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REVIEW OF THE IRISH SALMON INDUSTRY

A. E. J. Went, D.Sc.

For centuries the salmon has been an important item of commerce in Ireland and in many parts of the country today it is still very important in the general economy of the people, who obtain a living directly or indirectly from it. It is important from two points of view. It provides sport for the angler and it supports a commercial fishery.

The Fisheries Division of the Department of Lands* now publishes each year in the **Report of the sea and inland fisheries**, annual statistics relating to the catch of salmon and sea trout. Unfortunately up to the year 1945 such statistics were only published biennially so that there is a gap for the "even" years from 1928 to 1944, inclusive. Other long term statistics relating to Irish salmon are, however, available in

- (a) The export figures given in **Trade Statistics** published monthly, originally by the Department of Industry and Commerce and now by the Central Statistics Office, Dublin;
- (b) Statistics relating to the arrival of Irish salmon on Billingsgate Market, London, and
- (c) Statistics relating to the drift net fishery off the north-west coast of Ireland.

In addition some other information is available in the records of the Fisheries Division of the Department of Lands and is used in this paper. Previous surveys of the Irish salmon industry have been published by Southern (1934) and Went (1938, 1956 and 1957).

It is now proposed to consider the long-term statistics first before going on to consider the figures published annually in the **Reports of the sea and inland fisheries**.

The export returns. The publication **Trade Statistics** gives the monthly exports (cwt.) of "salmon and trout" from this country. Whilst they are said to relate to salmon and trout we know that comparatively small quantities of trout are exported under this heading and, therefore, we may regard the figures as virtually relating to salmon alone. These statistics are given in Table 1 and they do not, of course, include salmon originating in Counties Antrim, Armagh, Down, Fermanagh, Londonderry or Tyrone (Northern Ireland). Exports were low (less than 12,000 cwt.) in the years 1937, 1938, 1944, 1947, 1955, 1960 and 1961. They were high (over 20,000) in the years 1924-28, 1931-36, 1941, 1942, 1951 and 1963 (see also Fig. 1). These fluctuations seem to reflect to some extent the magnitude of the catches of salmon in any one year but they do not give, for various reasons, a quantitative idea of the catches. The reason is that in a poor year, particularly since the Second World War, a greater proportion of the catch is consumed at home so that in general, exports in a poor year form a smaller proportion of the total catch than in a more normal year. Consumption at home generally remains fairly constant so that in a year such as 1945 when runs were very poor indeed perhaps only half of the total catch was

*Subsequent to the preparation of the papers in this publication Fisheries Division was transferred from the Department of Lands to the newly designated Department of Agriculture and Fisheries.

Table 1.—Exports in cwt. of salmon and trout from 1924 to 1963, inclusive, together with the “10-year averages” Mean—1924/63 = 17,758 cwt.

Year	Cwt.	Year	Cwt.	Year	Cwt.	Year	Cwt.	Year	Cwt.
1920	—	1930	16,720	1940	14,849	1950	17,638	1960	10,920
1921	—	1931	24,223	1941	25,732	1951	22,809	1961	9,059
1922	—	1932	26,966	1942	21,427	1952	18,039	1962	18,834
1923	—	1933	20,156	1943	16,926	1953	16,766	1963	23,477
1924	20,527	1934	25,842	1944	11,076	1954	17,525		
1925	21,797	1935	24,333	1945	5,359	1955	11,135		
1926	24,510	1936	22,570	1946	10,408	1956	13,564		
1927	35,952	1937	10,518	1947	11,247	1957	15,710		
1928	23,801	1938	9,607	1948	17,745	1958	14,047		
1929	15,387	1939	12,848	1949	17,769	1959	13,682		
Yearly mean	23,662	Yearly mean	19,378	Yearly mean	15,254	Yearly mean	16,092	Yearly mean	15,573
Mean Jan./May	13,249	Mean Jan./May	9,882	Mean Jan./May	5,639	Mean Jan./May	5,823	Mean Jan./May	3,368
Mean June/Dec.	10,413	Mean June/Dec.	9,496	Mean June/Dec.	9,615	Mean June/Dec.	10,269	Mean June/Dec.	12,205

Table 2.—The average export prices of salmon for the years 1950/63 inclusive, based on Trade Statistics

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Per cwt. ...	£32-5	£36-9	£36-6	£39-8	£36-3	£40-6	£41-0	£34-0	£38-0	£40-0	£43-4	£39-0	£35-0	£35-5
Per lb. ...	5s. 10d.	6s. 7d.	6s. 6d.	7s. 1d.	6s. 6d.	7s. 2d.	7s. 4d.	6s. 1d.	6s. 10d.	7s. 2d.	7s. 9d.	7s. 0d.	6s. 3d.	6s. 4d.

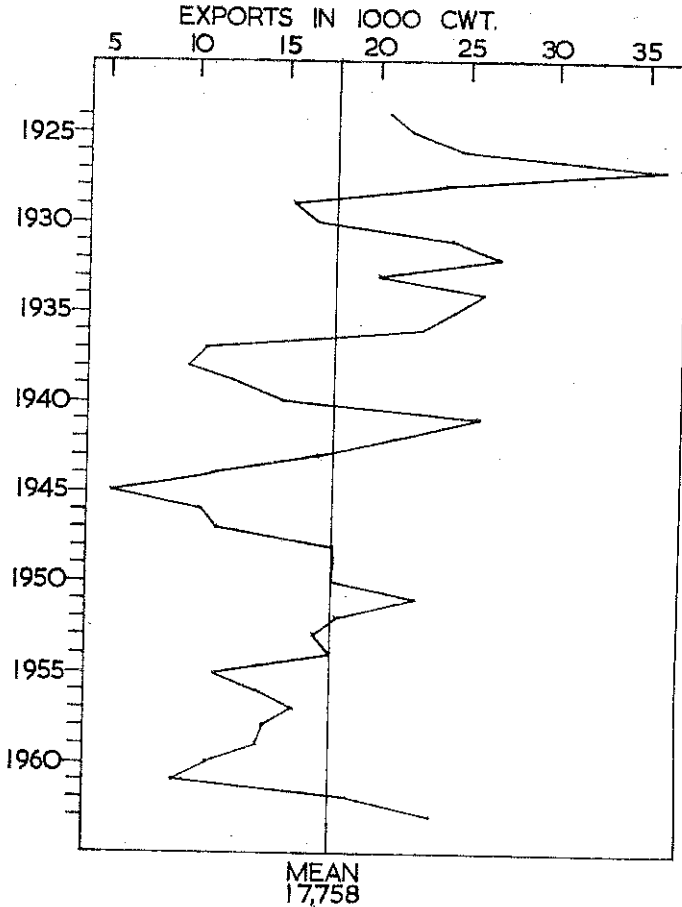


Fig. 1: Diagram showing exports (in cwt.) based on **Trade Statistics**.

exported. There is satisfactory evidence also that home consumption has increased since the last war, due to a great extent to the development of the tourist industry.

The remarks about the relationship between catch and exports do not however apply to the year 1962. In that year most of the fisheries in Ireland had a very good season for grilse and this was also the case in Scotland and those parts of Europe having important salmon fisheries. The sudden appearance on the market of large quantities of fish depressed the price. In consequence Irish salmon were sold at home, either whole or in cutlets, at prices which were about the same as those prevailing before the war. Home consumption was, therefore, exceptionally high and the low price even enabled the more modest priced catering establishments, including the fried fish and chips shops, to use salmon when normally, owing to the high price of this commodity, this would not have been possible.

In the period 1924/29 exports averaged 23,662 cwt and there was a decline in exports to 19,378 cwt in the period 1930/39 to 15,254

cwt in 1940/49 with a rise to 16,092 cwt for 1950/59 and a slight fall to 15,573 in the period 1960/63 (Table 1).

A very marked difference is discernible in the monthly figures for the earlier periods compared with those of later periods. This is perhaps best shown in the form of a diagram (Fig. 2). It is obvious that there has been a decrease in the number of fish exported in the

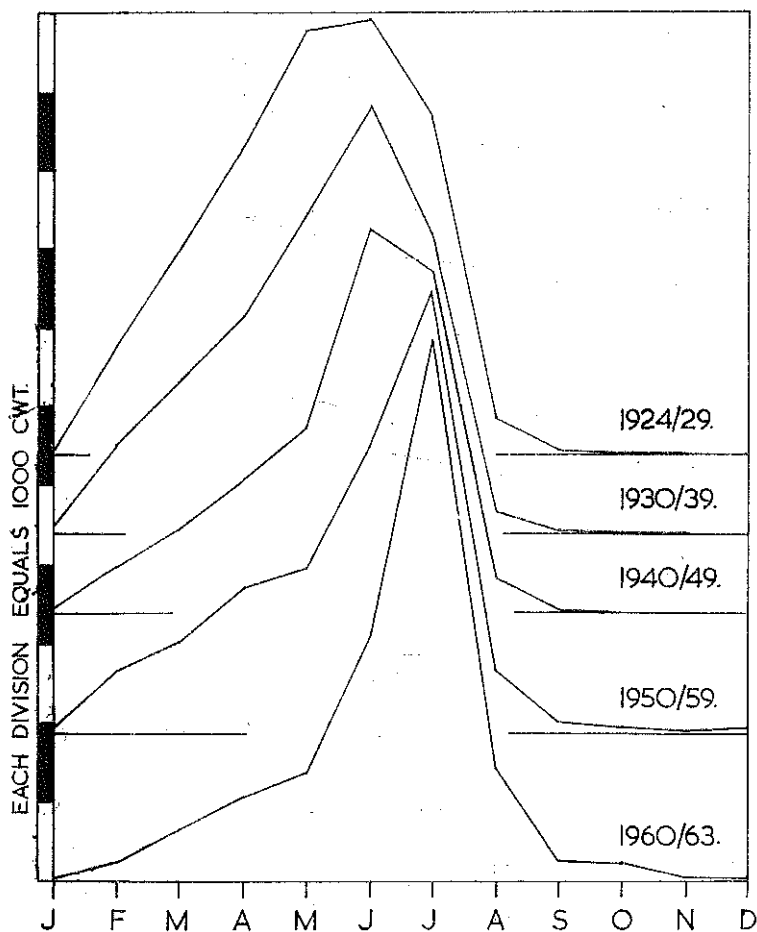


Fig. 2: Monthly average exports of salmon and trout for different periods (based on Trade Statistics)

early months of the year. This suggests a decline in the runs of the earlier fish, a matter which has been remarked upon in the **Reports of the sea and inland fisheries** for a number of years since the late "thirties". This can be shown in another way, however, by taking the exports for January/May and June/December respectively (Table 1). Exports in the January/May period have shown a decline from 1924/29 to 1960/63, whereas the exports in June/December have been well maintained. In other words the "salmon" exports have declined whereas the "grilse" exports have been maintained.

This matter will be discussed later (page 18). The exports in the months September to December in recent years have been mainly of quick frozen salmon taken much earlier in the year.

The export value per cwt of salmon is shown in Table 2. In view of the very big catches in 1962 and the low price for part of the summer on Irish markets the figure for 1962 may be surprising in relation to that of 1963. The position is that in the middle of July 1962 the price on British markets was so low that it did not pay, for a period, to send grilse, particularly the smaller sizes, to British markets and these fish were either consumed at home or quick frozen for subsequent sale. In other words as soon as the peak landings occurred in 1962 exports were reduced because of the low prices.

Table 3. Exports of salmon and trout to Great Britain, and all countries in the years 1950/1963 (to the nearest £1,000).

Year	Value of exports in £1,000		Percentage to Great Britain	Year	Value of exports in £1,000		Percentage to Great Britain
	To Great Britain	All countries			To Great Britain	To all countries	
1950	560	574	98	1957	479	534	90
1951	814	844	96	1958	470	534	88
1952	610	638	96	1959	460	547	84
1953	619	666	93	1960	404	474	85
1954	594	636	93	1961	323	393	82
1955	422	452	94	1962	519	657	79
1956	502	557	90	1963	721*	832	86

*Includes exports to Northern Ireland.

In 1963 no such depression of the prices occurred as the quantity of fish offered for sale by countries other than Ireland was not exceptionally large. These figures do not take into consideration the fluctuations from month to month in the price of salmon, some indication of which is given on page 11 (Table 7).

The actual values of salmon and trout exported from this country for the years 1950 to 1963, inclusive, are given in Table 3. It will be seen that whilst Great Britain is still Ireland's best customer for fresh salmon, a trade has been developing in exports to other countries on the continent.

Table 4. Number of boxes of salmon delivered to Billingsgate Market (based on the returns published by the Fish-mongers' Company, London) over the period 1924 to 1963 inclusive.

Year	Number of Packages		Total delivered
	Irish Salmon	Scottish Salmon	
1924	8,164	8,594	22,714
1925	7,256	8,811	22,748
1926	8,802	9,885	24,103
1927	12,127	11,130	30,030
1928	9,178	9,154	25,513
1929	7,298	8,359	21,382
1930	8,068	10,161	21,841
1931	10,590	11,826	26,646
1932	12,705	11,900	29,255
1933	10,602	9,689	24,291
1934	12,281	9,965	27,116
1935	12,786	12,157	30,828
1936	11,550	11,379	26,775
1937	5,320	13,372	22,363
1938	4,876	11,248	19,692
1939	5,744	11,543	21,382
1940	5,930	9,145	16,353
1941	9,221	7,834	18,114
1942	10,314	6,389	17,734
1943	9,162	6,279	15,685
1944	4,959	4,866	9,925
1945	2,192	2,501	4,725
1946	6,960	3,057	11,978
1947	4,620	3,325	12,595
1948	9,130	3,719	20,798
1949	9,730	5,454	21,515
1950	6,942	4,981	18,110
1951	8,522	6,236	21,292
1952	7,308	9,522	20,872
1953	6,775	8,713	17,594
1954	7,676	8,403	18,719
1955	5,392	10,094	17,328
1956	6,600	7,274	15,735
1957	8,678	8,350	18,294
1958	8,493	9,802	19,768
1959	9,627	10,235	21,348
1960	7,851	10,330	21,109
1961	8,116	8,673	19,266
1962	11,933	14,499	31,028
1963	14,277	11,443	29,010
Mean	8,444	8,757	20,889
Percentage	40.4	41.9	—

The Billingsgate Market returns. Each year the Fishmonger's Company, London, issues a statement of the number of packages of salmon received from various sources on Billingsgate Market in the city of London and again these figures can be used to get a qualitative idea of the catches of fish in Irish rivers. There has, however, been a change in the size of the box used to send salmon to market over the years so that this must also be taken into consideration when making use of these figures. The number of boxes of Irish salmon delivered to Billingsgate Market in the period 1924 to 1963, inclusive, have been given in Table 4. The maximum number of boxes of salmon delivered in the period 1924/63 was for the final year of the period when 14,277 packages were delivered. Over the period 1924/63 Scotland had supplied Billingsgate market with on average about four hundred packages of salmon in excess of those obtained from Irish sources (Table 4). Altogether Scotland and Ireland have contributed over four-fifths of all the salmon received on Billingsgate Market in the period 1924/63, inclusive. Consequently the size of the supplies on this market from Scotland and Ireland has a very marked influence on the price paid for supplies from other sources.

One other interesting feature of the Billingsgate returns is the variations between the Scottish and Irish figures from year to year. Years with heavy supplies have usually coincided as have also years with small supplies. On other occasions Ireland's good supplies have not been followed by good supplies from Scotland and vice versa. Diversion of supplies of salmon from Billingsgate to other markets due to a variety of factors must, of course, play a part in this, as explained in the case of 1962 when large quantities of Irish salmon were consumed at home.

At one period Billingsgate market used to take more of the earlier and higher priced salmon than other markets but this tendency seems to have changed in recent years. As will be seen in Table 5 Billingsgate Market now seems to take a fairly regular proportion of the supplies over the season. We do know from market inspections that very large quantities of small Irish salmon or grilse are sold in Manchester, Liverpool and other north of England markets, presumably for the catering trade in the holiday areas such as Blackpool etc. and even much farther away.

The actual distribution of the arrivals each month at Billingsgate Market has shown a similar change to that referred to in connection with the exports (see Fig. 2). The times of arrivals have been divided up into the same two periods as mentioned in Table 1, namely January/May and June/December and the relevant details are given in Table 6. In the period 1924/29 almost two-thirds of the arrivals were in the January/May period, and the relevant figures for the four succeeding periods were 55.9 per cent, 39.5 per cent, 41.3 per cent and 20.6 per cent respectively. In other words the Billingsgate figures reflect to a great extent the changes in the monthly distribution of the exports in the same period.

The average monthly prices on Billingsgate Market for Irish salmon from 1950 to 1963 inclusive have been given in Table 7. In

Table 5. The monthly percentage of total of Irish salmon sold at Billingsgate Market (A) compared with the monthly percentage of total exports (B) in the years 1960-1963, inclusive.

Month	1960		1961		1962		1963	
	A	B	A	B	A	B	A	B
Jan.	0.2	0.4	—	+	+	+	0.1	0.2
Feb.	2.5	2.4	1.1	1.8	0.6	1.0	0.8	1.9
Mar.	6.7	5.6	5.0	6.0	1.7	1.9	4.3	4.9
April	10.7	9.2	5.7	8.8	3.7	3.7	7.7	7.7
May	15.2	12.5	6.9	9.6	6.4	7.1	7.5	8.3
June	20.8	24.4	15.6	21.0	24.1	23.3	13.6	16.1
July	38.9	36.0	44.4	47.1	39.3	48.9	48.9	44.4
August	4.9	5.7	21.2	4.7	24.0	9.9	17.1	12.0
Sept.	0.1	1.6	+	0.7	0.2	1.9	+	1.6
Oct.	—	1.3	—	+	—	1.9	—	1.8
Nov.	—	0.2	—	+	—	0.4	—	0.5
Dec.	—	0.7	—	0.2	—	—	—	0.6

general the price at the beginning of the year is high, there is a rapid fall in February, when many important Irish fisheries open and the price tends to fall until July with a rise thereafter. Sometimes there is a short term rise in price about Easter. However, due to the great fluctuations in supplies from year to year it is difficult to predict the price range for any one period, except to say that the advent of the grilse season generally brings down the price considerably.

The extent to which Billingsgate Market disposes of Irish salmon can be judged by the available information. If we assume that each package of Irish salmon on Billingsgate Market contained 100 lb of fish the ratio of salmon sold on Billingsgate Market to the Irish exports in the period 1954/63 is as shown in Table 8. The arrivals of salmon on Billingsgate Market, of course, include fish from Northern Ireland but be that as it may it is obvious that Billingsgate Market handles a very high proportion of all the fish produced in Ireland as a whole.

The Dublin Market returns. It is convenient to deal with these returns here albeit they have only been available since the year 1953.

As stated previously (Went, 1957) the Dublin Wholesale Fish Market provides now the only genuine auction for Irish salmon, the fish elsewhere being sold at prices fixed by the merchants, bearing in mind the supply and demand. No official statistics have been collected from the Dublin Wholesale Fish Market but in 1953/55 details of the number of fish handled and the prices obtained were extracted from the market reports compiled by the Dublin newspapers, namely **The Irish Times**, **The Irish Independent** and **the Irish Press**, the Dublin "dailies", and also by the Dublin evening papers **The Evening Herald**, **The Evening Press** and the now defunct paper **The Evening Mail**. Since 1956, however, the details of the number and weight of fish handled on the Dublin Wholesale Fish Market are available through extracts of the market dealers' registers, which salmon dealers are obliged under the law to keep (Table 9).

Since 1953 the number of fish handled on the Dublin Wholesale Fish Market has risen from just over 20,000 in 1953 to just over 131,000 in 1962 and 104,000 in 1963. From 1956 to 1963 inclusive the annual weight of salmon handled amounted to the percentages of the total Irish catch as follows:—

1956	1957	1958	1959	1960	1961	1962	1963
20	21	25	25	25	23	33	27

The rise in the proportion in 1962 is easily explained. In that year the price on British markets was low during the peak of the run of grilse and large quantities were diverted from the traditional markets to Dublin where, in fact, only a proportion of the fish diverted were handled through the Dublin Wholesale Fish Market. In order to get a comparison of the weight of Irish salmon handled on the Dublin Wholesale Fish Market with that handled on Billingsgate Market we must again use the estimates given in Table 8 for the weight of fish handled in Billingsgate. Using these figures the quantity of fish handled on the Dublin Wholesale Fish Market as a percentage of

Table 6.—Division of arrivals at Billingsgate Market January/May and June onwards

					1924	1925	1926	1927	1928	1929	Averages		
											1924/29	%	
Jan./May				4,339	4,042	5,252	9,121	6,617	5,114	5,746	65.3	
June onwards	...				3,825	3,214	3,550	3,006	2,561	2,184	3,057	34.7	
		1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1930/39	%
Jan./May	3,759	5,985	7,293	5,726	6,024	7,235	7,127	3,732	3,019	2,870	5,278	55.9
June onwards	...	4,309	4,605	5,412	4,876	6,257	5,551	4,423	1,588	1,857	2,874	4,136	44.1
		1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1940/49	%
Jan./May	2,451	3,427	4,240	3,999	2,432	1,188	1,396	1,843	4,038	3,485	2,850	39.5
June onwards	...	3,479	5,794	6,074	5,163	2,527	1,004	5,564	2,777	5,092	6,245	4,372	60.5
		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1950/59	%
Jan./May	3,183	3,535	3,515	2,753	3,755	3,141	2,642	2,721	2,775	3,394	3,141	41.3
June onwards	...	3,759	4,987	3,793	4,022	3,921	2,251	3,958	5,957	5,718	6,233	4,460	58.7
		1960	1961	1962	1963							1960/63	%
Jan./May	2,773	1,525	1,483	2,917							2,175	20.6
June onwards	...	5,078	6,591	10,450	11,360							8,370	79.4

Table 7.—Average monthly prices on Billingsgate Market for Irish Salmon from 1950 to 1963

(Per pound to nearest penny)

Month	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
January ...	6/8*	12/7	11/5	12/5	12/1	13/1	15/5	13/3	14/11	14/7	17/9	—	26/6	25/9
February ...	6/8*	8/10	7/11	9/1	7/6	8/3	9/6	9/6	10/1	8/10	10/10	11/2	11/-	9/11
March ...	6/8*	8/11	8/1	9/5	7/9	8/6	9/6	8/10	10/-	8/11	10/3	12/-	9/6	8/7
April ...	6/8* 7/11†	8/1	7/4	9/5	7/3	8/4	10/9	9/11	9/3	8/8	12/11	10/8	11/8	9/8
May ...	7/6	8/1	7/2	9/5	6/11	8/1	9/10	8/7	9/7	9/3	10/1	11/9	11/1	8/5
June ...	6/10	8/1	6/5	7/10	7/4	7/6	8/9	8/4	9/2	8/6	10/5	9/9	9/11	8/5
July ...	6/9	6/2	7/-	7/3	7/2	7/9	8/3	6/9	8/2	8/-	8/7	9/2	7/7	6/2
August ...	7/11	7/3	7/11	8/1	7/6	7/9	9/1	7/-	7/6	8/-	8/8	9/7	6/4	6/4
September ...	8/3	9/4	—	—	9/-	8/5	8/10	8/6	8/-	8/9	8/6	10/6	7/-	6/3

* Control price up to 14th April, 1950, and free price thereafter.

† From 15th April.

Table 8. Estimated weight of arrivals of Irish salmon on Billingsgate Market annually compared with exports for the period 1954/63, inclusive.

Year	Weight of arrivals on Billingsgate Market in lb.*	Weight of fish exported cwt.	Weight of arrivals at Billingsgate as percentage of export
1954	767,600	17,525	39
1955	539,200	11,135	43
1956	660,000	13,564	43
1957	867,800	15,710	49
1958	849,300	14,047	54
1959	962,700	13,682	63
1960	785,100	10,920	64
1961	811,600	9,059	80
1962	1,193,300	18,771	57
1963	1,427,700	23,477	54
Mean	—	—	54

* On basis of 100 lb. per package.

that handled on Billingsgate Market for the years 1956 to 1963 inclusive would be as follows:—

1956	1957	1958	1959	1960	1961	1962	1963
44	44	48	42	43	37	78	54

There is a good agreement between these figures for normal years but marked changes for the two rather abnormal (exceptionally good) years 1962 and 1963. This again indicates the diversion of salmon from outside markets to Dublin in the year 1962 and to a lesser extent in 1963.

From Table 9 it will also be seen that, as in the case of Billingsgate Market, there is a gradual rise in the number of fish handled monthly until July and a fairly rapid fall thereafter to October, when comparatively few fish were handled because of the advent of the close season.

The open sea drift net returns. Details have been given earlier of the drift net fishery off the north-west coast of Ireland (Went, 1956 and 1964) so it is not necessary to repeat what has already been published. Since the previous survey was published in 1956 a number of motor boats from 28 to 32 feet have been introduced along the north coast of Mayo, thus replacing the older oared currachs and other boats. The statistics available from this fishery consist of annual landing figures (numbers and weights) for the Donegal and "Mayo" areas for the period 1925 to 1963 inclusive.

This fishery depends mainly upon grilse and, therefore, other things

Table 9.—Sales of salmon on the Dublin Wholesale Fishmarket *

Month	Years										
	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
January	220	236	235	219	234	260	233	171	212	211	221
February	1,078	700	516	725	1,448	1,105	1,826	1,154	1,002	1,237	1,241
March	1,144	1,166	1,417	2,060	2,695	2,073	3,289	1,662	1,566	2,256	3,644
April	2,110	2,319	2,271	2,610	3,307	2,812	3,861	2,195	1,687	3,226	4,396
May	3,462	4,304	2,706	4,415	3,741	4,290	4,561	4,010	3,459	5,584	6,075
June	7,502	3,955	5,375	9,041	12,276	7,980	8,387	11,739	11,207	21,742	21,494
July	1,426	9,767	6,367	14,943	22,100	32,138	21,363	18,933	19,065	78,446	51,933
August	2,473	3,722	3,338	4,223	5,644	6,180	6,569	4,673	3,104	16,029	12,896
September	1,121	1,504	979	1,155	1,416	1,515	777	778	914	2,267	2,443
October	46	21	—	81	179	242	120	106	100	217	132
"Spring fish"	8,014	8,725	7,145	10,029	11,425	10,540	13,770	9,192	7,926	12,514	15,577
"Summer fish"	12,628	18,969	16,059	29,443	41,615	48,055	37,216	36,229	34,390	118,701	88,898
Total	20,642	27,694	23,204	39,472	53,040	58,595	50,986	45,421	42,316	131,215	104,475
Weight in lb.	Not known	Not known	Not known	293,503	407,902	381,745	401,252	340,841	303,883	934,788	776,381

* Figures for 1953/55 inclusive taken from reports in the Dublin newspapers and for the remaining years from the dealers' registers.
 ("Spring fish" = fish handled Jan./May and "Summer fish" from June onwards.)

being equal the catch in a good grilse year may be high and in a poor grilse year low. In Table 10 the available statistics are given. In the period under review the average annual catch in both areas has been a little under twenty-three thousand fish but as will be seen from Fig. 3 there have been very great fluctuations from year to year in the proportions of fish taken in the two areas. In the Donegal area very good catches (over 30,000) were made in 1925, 1930, 1962 and 1963 whereas in the Mayo area very good catches (over 11,000) were made in the year 1948, 1960, 1962 and 1963. Poor catches (below

Table 10. Details of the landings etc. from the open sea drift net fishery for salmon.

Year	No. of fish landed			Total Weight (cwt.)	Average weight (lb.)
	Donegal	Mayo	Total		
1925	30,563	8,293	38,856	2,125	6.1
1926	34,951	8,087	43,038	2,324	6.0
1927	18,064	4,586	22,650	1,375	6.8
1928	13,896	2,406	16,302	878	6.0
1929	3,922	1,066	4,988	317	7.1
1930	35,482	5,190	40,672	2,301	6.3
1931	25,300	7,710	33,010	1,884	6.4
1932	9,430	4,717	14,147	864	6.8
1933	16,249	4,614	20,863	1,333	7.2
1934	13,127	5,838	18,965	1,112	6.5
1935	14,564	8,969	23,533	1,374	6.5
1936	13,393	4,154	17,547	1,136	7.2
1937	7,261	2,914	10,175	585	6.5
1938	6,486	3,415	9,901	553	6.3
1939	8,207	4,403	12,610	780	6.9
1940	9,531	6,234	15,765	948	6.7
1941	11,270	5,578	16,848	1,029	6.8
1942	17,457	4,643	22,100	1,475	7.5
1943	5,446	5,816	11,262	686	6.8
1944	5,374	2,886	8,260	479	6.5
1945	2,256	1,443	3,699	228	6.9
1946	4,633	4,034	8,667	517	6.7
1947	11,488	7,266	18,754	1,151	6.9
1948	16,943	11,286	28,229	1,729	6.8
1949	14,172	9,020	23,192	1,286	6.2
1950	17,903	11,981	29,884	1,733	6.5
1951	20,932	7,602	28,534	1,730	6.8
1952	16,499	7,582	24,081	1,515	7.1
1953	17,111	7,026	24,137	1,442	6.7
1954	18,217	6,953	25,170	1,381	6.1
1955	9,642	4,747	14,389	867	6.4
1956	14,877	6,787	21,664	1,282	6.4
1957	18,509	10,568	29,077	1,779	6.5
1958	15,663	6,520	22,183	1,270	6.2
1959	15,462	5,465	20,927	1,225	6.4
1960	16,851	11,769	28,620	1,591	5.9
1961	14,014	8,574	22,588	1,353	6.5
1962	32,094	26,453	58,547	3,545	6.2
1963	45,242	14,955	60,197	3,689	6.3
Mean	15,961	6,963	22,924	1,356	6.6

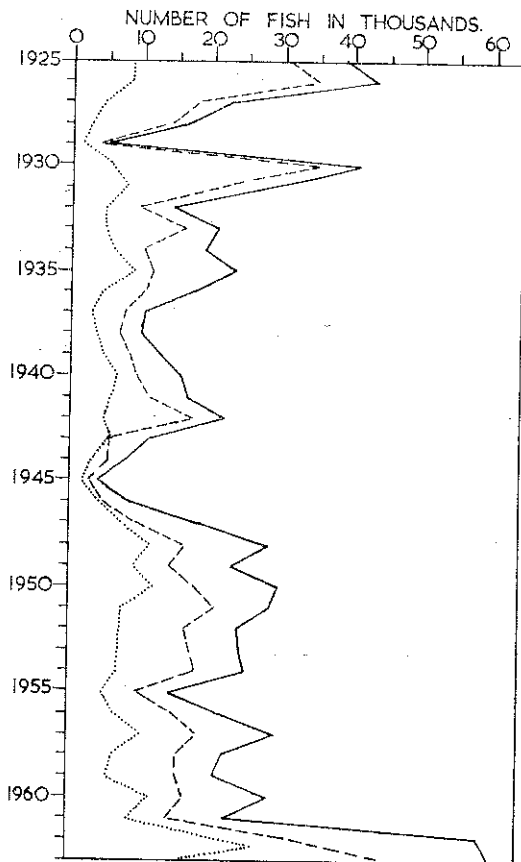


Fig. 3: Statistics from the open sea drift net fishery. (Broken line=Donegal; dotted line=Mayo, and full line=total catch.)

7,000) were made in the Donegal area in the years 1929, 1938, 1943-46, and in the Mayo area (below 3,000) in the years 1928, 1929, 1937 and 1944-45. There is, as will be seen from Fig. 3, some coincidence of peaks and troughs in the catch distribution curves from the two areas. In 1962 and 1963 the drift net fisheries in both areas benefited from the greatly enhanced runs of grilse as did the other fisheries in the country.

The average weight of salmon landed in this fishery has fluctuated from 6.0 to 7.2 lb. with an average of 6.6 over the whole period. These averages reflect the changes in average weight of the runs of grilse only to a limited extent because the gear used is highly selective and some of the very small grilse may be able to pass through the net without being caught.

The present statistics include only the "open sea" catch by salmon drift nets. For the years 1952, 1953 and 1954 the reports of the Foyle Fisheries Commission do not differentiate between "open sea"

and "lough" drift nets but subsequently they are so differentiated. In Table 11 for these years the number of licences issued by the Foyle Fisheries Commission for open sea drift netting has been assumed to be ten and catch/effort statistics have been calculated accordingly.

The number of drift net licences has decreased very much since the "twenties" probably for a number of reasons which we need not discuss here but the mean catch per licence has increased due, in the main, to the change over from oared boats to larger boats propelled by motors, which can carry longer nets. Each boat is, therefore, exerting a much greater intensity of fishing than in the beginning of the period under review. The low number of licences and the low yield in the war years was probably associated with shortage of gear and fuel. In many cases, of which the writer is aware, short nets — much shorter than normally used — were in operation during part of the period due to the difficulty of obtaining materials. Also nets which would normally have been replaced were kept in use long after they had reached the stage when their efficiency was seriously impaired.

The mean catches (in cwt) per licence for the period 1925/1963 have been given in Table 11. As in the case of most Irish fisheries the peak in the mean catch per licence was in 1962 when it was well

Table 11. Number of licences issued for open sea drift net operations along the north west of Ireland*

Year	No. of licences issued	Mean catch (cwt.) per licence	Year	No. of licences issued	Mean catch (cwt.) per licence
1925	100	21.3	1945	43	5.3
1926	244	9.5	1946	51	10.1
1927	233	5.9	1947	57	20.2
1928	234	3.8	1948	73	23.7
1929	184	1.7	1949	92	13.9
1930	194	11.9	1950	102	17.0
1931	198	9.5	1951	111	15.6
1932	194	4.5	1952	93**	16.3
1933	187	7.1	1953	117**	12.3
1934	166	6.7	1954	103**	13.4
1935	150	8.8	1955	99	8.8
1936	144	7.9	1956	85	15.1
1937	83	7.1	1957	93	19.1
1938	74	7.5	1958	87	14.6
1939	85	9.2	1959	83	14.7
1940	93	10.2	1960	88	18.1
1941	81	12.7	1961	96	13.0
1942	83	17.8	1962	104	34.1
1943	76	9.0	1963	132	27.8
1944	80	6.0			

* Off counties Mayo, Sligo and Donegal.

** No separate figures for open sea and other drift nets for the Foyal Fisheries Commission for these years so number of licences estimated at 10.

over twice the recent (for twenty years) average. The very high catches in 1962 certainly induced a number of people to undertake drift netting for salmon in 1963, when the number of licences issued exceeded those for each year since 1937.

The catch returns. From 1927 to 1944 catch figures were available only for the "odd" years but from 1945 onwards catch figures were compiled annually. Since the earlier figures were only available biennially it is proposed in this section of the paper to deal with the returns for the period from 1945 onwards. The returns in question were given in *Statistics of salmon, sea trout and eels* published annually for the years 1945 to 1948, inclusive, and subsequently in the annual *Report on the sea and inland fisheries*. One matter calls for comment in connection with these statistics. Up to and including 1951 the catch in the Merville District (i.e. that part of the catchment area of the River Foyle within the State) was included in these statistics but thereafter, on the establishment of the Foyle Fisheries Commission, they have been excluded. Returns for the Foyle system are given annually in the Reports of the Foyle Fisheries Commission.

It is convenient to group all the commercial fisheries together for the purpose of this paper and this has been done in Table 12 and Fig. 4. The fluctuations in the catch returns for all methods range

Table 12. Catch returns to nearest 1,000 lb. for the years 1945 to 1963, inclusive, together with numbers of licences issued and average catch per licence*

Year	Catch in 1000 lb.			No. of licences for commercial engines	Mean catch per commercial licence to nearest 10 lb.
	By commercial methods	By rods	By all methods		
1945	905	114	1,019	1,070	840
1946	1,483	109	1,592	1,050	1,410
1947	1,514	150	1,664	1,034	1,460
1948	1,908	176	2,084	1,238	1,540
1949	2,020	173	2,193	1,403	1,440
1950	1,861	242	2,103	1,489	1,250
1951	2,580	250	2,830	1,547	1,680
1952	1,633	225	1,858	1,383	1,180
1953	1,640	211	1,851	1,373	1,190
1954	1,684	293	1,977	1,305	1,290
1955	1,014	247	1,261	1,244	810
1956	1,179	264	1,443	1,229	960
1957	1,491	309	1,800	1,246	1,200
1958	1,279	375	1,654	1,146	1,120
1959	1,364	260	1,624	1,230	1,110
1960	1,134	230	1,364	1,195	950
1961	1,153	193	1,346	1,121	1,030
1962	2,606	258	2,864	1,180	2,210
1963	2,495	342	2,837	1,289	1,940
Mean	1,629	233	1,862	1,251	1,300

* From 1952 onwards excluding the catch in the former Merville Fishery District, now part of the Foyle Fisheries Commission's area.

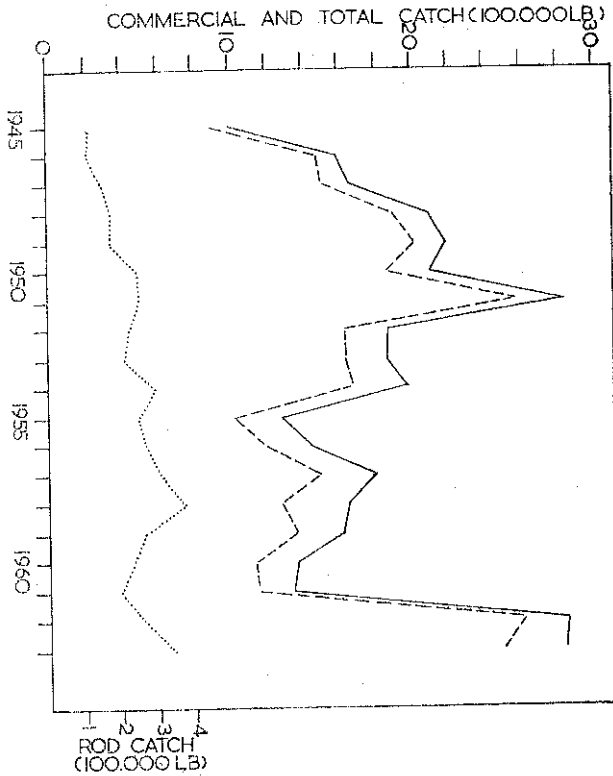


Fig. 4: Catch figures in lb. of salmon from 1945 to 1963, inclusive. (Broken lines—commercial catches; dotted line—rod catches, and full line—catches by all methods.)

from 1,019,000 lb. in 1945 to 2,864,000 in 1962, the returns for 1963 only being marginally less than those of the previous year. It was perhaps unfortunate that the start of the collection of annual statistics in 1945 should have coincided with a very poor year, possibly the poorest year for Irish salmon for upwards of eighty years.

In the period under review exceptionally good catches were made in the years 1951, 1962 and 1963 and very poor catches in 1945 and 1955. More fish per unit weight were undoubtedly caught in 1951 than in 1962 and 1963 because in the former years there were fairly large numbers of salmon, as opposed to grilse, whereas in the latter two years the catch was largely made up of grilse with comparatively few salmon early in the year.

Some of the fluctuations in catch result, of course, from fluctuations in the number of fishing engines in use. At the end of, and immediately after the war, gear was in short supply and, therefore, there was a tendency for the number of commercial engines used to be low. There was a comparatively rapid rise in 1951 with a fall thereafter. The actual number of licences issued for commercial engines each year have been given in Table 12. Whilst it is clear

that part of the fluctuations in catch may be due to the fluctuations in the number of commercial engines in use, it is clear from details of the mean catch per licence as shown in Table 12 that there were very marked differences in the numbers of fish available for capture. The catch per licence has, of course, its limitations in that it assumes every type of fishing gear has the same efficiency which, of course, is not the case. Be that as it may the mean catch per licence indicates the fluctuations in the yield and tends to level out the effect of changes in numbers of engines used. High yields per licence (over 1,500 lb.) were obtained in the years 1948, 1951, 1962 and 1963 and low yields (less than 1,000 lb.) in 1945, 1955, 1956 and 1960.

The rod catch has increased over the period under review from an average of approximately 162,000 lb. in the period 1945/49 to 256,600 lb. in the period 1958/62. This increased catch, however, was made as will be seen from Table 13 mainly as a result of the extra effort involved because the actual catch per effort has decreased. Excluding the endorsement licences (i.e. the licences issued for a second or subsequent fishery district) the number of rod licences has risen rapidly from below 3,000 in 1945 to 8,295 in 1958. A change in the licensing scheme was introduced in 1959 when a total of 7,791 rod licences were issued and these have risen to 9,745 for 1963. The actual numbers, weight of fish, taken on rod and line are also available (Table 13).

Table 13. Catch in 1000 lb., number of rod licences issued and mean catch per licence.

Year	Catch		Number of licences issued	Mean catch per licence	
	1000 lb.	Number		lb.	No.
1945	114	12,179	2,521*	45.2	4.8
1946	109	11,990	3,128*	34.8	3.8
1947	150	15,157	3,568*	42.7	4.3
1948	176	18,226	4,334*	40.6	4.2
1949	173	18,587	4,232*	40.8	4.4
1950	242	26,450	4,591*	52.6	5.7
1951	250	27,055	5,102*	49.0	5.3
1952	225	23,838	5,716*	39.4	4.2
1953	211	26,931	6,050*	34.9	4.5
1954	293	33,225	6,195*	47.3	5.4
1955	247	28,561	6,604*	37.3	4.3
1956	264	35,757	7,495*	35.3	4.8
1957	309	39,647	7,785*	39.7	5.0
1958	375	49,696	8,294*	44.9	5.9
1959	260	31,338	7,791†	35.4	4.0
1960	230	27,199	8,742†	26.4	3.1
1961	193	25,349	8,578†	22.5	3.0
1962	258	34,271	9,009†	28.6	3.8
1963	342	40,394	9,745†	35.1	4.1

*Excluding endorsements.

†All licences issued according to the Fisheries (Amendment) Act, 1958 and Fisheries (Consolidation) Act, 1959.

Table 14.—Numbers of rod licences in the different categories issued to people from different places

Year	Licencees residence, etc.	Type of licences							Total of all licences
		All district, seasonal £4	District, seasonal £3	Late Season all district £3	Late Season district £2	21 days	7 days	Foyle extensions	
1960	Great Britain	30	85	19	251	9	1189	—	1583
	Northern Ireland	46	92	3	47	3	297	250	745
	Other foreign countries	9	7	4	21	—	263	—	339
	Total issued	1544	3435	126	840	12	2520	265	8742
	A	6	5	21	38	100	79	94	30
1961	Great Britain	24	53	13	254	—	1042	5	1391
	Northern Ireland	63	139	3	55	—	237	210	707
	Other foreign countries	13	10	7	21	—	284	—	335
	Total issued	1482	3193	140	967	7	2533	256	8578
	A	7	6	16	34	—	62	84	28
1962	Great Britain	27	86	27	281	4	1516	3	1944
	Northern Ireland	65	103	12	44	—	358	205	687
	Other foreign countries	10	5	31	23	—	276	—	325
	Total issued	1563	3026	249	960	8	2974	229	9009
	A	6	6	20	36	50	72	91	33
1963	Great Britain	41	61	36	214	2	1580	1	1935
	Northern Ireland	71	119	26	59	—	339	266	880
	Other foreign countries	12	7	16	14	—	367	—	416
	Total issued	1675	3132	182	1178	2	3266	310	9745
	A	7	6	43	24	100	70	86	33

A = Percentage of persons from outside the State taking out category of licence

The mean catch per licence figures for the period 1945/1958 can be regarded as calculated on a consistent basis and those for the period 1959/63 on another consistent basis. Unfortunately it is not possible to give the relationship between the two sets of figures because of the change in the licensing system from 1959 onwards.

The holders of rod licences. Although not published, information as to the place of residence of rod licence holders is available in the records of the Fisheries Division of the Department of Lands. In some cases the address of the holder is given as a hotel or guest-house and in others the address is not recorded. These people are almost certainly visitors from outside the State but they have not been included in the returns given in Table 14 in which the numbers of licences known to have been issued to certain categories of persons are recorded. Accordingly, these figures must be considered, for the reasons already stated, as minima. As might have been expected most of the holders of Foyle extension licences come from Northern Ireland and substantial numbers of people holding other types of licences also come from that region. The "all district" £4 licences and the £3 district licences were, in the main, taken out by residents of the State, whereas substantial proportions of the late season and 7-day licences were taken out by visitors. The so-called "salmon" rod licence is also available for fishing for sea trout so that some of

Table 15. Number of licences issued to persons residing outside Great Britain and Ireland.

Area	1960	1961	1962	1963
EUROPE				
Austria	18	12	1	—
Belgium	2	2	14	14
Denmark	—	18	8	6
Finland	—	—	5	6
France	62	65	75	91
Federal Republic of Germany	53	40	21	34
Gibraltar	—	—	—	1
Holland	15	12	8	10
Italy	3	—	—	2
Portugal	1	—	—	—
Spain	4	1	—	1
Sweden	3	3	6	6
Switzerland	37	43	23	39
Yugoslavia	1	—	—	—
OUTSIDE EUROPE				
Africa	60	8	14	25
Asia	4	4	7	4
Australia	2	6	2	2
New Zealand	2	1	—	—
North America (mainly U.S.A.)	68	113	138	171
South America	2	5	1	—
West Indies	2	2	2	4
Total	339	335	325	416

these licences may also have been taken out by persons who intended to fish for sea trout rather than salmon. In the Connemara Fishery District and some other districts also a fairly large number of holders of licences would, in fact, have really been after sea trout rather than salmon.

We can subdivide the holders of licences into a number of convenient groups based on their country of residence (Table 15). Most of the people coming from outside Great Britain and Ireland were from North America (Canada and U.S.A.). In the period 1960/1963 the relevant numbers were 68, 113, 138, and 171 respectively. The next country in importance was France with 62, 65, 75 and 91 respectively. In fact visiting anglers to Ireland were drawn from all over the six continents, albeit only small numbers were from the more remote areas and no doubt, some of the people from the Commonwealth were Irish people home on holiday. These figures do show, however, the importance of the salmon rod fishery as an amenity for the visitor and resident alike. In the period under review at least 28% (1961) to 33% (1962 and 1963) of the rod licences were taken out by visitors to the country. The actual numbers of rod licences issued to people from outside the State were at least 2,632, 2,433, 2,936, and 3,231 respectively, for the years in question.

Levy returns. Under the provisions of the Fisheries Acts a levy of 2d. per pound is collected on all salmon exported up to 31st May each year and 1d. per pound thereafter. The forms required for export with the attached cancelled stamps representing levy paid are returned to the Department of Lands, Fisheries Division, and on these the point of export is recorded. In the period 1960/63 exports from each centre involving more than 20,000 pounds weight of salmon were exported as follows:

Custom stations or ports	Quantity of exports 1960/63 (in 1,000 lb.)	Percentage of total exports
Rosslare Harbour	3,665	51.4
Co. Donegal customs station and land frontiers	1,483	20.8
Dublin (Ship)	828	11.6
Cork (Ship)	463	6.5
Dublin (Airport)	462	6.5
Shannon (Airport)	91	1.3
Waterford (Ship)	42	0.6
Dundalk (Land Frontier)	20	0.3
Total	7,119	—

The reason for the popularity of Rosslare Harbour as a port of export is obvious. The trains to Rosslare run alongside the ship and the cases of salmon (with other passenger train merchandise) are loaded directly from the train to the ship. Similarly at Fishguard Quay the fish can be unloaded from the ship on to the train alongside. These facilities permit in many cases shippers of salmon to dispatch the fish later at relatively remote centres than would be possible for other routes, a matter of considerable importance, particularly in hot weather. Salmon shipped via Dublin and Shannon Airports are destined mainly for continental markets. Only small

quantities of salmon have been shipped so far from Cork Airport which, of course, has only been in operation for a comparatively short time, the total for 1963 reaching 7,375 lb.

Examination of the levy returns also indicates the routes by which salmon are conveyed to Great Britain. These routes are the same as set out in a previous publication (Went, 1957). The main sea routes direct from the State are those from Rosslare to Fishguard, Dublin to Holyhead and Liverpool, Cork to Fishguard. From the north west part of the country salmon is shipped via Northern Ireland mainly to the north of England via Larne/Stranraer, and Belfast to Heysham and Liverpool. Direct shipments of salmon are made by Irish shippers to most important centres of population in England although the main markets are those at Billingsgate, Manchester and Liverpool. Incidentally small but growing quantities of salmon, mainly small smoked grilse are being exported by parcel post to Great Britain following upon a recent intensive advertising campaign in some British newspapers.

General. This survey indicates the importance of the trade in Irish salmon. A very large part of the salmon taken annually is captured by commercial methods by persons who fish under the "common law right", that is to say, they fish in the sea or in the tidal waters of rivers to which a valid claim to a several or exclusive fishery has not been established. Although in many cases these fishermen do not obtain their sole livelihood from salmon fishing, their income from this source is such that with small farms or even other fishing activities the men can enjoy a reasonable standard of living. Without the salmon fishing in many cases they would be unable to exist on the other available income. The real importance of the catch of salmon in these circumstances is, therefore, out of all proportion to the money which it realises. Employment is also given by the salmon fishery to people who provide services for anglers in many ways. The value of the fish landed is only a small proportion in many cases, of the actual expenditure by the angler, and in particular the tourist, whether he be an Irish resident or not. Inquiries made by us suggest that the visitor from abroad spends on average on hotels, transport services, and incidental expenses not less than £30 to catch a salmon. In many cases he will bring with him his wife and family, none of whom fishes, so that but for the attraction of the salmon fishing many of these family parties would not come to Ireland at all.

The income from the salmon fishery is obtained from

- (a) The commercial fishery (for which returns are given annually in the **Report of the sea and inland fisheries** and in the Reports of the Foyle Fisheries Commission);
- (b) Visiting anglers, and
- (c) Resident anglers.

Income from items (b) and (c) is difficult to estimate closely for obvious reasons. The value of salmon landed by anglers is also given annually in the **Report of the sea and inland fisheries** but this is clearly only a small part of the value of the salmon angling. Visiting

anglers have to pay hotel, transport and incidental expenses, as do those anglers resident in the State who take angling holidays. As regards visitors from outside the State on the basis that holders of seasonal licences spend four weeks, holders of late season and 21 day licences, 3 weeks, and holders of 7 day licences one week in the country, then the angling weeks spent in the country by persons residing outside the State would be as follows:—

1960	1961	1962	1963
3,901	3,833	4,540	4,612

These figures do not include the holders of Foyle extension licences resident in Northern Ireland it being assumed that, in general, they tend to make day trips rather than stay for extended periods in the State.

Inquiries into the average cost of accommodation and incidental expenses indicate that most tourist anglers who fish for salmon spend over and above the value of the fish landed at least £30 per week whilst in the country, some very much more so. Taking £30 per week for the numbers of weeks estimated above the income from visiting anglers from outside the State in the years in question would be

1960	1961	1962	1963
£117,030	£114,990	£136,200	£138,360

We have now to consider the income derived from holiday angling by residents in the State. This is a very difficult thing to estimate as the necessary information is not available and we are forced to make several assumptions. The holders of 7 day and 21 day licences resident in the State are mainly holiday fishermen and these would account for 871, 970, 824 and 986 "angler weeks", respectively for the years 1960 to 1963 inclusive, with estimated expenditure as follows — again on the assumption of a weekly average of £30.

1960	1961	1962	1963
£26,130	£29,760	£25,080	£29,580

It is possible, of course, that a substantial part of such expenditure would not depend entirely on the availability of salmon angling, some of the expenditure by resident anglers, who take out seasonal or late season licences could also be taken into consideration in estimating the value of the salmon angling to the country but we have no means of assessing it.

Catch figures are given for the River Foyle in the annual reports of the Foyle Fisheries Commission. Unfortunately no values are given therein, but we can reckon the value of the "first hand" price and from observations made on the Foyle it seems likely that about half the total catch is made by residents of the State, the remainder being made by fishermen residing in Northern Ireland and by the Commission itself. On this basis the value of the salmon fishery in the River Foyle from 1960 to 1963 inclusive would be

1960	1961	1962	1963
£66,924	£51,556	£112,512	£114,606

On the basis of the foregoing figures the total value of the salmon fisheries for the years 1960/63 would be as follows:—

	Value in £ to nearest £1,000			
	1960	1961	1962	1963
Commercial catch as published (including estimates for the Foyle) ...	401	397	659	717
Rod catch (ditto) ...	76	65	74	101
Expenditure by visiting anglers ...	117	115	136	138
Expenditure by resident anglers on holidays ...	26	30	25	30
Total ...	620	607	894	986

In the years 1960 to 1963, therefore, the estimated value of the salmon fishery has ranged from about £600,000 to approximately £1,000,000.

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SALMON OF THE RIVER SHANNON (1957 to 1962)

Eileen Twomey, M.Sc.

A routine analysis of the stocks of salmon entering the River Shannon has been in progress since 1944 (Went 1946, 1950 and 1953, Twomey 1957). The present paper deals with material collected from 1957 to 1961. No scale material was collected for 1962 but the estimated runs of fish into Thomond Weir have been included. Thomond Weir is the commercial fishing weir situated in the upper tidal limits of the Shannon (see Went, 1943). The fish entering it during the open season are recorded daily and the "ten day" runs are given in Table 1. The runs of salmon from 1957 to 1959 were average for the Shannon; those of 1960 were below average; those of 1961 were the worst on record — even being worse than those of 1945, which Went (1953) describes as "probably the worst for over 50 years as regards the runs of salmon into Irish rivers". The runs of fish in 1962 (18,322 were similar in size to those of 1942 and 1943, which were considered to be very good runs. On the basis of time of running in 1962 it may be presumed that the bulk of the fish were grilse, since eighty-five per cent of the total ran from June 11 to July 19. From 1954 onwards with only a few exceptions the peak in the runs occurred during the first ten days of July, whereas up to 1953 it varied between June 10 and June 30. (Fig. 1).

The numbers of fish running up to May 20 and thereafter until the end of the fishing season are given in Table 2 and Fig. 2. Fish running up to May 20 may be regarded as "spring fish" and thereafter as "summer fish". In 1957 and 1959 there was a fairly high percentage of "spring fish" when compared with the 1941 figures, those for the years 1958, 1960 and 1961 showing a marked decrease in the number of early run ("spring") fish. There was a steady decrease in the number of summer fish from 1957 to 1961 with a rise again in 1962. In 1962, however, the number of fish running after May 20 was the highest since 1941.

Analysis of stocks:

Material consisting of 3,418 sets of scales was collected for the years 1957 to 1961. The number of sets taken in each year was as follows:—

Year	1957	1958	1959	1960	1961
Number of sets of scales examined	301	951	1,039	786	341

The smolt classes and age groupings were noted for each fish and, as the proportion of fish sampled in each month fluctuated, suitable arithmetical adjustments were made. The smolt classes (Table 3) were of the same order as those found in previous years, except for 1961 when there was an increase in the proportion of one-year-old smolts. Grilse were, as usual, the predominant age group (Table 4).

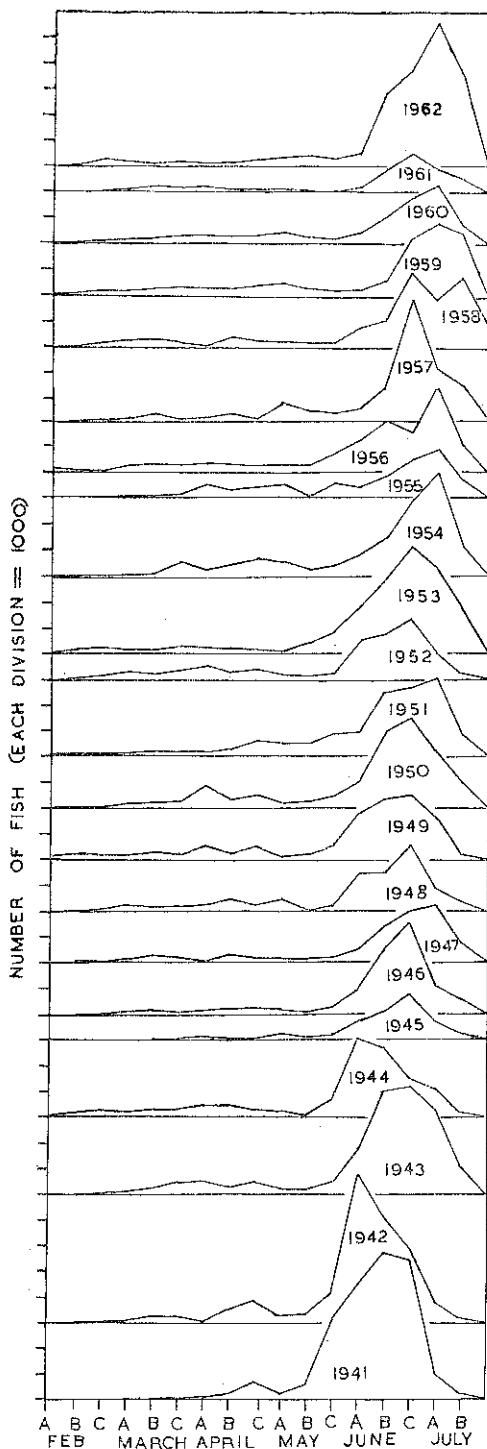


Fig. 1: Diagram showing strengths of the run entering Thomond Weir in 10-day periods throughout the season from 1941 to 1962, inclusive. (A—1st to 10th day, inclusive; B—11th to 20th, inclusive and C—21st to end of month.)

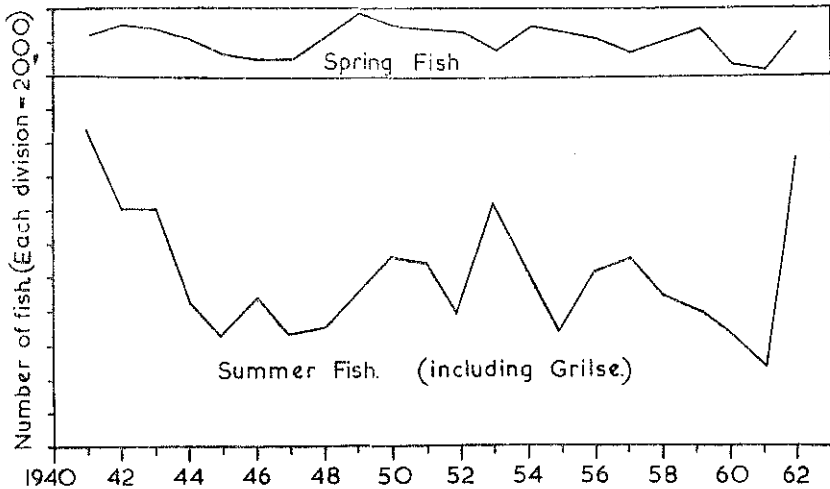


Fig. 2: Estimated numbers of "spring" and "summer" fish running in the years 1941 to 1962, inclusive.

In 1959, however, there was an increase in the proportion of small spring fish, small summer fish and previous spawners, thus reducing the grilse to sixty-two per cent of the total. A comparison was made between the numbers of "spring fish" and "summer fish" estimated according to the time of running and actual numbers estimated from scale reading (Table 5). With the exception of 1957, when there was a large number of early running summer fish (2+) in the catch, over eighty-six per cent of the fish running up to and including May 20 are true spring fish, whereas over ninety per cent of the fish running after May 20 are summer fish. On the time basis the relative abundance of spring and summer salmon is shown graphically in Fig. 2 for the period 1941 to 1962.

From the actual number of fish running and scale analysis the number of fish in each age group has been calculated (Table 6, Fig. 3). In Fig. 3 the years 1942 and 1943 are not included as there was no scale material available. From 1957 onwards there is a steady decline in the number of grilse up to 1961. This decline can be associated with the decline in the total number of fish in the run during the same period. The year 1959 gave the highest return of small spring fish in the period under review. The run of small summer fish in 1957 was the highest since 1954, the figure for 1958 was poor when compared with previous years, but not so poor as those of 1960 and 1961. The large spring fish which at one time formed over fifty per cent of the Shannon stocks (Southern, 1928) was almost extinct. There was a very large number of previous spawners in the 1959 catch when compared with previous years and it was on a par with the 1953 figure, which was the highest since 1941.

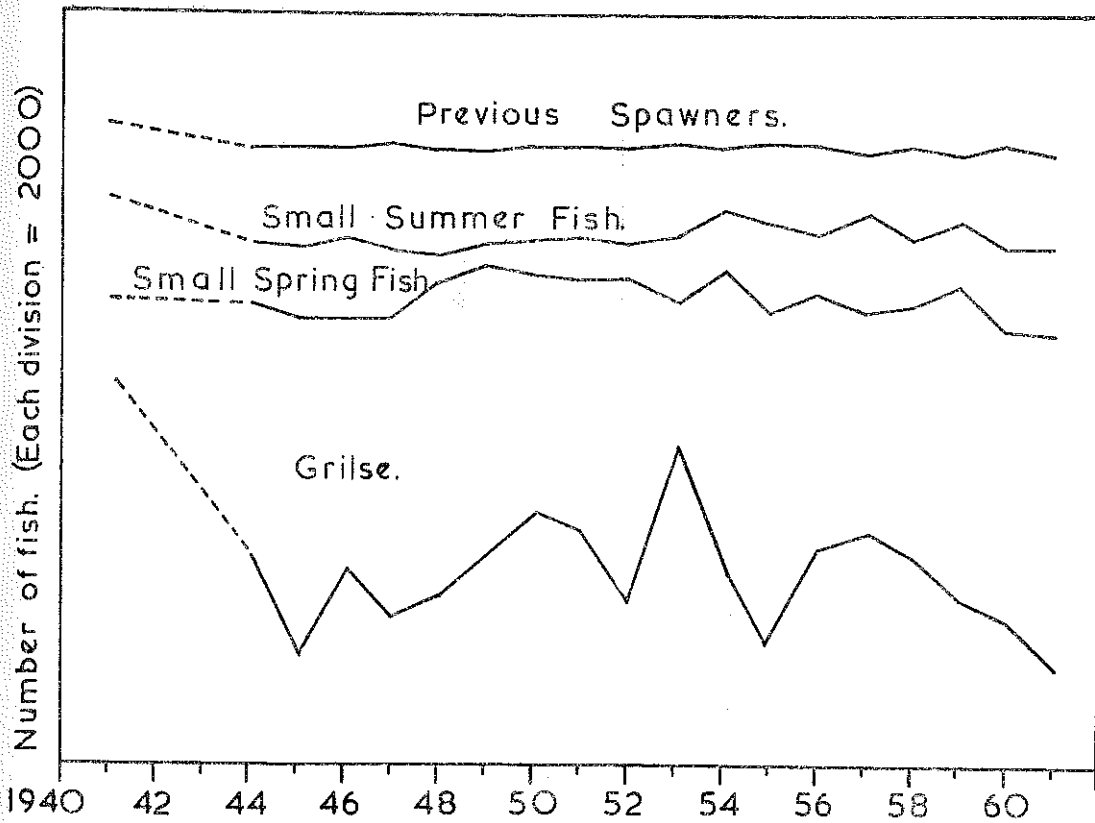


Fig. 3: Fluctuations in the numbers of the four most important age groups from 1941 to 1961, inclusive, based on scale readings (no returns for 1942 and 1943).

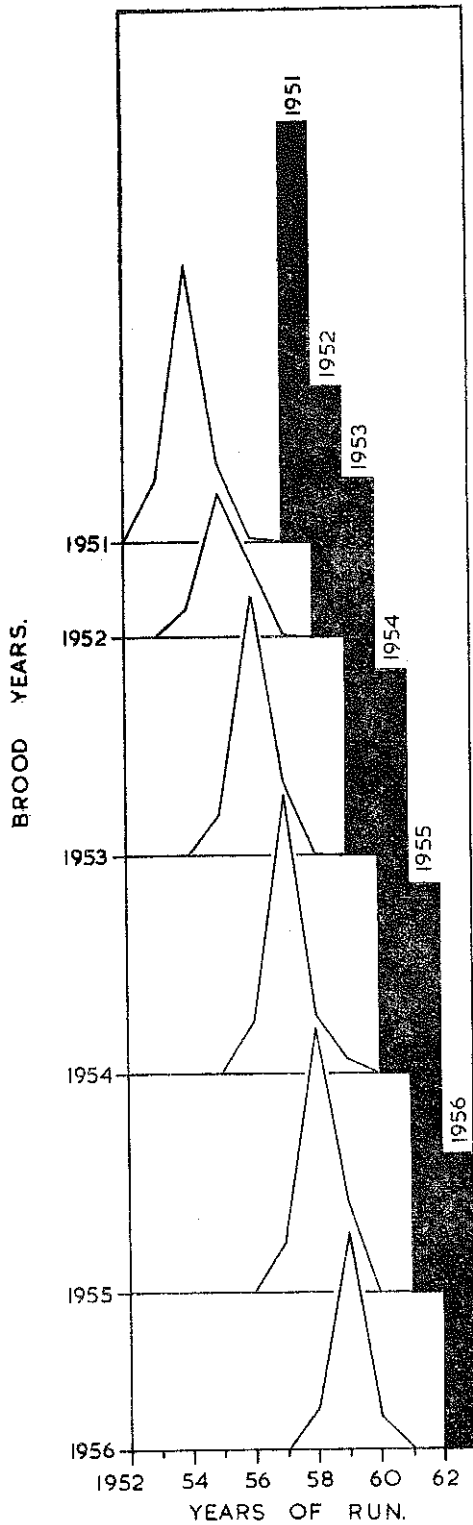


Fig. 4: Diagram showing the strengths of the different brood years and their distribution in the catches for the different years.

Information relating to six complete brood years from 1951 to 1956 is given in Table 7 and represented graphically in Figure 4. The year 1957 is almost complete; only the numbers of large spring and large summer fish (which did not run until 1962) are missing and these form a very small proportion of the total run. Data on thirteen complete brood years (Twomey 1957 and opus cit.) are now available.

In the period under review the return from the 1951 brood year is the best and that from 1952 brood year the worst. No definite relationship can be established between the strength of the brood year and the strength of the return of adults.

Summary

1. Collections of scales and data from salmon of the River Shannon from 1957 to 1961 were analysed, and the variations in the runs of fish were indicated (Tables 1 and 2, Figures 1 and 2).
2. Two-year-old smolts were the dominant smolt class. The one-year-old smolts varied from 17.8 per cent to 25.7 per cent. The three-year-old smolts never exceeded 2.4 per cent (Table 3).
3. 3. The grilse were the most important age group, followed by the small spring fish. The year 1959 gave the highest return of small spring fish in the period under review. In 1957 and 1959 there was a marked increase in the number of small summer fish (Table 4).
4. The number of spring and summer fish in each year was calculated and a comparison was made between the numbers obtained by consideration of the time of running and the actual data obtained from scale reading (Table 5, Figure 2).
5. The number of fish in each age group was calculated (Table 6, Figure 3).
6. Information on the progeny of six complete brood years is given in Table 7 and represented graphically in Figure 4.

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Table 1. Estimated runs of fish based on the returns from Thomond Weir

Year	1957	1958	1959	1960	1961	1962
1 Jan. - 10 Feb.		30	98	5		52
11 - 20 Feb.	19	20	123	21	9	128
21 Feb. - end of month	43	20	151	55	45	26
1 - 10 March	164	149	153	125	45	61
11 - 20 "	243	225	179	87	112	36
21 - 31 "	145	198	335	71	95	136
1 - 10 April	222	46	360	160	110	53
11 - 20 "	374	476	320	101	54	112
21 - 30 "	191	402	354	95	83	262
1 - 10 May	629	302	465	218	178	423
11 - 20 "	385	223	295	184	62	434
21 - 31 "	338	260	251	251	93	323
1 - 10 June	451	911	326	532	249	484
11 - 20 "	1,275	1,097	611	1,073	997	2,938
21 - 30 "	4,874	2,935	2,327	1,819	1,604	3,879
1 - 10 July	2,131	1,936	2,712	2,349	973	5,521
11 - 19 "	1,643	2,751	2,458	820	385	3,454
Total	13,127	11,981	11,518	7,966	5,094	18,322

Table 2. Number and proportion of fish running up to and including 20 May and thereafter

Year	Number up to 20th May	Percentage relative to 1941	Number after 20th May	Percentage relative to 1941
1957	2415	112	10,712	54
1958	2091	93	9,890	45
1959	2833	121	8,685	43
1960	1122	50	6,844	34
1961	793	35	4,301	22
1962	1289	51	17,033	86

Table 3. Percentage of each smolt class in the different years

Salmon run of	Smolt class		
	1	2	3
1957	19.6	78.8	1.6
1958	18.4	79.2	2.4
1959	17.8	79.3	2.4
1960	19.0	79.1	1.9
1961	25.7	73.5	0.8

Table 4. Percentage of each age group in the different years

Year	Age group in winters					Total
	1+	2	2+	3	With SM's	
1957	75.6	13.3	9.9	—	1.2	100.0
1958	77.3	14.9	4.9	0.9	2.0	100.0
1959	62.8	20.7	9.6	0.9	6.0	100.0
1960	80.9	11.0	2.5	1.2	4.4	100.0
1961	83.0	13.5	2.0	0.5	1.0	100.0

Table 5. Comparison of numbers of "Spring fish" and "Summer fish" estimated according to the time of running and to scale examination

	1957	1958	1959	1960	1961	1962
Number of fish running up to 20th May	2415	2091	2833	1122	793	1289
Calculated number of <i>spring</i> fish from scale reading	1660	1865	2433	961	744	—
Number of fish running after 20th May	10,712	9890	8685	6844	4301	17,033
Calculated number of <i>summer</i> fish from scale reading	9737	8818	8502	6666	4133	—

Table 6. Number of fish (to the nearest ten) in the different age groups for each year

Age Group	1957	1958	1959	1960	1961
1 +	9920	9260	7230	6440	4230
2	1750	1800	2380	870	690
2 +	1300	570	1110	190	110
3	—	110	100	100	10
With SM's	160	240	700	370	50
Total:	13,130	11,980	11,520	7,970	5,090

Table 7. Estimated numbers of the different brood years in the catches of the different years (previous spawners omitted).

Brood Year	1953	1954	1955	1956	1957	1958	1959	1960	1961		
1951	1987	8820	2480	120						13,407 complete	
1952		940	4580	2360	66					7,946 "	
1953			1300	8390	8900	2350	59			12,099 "	
1954				1730		8900	1867	460		12,957 "	
1955						1653	8458	2899	55	13,065 "	
1956							1365	6915	1075	9,401 "	
1957								955	5262	46	6,807 almost complete
1958									1218	590	4,529 incomplete
1959										3311	1,095 incomplete
Total	1987	9760	8360	12,600	12,969	11,749	11,229	7610	5042		

III.

THE EFFECTS OF ARTERIAL DRAINAGE WORKS ON THE SALMON STOCK OF A TRIBUTARY OF THE RIVER MOY

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In recent years arterial drainage has become very important in land reclamation in Ireland. Some of our best salmon rivers, the Corrib, Dee, Glyde and Feale have been subjected to major drainage schemes in the past decade. It was accepted rather than proven that dredging had a detrimental effect on our salmonid stocks and the food thereof. When the River Moy drainage scheme was initiated in 1960 it was decided to investigate the possible effects of dredging on fish and bottom fauna. The Bunree River, an important spawning tributary of the River Moy, was selected for investigation as it presented a short term dredging programme (1 year approximately) and also since it contained roughly 25 per cent of the spawning potential of the River Moy. This tributary is not an angling river as the main run of fish does not enter it until November or December, and this aspect of the problem did not receive attention. The survey was dealt with under five major headings:—

- I. Changes in the topography of the river bed by the dredging.
- II. Physical and chemical survey of two selected stations.
- III. Faunistic survey of the above two stations.
- IV. Population of young salmonids in selected stretches.
- V. The effect of silt on the runs of adult salmon and spawning.

Changes in the topography of the river bed

The Bunree was a typical moorland river with alternating sharps and flats. The lower stretches flows slowly through fairly good agricultural land which is liable to flooding. It had some excellent holding pools and spawning fords for salmon. The middle reaches of the river with its many tributaries — Cloonta, Brusna, Black and Spring rivers flows through poor agricultural and bog land, the upper reaches, referred to as Glenree river is swift, flowing through rather high ground.

The Bunree rises in the Ox mountains which are of metamorphic rocks composed of mica schist and gneiss. In its lower reaches the river bed is composed mostly of glacial drift, the boulder clay being brown in colour or occasionally blue with glacial pebbles; in some places this boulder clay is covered with peat to a depth of 3 to 4 feet. The dredging, which commenced in June, 1960, in many instances removed the peat tops and exposed the glaciated gravel. In time most of the clay was washed downstream leaving the gravel, and the end result was that new spawning stretches were made available. As an example of this, before the Cloonta river was dredged, an average number of six salmon redds was counted each year for six

seasons, but in the spawning season of 1962/63 ninety-nine were recorded.

The object of arterial drainage generally is to lower the existing river bed giving a bigger channel, so that surplus water can run off more quickly. After dredging the bed of the Bunree was lowered by a maximum of four feet. Its section was made trapezoidal in shape in order to minimise the effect of erosion, and all the existing pools in the river were removed. There was a considerable increase in water velocities while dredging was in progress but on completion of the scheme velocities decreased generally. After the winter floods of 1961-62 it was evident that pools were beginning to form again.

The action of the dredgers was to dig out the soil and gravel of the river bed to a pre-determined depth by means of a drag line and toothed bucket (Fig. 1). The spoil was deposited on the banks in mounds together with undetermined numbers of food organisms as well as ova and alevins in season, but it was noted that in the first one or two casts over an undredged area, the teeth of the bucket seldom bit into the river bed but scraped abortively along its surface and succeeded only in dislodging rocks, gravel and soil together with an apparently considerable number of their invertebrate residents.

Physical and chemical changes

These changes were studied by selecting two rather small areas for detailed study. Station 1 was a section of the Cloonta river which was due to be dredged and Station 2, a similar type station on the Glenree, was chosen as a control on a stretch not scheduled for dredging. Table 1 gives details of the substratum area, water depth, current rate and chemical conditions before dredging took place and Table 2 gives the post drainage conditions recorded at both stations from November, 1960, to September, 1962. The pre-drainage and post-drainage physical conditions at Station 1 are also illustrated in Fig. 2a and 2b. As a result of dredging there was a complete change in the substratum of the river bed. Before dredging, it was relatively stable being composed of some large moss covered stones which provided shelter for food organisms. There were some isolated tufts of *Potamogeton* sp. with mud and gravel in between. Immediately after dredging, because of the increased velocity and turbidity as measured by suspended solid content (Fig. 3), the bottom became unstable and heavily silted. With the cessation of dredging in August, 1961, and the winter floods of 1961-62 much of the silt and clay disappeared. The original area of the station was decreased to about half its original size due to the straightening of its course. No appreciable change in depth was noted. The velocity increased to a maximum of 700 per cent of the pre-drainage value immediately after dredging but as the dredger moved upstream the velocity decreased but did not revert to its former pre-drainage figure of 16 cm per sec. A high initial increase in turbidity was also noted. While the dragline was in operation immediately upstream of the station, the silt content increased from 8 p.p.m. to 798 p.p.m. (Fig. 3) but according as the machine moved upstream the silt content decreased. There was a slight decrease in pH after dredging which can be attributed to the many bog drains which were opened up and flowed in

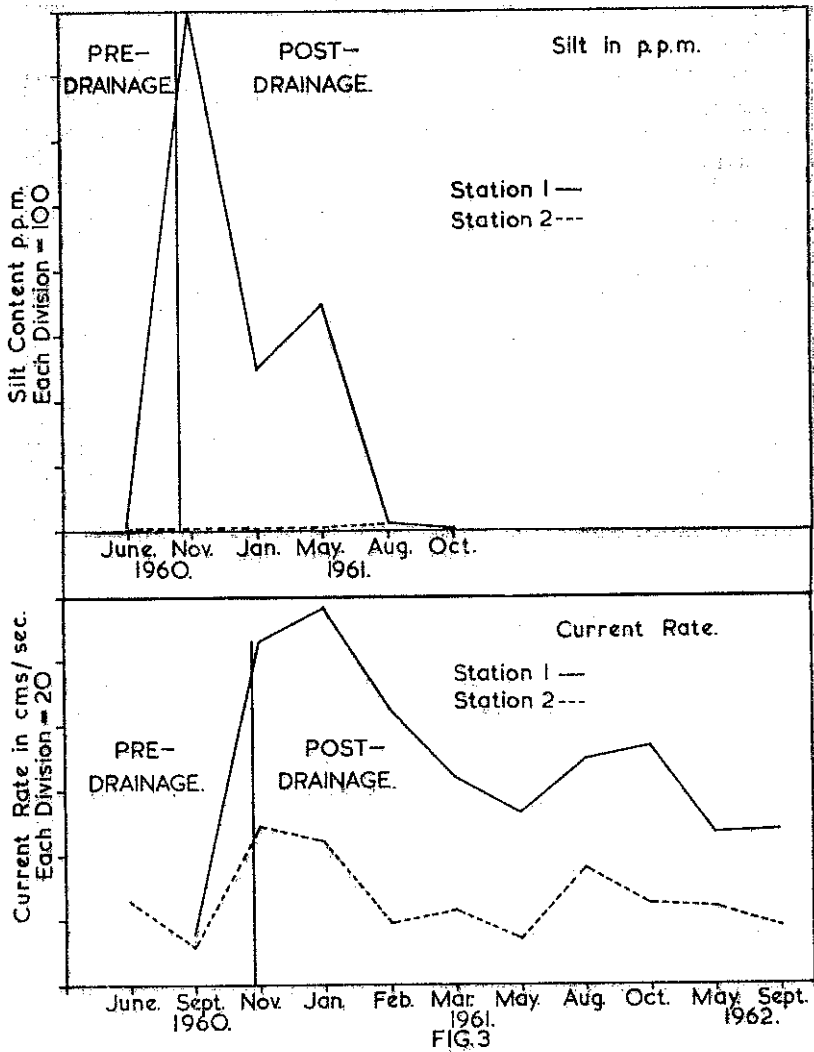
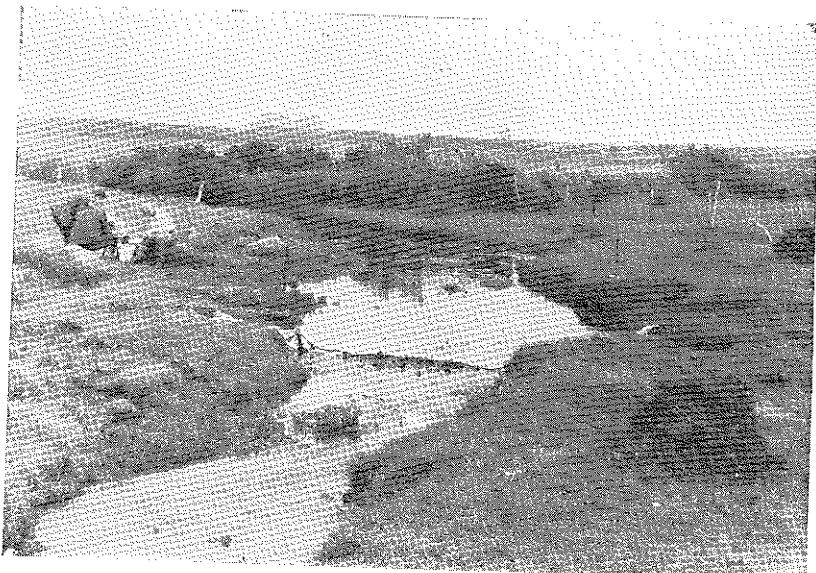


Fig. 3: Silt content and current rate for the pre- and post-drainage conditions at Stations 1 and 2.

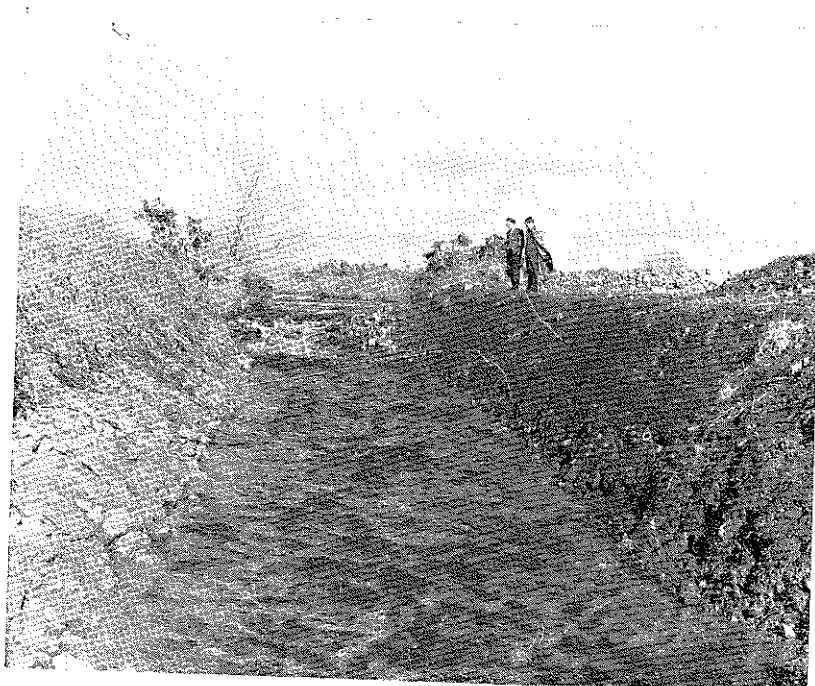
upstream of Station 1. No change in the oxygen content of the water was noted.

Faunistic survey

To determine the effects of dredging on bottom fauna, areas of 42 m² at Stations 1 and 2 were sampled at intervals from June, 1960 to September, 1962. Details of pre-drainage quantitative analysis for these stations are given in Table 3 and represented graphically in Fig. 4. In June, 1960 the number of organisms at Station 2 was much greater than the number found at Station 1 but this was due to the presence of very large numbers of minute individuals of

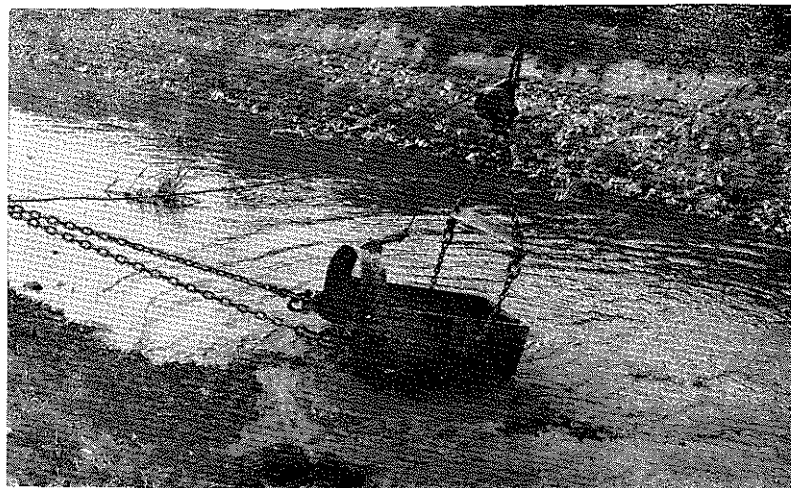


a.

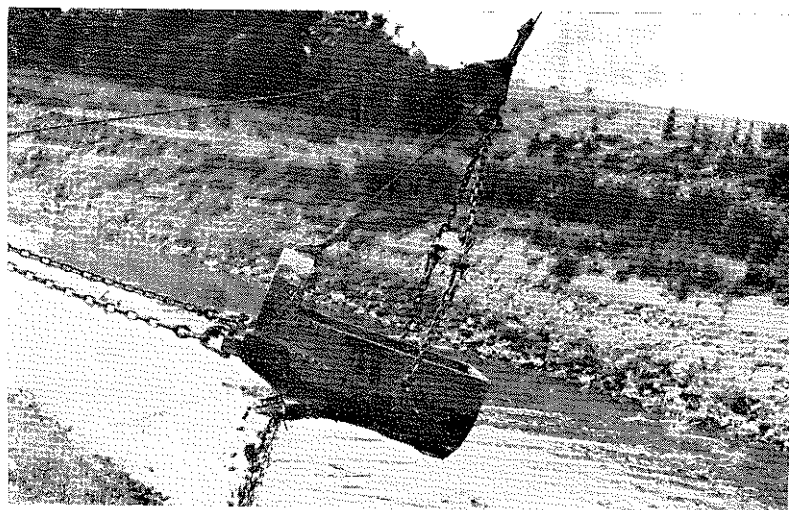


b.

Fig. 2: a, Pre-drainage view of Station I and b, post-drainage of Station I, showing cutting upstream.



a.



b.

Fig. 1: a, Dragline in operation and b, close-up of dragline bucket.

Ancylastrum fluviatile and Chironomid larvae. Due to the difficulty of counting them, these organisms were not considered in later surveys. Post-drainage counts showed a substantial reduction in the number of organisms present in Station 1. There was a decrease of ninety per cent in the first three samplings made after drainage. Both the centre and sides of the stream were sampled on each visit as it was noted that there was a tendency for the displaced organisms to settle more at the sides where the current was slower (Table 4). Sometimes, however, vegetable debris or large rough-surfaced stones in the centre of the stream provided excellent protection from the current.

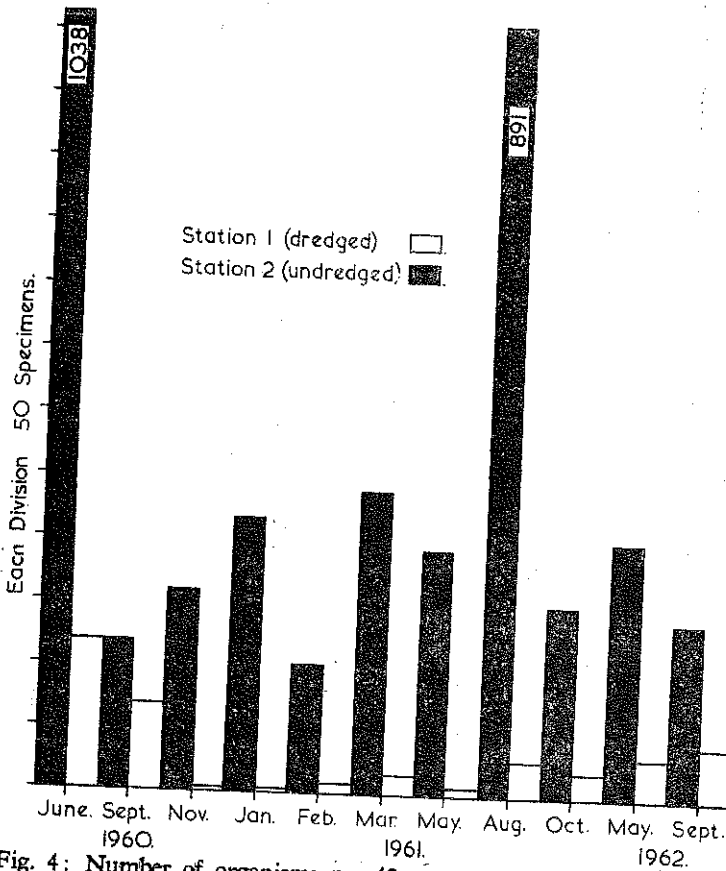


Fig. 4: Number of organisms per 42 cm. sq. in Station 1 and 2 from June, 1960 to September, 1962.

The relative abundance of the four major groups of organisms is represented graphically in Fig. 5. (See also Tables 5 and 6 for a more complete list.) *Gammarus* sp. was very much in evidence in the collections made in the first few months after dredging (Tables 5 and 6). This was presumably due to the fact that on escaping the

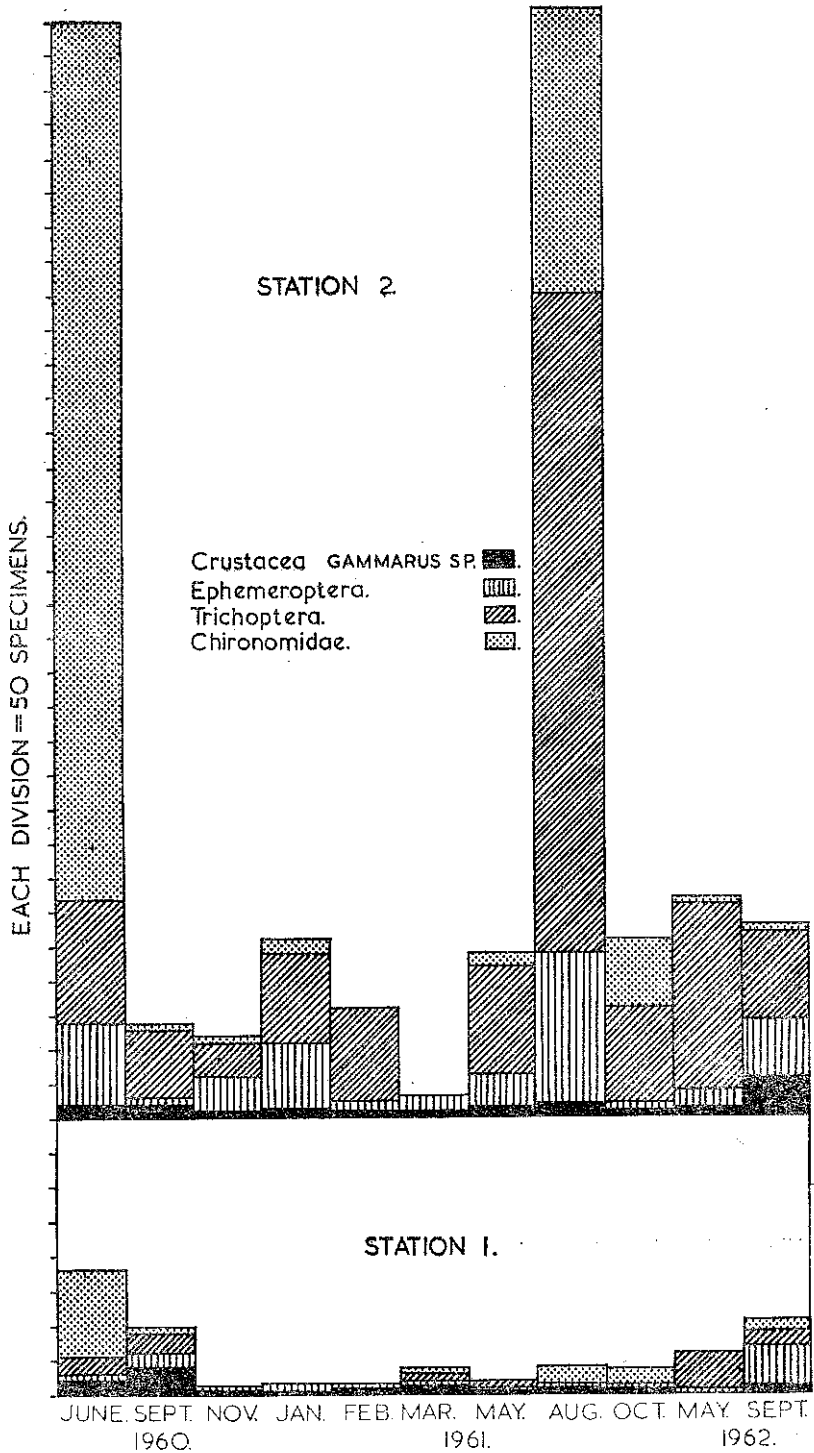


Fig. 5: Rate of recovery of the most abundant organisms found in the bottom sampling in Station 1. Station 2 is also included for comparison.

dredger it succeeded in re-establishing itself downstream. Other less mobile organisms, e.g. chironomids and ephemeropterans, were completely absent. These two groups reappeared in August, 1961, a little less than one year after dredging. Their return may have been associated with the reduced current rate. The bulk of the ephemeropterans found in September, 1962, belonged to the genus *Baetis* and these were all minute specimens which probably originated from the June or July hatch of that year. The major difference between the pre-drainage and post-drainage qualitative analysis for Station 1 is the almost complete absence of trichopteran larvae, and there was no evidence up to September, 1962, that they were becoming re-established.

Examination of the spoil cast up by the dredger showed that large numbers of bottom organisms were thrown on the bank to die but the fact that some also escaped downstream as stated was shown as follows. A muslin net covering approximately one third the width of the river was held downstream of the dragline for 3 minutes. In that time 933 individual organisms were collected; ephemeropterans comprised thirty-three per cent, gammarids twenty-one per cent and chironomids fourteen per cent. Only a few trichoptera and coleopteran larvae were counted which would suggest that they stood very little chance of escaping or of resettling after escape. Even though ephemeropterans escaped the dredger it is evident that either the turbidity or the current rate affected them subsequently, otherwise they should have been present in some quantity in the immediate post-drainage collections.

Population of young salmonids

The population of salmonids was estimated by electro-fishing the selected stretches as uniformly as possible. The presence or absence of other fish species was also noted. In the vicinity of Stations 1 and 2 the area fished was about 90 m² before dredging. The area around Station 1 was reduced to 40 m² after dredging but Station 2 remained constant. The area was fished twice on each visit and a stop net was placed downstream of the station to collect all escapees. The June pre-drainage fishing showed a large population of fish at both Stations; by September there was a reduction in numbers (Table 7) but as many of the salmonids were fish of the year, this reduction can be attributed either to natural mortality or to the fact that they had taken up new territory downstream or to both factors. In November, 1960, immediately after dredging there was a 30 per cent decrease in the numbers of young salmonids in Station 1 when compared with the September, 1960, figures but no decrease in Station 2. The decrease in the number of fish at Station 1 was attributed to the 50 per cent reduction in the living quarters and the lack of food organisms. An average of 20 salmonids per sampling was obtained up to March, 1962, at Station 1 but in May, 1962, there was a big increase in the population (Table 8) due possibly to the new spawning ground which was opened up in the Cloonta River after dredging. The majority of these fish (89 per cent) in May, 1962, belonged to the 0+ age group, whereas in May, 1961, the number of 0+ fish was only about 20 per cent of the total. The number of fry surviving from the 1960/61 spawning season was indeed very poor

as the river was being dredged during all the spawning period and the majority of the redds were silted up; the mechanical action of the dredger was also responsible for removing many redds and displacing some fish. There was no evidence of the dredger directly killing fry of three months old or over but it was observed that fish were driven upstream in front of the dredger in large numbers. An attempt was made to trace the movements of these fish by finclipping and recapture but heavy floods intervened between marking and recapture and dispersed them. The number recovered was too small to form the basis of any conclusions. There was a reduction in the number of young salmonids in Station 2 in the January, February and March, 1961, samplings but in May, when the fry of the year were included, the population was back to the June, 1960, level. Rees (1959) estimated a reduction of 5 per cent over a period of 11 months as a direct result of dredging in Little Bear Creek.

Large numbers of sticklebacks (*Gasterosteus aculeatus*) were recorded for Station 1 before dredging but they disappeared completely after dredging. Browne (unpublished data) found that sticklebacks made their appearance on a stretch of the River Spaddagh after dredging on which they had not been present previously. A number of salmonids (*Salmo trutta* and *S. salar*) were taken for stomach content examination from each fishing. The pre-drainage data on the diet of the salmonids is very scanty as only sampling (in September, 1960) was carried out. A comparison was made, however, between the stomach contents of salmonids taken from the dredged and undredged sections of the river (Table 9). Both species showed a preference for ephemeropteran and chironomid larvae before dredging. More *Gammarus* sp. were found in the stomach contents after dredging at Station 1 but no such preference was noted in the stomach contents of the salmonids at Station 2. Chironomid larvae were relatively unimportant in the post-drainage food of the salmonids at both stations until August 1962, but the falling off in the chironomid larvae during the winter months was considered to be seasonal rather than a direct effect of dredging. In this survey ephemeropterans were found to be the most important food organisms in salmonid stomachs in the winter and early spring period. McCormack (1962) in a study of the food of young trout noted a return to chironomid larvae in May, July and August although ephemeropterans supplied the bulk of the food during the rest of the year.

The effect of silt on the runs of adult salmon and spawning

During the 1961-'62 spawning season when the dredgers were still working, large numbers of salmon were seen to run into the silt laden waters and to spawn therein. Other workers have observed that high concentrations of suspended solids do not stop salmonid fish from passing through. Smith and Saunders (1958) whilst studying the movement of brook trout between fresh and salt water found they were not affected by turbidity and Ward (1938) records that concentrations of suspended solids between 137 and 395 p.p.m. did not deter salmon from entering the Rogue River in Oregon. There was no actual count made of the number of fish entering the

Bunree River and the only available information of the numbers entering the system is based on redd counts. The unreliability of redd counts as a measure of the numbers of spawners is fully recognised but they were the only available data on which to base any comparisons. Even though the salmon went up to spawn in 1960-'61 and apparently spawned successfully, as judged by the redd numbers, the survival rate of ova in the silt laden water was indeed very poor. The mortality in the natural redds varied from 7 per cent in a redd which was opened in an area of the river free from silt to 93 per cent in a section of the river which was receiving between 590 p.p.m. and 100 p.p.m. of suspended solids 6 days each week. Tests were also carried out by placing Vibert boxes in the river as near as possible to the natural redds. The mortality of the ova in the Vibert boxes is given below with the corresponding figures for suspended solids.

	Locality	Silt content p.p.m.	dredged	% mortality
1	22 dredgers upstream	323	No	100
2	18 " "	591	No	58
3	5 " "	499	Yes	71
4	3 " "	100	No	11
5	2 " "	100	Yes	25
6	1 " "	172	Yes	63
7	1 " "	172	Yes	100
8	In control stretch upstream of dredger	4	No	62

From the table above it can be seen that the highest mortality was not always associated with the highest figure for suspended solids. Although no exact measurements were made it seemed obvious that water velocities played an important part in preventing or allowing the deposition of silt particles on the redds. Stuart (1953) has shown that salmonid eggs can develop successfully only if a current of water passes through the gravel. During dredging in the River Bunree a silt layer was formed on many of the redds thus preventing percolation of water and depriving the eggs of the oxygen essential for their development. Wickett (1954) has shown that the amount of oxygen available to salmon eggs depends not only on its concentration in the water but also upon the rate at which it flows over the redds.

Besides the mortality of ova due to silt deposition the dredgers, as mentioned earlier, mechanically removed large areas of spawning gravel containing ova and alevins from the river since the whole of the system was being dredged during the spawning season of 1960/61.

In March, 1962, electro-fishing of the system with three D.C. sets was carried out. In the whole system 529 migrating smolts were counted. From a population analysis made it was estimated that a quarter of the population was sampled. A population of a little over 2,000 smolts was considered to be very poor. The greatest concentration of smolts was found just above the tidal portion of the river. The possibility of their migrating earlier due to increased current rate was considered but the most reasonable assumption is

that the mortality due to the reduction in food organisms was higher than usual.

The redd counts for the six years preceding the drainage (1955 to 1960) and for the four post-drainage (1961-1964) are given here-under:

1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
1455	1864	2739	3509	4495	1922	2296	2019	2720	962

No significant reduction in the numbers of redds was recorded from 1961 to 1963 but the drop in numbers in the 1963-'64 season to about one-third of the average for the previous six years must be considered significant and related to a poor survival of the 1960-'61 fry. The River Moy is predominantly a grilse river and the majority of the smolts migrate as two-year-olds (Twomey, 1956). The poor run of spawners in 1963 therefore may be related to the paucity in numbers of the 1962 smolt run.

Summary

In June, 1960, a programme of work was initiated and continued until September, 1962, to study the effect of dredging on salmonid fish and their food organisms.

Fig. 1 shows the changes brought about in the topography of the river. What was once a slow meandering stream became canal like. The channelling of the river bed resulted in the removal of a large percentage of food organisms in the test area. The recovery rate of food organisms was slow but in the last analysis made (in September, 1962) the large number of chironomids and ephemeropterans was very satisfactory. Trichopteran larvae were affected more seriously than any other type of organism.

The numbers of fry in the area sampled by electrical fishing showed a decrease of 30 per cent between the September pre-drainage sampling and the November post-drainage sampling at Station 1. Part of this reduction could be attributed to natural mortality as a similar reduction occurred in Station II up to and including March, 1961. In May, 1962, population estimates made at Station I compared favourably with the pre-drainage estimate.

Analysis of stomach contents of young salmonids showed a preference for ephemeropterans and chironomids in the pre-drainage period and the chironomids were replaced by gammarids in the post-drainage sampling.

The runs of adult salmon did not seem adversely affected by the silt laden waters as large numbers of salmon were seen to run and spawn in them. Redd counts made at the end of the 1960-61 spawning season compared favourably with the average of those made in the previous six years. The survival rate of fry was, however, affected. Mortality was as high as 93 per cent in natural redds and 100 per cent in tests carried out with Vibert boxes. Heavy mortality of fry probably had an adverse effect on the run of adults in the 1963/'64 spawning season.

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Table 1.—Pre-drainage Physical and Chemical Conditions recorded at Station 1 and 2 in 1960

Station	Substratum	Area M ²	Water Depth in cm.			Current Rate cm./sec.	Temp. °C	pH	Oxygen p.p.m.	Silt p.p.m.	Remarks
			Max.	Min.	Av.						
Station 1	Stable sub-stratum										
June 11 ...	Stones; a few isolated tufts of <i>Potamogeton</i> spp.	66.9	29.2	10.2	14.5	Not Recorded	16.5	7.3	0.9	6.8	Test station
Sept. 12 ...	—	—	25.4	5.1	10.1	16	14.5	7.7	—	—	
Sept. 14 ...	—	—	22.9	5.1	11.4	16	13.5	7.9	0.95	—	
Station 2	Stable sub-stratum										
June 14 ...	Stones; one clump of <i>Mentha aquatica</i> (2 ft. square approx.), one clump of <i>Myriophyllum</i> sp (approx. 6 ft. x 1 ft.)	69.0	33.0	7.6	21.5	26	14.5	7.1	0.95	4.8	Control station
Sept. 12 ...	—	—	29.2	4.4	16.5	Not Recorded	13.0	7.4	—	—	
Sept. 14 ...	—	—	33.0	8.8	18.7	22	13.0	7.5	1.00	—	

Table 2.—Post drainage Physical and Chemical conditions recorded at Station 1 and 2

Date	Place	Substratum	Area in metres	Water depth in cm.			Current rate cm/sec	Temp. °C	pH.	Oxygen p.p.m.	Silt p.p.m.	Remarks
				Max.	Min.	Av.						
30/11/'60	Station 1	Unstable, composed of dobe and silt, settling out on sides, devoid of vegetation.	33.4	20.3	6.3	15.7	105	10.6	6.8	1.00	8.4	Dragline not in operation
	Station 2	Stable substratum stones and gravel one clump of <i>Mentha aquatica</i> L. and one clump of <i>Myriophyllum</i> sp.	69	38.1	12.5	24.8	49	9.5	7.0	1.05	797.9	Dragline in operation Control Station
4/1/'61	Station 1	—	—	25.4	8.9	19.6	116	45	7.1	1.00	10.2	37 days after dredging. Dragline not in operation. Dragline in operation
	Station 2	—	—	34.9	15.2	22.4	44	4.0	6.8	1.02	244.2	
13/2/'61	Station 1	—	—	22.9	3.8	15.5	85	9.5	7.0	1.05	—	
	Station 2	—	—	30.5	11.4	19.6	19	8.0	7.3	1.10	—	
18/3/'61	Station 1	—	—	20.3	3.8	12.7	64	10.0	7.4	0.80	178	110 days after dredging. Dragline in operation.
	Station 2	—	—	30.5	7.6	16.0	23	8.4	7.4	0.90	—	
27/5/'61	Station 1	—	—	22.9	5.7	12.7	53	14.0	7.6	0.90	346.6	Taken 2 hrs. after dragline commenced work. Taken 2 hrs. after dragline had ceased work. Control Station
	Station 2	—	—	43.2	2.7	16.8	14.1	13.0	7.5	1.10	72.8	
6/8/'61	Station 1	—	—	24.4	6.3	13.4	69.4	13.0	6.2	0.90	—	Dredging of tributary completed
	Station 2	—	—	34.2	8.1	20.6	36.3	12.5	7.1	100.	—	
4/10/'61	Station 1	—	—	17.1	2.5	11.1	72.5	10.5	7.8	1.00	7.0	
	Station 2	—	—	33.0	7.6	24.9	24.6	10.5	8.1	1.00	1.4	
18/5/'62	Station 1	Substratum more stabilised silt disappearing, no recent growth of plants.	—	17.3	5.1	11.3	47.3	14.4	8.0	0.80	—	
	Station 2	Substratum as recorded on 30/11/'60.	—	22.8	2.5	12.1	24.3	10.5	7.6	1.00	—	
5/9/'62	Station 1	—	—	16.5	6.9	12.1	48.3	14.0	7.2	0.80	—	
	Station 2	—	—	24.8	6.4	16.5	19.5	11.9	6.5	0.80	—	

Table 3. Quantitative analyses at Station 1 and 2 before dredging.

<i>Organisms present</i>	June 11, 1960		Sept. 12, 1960		Sept. 14, 1960	
	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2
Annelida Oligochaeta	—	—	5	—	—	1
Hirudinae	—	—	2	1	3	3
Crustacea (<i>Gammarus sp.</i>)	14	9	22	9	13	8
Plecoptera nymphs	3	7	—	—	—	—
Ephemeroptera nymphs	7	61	16	7	7	3
Trichoptera larvae	29	103	25	50	32	63
Nematocera (mostly chironomidae)	65	643	11	5	1	—
Coleoptera larvae	—	3	3	—	2	—
Mollusca	1	212	2	80	2	5
Total	119	1,038	86	152	60	83

chironomidae)	3	2	—	5
Coleoptera larvae	212	2	80	—
Mollusca	1	2	—	—
Total	119	60	152	83

Table 4.—Quantitative Analyses at Station 1 and 2 from November

Station 1	November 30, 1960		January 4, 1961		February 13, 1961		March 19, 1961	
	Centre	Side	Centre	Side	Centre	Side	Centre	Side
No. of Organisms present								
Planaria	—	—	—	—	—	—	—	1
Nematoda	—	—	—	—	—	—	—	1
Annelida:								
Oligochaeta	—	—	—	—	—	—	—	—
Hirudinae	—	—	—	—	—	—	—	—
Crustacea (<i>Gammarus sp.</i>)	1	3	—	1	2	5	5	11
Plecoptera	—	—	—	—	—	—	—	2
Ephemeroptera	—	1	—	—	—	—	2	4
Trichoptera	1	—	5	—	2	—	2	5
Nematocera (mostly chironomids)	—	—	1	—	—	2	—	—
Coleoptera larvae	—	—	—	—	—	1	2 ^y	4
Hydracarina	—	—	—	—	—	—	1	—
Mollusca	—	—	—	—	—	—	6	—
TOTAL	2	4	6	1	5	8	18	28
Station 2	Centre	Side	Centre	Side	Centre	Side	Centre	Side
Planaria	3	—	—	—	—	—	—	—
Nematoda	—	—	—	—	—	—	—	—
Annelida:								
Oligochaeta	2	—	—	—	—	—	—	—
Hirudinae	1	—	—	—	1	—	—	—
Crustacea (<i>Gammarus sp.</i>)	2	3	—	—	—	—	—	—
Plecoptera	4	4	—	—	2	—	—	3
Ephemeroptera	4	6	—	—	3	—	—	—
Trichoptera	28	46	—	—	10	—	—	17
Nematocera (mostly chironomids)	28	73	—	—	59	—	—	126
Coleoptera larvae	4	8	—	—	—	—	—	—
Mollusca	5	4	—	—	—	—	—	—
TOTAL	84	69	—	—	27	—	—	94
	161	214			102		240	

y = adults.

x = very large population of *Baetis sp.*

Quantitative Analyses at Station 1 and 2 from November, 1960 to September, 1962 (area sampled 42 cm.²)

February 13, 1961		March 19, 1961		May 27, 1961		August 6, 1961		October 5, 1961		May 28, 1962		September 5, 1962	
78 days after dredging		110 days after dredging		180 days after dredging									
Centre	Side	Centre	Side	Centre	Side	Centre	Side	Centre	Side	Centre	Side	Centre	Side
—	—	—	1	—	—	—	—	—	—	—	—	—	—
—	—	—	1	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	5	5	11	1	1	8	2	—	5	—	—	2	7
—	—	—	2	—	—	1	—	—	—	2	1	—	—
2	—	2	4	1	2	5	—	2	2	2	—	18 ^x	30 ^x
1	2	2	5	10	5	—	—	—	—	—	—	2	14
—	—	—	—	—	—	4	24	20	11	44	15	2 ^z	3 ^z
—	1	2 ^y	4	—	—	10	—	—	—	—	—	—	—
—	—	1	—	—	—	—	—	—	—	—	—	—	—
—	—	6	—	—	—	—	—	—	—	—	—	—	—
5	8	18	28	12	8	28	26	22	18	48	19	24	54
Centre		Centre		Centre		Centre		Centre		Centre		Centre	
—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	12	—	—	—	—	—	—	—	—	4
—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	—	12	3	—	—	1	—	—	—	—	1
—	—	—	—	—	—	—	—	—	—	—	—	—	30
2	—	3	—	12	16	—	—	6	—	7	—	—	2
3	—	—	—	4	13	—	—	—	—	2	—	—	40
10	—	17	—	22	107	—	—	8	—	12	—	—	65
59	—	126	—	94	504	—	—	70	—	134	—	—	4
—	—	—	—	12	213	—	—	50	—	5	—	—	4
—	—	—	—	4	2	—	—	1	—	—	—	—	4
27	—	94	—	36	33	—	—	18	—	45	—	—	31
102	—	240	—	208	—	891	—	154	—	205	—	181	—

population of *Baetis* sp.

^z = very large population of small chironomids.

Table 5. Pre drainage qualitative analyses of organisms at Station 1 and 2 in June, 1960.

<i>Organisms present</i>	Station 1	Station 2
Nematoda	X	X
Annelida		
Oligochaeta	X	X
Hirudinae	X	X
Crustacea		
<i>Gammarus</i> sp.	X	X
Plecoptera		
Perlodidae	X	X
<i>Chloroperla torrentium</i>	—	X
Unidentified nymphs	X	X
Ephemeroptera		
<i>Baetis</i> sp.	X	X
<i>Caenis</i> sp.	X	X
<i>Ephemerella</i> sp.	X	X
<i>Ephemera</i> sp.	X	—
<i>Centroptilum</i> sp.	X	—
Trichoptera		
Odontoceridae lv.	—	X
Hydropsychidae lv.	X	X
Limnophilidae lv.	X	X
Rhyacophilidae lv.	X	X
Sericostomatidae lv.	X	X
Hydroptilidae lv.	X	X
Polycentropidae lv.	X	X
Leptoceridae lv.	X	—
Nematocera		
Tipulidae lv.	X	X
Simuliidae lv.	X	X
Chironomidae lv.	X	X
Coleoptera		
Dytiscidae lv.	X	X
<i>Gyrinus</i> (adult)	X	—
Unidentified lv.	X	X
Mollusca		
<i>Ancylastrum fluviatile</i>	—	X
<i>Limnea pereger</i>	X	X
<i>Sphaerium</i> sp.	X	—
<i>Hydracarina</i> sp.	X	—

X denotes present — denotes absent lv.: larvae.

Table 6.—Post Drainage Qualitative Analyses of Organisms at Stations 1 and 2.

Organisms Present	Nov. 30, 1960		Jan. 4, 1961		Feb. 13, 1961		March 19, 1961	
	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2
Nematoda	—	—	—	—	—	—	—	—
Annellida:								
Oligochaeta	—	—	—	—	—	—	—	—
Hirudinae	—	—	—	X(1)	X(8)	—	—	—
Crustacea:								
<i>Gammarus</i> sp. ...	X(12)	X(6)	X(5)	X(3)	X(19)	X(9)	X(10)	X(2)
Plecoptera:								
Perlodidae ny. ...	—	X(1)	X(1)	—	—	—	X(1)	—
<i>Protonemoura</i> sp. ny. ...	X(1)	—	—	X(1)	—	X(1)	—	X(2)
<i>Leuctra</i> sp. ny. ...	X(2)	—	—	—	X(1)	—	—	—
Plecoptera ny. and lv.	—	—	X(1)	—	—	—	—	X(1)
Ephemeroptera:								
<i>Baetis</i> sp.	—	—	X(3)	X(3)	X(2)	X(8)	X(2)	X(2)
<i>Ecdyonerus</i> sp. ...	X(3)	X(3)	—	X(2)	X(15)	X(4)	X(4)	X(14)
<i>Ephemerella</i> sp. ...	—	—	—	—	—	—	—	X(2)
Trichoptera:								
Odontoceridae lv. ...	—	—	X(1)	—	X(1)	—	X(2)	X(2)
Hydropsychidae lv. ...	X(1)	X(1)	X(1)	—	X(1)	X(2)	—	—
Limnophilidae lv. ...	—	X(6)	—	X(3)	X(2)	—	—	—
Rhyacophilidae lv. ...	—	X(1)	—	X(1)	—	X(3)	—	—
Seriestomatidae lv. ...	—	X(1)	—	—	—	X(3)	—	—
Hydroptilidae lv. ...	—	—	—	X(146)	—	—	—	X(10)
Polycentropidae lv. ...	—	—	—	—	—	—	—	—
<i>Agapetus</i> sp.	—	—	—	—	—	—	—	—
<i>Philoptamus</i> sp. ...	—	—	—	—	—	—	—	—
Trichoptera lv.* ...	—	X(2)	—	X(2)	—	X(14)	X(1)	X(14)
Nematocera:								
Tipulidae lv.	—	—	—	—	—	—	—	—
Simuliidae lv.	X(1)	—	X(2)	—	X(1)	X(6)	—	—
Chironomidae lv. ...	—	—	—	—	—	X(1)	—	—
Coleoptera:								
Helodidae lv.	X(2)	X(4)	—	—	X(1)	—	—	—
Haliplidae lv.	—	—	—	—	—	—	—	—
<i>Gyrinus</i> sp. lv.	—	—	—	—	—	—	X(1)	—
<i>Latemis</i> sp. lv.	—	—	—	—	—	—	—	X(1)
Coleoptera lv.*	—	—	—	—	—	X(1)	—	—
Mollusca:								
<i>Ancylastrum fluviatile</i> ...	—	—	—	X(10)	—	X(9)	—	—
<i>Limnea pereger</i>	—	—	X(1)	X(2)	—	—	—	—
Total No. of specimens ...	22	25	15	174	51	61	21	50

ny: nymph

lv: larva

x: present

— absent

Species of Organisms at Stations 1 and 2. From November, 1960 to September, 1962

Feb. 13, 1961		March 19, 1961		May 27, 1961		Aug. 6 1961		Oct. 4, 1961		May 28, 1962		Sept. 5, 1962	
Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2
—	—	—	—	—	—	—	—	—	—	—	—	X(1)	—
—	—	—	—	—	X(1)	—	—	—	—	—	X(1)	—	—
X(8)	—	—	—	—	—	—	X(2)	—	—	—	—	—	—
X(19)	X(9)	X(10)	X(2)	X(7)	X(3)	X(16)	X(38)	X(1)	X(31)	X(3)	X(33)	X(5)	X(19)
—	—	X(1)	—	—	X(1)	—	—	—	—	—	—	—	—
X(1)	X(1)	—	X(2)	—	—	—	—	—	—	—	—	—	—
—	—	—	X(1)	—	—	—	—	—	—	X(3)	X(3)	—	—
X(2)	X(8)	X(2)	X(2)	X(1)	X(5)	X(30)	X(6)	X(9)	X(6)	X(14)	X(11)	X(35)	X(10)
X(15)	X(4)	X(4)	X(14)	X(4)	X(10)	—	X(4)	—	X(5)	X(3)	X(3)	X(3)	—
—	—	—	X(2)	X(2)	X(2)	X(12)	X(26)	—	X(1)	X(1)	X(9)	X(1)	X(9)
X(1)	—	X(2)	X(2)	X(12)	—	—	—	—	—	—	—	—	—
X(1)	X(2)	—	—	X(4)	X(2)	—	—	X(1)	—	X(1)	X(1)	X(2)	X(2)
X(2)	—	—	—	—	—	—	X(10)	X(1)	—	—	X(20)	—	X(11)
—	X(3)	—	—	—	X(1)	—	X(2)	X(1)	X(1)	—	—	—	—
—	X(3)	—	—	—	—	—	X(10)	—	X(17)	—	X(3)	—	X(2)
—	—	—	X(10)	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	X(8)	—	X(1)	—	—	—	X(1)
—	—	—	—	—	—	—	X(64)	—	X(29)	—	X(28)	—	X(7)
—	—	—	—	—	—	X(2)	X(12)	—	—	—	X(1)	—	—
—	X(14)	X(1)	X(14)	X(1)	X(72)	—	X(10)	X(2)	X(13)	X(4)	X(1)	—	X(3)
—	—	—	—	—	—	X(1)	—	—	—	X(1)	—	—	—
X(1)	X(6)	—	—	—	X(1)	X(8)	—	—	—	X(32)	—	X(8)	—
—	X(1)	—	—	X(1)	X(3)	X(14)	X(48)	X(13)	X(15)	X(14)	X(10)	X(23)	X(3)
—	—	—	—	—	—	—	—	—	—	—	—	—	—
X(1)	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	X(1)	—	—	—	—	—	—	—	—	—	—	—
—	—	—	X(1)	—	—	X(2)	—	—	X(20)	—	—	—	—
—	X(1)	—	—	—	—	—	—	—	—	—	X(1)	X(1)	—
—	X(9)	—	—	—	X(4)	—	X(8)	—	X(19)	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—
51	61	21	50	32	105	85	248	28	158	76	125	79	67

absent

(): No. present

*: excluding named genera.

Salmonids	117	2	34	1
Sticklebacks	18	3	5	3
Eels	5			
Total No. of Specimens	140	95	94	33

Table 8.—Post-drainage; Fish Population Analyses at Stations 1 and 2

	Nov. 30, 1960		Jan. 4, 1961	Feb. 11, 1961		Mar. 18, 1961		May 27, 1961		Aug. 7, 1961		Oct. 4, 1961		May, 29, 1962	
	Station 1	Station 2	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2	Station 1	Station 2
Salmonids	16	38	17	20	11	17	11	23	35	24	59	19	58	64	90
Sticklebacks	2	—	—	5	—	3	—	1	—	—	—	—	—	—	—
Eels	1	1	—	—	2	2	1	1	1	—	1	2	2	—	6
Total No. of Specimens	19	39	17	25	13	22	12	25	36	24	60	21	60	64	96

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Fishing at Station 1 on January 4th not conclusive as stop net became detached — hence results not included.

Table 9. Stomach Contents of Salmonids at Station 1 (before dredging) and 2 in September, 1960.

		Station 1		Station 2	
No. examined		31		28	
Size range in cms. 0-1 age group		3.9—4.9		2.8—5.9	
1-2 do.		10.3—10.4		8.3—12.3	
Food organisms in stomach		present	dominant	present	dominant
Copepoda		—	—	1	0
Nematoda		—	—	1	0
<i>Gammarus</i> sp.		2	0	2	1
Ephemeroptera nymphs		13	5	22	13
Trichoptera larvae		9	4	2	0
Simulium larvae		1	0	—	—
Chironomid larvae		22	11	11	7
Coleoptera larvae		1	0	—	—
Winged insects		3	2	6	3
Stomachs empty		0		1	

Table 10.—Stomach Contents of Salmon taken at Station 1 (after dredging) and Station 2 from November, 1960 to May, 1962

Station 1	Nov. 1960		Feb. 1961		Mar. 1961		May, 1961		Aug. 1961		Oct. 1961		May, 1962	
	No. examined		8		6		7		6		8		18	
	Size range in cm		1.8-2.6		5.2		3.4-5.9		4.5-6.4		3.6-5.9		2.6-4.3	
	16		3.8-4.3		6.3-7.2		6.8-8.4		9.2-9.8		8.9-9.4		—	
	0-1 age group													
	1-2 age group													
	P.	D.	P.	D.	P.	D.	P.	D.	P.	D.	P.	D.	P.	D.
Food organisms in stomach														
<i>Eisenella</i> sp.	—	—	—	—	—	—	—	—	2	1	—	—	1	0
Copepoda	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Gammarus</i> sp.	5	4	4	3	—	—	—	—	—	—	—	—	—	—
Ephemeroptera nymphs	7	4	6	2	2	1	1	1	2	1	1	0	—	—
Trichoptera Larvae	4	3	1	0	5	4	2	2	—	—	8	1	—	—
Simulium larvae	—	—	—	—	3	0	3	3	1	0	—	—	4	0
Chironomid larvae	2	0	1	1	1	0	—	—	—	—	3	0	—	—
Tipulid larvae	—	—	1	0	—	—	1	0	4	4	6	6	17	17
Coleoptera larvae	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mollusca	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Winged Insects	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Stomach's empty	0	—	0	—	0	—	1	0	1	0	0	1	0	1
Station 2														
No. examined	10		5		5		14		13		10		24	
Size range in cm	8.2-13.1		2.3-3.7		5.5-11.3		2.8-4.3		4.4-6.0		5.5-6.5		2.8-4.9	
	1-2 age group		—		—		4.5-10.0		9.7-11.8		7.5-12.8		8.0-9.3	
Food organisms in stomach														
<i>Eisenella</i> sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Copepoda	1	0	—	—	—	—	—	—	—	—	—	—	—	—
<i>Gammarus</i> sp.	1	0	3	2	1	1	2	0	—	—	—	—	—	—
Ephemeroptera nymphs	6	4	3	2	4	4	11	7	2	1	4	4	4	4
Trichoptera larvae	3	3	1	0	—	—	6	3	5	2	6	3	16	11
Simulium larvae	—	—	—	—	—	—	—	—	3	0	1	0	—	—
Chironomid larvae	1	0	2	0	—	—	—	—	—	—	—	—	—	—
Coleoptera larvae	—	—	—	—	—	—	1	1	11	10	5	1	10	1
Mollusca	—	—	—	—	—	—	—	—	1	0	—	—	—	—
Winged Insects	—	—	—	—	—	—	—	—	1	0	—	—	—	—
Stomach's empty	0	—	1	—	0	—	2	0	1	0	2	0	1	0

P. — Present and D. — Dominant.

IV.

RECAPTURES OF IRISH TAGGED SALMON OFF GREENLAND

A. E. J. Went, D.Sc.

Up to October 1964 no salmon tagged in Ireland had been reported as having been recaptured outside Europe. Indeed with the exception of a single fish recaptured in Sweden (Moriarty, 1962) the only recaptures outside Ireland were from Great Britain (Went, 1964). In October 1964 no less than four salmon tagged in Ireland were reported as having been recaptured off the west coast of Greenland where, in recent years, a gill-net fishery for salmon had developed. The details of these four fish were as follows:—

TAGGING DETAILS			RECAPTURE DETAILS			
Date	Place	Estimated Weight (lb.)	Date	Place	Estimated Weight (lb.)	Minimum distance travelled in miles
5/9/63	Carrowmore L.	12.6	6/10/64	Near Julianehaab (60° 40'N., 46° 15'W.)	17½	1700
12/9/63	"	10.4	21/10/64	Near Sukkertoppen (65° 25'N., 53° 00'W.)	15½	2000
25/3/64	Burrishoole R.	—	18/10/64	Near Kangamiut (65° 49'N., 53° 19'W.)	8½	2000
20/4/64	"	—	17/10/64	"	10½	2000

The first two fish were tagged by Mr. B. Doolan of this Department when netting salmon in Carrowmore Lake in connection with the investigations of the stocks of that lake and the third and fourth by Dr. D. J. Piggins of the Salmon Research Trust of Ireland, Inc. sponsored by Messrs. Arthur Guinness Son & Co. Ltd., and the Minister for Lands.

As we do not know when these fish reached Greenland we can only estimate the minimum speed of travel by dividing the minimum distance by the number of days at liberty. These estimates which I prefer to call the apparent speeds were 4.3, 5.0, 9.7 and 11.1 miles per day. It must be remembered, however, that the Carrowmore Lake fish did not leave the river system until much later than the date of tagging so that the speeds were certainly very much in advance of those given above.

A number of reports of recaptures in Greenland of fish tagged as either kelts or smolts in Great Britain and Canada were recorded (Menzies and Shearer, 1957; Kerswill and Keenleyside, 1961; Nielsen, 1961; Swain, Hartley and Davies, 1962; Swain, 1963, and Allen and Bulleid, 1963). Hansen (personal communication) in an address to the Salmon and Trout Committee of the International Council for the Exploration of the Sea in October, 1964, gave details of recaptures which had been brought to his notice and included two fish originally tagged in Sweden. A considerable number of salmon

tagged in Canada, Great Britain, Ireland and Sweden have been recaptured off the west coast of Greenland so that there is a common feeding ground in this area for salmon derived from rivers on both sides of the Atlantic.

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