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REPORT



ON

EXPERIMENTS WITH MARKED FISH DURING 1902-3.

BY

WALTER GARSTANG.

WITH 31 DETAILED TABLES, 2 APPENDICES, AND 6 CHARTS.

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CONTENTS

	Page
I. PREFACE.	
§ 1. Introduction	15
§ 2. The Labels used	15
§ 3. The Vitality of the Marked Fish	15
§ 4. Co-operation of the Fishermen and Local Agencies	16
§ 5. Registration of the Data	17
§ 6. Interpretation of Results	18
II. PLAICE.	
§ 1. Migrations	19
Dutch Coasts, Flemish Bight, and Leman Ground	19
Summer Migrations pp. 19-26	
Winter Migrations pp. 19-26	
Summary	27
Yorkshire and Lincolnshire Coasts	28
Northumberland Coast	29
Horn Reef Outer Grounds	30
Causes of the observed Migrations	31
§ 2. Intensity of Fishing	32
§ 3. Relative influence of Steam and Sailing Trawlers and of English and Foreign Boats	33
III. SOLES	35
IV. DETAILED TABLES showing particulars of liberation and recapture of Plaice for each experiment	36
V. APPENDICES I.—List of Local Agents	43
II.—Copy of Notice posted during 1903	43

I.—PREFACE.

§ 1. INTRODUCTION.

The attachment of numbered labels to sea-fishes has been shown by previous investigations* to provide a valuable means of throwing light upon the wanderings and rate of growth of fish, especially flat fish, as well as upon the intensity of fishing in particular areas.

The conditions upon which the success of such experiments chiefly depend are as follows,—(1.) the labels must be distinctive, durable, sufficiently conspicuous, and capable of firm attachment without causing serious inconvenience or injury to the fish; (2.) the marked fishes must be healthy and lively when set free; (3.) the effective co-operation of the fishermen and fish merchants must be secured, and adequate arrangements made for ensuring prompt and reliable reports concerning all recaptured fish.

§ 2. THE LABELS USED.

The labels used in all our experiments upon flat fish since December, 1902, are based upon Dr. Petersen's model with certain modifications, and consist of a couple of small discs, perforated in the centre, and connected by a small piece of silver wire passing through the holes. The wire, with a small bone button at its lower extremity, is passed through the dorsal edge of the body of the fish on the lower or blind side, about half way down, and is then connected on the upper or eyed side of the fish with an oval concave disc of thin brass (1·7 by 1·1 cm.).

The brass disc bears on its concave side a letter (E. for England) and a distinctive number stamped upon it. The convex side of the disc lies next the fish, the shape having been designed to prevent the edge of the disc from cutting into the flesh of the fish. This object has been fully attained. The number on the disc remains perfectly legible, and the brass quite free from foreign growths, even after prolonged immersion. During our earliest experiments in November and December, 1902, before the special labels had been received from the makers, bone discs were used alone, but their employment caused the loss of several records of growth, owing to decay of the bone and consequent illegibility of the numbers after a certain lapse of time.

§ 3. THE VITALITY OF THE MARKED FISH.

In order to ensure that the marked fish should be set free in as healthy a condition as possible, we have usually kept the trawl down for a short time only (one to two hours) when getting the fish for use in these experiments. The only exceptions to this rule in 1902–3 were in the case of experiment V., on the Leman Ground, when the trawl was kept down for seven hours, though only 30 Plaice were marked out of a total catch of 340, and experiment XXVI., on the Horn Reef Outer Ground, when 29 Plaice were marked out of a total catch of 415, after a haul of five hours' duration.

* Fulton, *Eleventh Annual Report of the Fishery Board for Scotland*, III., 1893, p. 176.

Petersen, *Reports of the Danish Biological Station*, IV., 1894, p. 140. VI., 1896, pp. 1–36.

Report on Trawling and other Investigations in the Bays on the South-east Coast of Devon. *Journal of the Marine Biological Association*, VI., 1904, p. 476.

Immediately after hauling the trawl the fish have been selected for marking and placed in deck tanks of running sea-water. Weakly fish have been rejected, and the remainder marked and measured one by one in the deck house by the operator, while his assistant has recorded the length of the fish and the distinctive number of the label. The fish, when marked, have been immediately returned to the tanks by an attendant fisherman and kept there until the entire series has been dealt with, so as to provide a further opportunity of rejecting fish whose vitality might seem to have been impaired.

From the small percentage of recaptures in the case of Soles, as well as from observations at the time of liberation in certain cases, we are less satisfied as to the healthy condition of these fish when liberated than in the case of the Plaice experiments. The greater delicacy of Soles is well known, and it is possible that they are more seriously injured by the hauling of the trawl and by the methods of marking than the commoner species. On the other hand it is to be borne in mind that a lower percentage of recapture is to be expected for Soles than for Plaice, owing to the greater facility with which the former species escapes through the meshes of the fishermen's nets.

§ 4. CO-OPERATION OF THE FISHERMEN.

Experiments of this kind would be useless for the study of migration if the fishermen showed any reluctance to give accurate information as to the localities in which the recaptured fish were found. We have met with no cases of this kind, but, on the other hand, have found a general disposition on the part of the fishermen to give us, and our local agents, any information that we might desire on the subject. Every fisherman has his own views as to the wanderings and growth of fish, and in a great number of cases the fishermen have shown a greater desire to know where and when and at what size the particular fish recaptured by them were set free than to receive the advertised rewards. The general consistency of the particulars of recapture reported by the fishermen, as described below, points strongly to the conclusion that the accuracy of the returns may be relied upon in the great majority of cases.

It was however considered desirable that, as far as possible, all the marked fishes caught by the fishermen should be forwarded to the headquarters of the Association at Lowestoft, in order that the size and other characters of the fish might be determined under the direct supervision of the scientific staff.

Agents were therefore appointed at the chief trawling ports along the East Coast, and these gentlemen kindly undertook to receive the fishes from the fishermen, to take down the fishermen's statements as to the particulars of recapture, to pay the authorised rewards on account of the Association, and to forward the fishes to the Lowestoft laboratory. A complete list of the Association's Agents is given in Appendix I., p. 43. To all these gentlemen, and especially Mr. O. T. Olsen, F.L.S., F.R.G.S., of Grimsby, Mr. W. C. Edwards, Collector of Statistics for the Board of Agriculture and Fisheries at Hull, and Mr. A. Johnson, Chief Inspector of the Fishmongers' Company, Billingsgate Market, the Association is greatly indebted for the cordiality and efficiency of their assistance. Mr. Edwards at Hull, and Captain H. E. Inskip, R.N., at Ramsgate were already acting as statistical officers for the former Fishery Department of the Board of Trade. The Association is much indebted to the Board of Trade and to the present Board of Agriculture and Fisheries for permission to invite and retain the services of these gentlemen, as well as to the Worshipful Company of Fishmongers for a similar privilege as regards the services of their staff of Inspectors.

Notices announcing the arrangements as to agents and the scale of rewards concerning the returns of marked fish were posted up in the chief trawling ports in the spring of 1903 (Appendix II.), and were preceded by newspaper notices, especially in the East Anglian press, in the autumn of 1902. The

establishment of North Sea headquarters at Lowestoft caused the arrangements as to marked fishes to be quickly known among the fishermen at that port.

The earlier experiments were restricted to the southern part of the North Sea on this account, and were not extended to the central and northern parts of the North Sea until the summer of 1903, when the fishermen generally were informed as to the nature of the experiments and of the information desired. Weekly advertisements were inserted in the *Fish Trades Gazette* from May to August of 1903, and full particulars were announced in Olsen's *Nautical Almanack* for 1904.

International arrangements were made in 1902 for an exchange of information concerning recaptures of fish belonging to the experiments of other countries.

It is not improbable that a certain number of recaptures failed to be reported during the first few months of the investigations, but there is no present indication that the number of such cases was appreciable at any period. This remark does not, of course, refer to cases of unmarketable fishes actually recaptured, but overlooked by the fishermen at sea and subsequently thrown overboard. In the results of the transplantation experiments during 1904 we have had clear evidence as to the frequency of such occurrences, especially in the case of steam trawlers.

§ 5. THE REGISTRATION OF THE DATA.

The marking of the fish and the measurement of their length at the time of liberation was carried out on the voyages of the "Huxley" by different members of the scientific staff of the Association, with effective assistance from other members of the staff from time to time. The recaptured fishes returned to the laboratory were examined and measured by the scientific staff during the first few months, but this work was subsequently delegated to trained assistants, who were also entrusted with the registration of the data. The information from the local agents of the Association was provided and forwarded to the laboratory upon prescribed and printed forms, duplicates of which were kept by the agents to facilitate enquiries. The original data concerning the fishes liberated, the information from the agents, and the laboratory observations were then copied upon cards and filed as a card catalogue for working purposes, one or more cards of a distinctive colour being kept for the particulars of liberation in each experiment, and separate cards of another colour for the particulars of recapture of each fish.

The keeping of this card catalogue has been the work of Mr. A. L. Ansell from the beginning. The tables at the end of this report have been extracted from the card catalogue so prepared.

The charts illustrating the positions of recapture have been prepared by Mr. J. Potter, senior assistant and draughtsman, who has also determined the positions of recapture from the fishermen's statements (Table IV.).

I have much pleasure in acknowledging the care and accuracy with which both branches of the work have been carried out.

In the general revision of the data I have been greatly assisted by my colleagues, Mr. Borley and Mr. Todd.

The examination of the otoliths of marked Plaice was not undertaken before Dr. Wallace's investigations on the validity of this method for the determination of the age of fish had reached a satisfactory stage. From April, 1904, onwards the otoliths of all marked Plaice received at the laboratory were extracted, and Dr. Wallace's determinations of the age of these fish are included in the detailed tables at the end of this report.

§ 6. INTERPRETATION OF RESULTS.

It is an essential feature of these experiments that both the number of recaptured specimens and the localities in which they are found, depend to a large extent on the distribution of the fishing boats. It is necessary to bear this in mind when drawing conclusions as to the migrations of the fish. It is conceivable, for example, that in a particular experiment the fish may have scattered radially in all directions from the point of liberation, without any marked tendency in one direction more than another. If the boats were equally distributed this result would be shown by the returns; but if the boats were concentrated in one locality more than another, the returns would show a preponderance of recaptures in that locality. The conclusion that the fish had shown a preponderating tendency in that direction would be invalidated under such circumstances.

On this subject I would submit the following considerations:—

(1.) The marking experiments represent only one section of the data bearing upon the migrations of fish, and the conclusions derived from them must agree with those deduced from the trawling investigations and from the available statistics before they can be regarded as more than working hypotheses.

Inferences as to migrations may be drawn merely from a comparison of the facts of distribution over adjacent areas at successive periods, and possess a greater or less degree of probability according to the completeness and reliability of the data. But such inferences possess but a provisional character so long as the experimental test is lacking.

This test is provided by the positive results of the marking experiments, which show, above all things, whether there is, or is not, evidence of the passage of a particular class of fish from one specified locality to another at a given season.

(2.) In the absence of formal data as to the periodic distribution of fishing boats, there are no independent means of deciding whether a paucity of returns of marked fish from a given locality is indicative of a relative scarcity of the fish or of the fishing boats or of both in that locality. It would be possible under these circumstances to describe the results of the experiments in a purely objective manner, so as to avoid the risks of error attendant upon arbitrary interpretations. On the other hand, the early formulation of a general theory of fish migrations appears to offer the best prospect of attaining definite conclusions. It is easy to correct an erroneous interpretation in the light of new facts, but by no means easy to make progress if the interpretation of details is postponed by each worker to an unknown future when the influence of every hypothetical factor upon his experiments may be estimated with precision.

Putting aside, therefore, any idea of finality concerning the first interpretations of fact in the early stages of these investigations, I have considered it advantageous to discuss the returns from a number of these experiments on the assumption that differences in the intensity of fishing in different areas were not alone sufficient to account for the more prominent differences observed concerning the frequency of recaptures in different localities.

(3.) The error introduced by this assumption in the cases under consideration in the present report is reduced to small proportions by the facts that Plaice form the chief object of the trawl fisheries in the area known as the Flemish Bight, within which most of our experiments during 1902-3 were carried out, and that the distribution of the fishing boats within that area is consequently determined chiefly by the distribution of the Plaice from time to time. In the northern and central parts of the North Sea the distribution of steam trawlers is largely influenced by the wanderings of Haddock, but this species is

practically absent from the Flemish Bight. Accordingly the results of the marking experiments upon Plaice in this area, while influenced by the distribution of the boats, are indicative of the movements of Plaice at the same time.

It is important to note that in this area the boats are mostly sailing boats. The Lowestoft smacks make weekly voyages and traverse the entire area ; but large numbers of Dutch, Belgian, and Ramsgate boats are of smaller tonnage, and make short voyages of one or two days only in proximity to their respective ports. Consequently there is a large stretch of coastal waters from the North Foreland to Texel within which trawling takes place with considerable intensity the whole year round.

II.—PLAICE.

§ 1. MIGRATIONS.

The first experiments were carried out off the Dutch coasts in order to find out the direction in which the small fish, which are so abundant off these coasts, migrate during the winter months, and at the same time to throw light upon the extent of their wanderings.

EXPERIMENT I. WEST COAST OF HOLLAND (CHART 1).

Forty-one Plaice were marked and liberated off the west coast of Holland, abreast of Ymuiden, on November 20th, 1902. All the fish were below 30 cm. (12 inches) in length.

The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group (1) during the first year after liberation, and (2) up to December 31st, 1904 :—

Experiment No. 1.	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30+			
Number liberated	4	29	8	—	41	—	—
Recaptured within one year	—	8	1	—	9	21·9	8
Recaptured to December 31st, 1904 ...	—	9	1	—	10	24·4	—

The first recaptures were reported in February, 1903, one of them from the Eastern Deep Water, 50 miles west of the place of liberation, the other on the Hinder Ground, near the Straits of Dover, 90 miles south-west of the point of liberation. In March two fish were recovered near the original locality, slightly south of it, and between April and August five additional fish were recovered on the grounds between Brown Ridges and the Dutch coast, all except one of the recaptures being north of the original locality. These results are shown graphically upon chart 1, where it will be seen that the area of recapture for the first quarter of the year forms an elongated band stretching southwards, while the area of recapture during the spring and summer months forms a triangular area the base of which runs parallel with the Dutch coast, the apex pointing northwards in latitude 53°. It is noticeable that the original size of the fish recovered during the winter quarter was higher than that of the fishes recovered during the summer months. Three out of the four fish recovered in the winter months measured 24 or 25 cm. (9½ to 10 inches) at the time of liberation. Of the summer recaptures two were

originally 20 cm. (8 inches) in length, two 22 cm. ($8\frac{3}{4}$ inches) in length, and the largest measured at the time of liberation only 23 cm. (9 inches). It is also noticeable that the northern apex of the summer triangle is formed by a fish recaptured towards the end of the season in August, 35 miles north of the point of liberation: the recaptures in April and May were all within a radius of 25 sea miles from the original locality.

The only fish from this experiment reported during 1904 was taken in July north of the Leman Banks—a distance of 100 miles N.W. from the place of liberation.

Inferences.—It would appear from these facts that the smaller fishes below 24 c.m. ($9\frac{1}{2}$ inches) in original length had for the most part remained during the winter in much the same locality, migrating offshore in a north-westerly direction in the course of the following summer, whereas the fishes exceeding the size mentioned migrated southwards and westwards during the winter soon after the date of the experiment.

EXPERIMENTS II. AND III. NORTH COAST OF HOLLAND (CHART 1).

On the 8th December, 1902, 147 Plaice were marked and liberated from 10 to 15 miles north of the islands Ameland and Terschelling.

The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size group (1) during the first year after liberation, and (2) up to December 31st, 1904:—

Experiments Nos. 2 and 3 (combined).	Initial length in cm.				Total.	Percentage recaptured.	Number recaught in first half year.
	< 20	20-24	25-29	30+			
Number liberated	10	87	43	7	147	—	—
Recaught within one year	2	26	14	1	43	29.2	22
Recaught to December 31st, 1904 ...	2	30	17	1	50	34.0	—

As in the previous experiment, the fishes were of small size, only seven out of the total liberated attaining a length of 30 cm. (12 inches). They were set free in three batches as indicated on chart 1. In spite of the greater distance of the point of liberation, the first recapture from these experiments was again on the Hinder Ground, the fish being recovered towards the end of January. The minimum distance travelled during the six weeks from the time of liberation was 175 miles. In the course of the next two months, to the end of March, 1903, 12 additional recaptures were reported, and all were distributed within a narrow elongated band stretching along the entire coasts of Holland and Belgium about 20 to 30 miles offshore. The sizes of the fish recovered during this period were fairly uniform, owing to the relative scarcity of the smallest fish, and the fish were fairly evenly distributed along the area of recapture. It is, however, noticeable that the fish which had made the longest journey in the shortest time was the largest in the entire series, viz., 32 cm. ($12\frac{1}{2}$ inches). During April and May the fish were recovered in two distinct areas, viz., (1) along the north coast of Holland (including two fish caught near the original place of liberation and one off Norderney), and (2) a larger area extending westwards from the island of Texel across the Brown Ridges towards the Leman Banks. Six fish were recaptured in the latter area. The original sizes of all recaptures are specified upon the chart, and it will be seen that all the larger fishes caught during this period were recovered in this southern area. In the summer months, from June to September, a considerable number of additional recaptures was reported, and these were again distributed in two distinct areas, overlapping the areas previously described, though still more

distinctly circumscribed. The northern area near the original point of liberation included a great majority of the smallest fish. Only one of the 11 recaptures in this area exceeded a length of 23 cm. (9 inches) at the time of liberation, whereas in the southern or western area four out of the seven recaptures exceeded this length and only one fell below it. The average of the original lengths of the northern recaptures was 21.4 cm. ($8\frac{1}{2}$ inches), that of the southern recaptures 23.7 cm. ($9\frac{1}{2}$ inches).

It is worthy of note that the two fish which completed the journey across to the Leman Banks were the largest recaptured during the summer, viz., 27 cm. ($10\frac{3}{4}$ inches) on liberation.

During 1904 seven recaptures were reported, viz., four south of 53° during the first three months, two off Ameland in the spring, and one off Norderney in September.

Inferences.—It is thus fairly clear that, as in the case of the first experiment, the great majority of the smallest Plaice did not migrate from the original locality during the winter months, while the majority of the fishes exceeding 23 cm. (9 inches) migrated considerable distances southwards during the winter. Although the largest fishes (about 30 cm.) apparently reached the Hinder Grounds, it would appear that the majority of those about 25 cm. (10 inches) in length distributed themselves between the parallels 52° and 53° . On the approach of spring another movement offshore set in generally, the small fishes which had remained near the original locality migrating directly northwards, though for the most part to no great distance, and the larger fishes, which had previously wandered southwards, migrating westwards and northwards towards the Leman Banks.

EXPERIMENTS IV., VI., AND VII. CENTRAL GROUNDS OF FLEMISH BIGHT (CHART 2).

These experiments were carried out in the spring of 1903, between the latter part of March and the beginning of May, in order to follow out the further course of the migrations of those plaice which had spread themselves, according to the evidence of the previous experiments, over the southern part of the Flemish Bight, especially in the region of the Hinder Grounds and the Eastern Deep Water. It will be remembered that the fish recovered in this region during the winter months were the largest of their respective experiments.

The following table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group (1) during the first year after liberation and (2) up to December 31st, 1904:—

Experiments Nos. 4, 6, 7.	Initial length in cm.				Total.	Percentage recaptured.	Number recaught in first half year.
	< 20	20-24	25-29	30 +			
4.—Number liberated	—	10	12	5	27	—	—
Recaught within one year ...	—	2	2	2	6	22.2	3
Recaught to Dec. 31st, 1904 ...	—	2	3	2	7	26.0	—
6.—Number liberated	4	23	35	6	68	—	—
Recaught in one year	1	3	8	1	13	19.1	10
Recaught to Dec. 31st, 1904 ...	1	3	8	2	14	20.6	—
7.—Number liberated	2	7	12	5	26	—	—
Recaught in one year	—	—	3	4	7	26.9	5
Recaught to Dec. 31st, 1904 ...	—	—	5	4	9	34.6	—

Experiment IV.—On the 21st March, twenty-seven plaice were set free north of the Hinder Light Vessel (chart 2), the majority of the fishes marked exceeding a length of 25 cm. (10 inches), and five exceeding a length of 30 cm. (12 inches). In May the first recapture was reported in the Deep Water 25 miles east of Yarmouth—*i.e.*, 50 miles due north of the locality of liberation. In July another fish from this experiment was recaptured 20 miles north of the last position. In August, another was reported 25 miles still further north, on the Lemman Ground, and in September another recovery was reported from the northern part of the Lemman Shoals, 100 miles north of the original locality of liberation. During the spring and summer months, therefore, the fish from this experiment showed a uniform northward tendency. In October and December two other recaptures were reported, one from the Brown Ridges and the other off Orfordness. Whether these fishes had previously wandered further north, and had subsequently migrated back again, must remain doubtful, although experiments to be described later render it not improbable that such was their real course. No further recaptures were reported until June, 1904, fifteen months after the date of the experiment, when one large fish was reported from the Dowsing Grounds, 110 miles north of the original point of liberation.

Experiment VI.—On the 6th May 68 fish were marked and liberated in the Eastern Deep Water (chart 2). As the positions and course of the migrations are indicated on the chart it is unnecessary to describe the details separately. In May two fish were recaptured in the north part and north-west of the Brown Ridges, 36 and 42 miles north of the points of liberation, while during the summer months five recaptures were reported, of which three were taken on grounds still further north, the distances in all cases falling between 34 and 96 miles north of the points of liberation. One small fish, 19 cm. ($7\frac{1}{2}$ inches) in length at the time of liberation, was recaptured, it is true, in June, close to the point of liberation; but this case merely indicates the non-migrant habits of the smallest Plaice. In the following February, March and April, 1904, three fish were recaptured from this experiment between the original place of liberation and the Dutch coast. Their sizes (25 to 30 cm.) show that they were capable of long migrations. It is probable, therefore, that they had previously migrated northwards, in accordance with the general tendency, and had then returned southwards in the winter following the experiment. In the following July a large fish was taken by a Grimsby trawler in latitude $53^{\circ} 42' N.$, north of the Black Bank, a distance of 135 miles N.E. of the place of liberation.

Experiment VII.—On the 7th May 26 Plaice were liberated on Winterton Shoal, between the Brown Ridges and the Lemman Ground. In June one fish was caught on the south-west part of the Lemman Ground, and in August two fish were recovered in the neighbourhood of Smith's Knoll, one to the eastward and one to the westward of this bank. In September one fish was recaptured near the original locality of liberation. In October another fish was recovered on the southern extremity of the Well Bank. Up to the end of October all the recaptures were reported from fishing grounds west or north-west of the original point of liberation, within a radius of 25 miles. In November a fish was recovered 20 miles west-south-west of the original point of liberation, the position of this recapture being consistent with the southward tendency of fish in this region during the autumn and winter months as shown subsequently in experiments XXX. and XXXI. In February one fish was recovered on the south part of the Dogger Bank, a distance of about 100 miles from the original point of liberation. This fish was 31 cm. ($12\frac{1}{4}$ inches) in length at the time of liberation and had grown 5 cm. (2 inches) in the interval.

Inferences.—The three experiments just described agree in displaying a general tendency of the Plaice in the southern and central parts of the Flemish Bight in the spring of 1903 to migrate northwards or westwards towards the Lemman Ground and Lemman Banks. The results of these experiments thus support the interpretations previously drawn with regard to the results of experiments I., II. and III. off the Dutch coasts. The smallest fishes (below 20 cm.) appear to have lagged behind in this general

movement, while many of the largest fishes, exceeding 30 cm. (12 inches) in length, tended to emigrate altogether outside the southern area in a north-westerly direction. With the onset of autumn and winter the smaller fish appear to have migrated back again in a southerly direction. After the first summer, *i.e.*, from October, 1903, to December, 1904, 13 of these fishes altogether were recaptured, of which 4 were less, and 9 more than 30 cm. in length when recaptured. All the smaller fish were caught south of 53°; but, of the larger fish, 5 were caught south, and 4 north of that latitude.

EXPERIMENTS V., VIII. AND IX. LEMAN GROUND. SPRING (CHART 3).

From the 27th April to 8th May, 1903, 229 Plaice were marked and liberated on the Lemman Ground, 10 or 15 miles east of the Swarte Bank. The fish were of all sizes, but there was a greater proportion of the larger fishes than in previous experiments, 71, that is about one-third of the total number, exceeding a length of 30 cm. (12 inches).

The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size group (1) during the first year after liberation, and (2) up to 31st December, 1904 :—

Experiments Nos. 5, 8, and 9 (combined).	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
Number liberated	15	65	78	71	229	—	—
Recaptured within one year	1	14	14	12	41	17.9	36
Recaptured to December 31st, 1904 ...	2	16	18	16	52	22.7	—

In this case only the broad results of the experiments are graphically represented upon the chart 3. As in previous experiments the distance traversed by the different fishes varied considerably with the size of the fish, but the general tendency of the migrations was much the same in all cases.

During the spring months, from April to June, the fish (14 recaptures with statements of locality) distributed themselves with one exception over an oval area about 45 miles long and 30 miles broad immediately west of the point of liberation. The long axis of the ellipse was in a north and south direction, and the centre of it slightly south-west of the point of liberation. Most of the fish, therefore, during this period were recovered either on the north-western parts of the Lemman Ground itself or among the Lemman Banks to the south-westward. The exception referred to was a single fish measuring 24 cm. (9½ inches) in original length, which was recovered on the 20th June by a Shields trawler 70 miles E. ½ S. from Tynemouth—a remarkable journey for so small a fish (*cf.* experiment XXIII. below).

During the summer months, from July to September, the fish (15 recaptures) spread over a wider area seawards, *i.e.*, to the north and east, the northward limit of the area of recapture being considerably extended by a single fish recaptured in August on the Flamborough Off Grounds, 70 miles northwards of the original locality of liberation. As in previous instances of exceptionally long travel, this was the largest fish recovered during the period in question, its original length being 33 cm. (13 inches). The recaptures during this period include the exceptional case of a fish, 25 cm. (10 inches) in length, which was reported to have been recovered off the Terschelling Light Vessel in July by a Yarmouth smack, but the record is not free from doubt. This was the only instance of a pronounced eastward migration on the part of the fish liberated in this experiment; the reported locality would indicate a migration due eastwards of about 75 miles.

From October to the end of the year only four fishes were recovered, all in the immediate neighbourhood of the point of liberation. Two out of these were certainly small non-migrant fishes, measuring 19 cm. ($7\frac{1}{2}$ inches) in original length.

During the winter months, from January to March, four fishes were recovered, all to the north-westwards of the point of liberation. The three smallest were recovered between 20 and 40 miles off, the largest of these measuring 27 cm. ($10\frac{1}{2}$ inches) at the time of liberation. The largest fish, measuring 39 cm. (15 inches) in original length, had travelled a long distance (130 miles) to the north-westward, being recovered by a Scarborough boat 18 miles north-east of Whitby on the 23rd January, 1904.

During the following spring and summer months a small number of recaptures was reported. The largest of these, 32 cm. ($12\frac{1}{2}$ inches) in original length, was caught in the Bight of the Dogger Bank in August, where it had grown to a length of 39 cm. ($15\frac{1}{2}$ inches). The other fishes of smaller size were recovered in the neighbourhood of the Leman Ground and Leman Shoals. In November, 1904, a single fish was recaptured on the Broad Fourteens, 75 miles south-east of the point of liberation. This fish was one of the smallest dealt with in this experiment, measuring 19 cm. ($7\frac{1}{2}$ inches) in original length. It had grown in the interval to 28.5 cm. ($11\frac{1}{4}$ inches). It is probable that this fish was too small originally to undertake the northern migration in the summer of 1903 and had migrated southwards during the following winter, in accordance with the general tendency to be described in the next experiments.

It will be convenient now to depart from a chronological arrangement of the experiments, and to consider the results of experiments which were made upon the Leman and Terschelling Grounds in the autumn of 1903, in order that the marked contrasts between the winter and summer migrations of fish in this region may be clearly realised.

EXPERIMENTS XXX. AND XXXI. LEMAN GROUND. WINTER (CHART 4).

On the 11th and 12th December, 1903, 111 Plaice were marked and liberated on the Leman Ground, 16 in the south part of this area and 95 in the northern part.

The following table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size group (1) during the first year after liberation, and (2) up to December 31st, 1904:—

Experiments Nos. 30 and 31.	Initial length in cm.				Total	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
30.—Number liberated	—	—	6	10	16	—	—
Recaptured within one year ...	—	—	4	3	7	43.7	6
Recaptured to Dec. 31st, 1904...	—	—	4	3	7	43.7	—
31.—Number liberated	—	6	51	38	95	—	—
Recaptured within one year ...	—	—	11	4	15	15.8	11
Recaptured to Dec. 31st, 1904...	—	—	11	4	15	15.8	—

Without describing the separate positions of the various recaptures, which are shown upon the chart, it will suffice to draw attention to the pronounced southward tendency which the fish in these experiments exhibited during the winter months. From January to March only three fish were recovered to the north of their localities of liberation, one of these from experiment XXX. being recaptured in or near the Great Silver Pit in February, the other two from experiment XXXI. within a radius of 15 miles north-eastward of the point of liberation. On the other hand, eight other fishes recovered during the same period were recaptured in various parts of the southern area between the English and Dutch coasts, the largest fishes (29 to 33 cm.) showing a preponderating tendency towards the deep water area west of 3° longitude. In February one of these was recaptured off the Essex coast, and in March another was recovered by a Hastings trawler off Winchelsea in the English Channel. As in other cases, this fish was the largest of its series, measuring 33 cm. (13 inches) in original length. It had travelled a minimum distance of 175 miles since the date of liberation.

The recaptures during the following spring were reported from the neighbourhood of the Brown Ridges in April and May (three fish) and from the Leman Ground in June (three fish). In the summer only two recaptures were reported, both north of the Flemish Bight, viz. one off Mablethorpe, Lincolnshire, and one from the deep water off Terschelling.

EXPERIMENTS XXIV., XXV., XXVII., AND XXVIII. N.W. COAST OF HOLLAND
(CHARTS 3 AND 4).

These experiments were carried out off the north-west coast of Holland in September, 1903. The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group during the first year after liberation and the total recaptures reported to December 31st, 1904:—

Experiments Nos. 24, 25, 27, 28.	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
24.—Number liberated	1	10	12	12	35	—	—
Recaptured within one year ...	—	1	1	2	4	11·5	3
Recaptured to Dec. 31st, 1904 ...	—	1	1	2	4	11·5	—
25.—Number liberated	1	11	34	27	73	—	—
Recaptured within one year ...	—	—	3	4	7	9·6	3
Recaptured to Dec. 31st, 1904 ...	—	1	3	4	8	11·0	—
27, 28.—Number liberated	4	22	21	34	81	—	—
Recaptured within one year ...	—	4	3	7	14	17·3	5
Recaptured to Dec. 31st, 1904 ...	—	5	4	8	17	21·0	—

The five winter recaptures from these experiments were all reported from grounds south of the localities of liberation—three from the central part of the Flemish Bight, between the Brown Ridges and the Hinder Ground, and two nearer the points of liberation, off the islands of Texel and Terschelling,

respectively. In the following spring (April to June) five recaptures were reported, of which four were south of the points of liberation, between the Texel Ground and the Brown Ridges, and one was a few miles north of the point of liberation. In the summer months (July to September) five recaptures were reported, of which one was south of latitude 53° , on the Winterton Shoal, one in August came from the Texel Ground, and two in early September from near Terschelling. Later in the same month and during October two fish were reported from the Upper Scruff, south-east of the Dogger Bank, 48 and 90 miles north of the point of liberation, and one in October was reported near the locality of liberation (Experiment 28).

Inferences.—It would appear from these experiments that the southward tendency of Plaice shown during the winter of the preceding year in experiments 2 and 3 was also manifested during the winter of 1903-4, but there is no obvious correlation between the distance travelled and the initial size of the fish.

These experiments also yield little evidence of a westward tendency from the Dutch coast towards the Leman Ground in the summer months, which was one of the features of the experiments of the preceding year. The difference in the date of the experiments in the two years probably accounts for some difference in the results, since the fish were still on their offshore migration when marked in September, 1903.

EXPERIMENT XXIX. (CHART 3). OFF AMELAND.

This experiment was carried out off the north coast of Holland, but further eastward and closer inshore than in the case of the three preceding experiments, the place of liberation being a few miles north of the island of Ameland. There was also a difference in the date of the experiment, the fish being liberated in the first week of December, 1903.

The following table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group (1) during the first year after liberation and (2) up to December 31st, 1904 :—

Experiment No. 29.	Initial length in cm.				Total.	Percentage recaptured.	Number recought in first half year.
	< 20	20-24	25-29	30+			
Number liberated	4	15	12	2	33	—	—
Recought within one year	—	6	6	1	13	39·4	4
Recought to December 31st, 1904 ...	—	6	7	1	14	42·4	—

During the winter months (January to March) only two fish were recovered from this experiment, one close to the point of liberation, and the other in the central part of the Flemish Bight. During the spring months (April to June) all the fishes recaptured were reported from the north coast of Holland or from the eastern part of the German Bight, four being recovered within thirty miles north-west of Ameland, two off the island of Norderney, and one on the Sylt Inner Grounds. During the summer months (July and August) four recaptures were reported, of which three were from the Flemish Bight and one half-way between the Dutch coast and the Dogger Bank. In the following December a single fish was reported from the Hinder Ground in the south part of the Flemish Bight.

Inferences.—The results of this experiment are of a mixed character, and not easy to interpret, owing to the curious separation between the localities of the fish recovered in spring and summer respectively. The southward influence in winter appears to have been felt, but there are no signs of that marked segregation of the fishes according to size which was shown by experiments 2 and 3 in the preceding year.

While there is a general resemblance between the results of experiments 2 and 3 in the winter of 1902 on the one hand and of the experiments just described on the other, the differences are sufficiently marked to suggest the probability that the amount and extent of the winter migrations is largely dependent on conditions which vary from year to year, and probably have an intimate connection with the prevalence or otherwise of stormy weather, and the force and direction of the winds.

SUMMARY FOR SOUTHERN AREA.

In order to show graphically and in a summary manner the alternating northward and southward seasonal migrations of Plaice observed in the Southern North Sea, two charts have been prepared by my colleague, Mr. Borley (charts 5 and 6), in which the mean position of the various recaptures in each successive period has been determined and entered upon the chart for each experiment,* the successive mean positions being connected by a curved line with the original site of liberation. The mean tendency of the fish during the winter months (September to March) in each experiment is represented by a blue line; the mean tendency during the summer months by a red line; the arrow-heads mark not only the calculated direction of travel, but also the mean position for the periods stated on the chart. The period of recapture is indicated by Roman numerals representing the corresponding months of the calendar; the Arabic numerals alongside represent the number of fish recaptured in the interval; and the Arabic numerals in brackets represent the average initial size of the same fishes. The experiments have been grouped according to the season of liberation, viz., those carried out from September to December on one chart (winter chart), and those carried out from March to May on the other (summer chart). The effect of this arrangement is that the results of each experiment on the winter chart begin with a blue line leaving the point of liberation, those on the summer chart begin with a red line. Bearing in mind that blue lines indicate winter travel, and red lines summer travel, a glance at the two charts shows how general was the southward tendency in the winter south of latitude $53^{\circ} 30'$, and how general was the northward tendency during the spring and summer. The earliest experiments carried out in December, 1902, and in the spring of 1903, show these alternating movements repeating themselves in the same order for two years in succession. This is especially noticeable in the curve for experiments II. and III. on the winter chart, and for experiment VI. on the summer chart.

For reasons already explained in the previous description of the experiments, the curve representing the movements in experiments II. and III. has been duplicated after the winter quarter in order to show separately the movements which took place in the case of the larger winter migrants which had travelled southwards, and those of the smaller fishes which had remained throughout the winter near the original locality.

On the summer chart the combined results of experiments V., VIII. and IX., have also been analysed according to the sizes of the fish. One curve shows the movements of the small Plaice below 30 cm. (12 inches), and the longer curve to the northward shows the movements of the larger fishes exceeding 30 cm. (12 inches) in original length. This arrangement brings out graphically the marked contrast between the migrant habits of the larger fish and the non-migrant habits of the small—which is especially clear in these experiments in the case of the fishes recovered during the first six months after liberation.

* Excepting Experiment XXIX., which did not admit of treatment in this manner for reasons already stated.

With one exception (experiment XXVI.) the remaining experiments during 1903 were carried out in the shallow waters off the north-east coast of England north of the Wash. The course of these experiments will now be referred to.

EXPERIMENTS X AND XXIII.—YORKSHIRE AND LINCOLNSHIRE COASTS (CHART 3).

The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group (1) during the first year after liberation, and (2) up to December 31st, 1904 :—

Experiments Nos. 10 and 23.	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
10.—Number liberated	6	34	—	—	40	—	—
Recought within one year ...	—	—	—	—	—	—	—
,, to Dec. 31st, 1904 ...	—	4	—	—	4	10.0	—
23.—Number liberated	3	31	17	2	53	—	—
Recought within one year ...	—	4	1	—	5	9.4	—
,, to Dec. 31st, 1904 ...	—	6	2	—	8	15.1	—

Experiment X.—On the 10th June, 1903, 40 Plaice were marked in the south part of Bridlington Bay, off Hornsea. None of the fishes in this experiment exceeded a length of 25 cm. ($9\frac{3}{4}$ inches). As Plaice of this size do not usually display migratory habits, and as trawling in the inshore waters of the Yorkshire coast is prohibited, it is scarcely surprising to note that considerable time elapsed before any fish were recovered from this experiment. The first recapture was reported in July, 1904, 13 months after the date of the experiment, from the western end of the Great Silver Pit. The fish had grown 10 cm. (4 inches) in the interval. In August another fish was reported from the Dowsing Grounds; and in September another fish was reported east of Hartlepool. All three had travelled distances of 40 or 50 miles from the place of liberation; but beyond a general tendency of the fish to migrate seawards, it is impossible to detect any special tendency in one direction, owing to the small number of recaptures.

Experiment XXIII.—On the 12th August 53 Plaice were marked and liberated in the shallow waters of the Lincolnshire coast near Mabelthorpe. All sizes were represented in the experiment, but more than half the fish were between 20 and 25 cm. in length (8 to 10 inches). Only two of the fishes exceeded a length of 30 cm. (12 inches), and neither of these has been recovered. A considerable interval elapsed before any fishes were recovered from this experiment, the first being reported in April, 1904, eight months afterwards, from St. Andrew's Bay. Its original length was 21 cm. ($8\frac{1}{4}$ inches), and it had grown in the interval to 26 cm. ($10\frac{1}{4}$ inches). The distance travelled is remarkable, being about 210 sea miles, but the evidence is perfectly satisfactory, and is corroborated by the capture of two other specimens off the Northumberland coast in September and December of the same year by Shields fishing vessels. Three other recaptures were reported in May, July and August, near the original locality of liberation, two on the same spot and one about 30 miles to the northward off Bridlington Bay. The pronounced northward tendency of the fishes in this experiment is quite in agreement with the tendency previously shown by the summer experiments on the Leman Ground, Nos. V., VIII. and IX.

EXPERIMENTS XI. TO XXII. NORTHUMBERLAND COAST (CHART 3).

These experiments were carried out from the end of June to the beginning of September, 1903, in the inshore waters of the Northumberland Coast by Mr. Alexander Meek, M.Sc., of the Cullercoats Marine Laboratory, and the Armstrong College of Science, Newcastle-upon-Tyne, in accordance with a co-operative arrangement made by Mr. Meek with the North Eastern Sea Fisheries Committee and the Association. The fish in the first seven experiments were marked with the brass labels employed by the Association; those in the last five experiments with brass labels of slightly smaller size of Mr. Meek's design. The total number liberated in the course of the season was 469. The localities and dates of liberation are shown in the detailed tables at the end of this Report.

The following Table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size group (1) during the first year after liberation, and (2) up to December 31st, 1904:—

Experiments Nos. 11 to 22.	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
11 and 12 (June).							
Number liberated	4	8	6	—	18	—	—
Recaptured within one year ...	—	3	4	—	7	38·9	1
Recaptured to December 31st, 1904	—	3	4	—	7	38·9	—
13 to 16 (July).							
Number liberated	28	78	19	1	126	—	—
Recaptured within one year ...	2	13	2	—	17	13·5	4
Recaptured to December 31st, 1904	2	15	3	1	21	16·7	—
17 to 20 (August).							
Number liberated	45	126	14	—	185	—	—
Recaptured within one year ...	—	5	4	—	9	4·9	—
Recaptured to December 31st, 1904	—	6	4	—	10	5·4	—
21 and 22 (September).							
Number liberated	25	98	18	—	141	—	—
Recaptured within one year ...	2	13	8	—	23	16·3	2
Recaptured to December 31st, 1904	2	14	8	—	24	17·0	—
11 to 22 (combined).							
Number liberated	102	310	57	1	470	—	—
Recaptured within one year ...	4	33	18	—	55	11·7	7
Recaptured to December 31st, 1904	4	38	19	1	62	13·2	—

The chief localities of liberation are indicated upon the chart. An account of the earlier results of the experiments has already been issued by Mr. Meek in the Reports of the Northumberland Sea Fisheries Committee for 1903, pp. 36 and 37, and 1904, pp. 70—79.

With the exception of a single fish* (which has not been recovered) all the fishes marked in these experiments were below 30 cm. (12 inches) in length when originally set free, and a considerable number (102) were less than 20 cm. (8 inches). The majority of the fishes in almost all the experiments were between 20 and 25 cm. (8 to 10 inches) in original length. Trawling is prohibited within the territorial waters of the Northumberland coast. This fact, together with the small size of the fishes marked, accounts for the small number of recaptures reported during the first half-year: a considerable number, however, have since been reported.

The chief feature which distinguishes the results of these experiments from most of those which have been described from the southern area of the North Sea is the remarkably sedentary character of the Plaice in this area, all the fishes with two exceptions having been recovered practically in their original localities, in spite of considerable growth in certain cases. The only experiment in which the fish wandered any distance from the point of liberation was No. XII., carried out in Goswick Bay, off Berwick, immediately to the north of Holy Island, on the 26th June, 1903. In November of the same year one Plaice measuring originally 27 cm. ($10\frac{3}{4}$ inches) was recaptured in St. Andrew's Bay, a distance of about 40 miles; another fish was recaptured towards the end of May, 1904, off the Isle of May, at the mouth of the Firth of Forth. The original length of the latter fish was 28.7 cm. ($11\frac{1}{2}$ inches). These two fishes were among the largest liberated in this experiment.

It is not easy to understand why fishes of similar size did not also migrate from the other bays (cf. experiments XVIII., XXI. and XXII.), but it is noteworthy that the one experiment in which the fishes showed evidences of migration was carried out in the most northern locality investigated, where, owing to the configuration of the coast, the fish would be exposed to a greater variety of conditions than in the bays further south (especially north-westerly gales).

The minimum size at which the Plaice showed any tendency to emigration in this region was about 27.3 cm. ($10\frac{3}{4}$ inches), whereas in the southern area many individual fishes may be seen from the charts to have migrated fair distances at a length of only 19 or 20 cm. (8 inches), and a general tendency to migration at certain seasons of the year was shown by most of the fishes above 23 cm. (9 inches). The difference between the two areas in this respect may be due either to the differences which they also exhibit in regard to the proximity of deep water, or to the competition for food being less severe in the northern area, owing to the scantier population.

The only experiment which remains to be described is a small one carried out in the eastern part of the North Sea.

EXPERIMENT XXVI. HORN REEF OUTER GROUNDS (CHART 3).

Twenty-nine Plaice were marked and set free on the Horn Reef Outer Ground on the 15th September, 1903.

The following table shows the number of fish marked and liberated, classified according to their initial lengths, together with the number of recaptures reported under each size-group (1) during the

* No. E. 858. The recapture of this fish has since been reported from the Aberdeen Market.

first year after liberation, and (2) up to December 31st, 1904:—

Experiment No. 26.	Initial length in cm.				Total.	Percentage recaptured.	Number recaptured in first half year.
	< 20	20-24	25-29	30 +			
Number liberated	—	3	17	9	29	—	—
Recaptured within one year	—	1	5	1	7	24.1	2
Recaptured to Dec. 31st, 1904	—	1	5	1	7	24.1	—

The first fish recovered from this experiment was reported from the Horn Reef in November. In May one fish was recovered in the Lower Scruff about 45 miles to the westward, and another on the Sylt Inner Grounds about 65 miles to the eastward of the place of liberation. In September another fish was recovered south of Heligoland. It is impossible to interpret the results of this experiment without further information as to the movements of marked fish in the eastern waters, for evidence of which we must look to the experiments of the other participating countries. But several features of this experiment are of much interest. It is shown in another place in connection with the trawling experiments (p. 99) that the Plaice caught in September on the Horn Reef Outer Grounds (O. 111, 112, 113) consisted for the most part of fish emigrating from the inshore grounds, the majority of the catch consisting of small Plaice below 30 cm. (12 inches) in length which were practically absent on the same ground in the previous spring (B. 8, 9, 10). The dominant sizes in September (as shown by the detailed table, p. 130) ranged from 25 cm. to 32 cm. (10 to 12½ inches). The fishes marked at the time in this experiment were fairly representative of the prevalent sizes. (Cf. table above). Unfortunately, no locality is recorded for the single fish above 30 cm. which has been recaptured from this experiment. The initial sizes of the four recaptured fishes for which particulars of locality are available range from 23 to 29 cm. (9 to 11½ inches). It is remarkable that three out of four of these fishes should have been recaptured again on the inshore grounds in depths of about 10 to 12 fathoms. The numbers are too small to be conclusive, but the experiment suggests that only a minority of the smaller fish which emigrate offshore in the summer months continue their journey towards the Dogger Bank, and that a considerable number are driven shorewards again in the later autumn or winter.

Causes of the Observed Migrations.

Since Fulton's investigations with marked fish in the Firth of Forth it has been generally held that the migrations of Plaice have a preponderating tendency in opposition to the prevailing currents, so as to compensate for the drift of the eggs in the reverse direction. There is much in the results of the present experiments to support this idea, notably the northward trend of Plaice along the east coast of England, in opposition to the southward drift of the current, and, again, the southward tendency of the Plaice in winter in the southern North Sea (Flemish Bight) in opposition to the general north-eastward drift.

On the other hand, the reversal of this tendency in the southern area in summer appears to have a more direct relation with the search for food, the dominant feature of this offshore migration being the movement of fish from areas of high to areas of low density of population. There are also various indications that the southward migration in winter is not so much an adaptation for spawning purposes as a direct consequence of the disturbance of the sea bed on the shallow grounds between 53° and 54° latitude, as well as on the Dogger Bank, by autumnal and winter gales. A radial scattering of the fish on the Dogger Bank and neighbouring grounds would produce the appearance of westward migrations on the western grounds, southward migrations on the southern grounds, and so on. (Cf. Report on Transplantation Experiments, this volume, p. 48.)

§ 2. INTENSITY OF FISHING.

The proportion borne by the number of recaptures to the total liberated on different grounds provides a direct means of estimating the intensity of fishing in different localities, if due regard be paid to the conditions of the experiments and to the possibility of a certain number of the recaptured fish escaping the notice of the fishermen. It is quite possible that a certain number of fishes receive injuries during the act of trawling which are incapable of detection at the time when the fish are marked and yet may be severe enough to cause a certain mortality among the fish used in the experiments. It is beyond doubt that other fish escape detection by the fishermen, especially upon steam trawlers, where large quantities of fish are dealt with. These considerations are sufficient to show that the percentage of recaptures provides only a minimum measure of the intensity of fishing. The smallest fishes are not only the most liable to be injured in the act of hauling the trawl, but they are also more liable than the larger fishes to pass through the meshes of the net, as well as to escape the notice of the fishermen when actually recaptured. On this account it is necessary to divide the fish into size-groups and to limit any deduction which may be drawn as to the intensity of fishing to the results yielded by the larger fish.

The numbers of fish marked and recaptured, classified according to size, have already been given for the separate experiments.

For general purposes, however, a further condensation of the figures for different areas is desirable, and the following table is therefore provided :—

TABLE 1, showing for different areas the Percentage of Marked Plaice recaptured within one year from the date of liberation, distinguishing between fish above and below 25 cm. (10 inches) in length at the time of liberation :—

Ground and Number of Experiments.	Significance of Figures.	Number of Fish liberated.		Number recaptured in 12 months.	
		Cm.		Cm.	
		< 25	25 +	< 25	25 +
I.—Offshore :—					
Dutch coasts :	No.	198	212	47	43
Experiments 1-3, 24, 25, 27-29 ... ..	%	...	...	23·7	20·3
Deep Water, Flemish Bight :	No.	46	75	6	20
Experiments 4, 6, 7 ... ..	%	...	...	13·0	26·6
Leman Ground :	No.	80	149	15	26
Experiments 5, 8, 9 ... ..	%	...	...	18·7	17·4
Leman Ground :	No.	6	105	...	22
Experiments 30, 31 ... ..	%	...	..	...	21·0
Horn Reef Outer Ground :	No.	3	26	1	6
Experiment 26 ... ..	%	...	...	33·3	23·0
II.—Inshore :—					
Wash to Flamborough :	No.	74	19	4	1
Experiments 10, 23 ... ..	%	...	...	5·4	5·2
Northumberland Coast :	No.	412	58	37	18
Experiments 11-22 ... ..	%	...	...	9·0	31·0

In this Table the whole of the experiments have been classified in six local groups, the experiments carried out on the Leman Ground being further sub-divided according to the season of liberation. This separation seemed to be required by the marked contrast in the direction of migration as shown by the summer and winter experiments previously described.

In spite of the remarks advanced above concerning the greater liability of the small fish to escape capture, it will be observed from this Table that the proportion of small fish recovered from these experiments within twelve months was approximately similar to that of the large. In the experiments conducted off the Dutch coast 24 per cent. of the Plaice below 25 c.m. (10 inches) were recovered in one year, and 20 per cent. of the large; in the western portion of the Flemish Bight on the other hand the proportion of small fish recaptured was distinctly less than that of the large, viz., 13 per cent. as against 27 per cent. In the summer experiments on the Leman Ground, 19 per cent. of the small fish were recaptured and 17 per cent. of the large, the proportion in the latter case being somewhat less than that yielded by the winter experiments on the same grounds, viz., 21 per cent. It is interesting to notice this difference, seeing that the tendency of migration in the winter period was to the southward, in which case the percentage of recaptures approximates to that of other experiments in this region; while the lower percentage yielded by the summer experiments, when the tendency of migration was northward, appears to be indicative of a less intense fishery over the rough grounds between the Leman Ground and the Yorkshire coast. The single experiment carried out on the Horn Reef Outer Ground was of too small a character to justify any general conclusions.

The experiments carried out in the inshore waters from the Wash to Flamborough and along the Northumberland coast yield low percentages in each case for the small fish, a fact which is probably to be accounted for, to some extent, by the prohibition of trawling in the inshore waters of both regions.

The high percentage yielded by the Northumberland experiments in the case of the larger fish is almost entirely due to the large numbers which were caught by line-boats, and to some extent by salmon and trout nets in certain of the bays.

It would appear from the results of these experiments that trawl fishing is carried on with an intensity sufficient in the southern part of the North Sea to cause an appreciable reduction in the numbers of the larger Plaice of 10 inches in length and upwards, this reduction amounting to from 20 to 30 per cent. of the total population of this size in one year.

§ 3. RELATIVE INFLUENCE OF STEAM AND SAILING TRAWLERS, AND OF BRITISH AND FOREIGN BOATS.

The records of recaptured fish also provide an independent means of estimating the relative influence of steamers and sailing vessels, and of British and foreign boats in the same areas. The following Table has been prepared to provide information upon this point.

TABLE 2, showing the number of marked fish caught by Steamers and Sailing Vessels respectively, distinguishing between British and Foreign Vessels.

GROUND.	Experiments.	First Twelve Months.						Whole Period to 31/12/04.						Significance of Figures.
		Steamers.			Sailing Vessels.			Steamers.			Sailing Vessels.			
		English.	Foreign.	Total.	English.	Foreign.	Total.	English.	Foreign.	Total.	English.	Foreign.	Total.	
I.—OFFSHORE.														
Dutch Coasts	1-3, 24, 25	35	9	44	21	24	45	39	11	50	24	28	52	No. of Vessels.
	27-29	39	10	49	24	27	51	38	11	49	24	27	51	% „ „
Deep Water, Flemish Bight	4, 6, 7	6	...	6	19	1	20	8	...	8	21	1	22	No. „ „
	...	23	...	23	73	4	77	27	...	27	70	3	73	% „ „
Leman Ground (Summer)	5, 8, 9	26	...	26	15	...	15	32 ¹	...	32	19	...	19	No. „ „
	...	64	...	64	36	...	36	63	...	63	37	...	37	% „ „
Leman Ground (Winter)	30, 31	9	1	10	10	2	12	9	1	10	10	2	12	No. „ „
	...	41	4	45	46	9	55	41	4	45	46	9	55	% „ „
Horn Reef Outer Ground	26	4	1	5	...	2	2	4	1	5	...	2	2	No. „ „
	...	57	14	71	...	28.5	28.5	57	14	71	...	28.5	28.5	% „ „
		80	11	91	65	29	94	92	13	105	74	33	107	Total No. of Vessels.
		43	6	49	35	16	51	43	6	49	35	16	51	% of all Vessels.
II.—INSHORE.														
Wash to Flamborough	10, 23	4	...	4	1 ²	...	1	10	...	10	2 ⁵	...	2	No. of Vessels.
	...	80	...	80	20	...	20	83	...	83	17	...	17	% „ „
Northumberland Coast...	11-22	4 ¹	...	4	51 ³	...	51	7 ⁴	...	7	55 ⁶	...	55	No. „ „
	...	7	...	7	93	...	93	11	...	11	89	...	89	% „ „
		8 ¹	...	8	52	...	52	17 ⁴	...	17	57	...	57	Total No. of Vessels.
		13	...	13	87	...	87	23	...	23	77	...	77	% of all Vessels.

¹ Including 4 recaptures by research steamer *Stanley*.² By line boat.³ Of these, 45 were by line boats, 6 in Salmon or Trout nets; none trawled.⁴ Including 5 by *Stanley*.⁵ 1 by line boat, 1 trawled.⁶ Of these, 49 were by line boats, 6 in Salmon or Trout nets; none trawled.

It is noticeable that in the experiments off the Dutch coasts the recaptures by steamers (49 per cent.) and sailing vessels (51 per cent.) were about equally numerous, whereas in the western portion of the Flemish Bight the recaptures by smacks greatly preponderated (only 23 per cent. by steam trawlers as against 77 per cent. by sailing vessels). In the Leman Ground experiments, steamers caught the greater proportion of the recaptures during the summer period when the tendency of migration was northward, and a minority of recaptures during the winter period when the migration was to the southward. In all the offshore experiments together 49 per cent. of the recaptures were effected by steamers, and 51 per cent. by sailing vessels.

The nationality of the boats which reported recaptures was naturally much affected by the locality in which the experiments were carried out. Thus all the recaptures from the experiments in the western part of the Flemish Bight were reported by English boats, and the same remark applies to the summer experiments on the Leman Ground, when the tendency of migration was away from the continental

shores. On the other hand in the experiments carried out off the Dutch coasts 38 per cent. of the recaptures were effected by foreign trawlers, of which the sailing vessels were distinctly in excess. A few recaptures were also effected by foreign boats from the Leman Ground experiments carried out in the winter, when a certain number of the fishes wandered towards the Dutch coasts. The foreign vessels, as was natural, were in most cases of Dutch nationality, a small proportion only being Belgian.

III.—SOLES.

Experiments I.-III.—During August, 1903, 101 soles were marked and set free off the coasts of Norfolk and Lincolnshire; all were small, the majority being between 8 inches and 9½ inches in length. The date and position of liberation, and a classification of fish according to size, are given in the following table:—

Number of Experiment.	Date.	Position of Liberation.	Initial length (cm.).					Total.
			15-19	20-24	25-29	30-34	35-39	
I.	Aug. 11, 1903 ...	53° 8' N., 1° 4' E ...	...	11	10	..	...	21
II.	Aug. 12, 1903 ...	53° 21' N., 0° 16¼' E ...	...	19	18	4	...	41
III.	Aug. 13, 1903 ..	52° 56' N., 0° 16' E ...	2	16	8	9	4	39
I.-III.			2	46	36	13	4	101

Only two recaptures have been reported, neither of which showed any evidence of growth. From Experiment II. a 29 cm. sole was recovered on June 7th, 1904, near the place of liberation, viz., at 53° 15' N., 0° 38' E. (near the Inner Dowsing Light Vessel in 9 fathoms). A 24 cm. fish from Experiment III. had, however, travelled about 85 miles northwards in six months, being caught on February 17th, 1904, off Scarborough at 54° 21' N., 0° 0' E.

Experiments IV.-VI.—The following table shows the date and position of liberation of nine soles marked off Terschelling Light Vessel during September, 1903:—

Number of Experiment.	Date.	Position of Liberation.	Initial length (cm.).					Total.
			15-19	20-24	25-29	30-34	35-39	
IV.	Sept. 3, 1903 ...	53° 40½' N., 4° 57½' E.	...	...	2	3	1	6
V.	Sept. 17, 1903 ...	53° 39' N., 4° 26' E.	...	...	1	1	...	2
VI.	Sept. 17, 1903 ...	53° 36' N., 4° 31½' E.	...	...	1	...	...	1
IV.-VI. ... ..			...	...	4	4	1	9

Only one fish has been reported as recovered. This was a 30 cm. sole from Experiment IV., recaptured by a Dutch fisherman about April 18th, 1904, near one of the Dutch islands, apparently Texel, though the exact locality is uncertain. Owing to an injury sustained by the tail, accurate measurement of length was impossible on its return.

DETAILED TABLES (PLAICE).

No. of Experiments.	Particulars of Liberation.	Date.	No. of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms.	Ultimate Length, cm.	Weight, Grams.	Sex.	Remarks.	
III.	Liberated— 5th Dec 1902. 46 Plaice. Lat. 53° 39' N., Long. 5° 10' E.	16th Mar. 1903	741	24	65 miles S.E. by E. from Lowestoft (52° 9' N., 3° 25' E.).	LT. Smack ..	..	24'3	..	..
		17th " "	727	25	20-25 miles W.N.W. of Egmond? (52° 40' N., 4° 0' E.).	Dutch Smack, SCH.	..	26'2	13/	..	Fish bad.	
		24th " "	722	26	40 miles W. of Zandvoort (52° 12' N., 3° 29' E.).	Dutch Smack, SCH.	..	27'8	170	..	F.	
		4th Apr. "	737	20	Between Ymuiden and Haaks (52° 45' N., 4° 20' E.).	Dutch Smack, U.K.	..	20'8	..	..	M.
		2nd May "	742	23	Brown Ridge Gut (52° 30' N., 3° 20' E.).	LT. Smack ..	..	24'2	..	..	..
		3rd " "	750	23	12 miles N.W. by N. Ameland Light (53° 35' N., 5° 23' E.).	YH. St. Tr. ..	..	25'7	..	..	..
		4th " "	760	23	Norderney (auf Stiden) (53° 56' N., 7° 12' E.).	German Smack, A.N.	12	24	..	..	..
		21st " "	735	20	Terschelling L.V. bearing S. by E. (53° 40' N., 4° 40' E.).	GY. St. Tr. ..	18	22	..	..	F.
		29th " "	725	19	65 miles off Lowestoft E. by N. (52° 50' N., 3° 25' E.).	LT. Smack ..	18-19	20'5	..	..	M.
		10th June "	731	17	About 15 miles N.N.W. from Terschelling L.V. (53° 40' N., 4° 35' E.).	Dutch Smack, TX.	..	19'4	..	..	F.
		14th " "	763	22	About 20 miles N. of Terschelling L.V. (53° 47' N., 4° 41' E.).	YH. St. Tr. ..	21	24'5	..	..	M.
		17th " "	740	25	Lower part of Brown Ridges, Lowestoft, W. by S., distant 60 miles 52° 57' N., 3° 12' E.).	LT. Smack ..	..	30	..	..	..
		24th " "	743	21	40 miles N.W. of Terschelling Land Light (53° 47' N., 3° 54' E.).	BN. St. Tr. ..	22	24'5	..	..	F.
		29th " "	755	20	Lat. 53° 49' N., Long. 5° E.	GY. " ..	22	21	..	..	M.
		30th " "	736	20	Terschelling L.V. bearing S.E. (53° 30' N., 4° 45' E.).	" " ..	16	..	..	..	..
		6th July "	723	23	45 miles E. by N. from Lowestoft 52° 50' N., 2° 52' E.).	LT. Smack ..	20	25	..	..	..
		20th " "	751	21	About 39 miles W.N.W. from Ymuiden (52° 33' N., 3° 30' E.).	Dutch St. Tr., YM.	..	24'9	..	..	F.
31st " "	728	26	150 miles E. 1/2 S. from Spurn (54° 6' N., 4° 12' E.).	GY. St. Tr. ..	..	29	..	..	M.		
26th Feb. 1904	732	25	52° 57' N., 4° 20' E.	Dutch Smack, YM.	..	29'2	..	..	..
24th Apr. "	764	21	53° 35' N., 5° 30' E.	Dutch, St. Tr., YM.	9	24'4	112	..	F.			
20th or 21st Sept. 1904.	724	21	About 54° 10' N., 7° E.	GY. St. Tr. ..	19	26'5	..	..	M.		
IV	Liberated— 21st Mar. 1903. 27 Plaice. N. Hinder L.V., S. by W 1/2 W. 11 miles. 51° 45' N., 2° 35' E.	24th May 1903	E. 17	30	Lat. 52° 36' N., Long. 2° 25' E.	LT. Smack ..	25	30	..	..
		31st July "	E. 8	30	12 miles E.N.E. from Smiths Knoll L.V. (53° 0' N., 2° 30' E.).	" " ..	..	33'5	..	..
		8th Aug. "	E. 28	23	30-40 miles E. of Leman and Ower L.V. (53° 18' N., 2° 56' E.).	" " ..	15-16	25	..	F.		
		30th Sept. "	E. 12	27	Lower part of Ower Sand, about Lat. 53° 25' N., Long. 1° 40' E.	" " ..	13	30	..	F.		
		18th Oct. "	E. 20	26	60 miles E. by S. from Lowestoft (52° 24' N., 3° 25' E.).	" " ..	15	26	..	M.		
		10th Dec. "	E. 10	23	12 miles W. by N. of Outer Gabbard (51° 58' N., 1° 47' E.).	R. Smack ..	22	25'5	..	..	"10 inches". Fide Fisherman.
V.	Liberated— 27th April, 1903. 30 Plaice. Leman Ground. 53° 25' N., 2° 26' E.	19th June 1903	E. 42	34	60 miles E. by S. from Spurn (53° 36' N., 1° 52' E.).	LT. Smack ..	15	34'9	..	F.		
		9th July "	E. 51	30	64 miles E. of Spurn (53° 48' N., 1° 57' E.).	GY. St. Tr. ..	..	30	..	M.	
		Prior to 28th Aug. 1903.	E. 50	31	Found on Pontoon, Grimsby .. ..	" " ..	..	33'5	..	M.	
		5th Oct. 1903	E. 40	25	Lat. 53° 44' N., Long. 2° 20' E.	LT. Smack ..	16	29	..	M.		
		15th Oct. "	E. 32	29	80 miles E.S.E. from Spurn L.V. (53° 22' N., 2° 26' E.).	GY. St. Tr. ..	..	29	..	M.	
VI.	Liberated— (a.) 6th May, 1903. 34 Plaice. East Deep Water. 52° 7 1/2' N., 2° 47 1/2' E. (b.) 6th May, 1903. 34 Plaice. Middle Ground. 52° 13 1/2' N., 2° 54' E.	20th May 1903	E. 100	33	40 miles E. by N. from Lowestoft (52° 49' N., 2° 52' E.).	LT. St. Tr. ..	18	33	..	M.		
		20th " "	E. 114	27	East of Brown Ridges (52° 45' N., 3° 25' E.).	LT. Smack ..	..	26'8	..	..
		9th June "	E. 94	19	56 miles S.E. by E. from Lowestoft 52° 11' N., 3° 13' E.).	" " ..	About 23	19	..	M.		
		11th July "	E. 124	29	East of Lowestoft, 35 miles (52° 39' N., 2° 42' E.).	" " ..	..	31	..	M.	
		27th " "	E. 111	27	60 miles E.N.E. from Lowestoft (53° 4' N., 3° 5' E.).	" " ..	..	28'5	..	M.	
		31st " "	E. 77	28	Winterton Shoal (52° 53' N., 2° 45' E.) ..	YH. St. Tr. ..	..	29	..	M.	
		23rd Aug. "	E. 106	27	49 miles E. by S. from Spurn (53° 37' N., 1° 34' E.).	GY. " ..	13	29	..	M.		
		23rd " "	E. 98	24	E. by S. 60 miles from Lowestoft (52° 34' N., 3° 23' E.).	LT. Smack ..	17	25	..	M.		
		24th Sept. "	E. 74	24	?	Dutch St. Tr., HR.	..	24'7	..	M.		
		13th Oct. "	E. 87	26	E.S.E. 55 miles from Spurn L.V. (53° 27' N., 1° 43' E.).	GY. St. Tr. ..	..	27'5	..	M.	
		23rd Feb. 1904	E. 109	27	W.N.W. 15 miles from Maas L.V. (52° 4' N., 3° 27' E.).	LT. Smack ..	..	30	..	F.	
		22nd Mar. "	E. 112	25	18 miles W. of Scheveningen (52° 2' N., 3° 48' E.).	" " ..	About 17	25'5	..	M.		
		22nd Apr. "	E. 76	24	E.S.E. 55 miles from Lowestoft (52° 24' N., 3° 14' E.).	" " ..	17	27'1	178	..	M.	IV. Years old.
		21st July "	E. 129	32	85 miles E. by S. from Spurn (53° 42' N., 2° 37' E.).	GY. St. Tr. ..	22	36'4	M.	IV+ Years old.

GARSTANG: EXPERIMENTS WITH MARKED FISH.

No. of Experiments.	Particulars of Liberation.	Date.	No. of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms.	Ultimate Length, cm.	Weight, Grams.	Sex.	Remarks.
VII.	Liberated— 7th May 1903. 26 Plaice. Win- terton Shoal, 52° 52' N., 3° 0' E.	18th June 1903	E. 139	33	Smith's Knoll L.V. S.W. by S. 18 miles (53° 10' N., 2° 23' E.).	L.T. Smack ..	17-18	..	..	F.	
		14th Aug. "	E. 141	30	96 miles S.E. from Spurn (52° 47' N., 2° 31' E.).	G.Y. St. Tr. ..	21	34.5	..	M.	
		19th " "	E. 151	25	7 miles W.S.W. Smith's Knoll (52° 48' N., 2° 5' E.).	L.T. Smack ..	..	19.25	..	F.	
		1st Sept. "	E. 157	24	S.E. by E 106 miles from Spurn (52° 59' N., 2° 59' E.).	G.Y. St. Tr. ..	..	..	..	..
		19th Oct. "	E. 145	33	40 miles N.E. of Lowestoft (53° 5' N., 2° 16' E.).	L.T. Smack ..	20	35.0	..	F.	
		30th Nov. "	E. 149	28	Lowestoft bearing W. 35 miles (52° 39' N., 2° 40' E.).	" " ..	23	32.0	..	F.	
		24th Feb. 1904	E. 159	31	E.N.E. of Spurn 105 miles (54° 39' N., 2° 35' E.).	G.Y. St. Tr. ..	11	36.5	..	F.	
		18th May "	E. 148	29	E. of Lowestoft 50 miles (52° 42' N., 3° 4' E.).	L.T. Smack ..	20	30.6	..	M.	V. years old.
	29th " "	E. 160	25	"Between Winterton and Knoll" (52° 45' N., 2° 0' E.).	" " ..	..	31.7	315	F.	VI. years old.	
VIII.	Liberated— 8th May 1903. 71 Plaice. Leman Ground, 53° 25½' N., 2° 35' E.	6th June 1903	E. 189	28	Spurn bearing N.W. by W. 96 miles (53° 6' N., 2° 42' E.).	G.Y. St. Tr. ..	..	28.0	..	F.	
		20th June "	E. 171	27	85 miles E.S.E. from Spurn (53° 24' N., 2° 30' E.).	" " ..	..	..	..	..
		20th " "	E. 161	24	70 miles E. ½ S. from Tynemouth (55° 10' N., 0° 38' E.).	S.N. " ..	..	25.0	..	M.	
		17th July "	E. 206	32	55 miles E. by S. from Spurn L.H. (53° 40' N., 1° 43' E.).	G.Y. " ..	..	33.5	..	M.	
		17th Sept. "	E. 172	27	90 miles S.E. from Spurn L.V. (52° 51' N., 2° 20' E.).	" " ..	..	27.5	..	F.	
		22nd Jan. 1904	E. 209	24	70 miles E. by S. from Spurn L.V. (53° 40' N., 2° 6' E.).	" " ..	15	29.6	..	F.	
		23rd " "	E. 181	39	18 miles N.E. by N. of Whitby Light (54° 45' N., 0° 24' W.).	S.H. " ..	..	40.0	..	F.	
		6th June "	E. 162	23	53° 42' N., 1° 55' E.	G.Y. " ..	16	30.0	..	M.	IV. years old.
	30th Nov. "	E. 174	19	75 miles E. by S. from Spurn (52° 33' N., 3° 48' E.).	" " ..	13	28.5	..	M.	Tail dry. IV+years old.	
IX.	Liberated— (a) 8th May 1903. 63 Plaice. Le- man Ground, 53° 24½' N., 2° 20' E. (b) 8th May 1903. 65 Plaice. Le- man Ground, 53° 25' N., 2° 16½' E.	9th May 1903	E. 321	23	E. of Swarte Bank, 53° N., 3° E. (sic)	G.Y. St. Tr. ..	..	22.5	..	..
		29th " "	E. 257	22	Middle Gut of Leman, 7 miles S.W. of Leman (53° 3' N., 1° 53' E.).	L.T. Smack ..	16	22.5	..	M.	
		3rd June "	E. 332	24	10 miles N.E. of Leman and Ower L.V., (53° 17½' N., 2° 7' E.).	" " ..	22	24.5	..	M.	
		6th " "	E. 302	24	20 miles N.E. Leman Light (53° 27' N., 2° 15' E.).	YH. Smack ..	17	24.5	..	..
		8th " "	E. 333	32	35 miles N.N.E. of Leman Light (53° 43' N., 2° 6' E.).	L.T. Smack ..	15	32.5	..	M.	
		15th " "	E. 235	23	75 miles E.S.E. from Spurn (53° 26' N., 2° 14' E.).	G.Y. St. Tr. ..	..	24	..	M.	
		16th " "	E. 300	21	Leman L.V., N.W. 10 miles (53° 4' N., 2° 12½' E.).	YH. " ..	19	21.8	..	F.	
		19th " "	E. 276	23	Well Bank Gut (53° 20' N., 2° 6' E.).	YH. Mission Smack ..	19-21	23.5	..	F.	
		20th " "	E. 330	23	Smith's Knoll L.V., S.W. 10-12 miles (53° 2' N., 2° 22' E.).	L.T. Smack ..	19	23.7	..	..
		30th " "	E. 305	29	85 miles E.S.E. of Spurn (53° 25' N., 2° 30' E.).	G.Y. St. Tr. ..	17	..	..	..
		1st July "	E. 247	23	14 miles N.E. of Leman L.V. (53° 22' N., 2° 10' E.).	G.Y. " ..	..	..*	..	..	*Fish put overboard again alive.
		4th " "	E. 296	31	E.N.E. from Leman and Ower L.V. about 25 miles (53° 25' N., 2° 30' E.).	L.T. Smack ..	18	32.5	..	M.	
		4th " "	E. 267	24	55 miles N.N.E. from Lowestoft (53° 24' N., 1° 55' E.).	L.T. " ..	13	24.5	..	..
		Few days prior to 13th July 1903.	E. 352	25	Off Terschelling Light Vessel (53° 30' N., 4° 40' E.?).	YH. " ..	..	25	..	..	"9½ inches."
		On or before 10th July 1903.	E. 239	25	.. .. .	G.Y. St. Tr. ..	..	26.5	..	M.	
		29th July 1903	E. 263	26	90 miles E. by S. from Spurn (53° 42' N., 2° 39' E.).	" " ..	..	27.5	..	F.	
		30th " "	E. 243	32	85 miles E. by S. from Spurn L.H. (53° 42½' N., 2° 25' E.).	" " ..	..	33	..	M.	
		During July	E. 242	35	Found on Pontoon, Grimsby .. ..	" " ..	..	35	..	M.	
		14th Aug. 1903	E. 259	27	7 miles N.E. from N. end of Swarte Bank (53° 34' N., 2° 7' E.).	L.T. Smack ..	15	28.5	..	M.	
		20th " "	E. 237	23	74 miles E.S.E. from Spurn (53° 26' N., 2° 13' E.).	G.Y. St. Tr. ..	..	27	..	M.	
		28th " "	E. 299	33	35 miles N.E. ½ E. of Spurn (54° 2' N., 0° 50' E.).	" " ..	27	36.5	..	M.	
		11th Sept. "	E. 340	27	75 miles E.S.E. from Spurn (53° 26' N., 2° 13' E.).	" " ..	..	31	..	F.	
		16th " "	E. 347	32	Lower part of the Shoals of the Leman, 20 miles N. of the Leman L.V. (53° 28' N., 1° 50' E.).	L.T. Smack ..	14	33	..	M.	
25th " "	E. 313	28	70 miles E. by S. of Spurn (53° 40' N., 2° 7' E.).	G.Y. St. Tr. ..	16	30°	..	F.	*Tail dry.		
30th " "	E. 241	26	"Kettle Hole" (??). Found on Pontoon, Grimsby.	" " ..	..	..	..	..
12th Oct. "	E. 273	35	40 miles N.N.E. from Smith's Knoll L.V. (53° 32' N., 2° 20' E.).	L.T. Smack ..	16	37.5	..	F.			
12th Nov. "	E. 355	19	Leman L.V., W.S.W. 18 miles (53° 23' N., 2° 22' E.).	" " ..	16	23(?)	..	..	"About 9 inches," Fide fishermen.		
11th Mar. 1904	E. 341	20	E.S.E. 45 miles from Spurn (53° 29' N., 1° 26½' E.).	G.Y. St. Tr. ..	17-22	25.5	154	F.			
14th " "	E. 331	27	E. by S. ½ S. 50 miles from Spurn (53° 34' N., 1° 35' E.).	" " ..	15	30.7	216	F.			
22nd June "	E. 252	26	About 60 miles N.E. by N. of Lowestoft (53° 25' N., 2° 15' E.).	L.T. Smack ..	14	30.1	256	F.	Gutted. Age: IV.		
25th June "	E. 350	23	Between Leman and Ower (53° 10' N., 1° 52' E.).	" " ..	19-20	33.5	397	M.	Gutted. Age: IV.		

No. of Experiments.	Particulars of Liberation.	Date.	No. of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms.	Ultimate Length, cm.	Weight, Grams.	Sex.	Remarks.	
IX.—	<i>continued.</i>	4th July 1904	E. 279	25	4 miles E.S.E. of Knoll L.V. (52° 52' N., 2° 20' E.).	R. Smack	..	34.9	393	M.	Gutted. Age: IV.	
		11th Aug. "	E. 351	26	Found on Pontoon, Grimsby .. ..	..	..	36.1	439	F.	Tail slightly dry.
		25th " "	E. 240	32	54° 20' N. 1° 35' E.	GY. St. Tr.	..	39.0	600	F.	Gutted. V+. Gutted. Age: V+.	
		10th May "	E. 311	34	Found on Pontoon, Grimsby
		Oct. "	E. 338	33	Returned by a fishmonger	567?	..	Weight 1½ lbs.
		Prior to 22nd Oct. 1904. Prior to 12th Nov. 1904.	E. 337 E. 348	26 31	LT. Smack	..	35.0 34.8	414 360	F. M.	Gutted. Age: VI+. Tail dry. Gutted. Age: IV+.
X.	Liberated— 10th June, 1903. 40 Plaice. Lat. 53° 51' N., Long. 0° 3½' E.	13th July 1904	E. 361	21.0	55 miles E. by N. Spurn L.V. (54° 2' N., 1° 35' E.).	GY. St. Tr.	33	31.1	272	M.		
		4th Aug. "	E. 392	20.5	40 miles E. by S. Spurn L.V. (53° 30' N., 1° 21' E.).	" "	12	..	..	..	..
		11th Sept. "	E. 371	23.5	28 miles E. by S. Hartlepool (54° 44' N., 0° 21' W.).	HL. "	33	29.1	215	F.	Tail dry. Gutted V+ years old.	
		28th Oct. "	E. 373	22.0	.. ..	.. ..	..	..	..	..	..
XI.	Liberated by Mr. Meek— 26th June, 1903. 2 Plaice. Skate Roads (between Holy and Farne Is.).	8th April 1904	E. 818	26.7	Skate Roads (55° 39' N., 1° 42' W.)	Line Boat	..	30.6	..	M.		
XII.	Liberated by Mr. Meek— 26th June, 1903. 16 Plaice. Goswick Bay (north of Holy Is.).	5th Nov. 1903	E. 805	27.3	In St. Andrew's Bay (56° 22' N., 2° 42' W.)	Line ?	..	29.0	..	F.		
		18th Mar. 1904	E. 810	27.3	Skate Roads (55° 39' N., 1° 42' W.)	Line Boat	..	..	..	..	Label only.
		5th April "	E. 802	22.5	Skate Roads (55° 39' N., 1° 42' W.)	" "	..	28.2	..	M.		
		11th " "	E. 806	22.2	Goswick Sands (55° 43' N., 1° 47' W.)	" "	..	26.0	..	F.		
		27th May "	E. 808	28.5	7-8 miles E. of Isle of May (56° 13' N., 2° 19' W.).	" "	..	33.0	285	M.		
		?	E. 816	20.3	Goswick Bay (55° 43' N., 1° 52' W.)	" "	..	?	..	?		
XIII.	Liberated by Mr. Meek. 1st July, 1903. 23 Plaice. Alnmouth Bay, in 3 fathoms.	21st Apr. 1904	E. 830	22.5	Amble (Warkworth) Harbour, (55° 22' N., 1° 35' W.).	Line Boat	..	23.5	..	F.		
		10th Aug. "	E. 842	21.6	1 mile S. of Alnmouth (55° 22½' N., 1° 35' W.).	..	..	33	454	..	
XIV.	Liberated by Mr. Meek. 9th July, 1903. 4 Plaice. Cambois Bay, in 5 fathoms.	..	..	..	None.	..	..	..	..	..
XV.	Liberated by Mr. Meek. 15th July, 1903. 34 Plaice. Druridge Bay, in 3 fathoms.	24th Mar. 1904	E. 878	22.8	Warkworth Harbour (55° 22' N., 1° 35' W.).	Line Boat	..	25.2	..	..
		9th July "	E. 883	18.4	Druridge Bay (55° 17' N., 1° 32' W.)	Trout Net	..	22.8	..	M.		
		4th Oct. "	E. 882	20.6	Druridge Bay (55° 17' N., 1° 32' W.)	Line Boat	..	33	..	F.		
		22nd Nov. "	E. 879	26.0	Returned from Billingsgate .. ..	..	..	37.5	527	M.	Gutted. Age: IV+.
		17th Dec. "	E. 858	32.7	(Fish Market, Aberdeen) .. ..	..	..	44.2	887	..	Reported 22/9/05.
XVI.	Liberated by Mr. Meek— 23rd July 1903. 66 Plaice. Blyth Bay in 4 fathoms.	6th Aug. 1903	E. 913	19.4	Seaton North Point (55° 12' N., 1° 30' W.)	Salmon Net	..	..	..	..	Number only received.
		20th " "	E. 929	20.3	Between Hartley and Seaton Sluice (55° 7' N., 1° 28' W.).	" "	..	..	..	..	Put in sea alive at Cullercoats.
		21st " "	E. 939	23.5	Blyth Bay (55° 7' N., 1° 28' W.)	Line Boat	..	..	..	..	Label only returned.
		End of Aug.	E. 932	20.0	Seaton Sluice (55° 7' N., 1° 28' W.)	Salmon Net	..	..	..	..	Label only returned.
		16th Feb. 1904	E. 954	23.8	Blyth Harbour (55° 7' N., 1° 28' W.)	Line Boat	..	28 (?)	..	..	"About 11 ins."
		5th Mar. "	E. 930	23.5	Blyth Harbour (55° 7' N., 1° 28' W.)	" "	..	23.5	142.5	F.		
		5th " "	E. 956	22.8	Blyth Harbour (55° 7' N., 1° 28' W.)	" "	..	21.6	125.5	M.	Tail cut; measurement to base.	
		24th " "	E. 892	21.6	Blyth Harbour (55° 7' N., 1° 28' W.)	" "	..	23.2	..	M.		
		24th " "	E. 895	25.1	Blyth Harbour (55° 7' N., 1° 28' W.)	" "	..	22.5	..	F.	Tail cut; measurement to base.	
		7th Apr. "	E. 925	22.5	Blyth Bay (55° 7' N., 1° 28' W.)	" "	..	25.4	..	F.		
		8th " "	E. 890	24.1	Off Cullercoats (55° 2' N., 1° 24' W.)	" "	..	26.3	..	F.	Fish liberated again.	
		14th " "	E. 893	21.6	Blyth Bay (55° 7' N., 1° 28' W.)	" "	..	20.3*	..	M.	Tail cut; measurement to base.	
27th " "	E. 891	22.5	Blyth Harbour (55° 7' N., 1° 28' W.)	" "	..	25.9	..	M.				
26th May "	E. 927	25.4	St. Mary's Island, in salmon net (55° 5' N., 1° 27' W.).	" "	..	27.9	..	M.				

GARSTANG.: EXPERIMENTS WITH MARKED FISH.

No. of Experiments.	Particulars of Liberation.	Date.	No of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms.	Ultimate Length, cm.	Weight, Grams.	Sex.	Remarks.	
XVII.	Liberated by Mr. Meek— 4th Aug. 1903. 42 Plaice. Skate Roads in 3 fathoms.	10th Mar. 1904	E. 991	24'1	Skate Roads (55° 39' N., 1° 42' W.) ..	Line Boat	25'4	..	F.	Fish thin. Label only re- turned.	
		12th " "	E. 998	26'6	1 mile S. of Holy Island (55° 39' N., 1° 47' W.) ..	" " ..	..	29'2	..	M.	
		9th April "	E. 969	20'6	Holy Island (55° 41' N., 1° 47' W.) ..	" " ..	..	20'6	..	M.	
		9th " "	E. 995	26'0	Skate Roads (55° 39' N., 1° 42' W.) ..	" " ..	..	..	..	..
		23rd " "	E. 975	24'1	Skate Roads (55° 39' N., 1° 42' W.) ..	" "	25'5	..		M.
		25th " "	E. 976	23'5	Skate Roads (55° 39' N., 1° 42' W.) ..	" "	26'0	..		F.
		2nd May "	E. 994	22'2	Skate Roads (55° 39' N., 1° 42' W.) ..	" "	24'4	..		F.
		27th " "	E. 983	26'3	Skate Roads (55° 39' N., 1° 42' W.) ..	" " ..	..	33'0	..	F.	
XVIII.	Liberated by Mr. Meek— 12th Aug. 1903. 40 Plaice. Druridge Bay in 3 fathoms.	15 Apr. 1904	23	28'6	Druridge Bay (55° 17' N., 1° 32' W.) ..	S.Y. "Stanley"	..	30'6	..	F.		
XIX.	Liberated by Mr. Meek— 19th Aug. 1903. 63 Plaice. Alnmouth Bay in 3 fathoms.	7th Sept. 1904	88	21'9	Alnmouth Bay (55° 23' N., 1° 35' W.) ..	S.Y. "Stanley"	..	29		
XX.	Liberated by Mr. Meek— 26th Aug. 1903. 40 Plaice. Cambois Bay in 4 fathoms.	None		
XXI.	Liberated by Mr. Meek— 2nd Sept. 1903. 57 Plaice. Blyth Bay in 3 fathoms.	5th Mar. 1904	182	27'3	Blyth Harbour (55° 7' N., 1° 28' W.) ..	Line Boat	Label only returned. ** Amended record. A. Meek.	
		22nd " "	188	25'1	Blyth Harbour (55° 7' N., 1° 28' W.) ..	" " ..	..	25'4	..	M.	
		1st Apr. "	184	27'3	Blyth Bay (55° 7' N., 1° 28' W.) ..	" " ..	..	28'2	..	M.	
		3rd May "	159	24'8	Off Hartley (55° 7' N., 1° 28' W.) ..	" " ..	..	26'6	..	M.	
		3rd " "	187	22'5	Blyth Bay (55° 7' N., 1° 28' W.) ..	" " ..	..	22'3	..	M.	
		1st Aug. "	193	*21'6	Off Cullercoats (55° 3' N., 1° 25' W.) ..	Salmon Net
		17th " "	183	26	Blyth Bay (55° 7' N., 1° 28' W.) ..	S.Y. "Stanley"	..	34'2	453
		17th " "	178	24'1	Blyth Bay (55° 7' N., 1° 28' W.) ..	S.Y. "Stanley"	..	33	481	..		
XXII.	Liberated by Mr. Meek— 9th Sept. 1903. 84 Plaice. Druridge Bay in 3 fathoms.	1st Oct. 1903	279	25'4	Druridge Bay (55° 17' N., 1° 32' W.) ..	Line Boat	Fish poor.	
		23rd " "	205	21'6	Off Creswell in 2 fathoms (55° 14' N., 1° 30' W.) ..	" " ..	2	22'2	..	M.		
		23rd Mar. 1904	225	22'8	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	22'8	..	F.	
		18th Apr. "	280	25'4	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	26'0	..	M.	
		20th " "	231	23'5	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	23'5	..	M.	
		20th " "	261	22'8	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	24'2	..	M.	
		27th " "	201	23'2	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	23'6	..	M.	
		28th " "	254	27'3	Druridge Bay (55° 17' N., 1° 32' W.) ..	" " ..	..	28'8	..	F.	
		19th May "	217	26'0	Druridge Bay, (55° 17' N., 1° 32' W.) ..	" " ..	..	26'0	..	M.	
		26th " "	208	18'1	Druridge Bay, (55° 17' N., 1° 32' W.) ..	" " ..	..	18'0	..	F.	
		6th June "	216	24'4	Druridge Bay, (55° 17' N., 1° 32' W.) ..	S.Y. "Stanley"	..	26'3	..	F.		
		15th " "	251	22'8	Druridge Bay, (55° 17' N., 1° 32' W.) ..	Line Boat ..	..	23'2	..	M.	
		21st " "	247	22'2	Druridge Bay, (55° 17' N., 1° 32' W.) ..	Trout Net ..	..	23'5	..	F.	
		6th July "	235	19	Druridge Bay, (55° 17' N., 1° 32' W.) ..	" " ..	..	22'25	..	..
		29th Aug. "	253	23'2	Druridge Bay, (55° 17' N., 1° 32' W.) ..	Line Boat ..	..	30'4	..	F.	
25th Oct. "	206	24'1	Druridge Bay, (55° 17' N., 1° 32' W.) ..	.. .. .	..	33	..	F.		

No. of Experiments.	Particulars of Liberation.	Date.	No. of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms.	Ultimate Length, cm.	Weight, Grams.	Sex.	Remarks.
XXIII.	Liberated— 12th Aug. 1903. 53 Plaice. Lat. 53° 22' N., Long. 0° 21' E.	19th April 1904	E. 448	21	St. Andrew's Bay, Scotland. (56° 22' N., 2° 42' W.).	Caught by line	..	25'8	114	M.	IV. years old.
		13th May "	E. 455	24	Lat. 53° 20' N., Long. 0° 30' E.	G.Y. St. Tr. ..	..	24'9	96	M.	Gutted. IV. years old.
		Prior to 1st June 1904	E. 466	23	Returned through Fishmongers' Company.	.. ..	..	27'6	140	M.	Tail slightly dry. Gutted. IV. years old.
		19th July 1904	E. 432	23	53° 20' N., 0° 25' E.	G.Y. St. Tr. ..	7	27'1	168	M.	V+ years old.
		11th Aug. "	E. 458	25	19 miles N.E. Spurn L.V. (53° 52' N., 0° 28' E.).	SN. " "	19	32'4	102	F.	Gutted. IV. years old.
		26th Sept. "	E. 430	26	48 miles N.E. by E. 1/2 E. of Shields (55° 33' N., 0° 20' W.).	SN. " "	37	..	..	M.	
		Prior to 13th Dec. 1904.	E. 454	24	Found on Pontoon, Grimsby .. ..	.. ..	..	31'8	310	F.	Gutted. IV+ years old. Immature. Middle rays of tail fin abraded. Length to longest outside fin ray.
		19 Dec. 1904	E. 461	22	13 miles E. by S. of Tyne (55° 1' N., 1° 1' W.).	S.N. St. Tr. ..	..	28'3	..	M.	
XXIV.	Liberated— 3rd Sept. 1903. 35 Plaice. 53° 40' N., 4° 57' E.	7th Sept. 1903	E. 585	22	160 miles E. by S. from Spurn (53° 46' N., 4° 35' E.).	G.Y. St. Tr. ..	..	21'5	..	F.	
		Prior to 26th Oct. 1903.	E. 586	33	Found on Pontoon, Grimsby .. ..	.. ..	..	34	..	M.	
		27th Feb. 1904	E. 581	34	52° 38' N., 3° 32' E.	Dutch Smack, SCH.	..	34'5*	..	F.	*Tail dry.
		19th Aug. "	E. 569	28	51 miles E. by N. of Lowestoft (52° 50' N., 2° 59' E.).	L.T. Smack ..	22-23	34'0	372	F.	Gutted. IV. years old.
XXV.	Liberated— 3rd Sept. 1903. 73 Plaice. Lat. 53° 42' N., Long. 5° 20' E.	12th Sept. 1903	E. 658	26	Lat. 53° 49' N., Long. 4° 20' E.	G.Y. St. Tr. ..	..	..	..	M.	Threw fish overboard alive.
		17th Oct. "	E. 625	29	Terschelling L. V., bearing S.S.W. 16 miles (53° 44' N., 4° 54' E.).	LO. " "	16	28*	..	F.	*Landed at Lowestoft. Tail mutilated and dry.
		Prior to 5th Nov. 1903	E. 607	30	Claydeep? Recovered from fish-packer.	SN. " "	..	30	..	F.	
		8th-9th Mar. 1904.	E. 655	36	Lat. 53° 6' N., 7 miles off Texel (53° 6' N., 4° 30' E.).	Dutch Smack, SCH.	..	35'7*	..	M.	*Tail dry.
		16th Mar. 1904	E. 634	32	Lat. 52° 32' N., 3° 10' E.	Dutch Smack, KW.	..	32'1	240	M.	
		20th " "	E. 643	31	Ameland Light, 14 miles S.E. (53° 34' N., 5° 17' E.).	A. St. Tr. ..	..	31'5	333	F.	
		15th June "	E. 639	28	Found on Pontoon, Grimsby .. ..	.. ..	..	30'5	226	F.	Gutted. IV. years old.
		4th Sept. "	E. 650	24	53° 35' N., 5° 12' E. 15 fathoms	G.Y. St. Tr. ..	15	26'2	123	F.	Tail dry. Gutted. IV+ years old.
XXVI.	Liberated— 15th Sept. 1903. 29 Plaice. Lat. 55° 25' N., Long. 6° 2' E.	6th Nov. 1903	E. 685	29	Horn Reef L.V., S. by E. 4 miles (55° 30' N., 7° 25' E.).	.. ..	..	27'5	..	F.	
		Prior to 10th Nov. 1903.	E. 683	26	Found on Pontoon, Grimsby .. ..	.. ..	..	26	..	M.	
		14th May 1904	E. 679	25	Found on Pontoon, Grimsby .. ..	.. ..	..	24'8*	120	M.	*Very dry. IV years old.
		24th " "	E. 697	29	Lat. 55° 15' N., Long. 4° 50' E.	LO. Steam Cutter.	..	30'8	250	F.	IV. years old.
		27th " "	E. 690	25	16 miles S.W. of Graa Deep (55° 12' N., 7° 56' E.).	Danish ..	12	25'5	..	F.	
		3rd July "	E. 698	23	1/2 mile from Weser L.V., E. to S.S.E. (53° 54' N., 7° 49' E.).	German Smack, HF.	..	23'5	..	F.	
		14th " "	E. 687	31	Found on Pontoon, Grimsby .. ..	.. ..	..	307	F.	Gutted. V+ years old.	
XXVII.	Liberated— 17th Sept. 1903. 31 Plaice. Lat. 53° 39' N., Long. 4° 28' E.	Prior to 22nd Oct. 1903.	E. 721	37	Returned by a London fishmonger .. ..	.. ..	..	..	1 1/2 lbs.	F.	
		25th Dec. 1903	E. 720	29	5 miles N.N.E. from N. Hinder L.V. (51° 42' N., 2° 35' E.).	L.T. Smack ..	20	28'4*	..	M.	*Dry.
		Prior to 15th June 1904.	E. 710	35	.. ..	G.Y. St. Tr. ..	..	37'5*	503	F.	*Tail slightly dry. V. years old.
		5th Sept. 1904	E. 712	35	53° 54' N., 5° 10' E.	" "	..	38'1	499	F.	Gutted. V+ years old.
		2nd Nov. "	E. 704	31	53° 40' N., 4° 20' E.	Dutch Smack, AM.	16	35'1	44	F.	Ovaries well developed but not ripe.
XXVIII.	Liberated— 17th Sept. 1903. 50 Plaice. Lat. 53° 36' N., Long. 4° 31' E.	23rd Sept. 1903	E. 746	20	Near Terschelling L.V. (53° 30' N., 4° 30' E.).	LO. St. Tr. ..	17-18	20	..	F.	Fish landed at Lowestoft.
		26th " "	E. 761	25	145 miles E. by S. from N.E. Docking Buoy (on the Terschelling ground) (53° 25' N., 4° 45' E.).	BN. " "	17-18	25	..	F.	
		1st Oct. "	E. 744	30	E. by S. 1/2 S. 135 miles from Spurn L.V. (53° 30' N., 4° 1' E.).	G.Y. St. Tr. ..	..	30	..	M.	
		1st April 1904	E. 745	33	ca. 52° 44' N., 4° 3' E.	Dutch Smack, YM.	..	35'0	360	F.	Gutted.
		22nd " "	E. 757	24	Weser L.V. (53° 53' N., 7° 40' E.)	German Smack, H.	..	24	94	M.	
		6th May "	E. 764	24	Haaks L.V. (53° 3' N., 4° 10' E.)	Dutch Smack, TX.	15	25'5	..	F.	
		12th " "	E. 785	30	50 miles E. by S. of Corton L.V. (52° 35' N., 3° 22' E.).	YH. Mission Ship.	22-23	33'1	..	F.	V. years old.
		12th June "	E. 781	31	35 miles W. by S. of Terschelling L.V. (53° 12' N., 3° 58' E.).	LO. St. Tr. ..	15-16	32'3	..	M.	Fish landed at Lowestoft. V years old.
		21st " "	E. 778	24	148 miles E. by S. from Spurn (53° 44' N., 4° 23' E.).	G.Y. " "	20	25'9	..	M.	IV. years old
		17th Aug. "	E. 771	27	165 miles E.S.E. Spurn L.V. (loc. incert.; ca. 53° 30' N., 4° 40' E.).	" "	17	31'2	..	F.	IV+ years old.
		25th Sept. "	E. 737	26	200 miles N.E. by N. Ostend (54° 23' N., 4° 36' E.).	Belgian St. Tr., O.	..	30'5	..	F.	
		8th Oct. "	E. 749	23	55° 4' N., 4° 15' E.	G.Y. St. Tr. ..	25	24'5	95	M.	Gutted. V+ years.

GARSTANG: EXPERIMENTS WITH MARKED FISH.

No. of Experiments.	Particulars of Liberation	Date.	No. of Label.	Original Length, cm.	Locality Reported.	Vessel.	Depth, fms	Ultimate Length, cm.	Weight, Grams	Sex.	Remarks.	
XXIX	Liberated— (a) 3rd Dec. 1903. 19 Plaice. Lat. 53° 33' N., Long. 5° 52' E. (b) 3rd Dec. 1903. 14 Plaice. Lat. 53° 34' N., Long. 5° 47½' E.	30th Jan. 1904	E. 799	28.6	Lat. 53° 40' N., Long. 6° E.	GY. St. Tr. . .	..	28.6	..	F.	
		23rd Apr. "	E. 791	26.7	Lat. 54° 45' N., Long. 8° E.	" " " "	(Sic) 12	29.0	..	F.	(Depth inconsistent —W.G.) IV. years old.	
		26th " "	E. 795	26.3	Light of Ameland S.S.E. 10 miles (53° 35' N., 5° 30' E.).	Belgian St. Tr., O.	12	27.0	180	F.	V. years old.	
		26th " "	E. 794	30.9	5 miles N.E. of Ameland Light (53° 31' N., 5° 40' E.).	GY. St. Tr. . .	12	31.2	245	M.	Gutted. IV. years old.	
		8th June "	E. 793	28.0	S.W. by S. to W. by S. 5 miles of Norderney (53° 48' N., 7° 16' E.).	" " " "	8-9	29.0	
		18th July "	E. 789	26.5	52° 37' N., 4° 7' E.	Dutch Smack, YM.	..	28.5	M.	
		19th Feb. "	E. 1507	26.5	S.E. by E. 55 miles from Lowestoft (52° 12' N., 3° 10' E.).	LT. Smack ..	18	26	M.	
		9th Apr. "	E. 1513	23.5	9 miles N.N.W. off Ameland (53° 35' N., 5° 29' E.).	Belgian St. Tr., O.	..	23	F.	IV. years old.
		18th May "	E. 1509	24.7	N. of Norderney in 11 fathoms (53° 51' N., 7° 18' E.).	German St. Tr., SD.	11	25	M.	
		4th June "	E. 1514	23.9	53° 48' N., 5° 10' E.	Belgian St. Tr.,	26.5	M.	
		5th July "	E. 1517	24.0	90 miles E. of Lowestoft (52° 53' N., 4° 13' E.).	LT. Smack ..	16	29.5	235	M.	Gutted.	
		1st Aug. "	E. 1516	20.7	Lat. 52° 45', Long. 3° E.	GY. St. Tr. . .	20	25.8	112	F.	Gutted. III+ years old.	
		26th " "	E. 1511	23.1	160 miles E. by N. Inner Dowsing (54° 28' N., 4° 44' E.).	BN. " " "	26	28.7	180*	F.	*Weight when received. 8 ozs.=228 grs. when fresh, fide agent. IV+ years old.	
29th Dec. "	E. 1506	29.5	N. Hinder L.V. bearing S. about 6 miles (51° 43' N., 2° 31' E.).	R. Smack ..	23	31.1	245	M.				
XXX.	Liberated. 11th Dec. 1903. 16 Plaice. Lat. 53° 3½' N., Long. 2° 42½' E.	30th Jan. 1904	E. 1534	25	Lat. 52° 40' N., 3° 50' E.	Dutch Smack, SCH.	..	26.1	121	M.		
		5th Feb. "	E. 1522	30	About 30 miles E. by S. of Lowestoft (52° 32' N., 2° 34' E.).	LT. Smack ..	26	30.2	213	M.	Fish thin.	
		Prior to 25th Feb. 1904.	E. 1531	44	Found on Pontoon, Grimsby .. .	" " " "	..	45	F.	
		27th Feb. 1904	E. 1527	28	E. by N. 65 miles from Spurn L.V. (54° 3' N., 1° 50' E.).	GY. St. Tr. . .	36	28.3	194	F.	Tail slightly dry.	
		20th Mar. "	E. 1528	26	E.S.E. 40 miles from Lowestoft (52° 25' N., 2° 50' E.).	LT. Smack ..	18	27.2	166	F.		
		29th Apr. "	E. 1520	29	E. by S. 53 miles from Lowestoft (52° 34' N., 3° 12' E.).	" " " "	18	32.1	350	F.	IV. years old.	
		28th Aug. "	E. 1526	32	175 miles N.E. by E. from Ostend (51° 2½' N., 4° 29' E.).	Belgian St. Tr., O.	..	36	
XXXI.	Liberated— (a) 12th Dec. 1903. 62 Plaice. Lat. 53° 26½' N., Long. 2° 35' E. (b) 12th Dec. 1903. 33 Plaice. Lat. 53° 28½' N., Long. 2° 29' E.	3rd Feb. 1904	E. 1556	29	8 miles N. by W. of Galloper L.V. (51° 52' N., 1° 50' E.).	R. Smack ..	16	29.5	186	M.	Fish thin. Gutted	
		6th " "	E. 1571	28	55 miles E. by N. of Lowestoft (52° 54' N., 3° 8' E.).	LT. Smack ..	18	27.5	200	F.		
		Prior to 12th Feb. 1904.	E. 1545	28	Found on Pontoon, Grimsby .. .	" " " "	..	29	222	M.		
		15th Feb. 1904	E. 1587	25	Lat. 53° 40' N., Long. 2° 40' E.	GY. St. Tr. . .	19	25.2	1.3	M.	Tail slightly dry.	
		6th Mar. 1904	E. 1610	31	Lat. 53° 35' N., Long. 3° E.	" " " "	17	32	277	M.	Gutted.	
		11th " "	E. 1550	28	Lat. 52° 48' N., Long. 4° 33' E.	Dutch Smack, KW.	..	28	155	M.		
		23rd " "	E. 1598	33	7 miles off Winchelsea (50° 49' N., 0° 45' E.).	Hastings boat ..	..	..	426	..	15 ozs.
		30th " "	E. 1580	27	About 10 miles E.N.E. of Leman and Ower L.V. (53° 15' N., 2° 10' E.).	LT. Smack ..	17	28.2	191	M.	Gutted.	
		2nd Apr. "	E. 1536	28	50 to 60 miles E. by S. of Lowestoft (52° 35' N., 3° 16' E.).	" " " "	15-16	28.6	190	F.	Gutted. IV. years old.	
		15th " "	E. 1613	33	76 miles E. by S. ¼ S. from Spurn (53° 32' N., 2° 20' E.).	GY. St. Tr. . .	14	34.4	325	F.	V. years old.	
		16th May "	E. 1535	27	50 miles S.E. by E. of Lowestoft (52° 14' N., 3° 10' E.).	LT. Smack ..	16	29.0	221	M.	Gutted. IV. years old.	
		21st June "	E. 1594	27	60 miles N.E. of Lowestoft (53° 20' N., 2° 34' E.).	" " " "	15	29.8	245	M.	Gutted. IV. years old.	
		26th " "	E. 1614	27	85 miles E. ¼ S. from Spurn L.V. (53° 52' N., 2° 30' E.).	GY. St. Tr. . .	24	31.3	360	M.	V. years old.	
		4th July "	E. 1584	32	Found on Pontoon, Grimsby .. .	" " " "	..	33.2	296	M.	Gutted. IV. years old.	
16th Sept. "	E. 1619	26	53° 22' N., 0° 23' E. 4 miles off Mablethorpe.	GY. St. Tr. . .	5	30.5	260	M.	Gutted. IV+ years old.			

APPENDIX I.

MARINE BIOLOGICAL ASSOCIATION.

List of Local Agents for receiving Marked Fish.

NORTH SHIELDS.—Mr. A. J. Freeth, Fish Quay.
 HARTLEPOOL.—Messrs. J. Graham & Sons, 1, Fish Market.
 SUNDERLAND.—Mr. James Hall, South Dock.
 SCARBOROUGH.—Messrs. J. Sellers & Son, Limited, 1, West Pier.
 BRIDLINGTON.—The Harbour Master (Mr. A. R. Stephenson).
 HULL.—Mr. W. C. Edwards, Mercantile Marine Office, St. Andrew's Dock.
 GRIMSBY.—Mr. O. T. Olsen, F.L.S., F.R.G.S., Fish Dock Road.
 BOSTON.—Mr. F. Donnison, Manager, Deep Sea Fishing and Ice Company.
 YARMOUTH.—Mr. H. E. Hurrell, "Norfolk News" Office, 25, Regent Street.
 LOWESTOFT.—Marine Biological Laboratory.
 BILLINGSGATE.—The Chief Inspector of the Fishmongers' Company, Billingsgate Market.
 RAMSGATE.—The Harbour Master (Capt. H. E. Inskip, R.N.).
 HASTINGS.—Mr. W. Diton, 4, The Croft.
 BRIGHTON.—Messrs. R. Gillam & Son, 173, Arch, Beach.
 BRIXHAM.—Mr. W. J. Sanders, J.P., St. Elmo.
 PLYMOUTH.—Marine Biological Laboratory, Citadel Hill.

APPENDIX II.

Copy of Notice posted during 1903.

INTERNATIONAL FISHERY INVESTIGATIONS.

MARKED FISHES IN THE NORTH SEA.

NOTICE TO FISHERMEN.

A large number of living flat fish, especially PLAICE and SOLES, have been marked with numbered labels of different kinds (bone buttons, brass disks, aluminium rings, &c.), and have been set free in various parts of the North Sea, in order to trace their migrations.

English fishermen, who catch any of these marked fishes, are requested to take note of the PLACE, DEPTH and DATE OF CAPTURE, and to hand the fish, with particulars of capture, to the local agents of the Marine Biological Association of the United Kingdom.

REWARDS.

The following Rewards will be paid :—

- | | | | |
|------|---|--------|----------------|
| I. | For the fish and label complete, with information as to PLACE and DATE OF CAPTURE | ... .. | TWO SHILLINGS. |
| II. | For the label alone, with the same information | ... .. | ONE SHILLING. |
| III. | For the label alone, without information | ... .. | SIXPENCE. |

In the case of valuable fishes the market price will be paid in addition to the reward.

AGENT at

AT OTHER PORTS fishermen are requested to consult the notices posted on the fish quays, or to forward the fish direct by post (packed in a cardboard box or in brown paper), together with full particulars, to the undersigned. In such cases postage expenses will be repaid and the rewards forwarded by post.

(Signed) WALTER GARSTANG,
Marine Biological Association,
 LOWESTOFT.



SOUTH PART OF NORTH SEA
 Scale 1:1,200,000
CHART I.
MIGRATIONS OF MARKED PLAICE.

Experiment 1 - November, 1902. (Red).
 Experiment 2 & 3 - December, 1902. (Blue).

Positions of liberation are shown by thick coloured circles enclosing the number of the experiment.

Each position of recapture is marked by a dot, by the side of which is placed a Roman number, indicating the month of recapture, and an Arabic number representing the initial length of the fish in cm.

Contour lines define the distribution of recaptures from each experiment for stated periods.

CONTOUR LINES.

—	10	METRE LINE.
- - -	20	"
.....	40	"
- - - - -	60	"

EQUIVALENT DEPTHS.

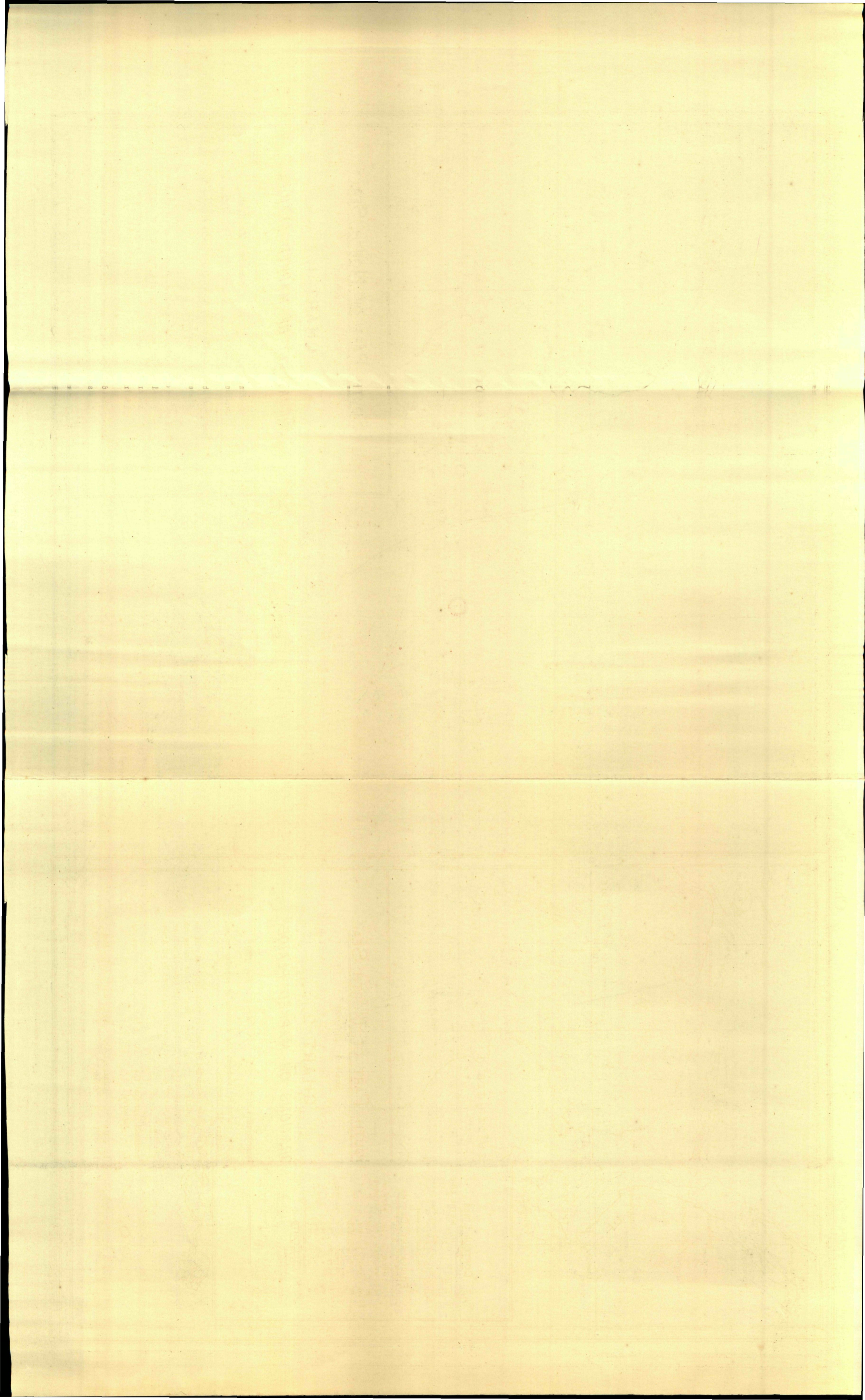
1	METRE = 0.5	FATHOM
10	METRES = 5.4	FATHOMS
20	" = 10.9	"
40	" = 21.8	"
60	" = 32.8	"

1	FATHOM = 1.8	METRES
5	FATHOMS = 9.1	"
10	" = 18.2	"
20	" = 36.6	"
30	" = 55.0	"

LIGHTS.
 HOUSES - - - - -
 VESSELS - - - - -
 THE POSITION OF THE LIGHT IS INDICATED BY THE BLACK SPOT.

Two other captures further North, Nos. 686 & 728, in July & August. (Exp. 2 & 3).

Declination at 53° 20' N. 3° 20' E. (1895)





Exp. 17. One recapture on Digger Bank in Feb., 1903. (No. 159. 31 cm.)

CONTOUR LINES.	
—	10 METRE LINE.
- - -	20 " "
· · ·	40 " "
· · ·	60 " "

EQUIVALENT DEPTHS.	
1	METRE = 0.5 FATHOM
10	METRES = 5.4 FATHOMS
20	" = 10.9 "
40	" = 21.8 "
60	" = 32.6 "

EQUIVALENT DEPTHS.	
1	FATHOM = 1.8 METRES
5	FATHOMS = 9.1 "
10	" = 18.2 "
20	" = 36.6 "
30	" = 55.0 "

LIGHTS.

HOUSES ————

VESSELS ————

THE POSITION OF THE LIGHT IS INDICATED BY THE BLACK SPOT.

SOUTH PART OF NORTH SEA

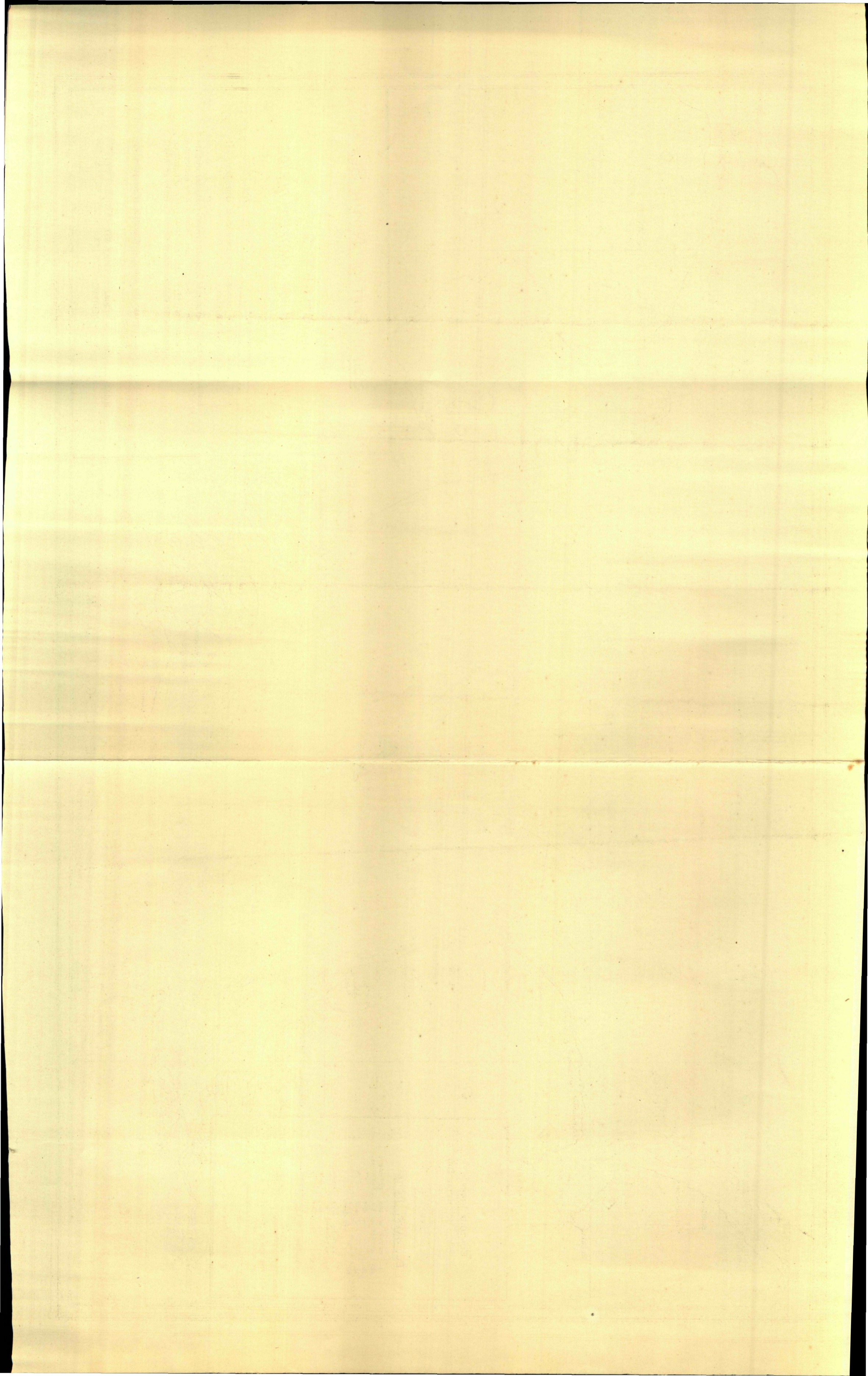
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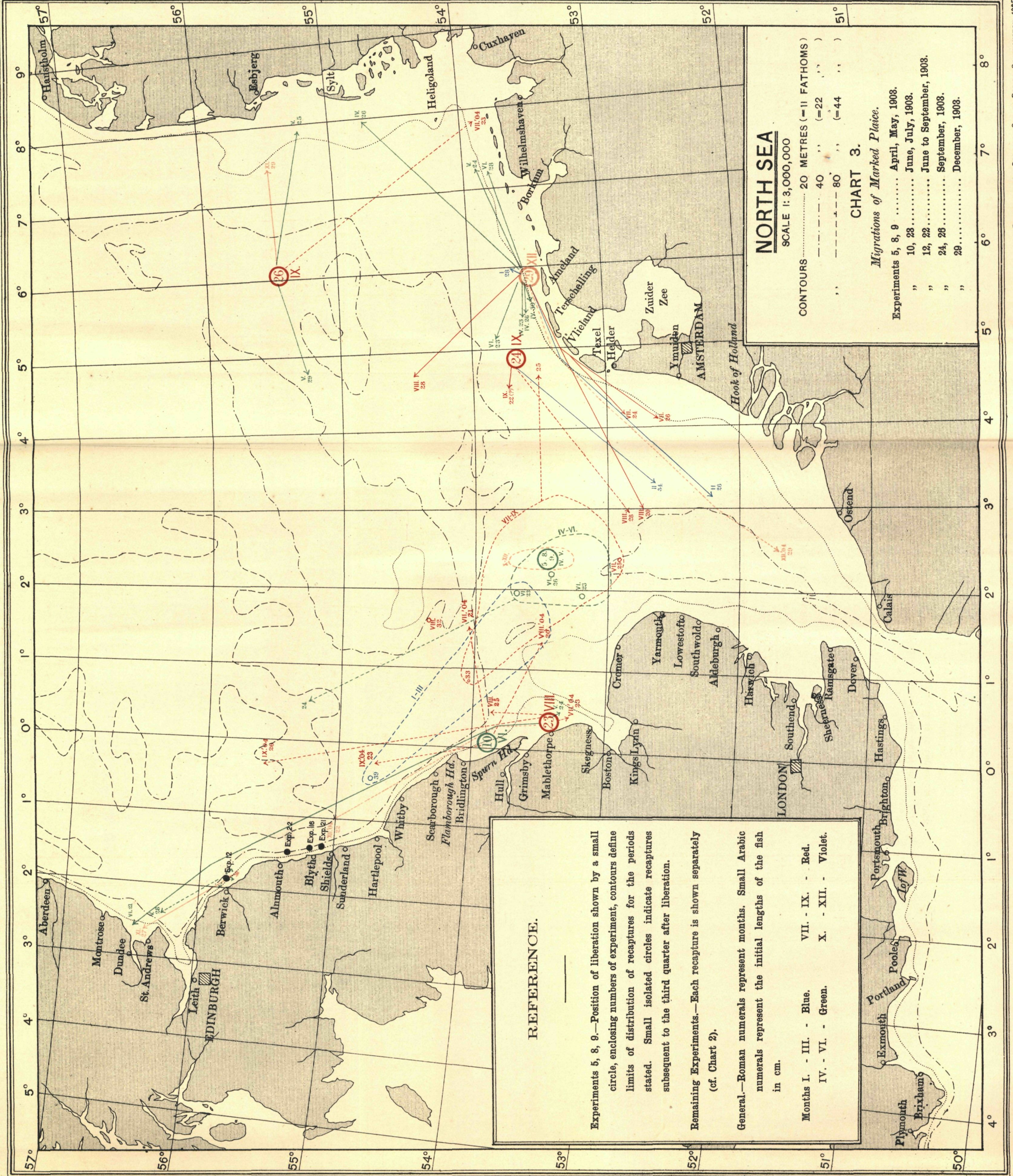
CHART 2.
MIGRATIONS OF MARKED PLAICE.

Experiments 4, 6, 7 - - - - - March - - - - - May, 1903.
Large Arabic numerals represent the numbers of experiments and positions of liberation.

Positions of recapture are marked by small symbols connected with the liberation points by straight lines. Broken lines distinguish recaptures subsequent to the third quarter after that of liberation. The initial size of each recaptured fish is shown by an Arabic numeral.

Roman numerals represent the month of liberation or recapture, e.g.
I - - - - - January.
Months I. - III. - - - - - Blue. VII. - IX. - - - - - Red.
IV. - VI. - - - - - Green. X. - XII. - - - - - Violet.





REFERENCE.

Experiments 5, 8, 9.—Position of liberation shown by a small circle, enclosing numbers of experiment, contours define limits of distribution of recaptures for the periods stated. Small isolated circles indicate recaptures subsequent to the third quarter after liberation.

Remaining Experiments.—Each recapture is shown separately (cf. Chart 2).

General.—Roman numerals represent months. Small Arabic numerals represent the initial lengths of the fish in cm.

Months I. - III. - Blue. VII. - IX. - Red.
 IV. - VI. - Green. X. - XII. - Violet.

NORTH SEA

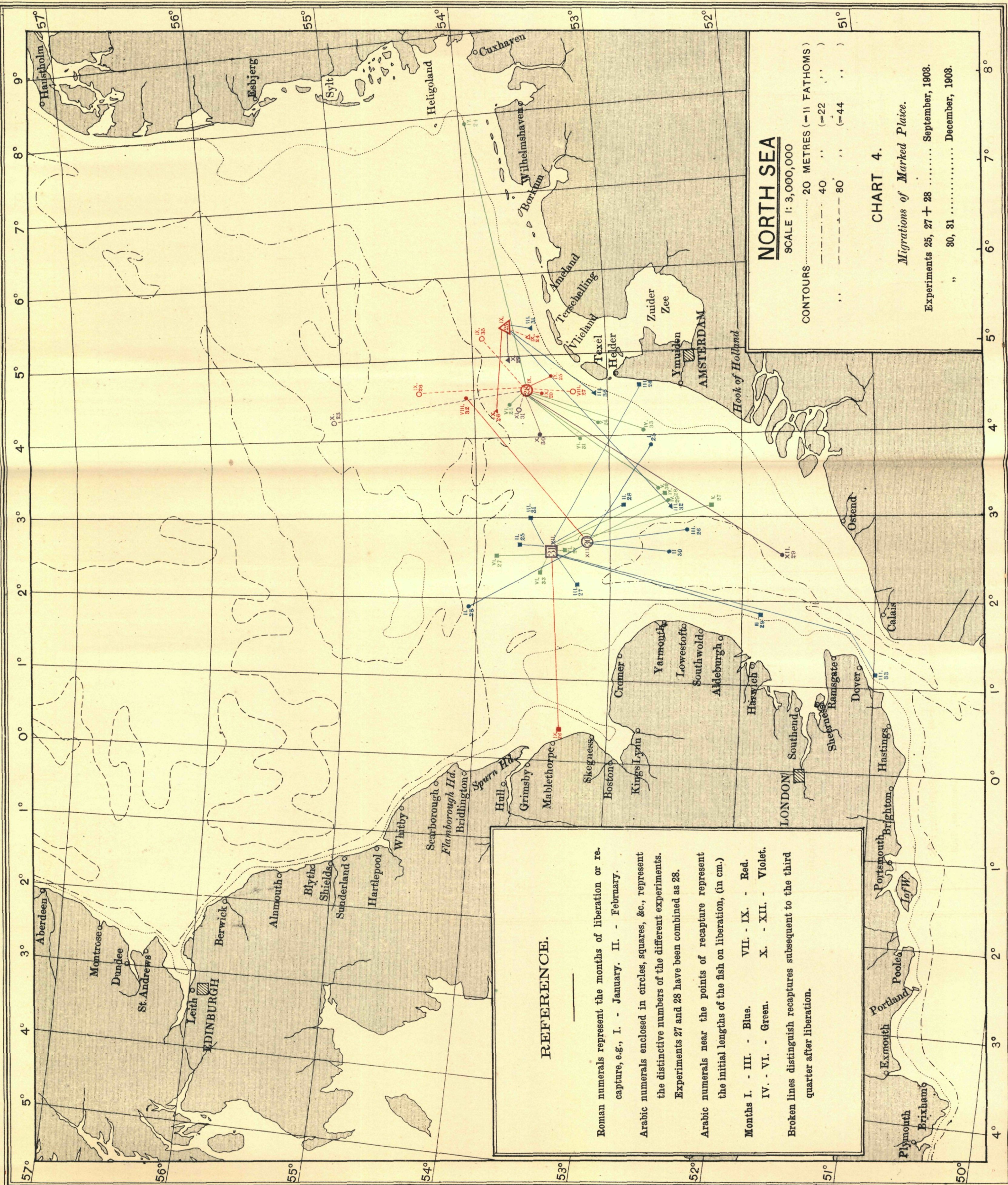
SCALE 1: 3,000,000

CONTOURS 20 METRES (= 11 FATHOMS)
 - - - - - 40 " (= 22 ")
 - - - - - 80 " (= 44 ")

CHART 3.

Migrations of Marked Plaice.

Experiments 5, 8, 9 April, May, 1903.
 " 10, 23 June, July, 1903.
 " 12, 22 June to September, 1903.
 " 24, 26 September, 1903.
 " 28 December, 1903.



REFERENCE.

Roman numerals represent the months of liberation or recapture, e.g., I. - January. II. - February.

Arabic numerals enclosed in circles, squares, &c., represent the distinctive numbers of the different experiments. Experiments 27 and 28 have been combined as 28.

Arabic numerals near the points of recapture represent the initial lengths of the fish on liberation, (in cm.)

Months I. - III. - Blue. VII. - IX. - Red.
 IV. - VI. - Green. X. - XII. - Violet.

Broken lines distinguish recaptures subsequent to the third quarter after liberation.

NORTH SEA

SCALE 1: 3,000,000

CONTOURS 20 METRES (= 11 FATHOMS)
 - - - - - 40 " (= 22 " "
 - - - - - 80 " (= 44 " "

CHART 4.

Migrations of Marked Plaice.

Experiments 25, 27 + 28 September, 1908.
 " 30, 31 December, 1908.

