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REPORT

ON

GRANTON TRAWLING STATISTICS, 1886-1903,

BY

D'ARCY WENTWORTH THOMPSON.

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REPORT  
ON  
GRANTON TRAWLING STATISTICS, 1886-1903,  
BY  
D'ARCY WENTWORTH THOMPSON.

By the kindness of Mr. James Caw, Manager of the General Steam Fishing Company, Granton, we have received an interesting and valuable series of statistics of the catches made by the vessels of his Company from the commencement of the fishing in 1886 down to the present time. The keeping of this record was begun and continued for a number of years by the late Manager, Mr. James Scott, to whom the whole trawling industry is indebted for the invention and introduction of the Otter-trawl; and the statistics are still kept with the same care as formerly.

The special value of these statistics arises from the fact that the Granton trawlers, being comparatively small boats and furthermore being engaged in a trade that requires only fish in the best of condition, make no distant voyages, but pursue their fishing in the near neighbourhood of the Firth of Forth. Though the vessels only return to Granton once a week, they deliver their catches every day, or every alternate day, to a carrier-vessel close by the Isle of May.

It is not possible to say precisely within what range this fishing has been carried on or what areas have been especially frequented over so long a term of years, but we shall be on the safe side in saying that almost the whole of it has been within a radius of 40 miles from the Isle of May, and the greater part within a distance considerably less. Very recently, and so recently as not to make an appreciable difference in the statistics, one or two newer and faster vessels have begun to extend their operations to a somewhat greater distance, but otherwise under the same conditions as of old. We may accordingly take it that these statistics give us a valuable indication of the relative abundance of the several species of fish upon the same ground from season to season and from year to year during the past 18 years.

The form in which the statistics have been kept gives us (1) the total quantity of each kind of fish landed in each week and month of the year, and (2) the number of vessels engaged in fishing during the same periods. We have drawn from these *the average take of each vessel per week and month*. No record of the number of hours during which actual trawling was carried on has been kept, and we cannot, therefore, compare these statistics directly with those which we now obtain from the Aberdeen trawlers; but the method of operations above described permits us to assume that the work was practically continuous, no long passages having to be made, and that, therefore, the weekly takes are, on the average, safely comparable one with another.

Though the Granton statistics are made up both for weekly and monthly periods, we have used the latter only as being sufficient for all practical purposes.

I am very sensible of the fact that a great responsibility attaches to the use of such statistics as these. It is easy to draw deductions from what is apparently indicated by the figures in the Tables and by the features of the curves, which deductions may be shown by more careful and more skilled analysis to be dubious or unwarranted; while at the same time the same skilled analysis may prove in a high degree confirmatory of other of the apparent indications. In other words, it is of the utmost importance, but not always easy, to separate the fortuitous fluctuations or coincidences that any random collection of numbers will be found to exhibit from those other fluctuations or coincidences that may be relied upon as

revelations of an underlying truth. Most especially is caution necessary when we desire to ascertain from statistics such as these whether the results of a succession of years are fairly constant on either side of an unchanging average, or on the other hand show signs of progressive improvement or progressive decadence. One or two years of poor fishing may cause great hardship to a fishing community, and may give rise to allegations that the sea is being or has been depleted of its stock of fish; and if, perchance, a year of somewhat exceptional plenty had preceded such years of scarcity, the contrast is all the more striking, and the alarm and apprehension all the greater. The period of years under consideration in the present case is much longer than is commonly available for the comparison of uniform statistics of the kind; but, nevertheless, it proves, as will be shown in the sequel, to be hardly long enough yet to permit us to judge with certainty of a trend towards increase or diminution of the yield of fish.

In view of such considerations as these, and in order to have a check upon my own reading and interpretation of the statistics, I put this Report into the hands of Mr. A. L. Bowley, author of a well known work on the "Elements of Statistics" and Lecturer on Statistics in the London School of Economics. Mr. Bowley has submitted all the figures to an analysis as careful and elaborate as time allowed, and his remarks are appended to the Report in the shape of footnotes.

GRANTON TRAWLERS.—STATEMENT OF THE NUMBER OF VESSELS EMPLOYED BY THE GENERAL STEAM FISHING COMPANY, 1886-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	—
1886 ...	5	5	5	5	5	5	5	5	5	5	5	5	
1887 ...	5	5	5	5	5	5	5	5	5	5	5	5	
1888 ...	5	5	5	2	6	6	6	6	6	6	6	6	3
1889 ...	2	2	2	2	6	6	6	6	6	6	6	6	6
1890 ...	7	7	7	7	7	7	7	7	7	7	7	7	7
1891 ...	7	7	7	7	7	7	8	8	9	9	9	9	9
1892 ...	9	9	9	9	9	9	9	9	9	9	9	9	9
1893 ...	9	9	9	9	9	9	9	9	9	9	9	9	9
1894 ...	9	9	9	9	9	9	9	9	9	9	9	9	9
1895 ...	9	8	8	8	8	8	8	8	8	8	8	8	8
1896 ...	8	8	8	8	8	8	8	8	8	8	8	8	8
1897 ...	8	8	8	8	8	8	8	8	8	8	8	8	8
1898 ...	8	8	8	8	8	8	8	8	8	8	8	8	8
1899 ...	7	7	7	7	7	8	8	8	8	8	8	8	8
1900 ...	6	6	6	7	7	8	8	8	8	7	7	7	7
1901 ...	7	7	7	7	7	8	8	8	8	8	8	8	8
1902 ...	6	6	6	7	7	7	7	8	8	8	8	8	8
1903 ...	8	8	8	8	8	8	7	7	8	9	9	9	9
Total ..	125	124	124	123	131	134	134	135	137	137	137	134	Mean Monthly Average. 7.3
Monthly Average. }	6.9	6.9	6.9	6.8	7.3	7.4	7.4	7.5	7.6	7.6	7.6	7.4	

## GRANTON TRAWLERS.—AVERAGE TOTAL QUANTITY OF FISH OF ALL KINDS (IN CWTs.) PER VESSEL EMPLOYED, 1886-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average for the Year.	Average per Month.
1886 ... ..	297.2	417.0	304.0	255.3	295.6	369.4	513.2	572.0	395.6	665.4	549.4	223.4	4857.5	404.8
1887 ... ..	441.4	257.6	339.4	572.2	435.2	474.8	729.0	550.6	510.4	291.4	311.0	335.2	5248.2	437.3
1888 ... ..	331.4	306.2	302.0	321.0	251.0	464.6	528.7	563.0	512.3	465.3	133.3	340.8	4518.9	376.6
1889 ... ..	318.5	305.0	622.0	492.0	287.0	582.4	490.0	420.2	746.1	366.0	528.5	298.0	5455.7	454.6
1890 ... ..	175.7	381.5	472.2	493.5	385.1	408.9	349.7	930.9	355.5	398.7	377.9	312.5	5042.1	420.2
1891 ... ..	342.5	395.9	262.3	397.5	423.3	403.3	332.2	397.5	384.4	391.7	990.1	225.7	4946.4	412.2
1892 ... ..	314.9	221.3	426.0	383.6	305.2	308.0	518.6	365.7	480.9	279.6	324.4	202.6	4130.8	344.2
1893 ... ..	308.4	279.4	308.0	475.2	382.5	301.5	363.2	352.4	225.0	284.5	194.0	278.7	3752.8	312.7
1894 ... ..	166.9	223.0	381.3	370.1	267.7	428.8	231.9	275.9	408.5	438.6	457.4	316.4	3966.5	330.5
1895 ... ..	182.3	369.1	344.8	482.5	628.5	683.7	601.4	784.6	559.0	554.5	406.6	197.4	5794.4	482.9
1896 ... ..	409.8	294.3	412.1	549.6	536.6	523.2	652.2	560.4	316.5	191.5	250.6	184.1	4880.9	406.7
1897 ... ..	99.3	246.5	244.1	440.3	280.0	340.3	443.8	340.4	441.0	297.5	315.6	285.4	3774.2	314.5
1898 ... ..	278.9	282.8	491.4	457.1	274.9	451.8	290.9	324.7	401.1	277.4	236.2	124.1	3891.3	324.3
1899 ... ..	221.0	291.6	338.5	216.8	258.8	378.8	337.6	468.2	301.8	319.7	274.4	218.2	3625.6	302.1
1900 ... ..	154.3	137.1	309.0	220.9	348.9	313.7	317.5	403.0	334.4	316.1	338.7	160.4	3359.0	280.0
1901 ... ..	137.8	230.4	208.5	252.8	339.0	296.4	339.5	456.9	350.7	441.0	206.2	104.2	3357.4	279.8
1902 ... ..	191.9	373.3	297.6	294.9	372.4	364.5	747.2	416.0	441.2	534.4	300.0	253.1	4586.5	382.2
1903 ... ..	298.1	237.2	337.4	371.1	283.6	376.5	503.2	471.6	540.2	472.2	322.7	310.2	4524.0	377.0
Total ... ..	4670.3	5249.2	6400.6	7046.4	6355.3	7464.6	8289.8	8659.0	7704.6	6985.7	6517.0	4370.4	79712.2	6642.6
Average ... ..	259.5	291.6	355.6	391.6	353.1	414.7	460.6	481.1	428.1	388.1	362.1	242.8	4428.5	369.0

Average Catch per year ... .. 4628.5 cwts.  
 " " per month ... .. 369.0 ..

In studying these statistics we have followed the same plan that has been adopted elsewhere in this Report ; that is to say, the monthly averages have first been plotted out in a continuous curve, in order to give a graphic representation of the whole series of fluctuations during the period under consideration (though these continuous curves are not in all cases reproduced here) ; and, secondly, the averages of corresponding months, all the Januaries, all the Februaries, and so forth, have been added together and averaged, so as to give the essential or average features of each month, and hence *the mean seasonal fluctuations*.\*†

\* In drawing these curves of monthly variation, the simple plan has been adopted of averaging the annual monthly averages. If it be held that we ought rather to revert to the original figures, and draw a fresh average for the whole quantity of fish caught and the whole number of vessels employed in the course of all the eighteen Januaries, &c., the result is shown below in the case of Haddock, Cod, and Plaice ; and it will be seen that the figures do not differ materially from those obtained in the simpler way.

† *On the Test for Seasonal Variation*.—To find the “probable deviation from the average,  $r$ .”

Two hundred and sixteen months are under consideration : if an average of eighteen taken at random be compared with another average of eighteen taken at random, the differences are as likely as not to be as great as  $\frac{r}{3}$ . If this average for the series of Augusts differs from that for the series of, for instance, the Julys by no more than  $\frac{r}{3}$ , the difference might arise purely by chance fluctuation, and not because of seasonal influence. But a difference amounting to  $\frac{2r}{3}$  would only arise once in six times by chance, and one of  $\frac{4r}{3}$  only once in 160 times. This affords a test of the significance of a difference. In addition, the number of times in which August would exceed July (without paying attention to the amount of excess) purely by chance is easily calculated, and thus the existence of a seasonal maximum is tested. Both these tests have been applied to the seasonal changes of the five kinds of fish.

For the Annual Fluctuations I have applied the method discussed in my “Elements of Statistics,” pp. 313-315, in a developed form ; but the logical basis, when only eighteen years are available, is not altogether sound.—A. L. B.

Of the curves which follow, one series represents these monthly averages for each kind of fish over the whole period of 18 years. It will be observed that the curves are remarkably simple in form, and are especially smooth and regular in the case of the Haddock, in which fish the total quantities dealt with are much the largest.

In the first place it will be seen (Fig. 1) that in the total supply of fish we have a well-marked annual fluctuation, the catch per vessel rising to an annual maximum in August and falling to a minimum in December. In addition to this main wave there is a temporary increase in April followed by a temporary diminution in May; and the fluctuation is of so large a kind that the average catch for August

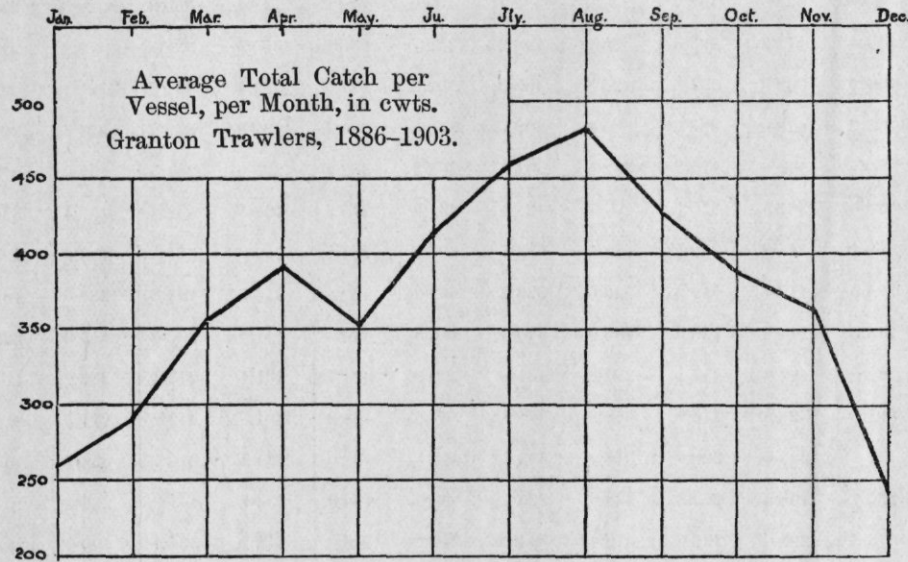


FIG. 1.

is just about twice as great as that for December. This curve and the phenomenon which it represents give, of course, the resultant of the combined phenomena for the several species of fishes: and are especially influenced by the results for Haddock, which in this region are by far the most abundant of the fish obtained. We pass at once therefore to the more detailed consideration of the several species.

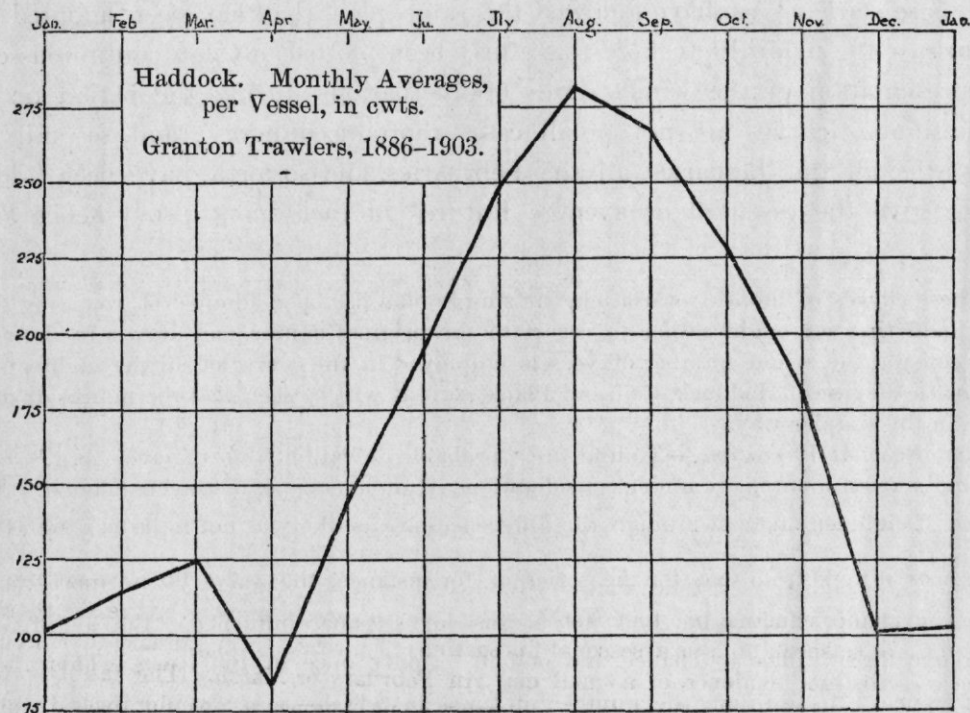


FIG. 2.

In the case of the *Haddock* (Fig. 2), we see that the curve has a double crest, or consists of two regular waves; a smaller one rises to a low maximum in March, and immediately drops to a minimum,

the lowest of the year, in April ; from that month onwards it steadily and smoothly ascends to an annual maximum in August or September, and then descends as smoothly to a second minimum which includes the months of December and January. This curve, then, tells us, or seems with every appearance of certainty to tell us, that to the area in question there are two annual migrations of the Haddock, one, of small extent, in the early spring, and another, a great and important one, culminating in the end of summer.\*

These facts, interesting as they are in themselves, only suggest other questions or hypotheses to which answer or proof are not yet forthcoming. It is conceivable, for instance, that we are dealing, at both seasons of increase, with the same haddocks, passing to and fro in the course of a single annual migration ; or it is quite possible that we are dealing with migrating bodies of fish of different ages, the younger reaching and passing through our area at one time of year, the older at another ; or it is not impossible that we have to do with two distinct and separate races or stocks of fish. Two points may be briefly

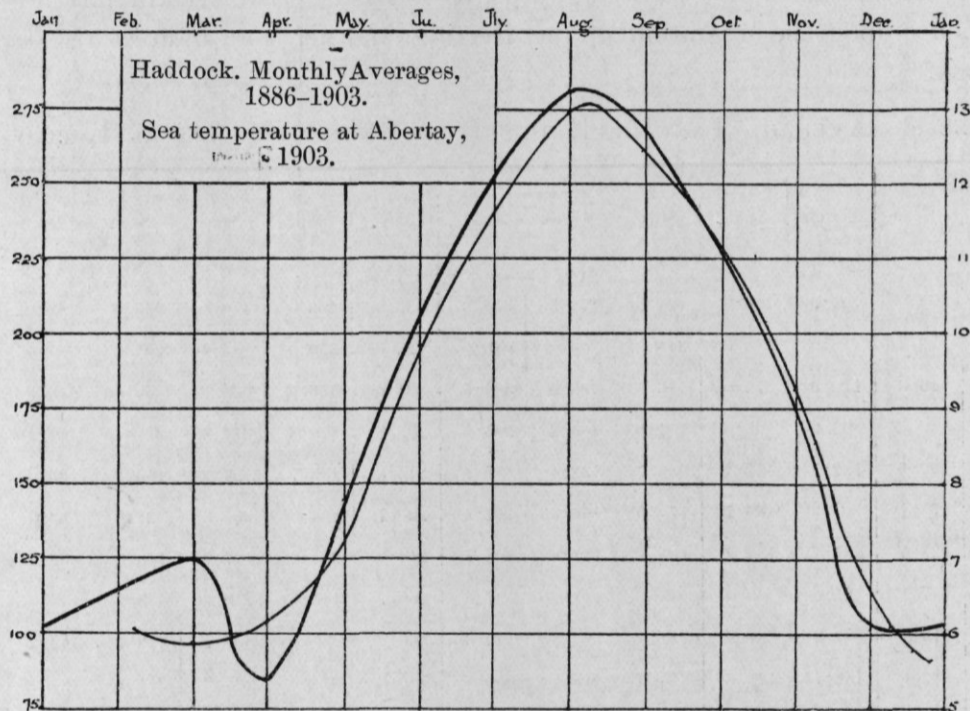


FIG. 3.

Thick Line.—Average Catch of Haddock.  
Thin Line.—Surface-temperature of Sea.

mentioned as tentative suggestions for further enquiry. Firstly, the two periods at which our curve shows the Haddock to reach a maximum of annual abundance coincide pretty accurately with the height of the Winter and Summer Herring Fishings in the same neighbourhood. Secondly, as far as the latter and greater portion of the curve is concerned, it appears to coincide very exactly *with the rise and fall of the Temperature of the Sea*. We have no record available of the temperature of the bottom waters, nor even for the surface waters actually on the Haddock grounds ; but, on the one hand, in our shallow waters the surface temperature differs little from that at the bottom, and on the other hand, the mean surface temperature does not differ greatly within moderate distances. Accordingly, we may use for comparison

\* *Haddock*.—The Table contains evidence that a difference of as much as 22 cwts. between one month's catch and another's may be due simply to chance ; in other words, unless the difference shown be greater than this, we are not at liberty to ascribe a cause or to speak of it as a seasonal fluctuation. The rise from January to March is rather doubtful in amount, but there is distinct evidence of a small cusp in February or March. The fall from March to April is significant, and so is the cumulative rise from April to August ; but August is not significantly greater than July or September. The cumulative fall from August to December is significant.—A. L. B.

our record of the surface temperature at Abertay Lightship, at the mouth of the Tay, for which station we have from Mr. Swaddel, the Officer in charge, very accurate observations for the year 1903, and continuous observations only a little less precise for many previous years. When we place, as is done in the annexed diagram, our seasonal curve of Haddock in juxtaposition with the seasonal curve of temperature for the surface-water at Abertay, the coincidence between the two curves is remarkable; the Haddock increases in abundance as the temperature rises through the season, and begins to abate as soon as the temperature falls away.

But at the same time it is important to bear in mind that the very fact of the coincidence of these annual periods of increased abundance of Haddock with the seasonal migrations of the Herring to the same coast is in itself a warning that we must not ascribe the phenomena in the case of the Haddock too hastily to an effect of temperature. For we know that Haddock are fond of feeding upon Herring spawn, and we may take it that the attraction of this food is in part, and possibly in great part, an explanation of their local increase in spring and autumn. In other words, it is possible that certain physical conditions may have a direct influence upon the migration of the Herring, and hence an indirect, or secondary one, upon that of the Haddock.

GRANTON TRAWLERS.—AVERAGE TAKE OF HADDOCK (IN CWTs.) PER VESSEL EMPLOYED, 1886-1903.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average for Year.	Average for Month.
1886 ... ..	86.4	174.0	94.0	126.0	124.0	178.8	358.0	433.4	266.0	470.0	356.0	88.0	2754.6	229.5
1887 ... ..	248.0	89.2	118.0	114.0	248.0	300.0	580.0	426.0	330.0	181.4	204.0	207.0	3045.6	253.8
1888 ... ..	136.0	146.0	110.0	75.0	116.6	286.0	384.6	391.6	356.0	326.3	50.16	116.0	2494.3	207.8
1889 ... ..	125.5	59.5	305.0	199.0	157.0	383.3	295.5	233.3	520.3	211.6	277.16	114.16	2881.3	240.1
1890 ... ..	71.6	162.4	182.1	51.4	59.0	132.4	159.1	215.0	195.7	97.4	163.2	135.0	1624.3	134.7
1891 ... ..	174.3	175.1	94.3	65.7	170.0	166.6	152.5	200.75	264.0	205.6	328.9	63.3	2061.0	171.75
1892 ... ..	181.3	125.6	284.4	132.2	131.1	137.8	306.7	244.4	265.6	127.8	150.0	62.2	2149.1	179.1
1893 ... ..	96.2	137.4	125.6	80.0	193.3	144.7	197.8	266.7	145.6	213.3	123.1	140.0	1863.7	155.3
1894 ... ..	78.3	112.4	82.2	38.9	122.3	187.8	120.0	160.9	286.7	306.7	240.0	142.2	1878.4	156.5
1895 ... ..	68.0	185.6	162.75	121.5	345.0	415.1	350.5	485.0	371.9	421.9	251.25	81.25	3259.7	271.6
1896 ... ..	133.75	126.0	88.125	115.0	247.25	267.375	421.5	417.5	226.9	88.5	142.5	98.75	2373.1	197.8
1897 ... ..	31.875	145.0	101.25	77.5	65.625	100.0	211.25	216.25	257.625	132.5	145.5	124.0	1608.4	134.0
1898 ... ..	126.0	138.0	150.25	51.75	99.375	192.5	128.75	242.5	172.625	117.0	100.25	47.5	1566.5	130.5
1899 ... ..	60.9	101.6	80.0	45.7	100.4	160.0	126.75	149.0	133.75	182.5	120.0	106.25	1373.8	114.5
1900 ... ..	49.16	49.16	115.0	55.7	119.3	144.75	131.25	244.0	229.5	175.0	174.3	48.1	1535.2	127.9
1901 ... ..	15.3	56.9	38.3	36.4	138.9	86.25	117.125	229.5	205.0	248.75	101.625	18.875	1292.9	107.7
1902 ... ..	14.3	20.5	37.16	24.3	33.0	108.9	221.4	281.25	290.0	313.375	181.5	97.5	1623.2	135.3
1903 ... ..	127.0	61.25	82.5	81.5	137.6	133.7	192.4	244.0	283.7	267.2	142.2	116.9	1869.9	155.8
Total ... ..	1823.9	2072.6	2250.9	1491.5	2607.7	3525.9	4455.1	5081.0	4800.9	4086.8	3251.6	1806.9	3725.5	3103.65
Average ... ..	101.3	115.2	125.0	82.9	144.9	195.9	247.5	282.3	266.7	227.1	180.7	100.4	2069.6	172.4
Average from original Totals. }	99.4	118.8	121.0	77.6	146.7	190.0	236.7	274.3	260.1	222.7	177.6	97.7	2064.0	170.6

Average Catch per year ... .. 2064 cwts.

" " per month ... .. 172 "

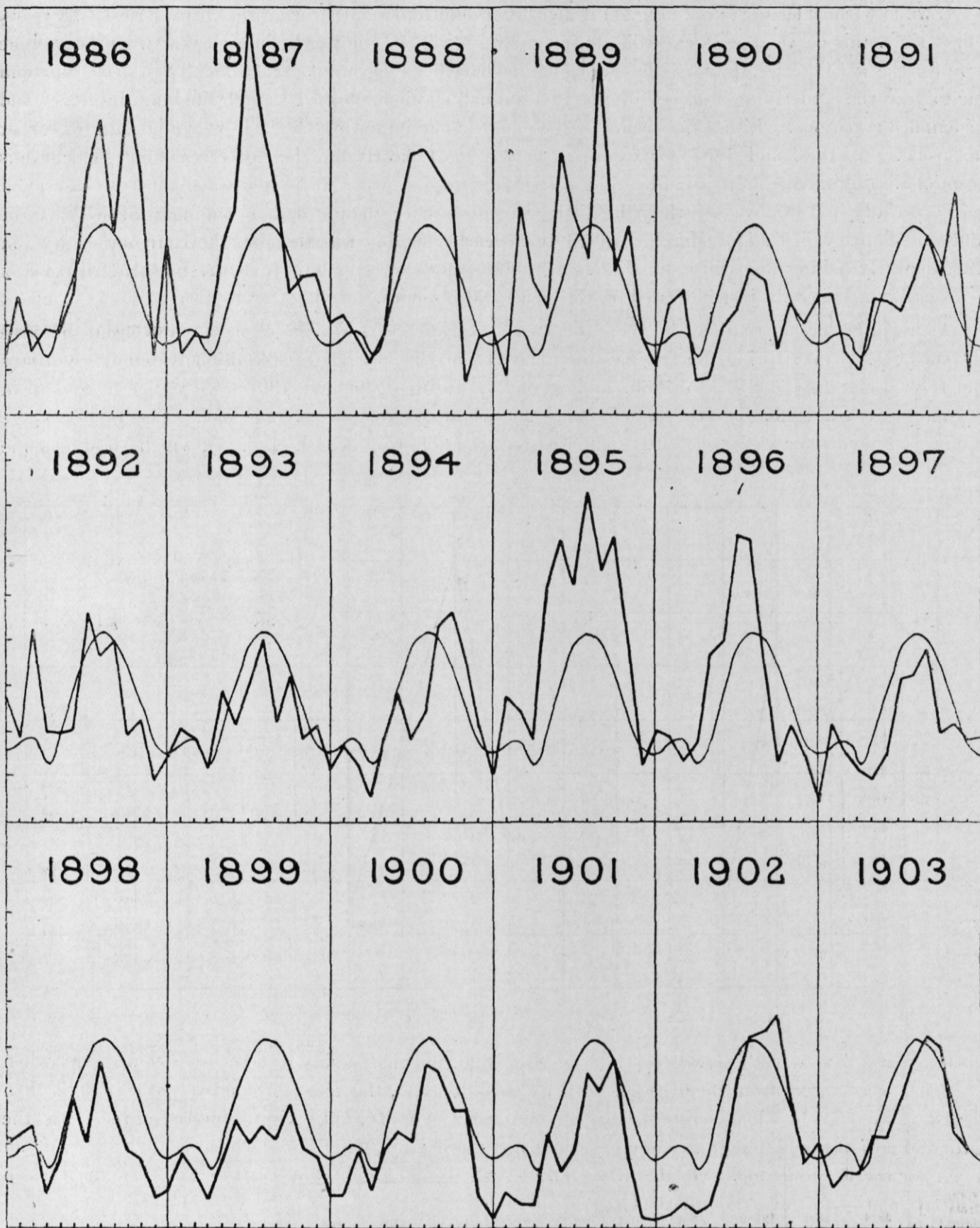


FIG. 4.

Haddock. Annual Monthly Averages, per Vessel, in cwts. Granton Trawlers, 1886-1903.

Thick Line.—Average month by month for each year.

Thin Line.—Composite Monthly Averages for the whole period.

If we now consider the curve (Fig. 4) drawn from month to month during the entire series of 18 years, at first sight this curve appears exceedingly irregular; but if we compare it in each year with the average curve for the whole series, drawn as has been just described, we have but little difficulty in detecting from year to year the underlying features of the two annual maxima, cloaked though these are by minor and accidental fluctuations. Either the spring or the summer maximum may be less or greater, later or earlier than usual. In 1886 and 1887, for example, we see most clearly for the latter year that the curve is exceptionally high, both in its smaller and earlier and in its larger and later wave; in both cases, and again especially in 1887, we see that the little wave is earlier than usual, coinciding in 1887 with the month of January instead of March. In 1890, the earlier fishing was abundant, the late one scanty; in 1892, the early fishing was still more abundant, the late about an average. In 1902, the spring maximum is so small that it is only just indicated on the curve and no more.

As regards the fluctuations in the catch from year to year, we can see at a glance from the same diagram (Fig. 4) that during the 18 years there have been two periods of exceptional abundance, firstly from 1886 (or perhaps earlier) to 1889, and secondly, during 1895 and 1896; we notice also that in only one year, viz., 1899, does the actual curve lie wholly below the average one. The total average catches per month for each year are summarised in the following curve (Fig. 5), which shows us the

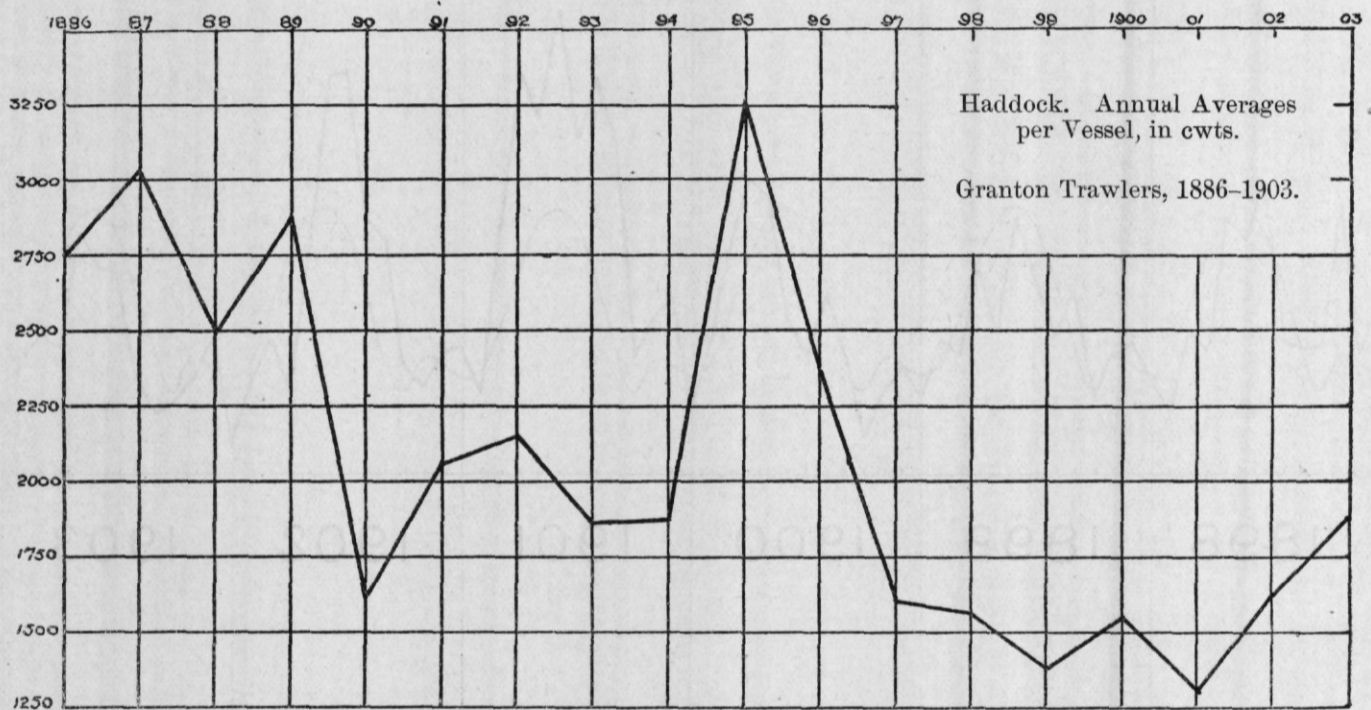


FIG. 5.

plentiful years 1886-1889 followed by the lean year 1890, and that again followed by a few years when the catches were not far from the average, until we come to 1895, the most productive year of all; then after 1896, we come to a long series of years of comparative scarcity, until within the last three years the curve gradually ascends though it has not yet touched the line (2,069 cwts.) which would represent an average for the whole period. On the whole, there can be no doubt but that recent years have been distinctly inferior to the earlier years of our period.

The average catch *per month* over the whole period of 18 years is found to be 172 cwt.; and we observe, on studying the Tables, that no year, however plentiful, yielded this average monthly return in every one of its 12 months. Taking the 18 years together, we find that, on the average, *seven*

months in each year give us less, and five months in each year yield us more than the average monthly catch of 172 cwts. The following Table shows :—

THE NUMBER OF MONTHS IN EACH YEAR, IN WHICH THE AVERAGE CATCH OF HADDOCK ROSE ABOVE 172 CWTs.

1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
7	9	5	8	3	6	5	4	4	8	5	3	3	1	4	3	5	4

The heavy catches of Haddock made during 1887, and their continued abundance during 1888 and 1889, are interesting from the point of view of protective legislation, and with respect to the danger of drawing inferences from a short series of observations.

It was in the spring of 1886 that the Firth of Forth was closed to Beam trawlers by Bye-law. In the Board's Annual Report for the year 1887, frequent and emphatic reference is made to the increased abundance of fish, and those responsible at that time for the scientific work of the Board did not hesitate to draw the conclusion that the increase was directly due to the closure. "In regard to the relative abundance of fish since the suspension of trawling we have statistics of much value for the Firth of Forth and St. Andrews Bay. In both these areas the number of fish has largely increased; the round fish, such as Haddocks, etc., have become more numerous, and the remarkable increase in flat fish has taken place in both regions, more especially in St. Andrews Bay, etc." (S.F.B. Report for 1887, Pt. iii, p. 3). At the period in question the whole subject was but little understood, the demand for restrictive legislation was urgent, and the faith in its efficacy was very great. Without questioning, and I for my part do not doubt, the wisdom of closing the *inshore* areas against trawling, it is plain from an inspection of these Granton Trawling Statistics alone that the benefits assumed to result from the suspension of trawling did not continue, and it is in a high degree probable that the prosperous fishing of the period about 1887 was a phenomenon due to natural causes similar to that period of abundance which recurred again in the years 1895-1896. The small value of statistics collected for a brief period and the great value of statistics over a long term of years, covering, that is to say, the greater periodic variations, is the chief lesson for us to draw.

The composite curve of monthly averages for *Whiting* is very different indeed from that for Haddock. But let us in the first place note that, from an inspection of the Table, it is plain that one year, namely 1897, was a very abnormal one. In that year there was an enormous influx of Whiting in the month of July, when great shoals were met with, as Mr. Scott tells me, chiefly in the neighbourhood of St. Abbs Head, the same period being marked by an altogether exceptional scarcity of Cod; in 1891 there had been a somewhat similar and rather more protracted period of exceptional abundance in the months of October and November, though not such as to disturb the averages to the same degree. Let us, therefore, consider the average monthly curve with the omission of the year 1897 (Fig. 6). It shows us one main wave rising from a minimum apparently in June, and at least at some time between May and August, to a maximum in February. The maximum in February is pretty nearly contemporaneous with the lesser maximum in the Haddock curve, but for the rest of the year the two curves are, roughly speaking, the converse one of the other, the Whiting dropping to a minimum and the Haddock rising to a maximum in the summer

months. The chief influx of Whiting comes then to this area at or about the period of the coldest water, and the chief influx of Haddock at the period of the warmest.\*

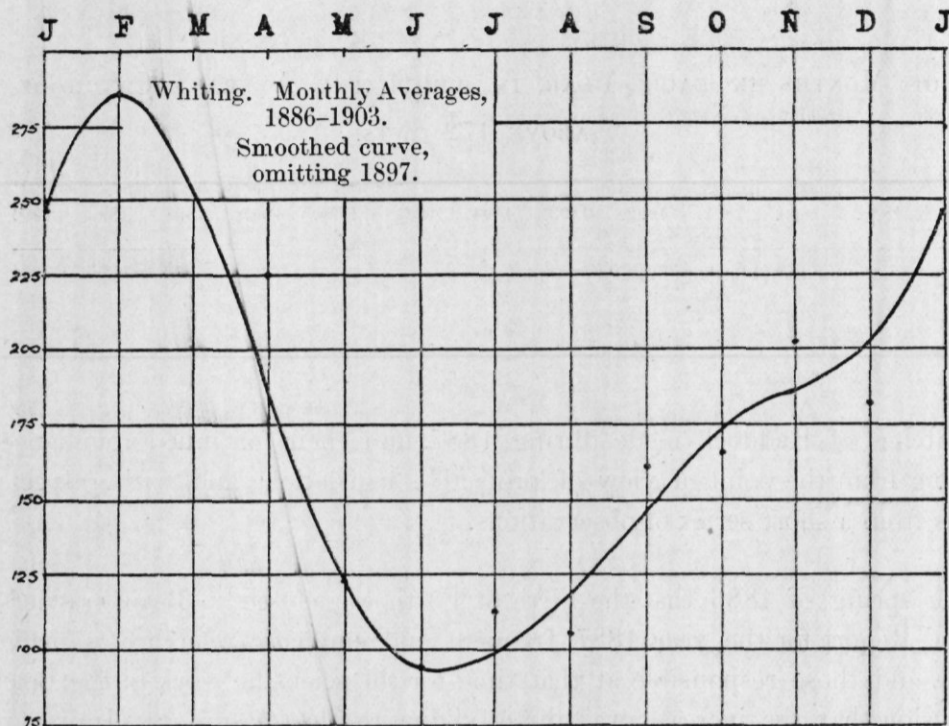


FIG. 6.

The monthly curve of Whiting has also been drawn up for the complete period, without the omission of the exceptional year 1897. We see in the curve (Fig. 7) the same main features as in the former one,

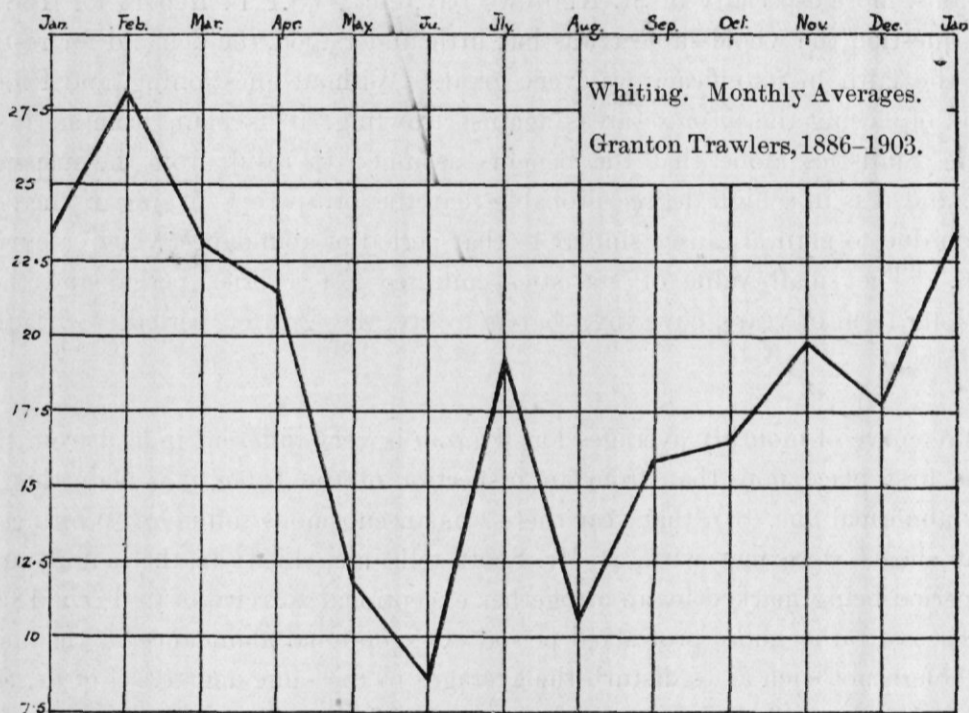


FIG. 7.

\* *Whiting*.—A difference of 4 cwts. between two monthly averages would occur by chance. February is the maximum, but its excess over January or March is not significant. January to April are distinctly above May to August. None of the changes from May to October are significant, and the July maximum is due to the single catch in 1897; but May to August are less than November to March.—A. L. B.

a maximum in February and a minimum in June. The high secondary cusp in July is mainly due, as stated above, to the year 1897, but it is interesting to note that it is not wholly so; for we can see from the Table a tendency to a July maximum in, for instance, the years 1889, 1891, 1902 and 1903; moreover, we shall see that a similar July maximum is marked upon the corresponding curve for Montrose. All this tends to show that the phenomenon of July, 1897, was only an intensification of something that commonly occurs, only in a much less degree. There seems also to be a tendency to a slight special increase in or about November. The same subject will be referred to again in the Report on the Montrose Statistics.

Turning from the monthly to the annual fluctuations we see a well-marked period of depression extending from 1892-1899. During the four years 1892-1896 the catch was very far indeed below the average, and the same would have been the case in 1897 had the total for that year not been raised by the

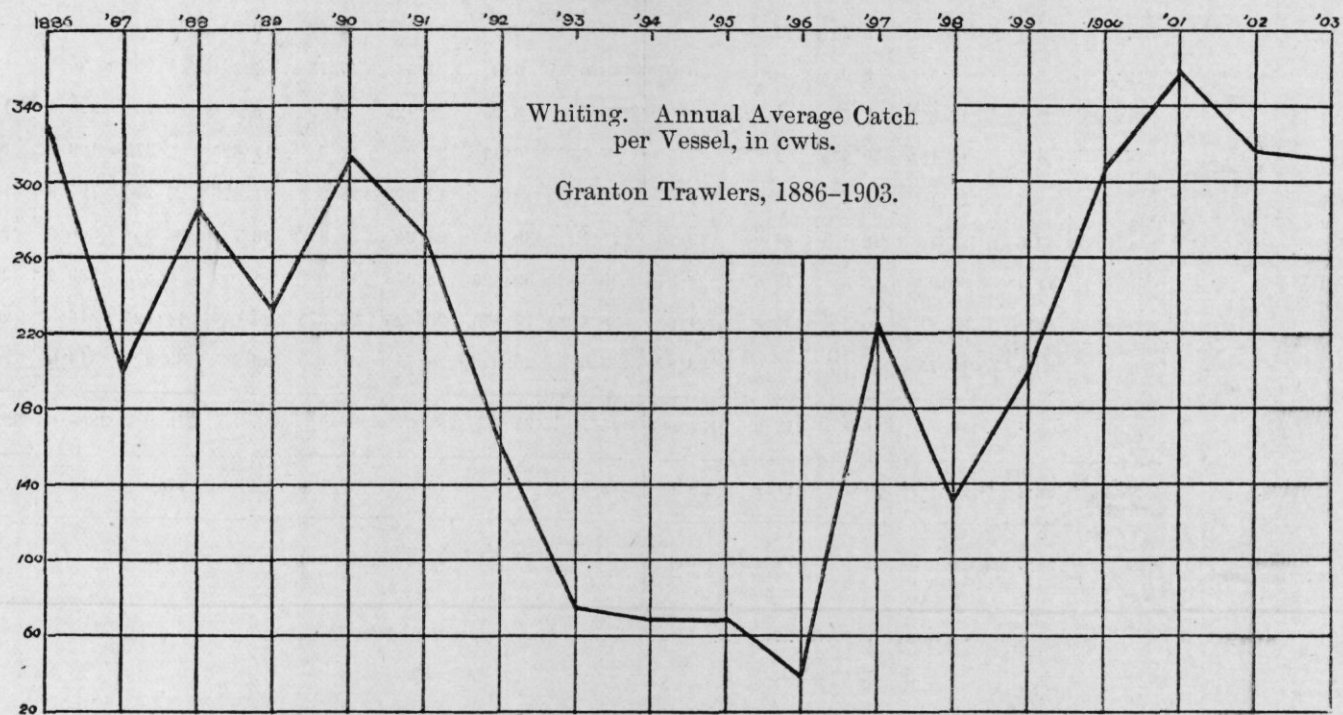


FIG. 8.

great catches of July. These years of scarcity in the case of Whiting are synchronous with a period of more than average abundance of Haddock. On the whole the last four years, 1900-1903, are the best consecutive years of the whole period covered by our statistics, and in 1901 the curve reached its highest point during the whole period of 18 years.

## GRANTON TRAWLERS.—AVERAGE TAKE OF WHITING (IN CWTS.) PER VESSEL EMPLOYED, 1886-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Average for the Year.	Average per Month.
1886... ..	85.4	123.0	34.0	10.0	1.6	0.6	1.6	6.0	30.0	8.0	4.0	26.0	330.2	27.5
1887... ..	50.0	41.6	22.0	26.0	1.8	1.0	1.0	2.4	10.0	10.0	4.0	30.0	199.8	16.6
1888... ..	76.0	66.0	50.0	20.0	3.6	0.66	0.5	6.16	17.8	3.3	10.8	31.6	286.4	23.8
1889... ..	20.0	20.0	20.0	25.5	1.3	2.16	23.3	14.3	18.6	22.5	39.3	25.0	232.0	19.3
1890... ..	22.9	51.4	40.7	28.9	26.1	32.1	10.0	7.1	9.4	8.3	34.3	41.0	312.1	26.0
1891... ..	35.7	18.6	14.0	25.7	20.0	8.9	1.625	7.5	8.4	47.6	67.3	15.6	270.9	22.6
1892... ..	31.1	16.7	33.6	24.4	6.7	2.0	11.7	5.0	20.0	5.8	3.3	0.0	160.5	13.4
1893... ..	1.1	7.8	6.7	32.7	12.2	4.9	4.9	0.0	2.45	1.1	0.45	0.9	75.2	6.3
1894... ..	5.0	15.6	14.4	12.6	5.8	1.1	0.0	0.56	0.0	0.22	5.6	6.7	67.0	5.6
1895... ..	4.0	13.125	16.0	13.75	2.25	0.0	0.0	0.0	0.0	0.625	0.25	17.5	67.5	5.6
1896... ..	12.5	5.0	7.5	3.0	0.0	0.0	0.0	0.0	1.5	3.75	1.5	1.75	36.5	3.0
1897... ..	1.325	17.5	12.375	4.75	4.125	0.0	150.0	3.25	8.125	8.75	9.5	5.75	225.4	18.8
1898... ..	8.5	9.5	13.125	10.875	2.875	3.5	3.75	6.25	35.0	22.5	11.625	2.375	129.0	10.7
1899... ..	5.7	11.4	17.1	13.6	8.0	11.0	17.125	18.5	12.375	28.0	31.875	23.25	197.9	16.5
1900... ..	10.3	13.5	31.16	22.1	23.9	15.25	21.5	30.25	23.25	24.3	56.7	34.3	306.5	25.5
1901... ..	13.0	41.4	32.9	33.3	33.6	24.375	30.75	39.625	38.375	47.0	18.0	6.875	359.2	29.9
1902... ..	18.8	22.8	33.8	40.7	37.4	24.6	36.4	17.875	20.625	23.375	26.0	14.125	316.5	26.4
1903... ..	20.0	10.875	16.75	38.75	21.0	22.875	33.6	26.9	28.75	31.1	29.2	33.2	313.0	26.1
Total ... ..	421.3	505.8	416.1	386.6	212.2	154.3	347.7	191.7	284.6	296.2	353.7	315.9	3885.6	323.6
Average ... ..	23.4	28.1	23.1	21.5	11.8	8.6	19.3	10.6	15.8	16.5	19.65	17.6	215.9	17.98
Average, omitting 1897. {	24.7	28.7	23.7	22.5	12.2	9.1	11.5	11.1	16.3	16.9	20.2	18.2	—	—

Average per year... .. 216 cwts.

" per month ... .. 18 "

We may describe somewhat more briefly the records for the other species of fish.

The curve of monthly averages for *Cod* (Fig. 9) shows a very high maximum in April; the absolute minimum occurs in October. The secondary cusp in July would be higher and more distinct were it not for the occurrence in July, 1897, of a catch so small as to indicate apparently an all but entire absence of *Cod* upon the fishing grounds, and this temporary scarcity is the more remarkable because it coincided in date with the well-authenticated fact of an extraordinary abundance of *Whiting*. But be that as it may, the cusp in July is but a small one, and but little separated from the great one in April. So far as the essential phenomena of the Granton *Cod* fishing are concerned, we might treat the whole curve as a very simple one, falling from a conspicuous maximum in April to an equally well-marked minimum between September and November. But the secondary cusp in July acquires new interest and importance when we compare the Granton curve with that for *Montrose*, and see that the striking feature of the latter is a high maximum in July. In short, the Granton curve reflects in a minor

degree the conspicuous July maximum of the Montrose curve, as the latter conversely shows a diminutive cusp in March analogous to the principal Granton maximum which occurs in April.\*

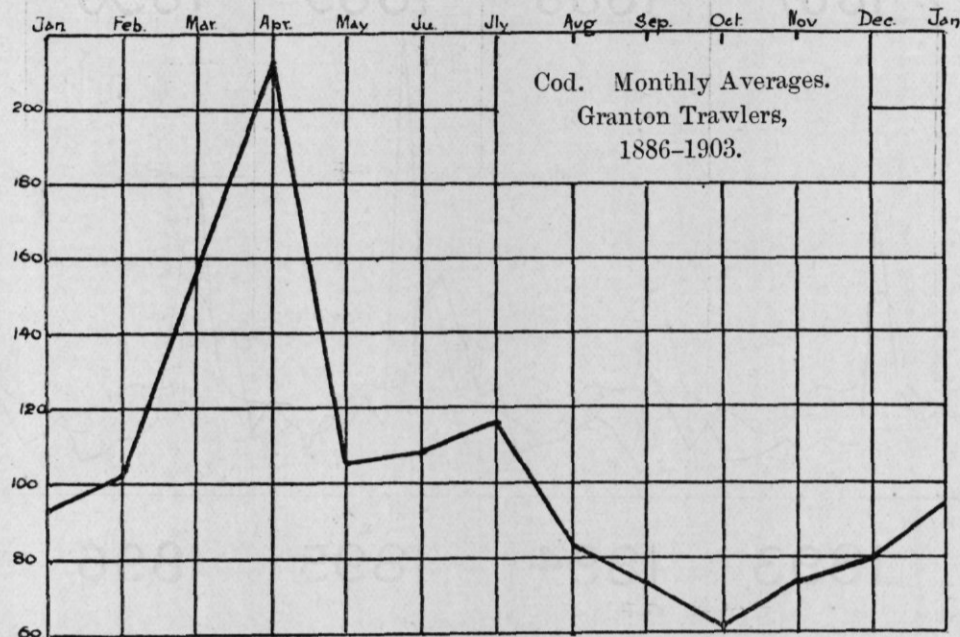


FIG. 9.

When we now turn to inspect the continuous curve (Fig. 10) of Monthly Averages, drawn from year to year, we see that the Spring maximum is clearly marked in the case of almost every year, and that it is for the most part exceedingly sharp and constant as to date; it is only in the years of the poorest fishing, 1900 and 1901, that it ceases to be characteristic. It is clear that this Spring immigration of Cod is a regular and important factor in the Trawlers' catch, and that the Autumn scarcity is a phenomenon of equally regular recurrence. The secondary increase about the month of July will be found to be not infrequently discernible on the curve. It is well seen in 1895, 1896, 1899, 1901, and 1903, and assumes exceptional importance in 1902.

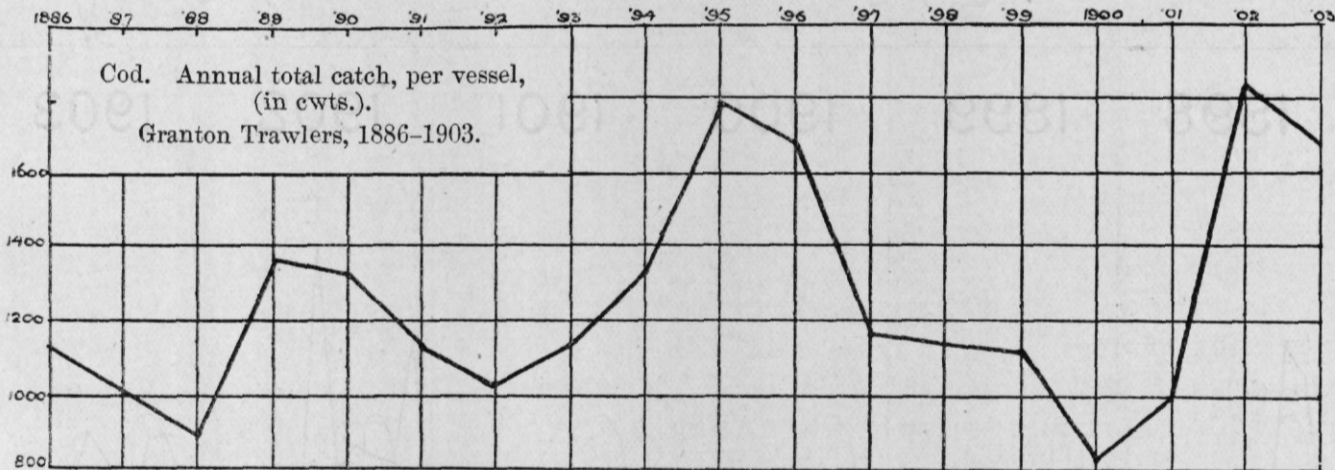


FIG. 11.

The curve (Fig. 11) which shows the fluctuations of the total annual catch is an irregular one, and shows alternating periods of comparative scarcity and abundance. For the years 1886-1894, the

\* *Cod.*—A difference of 10 cwts. between one month and another would come without any seasonal influence. An April maximum is proved, and the catch for March is greater than that for February. The months from August to November show smaller catches than those from February to July. The July catch is not significantly greater than that for June, being greater ten times, and less eight times, in eighteen years. Other differences are not significant.—A. L. B.

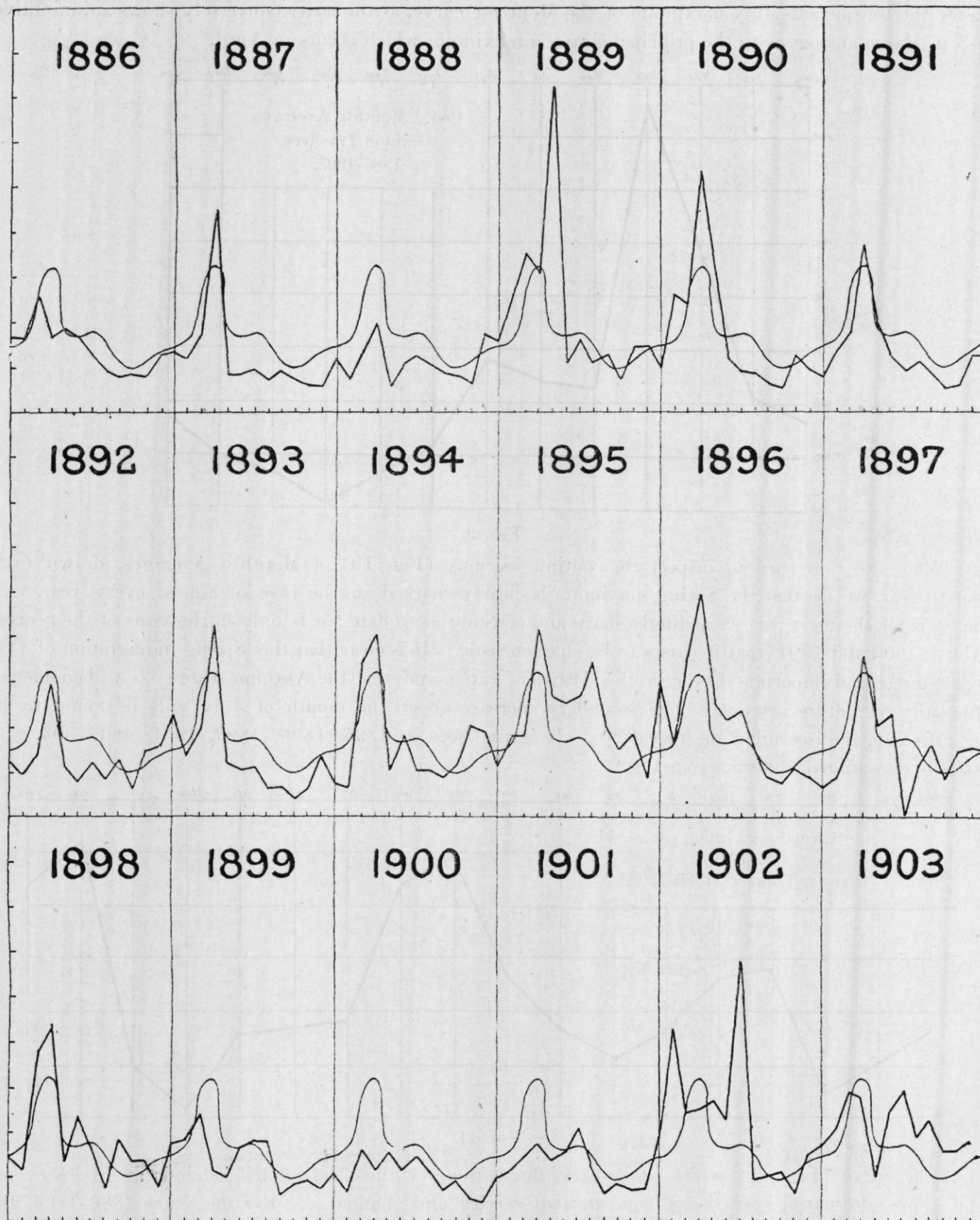


FIG. 10.

Cod. Annual Monthly Averages, per vessel, in cwts.  
Granton Trawlers, 1886-1903.

Thick Line.—Averages month by month for each year.

Thin Line.—Composite Monthly Averages for the whole period.

catch was on the whole much below the average, only reaching or very slightly exceeding it in 1889, 1890, and 1894. The catch was very much in excess of average during the years 1895 and 1896, but was below average during four out of the five following years; in 1902, after three bad years, the catch was a great one, and it was but little less in 1903. There is no sign whatsoever of progressive increase or decrease.

## GRANTON TRAWLERS.—AVERAGE TAKE OF COD (IN CWTs.) PER VESSEL EMPLOYED, 1886-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average for the Year.	Average per Month.
1886 ... ..	108·8	108·0	170·0	110·0	124·0	112·0	86·0	62·0	54·0	58·4	56·0	84·0	1133·2	94·4
1887 ... ..	90·0	80·0	114·0	300·0	58·0	57·2	64·0	50·0	64·0	50·0	42·0	40·0	1009·2	84·1
1888 ... ..	80·0	50·0	92·0	132·5	40·0	68·0	83·0	69·5	60·3	53·16	44·5	117·0	890·0	74·2
1889 ... ..	107·5	175·0	234·0	207·0	47·8	73·8	109·16	74·6	85·3	49·3	97·5	99·3	1360·3	113·3
1890 ... ..	67·1	102·9	160·0	357·1	201·4	81·9	62·3	59·7	45·7	36·3	84·7	65·7	1324·8	110·4
1891 ... ..	57·4	92·3	119·3	247·1	131·9	83·1	65·5	74·25	58·0	36·7	40·7	82·2	1088·45	90·7
1892 ... ..	82·2	64·9	93·3	197·1	74·3	52·8	78·0	56·8	82·9	42·2	98·9	102·2	1025·6	85·5
1893 ... ..	151·1	93·3	130·0	284·4	82·2	73·3	73·3	44·4	43·3	27·8	44·5	90·0	1137·6	94·8
1894 ... ..	53·3	47·1	227·8	268·9	71·8	120·0	71·3	69·45	61·1	79·45	137·0	125·6	1332·8	111·0
1895 ... ..	75·8	122·25	122·25	278·75	180·0	172·5	181·875	228·125	136·25	101·5	123·125	60·0	1782·4	148·5
1896 ... ..	198·75	113·25	230·5	328·75	167·9	145·0	155·6	101·0	60·6	52·5	70·0	61·25	1685·1	140·4
1897 ... ..	45·75	60·625	105·0	238·75	135·0	152·5	·625	77·625	106·25	58·0	97·5	104·0	1181·6	98·5
1898 ... ..	97·5	77·5	253·75	292·5	90·0	156·75	115·125	52·5	120·0	92·0	90·0	53·125	1490·75	124·2
1899 ... ..	118·0	125·7	160·0	77·1	67·7	111·25	123·0	121·25	41·875	58·75	65·0	48·75	1118·4	93·2
1900 ... ..	70·7	45·0	107·8	75·7	101·4	76·25	96·25	73·25	47·3	60·3	37·4	31·4	822·5	68·5
1901 ... ..	66·9	76·4	97·7	115·4	90·0	102·5	139·125	85·875	45·0	58·75	49·75	53·75	981·2	81·8
1902 ... ..	126·0	287·7	164·5	170·0	180·9	152·9	387·1	62·25	70·0	74·75	44·5	101·25	1824·9	152·1
1903 ... ..	115·0	138·75	194·375	187·125	68·25	164·375	195·7	128·9	151·625	106·9	105·9	121·7	1678·6	139·9
Total ... ..	1711·8	1861·675	2776·275	3868·175	1912·55	1956·125	2086·96	1494·475	1333·2	1096·76	1328·975	1441·225	22867·4	1905·5
Average of Monthly Averages. }	95·1	103·4	154·25	214·9	106·3	108·7	115·9	83·0	74·1	60·9	73·8	80·1	1270·4	105·9
Average from Annual Totals. }	95·4	100·5	153·6	223·5	107·5	108·9	115·4	83·9	74·2	62·5	76·2	79·1	105·8	—

Average per year ... .. 1270·0 cwts.  
 „ per month ... .. 106·0 „

The composite monthly curve for *Plaice* is very irregular: but it is clear that we have a maximum in late summer or autumn, and a minimum in winter or early spring. The minor cusps for August and October are chiefly, if not wholly, due to catches in August, 1899, and October, 1890, so great as manifestly to derange the averages. Between December and April the curve shows apparently a small subordinate wave, leading to a low maximum in February or March. It will be remembered that we

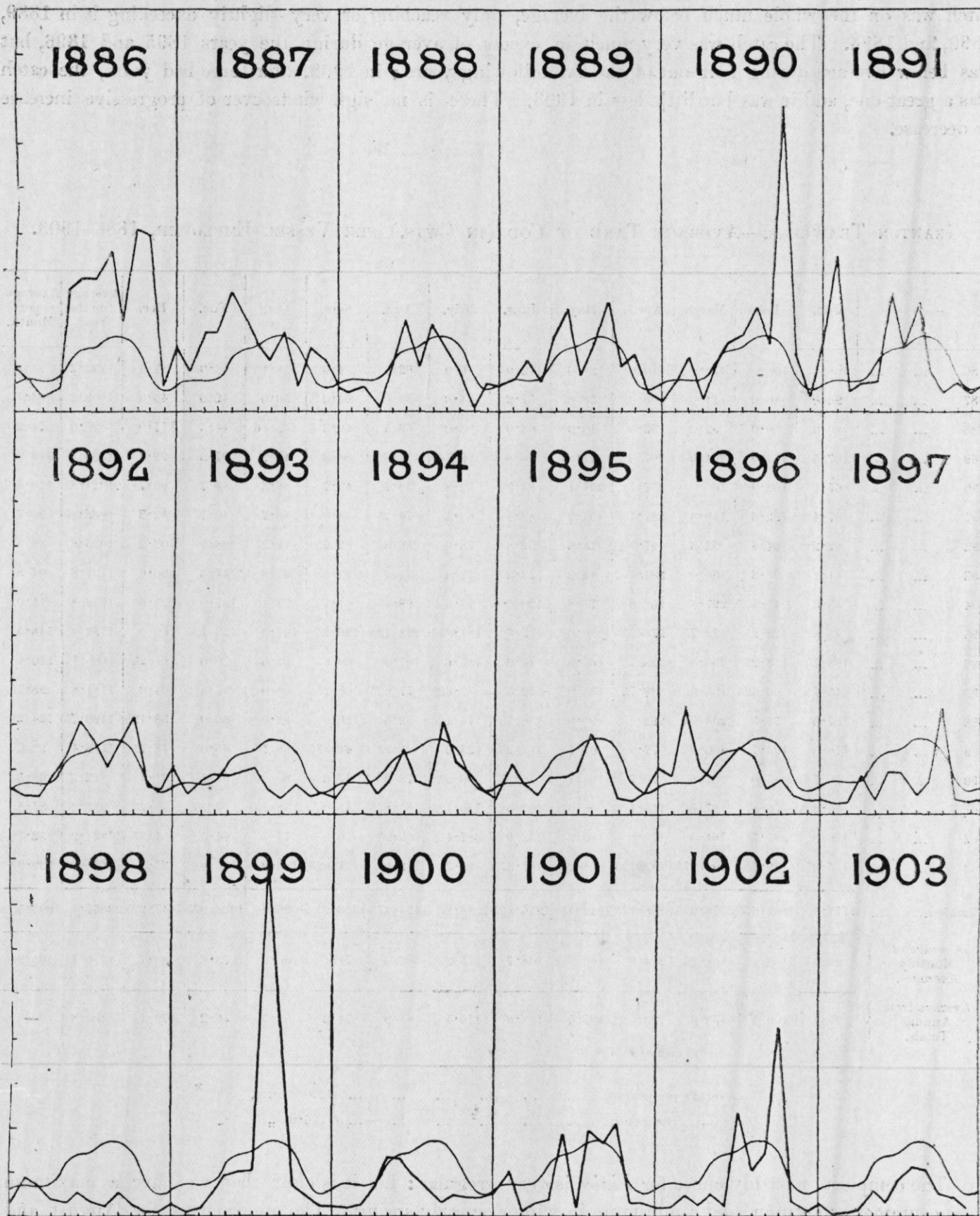


FIG. 13.

Plaice. Annual Monthly Averages, per vessel, in cwts.  
Granton Trawlers, 1886-1903.

Thick Line.—Average month by month for each year.

Thin Line.—Composite Monthly Average for the whole period.

found at this period a distinct secondary maximum in the case of Haddock, whose chief annual maximum likewise coincides with that of the Plaice; but it must be confessed that the existence of a low spring

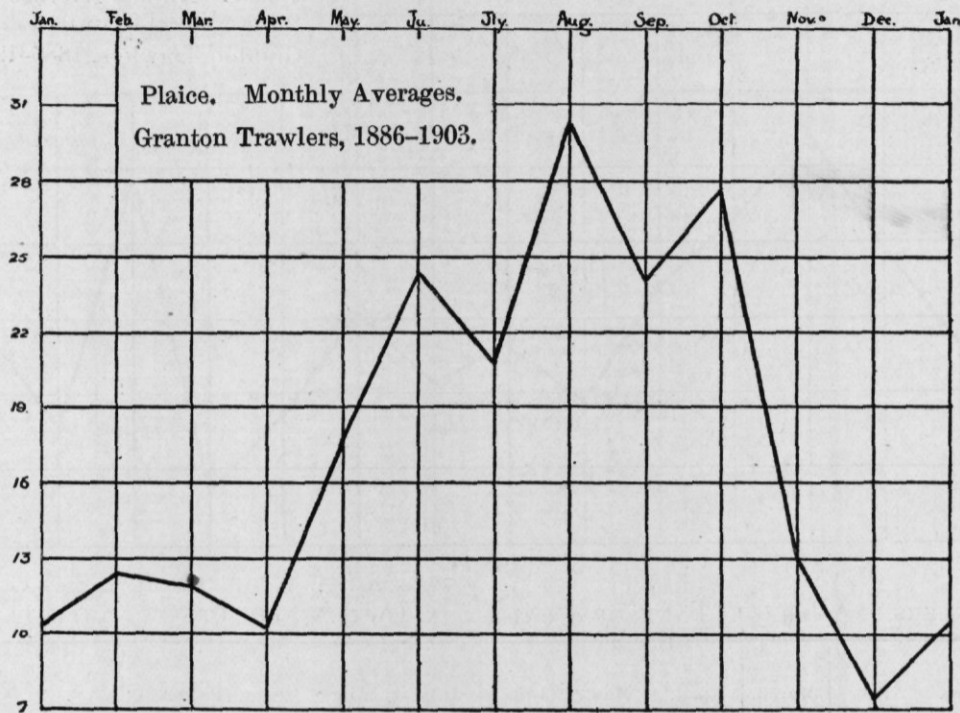


FIG. 12.

maximum for the Plaice is not nearly so well defined as in the case of the Haddock. From April onwards the increase in the abundance of the Plaice until the autumn months is clearly shown.\*

The continuous monthly curve is again shewn for Plaice (Fig. 13), as it was in the case of Haddock and of Cod, and it deserves to be studied in the same way. It will be seen at a glance that the fishing has been subject to great irregularities; that 1903 is the only year of the whole series during which the catch has fallen below the average for every month of the year; that the summer maximum is fairly well shewn in every year with the single exception of 1898; and that even in the best years the fishing was far from being uniformly good, but was swollen by comparatively short periods of abundance alternating with the usual seasons of comparative scarcity.

The annual curve for Plaice (Fig. 14) starts in 1886 at a higher point than it ever reaches again. It falls to below the average for the whole period in 1888, but afterwards remains above it until 1892. Thereafter it only once ascends above the average, viz, in 1900. The years 1898 and 1903 are the worst years of the series. During 1886, fishing was still permitted in the Bays, such as St. Andrew's and

\* *Plaice*.—A difference of 2 or 3 cwts. between two monthly averages would occur by chance. August and October are months of maximum, but the fall in September is not significant; and it is not safe to speak of two maxima in this case. The fall from June to July might also easily arise by chance and is not significant. The fall from October to November and from November to December is significant, as are the rises from April to May and May to June; but none of the changes from December to April are significant.—A. L. B.

Carnoustie; in such places the Flat-fish gather, and this circumstance probably accounts for the good fishing of that year. The later fluctuations give no clear evidence of progressive decline.

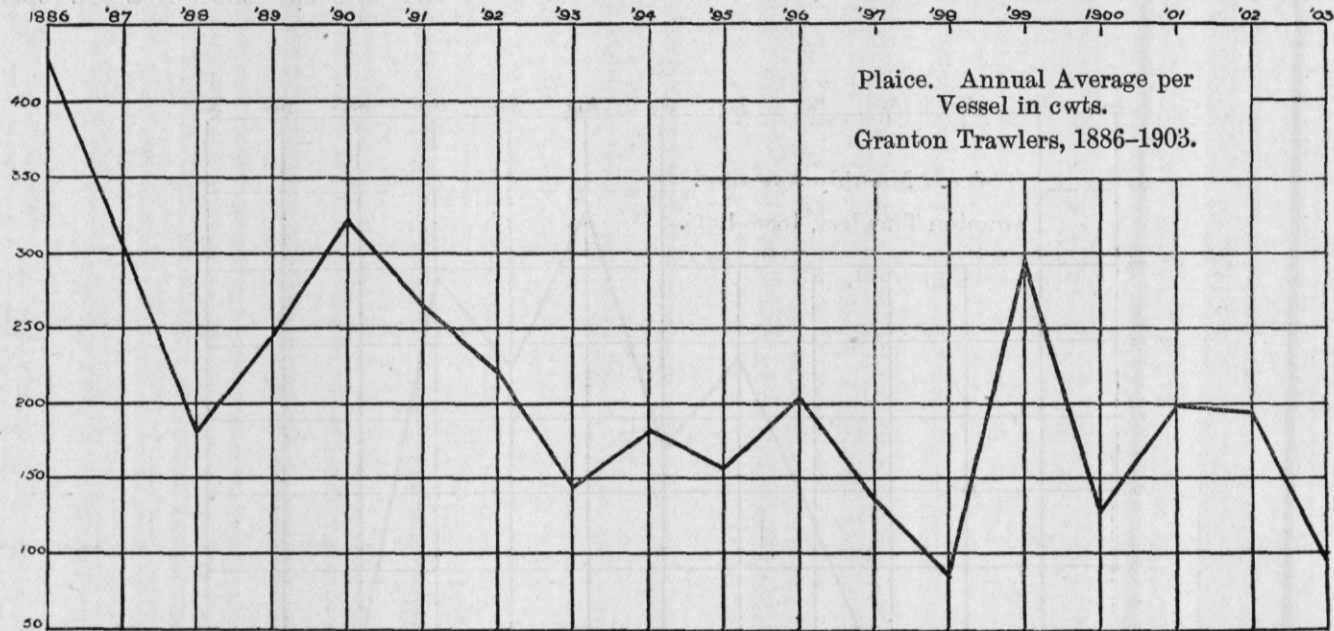


FIG. 14.

GRANTON TRAWLERS.—AVERAGE TAKE OF PLAICE (IN CWTS.) PER VESSEL EMPLOYED, 1886-1903.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average for the Year.	Average per Month.
1886	16.6	12.0	6.0	9.4	46.0	50.0	50.0	60.0	34.0	68.0	66.0	10.0	428.0	35.7
1887	24.0	15.0	30.0	30.0	44.0	34.0	26.0	20.0	30.0	10.0	24.0	20.0	307.0	25.6
1888	9.0	8.0	9.0	2.5	16.8	34.0	17.8	33.3	23.5	16.6	1.5	10.3	181.3	15.1
1889	10.0	12.5	19.0	12.0	26.8	38.5	14.5	26.0	40.5	17.0	21.16	7.8	245.8	20.5
1890	4.6	11.4	20.4	5.7	17.6	26.0	28.6	39.6	25.7	114.4	21.7	5.9	321.6	26.8
1891	28.6	58.6	8.0	6.1	11.7	43.7	24.75	40.875	15.0	7.9	11.3	7.1	263.6	22.0
1892	9.6	7.1	6.7	14.0	22.0	34.1	27.8	17.8	27.1	35.6	10.3	9.4	221.5	18.5
1893	17.8	8.0	12.2	15.0	15.0	15.8	16.9	10.0	6.3	11.1	6.7	8.1	142.9	11.9
1894	6.45	13.3	15.6	7.8	12.2	24.0	12.2	11.6	33.4	19.6	15.6	8.9	180.6	15.0
1895	5.6	18.25	11.75	7.75	14.375	14.0	16.25	30.0	18.75	5.875	5.0	8.25	156.4	13.0
1896	17.9	13.75	38.75	17.75	15.25	20.0	25.0	18.125	10.0	13.25	6.875	5.25	201.9	16.8
1897	5.625	4.625	2.5	13.75	5.875	16.25	15.75	7.75	12.0	39.625	5.75	5.0	134.5	11.2
1898	6.0	15.0	11.75	7.0	6.25	9.375	6.25	4.5	8.875	4.875	2.0	1.875	83.7	7.0
1899	2.6	1.9	3.6	9.3	15.6	17.0	17.5	130.0	72.5	12.625	8.375	5.0	294.0	24.5
1900	3.8	3.8	4.7	11.7	22.9	22.0	15.375	10.75	6.125	8.6	8.0	7.7	125.4	10.4
1901	8.6	17.1	2.3	6.0	7.1	30.875	4.625	48.75	27.875	34.625	5.5	5.0	198.3	16.5
1902	3.8	3.8	7.8	4.9	8.6	4.6	39.4	17.5	24.0	70.625	5.5	2.0	192.5	16.0
1903	5.625	1.1	1.5	3.25	10.0	5.5	13.7	18.4	17.375	8.9	6.7	3.1	95.1	7.9
Total..	186.2	225.22	211.55	183.9	318.05	439.7	372.4	544.95	433.0	499.2	231.96	130.675	3774.1	314.4
Average of Monthly Average.	10.3	12.5	11.75	10.2	17.7	24.4	20.7	30.3	24.05	27.7	12.9	7.3	209.7	17.5
Average from Original Figures.	10.1	12.5	10.8	10.2	16.4	23.3	19.9	29.5	23.5	26.7	12.1	6.8	204.2	17.2

Average per year ... .. 204 cwts.  
 „ per month... .. 17 „

*Turbot and Lemon Sole* are not separated, but are taken together, in the Granton statistics. We may take it as probable that Lemon Soles predominate considerably in the actual totals. The average monthly curve for the two fish taken together (Fig. 15) gives us one great annual wave, rising from a

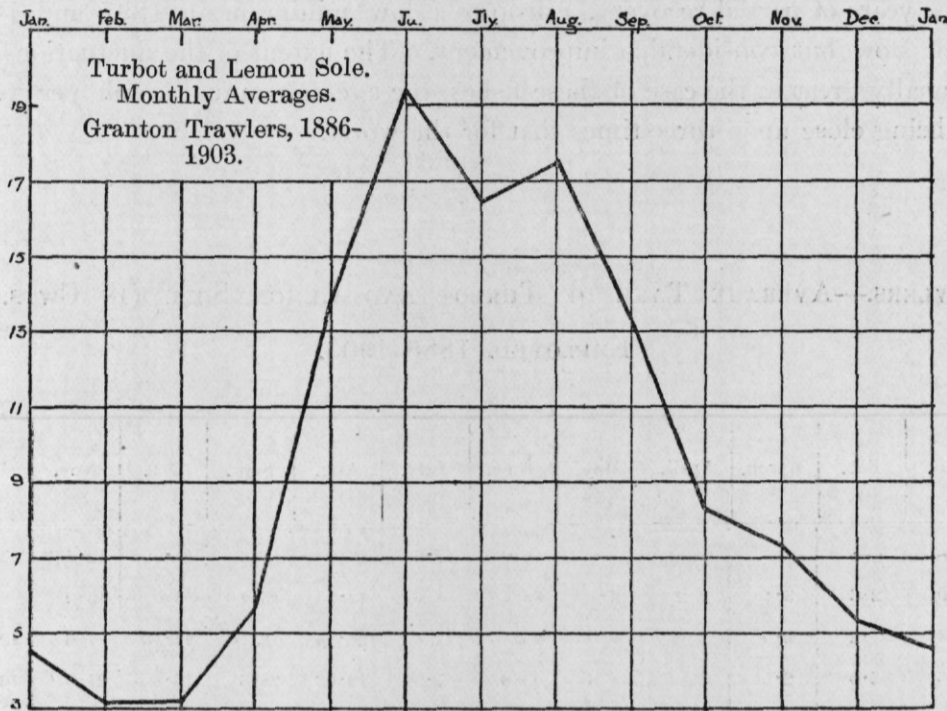


FIG. 15.

minimum in February and March to a summer maximum with cusps in June and August. The greater dubiety attaching to this case, owing to the intermingling of two sorts of fish in the same statistics

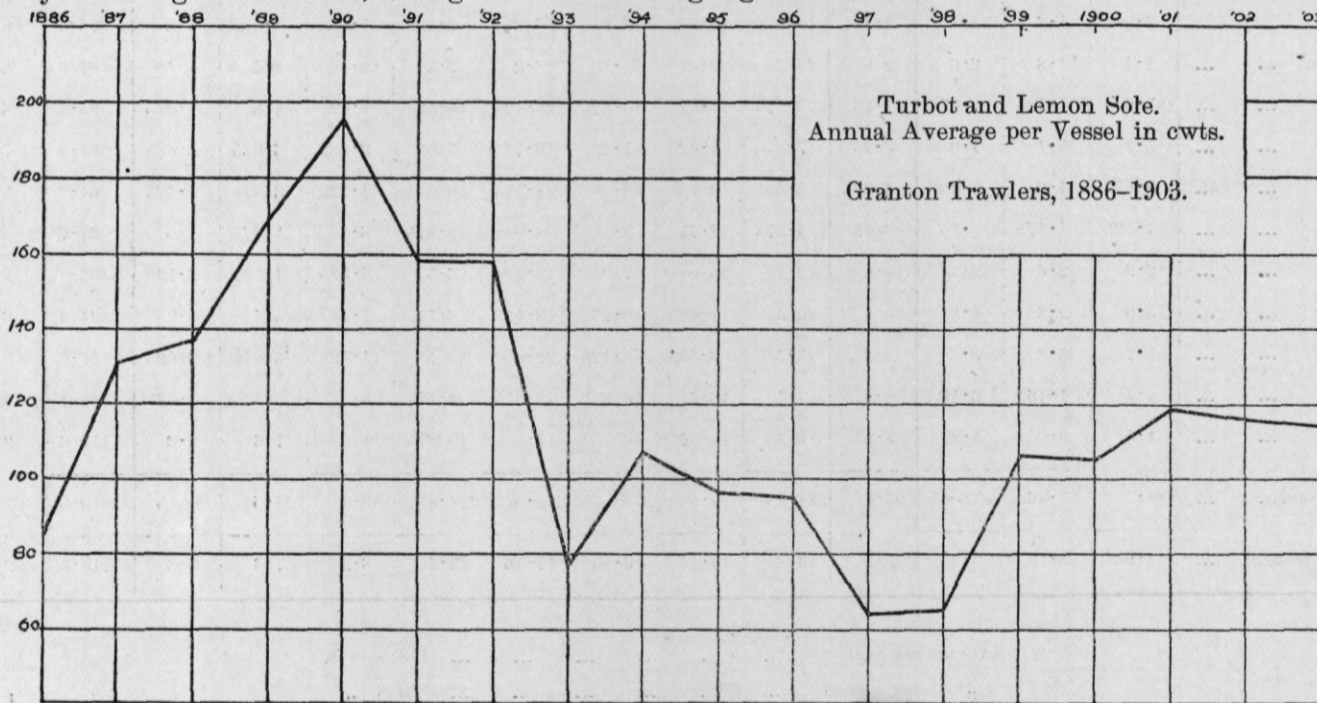


FIG. 16.

renders it even less necessary to pursue this question here than in the cases of the Whiting and the Plaice.\*

\* *Turbot and Lemon Sole*.—A difference of 2 cwts. between two monthly averages would occur by chance. The maximum is from June to August. The fall from August to September and from September to October, and the successive rises from March to June, are all significant. The changes from October to March are not separately significant, but the minimum is in February or March.—A. L. B.

The curve of *annual* variation for Turbot and Lemon Sole (Fig. 16) shows that the earlier years of our series were much better than the more recent years; in 1890, the average take reached a maximum at a point not very far from double the average take of 1903. From 1890 there was a steady decline till 1893, and then after three years of partial recovery, a drop to a low minimum in 1897 and 1898, since which year there has been slow but considerable improvement. The extent of the fluctuations from one year to another is exceptionally great in the case of these fishes, the average annual catch per vessel in the best year of the series being close upon three times that for the worst.

GRANTON TRAWLERS.—AVERAGE TAKE OF TURBOT AND LEMON SOLE (IN CWTS.) PER VESSEL  
EMPLOYED, 1886-1903.

—	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average for the Year.	Average per Month.
1886 ... ..	—	—	—	—	—	16·0	17·6	13·0	11·6	11·0	12·4	3·4	85·0	12·1
1887 ... ..	6·0	2·6	3·4	6·2	16·4	18·6	18·0	12·2	15·4	8·0	13·0	11·0	130·8	10·9
1888 ... ..	6·4	4·2	5·0	1·0	9·0	25·16	12·6	26·16	16·16	14·16	4·6	12·6	137·0	11·4
1889 ... ..	12·5	3·0	2·5	2·0	18·8	25·8	7·5	19·0	28·6	16·6	21·6	10·0	167·9	14·0
1890 ... ..	6·7	7·3	5·7	6·1	17·1	39·6	30·3	35·6	22·3	8·7	9·6	5·6	194·6	16·2
1891 ... ..	7·9	2·7	3·0	2·9	19·6	37·1	30·875	24·25	13·6	6·7	6·1	3·4	158·1	13·2
1892 ... ..	6·0	4·1	3·7	9·2	14·7	24·7	27·0	21·7	20·9	8·2	13·6	4·4	158·9	13·2
1893 ... ..	3·9	1·8	1·45	4·45	10·9	12·6	13·9	8·2	6·3	5·1	3·8	4·2	76·6	6·4
1894 ... ..	1·4	1·8	2·6	2·9	16·2	22·0	10·1	18·2	9·2	10·44	8·1	4·1	107·0	8·9
1895 ... ..	1·6	1·125	·875	1·75	10·375	11·625	15·625	23·125	15·625	4·625	4·5	4·625	95·5	8·9
1896 ... ..	5·1	5·1	1·0	6·25	17·375	14·625	17·25	13·75	5·625	2·625	3·625	2·625	94·9	7·9
1897 ... ..	3·875	1·0	·75	4·375	5·625	9·75	10·75	8·5	10·0	4·125	3·875	1·625	64·2	5·3
1898 ... ..	1·125	·875	·75	3·125	5·375	12·75	9·5	8·0	13·375	6·5	1·875	1·5	64·75	5·4
1899 ... ..	2·9	2·6	2·9	10·0	12·4	25·0	17·0	13·625	6·5	5·625	4·125	3·125	105·8	8·8
1900 ... ..	3·0	2·8	4·8	10·6	20·3	12·625	10·75	13·125	8·75	7·9	6·4	3·9	104·9	8·7
1901 ... ..	5·7	5·3	3·6	9·4	13·7	9·625	15·125	22·0	12·5	11·125	6·875	2·625	117·6	9·8
1902 ... ..	5·7	4·16	6·16	8·1	17·1	16·6	16·6	13·375	9·125	8·5	5·375	5·625	116·4	9·7
1903 ... ..	4·5	3·0	5·875	8·25	9·5	11·375	16·7	17·7	10·875	11·0	7·6	9·2	115·6	9·6
Total... ..	84·3	53·46	54·06	96·6	234·45	329·535	279·575	298·5	224·8	139·9	124·6	90·15	2010·55	167·4
Average ...	4·96	3·15	3·2	5·7	13·8	19·4	16·45	17·56	13·2	8·2	7·3	5·3	118·3	9·8

Average per year ... .. 118·3 cwts.  
 „ per month ... .. 9·8 „

Finally, for all the species of fish, the averages for the 18 successive years have been combined in nine ten-year periods, and the resulting Table deserves to be studied in connection with those that show the successive averages for the single years.

## GRANTON TRAWLERS.—AVERAGE MONTHLY CATCH PER VESSEL (IN CWTS.) FOR TEN-YEAR PERIODS.

	1886-1895.	1887-1896.	1888-1897.	1889-1898.	1890-1899.	1891-1900.	1892-1901.	1893-1902.	1894-1903.
Total Catch ... ..	397.6	397.8	385.0	380.3	365.0	351.0	337.8	341.6	348.0
Haddock ... ..	200.1	196.9	184.9	177.2	164.6	163.9	157.5	153.1	153.2
Cod ... ..	100.7	105.3	106.7	111.8	109.7	105.5	104.7	111.3	115.8
Whiting ... ..	16.7	14.2	14.4	13.1	12.6	12.8	13.5	14.8	16.0
Plaice ... ..	20.4	18.5	17.1	16.3	16.7	15.0	14.5	14.3	13.9
Turbot and Sole ... ..	—	11.0	10.5	9.9	9.3	8.6	8.3	7.9	8.2

## GRANTON TRAWLERS.—AVERAGE CATCH PER VESSEL FOR TEN-YEAR PERIODS, REDUCED TO PERCENTAGES OF THE FIRST TEN-YEAR PERIOD.

	1886-1895.	1887-1896.	1888-1897.	1889-1898.	1890-1899.	1891-1900.	1892-1901.	1893-1902.	1894-1903.
Total Catch ... ..	100.0	100.0	97.0	95.6	91.8	88.3	84.9	85.9	87.5
Haddock ... ..	100.0	98.4	92.4	88.6	82.3	81.9	78.7	76.5	76.6
Cod ... ..	100.0	104.6	106.0	111.0	109.0	104.8	103.9	110.5	115.0
Whiting ... ..	100.0	85.3	86.1	78.7	77.0	76.8	81.2	89.0	95.9
Plaice ... ..	100.0	90.8	83.7	79.7	81.7	73.7	71.0	69.8	67.9
Turbot and Sole ... ..	—	100.0	95.0	89.5	84.8	78.0	74.9	71.7	74.7

## GRANTON TRAWLERS.—TEN-YEAR PERIODS. PERCENTAGE INCREASE OR DECREASE OF THE AVERAGE CATCH PER VESSEL IN EACH PERIOD COMPARED WITH THE PRECEDING ONE.

	1886-1895.	1887-1896.	1888-1897.	1889-1898.	1890-1899.	1891-1900.	1892-1901.	1893-1902.	1894-1903.
Total Catch ... ..	—	0.0	-3.1	-1.4	-4.0	-3.8	-3.8	+1.1	+1.9
Haddock ... ..	—	-1.6	-6.1	-4.2	-7.1	-0.5	-3.0	-2.8	0.0
Cod ... ..	—	+4.6	+1.4	+4.7	-1.8	-3.8	-0.8	+6.4	+4.0
Whiting ... ..	—	-14.7	+1.5	-8.9	-2.2	-0.4	+5.7	+9.6	+7.7
Plaice ... ..	—	-9.2	-7.8	-4.8	+2.5	-9.8	-3.6	-1.7	-2.8
Turbot and Lemon Sole ... ..	—	—	-5.0	-5.8	-5.4	-8.0	-3.9	-4.3	+4.1

If we attempt to compare the annual fluctuations of the several species of fish, as shown by the foregoing curves, it is at once plain that there is no close and obvious similarity between them. There is certainly no such resemblance as we should expect to find were only one common cause operating to the increase or decrease of each species. But, at the same time, we do seem to be able to detect certain resemblances, or certain contrasts, between particular cases.

There is a certain rough resemblance, though by no means a close one, between the curves for Plaice and for Whiting, both of them passing about 1890 from a period of comparative plenty to a period of relative scarcity; though the more recent years of abundance (from 1900) in the case of the Whiting, are unhappily not shared in the case of the Plaice. The curve for Cod is a totally different one, that fish having a marked period of abundance from 1895 to 1897, when Whiting, Plaice, and also Turbot and Sole, were all scarce; but this period of the Cod's abundance was at least in part coincident with a temporary abundance of the Haddock. On the whole, however, it must be confessed that the resemblances between these curves are few as compared with the differences between them; and we may take this as a sure sign that the causes of these fluctuations, if they be discoverable at all, are remote and complicated.

GRANTON TRAWLERS.—ANNUAL TOTAL CATCH (IN CWTS.) OF VARIOUS FISHES, PER VESSEL.

	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	Average per Year.	Average per Month.
Cod .. .. .	1,133	1,009	890	1,360	1,325	1,088	1,026	1,138	1,333	1,782	1,685	1,182	1,490	1,118	822	981	1,825	1,679	1,270	106
Haddock .. .	2,755	3,046	2,494	2,881	1,624	2,061	2,149	1,864	1,878	3,260	2,373	1,808	1,566	1,374	1,535	1,293	1,623	1,870	2,064	172
Whiting .. .	330	200	286	232	312	271	160	75	67	67	96	225	129	198	306	359	316	313	216	18
Plaice .. .	428	307	181	246	322	264	221	143	181	156	202	134	84	294	125	198	192	95	204	17
Turbot and Lemon Sole .. .	—	131	137	168	195	158	159	77	107	96	95	64	65	106	105	118	116	114	117	10

It will be seen that the average catch of Cod was at its lowest during the first ten-year period, and at its highest in the last, the progressive increase having, however, been interrupted in the periods covered by the periods 1890–1899 to 1892–1901: there is no indication of decrease, nor, on the other hand, is there clear evidence of important increase.

The averages for Whiting descended gradually until the period 1891–1900, and afterwards ascended steadily to a point all but identical with that at which they began.

All the other fish, and also the Total Catch, show a steady or very nearly steady diminution, amounting to 25 per cent. for Haddock and for Turbot and Lemon Sole, 32 per cent. for Plaice, and 14 per cent. for the Total Catch.

But several things have to be borne in mind before we assume that these figures indicate a serious peril for the future.

In the case of Turbot and Lemon Sole, the curve for the single years seems to show clearly that the years 1897–1898 were at the bottom of a wave, from which there has since been a considerable recovery.

In the case of Plaice, our last ten-year period includes two years, viz., 1898 and 1903, in which the catch was quite exceptionally small: and our first period include the year 1886, when (p. 269) more profitable grounds were open to fishing.

In the case of Haddock, there are signs of marked improvement since the lean years that began in 1897 and that came to their worst in 1901.

Moreover, the fact that of our five categories of fish, one, the Cod, has shown, if anything, an increase one, the Whiting, after diminishing has recovered again, while three show, so far, signs of diminution in greater or less degree, is in itself a clear indication that no sweeping statements ought to be made with reference to a falling off of the fish-supply and still less as to the cause thereof, without first descending to particulars and ascertaining the actual facts as regards each separate species.

Lastly, we must not forget that we are dealing here with the average catch *per vessel*, and that the number of vessels employed and the total catch drawn from the grounds in question have undoubtedly increased enormously. And though we cannot enter at present into all the complicated questions that arise, yet it is plain enough that we cannot expect to obtain for ever an undiminished catch from each vessel of a continually increasing fleet unless we assume the available stock of fish to be infinite indeed.\*

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\* *The Annual Fluctuations.*—In the case of *Cod*, the fluctuation is considerable, but quite irregular: there is no evidence of any causes being at work to produce either a permanent increase or decrease. *Haddock* show a distinct falling off during the eighteen years; the minor fluctuations are considerable, but are not sufficient to account for the apparent falling off: some cause or causes are here at work tending to a decrease. *Plaice* show a perceptible falling off during the earlier years of the period, but from 1893 to 1903 they fluctuate with no significant changes. In the case of *Turbot and Lemon Sole*, the catches from 1887 to 1892 were much greater than subsequently; but other information, such as information for antecedent years, would be required to tell us whether this excess was exceptional or not: no significant change is perceptible during the last ten years. In the case of *Whiting*, a great fall and a subsequent recovery suggest some special cause of diminution having been at work during the years 1891 to 1897; but the whole period under consideration is not long enough for a definite conclusion.—A. L. B.