SERIES A (Freshwater) No. 31 1988

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Edward Fahy and Ruary Rudd

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Roinn na Mara

(Department of the Marine)

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The Currane, Co. Kerry, Sea Trout Fishery, 1980-1986

by

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ABSTRACT

An updated account of the unique Waterville sea trout stock is provided. The latest genetic work is reviewed and the vulnerability of these fish to introgression by other strains of trout is considered.

Waterville sea trout are relatively long lived and the consequences of this fact are documented with data supplied by anglers over a period of six years. On average, Waterville sea trout are the largest in Ireland although bag sizes in the fishery are small.

Alterations in the stock are monitored over seven years from 1980 using angler caught material. Back-calculations of lengths at various ages are supplied together with information on weight: length relationships, condition factors and sex ratios. The main influence on the age structure of the stock was the recruitment of post-smolt annually. Freshwater productivity could be explained by the influence of length of growing season but regulating factors in the saline environment were not identified.

There was some agreement between indicators of recruitment in the Waterville and Burrishoole (Co. Mayo) fisheries. The relationship between B type increment — a crucial element of growth bringing parr to migratory dimensions — and growing season is investigated and various methods of expressing the B increment in quantitative terms are examined.

INTRODUCTION

In the earliest review of the biological characteristics of Irish sea trout *Salmo trutta* L. Nall (1931) recognised the unusual nature of the fish from the Cummeragh* system which he appropriately discussed in the context of sea trout from the Ailort in Western Scotland. The Waterville catch was later examined by Went and Barker (1943) by Went (1944) and by Fahy (1980b) who described material collected in 1973 and 1974. These exercises were all fairly similar, their objective being to characterise certain stocks or populations of sea trout. The basic procedure had been developed by Nall in Scotland and was later adopted by Went and Fahy in Ireland and by Harris (1970) in Wales. The exercises conform to a time honoured format, the resulting assessment being based on data collected in one or two years. The assessments have been a useful means of classifying sea trout stocks in Britain and Ireland (Fahy, 1978b).

From the earliest investigations the unique nature of the Waterville stock was obvious. Its most unusual characteristic is its high diversity of age categories, a consequence of these fish being long lived. The Waterville stock is the only one of its kind in Ireland; similar populations have been described in Britain where they tend to be concentrated along the west coast of Scotland and Wales. In recent years much effort has been made to identify the factors to which their longevity might be attributed.

The practical expression of the long lived Waterville fish in a longer angling season has been described (Fahy, 1982b). The spawning behaviour of the fish was investigated (Fahy, 1982a) and the growth characteristics of the larger trout for which Waterville is especially famed, were critically examined (Fahy, 1982c, Fahy and Rudd, 1983). Some of the biochemical genetic features of the fish were described by Fleming (1982).

The investigations which commenced in 1980 were intended to monitor alterations in the stock (represented in the catch) over a period and to relate such changes as occurred to environmental variables. The Waterville stock was selected for the exercise because its longevity enabled comparison among cohorts, something which would not be feasible in the short-lived populations of most Irish catchments, the vast majority of whose sea trout are post-smolt (i.e. trout which have descended to the sea, but which have not reached the end of their first sea-winter).

This paper is intended to review the Waterville investigations generally and to describe changes in the stock over a period of seven years.

*"Waterville Fishery" refers to the entire Cummeragh system which adjoins the town of Waterville. Its principal angling lake is Lough Currane.

Genetics

Allusion has been made to the work of Fleming (1982). The biochemical genetic technique he used enables the recognition of strains of trout. His review demonstrated the uniqueness of populations resulting from their isolation which is, in turn, a consequence of homing to spawn in specific streams.

One of the genes whose distribution among Irish trout was described by Fleming was the lactate dehydrogenase-5 (LDH-5) (105) allele which is widespread, though usually at a very low incidence. Its highest frequency occurs in certain populations of freshwater trout traditionally known as *ferox*, notably in that of Lough Melvin. The term *ferox* has been validated to denote a discrete taxon (Ferguson and Mason, 1981; Campbell, 1979). Although it indicates a distinctive race of *Salmo trutta*, the term has been more loosely used in Ireland to refer to a large, usually lake dwelling, brown trout rather than the "great lake trout" (Fahy, 1986a).

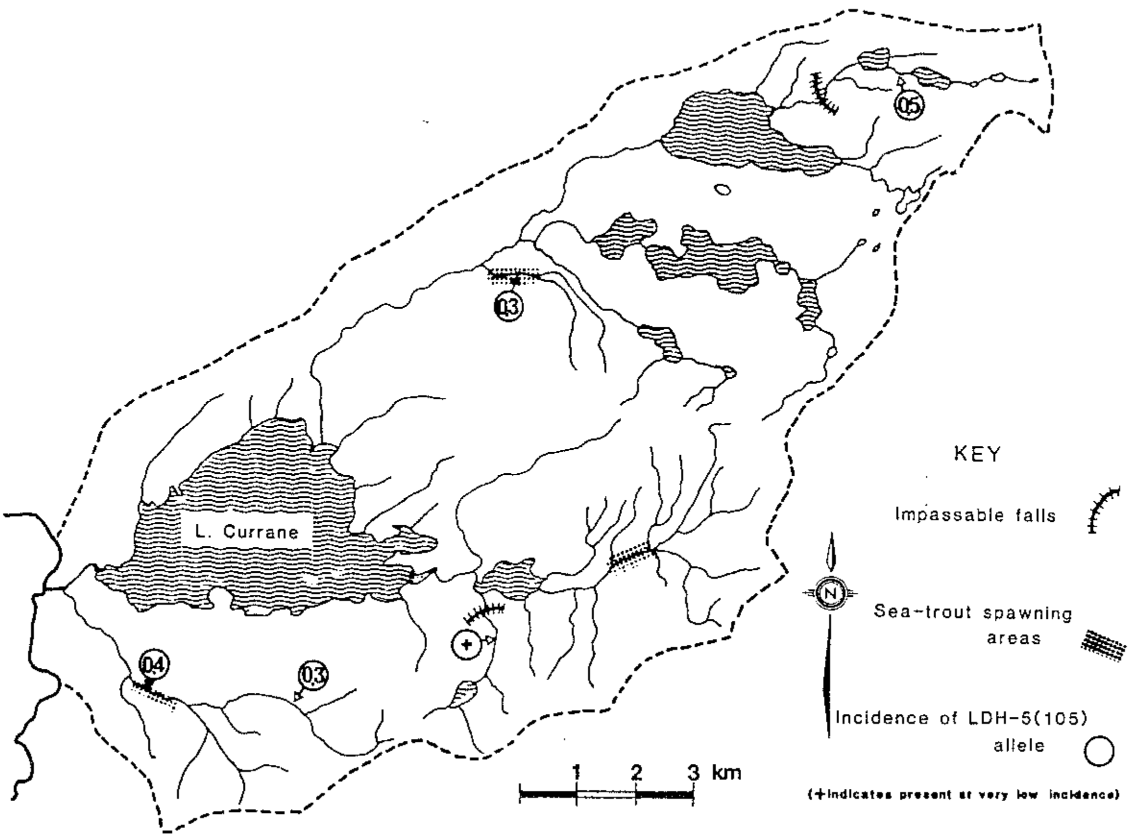

Figure 1. The Cummeragh catchment with impassable falls, known sea trout spawning areas and the incidence of the LDH-5 (105) allele in the freshwater trout populations marked.

The high incidence of the LDH-5 (105) allele in *ferox* lake trout which obtain their large dimensions as a result of their longevity (Campbell, 1979) and in the Waterville stock whose greater than average weight characterises this fishery, suggests a close relationship between the two which has prompted the proposal that the Waterville fish are relict descendents of the sea run race of long lived trout which originally distributed freshwater *ferox* trout (Fahy and Warren, 1984).

The LDH-5 (105) allele occurs in substantial frequency only in a small number of British trout populations which are isolated from more "modern" races by impassable falls (Ferguson and Fleming, 1983). The barriers arose from an isostatic response of the land to the retreat of the ice sheets at the conclusion of the last glacial period. From these upstream refuges genetic material is occasionally leaked through individuals moving downstream. By this mechanism the gene is maintained in the sea run stock in which it would be otherwise diluted by more recent trout races immigrating from the sea. An account of this mechanism is given by Fahy (1985b). Fahy and Nixon (1982) showed that certain short and long lived populations of sea run trout display different spawning behaviour which, were they to occur in the same catchment, would be likely to result in a dilution or extinction of the long lived strain.

In July 1985 electrofishing of the juvenile trout populations of the Cummeragh was undertaken to ascertain the incidence of the LDH-5 (105) allele. The exercise showed the allele is very evenly distributed throughout the catchment (Hamilton, pers. comm.) (Fig. 1). The low frequency of the allele above impassable falls suggests either that other strains of *Salmo trutta* immigrated before their formation or that later introductions diluted the original long lived strains in the catchment. Compared with other, more isolated, Scottish and Welsh long-lived sea trout populations which occur in close proximity to isolated freshwater populations, the sea trout of the Cummeragh must be regarded as relatively more vulnerable to introgression by other strains of trout.

Importance of the Waterville sea trout fishery

Older sea run trout return to freshwater before the younger, smaller members of a stock and populations which are long lived display a sizeable spring run which may appreciably extend the angling season (Fahy, 1982b). Since 1981 rod licence returns have been analysed annually. They contain details of waters fished and the data for Currane have been extracted (Tables 1 and 2). The rod catch in Currane was of significantly heavier weight than elsewhere — the data are given in lb., the unit best appreciated by anglers. Resulting from the influence of the Currane figures of individual catch weight, the Kerry returns are higher than those from any other fishery district. However the yield per rod day tends to be lower than in the great sea trout producing region, Connemara, whose sea trout are, on average, smaller.

There can be little doubt that Currane is a unique producer of sea trout in Ireland if a "sulky" lake to angle. Irish sea trout fisheries evaluate their importance in terms of the Waterville Fishery and there have been claims of similar sea run trout stocks elsewhwere. However, even the strongest candidate for this status, the Delphi Fishery in Co. Mayo, can be discounted (Fahy, 1986b).

THE SEA TROUT CENSUS

Procedure

Material was collected in the Cummeragh catchment, mainly from Lough Currane, in July and August of each of the seven years from 1980. The collection period was chosen to provide the greatest mixture of age classes available during the year and the likely greatest abundance of fish during the summer angling season. That the landings are representative of available fish is the assumption underlying the work.

Each fish was sexed, weighed and a fork measurement taken. Scales were removed for ageing and back-calculations of length at age were carried out on three scales from each pre-spawned trout.

RESULTS

The main sea age classes collected during the Waterville investigations are set out diagramatically in Fig. 2 which shows that .0+ and .1+ fish comprised the majority. In only one year — 1980 — did fish of one sea winter constitute the majority of the catch; in all others post-smolt dominated, their best years being, in descending order, 1983, 1981 and 1985. Contrary to the data provided in Table 1, which come from landings made throughout the season, the summer catches are of lower average weight, due to the large proportion of post-smolt they contain.

Several characteristics of the Waterville collections are clearly inter-related (Table 3). A higher average individual weight is associated with a longer average fork length and a higher percentage of previous spawners is inversely correlated with the percentage of post-smolt. Fluctuations in the percentage of post-smolt (measured relative to the numbers of .1+ fish) are regarded as the most influential source of variation in the stock from one year to the next.

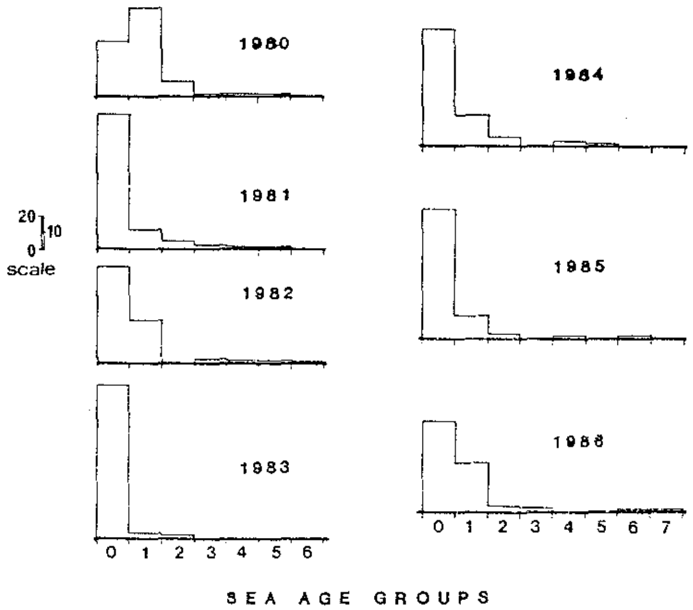

Figure 2. Percentage sea age distribution among the summer sea-trout catch, 1980-1986.

Freshwater growth

The general principles governing freshwater growth in sea trout populations have been described (Fahy, 1979). There is some variation in growth rate among individual members of a cohort which increases as they extend in length. At an early stage fast and slow developers are distinguished with great difficulty; at migration to sea and later they may be easily recognised from earlier patterns of scale formation.

The majority of smolts are two year olds. The next largest class takes three years to achieve migratory dimensions. Each of these groups is further divided into faster (A type) and slower (B type) growers, the latter making the decisive extra growth increment which will ensure their descent, in the spring of their year of first migration.

There is considerable overlap in the length achieved by different age classes and cohorts in the same year but certain general statements can be made; the B type component of an age group is generally largest among the youngest age classes, decreasing as the smolt age classes are ascended and the average B type increment (the extra length made in the spring of first migration) decreases among the older smolts. B type growth may owe something to the nature of the river in which freshwater growth is made and systems like the Foyle and Moy which have long estuaries have been known to produce two phased B type smolts (Fahy, 1978a). The Cummeragh system does not have an appreciable estuary and the transition from fresh to salt water is sudden, a fact which enables comparison of the incidence and amount of the B type increment over a period of seven years. Back calculated lengths at age of the two largest smolt classes are presented in Tables 4 and 5.

Growth at sea

Once migratory salmonids reach salt water their growth accelerates rapidly. Various assessments suggest that the slight advantage obtained by an older trout leaving freshwater is maintained to first return (Fahy, 1979) although the Waterville data suggest it is later lost or obscured by marine growth. Correlations were attempted between the back-calculated lengths of smolts at migration, the lengths of post-smolts in the same year and the back-calculated lengths of sea run fish at the end of their first "sea winter", one year later (Table 6). None of these was significant ($P > 0.05$).

Weight: length relationships

At the end of the first "sea-summer" there is an evening-up of lengths in various smolt age classes (Fahy, 1978) and there is little variation at this stage between post-smolt from one year to the next. Those which do occasionally occur are likely to represent favourable growing conditions in salt water which result in slightly greater lengths, possibly accompanied by heavier weights (Table 7).

Waterville sea trout have been described as a slim-bodied, Atlantic feeding stock (Fahy and Rudd 1984) but the variations in weight at length from one year to the next have not been examined.

Sea trout are assumed to lose condition rapidly on entering freshwater from the sea, hence fish caught in July and August are considered separately on the assumption that a proportion of the August fish would have entered the system in the previous month, July being the time of the main post-smolt immigrations. Regressions of log weight on log length for all post smolt in each of the two months are set out in Table 8. All are highly significant ($P < 0.001$). Between month comparisons by F test revealed the only significant difference to have occurred between July and August 1982 ($P < 0.05$). The July and August samples were next combined and compared among years by F test (Table 9) and certain inter-year differences were revealed.

Log weight: log length relationships describe the alterations in shape of a group of fish as they extend in length, a slope of 3 indicating isomorphic growth. The condition of a fish of a particular length could be established by reference to the log weight: log length of a stock — such a procedure is recommended (Fahy and Rudd 1984). More usually, the weight length relationship is established on a "standard formula" which assumes a constant shape:

$$K = \frac{100w\ (g)}{L^3\ (cm)}$$

Using this formula the mean condition factors and their variances were calculated for post-smolt in July and August of each year (Table 10). An analysis of variance gave the following:

Source of variance	Sum of squares	Df	Estimated variance
Between	0.7618	13	0.0586
Within	10.4501	514	0.0203
Total	11.2118	527	—

The variance ratio was 2.882 so that the sample means differ very significantly ($P < 0.005$). Tests between the sample means of each pair of months in each year were significant in the following cases:

Year	P	Significance	Percentage loss
1981	<0.05	Significant	5.9
1982	<0.05	"	7.5
1986	<0.01	Very significant	7.7

Longevity, sex ratio

Sex ratio within a sea trout stock is influenced by two criteria, the differential longevity of males and females and the numbers of each sex which migrate. Data on the mean age of both sexes and of the ratio of females to males among post-smolt, the largest sea age group, and in the entire population are set out in Table 11.

Contrary to the results presented here, there is general agreement that females predominate among sea trout (Campbell, 1977) but there are very few published accounts with which to put the Waterville results in context. Waterville female post-smolt tend to be older, a feature which is accentuated within the population as a whole. But the feature is not so marked as among spawning fish (Fahy, 1982a) and the overall impression suggests that more males than females run to sea.

DISCUSSION

Much of the Waterville work puts information on the record without interpretation because there are so few data with which to place it in context. Further investigations elsewhere may elucidate the fluctuations in sex ratio among post-smolt. Another group of phenomena for which additional investigations are required, is the influence of the marine environment. There is no ready explanation for the heavier post-smolt which ran into freshwater in 1985 for example.

The Waterville investigations were undertaken to ascertain how much information on changes within a sea trout stock could be obtained from an examination of anglers' catches. Sea trout are a difficult fish to monitor because, at any time, an unquantifiable proportion of any pre-mature cohort is at sea and, as alluded to above, little is known about the marine environment of *Salmo trutta*. A further complication is the nature of the sea trout run to freshwater, composed as it is of a mixture of juvenile and mature fish observing a declining size/age sequence from spring to early autumn. Confident sampling of a stock would require a complete count of the run and frequent sub-sampling for the 30 or so combinations of freshwater and sea age which frequently occur in stocks such as the Waterville population.

The Cummeragh system was selected for the work because its long lived sea trout provide an opportunity to compare the relative proportions of two sea age groups, .0+ and .1+ trout. The summer months of July and August were chosen because it is during this time that most age groups are available in freshwater.

A number of environmental factors, natural and man made, acting independently or in combination, are potential influences on each trout production. Of these the agricultural growing season has been identified as the most important in Ireland (Fahy, 1980a; Fahy & Rudd, 1983). A long growing period, it has been proposed, increases the amount of freshwater growth made by trout which accordingly reach migratory dimensions in and occupy nursery areas for a relatively short time. The shorter sojourn means that a larger number migrates, mortality in a cohort being time-dependent. A succession of mild springs would be accompanied by a build-up of stocks.

The period 1980-86 saw a deterioration in spring weather (Fig. 3) and the shortest growing season since records commenced in 1948. The statistic used here to indicate the lengths of growing season is the number of days on which the dry bulb temperature at the Shannon Synoptic Weather Station reached or exceeded 5.6°C (Fahy, 1982c).

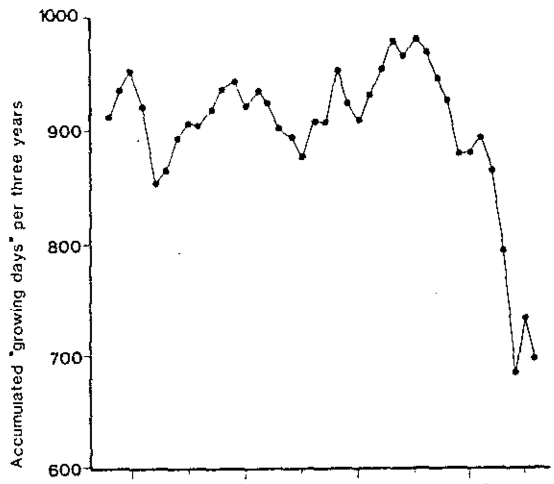

Figure 3. Accumulated growing days per three years, 1948-1986, calculated from observations at the Shannon Synoptic Weather Station.

The influential development time for trout has been identified as M+(M−1)+(M−2) where M is the number of growing days in the year of migration, M−1 is the preceding year etc. More precisely, this could be expressed as the number of growing days in the two years preceding migration plus the number of growing days in the spring of first migration.

The relationship between growing conditions and trout numbers is not a rigid one, as might be expected. Other influences such as rainfall, which could alter the area of stream bed available, contribute and the numbers of trout in freshwater will interact with faster and slower developers to enhance or diminish the next exodus. For all that there is a relationship, illustrated by the numbers of trout descending from the Burrishoole Fishery in Co. Mayo, the only catchment in which it is possible to examine the hypothesis (Fig. 4).

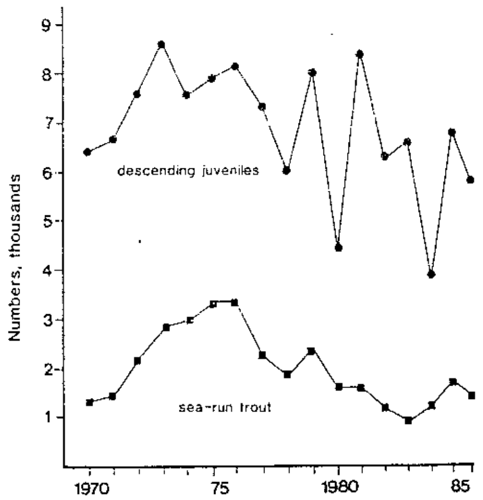

Figure 4. Descending and incoming trout through the traps at Burrishoole, Co. Mayo, 1970-1986.

A noteworthy aspect of the Burrishoole data is the uneven production of juvenile trout with the deterioration of growing conditions, a consequence which was modelled (Fahy, 1985a). The model suggested that a large, slowly developing year class would detrimentally interfere with its successor, reducing the numbers to descent to the sea the following year. Divided return to freshwater would make for a depressed sea trout run.

The output of juveniles from freshwater in Fig. 5 comprises spring descending smolts and autumn descending brownies in the same year; of these the group which is likely to reappear in greater strength in the post-smolt is the spring descending smolt. A crude comparison between Waterville and Burrishoole is made by correlating the number of smolts counted through the traps at Burrishoole in each year of the investigation with the percentage post-smolt in the Waterville samples. While not statistically acceptable ($P > 0.05$) the outcome may indicate some correspondence between the two ($r = 0.6696$, df. = 5, $P = 0.10$).

The most influential interval in the 2+ years in which the B type two year smolts, the largest smolt group, develops, is the final spring which brings trout of this age to the size threshold for descent. Elson (1957) demonstrated the importance of this final increment in the migration of Atlantic salmon. Although suspected, the relationship between growing season and B type growth has not been conclusively shown and there have been difficulties expressing B type growth in quantitative terms (Fahy, 1985a). To explore these questions further the Waterville data have been extracted from Tables 4 and 5 and are re-presented in Table 12 alongside data on the length of the agricultural growing season.

A series of correlations are attempted using the data in Table 12 in which the following dependent variables are correlated with the independent number of growing days in the spring (January to May inclusive) of each year:

(i) The percentage B types among all two year post-smolt, the largest smolt class
(ii) The average B increment (cm) in all B type two year olds
(iii) Index a, derived by multiplying the percentage of two year smolt with the average B type increment (cm) in that class

(iv) Index b, derived by dividing Index a by the mean smolt age, MSA. The mean smolt age is calculated

$$\frac{(\%\ 1\ \text{year old smolts} \times 1) + (\%\ 2\ \text{year old smolts} \times 2) \ldots\ldots\ldots}{100}$$

(v) The average B type increment expressed as a percentage of the average length of the 2 year B type smolt at the end of the second freshwater winter.

All provide significant correlations, the strongest by the average B type increment (cm). B type representation among various smolt classes tends to be inter-related in both incidence and amount so that the use of two year olds as an indicator to that part of the population undertaking a first descent may be adequate. Convention (iv) encompasses several criteria and so is likely to be more representative of all age groups of first descending trout. Conventions (ii) and (iv) are plotted in Fig. 5 which shows their close agreement.

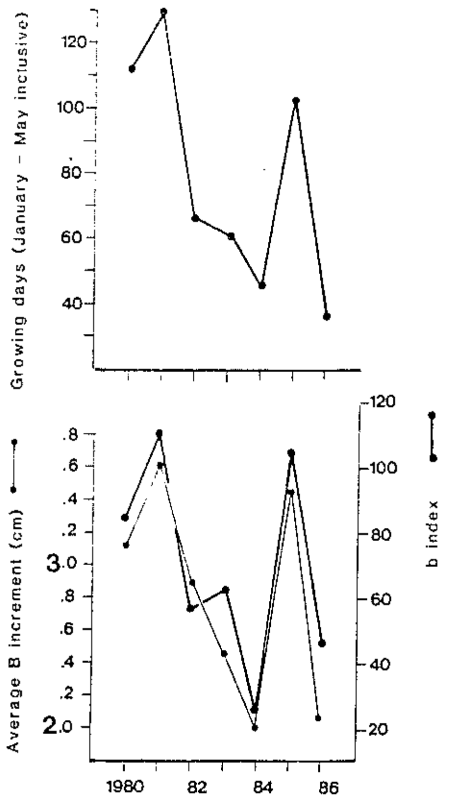

Figure 5. Spring "growing-days" 1980-1986 (above) and (below) variations in two indicators of B type growth over the same period.

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Table 1. Details, as reported by anglers, of the average weight of sea trout (lb) in various fishery districts and in Lough Currane, 1981-1986 (1lb = 0.45kg).

	1981	1982	1983	1984	1985	1986	Averages
Dundalk	1.01	0.55	1.13	1.30	1.06	0.99	1.01
Drogheda	1.23	1.23	0.83	0.94	0.85	1.34	1.07
Dublin	1.83	1.22	1.43	1.23	1.19	0.98	1.19
Wexford	0.84	0.85	0.71	0.68	0.83	1.10	0.84
Waterford	0.63	0.95	0.91	1.00	0.90	2.38	1.13
Lismore	1.04	1.15	0.80	0.74	0.86	1.01	1.03
Cork	0.84	0.73	0.75	0.76	1.27	1.12	0.91
Kerry	1.37	1.24	1.49	1.37	1.30	1.16	1.32
Currane	1.57	1.52	1.50	1.50	1.33	1.35	1.46
Limerick	0.91	0.87	0.65	0.77	0.84	1.15	0.87
Galway	1.38	0.70	0.88	1.07	0.77	0.89	0.95
Connemara	0.99	1.12	0.92	1.13	1.16	0.90	1.04
Ballinakill	1.04	0.83	0.81	0.92	0.85	1.00	0.91
Bangor	0.86	1.17	1.09	1.00	0.85	0.96	0.99
Ballina	1.03	1.50	0.85	1.05	0.94	1.08	1.08
Sligo	1.27	1.26	0.81	1.26	1.98	1.70	1.38
Ballyshannon	1.17	1.29	0.95	0.96	0.96	0.85	1.03
Letterkenny	0.81	1.17	0.70	0.87	0.87	0.84	0.88
Average (from National totals)	0.95	1.07	0.95	0.99	0.97	1.01	
Number of licences returned	930	817	746	683	610	795	

Table 2. Details, as reported by anglers, of sea trout catch (weight — lb per rod day) in various fishery districts and in Lough Currane, 1981-1986.

	1981	1982	1983	1984	1985	1986	Averages
Dundalk	0.56	0.40	1.27	0.75	0.47	0.64	0.68
Drogheda	0.45	0.30	0.83	0.30	1.53	0.60	0.67
Dublin	0.15	0.43	0.11	0.05	0.34	0.17	0.21
Wexford	0.56	0.51	0.58	0.43	0.49	0.27	0.47
Waterford	0.42	0.53	0.49	0.39	0.25	0.99	0.51
Lismore	0.67	1.56	0.94	1.24	0.24	0.57	0.87
Cork	0.65	0.62	0.99	1.10	0.51	0.36	0.71
Kerry	1.14	1.06	1.44	0.73	1.40	1.16	1.16
Currane	1.30	1.45	1.67	1.10	1.96	1.43	1.49
Limerick	0.57	0.43	0.22	0.13	0.43	0.69	0.41
Galway	1.36	0.17	0.69	0.76	0.99	0.30	0.71
Connemara	1.99	1.86	2.58	3.48	3.06	1.76	2.46
Ballinakill	1.38	1.22	1.91	1.13	2.03	1.17	1.47
Bangor	1.24	1.13	1.05	0.82	1.70	1.81	1.29
Ballina	0.97	1.73	0.70	0.28	0.36	0.24	0.75
Sligo	0.71	0.39	0.85	0.79	0.25	0.19	0.53
Ballyshannon	0.96	1.00	0.21	0.27	0.58	0.17	0.53
Letterkenny	0.71	0.91	0.33	0.24	1.81	0.56	0.76
Average (from National totals)	0.84	0.82	0.85	0.79	1.21	0.70	

Table 3. Characteristics of collections of sea run trout from Lough Currane, 1980-1986.

Criterion	Year						
	1980	1981	1982	1983	1984	1985	1986
Sample size	214	340	108	86	88	183	172
Average weight (g)	725	382	559	358	484	476	550
Average fork length (cm)	38.6	31.5	35.2	30.5	33.6	33.8	34.7
Percentage post smolt in sample	33.6	82.1	59.2	93.9	70.9	78.7	64.3
Percentage previous spawners in sample	16.4	7.7	16.0	3.8	11.6	9.2	11.1

Table 4. Back-calculated lengths at age (cm) of two year post-smolt migrating in each of the seven years of the Waterville investigations.

	1980	1981	1982	1983	1984	1985	1986
A type							
at 1 year	8.6	8.2	9.3	7.7	9.0	9.8	7.9
at 2 years	23.0	21.6	22.1	21.9	23.4	23.2	24.3
Number measured	26	35	16	20	31	27	40
B type							
at 1 year	8.5	7.8	8.0	8.0	7.2	7.8	8.2
at 2 years	21-0	19.5	20.6	19.8	20.0	21.8	23.4
at migration	24.1	23.2	23.4	22.6	22.0	24.9	25.4
Number measured	34	69	17	30	13	64	43

Table 5. Back-calculated lengths at age (cm) of three year post-smolt migrating in each of the seven years of the Waterville investigations.

	1980	1981	1982	1983	1984	1985	1986
A type							
at 1 year	6.2	7.1	4.9	6.1	6.6	7.5	6.0
at 2 years	21.4	18.5	15.8	17.6	17.0	19.0	17.8
at 3 years	26.2	24.6	24.0	23.0	25.4	26.0	26.0
Number measured	5	33	14	13	11	21	18
B type							
at 1 year	7.6	6.6	6.7	5.7	6.7	6.6	7.1
at 2 years	17.1	16.4	16.7	17.5	16.9	18.1	18.6
at 3 years	24.8	22.4	23.9	22.9	24.9	24.8	26.2
at migration	27.0	25.2	25.5	24.8	26.8	27.3	28.0
Number measured	6	17	11	11	6	24	8

Table 6. Aspects of growth in the Waterville sea trout, 1980-86.

	1980	1981	1982	1983	1984	1985	1986
Post-smolt							
Number	72	163	61	75	61	140	110
Average length (cm) at migration (back-calculated)	24.1	23.4	23.6	22.8	23.8	25.2	25.3
Average length (cm) of all post smolts	29.6	29.4	29.7	29.7	29.5	31.5	30.4
.1+ fish							
Number	103	8	28	3	17	26	51
Average length (cm) (back-calculated)	34.7	32.4	38.1	44.2	33.2	34.2	33.8

Table 7. Average weights (g) and lengths (cm) of post-smolt 1980-86.

Year	Numbers examined	Average weight (g)	Average length (cm)
1980	72	316	29.6
1981	163	301	29.4
1982	61	295	29.7
1983	75	327	29.7
1984	61	296	29.5
1985	140	362	31.5
1986	110	336	30.4

Table 8. Log weight: log length relationships among post-smolt caught in July and August, 1980-1986.

Year	July				August			
	No.	Slope	Intercept	r	No.	Slope	Intercept	r
1980	30	2.88	−1.76	0.903	38	2.58	−1.31	0.847
1981	57	2.71	−1.51	0.908	19	3.98	−3.35	0.823
1982	31	1.93	−0.39	0.721	23	2.82	−1.71	0.950
1983	22	3.14	−2.11	0.958	43	2.52	−1.22	0.909
1984	32	2.38	−1.04	0.873	19	2.13	0.66	0.914
1985	65	2.94	−1.85	0.938	49	2.58	−1.32	0.881
1986	74	3.02	−1.95	0.922	27	2.94	−1.87	0.938

Table 9. Log weight: log length relationships among post-smolt, 1980-1986 (above) and (below) pair comparisons by F test.

Year	No.	Slope	Intercept	r
1980	68	2.71	−1.51	0.871
1981	76	3.03	−1.99	0.930
1982	54	2.35	−1.01	0.841
1983	65	2.64	−1.39	0.923
1984	51	2.27	−0.87	0.870
1985	114	2.81	−1.67	0.919
1986	101	2.94	−1.84	0.913

Year	1980	1981	1982	1983	1984	1985	1986
1980		P>.05 non sig	P>.05 non sig	P>.05 non sig	P>.05 non sig	P>.05 non sig	P>.05 non sig
1981			P<.03 sig	P<.04 sig	P<.0001 v.sig	P>.05 non sig	P>.05 non sig
1982				P>.05 non sig	P>.05 non sig	P>.05 non sig	P<.02 sig
1983					P>.05 non sig	P>.05 non sig	P>.05 non sig
1984						P<.01 v.sig	P<.003 v.sig
1985							P>.05 non sig
1986							

Table 10. Mean K (Condition factor) and its variance among post-smolt caught in July and August, 1980-1986.

	July		August	
Year	Mean K	Variance	Mean K	Variance
1980	1.19	0.013	1.17	0.02
1981	1.18	0.012	1.11	0.009
1982	1.15	0.031	1.07	0.010
1983	1.26	0.009	1.21	0.015
1984	1.14	0.014	1.16	0.011
1985	1.14	0.011	1.13	0.012
1986	1.20	0.014	1.11	0.006

Table 11. Mean ages and sex ratios among selected groups of Waterville sea-run trout.

Mean Age	1980	1981	1982	1983	1984	1985	1986
Total sample ♂	3.0	2.5	2.6	2.4	2.2	2.5	2.5
♀	3.4	2.5	3.3	2.5	2.2	2.8	2.6
Post smolt ♂	2.2	2.3	2.4	2.3	2.2	2.3	2.2
♀	2.0	2.4	2.5	2.4	2.2	2.4	2.4
Sex ratio							
Total sample	1.15	0.88	1.21	0.70	0.86	0.63	0.81
Post smolt	0.78	0.91	0.82	0.79	0.92	0.56	0.83

Table 12. Raw and derived data (from Tables 4 and 5) used in the elucidation and expression of B type growth.

Column numbers	1	2	3	4	5	6	7
Year	Growing days	% B type smolts	B incre. (cm)	MSA	Index a	Index b	B measurement as % of length at 2
1980	113	56.7	3.11	2.13	176.3	82.8	14.8
1981	129	70.9	3.60	2.32	255.2	110.0	18.9
1982	66	50.0	2.90	2.46	145.0	58.9	13.5
1983	61	58.0	2.46	2.32	142.7	61.5	14.1
1984	46	29.5	2.00	2.28	59.0	25.9	10.0
1985	103	70.3	3.45	2.37	242.5	102.2	14.2
1986	37	51.8	2.07	2.26	107.2	47.5	8.9

Notes: Column 1 January-May inclusive
2 Among 2+ post smolts
3 Average length in 2+ B type smolts
4 Among all post-smolts
5 Column 2 × Column 3
6 Column 5/Column 4

Regressions:

Variables	r	P	No. in text
Column 2 on Column 1	r = 0.7535	0.05	(i)
,, 3 on ,, 1	r = 0.9382	<0.01	(ii)
,, 5 on ,, 1	r = 0.8907	<0.01	(iii)
,, 6 on ,, 1	r = 0.9193	<0.01	(iv)
,, 7 on ,, 1	r = 0.8954	<0.01	(v)

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