

The Immature Fish Question.

By

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I. STATISTICS.

It is only eight years since the Royal Commission on beam trawling issued its report, and already a Select Committee of Parliament has been appointed to make a new inquiry into one of the principal subjects investigated by that Commission, namely, the decrease of the fish supply and the advisability of remedial measures. Among the conclusions of the Commission was this one :

“That in the absence of a proper system of fishery statistics and scientific observations, it is impossible to measure the fluctuations of the fisheries or to discover their causes.”

In consequence of this statement the Board of Trade began the collection and publication of fishery statistics in 1886. Before that time only a return of the quantity of fish conveyed inland by rail had been issued ; and although the Scottish Fishery Board had for many years obtained some statistics of the fish caught and landed in Scotland, none had been recorded in England, Wales, or Ireland. The Fishery Statistics are now annually issued in a series continuous with the old return of rail-borne fish, which is still included among the tables. The return now gives the total quantity and value of the different kinds of fish landed, the average price, the quantities for the different coasts of England and Wales, the quantities for the different months, and the totals for each port or district.

Within the last few years an agitation has developed among those engaged in the fishing industry on the east coast of England, concerning the capture of immature or undersized flat-fish, and the decrease in the supply of the more valuable kinds of these fish, namely, soles, turbot, brill, plaice, and lemon soles. The conclusion of the Commission of 1883-5 on this subject was as follows :

After carefully considering the whole evidence on the question of the decrease of fish, we are of opinion that—

As regards territorial waters :

(1) On many fishing-grounds, from the Moray Firth to Grimsby, there has been a falling off in the takes of flat-fish, both as regards quantity and quality.

(2) There has also been a decrease in the takes of haddock in certain places, chiefly in bays and estuaries.

As regards off-shore waters :

(3) No decrease, except in the case of soles, has been proved in the total takes of the North Sea.

Now let us turn to the statistics that have since been collected. The return for the year 1892 is not yet issued,* so that we have only six years to compare altogether ; and this is a very short period to draw conclusions from, even if the statistics furnished all the particulars that were required to show the increase or decrease of the supply. The table below shows the total quantities in cwts. of the

England and Wales—all Coasts.

	1886	1887	1888	1889	1890	1891	1892
Brill	—	—	—	—	15,403	16,571	17,740
Turbot	59,850	63,166	55,041	53,576	51,879	56,875	62,630
Soles	98,078	85,316	72,522	74,143	72,129	82,688	72,821
Other prime fish	370,014	115,850	113,415	35,982	46,771	38,754	50,655
Total prime fish	527,942	264,332	240,978	163,701	186,182	194,888	203,846
Plaice	—	—	698,142	594,307	622,577	711,322	696,227
All fish except } shellfish	6,412,433	6,029,481	6,348,072	6,464,564	6,100,630	5,966,076	6,485,699
Total, excluding } salmon	6,397,367	6,012,371	6,340,774	6,460,064	6,095,512	—	—
Total value, ex- } cluding shellfish } £	3,688,079	3,778,958	3,948,013	3,862,389	4,368,552	4,491,018	4,628,705
Drift-net fish	2,740,579	2,080,435	2,299,383	1,428,118	1,291,661	1,789,561	2,059,062
Bottom fish	3,671,854	3,949,046	4,048,689	5,036,446	4,808,969	4,176,515	4,426,637

more valuable flat-fish landed on the coasts of England and Wales, and includes certain other items from the official tables. It will be seen

* See postscript.

from this table that the total quantity of all fish exclusive of shell-fish shows fluctuations, but not steady increase or decrease. It is true that the quantity for 1891 is the least of the six totals, but the difference is not great, and the fluctuations in the other five years show that no definite importance can be attached to it. The inclusion or exclusion of the item salmon makes no appreciable difference in the result, but it is puzzling to find that there is no separate item for salmon in the year 1891, and no explanation of the omission is to be found in the memorandum which precedes the tables.

It will be seen that the figures under the item "Prime fish not separately distinguished" are so irregular that it is quite impossible to understand them. The cause of the irregularity lies evidently in changes in the method of classifying and estimating the fish followed by the returning officers. We cannot believe that certain kinds of fish constantly included under this item have fallen off to such an extent. We must conclude that this item has been enormously diminished by the abstraction from it of increasingly greater quantities which have been included under the special items. For practical purposes, then, this item is useless. If we look at the item soles, we find that the quantity for 1891 was greater than for any year except 1886 and 1887, so that on the whole there has been no very great decrease. Exactly the same is true of turbot. Assuming the figures to be reliable, however, there is a decrease in these items since 1886. Plaice has only been separately distinguished since 1888, and the annual total shows an increase, the figures for 1891 being the maximum. Brill has only been separately distinguished for two years, and nothing can therefore be said about it. It is a remarkable fact that there is no mention of lemon soles as a separate item, although these fish are sold separately at most of the fishing ports, and form an important proportion of the total catch of the deep sea trawlers. Moreover the fishing industry includes lemon soles among the flat fishes for which protection is demanded. We may note that the total value of the fish landed has increased enormously in the six years, the value in 1891 being three quarters of a million pounds greater than in 1886.

As it is trawl-fishing which is chiefly concerned in the present agitation I have added together the quantities under the items mackerel, herrings, pilchards, and sprats, and given the result separately as the total of drift-net fish, and given the remainder of the whole quantity as the total of bottom fish. The latter item includes certain other fish which are not bottom fish, such as salmon and mullet; but the quantities of these are relatively small, so that the figures I have obtained as bottom fish probably represent fairly well the total catch of deep sea trawlers. It will be seen, then, that there

has been a much greater falling off in drift-net fish than in bottom fish, considering all the coasts of England and Wales together. The item bottom fish increased greatly till 1889, but has fallen off in the following two years.

If we examine the various coasts separately, we find that the results for the east coast are closely similar to those for all coasts together. In the total quantity of fish landed, there was practically no decrease until 1889, but a decrease in 1890 and 1891. The total

England and Wales—East Coast.

	1886	1887	1888	1889	1890	1891	1892
Brill	—	—	—	—	11,746	13,531	14,590
Turbot	55,524	57,561	48,760	44,272	40,763	47,594	52,780
Soles	82,677	67,874	52,151	47,747	46,187	61,287	52,934
Other prime fish	364,557	109,424	105,057	25,848	34,391	30,197	40,265
Total prime fish	502,758	234,859	205,968	117,867	133,087	152,609	160,569
Plaice	—	—	628,658	518,688	548,784	647,915	620,951
Total except shellfish	5,321,656	5,157,678	5,260,350	5,223,635	4,719,237	4,670,646	5,105,814
Drift-net fish	1,965,657	1,628,102	1,664,854	1,790,350	1,307,410	1,100,410	1,388,937
Bottom fish	3,355,999	3,529,576	3,595,496	3,433,285	3,411,827	3,570,236	3,716,877

quantity of soles was greater in 1891 than in any other year except 1886 and 1887. The quantity of turbot was less than in 1886, 1887, and 1888, but greater than in 1889 or 1890. The quantity of plaice is at a maximum in the last year of the series.

On the south coast the total quantity of all fish except shellfish has greatly decreased, but the decrease has been in drift-net fish, not in flat fishes or trawled fish generally. The quantities of turbot and soles landed has greatly and steadily increased, although there was a slight falling off in 1891. Plaice, on the other hand, has decreased.

The west coast shows an enormous and steady increase in the total quantity of fish landed, the amount in 1891 being more than three times that of 1886. The increase has been largely in mackerel. With regard to flat-fish, turbot and soles have very

greatly increased, with a slight falling off in 1891; and plaice, as on the south coast, has decreased.

South Coast.

	1886	1887	1888	1889	1890	1891	1892
Brill	—	—	—	—	2,822	2,070	2,070
Turbot	3,211	3,582	4,408	5,838	6,733	5,392	6,231
Soles	9,555	9,314	11,256	12,709	12,159	10,808	9,126
Other prime fish	5,457	6,426	8,358	10,134	12,380	8,557	10,390
Total prime fish	18,223	19,322	24,022	28,681	34,094	26,827	27,817
Plaice	—	—	55,788	52,360	46,588	44,378	47,207
Total except shellfish	871,041	642,914	605,808	652,471	586,501	595,705	599,749
Drift-net fish	638,479	349,464	307,188	312,834	227,808	319,353	319,275
Bottom fish	232,562	293,450	298,620	339,637	358,693	276,352	280,474

When we separate the quantities of drift-net fish, as was done for all the coasts together, and describe the remainder as bottom fish,

West Coast.

	1886	1887	1888	1889	1890	1891	1892
Brill	—	—	—	—	835	970	1,080
Turbot	1,115	2,023	1,873	3,466	4,383	3,889	3,619
Soles	5,846	8,128	9,115	13,687	13,783	10,593	10,761
Other prime fish	—	—	—	—	—	—	—
Total prime fish	6,961	10,151	10,988	17,153	19,001	15,452	15,460
Plaice	—	—	13,696	23,259	27,205	19,029	28,069
Total except shellfish	219,736	228,889	481,914	588,458	794,892	699,725	780,136
Drift-net fish	136,443	102,869	327,341	324,934	465,426	369,798	350,850
Bottom fish	83,293	126,020	184,573	263,524	329,466	329,927	429,286

we find that on the east coast the latter item has varied but little. It was greatest in 1888, and the next highest figure is that for 1891. On the other hand, the total of drift-net fish has decreased steadily since 1886. On the south coast the annual quantity of drift-net fish has been pretty steady for four years out of the six, but the total for 1891 is only half that for 1886. Bottom fish on the south coast increased greatly to a maximum in 1890, but fell back considerably in 1891. On the west coast both drift-net fish and bottom fish have enormously increased.

These results are chiefly, perhaps entirely due to the fact that in recent years a large number of east coast boats of the largest size, both trawlers and drifters, have annually spent a portion of the year in fishing on the more distant grounds on the south and west coasts of England and the south coast of Ireland. Sailing and steam trawlers have fished on the grounds to the south and west of the Wolf Rock between the Scilly Isles and Mount's Bay, off the north coast of Cornwall and in the British Channel. Every spring a large fleet of mackerel boats from Lowestoft make Plymouth their headquarters, and land their fish at that port. The effect of this recent movement in the fishing industry is plainly indicated by the figures in the official return of the total quantities of fish landed at the principal ports on the several coasts (Table below). Thus we see that the quantity landed at Grimsby has slightly decreased, at Lowestoft has varied but little, at Plymouth has steadily increased, and also at Brixham; at Tenby there has been a decrease, while Milford (including Neyland) has sprung from nothing to be as important a port in relation to landing fish as Lowestoft.

	1886.	1887.	1888.	1889.	1890.	1891.	1892.
	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.
Grimsby . . .	1,363,595	1,342,240	1,401,270	1,350,430	1,297,560	1,258,840	1,377,640
Lowestoft . . .	502,097	476,947	476,718	599,946	417,373	572,777	627,578
Plymouth . . .	141,712	150,157	132,087	164,864	163,884	179,353	135,241
Brixham . . .	48,280	59,863	62,891	81,317	95,612	61,460	59,103
Tenby . . .	10,232	9,451	10,363	8,791	6,910	6,349	4,201
Milford and Neyland . . .	—	5,690	157,419	270,576	484,006	403,657	370,687

Now it is clear that an increase in the quantity of fish landed may very well be produced by an increase in the size and number of boats, and the fact that they visit new and distant grounds, at the same time that the productiveness of grounds formerly used is declining. The most rigid and reliable test of the productiveness of a given fishing-ground would be to compare the average quantity of

fish caught in a given time by the same or a similar boat in successive years. The Fisheries Department of the Board of Trade has not yet attempted this. Indeed, it has not attempted anything in relation to this subject beyond the collection of the quantities of fish landed, distinguishing certain kinds of fish, different coasts, and different ports. There is absolutely nothing in the statistical tables and memorandum concerning the number of men and boats or the size and character of the boats employed in the fisheries, if we except a brief reference in the memorandum of the first return, that for 1886. In this memorandum the number of boats and men was quoted from the Annual Statement of Navigation for 1885, and the *value* of fish landed was calculated per boat and per fisherman. In order, then,

*Boats registered in England and Wales under Sea Fisheries Act,
1868.*

	Total number of 1st class boats.	Total tonnage 1st class.	Total number all classes.	Total tonnage all classes.	Total number of regular fishermen.	Number of men required for boats.
1871	2,582	90,224	15,615	131,092	—	—
1872	2,778	100,332	15,331	140,535	—	—
1873	2,851	104,642	15,049	145,134	—	45,398
1874	2,934	110,500	15,029	150,268	25,576	46,525
1875	2,979	111,784	14,830	151,041	26,245	44,142
1876	3,142	121,445	14,809	160,332	28,238	43,399
1877	3,425	137,768	13,294	174,174	30,408	35,883
1878	3,637	149,343	10,786	182,415	30,480	31,277
1879	3,767	155,941	10,639	189,006	29,408	31,375
1880	3,840	161,450	10,524	194,532	28,835	28,085
1881	3,870	162,417	10,357	195,348	29,141	27,792
1882	3,931	170,367	10,373	203,355	30,802	27,512
1883	3,743	161,830	8,880	190,517	31,810	30,152
1884	3,840	169,161	8,622	197,300	32,631	28,020
1885	4,040	183,694	8,826	212,176	33,422	28,520
1886	4,011	189,375	8,447	216,349	34,080	32,086
1887	4,014	190,464	8,390	217,346	34,526	30,914
1888	3,982	189,292	8,417	215,725	33,509	32,823
1889	3,928	187,724	8,271	213,542	33,474	33,429
1890	3,879	183,910	8,050	208,389	32,503	30,330
1891	3,873	183,421	8,063	207,515	33,044	28,885
1892						

to ascertain the number or particulars of boats and men employed in our fisheries in successive years we have to examine the Annual Statements of Navigation and Shipping. We find there the number of boats registered under the Sea Fisheries Act of 1868, arranged in three classes. The Navigation Statement has, since 1876, been prepared by the Commercial Department of the Board of Trade, and, since it is signed only by the Assistant Secretary of that department, it appears that the Fisheries Department has nothing to do with it. So that, notwithstanding the organisation of the Fisheries Depart-

ment in 1886 to take over all fisheries business, the Act of 1868 is not administered by that department. The first class of fishing-boats includes those of fifteen tons and upwards; the second class, those less than fifteen tons not navigated by oars only; the third class, boats navigated by oars only. The table on the preceding page shows the boats on the register in successive years from 1871 to 1891. I have also extracted the number of men and boys constantly employed in fishing, compiled from estimates made by the collectors of customs, omitting the figures of those occasionally employed, and I have given the number of men and boys required to work the boats whose certificates were produced and endorsed. But both these sets of figures are only approximations, for the production of certificates every year is not everywhere rigidly enforced. The important points brought out by these figures concerning boats and men are the following.

The total number of first-class boats increased steadily from 1871 to 1885—namely, from 2582 in 1871 to 4040 in 1885. Since the latter year the number has slightly decreased down to 3873 in 1891. The total number of boats of all classes steadily decreased from 15,615 in 1871 to 8063 in 1891. The total tonnage of all classes included increased steadily from 131,000 in 1871 to 217,000 in 1887, since when it has slightly decreased to 207,000 in 1891. The total number of regular fishermen increased from about 25,000 in 1874 to 34,526 in 1887, since when it has decreased to 33,044.

Now, logically to pursue the inquiry into the increase or decrease of the fish supply, in particular of the supply of various kinds of trawled fish, and of all kinds together, it would be necessary to be able to compare the catch obtained by equal catching power in a series of years. This has recently been attempted by the Fishery Board for Scotland, which, having adequate powers, has been able for the past three years to collect statistics of the tonnage and value of trawlers fishing on the Scottish coast, and the quantities of fish landed by these trawlers, apart from the fish landed by other boats. This has not been done for England and Wales, and could not be done by the present defective organisation of fishery authorities in this part of the kingdom. The Scottish Board has an efficient scientific department managed by competent scientific men, who have devoted their trained powers and scientific methods to the problems of sea fisheries. They have also the whole coast divided into districts, each provided with a competent fishery officer who has complete knowledge and experience of the fisheries, but no pecuniary interest in them. The scientific authority can thus without difficulty obtain any information it requires.

The statistics thus obtained by the Scottish Board are discussed

in detail by Dr. Fulton in the Board's tenth report, 1892. He finds that the tonnage of Scottish trawl-vessels has increased from 2004 in 1883 to 6484 in 1891. The separate particulars of steam trawlers, which make up the greater part of this tonnage, have only been obtained since 1889. The fish landed by trawlers in Scotland has been separately recorded since 1888, and Dr. Fulton states that the total quantity has increased from 250,000 cwt. in 1888 to 323,046 cwt. in 1891. But, on the other hand, the quantity of fish per ton of the vessels' tonnage has decreased from 92·9 cwt. to 49·8 cwt. He is able further to give the quantity of round-fish and flat-fish per ton of the vessels' tonnage separately, and also the proportional quantity of several single kinds of fish. He finds in all except in skates a great falling off.

However, it must be pointed out that, in the first place, it is not safe to rely upon conclusions drawn from a series of statistics extending over so short a period; and in the second place, that the Scottish trawlers have been greatly handicapped by the closure of such extensive areas as the Firth of Forth and other territorial waters where they formerly fished.

In the following table I have indicated all that can be done in the way of comparing the statistics of fish caught, and boats employed,

	Cwt. soles per 1st-class boat.	Cwt. soles per ton 1st class.	Cwt. total fish per ton total tonnage.	Cwt. turbot per 1st-class boat.	Cwt. turbot per ton 1st class.	Total value per ton total tonnage.
1886	24·45	·51	29·63	14·92	·31	£17
1887	21·25	·44	27·74	15·73	·33	17
1888	18·21	·38	29·42	13·82	·29	18
1889	18·87	·34	30·27	13·63	·28	18
1890	18·59	·33	29·22	13·37	·28	20
1891	21·34	·45	28·75	14·68	·31	21
1892	—	—	—	—	—	—

available for England and Wales. It will be seen that the hundred-weights total fish per ton of total tonnage of fishing-boats shows slight fluctuations, but no continuous increase or decrease. There is no possibility of distinguishing trawlers and drifters among the boats registered. I have, therefore, compared the quantities of soles and turbot per first-class boat, and per ton of the aggregate tonnage of first-class boats; that is to say, I have supposed the number and tonnage of trawlers to be always in the same proportion to the aggregate numbers and tonnage of first-class boats—a supposition which may be correct or not. The results, however, are not without interest. Thus the quantities of soles per first-class boat for the several years follow almost exactly the same order as the total quan-

tities of soles landed. But whereas the absolute quantities in 1890 and 1891 are less than in the years 1888 and 1887 respectively, the quantities per first-class boat in the former years are greater. When we examine the quantities per ton of first-class boats we find a still greater difference from the absolute quantities, the proportion for 1891 being higher than for any other year except 1886. Taking next the turbot, we find that the quantities per boat follow the same order as the absolute quantities, and so also do the quantities per ton of first-class boats. The last column of the table shows that the annual earnings per ton of total tonnage have steadily increased in the six years, so that although the public are poorer on account of the increase in the price of fish, it would seem that the men and boats actually earn more money every year. But this result, again, requires qualification, for there has been especially on the north-east coast of England a great increase in the number of steam trawlers, and everywhere within the last six or seven years steam machinery has been more and more generally used on sailing vessels as well as steamers for hauling up the trawl. The steam trawler can make more hauls than the sailing vessel, and yet her tonnage is registered as less than that of a sailing vessel of the same size. For instance, a steam-vessel of fifteen tons gross is registered in the first class, but the tonnage entered for her is the net registered tonnage, which is less than fifteen tons. Taking these difficulties into consideration, it is not worth while to calculate the quantities of fish per boat or per ton for the several coasts separately.

Summary.—To summarise these results, then, the analysis shows that there has been no continuous decrease in the total quantity of fish caught, nor in the quantity of total fish per ton of the total tonnage of all kinds of boats. When we deduct the quantities of mackerel, herrings, pilchards, and sprats, we find there has been a considerable decrease in the total quantity of drift-net fish landed, and a corresponding increase in the total quantity of other kinds of fish. The total number of fishing-boats has steadily decreased since 1871, but the total tonnage reached a maximum in 1887. There has been a decrease, but not a continuous decrease in the quantity of soles and turbot landed, but an increase in the total quantity of plaice. The decrease in the quantities of soles and turbot has been confined to the east coast, and there no decrease in plaice has occurred. On the south and west coasts the quantities of soles and turbot landed have largely increased, and plaice also on the west coast; on the south coast plaice have somewhat decreased.

Postscript.—After this paper was finished the statistical tables and memorandum for 1892 were published. I have therefore inserted the figures for this year in the tables, but time is not avail-

able to recast the paper and incorporate the returns for this year in it. It will be seen that my general arguments are confirmed by last year's figures. Soles for all coasts have fallen again, but turbot have nearly reached the maximum figures of 1887. The total fish excluding shellfish is greater than in any other year since statistics were collected, and so is the value. Drift-net fish have increased again, and the total of bottom fish is higher than in 1891. Similar remarks apply to the east coast considered separately.

A new feature in this return is Part III—A Statement of the Boats and Men for the years 1888 to 1891 inclusive. I have given these years among the whole series of years for which I have extracted these particulars from the Annual Statement of Navigation, and what I have said on this head requires no modification.

My hope and expectation that the extraordinary treatment of lemon soles in the tables would be remedied in this return are utterly disappointed. No change whatever is made. Lemon soles are placed in the Scotch tables as prime fish equivalent to soles in the English tables, while they are not mentioned at all in the latter, and English soles and Scotch lemon soles are added together to produce the total of soles for the United Kingdom. The official statistics of fish remind one of the French phrase, "Plus ça change, plus c'est la même chose."

II. SCIENTIFIC INQUIRIES.

1. AT PLYMOUTH.

Since last Christmas, in accordance with the Council's special instructions, I have been making systematic investigations into the question of the capture and destruction of immature or undersized fish at Plymouth. The following is my report on these investigations as far as they have yet gone. By immature fish in the tables I mean females in which there is no trace of yolk in the young eggs in the ovary when examined under the microscope. Immature males have been distinguished by the extremely undeveloped state of the testes. All the males registered as mature either contained ripe spermatozoa or were obviously spent.

Lemon Soles or Merry Soles.

Between January 1st and March 11th I examined 220 specimens of this species (*Pleuronectes microcephalus*) procured from the fish quay as landed for sale. The examination was carried out in the

Laboratory with the utmost minuteness and attention, and the results are shown in the following table.

Lemon (Merry) Soles, December 31st, 1892, to March 11th, 1893.

Length.	No. examined.	MALES.		FEMALES.	
		Mature.	Immature.	Mature.	Immature.
6 inches	0	0	0	0	0
7 "	10	7	0	3	0
8 "	14	10	0	4	0
9 "	26	16	0	10	0
10 "	50	34	0	16	0
11 "	54	31	0	23	0
12 "	28	17	0	11	0
13 "	26	12	0	14	0
14 "	9	2	0	7	0
15 "	1	1	0	0	0
16 "	2	0	0	2	0
17 "	0	0	0	0	0
18 "	0	0	0	0	0
	220	130	0	90	0

Under 11 inches—100.

Over 11 inches—120.

Not one specimen was immature. The period extended from just before the spawning period to the middle of that period, and every specimen was either ripe, or in such a condition that it would evidently have spawned this season if it had been left alive in the sea. All the males were actually ripe, yielding ripe milt when squeezed, or were nearly spent. The excess in the number of males over females is probably due to the fact that a disproportionate number of small fish were examined, and the males being smaller, a given number of small fish includes more males than females. It is probable enough that some of these fish were preparing to spawn for the first time in their lives, so that they were killed before they had actually been allowed to reproduce their kind; but it is not possible in such an examination of the fish as this with our present knowledge to ascertain whether a specimen is ripening for the first time or has spawned in previous seasons. But the evidence proves that in the period mentioned immature merry soles are not landed at Plymouth. At other times of the year immature specimens may be landed, but if so, I believe the proportion of such is small and unimportant. At the Conference convened by the National Sea Fisheries Protection Association in 1892, the limiting size adopted

for lemon soles was 11 inches in total length. Of the specimens included in the above table 100 were under that size and 120 over—that is to say, 45 per cent. of the number were under 11 inches in length. This, however, may not represent accurately the average proportion among all the fish of this kind landed. I will give, therefore, the results of observations which I made during a three days' trip on board a trawler at the beginning of March. We were trawling off Dodman Point in Cornwall, a ground where merry soles are usually abundant. We took 264 of these fish altogether. None of these were immature, and none were returned to the sea as unsaleable; the smallest was 7 inches long, 179 of these were over 11 inches in length, 85 were under that length. That is to say, 32 per cent. of the merry soles caught were under the proposed limit. Merry soles form a very important part of the total catch of a trawler fishing out of Plymouth, and they fetch a very good price. There would be the strongest opposition on the part of Plymouth trawlers to a proposal that they should be compelled to throw away 32 per cent. of the merry soles they catch.

The smallest merry sole I have ever obtained at Plymouth was 6.4 inches long, and this was a perfectly ripe male. As far as my experience goes, smaller specimens than this are never caught either by deep sea trawlers or any other kind of fishing-boats.

The merry sole or lemon sole is not a large fish. The largest obtained by Dr. Fulton on the east coast of Scotland was 18 inches long. I have not yet seen any at Plymouth over 17 inches in length, and no males over 16 inches.

On the south coast merry soles, large or small, are not captured by any boats, or very exceptionally, other than the deep sea trawlers, and they are only found in abundance at a considerable distance from the coast. The inshore waters, which yield often plenty of plaice, supply very few merry soles. Neither the full-grown nor the young of this species are taken in any numbers in territorial waters on British coasts. The evidence available shows that the young lemon soles when they first go to the bottom, instead of seeking the shore as young plaice do, travel in the opposite direction, and pass the first period of their lives at depths greater than those where the adults abound. Dr. Fulton, in his systematic search on the coast of Scotland, obtained only four specimens as small as 2 inches, although he obtained 64 out of a total of 195 under 8 inches. On the west coast of Ireland, the Irish Survey of 1890-91, obtained three specimens $1\frac{1}{4}$ inches long at depths of fifty-two to sixty fathoms. Mr. Holt has, however, recently found that young lemon soles 2 to 4 inches in length are not rare in the estuary of the Humber in autumn. But these were not in large numbers, the greatest number caught in one

haul of the shrimp trawl being sixteen. We may, therefore, practically confine our attention to the deep sea trawlers.

Mr. Holt has been investigating the question on the east coast for the North Sea since January, 1892. He says that the male lemon sole is sometimes mature at 6 inches, and that no specimen smaller than this could be procured. He says he has found immature females from 6 inches to 12 inches in length. But not all females are immature under 12 inches or under 11 inches. Many were mature at 10 inches, some at 9 inches, and one female even at 8 inches. Mr. Holt examined 424 specimens, the smallest he could procure, by far the greater number under 11 inches in length; and of these, 125 were immature—that is, 29 per cent. If we take only those under 11 inches examined by him, the numbers are these:—Total number examined, 263; immature, 101, or 38 per cent. Even this is not a very large proportion. I do not think it is large enough to justify any legislative interference with the capture of lemon soles. Mr. Holt states that young lemon soles are not taken on the eastern grounds.

It is certain, therefore, from the evidence reviewed that neither immature nor undersized lemon soles are captured by the deep sea trawls in excessive proportion on any particular grounds, and the question with regard to this particular fish is narrowed down to this:—Is it necessary or advisable to interfere in any way with the capture and sale of the smaller lemon soles, which the trawlers at present take on all ordinary off-shore fishing-grounds?

In the first place it must be noted that all the lemon soles taken are saleable and good for food. None are thrown overboard as useless, and all find a ready market. If a limiting size is enforced either the prohibited fish must be thrown overboard, or the fishermen must find a method by which they can avoid catching them. If they are forced to throw the small fish overboard, it is certain that they will not all be returned to the sea alive. It is doubtful if any or more than a very small proportion would survive if thrown overboard. According to my experience at Plymouth, it is seldom that the fish are sorted out and picked up as soon as they are emptied from the trawl on to the deck. In rough weather, and when the trawl contains a large quantity of stuff, the fish have been subjected to a good deal of mechanical violence before they reach the deck. Then the trawl is frequently torn, and it is mended and shot away before the fish receive any attention. Again, hauls are frequently made at night, when it would be troublesome and difficult to distinguish the smaller fish. In a great many cases the fish would not be thrown overboard until they were dead or beyond hope of recovery.

An enlargement of the mesh of the net has often been suggested;

but this will be considered in reference to the protection of immature fish generally. It is enough to state here that no enlargement of the mesh sufficient to allow lemon soles of 7 or 8 inches in length has yet been proved to be practicable.

It has been shown by my own observations at Plymouth, and Mr. Holt's at Grimsby, that practically no lemon soles are taken which are less than 7 inches in length. Now this length bears the same proportion to 18 inches, the maximum length of the lemon sole, as $10\frac{1}{2}$ inches does to 28 inches, the maximum length of the plaice. Therefore, since it is proposed to restrict the capture of plaice to those above 10 inches, the corresponding restriction with regard to lemon soles, as actually now enforced by natural conditions, is an established fact without the aid of law. To put this aspect of the matter in another light, if it is proposed to set up a limit of 11 inches for lemon soles, then the corresponding limit for plaice must be 17 inches, for 11 bears to 18 the same proportion as 17 to 28. I do not think the fishing industry would consent to a law which prohibited the landing or sale of plaice under 17 inches. The limiting sizes adopted by the conference of 1892 were for turbot and brill 12 inches, for lemon soles 11 inches, for plaice and soles 10 inches; and yet both the plaice and the sole grow to a larger adult and maximum size than the lemon sole.

My conclusion, then, is that no case has been made out for any interference with the capture, landing, or sale of lemon soles. Where it is found that a kind of fishing is practised which is diminishing or endangering the supply of a particular kind of fish without producing any great profit either to those engaged in it or to the community, then it is allowable to restrict or prohibit that kind of fishing. But the evidence at present available shows that any restriction of the fishing for lemon soles now carried on would be a hardship to the fishermen, a loss to the public, and of no certain benefit to the fishery.

It does not necessarily follow that if the supply of a certain kind of fish is diminishing, laws must be passed with the object of stopping the diminution. It may not be possible to improve the supply by special measures. When that is the case we must wait until the limit of diminution is reached; at a certain point the increase of the appliances for capture will also cease, because profits will be reduced to a minimum, and so an equilibrium will be established. But it is necessary to point out that in the case of lemon soles we have no sufficient evidence that the supply is diminishing or has diminished; scarcely any evidence at all on the question. For England and Wales we have no statistics of any kind with regard to lemon soles; as far as this fish is concerned no statistics have yet been collected. Trawlers

and fish traders at Plymouth unanimously maintain that in that neighbourhood the supply of merry soles has increased in recent years. They say that formerly, ten years ago, merry soles were not abundant enough to be sold separately; they were sold mixed with plaice as flat-fish. Now they are sold separately, and form an important item in the trade. The fishermen say that this is not due to an increase in the number of boats or an increase in the price of the fish, nor to the working of new grounds. They say that they get many more merry soles now on the same fishing-grounds than they did from five to ten years ago. What is the case in the North Sea I cannot say, but for the east coast of Scotland we have statistics. The gross quantity of lemon soles landed in Scotland is still increasing, while the total quantity of turbot, and of flounders, plaice, and brill together, appear to have reached a maximum about 1888 or 1889. Between 1888 and 1891 the quantity of lemon soles has increased from 12,667 hundredweight to 17,739 hundredweight. But, on the other hand, Dr. Fulton finds that the quantity of lemon soles caught by beam trawlers per ton of the vessels' tonnage decreased in the years 1889 to 1891. As I have mentioned before, no important conclusions can be drawn from statistics limited to three years. Thus it is shown that, on the one hand, there is no evidence at present of a statistical nature of a decrease in the supply of lemon soles, nor, on the other hand, any evidence from the natural history of the fish, or an examination of the fishery, that benefit could be obtained by imposing regulations or restrictions, or interfering in any way whatever.

Plaice.

The following table gives the results of examination of all the plaice examined in the period mentioned. It simply serves to show the relation of sexual maturity to size in this species at Plymouth.

The largest immature female was $14\frac{1}{2}$ inches long, the smallest mature female 9 inches, so that from 9 inches to $14\frac{1}{2}$ inches is the borderland within which some females are mature and others immature. The smallest mature male was also 9 inches long and the largest immature 12 inches.

Mr. Holt's results from observations on the east coast, as described in the preceding number of this Journal, are somewhat different. It is true he had examined a larger number of specimens. He once found a ripe male only 6 inches long, but this he rightly regards as quite exceptional. Apart from this, his smallest mature male was 9 inches long, and his largest immature 15 inches. Of females, his smallest mature was 13 inches long, and his largest immature 17 inches. These differences correspond closely with the

difference in maximum size of plaice on the east and south-west coasts of Britain. Dr. Fulton states (8th Report of Scottish Fishery Board) that the largest plaice found on the east coast of Scotland was 28 inches long. Mr. Holt tells me that he has never seen a North Sea plaice more than 27 inches long, although possibly one of 28 inches may occur occasionally. The maximum observed by me at Plymouth is 25 inches. There can be no doubt that the average

Length.	No. examined.	MALES.		FEMALES.	
		Mature.	Immature.	Mature.	Immature.
6 inches	1	0	0	0	1
7 "	26	0	10	0	16
8 "	13	0	4	0	9
9 "	4	2	0	1	1
10 "	8	4	1	0	3
11 "	6	3	1	1	1
12 "	8	4	1	1	2
13 "	12	5	0	5	2
14 "	10	4	0	3	3
15 "	3	1	0	2	0
16 "	9	1	0	8	0
17 "	1	0	0	1	0
18 "	2	0	0	2	0
19 "	1	1	0	0	0
20 "	1	0	0	1	0
21 "	2	0	0	2	0
22 "	0	0	0	0	0
23 "	0	0	0	0	0
24 "	1	0	0	1	0
25 "	1	0	0	1	0
	109	25	17	29	38

adult size corresponds to the maximum size. There is still some little uncertainty in distinguishing an immature fish from one that has recovered from spawning. Mr. Holt's discussion of this question in the preceding number of the Journal does not entirely exclude the possibility that some months after spawning the roe of a spawned fish may be similar to that of one which has never spawned at all. But among fish examined during the spawning season, as most of Mr. Holt's and all of mine were, there can be hardly any uncertainty from this cause. Therefore, if we take what Mr. Holt calls the biological limit, the length which will certainly exclude all immature fish, which is 18 inches for the North Sea, it is 15 inches for the south-west coast. So much for the biological question apart from the practical.

The fish included in the first table were partly samples of those landed by trawlers, deep sea trawlers, and partly samples of those

captured by small ground seines in the estuaries near Plymouth, chiefly in the estuary of the Tamar, called the Hamoaze. It is very instructive to exhibit the details concerning these two classes of fish separately, as I have done in the tables on this and the next page.

Plaice : January 1st to March 11th, 1893.

From Trawlers.

Length.	No. examined.	MALES.		FEMALES.	
		Mature.	Immature.	Mature.	Immature.
7 inches	1	0	0	0	1
8 "	2	0	2	0	0
9 "	3	2	0	1	0
10 "	8	4	2	0	2
11 "	5	3	1	1	0
12 "	8	4	1	1	2
13 "	12	5	0	4	3
14 "	10	4	0	3	3
15 "	3	1	0	2	0
16 "	9	1	0	8	0
17 "	1	0	0	1	0
18 "	2	0	0	2	0
19 "	1	1	0	0	0
20 "	1	0	0	1	0
21 "	2	0	0	2	0
22 "	0	0	0	0	0
23 "	0	0	0	0	0
24 "	1	0	0	1	0
25 "	1	0	0	1	0
	70	25	6	28	11

Total number examined 70.
 Immature 17=24 per cent.
 Under 10 inches 6=8 "
 Under 17 inches 61=87 "
 Under 14 inches 39=55 "

Thus, of the plaice landed by trawlers, 24 per cent. were immature, of those landed by the seines, 100 per cent. The trawled fish contained more than the average number of small fish, because on several occasions small fish were selected for examination, and consequently the percentage of immature among trawled fish taken all together is less than 24. The other percentages given are interesting in relation to the various proposals for restriction which have been made.

It is a well-established fact, the evidence for which has been published in full by Dr. Fulton, Mr. Holt, and myself, that the young of the plaice when they first take to living on the sea bottom seek the shore, and pass the first part of their lives in bays and

estuaries and in shallow water. In consequence of this fact we see that at Plymouth the principal destruction of small fish is caused by inshore fishing, such as the seines in the Hamoaze. Inshore trawling and large ground seines used at Teignmouth and Dawlish doubtless are equally destructive. It must be remembered that this

Plaice : January 1st to March 11th, 1893.

From Seines in Hamoaze, &c.

Length.	No. examined.	MALES.		FEMALES.	
		Mature.	Immature.	Mature.	Immature.
6 inches	1	0	0	0	1
7 "	25	0	9	0	16
8 "	11	0	2	0	9
9 "	1	0	0	0	1
10 "	0	0	0	0	0
11 "	1	0	0	0	1
12 "	0	0	0	0	0
	39	0	11	0	28

Total number examined	. . . . .	39.
Smallest	. . . . .	6½ inches.
Largest	. . . . .	11¼ "
Immature males	. . . . .	11.
„ females	. . . . .	28.

destruction is not remunerative to the men who practise it. Plaice of 7 or 8 inches long fetch a low price, and are poor food even as compared with merry soles of the same size. There can be no doubt that trawlers working in shallow water, in the bays and close to shore, take a large proportion of small and immature plaice. On the southwest coast there are no flats which extend far out from the shore into extra-territorial waters, and I know of no ground where small plaice are taken in excessive proportion to large except in territorial waters. It has been proposed by the Devon Fisheries Committee to exclude beam trawling in great part of their territorial waters altogether. This would of course put an end to the destruction of small plaice at present effected by those boats in those waters. But it would not affect the destruction, which is due to other kinds of fishing, in particular to ground seining.

The measures which might be carried out for the protection of small plaice may be of the following kinds.

(1) Prohibition of landing, possession, or sale of fish under a certain limit of size.

- (2) Prohibition of fishing on certain grounds.
- (3) Prohibition of capture in certain seasons.
- (4) Mesh regulations.

The proposal to establish a size limit offers many difficulties. If the limit of 10 inches proposed by the National Sea Fisheries Protection Association were applied rigorously to all coasts of the kingdom, it would not bear very hardly on deep sea trawlers in the south-west. It would mean throwing overboard about 8 per cent. of the plaice caught, and as these are the smallest fish, it would not be a very great loss of earnings. Still it would be some loss, and would be strongly opposed by the fishermen. Then, again, the fish thrown overboard would not all be alive. Trawling in winter-time in strong winds is such rough work, and so much attention has to be given to mending and shooting the trawl and navigating the vessel, that the fish often cannot be picked out from the mass of stuff brought up by the trawl until it has been on deck some time. It is making a great demand on the crews of trawlers to expect them to carry a measure and measure their fish; and if they were forced to do it, they would think more of the importance of not throwing overboard any fish which they could legally keep than of returning the fish to the sea alive and in good condition. Fishermen, as a rule, do not understand the conditions necessary to the life of a fish. They almost always fail to bring fish alive when requested and paid to do so, because they do not handle them with enough care, or supply them with water properly.

On the other hand, Mr. Holt has proved that the Conference limit of 10 inches would not prevent fishing in the eastern grounds of the North Sea, the destruction of small plaice on which gave rise to the present agitation. No higher limit would be tolerated by the south coast trawlers. It must be remembered that it is not practicable to enforce the biological limit. On the south-west coast the limit is 15 inches, but a large proportion of the fish under this size are mature, and they are certainly marketable. To enforce this limit would deprive the trawlers of about 50 per cent. of the total number of their plaice, and probably dislocate the industry. Mr. Holt believes that a limit of 14 or 15 inches would be enough to prevent fishing on the eastern grounds of the North Sea, but he tells me that in winter a good many fish of this size are taken on other grounds, and suggests enforcing the restriction only in summer. It is of course true that the imposition of a size limit would prevent to a great extent the capture of small plaice by shrimping and seining in inshore waters. But there is a great deal of destruction carried on in shrimping and seining of plaice which are so small as to be

unmarketable, and this would not be affected by the establishment of a legal size limit.

It seems to me that, apart from the question of the extra-territorial eastern grounds of the North Sea, if the capture of plaice could be prevented altogether in territorial waters in this country the fish would be protected to a most important extent, and the difficulty of interfering with the operations of deep sea trawlers would be avoided. At the same time beam trawling, except for shrimps, should not be allowed in territorial waters. There would be no greater difficulty in this than in preventing the capture of salmon by illegal nets, which has been done for years. Plaice taken by shrimp-net and seines can be returned to the water alive; those taken by deep sea trawls, speaking broadly, cannot. The wanton destruction of plaice by shrimpers and seiners can be easily punished by the local committees.

This proposal could not be carried out on the west coast of Ireland, where nearly all the available trawling-ground is inside the territorial limit. But there is no need for protection on that coast at present.

I need not consider the question of the enlargement of the mesh, because on the south-west coast the deep sea trawlers refuse to consent to it, for the reason that with a larger mesh they would not catch thickbacks (*Solea variegata*), queens (*Pecten opercularis*), or squid (*Loligo*), which make part of the men's earnings.

In order to prevent destruction on the eastern grounds of the North Sea it would be necessary, without a size limit, to close the grounds wholly or partially by means of an international convention.

It must be remembered that, as I have shown in the first portion of this paper, we have as yet no statistical evidence of a diminution in the supply of plaice, except a decrease in the total quantity landed on the *south coast*. Even Dr. Fulton's figures do not include separate figures for plaice.

Soles.

The soles of which the particulars are contained in the following table (p. 75) were all taken by trawlers and purchased on the landing quay. All of them were selected on account of their small size. The number is small, but the results are not likely to be greatly altered by examination of a larger number. There are no immature males among them. The smallest mature female is 12 inches long, the largest immature is 13 inches. Mr. Holt found in the North Sea no immature females above 12 inches, while his smallest mature female was only 10 inches long. Perhaps the soles on the south-west

coast are a little larger in average adult size than in the North Sea. On the other hand, Mr. Holt found some males immature at 11 inches, and I have seen no immature males; but since the testes are so small it is difficult to be certain that a male is immature. The difference is in any case slight: according to Mr. Holt the "biological limit" of immaturity is 12 inches, according to my result 13 inches; but to exclude all immature fish it would have to be 13 and 14 inches respectively.

Soles : January 1st to March 11th, 1893.

Length.	No. examined.	MALES.		FEMALES.	
		Mature.	Immature.	Mature.	Immature.
6 inches	0	0	0	0	0
7 "	0	0	0	0	0
8 "	0	0	0	0	0
9 "	5	5	0	0	0
10 "	5	3	0	0	2
11 "	15	12	0	0	3
12 "	21	12	0	5	4
13 "	3	0	0	1	2
14 "	8	0	0	8	0
15 "	3	1	0	2	0
16 "	1	0	0	1	0
17 "	0	0	0	0	0
	61	33	0	17	11

Total number examined 61.
 Immature 11=18 per cent.
 Mature males 33=54 "
 Under 10 inches 5= 8 "

It is important to notice that only eleven of these fish were immature, 18 per cent.; while among the sixty-one selected as the smallest obtainable, 54 per cent., more than half, were mature males. This shows how comparatively slight is the destruction of immature soles by deep sea trawlers on the south-west coasts. The smallest sole obtained was 9 inches long, but smaller specimens down to 8 inches have been seen on other occasions. Soles less than 8 inches long are not destroyed by deep sea trawlers landing fish at Plymouth. If the Conference limit of 10 inches were enforced it would mean throwing overboard much less than 8 per cent. in number of the soles taken.

It seems, then, more important to ascertain whether soles less than 9 inches long are destroyed, and if so how and where. A few are taken at Plymouth by the shrimp trawlers, but I have no statistics,

and the number is not very great. I have heard that larger numbers are taken by the ground seines on the coast of Devon, but have not yet made personal investigation of this mode of fishing.

Curiously enough on the eastern grounds, which are so often referred to, small or immature soles are not taken in any important numbers, according to the observations of Mr. Holt. The destruction of soles too small for the market by inshore fishing in the Humber has been shown to be insignificant by Mr. Holt in the preceding number of this Journal, as they are returned to the sea alive. A considerable number, however, from 6 to 10 inches long are taken and sent to market by shrimp trawlers in the Humber. On the Lancashire coast Mr. Dawson finds similar facts with regard to soles. Large numbers of soles are taken in the district much under the size which should be taken, but few under 4 inches have been observed. In trials with the shrimp trawl Mr. Dawson constantly took small soles and plaice in such proportions as 4 to 900, 136 to 520, 8 to 720, and so on. The whiting were even more numerous than the plaice. On the west coast of Ireland Mr. Holt found only three soles under 10 inches out of a total of 529. The history of the early stages of the sole is by no means cleared up. The probable conclusion is that the young are not principally aggregated at particular depths or in particular regions, and few have been taken in deep water because small-meshed trawls have been little worked there. It is desirable, however, to protect the young which do occur in shallow water, and I think the best way would be not to allow them to be taken in territorial waters. As in the case of the plaice, it would be possible to compel the men to return all soles caught by inshore fishing alive to the water. It has been urged that it would not be practically easy to discriminate between fish caught in territorial waters and others. But it would be sufficient to inflict penalties for taking certain fish in territorial waters, without interfering with market, landing, or sale. In places where the fish were exceedingly abundant all kinds of fishing could be prohibited.

Turbot.

Hitherto I have only examined seven turbot, and these were the smallest I could obtain; none were under 12 inches, and all were landed by deep sea trawlers. Three were mature males, the smallest 13 inches long; there were no immature males. Three were immature females, the largest 17 inches long. The smallest mature female was 19 inches long. These results, so far as they go, indicate that there is no difference between the south-west coast and the North Sea with regard to this fish. Mr. Holt says the prohibition of turbot

under 12 inches would not prevent the fishing in the eastern grounds in the North Sea, where a large number of immature turbot are taken and brought to market. There is no great destruction of turbot under 12 inches, saleable or unsaleable, anywhere; but some are taken in inshore waters, &c., and it would be advisable to compel the men to return these to the sea alive. What has been said of the distribution of soles and measures for their protection applies also to turbot.

Brill.

I have examined eight brill, none under 12 inches, and all from deep sea trawlers, the smallest I could procure. There were no immature males and no immature females. The smallest mature female was 16 inches long. Immature brill are not taken, according to Mr. Holt, on the eastern grounds in the North Sea.