.60	0.32	0.38	0.30
XIII ...	1901-05	0.05	2.93	0.25	2.80	6.30	5.06	2.50	1.73	2.36	2.96	1.50	0.70
	1906-10	0.90	3.90	1.70	1.74	2.04	1.30	0.52	1.06	0.68	3.32	1.52	0.75
XIV ...	1901-05	0.05	0.35	0.27	1.12	0.05	0.85	0.30	0.72	1.20	1.02	0.86	0.14
	1906-10	0.32	0.30	0.48	0.20	0.53	1.36	0.80	0.54	0.42	0.52	0.68	0.40
XVII ...	1901-05	2.75	2.40	4.57	1.46	2.44	2.87	2.40	1.48	0.73	0.97	1.30	4.30
	1906-10	1.00	0.82	0.64	1.24	1.78	0.96	0.60	0.36	0.14	0.54	0.26	0.52
XVIII ...	1901-05	0.00	0.05	0.07	0.22	0.53	0.30	0.14	0.04	0.08	0.12	0.18	0.10
	1906-10	0.02	0.06	0.06	0.04	0.00	0.02	0.02	0.00	0.00	0.10	0.06	0.02
XIX ...	1901-05	0.05	0.02	0.10	0.00	0.00	0.04	0.04	0.30	0.00	0.12	0.41	0.04
	1906-10	0.04	0.10	0.08	0.06	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00
XX ...	1901-05	0.43	0.50	0.17	0.00	0.54	0.52	0.50	0.37	1.57	0.50	0.50	0.42
	1906-10	0.80	0.50	0.16	0.06	0.76	0.30	0.20	0.00	0.10	—	0.04	0.12
XXIII ...	1901-05	0.12	0.27	0.75	0.22	0.40	0.36	0.32	0.24	0.24	0.26	0.20	0.24
	1906-10	0.16	0.32	0.30	0.16	0.12	0.08	0.04	0.02	0.04	0.02	0.06	0.08
XXIV ...	1901-05	0.05	0.00	0.02	0.00	0.05	0.20	0.26	0.16	0.06	0.14	0.16	0.00
	1906-10	0.00	0.08	0.00	0.00	0.13	0.10	0.04	0.00	0.00	0.04	0.02	0.00
XXV ...	1901-05	1.05	0.10	1.55	0.00	1.02	1.12	1.24	1.38	0.92	0.86	0.60	0.45
	1906-10	0.00	0.52	0.40	0.20	0.50	0.36	0.50	1.00	1.20	1.10	0.60	0.37
XXVIII .	1901-05	—	2.30	0.70	—	0.45	0.10	0.47	0.00	0.00	0.32	0.60	0.70
	1906-10	0.22	0.46	1.26	0.20	0.30	0.20	0.05	0.15	0.12	0.14	0.12	0.14
XXIX ...	1901-05	0.16	0.43	1.20	0.42	0.30	0.26	0.18	0.26	0.20	0.24	0.08	0.08
	1906-10	0.44	1.06	0.58	0.14	0.06	0.08	0.10	0.10	0.10	0.12	0.00	0.04
XXX ...	1901-05	0.00	0.00	0.00	—	—	—	0.53	0.28	0.70	0.44	0.05	0.02
	1906-10	0.00	0.00	0.10	—	—	0.00	0.00	0.16	0.12	0.10	0.00	0.00
XXXI ...	1901-05	0.05	0.25	0.13	—	0.74	0.70	0.57	0.66	0.52	0.42	0.40	0.05
	1906-10	0.00	0.82	—	0.60	0.50	0.30	0.30	0.40	1.20	0.36	0.23	0.00
XXXII ..	1901-05	—	0.20	—	—	1.10	0.53	1.00	0.64	1.52	0.62	2.66	0.30
	1906-10	—	—	0.60	1.50	—	0.90	—	0.00	1.80	0.60	—	1.60

MEDIUM PLAICE.

X ...	1901-05	13.17	9.72	9.67	13.34	13.72	10.75	5.57	16.23	2.71	5.60	6.94	10.87
	1906-10	4.64	7.86	5.00	4.16	3.64	3.26	2.86	2.10	1.98	1.74	2.92	2.76
XI ...	1901-05	0.12	0.17	0.10	0.18	0.18	0.23	2.71	0.80	0.57	1.02	0.76	0.54
	1906-10	0.57	1.02	0.26	0.22	0.25	0.00	0.20	—	0.77	1.03	1.10	0.52
XII ...	1901-05	0.00	2.20	0.32	0.10	0.23	0.20	0.70	2.90	1.65	2.30	1.85	0.73
	1906-10	0.84	0.86	0.38	0.14	0.23	1.60	1.07	1.90	1.50	0.40	0.58	0.84
XIII ...	1901-05	0.70	6.77	2.15	6.77	28.85	15.90	14.88	8.50	10.37	10.80	8.33	2.20
	1906-10	3.00	12.13	8.58	9.86	14.36	7.94	6.72	3.76	5.42	9.24	11.92	2.82

MEDIUM PLAICE—continued.

Year.	Period.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XIV ...	1901-05 1906-10	0.17 1.04	0.50 1.04	0.60 1.12	9.47 0.60	0.37 3.47	2.80 3.60	1.63 4.30	3.52 2.12	4.14 1.84	5.92 2.30	3.40 2.02	0.74 1.20
XV ...	1901-05 1906-10	0.02 0.06	0.47 0.14	0.20 0.20	0.24 0.56	1.87 0.00	0.00 0.10	0.45 0.00	0.10 1.50	1.00 0.50	1.64 0.45	0.50 0.38	0.20 0.16
XVII ...	1901-05 1906-10	6.35 3.44	6.33 3.56	19.32 5.12	5.00 3.64	8.82 5.94	9.40 5.30	8.78 4.32	4.70 3.12	7.77 3.96	6.57 3.88	5.57 3.70	9.60 4.82
XVIII ...	1901-05 1906-10	0.12 0.32	0.30 0.34	0.35 0.82	1.00 1.58	1.30 0.54	1.20 1.94	1.74 0.78	0.88 0.34	0.76 0.46	0.65 1.17	0.50 0.42	1.00 0.20
XIX ...	1901-05 1906-10	0.12 0.14	0.20 0.48	0.55 0.46	0.16 0.53	0.28 0.20	0.04 0.18	0.10 0.18	0.26 0.05	0.54 0.50	0.46 0.22	0.60 0.12	0.14 0.08
XX ...	1901-05 1906-10	1.30 2.50	3.30 2.74	3.27 1.38	1.38 0.93	5.22 5.37	8.37 2.80	8.53 4.90	5.10 5.20	11.90 3.30	3.82 —	4.70 0.60	3.42 1.17
XXIII ...	1901-05 1906-10	3.55 4.72	4.20 5.48	8.42 5.02	5.08 3.54	4.28 2.50	3.50 2.20	2.34 1.72	2.28 1.62	3.08 2.36	4.40 1.82	4.36 3.08	3.90 3.00
XXIV ...	1901-05 1906-10	0.80 0.08	0.27 0.88	0.32 0.50	0.20 0.50	0.42 0.47	1.80 0.93	2.90 1.06	2.10 0.66	1.34 0.92	1.26 0.74	0.84 0.50	0.14 0.22
XXV ...	1901-05 1906-10	3.10 0.55	1.60 3.68	10.30 3.60	8.05 2.45	8.26 5.93	8.14 8.27	7.60 6.70	9.12 9.30	5.88 9.75	6.46 6.90	5.22 1.67	5.12 2.65
XXVIII.	1901-05 1906-10	— 9.88	32.00 7.64	8.80 14.22	— 9.57	7.10 5.12	6.40 3.90	7.77 5.20	6.50 5.60	0.00 4.88	11.77 5.90	7.83 6.34	10.13 6.90
XXIX ...	1901-05 1906-10	4.13 5.40	8.70 8.20	16.32 8.00	6.14 5.58	3.64 3.00	4.32 3.06	4.44 3.28	4.54 3.00	4.46 2.94	4.46 3.08	3.92 2.26	2.98 1.86
XXX ...	1901-05 1906-10	0.05 1.32	0.15 0.80	0.30 0.80	— —	— —	— 1.47	4.13 1.25	3.95 1.00	1.70 2.25	1.76 1.50	0.67 0.43	0.22 0.38
XXXI ...	1901-05 1906-10	0.65 2.70	0.30 5.97	2.70 —	— 11.90	4.58 11.20	4.75 4.65	6.17 3.80	7.54 4.50	4.35 7.00	3.86 2.23	3.08 2.57	0.77 0.90
XXXII..	1901-05 1906-10	— —	3.67 —	— 5.00	— 7.10	9.22 —	8.20 9.50	7.52 —	6.16 4.90	9.92 3.50	7.28 4.70	17.50 —	5.50 3.60

SMALL PLAICE.

X ...	1901-05 1906-10	1.65 0.46	1.18 1.42	0.62 0.84	0.48 0.58	0.48 0.44	0.15 0.28	0.16 0.24	0.45 0.22	0.01 0.14	0.02 0.08	0.10 0.14	0.20 0.24
XIII ...	1901-05 1906-10	0.00 1.15	0.26 0.72	1.05 0.70	2.03 4.22	9.75 2.48	1.41 0.82	1.48 6.54	0.90 1.28	2.01 2.04	1.03 1.44	0.83 0.32	0.64 0.75
XVII ...	1901-05 1906-10	0.15 0.20	0.42 0.32	0.35 0.38	0.27 0.20	0.93 0.32	0.60 0.42	0.15 0.57	0.17 0.37	0.66 0.54	0.63 0.20	0.02 0.22	0.55 0.92
XXIII ...	1901-05 1906-10	0.39 3.46	0.42 3.12	0.87 1.36	0.43 0.63	0.61 0.18	0.25 0.14	0.07 0.06	0.08 0.14	0.23 0.68	0.75 1.84	1.02 4.06	0.64 6.50
XXV ...	1901-05 1906-10	0.00 0.02	0.25 0.06	0.00 0.10	0.15 0.05	0.10 0.36	0.20 0.10	0.13 0.50	0.06 0.00	0.00 0.50	0.02 0.00	1.15 0.00	0.00 0.02
XXVIII.	1901-05 1906-10	— 2.82	5.77 2.30	1.33 2.92	— 5.07	1.84 0.75	0.00 0.03	0.00 0.20	0.00 0.17	0.00 0.50	4.25 4.92	1.40 4.24	1.80 1.94
XXIX ...	1901-05 1906-10	0.17 1.22	0.70 1.32	1.93 1.14	0.40 0.50	0.12 0.12	0.04 0.04	0.02 0.04	0.04 0.06	0.02 0.18	0.06 0.82	0.16 0.10	0.12 0.20
XXXI ...	1901-05 1906-10	0.15 0.00	0.05 0.13	0.43 —	— 0.40	0.16 0.70	0.10 0.25	0.16 0.60	0.05 0.00	0.15 0.30	0.02 0.00	0.00 0.47	0.00 0.00
XXXII...	1901-05 1906-10	— —	0.60 —	— 0.00	— 0.00	0.15 —	0.27 1.80	0.20 —	0.30 0.00	0.15 1.00	0.18 0.25	0.03 —	3.82 0.00
XXXIII.	1901-05 1906-10	0.70 —	— —	— —	1.10 —	0.80 —	0.23 —	2.10 —	12.60 —	0.40 5.78	2.00 2.30	1.40 —	— —

III.—THE DISTRIBUTION AND SEASONAL FLUCTUATIONS OF THE VARIOUS SPECIES.

I now proceed to describe the distribution and the seasonal fluctuations of the various species included in the statistics.

It is a subject of interest and value in many ways, but it is not, as previously explained, to be compared in importance to the consideration of the question as to the impoverishment of the fishing grounds, dealt with in the preceding section.

I find moreover that the description published in my former paper with respect to the distribution and seasonal variations among the flatfishes holds essentially now, in the fuller information obtained in the years that have elapsed since that paper appeared. Such changes as have been necessary in the descriptions are made in the following pages, but it has been the aim to keep the part referring to each species as brief as possible, consistent with accuracy. Most space has been devoted to the plaice, in considerable detail.

THE TURBOT (*Rhombus (Bothus) maximus*). (Pl. 1).

The statistics for this fish have been tabulated and the averages calculated for sixteen of the squares, lying in the northern and western part of the North Sea. The only areas dealt with south of the 57th degree of north latitude are XXVIII and XXIX, adjacent to the Scottish coast. It is obvious that only a partial account can be given from these data as to the distribution of the turbot in the North Sea, for it is known from other sources that the fish is more abundant in the eastern and southern parts than in the northern and western.

In only two of the sixteen areas was the mean catch over 1 cwt. per 100 hours' fishing, viz., in XXIII and XXIX, the two areas contiguous to the east coast of Scotland; in the former it was 1.33 cwts., and in the latter 1.52 cwts. The next highest averages were for squares XIII, comprising the northern parts of the Orkney Islands, and square XXVIII, along the Scottish east coast from Stonehaven to the Forth; in the former it was 0.85 cwts. per 100 hours' trawling, and in the latter 0.81 cwts. Other squares with relatively good averages were XXIV, where it was 0.77; XVII, in which it was 0.60; XII, where it was 0.55, and X, where it was 0.41 cwts. The squares with the smallest averages (among the sixteen included) were XV, XI, and XIX in which the figures were respectively 0.07, 0.14, and 0.16 cwts.

When all the information is placed upon the charts, it becomes evident that the turbot is most abundant near the shores and least abundant in the deeper waters; its abundance also increases towards the south. (See chart Pl. 1.) The depth of water appears to have much influence in this regard. Thus the average in square XII, which contains the Viking Bank, with depths of from about 40 fathoms upwards, was higher than in square X, around the Shetlands, and much higher than the intervening deep-water area, square XI. In square XIX the average was considerably less than in XX, though the latter lies farther from land, but part of it is much shallower, and this probably accounts for the better average. Square XV, in the middle of the North Sea, between the parallels of 59° and 60° N. latitude, had the lowest average of all, and there the water is deep.

With regard to the variations in the abundance of the turbot at different seasons of the year, there is one generalisation that may be made, based upon the curves for each of the squares for all the years combined. In all those which are not related to the coast, or the Shetland or Orkney Islands, the maximum abundance is in summer, and nearly always in June or July. This is the case with squares XI, XII, XIV, XV, XVIII, XIX, XX, XXIV, and XXV. In the two areas in the latitude of the Shetlands, XI and XII, August and not June shows a density next to that of July, or equal to it; the two next to them, to the south (XIV, XV) have the maximum in July, and those farther south in June. In the offshore grounds there is thus an accumulation of turbot in the summer, during the spawning season.

The form of the curve based upon the monthly averages in these offshore grounds varies a little. In the most southerly and easterly there is a gradual rise from January to the maximum, and a gradual fall thereafter to the end of the year, the absolute minimum being usually in December, occasionally in January. This is the case in areas XXV, XXIV, XX, XIX, XVIII and XIV. In all these the period of greatest scarcity of turbot is in the winter, from October or November to February or March. The two most northerly squares, XI and XII, differ in having the minimum not in the winter months, but in spring, March and April, there being a second period of density (though much less than in the summer maximum, but still distinct) in December and January.

The fluctuations throughout the year in the areas contiguous to the land are quite different, as indicated by the averages for all the years combined. In three of them the greatest abundance of turbot is in winter, and the least abundance in the early part of summer. Thus, in square X, which includes the Shetland Isles, the maximum for the year, as shown by the smoothed means, is in January, from which month there is a regular decline to the minimum in May; there is then a slight rise to August, followed by a slight decline in September and October, and a rise again in November and December. Thus there are two periods of scarcity and two of abundance, but of very different degree; the period of greatest abundance extends from November to February, inclusive, and the periods of scarcity are in spring and autumn.

The seasonal variations in abundance in square XXVIII, on the east coast of Scotland from Stonehaven to the Forth, are of the same type. The averages fall from January to May, which is the period of greatest scarcity; they then rise to a maximum in October and November, after which they decline to December and on to May. There is thus a period of abundance from August to January, and a period of scarcity from February to June or July.

In area XVII, which embraces part of the Orkney Isles, the fluctuations are similar. In January the average, when smoothed, is the highest of the year; there is then a steady and regular decline to May, when the minimum occurs, and thereafter the rise goes on until the end of the year, but not quite regularly, as there is a fall from a relatively high position in August to September and October. Turbot are thus in greatest abundance in this area in the autumn and winter, from August to February, and in least abundance in the period from April to July. The comparatively high average in August is not without significance, and it corresponds to what occurs in some of the neighbouring squares.

The variations in square XIII, which includes the northern part of the Orkney Islands, are rather different. Here there is a rise in the averages from January to March, April and May, in which months the density is almost or quite uniform, and is the maximum for the year; there is a fall to July and August, then a rise to September and October, and then a decline to December, which has the lowest average for the year. There are thus two periods of abundance, the main one from March to May or June, the smaller in September and October, and two periods of scarcity, namely, in July and August and in December.

This type of fluctuation is also exhibited in the two areas lying off the east coast of Scotland, XXIII and XXIX, the latter however nowhere touching the coast. In XXIII, the averages increase from the minimum for the year in January to the maximum in April; they then decline to July, rise again in August, after which they fall to December. There are thus two maxima and two minima; the larger maximum, or the greatest density of turbot, is in April and May, and the smaller in August and September; the greatest scarcity is in August, the smaller in January.

In square XXIX the same feature of a high spring average occurs, the maximum being in May, as well as an increase in autumn, but in this case the latter is much less marked and is later in appearing, viz., September and October. The lowest averages are in August and January.

A comparison of the curves, based on the smoothed means for the whole period, relating to these coastal areas and those contiguous to them, furnishes a possible explanation of the fluctuations. Thus the special features exhibited by the curves for squares XXVIII and XXIX might be explained by the turbot passing seawards from the coastal grounds (XXVIII) to those farther off (XXIX) from December to May, and returning again in greater and greater numbers up to about the end of the year. Similar explanations might be suggested in other cases, but in none of them is the relationship complete—the fluctuations do not fit in to one another with any exactitude—which indeed could scarcely be expected, if for no other reason than the artificial character of the squares. What was stated in my former report is however clearly true of these further statistics, that they show a great preponderance of turbot on the offshore and usually deeper grounds in the summer, and a scarcity there in winter; while on the inshore grounds the opposite is the case, a predominant density in winter and a scarcity in the early summer.

The statistical tables for the other areas in the North Sea, lying to the east and south, are not available, the fishing in them having been comparatively small in extent and irregular as to period in the different years, but so far as they go they indicate very high averages in winter, and in some of them at least low averages in the latter part of summer.

The averages for the various years must now be examined in detail, and those referring to the uncomplicated offshore areas may first be dealt with. In area XXV

there was very little trawling in the years from 1907 to 1910, but in each of the other years there was fishing in almost every month except January–April in 1901 and 1902, and in each year the averages fluctuated in the same way, indicating a maximum abundance in summer and a minimum in winter. In 1901 and 1902 there was no fishing in the area before May, in the latter year the highest of the averages was in that month; in 1902 it was in July. In 1903 and 1906 the maximum was in May; in 1904 and 1905 it was in July. The minimum was either in December or January. These features agree with those of the compound curve.

In area XXIV the continuous curve for the various months also show a wave of abundance in each year, beginning in spring, attaining its maximum in summer and declining to winter. In this case the maximum occurred generally in July, sometimes in June, while the minimum was either in January or December.

In area XX the same result appears from an examination of the continuous averages; in three of the years the maximum was in July, in two it was in June, in one the June and July averages were the same, and in one year it was in May. The lowest averages were usually in December, sometimes in January. In 1909 and 1910 there was no fishing from May to October.

In square XIX the maximum in the various years occurred in June in three, in July in three, in June–July in one, in May in one, in May–June in one and in April and July in another; the minimum being either in December or January. In the adjoining square, XVIII, the summer maximum was attained in July in five of the years, in June in one, in June–July in one, in May–June in one, and in July and April in two. In seven of the years no turbot were taken in January, and in six none in December.

The only other square in which the compound curve based on the combined averages shows the same type of fluctuation is XIV. In three of the years there was no trawling in the mid-months of summer, but the remainder of the averages in these years are consistent with a summer maximum. In two years the maximum was in June, in two it was in July, in one in July–August, in one in May, and in one in May and July. In square XV the trawling records for the middle of summer are defective.

In the two northern areas in which the fluctuations showed some variation from the type, viz., XI and XII, it was the exception to have fishing in June or July, but when the records are complete for this period, the maximum occurred in one or other of these months.

In the coastal areas in which the type of the seasonal fluctuations is different, indicating scarcity in spring and early summer with high averages in autumn and winter, the variations in the separate years do not show the same uniformity.

In area X, the fluctuations in the years 1904, 1905, 1906, and 1909 correspond fairly with the fluctuations as represented on the compound curve, particularly with respect to the winter maximum, the second period of slightly increased density in summer being but little evident in 1904, 1906, and 1909, and exaggerated in 1905. In 1907, when the averages as a whole were considerably lower, the decline from the high position in January went on till June; there was a slight increase in August and September, a decrease in November, and a very slight increase in December. The variations in 1908 were anomalous, the averages in January and February being very low, the chief feature being an increase from the minimum in March to a maximum in July and August, a decline in September and October, and a rise in November and December. The highest averages for the year were in July, August, and June. In this year the fluctuations thus resembled those in the offshore areas as above described, a fact that might be accounted for by the predominant fishing being made in 1908 on different grounds, or off a different part of the coast.

In square XVII, off the Moray Firth, the fluctuations in 1903, 1904, and 1905 correspond well with the variations in the combined curve, there being a high winter average, a fall to May or June, a slight rise in the middle of summer followed by a fall, and then again a rise to the winter point. But in 1906 the rise at the end of the year was very slight, and the curve goes on rising in 1907 to a high maximum in August and September, followed by a sudden fall to November and a very slight rise in December. In 1908 the fall goes on from January to March, the averages in March–June are low and uniform, and then there is a gradual ascent to the relatively high winter position. In 1909 and 1910 there were marked maxima in autumn, and in 1910 in May, the minima in both years being in April and August. The statistics for square XXVIII are too fragmentary to enable the variations in the various years to be traced.

The two periods of maxima shown in the combined averages for the square XXIII, one in spring and the other in autumn, are generally shown in the separate years also, but in some much more distinctly than in others. It is most distinct in the averages for

1902 and 1907, and least distinct in 1903 and 1906, while in 1908 and 1909 there is no autumn maximum represented. Usually, as brought out in the combined curve, the maximum in spring is higher than in autumn, but in 1902 it was the opposite. In almost every year the minimum was in winter, but in two of the years, 1902 and 1906, it was in summer, between the periods of maximum abundance.

In the other square of the series exhibiting the same type of fluctuations, XXIX, the two periods of maxima are usually well shown in the separate years, the spring maximum being always the greater except in 1907, when it was altogether absent. On the other hand, the spring maximum in 1908 was relatively to the previous years enormous, the averages being 6.4 in March and 8.0 in April, as compared with a mean for those months of 2.25 and 3.03 cwts. per 100 hours' fishing, and the disproportion between the spring and autumn maxima in the combined averages is largely due to this exception. In this year, moreover, 1908, and in 1903, the autumn maximum did not exist, so that there was practically no increase in abundance of the fish from the low point in late summer.

In square XIII, including the northern part of the Orkney Isles, the variations in the individual years for the most part correspond with those indicated in the compound curve for the whole period together. A spring maximum always occurs, but it may vary from February to May as to its appearance, and it may be limited to one month or extend over several months. The second period of increased density of the turbot in autumn is usually relatively small, sometimes absent or almost so, while in two years, 1907 and 1909, it was more marked than the first such period in spring. The averages for 1907, indeed, furnish a most symmetrical curve, the spring maximum culminating in May and the autumn one in October, while in July and August the averages are as low as in the winter.

From the above review of the variations in the abundance of turbot in the various areas of the North Sea at different seasons of the year, it may be concluded that this fish is most abundant in the summer time in the offshore waters, and in the winter near the coast. It is to be borne in mind in this connection, that these statistics of the Aberdeen trawlers do not indicate the distribution, or the seasonal fluctuations, of this or any other fish within the three-mile limit or the large area of the Moray Firth; nor do they furnish a picture of the conditions in the south-eastern parts of the North Sea, where turbot are normally more abundant than in the northern and western parts. Had the information been complete, it would in all probability have been shown satisfactorily that the winter maximum on the inshore grounds is even greater than appears from the statistics as they exist. It may be suggested that the variation according to the season and the place as above brought out is in the main caused by migration of the fish from the offshore to the inshore and *vice versa*. The spawning of the turbot takes place from April to August, the height of spawning being in June. The period of reproduction therefore corresponds very well with the period of maximum abundance of the fish on the offshore grounds and with the period of least abundance on the grounds near the shores.

In order to interpret the statistics thoroughly, however, it would be necessary to have at disposal much fuller information than is available as to the sizes of the fish, the condition of their reproductive organs, and their food at different seasons and on different grounds. Very useful also would be the information obtainable from marking experiments carried on on a large scale, and according to a comprehensive scheme. It might in itself prove whether the migrations of the fish from inshore to offshore and back again according to the season really occur, and whether such migration is related to reproduction or to food.

THE BRILL (*Rhombus laevis*, Rond.). (Pl. II.)

The brill is the least important of the flatfishes landed in Scotland, the total quantity in 1909 amounting to only 700 cwts., valued at £1,620.

It is widely distributed in the North Sea, but is found in much greater abundance in the neighbourhood of the coasts, and is exceedingly scarce in the deeper water and on the offshore grounds. The chart (Pl. II) shows the distribution and the seasonal abundance very well, and the table giving the average catch per 100 hours' fishing (p.) furnishes the figures for each of the squares.

It will be seen that the squares where the brill was most plentiful lie on each side of the region fished over by the Aberdeen vessels, that is, on the east coast of Scotland and towards the mouth of the Skagerrack and the coast of Jutland. In square XXVIII, which includes the east coast from a little south of Aberdeen down to the Berwick coast, the mean catch was the highest of all, 0.57 cwts. per 100 hours' fishing. The next highest was square XXVII, at the mouth of the Skagerrack, where it was 0.48 cwts.; but the fishing was irregular and non-representative. In square XVII (near the Moray

Firth and including the south part of the Orkneys) the average was 0·40 ; and in the one immediately south of it, XXII, it was 0·29. The square taking next position was XXVI on the other side of the North Sea, to the west of XXVII, where the average was 0·27, but the fishing in no year was quite representative.

In XXIII, which touches the north-east coast of Aberdeenshire, the mean was 0·15 ; and in XIII, embracing part of the Orkneys, it was a trifle less, viz., 0·14. In IX, to the west of the Shetlands, XIV and XV, to the south and south-east of these islands, the average works out at 0·1 cwts. per 100 hours' fishing.

In square X, containing the Shetlands, in XI and XII, to the east of them, in XVI, and in XXIV and XXX, lying off the Scottish coast, the mean catch works out at 0·0. Brill were got in all these areas but so rarely, and in quantities so small, that the average cannot be given, except as a very small fraction. In X some were taken in April, 1902, July, 1904 and 1905, September, 1903, and October, 1906. In XI a few were caught in April and May, 1901, and in November, 1910. In XII they were taken in March, 1903, and December, 1908. In XVI a few were obtained in March, 1903, and February, 1904. In XXIV the months in which they were represented were March, 1903 and 1909, November and December, 1903, and July, 1909, while in XXX they were got in November and December, 1903, and in January, 1909. In these squares such brill as were caught were thus obtained mostly in spring or late in the year.

In considering the fluctuations in the various months, it may be best to take square XXIII first, as the fishing within it was very regular, and the mean catch is moderate. The curve formed on the combined monthly means for the ten years shows a regular steady rise to March and a steady fall to August, which is the minimum, and a rise thereafter till December, the mean for which is exactly the same as the mean for January. Thus, from August the density of the brill on these grounds increases from a minimum right through the winter months and on to February and March, and then slowly declines again.

This is shown also by an examination of the fluctuations in the separate years, with some variation as to the period of maximum. In 1902, 1905 and 1907 the maximum occurred in March ; in 1906 in February ; in 1903 it was delayed till May and June—and the catches were exceptionally high ; in 1904 the highest mean was in January ; in 1908 and 1909 the means for January and February were the highest, equal and relatively to other years very low. The minimum varied from June to August ; but in the last few years of the period the fish was exceedingly scarce. In 1907, brill were caught in six months, in 1908 in three months, in 1909 in two months, and in 1910 only in a single month. On the other hand, in 1901 they were taken in eight of the nine months, in 1902 in ten of the twelve months, in 1903 in each month of the year, and in 1904 in ten of the twelve months. The averages also fell very greatly.

In XXVIII, which has the highest average catch of all the areas, the fishing was not representative except in the last three years. The curve for the averages of all the years is much like that for XXIII. The maximum is in March, after which there was a fall to the summer months, the lowest mean being for September ; then there is a rise to the end of the year. Compared with XXIII, the January mean is high, higher than it is in February.

The fluctuations in the separate years, as far as represented, show a maximum in spring and a minimum in summer, with an increase again towards the end of the year. The maximum was usually in March.

In square XVII the fishing was almost quite regular and representative, and the average for the whole period, as above stated, was 0·40. The curve formed on the combined monthly means shows a rise from January to March and April and May, and a decline to August, after which the fluctuations are somewhat irregular, but there is on the whole a continued decline to November and December, to practically the same level as in January. In the early years the average catches in spring were large, those in summer were small, while there was an increase again towards the end of the year. In most of the later years, however, the density as a rule diminished from January to April, after which there was a slight increase for a month or two, followed by a minimum in autumn and a rise towards the end of the year. These differences are no doubt partly owing to change of grounds in different years.

In XIII the compound curve shows an increase from January to a maximum in June, and a decline thereafter till December, the minimum for the year. The fishing in this area after 1903 was regular, and the means for the separate years show generally that the greatest density was in spring, with a minimum in summer and an increase again in the later months. But in 1905 and 1909 the maximum was in summer, from May to July, and as the averages in these months in those years were large, they have modified the means for the whole period of years somewhat unduly.

In XXII, XXVI and XXVII the fishing was extremely irregular and unrepresentative, and little can be said about the seasonal fluctuations within them; and in most of the other squares, as already explained, the fishing was either very restricted or the quantity of brill taken exceedingly small. In most of them in which brill were taken in very small quantities, they were got chiefly in the early part of the year:—In XV in February, April and June; in XVIII and XIX chiefly in March, April and May; in XX in April, May and June; in XXV from March to June; in XXVI from April to July, and in XXXI chiefly in March.

As mentioned in my former report, the fluctuations in the abundance of brill resemble those of the turbot, but the period of maximum is earlier in the year and of briefer duration, and it corresponds to the occurrence of the spawning season.

The changes in the quantity of brill over the period of ten years is dealt with on p.

THE HALIBUT (*Hippoglossus vulgaris*, Flem.). (Pl. III.)

The halibut is taken by the Aberdeen trawlers in the North Sea throughout the year, and, as it is a deep-water fish, the greatest quantity is obtained on the northern grounds, to the eastward and south-eastward of the Shetland Isles. The highest averages per 100 hours' fishing, in areas where fishing took place in each month of the year, were in squares X, XI, XII, XIII, and XVI, and particularly in squares XII and XVI, bordering the Norwegian deep water. High averages were also obtained in the months in which fishing occurred in the areas VI, VII, and VIII, north and north-east of the Shetlands, where the water is deep. In the areas lying to the south of those mentioned, the abundance of halibut was considerably less, the averages diminishing as one passes to the south; and, as pointed out in the former report, comparatively little halibut is secured south of 57° N. latitude. Moreover, this fish is present in greater abundance on the grounds lying on the eastern side of the North Sea than on those off our East Coast, as may be seen by comparing the averages in the squares to the east and to the west of 2° E. longitude. This difference, as formerly indicated, is probably due to the existence of the neighbouring deep water of the Norwegian Channel and the Skagerrack, for the depths over the eastern areas referred to are less than the depths over the western areas. What was stated in the previous report with regard to the distribution of the halibut in the North Sea is confirmed by the additional statistics in the succeeding years.

With respect to the seasonal abundance, the detailed figures for a few of the most-fished areas may be examined. The squares in which the fishing was most regular throughout the period were X, XIII, XVII, XVIII, XIX, XXIII, XXIV, and XXIX. In square XXIII there was fishing in each of the 117 consecutive months—though this area is not one of importance for the halibut—and in some of the others the gaps were of small extent. On the other hand, the fishing in some of the other squares was markedly incomplete, all the months in only one or two years being represented. The average or mean quantity per 100 hours' fishing in each month for the years 1901–1910 combined, is shown for 18 of the squares in Table

It will be seen from the Table (and the fact is more conspicuous when the curves of the averages are plotted out on the squares themselves, Pl. III), that there is a more or less well-marked maximum in summer in the northern areas, the minimum occurring in autumn or spring. The facts on this point may be brought together as follows:—

Square.	Maximum.	Minimum.
X	May–July	October, November.
XI	” ”	December–January.
XII	June–August	October.
XIII	June, July	March.
XIV	June–August	February.
XVII	” ”	November.
XVIII	August–October	March.
XIX	August–September	January, February.
XX	April–May	October, November.
XXIII	June–August	November–January.
XXIV	May–July	September.
XXV	April	November.
XXIX	”	November–January.
XXXI	March–May	November.

It is noteworthy that in the most northern areas the maximum abundance of the halibut occurs in May, June, and July, namely, in squares X, XI, and XII, in the latter the abundance being continued into August, whereas in the southern areas the maximum is in spring, as in squares XXIX, XX, XXV, XXXI, and in the areas in the north-west, the maximum is in June and July, namely, in XIII, XVII, and XXIII, the squares in relation to the Orkney Islands, the Moray Firth, and the east coast of Aberdeenshire. In the more central areas north of 58° N. latitude, the maximum is usually later, occurring in square XIV, June to August, in squares XVIII and XIX, from August to September and October. If a line be drawn in a north-easterly direction from the Firth of Forth at latitude 56° N. to the Norwegian coast in latitude 60° N., it will be found that all the squares lying to the south-east of that line have the maximum in spring, the month of highest average being in almost all cases April; but one of them, XXIV, has a somewhat higher average in June than in March.

The lowest average abundance for the year lies sometimes in front of the maximum and sometimes behind it, that is, either in the early part of the year or in the latter part. In the three most northern squares, X, XI and XII, the minimum is in October or later; in those to the south-west of these it is in February or March, while in the squares to the south-east of the line referred to above from the Firth of Forth to the Norwegian coast the minimum is usually in September. The differences, however, between the low average in spring and the low average later in the year is often very little.

These averages, as explained above, are for all the years combined, and it is necessary now to compare them in the different years, in order to ascertain whether the fluctuations in each of the separate years are of the same character.

Taking first square X, at the Shetland Isles, which comprises seven complete years and 89 consecutive months of fishing, it will be found that the maximum abundance was in two of the years in June—1909, 1910; in three of the years in May and June, viz., in 1905–1907; in 1904 there were two maxima, June and August, the average in July being less; in 1908 the averages in May and June were small, less than those in March and April, the form of the curve suggesting that the usual increase of the fish in summer failed in that year. The compound curve, therefore (for all the years combined), fairly accurately represents the usual condition. The influx of halibut in this area appears to be usually in May and June, beginning as a rule a month or so earlier. The autumn scarcity is generally greater than that in spring, most notably in September and October; there is a slight increase again in winter, usually in January or December, but its extent, never great, varies as well as the period.

The statistics for the squares XI and XII, lying to the east of X, in the same latitude, are imperfect, in each case only one complete year being represented. They indicate, but unsatisfactorily, an increased abundance in spring or summer as a rule.

In square XIII, to the south of X, and including the northern part of the Orkney Isles, the fishing was regular, or almost so, in the last seven years of the period. The compound curve for all the years together indicates a maximum in June and July and a high average in winter. The individual years show very considerable differences; in 1904 the greatest abundance was in May and next in July and August; in 1905 the maximum was towards the end of the year, September to November (there was no fishing in December); in the next year the highest average was in January, an apparent continuation of the abundance at the end of 1905; in 1907 the highest point was reached in June, the December position being next; in 1908 the maximum abundance was from May to August; in 1909 it was in May, June, and July; in 1910 in May and June. There would thus appear sometimes to occur, as is suggested in the compound curve, two periods of maxima in this area, in summer and in winter, the former being usually the most marked.

In square XVII, which lies south of XIII, and includes the southern portion of the Orkneys and the region lying off the Moray Firth, the figures for nine years are almost complete. The compound curve shows a maximum in June–August, and chiefly in June; in 1904, 1905, and 1909 the maximum was in June, in 1910 in May and June, in 1907 it was in July, and in 1908 in August; in 1905 the averages were very low, the highest being in January and the next in August. In the early and the late months of the year halibut were scarce.

In square XVIII, lying to the east of the last named and in deeper water, the fishing was complete for the last six years of the period, and nearly so for the previous three years. In the compound curve the minimum was in March and the maximum in August, September, and October, and this autumnal increase is borne out in most of the individual years. It is as if the influx of halibut in this area were later than farther to the north and west.

In square XIX, still farther to the east, and including the well-known Fladen Grounds, the compound curve shows a gradual rise, with slight irregularity in the spring to a maximum in August and September, and a more regular decline to the end of the year. With the exception of three months (August–October) in 1908; April, August, September, 1909; and April and August, 1910, there was fishing in this area in each month from April, 1901, to December, 1910, and the mean catch per 100 hours' fishing is good (1.52 cwts.). The averages for the months in the various years show generally an abundance of halibut in autumn, the period varying from June to October, but being usually in September and October. In several of the years there also occurred a slight increase in the density of the fish in spring, and in most of the years the average in winter was low.

The fishing in square XX, still farther to the east and nearer the coast of Norway, was less regular, only two years being complete and two nearly so. This square has very different depths and grounds, the north-east corner comprising a part of the Norwegian Channel, with depths up to about 150 fathoms, and the south-western part being within the 50-fathom line. Here the compound curve shows a marked maximum in Spring, March to May, and chiefly in April, and this is generally the condition in each of the years. The maximum occurred in March in 1907, in May in 1901 and 1904, and in April in 1902, 1903, and 1906, in the latter year the averages for March and May being nearly as high. In 1905 the condition was exceptional, the spring averages being low and the maximum occurring in the latter part of the year. In 1909 and 1910 there was fishing within the square only in the first three and the last two months of each year.

In square XXV, immediately to the south, where the compound curve for the period shows the same features, the individual years (two complete and two nearly complete) also exhibit a maximum in spring, in April and March.

Farther west, in square XXIV, the compound curve shows two maxima in the early part of the year, one, the smaller, in March and the other in June, the average for April being lower. This is well shown in the only years which are complete, 1905 and 1908, and is partly shown in some of the others. The features in this area thus resemble on the one hand, in the spring rise, those of the areas to the east and south of it, and on the other, in the summer maximum, the areas to the north and west.

The area to the west is XXIII, contiguous to the coast of Aberdeenshire, and, as already stated, there was fishing in it in each of the 117 months of the period; unfortunately, however, halibut is rather scarce in this region, and the averages are consequently small. The compound curve for all the years together indicates a minimum from October or November to January, the density rising from January to June, July, and August, and falling thereafter to the end of the year. That is with the smoothed means; the unsmoothed means indicate a maximum in July, the next highest being in April. The averages for the separate years show the summer maximum in July or June, and some of them, but not all, also an increased density in spring; in 1910 the maximum was in March and April, the averages in the next four months being slightly lower.

The area lying off the east coast of Scotland, south of the above, namely square XXIX, in which the fishing was almost completely represented throughout the period, shows a maximum in the compound curve in March–May, the highest point being in April, while the minimum occurs in November–January. The means are throughout small, but the spring maximum is usually indicated in the separate years, notably in 1904 and 1909, when it occurred in March; in 1907 when it was in May, and in 1908 and 1910, when it was in April.

THE WITCH (*Pleuronectes cynoglossus*). (Pls. IV–VI.)

Like the halibut and the megrim the witch is a northern or deep-water form, and is found in greatest abundance between 58 and 60 degrees of North latitude, in the deep water to the east of the Orkneys and the coast of Caithness. As is indicated on the chart (Plate IV) the fish is most abundant in square XIX, where the mean annual catch for the whole of the period, 1901–1910, amounted to 16.56 cwts. per 100 hours' fishing. In the adjoining square to the west (XVIII), the average for the whole period was 13.30 cwts. per 100 hours' fishing; and in that to the north (XV) it was 11.41 cwts. These areas included the well-known "witch grounds" frequented by trawlers, by whom this fish is almost exclusively taken. The averages in square XI, to the north, and in square XXIV, to the south were nearly equal, viz., 7.02 cwts. for the former, and 7.17 cwts. for the latter. Some witches are found farther south and east, as in squares XXX, XXXI, XXXII, and XXVII, but in relatively small quantity, and they may be found also in the more southern areas in still lesser numbers, though not represented in the tables furnished

to me. In the neighbourhood of the Shetland Isles and in the squares west of 2 degrees of west longitude, and in those near the coast, the witch is not abundant.

These remarks refer to the total witches, large and small, and they agree with what was stated as to the distribution of the fish in my former report. The distribution of the large and of the small witches is very similar, but the small fish are less numerous, in proportion to the large, in the southern squares and in those near the coast. In the areas of chief abundance the proportion of small fish ranges from about 33 to 37 per cent. of the total witches. The sizes of the large and small witches in the market classification, it may be said, according to the measurements described in my previous report, show a mean size of about 29 cm. (11½ inches) for the "small," and of about 38 cm. (15 inches) for the "large." Practically all the large witches are adult, and probably about one-third of the small.

With regard to the seasonal abundance, a glance at the chart shows that in the areas where the fish is most common, on the Fladen or "Witch Grounds," there are, in the compound curves, which represent the monthly means for the whole period, 1901-1910, two well-marked periods of abundance and two of scarcity. The maximum abundance is in summer, during the spawning time, from May to July or August, the second maximum, much less marked, occurring in the winter months. The minima are of about equal extent and occur in spring and autumn. These features are well represented in the squares XV and XIX, where, as stated, the witch is extremely abundant. The monthly means for the ten years for these two areas are as follows:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
XV	7.45	6.65	5.34	6.29	8.25	11.83	10.67	8.69	5.99	5.96	6.78	7.29
XIX. ...	7.95	7.08	8.08	11.49	15.41	16.22	15.28	13.30	10.86	8.26	7.46	7.82

They may be taken as typical of the seasonal variations in the abundance of the witch in the chief habitat of the fish in the North Sea. In square XI, to the north of XV, where the fish is also fairly plentiful, the same type of variation is to be observed, the maximum abundance being from May to August and especially in June and July, and the minima in April and November; but in this instance the winter maximum, in January and February, is relatively much greater, the means for these months being not far short of those for June and July. In square XVIII, off the Moray Firth, the same type prevails but not so clearly; the minimum is in March, the maximum in May and June for the summer and in November-January for the winter, the highest mean catch being in December, while the autumn depression, in August, is much less marked.

Another type of fluctuation occurs in squares IX, X, XIII, XVII, XX, XXV and XXXI, lying around the central area where the fish are most abundant. In those cases the outstanding feature is the paucity of the witch in summer and its abundance in winter, so that the graph constructed on the monthly means is cup-shaped. The following examples may be cited:—

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
X	3.75	3.53	2.44	1.78	0.59	0.55	0.48	0.91	1.31	2.24	3.29	3.95
XIII ...	5.64	4.02	1.30	0.87	0.30	0.37	0.56	0.81	1.05	1.86	3.80	6.21
XVII ...	1.74	1.59	1.19	0.82	0.50	0.29	0.42	0.71	0.77	0.84	0.02	1.57

There is thus the opposite condition from that in the squares above referred to, where the greatest abundance of the fish occurs in summer, and, as I pointed out in the former report, the impression remains strong that the difference is accounted for by the migration of the fish in increasing numbers in spring and early summer from the surrounding areas to the predominant "witch" grounds, for the purpose of spawning.

The seasonal fluctuations in some of the other squares show an intermediate condition, the maximum occurring in April or May, and the minimum usually in the latter part of summer. This is indicated in squares XIV, XXIV, XXVI, XXVII, XXIX, XXXII.

The above remarks have reference to the monthly means for the ten years together, but it is necessary to examine also the monthly means for the separate years, in order to discover to what extent the variations shown by the former may be taken as representing the normal fluctuations within the area.

Taking first square XIX, where the witch is present in greatest numbers and where the fishing was regular and well distributed, it is found from the plotting out of the means that the outstanding feature in each year is the existence of a wave of maximum abundance in summer. This is shown in each of the graphs, but the particular month in which it occurs to the greatest extent, and its duration, vary in different years. The central cone, so to speak, may be narrow, or it may be broad. In 1904 the actual maximum occurred in April; in 1902, 1903, 1908 and 1910 it was in May; in 1905, 1907 and 1909 it was in June; in 1906 the abundance continued fairly uniform in May, June and July; in 1901 there were two maxima, the smaller in May, the greater in August. The latter, as mentioned below, is indicated more or less distinctly in most of the other years.

The second period of abundance occurs in the winter months, falling partly into one year and partly into the succeeding year; the maximum month is usually January (1903, 1907, 1908, 1909, 1910) or December (1901, 1903, 1904); in 1905 it was in November. The winter maximum is quite small compared with the great maximum in summer (but in the winter of 1906-1907 it was nearly as great as the summer maximum that preceded or which followed); it is also less regular.

The two periods of minimum abundance are in spring and autumn, usually in March or April and in October or November. In 1901, 1902 and 1903 the minimum for the year was in autumn; in all the other years, 1904 to 1910, it was in spring.

With regard to the summer maximum, represented by the great cone in the graphs, the highest point is reached, so to speak, at a bound, abruptly, from the spring minimum, or at most with one month intervening. Thus the increase in the density of the witches on the grounds is sudden, most likely by a rapid migration from the areas where a decrease in the density at the same period is also sudden. In the graphs, therefore, the line of ascent of the curve is regular or almost regular. But the diminution of the density of the fish in the later months is gradual and irregular; the descending line in the graph passes over several months till the autumn minimum is reached, and it is irregular in most of the years. Very commonly there is a distinct increase in density before the minimum is reached, usually in September, but it may be in October or even in November. In 1901, as above stated, this increase, in August, was marked, forming the maximum for the year; in 1902 it was also very distinct and occurred in September; in 1903 it was likewise distinct in September; in 1904 it occurred in October; but in the following years it is less distinctly represented.

The table and graph for this square, XIX, therefore, in which the monthly means for the combined years, 1901-1910, are given, may be considered to represent the typical or normal fluctuations that take place at the different seasons, the exact period of greatest or least abundance varying, as was to be expected, to some extent in the different years, as well as in the degree of the fluctuation. The only thing that is not shown is the secondary increase in September or October, which occurred in several of the years, and is obliterated in the fusion and the smoothing of the separate means.

In square XV, where the compound curve, formed on the monthly means for all the years together, is of the same type, the summer maximum being just a little later, the fishing unfortunately was by no means so regular, and the observations are therefore imperfect. In most of the years there was no fishing in the square in the summer months, in May only in six of the ten years, in June in four, in July in three, in August in five. In only one year was there trawling in each of the months, viz., 1905, and the fluctuations in that year very fairly correspond with those represented in the compound curve, a marked maximum in June being shown, a second maximum in winter, and minima in spring and autumn. For the reason indicated, the paucity of the fishing in summer, it will serve no useful purpose to trace the variations that are really shown in each of the other nine years; and looking at the broken records it is remarkable how the compound curve should so well represent what the complete single year shows, and what might be expected from the position of the square in relation to the witch grounds.

In square XVIII, lying nearer the coast, off the Moray Firth and the southern part of the Orkney Islands, and where the witch is an abundant fish, the trawling was very regular, as a rule, and quite so during the last seven years. The compound curve, as stated above, is of much the same type as in XIX, but the increase in the density of the fish in the summer is much less marked, and the winter means (January and December) are slightly higher than those in summer; the degree of the fluctuations throughout the year is less.

The fluctuations in the different years by no means correspond with one another. In some of the years part or all of the summer is characterised by paucity of fish, the winter by abundance, so that the curve or graph drawn on the means is of the cup-shaped type, like that for square XII, &c., the very opposite of the condition in XIX. This was especially marked in 1902 and 1909, but it is also the predominant feature in the means

for 1903 and 1904. In some of the other years the maximum abundance was in summer, the period of greatest abundance being, as a rule, brief. It 1905 it was in May, as it was also in 1907 and 1910; in 1908 it occurred in June, in 1906 in July, in 1904 the maximum was in September. The minimum was almost always in spring, usually in March, at other times in April or May. Moreover, the winter maximum might often be more correctly described as a late autumn maximum, the greatest density being generally in November or in October, with the January level low.

Not improbably the difference in the nature of the seasonal fluctuations in this area in different years was due not so much to variations in the abundance of the fish as to change of fishing ground. In the eastern part of the square the water is from 70 to 80 fathoms in depth, and the grounds are in fact part of the "Witch" grounds, whereas in the greater part of the square, and in particular in the western part, the depth is much less, and the character of the bottom different, so that it resembles rather the adjoining square XVII, in which the witch is scarce in summer and abundant in winter. It would be of much value to have charts showing the position of the fishing vessels, that is, the place where the fish were caught in the various months of the different years.

Turning now to the other type of fluctuation, where the fish are in least density on the grounds in summer and in greatest density in winter, a few examples may be given. In square X, the fishing was tolerably regular as to the months; only one was omitted during the last seven years. In all these years (and in the preceding years where there were observations, with the exception of July, 1901) the means in the summer were very low, showing a normal and almost uniform paucity of witches, while those at the beginning and the end of the year were relatively high. Generally the period of greatest abundance was early in the year, January or into February, but the increase in the numbers of fish always began in November or even in October. The fluctuations in this square, in the separate years, thus corresponded to the fluctuations indicated in the compound curve for all the years together.

In square XIII (containing the northern portion of the Orkneys) the fishing was also very regular during the last seven years. With the exception of 1904, the summer means were very small, the witch being generally altogether absent (in 18 out of 28 of the months, May–August), while the means in the winter months were high, particularly in December and January. In 1904 the low level in summer was interrupted by a considerable rise in July and August, which might quite well be explicable by a change of ground on the part of the trawling vessels. For this square also the annual variations that normally occur are faithfully represented in the compound curve for the whole period.

In square XVII the fishing was likewise regular, and the summer means were usually low, and the scarcity of the fish continued later in the year, as a rule. The January and December positions were high, and in two of the years (1905 and 1908), there was a sudden increase indicated in August or September—the maximum for the year occurred in August, 1908—a condition also suggested in 1904. The influence of these variations is to be traced in the smoothed compound curve of the combined monthly means, by a slight swelling in the autumn.

The fishing in square XX, which shows the same type of fluctuations in the compound curve, was much less regular, only two of the years being completely represented; the deficiency occurred in the period from July, or even from April, to October. In the more perfect years, the maximum abundance in winter is well shown, the actual maximum being usually in January. The summer minimum is not always so well or regularly represented; it is most marked in the years 1904, 1906, 1902.

A similar type of fluctuation is shown in square XXV and in XXXI. In the first six years of the period the trawling in the former was fairly regular, although quite complete in only two of them. In these, and in nearly all the other cases as far as the observations go, there is the characteristic low means in summer and the high means in winter, especially in December and January. In 1901, in which there were fishings in the months May–October, the highest mean was in August, the lowest in July; but the August figures represented a single voyage and only 80 hours' fishing.

The fishing in XXXI was quite complete in none of the years, but it was nearly so in 1904 and 1905, and in the last eight months of 1902 and 1903. In all those years there is the characteristic fluctuation—low summer and high winter averages, the former prolonged over many months, the latter restricted to a few months. In square XXXII, as far as the imperfect observations carry us, the same type of fluctuations is shown.

As formerly stated, in some of the areas an intermediate type is shown, but unfortunately in almost all such cases the fishing was imperfect. In square XXVI, which lies on the other side of the North Sea, opposite to the mouth of the Skagerrack,

there is enough to show that the fish is abundant in spring, compared with summer, and that an increase occurs in autumn. In square XXIX, where the fishing was regular, but the fish, especially after 1903, exceedingly scarce, it is not easy to trace in the separate years the spring and the autumn maximum shown in the combined monthly means for the whole period, but the detailed means are quite consistent with them.

The above facts appear to me to justify the hypothesis that extensive migrations of the witch occur, a concentration taking place in summer on the deep water grounds, at and about the Fladen Ground, in from about 60 to 80 fathoms, the fish migrating from the areas lying nearer the coast, and from the southern and eastern areas, in which their greatest scarcity is in summer. This migration is evidently for the purpose of spawning, the maximum abundance coinciding with the spawning season. Then, later in the year, large numbers disperse and make their way back to the areas from which they came. The region of the Fladen Ground may be regarded as the chief habitat or home of the witch in the North Sea, where spawning mostly takes place.

Unfortunately, the system of tabulation in squares is not well adapted to bring out the fluctuations, for part of the Fladen Ground is in square XIX, part in XV, part in XVIII, and a small portion in square XXIV. To treat the subject satisfactorily it would be necessary to arrange the statistics of the catches of the witch with reference to the Fladen Ground as a whole, quite independently of the squares, and I hope this may be done.

It may be mentioned that the duration of the pelagic or larval and post-larval stages of the witch is prolonged (*see* my former report, p. 547), and it is probable that the witch in the southern and eastern areas is mainly derived from the Fladen area, the prevailing current carrying the floating eggs, larvæ and post-larvæ, to some extent, to the southwards and eastwards. There is at present, as Ehrenbaum points out,* no information as to the quantitative distribution of the eggs of this fish, but this deficiency may be remedied when the collections of the *Goldseeker* are worked up and published. Ehrenbaum expresses the opinion that the witch is probably rather a sedentary fish, but no evidence for this view is given. Last summer (1910) about 130 large witches were marked by the *Goldseeker* in square XIX, in order to ascertain something about the migrations of the fish, but up to the present none of them have been returned to me.

THE MEGRIM (*Lepidorhombus Whiff*) (Penn.), (Walb.). (Pls. VII, VIII).

The megrim, like the halibut, is rather a deep water fish, being found in depths down to 220 fathoms, and although it is also to be found in water of much less depth, the areas in which it exists in greatest abundance are in the northern and north-western parts of the North Sea which are not far from the 100-fathom line.

In the market statistics with which we are dealing, the megrims are divided into two classes, "large" and "small." The mean size of the small megrims may be placed at about 30 centimetres, or $11\frac{3}{4}$ inches, the range being from about 17 centimetres to 42 centimetres, that is, from $6\frac{3}{4}$ to $16\frac{1}{2}$ inches. The large megrims vary from about 29 centimetres, or $11\frac{1}{2}$ inches, to about 61 centimetres, or 24 inches, the mean size being approximately 41 centimetres, or 16 inches. The two series thus overlap to a considerable extent; the point of division lies about 35 centimetres ($13\frac{3}{4}$ inches); most of those above that size are "large" most below it are "small." As the megrim may be mature at about 12 inches in length, it is evident that many of the "small" fish may be adult, but probably very few of the "large" are below the size at first-maturity.

With regard to the distribution of this fish in the North Sea, its maximum abundance, as above stated, is in the squares in relation to the deep water and nearest the Atlantic. The area which shows the highest average for the period is XIII, between the Shetland and the Orkney Islands, the figure being 8.3 cwts. per 100 hours' fishing.

The area in which the megrim is next most abundant is X, contiguous to XIII and around the Shetlands. The next highest is not XIV, whose mean catch was 3.1 cwts., but XVIII off the Moray Firth and Orkneys, where the mean catch amounted to 6.0 cwts.

Then come the squares to the east of the Shetlands, XI and XII, with means of 4.9 and 4.5 cwts., and the central areas south of them, XV and XIX, both of which have an average catch of 1.5 cwts. per 100 hours' fishing.

Then the squares XXIII and XXIV have means of 1.0 cwts., and XXVIII, farther south along the east coast, has 0.9. In all the other squares the average was low, and often very few fish were got at all. In XXIX, to the east of XXVIII, the mean catch

* Eier und Larven von Pleuronectiden der Nordsee und Benachbarter Gewässer, Rapports et Procès-Verbaux du Conseil International pour L'Exploration de la Mer, vol. XII, p. 17, 1910.

was 0.5 cwts., and in those farther to the east an average can scarcely be calculated. In XXV it amounted to 0.2, and in the square next to it to the east, XXVI, it was about 0.01. A few were taken in XXX, XXXI, and XXXII; none of these were small fish.

We may now compare the distribution of the large and the small megrims in the different areas. In the adjoining table I have shown the average catch of the large and the small fish in each of the squares, and have also calculated the percentage proportions.

Showing the Average Catch and the Percentage Proportion of Large and Small Megrim in various Areas.

Squares.	Average Catch.		Percentage Proportion.	
	Large.	Small.	Large.	Small.
X... ..	4.5	1.9	70.3	29.7
XI	3.4	1.2	74.0	26.0
XII	3.4	0.8	79.0	21.0
XIII	5.8	1.9	74.4	25.6
XIV	2.5	0.5	83.3	16.6
XV	1.3	0.2	86.6	13.5
XVII	0.8	0.15	84.2	15.7
XVIII	4.2	1.2	80.8	19.4
XIX	1.3	0.2	86.6	13.4
XX	0.3	0.06	(75.0)	25.0)
XXIII	0.9	0.27	77.0	23.0
XXIV	0.8	0.07	88.7	11.2
XXV	0.16	0.03	80.0	20.0
XXVI	0.04	—	—	—
XXVIII	0.80	0.10	88.8	11.2
XXIX	0.40	0.02	95.2	4.8
XXX	0.23	0.00	—	—
XXXI	0.06	0.00	—	—

It will be noticed that in those areas situated nearest the centre of distribution of this fish, in the Atlantic, the proportion of the small fish is greater than in the southern and eastern areas where the fish is scarce. This is the case with various other species, and shows the extension of the distribution by the wandering of the adults. In X, XI, and XIII, the outermost squares, the percentage of the small fish ranged from 25.6 to 29.7.

In those squares where the megrim is scarce the percentage of the small fish was much lower, as in XXIV, XVIII, and XXIX; but the total catch was not very great. An apparent exception is square XXIII, where although the total was small the fishing was regular and representative, and here the small megrims formed about 23 per cent. of the catch.

Considering now the fluctuations in the abundance of the fish in the various months of the year, we may begin with a square in which the mean for the whole period is large and the fishing as regular as possible.

In the Shetland square, X, the feature of the curve for the monthly means combined is the abundance of the fish in the first and last portions of the year, and its scarcity in the middle of summer. There are thus two maxima and two minima; the former in spring and autumn are of practically equal extent; the latter in summer and winter, and the winter minimum is much less than the summer one. The highest means are in April and October; the lowest in February and July.

The same curve is shown both for the large and the small megrims, but with this difference, that in the case of the large fish the spring maximum is greater than the autumn one, while in the case of the small fish the autumn maximum is the greater.

In the continuous curve for the separate years, the same feature is repeated in each, but there is often great disparity between the spring and the autumn maxima, sometimes the one and sometimes the other being most marked; but each year shows the distinct minimum in summer. Even with the large fish this occurs, and the spring maximum was much less than the autumn one in 1904 and 1905.

With the small megrims the autumn maximum was almost always much more marked than the one in spring, which in some years was but slightly represented. It was, however, nearly as great as the autumn maximum in 1906, and was even greater in 1908.

This type of fluctuation, with a double maximum and a minimum in summer, can be traced in most of the areas north of 58° N. latitude—in the areas where the fish is normally most abundant—but the periods vary, and also the relative extent of the changes. Thus, in XI, lying east of X, where the fishing, however, was not so complete, the spring maximum is very marked, the highest mean was in May instead of in April; the summer minimum was in August and September, and was less marked; the autumn increase was comparatively small; and the minimum in the winter months was lower than the minimum in summer.

This type was exhibited both by the large and by the small fish, and though the fishing in the separate years was not complete, it can be made out for most of the years. The winter minimum is invariably present, and two periods of maxima are usually represented in whole or in part, both by the large fish and by the small, and in both the spring maximum is generally the greater.

In the square still farther east, XII, only a single maximum is indicated, in spring, the autumn one being absent, at all events in the curves for the total megrims and for the small, and only barely indicated in that for the large fish. The maximum in this square extended from April to June, the mean for the latter being the highest of the year, and the minimum was from September to February, the means for November, December, and January being the lowest, and equal. The small fish and the large fluctuated together, but the scarcity of the small fish in the winter was more marked than with the large, and only in one of the years did they show an increase in autumn, which was indicated in several years in the case of the large fish.

In the two squares lying to the south of the above, viz., XIV and XV, the type of fluctuation is like that in XI. There are two maxima and two minima, one of the latter in winter and the other in summer.

In XIV the density increases from January to April, then it diminishes to July and August, rising again in September, October, and November, whose means are almost equal, to fall again in December. It is in March and April that the greatest density occurs, the increase in autumn being comparatively slight.

The same features are presented by the compound curves for the large and the small fish, except that the increase in autumn among the small hardly is more than indicated, the outstanding feature being the great increase in spring and the low and almost equal means for the last six months of the year. On the other hand, the autumnal increase among the large fishes is quite distinct.

Examination of the curves for the separate years shows the spring increase in each of the years both for the large and the small fish; in only one year (1904) is the autumnal increase in the case of the large fish the greater; an increase is usually just indicated in the case of the small. The decline in the means in this square in the later years of the period is considerable, showing that the megrim was scarcer.

In XV the fluctuations are practically the same as in XIV, but the greatest minimum is in winter and not in summer; the maximum is in April and May, and the second maximum in August and September. With the large megrims the chief minimum is also in winter, the maximum in March, April, and May, and again in August, the minimum in June being much less than that in winter, especially in December and November. With the small fish the maximum is in April and May, and the summer minimum in July and August is the lowest of the year, there being a distinct increase of the small fish from August to November, a slight decrease taking place in December.

The curves of the continuous fluctuations in the separate years show generally that the fluctuations of the large and small fish were much the same, but the increase of the large fish in late summer was only present in some years in the case of the small fish. The proportion of the latter in the square was not great, and the fishing was not quite regular.

The type of double maximum and double minimum was also exhibited in square XVIII, lying immediately to the south of XIV, opposite the Moray Firth, but the second maximum was relatively small. The density of the fish increased from January to March and April, the highest point being reached in the latter month; there was then a decrease to August, a slight rise in September and October, and a fall to December, the lowest point of the year.

The curves for the large and the small fish show the same general features, but the decrease to August after the April maximum is much more marked with the small fish and the rise in August–October very slight. With the large fish the autumn level is much higher. This is also the distinguishing thing in the continuous curves for the two classes of fish.

With the large, there occurred in almost every year a marked double maximum, which in 1903 and 1905 was greater than the spring maximum, whereas the increase in autumn with the small fish was little marked, or absent. The distinction between the two periods of maxima in the case of the large megrims is much clearer in the separate years than in the curve on the combined means, where the separation between the two has become largely obliterated by the variation of the minimum between them, from April to August, and the duration of the maxima, the highest point in the autumnal one ranging from August to October in different years.

In XXIV, much the same type of fluctuation occurred. For the combined means of total megrims, three periods of maxima are indicated, a great one in March, April, and May, a smaller but quite distinct one in August–October, and a slight one in December. The combined curves for the large and small differ; the two periods of maxima are as in the combined curve in the case of the large; for the small (which were caught in scanty numbers) there was a slight rise in April and a more considerable one in October. The continuous curves for the different years show considerable variation, the autumn maximum being usually present, but not nearly so marked as the spring one, which is sometimes absent.

Passing inwards to XXIII, on the coast of Aberdeenshire, a change in the fluctuations is to be observed. The combined curve for the whole period, and both classes of fish, is of the cup-shaped type, with a large cone in the middle of summer, and a very small one in autumn. The great maximum periods are in winter, December to February, and summer, May and especially June and July, while the minima are in March and April, and in August, October.

The fluctuations of the large fish were essentially similar, but with the small there was scarcely any increase in May, June, and July, while the maximum for the year was in August; the small fish were scarce in the period February–July, and particularly in February to April, and much more abundant from August to January. The fluctuations in the different years varied considerably; in some years the summer maximum was barely represented.

In XXIX, lying south of XXIII, the combined curve exhibits the cup-shaped type, with a high maximum in winter, December–February, and a minimum in summer, the bottom of the cup, so to speak, having a slight elevation in June and July. Very few small fish were got in this area, and the type of fluctuations for the large fish was similar to that for the total; but the little elevation in summer is hardly shown, it being due to small megrims.

The continuous curve for the individual years and months shows much regularity in the fluctuations, the winter extreme maximum varying however from November to March; with the exception of 1907 the summer means were always low.

In the square to the westwards, XXVIII, along the east coast, where the fishing was much less representative, the type of fluctuation differs. The great feature is a period of maximum in summer, May to July, and while there was also a second maximum in winter it was very small; the extreme minima were in April and November. The curve for the large megrims is the same, very few small fish having been taken in this area.

The changes in XXVIII thus resemble in part those in the other coast area XXIII, with this notable difference that the high density in winter in XXIII is replaced by a low density. Looking at the curves of XXIII, XXVIII, and XXIX, the conclusion seems evident that an interchange of megrims takes place, *e.g.*, an outward migration in winter from the inshore grounds in XXVIII to the deeper waters of XXIX, and a reverse movement in summer.

In XIII, the northern Orkney square, and in XVII, just south of it, we get the type of fluctuations shown in squares XXIX and, partly, in X, that is, with high means in the colder months and low means in the summer, the curve being of the cup-shaped variety.

In XIII, where the maximum catch of megrims was obtained, and where the fishing since 1903 has been representative, the curve formed on the combined monthly means for the whole period is deeply cup-shaped, with a slight elevation in the latter part of summer. Here are the monthly means:—

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
20·2	10·5	2·3	1·8	1·6	3·3	4·9	6·1	5·5	6·7	15·4	22·5

There thus occurred in this area a great and sudden increase in the abundance of megrims from October to January, rapidly disappearing in the spring. The course of the fluctuations was therefore such as also occurred with the witch.

The curves for the large and for the small megrims were of the same kind, but in the case of the small the bottom of the cup—the scarcity in summer—was more marked, while in the case of the large fish there was a small secondary maximum in July and especially in August. With the small fish the fall from the maximum in December and January is more sudden, the minimum being reached at a bound, in March–May, while with the large the minimum is not reached till May.

There are some differences in the fluctuations in the different years. There was always a very high maximum in the winter, and in almost all a very low position in the summer, but in 1904 this was replaced by a great increase in July and August, which was common to both the large and the small fish. The small fish fluctuated in the same way as the large fish in the different years.

In XVII, to the south of XIII, where the fishing was also regular and representative, the compound curve is of the same cup-shaped type. The maximum is from October to March, the highest level being in November and December, and the minimum is in June, July, and August. This precisely describes the curve for the large megrims also, but not for the small. The minimum is for them also in June–August, but the mean for January is as low, and there is a rise to February, the mean for that month and for March–May being equal; then there is a rise from August to the maximum for the year in October and November, December showing a fall.

The continuous curve for the large fish shows usually a high winter position, the maximum however being sometimes delayed till March or even April, and in some years there was a sudden increase in a single month in autumn, August, October or November, forming the chief maximum for the year.

In the continuous curve for the small fish the winter position was always low, and in some of the years the maximum was in September or November.

In square XIX, which is an offshore area with deep water, and where the average catch was 1.3 cwts. for the whole period, the type of fluctuation is peculiar, and it differs for the large and the small fish. The combined curve for the total megrims is a great cone, the line increasing from the beginning of the year to a maximum in August and September, and then falling to December. This also describes the fluctuations of the large fish, the maximum being in August. But the fluctuations of the small megrims are different, the curve being of the cup-shaped type, with the maximum in winter, the extreme minimum in April, and in May–July.

The monthly means for the large and small fish and for the totals are as follow :—

—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Total	0.6	0.5	0.7	1.1	1.7	1.9	2.2	2.6	2.4	2.0	1.1	0.8
Small	0.5	0.3	0.2	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Large	0.5	0.5	0.6	1.0	1.5	1.7	2.0	2.4	2.1	1.7	0.9	0.7

In the continuous curve for the separate years there is always a summer maximum for the large fish, and sometimes a double maximum in summer, separated by a month or two, and the winter position is always low. In the corresponding curve for the small fish it is difficult to see any great increase in the winter months, the actual maximum in most of the years being in summer, or from July to October, in the unsmoothed means. The curve and arrangement of the means for the small fish, then, cannot be regarded as typical, but rather as a result of the smoothing.

From what has been stated above as to the fluctuations in the seasonal abundance of this fish in the different areas, and which are represented on the chart (pls. VII, VIII,) it is obvious that it performs considerable migrations. So far as I know, no results have yet been got from marking experiments with the megrim, and indeed no considerable numbers appear to have been marked.

THE LEMON DAB (*Pleuronectes microcephalus*). (Pls. IX–XI).

This fish, like the witch, is taken almost exclusively by the trawl net, and a glance at the chart (Plate IX) will show that its distribution is very different from many of the other flat fishes. As with the plaice, it is abundant on the grounds near our east coast, but it differs from it in not being distributed in any great number on the eastern grounds towards the coast of Denmark. It is found chiefly in the squares contiguous

to the east coast of Scotland, from the Moray Firth to the south of the Firth of Forth, and this is consistent with the fact that it prefers hard bottoms and the neighbourhood of rocks.

The squares in which it is most plentiful, and those in which it is least so, are given in the table on page , which shows the mean catch in cwts. for the whole of the 10 years, 1901-1910, per 100 hours' trawling.

It will be seen that the square which has the highest mean catch for the long period of 10 years is that which contains the Moray Firth, XXII, and only a small portion of the area is open to trawlers. The next highest is that to the south, XXVIII, embracing the coast from a little south of Aberdeen to the south shores of the Firth of Forth; the third is the square XXIII, extending along the coast of Aberdeenshire, and stretching some 50 miles from land, and the fourth is the square XXIX extending seawards from the mouth of the Firth of Forth. It is noteworthy that the mean catch in square XXIV which lies over 50 miles from the coast is not much less than that in square XVII, which contains the southern part of the Orkney Islands, and the grounds off the northern part of the Moray Firth; it contains, however, a considerable patch of hard ground, shelly and stony, in a moderate depth of water, very suitable for this fish. Even larger areas of this kind of bottom are to be found in other squares where the lemon dab is comparatively scarce, as in XIII, XVI, XX, and XXVI. The two former have water of some depth, but the depth in the two last named is moderate, and suitable for the lemon dab, but they are situated far from the east coast and towards the other side of the North Sea.

The centre of the distribution of this fish then may be taken to be the east coast of Scotland. It is much less abundant towards the north, as for example in square X, which includes the Shetland Isles, where the mean catch was only 1.80 cwts. per 100 hours' fishing; and it becomes scarcer and scarcer towards the eastern and south-eastern grounds. From the investigations made by the research vessel, the *Garland*, and on board commercial trawlers some years ago, it is evident that the Moray Firth, and in particular the northern coast of it, is well supplied with the lemon dab.

With regard to the seasonal abundance of the lemon dab, a very common type of fluctuation in the squares is the very gradual increase in the density of the fish, culminating in a maximum in summer, and usually in late summer, and a gradual decline thereafter till the end of the year. In some of them the rise or increase is preceded by a low mean for several months, or by an actual decrease or fall, but in none of them do we find the type so common with the witch, for example, where the summer means are the lowest, so that the graph drawn upon them has a cup-like form. In all cases the maximum abundance is in summer or in autumn, and never in winter, the main difference between one square and another being the extent of the fluctuation and the month in which the extreme maximum occurs. The minimum is nearly always in the early months of the year, the means in December being as a rule higher than those in January or February.

Taking first the squares in which the fish is most abundantly represented, and the fishing most regular, the best example is XXIII, where the fishing throughout the whole period was extensive and took place in each of the 117 consecutive months. Here the fluctuations are of the same type as in squares XVII, XXVIII, and XXIX, as shown in the combined monthly means for the whole period of ten years, and thus represents the variations in abundance on the coastal grounds. There is a regular, steady and somewhat rapid increase in the numbers of fish from January on to August when the maximum for the year is reached, and thereafter a steady decline to the end of the year, the mean for December being but little above that of January. The graph or curve constructed on the means is thus mound-shaped. There is however a tendency shown for the rise to be interrupted in May, the means for January to April increasing quickly, and then becoming rather uniform, to increase again in July. The means from April to August are as follows:—10, 42, 10, 31, 10, 46, 11, 11, 11, 51. There is an indication of this tendency in the compound curve of other squares.

An examination of the continuous curve for the individual means for the 117 months, shows that in several of the years this division into two periods is extremely marked and is indicated in each of them. The compound curve indeed tends to mask and obliterate what must be looked upon as the normal fluctuation. It is especially distinct in 1902 and 1909, so that in these years two very clearly marked periods of maxima occurred, the curve showing two cones. Thus in 1902, the mean rises from the minimum for the year in January to March and April, falls in May and June to a point almost as low, rises again to the maximum of the year in August, and then falls to November, the position in December being a little higher. In 1909 the spring cone or

maximum culminates in March, which is the highest for the year, the sulcus between it and the summer cone is in May, which represents the minimum for the year, the second maximum occurring in July, after which there is a steady decline to December.

The means (unsmoothed) for this square in these two years are as follows :—

—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1902	2.64	6.79	10.17	10.20	7.38	3.54	11.95	14.18	10.91	5.91	4.46	5.54
1909	7.8	9.6	13.7	11.0	6.9	11.6	12.7	1.2	10.4	8.2	7.6	7.2

This double maximum is indicated in all the years, except in 1901, where however the means for the first three months are absent. In five of the years, 1904, 1905, 1906, 1908, 1909, the spring maximum is the higher; in three the summer maximum is the greater, viz., in 1902, 1903, 1907, while in 1910 the spring and the autumn positions are almost precisely the same.

In this area, then, the course of the fluctuations shows a gradual increase in the density or abundance of the fish from the minimum position in winter to a high position in spring; then for a month or two there is a rapid and sometimes great diminution in abundance; this is followed by an increase again, and then by a fall to the end of the year. The occurrence of the maxima in this important square in the various years may be shown as follows :—

	Spring Maximum.	Summer Maximum.
1901	—	August, September.
1902	March, April	August.
1903	April, May	August.
1904	April	August.
1905	April, May	August, September.
1906	April	September.
1907	April	July.
1908	April, May	July, August.
1909	March	July, August.
1910	—	June.

There is thus a considerable degree of regularity. The winter minimum, with the lowest means usually in December or January, lasts much longer than the minimum in the early part of summer. There appear to be in this area two well marked migrations of the lemon dabs to other areas. The continuous curves of the means for the large and the small lemons show the same features, with these differences :—(1) the fluctuations are less marked with the small fish, the increase in spring being not so great; (2) the maxima for the small fish are usually a month or more after the occurrence of the maxima of the large fish.

In square XVII, where the curve on the combined averages has the same form, the fishing was not so regular. Usually two well marked periods of maximum abundance are indicated, separated only by a brief period of diminished abundance, which may last only for a month or two. The first is usually in May, but sometimes in April or June, once in March, and it is often the maximum for the year; the second maximum is generally in August. The period of scarcity is in winter as a rule, but occasionally in spring. The small lemons take little part in the fluctuations, the great maxima being due almost entirely to the large fish. It is noteworthy that both in this square and in XXIII the means for the small fish approach much more closely to those for the large in later than in previous years; that is to say, the totals are made up to a greater extent of the small fish in those years.

In XXIX, where the curve for the combined means has the same form, the means for the separate years do not clearly show the double maximum, and are less regular. The fish are always most abundant in the summer months and usually most scarce in spring, but there was considerable variation on the different years.

This form of fluctuation, with a minimum in spring, is seen in the curves on the combined averages for squares IX, XI, XII, XV, XVI, XIX, XXVIII, XXXI, but not in all with the same distinctness. In most of these areas the fishing was either irregular and unrepresentative, or the quantity taken very small.

In square XXVIII, where the quantity was large, the fishing was regular in the last three or four years, and the means show as a rule a scarcity in spring and always a

maximum late, either in September or October; there are also indications of several waves of abundance in a year. Very noteworthy is the manner in which the proportions of the small lemons increase in this area, compared with the large fish, in the later years of the period. In the summer of 1910 they formed the maximum, exceeding the large fish in August, and in each of the three preceding years their ratio to the large fish is great. In May and June, however, when there is an increase in the numbers of the large lemon dabs, the small ones are comparatively scarce.

In square XIX, which includes the Fladen Grounds, the curve on the combined means shows a slow gradual increase from January to May, then a rapid rise to August, September, and October, a rapid fall in November and in December the position is almost as low as in January. The figures for the separate years, in all cases where the fishing was completely representative, show a maximum abundance in the latter part of the year, in some years being much better than in others, and varying also as to duration. The maximum fell in August, September, October or November. Practically no small lemon dabs were found in this square, where the water is deep.

In square XI, to the east of the Shetlands, the fishing was very unrepresentative, but in X, which includes the Shetlands, the continuous curve of the monthly means for the successive years shows often a small rise in spring and a great one in the summer forming a maximum, and sometimes a double maximum is indicated.

A very striking feature in the distribution of the lemon dab is the difference between the large fish and the small fish. In order to bring this out, I have arranged the squares in the order of the value of their means for the whole period, 1901-1910—that is to say according to their richness in this fish—and have then calculated the percentage proportions of the large and small fish in each. The facts are brought together in the sub-joined table.

Showing the Proportional Distribution of the Large and Small Lemon Dabs in different Areas of the North Sea.

Square.	Average Catch (Cwts. per 100 Hours' Trawling).	Percentage of	
		Large.	Small.
XXII	13·11	72·8	27·3
XXVIII	10·11	68·1	31·9
XXIII	9·45	76·8	23·1
XXIX	8·81	85·7	14·3
XVII	6·82	81·5	18·5
XXIV	5·21	95·1	4·9
XIII	2·93	72·3	27·7
IX	3·08	66·8	33·1
XXX	2·89	93·7	6·3
XIV	2·60	65·0	35·0
XVIII	2·25	86·2	13·8
X	1·80	65·0	36·0
XXXI	1·73	96·5	3·5
XXV	1·51	98·0	1·9
XXXII	1·42	98·5	1·5
XXVII	1·23	89·6	10·4
XX	1·15	98·2	1·8
XXVI	1·14	95·5	4·5
XIX	0·94	95·6	5·5
XV	0·57	94·6	5·4
XI	0·55	87·3	12·7
XII	0·49	89·8	10·2
XXI... ..	0·43	97·6	2·4
XVI... ..	0·29	100·0	0·0

It will be seen (1) that in almost all the squares where the average catch of lemon dabs is large, there also the proportion of the small fish is large, with one or two exceptions to be referred to immediately; (2) that where the total catch is small the average catch of small fish is also small, and the average catch of large fish large; (3) that towards the eastern and south-eastern parts of the North Sea the proportion of small lemon dabs is very small; (5) that the proportion is usually also small in the deeper water areas. Thus in the eight squares which are in relation to the shores on the Scottish side the proportion of the small fish, calculated on the means, range from 18·5 to 36·1 per cent. In square XXIX, which comes very close to the east coast of Scotland the

percentage proportion of the small fish is 14.3; it is 10.6 in square XXVII, off the Skagerrack, and near the coast; it is 13.8 in XVIII, which is an exception, lying off the Moray Firth. There are exceptions also in squares XI and XII, to the east of the Shetlands, and with deep water, not easy to understand, for the total catch or mean catch in these squares is small. On the other hand in the areas lying towards the middle of the North Sea, even when the water is of moderate depth, the proportion of the small fish is low, and the total is also low.

Perhaps of even greater interest is the fact that in many of the squares a larger and larger proportion of the small lemon dabs is in recent years making up the totals. Fewer of the large fish and more of the small are being taken, or at least brought to market. An examination of the continuous curves shows this fact at a glance. It is specially remarkable in squares IX, X, XIII, and XIV, that is in the north-west, but is to be seen in all the other areas, as XVIII and XV, XVII, XVIII, XXIII, XXIV, XXIX. In square IX the small lemons were more abundant than the large lemons in 1911; in square X they were more abundant than the large both in 1909 and 1910. In the early years of the period the proportion of small lemon dabs was much less than the large. This subject is dealt with on page

THE PLAICE (*Pleuronectes platessa*). (Pls. XII-XV.)

Taking the whole of the North Sea, the plaice is the most valuable of the flatfishes, and is landed in greater quantities than any other, particularly by the English trawlers. In Scotland it is also landed in larger quantity than any other flatfish—58,977 cwts. in 1909—but in value it is exceeded by the halibut and the lemon dab. Of all the food fishes it is the one which has engaged special attention in connection with the international fishery investigations, and it may, therefore, be considered at some length and in some detail.

It is widely distributed throughout the North Sea, but is particularly abundant in the neighbourhood of the coasts and on certain banks, and is specially plentiful in the eastern and south-eastern region, where the Aberdeen trawlers very rarely fish to any extent.

The distribution of the fish, so far as shown by these statistics over the ten years, may be seen on the chart (plate XII), and in the appended table (p.), which gives the arithmetic mean quantity in cwts. per 100 hours' fishing for the more important squares, or, in other words, the mean density on the different grounds.

The square with the highest mean density was XXXIII, close to the coast of Jutland, the figure being 13.18 cwts. per 100 hours' trawling. The fishing in this area was, however, very limited, and during the five years 1906-1910 was confined to the month of September, except in 1908, when some fishing was also made in October; and the figures for previous years prove that this is the time when plaice are most abundant there. The fishing was thus quite unrepresentative. The square with the next greatest mean density was XIII, where the average amounted to 12.06 cwts. per 100 hours' fishing. This area lies south-west of the Shetlands and includes the northern part of the Orkney Isles. The area with the next highest density, namely, 10.99 cwts. per 100 hours' fishing, was XXVIII, and it embraces the part of the east coast of Scotland which lies between the neighbourhood of Stonehaven and St. Abbs Head, including the mouths of the Firths of Forth and Tay. The area with the next highest density was XXXII, to the west of XXXIII, where the mean was 9.83 cwts. Then comes X, which includes the Shetland Isles, where it was 8.23. The next area, with a density of 7.74 was XVII, lying immediately south of XIII, and including the southern part of the Orkneys, the Pentland Firth and the waters off the Moray Firth. In area XXIX, which lies to the east of XXVIII, the density was also considerable, viz., 5.67; while in the area immediately to the north of it, XXIII, off the coast of Aberdeenshire, the density was 5.02 cwts. per 100 hours' fishing.

In the areas lying immediately to the eastward of those named, the mean density was low, being above one in only a single case, and usually below one. But further to the eastward still, viz., in areas XX, XXV, and XXXI, the density was again high, being 4.80, 6.72, and 4.87 respectively. A glance at the chart shows generally that the greatest density is along the eastern coast of Scotland and around the northern isles, and the next greatest density is in the areas lying in the neighbourhood of the Great Fisher Bank and towards the Danish coast. In the areas between the two, where the depths are greater, as well as the distance from shore, the abundance of the plaice is much less.

The mean density as stated above is that for the whole period of 10 years, but the squares with the greatest density varied in different years.

I now proceed to consider the general distribution and the seasonal variations in the abundance of the three classes into which the plaice are divided, the large, the medium and the small.

The "large" plaice are those with a mean size of 59 centimetres ($21\frac{1}{2}$ inches) and a range of from about 40 to about 80 cm. ($15\frac{3}{4}$ – $31\frac{1}{2}$ inches); the "medium" plaice have a mean size of 42 cm. ($16\frac{1}{2}$ inches) and a range of from about 25 to 63 cm. (10 – $24\frac{3}{4}$ inches); the "small" plaice have a mean size of 29 cm. ($11\frac{1}{2}$ inches) and a range of from about 19 to 46 cm. ($7\frac{1}{2}$ – 18 inches). The great overlapping which is shown in the various classes is due to inexact assortment by the trawlers; but the approximate point of division between the large and the medium fish may be placed at 51 cm., or 20 inches; that between the medium and the small may be placed at 35.5 cm., or 14 inches.

The importance of the distinction of one class from another lies mainly in the separation of the adult fish from the immature, especially in relation to the seasonal distribution. There is little difficulty on this score with the "large" plaice, for practically all of them may be considered as adult fish which have reached the size of maturity. It may also be assumed that the great bulk of the "small" plaice on the other hand are fish which are still immature and have not reached maturity, though a small proportion even of these may have done so. The difficulty in this respect lies with the "medium" plaice, and they unfortunately form the greater part of the total catch, amounting to about 75 per cent. of the whole. It is, however, probable that about one-half, and possibly rather more than a half, of the medium plaice as selected for the market are fish which have attained adult size.

THE DISTRIBUTION OF THE "LARGE," "MEDIUM" AND "SMALL" PLAICE.

It is well known that there is a considerable difference in the distribution of the small, medium and large plaice in relation to the coast and the depth of water—a fact which was elucidated by the s.s. "Garland," some twenty years ago, for the east coast of Scotland, and has since been described for other coasts. In the adjoining table I have

Showing the Average Catch of Plaice in each Square for the years 1901–1910 combined, distinguishing the Market Classes and the Percentages.

Square.	Average Catch.				Percentages of each Class.		
	Large.	Medium.	Small.	Total.	Large.	Medium.	Small.
X	1.66	6.20	0.52	8.23	19.8	74.0	6.1
XIII	1.92	8.41	1.68	12.06	16.0	70.0	14.0
XIV	0.60	2.42	0.10	3.08	19.2	77.6	3.2
XVII	1.43	5.91	0.41	7.74	18.4	76.2	5.3
XXIII	0.21	3.78	1.24	5.02	4.2	72.3	23.7
XXVIII	0.41	8.14	1.90	10.99	3.9	77.9	18.2
XXXIII	1.54	8.87	2.81	13.18	11.6	67.1	21.3
XX	0.38	4.28	0.03	4.80	8.1	91.3	0.06
XXV... ..	0.75	5.77	0.16	6.72	11.2	86.3	2.4
XXXI	0.44	4.26	0.16	4.87	9.0	87.7	3.3
XXXII	1.07	7.28	0.39	9.83	12.2	83.1	4.4
XI	0.24	0.61	0.00	0.83	28.2	71.9	0.0
XII	0.45	0.94	0.01	1.40	32.1	67.1	0.07
XV	0.10	0.45	0.00	0.54	18.2	81.7	0.0
XVIII	0.09	0.77	0.03	0.89	10.1	84.3	3.4
XIX... ..	0.06	0.27	0.00	0.34	18.2	81.7	0.0
XXIV	0.06	0.81	0.02	0.87	6.7	91.0	2.2
XXIX	0.28	4.96	0.41	5.67	4.9	87.8	7.3
XXX	0.13	1.39	0.02	1.53	8.4	90.2	1.3

brought together the facts with reference to the distribution of the different size-classes as revealed by these statistics, and have calculated the proportion in which they exist on the different grounds. The statistics for some of the squares were not furnished to me, the fishing being probably not sufficiently representative, but it will be seen from the table that the distribution is very varied.

In the first six of the areas (X-XXVIII) the water in each is in relation to the land; it possesses a shore or beach, differing in extent however in different squares. The total average catch is large, and the proportion of the small plaice is high in most of them. In X, XIV and XVII the percentage of the small fish is rather small, and the proportion of the large fish is on the other hand rather high. Square X contains the greater part of the Shetland Islands; XIV contains a small part and also Fair Isle and XVII contains the southern part of the Orkneys and part of the north-east coast of Scotland. In these areas the water on the whole is deep, and probably most of the fishing took place in some considerable depth. But in XIII, including the northern part of the Orkneys; XXIII and XXVIII, embracing the east coast of Scotland, south of the Moray Firth, the proportion of the small plaice was large. The maximum catch in any area in the North Sea frequented by the Aberdeen trawlers was in square XXIII, the average for the whole ten years being 23.7 cwts. per 100 hours' fishing. This is discussed elsewhere (p.).

The small plaice were still more abundant judged by the average catch, and almost as abundant in proportion to the other classes, in XXXIII, close to the coast of Jutland, Denmark. They were scarce on what may be termed the Fisher Bank areas, XX, XXV, XXXI, and XXXII, where, on the other hand, the medium plaice were best represented. The small plaice were very poorly represented in the offshore areas, especially where the water is of some depth. None at all were got in squares XI, XV, XIX, that is in the area between 58° and 61° North latitude and 0° to 2° East longitude. In squares XII, XX and XXX they were very scarce. In considering the presence of "small" plaice in these areas, the size-limits given on page must be kept in view.

The large plaice were best represented in squares XI and XII, to the west of the Shetlands, where the water is deep, though the average catch was of course small; next in squares X, XIV, XV, XVII, and XIX, and the average catch in X and XVII was also large. They were scarce on the grounds in squares XXIII, XXVIII and XXIX, on our east coast.

Medium plaice were best represented on the Fisher Bank areas, XX, XXV, XXXI, and XXXII, where the percentage as well as the average catch was high, and in the deep-water offshore areas, though the average catch in these was as a rule very small. In every square it will be observed that the medium plaice formed the bulk of the catch, forming never less than 67 per cent. and going as high as 91.3 per cent. In these areas, however, and in particular in XXXI and XXXIII the fishing was very irregular, and cannot be considered as representative.

SEASONAL DISTRIBUTION OF LARGE PLAICE.

With regard to the seasonal fluctuations it may be convenient first to consider the areas in which the average catch of plaice is largest.

In area X, or what may be called the Shetland area, where the mean density amounted to 1.66 cwts. of large plaice per 100 hours' fishing, the outstanding features of the monthly averages, for all the years together, are (1) a high density in the earlier months of the year and (2) a low density in autumn. The actual mean catch per 100 hours was 1.7 cwts. in January, 3.4 in February, 2.2 in March, and about the same till June, when it was 1.7; in August it rose to 2.3, falling to the minimum in September and October, with means of 0.4 and 0.5 respectively, and rising again towards the end of the year to 1.0 in November and 1.3 in December. When, however, the average or mean catches are smoothed in three-monthly groups, the method which has been adopted by Professor Thompson, the resultant curve formed by the smoothed figures, shows a maximum density in February and March, and a gradual fall to October (with a slight interruption in July) and an increase in density again in November and December and on again to January.

So far then as the smoothed monthly means for the whole period go, they show that in this area there is an accumulation of adult plaice during the months which comprise the spawning season, and mainly in March and February; that the density continues large until July and thereafter the adult plaice becomes much scarcer.

Looking now to the figures for each of the years separately, it may be noted that the fishing in the area was irregular until 1904. In 1901 there was trawling in five months; in 1902 in eight months; in 1903 in ten months. In the first of these years the maximum was in April; in 1902 it was in December, April coming next; in 1903 it was in August. In the five years, 1904-1908, there was trawling in each month of the year, the greatest density or maxima occurring in different years in February, March, April or May, and the least density in September or October. When the average catches are

smoothed in three-monthly groups, the following appears. In each year the maximum density occurred in the early months, and the minimum in the autumn (in 1909 in June), the general features of the curve for all the years combined being repeated in each. But in 1904 the greatest density was in April, May and June, the minimum being in October, September and November; in 1905, 1906 and 1907 the greatest density was in February and March (and in April in 1905). One conspicuous feature of the average catches in this area is the remarkable decline in the abundance of the adult plaice in the years 1904-1910, as may be seen from the tables, from whatever cause arising. The diminished abundance in 1905 was not very marked as compared with 1904; but after that, each year showed a considerable falling off from the year before. Thus while the mean for the year in 1904 was about 4 cwts. per 100 hours' fishing, it was only about 0.5 cwts. in 1908 and 0.75 in 1910.

In area XIII, which may be referred to as the Orkney area, the mean for the whole period amounted to 1.92 cwts. of large plaice per 100 hours' fishing. The mean monthly averages of the actual catches over the whole period indicate high densities in February, May, June and October, and low densities in January, December, March, August and September. But when the figures are smoothed in three monthly groups as before, the curve formed on the resulting figures shows a density increasing from January to May, when it was represented by 2.7 and decreasing thereafter till August. In September, October and November the density again increased to 1.93 and 2.0, falling to 0.96, the minimum of the year, in December.

An examination of the figures for the individual years shows that trawling in this area was trifling and irregular till the latter half of 1903. In the succeeding years there was fishing in each month, with the exception of December, 1906, and January, 1907. A study of the curves formed upon the smoothed monthly means shows that in 1904, 1905, 1906, 1908, and 1909, the density of the large plaice was large in the earlier months of the year, while in the latter months it was relatively small. The period of maximum density, however, differed somewhat in the different years. In 1904 there was a very decided rise from low means in January and February to the highest for the year in May, when it was 7.1, and a steady fall thereafter (with a slight interruption in September) to December, when the lowest point was reached, the mean being only 0.1. From this low point it rose to 1.9 in January, 1905, and it remained at much the same level in February, March and April, rising a little in May and attaining the maximum in June, when it was 3.0. Thereafter there was a fall to September, and in the remaining months of the year the density remained low. From a mean of 0.9 in December there was a rise to 3.8 in January, 1906, and the rise continued to March, when the maximum of 5.7 was attained; thereafter it fell to August. In the smoothed means, there are no figures for the four months November, 1906-February, 1907, and one cannot therefore say whether or not in any part of that period an increase of density, as occurred in January and February of the previous years, took place. The means for March and April are comparable to those in the same months in 1905; there was a slight increase in May, and a decrease thereafter till August, when the mean amounted to 0.2. After this, however, there was a great rise to 4.6 in September, 5.9 in October, and 6.6 in November, thus contrasting with the previous years. An examination of the figures showing the real means (unsmoothed) shows that this autumn increase was owing to a very high average in October, when 13.1 cwts. of large plaice were taken per 100 hours' fishing, the total fishing being 445 hours. This is by far the highest average catch for any month throughout the eight years, and it may well have been due to exceptional circumstances, possibly connected with the place of fishing in that month. In 1908 the curve based upon the smoothed monthly means has essentially the same character as in 1904, 1905 and 1906. There was a rise from January to February and March, the period of greatest density, and then a decline to May, after which some small fluctuations occurred, not of great extent, and the lowest point was reached in November. In 1909, from the maximum of 2.4 in January and 2.3 in February, there was a rapid fall to 0.6 in April, and then with little interruption a fall to 0.2 in December. In 1910 very few large plaice were caught, the maximum being 0.2 in January and May, and none were got in the last six months.

Setting aside the imperfect and perhaps abnormal means for 1907, the broad feature of the changes in density of large adult plaice in this area was the accumulation of fish during the months of spawning, and a diminished abundance in the latter part of the year, and the decrease in total number during the last three years.

Taking now the area XVII, in which the density was also very high for the period, viz., 1.7 cwts. per 100 hours' fishing, and which lies immediately to the south of the last, the same general features are shown as in areas X and XIII. The curve formed on

the smoothed monthly means for the whole period shows maximum density in the earlier part of the year, the highest point being in April, with a decline to a minimum in September and October, followed by a rise in November and December. The extent of the fluctuation or variation was however not so marked as in the other areas referred to, the maximum in April being 1.95, and the minimum in October being 0.61. With regard to the separate years, there were trawlings in this area in 1901 in only six months, in 1902 in nine months, and in 1903 in ten months. In the following seven years there was fishing in practically every month. In the curve based on the smoothed means, one sees that in 1902 there was a fall from a maximum in March of 5.2, to 1.1 in May; a slight rise in June and July, a fall to a minimum of 0.5 in September, and a rise thereafter. The means for the months of January and February and for the later months of 1901 are wanting. There is again a break in the means from November, 1902, to April, 1903, when the figure was relatively high, 2.8, after which the means declined to 1.0 in August, and after this there was a practically continuous rise to the end of the year, the maximum being in November, when it was 4.7. Then the density diminished until March, 1904, when it was 1.1, and rising again to June 5.1, it steadily fell until October when it was 0.8, rising again in November and December. In this year, 1904, there were thus two periods of low density, March and October, with the accumulation of adult plaice in the middle of the year and the maximum density in June; while there were also at the beginning and the end of the year relatively high means, representing part of the fluctuation of high densities at the end of 1903 and the beginning of 1905. In 1905 the curve formed upon the smoothed means shows two cones or periods of high density, one in January and February, the other in May, June and July, and there is a slight indication of a third rise at the end of the year. The periods of low density were in March and April, and in September and October, when the scarcity of the large plaice was most marked. In 1906 there was only one period of high density of adult plaice, the means rising from February to May and June when the maximum of 2.5 was reached, and falling to October and November, when they were 0.3, December showing a slight increase to 0.6. In 1906 there was also an accumulation of large plaice with the maximum in May, and another, but smaller, increase in density towards the end of the year, most notable in November, while the periods of minimum density were in January and February and again in July, August and September. In 1908 the means were on all occasions low, never exceeding (in the smoothed figures) 0.9; the greatest densities were in the earlier months of the years and the lowest in August, September and October. In 1909 the maximum abundance of large plaice was in January-March, the density steadily diminishing to September, October and November, and increasing again in December. The highest mean for the year was 1.2 and the lowest 0.1. In 1910 large plaice were scarce, the maximum was 0.8 in January and May; the minimum 0.0 in October and November.

The interpretation of the continuous curve for this area over the whole period is not so simple as in the others referred to above. The waves of increasing and decreasing density, so to speak, as indicated in the diagram, are clear enough, but they do not coincide with the same period in the different years, whatever may be the reason. I am not aware of the limits of the spawning season in this area and have no information either as to the occurrence of breeding fishes or of floating-eggs within it, but generally speaking there is a decrease in the abundance of the large plaice at the height of the spawning time as usually understood, and an increase in the density before and after it. It may be added that, as in the other areas referred to, the mean catch for the year is a decreasing one. (*See p.*).

The other areas lying adjacent to the east coast of Scotland are XXIII, XXVIII, and XXIX. In none of them were the quantities of large plaice, or at least the means per 100 hours' fishing, large.

In XXIII, lying south-east of XVII, adjacent to the coast of Aberdeenshire, the mean for the whole period was only 0.21 cwts. per 100 hours' fishing. On the other hand, the observations are very complete, trawling having taken place within the area in every month throughout the whole period. The highest mean for any month was 1.1 (March, 1902), whereas it was not uncommon for these adult or large plaice to be absent from the catches for a whole month. The curve formed upon the smoothed monthly means for the whole period shows very distinctly a maximum density in February, March and April, and a decreased density, by one half, for the rest of the year.

The continuous smoothed curve showing each month of each year separately brings out the same general feature, with some modifications. In each year the maximum density is in the early months. In 1902 it was in February, March and April; in 1903

it was later, in April, May and June ; in 1904 it was in February–May ; in 1905 it was in February and March ; in 1906 it was in February and March ; in 1907 it was also in February and March ; in 1908 it was chiefly in March, but also in January, February and April ; in 1909 it was in February–April, and in 1910 in February and March. The broad feature is therefore a maximum abundance during the spawning season of plaice. With regard to the remaining portion of the year there were some differences. After the period referred to, when presumably the fish were collected together for reproduction, the density rapidly diminished, the least abundance being usually coincident with late summer and autumn. But in three of the ten years, 1902, 1905 and 1908, there was a second period of increased density, in 1902 in July, August and September ; in 1905 in September, October and November ; and in 1908, where it was least marked of all, after July. In this area also there was over the period a decrease in the mean quantity taken per annum, the average catch in 1908 being only about half of what it was in 1901 and 1902, and it was still lower in 1910.

In area XXVIII, the mean density of large plaice for the whole period amounted to 0.41 cwts. per 100 hours' fishing. The curve formed upon the smooth monthly means for the years 1901–1910 combined, shows a maximum density in the first four months of the year, and especially in February and March, with a minimum in July, August and September, and a slight rise again in the closing months of the year. The observations in this area were however very imperfect, the only years in which trawlings were made in each month being 1908, 1909 and 1910, while in some of the other years they were made in only two or three months. So far as they go, they show a maximum abundance of large plaice at the spawning time, and scarcity in late summer and autumn.

In area XXIX, which lies contiguous and to the east of XXVIII, the mean of large plaice for the whole period amounted to 0.28 cwt. per 100 hours' fishing. The observations were almost complete throughout the ten years, and the curve formed by the smoothed means for the different months, in the years 1901–1910 combined, is much the same as that for XXVIII, the spring cone being higher. The maximum abundance or density was in the first four months of the year, and in particular in February and March, and after that period there was a decline, the lowest point being reached in October and November. The general features of the curve for the combined years are repeated in that for each year, the month of greatest density varying a little. In 1903 it was in April, in 1904 in February and March, and in 1905 in January, February, and March, and in the other years in February, except 1910 when it was in March. In 1902 and 1903 there was a limited period of increase of density in the autumn, and an indication of it in some of the other years. The great feature in each year is a sudden increase in the abundance of adults which lasts for three or four months, coinciding with the spawning season.

Turning now to the areas on the eastern side in which the mean catch of large plaice was large, viz., XXXII and XXXIII, where the mean for the whole period was 1.07 and 1.54 respectively, one finds that the observations were imperfect, the fishing being practically confined to the latter half of the year, and in some years to a single month. No statement can therefore be made as to the seasonal variation in the density of the fish, but it may be noted that in both cases the smoothed averages available from May to November indicate an increased density in autumn, in XXXII in October and partly in November, and in XXXIII in September and October and partly in August.

In the areas in the middle portion of the North Sea where the mean catch of large plaice was moderately large, viz., XXV, XX and XXXI, with means of 0.75, 0.38, and 0.44 respectively, the observations are not so complete as in some of the other squares.

In area XX, which is the most northerly of the three, and has a considerable variation in the depth of the water in different parts, the curve formed upon the smoothed monthly means for the whole period shows high densities in January, February, and again in June ; whereas in March and April the density is low ; after June the density slowly but steadily decreases till November, a slight rise occurring in December. A study of the curves for the separate years, so far as they exist, shows, however, so much variation from one year to another that the above statement cannot be applied generally.

In area XXV, where the average depth is less and much more uniform, the curve formed on the smoothed monthly means for the whole period, shows a very different type. The maximum density of large plaice is in June, July, August, and September, the highest level being in August, and the minimum densities at the beginning and end of the year. There is here no indication of an accumulation of plaice at the spawning period (as usually described), but the opposite. It has to be remembered, however, that,

as above said, the observations in the early months of the year are imperfect. In only two of the years were there trawlings in each month, namely, in 1904 and 1906. In the former the period of greatest density was in March and April (1.4 and 1.9), the mean from June to September standing at 1.2. In the latter the highest means were at the latter end of the year, October, November, and December, and the lowest in February and March.

In area XXXI, which also forms part of the Fisher Bank plateau, and has fairly uniform and moderate depths, the curve formed upon the smoothed means for the whole period shows a similar high density of large plaice in the summer months, and a low density at the beginning and at the end of the year. From May to August inclusive the means were above 0.6 cwts. per 100 hours' fishing; in January, February, and November they were under 0.3, and in December 0.13. The means for the first four months depend on 13 months (out of a possible 40) in the period, but (with a single exception) none of them are so high as the means for the later months in the same year when these exist.

Turning next to the areas with low densities it is found, when the means are placed upon the chart, that they lie intermediate between the inshore areas and the areas in relation to the Fisher Bank plateau; that is to say, they extend in a north and south direction in the deeper water from the Gut (area XXX) in the south to the south-east of the Shetland Islands. In these areas—XV, XVIII, XIX, XXIV, XXX—the mean catch of large plaice over the whole period amounted to only from 0.13 to 0.06 cwts. per 100 hours' fishing. That the depth of water is not the sole explanation of the paucity of the adults in this region is shown by the fact that in area XI where the water is deeper on the whole than in most of the others, the mean amounted to 0.24. The distribution referred to—and there are other facts that point in the same direction—suggests that the stock of plaice to the eastwards of the deeper water off the Scottish east coast, say east of longitude 2° E. and north of latitude 56° N., is derived from the eastern and south-eastern grounds, and not from the nearer areas along the Scottish coast. One general characteristic of those areas is the increase in the abundance of large plaice in late summer and autumn, and this may be associated with low density in the earlier part of the year or with total absence. The indications are that during the spawning season adults are mostly absent from those grounds, and that after the spawning season they return again for feeding, a fact which our work on trawlers to the south-east of the Shetlands bears out.

MEDIUM PLAICE.

As already mentioned, a considerable proportion of these must be considered as adult fish, and it is unfortunate that the classification for the market is such as to include in one category immature fish on the one hand and mature fish on the other. It would have been of value had there been a good body of evidence collected at the market during the spawning season to indicate what the proportions are. The medium plaice constitute by far the greater part of the catches of the trawlers, forming indeed about three-fourths of the whole. Their mean density over the whole period varied, the maximum, as a general rule, being in the areas where the density of large plaice was great. Thus the greatest abundance of both was in areas XXXIII and XIII; but in area X, in which the large fish were nearly as abundant as in area XIII, the medium fish were in fewer numbers. On the eastern grounds, XXXII and XXXIII, both kinds were in considerable numbers. If we take again, first of all, the areas along the east coast of Scotland from the Shetlands southwards, the means for the whole period were as follows:—in the Shetland area, X, the mean was 6.20 cwts. per 100 hours' fishing; in XIII (embracing the northern part of the Orkneys) it was 8.41; in XVII it was 5.91; in XXIII it was 3.78; in XXVIII it was 8.14 (as compared with 0.41 for "large"); in XXIX it was 4.96 as compared with 0.28 for large.

In the areas on the Fisher Bank plateau the density of the medium plaice was large—on XX amounting to 4.28, on XXV to 5.77, and on XXXI to 4.26. The absolute density was still greater (but less in proportion to that of the "large") on the grounds extending from the latter to the coast of Jutland, viz., areas XXXII and XXXIII, the means being respectively 7.28 and 8.87. In the deeper water areas between those on the Scottish coast and those on the Fisher Bank plateau the means were, as in the case of the large plaice, small, being 0.27 in XIX, 0.45 in XV, 0.77 in XVIII, 0.81 in XXIV, and 1.39 in XXX, while in XIV it was 2.42. It is to be noted that the proportion of the large plaice in relation to the medium was considerably greater in the northern deep water areas than in the others, as the following table shows. It

indicates the percentages of these two classes to the *total of them combined*, the "small" plaice being excluded:—

1. Scottish Coastal Areas, from North to South:—

Area.	Percentage of	
	Large.	Medium.
X	21.0	79.0
XIII	18.6	81.4
XVII	19.4	80.5
XXIII	5.3	94.7
XXVIII	4.8	95.1
XXIX	5.3	94.7

2. Middle Fisher Bank Areas:—

XX	8.1	91.7
XXV	11.5	88.5
XXXI	9.4	90.6

3. Intermediate Deep Water Areas:—

XI	28.2	71.8
XII	32.4	67.5
XIV	19.8	80.1
XV	18.2	81.7
XVIII	10.4	89.6
XIX	18.2	81.8
XXIV	7.0	93.0
XXX	8.4	91.6

The figures show that the proportion of the large fish is much greater in the northern areas and greatest of all in the deep water ones. The explanation may be found in a difference of growth-rate (about which there is some evidence, but not enough); the known relation of distribution of plaice according to size and depth of water; perhaps also in the greater intensity of fishing in the southern areas over a term of years.

THE SEASONAL DISTRIBUTION OF MEDIUM PLAICE.

If we now consider the seasonal variations, it will be found that, as a rule, the fluctuations in the mean density of the medium fish coincide with the fluctuations in the large fish.

In area X, the greatest density (taking all the years together) is in the spring and winter, from December or January on to April or May, the maximum being in March and April, after which the density diminishes to October, the minimum for the year, increasing again in November and December. The means for the separate years show the same feature, but in the first three years there was no fishing in the summer months. If we study the continuous curve formed upon the smoothed monthly means from the later months of 1903 onwards, we find a rise to a maximum in February, March, and April in 1904, a fall to October, and a rise to December. This is continued further to January and February, 1905; there is then again a gradual decline to October; a rise to a maximum in January and February, 1906; a fall to September; a rise again to a maximum in 1907 in March and April, and a fall to October; a rise to a maximum in January and February, 1908; and a decline again to September, and a rise to the end of the year, and into the early months of 1909. In 1910 the same sort of fluctuation occurred, but owing to the scarcity of the fish and the low means, it was much less marked.

As was the case with the large fish in this area, and corresponding to the change in many other areas, the means for the various years show a diminishing figure from 1904 to 1910. In other words, the medium plaice became scarcer. Thus from 1904 the maximum for the year was successively 22.0, 17.2, 10.3, 10.3, 4.1, 2.7, 3.1, while the minimum was successively 7.6, 4.2, 3.3, 1.6, 0.9, 1.5, 0.9 cwts. per 100 hours' fishing.

In area XIII, the variations in the smoothed monthly means also resemble the variations for the large plaice, and they differ in the same way as the variations for area X. The lowest density is at the commencement of the year in January and February; from this time the density increases, attaining a maximum in May and June,

and after this declining to autumn, when there is a slight increase in density, less marked, however, than with the large plaice. In this area then there is distinct evidence of a twofold change in the course of the year, namely, two periods of increased abundance and two periods of scarcity, for both the large and the medium fish, the latter, however, lagging a little, so to speak, behind the change in the large. When the means for the two classes are averaged the maximum occurs in June and the minimum in August.

Study of the separate years shows generally the same features. There was practically no trawling in the area until the middle of 1903, but in each year thereafter, with the exception of 1905 and 1910 (as indicated by the smoothed averages), there was the double change in density referred to. Although the smoothed averages for 1905 indicate only a retardation in the decline, the second period of increased density is clearly shown in the actual averages (July, 8.4; August, 3.2; September, 4.9; October, 7.8; November, 2.3). The smoothed figures for the year 1908 show considerable irregularity, owing, in the main, to an exceptionally small catch for April. As in most of the other areas, medium plaice were much less abundant in the later years of the period.

In area XVII the type of the curve formed upon the smoothed means for the whole period is essentially the same as that for the large fish, but the fluctuation is less, and the density in winter is relatively much lower. The maximum is in the spring months, most marked in April, and there is a rise in June; the minimum is in September; a slight rise after this is indicated in November, but the means for December and January are nearly as low as that for September. The means for the various months in the individual years show much the same condition and changes as for the large fish, but the extent of the fluctuations is less in proportion, and the same is true for the means for the whole period. The year showing the greatest contrast between the two classes is 1908.

In area XXIII, the monthly means for the large and the medium fish also show much the same variations when the whole period is taken. The maximum density is in February, March and April, and the minimum in July and August, after which there is a steady rise to the end of the year, the means for the later months showing a much more regular rise than in the case of the large fish. In each year the maximum was in the spring, usually in February, and the minimum in the late summer or in autumn, but the second period of increased density, indicated in some of the years with the large fish, is less frequently represented among the medium. There is not the same diminution in the abundance of the fish in this area as in those above mentioned.

Going further down the east coast to area XXVIII, we find the curve formed upon the monthly means for the period very much like that for area XXIII but, as it were, exaggerated; and here again it is more uniform and regular in its changes than the one for the large plaice. The maximum density is from January to April, the highest point being reached in February and March, while the minimum is in August. The slope of the curve throughout is very even and regular. Except in 1908, 1909 and 1910, however, there was little trawling within this area between the spring and autumn months; but such trawling as did take place indicated the same feature of high density at the end and the beginning of the year. The fluctuations in 1909 were more irregular than in 1908 and 1910.

The area XXIX, lying seawards of XXVIII, showed practically the same variations among medium plaice as among large, the maximum density being in the spring months, chiefly in March and February, but not so great, and the means from June onwards were low, the minimum being in November and October. The curve differs from that for the last area in the January and December positions, being relatively low, a feature also present, but not so prominently, in the curves for the large fish. The means for the separate years show the same general feature, the maximum usually occurring in March, but in one year (1906) in February; and one conclusion that I draw is that the increased density is in connection with spawning, many of the medium fish, and in particular those which are males, being in reality adults. In several of the years there is an indication of a second period of increased density in the autumn, but the great feature of each year is the great density in spring.

Turning now to the areas on the Fisher Bank plateau, one finds the relation between the large and the medium fish to differ. In area XX, part of which however has deep water, the curve formed on the monthly means for the period shows a maximum density in late summer and a minimum in winter and spring, whereas with the large plaice the maximum was in January and February and again in June. The lowest mean, however, was in March, as with the large plaice, though it differed but little from the means for the preceding three months. The fishing in this area was not very regular, but where it was the same broad feature is indicated, a maximum density in the summer (usually

July) and a minimum in winter, or at the spawning time, that is, in the earlier months of the year.

In area XXV, on the other hand, the monthly means correspond in their variations tolerably well with those for the large plaice, with this difference, that in the case of the latter the means in the early part of the year are less regular. The curve formed by the means for the medium plaice is very regular and uniform, dome-shaped, rising from a minimum in January to a maximum in June, July and August, and declining steadily thereafter to the end of the year. We have thus the density doubled in the summer months. The trawlings in the various years in this area were not very regular in the later years but the increased abundance in summer is usually well shown. In one year however, 1904, there were two distinct periods of increased density of medium plaice, one reaching a maximum in March and April and the other mainly in September.

In area XXXI, the monthly means (smoothed) for the whole period indicate increased density from March to September, chiefly in July and August, the minimum occurring in the winter. The means for the separate years, however, so far as they exist, show rather a difference. In 1904, there is a gradual rise right on from January to July, and a regular fall thereafter, the lowest point being reached in November and December. In the spring of the next year the rise is slight and there is some variability till May, after which there is an increase till August when the maximum is reached, the density diminishing thereafter. In 1906 the density increased from a minimum in January to a maximum in May, declining thereafter to September, but there were no trawlings later than this month, and very few indeed in subsequent years.

In what I have termed the intermediate deep-water areas and in the areas east and south-east of the Shetlands, the seasonal variations show differences in type, and a comparative study of the curves formed by the monthly means makes one feel the need of a more natural grouping of the records than occurs by the system of squares.

In the deep-water areas, XI and XII, to the east of the Shetlands, the fluctuations, as indicated by the means for the whole period, are somewhat similar. In both, the density of the fish on the grounds diminished from January to April or May, and then increased rapidly to July or August, but while in XI a decrease immediately occurs to September, after which the averages continue nearly uniform to the end of the year, the summer maximum in XII is continued till October, the fall occurring after that. In neither of the areas was the fishing very regular or representative. In XI only 1901 is characterised by a high summer maximum; both in 1905 and 1906, the other years in which the fishing was most regular, the minimum occurs in summer and the maximum in the winter and spring months. In XII, only two years are complete, 1905 and 1906, and both show a maximum in late summer, the minimum being in May and in April respectively.

The variations in these areas are to a large extent complementary to those in areas X and XIII.

In area XIV (which contains land) the type is different. Here the minimum is in January and February, there being (in the smoothed means) a rapid rise to March and on to May, the increased density continuing, with some fluctuation, to October, and falling again to December. The variations are thus very similar to those of the large plaice. The smoothed means in this instance perhaps somewhat obscure the condition that more normally obtains, owing to an exceptional average catch in April, 1903 (37.3), the unsmoothed means for January to June being as follows:—0.6, 0.8, 0.9, 5.8, 1.0, 3.7; and the means for the separate years, and the curves constructed upon them, show a minimum density in the spring months in all the other years, with a rise to a maximum in summer and autumn, the highest point being reached usually in June. In this square the diminution in the abundance of medium plaice in the later years is conspicuous.

In areas XV and XIX, the smoothed means for the ten years show two well-marked periods of maximum density, one in spring or early summer and the other towards the latter part of the year. In XV, the density increases from a minimum in January and February to a maximum in April, May and June, there is then a fall in July and a rise in September and October. There was, however, comparatively little trawling in this area in the summertime. In only two years was there fishing in each month, and in one of them, 1902, the minimum was April–July, when no medium plaice were taken at all, while in the other year, 1905, the smoothed means were largest in March and especially in September and October.

In XIX the observations were much more regular and numerous. In this case the abundance of medium fish increased from January to February, March and April, the highest average catch being in March; it then diminished to a minimum in June and July, increasing again in September and October, falling once more to December, which had

the same mean as January. The means for the separate years show a good deal of variability. Usually, but not always, the two periods of high density can be made out, and they are most marked in 1903 and 1905. But neither in 1906, 1907 nor 1908 was the second period indicated, while in the two latter years the maximum in spring was relatively great. There was little fishing in this area in 1909 and 1910.

In XVIII, which lies to the inside, or westwards of XIX, the type of variation was different, the greatest density being in May, June and July, contrasting thus with the fluctuation among the large plaice, while the minimum was in February. In some years, but not in all, there was an indication of a slight increase in the autumn.

In area XXIV, the maximum density was in summer, as it was also in area XXX. The minimum in the former was in December and January; there was an indication of a slight increase in February and March, a fall in April, and a rise then to July and August, followed by a steady decrease to December. The means for the separate years here again show some variability, but there was generally a low density in the earlier months of the year (but not in 1908, when it was high) and a high density in late summer or autumn. In area XXX, the trawlings were imperfect, but from the means available the density appears to have been low at the beginning and the end of the year and high in July, August and September, and this applies to all the years for which data exists.

THE SMALL PLAICE.

In these records the proportion of small plaice is not large, so far as it is shown by the weight of the fish, a very different thing of course from the numbers of the fish. They barely exceed the large, forming less than 12 per cent. of the total. Their distribution is shown in the Table on p. , and what was said as to their range in size in the market classification must be kept in view.

SEASONAL DISTRIBUTION OF SMALL PLAICE.

Considering now the seasonal variations in abundance or density, and beginning with the areas on the Scottish coast, we find that in X the smoothed means form a regular curve. The period of chief density is in January, February (especially) and March, after which it steadily diminishes to September and October, rising again at the end of the year. The curve resembles those for the larger classes, but the density much more rapidly diminishes after March. The means for the separate years show little variation. In each the great increase of density of the fish in the early months is conspicuous. In 1908 the means do not go so high and remain the same till June. Changes of this kind may of course be as much due to changes in the place of fishing within the area as to variations in the distribution of the fish. Comparison with the curves for large and medium plaice in the various years show that all fluctuate together; but the decrease in the smaller plaice in the last three years is much less than in the larger classes.

In area XIII the greatest density was in summer and the lowest in the winter, from December to February inclusive, and the curve formed upon the smoothed monthly means is tolerably regular. There was a slight increase in the abundance of the small plaice in August, corresponding to the autumnal increase among the medium fish and the considerable increase among the large. In the separate years this is best seen in 1906, but it is shown in most of them. The great increase in density in summer is also indicated in the means for each year, best in 1907 and 1904, least in 1908, 1905 and 1910.

In XVII the curve formed on the smoothed monthly means for the period is not very regular. The density was least in February and March and in December; greatest in May, June and August and September. This irregularity is due to the irregularities in different years. Thus in 1903 the averages declined from April and continued low in late summer and autumn; in 1904 there was an increase to August and it continued in September and October; in 1905 the period of greatest density was April, May and June, the remaining means being low; in 1907 the period of greatest density was in the latter part of the year, from August; in 1909 the density from February to June was high, and increased again in November. Here again it is impossible to say whether these variations represent actual variations in the distribution of the fish, or variation in the place of fishing.

In XXIII, off the coast of Aberdeenshire, where fishing was very regular throughout the period, the variation in the density of the small plaice with the season was very uniform and marked. The curve formed upon the smoothed monthly means for the whole period resembles that for the medium plaice, with this difference that the cone

showing maximum density at the spawning season is, so to speak, cut off, and the position at the end of the year is high. The form of the curve is cup-shaped, like the type so common with the witch, there being a steady fall from January to July, and a steady rise to December. Comparison of the curves for the three classes of fish in this area shows the reduction of the density in spring and the increase of density in the latter part of the year, as one passes from the large fish to the small. In the means of the separate years, the increased density towards the end of the year is seen in all of them, more conspicuously in some than in others, and most marked in 1908; the lowest density is always in July or August. As with the small plaice generally the means for the year are rather higher in the later than in the earlier years, thus contrasting with the means for the medium and large fish. There was a most remarkable increase in the average catch of small plaice in this square in the winters 1908-9 and 1909-10.

In area XXVIII, which has the highest mean density of small plaice on the Scottish coast, the trawlings, as already indicated, were not very regular throughout the period, most of them being in the late months or the early months of the year, but in three years, 1908-1910, all the months are represented. The curve formed on the monthly means is a regular one, showing a high density in the spring months, January to April, a diminution to a minimum in July and August, and a rise thereafter to the close of the year. It differs from the curves for large and medium by the higher position at the end of the year. The means for the separate years show some differences. The means for the latter part of the year (when smoothed) are somewhat higher than those for the early months; but in 1909 there was no increase at all at the end of the year. The minimum was always in summer.

In area XXIX, adjacent and to seaward, the variations were of the same type, the highest density being in February and March, and the lowest in June, July and August; but the rise in the latter part of the year was much less. The means for the separate years all indicate an increased density in spring, very notable in 1908, with the maximum in February or March. In one of the years, 1906, there was a second period of increased density in October, November and December—the greatest for the year—followed by a rapid decline to January, 1907, and the spring rise in this year was comparatively small.

In area XXIV very few small plaice were taken, and then almost only in the summer in a few years; in several years none were obtained. The same statement applies to area XX, but in XXV small catches were usually made. Here the smoothed means (and the greatest was 0.4) show a low density at the beginning of the year and in September, the highest densities being in October, November and December, and in May and June; but the high mean for the latter part of the year is due to a large extent to an exceptional average catch of 4.4 cwts. per 100 hours in November, 1903.

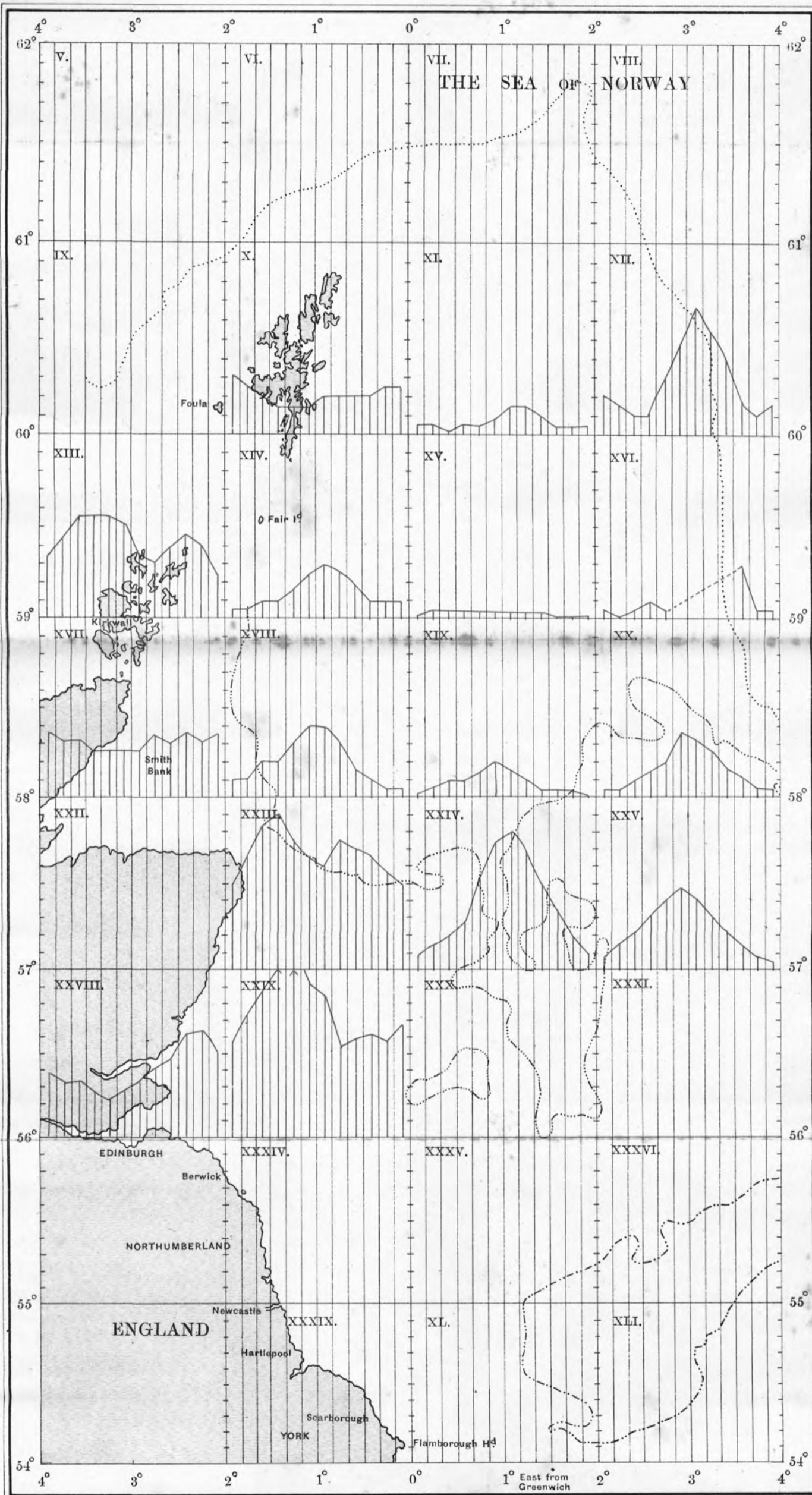
In areas XXXII and XXXIII towards the Danish coast, the trawlings were rather irregular, but the means indicate so far as they go an increased density in XXXIII in August and September, while in XXXII the highest densities were in December and in June.

IV.—EXPLANATION OF THE PLATES.

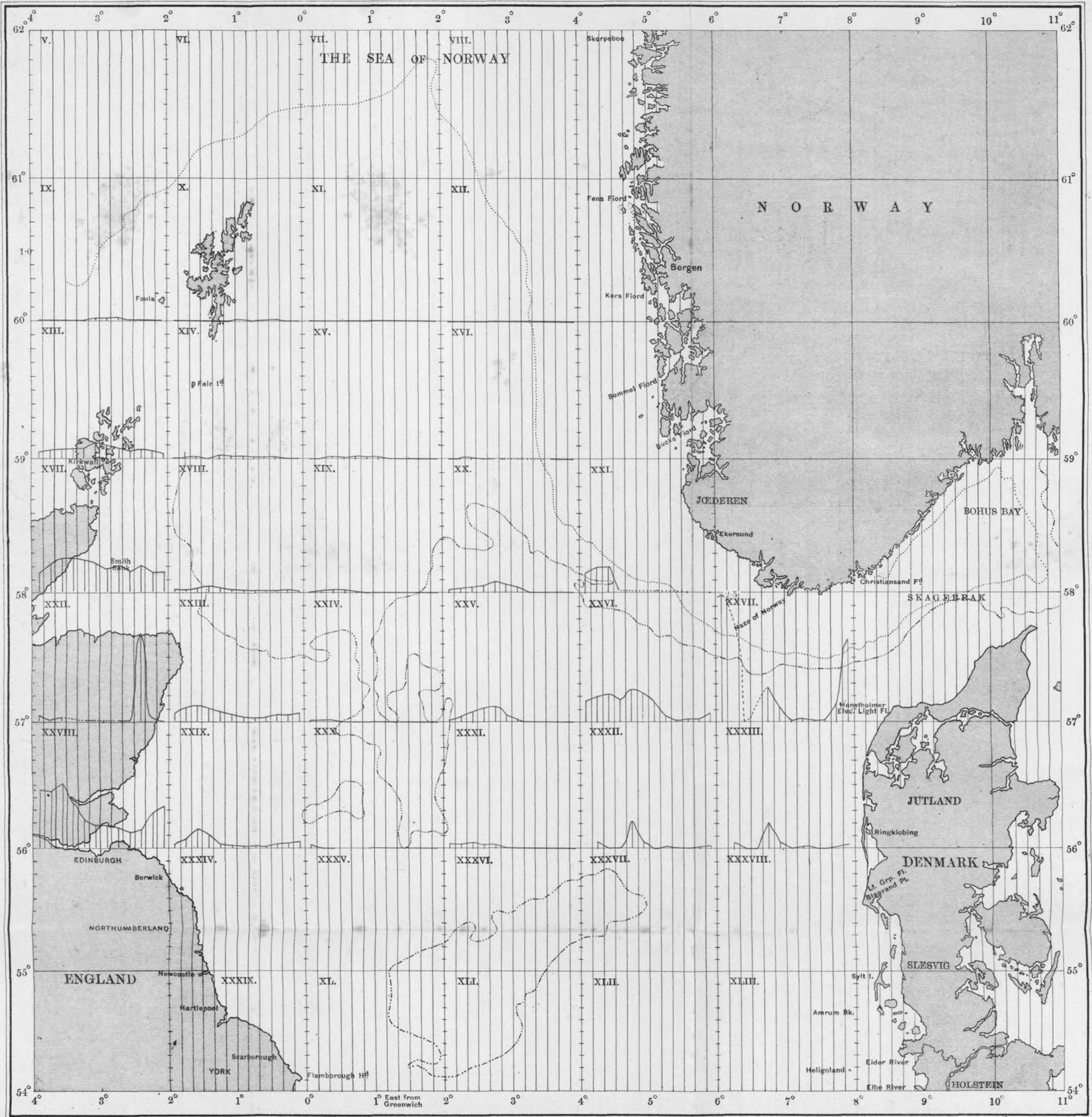
Each of the imaginary Squares into which the North Sea has been divided for the purpose of tabulating and treating the Statistics, is divided vertically into twelve spaces for the months of the year, and on each has been represented a curve showing the fluctuations of the fish from month to month within it. This curve is based on the composite or average means for the whole of the years, 1901-1910, and represents what may be taken as the normal fluctuations that occur. Different scales have been used on the different Charts, as the figures varied greatly; but the same scale is employed throughout any individual chart, and thus a picture is obtained, not only of the seasonal fluctuations, but of the distributive c. of the fish within the Region covered by the Statistics.

Turbot 1901-10.

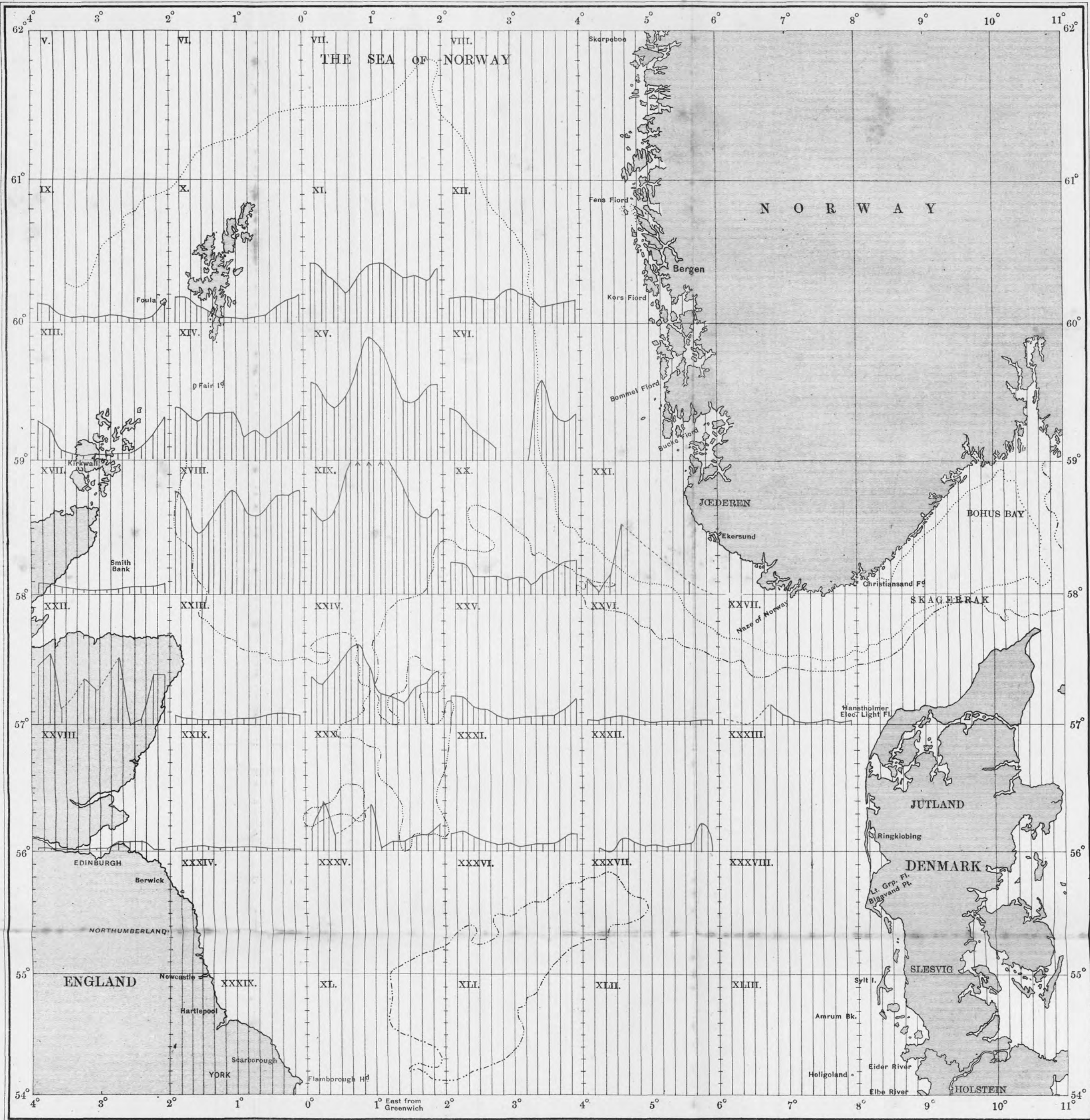
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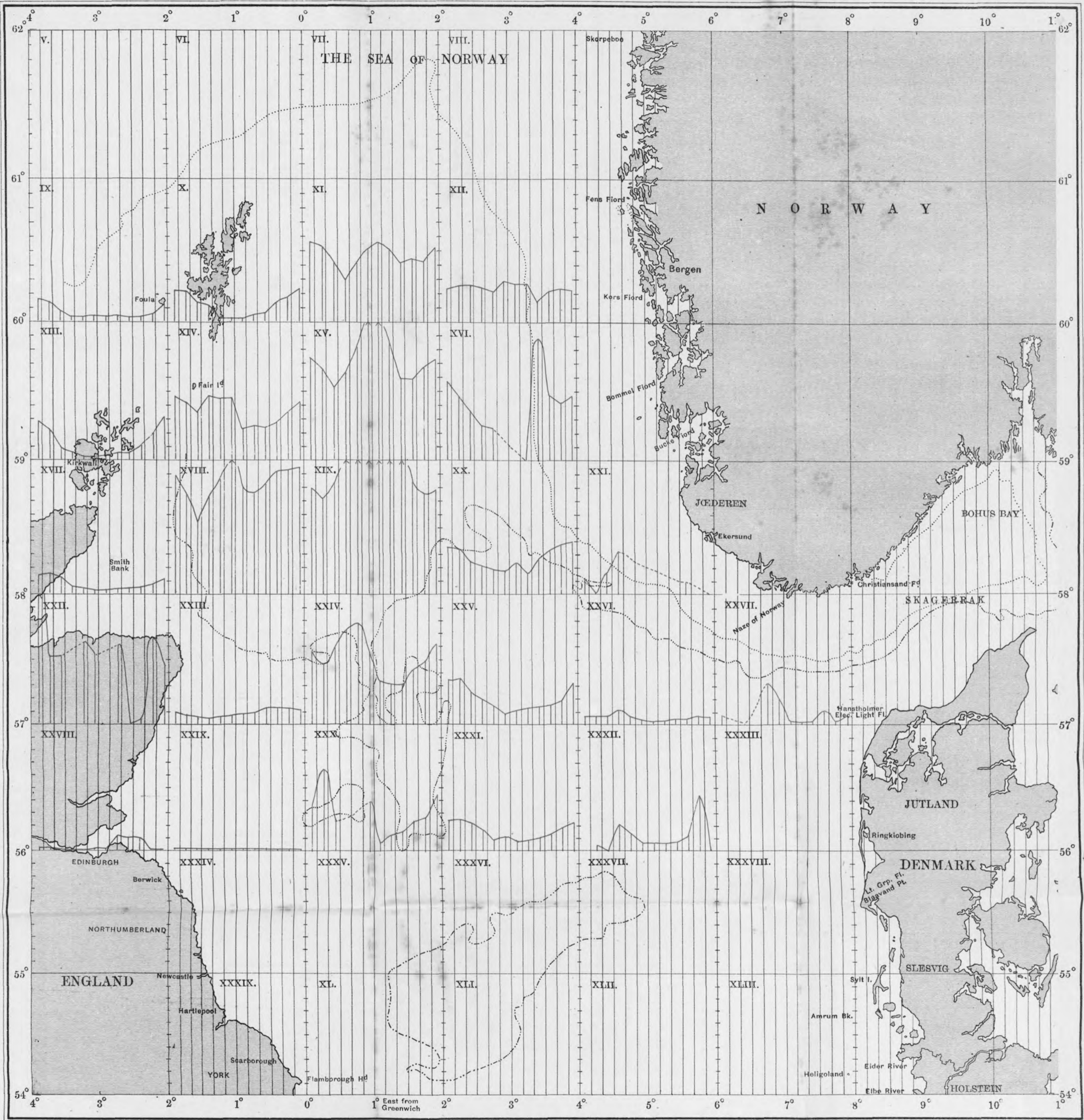
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Scale
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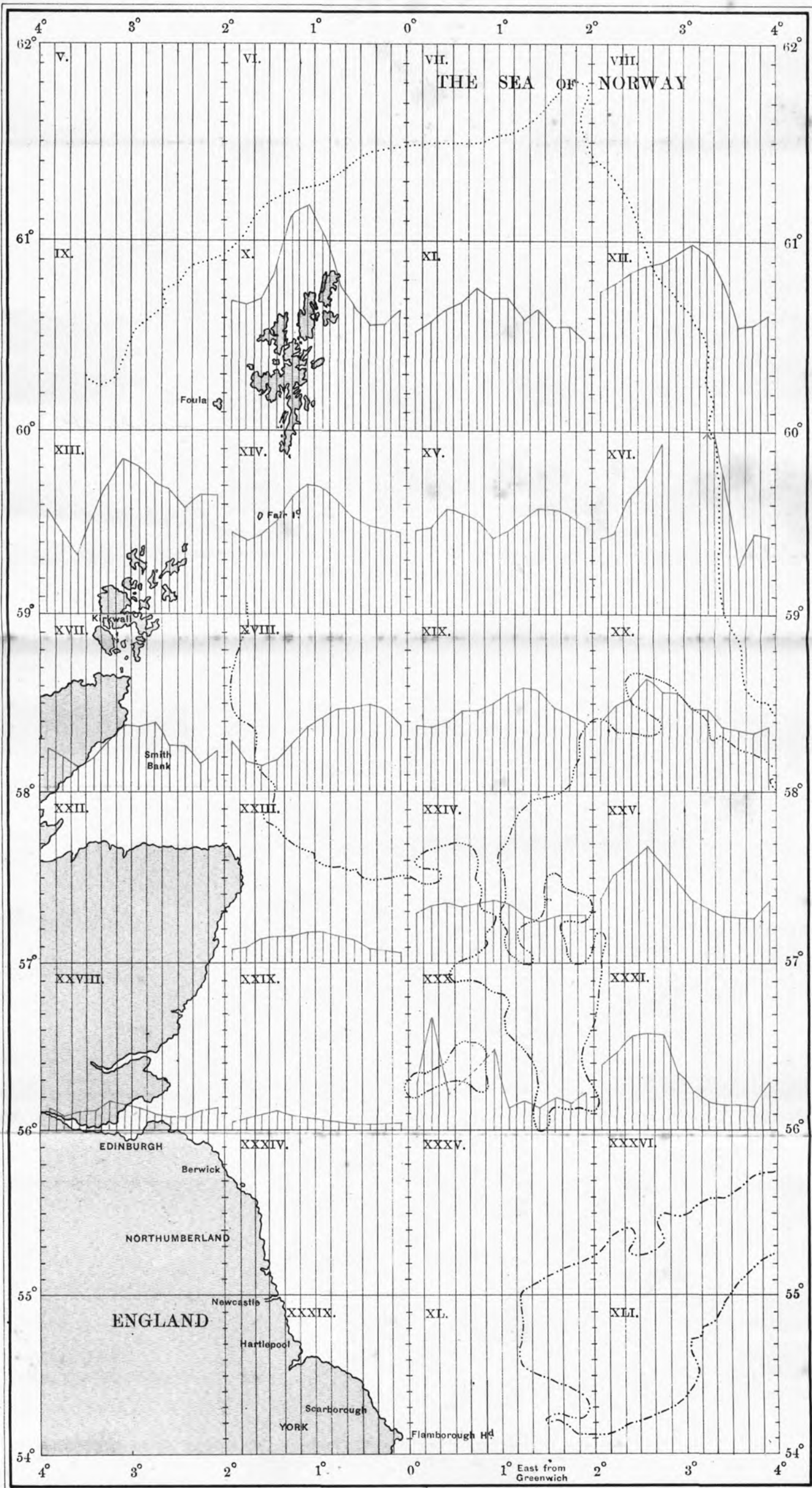


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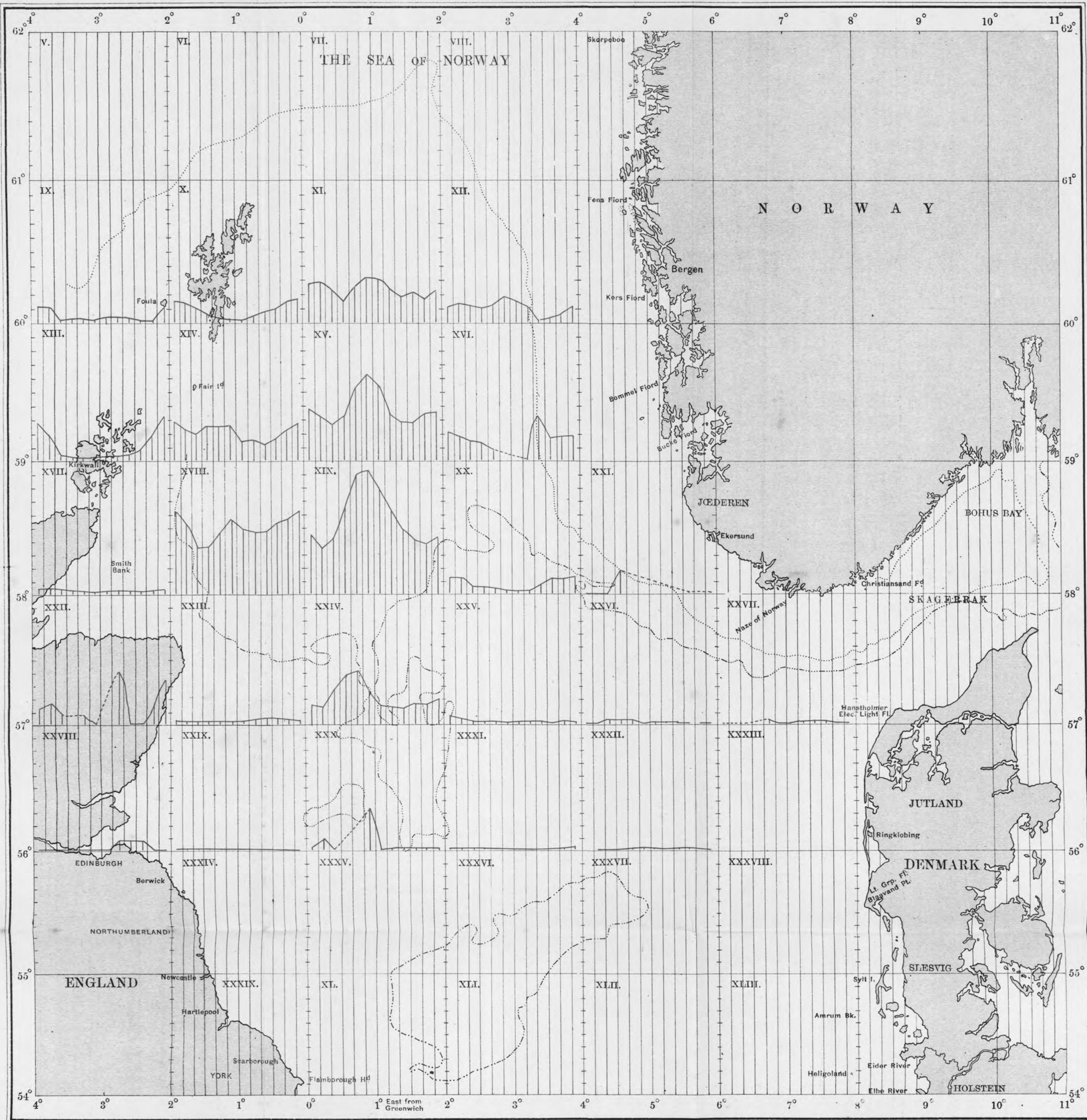


Halibut 1901-10.

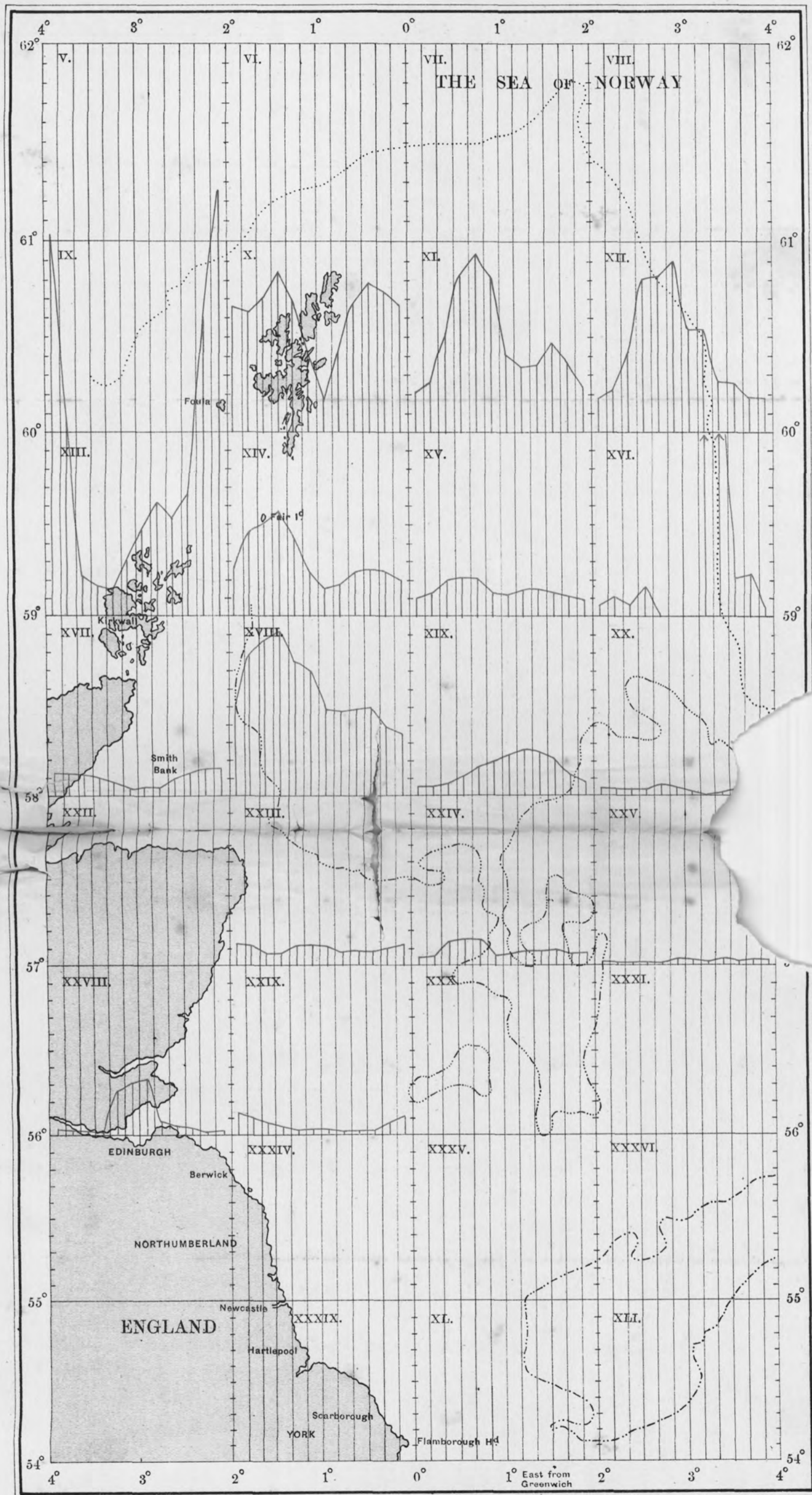
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Scale
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2
1



Ordnance Survey, Southampton, Eng.

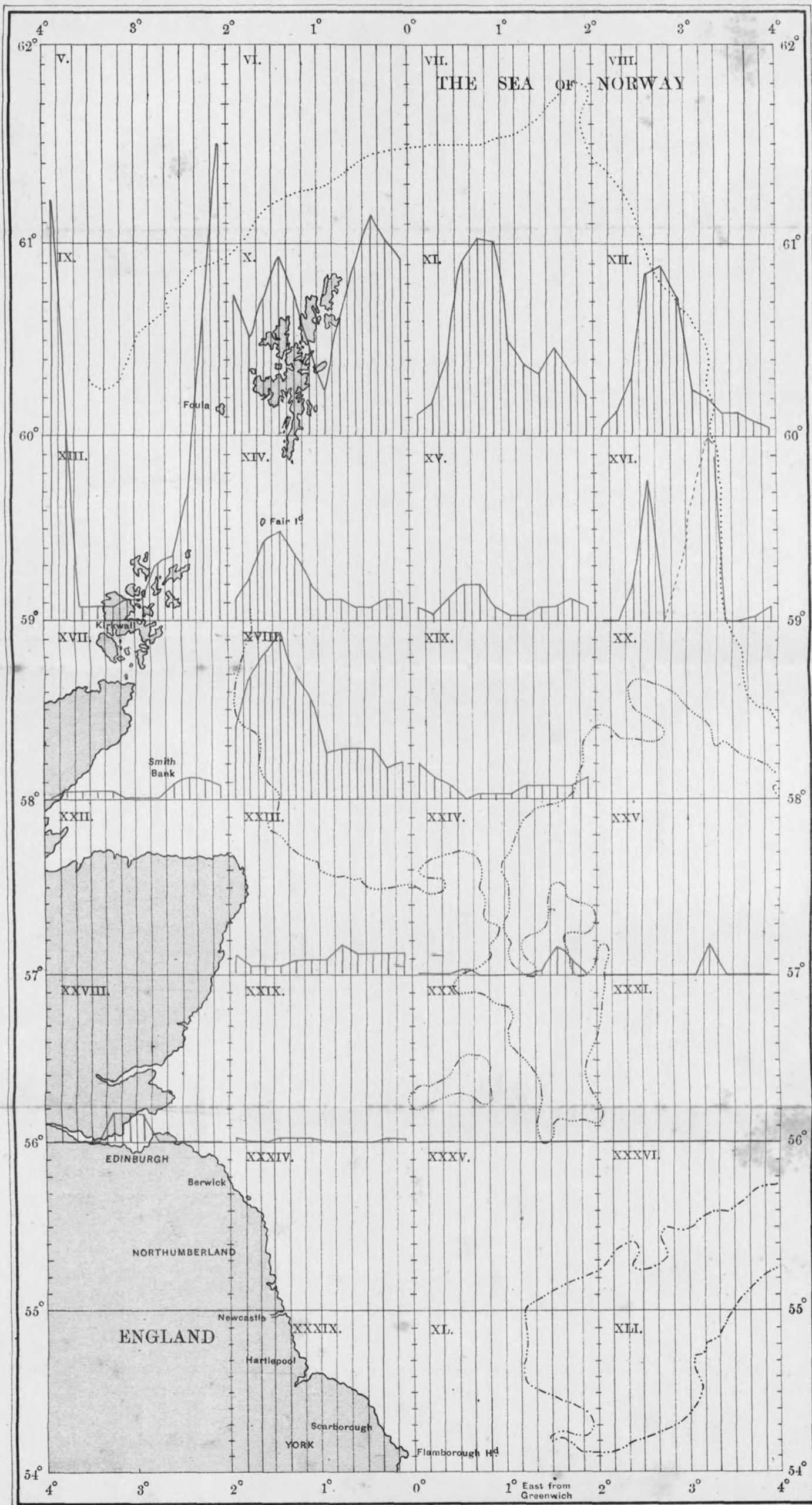


Total Megrim's 1901-08.

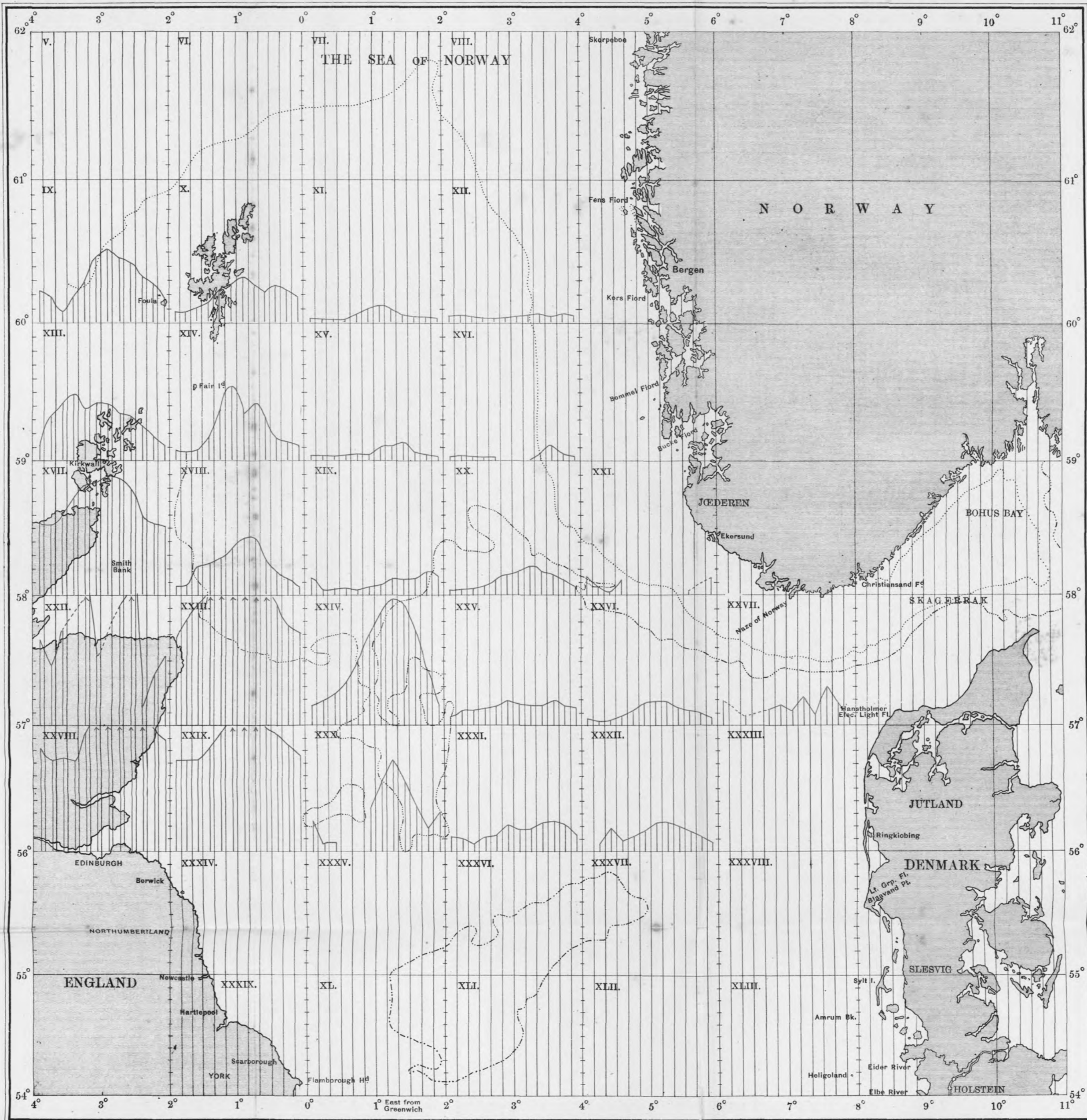
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Small Megrim 1901-08.

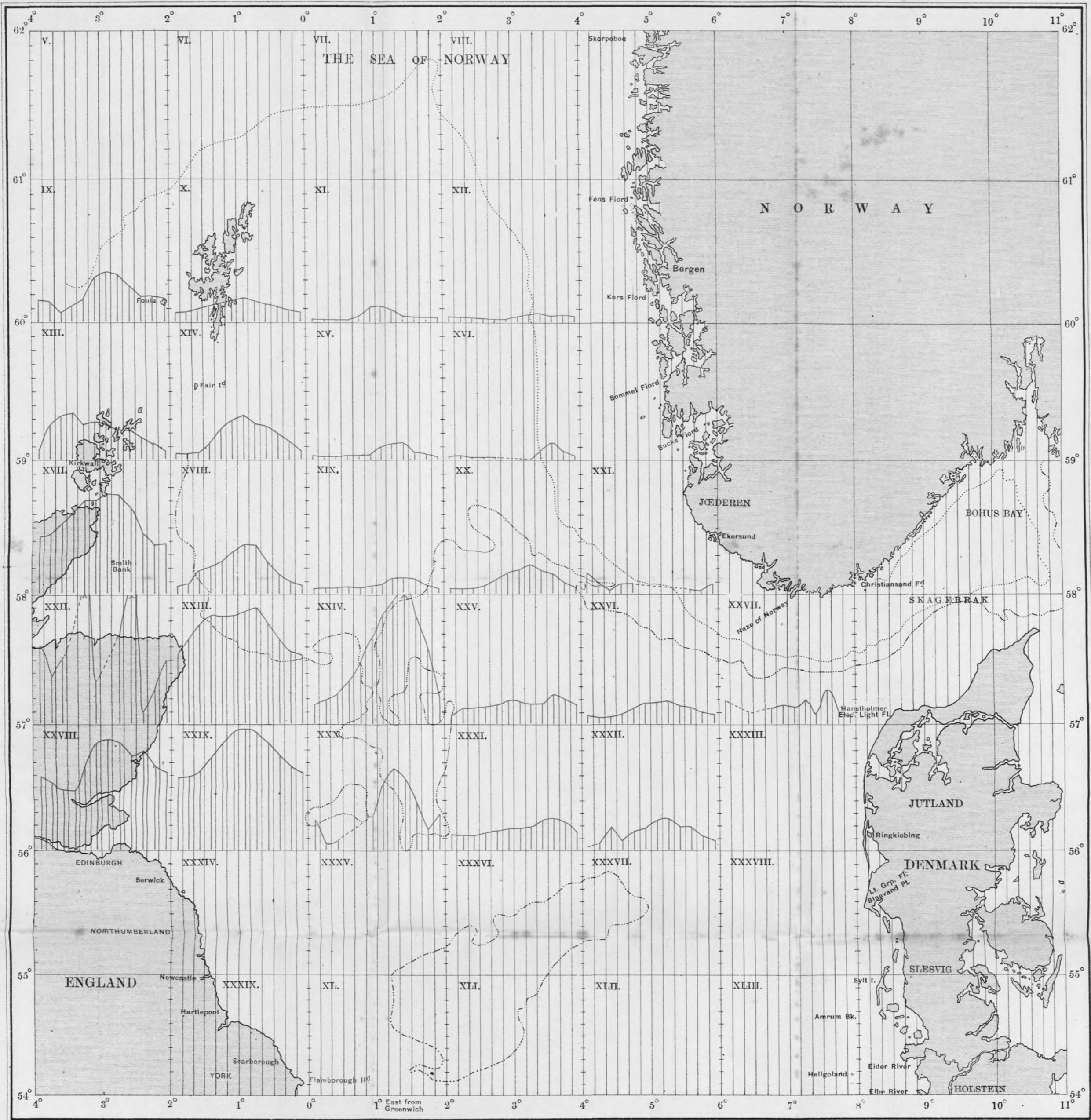
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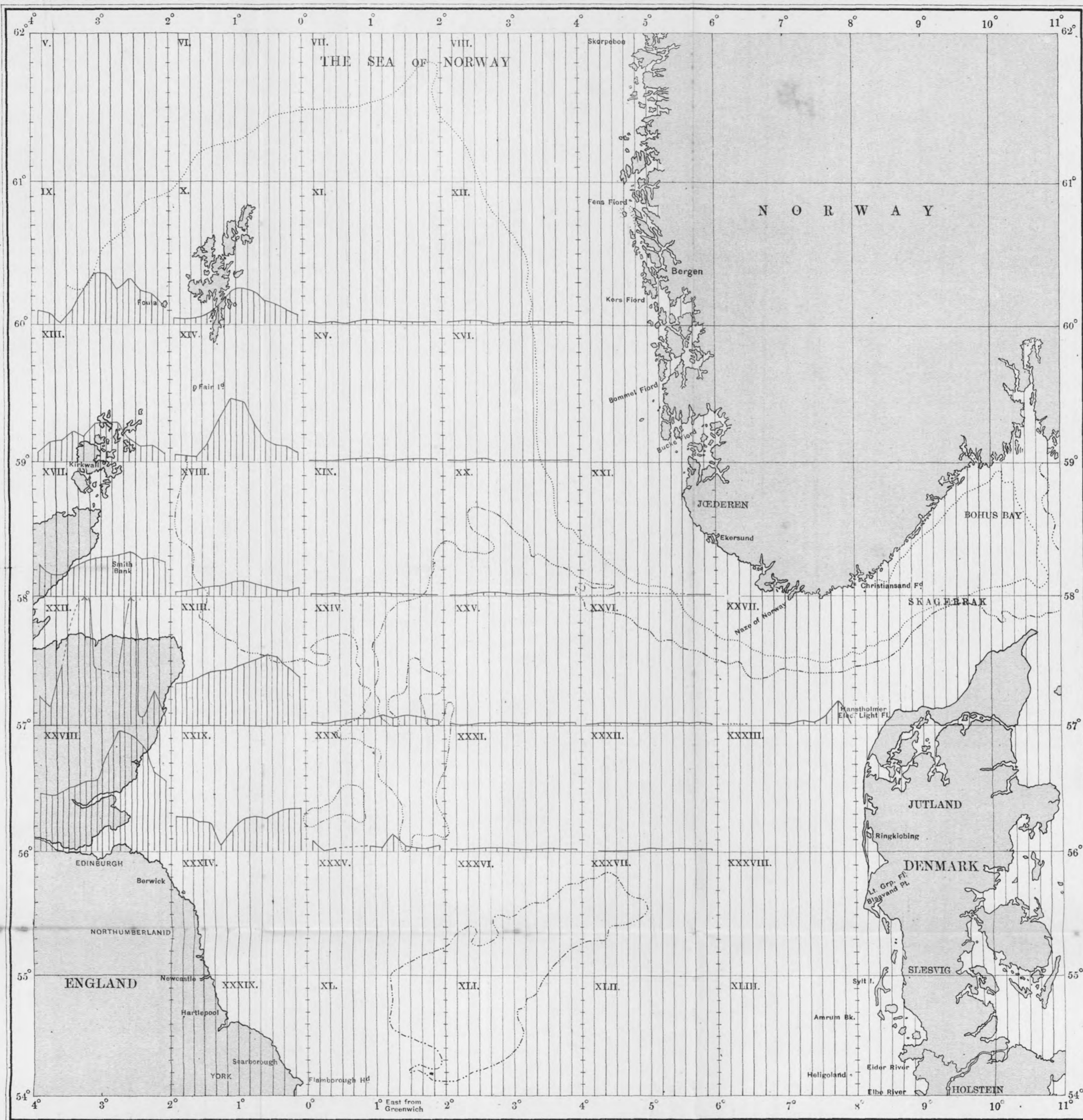
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2
1



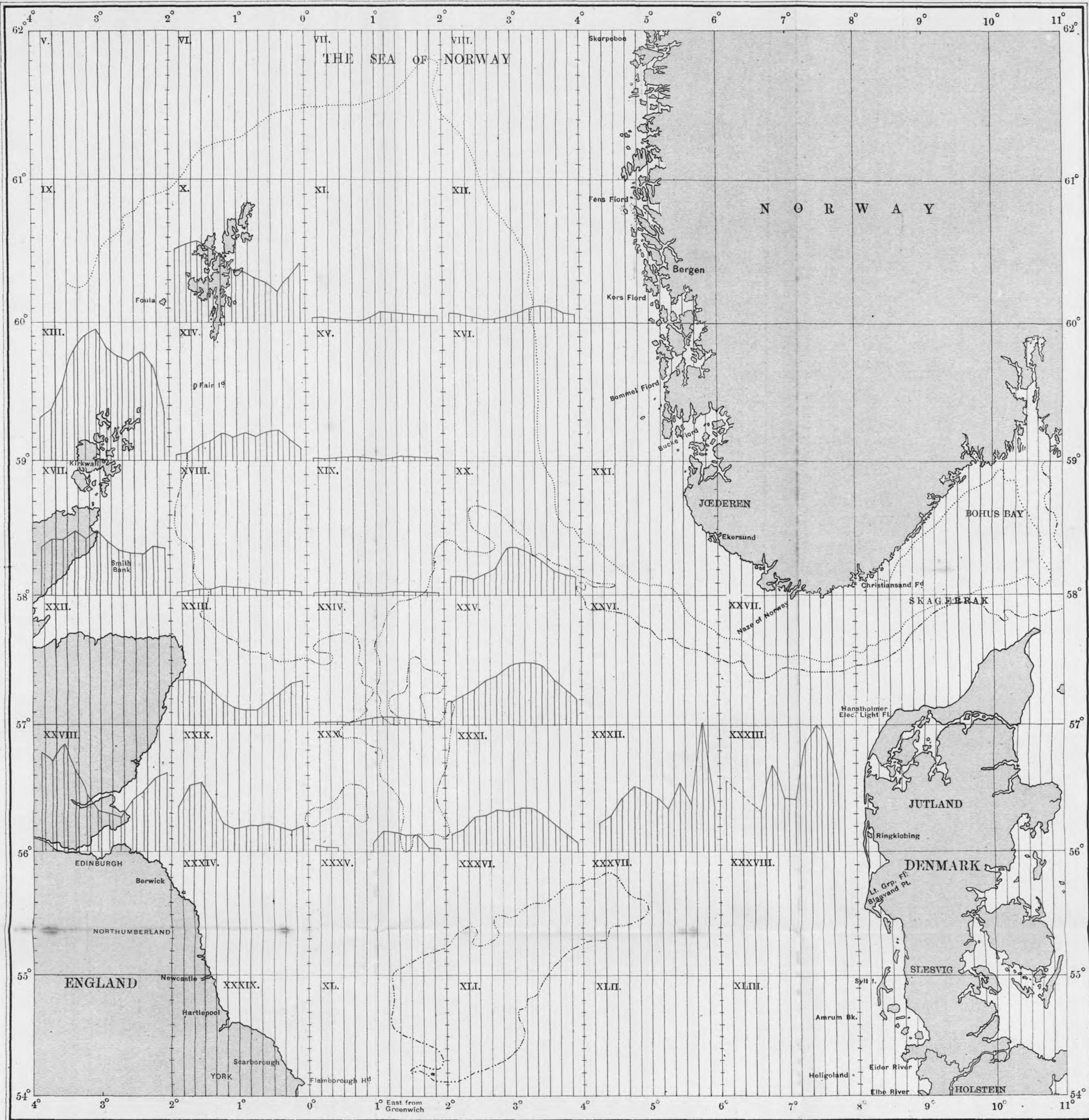
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Scale
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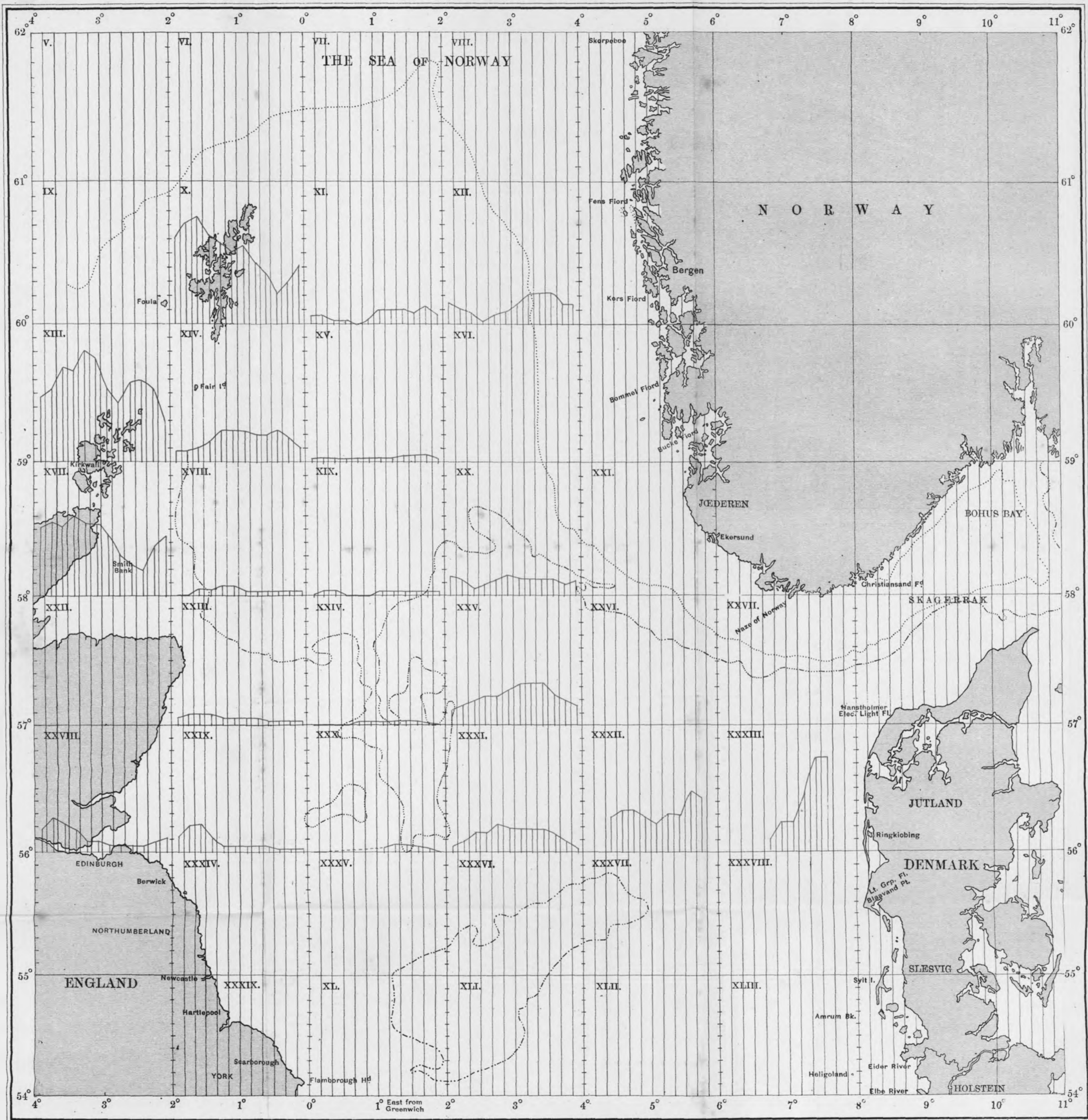


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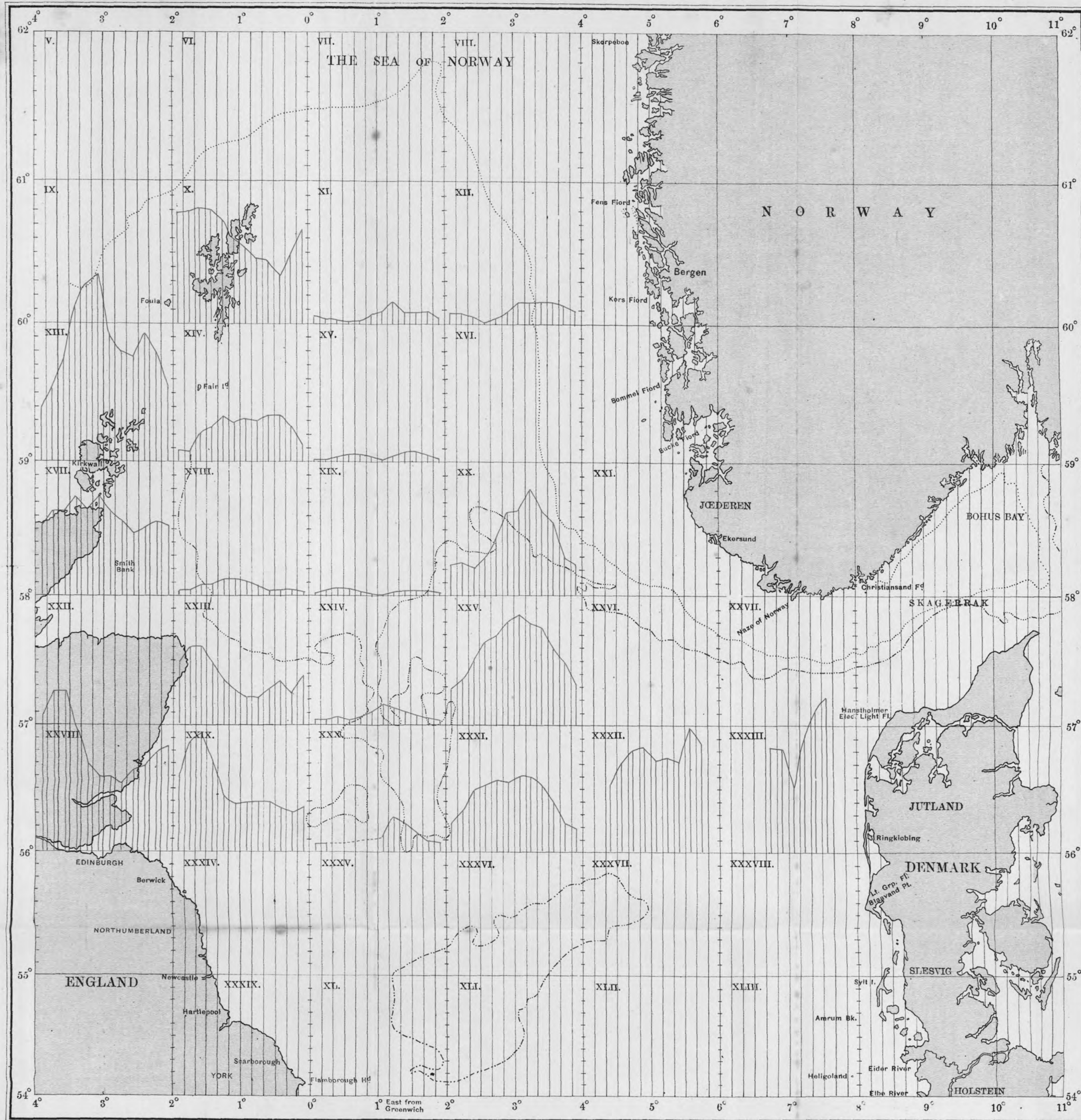


Ordnance Survey, Southampton, 1912

Scale
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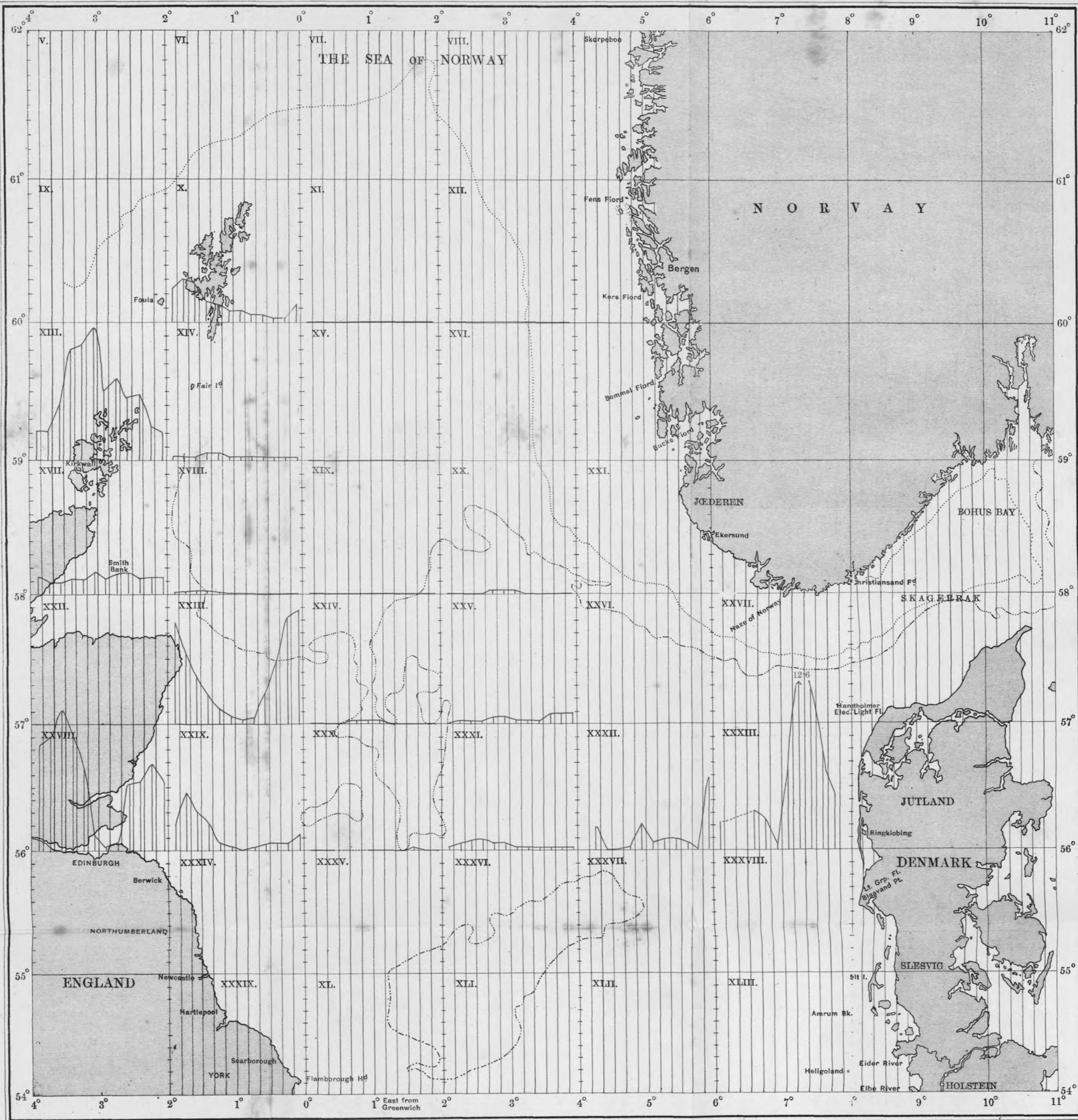


Scale
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Ordnance Survey, Southampton, 1912

Scale
3 units = 1



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