

COMPTON

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REPORT

ON

MONTROSE TRAWLING STATISTICS, 1892-1903,

BY

D'ARCY WENTWORTH THOMPSON.

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## REPORT

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D'ARCY WENTWORTH THOMPSON.

By the kindness of Messrs. J. Johnston and Sons, Montrose, and of Captain Walker, who has the management of the firm's trawlers, and with the help of Mr. W. Nisbet, Fishery Officer at the Port, we are in possession of detailed statistics of the monthly catches of Messrs. Johnston's vessels from the year 1892 until the present time.

The Montrose trawlers are comparatively small vessels and of an old type. Their trade is in fresh or "live" fish only, and accordingly they make no long-distance voyages, but fish, like the Granton ones, systematically over the same ground year after year, or have done so, at least, since the closure of the Moray Firth to British Trawlers in 1892. Their grounds, as Captain Walker tells us, are from five to 50 miles E.N.E. to S.S.E. of Montrose, most of the trawling being done, when weather permits, from 25 to 35 miles off. These grounds are very much the same as those fished by the Granton trawlers, but are probably, on the whole, a little further to the North-east.

Three trawlers were employed from the beginning of the period in question down to March, 1901, and two only since that time. The vessels do not, as the Granton boats do, land their fish for the most part by carriers, but return to port at frequent intervals. They are at sea usually for something between one and two days, and only occasionally for three.

The statistics record the number of "shots landed," that is to say of trips or voyages made, in each month. We have accordingly two methods open to us of treating the statistics, either to deal with them on the basis of the average quantity of each sort of fish landed *per shot* or voyage, or according to the simpler method of taking the average monthly landings *per vessel employed*. Both methods are far from perfect, and the difficulties attending them illustrate the need for caution that is always associated with the use of statistical methods.

Were the voyages on the whole of equal length throughout the year, the two methods, the method of the average shot and the method of the whole monthly average, would give us identical results; but this is not so. In the first place, during the summer Herring fishing, that is to say, chiefly during July and August, the vessels are frequently employed towing the sailing boats to and from the fishing grounds, and this breaks in upon the time that would otherwise be given to trawling. Not only are the vessels induced to return to port more frequently at this season than they would otherwise do, but even during these shorter voyages somewhat less than a proportionately short period is devoted to trawling. Nor is this, apparently, the only cause of irregularity in the duration of the voyages. If we take the average number

of trips per month made by each vessel over the whole period of 12 years, we obtain the following curve (Fig. 1), which shows us that the average number of trips per month is fairly constant from January to May, but then rises rapidly to a maximum in August, and then falls, at first very quickly and afterwards more slowly until the end of the year. Moreover, the differences involved are large ones, nearly twice as

STATEMENT OF THE NUMBER OF SHOTS LANDED (OR VOYAGES MADE) BY TRAWLERS AT MONTROSE, DURING THE YEARS 1892-1903.

—	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average Annual Number of Trips per Vessel.
1892 ... ..	35	22	26	24	18	27	44	50	41	31	33	39	130
1893 ... ..	28	27	25	24	30	32	43	39	35	39	29	26	126
1894 ... ..	21	31	29	19	25	42	38	44	52	35	28	29	131
1895 ... ..	22	18	31	34	22	27	51	50	41	43	32	21	131
1896 ... ..	33	31	33	28	32	31	43	51	52	36	27	31	143
1897 ... ..	24	36	28	27	23	28	44	45	33	38	32	35	131
1898 ... ..	38	26	21	17	19	14	33	50	42	34	34	40	123
1899 ... ..	41	29	32	28	36	45	54	52	45	37	31	25	152
1900 ... ..	16	15	14	24	25	25	38	41	27	21	25	28	100
1901 ... ..	25	18	19*	27	16	20	22	28	20	26	26	12	119
1902 ... ..	14	17	24	13	23	17	27	43	28	36	20	20	141
1903 ... ..	17	26	21	26	17	35	40	30	21	24	31	28	158
Average Number of Trips per Vessel, for each Month.	9.2	8.8	9.0	8.4	8.7	10.5	14.2	16.0	13.1	12.1	10.7	10.1	1,585 132.1 Av. per year. 11.0 Av. per month.

many trips being made on an average in the month of August as in the month of April, which stands at the other end of the scale. The curve, then, is probably affected by various circumstances; by towage duties in the height of summer as has been already said, probably by the usual recurrence, at some time or other in spring, of the annual period of repair and overhaul, probably also by a tendency to make more frequent and shorter trips all through the warmer weather that the fish may be landed in the best condition, and very probably also by a tendency to shorten the voyage at times when the fish are most plentiful.

Let us next enquire what is likely to be the effect of these variations on our statistics, or on the deductions we may be apt to draw from them. We know nothing whatsoever about the number of hours actually spent in trawling, nor what proportion of time is spent on the passage to and from the fishing-grounds or between trips in port; but it is at least plain that the more trips the less fishing. If we

\* NOTE.—Three vessels employed to the end of March, 1901; thereafter, two only.

reduce our figures to average values of so much *per trip* we shall certainly go wrong, for the obvious reason that a trip in spring means so many hours fishing, and a trip in autumn an unknown but very considerable number of hours less. The average amount of fish per trip will therefore come out in relatively lower values for August, for instance, than for March. If, then, we find our statistics telling us that less Lemon Soles are taken on an average per trip in August than in March, we cannot be sure that that implies a greater scarcity; but if, on the other hand, we find that more Haddocks are taken per trip in August than in March, there is very good reason indeed for assuming that that does imply a greater abundance, inasmuch as larger landings are shown *in spite of* the shorter duration of the trips.

I think it is plain that we shall get, on the whole, much better and safer results by neglecting the number of trips and by basing our averages simply on the month's work of the vessels. There will still be certain incongruities, and especially July and August, owing to the time then spent on other duties, will show somewhat less than their fair average quantity of fish. But if, and in the case of these near

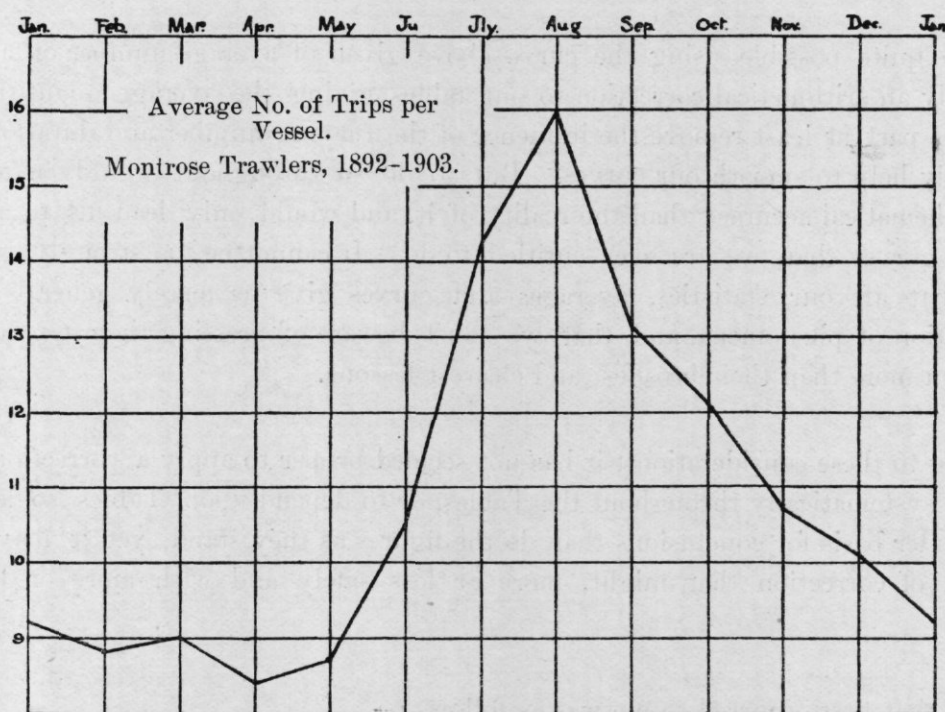


FIG. 1.

grounds we may assume it is so, the time spent in fishing is relatively great compared with that consumed in the passage out and home, it follows that while the making of numerous trips must greatly diminish the number of hours' fishing on each trip, it need not, and probably will not, diminish in anything like the same proportion the number of hours' fishing in the entire month.

This matter is somewhat important, and though really very simple it may be worth while to simplify it still further by an illustration. Suppose that every time a vessel goes out and home, she spends on an average, upon her passage and in detention in port, twenty-four hours; and suppose that all the rest of her time be spent in fishing. Then if she makes ten trips in a month, her actual time of fishing is twenty days, for she has ten times lost twenty-four hours, and on each trip she does two days' fishing; if she makes five trips only in the month, then she does altogether twenty-five days' fishing, and five days' fishing on each of these trips. Therefore if we compare the differences per trip, we ought to find that each trip was twice and a half as productive in the one case as the other, there being five working days in the one case and in the other two; but if, on the other hand, we compare the total results of the

month's work in each case, there ought to be a difference of only 25 per cent. (one-tenth part of the difference in the other case), the difference, that is to say, between twenty days and twenty-five days' fishing.

We come easily to the conclusion accordingly, that, although the fact that the voyages are unequal in number and in length at different seasons of the year cannot but detract from the value of our statistics, yet the resulting error is very much less if we deal simply with the total catches per month than if we make use of the average landings per trip. And, as we have shewn above, although the amount of error which remains may be undetermined, we know at least in what direction it lies, namely, in leading us to *underrate* the fair average results of the fishing in the summer and autumn months. It is so far fortunate that the method to which these considerations lead us, namely, the use of the average catch per vessel per month, is the same as that which we have used, and which was alone available, in the case of the Granton trawlers.

It would be quite possible, using the curve above given of average number of landings per month per vessel, to apply an arithmetical correction to our tables giving the average quantities of fish landed, such as would in part at least remove the influence of the varying number and duration of the trips, and would undoubtedly help to smooth our curves. But to do so throughout would be to give rather the semblance of mathematical accuracy than the reality of it, and would only lead us to rely more on the indications of our curves than we are ever entitled to do. It cannot be too strongly emphasised or too often repeated that all our statistics, averages and curves give us merely general indications of the tendency or direction of phenomena, and that we must beware of pressing them too far, or of hastening to draw from them more than their broadest and clearest lessons.

While, owing to these considerations, it has not seemed proper to apply a correction for the varying length of voyage systematically throughout the Tables, or to depend upon Tables so adjusted as giving necessarily a sounder basis for conclusions than do the figures as they stand, yet it may be well here to indicate the kind of correction that might, more or less safely and with more or less advantage, be applied.

The method that first occurred to me was as follows :—

Instead of plotting our curve, as has been done above, from the simple numbers given as the average catch per vessel per month, we may multiply each of these monthly totals by the number of trips made on an average in that month ; the effect obviously being to give us relatively larger numbers than before in proportion to the frequency, that is to say to the shortness, of the fishing voyages, in other words, to relatively increase our numbers somewhat in those cases when the work, according to the considerations already set forth, was of such a nature as to cause them to be somewhat too low. All that we can say of such an operation is that it is in the right direction, but whether it be too small a correction or whether it go too far on the other side, we cannot say.

This method has been used below in drawing the curves of monthly variation in the case of Haddock (Fig. 3) and of Cod (Fig 8). It is, confessedly, an artificial method ; and since this Report was put for the most part into type and the figures drawn, Mr. A. L. Bowley has suggested and worked out for me another and a better way, which I should have made more use of had I had the advantage of it earlier. Mr. Bowley's method of adjustment is as follows :—

If we make the assumption that, in one way or another, one day is lost each time the vessel comes to land, then, on the basis of the average number of voyages made in each month according to the Table on p. 280, we have left, as the average number of days spent in actual fishing, the following:—

Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
22	19	22	22	22	20	17	15	17	18	19	21

We may then, in order to obtain a uniform or standard month of 22 or 23 days, add to the actual catch for each month a proportionate amount: that is to say, we shall have to increase the actual August catches by one-half, those of July and September by one-third, of February, October and November by one-fifth, of June by one-eighth, and of December by one-tenth. It will be noticed that this method has at the same time the effect of raising the catch for February to an equal ratio with that of the other months: and this is a distinct advantage, for it is certain that the shortness of February is quite sufficient to make a distinct impression, and to tend to the appearance of a non-existent minimum upon our curves.

As a matter of fact, it will be found that, save for removing the false impression of an unreal minimum in February, even this severe process of adjustment or "weighting" produces very few changes of significant amount in our curves: in other words, the phenomena that are called attention to in the body of this Report are for the most part of sufficient magnitude to come to light whether with or without the application of such a system of weights.

In order to show the actual effect of the operation of weighting as above described, I subjoin the following Table, in which are shown:—I. The average monthly quantity of fish, of all kinds, per vessel, for the twelve years 1892-1903, according to the Table on p. 292, reduced to percentages of the total annual catch; II. The same figures adjusted according to the method at first adopted by me, as described on p. 290; III. The same figures adjusted according to the method devised by Mr. A. L. Bowley.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
I. Unadjusted ... ..	7·2	6·7	7·5	6·5	5·9	7·6	8·7	11·2	12·5	9·4	9·1	7·4	99·7
II. D. W. T. ... ..	5·8	5·2	6·2	4·8	4·5	7·0	11·1	15·8	14·3	10·0	8·6	6·5	99·8
III. A. L. B. ... ..	6·0	6·7	6·3	5·4	4·9	7·1	9·9	14·0	13·8	9·4	9·2	6·8	99·5

If these figures be reduced to curves, it will be found that the main features of the curve are alike for all, save only that a February minimum, which is indicated in the first two series, disappears in the last, or rather is there replaced by the appearance of a small maximum, insignificant in amount.

As regards the classification or discrimination of the fish, the Montrose records are superior to the Granton ones. Turbot are separated from Lemon Sole, and there are separate statistics for Ling, Saithe, Halibut, Conger and Skate, all of which are thrown into a miscellaneous category in the Granton tables.

MONTROSE TRAWLERS.—AVERAGE TOTAL QUANTITY OF FISH OF ALL KINDS (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892	...	...	158	223	287	261	171	285	277	509	463	290	331	321	3,576	298
1893	...	...	249	187	366	248	231	277	338	355	331	223	253	227	3,285	274
1894	...	...	135	183	282	199	262	402	256	283	709	460	368	385	3,924	327
1895†	...	...	237	278	326	337	182	254	290	577	859	352	252	136	4,080	340
1896	...	...	424	367	438	206	231	225	284	562	417	234	317	240	3,945	329
1897	...	...	181	381	277	258	127	219	246	174	263	382	310	301	3,119	260
1898	...	...	384	205	261	135	110	183	350	577	618	316	515	565	4,219	352
1899	...	...	481	296	285	226	356	382	396	378	425	364	337	214	4,140	345
1900	...	...	337	100	96	181	188	173	258	250	278	234	237	137	2,369	197
1901	...	...	106	97	121	324	125	204	209	226	201	363	234	87	2,297	175
1902	...	...	92	152	171	135	250	213	375	518	317	517	219	187	3,146	262
1903	...	...	223	325	157	302	240	428	573	349	242	296	531	286	3,952	329
Total...	...	...	3,007	2,794	3,067	2,812	2,473	3,245	3,852	4,758	5,123	4,031	3,904	3,086	42,152	3,512
Average*	...	...	251	233	256	234	206	270	321	396	427	336	325	257	3,512	293

Average per year ... .. 3,512 cwts.  
 „ per month ... .. 293 „

MONTROSE TRAWLERS.—AVERAGE TOTAL CATCH (IN CWTS.) OF VARIOUS FISHES, PER VESSEL.

—			1892.	1893.	1894.	1895.†	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Total in 12 Years.	Average per Year.
Cod	...	...	337·0	762·0	745·0	741·0	619·0	610·0	845·0	1316·0	626·0	758·0	959·0	1025·0	9373·0	782·1
Haddock	...	...	1930·0	1488·0	2451·0	2647·0	2502·0	1699·0	2614·0	2021·0	1195·0	981·0	1588·0	2229·0	23395·0	1949·6
Ling	...	...	29·0	27·7	31·7	24·3	20·0	20·7	18·7	26·7	19·7	17·7	15·0	17·0	268·2	22·35
Saithe	...	...	9·3	40·7	13·0	13·3	6·7	1·3	49·7	20·3	36·7	30·8	21·5	14·5	257·8	21·5
Whiting	...	...	29·4	42·8	13·8	29·8	41·7	72·2	117·2	85·1	64·3	146·1	174·0	271·0	1087·4	90·6
Halibut	...	...	12·7	—	—	—	6·3	2·8	1·5	1·3	2·3	3·2	1·0	2·0	33·1	2·76
Lemon Sole	...	...	234·0	225·0	237·0	161·0	165·0	193·0	113·0	143·0	176·0	145·0	136·0	148·0	2076·0	173·0
Plaice‡	...	...	426·0	285·0	181·0	233·0	366·0	234·0	185·0	217·0	134·0	122·0	120·0	123·0	2626·0	218·7
Turbot	...	...	58·1	65·6	38·8	39·3	64·1	28·2	36·9	45·0	32·2	29·0	24·0	23·0	489·5	40·76
Conger Eel	...	...	2·3	0·7	2·0	—	—	0·3	1·3	0·7	—	—	—	—	7·3	0·6
Skate	...	...	59·0	37·0	78·0	78·0	31·0	6·6	14·0	30·0	33·0	28·0	34·0	18·0	446·6	37·2

In Fig. 2, we shew in the form of a curve the total landings of all kinds of fish taken together, for each month of the year, the results of the whole twelve years' work being here reduced to an average.

\* A slight discrepancy will be found between this Table and the curve which illustrates it on p. 293, but in its main features the curve is sufficiently correct.

† Otter Boards, to replace the Beams, were adopted in 1895.

‡ Includes also Flounder and Brill.

The curve shows a minimum in the month of May, and a maximal catch in the month of September. As has been pointed out in connection with the Granton statistics, the Total Catch of fish is made up so

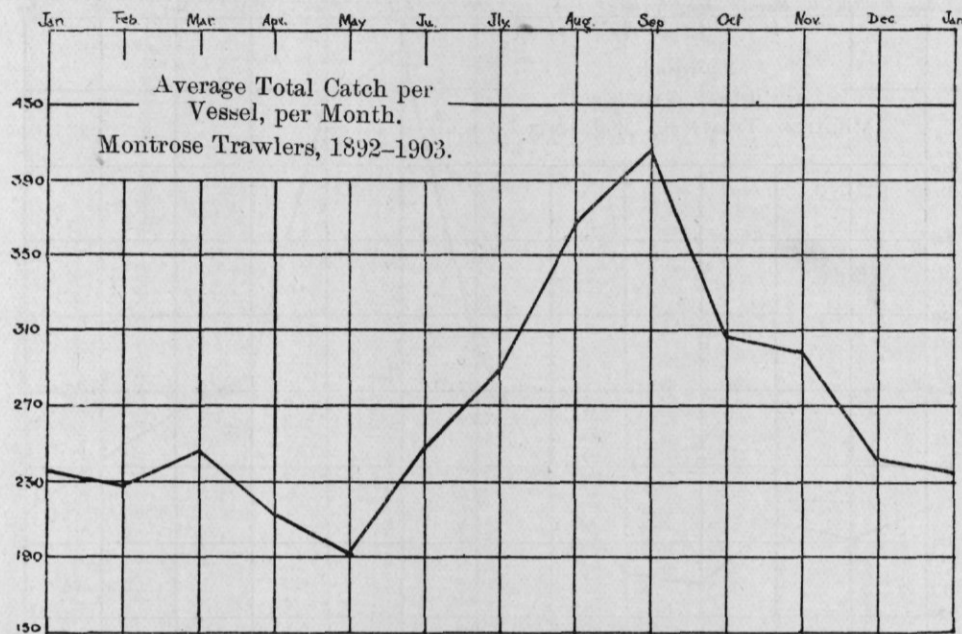


FIG. 2.

largely of Haddocks, in other words, Haddocks preponderate so largely in this region over the other food-fishes, that the features of this curve are mainly dominated by the Haddock statistics, and accordingly this curve need not here be dealt with further.

MONTROSE TRAWLERS.—AVERAGE TAKE OF HADDOCK (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	67.3	84.6	154.0	121.6	60.6	149.6	177.6	395.3	330.6	113.6	195.0	130.0	1980.0	165.0
1893 ... ..	113.3	63.6	186.6	75.0	129.3	116.3	152.3	225.6	179.6	73.3	95.3	78.3	1488.0	124.0
1894 ... ..	52.6	61.3	131.3	56.3	114.0	266.0	138.3	187.6	600.3	320.0	246.6	276.6	2451.0	204.2
1895 ... ..	150.0	170.3	116.0	178.6	85.6	150.6	156.0	466.6	753.3	181.6	165.0	73.3	2647.0	220.6
1896 ... ..	243.6	192.3	301.6	117.6	121.6	126.6	151.6	491.6	297.0	74.6	218.3	165.3	2502.0	208.5
1897 ... ..	98.0	273.3	166.6	103.3	50.6	83.3	93.3	123.3	160.0	229.6	137.6	180.0	1699.0	141.6
1898 ... ..	228.0	131.3	183.3	73.3	47.3	84.0	192.6	341.6	410.6	192.6	336.6	393.3	2614.0	217.8
1899 ... ..	288.0	138.0	113.6	70.6	133.6	148.3	191.0	208.0	227.6	174.0	199.0	129.6	2021.0	168.4
1900 ... ..	160.0	54.0	24.6	38.0	54.0	64.6	110.0	124.6	174.3	149.3	118.0	123.3	1195.0	99.6
1901 ... ..	37.6	21.0	37.3	67.5	69.0	72.0	89.0	106.5	111.5	227.0	106.0	37.0	981.0	81.7
1902 ... ..	15.0	15.0	15.0	20.5	100.0	106.0	167.5	343.0	211.5	358.5	143.0	93.5	1588.0	132.3
1903 ... ..	127.0	175.0	75.0	142.5	138.8	234.0	312.0	201.0	157.0	185.0	333.0	149.0	2229.0	185.7
Total ... ..	1580.4	1379.7	1504.9	1064.8	1104.4	1601.3	1931.2	3214.7	3613.3	2279.1	2293.4	1829.2	23395.0	1949.4
Average ... ..	131.7	115.0	125.4	88.7	92.0	133.4	161.0	268.0	301.0	190.0	192.8	152.5	1949.0	162.0
Weighted Average (vide page 290).	121.2	101.2	112.9	73.2	79.2	134.3	228.6	428.8	394.3	230.0	206.3	154.0	—	—

After making due allowance for "chance differences" between the monthly averages, as Mr. Bowley has determined them for me, (*see* p. 313), we find that the *Haddock-curve* shows us a very distinct period,

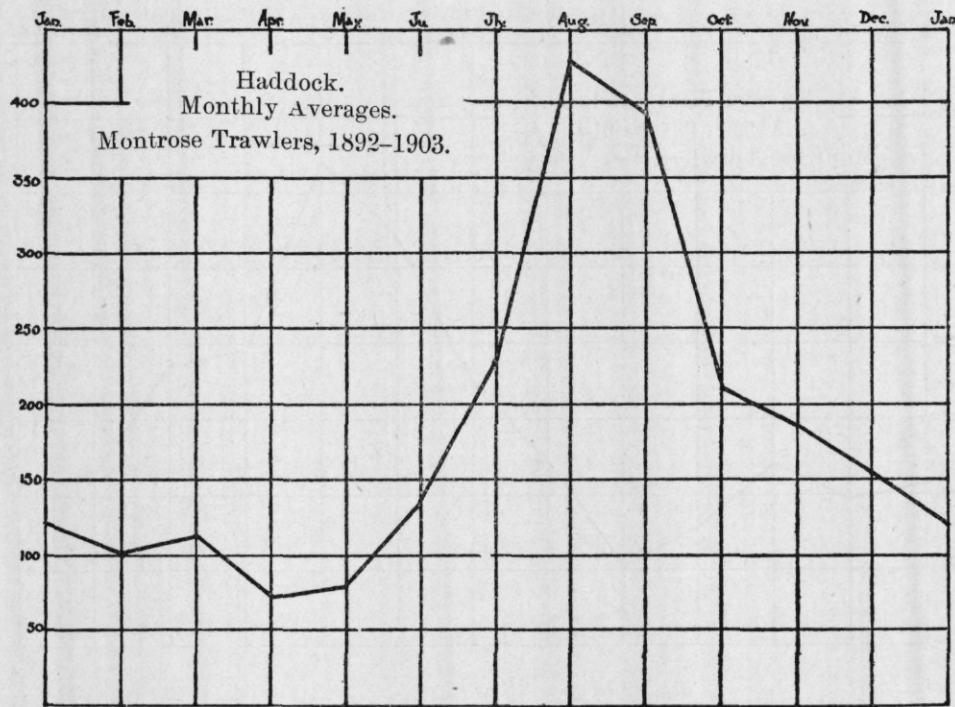


FIG. 3.

with a single maximum in August-September and a minimum in April-May. There is a sharp fall from September to October: October and November are equal; there is then a slight fall to January, but January, February and March are approximately equal; the whole fall from November to April is significant. April and May are equal; and there is thereafter a distinct rise, month by month till August.

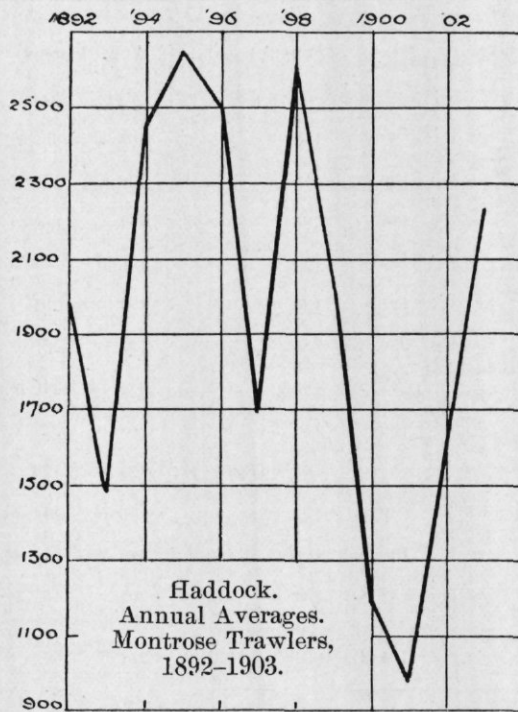


FIG. 4.

The apparent evidence for a cusp in Spring, which we discussed in the Report on the Granton Statistics, is not borne out after careful analysis of the figures. The *only* difference between the Granton

and Montrose Haddock-curves is that in the former the catches for July are more nearly equal to those for August than at Montrose. The curve shewn in Fig. 3 is based on the simple method of weighting that I at first adopted (cf. p. 290), but it does not differ significantly from the curve that Mr. Bowley's adjustment of the figures will be found to yield.

If we next examine the complete Table of monthly catches for the Montrose Haddocks, comparing it at the same time with the Granton one, we find them to be on the whole similar, but to show a few more or less striking differences. The chief of these differences are exhibited by the years 1894, 1895 and 1898. In 1894, the Montrose trawlers had a great catch of Haddock in September, scarcely reflected in the Granton records. In 1895, the unusually high figures which lasted in the case of the Granton boats from June to October, are only found during August and September for Montrose. In 1898, the Montrose boats had large catches from August to the end of the year, while the Granton boats had nothing of the kind.

As for the Total Annual Catches (Fig. 4), the fluctuations have been very large: the worst year of the twelve, 1901, shewing a yield only equal to 44 per cent. of that for 1903 and to 37 per cent. of that for 1895. No general trend towards increase or diminution is perceptible amid the fluctuations of the series of years. If we compare the annual catches with those for Granton, as set forth in the preceding Report, we see that 1894 and 1896 share in a greater degree for the Montrose boats than for the Granton ones in the abundance that characterised and culminated in 1895; that 1898, owing to the great autumn catches just alluded to, figures in the Montrose curve as a sharp cusp which the Granton curve does not show; and that the improvement during the last two years, since the lean year of 1901, has been more rapid for Montrose than for Granton. But, taking one month with another, and one year with another, the two fleets will be found to have enjoyed a very equal measure of success. The total landings of Haddock per vessel in the course of the twelve years 1892-1903 have been 22,386 cwts. per vessel for Granton, and 23,355 cwts. for Montrose, a difference of only about 4 per cent. By far the greatest discrepancy for any one year is that shewn in 1898, when the Granton boats had on an average 1,566 cwts., and the Montrose boats 2,617 cwts. If we deduct in each case the catches for this anomalous year, we find that for the other eleven years each Granton boat had 20,820 cwts., and each Montrose boat 20,738 cwts., an extraordinarily close agreement, shewing a difference of less than one-half per cent.

TOTAL LANDINGS OF HADDOCK PER VESSEL.—GRANTON, MONTROSE. 1892-1903.

								Granton.	Montrose.
1892	...	...	...	...	...	...	2,149	1,980	
1893	...	...	...	...	...	...	1,803	1,507	
1894	...	...	...	...	...	...	1,878	2,451	
1895	...	...	...	...	...	...	3,259	2,648	
1896	...	...	...	...	...	...	2,373	2,502	
1897	...	...	...	...	...	...	1,608	1,696	
1898	...	...	...	...	...	...	1,566*	2,617*	
1899	...	...	...	...	...	...	1,371	2,021	
1900	...	...	...	...	...	...	1,535	1,135	
1901	...	...	...	...	...	...	1,292	981	
1902	...	...	...	...	...	...	1,623	1,588	
1903	...	...	...	...	...	...	1,869	2,229	
Total ...								22,386	23,355
Average per annum								1865.5	1996.2
Total (omitting 1898)								20,820	20,738
Average per annum (omitting 1898)								1892.7	1885.3

In regard to *Whiting*, two curves are reproduced here, the one (Fig. 5) shewing the monthly averages as drawn from the whole period of twelve years, while from the other (Fig. 6) the returns for the year 1903 have been omitted. It will be seen at once from the Table that the year 1903 was exceptional in character; the total catch for the year was very large, and there was a catch in July of quite exceptional amount for that month. In neither of these two curves can any periodicity be clearly traced; and this absence of periodicity is in marked contrast to the obviously periodic character of every other monthly curve (with the exception of that for Skate) that is considered in this or the preceding Report. The most that can be said is that there is an indication of a somewhat increased yield from January to April, an indication that is so far confirmed by the better evidence for a maximum occurring about that season according to the Granton statistics. In the case of *Whiting*, as of other of the less valuable fishes, we can never be sure that the entire catch was brought to market; and there can be little or no doubt that our Montrose statistics for *Whiting* are on this account very imperfect, especially in the earlier years.

As for the course of the annual averages, from year to year, there is a distinct and persistent rise almost from the very beginning of our period to the present time. But this apparently steady increase only tends to support the belief that the catch of *Whiting* was more or less neglected during the earlier years; and though there is some other evidence at hand to tell us that *Whiting* have been more plentiful than usual in very recent years we dare not draw upon the Montrose statistics for proof of the fact.

The catches of the Montrose boats are, especially in the earlier years, very much below those of the Granton ones.

MONTROSE TRAWLERS.—AVERAGE TAKE OF WHITING (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	8.0	1.6	2.6	4.0	3.3	—	2.6	—	4.0	3.3	—	—	29.4	2.5
1893 ... ..	1.3	—	7.0	12.0	9.3	2.0	1.0	4.0	2.3	0.6	2.0	1.3	42.8	3.6
1894 ... ..	—	—	3.0	2.3	1.3	0.6	—	—	—	3.3	3.3	—	13.8	1.2
1895 ... ..	1.0	7.0	—	5.6	—	—	7.6	—	—	3.3	5.3	—	29.8	2.5
1896 ... ..	—	1.3	6.6	4.0	5.3	2.6	—	6.6	3.3	4.0	4.0	4.0	41.7	3.5
1897 ... ..	4.0	19.3	5.0	2.6	0.6	0.6	3.3	3.6	9.3	9.3	4.6	10.0	72.2	6.0
1898 ... ..	11.3	3.0	9.0	4.6	1.6	6.3	11.3	6.6	28.3	8.6	14.0	12.6	117.2	9.5
1899 ... ..	3.3	3.0	7.6	6.6	8.3	4.6	7.6	6.0	12.3	14.6	6.6	4.6	85.1	7.1
1900 ... ..	7.6	5.3	6.3	6.3	5.3	3.0	10.6	6.3	7.3	2.0	2.0	2.3	64.3	5.4
1901 ... ..	3.3	6.3	21.0	33.5	12.0	9.0	2.5	11.0	4.5	25.0	15.0	3.0	146.1	12.2
1902 ... ..	21.0	40.5	19.5	16.5	13.5	7.5	15.0	15.0	3.0	10.5	3.0	9.0	174.0	14.5
1903 ... ..	25.0	43.0	17.0	27.0	7.0	28.0	43.5	7.0	10.5	12.5	24.5	26.0	271.0	22.6
Average (of 12 years). }	7.2	10.9	8.7	10.4	5.6	5.4	8.8	5.5	7.1	7.8	7.0	6.1	90.6	7.5
Average (of 11 years, omitting 1903). }	5.5	8.0	8.0	9.0	5.5	3.3	5.6	5.2	6.8	7.4	5.5	4.3	74.1	6.2

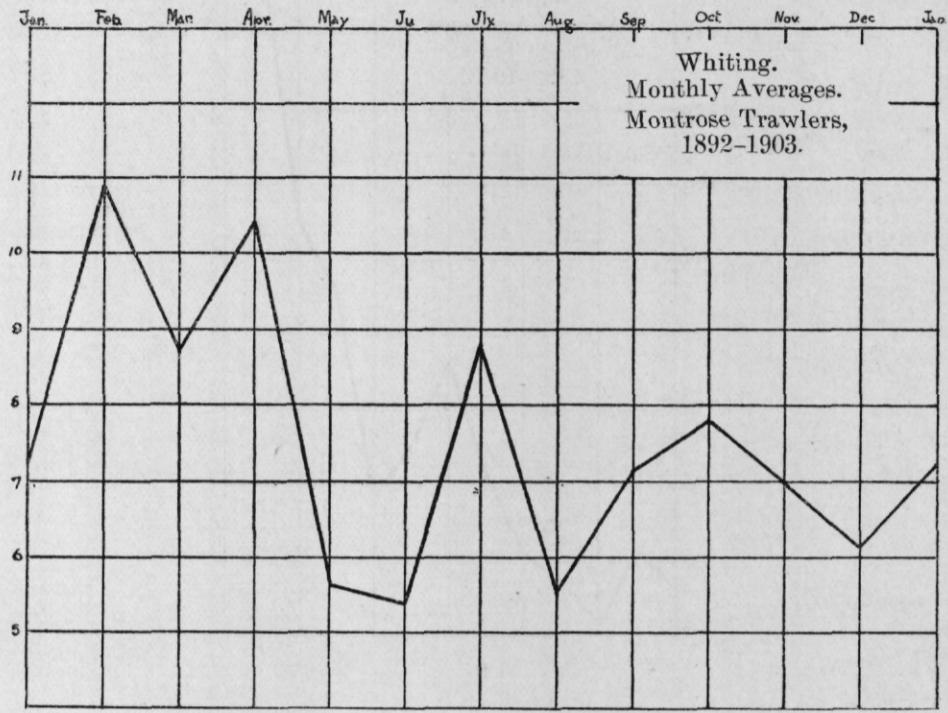


FIG. 5.

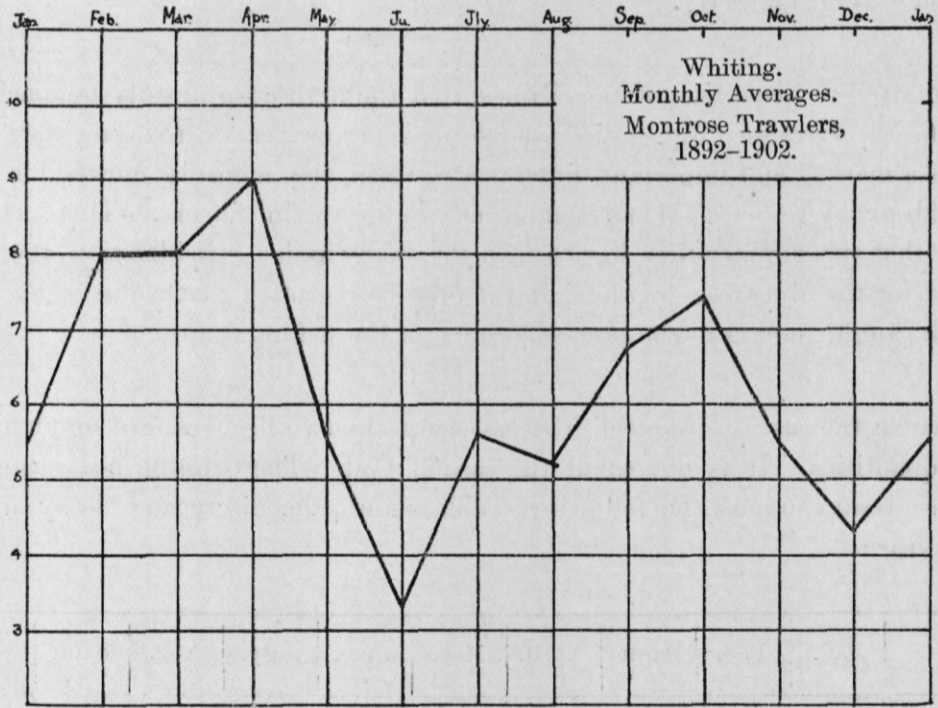


FIG. 6.

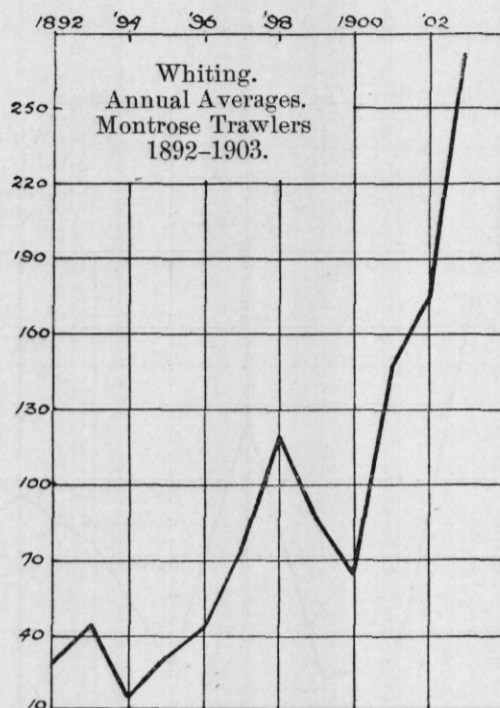


FIG. 7.

The mean monthly curve for *Cod* shows a distinct maximum in July; little if any fall to August; then a distinct fall in rather irregular steps to an inconspicuous minimum in May. From May to June and from June to July the rise is large and significant. There is an appearance of a small maximum in March, but it is not of significant amount, and is doubtless in the main due to the normal deficiency during the short month of February.

It will be found, from inspection of the Tables, that the high cusp in July becomes much higher still when we "weight" the averages (Fig. 8) in order to make allowance for the irregularities of the summer fishing. There is a marked and important difference between the monthly curves for *Cod* according to the Granton and Montrose returns. The Granton maximum was in Spring. There can, I think, be no doubt whatsoever that the summer-time has been in the years under consideration the period of greatest abundance of *Cod* for the Montrose trawlers, and it is to be regretted that we have no information as to the size of the fish caught, nor as to the precise locality of the fishing.

We found that in the case of Haddock, the vessels of the two fleets caught on an average, in the long run, about equal quantities. It is not so in the case of *Cod*. The Granton boats catch a vast deal more than the Montrose boats, and, as the following Table shows, the discrepancy is by much the greatest in the spring of the year:—

—			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Montrose	...	...	63	60	70	64	53	69	88	67	59	64	68	69
Granton	...	...	95	103	154	215	106	109	116	83	74	61	73	80

Or, expressing the Montrose catch in terms of percentage of the Granton catch, we get the following Table:—

—			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Montrose	...	...	66	58	45	30	50	63	76	81	80	105	93	86
Granton	...	...	100	100	100	100	100	100	100	100	100	100	100	100

There is so great a measure of regularity, in this discrepancy, so steady an increase in the proportion of the Montrose catch to that of Granton from its lowest point in April to its highest in October, that we can have no doubt that the phenomenon is a real one, and indicative of a distinct difference in the seasonal distribution of Cod on the grounds frequented by the two fleets.

The following Table shows the great and constant difference, in favour of Granton, between the annual average catches between the vessels of the two fleets.

COD.

—					Granton.	Montrose.
1892	...	...	...	...	1,026	338
1893	...	...	...	...	1,138	762
1894	...	...	...	...	1,333	743
1895	...	...	..	...	1,782	745
1896	...	...	...	...	1,685	619
1897	...	..	...	...	1,182	610
1898	...	...	...	...	1,491	846
1899	...	...	...	...	1,118	1,336
1900	...	...	...	...	822	626
1901	...	...	...	...	981	758
1902	...	...	...	...	1,825	958
1903	...	...	...	...	1,679	1,025
Total	...	...	...	...	16,062	9,366
Average	...	...	...	...	1,338	780

MONTROSE TRAWLERS.—AVERAGE TAKE OF COD AND CODLING (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	35.0	34.3	43.3	30.0	15.0	27.3	18.0	22.0	16.6	7.0	8.3	80.6	337.0	28.1
1893 ... ..	61.6	59.6	77.3	37.3	24.3	73.0	113.6	85.3	48.6	39.6	68.0	73.3	762.0	63.5
1894 ... ..	44.3	80.6	79.3	52.3	55.0	53.3	81.3	33.6	46.3	77.0	83.3	59.0	745.0	62.1
1895 ... ..	49.3	62.3	151.3	80.3	51.0	50.0	54.6	63.6	54.3	46.0	42.6	35.6	741.0	62.7
1896 ... ..	111.3	117.3	90.3	16.6	50.3	45.6	60.3	10.6	10.0	30.6	47.3	28.6	619.0	51.6
1897 ... ..	46.0	30.3	53.0	58.6	29.0	55.3	73.3	22.6	48.3	75.0	52.6	66.0	610.0	50.8
1898 ... ..	86.0	46.0	39.3	24.6	29.6	47.0	89.0	115.0	117.3	59.6	94.3	97.6	845.0	70.4
1899 ... ..	137.0	99.3	97.0	67.3	145.0	171.6	142.0	110.3	130.0	111.0	83.6	51.6	1346.0	112.2
1900 ... ..	37.6	20.0	31.0	80.3	63.3	55.3	76.0	62.6	56.6	48.0	58.3	36.6	626.0	52.2
1901 ... ..	38.3	35.6	45.0	163.5	45.0	63.5	56.5	62.5	49.5	79.0	86.5	33.0	758.0	63.2
1902 ... ..	37.0	61.0	91.5	62.0	75.0	68.5	132.5	117.5	79.0	118.0	56.0	60.5	959.0	79.9
1903 ... ..	52.5	73.5	43.5	91.5	56.5	110.5	161.5	96.5	46.5	74.0	135.0	83.5	1025.0	85.4
Total ... ..	735.9	719.8	841.8	764.3	639.0	820.9	1058.6	802.1	703.0	764.8	815.8	705.9	9373.0	782.1
Average ... ..	61.3	60.0	70.2	63.7	53.3	68.4	88.2	66.8	58.6	63.7	68.0	58.8	783.0	65.2
Weighted Average (vide page 282).	56.0	53.0	63.0	53.0	46.0	73.0	125.0	107.0	77.0	77.0	73.0	59.0	—	—

The curve of annual total catches of Cod for Montrose (Fig. 9) is also very different from the Granton one. Rising in both cases from a low minimum in 1892, the three years 1893-4-5 were nearly equally good at

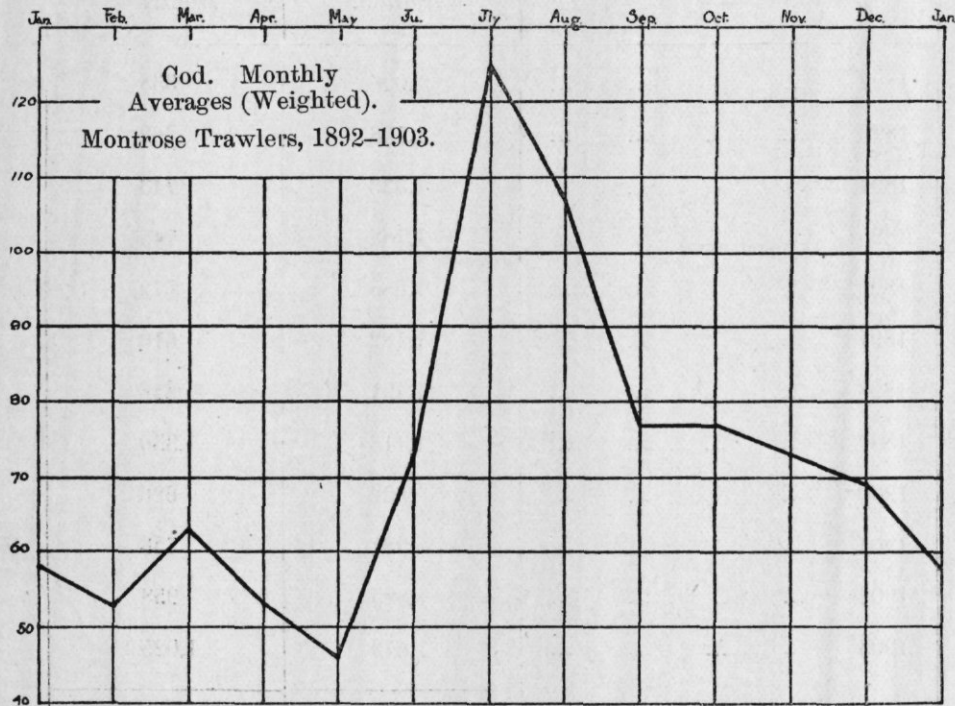


FIG. 8.

Montrose, and better than the two succeeding ones; but for the Granton fleet, 1894-5-6 were considerably better than the years immediately before and after. 1900 was a bad year in both cases, and in both cases

there has been a marked improvement since ; but for Montrose 1899 was the best year of all the period, while it fell below the average for the Granton vessels. It is furthermore remarkable that during that year of 1899, catches much over the average were obtained by the Montrose vessels during nearly every month of the year, the exceptions being April and December ; while the catches of the Granton boats were below average during at least half the year.

During the twelve years there are certainly no signs of gradual decrease in the Montrose catches of Cod ; rather, if anything, would there seem to be some slight indications of a tendency to increase ; but the period is not long enough to entitle us to speak more positively.

The Montrose curve for *Plaice* (with which are as usual included Flounder and Brill, though the quantities of these are without doubt unimportant) shows us as its most conspicuous feature a distinct maximum in October, followed by a marked fall in November and again a fall to a minimum in January-December. The curve (Fig. 10) drawn from the unweighted figures is then somewhat irregular from

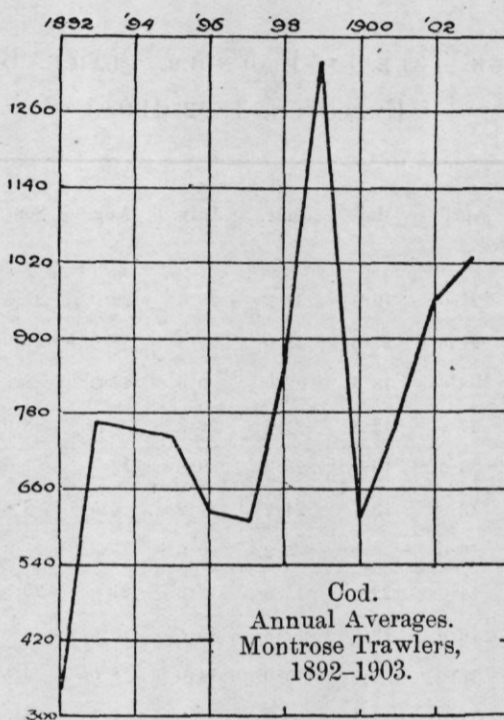


FIG. 9.

February to September, but the fluctuations are not significant in amount. If we turn to the Table (p. 313) which shows the same figures as adjusted by Mr. Bowley's method, we have some apparent indication of an increase during February and March, but it cannot be said to be significant and we have no real evidence of any maximum until the autumn one. This autumn maximum is the same that we have to do with in the Granton curve, but in the latter it begins earlier and continues longer. Otherwise the two curves are much the same.

If we examine the statistics for the whole period we see that the great October increase is largely, but by no means wholly, due to very large catches made at that season in 1892, 1895 and 1896, in the last of which years September was almost equally productive. A similar abundance characterises the month of November, 1897, and one of less degree November, 1898. We find corresponding cusps upon the Granton

curve for October, 1892, and October, 1897, but they are of no great magnitude; while, on the other hand, the great Granton catches of August, 1899, and October, 1902, are reflected, the former little, and the latter not at all, in the curves for Montrose. The inference is, accordingly, that the conditions of abundance which have led to these exceptional catches have been confined to comparatively narrow tracts or areas. I do not say that they are purely local phenomena, mere accumulations of fish from the immediate neighbourhood into crowded spots. The general evidence of the combined Granton and Montrose statistics rather is that an important migration of Plaice to this region does take place about October, though of such a kind that the migrating shoal is only now and then met with.

As will be presently mentioned, we have reason to believe that in 1892 the Montrose trawlers were fishing largely in the Moray Firth, and it is accordingly worth while to exclude the statistics of that year and to draw a curve of the monthly frequency of Plaice again for the remaining 11 years. As a matter of fact, however, the curve that we thus obtain does not differ materially, scarcely even perceptibly, from the curve shewn and discussed above.

MONTROSE TRAWLERS.—AVERAGE TAKE OF FLOUNDER, PLAICE, BRILL (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	12.3	66.6	58.3	26.0	19.3	32.3	28.6	22.0	27.3	83.3	25.3	24.6	425.9	35.5
1893 ... ..	18.0	20.6	38.6	27.6	27.3	28.0	21.3	8.6	27.0	30.6	20.3	17.3	285.2	23.8
1894 ... ..	11.6	7.0	17.3	8.6	13.0	22.0	9.6	27.0	8.0	26.6	12.3	17.6	180.6	15.1
1895 ... ..	12.0	11.6	9.6	27.0	12.3	21.6	22.3	8.0	8.0	88.3	8.6	4.0	233.3	17.4
1896 ... ..	17.0	20.0	5.0	33.3	19.3	23.3	29.0	12.3	71.3	90.3	23.3	21.6	365.7	30.5
1897 ... ..	5.0	7.6	10.6	13.3	13.7	24.2	21.2	6.5	8.6	26.4	84.6	12.6	234.3	19.6
1898 ... ..	9.3	7.6	5.6	6.0	8.0	5.2	9.0	15.3	21.3	31.6	42.8	23.0	184.7	15.4
1899 ... ..	14.0	18.6	34.0	14.0	22.6	15.0	12.3	21.0	20.3	21.3	16.6	7.0	216.7	18.1
1900 ... ..	7.6	3.3	5.0	16.0	19.0	12.3	15.6	13.6	9.0	10.6	12.3	9.3	134.0	11.2
1901 ... ..	8.6	17.5	10.0	16.0	9.5	15.0	14.0	8.0	5.5	8.0	6.5	3.0	122.0	10.2
1902 ... ..	6.0	17.5	26.0	11.0	14.5	9.0	12.0	7.5	3.5	4.5	4.0	4.5	120.0	10.0
1903 ... ..	6.5	11.0	7.5	8.5	9.0	16.0	15.0	11.5	14.0	6.5	12.0	6.0	123.0	10.2
Total... ..	127.9	208.9	227.5	207.3	187.5	223.9	209.9	161.3	223.8	428.0	268.6	150.5	2627.4	219.4
Average (of 12 years).	10.66	17.25	19.1	17.3	15.6	18.75	17.5	13.44	18.65	34.8	22.4	12.5	219.0	18.2
Average (of 11 years, omitting 1892).	10.5	12.9	15.4	16.5	15.3	16.6	16.5	12.7	17.8	30.4	22.1	11.4	199.8	16.5

The curve of annual totals for Plaice (Fig. 12) begins at a higher level in 1892 than it ever reaches again. During all but the last month of that year, the outer portion of the Moray Firth area, including Smith Bank, was open to trawling, the Byelaw by which the complete closure was enforced having been confirmed on the 22nd November, 1892. The Moray Firth was an important, if not the chief, fishing-ground of the Montrose trawlers in former days, and without doubt the high catches of Plaice shewn in the records for February, March and October of 1892 were obtained there.

In the later years, two cusps appear in the Montrose curve, corresponding to the years 1896 and 1899. The same cusps are visible also in the Granton curve ; but in the latter case the cusp for 1899 is

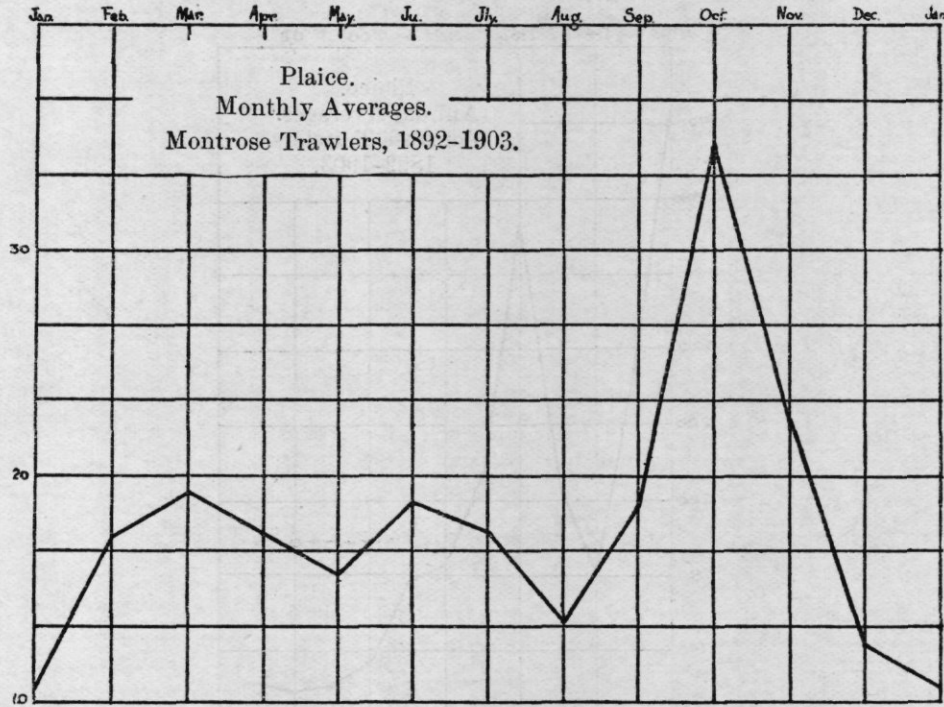


FIG. 10.

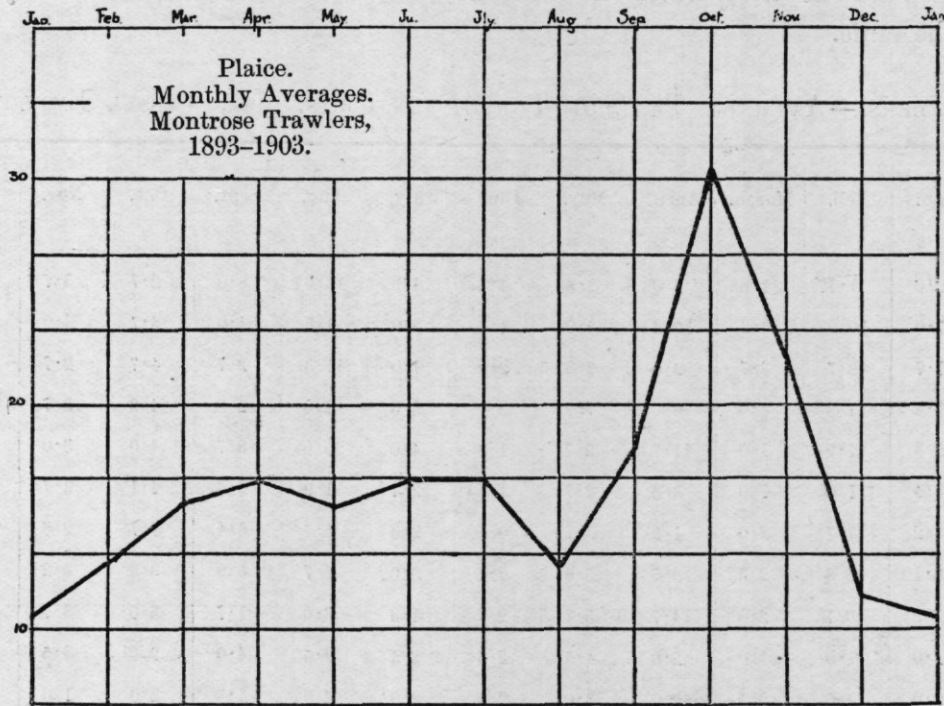


FIG. 11.

by much the higher of the two, while the reverse happens in the curve for Montrose. For the last four years, from 1900 to 1903, the Montrose catches of Plaiice have been very uniform, and very low.

Save only for the good fishing in 1896, we may say that the Montrose catch of Plaice has been perceptibly falling off, and at a fairly steady rate, during the twelve years that we have been investigating.

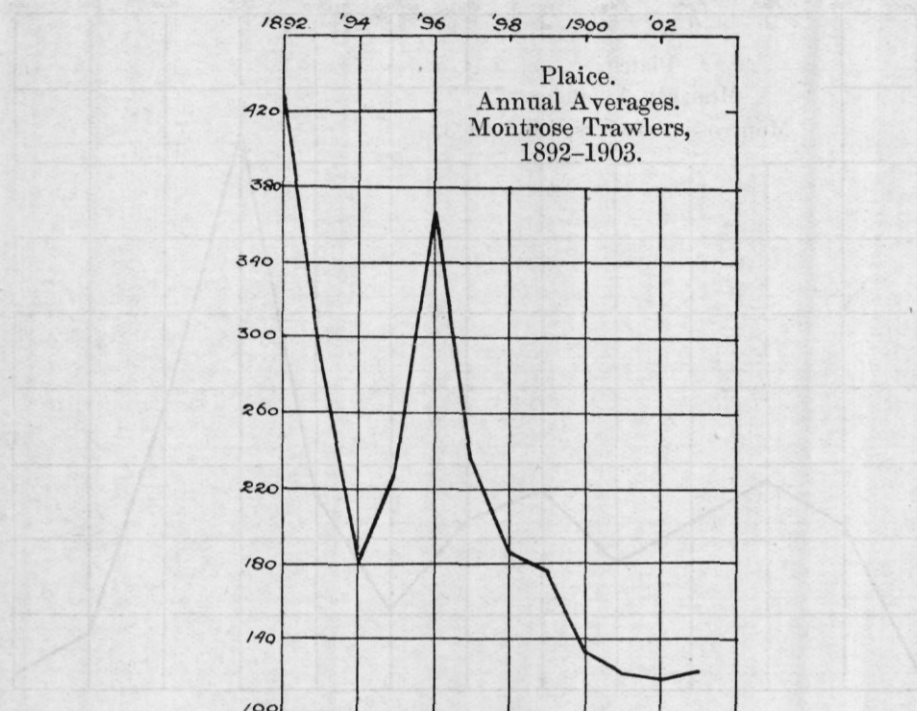


FIG. 12.

As has been already stated, the statistics for *Turbot* and *Lemon Sole*, which were thrown together in the Granton records, are shewn separately in those from Montrose. The mean monthly variations for the two fish are not the same.

MONTROSE TRAWLERS.—AVERAGE TAKE OF TURBOT (IN CWTs.) PER VESSEL EMPLOYED, 1892-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	2.0	1.17	1.83	5.0	2.83	4.3	4.3	16.0	8.0	2.7	3.7	6.3	58.1	4.8
1893 ... ..	7.0	10.0	5.3	10.3	5.0	4.3	5.0	4.3	4.0	3.7	3.0	3.7	65.6	5.5
1894 ... ..	1.7	2.7	3.7	2.0	2.3	2.0	1.0	11.3	2.7	4.7	2.7	2.0	38.8	3.2
1895 ... ..	1.7	1.3	1.0	6.7	7.7	3.0	5.3	2.0	2.3	4.3	2.7	1.3	39.3	3.3
1896 ... ..	2.3	7.7	1.0	11.7	2.7	1.3	4.0	20.0	3.7	4.0	3.0	2.7	64.1	5.3
1897 ... ..	1.4	1.0	1.0	3.3	2.7	1.8	2.4	1.9	2.6	4.1	3.7	2.3	28.2	2.3
1898 ... ..	3.2	1.7	2.0	1.2	3.7	0.7	2.3	5.7	6.4	1.7	2.8	5.5	36.9	3.1
1899 ... ..	6.1	3.3	2.3	3.5	5.6	2.1	3.0	4.7	5.9	3.3	3.2	2.0	45.0	3.7
1900 ... ..	1.0	0.7	2.0	4.7	5.7	2.7	1.3	3.0	1.7	3.0	3.7	2.7	32.2	2.7
1901 ... ..	2.0	1.0	1.0	2.0	4.5	2.5	2.5	2.5	4.0	2.0	3.5	1.5	29.0	2.4
1902 ... ..	2.0	1.5	2.5	2.0	3.0	2.5	2.0	2.0	1.5	2.0	1.0	2.0	24.0	2.0
1903 ... ..	0.5	1.5	0.5	2.5	3.5	1.5	3.0	3.0	1.0	3.0	5.5	2.5	28.0	2.3
Total... ..	30.9	33.6	24.1	54.9	49.2	28.7	36.1	76.4	43.8	38.5	38.5	34.5	489.2	40.6
Average ...	2.6	2.8	2.0	4.6	4.1	2.4	3.0	6.4	3.6	3.2	3.2	2.9	40.75	3.4

For *Turbot* (Fig. 13), we have a distinct maximum in August, followed by a sharp fall to September and then by a slower but cumulative fall to a minimum in March; there is a distinct rise in April-May and

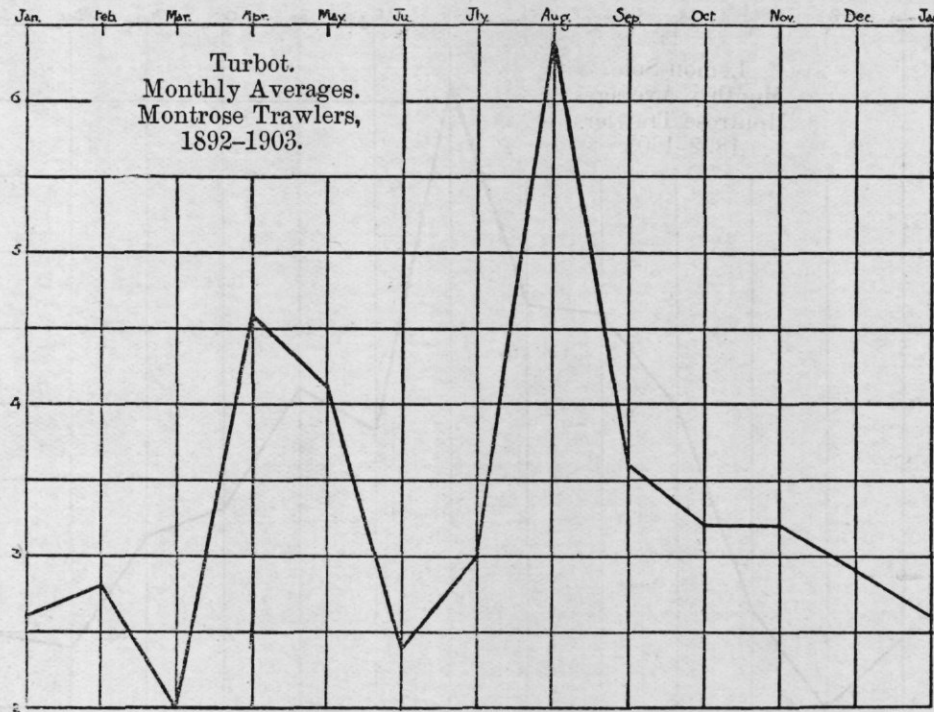


FIG. 13.

then a fall in June; there is probably a slight rise from June to July, and then a sharp rise to August. Thus in the case of *Turbot* we have good evidence of the existence of a *double annual maximum*.

In the case of *Lemon Sole* (Fig. 14), we have a distinct maximum in July. August and September are approximately equal; so, at a lower level, are October–November; and so again, still lower, are the months from December to March. There is a steady rise from March to July. The curves for *Lemon Sole* and *Turbot*, with their respective cusps in July and August, are consistent with the Granton curve in which the data for these two fishes were combined.

MONTROSE TRAWLERS.—AVERAGE TAKE OF LEMON SOLE (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	9.7	9.7	11.0	34.0	22.0	27.7	24.7	13.7	21.7	15.0	25.3	23.0	237.5	19.8
1893 ... ..	15.7	10.7	14.7	28.0	20.7	29.0	21.7	8.3	25.0	20.0	16.7	14.3	224.8	18.7
1894 ... ..	17.7	14.3	29.3	22.3	31.7	18.0	19.7	14.0	21.0	21.3	11.7	16.0	237.0	19.7
1895 ... ..	8.3	10.7	15.3	15.7	12.7	12.7	25.0	21.3	15.0	12.7	8.3	3.7	161.4	13.5
1896 ... ..	17.3	9.3	11.0	10.0	13.3	14.7	31.0	12.0	13.7	7.3	15.7	10.0	165.3	13.7
1897 ... ..	4.8	6.8	6.3	12.8	14.3	31.7	34.3	10.0	25.3	24.2	14.1	8.0	192.6	16.0
1898 ... ..	13.5	5.7	7.3	8.7	11.5	7.1	15.3	15.3	14.7	3.7	5.0	5.3	113.1	9.4
1899 ... ..	9.8	9.2	8.7	9.7	15.7	17.2	17.0	11.7	8.3	17.0	12.6	6.3	143.2	11.9
1900 ... ..	6.3	2.7	8.0	22.0	27.3	19.3	25.0	21.7	14.0	7.3	11.7	10.3	175.6	14.6
1901 ... ..	9.0	9.7	2.3	6.0	15.0	17.0	27.0	17.5	17.5	11.0	10.0	3.0	145.0	12.1
1902 ... ..	5.0	6.0	7.0	10.0	22.5	10.5	26.5	17.0	12.5	11.0	3.5	4.5	136.0	11.3
1903 ... ..	2.5	6.5	6.0	11.5	13.5	18.5	26.0	20.5	7.5	9.0	15.5	11.0	148.0	12.3
Total... ..	119.6	101.3	126.9	190.7	220.2	223.4	293.2	183.0	196.2	159.5	150.1	115.4	2079.5	173.0
Average ...	9.9	8.4	10.6	15.9	18.4	18.6	24.4	15.3	16.4	13.3	12.5	9.6	173.3	14.4

In the case of both fish the annual catch has fluctuated considerably, and in both cases the last three years at least have been below the average.

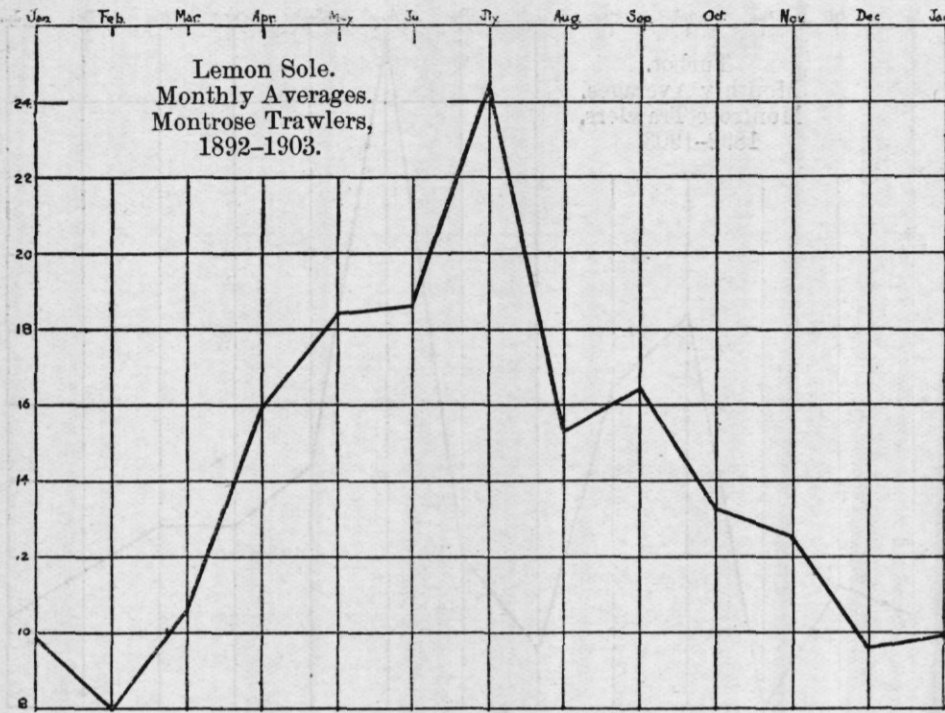


FIG. 14.

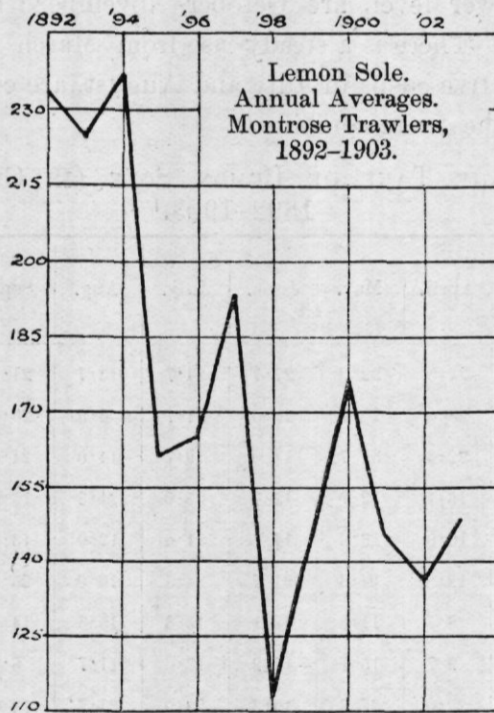


FIG. 15.

The curve for *Ling* (Fig. 16) shows a maximum in June and a second maximum in September, the intermediate falling-off during July and August being clearly marked. There is a sharp fall from September to

October, and then a cumulative fall to a minimum in December; then again a cumulative rise to March, a period of little or no change from March to May, and finally a rise to the June maximum.

Of the series of years, 1894 was the best for Ling; 1899 was again good, but the last four years have been below the average.

MONTROSE TRAWLERS.—AVERAGE TAKE OF LING (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	1.3	3.0	2.6	8.3	1.0	2.6	1.0	1.3	1.3	1.0	2.3	3.0	29.0	2.4
1893 ... ..	1.0	1.3	2.3	2.0	2.6	2.3	1.6	2.0	6.0	1.6	2.6	2.0	27.7	2.3
1894 ... ..	0.6	1.3	3.6	2.6	5.0	8.3	1.6	2.0	2.0	2.0	1.0	1.3	31.7	2.8
1895 ... ..	3.3	1.6	3.6	1.3	1.3	2.3	1.3	0.6	4.3	2.3	1.3	0.6	24.3	2.0
1896 ... ..	2.0	2.0	2.0	1.3	2.3	1.6	1.0	2.0	1.6	0.6	1.3	2.0	20.0	1.7
1897 ... ..	2.6	1.6	2.3	2.0	1.6	1.6	1.6	1.0	2.0	2.0	1.3	0.6	20.7	1.7
1898 ... ..	1.3	1.3	2.3	2.0	1.6	0.6	2.6	0.6	2.6	0.6	1.3	1.3	18.7	1.6
1899 ... ..	2.0	2.6	3.0	3.0	2.6	3.3	2.6	1.6	1.3	2.3	1.3	0.6	26.7	2.2
1900 ... ..	1.3	0.6	1.3	1.6	2.3	1.3	3.0	2.0	1.3	1.6	1.0	2.0	19.7	1.6
1901 ... ..	1.0	1.0	0.6	1.5	2.0	2.5	2.0	1.5	1.5	2.0	2.0	—	17.7	1.5
1902 ... ..	1.5	1.5	1.0	1.5	1.0	1.5	1.0	1.0	1.5	2.5	0.5	0.5	15.0	1.25
1903 ... ..	1.5	1.5	0.5	0.5	1.0	5.0	1.5	2.5	2.0	1.5	1.0	0.5	17.0	1.4
Total ... ..	19.4	19.3	25.1	27.6	24.3	32.9	20.8	18.1	27.4	20.0	16.9	14.4	268.2	22.4
Average ... ..	1.6	1.6	2.1	2.3	2.0	2.7	1.7	1.5	2.3	1.7	1.4	1.2	22.35	1.9

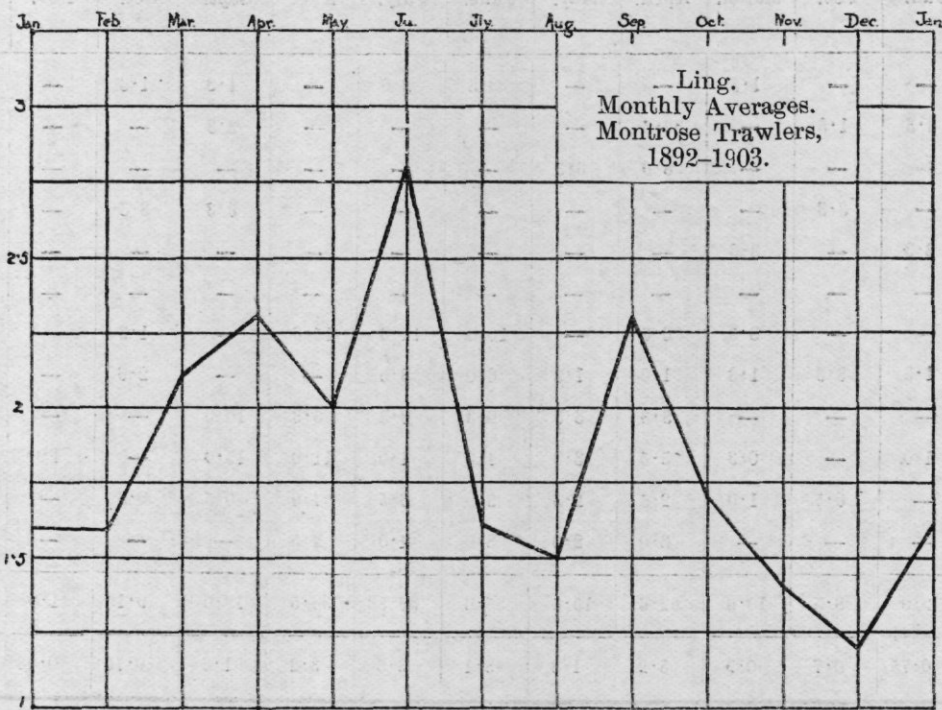
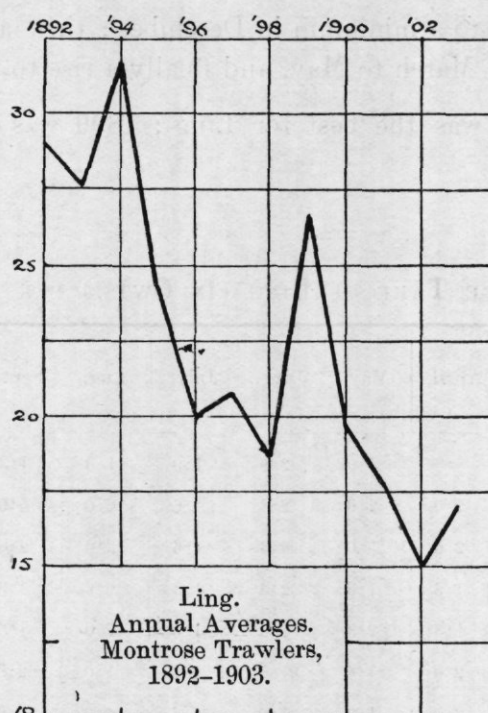


FIG. 16.



In the case of *Saithe*, large blanks occur in the Montrose statistics, the catch being for many months of the period in question non-existent or insignificantly small.

MONTROSE TRAWLERS.—AVERAGE TAKE OF SAITHE (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

—			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892	...	...	—	—	1.3	—	—	3.3	2.0	—	1.3	1.3	—	—	9.3	0.8
1893	...	...	3.3	1.3	—	32.6	—	—	—	—	3.3	—	—	—	40.7	3.4
1894	...	...	—	—	—	8.0	3.3	—	—	—	—	—	—	1.6	13.0	1.1
1895	...	...	—	3.3	—	—	—	—	—	—	3.3	3.3	—	3.3	13.3	1.1
1896	...	...	3.3	—	3.3	—	—	—	—	—	—	—	—	—	6.7	0.6
1897	...	...	—	—	—	—	—	—	—	—	—	—	—	1.3	1.3	0.1
1898	...	...	—	—	3.3	6.6	—	10.0	11.6	15.6	—	1.3	—	1.0	49.7	4.1
1899	...	...	1.3	3.3	1.3	1.0	1.3	6.0	3.3	—	—	2.6	—	—	20.3	1.7
1900	...	...	—	—	—	3.3	3.3	6.3	8.3	5.3	10.0	—	—	—	36.7	3.1
1901	...	...	1.0	—	0.3	5.5	3.0	4.0	4.0	11.0	15.0	—	1.0	0.5	30.8	2.6
1902	...	...	—	0.5	1.0	2.5	2.5	3.0	6.5	4.0	0.5	0.5	—	0.5	21.5	1.8
1903	...	...	—	—	—	3.0	2.0	3.0	4.0	2.5	—	—	—	—	14.5	1.2
Total...	...	...	9.0	8.5	10.6	62.6	15.5	35.6	39.83	38.5	19.0	9.16	1.0	8.3	257.8	21.6
Average	...	...	0.75	0.7	0.9	5.2	1.3	3.1	3.3	3.2	1.6	0.76	0.08	0.7	21.5	1.8

FIG. 17.

The absolute minimum of the year appears to be in November (Fig. 18), when the total catch for all the years is set down as a single hundredweight or to all intents and purposes nil. The period of comparative abundance is from April to August, with perhaps an intervening decrease in May. The cusp for April is greatly swollen by an exceptional catch in 1893, but even eliminating this, the cusp still remains.

The total catch for the year 1893 becomes, through this great April take, a considerable one; but apart from this, the whole of the first six years of our series show catches greatly inferior to the last six

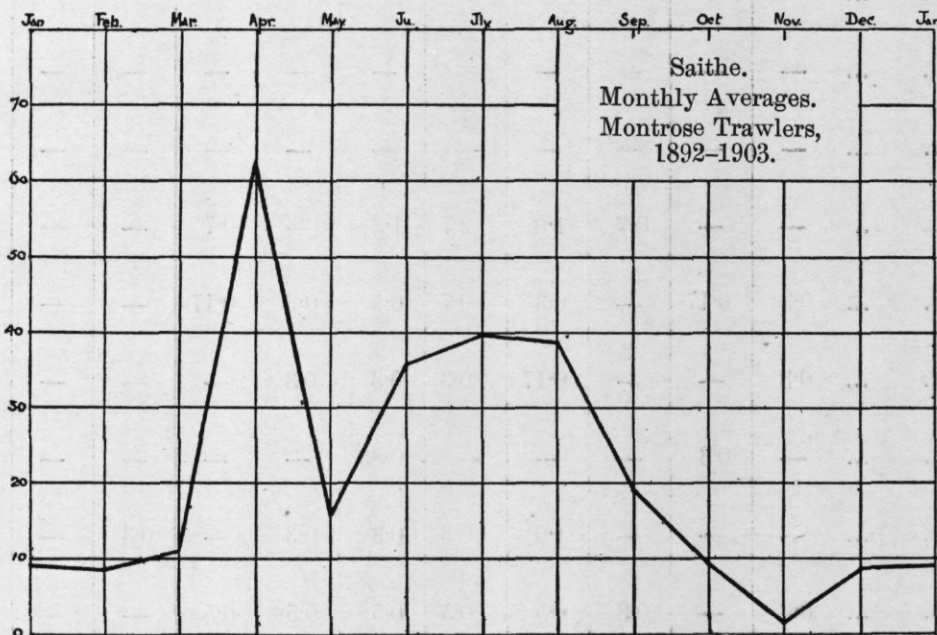


FIG. 18.

NOTE.—The quantities as represented in this curve are those for the whole twelve years, instead of as usual for a single average year.

(Fig. 19). Of these last six, 1903 was by a good deal the poorest. The total average catch per vessel for the first six years was 84.3 cwts., and of the last six 173.5 cwts., 14 cwts. and 29 cwts. per annum respectively.

The annexed Table for *Halibut* shews, as we should expect, large blanks representing many months during which no *Halibut*, or only an insignificant quantity, were obtained. The month of May, or, more generally, the late spring and early summer, seems to be the period of maximum abundance of *Halibut* on this coast. The catch in May, 1892, when very probably the fishing was further to the northward than in later years, was especially large; but even when we deduct the results for that year, the May maximum is prominent. 1896 was the best year of the series, next after 1892. In no single year were any *Halibut* recorded for the month of October, and from September to February the catch was never more than a

very trifling one. Our East Coast may be considered to be outside the normal range and habitat of the fish.

MONTROSE TRAWLERS.—AVERAGE TAKE OF HALIBUT (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1892 ... ..	—	—	0·3	0·3	11·7	—	0·3	—	—	—	—	—	12·0
1893 ... ..	—	—	—	—	—	—	—	—	—	—	—	—	—
1894 ... ..	—	—	—	—	—	—	—	—	—	—	—	—	—
1895 ... ..	—	—	—	—	—	—	—	—	—	—	—	—	—
1896 ... ..	—	—	0·7	1·0	2·7	1·3	—	0·7	—	—	—	—	6·3
1897 ... ..	0·3	0·17	—	0·3	0·7	0·5	0·3	0·17	—	—	0·17	0·17	2·8
1898 ... ..	0·3	—	—	0·17	0·3	0·3	0·3	—	—	—	—	—	1·5
1899 ... ..	—	0·3	—	—	—	0·83	—	—	—	—	0·17	—	1·3
1900 ... ..	—	—	—	1·0	0·3	0·3	0·3	—	0·3	—	—	—	2·3
1901 ... ..	0·3	—	0·3	0·5	0·5	0·5	0·5	0·5	—	—	—	—	3·17
1902 ... ..	—	—	—	—	1·0	—	—	—	—	—	—	—	1·0
1903 ... ..	—	—	—	0·5	0·5	—	0·5	0·5	—	—	—	—	2·0
Total ... ..	1·0	0·5	1·3	2·8	17·7	3·8	2·3	1·9	0·3	—	0·3	0·17	32·4

Average per year ... .. 2·7.

The Table of average catches of *Skate* is also subjoined, though it must be confessed that it seems to teach us little. The figures are very irregular, and it is more than probable that at times the catch of *Skate* was in whole or part wasted or neglected. Whatever indications of a periodical fluctuation might appear to be shown in the monthly totals tends to disappear on further inspection, owing to the fact that occasional heavy catches exert an undue preponderance on the totals; there is, in short, no close relation to be discerned of one year with another. Not only are our figures probably faulty from inadequate information, but it may be also that they are confused from inclusion under the general term "Skate" of several species, whose habits and fluctuations may very possibly be widely different. In any case the irregularity and obscurity of this Table are in contrast to the comparative simplicity and regularity of the statistics in other cases.

MONTROSE TRAWLERS.—AVERAGE TAKE OF SKATE (IN CWTS.) PER VESSEL EMPLOYED, 1892-1903.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average per Year.	Average per Month.
1892 ... ..	10.0	6.7	4.0	3.3	6.7	—	8.3	—	8.7	6.7	3.3	1.3	59.0	5.0
1893 ... ..	4.0	3.3	4.7	3.3	4.0	3.3	1.3	3.3	3.3	3.3	3.3	—	37.1	3.1
1894 ... ..	2.7	7.7	5.3	10.0	16.7	6.7	1.3	3.3	13.3	3.3	3.3	4.0	77.6	6.5
1895 ... ..	8.3	3.3	6.7	6.7	3.3	6.7	6.7	6.7	8.7	6.7	8.0	6.7	78.5	6.5
1896 ... ..	8.7	6.7	6.7	3.3	—	4.0	—	—	—	1.0	1.0	—	31.4	2.6
1897 ... ..	0.7	1.0	0.7	—	—	—	—	—	—	1.3	1.7	1.3	6.7	0.6
1898 ... ..	1.7	2.7	1.7	1.3	—	—	1.0	1.7	—	0.7	1.7	1.7	14.2	1.2
1899 ... ..	2.7	2.0	2.7	1.7	3.0	2.7	3.3	2.7	4.3	1.3	4.0	—	30.4	2.5
1900 ... ..	8.3	—	2.7	2.7	4.0	2.7	1.3	2.7	—	1.7	3.3	4.0	33.4	2.8
1901 ... ..	1.0	1.3	—	3.5	5.0	6.0	3.5	1.5	2.0	2.0	—	2.0	27.8	2.3
1902 ... ..	2.0	5.0	3.5	3.5	4.0	3.0	2.0	3.0	2.0	—	2.5	4.0	34.5	2.9
1903 ... ..	2.5	1.5	2.0	3.0	—	—	—	2.0	2.0	2.0	1.0	2.0	18.0	1.5
Total... ..	52.6	41.2	40.7	42.3	46.7	35.1	28.7	26.9	44.3	30.0	33.1	27.0	448.6	37.5
Average per Month. }	4.4	3.4	3.4	3.5	3.9	2.9	2.4	2.2	3.7	2.5	2.75	2.25	37.4	—
Weight Average. }	4.8	3.6	3.7	3.6	4.1	3.7	4.1	4.3	5.8	3.6	3.5	2.7	—	—

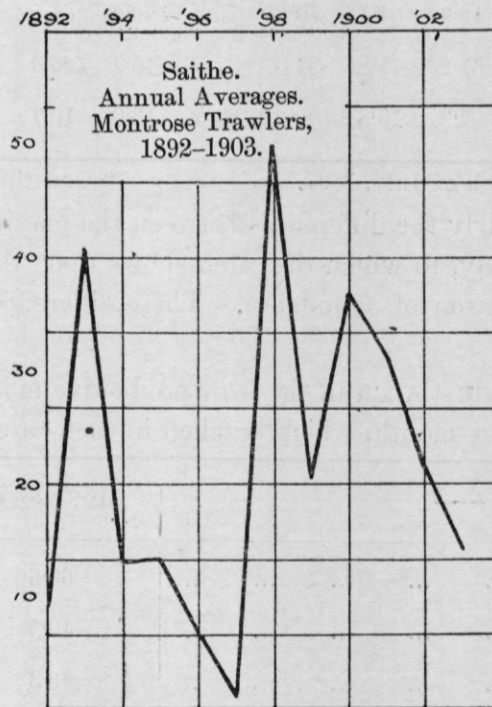


FIG. 19.

In the following Table we have re-arranged the figures above discussed, representing now the maximum monthly average for each fish by 100 and bringing the numbers for the other months into the same proportion. The curves drawn from these figures will therefore be all of equal height at their respective periods of maximum abundance, and they will be found somewhat more convenient than those given above for comparison one with another.



In the following Table are shown the monthly averages for the various fishes adjusted according to the method suggested by Mr. A. L. Bowley, as already described on p. 291. Owing to the scanty figures forthcoming in the case of Saithe and Halibut and the doubtful value of the information available in the case of Skate the statistics for these fishes have not been reinvestigated.

MONTROSE TRAWLERS. *Weighted* MONTHLY AVERAGES of the CATCH of various FISHES. 1892-1902.  
(A. L. BOWLEY).

—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Haddock ... ..	131.7	136.0	125.4	88.7	92.0	152.0	214.0	402.0	401.0	228.0	230.0	167.7	197.4
Cod ... ..	61.3	72.0	70.2	63.7	53.3	79.4	117.6	100.3	78.1	75.8	82.5	64.9	76.6
Whiting ... ..	7.2	13.0	8.7	10.4	5.6	6.1	11.7	8.2	9.4	9.3	8.4	6.7	8.7
Plaice ... ..	10.7	20.6	19.1	17.3	15.6	21.4	23.3	20.1	24.8	41.7	26.8	13.7	21.2
Turbot ... ..	2.6	3.2	2.0	4.6	4.1	2.7	4.0	9.6	4.8	3.8	3.8	3.2	4.0
Lemon Sole ... ..	9.9	9.0	10.6	15.9	18.4	21.2	32.5	22.9	21.8	14.9	15.0	10.5	16.9

Lastly, the following Table gives the "chance differences" as calculated by Mr. A. L. Bowley, for the various fish according to the Montrose statistics; that is to say, the figures here given express the differences that, if we find them existing between the returns for one month and another, may, as likely as not, be due to chance or accident alone, and must therefore be exceeded before we begin to assume that differences or fluctuations actually exist in the plentifulness of the fish.

MONTROSE TRAWLERS. TABLE of "CHANCE DIFFERENCES" in the MONTHLY RETURNS for the various species of FISH. 1892-1903.

—	Haddock.	Cod.	Whiting.	Ling.	Plaice.	Turbot.	Lemon Sole.
Tables unadjusted ... ..	22	8	3	.24	2.5	.6	2.5
„ adjusted, p. ... ..	28	10	—	—	3	—	—

## CONCLUSION.

The differences between the phenomena exhibited by the various species are both well-marked and numerous, and they are such as to show that we are dealing with actual phenomena proper to the fish themselves and not merely with deceptive appearances springing from a common cause, such as the seasonal irregularities of the operations of the ships.

With the unimportant exception of Skate, concerning which our information is probably defective and probably also confused owing to the inclusion of more species than one, all the fishes dealt with in these statistics show marked periodic fluctuations according to the season of the year.

No two species of fish show precisely the same periods of annual maximum and minimum.

There are great differences between the different species in regard to the stock remaining on the ground at the period of least abundance. Only in the case of Saithe and Halibut does the seasonal migration appear to go to such an extent as to leave the area under consideration altogether deserted by the fish.

As a general rule, each fish has, within the areas in question, a single maximum and minimum in the course of the year. Apparent evidence for the existence of a second and less conspicuous maximum, as discussed in the Granton Report for Haddock, Plaice and Cod, is not borne out by the Montrose statistics, and tends to disappear or to fall within the limits of uncertainty under a more rigorous investigation of the figures. In the case of Ling there are two maxima, not widely separated, and in the case of Turbot also there is better evidence than in the rest for the existence of a subordinate maximum.

No fish reaches its average annual maximum from November to January; and no fish reaches its average annual minimum from July to September.

From the Granton records, it would appear that the Whiting has its annual maximum in winter-time (February), and if that be so it is the only fish that has a winter-maximum in this area: the Montrose returns give us, unfortunately, no clear information in regard to this fish. Cod, according to the Granton returns, and Saithe and Halibut according to those for Montrose, have their maxima in Spring. The other fishes all have theirs in Summer or early Autumn.

The one thing certain is that there are notable seasonal fluctuations such as have been described. But there are many questions in regard to the cause of these fluctuations or migrations, the extent to which they are participated in by the fish of different sizes or ages, the relation of the phenomena within this area to those exhibited by neighbouring and more distant areas, the possible existence of different races of the same fish with different habits and different routes or periods of migration, all of which questions and many others of a like kind remain for future investigation.

With a view to throwing the more salient features into relief, I have drawn up another Table, in which are inserted the seasonal maxima and minima for each species of fish, to the neglect of all the minor fluctuations. When the minimum is ill-defined or spread over a lengthy period, as not unfrequently happens, it is not recorded here :—

SUMMARY, showing the periods of MAXIMUM and MINIMUM frequency of the various species of Fish, according to the Granton and Montrose Statistics.

---	Spring.			Summer.			Autumn.			Winter.			---
	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	
Haddock ...	...	—	...	...	..	+	...	...	...	...	...	...	Granton.
Haddock ...	...	—	—	...	...	+	+	...	...	...	...	...	Montrose.
Cod ...	...	+	...	...	...	...	...	—	...	...	...	...	Granton.
Cod ...	...	...	...	...	+	...	...	...	...	...	...	...	Montrose.
Saithe ...	...	+	...	...	...	...	...	...	—	...	...	...	Montrose.
Ling ...	...	...	...	+	...	...	+	...	...	—	...	...	Montrose.
Whiting ...	...	...	...	—	...	...	...	...	...	...	...	+	Granton.
Plaice ...	...	...	...	...	...	+	+	+	...	—	...	...	Granton.
Plaice ...	...	...	...	...	...	...	...	+	...	—	—	...	Montrose.
Turbot ...	—	...	...	...	...	+	...	...	...	...	...	...	Montrose.
Lemon Sole ...	—	...	...	...	+	...	...	...	...	—	—	—	Montrose.
Turbot and Lemon Sole	...	...	...	+	+	+	...	...	...	...	...	—	Granton.
Halibut...	...	...	+	...	...	...	...	...	...	...	...	...	Montrose.

Lastly, if only to show the irregularities of the fishing, I add a Table in which are shewn, since 1892, the years in which the catch of each sort of fish was equal to, or exceeded, the average ; the averages being in this case drawn, for Montrose and Granton alike, only for the twelve years 1892-1903, for which statistics are available from both places :—

TABLE showing the YEARS of AVERAGE or more than AVERAGE CATCH for each kind of FISH for the PERIOD 1892-1903. In each case the best year of the whole period is denoted by ++, the years of average or more than average catch by +, and the worst year of the whole period by —.

---	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	---
Haddock ...	+	+	+	++	+	...	...	...	...	—	...	+	Granton.
Haddock ...	+	...	+	++	+	...	+	+	...	—	...	+	Montrose.
Cod ...	...	...	+	+	+	...	+	...	—	...	++	+	Granton.
Cod ...	—	...	...	...	...	...	+	++	...	...	+	+	Montrose.
Saithe ...	...	+	...	...	...	—	++	...	+	+	...	...	Montrose.
Ling ...	...	+	++	+	...	...	...	+	...	...	—	...	Montrose.
Whiting ...	...	...	...	...	—	+	...	+	+	++	+	+	Granton.
Whiting ...	...	...	—	...	...	...	+	...	...	+	+	++	Montrose.
Plaice ...	...	...	...	...	+	...	—	++	...	...	...	...	Granton.
Plaice ...	++	+	...	+	+	+	...	+	...	...	—	...	Montrose.
Turbot ...	+	++	...	...	+	...	...	+	...	...	—	...	Montrose.
Lemon Sole ...	+	+	++	...	...	+	—	...	+	...	...	...	Montrose.
Turbot and Lemon Sole	+	...	+	...	...	—	...	+	+	+	+	+	Granton.
Halibut...	++	...	...	...	+	+	...	...	+	+	+	...	Montrose.
Total Catch ...	+	...	...	++	+	...	...	...	...	...	+	+	Granton.
	+	+	+	+	+	...	++	+	...	—	...	...	Montrose.