ATLANTIC SALMON TRUST

A REVIEW OF IRISH SALMON AND SALMON FISHERIES

By KEN VICKERS

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Biography - Ken Vickers

Born 29th May, 1924 at Seaham Harbour, Co. Durham and educated at Foyle College, Londonderry. After wartime service with RAF attended Queen's University, Belfast. Graduated B.Sc. in Zoology with 1st Class Hons. in June 1951. Spent some months with Fisheries Division, Department of Lands, Dublin as Technical Assistant. In September 1951 joined Government of Northern Ireland staff as Fishery Officer and retired as Chief Fisheries Officer in 1982, having been responsible for all technical matters and investigations concerned with sea and inland fisheries. Was Senior Northern Ireland Commissioner with Foyle Fisheries Commission from 1974 until retirement from the Department of Agriculture (Northern Ireland).

A REVIEW OF IRISH SALMON AND SALMON FISHERIES

by Ken Vickers

1. Introduction

Salmon fisheries have from earliest times been of importance in the Irish context. As an outcome of unsettled times and conquest the right to the exclusive exploitation in most of the river systems was granted to individuals or corporate organisations during the 16th and 17th centuries, and in many instances such grants included the estuaries in addition to fresh waters. However, many of the trapping installations on these fisheries had already been in existence for many years. Went (1964) gives a full historical and descriptive account of all the methods of salmon fishing used in Ireland together with maps illustrating the geographical locations of the fishing weirs and coastal nets.

2. Legislation and Background

Legislation concerning the conservation and protection of salmon dates back to the 16th century but this was consolidated and updated by the Fisheries Act of 1842 which repealed the earlier legislation. This Act was a landmark in salmon conservation but unfortunately, because of ambiguities or other defects, not all the provisions could be readily implemented. However provisions were made for the following:

(a) the appointment of Commissioners with extensive powers for the government, regulation and management of the fisheries;

(b) annual close seasons and weekly close times;

(c) a free gap (Queen's share) to be maintained in salmon weirs with conditions defined for the construction of these weirs; and

(d) fish passes over artificial and natural obstructions.

There were also provisions for:

(1) protection for fry and smolts, kelts and unseasonable fish;

(2) prohibition of a number of poaching methods, e.g. strokehauls, lights etc.; and

(3) protection against pollution or the use of fish poisons.

Penalties for conviction for infringements were specified and owners of fisheries could appoint water bailiffs to enforce the law with wide powers of entry and seizure.

A number of amendments and additions followed, including in 1863 strict limitations on the location and number of fixed nets to be used in the sea and tideways, although an earlier fundamental measure was introduced in 1848 when provision was made to license salmon fishing methods and to divide the country into 23 Fishery Districts. Each District was to be under the local control of a Board of Conservators consisting, in approximately equal numbers, of ex-officio representatives from the owners of the larger rated fisheries and elected members. The elected members represented the licence holders firstly in tidal waters, i.e. commercial fisheries, and secondly fresh waters made up of both commercial and angling interests. The entire catchment of each major salmon river was designated as being a District with the catchments of less important rivers either being attached to the larger Districts or, in some cases, being joined together as Districts in their own right. The outline map (Figure 1) shows the major river systems. This system remained in force in the Republic until 1974.

In the 1920's, with the formation of Northern Ireland, it was necessary to make some modifications to the hitherto existing Districts and it was decided that the Londonderry District (Foyle system) would be retained but those rivers and parts of the District in Co. Donegal would form the newly created Moville District in the then Irish Free State. The Coleraine District (Bann system) had added to it the small coastal rivers of Co. Down previously within the Dundalk District. The Ballycastle District (River Bush and smaller Co. Antrim rivers) remained virtually unchanged. That part of the Lough Erne catchment within Northern Ireland, i.e. Co. Fermanagh, formed the new Enniskillen District and the old Ballyshannon District was correspondingly reduced. Salmon are no respecters of man-made divides within a river system, nor indeed are poachers, and it is evident from the foregoing that there were problems ahead.

Problems did indeed occur in the 1940's when fishermen from Co. Donegal started to fish for salmon using draft nets in that part of the Foyle forming the boundary between Co. Donegal and Co. Londonderry. There had to be control exercised if the salmon stocks in the river were to be conserved, and consultation between the two Governments followed. An enabling Act was passed at Westminster in relation to Northern Ireland, and the Governments of the Republic and Northern Ireland each passed identically framed Foyle Fisheries Acts in 1952. This legislation extinguished the rights of The Irish Society in the tidal waters and established the Foyle Fisheries Commission with wide powers for management, conservation, protection and improvement of the Fisheries. The then Londonderry and Moville Boards of Conservators were dissolved and the Commission's bailiwick again extended to the Londonderry District as originally designated in 1848.

In Northern Ireland after the 1920's a number of Fishery Acts amending the earlier legislation were passed, culminating in 1966 with an Act consolidating earlier legislation and providing for

the remaining Boards of Conservators to be dissolved and replaced by the Fisheries Conservancy Board for Northern Ireland, consisting of ex-officio and nominated members.

A somewhat similar pattern has been followed in the Republic where, following the recommendations of the Inland Fisheries Commission in 1975, the then 17 Boards were dissolved and reconstituted in 1980 into seven Regional Boards and the Central Fisheries Board which has a co-ordinating and management role. The Regional Boards consist of elected members and nominated members. The Chairmen of each Regional Board form the membership of the Central Fisheries Board, together with a Chairman and five members nominated by the Minister responsible. At the time of going to press, however, it seems probable that the Regional Boards and the Central Fisheries Board will be dissolved and replaced by a new Fisheries Authority.

The present Central Fisheries Board in 1986 published a comprehensive review extending to 200 pages, entitled "Inland Fisheries - Strategies for Management and Development". Salmon are dealt with in chapters covering salmon fisheries, hatcheries and aquaculture and research. Elsewhere the subjects of the aquatic environment, fishing rights and promotion of angling cover a broader field in the inland fishery context. The existing serious conservation situation is considered to have its origin in the lack of any plan or policy directed to rationalising the use of salmon fisheries since 1960. Possible solutions for rectifying the problems are discussed and the suggestion made that the Government should issue a White Paper upon which planned development and management could be based.

The White Paper was presented to the Minister for the Marine in November 1987 as the "Report of the Salmon Review Group - Framework for the Development of Ireland's Salmon Fishery". The stated objectives are to conserve and develop individual unit stocks on the long-term basis of generating maximum employment and income. The main recommendations are summarised as follows.

(1) Organisation should be restructured to give full executive autonomy to the Fishery Authority, with only policy-making being retained by the Government.

(2) Pollution prevention and awareness should be given additional publicity and increased detection emphasis.

(3) Sea Drift Nets should be liable to additional controls which should include a system of quotas and tagging of all catches, supported by log books on commercial vessels. The White Paper also somewhat surprisingly supports the use of monofilament nets and a prohibition of drift netting at night. The length of boats and nets should be restricted, as should the depth of drift nets.

(4) Estuarine Nets should also be subject to tags and quotas, with a degree of fluidity for weekly close times and annual close seasons as directed by the Fishery Authority.

(5) Salmon Angling is recognised as a valuable asset and there should be local involvement in fostering management and development schemes for specific waters, failing which the Fishery Authority should formulate schemes. Salmon anglers should be on a catch quota basis and all fished tagged and recorded.

(6) Ownership of Fisheries is a vexed problem and the Fishery Authority should be given responsibility for the management of all State-owned fisheries and plan for the management and development of other inland fisheries, preferably in co-operation with any private owner.

(7) Research and Statistics should be the responsibility of the Government's Marine Institute, with additional emphasis on collection of statistics. An Advisory Unit should clear the areas of research needed to give the most effective management for the salmon fishery.

(8) Enforcement and Offences problems will be assisted if all inland fisheries field resources are under the control of the Fishery Authority and a closer system of liaison is developed between it and the police and the Navy. Much increased penalties should be available for assault against protection staff and there should be a general tightening-up of sanctions against unlawful activities.

(9) Finance as in the past will involve licence duties and rates, to which should be added other potential sources of income such as fees for inspections and funds from the European Community. However, it is envisaged that the major source of funds will be increased exchequer funding.

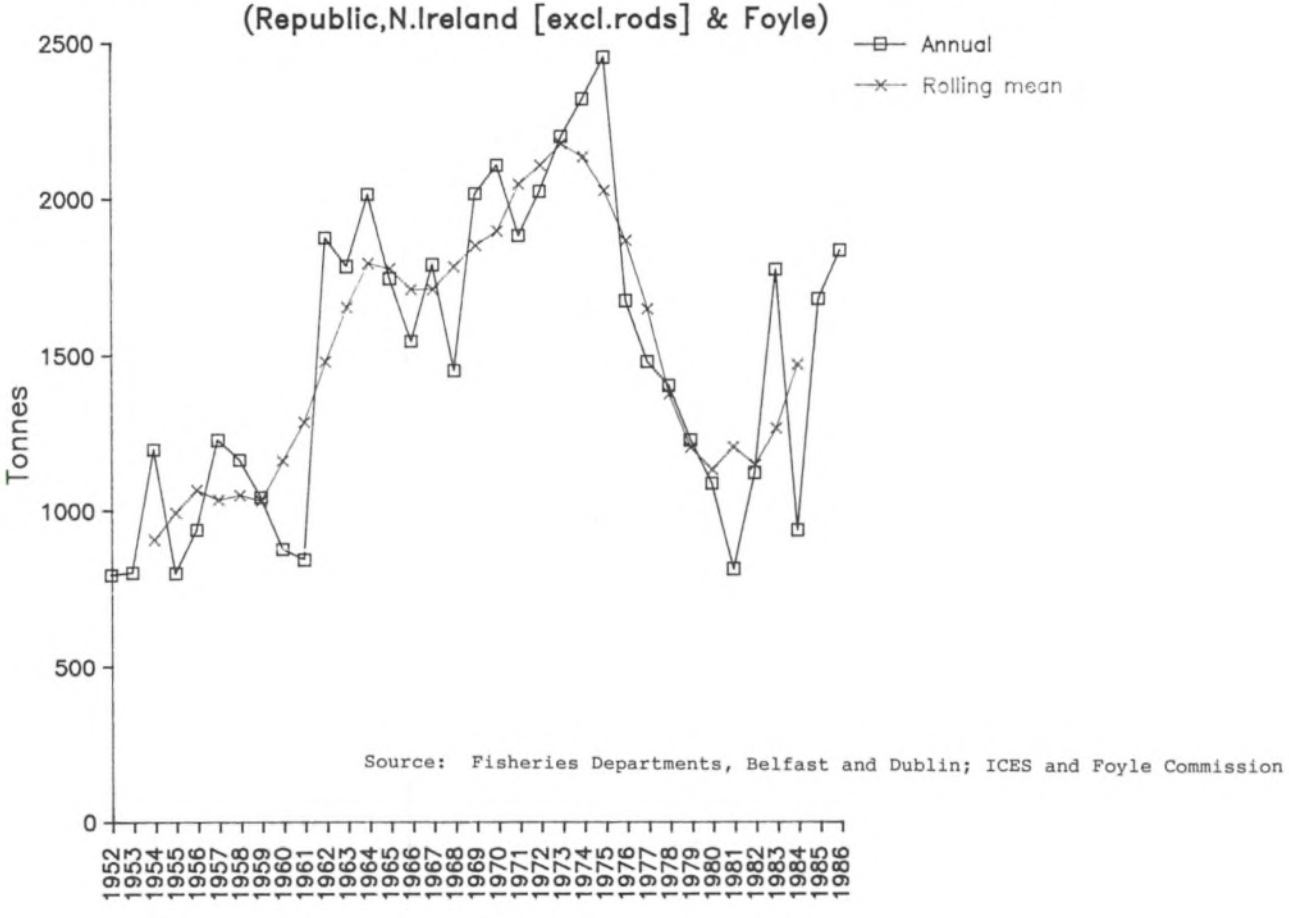
In view of recent legislation in Great Britain, it is interesting to note that since the 1920's there have been provisions for the registering of all purchases and sales of salmon, to be balanced on a daily basis, in both the Republic and Northern Ireland (the so-called 'Dealers' Registers'). This requirement was transferred to the Foyle Area insofar as the Moville and Londonderry Districts were concerned under the Foyle Fisheries Acts, 1952. Of importance in assisting the enforcement of the laws is that possession of illegally-caught salmon is an offence and the onus of proving lawful capture lies with the defendant. The most recent development in the Republic will be the requirement to 'tag' all salmon of lawful capture and to make the possession or sale of 'untagged' salmon an offence.

3. Fishing Methods and Development of Drift Netting

The traditional method of fishing for salmon in the rivers, estuaries and suitable on-shore sites was the draft net or shore seine and this method must have been in use for a very long time. Fishing weirs and fixed traps exist in a number of rivers and towards the middle of the last century a number of draft nets used on the sea coast were replaced by bag nets, the design of which was imported from Scotland. It was considered that the increasing use of fixed nets and weirs presented a threat to the salmon stocks. Accordingly, under the provisions of the 1863 Act, the entitlement to fish a fixed engine was validated or otherwise by the Inspectors of Irish Fisheries. The continued use of those deemed to be lawful was covered by a certificate specifying the description and size of the engine and all others were declared to be unlawful. Commercial fishing for salmon was therefore stabilised from this time until the advent of offshore drift netting affected the status quo. Figure 2 shows the combined annual catch for the Republic, Northern Ireland and the Foyle Area. Unlike the Republic and Foyle Area there is no statutory requirement for the annual return of salmon rod catches in Northern Ireland, but as this catch is relatively small this omission will have a minimal effect on the overall analyses.

Drift netting for salmon in the open sea using small boats and nets made from natural fibre, not exceeding a few hundred yards in length, took place on a relatively small scale from a number of centres in Donegal from the late 1800's. During the period between the World Wars drift netting on a relatively small scale in the overall analysis spread to a number of estuaries and inlets in the Republic, but this was not of sufficient magnitude to significantly affect the overall stock situation. However in the 1960's there was a large increase in the inshore fleet on the west coast, stimulated by grants and loans made available for the purchase of boats and gear. This grant and loan incentive scheme led to a steady increase in exploitation rates on the salmon stocks in the Republic, as is evident from Table 1. It must be stressed, however, that the accuracy of some published catch statistics is in doubt because of understatements in the returns, and discrepancies are evident from published information on the subject. Efforts had to be made in the late 1970's to stablilise or, if possible, reduce the number of licensed drift nets. There has been little success so far as a reduction in numbers is concerned, and there are good grounds for believing that not all the drift nets are licensed, that statutory close times are ignored, the length of nets greatly exceeds that permitted, nets are often of illegal monofilament and fishing takes place outside the internationally agreed seaward limit of 12 miles. In addition, because of the new materials in use fishing was no longer restricted to the traditional hours of darkness or subdued light. The outcome can be seen from the following Table showing the average number of licences and the catch for each decade.

FIGURE 2: TOTAL IRISH SALMON CATCH 1952–86



Source: Fisheries Departments, Belfast and Dublin; ICES and Foyle Commission

Table 1

Number of Commercial Licences and Catch (tonnes) for the 1950's to the 1980's

Period	Drift Nets		Draft Nets		Stake Nets etc.	
	No.	Catch	No.	Catch	No.	Catch
1950's	372	169	672	423	51	106
1960's	457	354	678	522	47	150
1970's	1007	1047	663	377	49	101
1980-86	840	910	548	139	29	42

Main source: Report of the Salmon Review Group, 1987

The larger mesh size of salmon drift nets could be expected to select a different size range when compared with seine or draft nets and fixed traps. Twomey (1980) has demonstrated that this is the case in the Galway area although the seine nets show the effect more clearly than the traps. She comments upon the observation that drift nets are selecting the middle range of the length and weight frequencies and goes on to remark that up to 58% of the River Moy seine net catch had passed through drift nets and in so doing had been damaged. In the case of the River Bush (1973-79) there have been occasions when 100% of the ascending fish have been similarly marked and comments are made on the relative severity of the damage to the fish. Likewise Piggins (1987) comments on the reduced average size of the grilse in the Burrishoole fishery which is ascribed to selection of the larger grilse by coastal drift nets. It is more than possible that this selection of the middle size ranges, if continued for a number of generations, could have genetic implications.

Prior to formation of the Foyle Commission there was no drift netting in the Londonderry District and any activity in the Moville District was restricted to areas seaward of Lough Foyle. Subsequently, drift netting began in Lough Foyle and this steadily increased. From the early 1960's this was associated with intensified operations at sea. These events are illustrated by the three-fold increase in the numbers of drift nets licensed in the Foyle Area from 40 in 1952 to 120 in 1970. Since then, efforts have been made to stabilise or reduce the numbers; in the event there has been a small transfer of effort from the Lough to seaward but it has not proved possible to achieve any significant reduction. In Northern Ireland the Fisheries Act of 1966 makes provision for the number of licences to be limited under bye-law. The number of drift net licences has increased from eighteen in 1967 to twenty-two in 1972 when a bye-law was made *inter alia* limiting the issue of licences to those who had been licenced in two of the preceding three years. This immediately reduced the

number to twelve, a reduction of 45%, since when the numbers have remained static. Unfortunately, despite this more resolute action by the Fisheries Conservancy Board, it is unlikely that there will be any great benefit to the Bann, Foyle and Bush stocks (see results of tagging on the North Antrim coast, below) in view of the intensity of drift netting further west and in the Foyle Area itself.

Salmon rod catch data for the Republic extracted on a similar basis (Table 2) indicates that the yield per rod has decreased during the period under review. Rod catches are subject to so many variables that for any given year they do not necessarily bear a relationship to the salmon stocks in fresh water and therefore cannot be relied upon to indicate whether a spawning stock is or is not adequate. It can, however, be deduced from these averages for 10 year periods that fresh water stocks decreased between the 1950's and 1970's, as shown in Table 2, and that this trend has stabilised at a low level, ranging since 1980 from 40 to 70+ tonnes.

Table 2

Rod Catches (tonnes) and Yield per Rod (kg) for the 1950's until the 1980's

Period	No. of Licensed Anglers	Catch (tonnes)	Yield per rod (kg)
1950's	7,696	133	17.3
1960's	10,080	129	12.8
1970's	12,478	56	4.5
1980-86	16,086	46	2.8

Source: Derived from Annual Reports of Fisheries Department, Dublin

Vital information regarding trends in escapement into fresh water is fortunately available for a number of rivers where fish counters (normally of the resistivity type) have been installed. All rivers in the Republic subject to hydro-electric development, including the Shannon, Erne, Clady, Liffey and Lee, plus those in the Republic and the Foyle Area with suitable fish passes, such as the Corrib, Inagh, Lennon, Mourne, Faughan, Boyne, Bandon and Blackwater, have fish counters installed. However, in the cases of the Shannon, Lee and Erne, because of intensive smolt rearing and associated sea ranching, the salmon stocks should not be considered as indicative of normal wild stocks. In addition, specific fish trapping devices for a complete census of all

ascending and descending fish have been built in the Republic and Northern Ireland on the Burrishoole and Bush systems, respectively. An account of the development of fish passes and fish counters in Ireland has been given by McGrath (1984). The data derived from some of the earlier resistivity counters is, however, rarely reliable as discussed during the proceedings of the Atlantic Salmon Trust Automatic Counter Workshop (1987).

It is also instructive to compare commercial and rod catches for the same period (Table 3).

Table 3

Commercial and Rod Catches
for the 1950's until the 1980's (tonnes)

	Commercial	Rods	% Rods of Total
1950's	698	121	14.7
1960's	914	116	11.2
1970's	1,529	56	3.5
1980-86 inc.	1,083	46	4.0

Source: Derived mainly from Annual Reports of Fisheries Department, Dublin

The rod catch in relation to total catch in the Foyle area shows a similar trend with the percentages for each of the above decades being 5.2, 2.5, 1.1 and 2.1, respectively. No rod catch information is available for Northern Ireland. It is hardly surprising, therefore, that Thorpe and Mitchell (1981) express the opinion that 98% of the Irish fishery is commercial as opposed to recreational and go on to say that 75-80% of the catch since 1974 has been by drift net at sea, where netting is licensed from March 16th to July 20th, within the 12 mile limit.

4. Biology

A considerable number of investigations in the natural history of salmon in Irish rivers were carried out by Went. He followed up early work on the Shannon (Southern, 1928) with his publications (Went, 1938; 1940) in which he showed that hydro-electrification was followed by loss of the specific spawning grounds and hence the stock of the multi-seawinter fish in this river system. This has been summarised in Went (1955). Between 1941 and 1948 he published the results of an analysis of data on smolt and adult age groups for six rivers, again summarised in Went (op. cit.). This information forms a useful record as does his work on the age

and size composition of the Foyle stock (Went, 1970). Others, notably Twomey (1956 and 1959) have furnished similar information in respect of additional rivers and have updated earlier work. All these results had to be based upon the scale reading of returning adults and consequently the smolt ages are probably not always representative of the stocks at migration. It is now known that there is a higher mortality of one year old smolts at sea when compared with the older age groups, probably arising from their smaller average size.

5. Salmon Research Trust of Ireland

The research programme begun in 1957 by the Salmon Research Trust of Ireland, which has been the subject of Annual Reports since 1955, has been reviewed by Piggins (1987). The work is centred on the Burrishoole fishery, which comprises a freshwater lake, Lough Feeagh (approx. 2.5 miles long and 0.5 miles wide), with its inflowing rivers and streams, which discharges via the Mill Race and Salmon Leap to the tidal Lough Furnace and thence via the Burrishoole River to the sea. From 1960 the main capital works have centred at the Mill Race, including upstream and downstream traps together with smolt rearing facilities. Under certain flow conditions the census was incomplete because of losses via the Salmon Leap, but this was remedied in 1970 by the construction of further traps at this site.

The original basis for the research was to obtain an answer to the question so often asked by persons with an interest in salmon, "Do spring fish breed spring fish?" To this end it was decided to rear smolts from parents of known sea age and to release them into the wild. From this it was found that, although in 99% of cases grilse parents produced grilse offspring, there were always a few 2-sea-winter fish even after eight generations of line-bred grilse. In the case of the 2-sea-winter fish the offspring turned out to be 85% grilse. Evidently, therefore, although a genetic influence does appear to be involved, it is possible for environmental factors to override this under certain conditions (Piggins 1973). As reported in the Annual Reports, the smolt rearing necessary for this work has yielded valuable data on disease control and husbandry of young salmon prior to the smolt stage and the survival of reared smolts at sea.

The census data obtained by use of the upstream and downstream traps has yielded a wealth of invaluable data on survivals at various stages in the life-cycle and revealed an alarming situation represented by a progressive decline in spawning escapements, and in turn declining smolt runs, which is attributed to excessive drift netting. It has also been possible to show that, if one pair of spawners must in turn produce another pair to maintain equilibrium, since 1970 only in 1971, 1975, 1981 and 1982 has the survival rate been above 2.0, the level required for a self-sustaining population. This problem is accentuated by the observed reduction in the average weight of the grilse, caused by the selective effect of drift netting since 1970 and the

consequent reduction in the number of eggs produced by each female.

Additional research work by the Trust has involved studies on sea trout, hybrids (salmon x sea trout), brown trout and eels, all outside the scope of this review. Investigations have also been conducted into the effects of peat silt and predation.

6. The River Bush

The Department of Agriculture (Northern Ireland) has been conducting research on the Bush since 1973, when a 30-year lease of the river commenced. The research facilities include traps for a full census of wild salmon smolts together with smolt rearing. The results so far have been reviewed by Kennedy and Johnston (1986). They deal with:

(1) The relationship between adult spawning stock and smolt production. Although there is a positive trend for increased smolt production from larger numbers of eggs, the results to date do not show a significant correlation, and reasons for this are discussed.

(2) Evaluation of stocking and juvenile ecology in nursery habitats based on use of green/eyed ova or swim-up fry in different types of stream. Recommendations based on facts useful to river managers have been determined. In the case of the Bush, an annual smolt production of 30 smolts per 100 m^2 was established, which is higher than for other areas where such assessments have been made.

(3) Evaluation and subsequent incorporation of measures for restoration of suitable habitats following drainage operations.

(4) Factors affecting survival rates of post-smolts at sea, with returns to the river ranging from 6.20 - 12.09% - direct correlations have been found between grilse and 2-sea-winter fish in the following year and the number of adults produced by known smolt runs.

In 1986 an investigation began into the effects of predation by cormorants as a contributary factor for the lack of correlation between ova deposition and subsequent smolt runs (Kennedy and Greer, 1988). The concentration of cormorants on the river is probably connected with large nesting populations nearby (because of protection numbers have much increased in recent years), but the end result is that predation is at an alarmingly high level and much higher than previously reported (e.g. Piggins, 1958). The authors calculate the daily rate of predation as being 653-1214 wild smolts and 107-231 hatchery smolts. These smolt losses represent 51-55% of the wild and 13-18% of the hatchery fish, respectively!

7. Genetics

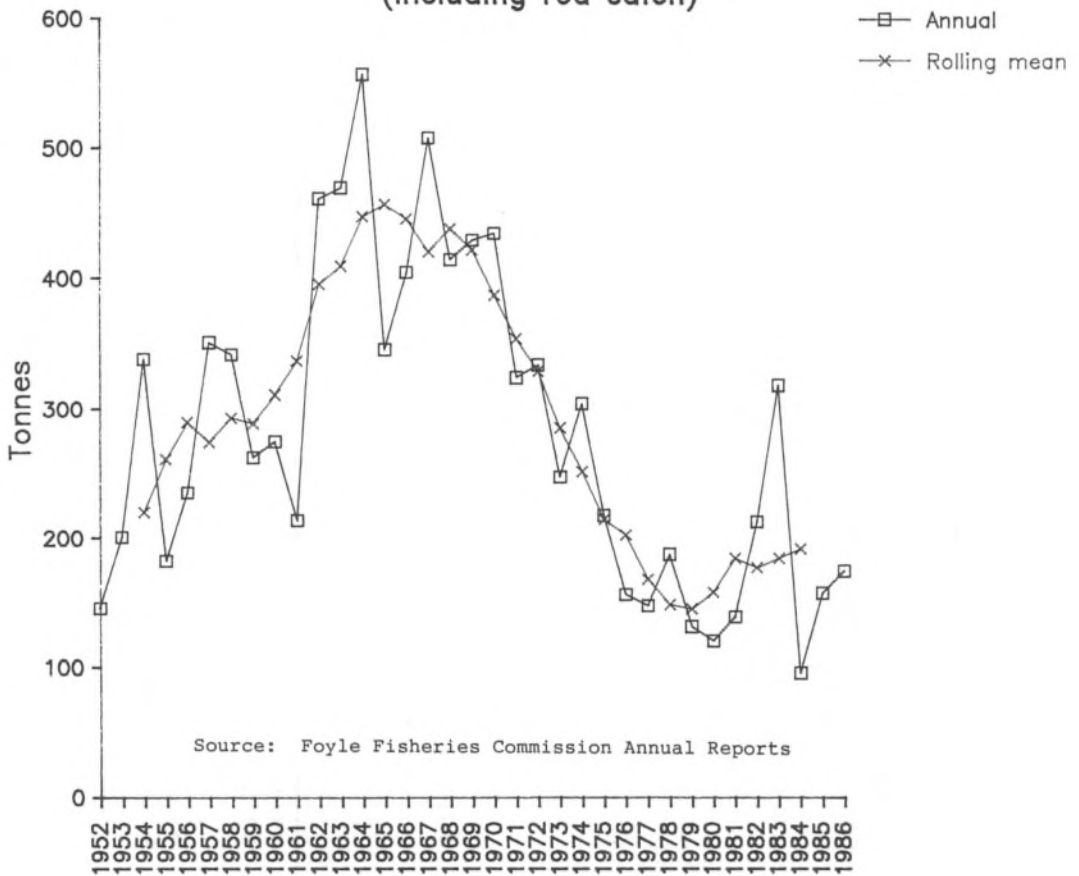
The genetic influence determining the age at return from the sea as discussed in the preceding section and the specific features of salmon from individual rivers has been suspected for many years, but it was only following the development and use of electrophoresis and associated techniques for the breakdown of protein or other enzyme characteristics that the story has unfolded. The stimulus for these developments was the need to distinguish the differences between European and North American salmon in the Greenland fishery, of which more later. The existence of two races of salmon in the British Isles was demonstrated for Irish salmon stocks by Payne, Child and Forrest (1971), comprising a Celtic race south of a line from Valentia Island to Wicklow and a Boreal race in the remainder of the country. However, it is suggested by Stähl (1987) that this does not correspond with his findings and that more extensive sampling of British and southern European populations is necessary to determine whether in fact there are two European races. There are, however, genetic differences among the stocks of different rivers (Cross, Healy, and O'Rourke, 1978), and these have important conservation and management implications. This demonstration of discrete river stocks reinforces the arguments that interceptory drift net operations at sea crop returning adults in a random manner which could adversely affect specific river stocks by taking an undue proportion of the stock of any one river system by accident and also by selecting for a limited range within the length/weight frequency range. Such operations also concentrate on fish returning within specific seasons only, largely directed at the grilse, rather than the 2-sea-winter fish thereby accelerating the run-down of already depleted stocks from possibly distant river systems.

8. Foyle Stock

The overfishing problem was highlighted by the investigation into the decline of the Foyle salmon catches after 1970 (Figure 3), and public concern at the increasing commercial catches with the apparent decline in spawning represented by redd counts subsequent to 1966, which was reported by Elson and Tuomi (1975). This very detailed and thorough analysis of all the available information broke new ground in the approach to salmon fishery management in Ireland. For example, although the basis for determining the number of spawners required does not have unanimous acceptance, it specified the desirable numbers of freshwater stock for each tributary of the Foyle to allow for both angling and spawning purposes. To achieve this objective, in which fish counters would play an integral role, the weekly close times and annual close seasons would have to be adjustable. In addition, and most controversially, it was proposed that the traditional draft nets and the drift nets in Lough Foyle should be suppressed and replaced by strictly controlled fixed nets. Expressions such as "too many nets chasing too few fish" and, in respect of the drift nets in the Lough, "grossly excessive fishing effort for this

FIGURE 3: RIVER FOYLE SALMON CATCH 1952–86

(including rod catch)



area", are used in the Report, but because of the politically sensitive nature of the proposal no recommendation was made for the number of fixed nets but rather for a period of trial and error. This was a brave effort to save and restore a valuable natural resource and in the event the use of counters to regulate fishing times was implemented, but the proposal for the use of fixed nets was too radical and politically sensitive to permit implementation. Neither was it possible for Elson and Tuomi to integrate the effects of the offshore drift net fishery into the analysis, and this, together with other inherent problems within the Foyle Area, e.g. poaching, explains why there has been no sign of improvement in the overall stock situation. Up to 1985 the spawning stock remained below the 7,748 redds suggested by Elson and Tuomi, as shown in Table 4. (In Table 4 the 'year' column shows the year adults entered fresh water, spawning towards the end of that year and early in the following year.) Using redd counts as a basis for the number of spawners can be subject to errors which may vary between tributaries in the same year, and in a given tributary between one year and another. The reasons include variations in river flows, e.g. counting is impossible under flood conditions, and the conscientiousness of individual census takers, and redd counts should therefore be treated with a degree of caution.

Table 4

Foyle Area Redd Counts

Year	No.	Year	No.
1975/76	2696	1981/82	3791
1976/77	3058	1982/83	3515
1977/78	1800	1983/84	3163
1978/79	3894	1984/85	2677
1979/80	3559	1985/86	4607
1980/81	2927		

Source: Foyle Fisheries Commission Annual Reports and personal communications.

9. Salmon Hatcheries and Aquaculture

The history of salmon hatcheries in Ireland dates back to the latter half of the 19th century when, in common with similar developments in North America and Europe, the propagation of salmon and indeed many other species including sea fish and crustaceans, was thought to be the panacea for all the problems besetting the conservation and management of fisheries. It is now recognised that this was too facile an approach, but nevertheless

under specific and well-defined situations salmon hatcheries, and where appropriate, rearing to the parr or smolt stage, have a role to play. Among the early hatcheries were those located on the Blackwater (Lismore), Owenea (Glenties), Foyle (Newtownstewart), Bann (Kilrea) and Bush (Bushmills) all of which released their production of ova or unfed fry although there was evidently a limited amount of experimental smolt rearing around the turn of the century at some of these centres. In recent years the Newtownstewart hatchery has been used only occasionally and that at Kilrea was closed in the 1950's. The outline map shows the locations of existing installations. With the hydro-electrification of rivers in the Republic it was found that, in spite of the construction of fish passes, in a number of cases the salmon stocks were not being maintained, particularly when associated with the intensification of drift netting and the onset of the salmon disease, UDN. Consequently, using as a model the successful techniques of smolt rearing used elsewhere, particularly in Sweden, a large hatchery and smolt rearing station was constructed on the Shannon at Parteen in the 1960's by the Electricity Supply Board, although it should be remembered that the Salmon Research Trust of Ireland has been releasing reared, tagged smolts from 1957 onwards. This has been followed by similar developments on the Lee at Carrigadrohid and most recently the Erne at Ballyshannon. Other hatcheries and/or smolt rearing centres have been provided as compensatory measures to provide fish for rivers affected by drainage operations. These include the rearing stations on the Corrib (Cong) and the Boyne (Virginia). As already mentioned, the Salmon Research Trust's facilities built in 1957 on the Burrishoole also include smolt rearing facilities. In 1984 over 5 million ova were stripped and 1.6 million releases of fry and parr took place, with 512,000 being released as smolts. These fish were released into both the parental rivers and other systems (Fish. Ann. Rep., Dublin, 1984). In Northern Ireland the installations on the Bush also include provision for smolt rearing. As might be expected, the drift net lobby in the Republic has over the years been vociferous in exerting pressure for increased smolt production. It might be argued that if the drift nets only cropped fish resulting from reared smolt releases and were prepared to pay the costs all would be well, but unfortunately, as already discussed, this type of fishery is unselective in the exploitation of salmon, the origin of which might be wild or reared. Recent smolt tagging techniques involving the use of magnetic microtags have yielded information on the proportion of reared smolts in the drift net fishery.

In general, it has been found that reared smolts in the Republic and in Northern Ireland have marine survival rates of about a quarter of wild smolts. This, together with the economic aspects of such developments, has been discussed by Piggins (1980).

Until recent years smolts have been reared, released to take their chance in the wild, then cropped on return, a practice generally referred to as 'sea ranching'. The lower survival of reared smolts is presumably because they are less able to avoid the perils of predation, and also because of a possible lag in

feeding. However, it is only fair to indicate that it is possible to obtain 50% survival from the egg to reared smolt compared with 0.5% in the case of wild smolt production, i.e. 100 times greater. Also survival to the coast, before drift net mortality, has been as high as 33%. Indeed, Browne (1986) shows that grilse originating from reared smolts form a significant part of the total catch made on the north-west, west and south-west coasts of the Republic.

Increasingly however, at suitable locations on the west and north-west coasts of the Republic, reared smolts are being retained and reared in sea cages. Production using this technique has increased from 385 tonnes in 1984 to 700 tonnes in 1985 and 1,200 tonnes in 1986. This activity is an integral part of an aquaculture development programme for the Republic and by 1990 the planned production will be 10,000 tonnes. Recent press reports indicate that a large-scale unit is projected for the north-east coast of Northern Ireland. There are important genetic implications to be considered in the overall field of salmon rearing and farming activities; these are discussed by Wilkins (1985).

10. Disease

The major diseases affecting wild salmon in Ireland are furunculosis and ulcerative dermal necrosis (UDN). Furunculosis was first noted in Europe in Germany during the 1880's, and in the British Isles in 1911, with subsequent heavy losses of adult salmon. It thought that the disease was probably brought to Europe from North America with rainbow trout eggs, but this view is not unanimously accepted (McCarthy, 1975). It is now endemic in wild salmon stocks and salmon hatcheries. The causative agent is a gram negative bacterium (Aeromonas salmonicida). Serious outbreaks are now unusual in wild fish unless there are stress factors, but there can be serious problems with fry and parr in some smolt rearing stations. A full acount of this disease can be found in the Furunculosis Committee Reports of 1930, 1934 and 1935. UDN was first observed in Waterville, Co. Kerry in 1964/65, and in 1965/66 was found in the Cork Blackwater. There was a rapid progression to other rivers along both the east and west coasts of Ireland in 1966, including the Foyle, Bann and Bush. In Great Britain, rivers in the Solway area were infected later the same year and the disease later spread to the remainder of Scotland, England and to Europe. In the early years there was much acrimonious debate as to the nature and cause of the disease and the only consistent factor appeared to be the inconsistencies! A number of rivers have never been affected; those stricken include a broad spectrum of river types ranging from the purest mountain torrents to the occasionally less pristine slower-flowing lowland rivers. The highest incidence in some waters occurred during the cold months but in others the fresh run grilse were heavily hit during the summer. It now appears that a similar outbreak occurred in the 1880's in Scotland, then died out after a period of years, and a similar pattern is evident in this latest

epidemic. A great deal of effort at a number of centres has been devoted to discovering the causative organism and the problem is well presented by Roberts (1972), who considers that the pattern of spread in association with the epidemiological evidence together with the cross-infection experiments by Irish and French workers suggests a virus is responsible. However, despite use of all the modern techniques available, no definite proof has been forthcoming! The heavy mortalities arising from the disease are in fact always associated with secondary fungal and bacterial infections. The practice in some rivers of removing as many affected fish as possible, including those showing only slight symptoms, and the evident inability of many infected fish to spawn gave rise to fears for the future of the stock. In the event, it would appear that compensatory mechanisms came into play and except for one possibly atypical case, represented by the Erne, no shortfall of juveniles arising from lack of spawners was been demonstrated (Vickers, 1969). In the Erne ascending salmon enter a submerged orifice fish pass at the upstream end of the estuary to by-pass the hydro-electric dam and meet with another a few miles further upstream. Probably due to stress arising from efforts to negotiate the downstream pass, for two successive seasons virtually no adults survived to ascend the second pass. Post spawning survival of wild grilse kelts trapped in the descending traps at the Burrishoole installations during the past 25 years has ranged from 28%, of which 2% were males in 1972 when UDN was rampant, to 56%, of which 26% were males in 1985 (Annual Report, SRTI, 1986).

11. Tagging and Results

Tagging is an essential tool in fisheries management, and in Ireland salmon tagging using kelts released from hatcheries was carried out for a number of years: up to 1947 a total of 22,516 kelts had been tagged of which 600 (2.7%) were recaptured by nets and rods on their subsequent return. As was expected, almost all of these were as clean fish in their rivers of origin (Went, 1947). Went also gives detailed results from early tagging of smolts, mainly in the Bann and Foyle, and these rivers also gave the most reliable results with about 2% of the smolts captured on return (Went, 1953). In the case of the Bann, 1,057 smolts were tagged, including some sea trout smolts. Of the 27 salmon recaptured, all were from the Bann with the one exception of a fish taken by drift net off Malin head in 1913. The next development was in the early post-war years when salmon captured in fixed nets (bag nets) at a number of locations on the coasts of the Republic and Northern Ireland were tagged. Went (1955) gives details of these experiments in his Buckland Lecture on "Movements of Salmon Around the Irish Coasts". The tendency was for tagged fish to move mainly in the direction of the largest salmon rivers in the area of tagging. For example from Baginbun, Co. Wexford the fish mostly moved towards the south-west, entering the Cork Blackwater, Suir, Barrow and Nore. From the Co. Antrim bag nets the predominant movement was towards the Bann and Foyle. However, superimposed on these movements were a number of much longer

migrations to rivers on the west and the east coasts of Great Britain. It would accordingly be expected that the catch of the offshore drift nets would include fish from a fairly wide geographical range of home rivers, but although Went (1958) did tag salmon from the Co. Donegal drift nets, unfortunately the recapture rate was very low, being some 5% compared with the bag nets' 30%. This lower survival is to be expected when the physical condition of the fish at the time of release is considered, i.e. meshed, scaled and exhausted to varying degrees. However, the evidence that the drift nets are taking salmon not of Irish origin is available from the recaptures of fish originally tagged as wild or hatchery smolts in Great Britain (mainly from Scotland) (12 in 1972, 21 in 1973 and 14 in 1974, (Went, 1976)). Other countries represented are France (1 in 1973), Denmark (1 in 1973 and 3 in 1974) and Northern Ireland (1 in 1974) (Went, 1973; 1974).

In the investigation so far described external tags of various designs were used and some gave better results than others, but in all instances there were tagging mortalities, differential rates of tag shedding and the variable skills of the taggers to be considered. In addition, if fishermen think that reporting the recapture of tagged fish could be detrimental to their interests they will naturally conceal such recaptures. For all these reasons and particularly because of the problem presented by the rapid growth between smolt and adult, a more effective tag was required. This came in the form of a coded magnetic tag only 1.1 mm long and 0.02 mm diameter, inserted into the nasal cartilage by an injector and traced on return by the use of a magnetic detector. As an additional aid to detection the microtagged fish also have the adipose fin removed. This method originated in North America for work on Pacific salmon in the 1960's and was first used in Ireland in 1979 when 127,000 hatchery-reared young salmon were tagged at five rearing stations. Catches of returning adults were examined at those shore stations where substantial numbers of drift net-caught salmon were landed and the results showed that the proportions of reared fish in the catches ranged from 2% in the north west to 13% on the Clare and Galway coasts (Browne, 1982). This increasingly successful programme is continuing and in 1982 the work was extended to include the Bush.

The most recent data on marine exploitation as revealed by microtagging for 1 and 2 year old smolts from the Burrishoole for the years 1981-86 inclusive ranged from 63% to 89% (85% and 90% for 1 and 2 year smolts in 1986) and survival from smolt to home waters 3% to 33% (33% in 1986). Survival from smolt until return to natal river ranged from 1.3% to 3.5% (4.8% and 2.6% for 1 and 2 year smolts in 1986) (Ann. Rep. SRTI, 1986; Browne, J. and Piggins, D.J.). In 1987 the marine exploitation of Bush salmon was broadly comparable at 82% and 75% for 1 and 2 year smolts (Kennedy and Crozier, pers. comm.), but whereas virtually all the marine exploitation was by drift nets in the Republic, some 26% of the Bush exploitation was by bag nets on the Antrim coast and the balance by drift nets along the Irish coast, of which 21% was off Co. Donegal. Survival from smolt until return to the Bush was

comparable to the Burrishoole, being 2.8% and 4.3% for 1 and 2 year smolts respectively in 1986. Updating these figures to give an overall exploitation pattern for the 1985 releases of hatchery smolts returning as grilse and salmon, the survival to the Bush was 4.19%, which compares with the survival of wild smolts microtagged in 1986 of 5.43%.

12. Distant Water Fisheries

The location at sea of the feeding grounds of Irish salmon was unknown until four fish tagged as kelts were recaptured in the Greenland area in the early 1960's (Went and Piggins, 1965). A small-scale fishery for salmon had commenced off the west coast of Greenland in 1960, with a catch of 60 tonnes. This escalated rapidly until 1973 when the catch was 2,341 tonnes, but subsequently the annual catch was fixed by international quota agreement at approximately 1,200 tonnes. Only post-grilse fish destined to spend two or more winters at sea were represented in the catch and it soon became evident that fish of European and North American (mostly Canadian) origin were being taken, in roughly equal proportions. The European fish were mainly from the British Isles, but interestingly, a number tagged in France as smolts were also recaptured; somewhat surprisingly, Norwegian and Icelandic salmon were not represented. Between 1969 and 1974 smolts tagged in four Irish river systems yielded 16 recaptures in the Greenland area. Wild smolts tagged at the Bush trap in 1974-75 yielded a recapture from Greenland from each year. That the use of microtags has considerably improved the recovery rate is shown by the fact that these yield more than 10 times the recoveries for equal numbers tagged than the earlier Carlin tags which previously gave the best results. Prior to 1971 salmon were tagged in the Greenland fishery from commercial vessels under the auspices of the International Council for the Exploration of the Sea (ICES) and in 1972 this effort was intensified by the use of research vessels from a number of member states. Tagged salmon were recaptured in Ireland and there were seven from the pre-1972 programmes with a further eight recaptures from the 2,364 tagged in 1972 (Went, 1974).

As already noted, the Greenland fishery is based upon salmon destined to spend more than one winter at sea, and this still left open the question of where the fish due to return as grilse were feeding, this age group being of course the most important part of the Irish catch. The answer was soon forthcoming, as in 1968 a small-scale long line fishery developed in the area of the Faroes. Catches remained small, averaging about 22 tonnes until 1979, when an increase occurred, and by 1981 reached 1,125 tonnes. Subsequently, the Faroese Government agreed to a voluntary quota, and this is now 625 tonnes. The original fishery was located close to the Faroe Islands and the catch consisted mainly of pre-grilse, but in 1981 and subsequent years there was a substantial movement of the fishery to the north of the Faroes, and here the catches consisted mainly of multi-seawinter fish. A total of 1,751 feeding fish were tagged in the earlier years and up to 1974

there were 13 recaptures from Ireland (Went, 1973; 1974) and 70 elsewhere; the proportion of Irish origin therefore amounted to 15.5% of the total. Long line exploitation was also developed in the Norwegian Sea and although subsequently prohibited is not of importance in the Irish context as the catch consisted mainly of salmon from Norway and the USSR.

13. Salmon Angling

Salmon angling, in view of increasing leisure and tourism, should be of increasing economic potential, but its true value cannot be realised with the present level of commercial exploitation. As shown in Table 3 the rods in the Republic during the 1970's took 3.7% of the total catch, or something approaching 17,000 fish. However, in considering the information given by Table 3, it is important to remember that anglers, for whatever reason, seem reluctant to furnish catch returns and therefore these percentages are underestimates. Elson and Tuomi (1975), for example, indicate that in the Foyle Area rod licence returns were as low as 8% and at the best only 50%! Table 4 shows the increase in the numbers of rod licences issued in the 1950's, 60's and 70's and the increasing interest in angling, with a total of 14,924 salmon rod licences being issued in the Republic in 1984 compared with less than 6,000 in 1950. In the Foyle Area there are now over 7,000 licences being issued, and in the Fisheries Conservancy Board's area the total exceeds 10,000. In Ireland as a whole it is therefore evident that, including visitors, there are nowadays over 32,000 salmon and game fish anglers, although some of them probably hold licences for both Northern Ireland and the Republic. As can be seen from Table 4 there has been an increase of 246% between the 1950's average and that for the 1970's.

Table 5

Salmon Rod Licences (000's)

	Republic	Foyle	Northern Ireland
1950's	7.7	1.8	6.7
1960's	10.1	2.9	11.0
1970's	12.5	3.6	10.3

Source: Annual Reports of Fisheries Departments in Belfast, Dublin and of the Foyle Fisheries Commission.

The value of salmon angling to the economy of the Irish Republic has been estimated by the Economic and Social Research Institute (O'Connor and Whelan, 1973; O'Connor, Whelan and McCashin, 1974).

In 1970 visiting salmon anglers numbered 3,800 and they spent an estimated I£696,000 or an average of I£183 each, mostly in the west of the country. This sum could be increased to I£829,000 when adjusted by a suitable "multiplier effect" taken by the authors to be 1.6 for the Republic as a whole and is additional to the "Value Added". The resident anglers in 1970 were considered to have spent I£326,000, giving a total for visiting and resident anglers of I£1.51 million. An update to these figures has been presented by Whelan, B.J. and Whelan, K.F. (1986) and they estimate that salmon angling was worth I£3.9 million in 1970 and I£5.0 million in 1982 (both based on 1982 prices). Additional data on the value of salmon angling is available for the Foyle Area in the study published by Hadoke (1972). Based on the Gross Expenditure Method, i.e. annual expenditure on licence, rent or fee, ghillie, transport, accommodation and cost of tackle, he derived a sum of £47. However, he felt this figure was too high in respect of local anglers who do not pay for accommodation and for whom travel costs are minimal. He arrived at a figure of £25, which is in close agreement with that of O'Connor et al. (1974) in respect of the local angler in the Republic.

The question in the Irish context of how "successful" the salmon angler is can now be considered. Unfortunately not a great deal of published information is available and is limited to only a few waters. Table 6 shows the catch per rod day for the specified waters and the data for the Republic is based on statistics available to the Central Fisheries Board (Whelan, pers. comm.).

Table 6

Average Catch per Rod Day for Selected Fisheries

Period	Fishery			
	Galway	Moy	Erriff	Bush
1978-84	0.48	n.a.	n.a.	0.18
1985	0.51	n.a.	0.22	0.28
1986	0.50	n.a.	0.24	0.27
1987	0.36	1.33	0.32	0.20

Source: Central Fisheries Board and Department of Agriculture, Belfast

It is well known that river flows and water conditions are the major factors affecting angling success, always providing a sufficient stock of suitable fish is available, and therefore catches in small spate rivers, e.g. Erriff and Bush fluctuate to a greater degree than in the larger rivers with more regular

discharges, e.g. Corrib (Galway) and Moy. In the examples given in Table 6 (except the Erriff) the results refer to single fisheries within each river system. It is evident that in 1987 it took on average five days to take a salmon on the Bush compared to less than one day on the Moy, and indeed on the latter river for July, when the peak grilse runs can be expected, 124 rod days yielded a catch of 273 fish, i.e. 2.2 fish per day. Data is also available for the Burrishoole fishery, but relates to lough fisheries and is complicated by variable proportions of hatchery fish in the total stock. However, from 1980-85 the average catch per rod day in the lough (Lough Furnace) downstream of the rearing station was 0.24 and for the upstream lough (Lough Feeagh) 0.14 salmon (Piggins, 1986).

It is also interesting to speculate upon the proportion of the escapement to fresh water which is taken by anglers, and this can only be obtained in rivers where an accurate count of the run is available. Unfortunately, rod catches for the entire River Bush are not available but the number of fish in the river is available. It is, however, known that the rods downstream of the trap have taken a minimum of between 4.0% and 12% of the run into the river during the years 1972-87, with an average of 7.8%. For the Foyle system, Elson and Tuomi (1975) estimated that for the period 1952-73 the rods exploited between 23.4% and 78.4% of the freshwater stock with an average of 44% for the years covered. However, as redd counts formed an integral part of the calculations the estimated exploitation rates might be considered suspect in respect of some years. It is interesting to note that Piggins (1986) states that for the Burrishoole fishery the exploitation by salmon rods has seldom exceeded 20%, and this is lower than for many river fisheries.

14. Costs of Protection and Conservation

The total value of wild salmon caught by nets, traps and rod in Ireland during 1984 can be estimated at I£5 million. Protection and conservation costs are difficult to quantify precisely because the three Conservancy Authorities also have responsibility for trout and coarse fish protection, and accounting procedures differ. In addition, the Central Fisheries Board has a responsibility for angling development and research to a greater degree than the others. However, if these latter roles, which employ a staff of about 170 and cost something over I£2 million are excluded, it is evident that expenditure by this Board is of the order of I£3 million, towards which licence duties contribute 11% and the balance in the main comprising grants from central Government. If the costs of the Republic's Electricity Supply Board's smolt rearing operations are added to this it is probable that expenditure on conservation and protection is approaching the total value of the catch. Comparable figures for the Foyle Area with a staff of 30 is that licence duties contribute 30% of current expenditure but the two Governments are contributing 93% of the running costs arising from current and accumulated deficits and these subventions are equal to about 15% of the total value of

the Foyle catch. In the case of the Fisheries Conservancy Board, with a staff of 56, licence income represents 38% of the total expenditure, the balance being derived from payments for agency work. The latter represents a contribution towards bailiffing costs on waters controlled by the Department of Agriculture for Northern Ireland and towards the costs of pollution control by the Department of the Environment. The total expenditure in the Fisheries Conservancy Board area is, however, a hefty 89% of the value of the salmon catch. These figures might be useful in stimulating some thoughts and reflections on the problems of meeting conservation and protection costs, always remembering that the costs incurred by the two Exchequers in their administrative and research roles are not included! It should, however, be emphasised that this is a problem not only in Northern Ireland and the Irish Republic. Similar problems are to be found in Great Britain if fisheries budgets are separated from the overall expenditure of the individual Water Authorities.

15. Conclusions

This review of the Irish salmon fisheries indicates that there are many problems, both extant and on the horizon, not least being the drift net situation. Obviously the Governments are willing to spend money on conservation and protection, but unless a solution can be found to resolve the problem of drift nets in the Republic and the Foyle area, together with poaching and pollution in general, the future does not augur well for the salmon fisheries. It is, however, hopeful that stronger action is on the way if the measures envisaged in the White Paper of November 1987 are implemented. It can only be hoped that the disruptive minority in the industry will be persuaded, by resolute action against their activities and pressures on them by the majority of users, that planned management and development is in the long run the only way forward.

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(i) Insert number of years. A covenant must run for a minumum of four years.

(ii) Enter the ANNUAL amount you wish to subscribe, in figures and words.

(iii) This date must be the same as or later than the date on which the Deed is signed.

The most convenient method of payment is by Banker's Order. Please complete the form overleaf and send it with your Deed of Covenant to The Atlantic Salmon Trust, Moulin, Pitlochry, Perthshire PH16 5JQ.

THE ATLANTIC SALMON TRUST LTD.

BANKER'S ORDER

Subscriber's Bank

To .....Bank Limited

Address & Branch .....

.....

PLEASE PAY to MIDLAND BANK plc, 20 Eastcheap, London EC3M 1ED (40-02-31) for the credit of THE ATLANTIC SALMON TRUST LTD. A/C No. 41013874 the sum of £ ..... (.....pounds) on the (i) ..... day of .....19.. and a like amount on the same day each (ii) month/quarter/half year/year for a total period of (iii) ..... years. Total number of payments .....

Signed ..... Date .....

Name in Block Letters .....

A/C No. .....

Address .....

.....

(i) This date must be the same as or later than the date on which the Deed is signed.

(ii) Please delete and initial the inappropriate words.

(iii) Insert number of years. A covenant must run for a minimum of four years.

PLEASE DO NOT send the Banker's Order direct to your Bank.

NOTES

ATLANTIC SALMON TRUST PUBLICATIONS

		£
Atlantic Salmon: Planning for the Future (Proceedings of the 3rd International Atlantic Salmon Symposium, Biarritz, 1986)	edited by D. Mills and D. Piggins -	45.00
The Biology of the Sea Trout (Summary of a Symposium held at Plas Menai, 24-26 October, 1984)	by E.D. Le Cren	1.50
Salmon Stocks: A Genetic Perspective	by N.P. Wilkins	1.50
Report of a Workshop on Salmon Stock Enhancement	by E.D. Le Cren	1.50
Salmonid Enhancement in North America	by D.J. Solomon	2.00
Salmon in Iceland	by Thor Gudjonsson and Derek Mills	1.00
A Report on a Visit to the Faroes	by Derek Mills and Noel Smart	1.00
Problems and Solutions in the Management of Open Seas Fisheries for Atlantic Salmon	by Derek Mills	1.00
Scotland's King of Fish	by Derek Mills	1.85
Atlantic Salmon Facts	by Derek Mills and Gerald Hadoke	0.50
The Atlantic Salmon in Spain	by C.G. de Leaniz, Tony Hawkins, David Hay and J.J. Martinez	1.50
Salmon in Norway	by L. Hansen and G. Bielby	1.50
Water Quality for Salmon and Trout	by John Solbe	2.50
The Automatic Counter - A Tool for the Management of Salmon Fisheries (Report of a Workshop held at Montrose, 15-16 September, 1987)	by A. Holden	1.50

FILMS AND VIDEO CASSETTES AVAILABLE FOR HIRE

"Will There Be a Salmon Tomorrow"	- 16 mm film
"Salar's Last Leap"	- 16 mm film
"The Salmon People"	- Video (VHS)
"Irish Salmon Harvest"	- Video (VHS)
"Managing Ireland's Salmon"	- Video (VHS)

Films and videos may be obtained from the Trust for private showing by Clubs, Fishery Managers, etc. A donation to AST funds is required in return.