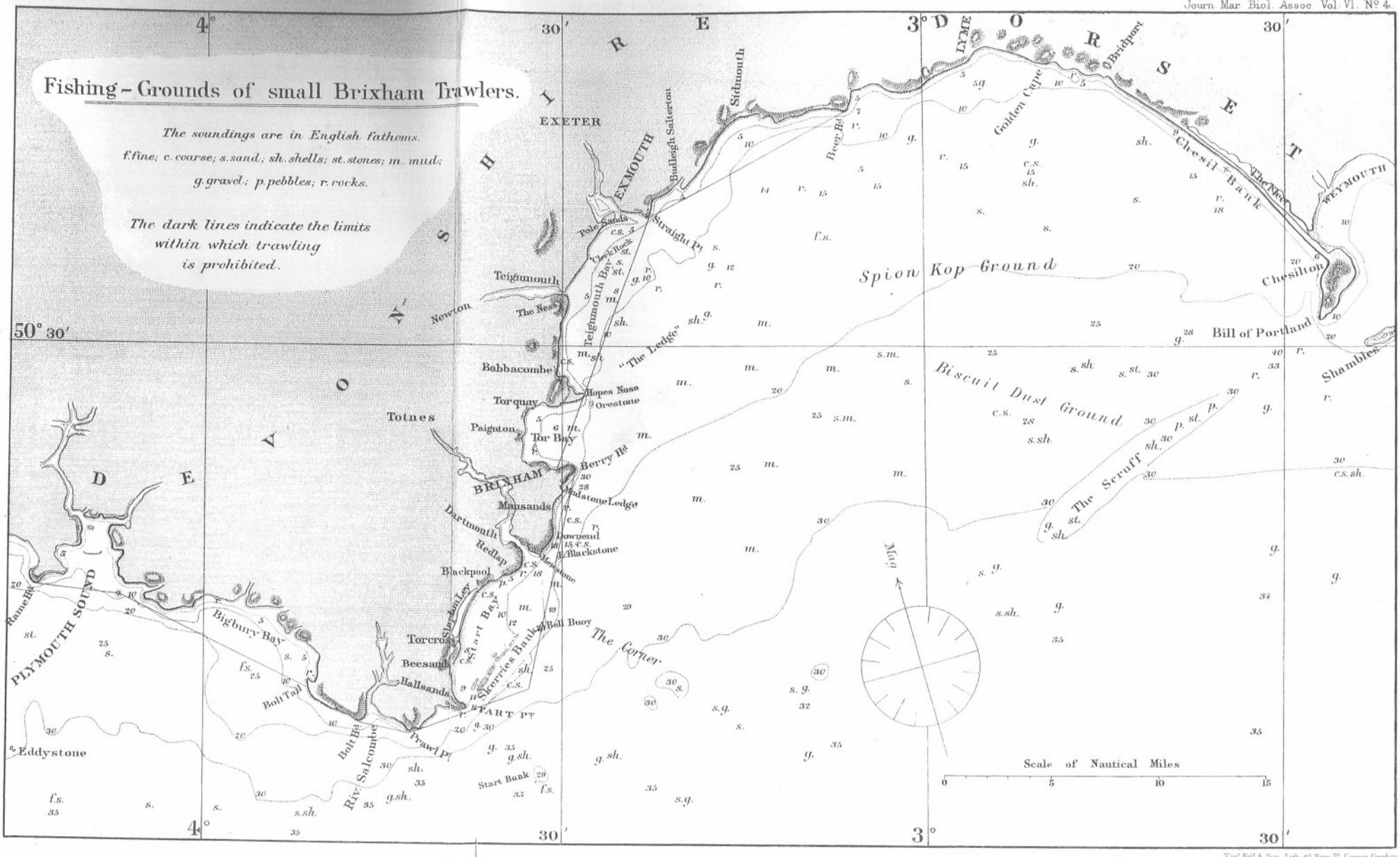

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Report on Trawling and other Investigations carried out in the Bays on the South-East Coast of Devon during 1901 and 1902.

PREPARED FOR
THE INFORMATION OF THE DEVON SEA FISHERIES COMMITTEE.

By

Walter Garstang, M.A., F.Z.S.,

Naturalist in charge of Fishery Investigations.

(*With one chart.*)

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INTRODUCTION.

THE investigation of the trawling-grounds in Start Bay, Torbay, and Teignmouth Bay, which had been previously investigated in 1895–8 by Messrs. Stead * and Holt,† was resumed by the Marine Biological Association in 1901, under authority from the Devon Sea Fisheries Committee.

* Stead, "Preliminary Note, etc.," *Journ. M. B. A.*, iv., 1896, pp. 90–6.

† Holt, "Report on Trawling, etc.," *Journ. M. B. A.*, v., 1898, pp. 296–329.

The new investigations were placed in the hands of Dr. H. M. Kyle, on his appointment as Assistant Naturalist to the Association, and were carried out by him at nearly regular monthly intervals from the end of July, 1901, to the beginning of September, 1902, by means of the Association's s.s. *Oithona*, and with the assistance from time to time of various members of the staff, especially Mr. Todd. Mr. L. W. Byrne, during his visits to the Plymouth Laboratory, also volunteered his assistance in the work at sea on several occasions.

In addition to the trawling investigations, Dr. Kyle arranged for the collection of special statistics dealing with the Brixham fisheries. These covered the period from the beginning of February, 1902, to the end of January of the current year.

The manuscript of Dr. Kyle's report was received in March, but owing to difficulties in the work of revision which supervened after Dr. Kyle's removal to Copenhagen, I received instructions from the Council of the Association to draw up a new report, embodying as much of Dr. Kyle's manuscript as might be possible, which accounts for the delay which has taken place in the publication of the results. With the exception of the tables dealing with the reproduction of the plaice, which were prepared by Dr. Kyle, the figures representing the *Oithona's* work in the present Report have all been compiled under my supervision direct from the original log-books. Mr. T. C. Jerrom was appointed to assist me in this work, and I have much pleasure in acknowledging the care and accuracy in detail with which he has carried out his task. The special statistics of the quantities of fish landed at Brixham have been retained in the form in which they were submitted by Dr. Kyle, except for the correction of some insignificant arithmetical errors.

SECTION I.

The Brixham Fishing-Grounds and Fishery Statistics.

By

H. M. Kyle, M.A., D.Sc.,

Late Assistant Naturalist to the Association.

(*With Table A at end.*)

There was a time, and that not many years ago, when the fishing-boats of Brixham sailed round to the east coast of England and joined with the fleets of London, Lowestoft, Yarmouth, and Grimsby in exploiting the fishing-grounds of the North Sea.* This carries us back at least two generations, but if one chose to hunt through old records, one might find mention of Brixham and its fishing many centuries ago.† The records may even go back to an earlier date than the Armada, but its past history, though of exceptional interest, is of no importance to our present purpose, and we may turn to the doings of the men of Brixham at the present day.

Even a casual visitor to this port of South Devon would notice at once that the big boats are of two distinct types and sizes, the larger ones ketch-rigged, the smaller mostly with the cutter rig, and this would suggest differences in the size of gear employed and in the fishing-grounds visited by each. The large boats are over fifty tons burden, intentionally under-rigged, and able to go anywhere and stand any sea short of that raised by a hurricane. The trawl they use is of forty-five to forty-seven-foot beam. The small boats mostly run about twenty-five tons, and in unsettled weather cannot venture more than a few miles from land. Their trawl has only a thirty-six to forty-foot beam. Between these two types of boat there is a third of about thirty tons, which from the fact of its being modelled on the boats of Ramsgate is, like them, called a "Tosher." Very few boats of this type, however, exist at Brixham.

* For the place which Brixham has taken in the development of the North Sea fishing, see E. W. L. Holt, *Journ. M. B. A.*, vol. iii. p. 363.

† See Holdsworth, *Deep Sea Fishing*, who suggests that Drake used the Brixham men and boats against the Spaniards.

The large boats, generally called the smacks or dandies, formerly journeyed every year to the North Sea, but some twelve years ago they were crowded out by the ever-increasing fleets of Lowestoft, Yarmouth, and Grimsby. Some of the men remained at these ports, and have aided in making them great fishing centres, but the majority turned in the opposite direction, and as the English Channel was seemingly not rich enough to support all, they made their way into the Bristol Channel. There they discovered new and exceedingly rich trawling-grounds, and year by year they have continued to pass round Land's End in early spring, gradually extending their field of operations along the North Cornwall, Welsh, and Irish coasts as far north as the Irish Sea, and opening up new fishing centres, as Milford and Dublin, wherever they went.

Since the majority of these boats are away from Brixham for the greater part of the year, and mostly land their fish at other ports, it is impossible to obtain even an approximate measure of the value of the grounds on which they fish. Some impression of their richness may, however, be obtained from the quantities of soles occasionally sent over to Brixham by rail from Padstow in North Cornwall.

During March, 1902, 12,700 pairs of soles.
„ April „ 17,400 „ „
„ May „ 8,300 „ „

The ground on which these are caught, said to be very coarse and rough, is called by the fishermen "ross"-ground on account of the hard masses of Lepralia and of Alcyonium on shells, which abound there. Plaice, turbot, and rays are also caught in considerable quantities, but the distinctive feature is undoubtedly the large supply of soles.

As the boats move further up the Bristol Channel and on to the Welsh grounds, their catches are quite lost to Brixham, which renders it impossible to give even a sample of what they obtain. According to all accounts, however, the characteristic of the fishing is still the great capture of soles.

Whilst the majority of the smacks spend the greater part of the year on the west coast, a varying number remain nearer home, and in the autumn all the boats are fishing in the English Channel. The grounds they work over extend from Portland to Land's End, usually between the twenty- and forty-fathom lines. The nature of the grounds is practically the same throughout, and is of coarse sand, shell, and gravel, with patches of stones and occasionally fine sand. As may be imagined, the catches consist largely of rays, red gurnards, and the prime fish—soles, turbot, etc. Sometimes the turbot seem to be exceedingly abundant, as during the past autumn, and in certain places,

e.g. Mount's Bay, large quantities of plaice and soles are caught in their seasons. On the rough patches, off the Start and off Portland, the liners ("bolters") procure great hauls of conger, cod, ling, and rays. Since the smacks frequently land their catches at Plymouth, or at various ports in the south of Cornwall, it has been found impossible to give even an approximate measure of the value of the grounds in question. That these are rich and valuable there can be no doubt, for they support the Plymouth sailing-trawlers all the year round as well as frequent steam-trawlers from French and English ports. But the roving instinct of the Brixham fisherman, as well as his desire for greater gains, leads him to prefer the Bristol Channel.

We come lastly to the home grounds and the small trawlers. A few of the large smacks fish on these grounds occasionally in the intervals of coming from and going to the Bristol Channel; but they may be neglected for the present until we have discussed the fishing of the small boats. These number about seventy, and are known locally by the peculiar term "Mumble Bees," said to be derived from a small fishing village called Mumbles, near Tenby in Wales. Some of the fishermen who went round to the Bristol Channel found at Mumbles this smaller type of boat, cutter-rigged and about twenty-five tons, and adopted it for the inshore fishing near Brixham. It follows that the Mumble Bees are a comparatively recent innovation, though it must not be supposed that there were no small trawlers at Brixham before their introduction. As a matter of fact, there was a smaller class of boat, under five tons and without deck, which still persists at that port and other places round the coast, but they are for the most part employed in hooking or lining at the present time.

The fishing-grounds of the Mumble Bees lie within the area Start Point to Portland (see chart). If a line were drawn from Start Point six miles to the south-east, thence to the inner edge of the "Scruff" and on to Portland, it would embrace the region beyond which the Mumble Bees seldom venture. The line would enclose about 700 square miles of sea, little more than one-half of which is worked by the trawlers. Rocks prevent trawling within the fifteen-fathom line from the Orestone off Torbay right to Portland, and there are several rocky patches off Downend, *i.e.* between Berry Head and Start Point. The trawlable area is thereby reduced to less than 400 square miles, and 70 square miles have been further cut off by the closure of the inshore grounds—that is to say, the proportion of the enclosed grounds to the outside trawlable area is about one-fifth.* Before the closure

* The proportion is less in reality, because the crab-pots on the Skerries Bank and the rocks closer inshore cut off one-third of Start Bay as a trawlable area. The proportion of trawlable area within the enclosed waters to that outside is therefore about one-sixth.

of the bays the outside trawling-grounds were more restricted, but since that time the fishermen have been driven by force of circumstances to trawl on grounds they had never before frequented.

The various parts of the trawling area are fairly well differentiated from one another by the bottom-soil, and are known to the fishermen by distinctive names. Along the northern portion, in fifteen to twenty-two fathoms, lies the "Spion Kop" ground, so called by the Brixham men from some fancied resemblance of the promontories along the coast to the famous battlefield in Natal. The soil is composed of medium to fine sand, with coarse patches here and there. Pectens (queens) and other shell-fish are abundant, and the ground is liable to become very foul by sudden incursions of star-fishes, sea-urchins, and drift-weed. How these can suddenly appear and as quickly disappear within a few days is one of the unsolved mysteries of the region.

The Brixham men did not trawl on this Spion Kop ground till three years ago, and visit it only during the spring. At that season the plaice are returning to the inshore waters, and this is one of the main lines of the migration. The plaice are not large, and last year (1902) they were said to be smaller on the average than in previous years. Soles are also obtained there, likewise whiting, dabs, and gurnards; but the mainstay of the fishing is the plaice.

To the south-east of the Spion Kop ground lies the "Biscuit Dust" ground, twelve miles off Berry Head and running up to within six miles of Portland. It is so called from the bright golden yellow colour of the coarse sand and shells which compose its soil. Starting at about twenty-seven fathoms, it extends out to thirty fathoms, where it merges into the "Scruff." The fish obtained here are plaice at the spawning time in early spring, soles, rays, and sometimes in the autumn considerable quantities of red mullet.

The Scruff is not a regular trawling-ground, its coarse soil and "hummocky" nature being too dangerous, especially for the comparatively light materials of which the small trawlers' nets are made. The large smacks with their stronger nets of manilla might tow over it, and at the eastern corner the liners often procure large catches of ling and rays. At the western end of the Scruff, however, lies a favourite trawling-ground, especially in late spring, when fine catches of whiting are often obtained.

Following along the line of the Scruff, towards Start Point, we come to the "Corner," which in late spring and summer is the rendezvous of all the small trawlers. It lies across the thirty-fathom line, six to ten miles off Dartmouth Fairway with Prawle Point clear of Start Point. Fish are abundant there during the season, and include soles, lemon-soles, a few turbot, plaice, dabs, whiting, gurnards, and rays; in

fact, it is the richest ground within the area. The invertebrate fauna is also rich and distinct from that of the other grounds. The crabs Polybius, Atelecyclus, Corystes, and the heart-urchin Echinocardium are more plentiful here than anywhere else.

The central region of muddy ground has no particular name, but is well fished over at all seasons of the year for the sake of the ubiquitous whiting. Along the western margin of the area there are several well-known trawling-grounds, *e.g.* "New Ridge," off Downend, and the "Hitches," off Berry Head, which really form part of the central region, and require no special mention.

Although the grounds are so distinct from one another that an expert salesman can tell where a catch of fish has come from, it has not been thought of any practical importance to distinguish them in the statistics. Also, as the Mumble Bees rarely go beyond the limits mentioned, it has been a comparatively easy task to obtain an approximate measure of the value of these grounds. A few small trawlers from other ports—Torquay, Exmouth, Beer—fish on the same grounds, but the quantities they catch are quite negligible. The same cannot be said, however, with regard to the large Brixham smacks which occasionally fish within the area, and their catches require to be taken into account.

An explanation may now be given of the method by which the data of the boats' catches have been obtained. As is generally recognised, it is by no means easy to collect statistics which will give precise information on any points other than those considered in the returns of the Board of Trade, for the simple reason that the mode of selling fish determined by custom and practice is in no way suited to theoretical requirements. It would be absurd to expect the fishermen and fish salesmen to alter their customs, and that in several and diverse directions, since theoretical requirements are many; so one is obliged to make the best compromise possible between what one wishes and what one can get.

The practice of the Brixham Mumble Bees in arranging their fish for sale is somewhat different from that employed on the east coast, where the fish are carried ashore in large baskets or panniers, and then put into a standard size of box, or arranged in lots. At Brixham the large boats treat their fish in the latter way; but the small boats, which carry no ice, and are only fishing for a day or two at a time, have them packed and ready for sale before landing. When the trawl is emptied on deck after a haul the smallest fish and the useless species are thrown overboard; the prime fish—soles, turbot, etc.—are laid apart, and the large fish of the remaining species (offal), as plaice and whiting, are separated from the small and placed in the trunks, whilst the small fish are packed into small baskets. A larger basket, called a "maund," is occasionally employed by the Mumble Bees when they have a few large fish, but not

sufficient to fill a trunk. On the other hand, the maund is the only small basket which the large smacks employ.*

As the fish are sold in trunks and small baskets, it might be thought a simple matter for an expert to tell the quantities of large and small fish. As a general rule this is the case, and the size used by the fishermen to distinguish large from small, *i.e.* the fish of the trunks from those of the baskets, agrees closely with a standard chosen for a special purpose of the present research. As shown in describing the fishing-grounds, whiting form the staple support of the fishermen for the greater part of the year, and if we omit the prime fish, plaice rank next in importance. Of the whiting and plaice, all below 8 inches are thrown overboard, those between 8 and 11 inches are packed in the baskets, and those over 11 inches in the trunks. Sometimes the small are placed in trunks when very numerous; this happens most often with whiting, but not so frequently with plaice. On the other hand, some larger plaice are often packed into the small baskets when too few to make up a maund, and they may be taken to counterbalance the small plaice packed in the trunks. This has been done in the present work, and it may be remarked that this method of forming an estimate lessens the number of small plaice rather than the large ones.

Sometimes also small plaice, when too few to fill a separate basket, are packed in the same basket with dabs and flounders, and similarly the whiting with gurnards. Their number is, however, negligible, as plaice and whiting are the best of the "offal," and it would be bad policy on the fisherman's part to mix them with the others.

The difficulties of obtaining the numbers of small and large plaice and whiting reduce themselves therefore to those of simple enumeration. When a large quantity of fish is landed at one time there is some difficulty in counting all the baskets and trunks, but as a general rule the task is a comparatively easy one.

The only other species which has been taken into account is the sole. The quantities landed of this fish are readily obtainable, as they are always spread out on the ground in pairs.

Plaice, soles, and whiting were chosen for special investigation, for the reason that they are by far the most important species; and, further, since the work was entirely new, and at first of considerable difficulty, it was considered more desirable to obtain definite information with regard to a few species than imperfect records of many.†

* The maund, four of which are equal to a trunk, is so seldom employed by the Mumble Bees that it might have been disregarded, but where it occurred in the statistics it has been converted into its equivalent in trunks.

† Mr. Will Sanders, a trustworthy fish salesman of Brixham, recorded the daily returns of fish landed. Although the information is definite, no claim is made that it is perfect. There are several shortcomings in detail. . . .

To begin with the plaice, Holt, in his *Examination of the Present State of the Grimsby Trawl Fishery*, p. 409, has given the numbers of plaice that a trunk will hold. He takes 250 as being the average number of plaice under 12 inches; for larger fish the numbers are considerably less. These numbers apply to the North Sea plaice, and it appears that 9 stone is about the average weight of a full trunk. For the plaice landed at Brixham these numbers are somewhat too high; a full trunk only averages about 7 stone, and the numbers vary from 60 or 70 to 200, according as the plaice are 16 to 18 inches on the average or 10 to 12 inches. After counting and weighing the contents of several trunks the number chosen as best representing a trunk was 90,* and the figures in the following tables are based on this.

As the small baskets contain plaice of approximately the same size, there is much less difficulty in finding a number which represents the average they contain. In the following table 25 is employed. The sizes which go into the small baskets are from 8 to 10 inches in the great majority of cases; but as plaice over 10 inches are often sold with those under 10 inches, 11 inches has been the limit chosen.

In the accompanying Table I. the actual numbers of plaice landed by the Mumble Bees† are tabulated for each month of the year. Inasmuch as some of the larger smacks are at times working on the same grounds—namely, between Start Point and Portland—the numbers of plaice captured by them have been added at the end of each quarter.‡

The total number of "large" plaice obtained during the year amounts to 180,180. Of this number more than half were captured during February, March, and April, when the plaice were spawning in the deep water or returning to the inshore grounds after having spawned. The months when the larger fish are least abundant offshore are September, October, and November. It is worthy of remark that the numbers for the months rise from 360 in November to 49,860 in April, and descend again to 450 in October in an almost uniform manner.

* This number was partly based also on the estimate that the average weight of plaice was 1 to 1½ lbs. All the factors stated here—for whiting and soles as well—require further testing.

† The plaice landed at Torquay by the Brixham boats have been omitted. The effect is that the numbers of the small plaice are lower than they might have been. The Brixham boats land their catches at Torquay in the summer-time only. I do not think the omission amounts to more than one or two per cent. of the numbers recorded in the table, and the conclusion as regards distribution of small plaice is quite unaffected.

‡ The returns of the large boats were also taken daily by Mr. Will Sanders, but as they are comparatively few in number, their importance is sufficiently recognised in merely stating the total number of plaice captured by them during each three months.

TABLE I. *Numbers of Plaice captured by Brixham Fishing-Boats on the Grounds between Start Point and Portland, with proportions of small to large.*

(Abridged from Table A, p. 501.)

Month.	No. of Plaice under 11 inches.	No. of Plaice 11 inches & over.	Proportion of small to large.
February, 1902	4,325	22,590	19 : 100
March ,,	4,375	20,700	21 : 100
April ,,	19,800	49,860	40 : 100
Total for three months	28,500	93,150	30 : 100
Plus number captured by large smacks	1,225	4,365	28 : 100
Grand total for three months	*29,725*	*97,515*	*30 : 100*
May, 1902	4,350	12,420	35 : 100
June ,,	8,850	14,760	60 : 100
July ,,	9,650	10,710	90 : 100
Total for three months	22,850	37,890	60 : 100
Plus number captured by large smacks	2,950	6,705	44 : 100
Grand total for three months	*25,800*	*44,595*	*58 : 100*
Total for the six months, February to July	**55,525**	**142,110**	**39 : 100**
August, 1902	10,650	2,250	473 : 100
September ,,	6,550	1,260	519 : 100
October ,,	6,800	450	1,511 : 100
Total for three months	24,000	3,960	606 : 100
Plus number captured by large smacks	16,875	2,070	815 : 100
Grand total for three months	*40,875*	*6,030*	*678 : 100*
November, 1902	8,350	360	2,319 : 100
December ,,	6,700	2,700	248 : 100
January, 1903	10,250	7,920	129 : 100
Total for three months	25,300	10,980	230 : 100
Plus number captured by large smacks	21,375	21,060	101 : 100
Grand total for three months	*46,675*	*32,040*	*146 : 100*
Total for the six months, August to January	**87,550**	**38,070**	**230 : 100**
Total for the year, February, 1902, to January, 1903	*143,075*	*180,180*	*79 : 100*

The most remarkable fact which this table reveals is the large number of small plaice which are captured in the deep water, not merely in one month or season, but throughout the year. The largest number—that recorded in April—is 19,800, but those for the other months vary between 4,000 and 10,000. On account of this uniform distribution throughout the months, the numbers of small plaice are sometimes greater and sometimes less than those for the large plaice. They are less from February to July, and greater from August to December. The proportions of small to large are stated in hundredths in the third column. The fluctuation in these proportions—from 19 in February to 2,319 in November—is simply another expression of the varying supply of large fish.

The number of small fish landed for the year is a little over 143,000. The total number of plaice, large and small, is about 323,000, and of these the small plaice amount to 44 per cent. The records for the large smacks suggest that the small plaice may be relatively more abundant some distance from land than inshore, as the smacks always fish further out to sea than the Mumble Bees. Fifty-three per cent. of all the plaice landed by these large boats consisted of small fish.*

When we pass later to a comparison of the offshore fishing-grounds with Start Bay, it will be shown how important is the fact that the small plaice under 11 inches are distributed over the offshore grounds. We find similar phenomena in the North Sea off the Dutch coast to the east of the Dogger Bank † and elsewhere,‡ so that to naturalists the fact will come as no surprise.

Though the plaice is of higher importance for the purposes of the present paper, it is of less value to the Brixham Mumble Bees than the soles or whiting. The whiting is undoubtedly the most abundant

* It must be admitted that there is a possibility of error in these records for the large smacks, owing to the fact that the plaice landed by them are mostly in small quantities at a time and all sizes are mixed together. The percentage of small fish may therefore be a little lower than that stated.

[It must also be borne in mind that, while the number of Mumble Bees is practically constant throughout the year, the smacks work in greater numbers in the autumn than in the spring period; *i.e.* their hauls are most numerous in the season when the small fish predominate. I cannot on this account share my colleague's opinion that the figures suggest a higher proportion of small fish to large on the grounds worked by the smacks than on those worked by the Mumble Bees. On the contrary, the quarterly ratio of small fish to large is seen in the table to be lower for the smacks than for the Mumble Bees in each quarter except the third. In that quarter it is much less than the ratio yielded by the catches of the Mumble Bees for the last month in the quarter, viz. October, and it was during this month that the smacks appear to have increased in number.—W. G.]

† See E. W. L. Holt, *Journ. M. B. A.*, vol. iii. p. 405.

‡ Mr. J. T. Cunningham, *Journ. M. B. A.*, vol. iv. p. 24, has already remarked on the presence of small plaice over the area described in these pages, but records no actual observations. (Mr. Garstang kindly pointed out this reference to me.)

species and the one on which the fishermen are mostly dependent. Some notion of the numbers caught throughout the year may be obtained from the subjoined tables. Accuracy is not claimed for these figures, because the approximations made are even greater than in the case of the plaice. As with the latter, whiting are brought to market in trunks and small baskets. Their size varies from 9 to 17 inches, and all sizes may be placed in the trunks, whilst the small baskets seldom contain any over 11 inches. It is necessary, therefore, to state the proportion of small whiting which are placed in the trunks.

The following proportions are based on personal experience and checked by information from fishermen and fish buyers. The whiting may be divided into three classes—"small" from 9 to 11 inches, "medium" from 11 to 14, and "large" above 14 inches. Only the small are placed in the baskets, each of which holds 36 on the average. The great majority of the fish in the trunks are also small, and in the tables one half of the trunks are allocated to the small fish, the multiplier used being 350.* The resultant product is added on to the quantity in the small baskets, and the total given in the last column.

Large whiting are never very plentiful nowadays, and it has been calculated that they are adequately represented by $\frac{1}{10}$th of the trunks. A trunk contains about 130 large whiting, so that the numbers in the second column are obtained by dividing the number of trunks by 10 and multiplying the remainder by 130, or more simply by multiply-the number of trunks by 13. When $\frac{6}{10}$ths of the trunks are thus disposed of for the small and large whiting, $\frac{2}{5}$ths remain for the medium-sized. A trunk holds from 150 to 250 medium-sized whiting, and the number chosen as the average is 200. Consequently if the number of trunks be multiplied by $\frac{2}{5} \times 200$, or more simply by 80, we get the total number of medium-sized whiting.

The numbers of whiting given in Table A speak for themselves; it is only necessary to mention that the great decrease during March to June is at the spawning time. It thus appears that the whiting are in mid-water, or, at least, not on the bottom when spawning. For the rest of the year the numbers per month are fairly constant, the highest record being in December (over 700,000) and the lowest in February (315,000).

There is little difficulty in ascertaining approximately the number of soles landed day by day, because, as already stated, they are laid out in pairs on the market. The data in Table A may therefore be regarded as fairly accurate. Few soles were obtained during March and April, and as these months form their spawning season it seems that, like the whiting, they disappear temporarily from the grounds

* That is to say, each trunk is taken to contain 175 small whiting on an average.—W. G.

where the Mumble Bees work. It is possible that they may be swimming up in the water more at that time than at others, but they may be further offshore in deeper water or on rough ground, *e.g.* the Scruff, where the Mumble Bees cannot get at them. It is well for the fishermen that the plaice are abundant during the months when soles and whiting are scarce.

* * * * * *

The important points displayed in the present section may be briefly summarised. The trawling area over which the Mumble Bees work is about 400 square miles. This area is divisible into a number of separate trawling-grounds, each of which has its "season." The most valuable species of food-fishes are the soles, whiting, plaice, in the order named. The proportion of small plaice on the offshore grounds is considerable, 44 per cent. of all the plaice captured being under 11 inches.

Section II.

Distribution and Migrations of Food-Fishes.

By

Walter Garstang, M.A., F.Z.S.

1.—TRAWLING INVESTIGATIONS.

(*With Tables B, C, D, E at end.*)

The trawling investigations in the bays were carried out at monthly intervals by means of the Association's steamer *Oithona*, a small yacht of 69 tons gross tonnage. Only one gap appears in the monthly records for Start Bay (March), and three in those for the other bays. The total number of hauls recorded in the tables is 138, viz. 70 for Start Bay, 36 for Torbay, and 32 for Teignmouth Bay. A few hauls were made on the offshore grounds, but they were not sufficiently numerous to furnish a basis of comparison with the inshore records. Their publication is therefore deferred.

During the previous investigation of the bays by the Association in 1895–8, already reported on by Messrs. Stead and Holt, operations were much hampered by the lack of a suitable steamer, and only 45 hauls in all were recorded. These, however, included a number of hauls by the Brixham smack *Thistle*, so that the actual numbers of fish dealt with in the former report fell not far short of those included on the present occasion, *e.g.* 5,467 plaice as against 6,089.

The apparatus employed during the *Oithona's* work is described more fully by Dr. Kyle in a separate paper.* It was a form of otter trawl specially adapted to the Brixham grounds. For greater lightness the twine employed was cotton, not manilla as in the ordinary otter trawl, and the mesh throughout was graded as in the trawls of the Brixham Mumble Bees. There has been no essential change in the structure of the nets of the latter since Mr. Holt carried out his investigations; and as the mesh of the trawls used by him was of a similar character, the present records are directly comparable with his, so far as regards the proportions of large and small fish. The differences between the nets, in regard to their total catching power, will be adverted to below in the discussion of the results.

The work at sea consisted in the enumeration and, with few exceptions, the measurement of all the fishes caught. During 1901 the measurements were recorded to the nearest half-inch, but during 1902 to the nearest half-centimetre. Experiments with marked plaice were also undertaken, as a means of studying the migrations of this fish.

In the present report the original measurements have been converted into inches, in order to facilitate comparison with Mr. Holt's results; but in the case of the marked fishes the original records in centimetres have been retained, owing to the greater convenience of this unit for comparisons of a minuter character.

The selection of the trawling stations was left entirely to Dr. Kyle, who is also responsible for the accuracy of the identifications and measurements, and for the general conduct of the work at sea. My own part has been limited to the tabulation and analysis of the records, and to the formulation of such conclusions as appeared to be substantiated by the facts and to be relevant to the main questions before the Devon Sea Fisheries Committee as to the advantage or disadvantage to the fishery of the closure of the bays to trawlers.

It will be convenient, before proceeding to details, to present a summary showing the general characteristics of the three bays as regards distribution and abundance of the chief kinds of fish. The following table has been prepared from Dr. Kyle's records, and represents the sum of the *Oithona's* catches of each species throughout the year, reduced to the average catch for one hour's fishing. This procedure is necessarily somewhat drastic, especially in the case of seasonal migrants, and in the case of the less common forms it naturally reduces the numbers in many instances to mere fractions. Where this fraction exceeds 0·5 it has been treated as 1; in cases where it is less than 0·5 the plus sign has been inserted in place of the fraction to indicate the

* Kyle, "Fishing Nets, with Special Reference to the Otter-Trawl," *Journ. M. B. A.*, this number, p. 562.

occasional presence of the fish. The minus sign, which is also employed, indicates entire absence so far as our records show.

The fish have been classified as "small" and "marketable" according to the limits assigned in the table for each species. The dimensions are those of total length, except in the case of the rays (Thornback, Homelyn, and Blonde), for which the maximum breadth has been substituted.

TABLE II., *showing, for each of the bays, the Average Catch per Hour of the Chief Fishes, distinguishing the small fish from those of marketable size.*

	Size of "small" fish. Below	Start Bay.			Torbay.			Teignmouth Bay.		
		Total.	Small.	Marketable.	Total.	Small.	Marketable.	Total.	Small.	Marketable.
Plaice	8 ins.	19	1	18	38	19	19	38	23	15
Dabs	8 ins.	23	13	10	61	55	6	13	9	4
Flounder	8 ins.	+	−	+	2	−	2	+	−	+
Sole	8 ins.	1	+	1	1	+	1	2	+	2
Brill	10 ins.	1	+	1	+	+	+	1	+	+
Grey Gurnard	8 ins.	10	5	5	4	4	+	3	3	+
Whiting	8 ins.	2	+	2	5	4	1	5	3	2
Dory	8 ins.	2	+	1	+	+	+	+	+	+
Thornback	12 ins.	1	1	+	9	8	1	16	10	6
Homelyn	12 ins.	1	1	+	+	+	−	+	+	+
Blonde	12 ins.	4	2	2	+	+	−	+	+	+

The table shows at a glance that, if both size and numbers are taken into consideration, the **Plaice** is the dominant fish in each bay, and that the fish which competes with it most closely in abundance is the **Dab,** the small size of which, however, renders it of little commercial value. The **Grey Gurnard** and **Whiting** occur in each bay, though mostly of small size, and in insufficient numbers to be of much value to the fishermen. The **Thornback** ray attains a certain measure of importance in Teignmouth Bay, but in Torbay it is represented mostly by small specimens, and in Start Bay it is virtually replaced by two other species, the **Homelyn** (or spotted ray) and the **Blonde,** which are practically absent from Torbay and Teignmouth Bay. The **Brill** is less rare in Start Bay than in the others, and the **Sole,** though present in all the bays, only approaches importance, in point of numbers, in Teignmouth Bay.

It will be seen that, speaking generally, Torbay occupies a position biologically as well as geographically between the other bays. It stands somewhat nearer to Start Bay than to Teignmouth Bay as regards its numbers of marketable plaice, but it shows a still closer resemblance to Teignmouth Bay than to Start Bay in the abundance of small plaice within its limits. The peculiar feature of Torbay is the abundance of small dabs, which distinctly outnumber the plaice. In Start Bay, also,

these fishes are numerically in excess * of the plaice, though slightly, and a far larger proportion of them attain the marketable size. In Start Bay alone are the marketable plaice in excess of the small ones, and these they outnumber by eighteen to one.

The problem of the bays, so far as it is a biological one, clearly hinges upon the plaice, and in the succeeding sections our records of the distribution and sizes of this fish have been accordingly subjected to a much closer analysis than those of the other species.

START BAY.

The following description of the trawling-grounds has been provided by Dr. Kyle :—

"The area closed by the by-laws includes about twenty-five square miles, but owing to the presence of crab-pots on the Skerries Bank and of rocks along the shore, the trawling-grounds are reduced to fifteen square miles. The bottom-soil is of three distinct kinds. Coarse sand to gravel is found along the shore from Blackpool to Hallsands, extending outwards about a hundred yards off the former; but off Hallsands it stretches right round the promontory, and extends outwards to join on to similar soil along the inner and outer margins of the Skerries. In the centre of the bay the soil is of medium to fine sand, whilst round Dartmouth Fairway it is of mud. As mentioned in a separate paper, storms make considerable alterations, for the time being, in the distribution of the various soils throughout the bay. During neap tides there is very little movement of the water in the centre of the bay, but during spring tides a current of two to three knots runs through it. This is stronger on the ebb and alongshore, where a two and a half to three hours' eddy on the latter half of the flood makes with the ebb a nine hours' current flowing from Slapton Sands to the Point. The presence of this current is of considerable importance, as it prevents the bay from becoming foul with drift-weed, mud, jelly-fishes, diatoms, etc., a fate which periodically overtakes the other bays during the summer. For this reason the sand of Start Bay is particularly clean and bright-coloured, and the plaice which live there have the same qualities. The brightness of their orange-coloured spots and the shiny appearance of their skin readily distinguish them from those of any other region. It is probable, also, that the general cleanliness of the bay has some influence for good on the invertebrate fauna which constitutes their food; certainly the plaice from Start Bay used to obtain the highest price on the market.

* As shown below (p. 458), this excess, in the case of Start Bay, was limited to the summer season of 1902, when, however, the preponderance of dabs was very conspicuous.

"The rocks which break up the trawling area of the bay lie in the south-west corner off Hallsands and Beesands and along the northern shore from Blackpool to the Mewstone on the far side of Dartmouth Fairway. To the south-west of Blackpool is a further patch of rocks, and off Torcross there is a shelving bank of slate-rock, running about a mile out to sea, with several isolated rocks near it. Since all these lie within or close to the zone of the coarse sand, and the plaice prefer this kind of soil, it may be well understood that the largest and strongest plaice are safe from the trawler, except when they are migrating from one region to another. There are one or two passages between the rocks close inshore, as well as open spaces at Blackpool and along Slapton Sands, and it is on these grounds that the large plaice are obtained.

"The inner passages are only known to the older fishermen who worked in Start Bay before the by-laws came into force, and the *Oithona* could not work there. The largest plaice are not truly represented in the statistics for this reason, and their presence would have remained unknown had we not ventured on several occasions to trawl closer to the rocks than was altogether good for the nets."

The total number of hauls of the trawl recorded for Start Bay amounts to seventy, and, as may be gathered from Table E, they were distributed through the successive months of the year with fair uniformity, the only month which is altogether unrepresented being March. Since the ground varies in character in different parts of the bay, the hauls have been classified into four stations, which approximately correspond with these natural distinctions. They have been defined as follows:—

Station I. The central and north-eastern parts of the bay. In practice an attempt was made to distinguish between these two parts as follows:—

Sub-station (i). "Centre of the bay; along the line Mewstone Rock, to the east of Dartmouth just inside Downend Point, to Freshwater Bay near Start Point. The trawl was shot in 12 to 15 fathoms, and lifted as a rule in 8 to 9 fathoms after passing Torcross. The bottom-soil is mud to fine sand" (H. M. K.).

Sub-station (ii). "The north-eastern triangle of the Bay, formed by the Mewstone, Blackpool, and Skerries Buoy. The depth varies from 10 to 20 fathoms, and the bottom-soil is for the most part mud" (H. M. K.).

The hauls referred to these sub-stations by Dr. Kyle have been distinguished in the detailed list of hauls (p. 503); but they have not been separated in the summary tables, since considerable overlapping took

place, and the general results of the work on the two sub-stations were practically identical. As Dr. Kyle remarks, "they display the general or average condition of the bay, omitting the Skerries Bank."

Station II. "Along Slapton Sands, [usually] in 6 fathoms. The bottom-soil is here coarse sand" (H. M. K.). Occasionally the haul was made in 7 to 8 fathoms (No. 19), or extended to 10 fathoms (No. 8). "The hauls on Station II. were made, for the most part, in summer, when the plaice are inshore; during winter this ground is almost devoid of fish of all kinds" (H. M. K.).

Station IIa. "This represents the trawling-ground from Start Point to off Torcross. It means skirting the rocks at the latter place, so that no further comment need be made on the fact that only one haul is recorded" (H. M. K.).

Station III. "Along the inner margin of the Skerries Bank. The depth varied from 5 to 10 fathoms, and the soil is also coarse sand" (H. M. K.).

The biological features of the different stations may be gathered from the accompanying table, which represents the *Oithona's* average catch per hour for the whole year on the different grounds.

TABLE III., *showing Average Catch per Hour for the entire period on the various stations in Start Bay.*

Species.	Station I.			Station II. 19 hrs. 15 min.		Station III. 15 hrs. 50 min.		Station IIa. 0 hrs. 40 min.		Totals.			
	hrs. min.	Small.	Market-able.	Small.	Market-able.	Small.	Market-able.	Small.	Market-able.	hrs. min.	Small.	Market-able.	Total.
Plaice . .	101 10	+	18	2	21	+	14	–	71	136 55	1	18	19
Dabs .	88 10	13	10	14	9	+	5	–	12	123 55	13	10	23
Sole . .	92 10	+	1	+	2	–	+	–	1	127 55	+	1	1
Brill . .	92 10	+	+	+	+	–	4	–	1	127 55	+	1	1
Grey Gurnard	88 10	5	5	10	6	+	2	–	4	123 55	5	5	10
Whiting .	92 10	+	2	+	+	–	+	–	–	127 55	+	2	2
Thornback .	89 10	+	+	3	+	+	–	6	4	124 55	1	+	1
Homelyn .	85 15	+	+	1	–	+	–	7	–	121	1	+	1
Blonde . .	85 15	1	1	+	–	11	11	–	1	121	2	2	4

The difference between Stations I. and II. is one of degree rather than of kind, and is for the most part due to differences in depth. It will be seen that plaice were somewhat more abundant on the inshore grounds than on Station I., and it was only on the former station that small plaice were present in appreciable numbers. Small dabs were also slightly more abundant on Station II. than on Station I., and large dabs slightly less numerous. Thornback and homelyn rays were more plentiful on Station II. than Station I.; while blondes, both large and small, were more plentiful on Station I. Station III., which corresponds with the Skerries Bank, is seen to possess distinct features. "It is characterised," as Dr. Kyle remarks, "by the numbers of large brill and

blondes (rays) found nowhere else in such abundance over the whole fishing area of the Mumble Bees. The plaice obtained here are also large, but there is a comparative absence of soles, dabs, gurnards, and other species."

Station IIA. is characterised by the general absence of small fish, and by the large size of the flat-fish which occur upon it. Only one haul of the trawl, however, is recorded for this station.

In order to represent the seasonal differences in the fishing of Start Bay it will be necessary to combine the records of all four stations, since there is a considerable amount of migration within the bay at different seasons from the shallower to the deeper parts and *vice versâ*. In view of the differences which the preceding table reveals, it will readily be understood that combinations of the results of trawling over these different stations will not be strictly comparable with one another unless the different stations are represented in each combination in equivalent proportions. In practice, the maintenance of any fixed proportional representation of the different stations throughout the monthly investigations was not found to be practicable. It is necessary, therefore, before proceeding to discuss the seasonal differences observed, to note the actual duration of trawling over the different stations in each season of the year. These details are provided in the following table:—

TABLE IV., *showing the Amount of Trawling over each station in Start Bay for each quarterly period of the year.*

Season.	Station I. No. of hrs.		Station II. No. of hrs.		Station IIA. No. of hrs.		Station III. No. of hrs.	
	hrs.	min.	hrs.	min.	hrs.	min.	hrs.	min.
July, August, September	9	25	7	45	—		6	0
October, November, December	38	25	7	55	0	40	5	20
January, February	9	15	—		—		1	30
April, May, June	27	55	1	0	—		3	0
July, August	14	40	2	35	—		—	
October	1	30	—		—		—	
TOTALS	101	10	19	15	0	40	15	50

It will be seen that during the first quarter Stations II. and III. received considerable attention as compared with Station I., but that in succeeding quarters Station I. was investigated far more extensively than the remaining grounds. The hauls on Station III. ceased after April, 1902.

SEASONAL CHANGES.

Although it is possible by an examination of Table E to obtain some general ideas as to the effect of the seasons on the numbers and distribution of the plaice in the bay, it is necessary to condense the results in order to grasp the chief features in these changes. Table F provides a series of monthly summaries showing the total catch, the catch per

hour, and the percentage frequencies of the fish of different size. The limits between the various size-groups are the same as those previously adopted by Mr. Holt, although the groups themselves are presented in this report in slightly different form. The groups are as follows:—

I. Unsaleable, or small immature—under 8 ins. in total length.
II. Immature medium-sized—from 8 ins. to 11 ins., both inclusive.
III. Medium-sized mature—from 12 ins. to 14 ins. inclusive.
IV. Large—15 ins. and upwards.

The study of Table F throws important light on various matters of detail, especially on the succession of changes which took place in the distribution of fish during the autumn and early winter of 1901; but the relatively short duration of the hauls made in certain of the months prevents the monthly summaries from possessing an equally representative character. It is accordingly desirable to summarise the results still more closely in quarterly periods. This has been done in the following table, which shows the average catch of plaice per hour for the different size-groups, and also the percentage frequency of the fish of these sizes during the five quarterly periods covered by the investigations.

TABLE V., *showing, for Start Bay, the Average Catch of Plaice per Hour, and the Percentage Frequency for each size, over all stations combined, for each quarterly period.*

Season.	hrs.	min.	Total caught.	Catch per Hour.					Percentages.			
				Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
July, Aug., Sept.,'01	23	10	444	19	2	3	8	6	9	18	44	29
Oct., Nov., Dec. „	52	20	1064	20	0·2	3	10	7	1	18	47	34
Jan., Feb. '02	10	45	115	11	1	4	4	2	10	36	32	22
April, May, June „	31	55	570	18	1	4	8	5	4	23	45	28
July, August „	17	15	403	23	1	11	8	3	3	47	35	15

The investigations began in the summer period, and it will be seen that the total catch of plaice, irrespective of size, increased slightly during the autumn period, fell to a minimum in the winter, and then increased steadily through the following spring and summer, the maximum in the summer season of 1902 being distinctly higher than during the corresponding season of the previous year.

The quarterly average catch of small plaice never exceeded two fish for an hour's fishing. The immature medium-sized fish steadily increased throughout the period of the investigations from an average catch of 3 per hour in the summer of 1901, to a catch of 11 per hour in the summer of 1902. The mature medium-sized fish began in the previous summer with an average abundance of 8 per hour, which increased to a maximum of 10 per hour in the autumn, declining conspicuously to

4 per hour in the winter, and again rising to the same original level of 8 per hour in the spring, which was maintained throughout the summer. The largest fish showed a similar sequence of changes for the first twelve months, but, according to the figures, declined during the last summer season to half their original frequency.

The sequence of changes shown by the mature medium-sized plaice is readily explained by the seasonal migrations of the fish, which are dealt with in a later section of this report. It is there shown that the plaice tend to immigrate into Start Bay from all quarters during the spring and summer months, from the offshore spawning-grounds in the spring, and from the other bays to the northward in summer and autumn. Towards the end of the year they again leave the bay for the offshore spawning-grounds. The figures illustrating the seasonal changes in the abundance of the largest fish would also be explicable in the same way, were it not for the unusual decline shown by the figures for the last summer quarter. If reference, however, be again made to Tables III. and IV., it will be seen, as previously mentioned, that Station III. is represented in the records for the first four quarterly seasons, but is not represented in the last, and it will be remembered that this station is characterised by the large size of its plaice. Station II. also, in which the actual abundance of marketable plaice is greater than in the other stations, is represented far more conspicuously during the summer season of 1901 than during that of the succeeding year. If the hauls on the Skerries Bank (Station III.) be omitted from the records for the first summer quarter, and if the influence of Station I. on the records for the second summer quarter be reduced to the same proportions as prevailed during the first, the catch per hour of the different groups of plaice takes the following dimensions:—

	Catch per Hour.					Percentages.			
Season.	Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
July–Sept., 1901	18	2	4	8	4	13	22	44	21
July–Aug., 1902	28	1	15	9	3	4	53	32	11

It will be seen that there is now no longer any material difference in the evidences of abundance of the largest groups of plaice in this season during the two years; while, on the other hand, the great increase in the abundance of immature medium-sized plaice becomes still more obvious. As will be seen in the case of the other bays, a marked increase in the numbers of this group of plaice in the summer of 1902, as compared with the summer of 1901, was a general feature which characterised each of the bays.

The important question now arises: Which of these years was most typical of the conditions normally prevalent in Start Bay? Was the scarcity of small plaice in 1901 normal or abnormal? Was this marked

increase during 1902 an exceptional feature, or merely the prelude of a return to more normal conditions?

There is no available means of answering these questions except by a comparison with the results contained in Mr. Holt's previous report on the Association's work in the bays during 1895 to 1898, from which the following table has been prepared.

TABLE VI., *showing the Catch per Hour and the Percentage Frequency of Plaice of different sizes in Start Bay during* 1895–1897, *based on the records of the "Thistle" and "Busy Bee" (compiled from Mr. Holt's report).*

Season.	Vessel.	hrs. min.	Total	Catch per Hour.					Percentages.			
				Total	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
March, '96, '97 .	*Thistle*, 3 hauls *Busy Bee*, 1 haul	9 0	423	47	13	23	8	3	26	50	18	6
May, June, '97 .	*Busy Bee*, 4 hauls	8 50	144	16	7	7	1	1	46	40	8	6
July, '98 . .	,, 2 hauls	3 45	58	15	4	8	2	1	29	50	14	7
Oct., Dec., '95, '96	*Thistle*, 6 hauls	23 (ea.)	1011	44	0·1	16	23	5	1	37	52	10

The chief difficulty in a comparison with these records arises from the fact that the previous investigations of the Association were carried out by means of two boats, the smack *Thistle* and the small steam yacht *Busy Bee*, which were of different catching power compared with one another as well as with the *Oithona*. It will be seen that the work in the winter and autumn seasons during the previous investigations was mostly carried out by the *Thistle*, and during the summer by the *Busy Bee*.

It will also be seen that the average catch of the *Busy Bee* in spring and summer was so markedly inferior to the catch of the *Thistle* in autumn and winter that no conclusions can be drawn from the figures as they stand in regard to the seasonal changes which formerly took place in the abundance of plaice in the bay; but at least two methods of comparison with the records of the *Oithona* are open to us, viz. (1) the percentage distribution of plaice of different sizes can be compared with the corresponding figures for the *Oithona's* work, and (2) the average hourly catch of the *Busy Bee* may be assumed to have been *not greater* than that of the *Oithona*, since the *Busy Bee* was a somewhat smaller vessel and carried a smaller trawl.

If we take the latter point first into consideration, we may observe that whereas in the spring and summer seasons the *Busy Bee* made, in Start Bay, an average hourly catch of 16 and 15 plaice respectively, the *Oithona*, during the corresponding seasons, caught 18 plaice per hour in the spring, from 18 to 19 per hour in the summer of 1901, and from 23 to 28 per hour in the summer of 1902. The total catch, as was to be expected, was therefore higher in the case of the *Oithona* than in that of the *Busy Bee*. Nevertheless, on turning to the table again, we see that during the spring quarter the *Busy Bee* caught a far higher average

quantity of small plaice per hour than did the *Oithona*, viz. 14 plaice per hour below 12 inches in length, as against only 5 per hour in the case of the *Oithona*. Again, during July the *Busy Bee* caught an average of 12 fish per hour below 12 inches in length, whereas in the summer quarter of 1901 the *Oithona* caught only 6 per hour. The conclusion appears to be that the small plaice below 12 inches in length were abnormally scarce in Start Bay during the summer of 1901; and the records show that this abnormal scarcity continued until the corresponding season of the following year.

We have already seen that in the summer of 1902 the *Oithona* caught a far higher number of immature medium-sized fish than in the corresponding season of the previous year. In Start Bay the average catch of these immature fish was from 13 to 16 per hour. For this bay, therefore, we may conclude that the marked increase in the small plaice during the summer of 1902 was not in itself an abnormal feature, but was rather a sign of the resumption by the bay of its normal characteristics, the scarcity of the small fish during the previous year having been an exceptional phenomenon.

The marking experiments, to be described below, give good ground for believing that the actual increase in numbers of the medium-sized plaice during the summer of 1902 was due to immigration from Teignmouth and Tor bays. There is also no evidence that any material proportion of the plaice of this size in Start Bay were derived by growth from the small stock of small plaice (below 8 ins.) previously in the bay.

The explanation of the scarcity of the small plaice during 1901 and the earlier half of 1902 is dealt with at a later stage (pp. 472 and 474); but it is worthy of note that the phenomena described in the case of the plaice were closely paralleled by changes which took place during the same period in the abundance of small dabs.

TABLE VII., *showing, for Start Bay, the total number of* DABS *measured, and the Catch per Hour and Percentage Frequency of Small and Marketable Fish for each Monthly or Quarterly Period.*

Season. 1901.	No. of Hours. hrs.	min.	Total caught.	Catch per Hour. 0-7″	8″+	Total.	Percentages. 0-7″	8″+
July, August	8	55	93	6	5	11	55	45
September	14	15	231	3	13	16	21	79
October	13	5	486	5	32	37	13	87
November	17	5	290	3	14	17	16	84
December	18	10	89	+	5	5	6	94
1902.								
January, February	10	45	77	3	4	7	36	64
April, May, June	25	55	472	13	5	18	74	26
July, August	14	15	1077	66	9	75	88	12
October	1	30	69	45	1	46	97	3
Totals	123	55	2884	13	10	23	56	44

Table VII. shows that in the summer and autumn of 1901 there was a great scarcity of small dabs as compared with the corresponding season of 1902. The difference cannot be attributed to differences in the combination of the stations, since Station III., which alone exhibits a deficiency of dabs, is not represented in the averages for July and August in either year.

If we again use Mr. Holt's figures for 1895–8 as a test, we find that in July the *Busy Bee* made an average catch of 29 dabs per hour, of which 22 were small and 7 marketable. Thus the *Oithona's* figures for 1901 may be taken as indicating an abnormal scarcity of dabs, especially small dabs, in Start Bay; while the figures for the spring and summer of 1902 indicate the gradual resumption by the dabs of at least their former abundance.

As a matter of fact, during the investigations in 1895–8, the dabs in Start Bay outnumbered the plaice in each season of the year; whereas in 1901–2 the reverse was the case until the summer of 1902, when three times as many dabs were taken as plaice.

TABLE VIII., *showing, for Start Bay,* (1) *the total proportion of Dabs to Plaice, and* (2) *the proportion of Large Dabs* (8 *inches and upwards*) *to Large Plaice* (12 *inches and upwards*), *for each quarter during the two sets of investigations. The number of Plaice has been taken in each case as* 100.

	Total Dabs to Plaice.		Large Dabs to Large Plaice.	
	1901–2.	1895–8.	1901–2.	1895–8.
July to September	73	186	68	225
October to December	86	120	91	126
January to March	67	114	79	139
April to June	91	106	32	255
July to September, 1902	311	—	77	—

These facts are shown in the accompanying table, in which the relative abundance of large dabs and plaice is also compared for the two periods. The size limits selected correspond roughly with the size of maturity in the two species. It will be observed that in 1895–8 the mature dabs outnumbered the mature plaice in Start Bay in each season of the year, whereas in 1901–2 the reverse was the case, even during the summer of 1902, when so many small dabs were taken.

It appears permissible to conclude from these data that, whatever the causes which had led to the scarcity of immature intermediate-sized plaice in 1901, the previous abundance of dabs was reduced to a still greater extent; and that both species were recovering from this wave of depression in the course of 1902. The previous scarcity of these fish cannot therefore be attributed to the "fouling" of the ground from lack of trawling, since under such circumstances the dab, as a mud-loving species, would probably have suffered less than the plaice, and

the subsequent signs of recovery of both species would receive no explanation.

The results of the *Garland's* experiments in the closed waters of the Scottish bays and firths have given rise to the belief that the prohibition of trawling in inshore waters may protect the dab more efficiently than the plaice, and increase the proportion of the former to the latter. It is therefore of interest to note that this idea receives no support from a comparison of the two series of trawling experiments in Start Bay. The chief feature of these experiments as regards the dab appears to be the liability of this species to fluctuations in numbers, which are more extensive even than in the case of the plaice.

TORBAY.

Dr. Kyle describes the characters of the trawling-grounds and stations as follows:—

"The physical conditions existing in Torbay are widely different from those of Start Bay. The tidal movements of the water are weak at all times, and so are the currents alongshore, except at the south-west corner, where the strong eddy of the Great West Bay makes itself felt as it passes round Berry Head. The direction of the currents is greatly affected by the prevailing winds.

"The comparative lack of tidal movements is reflected in the nature and disposition of the bottom-soil. In the centre of the bay there is nothing but mud, which is continuous from the long stretch of similar soil extending some ten to twelve miles off Berry Head. The mud is continued on the northern aspect right on to the beach at Torquay, where it grades into fine sand. Under the present bed of Torbay lie the remains of an ancient forest, and lumps of peat were occasionally brought up in the trawl. At times, also, fossil bones are obtained on the beach at Torquay, where, as at Brixham, there are famous caves containing fossil remains. On the southern half of the bay, from Paignton to Berry Head, the beach is quite free from mud, and various grades of sand extend from the shore for some distance, varying from a few yards off Fishcombe Rocks to a quarter of a mile off Goodrington Sands and the back of the breakwater at Brixham. Off the angle of the bay formed by Ellbury Cove lies a small patch of rocks, locally known as the 'Rough,' and it is close to this that the finest and largest fish are caught. There are several detached rocks on the Torquay side, extending from Torquay out to the Orestone, and various ('innumerable,' according to the fishermen) anchors scattered about the bay. The trawlable area is about seven square miles.

"As may be gathered from the preceding account of the physical conditions, Torbay is very liable to become 'foul,' especially during the

summer. The Brixham and Torquay fishermen will have it that this is partly, if not entirely, due to the absence of trawling, and though it is merely a matter of opinion, it is possible that they have a certain amount of right in their contention. Even a slight scraping of the bottom in, say, a stagnant pool has some influence on the distribution and circulation of muddy material. It is difficult, on the other hand, for the fishermen to recognise that the 'foulness' of the bay has not been caused by the Devon Committee's by-laws, but is due to its geographical situation and the weakness of its tides and currents. In the summer time, indeed, it is a veritable sink for a great part of the débris of the great West Bay, and it has sufficient decomposing material in its own composition to serve three or four bays.

"The trawling stations in Torbay are four in number, as follows :—

"**Station IV.** From Paignton Head to Torquay Harbour, half a mile from the shore. The bottom-soil is fine sand and mud, and the depth 3 to 4 fathoms. [Haul No. 4 on September 11th extended eastwards beyond Brixham breakwater.—W. G.]

"**Station IVa.** Round the 'Rough' from Paignton Head to off Ellbury, thence outward towards Brixham breakwater. The bottom soil is at first sand, later mud, and the depth from 3 to 4 fathoms.

"**Station V.** Centre of the bay, on line Brixham breakwater to Ilsham Valley, between Torquay and Hope's Nose. The bottom-soil is mud, and the depth 6 fathoms.

"**Station VI.** On line Berry Head to Orestone. The bottom soil is again mud, and the depth 8 to 10 fathoms. [This station lies just outside the limit fixed by the Devon Sea Fisheries Committee.—W. G.]

"The stations in Torbay differ less from one another than those of Start Bay, but the proportions of the various species of fish are, on the whole, similar. The dabs and plaice are the most numerous, whilst the remaining species taken together are fewer in numbers than the plaice by itself."

The following table represents the results of the *Oithona's* catches in Torbay during the year reduced to the average catch per hour for each of the four stations :—

TABLE IX.

Species.	Station IV. 9 hrs. 55 min.		Station IVa. 11 hrs. 30 min.		Station V. 10 hrs. 35 min.		Station VI. 7 hrs. 25 min.		Totals excluding Station VI. 32 hrs.		Totals including Station VI. 39 hrs. 25 min.		
	Small.	Marketable.	Small.	Marketable.	Small.	Marketable.	Small.	Marketable.	Small.	Marketable.	Small.	Marketable.	Total.
Plaice	36	29	11	18	22	21	3	6	23	22	19	19	38
Dabs	82	4	19	1	103	8	7	10	66	4	55	6	61
Sole	–	1	–	1	+	+	–	+	+	1	+	1	1
Brill	+	–	+	+	+	–	–	+	+	+	+	+	+
Grey Gurnard	4	+	1	+	11	+	3	+	5	+	4	+	4
Whiting	1	1	–	–	12	3	6	–	4	1	4	1	5
Thornback	9	–	2	–	6	+	23	3	5	+	8	1	9
Homelyn	–	–	–	–	–	–	+	–	–	–	+	–	+
Blonde	+	–	–	–	–	–	–	–	+	–	+	–	+

The table illustrates the following extract from Dr. Kyle's report:—

"The accompanying table shows that there are only two species in Torbay—the **plaice** and the **dabs**—which are worthy of any attention, amongst trawled fish that is to say, for the fishermen, especially of Torquay, earn a good living from the mackerel and other roving round fish which enter the bay. With these, however, we are not concerned; they are seldom obtained by the trawl, and to the trawlers as trawlers they are of no value. Amongst the trawled fish the large proportion of **thornback rays** demands a word of explanation. They are almost entirely small fish under 12 inches from wing to wing, and are most probably migrants from the neighbouring Teignmouth Bay, where their spawning ground seems to be.

* * * * * *

"The **dabs** are even more numerous in Torbay than in Start Bay, and their distribution over muddy ground is more clearly shown. On Station IVA., near the Rough, the proportion of dabs is less than that of the plaice, and the bottom-soil here, it will be remembered, is of a sandy nature. Over the rest of the bay, where the soil is muddy, the proportion of dabs is greatly in excess of the plaice.

"It appears from the table that the proportion of small dabs under 8 inches greatly exceeds that of the larger over this size and at all times of the year. This is not to be wondered at when it is remembered that the dab is mature on the average below 8 inches.

"**Soles** are by no means numerous, but the great majority were over 8 inches, only one being captured under that size. **Flounders** are more numerous, and were taken at all seasons of the year. Useless species, as **solenette, dragonet, bib,** and **scaldback,** are very common, but the useful forms other than those mentioned are few in numbers and mostly small."

It is, however, necessary to add to Dr. Kyle's remarks that Station VI., strictly speaking, lies outside the trawling limit of the bay, as fixed by the Sea Fisheries Committee.

The station, owing to its greater depth, naturally exhibits a preponderance of large fish over small, in the case of plaice and dabs. The actual catch per hour of the larger plaice is less than on the other stations, and of the larger dabs somewhat greater. The station exhibits a higher catch of thornbacks than any other in the bay.

As will be seen from a comparison of the parallel columns of "totals" excluding and including this station, the inclusion of the station in the summaries has the effect of slightly depressing the average catch of plaice, both small and marketable—the former slightly more so than the latter. It is obvious, also, that its inclusion will have a tendency to

slightly increase the percentage of large fish in the general averages at the expense of the small.

The following table shows the actual amount of fishing carried out by the *Oithona* on the various stations at different seasons of the year.

TABLE X., *showing the Amount of Trawling over each station in Torbay, for each quarterly period of the year.*

Season.	Station IV. No. of hours.		Station IVA. No. of hours.		Station V. No. of hours.		Station VI. No. of hours.	
	hrs.	min.	hrs.	min.	hrs.	min.	hrs.	min.
July, Aug., Sept., 1901	3	10	1	0	2	5	2	40
Oct., Nov., Dec. „	3	15	5	20	4	0	1	0
Jan., 1902 . . .	1	0	—		—		0	45
April, May, 1902 .	1	0	2	10	1	15	1	0
July, Sept. „ . .	1	30	3	0	3	15	2	0
Totals	9	55	11	30	10	35	7	25

SEASONAL CHANGES.

The following table represents a quarterly summary of the average hourly catches of plaice by the *Oithona* in Torbay, distinguishing the various size-groups.

TABLE XI., *showing, for Torbay, the Average Catch of Plaice per Hour, and the Percentage Frequency for each size, for each quarter of the year, over all the stations combined.*

Season.			Total caught.	Catch per Hour.					Percentages.			
	hrs.	min.		Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
July, Aug., Sept.,'01	8	55	408	46	22	13	9	2	47	27	20	6
Oct., Nov., Dec. „	13	35	507	37	21	7	6	3	57	19	15	9
Jan., 1902 . .	1	45	48	27	21	2	3	1	77	8	11	4
April, May, 1902 .	5	25	133	25	17	4	3	1	66	16	13	5
July, Sept. „ .	9	45	404	41	14	22	3	2	35	53	7	5

The total catch, irrespective of size, is seen to have steadily fallen from a maximum of 46 per hour in the summer of 1901 to a minimum catch of 25 per hour in the spring of 1902, after which the catch rose to 41 per hour in the following summer quarter. This second summer maximum is less than that which obtained in the previous year. The small fish, from 0 to 7 inches in length, are seen to have steadily diminished in abundance from 22 per hour in the summer of 1901 to 14 per hour in the summer of the following year. It is remarkable that the figures should show no sign during the last quarter of the increase in numbers which is usual at this season.

It will be seen, however, upon reference to Table X., which shows the relative amount of fishing on different stations for each season, that during the summer of 1901, as compared with the summer of 1902, the *Oithona* trawled twice as long over Station IV., where the small fish are most abundant, and only one-third as long over Station IVA.,

where they are much less abundant. If the influence of Stations IV., IVA., and V. for 1901 be reduced to the same relative proportions as prevailed in 1902, omitting Station VI. in each case, the catch per hour during the two seasons becomes altered as follows:—

	Catch per Hour.					Percentages.			
Season.	Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
July–Sept., 1901	45	15	14	11	5	33	32	24	11
July–Sept., 1902	51	18	27	3	3	35	53	7	5

Now that the two seasonal averages have been made comparable, it will be observed that the discrepancies in the general averages were largely attributable to the disproportionate combination of hauls over different grounds in the two seasons. Instead of a relative fall in the total catch of fish in 1902 as compared with the previous year, the maximum for 1902 is now seen to be somewhat in excess of that for 1901, and the small fish below 8 inches in length are seen in reality to have been not less numerous, but slightly more abundant in the later than the earlier year. The figures for the other size-groups are not so seriously affected, but the hourly catch of large fish above 15 inches is slightly raised in both years by the omission of Station VI., which, strictly speaking, lies outside the limits of the bay. It will be further noticed that the marked increase in the number of immature medium-sized plaice, which the general average in Table XI. revealed for the summer season of 1902, is confirmed.

With the exception of the season just referred to, it will be noticed that the smallest plaice were more abundant than any of the other size-groups at each season of the year, in spite of the depressing effect of a somewhat high representation of Stations IVA. and VI. in the general averages. Indeed, for the greater part of the year the fish below 8 inches in length were actually more numerous than the plaice of all other sizes taken together. This result contrasts markedly with the condition previously shown to have obtained in Start Bay, where the predominant group of plaice was, for the most part, that from 12 to 14 inches. In other words, the mature medium-sized plaice were the most abundant in Start Bay, while the small unsaleable fish took the lead in Torbay.

Nevertheless, the actual abundance of mature medium-sized plaice in Torbay during the latter half of 1901 was scarcely less than in Start Bay. Their greater scarcity in the summer of 1902 is an isolated feature which it is not easy to explain with certainty. The results of the marking experiments in the spring of 1902 demonstrate that the plaice in the mouth of Torbay showed a far stronger tendency to migrate southwards into Start Bay than into Torbay itself during the summer season; so that the trawling statistics accord with the migration

experiments on this point. Why the larger fish should have displayed this disinclination to enter the bay remains unexplained. It is not improbable that variations in the "foulness" of the ground in Torbay may be largely responsible for such fluctuations in the numbers of summer immigrants, as well as for emigrations of the normal inhabitants of the bay, as suggested below by Dr. Kyle in the case of Teignmouth Bay.

We may now compare these results with the distribution of the different sizes of plaice in Torbay, as recorded by Mr. Holt for 1895–8.

TABLE XII., *showing the Catch per Hour and the Percentage Frequency of Plaice of different sizes in Torbay during* 1895–8, *based on the records of the "Thistle" and "Busy Bee" (compiled from Mr. Holt's report).*

Season.	Vessel.	hrs.	min.	Total caught.	Catch per Hour.					Percentages.			
					Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
Jan., March, '97	*Thistle*, 3 hauls	4	50	420	87	23	35	26	3	26	40	30	4
June, '97 . .	*Busy Bee*, 2 hauls	2	55	410	141	90	27	20	4	64	19	14	3
July, '98 . .	,, ,,	2	25	110	45	11	29	4	1	24	63	9	4
November, '95 .	*Thistle*, 2 hauls	3	20	100	30	1	15	13	1	4	50	42	4

Bearing in mind the reservations previously expressed with regard to the comparability of these records (p. 456), it is nevertheless apparent that in July, 1898, the *Busy Bee*, in spite of its somewhat smaller catching power, caught a larger average number of plaice from 8 to 11 inches than did the *Oithona* in the summer season of either 1901 or 1902, and that the higher catch of the *Oithona* in 1902 more closely approached the *Busy Bee's* record than did the smaller catch of 1901. We may therefore conclude that in Torbay, as in Start Bay, the numbers of plaice of this size were abnormally low in 1901, but were increasing to more normal proportions in the course of 1902. The June records of the *Busy Bee* in 1897 suggest the further point that the smallest plaice (especially the 5-inch fish) were more abundant in that year than subsequently. As these fish, after one year's growth, would form the greater part of the 8-to-11-inch group in the succeeding year (see p. 489), it appears to be in the highest degree probable that the observed abundance of the 8-to-11-inch plaice in July, 1898, is traceable to the corresponding abundance of the smallest plaice in the preceding year. In a similar manner the increased abundance of the larger immature plaice in the summer of 1902 was preceded, according to the *Oithona's* records (Tables XI. and D), by a high average catch of the smallest fish (4 and 5 inches) throughout the preceding autumn and winter, an average much higher, it will be noted, than the *Busy Bee's* catches in July and November, and almost as high as the *Thistle's* catch in January to March.

Upon a consideration of all the data, it thus appears fairly certain that in Torbay the observed fluctuations in the numbers of the 8-to-11-inch plaice during recent years are attributable to corresponding fluctuations in the abundance of the still smaller fish in previous years.

Turning now to DABS, it will be seen from the following table that, as in Start Bay, there was a considerable increase in the abundance of small dabs in the summer of 1902 as compared with 1901—a result which is not attributable to any marked inequality in the combination of the stations.

TABLE XIII., *showing, for Torbay, the total number of Dabs measured, and the Catch per Hour and Percentage Frequency of Small and Marketable Fish for each quarterly period.*

Season.	No. of Hours.		Total caught.	Catch per Hour.			Percentages.	
	hrs.	min.		0-7″	8″+	Total.	0-7″	8″+
1901.								
July, August, Sept. .	8	55	641	62 ...	10 ...	72	87 ...	13
October, Nov., Dec. .	13	35	511	33 ...	5 ...	38	87 ...	13
1902.								
January . . .	1	45	10	6 ...	— ...	6	100 ...	—
April, May . .	5	25	138	22 ...	3 ...	25	87 ...	13
July, September .	9	45	1096	107 ...	5 ...	112	95 ...	5
Totals . .	39	25	2396	55 ...	6 ...	61	91 ...	9

In this case Mr. Holt's records show that the catch of dabs in the summer of 1901 was slightly less, in the case of small dabs, than the average catch of the *Busy Bee* for July, 1898, viz. 66 small, 4 large; total, 70. In June of 1897 the *Busy Bee* caught nearly twice as many dabs per hour as did the *Oithona* in the spring of 1902, the numbers being 38 small, 13 large; total, 51. There was, therefore, to some extent, a deficiency of dabs in 1901 and the first half of 1902, as compared with the previous period, 1895–8; but an increase in the summer of 1902, which caused the ultimate numbers of small dabs to attain a higher maximum than had previously come under observation.

As regards the relative numbers of dabs and plaice, there is no such striking contrast between the two series of investigations as was noticeable in the case of Start Bay. The proportion of mature dabs to mature plaice appears, in general, to have been slightly higher in 1901–2 than in 1895–8, especially during the summer of 1902, when, for the first time, the dabs above 7 inches outnumbered the plaice above 11 inches.

TABLE XIV., *showing, for Torbay,* (1) *the total proportion of Dabs to Plaice, and* (2) *the proportion of Large Dabs* (8 *inches and upwards*) *to Large Plaice* (12 *inches and upwards*) *in each quarter during the two sets of investigations* (*Plaice* = 100).

	Total Dabs to Plaice.		Large Dabs to Large Plaice.	
	1901–2.	1895–8.	1901–2.	1895–8.
July to September . .	157	152	82	64
October to December .	101	46	54	56
January to March . .	21	26	—	11
April to June . .	104	36	75	54
July to September, 1902 .	271	—	102	—

With one insignificant exception the total proportion of dabs to plaice was higher in each quarter of 1901–2 than during the previous period, the excess being particularly marked during the spring and summer of 1902. On the whole, therefore, the number of dabs does not appear to have diminished in Torbay during the recent fluctuations to anything like the extent which was manifest in Start Bay, or even to the same degree as the plaice—a difference which is possibly attributable to the muddy character of the bottom, which renders Torbay the chief headquarters of small dabs in the district.

TEIGNMOUTH BAY.

The following account of the physical conditions and trawling stations has been drawn up by Dr. Kyle:—

"With regard to the physical conditions, this bay is intermediate between Torbay and Start Bay. There is comparatively little tidal movement in the centre of the bay, with the result that we find there a long belt of mud extending from Hope's Nose to off Exmouth. In this respect it resembles Torbay. There are moderate currents alongshore, however, which in the northern portion of the bay seem in the main to tend northward towards Exmouth, but in the southern half towards Hope's Nose. We find, consequently, that there is a long stretch of sand, mostly coarse, extending from five fathoms on to the beach and from Hope's Nose to the Pole Sands at Exmouth. The best trawling-ground is along this belt of sand, and in the fall of the year it is quite as rich as any part of Start Bay in large plaice and soles. Along the line from Hope's Nose to Straight Point (the Rubicon for trawlers) lies the beginning of the rough ground called the Ledge. At this point it is not yet untrawlable, but the large quantity of oysters and stones make it somewhat dangerous for the net.

"This bay differs from the others in that two rivers, the Teign and the Exe, flow into it. These are of importance because the young

plaice of one to three years find them a harbour of refuge—from the trawlers only, for the seiners and cormorants exact toll.

"For the purpose of the experiments the bay was divided as follows:—

"**Station VII.** Off Babbacombe Bay to the Ness, near Teignmouth. The depth is 4–5 fathoms, and the bottom-soil sand. [Haul No. 4 was made in somewhat deeper water, but the particulars are doubtful.—W. G.]

"**Station VIII.** A continuation of the preceding to the Fairway Buoy off Exmouth. The depth and bottom-soil are still the same. Very few hauls were made over the entire length of this station. As a rule it was divided into two portions, one from off Teignmouth to off the Clerk Rock, the other along the Pole Sands at Exmouth, but as the composition of the ground and the fauna are practically identical the records are taken together.

"**Station IX.** On the line, Orestone to the Fairway Buoy off Exmouth, from near the Orestone to off Teignmouth. The depth is 11–12 fathoms, and the bottom-soil stones, large shells, but mostly mud. One haul [No. 26] was made from off Teignmouth towards the Fairway Buoy, but it is also included under Station IX. [This station lies just outside the limits fixed by the Devon Committee.—W. G.]

"The differences between these stations are so strongly marked as a rule that one can at once distinguish them by the catches. Station VII. lies in the southern corner of the bay, and is sheltered from the prevalent winds. Here we find a very large proportion of small fish, especially plaice. Station VIII., on the northern half of the bay, is very much exposed to the southerly and south-easterly gales, and the sand which composes its bottom-soil is in constant movement. Small plaice are consequently less abundant, and dabs are comparatively few. A further consequence of the variable nature of the physical conditions is that the catches vary greatly both as regards quality and quantity. The sole and painted ray (*R. microcellata*) are good examples of this. On one occasion, 13th September, 1901, nineteen large painted rays were obtained in one haul. On all other occasions it was almost entirely absent. Again, a considerable number of soles was twice obtained there in November, 1901, and September, 1902, the total number then caught making more than half of the soles obtained in Teignmouth Bay for the whole period. At other times, again, soles seem entirely absent from this region. Plaice and other species show the same fluctuation, and as already mentioned, all forms are more abundant in the fall of the year than at other times.

"Station IX. is readily distinguished by the greater variety of species, especially those useless for food, and the invertebrate fauna. The dominant species is the thornback ray. From the accompanying tables

it might appear as if the plaice were the most abundant, but an examination of the tables at the end shows that more than two-thirds (116) of the total (169) were obtained in one haul during July, 1902. Disregarding this haul as exceptional, probably due to the exceptional physical conditions during 1902 to be presently referred to, all the remaining hauls show that coarse fish, thornbacks, buffoons, and dog-fish are the distinguishing features of Station IX. The invertebrate fauna is also peculiar, cuttle-fish, oysters, Turritella, Trochus, Natica, Buccinum, hermit-crabs, Porcellana, swimming-crabs (especially *P. puber*), with various species of sea-anemones (especially *Actinoloba*), and hydroids being of exceptional abundance. The relation of the fish fauna to the invertebrates was not determined, but it may be gathered from what has been said that Teignmouth Bay offers a rich field for future research.

"Teignmouth Bay, like Torbay, is very liable to become 'foul' during the spring and summer, on account of the large quantities of drift-weed which the eddy of the Great West Bay carries down. The difficulties of trawling are thereby greatly increased, and the summer hauls are not truly representative of the fish of the bay. Station VII. is perhaps the worst in this respect, and it is probable that its normal inhabitants migrate outwards towards Station IX., whilst the seaweed 'plague' persists. This may account for the unusual number of plaice and dabs caught on the latter station in July, 1902.

"Holt has also remarked upon the incursion of seaweed into Teignmouth Bay during the summer."

The general characteristics of the stations may be gathered from the accompanying table, which has been prepared on the same lines as the corresponding ones for Start Bay and Torbay. The large proportion of small plaice usually caught in Station VII. shows that in any seasonal combination of the records of the different stations the results will not be strictly comparable unless due attention is paid to their proportional representation.

TABLE XV., *showing the Average Catch per Hour for the entire period on the various stations of Teignmouth Bay.*

Species.	Station VII.			Station VIII.			Station IX. 9 hrs.		Totals excluding Station IX.			Totals including Station IX.			
	hrs. min.	Small.	Marketable.	hrs. min.	Small.	Marketable.	Small.	Marketable.	hrs. min.	Small.	Marketable.	hrs. min.	Small.	Marketable.	Total.
Plaice	21 50	41	21	20 20	10	11	9	10	42 10	26	16	51 10	23	15	38
Dabs	,, ,,	16	5	,, ,,	2	2	8	1	,, ,,	10	4	,, ,,	9	4	13
Sole	,, ,,	+	1	,, ,,	+	4	+	2	,, ,,	+	2	,, ,,	+	2	2
Brill	,, ,,	+	–	,, ,,	+	+	+	+	,, ,,	+	+	,, ,,	1	+	1
Grey Gurnard	,, ,,	3	–	,, ,,	+	–	7	+	,, ,,	2	+	,, ,,	3	+	3
Whiting	,, ,,	5	2	,, ,,	+	4	+	1	,, ,,	3	3	,, ,,	3	2	5
Thornback	19 35	12	3	15 35	7	9	9	8	35 10	10	6	44 10	10	6	16
Homelyn	,, ,,	+	–	20 20	+	+	1	1	39 55	+	+	48 55	+	+	+
Blonde	21 50	+	–	15 35	+	1	+	–	37 25	+	+	46 25	+	+	+

In the following table the seasonal duration of the trawling on each station is indicated.

TABLE XVI., *showing the Amount of Trawling over each station in Teignmouth Bay for each quarterly period.*

Season.	Station VII. hrs.	min.	Station VIII. hrs.	min.	Station IX. hrs.	min.
August, September	4	0	4	25	2	0
October, November, December	9	35	6	15	—	—
January	1	30	0	45	—	—
April, May	5	15	4	45	4	30
July, September	1	30	4	10	2	30
Totals	21	50	20	20	9	0

It will be observed that while Stations VII. and VIII. were investigated for fairly similar periods in the summer of 1901 and spring of 1902, Station VII. monopolised two-thirds of the time in the autumn of 1901, and only one-fourth of the total time allotted to the stations in the summer of 1902. Station IX. does not appear at all in the records for the autumn and winter, and received relatively more attention in the summer of 1902 than in the corresponding season of the previous year.

The following table shows the general averages for the five seasons:—

TABLE XVII., *showing, for Teignmouth Bay, the Average Catch of Plaice per Hour, and the Percentage Frequency of each size, for each quarter of the year over all the stations combined.*

Season.	hrs.	min.	Total caught.	Catch per Hour. Total.	0–7″	8–11″	12–14″	15″+	Percentages. 0–7″	8–11″	12–14″	15″+
Aug., Sept., 1901	10	25	329	32	14	7	6	5	43	22	19	16
Oct., Nov., Dec. „	15	50	969	61	39	11	7	4	65	18	11	6
January, 1902	2	15	89	40	35	1	2	2	88	3	5	4
April, May „	14	30	292	20*	13	3	2	2	65	14	11	10
July, Sept. „	8	10	298	36	19	12	3	2	54	34	8	4

In the case of Teignmouth Bay it is not possible to draw a comparison between the *Oithona's* records and those of Mr. Holt as regards the abundance of fish in the summer quarter, since the latter was not represented during the previous investigations. It is obvious, however, that Teignmouth Bay is characterised, like Torbay, by the presence of a large stationary population of plaice of the smallest size which, with one exception, form the majority of the total catch in each season of

* The figures for the total catch per hour, and catch per hour of small plaice, during the spring quarter, are unduly depressed by the exceptionally large amount of trawling which took place over Station IX. If Station IX. be omitted, as in the two quarters preceding it, the total catch per hour is raised to 25, and the other figures become 19, 2, 2, 2 respectively. The percentage of small plaice also becomes raised to 76 per cent.

the year. It is also clear that the numbers of immature medium-sized plaice increased considerably in the summer of 1902 as compared with 1901—a feature which we have already seen was characteristic of each of the other bays. The influence of the winter emigrations from the bay is clearly shown for all the groups of plaice of 8 inches and upwards.

These features are not dependent on the disproportionate combinations of the stations in the different seasons, or on the inclusion of Station IX. (which does not materially influence the figures for any of the size-groups except the smallest). The influence of Station VII. on the averages for the first summer season was much greater than for the second, but its reduction to the same proportions merely reduces the total average catch for the first season from 32 to 28, the figures for the four size-groups becoming respectively 12, 6, 5, 5.

For the study of minuter points than those mentioned above, however, it is impossible to reduce the quarterly figures to a comparable basis of a reliable character owing to the small amount of trawling on Station VII. in the second summer, and to the irregular character of the midsummer records caused by the presence of drift-weed (cf. Tables C, D, hauls 2 and 29 on Station IX.). The most comparable records in the two years are those for September, the hauls for which month are limited to the inshore Stations VII. and VIII. It would appear from Table E that while the number of 8-to-11-inch plaice was twice as great in September, 1902, as in the same month of the previous year, the numbers of the smallest fish were about the same. These, however, as appears from the detailed Table D, were mostly 6- and 7-inch fish in the second year, with little admixture of 4-to-5-inch fish, whereas in the first year there was a considerable number of the latter. It would thus appear that in 1901 there was a greater abundance of the smallest plaice than in 1902, a view confirmed by the detailed records of the catches in July and August. As these smallest plaice would, a year later, become 8-inch fish, and as fish of this size preponderate in the 8-to-11-inch group, it is probable that the marked increase in the numbers of the 8-to-11-inch group during 1902 should be attributed to the abundance of 4- and 5-inch fish in the previous year. This conclusion has already been drawn in explanation of the same phenomenon in Torbay.

The increase of DABS during the summer of 1902, which has already been noticed in the case of Start Bay and Torbay, is equally conspicuous in the records for Teignmouth Bay, as the following table reveals :—

TABLE XVIII., *showing, for Teignmouth Bay, the total number of Dabs measured, and the Average Catch per Hour and Percentage Frequency of Small and Marketable Fish for each quarterly period.*

Season.	No. of Hours. hrs.	min.	Total caught.	Catch per Hour. 0–7″	8″+	Total.	Percentages. 0–7″	8″+
August, Sept., 1901	10	25	127	9	3	12	71	29
Oct., Nov., Dec. „	15	50	265	9	7	16	57	43
January 1902	2	15	4	2	–	2	100	–
April, May „	14	30	22	1	1	2	50	50
July, September „	8	10	242	27	2	29	92	8
Totals . .	51	10	660	9	4	13	73	27

In the following table the relative numbers of dabs and plaice caught during the two periods of investigation are displayed according to the plan adopted for the other bays. It will be observed that during each period the total number of dabs was generally less than half the total number of plaice at each season of the year, the only important exception being in the summer quarter of 1902, when, as in the other bays, there was a great relative increase in the number of dabs. This increase did not, however, lead to the plaice being actually outnumbered, as was the case in Start Bay. The fact that in Teignmouth Bay the plaice always maintain their superiority in point of numbers over the dabs is doubtless due to the perennial supply of young plaice from the estuaries which open into this bay, whereas the young dabs do not derive the same advantage from the proximity of these estuaries, owing to their less restricted habits. It will also be observed that during 1901–2 the proportion of dabs to plaice was distinctly lower than during the previous period 1895–8 at each season of the year for which there are corresponding records. This contrast holds whether the totals or the large fish alone are taken into consideration.

TABLE XIX., *showing, for Teignmouth Bay,* (1) *the total proportion of Dabs to Plaice, and* (2) *the proportion of Large Dabs* (8 *inches and upwards*) *to Large Plaice* (12 *inches and upwards*), *for each quarter during the two series of investigations* (*Plaice* = 100).

	Total Dabs to Plaice. 1901–2.	1895–8.	Large Dabs to Large Plaice. 1901–2.	1895–8.
July to September . .	39	(?)	32	(?)
October to December .	27	51	67	165
January to March . .	5	29	None	27
April to June . .	8	22	18	43
July to September, 1902 .	81	—	51	—

The Causes of the Observed Fluctuations.

It has been shown in the preceding pages that during the year 1901–2 there was a remarkable scarcity of immature medium-sized plaice (8 to 11 inches) in all three bays, as compared with the period 1895–8, previously investigated. This scarcity was limited to the year 1901 and the first half of 1902, and was followed in the summer of 1902 by an increased abundance of plaice of this size, as well as of small dabs.

We have seen that there are distinct indications in the trawling records that these fluctuations were generally preceded in the previous year by corresponding fluctuations in the abundance of fish one year younger. The available evidence does not amount to a conclusive demonstration; but the indications of this correlation are sufficiently definite to form the basis of a working hypothesis. The existence of such a correlation would lead at once to the conclusion that the causes of the observed fluctuations were quite independent of the restrictions placed upon trawling in the bays, and were to be sought in the conditions which naturally influence the reproduction of the fish from year to year. The fluctuations in the numbers of small flat-fish in the bays are therefore probably attributable to changes in the physical conditions in previous years, which caused sometimes a larger and sometimes a smaller proportion of the floating eggs and larvæ to set into the bays and undergo a successful metamorphosis there.

These remarks apply to Teignmouth Bay and Torbay, but only indirectly to Start Bay, which apparently possesses no natural rearing-ground (or "nursery") for the smallest plaice, and seems to derive the bulk of its population of medium-sized plaice by migration from the other bays to the northward.

Of the various physical factors capable of producing the changes above mentioned, none would appear to possess so great an importance as the direction of the winds during the spawning season of the fish, owing to their dominant influence upon the set of the currents.* The problem deserves fuller treatment than it is possible to give to it on the present occasion, but an analysis of the meteorological records of the Rousdon observatory (near Lyme Regis) for the years 1891 to 1901 lends distinct support to the view expressed.

For the region under discussion we may assume that south-easterly winds (*i.e.* E., S.E., and S.) would be favourable, and north-westerly winds (*i.e.* N., N.W., and W.) would be unfavourable,—the spawning season of the plaice in this district being January, February, and March.

(1) We have already seen that small plaice of 4 and 5 inches were

* Cf. Garstang, "Report on the Surface Drift of the English Channel and Neighbouring Seas during 1897," *Journ. M. B. A.*, vol. v., pp. 199–231. (Other literature cited.)

unusually abundant in June, 1897, according to Mr. Holt's records. These would be two-year-old fish,* hatched in the early part of 1895. During the first three months of that year the percentage of unfavourable winds was less than normal (49 per cent.), and of favourable winds above the normal frequency (21 per cent.), the range of variation throughout the decade being from 46 per cent. to 60 per cent. for "unfavourable" winds, and from 13 per cent. to 26 per cent. for "favourable" winds.

(2) Similarly the abundance of two-year-old fish in 1901 as shown by the *Oithona's* records may be attributed to the prevalence of south-easterly winds (E. to S.W. through S.) in February, 1899.

(3) The most unfavourable year in the decade was 1898, when the percentage of "favourable" winds was at its minimum (13 per cent.), and that of "unfavourable" winds at its maximum (60 per cent.). The plaice hatched in that year would be three and a half years old in the summer of 1901, *i.e.* for the most part between 8 and 9 inches in length. It can scarcely be without significance that the scarcity of plaice of this size in the summer of 1901 is one of the most striking features of the *Oithona's* records.

Mention may here be made of the fact that towards the end of January and in the early part of February, 1898, three dozen of the Association's drift-bottles were put overboard at various points between 14 and 20 miles S.E. and E.S.E. of Berry Head from the Brixham smack *Sunbeam*, through the instrumentality of Mr. W. J. Sanders, and every one of the bottles recovered was picked up on the French coast, with the exception of one bottle recovered by a Brixham smack two days after it had been thrown overboard. This bottle was found 6 miles S.E. of its initial position. If, as seems probable, an exceptionally large proportion of the eggs of the plaice drifted out to sea in that year in the same direction, it is scarcely surprising to find that the trawling investigations should subsequently reveal a phenomenal scarcity on the Brixham grounds of plaice derivable from that spawning season. The fact at any rate confirms the accuracy of the hypothesis from which we started.

Summary of the Trawling Records.

The following points appear to be established by the preceding analysis of the trawling records for the three bays:—

1. The population of flat-fish, especially of plaice and dabs, in the three bays is subject to considerable fluctuations, both from season to season and from one year to another.

2. The *seasonal* fluctuations are more pronounced in the case of the

* Fulton, "Rate of Growth of Sea Fishes," *Twentieth Report Scottish Fishery Board*, 1902, pp. 337 to 360.

larger fish of these two species than of the smaller fish. It will be shown below that, for the plaice, the explanation of this difference is to be found in the peculiarities of their migrations.

3. In Start Bay the seasonal fluctuations of plaice are only appreciable in the case of mature fish. Practically the whole of the plaice below 12 inches in length appear to reside in the bay throughout the year, and do not usually emigrate on the approach of winter until they have attained the size mentioned.

In Torbay and Teignmouth Bay the seasonal fluctuations of plaice extend also to the immature medium-sized fish. (Experiments with marked fish, especially in Teignmouth Bay, show that the plaice in these bays emigrate at a smaller size than in the case of Start Bay.)

4. The *annual* fluctuations in the abundance of plaice are traceable to changes which take place from year to year in the numbers of the smallest fish present in the bays. A decrease in the number of the smallest group one year is followed by a decrease in the number of fish one year older in the following year. An increase in the smallest is similarly followed by an increase in the numbers of larger fish in the years immediately following.

5. The observed changes cannot be explained as due to the prohibition of trawling in the bays, since fluctuations in both directions have taken place during the period of closure.

6. The facts are most fully explained on the hypothesis that changes from year to year in the physical conditions which influence the distribution of floating eggs and larvæ cause sometimes a larger and sometimes a smaller proportion of the eggs and fry to set into the bays and undergo a successful metamorphosis on the rearing-grounds there.

The chief agency capable of inducing these changes appears to be the direction of the winds during the spawning season. The records tend to show that a prevalence of south-easterly winds during the spawning season of the plaice in any year in the South Devon district is followed by the survival of a greater percentage of the fry of that year, and an unusual amount of north-westerly winds by an increased mortality.

7. The closure of the bays to trawlers does not appear to have appreciably favoured the dab at the expense of the plaice, since, during the year ending June, 1902, the proportion of dabs to plaice was less in Start Bay and Teignmouth Bay than during the previous investigations from 1895–98, and was higher only in the case of Torbay, where conditions peculiarly favourable to the dab are found. In the summer of 1902 an unprecedented increase in the number of small dabs was shown by the trawling records for each bay, and exceeded a simultaneous increase in the number of small plaice.

Changes of this kind may possibly, after a series of years, bring about a nett result to the advantage of the dab; but, as the spawning season of the dab does not precisely coincide with that of the plaice, a detailed examination of the fluctuations of the dab in relation to the physical conditions prevailing during the various spawning seasons is necessary before any such difference can be attributed with confidence to the differential effects of protection on dabs and plaice respectively. The only point established by the investigations as regards the dab is that this species is subject to even greater fluctuations in abundance than the plaice.

8. In spite of the seasonal and annual fluctuations to which the numbers of flat-fish in the bays are subject, it is clear that there is an essential difference between Start Bay and the other bays to the northward as regards the normal proportions of large and small fish.

The following table shows the extent of the seasonal fluctuations in the percentage of plaice of different sizes for each bay, as shown by the quarterly averages of the *Oithona's* records.

	Length of fish.	Start Bay. Per cent.	Torbay. Per cent.	Teignmouth Bay. Per cent.
Immature	0–7 ins. ...	1–13 ...	33–77 ...	43–88
	8–11 „ ...	18–53 ...	8–53 ...	3–34
Mature ...	12–14 „ ...	32–47 ...	7–24 ...	5–19
	15 ins. and above	11–34 ...	5–11 ...	4–16

Start Bay showed a preponderance of mature plaice at all seasons of the year, and an insignificant proportion of small plaice below 8 inches in length (never more than one-eighth of the total number present). On the other hand, Torbay and Teignmouth Bay always showed a preponderance of immature plaice, while the proportion of the smallest fish below 8 inches was never less than one-third, and sometimes (*i.e.* during the winter quarter) exceeded three-fourths of the total number present.

9. The following table shows the average percentage of plaice of each size in the three bays, irrespective of seasonal differences, as shown by the two series of experiments respectively.

	Thistle and *Busy Bee*, 1895–8.			*Oithona*, 1901–2.		
	Start Bay.	Torbay.	Teignmouth Bay.	Start Bay.	Torbay.	Teignmouth Bay.
0–7 ins. . .	12 ...	39 ...	32	4 ...	50 ...	60
8–11 ins. .	41 ...	35 ...	56	24 ...	30 ...	20
12–14 ins. .	38 ...	23 ...	10	44 ...	14 ...	12
15 ins. and above	9 ...	3 ...	2	28 ...	6 ...	8

Thus the preponderance of large plaice over small in Start Bay, and of small plaice over large in the other bays, was even more marked during the *Oithona's* investigations than during the earlier series of

experiments. The difference, however, is apparently attributable, not to any permanent change in the distribution and abundance of the fish caused by the closure of the bays, but principally to a temporary scarcity during 1901–2 of medium-sized plaice from 8 to 11 inches in length (three to four years old), caused by an unfavourable spawning season in 1898.

2. THE MIGRATIONS OF THE PLAICE.

In order to provide some definite information as to the movements of plaice to and from the bays, a considerable number of living fish were marked with numbered labels and set free in the autumn of 1901 and the early summer of 1902. After some preliminary experiments with other devices, Dr. Petersen's method was adopted. This consists in passing a small piece of silver wire through the dorsal edge of the body, about half-way down, between two of the interspinous bones below the base of the dorsal fin, and in attaching a couple of special bone buttons to the wire, one on the upper (or eyed) side, and one on the lower (or blind) side. One, and in some cases each, of the buttons bore a distinctive number stamped upon it. The numbered bone button on the upper side was advantageously replaced in some of the experiments by a thin oval disc of brass, also numbered. By this modification of Petersen's method the obliteration of the number by wear and decay of the bone was obviated, and the fishes appear to have suffered little, if any, inconvenience. The only observed injuries caused by the labelling were due to an accidental slackness of the wire in two or three cases, thus causing the hinder margin of the lower button to catch and cut into the skin. In the great majority of cases, however, the fish were recovered in good condition.

Neglecting the preliminary trials, the marking experiments fall into two groups: (1) fish marked and liberated in the bays in the autumn of 1901; and (2) fish marked and liberated outside the bays in the early summer of 1902. The details of liberation and recovery are given in Table XXV.

I. Start Bay.

Four batches of marked plaice were liberated in Start Bay between the 2nd October and the 9th November, 1901. During October 159 were marked, and during November 108, making a total of 267. Of these 62 fish had been recovered to the end of July, 1903, *i.e.* 23½ per cent. Of these 34, *i.e.* 13 per cent., were recovered in the first six months, and 23, *i.e.* 8½ per cent., in the second six months, making a total of 21½ per cent. recovered within one year of liberation. The size of the fishes marked varied from 17·5 cm. to 46 cm., *i.e.* from

7 to 18 inches. The following table shows the number of fish of each size which were marked, and also the number of each size which have been recovered.

TABLE XX., *showing the numbers and sizes of Plaice marked in Start Bay, and the numbers recovered in successive periods inside and outside the bay.*

Length on liberation.	Total marked.	Total recovered.	First half-year.		Second half-year.		Second year.		TOTAL.		
			*Inside.	Outside.	Inside.	Out. side.	Inside.	Outside.	Inside.	Outside.	Locality unknown.
7–8 inches .	9	1	1	—	—	—	—	—	1	—	—
9–10 ,, .	27	5	2	1	1	—	—	1	3	2	—
11–12 ,, .	69	18	1	10	5	2	—	—	6	12	—
13–14 ,, .	125	30	5	11	3	7	2	1	10	19	1 (1st ½-year)
15–18 ,, .	37	2	—	1	—	—	—	1	—	2	—
Size uncertain.	—	6	1	—	—	2	—	—	1	2	3 (2nd ½-year)
Totals . .	267	62	10	23	9	11	2	3	21	37	4
			33		20		5				
Locality unknown	—	—	1		3		—				
Grand total .	267	62	34		23		5				
Per cent. of total marked		23½ %	13 %		8½ %		2 %		8 %	14 %	1½ %

It is worthy of notice that the percentage of recoveries in the case of the largest and the smallest fish is very small. In the case of plaice from 9 to 14 inches in length at the time of liberation, 24 per cent. have been recovered, *i.e.* one out of every four; whereas of the fishes from 7 to 8 inches in length, only one out of nine has been recovered, and of those of 15 inches and upwards only two out of thirty-seven. It will be seen in the sequel that the explanation of this difference is probably to be found partly in the facts that the smallest fishes remain within the bays, and are, therefore, not liable to be captured by the trawlers in the ordinary way during the first year, and that the largest fishes tend to migrate away from the Brixham waters altogether, probably for the most part to the Eddystone trawling-grounds (cf. No. 176, caught on May 23rd, 1902, off the Eddystone).

The table shows further that nearly twice as many fish were recovered outside the bay as were found within its limits. The proportion borne by "outside" to "inside" captures is seen to increase

* NOTE.—The limit between "inside" and "outside" the bays in these tables is a purely geographical one, and does not strictly correspond with the trawling limits of the Devon Sea Fisheries Committee. Similarly the percentage of recoveries inside the bays is not to be taken as a measure of "poaching" on the part of the trawlers, since the returns include the captures by seiners, rod-fishermen, and the *Oithona* itself, as well as by trawlers.

pretty regularly with the size of the fish, the immature fish from 7 to 10 inches having been found mostly inshore, and the fish of the largest size-group only offshore. The smaller mature fish, *i.e.* from 11 to 14 inches, show, however, no such regularity when the season of the year is taken into consideration. During the first half-year, which, it will be borne in mind, included the winter period, twenty-one fishes were recovered outside, as against only six inside the bay. During the second half-year, extending from May to November, as many of these fishes were recovered inside the bay as outside.

The explanation of these facts becomes obvious upon a perusal of the detailed tables in which the localities of capture are recorded in chronological order. It will be seen that during October and November the fish were mostly found in Start Bay, but during December, January, and March most of the recoveries were made at considerable distances from the bay in deep water, especially on the Spion Kop ground, eight to ten miles off Beer Head, and on the Biscuit Dust ground, some twelve to fifteen miles off the same headland. During April and May the fish were still being recovered offshore, but nearer to the bay than during the preceding period, the ground locally known as the Corner being apparently the chief rendezvous of the fish at this season.* During the latter part of May and the succeeding summer months until October a considerable number of the fish were again recovered inshore, mostly in Start Bay, but one at any rate (No. 293) in Torbay.

There can be no doubt, therefore, that a large proportion of the plaice to be found in Start Bay make a periodical migration to the offshore grounds on the approach of winter. Out of a total of twenty-six fish recovered from December to April (both inclusive) four at most were found in the bay, and two of these were taken on December 1st, while the outward migration was still in progress. It has already been seen that this migration is for the most part limited to the fishes of 11 inches and upwards, *i.e.* to those which have attained the average size of maturity, and Dr. Kyle observed that the majority of the plaice recovered offshore from January to April in this experiment were either spawning or spent.

Analysis of the records also shows that there is no one route of migration, but rather a series of lines radiating fanwise from the bay in directions varying between N.N.E. and E. The smaller mature fish (between 11 and 13 inches) appear to have taken the shallower gradients to the northward, ultimately reaching the Spion Kop ground after passing Torbay and Teignmouth Bay (cf. Nos. 260, 279, 203, 210, 217, and 130). The larger fish, on the other hand, of about 15

* Also of the trawlers, who follow the fish in their migrations (cf. p. 440).

inches in length, appear to migrate more or less directly to the Biscuit Dust ground (cf. Nos. 207, 257, and 305), though the capture of one of these large fishes in Torbay on December 17th (No. 1) suggests that even for the larger fishes the actual route may be somewhat to the northward at the commencement of the migration.

After this spawning migration has taken place the smaller fishes tend to return again to the bays. The largest fishes may either return to the bays (cf. Nos. 57, 75, 139, 10, 252, and 293), or may pass to the south and west of Start Point altogether (cf. Nos. 176, 308, and 277).

II. Torbay.

Two small batches of marked plaice were liberated in Torbay—eighteen fish on October 10th, 1901, and seven fish on November 14th, making a total of twenty-five fish. Six of these have been recovered altogether, for the details of which reference may be made to the detailed table and the following analysis of the sizes of the fishes marked. The experiment was on too small a scale to render discussion of details necessary.

Table XXI., *showing the numbers and sizes of Plaice marked in Torbay, and the numbers recovered in successive periods inside and outside the bay.*

Length.	No. marked.	No. re-caught.	First half-year.		Second half-year.		Second year.		Total.	
			Inside.	Outside.	Inside.	Outside.	Inside.	Outside.	Inside.	Outside.
7–8 inches .	4	—	—	—	—	—	—	—	—	—
9–10 ,, .	5	2	2	—	—	—	—	—	2	—
11–12 ,, .	11	3	2	1	—	—	—	—	2	1
13–14 ,, .	3	1	—	—	—	—	1	—	1	—
15–18 ,, .	2	—	—	—	—	—	—	—	—	—
Total . .	25	6	4	1	—	—	1	—	5	1
			5		—		1			
Per cent. of total marked . .	24 %		20 %		—		4 %		20 %	4 %

III. Teignmouth Bay.

Three batches of marked fish were liberated in Teignmouth Bay—fifty-three fish on October 9th, twenty-one on November 13th, and twenty-eight on November 29th, making 102 in all. Of these thirty-four have been recovered, eighteen (18 per cent.) in the first half-year, and nine (9 per cent.) in the second half-year, making a total of twenty-seven (27 per cent.) within one year of liberation. The sizes of the fishes marked may be gathered from the accompanying table.

TABLE XXII., *showing the numbers and sizes of Plaice marked in Teignmouth Bay, and the numbers recovered in successive periods inside and outside the bay.*

Length.	No. marked.	No. re-caught.	First half-year.		Second half-year.		Second year.		Total.	
			Inside.	Out-side.	Inside.	Out-side.	Inside.	Out-side.	Inside.	Out-side.
7–8 inches .	32	5	2	—	1	2	—	—	3	2
9–10 ,, .	37	16	2	5	3	2	—	4	5	11
11–12 ,, .	17	10	2	6	—	1	—	1	2	8
13–14 ,, .	13	3	1	—	—	—	—	2	1	2
15–18 ,, .	3	—	—	—	—	—	—	—	—	—
Total . .	102	34	7	11	4	5	—	7	11	23
			18		9		7			
Per cent. of total marked		34 %	18 %		9 %		7 %		11 %	23 %

It will be seen that the general percentage of recoveries (34 per cent.) is much higher for this bay than for Start Bay, and that half the fishes from 9 to 12 inches were recovered; whereas in the Start Bay experiments only a quarter of the fishes of this size, and less than 24 per cent. of the total number liberated, were recaught.

The fact that none of the thirty-two fishes from 7 to 8 inches were recaught after the first year tends to show that the explanation advanced above, in the Start Bay section, as regards the small percentage of these fishes caught, is not sufficient to account for all the facts. One year's growth (from 3 to 4 inches for fishes of this size) would bring them to a length of 10 to 12 inches, at which size they would be capable, as the records show, of undertaking the ordinary migrations, and would thus be liable to capture by the trawlers outside the bays. The probability is that the rapid growth of fishes of this size causes the fish to suffer injury towards the end of the summer owing to the rigid character of the labels with which they are marked. The fish grow in thickness, but the length of the silver wire connecting the buttons remains the same. The consequence is that the buttons press too severely upon the skin and, by laceration, cause wounds of a serious character, or wear off altogether. I have seen good examples of this in our North Sea investigations. The statistics of capture of these small marked fishes should, therefore, be treated cautiously, and the fact that none of the fishes marked of this size-group (7 to 8 inches) have been recaptured after the first year in any of the Devon experiments receives an explanation which it would otherwise be difficult to supply.

Turning again to the table, it should be noticed that fully twice as many fish from this experiment have been recovered outside the bay as

have been caught inside, and that after the first year none of the fish were recovered within the bay, although as many as seven (= 20 per cent. of the total recovered, and 7 per cent. of the total marked) were taken during the second year outside the bay. We see further that after the first half-year the recoveries within the bay were limited to the immature fish below 11 inches in length. Since fishes exceeding this size formed a third of the total marked, this feature in the results cannot be without significance.

If, for the reasons already given, we omit the smallest fishes (7 to 8 inches) altogether from consideration, we find that 41½ per cent. of the Teignmouth Bay fish were recaught,—31½ per cent. in the first year and 10 per cent. in the second year. During the whole period 11 per cent. were recaptured in the bay and 30 per cent. outside. In the Start Bay experiments only 23½ per cent. of the fish were recaught, —21½ per cent. in the first year and 2 per cent. in the second year. Of the entire number recovered, 1½ per cent. had no locality assigned to them, 8 per cent. were recaught in the bay, and 14 per cent. outside the bay (see Table XXIV.).

The difference between the total percentages recovered (18 per cent.) in the two experiments appears to be an approximate measure of the proportion of Start Bay fish which migrated altogether outside the Brixham trawling-grounds, or acquired habits which placed them beyond the reach of the fishermen during the period under discussion, —10 per cent. escaping during the first year, and 8 per cent. during the first nine months of the second year.

The high percentage of fish recovered from the Teignmouth Bay experiments during the second year, coupled with the fact that after the first half-year none of the mature fish were taken in the bay, shows that this bay in no way approaches the conditions of a self-contained area, so far as plaice are concerned; but that it is essentially a rearing ground (or nursery) for young plaice, which leave the bay even before maturity is reached, and do not, as a rule, return to it.

Turning now to the detailed tables showing the localities of capture, it is obvious at a glance that the Teignmouth Bay plaice, on the approach of winter, migrate eastwards towards the same grounds as those visited by the Start Bay fish. Doubtless the larger fishes which undertake this migration spawn on the same grounds. Accepting, however, 11 inches (= 28 cm.) as the average size at maturity, it cannot escape notice that many of the fishes which had undertaken this migration were too small to be sexually mature (cf. Nos. 219, 225, 247, 337, and 343). It will also be noticed that whereas the Start Bay fish tended to return to Start Bay in the following summer and autumn after the spawning migration was over, the Teignmouth Bay showed

no general tendency to return to Teignmouth Bay,—several fishes recovered during the following summer having been found either in Torbay or Start Bay or in their immediate neighbourhood (cf. Nos. 268, 236, 320, and 357).

The details of capture thus confirm the results of the previous statistical treatment of these experiments. They show that Teignmouth Bay is an important source of supply of young plaice, both for the offshore grounds in the Brixham area and for the other bays to the southward. The upkeep of the general stock of plaice in the district would indeed appear to be largely dependent on the preservation from destruction of the young fish in this bay.

IV. Outside the Bays.

The three preceding sets of experiments in the bays were carried out in the autumn of 1901. In the early summer of 1902 Dr. Kyle marked and liberated a number of plaice outside Start Bay and Torbay in order to throw special light on the summer migrations. Eleven plaice were marked outside Start Bay on April 12th to 14th, and sixty-two plaice were marked and liberated midway between Berry Head and the Orestone on May 29th. As the recoveries in each case show the same general tendencies, they may be taken together. The following analysis shows the sizes of the fishes marked and the numbers recovered inside and outside the bays during successive periods. In comparing this table with the preceding tables referring to the bays, it should be borne in mind that the first half-year is now a summer and autumn period, and not a winter period, as in the previous experiments.

Table XXIII., *showing the numbers and sizes of Plaice marked outside Torbay and Start Bay, and the numbers recovered in successive periods inside and outside the bays.*

Length on liberation.	Total marked.	Total recovered.	1st half-year.		2nd half-year.		2nd year.		Total.		
			Inside.	Outside.	Inside.	Outside.	Inside.	Outside.	Inside.	Outside.	No locality.
7–8 inches .	2	1	—	—	1	—	—	—	1	—	—
9–10 ,, .	23	6	3	2	—	1	—	—	3	3	—
11–12 ,, .	41	16	7	7	—	—	1	—	8	7	1 (2nd hf.-yr.)
13–14 ,, .	7	3	1	1	—	—	—	1	1	2	—
15–18 ,, .	—	—	—	—	—	—	—	—	—	—	
Totals . .	73	26	11	10	1	1	1	1	13	12	1
			21		2		2				
Locality unknown		—	—		1		—				
Grand total .	73	26	21		3		2				
Percentage of total marked . .		36 %	29 %		4 %		3 %		18 %	16½ %	1½ %

It will be seen that the fishes marked were mostly from 9 to 12 inches in length. The percentage of recoveries over the whole period distinctly exceeds that for Start Bay, and even surpasses that for Teignmouth Bay, viz. 36 per cent. For the first twelve months the percentage is 33 per cent. Unlike the result of the Start Bay and Teignmouth Bay experiments, the majority of the fish were recovered inside the bays, and almost entirely during the first half-year.

On examining the detailed records showing locality of capture, it will be seen that most of the fishes recovered during the first half-year were either travelling towards or had made their way into Start Bay. Only one fish (No. 347) was recovered in Torbay, a fact which is all the more remarkable since the great majority of the specimens were liberated in the mouth of that bay. On November 16th one of the Torbay fish (No. 373) was recovered off the Eddystone by a Plymouth trawler. The movements of the fish during this season were, therefore, very similar to those of the Start Bay fish on their return migration from the spawning grounds, and they confirm the interpretation which was adopted in the section dealing with the Start Bay fish as regards the return migration.

During the second half-year, *i.e.* in the spring of 1903, one fish at least was recovered on the Spion Kop ground (No. 328), and the records of the fishes numbered 383 and 361 tend to show that during June and July the remainder of the fish were again returning to Start Bay.

In the following table the percentage of marked fish recovered from the various experiments, exclusive of the smallest fish from 7 to 8 inches, is shown side by side for the different periods for the sake of easier comparison. It has not been thought necessary to repeat the figures given in the separate tables concerning the totals of *all* sizes marked.

TABLE XXIV., *showing percentage of Plaice of* 9 INCHES AND UPWARDS *marked and recovered in the various experiments.*

Locality.	Numbers.		Percentages of totals marked.									
			First half-year.		Second half-year.		Second year.		Entire period.			
	No. marked.	No. recovered.	Inside.	Outside.	Inside.	Outside.	Inside.	Outside.	Inside.	Outside.	Locality unknown.	Total % recaught.
Start Bay . .	258	61	3·5	8·9	3·5	4·2	0·8	1·3	7·8	14·3	1·5	23·6
Torbay . .	21	6	19·0	4·7	—	—	4·7	—	23·8	4·7	—	28·6
Teignmouth Bay	70	29	7·1	15·7	4·3	4·3	—	10	11·4	30·0	—	41·4
All the bays combined *	349	96	5·1	10·0	3·4	4·0	0·9	2·8	9·4	16·9	1·1	27·5
Outside the bays	71	25	15·5	14·0	—	1·4	1·4	1·4	16·9	16·9	1·4	35·2

* In this combination of the bays, Start Bay fish recovered in Torbay and Teignmouth Bay, or *vice versâ*, have been treated as "inside," not "outside," as in the case of the tables for each bay separately.

TABLE XXV. *Records of Plaice-marking Experiments.*

START BAY.

Particulars of Liberation.	Particulars of Recovery.					
Date. No. of fish. Locality.	Date.	No. of fish.	Locality.	Initial size.	Ultimate size.	Sex.
				cm.	cm.	
BATCH I.						
Oct. 2nd to 4th, 1901.	1901. Oct. 11	98	Start Bay	33	—	—
99 Plaice (from hauls No.	,, ,, 21	90	,,	32	—	—
16, 18, 19, and 20).	,, Nov. 21	95	Off Dartmouth	30	33	—
Inside Skerries, from centre	,, Dec. 17	1	Torbay	37	—	—
of bay northwards.	1902. Jan. 15	84	15 miles off Berry Head (Start W. to W.N.W.)	34	—	—
Labels: bone buttons.	,, ,, 20	110	Offshore off Berry Head	36	—	♂ s.
	,, Feb. 13	120	Offshore in 25 fms.	30	—	♂ s.
	,, Mar. 20	130	"Spion Kop"	30	31·5	♂ s.
	,, ,, 22	135	Off Berry Head	28	29·5	♀ s.
	,, April 1	12	12 miles S. of Start Point	32	34	♀ s.
	,, ,, —	103 (or 105)	6 to 12 miles off Start Bay	32·5 (or 32)	—	—
	,, ,, 23	87	"The Corner" off Start Bay	33·5	35·5	♂ s.
	,, May 8	two	Off the Start	? ?	—	—
	,, ,, 11	28	Start Bay	31	—	—
	,, ,, 24	88	,,	31	33	—
	,, July 9	144	,,	35	38	♂ s.
	,, ,, 14	123	,,	28	30·5	—
	,, ,, 30	55	,,	26	33	—
	,, Aug. 30	57	,,	32·5	39·5	—
	,, Sept. 1	75	,,	36	35·5	—
	,, Oct. 1	139	,,	34	38	—
	,, ,, 2	10	,,	35	40·5	—
	1903. Feb. 24	18	10 miles off Sidmouth	35	43	—
II. Oct. 11th, 1901.						
6 Plaice (from haul 21).	1901. Dec. 8	260	Torbay	32	—	—
Centre of Start Bay.						
Labels: brass discs.						
III. Oct. 29th, 1901.	1902. Mar. 27	145	Spion Kop	32·5	34	♀ s.
54 Plaice (from special	,, April 11	163	,,	34	35·5	—
hauls)—35 between Red-	,, ,, 26	159	,,	33	35·5	—
lap and Dartm. Fairway,	,, May 23	176	Off Eddystone	35	35	♂ s.
1½ m. from shore; remain-	,, June 18	165	2 miles off Downend	28	—	—
der 1½ m. E. of Torcross.	1903. April 2	184*	8 miles off Downend	46	48	—
Labels: bone buttons.	,, July 28	155	Start Bay	26·5	39	—
IV. Nov. 7th to 9th, 1901.	1901. Nov. 14	299	,,	36	—	—
108 Plaice (from hauls No.	,, ,, 19	205	,,	21·5	21	—
7, 8, 9, and a special haul	,, ,, 19	227	,,	37	—	—
on Nov. 7th).	,, ,, 20	279	Teignmouth Bay	33	—	—
Inside Skerries, from off	,, ,, 29	219	Start Bay	33·5	33·5	—
Torcross to Dartmouth	,, Dec. 1	207	12 to 15 miles off Beer Hd.	39	38	—
Fairway.	,, ,, 1	276	Start Bay	34·5	—	—
Labels: bone buttons.	,, ,, 1	254	,, (+242 ?)	27	—	—
	,, ,, 2	257	12 to 15 miles off Beer Hd.	37·5	38	—
	,, ,, 5	218	2 to 5 miles off Berry Hd.	34·5	—	—
	,, ,, 9	204	Start Bay (?)	33	—	—
	1902. Jan. 25	305	In deep water off Beer Hd.	37·5	—	♂ s.
	,, Mar. 12	203	Off Beer, in 20 fms.	23·5	—	♂ s.
	,, ,, 22	307	Start Bay	25·5	25·5	—
	,, April—	210	Off Bridport	33·5	—	—
	,, ,, 2	217	Spion Kop	28·5	29·5	♂ s.
	,, ,, 23	222	Neighb'hood of Start Bay	36	36	♂ s.
	,, ,, 23	247	,, ,,	28·5	29·5	♂ s.
	,, May 10	202	4 miles off Dartmouth	28	32	—
	,, ,, 17	287	Offshore, off the Start	36	37 (*sic*)	—
	,, ,, 28	212	8 miles off Downend	35·5	38	—
	,, July 18	268	Back of New Ridge (3 miles off Downend)	34·5	38·5	—
	,, Aug. 11	252	Start Bay	32	37	—
	,, ,, 11	three	Locality unknown	? ? ?	—	—
	,, Sept. 13	308	Salcombe Range	33	38	—
	,, Oct. 17	29 (3 ?)	Torbay (3rd figure obscure)	34 ?	38	—
	1903. Feb. 6	277	20 miles S.W. of Start Pt.	27·5	34	—

* Doubtful; see note p. 488.

TORBAY.

Particulars of Liberation.	Particulars of Recovery.					
Date. No. of fish. Locality.	Date.	No. of fish.	Locality.	Initial size.	Ultimate size.	Sex.
				cm.	cm.	
Batch V.						
Oct. 10th, 1901.	1901. Dec. 1	287	Torbay	23	—	—
18 fish (from haul No. 11).	,, ,, 1	289	,,	27·5	—	—
Torbay.	,, ,, 1	294	,,	30	—	—
Labels: brass discs.	1902. Oct. 16	298	,,	33	38	—
Batch VI.						
Nov. 14th, 1901.	1901. Dec. 1	325	,,	31	—	—
7 fish (from haul No. 15).	1902. May 6	327	12 miles off Start (latter bearing N.W. ?)	30	30 (*sic*)	—
Torbay.						
Labels: brass discs.						

TEIGNMOUTH BAY.

Particulars of Liberation.	Particulars of Recovery.					
Date. No. of fish. Locality.	Date.	No. of fish.	Locality.	Initial size.	Ultimate size.	Sex.
				cm.	cm.	
Batch VII.						
Oct. 9th, 1901.	1901. Oct. 9	237	Off Dawlish	21	—	—
53 Plaice (from haul No. 7).	,, ,, 12	254	Teignmouth	29	—	—
Off Teignmouth.	,, ,, 12	263	Dawlish	21·5	—	—
Labels: brass discs.	,, ,, 12	265	Teignmouth	24·5	—	—
	,, ,, 30	278	Off Dawlish (caught with hook and line)	28	—	—
	1902. Jan. 13	256	Off Beer Head, in 20-25 fms.	28	—	—
	,, Feb. 6	219	Off Beer Head, in deep water	23	—	—
	,, Apl. 7	258	Teignmouth Bay, inside Ledge	27	31	—
	,, May 15	225	6 miles off Beer Head	20	23	—
	,, July 8	247	12 miles out from Torbay	21·5	—	—
	,, Sept. 4	268	Torbay	23·5	—	—
	,, ,, 10	236	Start Bay	25	30·5	—
	,, Oct. 11	248	Pole Sands, Teignmouth	21	26·5	—
	1903. Mar. 5	244	Spion Kop	27·5	34·5	—
	,, ,, 14	246	,,	27	37	—
Batch VIII.						
Nov. 13th, 1901.	1902. Mar. —	308	Off Sidmouth and Teignmouth	28	—	—
21 Plaice (7, and probably all, from hauls 11 and 12).	,, Apl. 8	314	Off the Start	29·5	—	—
Teignmouth Bay; liberated in three batches, off Minicombe, Dawlish, and Clerk Rock.	,, ,, 11	312	South of Beer Head, in 22 fms.	28·5	32	♂
	,, ,, 23	320	"The Corner" off Start Bay	32	—	—
	,, July 10	313	Start Bay	31	—	—
Labels: brass discs.	,, Nov. 10	305	Teignmouth Bay	24	30·5	—
Batch IX.						
Nov. 29th, 1901.	1901. Dec. 1	352	Teignmouth	35	—	—
28 Plaice (from special haul)	1902. Jan. 24	337	In deep water towards Portland (25 fms.)	24	—	—
Off Teignmouth 1 mile.	,, Apl. 11	340	South of Lyme	31·5	—	—
Labels: brass discs.	,, ,, 28	343	7 miles off Exmouth	23	—	—
	,, Apl. —	333	Off Teignmouth Bay	25·5	—	—
	,, May 14	355	3 miles off Mausands	23·5	27·5	—
	,, Oct. 11	335	Pole Sands, Teignmouth	24	26·5	—
	,, ,, 16	341	Babbacombe	25	30·5	—
	1903. Jan. 8	357	1 mile off Berry Head	23	30·5	—
	,, Feb. 7	350	Edge of Eastern Scruff	34	—	—
	,, Mar. 5	338	Spion Kop	33	38	—
	,, ,, —	339 (or 334)	,,	26 (or 29·5)	35·5	—
	,, ,, 28	336	,,	31·5	39·5	—

OUTSIDE THE BAYS.

Particulars of Liberation.	Particulars of Recovery.					
Date. No. of fish. Locality.	Date.	No. of fish.	Locality.	Initial size.	Ultimate size.	Sex.
Batch X.				cm.	cm.	
April 12th and 14th, 1902.	1902. Apl. 23	320	Neighbourhood of Start Bay	28	27 (*sic*)	♂ s. ♀
11 Plaice.						
Two liberated 12 miles off Dartmouth (none recovered), and 9 liberated 6 miles S.S.E. from Dartmouth.	,, May 6	315	8 miles E. by N. from the Start	33	—	—
	,, July 19	314	Start Bay	35	—	—
	,, ,, 23	313	,,	32	—	—
Labels: bone buttons.						
Batch XI.						
May 29th, 1902.	1902. June 5	354	The Corner, 6 miles off Dartmouth	32·5	—	—
62 Plaice.						
Liberated midway between Berry Head and Orestone.	,, ,, 14	343	4 miles off Downend	28	28	—
	,, ,, 21	360	10 miles off Downend	29	—	—
	,, ,, 21	364	2 miles off Mausands	27	—	—
Labels: bone buttons.	,, ,, 26	379	Start Bay	30·5	—	—
	,, July 8	369	Off Berry Head, amongst "The Hitches"	29·5	30	—
	,, ,, 10	322	New Ridge (3 miles off Downend)	23	24	—
	,, ,, 12	349	Start Bay	30	—	—
	,, ,, 17	338	2 miles off Downend	28	28	—
	,, ,, 19	365	Start Bay	24·5	26·5	—
	,, Aug. 30	342	,,	29	30	—
	,, Sept. 1	367	,,	29·5	33	—
	,, ,, 12	329	,,	25	27·5	—
	,, ,, 27	332	,,	27	27·5	—
	,, Oct. 2	344	,,	29	30·5	—
	,, 9	347	Torbay	29	35·5	—
	,, Nov. 16	373	Off Eddystone (Plymouth trawler)	30	—	—
	1903. Apl. 29	324	Torbay, just inside Berry Head	22	31·5	—
	,, May 1	328 (or 326)	Spion Kop	25 (or 26·5)	30	—
	,, ,, 27	336	(No locality; found in fish store)	28	30	—
	,, June 16	383	5 miles off Berry Head	35	42	—
	,, July 27	361	Start Bay	29	37·5	—

In the above tables the letter "s" after the symbol of sex indicates "spawning" or "spent."

3. RATE OF GROWTH OF PLAICE.

By comparing the sizes of the marked plaice when recovered with their original size when liberated, it should be possible, if due precautions are taken, to obtain a fairly reliable measure of their rate of growth. Nearly seventy of the marked fishes described in the previous section were measured on recapture, partly by Mr. W. J. Sanders at Brixham and partly by Dr. Kyle. Mr. Sanders's measurements appear to have been taken in most cases to the nearest quarter-inch; Dr. Kyle's measurements—which, however, form the minority—were taken to the nearest half-centimetre. The original measurements of the fish at the time of liberation were all taken to the nearest half-centimetre.

In the following table the plaice, whose ultimate sizes were recorded, have been sorted out in order according to the number of days which elapsed between their liberation and recapture, and the increase in length of each fish has been given as recorded. It will be seen that the increments of growth for the same period vary considerably, and it is not certain that they are all reliable, especially in the case of fishes marked with bone buttons, the numbers on which were, in some cases, obscure. The increments of growth recorded cannot, therefore, be relied upon as an exact measure of the range in growth for any one period. The specimens have been further grouped according to the number of months between liberation and capture. The first month is taken to correspond with the period of thirty days from the sixteenth to the forty-fifth after liberation, the mean of the period being thus the thirtieth day. The second month covers the period from the forty-sixth to the seventy-fifth day, and so on. The fishes have been further sorted out, according to their original size, on liberation, into three groups: (1) fishes from 8 to 11 inches, inclusive (20 to 30 cm.); (2) fishes from 12 to 15 inches (30·5 to 40 cm.); and (3) fishes of 16 inches and upwards (40·5 cm. and upwards). Only one instance of the latter size, however, occurs, and it is a somewhat doubtful record. A distinction has also been drawn between the fishes liberated in the autumn of 1901 and those liberated in the spring of 1902, since the rate of growth in winter and summer is already known to differ considerably.

TABLE XXVI., *showing the Growth of marked Plaice, classified according to* (1) *season of liberation,* (2) *original size on liberation, and* (3) *period of growth in months of thirty days.*

Liberated in October and November.								Liberated on May 29th.			
Length on liberation.								Length on liberation.			
20–30 cm. (=8″–11″).				30·5–40 cm. (=12″–15″).				20–30 cm. (=8″–11″).			
Month.	Label.	Days.	Increase (cm.)	Month.	Label.	Days.	Increase (cm.)	Month.	Label.	Days.	Increase (cm.)
[O]	205	12	—	[O]	219	12	—	I.	343	16	—
II.	95	49	3·0	I.	207	24	—		369	40	0·5
IV.	307	133	—		257	24	0·5		322	42	1·0
V.	217	146	1·0	V.	145	149	1·5	II.	338	49	—
	312	149	3·5		163	164	1·5		365	51	2·0
VI.	355	166	4·0	VI.	222	167	—	III.	342	93	1·0
	247	167	1·0		159	179	2·5		367	95	3·5
	130	167	1·5		12	181	2·0	IV.	329	106	2·5
	135	169	1·5		287‡	189	1·0		332	121	0·5
	327	173	—	VII.	212	202	2·5		344	126	1·5
	258	180	4·0		87	202	2·0		347	133	6·5
	202	184	4·0		176	206	—			—	—
VII.	225	218	3·0	VIII.	88	234	2·0			—	—
IX.	123	284	2·5		268	252	4·0			—	—
X.	55	301	7·0	IX.	252	276	5·0			—	—
XI.	335	316	2·5		144	278	3·0			—	—
	341	321	5·5	X.	308	308	5·0			—	—
	236	336	5·5	XI.	57	332	7·0	XI.	324	334	9·5
XII.	305*	362	6·5		75	334	—	XII.	336	363	2·0
	248	367	5·5	XII.	139	362	4·0	XIII.	361	395	8·5
XIII.	357	405	7·5		10	365	5·5				
XV.	277	454	6·5		298	371	5·0				
XVI.	339†	484	9·5	XV.	338	461	5·0				
XVII.	244	512	7·0	XVI.	336	484	8·0				
	246	521	10·0	XVII.	18	508	8·0				
XXI.	155	637	13·0								
Original length: 46 cm.								*Original length: 35 cm.*			
XVII.	184§	? 520	2·0					XIII.	383	383	7·0

It will be seen from the table that for many of the months the number of records is too small to enable an accurate curve to be drawn representing the increase in size through each month of the year. A considerable number of fishes, however, were recaptured during the sixth month after liberation, and a fair number about the twelfth month. In the latter case, however, the records for the eleventh and thirteenth months may also be taken into consideration in order to enlarge the field from which the average for twelve months' growth may be derived. The following table, based on this method, shows the average increase in length for the plaice recovered after six months' and a full year's growth respectively.

* Brass label (Batch VIII.). ‡ Bone label (Batch IV.).

† Record doubtful, possibly 334, in which case the increment would be only 6·0 cm.

§ Record doubtful, the date of capture being given as April 4th, 1902, in one place, and April 4th, 1903, in another. The latter, from other evidence, appears to be correct.

TABLE XXVII., *showing average increase in length of marked Plaice, recorded in the preceding table.*

Period of Growth.	Length when liberated.	
	20 to 30 cm.	30·5 to 40 cm.
Six months (Nov. to April) . .	2·3 cm. (7 fish)	1·4 cm. (4 fish)
Twelve months (XI. to XIII.) . .	5·9 cm. (9 fish)	4·8 cm. (6 fish)
,, omitting Nos. 335, 75, and 336	6·9 cm. (7 fish)	5·7 cm. (5 fish)

In the above calculation, as regards the half-year's growth, it has only been possible to consider the fishes liberated in October and November; but for the full year's growth the records derived from the autumn and spring fish have been combined. The average increase in size during the first six months is seen to have been 2·3 cm. ($\frac{7}{8}$-inch) in the case of seven fish belonging to the smaller group, and 1·4 cm. ($\frac{1}{2}$-inch) in the case of four fishes belonging to the larger group. This growth, however, included the winter period, and a reference to the detailed table shows that during the summer months the rate of growth was considerably higher. In the case of the fish liberated on May 29th the average growth of two fishes in three months was 2·2 cm. ($\frac{7}{8}$-inch), and of four fishes in four months 2·7 cm. ($1\frac{1}{8}$ inches). These figures refer to the smaller group of fishes from 8 to 11 inches in original length. During the winter period, therefore, these fishes grow no more in six months than they attain in three months during the summer.

For the entire year's growth the average growth of nine fish of the smaller group was 5·9 cm. ($2\frac{1}{3}$ inches), and for six fishes of the larger group 4·8 cm. ($1\frac{7}{8}$ inches).

In each case it is seen that the larger fishes grow more slowly than the smaller fishes, a result which, indeed, is shown by the averages for almost every period specified in the detailed table.

As regards the full year's growth, however, it will be seen in the detailed table that several exceptionally low increases occur among the records, viz. Nos. 335 (2·5 cm.), 75 (0·0 cm.), and 336 (2·0 cm.). As the possibility of errors of measurement or identification has to be borne in mind, we may omit these specimens altogether in order to get an idea of the most usual growth for the twelve months' period. The averages then become 6·9 cm. ($2\frac{3}{4}$ inches) for seven fishes of the smaller group, and 5·7 cm. ($2\frac{1}{4}$ inches) for five fishes of the larger group. If allowance be made for shrinkage of the fish after death before remeasurement, the full year's growth would appear to have been about 3 and $2\frac{1}{2}$ inches in the case of the two groups respectively. The true average growth

for plaice of the smaller size-group would probably, indeed, slightly exceed the figure assigned, since, as pointed out in the previous section, relatively few of the 8-inch fish were recovered, and we have seen in this section that the rate of growth was inversely proportional to the original size of the fish.

This experimental result agrees with the evidence of the trawling records. Station VII. in Teignmouth Bay is the chief rearing-ground for small plaice, and a representative haul on that station on October 9th (Table D, haul 7) shows that intervals of 4 inches and about $3\frac{1}{2}$ inches separated the sizes at which the plaice were most abundant, viz. 4 inches, 8 inches, and 11 or 12 inches. These sizes, according to Petersen's method, may be taken as the average sizes of plaice of successive yearly groups, and the intervals between them as the annual increments of growth (cf. also Torbay, same table, Station IV., hauls 1, 4, 8, and 34).

Section III.

The Reproduction of the Flat-Fishes.

By
H. M. Kyle, M.A., D.Sc.

1. SPAWNING PERIOD OF THE PLAICE.

"The spawning periods of the food-fishes have been fully ascertained for the east coast of Scotland by Dr. Fulton and other Scottish workers, and the present occasion afforded a good opportunity of determining the spawning time of the plaice on the south-west coast of England. Mr. Cunningham's work, published in previous numbers of this Journal, and in more compendious form in his book on *Marketable Marine Fishes*, covers the whole field of fishery investigation, and forms therefore an excellent basis for more definite and detailed research. The spawning period of the plaice, for example, is given as January, February, and March for the North Sea and English Channel, and in a general way this is quite correct, but it is somewhat vague. The plaice of the Bristol Channel also spawn during the months mentioned, but on the whole later than those of the English Channel. It is evident, therefore, that we must ascertain the periods at which most plaice are spawning or have spawned, in other words the maximum spawning period as it is generally called. The difficulties in the way of ascertaining this accurately arise from the facts that all fish do not spawn exactly at the same time, and that one fish may take two or more weeks in getting rid of all its spawn. We cannot, therefore, delimit the maximum spawning period to less than two to three weeks, and if we allow for

fluctuations in different years, one month is the nearest approximation we can make.

"It is well known that the spawning period extends over a number of months, and isolated cases may occur much earlier and later than the usual period. Specimens examined during November seemed, especially the males, quite ready to spawn, but it was not until the middle of December that spawning was actually observed.

"The observations made during December, January, and February are summarised in the following table, the details with regard to sizes being given in Table XXIX. The various conditions which the reproductive organs may show are classified under three headings: (1) maturing, (2) spawning, (3) spawned. As there has always been some dubiety

TABLE XXVIII. *Spawning Period of the Plaice.*

	December.		January 15th.		January 25th.		February 10th.	
	♂	♀	♂	♀	♂	♀	♂	♀
Maturing .	22	26	164	91	—	9	—	11
Percentage	*88*	*93*	*71*	*65*	—	*32*	—	*16*
Spawning .	3	1	66	27	2	3	35	10
Percentage	*12*	*3·5*	*29*	*19*	—	*11*	*100*	*14*
Spawned .	—	1	—	22	—	16	—	49
Percentage	—	*3·5*	—	*16*	—	*57*	—	*70*
Total .	25	28	230	140	2	28	35	70

Total, 292 ♂ + 266 ♀ = 558.

with regard to the demarcation of these stages from one another and from the immature condition, a description may be given of the symptoms chosen as guides for the present work. During the period when the observations were made the difficulty of distinguishing the immature from the mature, whether male or female, is reduced to a minimum. In every case the reproductive organs and not merely the external appearance were examined, and during this period the males only give some trouble. When the testes are clearly developed, but no milt is running, the males are considered to be maturing; if milt comes freely or on slight compression, they are considered as spawning. If the testes are flaccid and a little milt can still be expressed, the males are put down as having spawned. Doubtful specimens are not entered on the list.

"It appears from the table that up to the 15th January the great majority of the males were still maturing, and that less than 30 per cent. could be considered as spawning. After that date all the specimens examined were spawning. The percentages for both sexes agree in showing that the maximum spawning period is later than the 15th of January.

"The females are grouped under the same three headings as the males. Maturing females mean those in which the ova are developing, as far as the stage where a few ova are clear, *i.e.* ripe, but have not yet made their way into the oviduct. Spawning females include all those which have ripe ova in the oviduct, no matter what stage the ovary may be in as regards depletion or emptiness. Spawned females are those in which the ovary is flaccid, and very few, if any, ripe ova still remain.

"The number of maturing females diminishes from 93 per cent. in December to 65 per cent. on the 15th of January, and lastly to 16 per cent. on the 10th of February. The spawning females are at no time numerous, the highest percentage being 19 on the 15th of January. The percentage of spawned females increases from 3·5 in December to 16 on the 15th, 57 on the 25th of January, and 70 on the 10th of February.

"The maximum spawning period may be said to have been reached when 50 per cent. of the specimens observed have spawned, and to have passed when 70 per cent. is attained. On the other hand, if more than 60 per cent. of the specimens have not yet begun to spawn it is evident that the maximum spawning period has not yet arrived. Consequently, the spawning of the plaice on the south-west coast of England is at its height during the third and fourth weeks of January. This holds good for the year under observation, viz. 1902, and if we allow one week on either side for probable fluctuations in other years, we conclude that the maximum spawning period lies between the third week of January and the second week in February.

"From the fact that a number of specimens had not yet begun to spawn on the 10th of February we may conclude that the spawning period is prolonged into March. No specimens were examined during the latter month, but all those seen during the first fortnight of April had finished spawning.

"The number of specimens examined during the present investigations is sufficiently large to test the suggestion made by Holt* that the largest fish of a species spawn the earliest as a rule. The single specimen which was found to have spawned in December was 40 cm. (16 inches), and of the numbers examined in January the small (from 11 to 15 inches) and the large (over 15 inches) are equally distributed amongst the maturing and spawning specimens, but the large clearly preponderate amongst the spawned. Holt's conclusion is justified only partly therefore, and the records for February point in the reverse direction, as the largest specimens examined, 53, 55, and 65 cm. (21 to 26 inches), have not yet begun to spawn. Here, as elsewhere, considerable variation occurs and definite conclusions are hard to find.

* *Journ. M. B. A.*, vol. ii. p. 370.

TABLE XXIX.

Spawning Period of Plaice.

	MATURING.								SPAWNING.								SPAWNED.								TOTAL MATURE.		
	DEC.		JANUARY. 15th.		25th.		FEB. 10th.		DEC.		JANUARY. 15th.		25th.		FEB. 10th.		DEC.		JANUARY. 15th.		25th.		FEB. 10th.				♂ + ♀
cms.	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
22	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
23	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
24	—	—	5	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	6
25	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
26	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3
27	—	—	3	1	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	5	1	6
28	1	—	12	—	—	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—	—	—	16	—	16
29	—	—	9	—	—	1	—	—	—	—	4	—	—	—	6	—	—	—	—	—	—	—	—	2	19	3	22
30	3	1	11	—	—	—	—	1	2	—	5	1	—	—	5	1	—	—	—	1	—	1	—	1	26	7	33
31	1	2	12	2	—	—	—	1	—	—	2	1	1	—	3	—	—	—	—	—	—	—	—	—	19	6	25
32	5	1	23	2	—	—	—	1	—	—	6	—	—	—	3	1	—	—	—	—	—	—	—	1	37	6	43
33	—	1	11	1	—	1	—	1	—	—	9	—	—	—	3	1	—	—	—	—	—	—	—	5	23	10	33
34	2	3	13	3	—	—	—	—	—	—	6	1	—	—	4	—	—	—	—	—	—	—	—	7	25	14	39
35	5	2	19	4	—	1	—	—	—	—	5	2	—	—	2	1	—	—	—	3	—	—	—	—	31	13	44
36	1	4	13	4	—	1	—	—	—	—	6	1	1	—	3	—	—	—	—	—	—	1	—	2	24	13	37
37	—	—	12	6	—	1	—	2	—	—	—	1	—	—	3	2	—	—	—	1	—	1	—	1	15	15	30
38	2	—	6	1	—	1	—	—	—	—	5	2	—	—	—	2	—	—	—	1	—	—	—	5	13	12	25
39	—	2	2	11	—	—	—	—	—	—	5	3	—	—	—	—	—	—	—	—	—	1	—	3	7	20	27
40	—	2	3	5	—	1	—	—	—	—	3	3	—	2	—	—	—	1	—	—	—	—	—	4	6	18	24
41	—	1	3	6	—	—	—	1	—	—	2	1	—	—	—	—	—	—	—	2	—	1	—	4	5	16	21
42	—	1	2	4	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	1	—	—	—	2	3	10	13
43	—	2	—	4	—	—	—	—	1	1	4	3	—	—	—	—	—	—	—	1	—	—	—	1	5	12	17
44	—	—	—	8	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	2	—	1	—	13	13
45	—	1	1	6	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	3	—	1	—	3	1	16	17
46	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	1	—	1	—	11	11
47	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	3	3
48	—	—	—	1	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	1	—	1	—	5	5
49	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	6	6
50	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	4	4
51	—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	4	4
52	—	—	—	3	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	2	—	—	—	7	7
53	—	1	—	3	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	5
54	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2	2
55	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	2
56	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	1	—	4	4
57	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	3	3
58	—	—	—	1	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	4	4
59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
61	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
63	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
65	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Total	22	26	164	91	—	9	—	11	3	1	66	27	2	3	35	10	—	1	—	22	—	16	—	49	—	—	558

2. SPAWNING GROUNDS.

"It has been pointed out, under the section describing the migration of the plaice, that the majority of the specimens of this species travel some distance from the inshore waters in order to spawn. The largest plaice spawn in 30 to 35 fathoms some 20 to 25 miles offshore, whilst the medium-sized spawn in 25 to 30 fathoms along the line from Start Point to Portland. Some, however, travel but a short distance from the bays, and a few seem actually to spawn within territorial waters.

"During December, 1901, a haul in the deep water (20 fathoms) off Dartmouth Fairway gave, amongst a number not yet ripe, two males with the milt running freely, one spawning female, and one already spawned. During January two similar males and two spawning females were obtained in 15 to 20 fathoms water, whilst eight females had already spawned. In February a score of spawned females was obtained about the same place.

"It is possible that the spawned specimens had migrated outward to the 25-fathom line and returned, but the presence of the spawning males and females at depths less than 20 fathoms renders it probable that all those obtained in Start Bay during January had spawned there. The number was not great. Very few plaice, small or large, are obtained in Start Bay during January.

"The number of spawning and spawned plaice found in Torbay and Teignmouth Bay was still smaller. The depth in these bays, it will be remembered, is under 12 fathoms, where one would not expect to meet spawning plaice. In Torbay, near Berry Head, one spawning male was obtained in December, and two large females (22 and 23 inches) which had already spawned in January. During the latter month, also, three large spawned females were got in Teignmouth Bay. It has been remarked by Fulton that large gravid females occur within territorial waters during the spawning season, and it is probable that the specimens found in Torbay and Teignmouth Bay were of that nature and had not migrated from the bays.

"Of the remaining species of food-fishes which the trawl captured in the bays, only two were found in the spawning condition. During March and April spawning and spawned dabs were found all over the area, within, but mostly without, the territorial waters, whilst towards the end of April two spawning brill (one male and one female) were obtained in Teignmouth Bay. No comment need be made on the dabs, as their ubiquitous nature and habits are well known. The occurrence of spawning brill in less than 12 fathoms of water is, however, quite

exceptional, and it is interesting to note that Holt records the same phenomenon, also in Teignmouth Bay.

"The migratory round-fishes—herring, mackerel, and sprat—spawn in Torbay and Teignmouth Bay during the spring, summer, and autumn, but as these are captured by seines and not by trawls they do not concern us here.

3. AVERAGE SIZE AT FIRST MATURITY.

"The size at which fish become mature for the first time is of the greatest interest from the biological standpoint. It marks the stage where the species begins to reproduce its kind, and if for the moment we regard this as having been determined by natural selection, we may use the convenient terms of that theory in order to grasp the great significance of the line which divides the immature from the mature. It would be more correct to speak of age rather than size, but for present purposes the terms are interchangeable, whilst 'average size' conveys as yet more meaning to naturalists than 'average age.'

"We might say, then, that natural selection has regulated the size at which each species becomes mature for the first time, as it is of the greatest importance to the species under natural conditions that its individual components should reproduce as early as possible. If there is any risk of the species becoming exterminated, that is to say, if its enemies are many, then the sooner its individuals reproduce the greater will be the chances of the species surviving. Conversely, if its enemies beyond a certain size are comparatively few, so that the inevitable 'struggle' is *within* the species, then the later the stage of first maturity the stronger will be the individuals and the chances of extinction from ordinary causes practically nil. The latter seems to have been the condition of the plaice before man ventured on the deep-sea trawling, and even in these days the new fishing-grounds which are being opened up testify to the same thing. When man appears the conditions are slowly reversed, the large fish apparently grow scarcer, the average size of the race or species is consequently lowered, and a premium placed upon early reproduction. Is the species able, however, to adapt itself to the requirements of its new enemy? Would the average size at which the individuals reproduce for the first time —which size tends to be raised under natural conditions—become lower? In other words, would the individuals under the strain of the new conditions become mature in their third year, say, instead of their fourth as formerly?

"The circumstances which have given rise to the suggestion of this possibility are the following. Man's influence on the deep-sea fishing

has gradually spread during the past century from the English Channel northwards, over the North Sea, and within the past twelve years on to Iceland. The average size* at which the female plaice of the southern portions of the North Sea reproduce for the first time is 13 to 14 inches, and the smallest mature female so far recorded is 9 inches.† The largest immature female has been 17 inches. In the northern portions of the North Sea the average size is 15 to 16, whilst the smallest mature and largest immature recorded are 12 and 17 inches respectively. The plaice of Iceland have not yet been closely examined, but they seem to have even larger proportions. The difference between the plaice of the southern and northern portions of the North Sea is just one year's growth. Further, the characters of the adults of the former group resemble those of the younger stages of the latter.

"These problems have already been discussed in a previous paper, and it was left an open question as to whether man's influence, or simply differences in the environment had brought about these differences between the southern and northern North Sea plaice. Further observations and records incline me to lay more stress on the selection exercised by man, whilst not forgetting the possibility that the environmental conditions may play some part. The new records‡ referred to are those of a group of small spawning plaice discovered during March, 1901, near the Borkum Reef in the German Bight. The sizes of the spawning females varied from 21·3 to 26·2 cm. (8·5 to 10·5 inches), and apparently a large number was obtained. If we consider the average size to be 9·5 inches, the difference between this average and that obtained for the southern portion of the North Sea during 1898–1899, viz. 12·5 inches, is again one year's growth.

"The observations are comparatively few in number, it must be admitted, but they point to the conclusion that man's influence may be causing a retrogression in the average size at which the plaice spawn for the first time. This would seem to lead to the further conclusion that the numbers of the species will be maintained at their former level by the earlier reproduction, even if the older and larger fish have been removed by man. This idea has indeed been expressed, though from a different standpoint, but unfortunately nature offers no great compensation, for the large plaice have over ten times more offspring than the small.

"In a former paper the view has been expressed that if we could

* *Eighteenth Rep. S. F. B.*, iii. p. 197.

† J. T. Cunningham, *Journ. M. B. A.*, vol. iv. pp. 17 and 99.

‡ I am indebted to my friend Prof. Ehrenbaum, of Heligoland, for permission to mention these records.

regard the average size at first maturity as a comparatively fixed point in the life-history of the plaice, we might therefrom, by comparison with the average size of the adults, obtain a measure of the increase or decrease in the numbers of the species, but the considerations presented above show that we can no more rely upon it than upon any other variable and varying stage. One important consequence is that we cannot accept, without repeated investigation, the results obtained in previous years, as a record of ten years ago may no longer hold true.

"The plaice on the south-west coast of England have been investigated at various times by Mr. Cunningham, and the results are given in vol. iii. p. 69 *et seq.* of this Journal. One hundred and nine specimens were examined during the winter, *i.e.* during the spawning season, and of these forty-two were males, sixty-seven females. The smallest mature male was 9 inches long, the largest immature 12 inches. The smallest mature female was likewise 9 inches, and the largest immature 14 inches long.

"During the present investigations a considerable number of plaice were examined from all quarters and at all sizes. The spawning months, from November to March, were deliberately chosen, and all doubtful males have been excluded from the list. The following tables show the numbers at the various sizes mentioned:—

TABLE XXX.—1. *Males.*

Length in centimetres	20, 21	22, 23	24, 25	26, 27	28, 29	30, 31	32, 33	34, 35	36, 37	Total.
Immature . .	13	11	17	3	5	2	2	1	0	54
Percentage .	*81*	*61*	*63*	*25*	*14*	*5*	*4*	*2*	—	
Mature . .	3	7	10	9	30	40	55	50	33	237
Percentage .	*19*	*39*	*37*	*75*	*86*	*95*	*96*	*98*	*100*	

2. *Females.*

Length in centimetres	26, 27	28, 29	30, 31	32, 33	34, 35	36, 37	38, 39	40, 41	42, 43	Total.
Immature . .	5	18	22	11	17	11	6	0	1	91
Percentage .	*83*	*86*	*61*	*41*	*39*	*27*	*16*	—	*4*	
Mature . .	1	3	14	16	27	29	32	34	22	178
Percentage .	*17*	*14*	*39*	*59*	*61*	*73*	*84*	*100*	*96*	

"It appears from these tables that the ranges of variation are greater than those detected by Cunningham. The smallest mature males were 21 cm. long (8¼ inches), and a special search would, I think, discover even smaller mature specimens. The largest immature male was 34 cm. (13½ inches), or 13 cm. longer than the smallest mature. The smallest mature female was 26 cm. (10¼ inches), and the largest immature 42 cm.

(16½ inches). The range of variation is therefore from 13 to 16 cm. (5 to 6 inches). For the North Sea specimens the same range was found to be 12 to 14 cm.

"According to Dr. Fulton,* all plaice probably spawn at the same age, and the difference in size is simply a difference in the rate of growth. I am inclined to think, however, that the range of variation (6 inches) is too great for the difference due to the rate of growth under natural conditions. The fact, also, that the difference in average size at first maturity of the southern and northern North Sea plaice is approximately equal to one year's growth speaks in favour of the same conclusion."

* * * * *

The average size at which each sex matures for the first time being that at which 50 per cent. become mature, it may be concluded from these data that the average size for the females is 31·5 cm. (= 12·5 inches), and for the males about 25 cm. (= 10 inches). Dr. Kyle concludes:—"These values are a little less than those for the plaice of the southern parts of the North Sea. If we assume that the numbers of the males and females are approximately equal, then 28 cm. (11 inches) represents the average size at which all plaice of both sexes become mature for the first time."

Section IV.

General Summary and Conclusions.

By

Walter Garstang, M.A., F.Z.S.

The facts and experiments recorded in the preceding sections lead to the following main conclusions:—

(1) Plaice below 8 inches in length are practically confined to the inshore waters of the bays at all seasons of the year. They are especially abundant in Teignmouth Bay and Torbay, where they are caught with the usual trawl-mesh in numbers at least as great as those of all the larger sizes of plaice taken together. In Start Bay, on the other hand, these small plaice are far less numerous than the larger fish, which outnumber them by eighteen to one (Table II., p. 449).

In correlation with these facts the average size of all the plaice caught during 1901–2 was found to be 12·8 inches for Start Bay, 7·8 inches for Torbay, and 7·9 inches for Teignmouth Bay.

The actual percentages of small plaice caught in the bays were—Teignmouth Bay, 60 per cent.; Torbay, 50 per cent.; Start Bay, 4 per cent.

* *Twentieth Ann. Rep. S. F. B.*, iii. p 359.

(2) On attaining a length of 8 inches the plaice in Teignmouth Bay and Torbay tend to emigrate—in summer into Start Bay, and in winter over the offshore grounds. The special statistics appear to show that about 44 per cent. of the plaice caught offshore by the Brixham "Mumble Bees" are immature fish from 8 to 10 inches in length. These are doubtless derived for the most part from the two bays mentioned, although Sidmouth Bay and Lyme Bay probably contribute. Few of these fishes, however, are derivable from Start Bay; the marking experiments revealed a much slighter tendency for fishes of this size to emigrate from Start Bay than from the other two.

(3) Teignmouth Bay and Torbay are thus essentially nurseries or rearing grounds for the smallest plaice. They furnish the original stock from which Start Bay and the offshore grounds are annually recruited.

Start Bay, on the other hand, is not a nursery for plaice.

(4) Apart from seasonal changes in abundance caused by periodic migrations, the population of flat-fish in the bays is subject to considerable fluctuations from one year to another. These fluctuations are not traceable to the operation of the Committee's bye-laws, since fluctuations in both directions (viz. of increase and of decrease) have taken place at intervals during the period of closure. They appear to be attributable to the effects of good and bad spawning seasons, and especially to the direction of the winds during the period when the eggs and larvæ of the fish are drifting in the water prior to metamorphosis.

(5) The closure of the bays to trawlers appears to be useful only in so far as it protects the plaice from premature destruction. From this point of view the closure of Start Bay is ineffective, since the small fish are present in inappreciable numbers. Even the plaice below 12 inches in length in Start Bay did not amount, in 1901–2, to 30 per cent. of the total, which is considerably less than the percentage landed by the fishermen from the fishing grounds in general during 1902 (44 per cent.).

On the other hand, the closure of Teignmouth Bay and Torbay must be of great value for the upkeep of the fishery, since these bays furnish an important, and probably the chief, source of supply of young plaice for the trawling grounds in general.

(6) The closure of the bays does not protect the spawning fish to an appreciable extent, since the latter spawn mostly offshore.

(7) The closure of Teignmouth Bay (and probably of Torbay) defers the period of capture of a certain number of marketable fish, but does not cause any serious deprivation to the fishermen, since the same fish are available for capture after emigration from the bays when of larger

size and higher value. The marking experiments show that at least 41 per cent. of the marketable plaice marked in Teignmouth Bay were subsequently caught by the fishermen, viz. 31 per cent. during the first year, and 10 per cent. during the second.

On the other hand, the closure of Start Bay appears to deprive the small trawlers of a serious proportion of the large plaice which they would otherwise secure. Only $23\frac{1}{2}$ per cent. of the marked plaice from Start Bay were recovered, viz. $21\frac{1}{2}$ per cent. in the first year and 2 per cent. in the second. The difference between the percentages in the two experiments appears to indicate that about 10 per cent. of the large plaice in Start Bay annually migrate outside the area of the Mumble Bees altogether. It is impossible at present to say whether this migration materially affects the upkeep of the trawling grounds in the Channel, to which it undoubtedly contributes; but, regarding the matter merely from the standpoint of the Brixham fishery, it appears fairly certain that the closure of Start Bay altogether deprives the small trawlers of a considerable number of large plaice, against the capture of which no biological objections can be urged.

(8) In view of the facts ascertained by these investigations, and having regard to the permanent maintenance of the fishery, it would appear to be highly inadvisable to rescind the regulation which prohibits trawling in Teignmouth Bay and Torbay. On the other hand there are no biological reasons against the reopening of Start Bay, either as a whole or in its northern part alone, as suggested by Mr. Holt in his previous report.

In this connection it cannot be overlooked that the natural migrations of the fishes determine to a large extent the areas in a particular district which it is profitable or unprofitable for the trawlers to work over. There is no doubt that during the autumn months the plaice are concentrated in the bays, especially in Start Bay. At this season of the year the trawlers are limited by the closure of the bays to the soles and whiting on the offshore grounds (cf. Table A).

TABLE A.

Weekly number of Plaice, Soles, and Whiting captured by "Mumble Bees" during One Year (February 1st, 1902, to January 31st, 1903), with proportion of Small to Large.

	PLAICE.					SOLES.	WHITING.				
1902.	No. of Trunks.	No. of Fish.	No. of Baskets.	No. of Fish.	Proportion %.	Pairs of.	No. of Trunks.	No. of Fish (Large).	No. of Fish (Medium).	No. of Baskets.	No. of Fish (Small)
Feb. 3–8 .	38	3,420	50	1,250	— ...	525 ...	93	1,209	7,440	465	33,015
,, 10–15 .	81	7,290	56	1,400	— ...	1,560 ...	276	3,588	22,080	880	79,980
,, 17–22 .	79	7,110	24	600	— ...	1,040 ...	240	3,120	19,200	780	70,080
,, 24–Mar. 1	53	4,770	43	1,075	— ...	648 ...	216	2,808	17,280	455	54,180
Total. .	251	22,590	173	4,325	19 ...	3,773 ...	825	10,725	66,000	2,580	237,255
March 3–8 .	100	9,000	110	2,750	— ...	— ...	60	780	4,800	200	17,700
,, 10–15 .	16	1,440	—	—	— ...	— ...	20	260	1,600	100	7,100
,, 17–22 .	40	3,600	12	300	— ...	— ...	50	650	4,000	150	14,150
,, 24–29 .	74	6,660	53	1,325	— ...	— ...	14	182	1,120	160	8,210
Total. .	230	20,700	175	4,375	21 ...	— ...	144	1,872	11,520	610	47,160
Mar. 31–Ap. 5	98	8,820	76	1,900	— ...	— ...	—	—	—	200	7,200
April 7–12 .	135	12,150	250	6,250	— ...	— ...	—	—	—	22	792
,, 14–19 .	56	5,040	90	2,250	— ...	— ...	—	—	—	—	—
,, 21–26 .	65	5,850	126	3,150	— ...	— ...	—	—	—	—	—
,, 28–May 3	200	18,000	250	6,250	— ...	350 ...	19	247	1,520	65	5,665
Total. .	554	49,860	792	19,800	40 ...	350 ...	19	247	1,520	287	13,657
May 5–10 .	50	4,500	120	3,000	— ...	390 ...	28	364	2,240	115	9,040
,, 12–17 .	32	2,880	30	750	— ...	675 ...	28	364	2,240	100	8,500
,, 19–24 .	25	2,250	24	600	— ...	630 ...	15	195	1,200	45	4,245
,, 26–31 .	31	2,790	—	—	— ...	650 ...	39	507	3,120	130	11,505
Total. .	138	12,420	174	4,350	35 ...	2,345 ...	110	1,430	8,800	390	33,290
June 2–7 .	72	6,480	70	1,750	— ...	1,740 ...	98	1,274	7,840	430	32,630
,, 9–14 .	50	4,500	110	2,750	— ...	864 ...	114	1,482	9,120	378	33,558
,, 16–21 .	25	2,250	134	3,350	— ...	840 ...	102	1,326	8,160	600	39,450
,, 23–28 .	17	1,530	40	1,000	— ...	— ...	75	975	6,000	500	31,125
Total. .	164	14,760	354	8,850	60 ...	3,444 ...	389	5,057	31,120	1,908	136,763
June 30–July 5	16	1,440	18	450	— ...	300 ...	21	273	1,680	150	9,075
July 7–12 .	40	3,600	50	1,250	— ...	1,139 ...	135	1,755	10,800	750	50,625
,, 14–19 .	23	2,070	88	2,200	— ...	1,275 ...	69	897	5,520	630	34,755
,, 21–26 .	24	2,160	80	2,000	— ...	1,200 ...	228	2,964	18,240	1,470	92,820
,, 28–Aug. 2	16	1,440	150	3,750	— ...	1,800 ...	320	4,160	25,600	1,500	110,000
Total. .	119	10,710	386	9,650	90 ...	5,714 ...	773	10,049	61,840	4,500	297,275
Aug. 4–9 .	5	450	182	4,550	— ...	1,425 ...	128	1,664	10,240	1,310	69,560
,, 11–16 .	10	900	104	2,600	— ...	1,150 ...	157	2,041	12,560	1,450	79,675
,, 18–23 .	8	720	88	2,200	— ...	1,800 ...	240	3,120	19,200	1,400	92,400
,, 25–30 .	2	180	52	1,300	— ...	1,080 ...	103	1,339	8,240	1,360	66,985
Total. .	25	2,250	426	10,650	473 ...	5,455 ...	628	8,164	50,240	5,520	308,620

TABLE A—*continued.*

	Plaice.					Soles.	Whiting.				
1902.	No. of Trunks.	No. of Fish.	No. of Baskets.	No. of Fish.	Proportion %.	Pairs of.	No. of Trunks.	No. of Fish (Large).	No. of Fish (Medium).	No. of Baskets.	No. of Fish (Small).
Sept. 1–6 .	1	90	50	1,250	—	1,430	123	1,599	9,840	1,400	71,925
,, 8–13 .	2	180	72	1,800	—	2,310	228	2,964	18,240	1,900	108,300
,, 15–20 .	3	270	80	2,000	—	2,145	239	3,107	19,120	1,410	92,585
,, 22–27 .	8	720	60	1,500	—	1,425	180	2,340	14,400	1,410	82,260
Total . .	14	1,260	262	6,550	520	7,310	770	10,010	61,600	6,120	355,070
Sept. 29–Oct. 4	2	180	50	1,250	—	2,316	295	3,835	23,600	2,700	148,825
Oct. 6–11 .	1	90	50	1,250	—	1,000	197	2,561	15,760	1,420	85,595
,, 13–18 .	2	180	60	1,500	—	1,215	270	3,510	21,600	1,420	98,370
,, 20–25 .	—	—	48	1,200	—	1,380	55	715	4,400	740	36,265
,, 27–Nov. 1	—	—	64	1,600	—	2,320	126	1,638	10,080	1,550	77,850
Total . .	5	450	272	6,800	1,511	8,231	943	12,259	75,440	7,830	446,905
Nov. 3–8 .	—	—	76	1,900	—	1,000	248	3,224	19,840	2,300	126,200
,, 10–15 .	3	270	180	4,500	—	2,115	410	5,330	32,800	2,850	174,350
,, 17–22 .	1	90	18	450	—	600	255	3,315	20,400	1,550	100,425
,, 24–29 .	—	—	60	1,500	—	360	55	715	4,400	550	29,425
Total . .	4	360	334	8,350	2,319	4,075	968	12,584	77,440	7,250	430,400
Dec. 1–6 .	17	1,530	96	2,400	—	735	306	3,978	24,480	1,925	122,850
,, 8–13 .	1	90	70	1,750	—	585	298	3,874	23,840	2,525	143,050
,, 15–20 .	10	900	62	1,550	—	1,250	480	6,240	38,400	3,500	210,000
,, 22–31 .	2	180	40	1,000	—	150	245	3,185	19,600	1,810	108,035
Total . .	30	2,700	268	6,700	248	2,720	1,329	17,277	106,320	9,760	583,935
1903.											
Jan. 1–8 .	10	900	16	400	—	530	191	2,483	15,280	1,220	77,345
,, 5–10 .	31	2,790	94	2,350	—	—	345	4,485	27,600	2,120	136,695
,, 12–17 .	41	3,690	60	1,500	—	1,415	210	2,730	16,800	1,150	78,150
,, 19–24 .	4	360	134	3,350	—	1,619	252	3,276	20,160	1,320	91,620
,, 26–31 .	2	180	106	2,650	—	1,110	129	1,677	10,320	840	52,815
Total . .	88	7,920	410	10,250	129	4,674	1,127	14,651	90,160	6,650	436,625

TABLE B.

LIST OF TRAWLING STATIONS.

START BAY.

No. of Haul.	Date.	Locality and Course.	Station.	Hour Trawl Shot.	Duration of Haul. h. m.	Remarks.
	1901.					
1	July 30	Start Bay (inshore); two hauls combined.	II.	8.45 a.m.	2 35	18 Plaice marked (experimental).
2	,, 30	Start Bay (central part) . .	I.	1 p.m.	2 0	10 Plaice marked (experimental).
3	Aug. 7	,, ,, . .	I.	11.30 a.m.	2 0	12 Plaice marked (experimental).
4	,, 8	,, N.E. part; depth 8–12 fms.	I.	Forenoon.	1 10	
5	,, 9	Haul close inshore from Torcross to Street Gate in 5–6 fms.	II.	—	1 10	2 Plaice marked (experimental).
6	Sept. 6	From inside Skerries Buoy to Hallsands.	III.	1 p.m.	2 0	
7	,, 7	Shot farther to S.W. than on previous day, and continued farther down to off Hallsands, 1 mile from Start Point.	III.	6.10 a.m.	2 0	20 Plaice marked (experimental).
8	,, 7	From beginning of measured line above Torcross towards Street Head; direction N.E., then E.N.E., past Earlstone, towards East Blackstone until off Warren Point.	II.	9.50 a.m.	2 0	
9	,, 9	Start Bay (centre of bay) .	I.	6.35 a.m.	1 55	
10	,, 9	,, (inshore); stopped off Street Point, trawling against tide.	II.	9.40 a.m.	2 0	
11	,, 9	3 miles off Torcross, heading N. in thick fog, hauled up just above Torcross, about a mile from shore.	I.	5.30 p.m.	1 5	
12	,, 10	Round S.W. corner of Skerries	III.	6 a.m.	2 0	
13	,, 10	Down centre of Start Bay, from off Royal Sands Hotel, towards Start Point, ending off Hallsands.	I.	10.25 a.m.	1 15	
14	Oct. 1	From near Skerries Buoy towards Start Point.	III.	3.20 p.m.	1 10	
15	,, 1	Off Torcross towards Blackpool	II.	5.40 p.m.	2 0	
16	,, 2	Began off Dartmouth Fairway, Southern Point.	I.	Noon.	2 15	40 Plaice marked.
17	,, 3	Start Bay (central part) . .	I.	4 a.m.	1 30	
18	,, 3	,, ,, . .	I.	1.15 p.m.	2 0	38 Plaice marked.
19	,, 3	Inshore, along Slapton Sands, 7½ fms. and 8 later.	II.	4.30 p.m.	1 0	6 Plaice marked.
20	,, 4	Start Bay (central part) . .	I.	12.40 p.m.	1 10	15 Plaice marked.
21	,, 11	,, ,, . .	I.	1.50 p.m.	2 0	6 Plaice marked.
22	Nov. 6	,, ,, . .	I.	7.30 a.m.	2 0	
23	,, 6	On the Skerries . . .	III.	10.50 a.m.	1 0	
24	,, 7	Start Bay (central part) . .	I.	1.5 p.m.	3 0	11 Plaice marked.
25	,, 8	Inshore from Straight Point, ½ mile from shore, hence out off Gully, keeping house at foot in line with two trees on top until Blackpool and Cod Rock in line, then to Cod.	II.	12.30 p.m.	1 50	26 Plaice marked.

TABLE B—*continued.*

START BAY—*continued.*

No. of Haul.	Date.	Locality and Course.	Station.	Hour Trawl Shot.	Duration of Haul. h. m.	Remarks.
	1901.					
26	Nov. 9	Northern portion of bay . .	I.	3.45 a.m.	3 0	
27	,, 9	From Torcross to Straight Point, then out and turned back towards Torcross.	II.	8.15 a.m.	2 5	30 Plaice marked.
28	,, 9	Out round Oyster Bank to off Beesands.	II.	11.50 a.m.	1 0	
29	,, 15	Start Bay (centre) . . .	I.	2.10 p.m.	2 30	
30	,, 16	Start Point to Roughs . .	IIA.	7.25 a.m.	0 40	
31	Dec. 17	Start Bay (centre) . . .	I.	8 a.m.	3 0	
32	,, 17	Along inside Skerries (1 h. 30 m.), and again as before, but towing to Start Point (1 h. 40 m.); two hauls combined.	III.	12.20 p.m.	3 10	Trawl entangled in c or two crablines S.W. corner duri second haul.
33	,, 17	Start Bay (centre) . . .	I.	Night.	3 0	
34	,, 18	Northern portion, from Blackpool Sands to Skerries Buoy, in again to Slapton Sands, then out.	I.	1.40 p.m.	3 0	
35	,, 18	Northern portion of bay, starting from off Mewstone, trawling south to 20 fms., then in towards Blackpool Sands, then out to Skerries Buoy, returning over same course.	I.	7.10 p.m.	3 0	
36	,, 19	Northern portion, from Torcross, close inshore towards Mewstone, then off Blackpool towards eastwards to ½ mile from Buoy, then west to Torcross and out again.	I.	2.30 p.m.	3 0	
37	,, 19	Start Bay, all over Bay . .	I.	9.30 p.m.	4 0	Dabs and Gurna not measured.
	1902.					
38	Jan. 21	N.E. portion, from Blackpool towards Bell Buoy, then down centre.	I.	5.15 p.m.	1 45	
39	,, 22	Along inside Skerries . .	III.	2.15 p.m.	1 30	
40	,, 24	From off Blackpool to off Hallsands, and return.	I.	2 p.m.	3 30	
41	,, 25	Deep water from Mewstone to Skerries Buoy.	I.	—	1 0	
42	Feb. 4	N.E. portion, Bell Buoy to Mewstone.	I.	12.45 p.m.	1 45	
43	,, 5	N.E. corner, from Mewstone to Bell Buoy.	I.	10.15 a.m.	1 15	
44	Apl. 8	Start Bay, N.E. portion . .	I.	6.25 p.m.	0 40	
45	,, 14	Mewstone to Skerries Buoy .	I.	5.30 p.m.	1 0	
46	,, 15	On the Skerries . . .	III.	7.50 a.m.	1 0	
47	,, 15	Start Bay (centre) . . .	I.	9.30 a.m.	2 30	
48	,, 15	Inside Skerries . . .	III.	2.50 p.m.	2 0	
49	May 22	Start Bay, N.E. corner . .	I.	8.25 a.m.	2 0	
50	,, 22	,, (centre) . . .	I.	11.10 a.m.	2 0	
51	,, 22	N.E. corner, Blackpool to Buoy, then to Fairway.	I.	2.45 p.m.	3 0	
52	,, 23	Start Bay, N.E. corner . .	I.	6.20 a.m.	1 45	
53	,, 24	,, (centre) . . .	I.	10.5 a.m.	2 30	
54	,, 24	Inshore, along Slapton Sands to off Oyster Bank.	II.	1.45 p.m.	1 0	

TABLE B—*continued.*

START BAY—*continued.*

No. of Haul.	Date.	Locality and Course.	Station.	Hour Trawl Shot.	Duration of Haul. h. m.	Remarks.
	1902.					
55	May 29	Start Bay, N.E. corner . .	I.	Night.	6 0	Plaice alone measured.
56	June 19	,, ,, . .	I.	11.30 a.m.	1 0	
57	,, 26	,, ,, . .	I.	4.15 p.m.	1 0	
58	,, 27	,, (centre) . .	I.	5.50 a.m.	1 30	
59	,, 30	,, ,, Two hauls combined.	I.	6.55 p.m.	3 0	
60	July 21	Mewstone on Downend; shot rather outside marks, towed in towards Slapton Ley till marks were right, towed towards Redlap, hauled 1 mile off Blackpool.	I.	3.10 p.m.	2 25	Homelyn and Blonde Rays not distinguished.
61	,, 22	Shot off E. end of Slapton Sands, hauled off Torcross.	II.	10.10 a.m.	0 50	
62	,, 22	Shot off Fairway Buoy, Dartmouth, hauled off Torcross.	I.	12.10 p.m.	1 30	Homelyn and Blonde Rays not distinguished.
63	,, 25	Centre of bay, Downend on Mewstone; towed towards Blackpool Sands, then out again towards 2 m. S.W. of Mewstone	I.	8.25 a.m.	1 45	
64	Aug. 25	Start Bay, N.E. corner . .	I.	8.30 p.m.	1 0	
65	,, 26	,, (centre) . . .	I.	11.45 a.m.	3 0	
66	,, 27	Along Slapton Sands, starting from Street Point.	II.	3.55 p.m.	1 15	
67	,, 28	Inshore, Slapton Sands, hauled up before passing Street Point.	II.	11.55 a.m.	0 30	
68	,, 28	Start Bay, N.E. corner . .	I.	1 p.m.	2 0	
69	,, 28	,, (centre) . . .	I.	3.40 p.m.	3 0	Plaice alone measured.
70	Oct. 6	,, (N.E. part) . .	I.	9 a.m.	1 30	

TABLE B—*continued.*

TORBAY.

No. of Haul.	Date.	Locality and Course.	Station.	Hour Trawl Shot.	Duration of Haul. h. m.	Remarks.
	1901.					
1	July 31	Torbay, inshore . . .	IV.	10.40 a.m.	1 40	
2	,, 31	,, ...	VI.	4 p.m.	1 10	8 Plaice marked.
3	Aug. 1	,, ...	V.	8.55 a.m.	1 5	16 Plaice marked.
4	Sept. 11	,, hauled up beyond breakwater, Brixham.	IV.	11.35 a.m.	1 30	
5	,, 11	Torbay, from Berry Head to Orestone.	VI.	1.45 p.m.	1 30	
6	,, 12	From Goodrington Sands, along inside foul ground, ½ to ¾ mile from shore, as far as Fishcombe Cove.	IVA.	—	1 0	
7	,, 12	Diagonally across bay, from Berry Head to Torquay, ½ mile from shore, about ½ mile out from Torquay.	V.	3.40 p.m.	1 0	
8	Oct. 7	Torbay	IV.	12.35 p.m.	1 15	
9	,, 7	,, inside "Rough" . .	IVA.	2.45 p.m.	1 0	
10	,, 10	From Paignton Pier towards Brixham, inside Rough.	IVA.	7.15 a.m.	1 0	
11	,, 10	Torbay, trawling towards Brixham.	V.	9.15 a.m.	1 15	18 Plaice marked.
12	,, 11	Torbay, inside Rough . .	IVA.	—	1 0	
13	Nov. 11	Ilsham to Brixham . . .	V.	7.55 a.m.	1 0	
14	,, 12	Inside Rough	IVA.	8.25 a.m.	0 50	
15	,, 14	Hope's Nose to Berry Head, Torbay.	VI.	1.50 p.m.	1 0	7 Plaice marked.
16	,, 15	Torbay	V.	5.40 a.m.	1 0	
17	,, 15	Inside Rough, hauled off Paignton Pier.	IVA.	9 a.m.	1 30	
18	Dec. 12	Torbay	IV.	1.45 p.m.	2 0	
19	,, 14	Ilsham to Breakwater . .	V.	9.30 a.m.	0 45	
	1902.					
20	Jan. 28	Torbay	IV.	4.40 p.m.	1 0	
21	,, 29	,, ...	VI.	3.30 p.m.	0 45	
22	April 17	Inside Rough	IVA.	7.55 a.m.	1 30	
23	,, 17	Torbay	V.	10.55 a.m.	1 15	
24	,, 19	,, ...	VI.	9.30 a.m.	1 0	
25	May 26	,, inside Rough . .	IVA.	5.5 p.m.	0 40	
26	,, 26	,, ...	IV.	6.30 p.m.	1 0	
27	July 2	,, inside Rough . .	IVA.	2 p.m.	1 0	
28	,, 2	,, ...	IV.	4.35 p.m.	0 30	
29	,, 3	,, ...	V.	11.30 a.m.	1 0	
30	,, 24	Shot off Brixham, towed towards Kingston Valley.	V.	10.40 a.m.	1 30	
31	,, 24	Inside Rough, towed towards Goodrington Head.	IVA.	12.45 p.m.	1 0	
32	,, 24	Orestone to Berry Head . .	VI.	3.50 p.m.	1 0	
33	Sept. 1	Torbay, Ilsham to Breakwater .	V.	9.15 a.m.	0 45	
34	,, 1	,, Torquay to Paignton .	IV.	11 a.m.	1 0	
35	,, 1	,, inside Ledge . .	IVA.	1.15 p.m.	1 0	
36	,, 4	,, Berry Head to Orestone	VI.	4.25 p.m.	1 0	

TABLE B—*continued.*

TEIGNMOUTH BAY.

No. of Haul.	Date.	Locality and Course.	Station.	Hour Trawl Shot.	Duration of Haul. h. m.	Remarks.
	1901.					
1	Aug. 1	Teignmouth Bay . . .	VII.	11.20 a.m.	1 0	15 Plaice marked.
2	,, 1	,, ,, . . .	IX.	2 p.m.	2 0	
3	,, 2	,, ,, . . .	VIII.	9.50 a.m.	1 50	7 Plaice marked.
4	Sept. 13	From Anstis Cove to the Ness (in about 8 fms.).	VII.	8.10 a.m.	1 30	
5	,, 13	From off the Ness (4–5 fms.), along shore to Babbacombe.	VII.	10.50 a.m.	1 30	
6	,, 13	Off Teignmouth Bar, ½ mile along shore N.E. direction, in 5–7 fms., hauled off Dawlish and from off Langstone Point along shore in 5 fms., ¾ mile from Fairway Buoy.	VIII.	1.30 p.m.	2 35	
7	Oct. 9	Teignmouth Bay . . .	VII.	10.50 a.m.	2 15	53 Plaice marked. Rays not measured.
8	,, 9	,, ,, towards Pole Sands.	VIII.	2.15 p.m.	1 15	Rays not measured.
9	,, 11	Teignmouth Bay . . .	VII.	7.15 a.m.	1 15	Rays not measured.
10	Nov. 11	,, ,, off Babbacombe to the Ness.	VII.	4.15 p.m.	1 5	
11	,, 13	Teignmouth, after a S.W. gale on previous day.	VII.	9.50 a.m.	1 30	19 Plaice marked.*
12	,, 13	Along Pole Sands (in 5 fms. water)	VIII.	12.50 p.m.	2 0	2 Plaice marked.
13	,, 14	From off Dawlish, along Pole Sands.	VIII.	4.40 a.m.	2 0	Rays not measured.
14	Dec. 11	Babbacombe to the Ness and back again.	VII.	11.25 a.m.	3 30	
15	,, 13	Pole Sands, from Fairway Buoy to Langstone Point; course irregular, but mostly in 5 fms.	VIII.	12.40 p.m.	1 0	
	1902.					
16	Jan. 28	Teignmouth Bay . . .	VII.	7.15 a.m.	1 30	
17	,, 28	,, ,, Pole Sands .	VIII.	10.20 a.m.	0 45	
18	April 17	,, ,, . . .	VII.	3 p.m.	1 30	
19	,, 17	,, ,, on the Ledge off Teignmouth on line Exmouth to Berry Head.	IX.	5.15 p.m.	1 0	
20	,, 18	Teignmouth towards Dawlish, then to Fairway Buoy . .	VIII.	1.45 p.m.	3 0	Net full of weed.
21	,, 18	Teignmouth	VII.	9.30 p.m.	2 0	
22	May 27	Teignmouth Bay . . .	VII.	9.45 a.m.	1 45	Trawl full of *ulva*.
23	,, 27	Pole Sands, and . . / Pole Sands, outer part . (two short hauls combined)	VIII.	1.30 p.m.	1 45	Not much weed.
24	,, 27	From Pole Sands towards Hope's Nose, 2 miles from shore.	IX.	4.25 p.m.	2 0	
25	,, 28	Inside Ledge	IX.	11.40 a.m.	1 30	
26	July 2	On line Hope's Nose to Fairway Buoy, 2 miles off Teignmouth	IX.	5.40 p.m.	1 30	
27	,, 2	Pole Sands	VIII.	8.30 p.m.	1 0	
28	,, 5	Teignmouth Bay . . .	VII.	6.30 a.m.	0 45	
29	,, 5	,, ,, inside Ledge .	IX.	7.45 a.m.	1 0	
30	,, 23	Shot in 5 fms. just to N.E. of Parson and Clerk rocks; towed towards Fairway Buoy, Exmouth, and hauled ½ mile off.	VIII.	9.30 a.m.	1 40	
31	Sept. 4	Teignmouth Bay . . .	VII.	6.30 p.m.	0 45	
32	,, 4	Dawlish, along Pole Sands .	VIII.	8.15 p.m.	1 30	Rays not measured.

* Haul 11.—The entries in the log-books render the allotment of 14 of these marked fish open to slight doubt.

TABLE C.

Records of Hauls of the Trawl made with s.s. "Oithona" in 1901–1902.

START BAY.

STATION.		II.	I.	I.	I.	II.	III.	III.	II.	I.	II.	I.	III.	I.	III.
DATE.	1901.	July 30.	July 30.	Aug. 7.	Aug. 8.	Aug. 9.	Sept. 6.	Sept. 7.	Sept. 7.	Sept. 9.	Sept. 9.	Sept. 9.	Sept. 10.	Sept. 10.	Oct. 1.
HAUL.		1	2	3	4	5	6	7	8	9	10	11	12	13	14
DURATION OF HAUL.		2h. 35m.	2 hours.	2 hours.	1h. 10m.	1h. 10m.	2 hours.	2 hours.	2 hours.	1h. 55m.	2 hours.	1h. 5m.	2 hours.	1h. 15m.	1h. 10m.
1 Dab (below 8 in.)		24	8	5	14	—	1	1	39	—	7	1	—	—	—
1 *P. limanda*, L. (8 in. & above)		21	4	3	14	—	43	8	45	9	39	24	8	6	1
2 Flounder (below 8 in.)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 *P. flesus*, L. (8 in. & above)		—	—	—	—	3	—	—	—	—	—	—	—	—	—
3 Sole (below 8 in.)		1	1	—	—	—	—	—	—	—	—	—	—	—	—
3 *S. vulgaris*, Quen. (8 in. & above)		9	6	1	2	1	1	—	2	—	2	3	—	2	—
4 Sand Sole (*S. lascaris*, Risso.)		—	1	—	—	—	4	4	—	4	—	—	14	2	—
5 Thickback (*S. variegata*, Flem.)		—	—	—	—	—	1	—	—	—	—	—	—	—	—
6 Solenette (*S. lutea*, Bon.)		—	4	10	7	—	—	—	2	—	—	3	—	—	—
7 Lemon Sole (*P. microcephalus*, Don.)		—	—	—	—	—	—	—	—	—	—	1	—	—	—
8 Plaice (below 8 in.)		19	5	2	1	—	—	—	11	—	2	—	—	—	—
8 *P. platessa*, L. (8 in. & above)		39	16	20	24	5	39	72	22	26	57	30	30	24	17
9 Turbot (below 10 in.)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
9 *R. maximus*, Kl. (10 in. & above)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
10 Brill (below 10 in.)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
10 *R. lævis*, Kl. (10 in. & above)		—	—	—	—	—	2	18	1	2	—	—	7	—	6
11 Whiting (below 8 in.)		1	—	—	—	—	—	—	—	—	—	—	—	—	—
11 *G. merlangus*, L. (8 in. & above)		—	—	—	—	—	1	—	—	—	—	—	—	—	—
12 Bib (*G. luscus*, L.)		—	—	—	—	7	—	—	—	—	1	—	—	—	—
13 Poor Cod (*G. minutus*, L.)		—	—	—	—	2	—	—	—	—	—	—	—	—	—
14 Grey Gurnard (below 8 in.)		49	21	6	29	—	3	—	6	4	9	—	—	2	—
14 *T. gurnardus*, L. (8 in. & above)		3	3	—	—	2	12	4	10	4	4	—	4	—	2
15 Tub (*T. lucerna*, Will.)		16	—	2	6	1	1	—	10	—	7	5	—	1	—
16 Red Gurnard (*T. pini*, Bl.)		—	—	6	1	—	1	21	—	3	—	—	3	—	12
17 Streaked Gurnard (*T. lineata*, L.)		—	—	1	2	—	1	—	—	—	—	—	—	—	—
18 Dory (below 8 in.)		2	3	1	1	—	1	1	—	—	1	—	3	—	—
18 *Z. faber*, L. (8 in. & above)		—	—	—	—	—	2	5	3	3	6	2	1	—	1
19 Mullet (below 8 in.)		—	—	—	1	—	—	1	—	—	—	—	—	—	—
19 *M. surmuletus*, L. (8 in. & above)		—	—	—	—	—	—	1	—	—	—	—	—	—	—
20 Bream (*P. centrodontus*, C. et V.)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
21 Dragonet (*C. lyra*, L.)		24	6	57	65	3	6	3	21	6	—	—	6	6	—
22 Weever (*T. draco*, L.)		—	—	—	2	—	4	8	3	10	8	6	5	1	1
23 Thornback (below 12 in.)		40	16	1	—	—	—	—	2	—	—	—	—	—	—
23 *R. clavata*, L. (12 in. & above)		4	1	—	—	—	—	—	—	—	—	—	—	—	—
24 Homelyn (below 12 in.)		2	—	—	1	—	7	1	3	7	6	5	—	—	—
24 *R. maculata*, Mon. (12 in. & above)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
25 Blonde (below 12 in.)		—	—	—	—	—	22	22	3	35	—	1	98	6	2
25 *R. blanda*, Holt (12 in. & above)		—	—	—	—	—	15	75	—	44	—	—	33	2	11
26 Painted Ray (below 12 in.)		—	—	—	—	—	4	—	—	—	1	6	—	—	—
26 *R. microcellata*, Mon. (12 in. & above)		—	—	—	—	—	3	—	1	—	—	2	—	—	—
27 *S. canicula*, Cuv.		—	—	—	—	—	—	—	—	—	—	—	—	—	—
28 *Acanthias vulgaris*, Risso.		1	1	—	—	—	—	—	4	—	2	—	—	—	1
29 Buffoon (*R. squatina*, Gün.)		1	1	1	—	—	—	—	3	—	—	3	—	—	—
30 Scaldback (*A. laterna*, Rond.)		6	12	13	37	—	10	2	3	1	1	7	3	—	—
31 Cod (*G. morrhua*, L.)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
32 White Skate (*R. alba*, Lac.)		—	—	—	—	—	—	—	—	—	1	—	—	—	—
33 *Agonus cataphractus*, Bl.		—	—	—	—	—	—	—	—	—	1	—	—	—	—
34 *Conger vulgaris*, Cuv.		—	—	—	—	—	—	—	—	—	—	—	—	—	—

	II.	I.	I.	I.	II.	I.	I.	I.	III.	I.	II.	I.	II.	II.	I.	IIa.	I.	III.	I.	I.	I.	I.	I.
	Oct. 1.	Oct. 2.	Oct. 3.	Oct. 3.	Oct. 3.	Oct. 4.	Oct. 11.	Nov. 6.	Nov. 6.	Nov. 7.	Nov. 8.	Nov. 9.	Nov. 9.	Nov. 9.	Nov. 15.	Nov. 16.	Dec. 17.	Dec. 17.	Dec. 17.	Dec. 18.	Dec. 18.	Dec. 19.	Dec. 19.
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
	2 hours.	2h. 15m.	1h. 30m.	2 hours.	1 hour.	1h. 10m.	2 hours.	2 hours.	1 hour.	3 hours.	1h. 50m.	3 hours.	2h. 5m.	1 hour.	2h. 30m.	40 min.	3 hours.	3h. 10m.	3 hours.	3 hours.	3 hours.	3 hours.	4 hours.
1	10	17	3	18	—	6	8	11	—	7	4	21	2	—	1	—	3	—	—	2	—	—	12
	37	121	44	103	17	47	54	63	6	32	20	51	30	23	11	8	22	5	7	5	40	5	
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	3
	—	1	3	—	—	—	2	—	—	2	4	5	5	—	1	1	4	—	5	—	1	—	
4	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	2	—
5	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	1	—	—	—	1	—	—	3	2	2	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
8	—	2	1	1	—	—	2	—	—	—	2	—	—	—	1	—	1	—	1	—	—	—	2
	20	124	70	89	14	78	16	69	17	40	29	66	64	43	42	47	29	30	30	22	22	17	56
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	1	—	2	—	1	1	—	—	—	—	—	—	—	—	2	—
10	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—
	—	—	—	—	—	—	1	—	10	—	—	—	—	1	—	1	—	13	3	2	2	—	—
11	1	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	7	—	—	—	6	—	2
	—	—	—	1	—	—	2	4	—	2	1	—	—	—	3	—	5	—	—	1	22	1	
12	—	—	—	—	1	—	—	—	—	—	76	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	10	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
14	40	41	2	29	7	22	36	37	1	8	23	20	29	11	5	—	20	—	—	7	4	1	20
	16	16	3	35	15	36	26	59	2	27	11	9	25	13	33	3	45	—	—	12	32	10	
15	2	2	2	2	1	4	5	6	—	2	6	3	2	1	1	—	3	—	—	—	—	—	—
16	—	1	1	—	—	—	—	—	3	—	—	—	—	—	—	—	—	2	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	2	—	1	1	—	1	2	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—
	2	8	—	5	9	6	3	9	12	10	5	—	4	1	14	1	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
21	7	12	12	12	—	20	many	40	12	many	12	20	—	12	—	2	12	—	—	—	6	6	—
22	—	10	3	4	—	14	2	1	3	1	—	—	—	3	—	—	1	2	—	—	2	5	—
23	—	—	—	—	3	—	3	—	—	—	3	—	—	—	—	4	1	1	?	—	—	—	—
	—	—	—	—	1	—	—	—	—	—	1	—	—	1	2	3	—	—		—	—	—	—
24	—	—	7	1	—	—	3	—	—	3	2	1	3	1	—	5	—	—	?	—	—	—	—
	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—
25	—	—	—	—	—	1	—	—	17	—	—	—	—	—	—	—	—	19	?	—	12	8	—
	—	—	5	—	—	—	—	—	20	—	—	—	—	—	—	1	—	18		6	1	—	—
26	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	2	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	1	—	—	—	2	—	1	3	—	—	—	2	—	—
27	1	3	—	—	1	—	1	1	—	5	—	—	—	—	—	—	1	—	—	—	—	—	—
28	60	20	—	—	2	5	2	40	?	very many	1	—	—	—	20	—	12	—	—	—	2	—	—
29	—	2	—	—	4	—	—	1	1	—	1	—	—	1	—	1	—	—	—	—	—	—	—
30	3	13	3	3	1	5	few	5	1	5	5	5	—	5	—	—	—	—	—	—	3	—	—
31	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—
32	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
33	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
34	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	1	—	—

TABLE C—*continued.*

START BAY—*continued.*

	STATION.	I.	III.	I.	I.	I.	I.	I.	I.	III.	I.	III.
	DATE. 1902.	Jan. 21.	Jan. 22.	Jan. 24.	Jan. 25.	Feb. 4.	Feb. 5.	April 8.	April 14.	April 15.	April 15.	April 15.
	HAUL.	38	39	40	41	42	43	44	45	46	47	48
	DURATION OF HAUL.	1h. 45m.	1h. 30m.	3h. 30m.	1 hour.	1h. 45m.	1h. 15m.	40 min.	1 hour.	1 hour.	2h. 30m.	2 hours.
1	Dab (below 8 in.)	3	—	10	5	10	—	—	3	—	5	—
	P. limanda, L. (8 in. & above)	6	3	14	16	5	5	1	2	—	4	—
2	Flounder (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—
	P. flesus, L. (8 in. & above)	—	—	2	1	—	—	—	—	—	—	—
3	Sole (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—
	S. vulgaris, Quen. (8 in. & above)	1	—	1	1	1	3	—	—	—	—	—
4	Sand Sole (*S. lascaris*, Risso.)	—	1	—	—	—	—	—	—	—	—	—
5	Thickback (*S. variegata*, Flem.)	2	—	—	—	—	—	—	—	—	—	—
6	Solenette (*S. lutea*, Bon.)	—	—	—	—	—	—	—	—	—	—	—
7	Lemon Sole (*P. microcephalus*, Don.)	—	—	—	—	—	—	—	—	—	—	—
8	Plaice (below 8 in.)	—	—	3	1	7	1	2	1	—	3	7
	P. platessa, L. (8 in. & above)	3	2	33	17	31	17	1	16	3	33	9
9	Turbot (below 10 in.)	—	—	—	—	—	—	—	—	—	—	—
	R. maximus, Kl. (10 in. & above)	—	—	—	—	—	1	—	—	—	—	—
10	Brill (below 10 in.)	—	—	—	—	—	—	—	—	—	—	—
	R. lævis, Kl. (10 in. & above)	2	9	2	—	1	—	—	—	—	—	2
11	Whiting (below 8 in.)	—	—	—	—	4	—	—	—	—	—	—
	G. merlangus, L. (8 in. & above)	2	—	9	10	1	1	—	—	—	—	—
12	Bib (*G. luscus*, L.)	—	—	—	—	5	—	—	—	—	—	—
13	Poor Cod (*G. minutus*, L.)	—	—	—	—	—	—	—	—	—	—	—
14	Grey Gurnard (below 8 in.)	—	—	7	6	1	—	—	—	—	1	—
	T. gurnardus, L. (8 in. & above)	4	6	17	15	—	—	—	—	—	—	—
15	Tub (*T. lucerna*, Will.)	1	—	—	1	2	—	—	—	—	—	—
16	Red Gurnard (*T. pini*, Bl.)	—	—	—	—	—	—	—	—	—	—	—
17	Streaked Gurnard (*T. lineata*, L.)	—	—	—	—	—	—	—	—	—	—	—
18	Dory (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—
	Z. faber, L. (8 in. & above)	—	—	1	—	—	—	—	—	—	—	—
19	Mullet (below 8 in.)	1	—	1	2	—	—	—	—	—	—	—
	M. surmuletus, L. (8 in. & above)	—	—	—	—	—	—	—	—	—	—	—
20	Bream (*P. centrodontus*, C. et V.)	—	—	—	—	—	—	—	—	—	—	—
21	Dragonet (*C. lyra*, L.)	—	—	—	—	3	—	—	—	—	—	—
22	Weever (*T. draco*, L.)	—	2	—	—	—	—	—	—	—	—	3
23	Thornback (below 12 in.)	—	—	—	—	3	1	—	1	—	—	—
	R. clavata, L. (12 in. & above)	—	—	—	—	4	—	—	—	—	—	—
24	Homelyn (below 12 in.)	—	—	1	—	—	—	—	1	—	—	—
	R. maculata, Mon. (12 in. & above)	—	—	—	—	—	—	—	—	—	—	—
25	Blonde (below 12 in.)	—	19	3	4	1	—	—	—	2	4	7
	R. blanda, Holt (12 in. & above)	—	6	—	—	—	—	—	—	1	—	2
26	Painted Ray (below 12 in.)	—	—	—	—	—	—	—	—	—	—	—
	R. microcellata, Mon. (12 in. & above)	—	1	2	—	—	—	—	—	—	—	—
27	*S. canicula*, Cuv.	—	—	—	—	1	—	—	—	—	—	—
28	*Acanthias vulgaris*, Risso.	—	—	—	—	—	—	—	—	—	—	—
29	Buffoon (*R. squatina*, Gün.)	—	2	—	—	—	—	—	—	—	3	—
30	Scaldback (*A. laterna*, Rond.)	—	—	—	—	—	—	—	—	—	—	3
31	Cod (*G. morrhua*, L.)	—	—	—	—	—	—	—	—	—	—	—
32	White Skate (*R. alba*, Lac.)	—	—	—	—	—	—	—	—	—	1	—
33	*Agonus cataphractus*, Bl.	—	—	—	—	1	—	—	—	—	—	—
34	*Conger vulgaris*, Cuv.	—	—	—	—	—	—	—	—	—	—	—

	I.	I.	I.	I.	I.	II.	I.	I.	I.	I.	I.	II.	I.	I.	I.	I.	II.	II.	I.	I.
	May 22.	May 22.	May 22.	May 23.	May 24.	May 24.	June 19.	June 26.	June 27.	June 30.	July 21.	July 22.	July 22.	July 25.	Aug. 25.	Aug. 26.	Aug. 27.	Aug. 28.	Aug. 28.	Oct. 6.
	49	50	51	52	53	54	56	57	58	59	60	61	62	63	64	65	66	67	68	70
	2 hours.	2 hours.	3 hours.	1h. 45m.	2h. 30m.	1 hour.	1 hour.	1 hour.	1h. 30m.	3 hours.	2h. 25m.	50 min.	1h. 30m.	1h. 45m.	1 hour.	3 hours.	1h. 15m.	30 min.	2 hours.	1h. 30m.
1	—	—	—	2	—	—	29	59	129	122	32	—	30	9	175	111	279	52	260	67
	7	12	12	12	8	8	11	10	14	22	3	—	5	4	44	24	18	8	23	2
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	9	3	1	1	—	—	5	6	1	4	1
4	—	—	—	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	1	—	—	—	—	—	—	—	2	—	—	—	—	—	6	1	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	1	1	5	1	—	—	—	1	—	5	1	1	—
	35	42	74	57	54	7	10	38	25	94	26	4	23	5	46	78	71	23	61	16
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	1	—	—	—	—	2	4	—	—	—	—	1	—	—	1	1
11	—	—	—	—	—	—	—	2	1	2	—	—	—	—	2	—	—	—	—	6
	—	—	—	—	—	—	1	18	50	74	2	—	1	—	—	—	—	—	1	6
12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	3	—	—	12	14	45	7	—	1	—	34	6	16	5	15	4
	—	1	—	—	1	—	—	1	1	4	—	—	—	—	—	5	2	1	6	12
15	—	—	—	1	1	—	—	—	—	5	1	—	—	—	1	7	11	6	1	3
16	—	—	—	—	—	—	—	—	2	13	—	—	—	—	4	2	—	—	2	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	2	4	3	2	1	8	1	7	7	1	—	1	2	—	1	4	1	1	—
	—	4	13	1	1	—	—	—	2	—	1	—	—	—	—	—	7	1	1	7
19	—	—	—	—	—	—	—	2	14	—	3	—	—	—	—	—	—	3	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21	—	—	—	—	—	—	—	—	6	6	5	—	—	—	—	—	3	2	—	1
22	—	1	—	—	—	—	—	—	1	5	—	—	—	—	5	7	—	—	—	—
23	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	6	4	9	—
	1	—	—	—	—	—	—	—	1	—	—	—	—	1	—	—	2	1	1	—
24	1	1	1	—	1	—	1	—	—	6	3(?)—		1(?)—		—	1	—	—	2	—
	—	—	1	—	—	—	—	—	—	—	8(?)—		—	—	—	—	—	—	—	—
25	—	2	5	—	5	—	—	—	—	2	4(?)—		1(?)—		1	—	—	1	2	—
	—	—	2	—	—	—	—	—	—	13	13(?)—		—	—	—	1	—	—	—	—
26	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	1	—	1	—	—	—	—	—	—	—	1	2	—	—	—	—	1	1	—	—
30	—	—	—	—	—	—	2	—	3	—	—	—	—	—	—	—	2	—	—	1
31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE C—*continued.*

TORBAY.

	STATION.	IV.	VI.	V.	IV.	VI.	IVA.	V.	IV.	IVA.	IVA.	V.	IVA.	V.	IVA.	VI.
	DATE. 1901.	July 31.	July 31.	Aug. 1.	Sept. 11.	Sept. 11.	Sept. 12.	Sept. 12.	Oct. 7.	Oct. 7.	Oct. 10.	Oct. 10.	Oct. 11.	Nov. 11.	Nov. 12.	Nov. 14.
	HAUL.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	DURATION OF HAUL.	1h. 40m.	1h. 10m.	1h. 5m.	1h. 30m.	1h. 30m.	1 hour.	1 hour.	1h. 15m.	1 hour.	1 hour.	1h. 15m.	1 hour.	1 hour.	50 min.	1 hour.
1	Dab (below 8 in.)	117	10	58	265	12	28	66	145	7	—	98	2	67	—	5
	P. limanda, L. (8 in. & above)	3	14	4	17	20	2	25	7	3	2	12	—	10	2	15
2	Flounder (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	P. flesus, L. (8 in. and above)	8	—	—	12	—	4	—	3	4	1	—	1	—	1	—
3	Sole (below 8 in.)	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	S. vulgaris, Quen. (8 in. & above)	3	1	1	4	2	3	1	1	—	1	1	—	—	—	1
4	Sand Sole (*S. lascaris*, Risso.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	Thickback (*S. variegata*, Flem.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	Solenette (*S. lutea*, Bon.)	29	1	5	7	—	—	—	many	—	—	—	—	1	—	1
7	Lemon Sole (*P. microcephalus*, Don.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	Plaice (below 8 in.)	40	3	7	135	1	5	2	96	14	4	8	8	1	—	—
	P. platessa, L. (8 in. & above)	39	11	22	71	7	32	33	35	20	20	39	18	20	11	7
9	Turbot (below 10 in.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	R. maximus, Kl. (10 in. & above)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	Brill (below 10 in.)	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—
	R. lævis, Kl. (10 in. and above)	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—
11	Whiting (below 8 in.)	2	1	4	1	1	—	—	3	—	—	1	—	7	—	2
	G. merlangus, L. (8 in. & above)	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—
12	Bib (*G. luscus*, L.)	—	—	—	—	3	103	—	—	—	—	—	—	—	—	—
13	Poor Cod (*G. minutus*, L.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	Grey Gurnard (below 8 in.)	31	7	38	2	—	—	—	—	—	—	—	1	3	—	3
	T. gurnardus, L. (8 in. & above)	1	—	—	—	1	1	—	—	—	—	—	—	1	—	—
15	Tub (*T. lucerna*, Will.)	14	—	—	2	—	1	—	4	3	—	2	4	2	—	—
16	Red Gurnard (*T. pini*, Bl.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	Streaked Gurnard (*T. lineata*, L.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	Dory (below 8 in.)	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	Z. faber, L. (8 in. and above)	—	—	—	1	—	2	—	—	—	—	—	2	—	—	—
19	Mullet (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	M. surmuletus, L. (8 in. & above)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	Bream (*P. centrodontus*, C. et V.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21	Dragonet (*C. lyra*, L.)	24	22	24	30	—	—	—	6	—	—	—	—	6	—	12
22	Weever (*T. draco*, L.)	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
23	Thornback (below 12 in.)	32	88	20	9	7	—	2	26	5	1	9	6	—	—	15
	R. clavata, L. (12 in. & above)	—	6	3	—	1	—	—	—	—	—	—	—	—	—	—
24	Homelyn (below 12 in.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
	R. maculata, Mon. (12 in. and above)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25	Blonde (below 12 in.)	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—
	R. blanda, Holt (12 in. & above)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	Painted Ray (below 12 in.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	R. microcellata, Mon. (12 in. and above)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27	*S. canicula*, Cuv.	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
28	*Acanthias vulgaris*, Risso.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	Buffoon (*R. squatina*, Gün.)	6	1	—	4	5	4	—	—	1	—	—	—	1	1	—
30	Scaldback (*A. laterna*, Rond.)	25	8	9	30	4	6	10	few	few	—	many	3	few	—	2
31	Cod (*G. morrhua*, L.)	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—
32	White Skate (*R. alba*, Lac.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33	*Agonus cataphractus*, Bl.	2	2	—	1	1	—	—	3	—	—	—	—	—	—	—
34	*Conger vulgaris*, Cuv.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

	V.	IVA.	IV.	V.	IV.	VI.	IVA.	V.	VI.	IVA.	IV.	IVA.	IV.	V.	V.	IVA.	VI.	V.	IV.	IVA.	VI.
	Nov. 15.	Nov. 15.	Dec. 12.	Dec. 14.	1902. Jan. 28.	Jan. 29.	April 17.	April 17.	April 19.	May 26.	May 26.	July 2.	July 2.	July 3.	July 24.	July 24.	July 24.	Sept. 1.	Sept. 1.	Sept. 1.	Sept. 4.
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
	1 hour.	1h. 30m.	2 hours.	45 min.	1 hour.	45 min.	1h. 30m.	1h. 15m.	1 hour.	40 min.	1 hour.	1 hour.	30 min.	1 hour.	1h. 30m.	1 hour.	1 hour.	45 min.	1 hour.	1 hour.	1 hour.
1	67	9	16	28	7	3	36	74	10	–	–	11	42	346	–	12	2	287	223	112	10
	6	—	3	7	—	–	2	2	9	3	2	—	1	8	1	—	4	12	9	4	12
2	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	6	—	—	—	1	–	1	—	—	–	2	2	4	—	–	3	—	—	9	3	—
3	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	—	–	1	—	—	1	–	1	—	1	2	2	—
4	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
5	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
6	few	few	—	—	1	–	5	20	—	–	–	—	—	3	–	—	—	—	1	—	1
7	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	1	—	—	—	—
8	123	30	4	—	30	7	39	38	11	–	–	7	13	47	–	7	1	10	36	18	2
	15	17	7	10	8	3	5	24	8	4	4	9	7	28	6	5	4	22	114	65	3
9	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
10	2	1	2	—	—	–	1	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	1	–	–	—	—	—	–	—	—	—	—	—	—
11	42	—	1	14	—	–	—	—	—	–	–	—	1	23	–	—	10	56	8	—	34
	2	—	—	—	—	–	—	—	—	–	–	—	—	3	–	—	—	1	1	—	—
12	—	—	—	—	—	–	—	—	—	–	–	—	1	—	–	3	—	—	3	3	—
13	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	3
14	7	—	—	7	—	–	—	2	5	–	–	5	3	57	–	4	4	3	2	—	1
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	1	—	—	—
15	—	—	—	—	—	–	2	—	—	–	–	—	3	—	–	3	3	1	—	14	—
16	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	1
17	—	—	—	—	—	–	—	—	1	–	–	—	—	—	–	—	—	—	—	—	—
18	—	1	—	—	—	–	—	—	1	–	–	—	—	—	1	—	1	1	1	—	1
	—	2	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
19	—	—	—	—	—	–	—	—	—	–	–	—	1	—	–	—	—	—	1	1	—
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
20	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
21	few	—	—	3	—	–	1	—	—	–	–	—	—	12	–	—	—	12	—	—	—
22	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
23	18	4	—	—	1	1	—	2	15	2	–	—	1	4	–	7	7	6	12	—	40
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	1	—	9	—	—	—	4
24	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
25	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
26	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
27	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
28	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
29	—	3	—	—	—	2	—	—	—	–	–	—	—	—	–	—	—	—	4	—	9
30	—	—	—	3	—	–	5	12	—	–	–	—	—	6	–	—	—	3	3	—	2
31	—	—	—	—	1	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
32	1	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	—	—	—	—
33	3	2	—	—	—	–	2	3	—	–	–	—	—	—	–	—	—	—	—	—	—
34	—	—	—	—	—	–	—	—	—	–	–	—	—	—	–	—	—	1	—	—	—

TABLE C—*continued.*

TEIGNMOUTH BAY.

	STATION.	VII.	IX.	VIII.	VII.	VII.	VIII.	VII.	VIII.	VII.	VII.	VII.	VIII.
	DATE. 1901.	Aug. 1.	Aug. 1.	Aug. 2.	Sept. 13.	Sept. 13.	Sept. 13.	Oct. 9.	Oct. 9.	Oct. 11.	Nov. 11.	Nov. 13.	Nov. 13.
	HAUL.	1	2	3	4	5	6	7	8	9	10	11	12
	DURATION OF HAUL.	1 hour.	2 hours.	1h. 50m.	1h. 30m.	1h. 30m.	2h. 35m.	2h. 15m.	1h. 15m.	1h. 15m.	1h. 5m.	1h. 30m.	2 hours.
1	Dab (below 8 in.)	21	—	2	40	19	8	57	—	2	12	42	14
	P. limanda, L. (8 in. and above)	13	—	3	5	6	10	28	2	1	9	44	14
2	Flounder (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—	—
	P. flesus, L. (8 in. and above)	—	—	1	—	—	—	—	—	—	—	—	—
3	Sole (below 8 in.)	—	1	—	—	—	1	—	—	—	—	1	2
	S. vulgaris, Quen. (8 in. and above)	—	8	6	1	—	8	3	—	1	3	9	26
4	Sand Sole (*S. lascaris*, Risso.)	—	—	—	—	—	—	—	—	—	—	—	—
5	Thickback (*S. variegata*, Flem.)	—	—	—	—	—	—	—	—	—	—	—	—
6	Solenette (*S. lutea*, Bon.)	1	2	1	31	2	6	6	—	—	1	60	6
7	Lemon Sole (*P. microcephalus*, Don.)	—	—	—	1	—	2	—	—	—	—	—	—
8	Plaice (below 8 in.)	27	—	10	7	43	55	212	30	133	144	10	—
	P. platessa, L. (8 in. and above)	22	2	7	29	42	85	112	29	32	86	52	11
9	Turbot (below 10 in.)	—	—	—	—	—	—	—	—	—	—	—	—
	R. maximus, Kl. (10 in. and above)	—	—	—	—	—	—	—	1	1	—	—	1
10	Brill (below 10 in.)	—	—	1	—	—	4	1	1	3	3	1	1
	R. lævis, Kl. (10 in. and above)	—	3	1	—	—	1	—	1	—	—	—	—
11	Whiting (below 8 in.)	—	—	1	1	—	—	—	1	—	—	116	5
	G. merlangus, L. (8 in. and above)	—	—	—	—	—	—	—	—	—	—	38	58
12	Bib (*G. luscus*, L.)	—	—	—	1	275	2	—	—	—	—	11	29
13	Poor Cod (*G. minutus*, L.)	—	—	—	—	—	—	—	—	—	—	—	3
14	Grey Gurnard (below 8 in.)	—	12	3	1	—	1	3	1	—	23	5	4
	T. gurnardus, L. (8 in. and above)	—	3	—	—	—	—	—	—	—	—	—	—
15	Tub (*T. lucerna*, Will.)	10	—	6	1	3	28	15	8	6	1	—	—
16	Red Gurnard (*T. pini*, Bl.)	—	—	—	—	—	—	—	—	—	—	—	—
17	Streaked Gurnard (*T. lineata*, L.)	—	—	—	—	—	—	—	—	—	—	—	—
18	Dory (below 8 in.)	—	—	2	—	—	—	—	—	—	—	1	—
	Z. faber, L. (8 in. and above)	—	—	1	1	1	—	—	—	—	1	—	3
19	Mullet (below 8 in.)	—	—	—	—	—	—	—	—	—	—	—	—
	M. surmuletus, L. (8 in. and above)	—	—	—	—	—	—	—	—	—	—	—	3
20	Bream (*P. centrodontus*, C. et V.)	—	—	—	—	—	2	—	—	—	—	—	—
21	Dragonet (*C. lyra*, L.)	11	60	4	12	7	50	—	few	few	7	few	6
22	Weever (*T. draco*, L.)	—	—	—	—	—	—	—	—	—	—	—	—
23	Thornback (below 12 in.)	—	17	4	37	7	19	63	1	—	31	59	36
	R. clavata, L. (12 in. and above)	8	11	5	3	8	26			—	3	6	25
24	Homelyn (below 12 in.)	—	—	—	—	—	2	2	—	—	—	—	3
	R. maculata, Mon. (12 in. and above)	—	—	—	—	—	—		—	—	—	—	—
25	Blonde (below 12 in.)	—	—	—	—	—	3	—	8	—	1	—	—
	R. blanda, Holt (12 in. and above)	—	—	—	—	—	6	—		—	—	—	9
26	Painted Ray (below 12 in.)	—	—	—	—	—	—	—	3	1	—	—	—
	R. microcellata, Mon. (12 in. and above)	—	—	—	—	—	19	—		—	—	—	1
27	*S. canicula*, Cuv.	—	16	1	3	—	—	—	—	—	1	—many	
28	*Acanthias vulgaris*, Risso.	—	—	—	—	—	—	—	—	—	—	—	—
29	Buffoon (*R. squatina*, Gün.)	35	—	2	3	44	12	many	12	many	—	few	—
30	Scaldback (*A. laterna*, Rond.)	8	10	5	12	2	21	30	—	1	—	few	6
31	Cod (*G. morrhua*, L.)	—	—	—	—	—	1	—	—	—	—	1	—
32	White Skate (*R. alba*, Lac.)	1	—	—	—	—	—	—	—	—	—	1	—
33	*Agonus cataphractus*, Bl.	—	—	—	1	—	—	—	—	—	—	2	—
34	*Conger vulgaris*, Cuv.	—	—	—	—	—	—	—	—	—	—	—	—

	VIII.	VII.	VIII.	VII.	VIII.	VII.	IX.	VIII.	VII.	VII.	VIII.	IX'.	IX.	IX.	VIII.	VII.	IX.	VIII.	VII.	VIII.
	Nov. 14.	Dec. 11.	Dec. 13. 1902.	Jan. 28.	Jan. 28.	April 17.	April 17.	April 18.	April 18.	May 27.	May 27.	May 27.	May 28.	July 2.	July 2.	July 5.	July 5.	July 23.	Sept. 4.	Sept. 4.
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	2 hours.	3h. 30m.	1 hour.	1h. 30m.	45 min.	1h. 30m.	1 hour.	3 hours.	2 hours.	1h. 45m.	1h. 45m.	2 hours.	1h. 30m.	1h. 30m.	1 hour.	45 min.	1 hour.	1h. 40m.	45 min.	1h. 30m.
1	10	12	2	4	—	7	1	2	1	—	—	—	—	3	—	88	68	3	52	9
	12	2	2	—	—	3	—	4	2	—	1	1	—	—	1	2	7	—	7	2
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	12	—	1	—	—	—	—	2	2	—	3	2	—	4	2	—	2	—	1	21
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	3	—	—	—	—	?	—	—	—	—	—	—	—	—	—	few	—	—	—
7	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	2	89	5	74	4	84	—	67	39	—	—	1	—	3	5	18	78	8	26	21
	9	12	1	9	2	19	8	24	6	5	5	19	15	5	10	3	38	1	33	49
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—
10	1	3	—	—	—	1	—	4	—	—	—	1	—	—	—	—	—	—	—	1
	—	—	—	—	—	—	—	—	—	—	2	—	—	2	—	—	—	—	—	—
11	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	3	—	3	1
	17	—	1	—	—	—	—	—	—	—	—	—	—	3	—	—	3	—	—	—
12	few	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	8
13	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	5	—	—	—	3	5	1	1	—	—	—	—	4	—	22	41	2	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
15	1	6	—	—	—	—	—	—	6	—	—	—	—	3	1	2	—	—	3	15
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	2	4	—	—	—	—	—	1
	1	—	—	—	—	—	—	—	—	—	3	—	2	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2	—	—	—	3
	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21	few	few	few	—	—	—	?	—	—	—	—	—	—	—	—	—	few	7	few	few
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
23	few	12	6	4	1	58	4	50	32	2	—	7	5	2	—	14	45	—	3	±25
		—	18	—	3	11	12	50	10	2	17	19	10	10	4	12	9	8	—	
24	—	—	—	—	—	—	—	—	1	1	1	4	—	2	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	7	6	—	—	—	—	—	—	—	—
25	few	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	±25
		—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	
26	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
27	6	—	3	—	—	1	few	—	—	—	—	—	—	12	—	—	1	3	—	few
28	—	—	—	—	—	—	few	—	—	—	—	—	—	—	—	—	—	—	—	—
29	3	many	—	2	4	20	few	—	—	—	—	—	—	—	—	—	2	1	12	3
30	—	2	—	—	1	6	—	—	—	—	—	—	—	—	—	—	many	—	2	few
31	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	1	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE D.

Record of Plaice caught.

I. START BAY.

No. of haul.	Year.	Month.	Day.	Station.	Duration of haul h.	m.	(Inches.) 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total.
1	1901	July	30	II.	2	35	–	1	3	15	6	2	2	2	2	10	7	2	2	–	1	1	2	–	–	–	–	–	58
2	,,	,,	,,	I.	2	0	–	1	1	3	1	–	1	2	—	6	4	2	—	–	–	–	–	–	–	–	–	–	21
3	,,	Aug.	7	I.	2	0	–	1	–	1	1	–	1	1	7	4	5	1	—	–	–	–	–	–	–	–	–	–	22
4	,,	,,	8	I.	1	10	–	–	–	1	1	2	1	5	7	2	5	1	—	–	–	–	–	–	–	–	–	–	25
5	,,	,,	9	II.	1	10	–	–	–	—	–	–	–	–	—	—	—	1	1	2	1	–	–	–	–	–	–	–	5
6	,,	Sept.	6	III.	2	0	–	–	–	—	2	1	3	4	4	7	7	2	5	3	–	1	–	–	–	–	–	–	39
7	,,	,,	7	III.	2	0	–	–	–	—	–	–	–	–	5	12	18	20	10	3	4	–	–	–	–	–	–	–	72
8	,,	,,	,,	II.	2	0	–	–	–	11	–	1	–	1	3	4	5	2	1	–	3	1	1	–	–	–	–	–	33
9	,,	,,	9	I.	1	55	–	–	–	—	1	–	–	–	4	7	2	7	—	3	2	–	–	–	–	–	–	–	26
10	,,	,,	,,	II.	2	0	–	–	–	2	5	4	7	5	5	11	5	6	5	1	2	1	–	–	–	–	–	–	59
11	,,	,,	,,	I.	1	5	–	–	–	—	–	6	3	2	3	7	5	3	1	–	–	–	–	–	–	–	–	–	30
12	,,	,,	10	III.	2	0	–	–	–	—	–	–	–	–	1	6	5	10	5	3	–	–	–	–	–	–	–	–	30
13	,,	,,	,,	I.	1	15	–	–	–	—	–	1	2	1	2	4	6	5	2	1	–	–	–	–	–	–	–	–	24
14	,,	Oct.	1	III.	1	10	–	–	–	—	–	–	–	–	—	—	5	5	3	1	–	3	–	–	–	–	–	–	17
15	,,	,,	,,	II.	2	0	–	–	–	—	1	1	1	–	3	1	6	2	3	–	–	–	–	–	2	–	–	–	20
16	,,	,,	2	I.	2	15	–	1	–	1	–	8	8	8	19	18	33	21	6	2	1	–	–	–	–	–	–	–	126
17	,,	,,	3	I.	1	30	–	–	–	1	2	8	2	6	14	18	8	7	4	1	–	–	–	–	–	–	–	–	71
18	,,	,,	,,	I.	2	0	–	–	–	1	1	5	4	3	10	16	19	15	8	6	2	–	–	–	–	–	–	–	90
19	,,	,,	,,	II.	1	0	–	–	–	—	–	1	1	3	—	—	—	–	1	2	2	–	–	1	2	–	–	1	14
20	,,	,,	4	I.	1	10	–	–	–	—	5	2	6	7	9	14	14	11	9	1	–	–	–	–	–	–	–	–	78
21	,,	,,	11	I.	2	0	–	–	–	2	–	2	1	1	2	—	1	5	2	2	–	–	–	–	–	–	–	–	18
22	,,	Nov.	6	I.	2	0	–	–	–	—	2	5	3	4	7	22	14	7	4	1	–	–	–	–	–	–	–	–	69
23	,,	,,	,,	III.	1	0	–	–	–	—	–	–	–	–	—	3	1	6	5	2	–	–	–	–	–	–	–	–	17
24	,,	,,	7	I.	3	0	–	–	–	—	1	–	–	4	6	1	12	8	6	1	1	–	–	–	–	–	–	–	40
25	,,	,,	8	II.	1	50	–	–	–	2	2	6	1	4	3	3	3	4	–	–	–	–	2	1	–	–	–	–	31
26	,,	,,	9	I.	3	0	–	–	–	—	1	1	1	3	4	4	17	15	10	5	3	–	–	1	1	–	–	–	66
27	,,	,,	,,	II.	2	5	–	–	–	—	–	–	1	2	5	12	15	23	3	1	–	–	1	–	1	–	–	–	64
28	,,	,,	,,	II.	1	0	–	–	–	—	1	1	2	4	6	5	11	6	4	–	1	–	–	2	–	–	–	–	43
29	,,	,,	15	I.	2	30	–	–	1	—	1	1	1	–	5	2	10	10	5	4	–	1	2	–	–	–	–	–	43
30	,,	,,	16	II*a*.	0	40	–	–	–	—	–	1	2	5	5	9	10	11	1	–	1	–	2	–	–	–	–	–	47
31	,,	Dec.	17	I.	3	0	–	1	–	—	–	–	–	2	5	5	5	7	3	2	–	–	–	–	–	–	–	–	30
32	,,	,,	,,	III.	3	10	–	–	–	—	–	1	3	1	7	7	5	2	2	1	1	–	–	–	–	–	–	–	30
33	,,	,,	,,	I.	3	0	–	–	–	1	–	3	3	3	4	10	1	3	1	1	–	–	1	–	–	–	–	–	31
34	,,	,,	18	I.	3	0	–	–	–	—	1	–	–	2	1	3	3	4	2	2	3	–	–	–	1	–	–	–	22
35	,,	,,	,,	I.	3	0	–	–	–	—	1	–	–	1	4	3	3	4	2	1	2	–	1	–	–	–	–	–	22
36	,,	,,	19	I.	3	0	–	–	–	—	–	–	1	3	1	—	3	5	1	1	1	1	–	–	–	–	–	–	17
37	,,	,,	,,	I.	4	0	–	–	1	1	1	1	6	5	8	9	10	6	3	4	–	–	1	1	1	–	–	–	58
																												Total, 1901 . . .	1508

TABLE D—*continued.*

Record of Plaice caught.

I. START BAY—*continued.*

No. of haul.	Year.	Month.	Day.	Station.	Duration of haul. h. m.	(Inches.) 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total.
38	1902	Jan.	21	I.	1 45	–	–	–	–	—	—	—	—	1	2	—	—	—	–	–	–	–	–	–	–	–	–	3
39	,,	,,	22	III.	1 30	–	–	–	–	—	—	—	—	—	—	1	—	1	–	–	–	–	–	–	–	–	–	2
40	,,	,,	24	I.	3 30	–	–	1	2	3	2	2	5	5	6	5	2	2	–	1	–	–	–	–	–	–	–	36
41	,,	,,	25	I.	1 0	–	1	–	–	1	—	2	—	2	2	3	2	1	1	1	2	–	–	–	–	–	–	18
42	,,	Feb.	4	I.	1 45	3	2	2	–	5	—	9	6	2	1	3	3	1	–	–	–	–	–	1	–	–	–	38
43	,,	,,	5	I.	1 15	–	–	–	1	3	—	—	3	2	2	—	1	4	–	2	–	–	–	–	–	–	–	18
44	,,	Apr.	8	I.	0 40	–	1	1	–	—	—	—	—	—	—	1	—	—	–	–	–	–	–	–	–	–	–	3
45	,,	,,	14	I.	1 0	–	–	–	1	—	2	4	4	3	—	1	1	1	–	–	–	–	–	–	–	–	–	17
46	,,	,,	15	III.	1 0	–	–	–	–	—	—	—	—	—	—	—	—	1	–	1	–	–	–	1	–	–	–	3
47	,,	,,	,,	I.	2 30	–	2	1	–	—	—	1	2	8	4	6	3	6	3	–	–	–	–	–	–	–	–	36
48	,,	,,	,,	III.	2 0	3	3	1	–	—	—	—	—	—	2	3	3	—	–	1	–	–	–	–	–	–	–	16
49	,,	May	22	I.	2 0	–	–	–	–	—	—	1	3	3	4	10	4	7	1	–	–	–	1	1	–	–	–	35
50	,,	,,	,,	I.	2 0	–	–	–	–	—	1	2	3	6	5	8	5	5	6	–	–	–	–	1	–	–	–	42
51	,,	,,	,,	I.	3 0	–	–	–	–	—	1	9	7	14	11	13	7	4	4	2	1	–	–	–	–	1	–	74
52	,,	,,	23	I.	1 45	–	–	–	–	—	2	3	6	10	7	10	8	7	1	–	3	–	–	–	–	–	–	57
53	,,	,,	24	I.	2 30	–	–	–	–	—	1	2	4	10	6	8	9	11	1	–	1	–	–	2	–	–	–	54
54	,,	,,	,,	II.	1 0	–	–	–	–	—	—	—	5	1	—	—	1	—	–	–	–	–	–	–	–	–	–	7
55	,,	,,	29	I.	6 0	–	–	–	–	—	—	3	8	6	12	7	4	4	1	6	1	–	–	–	–	–	–	52
56	,,	June	19	I.	1 0	–	–	–	–	3	—	1	1	3	2	—	—	—	–	–	–	–	–	–	–	–	–	10
57	,,	,,	26	I.	1 0	–	–	1	–	2	—	3	9	4	4	7	3	4	2	–	–	–	–	–	–	–	–	39
58	,,	,,	27	I.	1 30	–	–	–	1	—	—	3	2	4	8	3	3	—	–	1	1	–	–	–	–	–	–	26
59	,,	,,	30	I.	3 0	–	–	2	3	3	3	11	15	14	17	13	4	4	4	2	1	1	–	–	–	1	1	99
60	,,	July	21	I.	2 25	–	–	–	1	3	—	2	2	6	4	3	1	3	–	–	–	1	–	1	–	–	–	27
61	,,	,,	22	II.	1 50	–	–	–	–	—	—	1	—	3	—	—	—	—	–	–	–	–	–	–	–	–	–	4
62	,,	,,	,,	I.	1 30	–	–	–	–	—	1	6	5	5	3	2	1	—	–	–	–	–	–	–	–	–	–	23
63	,,	,,	25	I.	1 45	–	–	–	–	—	—	—	2	2	1	—	—	—	–	–	–	–	–	–	–	–	–	5
64	,,	Aug.	25	I.	1 0	–	–	1	–	6	2	4	7	4	8	7	5	1	1	–	1	–	–	–	–	–	–	47
65	,,	,,	26	I.	3 0	–	–	–	–	10	11	6	10	5	7	9	11	4	2	2	–	–	1	–	–	–	–	78
66	,,	,,	27	II.	1 15	–	–	–	5	10	17	9	15	11	5	2	—	—	1	–	1	–	–	–	–	–	–	76
67	,,	,,	28	II.	0 30	–	–	–	1	5	4	1	3	5	2	—	2	—	–	–	–	–	1	–	–	–	–	24
68	,,	,,	,,	I.	2 0	–	–	–	1	4	7	7	10	12	7	4	4	3	1	1	1	–	–	–	–	–	–	62
69	,,	,,	,,	I.	3 0	–	–	–	2	4	3	8	6	6	6	12	4	6	–	–	–	–	–	–	–	–	–	57
70	,,	Oct.	6	I.	1 30	–	–	–	–	1	3	2	2	4	—	—	—	2	–	–	1	–	1	–	–	–	–	16

Total, 1902 . 1104
,, 1901 . 1508
Grand total . 2612

TABLE D—*continued.*

Record of Plaice caught.

II. TORBAY.

No. of haul.	Year.	Month.	Day.	Station.	Duration of haul. h. m.	(Inches.) 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total.
1	1901	July	31	IV.	1 40	8	7	1	8	16	12	2	2	5	3	4	9	2	–	–	–	–	–	–	–	–	79
2	,,	,,	,,	VI.	1 10	–	—	—	—	3	2	2	2	–	1	–	3	1	–	–	–	–	–	–	–	–	14
3	,,	Aug.	1	V.	1 5	1	—	—	2	4	1	1	—	4	7	4	1	2	2	–	–	–	–	–	–	–	29
4	,,	Sept.	11	IV.	1 30	5	103	17	5	5	13	14	3	9	9	10	7	5	–	–	1	–	–	–	–	–	206
5	,,	,,	,,	VI.	1 30	–	1	—	—	—	1	3	1	–	–	1	1	–	–	–	–	–	–	–	–	–	8
6	,,	,,	12	IVA.	1 0	–	1	2	—	2	9	5	1	–	1	2	5	3	1	–	2	–	2	–	1	–	37
7	,,	,,	,,	V.	1 0	–	—	—	—	2	9	2	5	3	7	2	4	1	–	–	–	–	–	–	–	–	35
8	,,	Oct.	7	IV.	1 15	7	62	23	—	4	9	8	4	1	5	6	–	–	–	1	–	1	–	–	–	–	131
9	,,	,,	,,	IVA.	1 0	1	8	3	—	2	3	4	—	1	1	2	1	1	–	2	2	2	1	–	–	–	34
10	,,	,,	10	IVA.	1 0	–	1	1	2	—	5	3	—	–	–	1	3	4	1	–	1	1	–	–	–	1	24
11	,,	,,	,,	V.	1 15	–	2	—	2	4	3	2	—	8	8	5	6	4	1	2	–	–	–	–	–	–	47
12	,,	,,	11	IVA.	1 0	–	3	4	—	1	6	5	2	–	–	2	–	1	1	–	1	–	–	–	–	–	26
13	,,	Nov.	11	V.	1 0	–	—	—	—	1	2	1	1	4	9	3	–	–	–	–	–	–	–	–	–	–	21
14	,,	,,	12	IVA.	0 50	–	—	—	—	—	2	1	2	–	–	2	2	–	1	–	–	–	–	–	–	1	11
15	,,	,,	14	VI.	1 0	–	—	—	—	—	—	1	—	–	2	1	1	–	2	–	–	–	–	–	–	–	7
16	,,	,,	15	V.	1 0	–	64	57	2	—	2	2	2	–	3	2	1	1	–	1	–	–	1	–	–	–	138
17	,,	,,	,,	IVA.	1 30	2	15	10	1	2	7	—	2	–	–	1	–	–	1	–	–	4	1	–	1	–	47
18	,,	Dec.	12	IV.	2 0	–	1	1	2	—	—	1	1	1	2	1	1	–	–	–	–	–	–	–	–	–	11
19	,,	,,	14	V.	0 45	–	—	—	—	—	—	—	—	–	5	1	–	3	1	–	–	–	–	–	–	–	10
																										Total, 1901 .	915
20	1902	Jan.	28	IV.	1 0	1	8	17	4	—	—	—	3	–	1	1	1	–	–	–	–	–	–	1	1	–	38
21	,,	,,	29	VI.	0 45	–	2	3	2	—	1	—	—	–	–	2	–	–	–	–	–	–	–	–	–	–	10
22	,,	April	17	IVA.	1 30	1	15	16	5	2	—	1	1	–	2	–	–	–	–	–	–	–	1	–	–	–	44
23	,,	,,	,,	V.	1 15	1	6	16	14	1	5	4	3	1	1	6	1	1	1	1	–	–	–	–	–	–	62
24	,,	,,	19	VI.	1 0	–	1	3	6	1	3	—	1	–	1	1	1	–	–	–	–	1	–	–	–	–	19
25	,,	May	26	IVA.	0 40	–	—	—	—	—	—	—	—	1	1	–	–	–	2	–	–	–	–	–	–	–	4
26	,,	,,	,,	IV.	1 0	–	—	—	—	—	—	—	—	1	3	–	–	–	–	–	–	–	–	–	–	–	4
27	,,	July	2	IVA.	1 0	–	1	—	4	2	4	1	1	–	1	–	–	–	1	–	1	–	–	–	–	–	16
28	,,	,,	,,	IV.	0 30	–	—	1	6	6	3	—	—	–	–	1	1	–	–	–	1	–	–	1	–	–	20
29	,,	,,	3	V.	1 0	–	—	4	30	13	7	1	8	3	1	1	3	–	3	–	–	1	–	–	–	–	75
30	,,	,,	24	V.	1 30	–	—	—	—	—	1	—	—	1	2	–	1	1	–	–	–	–	–	–	–	–	6
31	,,	,,	,,	IVA.	1 0	1	—	—	3	3	2	3	—	–	–	–	–	–	–	–	–	–	–	–	–	–	12
32	,,	,,	,,	VI.	1 0	–	—	—	1	—	1	1	—	–	–	1	–	–	–	–	1	–	–	–	–	–	5
33	,,	Sept.	1	V.	0 45	–	1	—	—	9	6	4	—	5	1	1	3	1	–	–	1	–	–	–	–	–	32
34	,,	,,	,,	IV.	1 0	2	9	1	3	21	53	34	16	2	2	2	2	–	2	–	–	–	–	1	–	–	150
35	,,	,,	,,	IVA.	1 0	–	3	—	4	11	24	17	10	3	3	2	–	–	1	–	–	1	–	3	–	1	83
36	,,	,,	4	VI.	1 0	–	—	—	—	2	1	—	—	1	–	–	–	–	–	–	–	–	1	–	–	–	5
																										Total, 1902 .	585
																										,, 1901 .	915
																										Grand Total .	1500

TABLE D—*continued.*

Record of Plaice caught.

III. TEIGNMOUTH BAY.

No. of haul.	Year.	Month.	Day.	Station.	Duration of haul. h.	m.	(Inches.) 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total.
1	1901	Aug.	1	VII.	1	0	2	—	—	18	7	5	1	—	2	2	4	3	1	1	1	2	-	-	-	-	-	-	-	49
2	,,	,,	,,	IX.	2	0	-	—	—	—	—	1	—	1	—	—	—	—	—	-	-	-	-	-	-	-	-	-	-	2
3	,,	,,	2	VIII.	1	50	1	—	4	3	2	—	—	1	—	2	1	1	—	-	1	-	1	-	-	-	-	-	-	17
4	,,	Sept.	13	VII.	1	30	1	1	—	1	4	6	4	1	5	5	2	3	1	-	2	-	-	-	-	-	-	-	-	36
5	,,	,,	,,	VII.	1	30	-	18	3	6	16	6	1	4	3	2	4	5	5	2	3	5	1	-	-	1	-	-	-	85
6	,,	,,	,,	VIII.	2	35	1	4	6	27	17	10	3	8	10	4	7	17	10	4	5	7	-	-	-	-	-	-	-	140
7	,,	Oct.	9	VII.	2	15	8	124	56	5	19	38	13	9	13	12	9	6	4	7	-	-	1	-	-	-	-	-	-	324
8	,,	,,	,,	VIII.	1	15	-	5	2	8	15	6	1	4	—	1	2	—	6	3	-	4	-	1	-	-	1	-	-	59
9	,,	,,	11	VII.	1	15	2	77	46	5	3	2	1	1	4	6	8	5	1	2	-	-	-	1	-	-	-	-	1	165
10	,,	Nov.	11	VII.	1	5	-	52	77	10	5	12	9	11	14	11	10	9	2	3	3	-	1	1	-	-	-	-	-	230
11	,,	,,	13	VII.	1	30	-	2	8	—	—	6	2	4	6	10	8	5	6	-	2	-	3	-	-	-	-	-	-	62
12	,,	,,	,,	VIII.	2	0	-	—	—	—	—	3	1	1	1	1	1	—	-	1	-	-	1	1	-	-	-	-	-	11
13	,,	,,	14	VIII.	2	0	-	1	1	—	—	1	—	1	3	—	1	2	-	-	-	1	-	-	-	-	-	-	-	11
14	,,	Dec.	11	VII.	3	30	1	29	54	4	1	1	3	1	1	—	2	1	2	-	-	1	-	-	-	-	-	-	-	101
15	,,	,,	13	VIII.	1	0	-	1	4	—	—	—	—	1	—	—	—	—	-	-	-	-	-	-	-	-	-	-	-	6
																														1298
16	1902	Jan.	28	VII.	1	30	5	47	18	3	1	—	1	—	2	1	2	—	1	-	-	-	-	2	-	-	-	-	-	83
17	,,	,,	,,	VIII.	0	45	-	1	2	1	—	—	—	—	—	—	—	1	—	-	-	1	-	-	-	-	-	-	-	6
18	,,	April	17	VII.	1	30	2	44	30	7	1	—	—	2	2	2	2	1	2	3	4	-	1	-	-	-	-	-	-	103
19	,,	,,	,,	IX.	1	0	-	—	—	—	—	1	—	1	1	—	2	—	-	1	2	-	-	-	-	-	-	-	-	8
20	,,	,,	18	VIII.	3	0	-	33	24	9	1	3	3	—	3	3	—	3	2	2	2	1	2	-	-	-	-	-	-	91
21	,,	,,	,,	VII.	2	0	-	18	18	3	—	—	1	1	1	—	—	2	-	1	-	-	-	-	-	-	-	-	-	45
22	,,	May	27	VII.	1	45	-	—	—	—	—	—	1	—	—	—	—	1	1	1	-	1	-	-	-	-	-	-	-	5
23	,,	,,	,,	VIII.	1	45	-	—	—	—	—	—	1	—	—	3	—	—	-	-	-	-	-	1	-	-	-	-	-	5
24	,,	,,	,,	IX.	2	0	-	—	—	—	1	—	4	2	4	1	1	4	1	2	-	-	-	-	-	-	-	-	-	20
25	,,	,,	28	IX.	1	30	-	—	—	—	—	—	1	5	3	—	4	2	-	-	-	-	-	-	-	-	-	-	-	15
26	,,	July	2	IX.	1	30	-	—	—	2	1	2	1	2	—	—	—	—	-	-	-	-	-	-	-	-	-	-	-	8
27	,,	,,	,,	VIII.	1	0	-	—	—	4	1	3	—	2	—	—	2	1	1	-	-	1	-	-	-	-	-	-	-	15
28	,,	,,	5	VII.	0	45	-	1	9	3	5	3	—	—	—	—	—	—	-	-	-	-	-	-	-	-	-	-	-	21
29	,,	,,	,,	IX.	1	0	-	—	11	48	19	21	4	4	8	1	—	—	-	-	-	-	-	-	-	-	-	-	-	116
30	,,	,,	23	VIII.	1	40	-	—	2	2	4	1	—	—	—	—	—	—	-	-	-	-	-	-	-	-	-	-	-	9
31	,,	Sept.	4	VII,	0	45	-	1	2	18	5	11	6	6	5	2	1	1	-	-	-	-	-	-	-	1	-	-	-	59
32	,,	,,	,,	VIII.	1	30	-	—	1	9	11	11	2	7	3	4	4	8	1	3	1	2	1	2	-	-	-	-	-	70

Total, 1902 . 679
,, 1901 . 1298
Grand Total . 1977

TABLE E.

Showing for each month—

(1) The total Plaice caught in each bay separately, distinguishing the four size-groups.
(2) The average size of Plaice caught (expressed in centimetres, with approximate equivalents in inches).
(3) The number of hours fishing.
(4) The catch of Plaice per hour's fishing.

I. START BAY.

Year.	Month.	No. of fish caught.				Total.	Average size.		No. of hours.		Catch per Hour.				
		0"–7"	8"–11"	12"–14"	15"+		cms.	ins.	hrs.	min.	0"–7"	8"–11"	12"–14"	15"+	Total.
1901	July	24	16	29	10	79	28·5	11¼	4	35	5·2	3·5	6·3	2·2	17·2
	Aug.	3	12	30	7	52	32·8	13	4	20	0·7	2·8	6·9	1·6	12·0
	Sept.	13	49	138	113	313	34·4	13½	14	15	0·9	3·4	9·7	7·9	21·9
	Oct.	6	87	210	131	434	34·2	13½	13	5	0·5	6·6	16·0	10·0	33·0
	Nov.	3	60	195	162	420	35·6	14	17	5	0·2	3·5	11·3	9·4	24·4
	Dec.	4	38	97	71	210	34·7	13¾	22	10	0·2	1·7	4·4	3·2	9·5
1902	Jan.	4	15	27	13	59	31·7	12½	7	45	0·5	1·9	3·5	1·7	7·6
	Feb.	8	26	10	12	56	28·8	11½	3	—	2·7	8·7	3·3	4·0	18·6
	April	13	13	28	21	75	31·1	12¼	7	10	1·8	1·8	3·9	2·9	10·5
	May	—	61	151	109	321	34·3	13½	18	15	—	3·3	8·3	6·0	17·6
	June	7	56	79	32	174	32·3	12½	6	30	1·1	8·6	12·2	4·9	26·8
	July	1	22	29	7	59	31·4	12½	6	30	0·1	3·4	4·4	1·1	9·0
	Aug.	10	169	112	53	344	30·0	11¾	10	45	0·9	15·7	10·4	4·9	32·0
	Oct.	—	8	4	4	16	31·8	12½	1	30	—	5·3	2·7	2·7	10·7
Totals		96	632	1139	745	2612	—	—	136	55	14·8	70·2	103·3	62·5	250·8
Means (14 months)		6·8	45·1	81·3	53·2	186·57	32·24	12½	9	46	1·0	5·0	7·4	4·5	17·9
General averages		—	—	—	—	—	32·17	12½	—	—	0·7	4·6	8 3	5·4	19·0

TABLE E—*continued.*

II. TORBAY.

Year.	Month.	No. of fish caught.				Total.	Average size.		No. of hours.		Catch per Hour.				
		0″–7″	8″–11″	12″–14″	15″+		cms.	ins.	hrs.	min.	0″–7″	8″–11″	12″–14″	15″+	Total.
1901	July	43	27	20	3	93	22·3	8¾	2	50	15·2	9·5	7·0	1·0	32·9
	Aug.	7	6	12	4	29	27·3	10¾	1	5	6·5	5·5	11·1	3·7	26·9
	Sept.	143	78	49	16	286	20·4	8	5	—	28·6	15·7	9·8	3·2	57·2
	Oct.	130	64	40	28	262	21·5	8½	5	30	23·6	11·6	7·3	5·0	47·6
	Nov.	154	29	27	14	224	17·0	6¾	5	20	28·9	5·4	5·0	2·6	42·0
	Dec.	4	3	10	4	21	28·8	11½	2	45	1·0	1·5	3·6	1·5	7·6
1902	Jan.	37	4	5	2	48	18·0	7	1	45	21·1	2·3	2·8	1·1	27·4
	April	88	19	13	5	125	18·4	7¼	3	45	23·5	5·0	3·5	1·3	33·3
	May	—	2	4	2	8	33·1	13	1	40	—	1·2	2·4	1·2	4·8
	July	75	37	12	10	134	22·0	8¾	6	—	12·5	6·2	2·0	1·6	22·3
	Sept.	66	176	16	12	270	23·8	9½	3	45	17·6	46·9	4·2	3·2	72·0
Totals .		747	445	208	100	1500	—	—	39	25	178·5	110·8	58·7	25·4	374·0
Means (11 months)		67·9	40·4	18·9	9·09	136·36	23·0	9	3	35	16·22	10·07	5·33	2·31	34·0
General averages		—	—	—	—	—	19·95	7¾	—	—	18·95	11·28	5·27	2·58	38·01

III. TEIGNMOUTH BAY.

Year.	Month.	No. of fish caught.				Total.	Average size.		No. of hours.		Catch per Hour.				
		0″–7″	8″–11″	12″–14″	15″+		cms.	ins.	hrs.	min.	0″–7″	8″–11″	12″–14″	15″+	Total.
1901	Aug.	37	11	13	7	68	23·1	9	4	50	7·6	2·3	2·6	1·4	14·0
	Sept.	105	61	49	46	261	25·8	10¼	5	35	18·8	10·9	8·7	8·2	46·7
	Oct.	375	92	49	32	548	17·9	7	4	45	78·9	19·3	10·3	6·7	115·3
	Nov.	156	75	58	25	314	21·8	8½	6	35	23·7	11·3	8·8	3·8	47·7
	Dec.	94	7	3	3	107	14·8	5¾	4	30	20·9	1·5	·6	·6	23·7
1902	Jan.	78	3	4	4	89	14·8	5¾	2	15	34·7	1·3	1·7	1·7	39·5
	April	190	19	15	23	247	17·6	7	7	30	25·3	2·5	2·0	3·0	32·9
	May	1	21	16	7	45	31·1	12¼	7	—	—	3·0	2·3	1·0	6·4
	July	112	51	4	2	169	19·0	7½	5	55	18·9	8·7	·6	·3	28·5
	Sept.	47	51	20	11	129	24·6	9½	2	15	20·9	22·6	8·8	4·9	57·3
Totals .		1195	391	231	160	1977	—	—	51	10	249·7	83·4	46·4	31·6	412·0
Means (10 months)		119·5	39·1	23·1	16·0	197·7	21·07	8¼	5	7	24·97	8·34	4·64	3·16	41·2
General averages		—	—	—	—	—	20·14	8	—	—	23·35	7·64	4·51	3·12	38·6

APPENDIX I.

Preliminary Report on the Trawling Experiments in the Bays on the South Coast of Devon.

THE investigation of the trawling grounds in Start Bay, Torbay, and Teignmouth Bay, which had been previously investigated in 1895–8 by Messrs. Stead and Holt, was resumed by the Marine Biological Associaton in 1901. The new investigations were placed in the hands of Dr. H. M. Kyle, Assistant Naturalist to the Association, and were carried out by him at nearly regular monthly intervals from the end of July, 1901, to the beginning of September, 1902, by means of the Association's s.s. *Oithona*.

In addition to the trawling investigations, Dr. Kyle arranged for the collection of special statistics dealing with the Brixham fisheries. These covered the period from the beginning of February, 1902, to the end of January of the current year.

The manuscript of Dr. Kyle's report was received in March, but the work of revision has been attended with considerable difficulty, owing to Dr. Kyle's removal to Copenhagen and the necessity of considerable correspondence. When it is mentioned that his report includes an analysis of nearly a hundred and fifty hauls of the trawl, in which every fish was counted and measured, and that elaborate calculations have been made from these data from a variety of points of view, it will be understood that the Council of the Association have felt the necessity of subjecting the work to a careful revision before transmitting a formal detailed report. As, however, there has already been some considerable delay, it is thought that the Devon Sea Fisheries Committee may be glad to receive a preliminary summary of the chief results of the investigation.

This summary is limited to questions affecting the plaice, except where otherwise stated.

Trawling Experiments in the Bays.

The new investigations confirm Mr. Holt's previous report on the following points:—

(1) Start Bay is not a nursery for small flat fish. Only 4 per cent. of the plaice caught were below 8 inches in length, while 71 per cent. of the plaice were 12 inches in length and over. This species matures at 11 inches.

(2) Teignmouth Bay and Torbay are nurseries for small plaice. In the former 61 per cent., and in the latter 50 per cent., were less than 8 inches in length. Three-quarters of the plaice in these bays were immature, and only 20 per cent. attained a length of 12 inches and over.

During the last year the preponderance of large fish over small in Start Bay, and of small fish over large in the other bays, was thus even more marked than during the previous investigations five years ago.

A remarkable feature of the bays last year, to which Dr. Kyle draws attention, was the relative scarcity of medium-sized plaice between 8 and 12 inches, as compared with the period covered by Mr. Holt's investigations. A discussion of the probable explanation of this feature must be reserved for the detailed report.

As was explained at the time of the commencement of the present investigations, no attempt could be made as a result of these experiments to provide a direct answer to any question as to the absolute increase or decrease in the abundance of fish on the grounds. The information provided by this report nevertheless points to distinct conclusions as to the probable effect of closure of the bays on the maintenance of the fishery as a whole.

Statistics of Fish landed.

Daily returns of the fish landed at Brixham by the small trawlers (Mumble Bees) have been provided by Mr. Will Sanders, the number of trunks being distinguished from the number of baskets. Dr. Kyle reports that the fishermen are accustomed to land their larger fish in the trunks and the small fish in the baskets. He considers that, generally speaking, the plaice above 11 inches are placed in the trunks, and those below that size in the baskets. He further estimates the average number of plaice in the trunks at about 90, and the average number of plaice in the baskets at about 25. From the returns provided by Mr. Sanders he has thus been able to obtain an approximate measure of the numbers of plaice above and below the limit of

11 inches landed by the Brixham smacks during the past year. He reports the total number of "large" plaice landed during the year as about 180,000. "Of this number more than half were captured during February, March, and April, when the plaice were spawning in the deep water, or returning to the inshore grounds after having spawned. The months when the larger fish are least abundant offshore are September, October, and November. It is worthy of remark that the numbers for the months rise from 360 in November to 49,860 in April, and descend again to 450 in October in an almost uniform manner."

"The number of small fish landed for the year is a little over 143,000. The total number of plaice, large and small, is about 323,000, and of these the small plaice amount to 44 per cent."

Dr. Kyle's comments on these figures may be here given. He says: "The most remarkable fact which this table reveals is the large number of small plaice which are captured in the deep water, not only in one month or season, but throughout the year. The largest number—that recorded in April—is 19,800, but those for the other months vary between 4,000 and 10,000."

It should be added that the fishing grounds from which these fish are derived lie almost entirely within the area Start Point to Portland, and that the landings are almost confined to those of the small trawlers (Mumble Bees), which are the chief fishing-boats on the grounds in question.

Experiments on Migration.

In order to trace the seasonal migrations of the plaice to and from the closed waters of the bays, Dr. Kyle marked nearly 500 fish with numbered labels of brass or bone, and liberated these partly in the inshore waters of each of the bays in October and November, 1901, and partly outside Torbay and Start Bay in April and May of the following year. A reward was offered and paid for every marked fish returned, and the greatest care was taken to obtain correct returns of the places where the fish were recaptured. The Association is again very greatly indebted to Messrs. Sanders for the efficient and friendly assistance which they rendered to Dr. Kyle in this respect. Thanks to their arrangements and to the friendly co-operation of the fishermen, more than 25 per cent. of the fish have been returned with reliable particulars of capture.

The results of the experiments show in a convincing manner that in November and December the great majority of the mature fish leave Start Bay for the deeper offshore waters in Lyme Bay, the larger fish taking a more or less direct course to the eastward, and the smaller ones a less direct course along the shallower gradients to the north-

eastward, their general destination being towards the "Biscuit Dust" ground in the first case, and the so-called "Spion Kop" ground in the second.

From Teignmouth Bay the winter migration of the fish above 8 inches was also directed towards the northern of these areas, *i.e.* off Beer Head in about 20 fathoms; but the fish below 8 inches in length were found to remain for the most part in the bays until the following summer.

In March and April the Start Bay fish were found to be returning towards the bay from the distant grounds, where they had spawned, and were recovered within the limits in considerable numbers from July to October. They were recruited on their return journey by a majority of the fish liberated off the northern end of Torbay in May, which also tended to set into Start Bay during the autumn months.

As Dr. Kyle points out, these experiments confirm the view that Start Bay is essentially a summer and autumn "feeding ground" for the large plaice. It is neither a nursery for the small fish nor a spawning ground for the large ones, since the latter almost entirely desert the bay in winter on the approach of spawning time, and do not return until the spawning is over.

The Protection afforded by Closure of the Bays.

From the three classes of evidence briefly summarised above, it is clear that the closure of Start Bay to trawlers cannot materially protect the small fish (since the latter are present there in inappreciable numbers), nor can it furnish a sanctuary for the spawning fish, since the latter spawn mostly offshore. Its closure is therefore ineffective as a remedial measure, and merely delays the capture of the large fish a month or two longer than would otherwise be the case.

The closure of Torbay and Teignmouth Bay appears, on the other hand, to be advantageous so far as trawling is concerned, since these bays, especially the latter, contain the chief nurseries of small fish known within the entire area from Start Point to Portland, and the closure is not rendered ineffective by any natural tendency of the fish to emigrate in their earliest stages of growth. The extent, however, to which the prosecution of seine-fishing limits the efficiency of closure has not been further investigated.

WALTER GARSTANG,
Naturalist in Charge of Fishery Investigations.

PLYMOUTH, *July 7th*, 1903.

APPENDIX II.

Preliminary Report on Trawling Experiments in the Bays of South Devon.

SUMMARY TABLES (PLAICE).

SUBMITTED FOR THE INFORMATION OF THE DEVON SEA FISHERIES COMMITTEE.

TABLE I., *showing the Average Yearly Percentage Frequency of Plaice of different sizes in each of the Bays* (i.) *for* 1901–2, *and* (ii.) *for* 1895–8.

	Percentages.				Number Measured.
Start Bay.	0–7″	8–11″	12–14″	15″+	
1901 to 1902 . .	4	24	**44**	28	2,612
1894 to 1898 . .	12	**41**	38	9	1,636
Torbay.					
1901 to 1902 . .	**50**	30	14	6	1,500
1895 to 1898 . .	**39**	35	23	3	1,040
Teignmouth Bay.					
1901 to 1902 . .	**60**	20	12	8	1,977
1895 to 1898 . .	32	**56**	10	2	2,791

TABLE II., *showing the Average Quarterly Catch per Hour of Plaice of different sizes in each of the Bays* (*s.y.* "*Oithona*") *compared with the same for July*, 1895–8 (*s.y.* "*Busy Bee*").

A.—START BAY.

Season	Catch per Hour.					Percentages.			
	Total.	0–7″	8–11″	12–14″	15″+	0–7″	8–11″	12–14″	15″+
July to Sept., 1901 .	18	2	4	8	4	13	22	44	21
Oct. to Dec. ,, .	20	0·2	3	10	7	1	18	47	34
Jan. to Feb., 1902 .	11	1	4	4	2	10	36	32	22
April to June ,, .	18	1	4	8	5	4	23	45	28
July to Aug. ,, .	28	1	15	9	3	4	53	32	11
July, 1895–8, *Busy Bee*.	15	4	8	2	1	29	50	14	7

SUMMARY TABLES (PLAICE)—*continued.*

B.—TORBAY.

Season.	Catch per Hour.					Percentages.			
	Total.	0-7″	8-11″	12-14″	15″+	0-7″	8-11″	12-14″	15″+
July to Sept., 1901 .	45	15	14	11	5	33	32	24	11
Oct. to Dec. „ .	37	21	7	6	3	57	19	15	9
January, 1902 .	27	21	2	3	1	77	8	11	4
April to May „ .	25	17	4	3	1	66	16	13	5
July to Sept. „ .	51	18	27	3	3	35	53	7	5
July, 1895-8, *Busy Bee* .	45	11	28	4	2	24	63	9	4

C.—TEIGNMOUTH BAY.

Season.	Catch per Hour.					Percentages.			
	Total.	0-7″	8-11″	12-14″	15″+	0-7″	8-11″	12-14″	15″+
July to Sept., 1901 .	28	12	6	5	5	42	22	19	17
Oct. to Dec. „ .	61	39	11	7	4	65	18	11	6
January, 1902 .	40	35	1	2	2	88	3	5	4
April to June „ .	20	13	3	2	2	65	14	11	10
July to Sept. „ .	36	19	12	3	2	54	34	8	4
June, 1895-8, *Busy Bee* .						69	17	8	6

TABLE III., *showing Average Size of all Plaice caught during the Trawling Experiments in each Bay during* 1901–2.

Start Bay	12·8 inches.
Torbay	7·8 „
Teignmouth Bay	7·9 „

TABLE IV., *showing Percentage of Marked Plaice (exceeding* 8 *inches) recovered in the case of Teignmouth Bay and Start Bay Experiments.*

Locality.	Liberated. Number.	Recovered. Altogether.	Recovered. After 1 Year.
Teignmouth Bay . .	70	41 %	10 %
Start Bay . . .	258	23·5 %	1·5 %
Difference		17·5 %	8·5 %

NOTE.—The difference (17·5 per cent.) appears to represent approximately the proportion of Start Bay Plaice (large) which migrated outside the Brixham trawling grounds altogether.—W. G.

LOWESTOFT, *October 5th*, 1903.