IONTAOBHAS TAIGHDE BRADAN na h-EIREANN IONCORPORTHA

(THE SALMON RESEARCH TRUST OF IRELAND INCORPORATED)

Sponsored by Arthur Guinness Son & Co. Ltd. and the Minister for Fisheries

ANNUAL REPORT
No. XXIII

REPORT FOR THE YEAR ENDED 31st DECEMBER, 1978.

COMMITTEE OF MANAGEMENT

Senator Dr. T. K. Whitaker W. M. Hutton Dr. I. R. Moore	*as Nominees of the Chairman of Arthur Guinness Son & Co. Ltd.*
Mr. J. Power Miss Eileen Twomey	*as Nominees of the Minister for Fisheries.*
A. E. J. Went, D.Sc. (*Hon Consultant*) (*Chairman*) Major C. W. Roberts	*Elective Members.*

R. G. Mallet, F.C.A., F.C.I.S.	*Secretary*
D. J. Piggins, Ph.D., B.S.c.	*Director*
C. J. McGrath, B.E., A.M.I.C.E.I.	*Consultant Engineer*
A. Nixon T. Lavelle M. Davitt P. Mulchrone	*Field Assistants*

Registered Office—St. James's Gate, Dublin 8.

Laboratory—Farran Laboratory, and Field Station,
Newport, Co Mayo.

REPORT FOR YEAR ENDED 31st DECEMBER, 1978.

The Report is set out in the following sections:—

Section A : GENERAL.

Foreword.

1. Committee of Management.
2. Personnel.
3. Installations.
4. Meteorological data.
5. Visits and communications.

Section B.1. : SALMONID REARING.

1. Salmon and Grilse ova hatched in 1976.
2. Salmon and grilse ova hatched in 1977.
3. Grilse ova hatched in 1978.
4. Grilse ova laid down in 1978.

Section B.II.

1. Preliminary results of a second feeding trial utilising single-cell protein.

Section C. CENSUS WORK ON FISH MOVEMENTS.

1. Wild Salmon.
   - (i) Upstream movements.
     - (a) Timing and numbers.
     - (b) Net-marked grilse.
     - (c) Spawning escapement.
     - (d) Survival from brood year ova to smolts and grilse.
   - (ii) Downstream movements.
     - (a) Smolts : timing and numbers.
     - (b) Survival of salmon smolts.
     - (c) Tagging of wild smolts.
     - (d) Salmon kelts.
     - (e) Ulcerative Dermal Necrosis (Salmon disease).

2. REARED SALMON.
   - (i) Upstream movements.
   - (ii) Downstream movements.

3. SEA TROUT.

(i) Upstream movements.
  (a) Timing and numbers.
  (b) Net-marked fish.
  (c) Spawning escapement.

(ii) Downstream movements.
  (a) Sea trout smolts.
  (b) Autumn-migrating trout.
  (c) Sea trout kelts.

4. EXPLOITATION RATES BY ROD-FISHING.

5. SILVER EELS.

APPENDIX I: Brackish water and sea-cage operations, 1975-'77. J. P. Lawrie.

APPENDIX II: Future research programme.

ANNUAL REPORT OF
THE SALMON RESEARCH TRUST OF IRELAND INCORPORATED

FOREWORD

The Committee of Management has pleasure in presenting its report on the work of the Trust in 1978.

The Trust which has now been in existence for 23 years continues to attract favourable comment, both nationally and internationally for the quality of its work and the results achieved in many important fields. That the Trust enjoys a high reputation is clearly indicated by the numerous requests from many organisations, both at home and abroad, for advice and assistance.

The Trust with its well designed and extensive installations is in a unique position in this country to investigate in depth many of the problems relating to Irish salmon and sea trout and their fisheries. It is the only organisation in Great Britain and Ireland which has long term data of a high degree of accuracy on the numbers of upstream migrating salmon and sea trout and the downstream migrating kelts (spent fish) and smolts of both species, eels and the autumn trout referred to in Section 3(II)(b) of the Report. These data have enabled the Trust to reach important conclusions on various aspects of salmon and sea trout biology, which have been described in detail later in this report, as well as in previous Annual Reports.

One of the most important conclusions so far reached by the Trust relates to the survival of salmon from spawning stock to adult fish returning to the home river. For the third season running it has been shown in 1978 (in the Burrishoole River system, on which the Trust has its installations) that overall survival from spawning stock to adult returns is only about half the requisite for a self-replenishing population, due to the very high rate of commercial exploitation at sea.

Another important aspect of the Trust's work has been the rearing of salmon with a view to producing the highest possible return of adults from smolts liberated into tidal waters. This has necessitated numerous trials with different fish, treatments for diseases, methods of release and handling generally. Survival rates of reared smolts have varied considerably over the period of the relevant experiments and the comparable survival rates of wild and reared smolts differ by a factor up to 4. 1. The low level of return of reared smolts from the sea is, therefore, disappointing and greatly reduces the advantage which may be obtained by rearing to the smolt stage. Further work in this field is necessary to ascertain if there are any physiological differences between reared and wild smolts at migration and to what degree, if any, latent infection in reared smolts adds to their poor survival in the sea. The importance of measuring restocking efforts in terms of adult salmon, rather than the number of smolts, or other stages released cannot be over-emphasised.

Completion of the pilot scale operations conducted by the Trust on salt water rearing of salmon indicated a commercial viability which is being pursued by a commercial undertaking. (Curraun Fisheries Ltd.). This presented the Committee of Management with an opportunity to review its research programme. Details of the

expanded programme of research agreed with the two sponsors are set out in Appendix II to this Report.

Experience has shown that large numbers of people moving around the rearing ponds containing young salmon produces abnormal stress, resulting (particularly in the warmer weather and drought conditions) in heavy mortalities which may vitiate any worthwhile conclusions from the experiments being conducted. For this reason the Trust reluctantly decided to close off its installations to the general public and to provide a special display area in which the work of the Trust is illustrated and where members of the public can feed fish in specially constructed rearing tanks, unconnected with the main experimental area.

However, bearing in mind the great local interest in the work of the Trust, the other installations are open for inspection by the public for one afternoon each August. In 1978 we were greatly honoured by having as our guests at the Open Day the Minister for Fisheries and Forestry, Mr. Brian Lenihan, T.D. and Mrs. Lenihan to whom the work of the Trust was described.

A. E. J. WENT.

SECTION A—General

1. COMMITTEE OF MANAGEMENT

The composition of the Committee remained unchanged during 1978, under the chairmanship of Dr. A. E. J. Went.

2. PERSONNEL

Mr. J. P. Lawrie, BSc, relinquished his post of Biologist to the Trust with effect from January 1, 1978 when the pilot scheme for sea-cage rearing (operated under the aegis of the Trust since 1974) became an independent commercial operation by Curraun Fisheries Ltd. Mr. Michael Hughes also transferred to Curraun Fisheries at the same time and Mr. Michael Davitt resigned from the Trust's employment to join the same company with effect from December 31, 1978.

Mr. G. McNeela served again in 1978 as second night-watchman at the Salmon Leap during the summer and Mr. Gerard Flynn, BA(Mod) was employed as Temporary Scientific Assistant from late August for the remainder of the year. Mr. P. Mulchrone was absent on sick leave from June 7 until the end of the year.

3. INSTALLATIONS

Construction of a second elver trap on the left bank of the Mill Race was begun in May, to complement the existing trap on the right bank. The new trap was completed, except for the toe-piece and the water supply, where this remaining work awaits a convenient period of low water levels in the Mill Race. The construction of the toe-piece is difficult and important as experience with the first trap has shown that it is easily undermined by floods, allowing elvers to bypass the trap. Only moderate catching success was experienced with the first trap during 1978, for this reason.

The larger of the two release ponds was refloored with 10 cm of reinforced concrete during the summer, the concrete of the original floor and outlet channel having weathered and broken up. The walls were raised by a further 25 cm at the same time and the pond is in daily use as an auxiliary smolt rearing pond.

The water-powered automatic feeders were replaced by electrically operated feeders on eight 2m diam and three 6m diam rearing ponds during the year and a small hut was constructed at the rear of the pond terrace to house the transformer and control equipment.

4. METEOROLOGICAL DATA

Rainfall was again slightly above average in 1978, at 1592.2mm (62.7"), which was 111% of the average value of 1430mm for the years 1973-77. This was the second year in succession of above-normal rainfall, the figure for 1977 being

similar, at 1580mm. The months of April and May were dry, with only 70mm rainfall for the two-month period, whilst January, March and September were very wet, with 230-260mm recorded during each of these months. Spawning conditions for salmon and sea trout during November and December were good, with a total of 355mm rainfall for this period. The highest recorded daily rainfall was 62.5mm on September 27, and 116.5mm was recorded over the three days September 26—28.

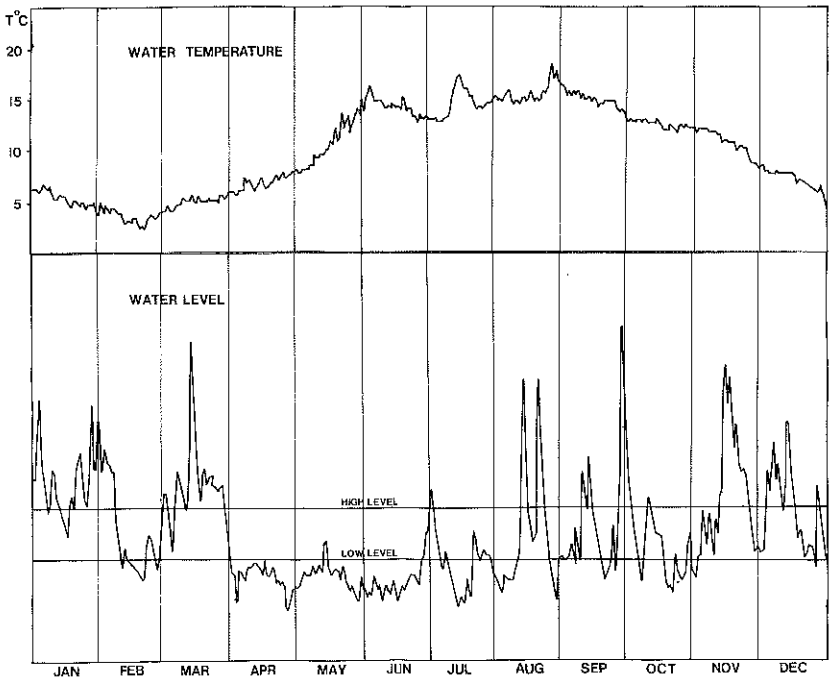

Fig. I Water temperatures and water heights in the Mill Race, 1978.

The water levels in the Mill Race (see Fig 1) showed a preponderance of high water conditions during the year, except for the period April—June. Some of the highest flood levels recorded over recent years were experienced in March, September and November but all major floods were of short duration.

Cold weather during February resulted in the water temperature falling to 2.5°C but thereafter, conditions were similar to those of 1977. The water temperature reached 10°C by May 13 (some two weeks later than average) and there were three summer peaks of 17°C (June 3), 17.5°C (July 14) and 18.5°C (August 26). In general, the water temperature was maintained at 15°C from early June to the end of September and it did not fall below 8°C until mid-December.

5. VISITS AND COMMUNICATIONS

The Director and the Chairman attended a symposium on "The Atlantic Salmon in the World of the Future", organised jointly by the Atlantic Salmon Research Trust and the International Atlantic Salmon Foundation at the University of Edinburgh, in September. The Director presented a paper entitled:—

"Constraints to the future of Atlantic salmon in Ireland."

The Director also attended meetings of the Anadromous and Catadromous Fish Committee of the International Council for the Exploration of the Sea, held in Copenhagen in late September.

The Trust was represented at the Salmon and Trout Association Conference in York in October by the Chairman, Dr. A. E. J. Went and he was accompanied by Miss Eileen Twomey and the Director on a familiarisation tour of the River Bush Salmon Project (Co. Antrim, N. Ireland) during July.

The Director continued to serve as consultant to the South West Water Authority in the United Kingdom and attended meetings of the Planning Group in May and September. He has also retained his membership of the Mariculture Sub-Committee in the newly-constituted National Board for Science and Technology. During November, the Director was elected as a member of the Administrative Council of the "Association Internationale de Défense du Saumon Atlantique" under the Presidency of Dr. Richard Vibert.

During the year, the Director has contributed a chapter in a book on sea ranching of salmon (Academic Press) edited by Dr. John Thorpe and a paper on updated costs of salmon smolt rearing to a meeting of the Irish Freshwater Research Group, held at the Fisheries Research Centre, Abbotstown, during May.

SECTION B.1—SALMONID REARING

(This section was compiled by J. P. Lawrie BSc (Managing Director) and Miss D. M. Cotter, MSc (Freshwater Manager) of Curraun Fisheries Ltd. The freshwater rearing operations of this company have been combined with those of the Trust during 1978, pending completion of separate rearing facilities for the company during 1979).

1. SALMON AND GRILSE OVA HATCHED IN 1976

Table I

	Original stock	93417	
	Remaining stock at December 31, 1976	56957	
	No of 1+ smolts produced in May 1976	25409	
As :	11062 : Furnace stock, Brand 'O' and adipose fin clip		
	1009 : Cold shock, Brand 'L' and adipose fin clip		
	9408 : Furnace stock transferred to Curraun Fisheries Ltd. (formerly referred to as Saltwater Rearing Project) for on-rearing in sea-cages.		
	887 : Carrowmore Spring Salmon stock transferred to Curraun Fisheries Ltd.		
	3043 : Furnace stock sold to Killary Sea Cage Operation.		
	May release of 1+ parr into the Burrishoole Fishery	5412	
	Remaining 1+ parr, May 1977	19029	
	Remaining 1+ parr, January 1978	11918	(corrected from 10747)
	No of 2+ smolts produced, April 1978	11204	
As :	9104 : Brand 'S' and adipose fin clip		
	2100 : Transferred to Curraun Fisheries Ltd.		

300 fish died over the period January 1 to smolt release in mid-May 1978, of which 87 were fish which died in the release pond. 414 fish were rejected at branding and there were no giant smolts (> 25cm) releases, these fish being included in the 2100 fish transferred to Curraun Fisheries Ltd. The mean length of the smolts released into Lough Furnace was 167mm.

2. SALMON AND GRILSE OVA HATCHED IN 1977

Table II

Stocks at December 31, 1977			69947
Losses in January 1978	526		
„ „ February „	218		
„ „ March „	434		
„ „ April „	847		
April release of 1+ parr		31128	
As : 24019 : Released into the Burrishoole Fishery			
4559 : Sold to th Glenisland Co-operative			
2550 : Sold to the Newport Angling Club			
No of smolts produced in May		16057	
Marks :			
2486 : Furnace stock, Brand 'T' and adipose fin clip			
4758 : Furnace stock, adipose fin clip only			
878 : Furnace stock, Brand 'K' and adipose fin clip to sea-cage for delayed release			
3200 : Thurso stock, to Curraun Fisheries Ltd. for sea-cage rearing			
4735 : Furnace stock, to Curraun Fisheries Ltd. for sea-cage rearing			
Losses in May „	3486		
„ „ June „	1183		
„ „ July „	808		
„ „ August „	453		
„ „ September „	258		
„ „ October „	169		
„ „ November „	101		
„ „ December „	90		
Total Mortality	8573		
Biological samples	505		
No of 1+ parr remaining December 31, 1978		13684	

Of the 16057 smolts reared in 1978, 7144 were released into Lough Furnace (average length 149mm: range 114mm to 185mm) via the release ponds over the period April 15 to May 13. A further 878 smolts (average length 153mm: range 130mm to 181mm) were transferred to a sea cage on May 9 for on rearing in the sea prior to release in late June. Release, in fact, occurred prematurely, ten days after transfer, when one corner of the temporary net cage in which the fish were being held broke loose and all the fish escaped. At the time of escape the fish were feeding well and the total mortality during cage captivity was 2.1%.

24019 small grade 1+ parr (no mark) were released into the lower Burrishoole River system over the period April 17 to May 2 as, 16143, mean length 70mm, to Lough Furnace and 7876, mean length 66mm, to the Yellow River. (See Frontispiece). 7109 small grade 1+ parr were sold locally for restocking purposes

1+ Parr 56,255

as 4559, mean length 86mm, released into tributaries of Lough Beltra in late April, and 2550, mean length 70mm, released into the Owengarve River, also in late April.

The 17251 1+ parr remaining at June 1 were held for on-rearing to the 2+ smolt stage, of which 12200 were used in a dietary experiment. (See Addendum to this Section for details). 1710 fish, mean length 150mm, branded 'C' and adipose fin clip were transferred on September 23 to a cage in Lough Furnace (situated close to the Lough outlet into the open sea). It is hoped to release these fish from the cage as 2+ smolts in April 1979, and compare survival to adults with the traditional form of release from release ponds, at the hatchery site. Furunculosis accounted for most of the losses over the period 1.6.78 to 31.12.78, survival to the latter date being 79%.

3. GRILSE OVA HATCHED IN 1978

Table III

Note that in the following section, the term "ranched stock" refers to ova obtained from fish which were reared to the smolt stage in ponds and then released to migrate to sea, returning after 15+ months at liberty.

	Ranched stock	Cage Grilse Stock	Late Spawning Cage Grilse Stock
Original stock	189220	10137	3473
Ova transferred to Burrishoole Fishery and Curraun Fisheries Ltd.	124587		
Stock retained for on-rearing	64633	10137	3473
December	270	58	1091
January	335	309	(total losses from January to April)
Losses in :—			
February	1680	1072	
March	2187	185	
April	1488	153	
May	8316	711	52
June	4580	337	979
July	537	151	151
August	388	38	27
September	325	31	15
October	250	15	18
November	2479-(1438-water blockage)	7	3
December	334	0	4
Stock remaining December 31, 1978	41464	7070	1133
% Survival to December 31, 1978	64.2	69.7	32.6

As in 1977, the increased commitment to smolt production for sea-cage rearing, and the resultant lack of pond space, made it impossible to follow accurately the effect

of warming the water during early rearing. The unit was used from February 8, to April 24, supplying 50,000 salmon ova with water at a constant 11°C (+1°C), some 3 to 8°C above ambient water temperature. The effect this had on improved growth was assumed to be similar to that reported in detail in 1975 and 1976. (See Ann. Rep. XX and XXI).

First feeding of the fry held in warmed water commenced on March 20 compared with April 21 for fry held at ambient water temperatures. Transfer of the warmed water fry to outside 2m ponds commenced on May 9 some ten days later than in 1977. The first fry held at ambient water temperatures were moved to outside 2m ponds on May 30, and the hatchery was cleared of fish on June 17, 14 days earlier than in 1977.

Losses during first feeding of both warmed water and ambient batches of fry were 14.1 and 27.2% respectively, and due to over-crowding are somewhat higher than the figure of 10.6% covering both batches in 1977. Despite a severe lack of pond space and consequent high density levels, summer mortalities were low at 4% and were mainly of weak fry.

Comparative figures are available for survival (see Table III) of ova stripped from ranched grilse and ova stripped from cage grilse brood stock, excluding late spawning cage grilse stock. Survival to hatching in the ova derived from cage reared grilse was poor at 87.7% there being a large percentage of infertile eggs, and compares with 96% for ova derived from ranched grilse. Thereafter, survival trends were reversed, and as can be seen in Table III, were by the end of the year slightly better at 69.7% for the cage grilse progeny than for the ranched grilse progeny at 64.2%. Growth of the cage grilse progeny was excellent, and by December 31, the top grade had attained an average length of 143mm, compared with 131mm for ranched grilse progeny.

Grading was carried out on four occasions over the period July to December. At December 31, parts of the ranched and cage reared stocks were mixed during grading due to lack of pond space, and for this reason the figures in Table IV refer to the various grades of the total stock remaining at the end of the year.

Table IV

1st Grade	
No	25463
% batch stock	51.3
Mean length mm	132
2nd Grade	
No	1310
% batch stock	2.6
Mean length mm	111
3rd Grade	
No	17759
% batch stock	35.8
Mean length mm	76
4th Grade	
No	5135
% batch stock	10.3
Mean length mm	66

4. GRILSE OVA LAID DOWN IN 1978

56 female and 46 male grilse were taken over the period October 12—December 7 and were held until stripping in the freshwater broodstock pen. The fish were injected with Terramycin (injectable grade) at capture, and the females were injected again after stripping. Three fish, two hens and one cock died from fungal infection over the period November 11 to December 4.

The first female was stripped on November 30, the same day as the first fish in 1977, and stripping was completed by January 4, 1979, five female fish being released on that day to spawn naturally. Fecundity values are given in Table V, the eggs taken in 1979 being included for convenience.

Table V

No of female fish	49	
No of fluid oz produced	1234.5	
No of ova produced	213084	
No of ova per fish	4349	
No of ova per litre	6032	(171/fluid oz)
Average weight of fish kg	2.75	(6.161 lb)
No of ova per kg weight	1581	

The size of the ova varied between 4550 and 7689 per litre (129 and 218 per fluid oz) as measured after they had been allowed to swell in water for at least 30 minutes.

SECTION B.II—PRELIMINARY RESULTS OF SECOND FEEDING TRIAL UTILISING SINGLE-CELL-PROTEIN

(D.J.P.)

Following the results from the use of single-cell-protein (ICI Pruteen) in a diet for yearling salmon over a period of three months, reported in Ann. Rep. XXII (1977), App. I, a further feeding trial was begun in June, 1978 and continued for the remainder of the year. It is intended that the fish will be maintained on this diet until smolt transformation in May, 1979, in order to test for any long-term effects that may become apparent but preliminary results for the first seven months are presented here in brief.

The formulation of test and control diets differed slightly from those used in the earlier work, in that Pruteen was used in the test diet to replace herring meal and fishmeal in the control diet, but both formulations contained 11% fish protein concentrate. The diets were identical in terms of crude protein and oil, as well as calcium, phosphorus and sodium levels.

The first batch of diets, which lasted from early June to mid-September, were prepared by a commercial fish food firm whilst succeeding batches were prepared by ICI.

Both test and control batches comprised 6100 yearling salmon initially, divided into four groups in 6m rearing ponds. The food was weighed daily into automatic feeders and the amounts were calculated from the weight of fish in each pond, correlated with the water temperature, where the % body weight of food fed was taken from the Ewos Feeding Chart for salmon.

Samples of 200 fish from each pond were weighed (in groups of five) and measured (individually) each month. Eight fish from each pond were killed monthly for haematocrit determinations and routine histological samples.

Results over the first seven months show a gradual decline in the growth of the test fish, which increased in length by 57% and in weight by 294%, compared with the performance of the controls, at 72% and 468%, respectively, (see Fig II). In addition, the mortality rate in the test fish at 20.7% was over twice as heavy as that of the controls, at 9.3%, although a large proportion of the deaths in the test fish occurred during the first month. One batch of control fish, on the other hand, survived with only 3.5% losses over the seven-month period. Most of the losses were attributable to furunculosis.

The Coefficient of Condition, as an index of fatness, increased until early October and then declined in both test and control fish whilst mean monthly haematocrit values showed no distinct trends, nor were any significant differences detected between the two groups.

The food conversion rates were normal for the first three months of the trial but thereafter results indicated that conversion efficiency became progressively

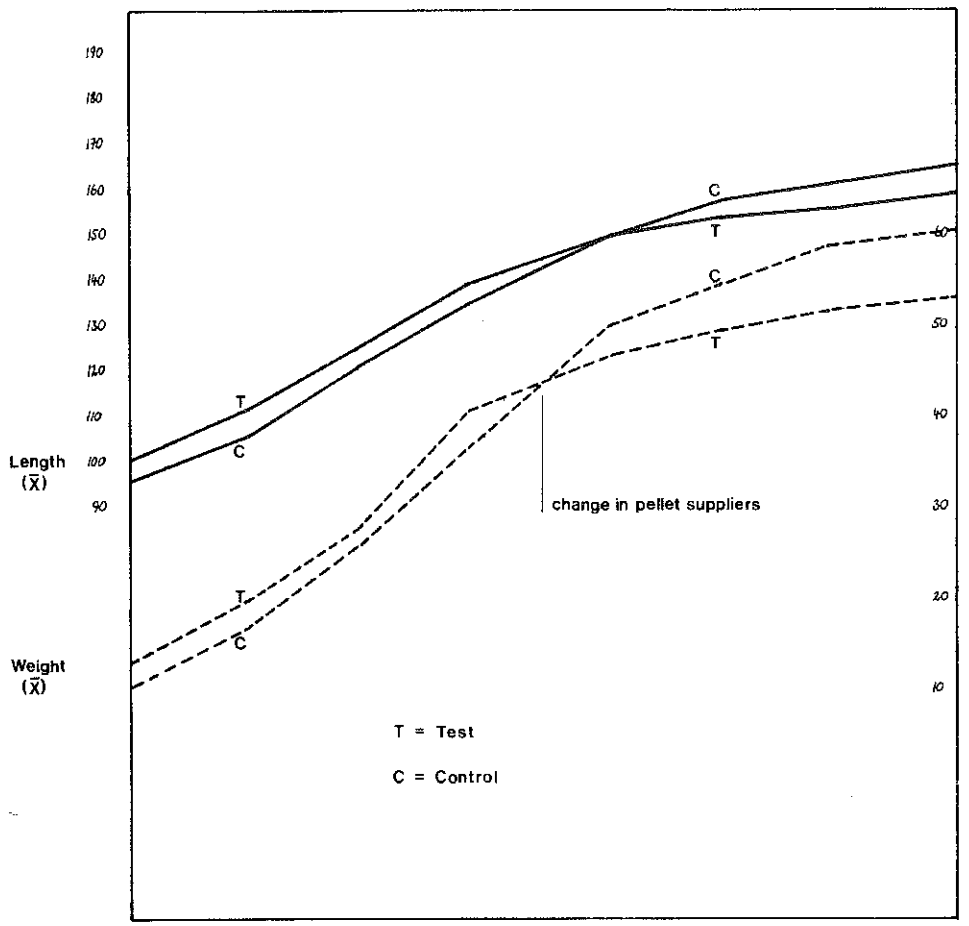

Fig. II Growth in length and weight (pooled results) of test and control fish in single-cell protein feeding trial.

worse, being more marked among the test fish. It may or may not be coincidental that this change occurred at or about the time when the pellet manufacturing process changed hands, even though the formulations remained identical. Similarly, the treatment of furunculosis by oral oxytetracycline administration was carried on over a longer period among the test fish than for the controls, and this may have contributed to poor food conversion efficiency.

What is certain, however, is that the recommended feeding rates, in terms of % body weight at various water temperatures are over-estimates when yearling salmon are entering on a natural period of declining growth. Even though the water temperature may remain high (eg 15°C during September), the effect of decreasing day-length slows down growth and food intake, resulting in waste of food if they are fed at the recommended rate of 2% of body weight. The feeding rate had reduced to 0.2% of body weight by the eighth month of the trial and there were indications that the conversion rates were approaching more acceptable levels.

A full report of the trial will be submitted in the Annual Report for 1979. Table VI gives details of the results obtained in 1978:—

Table VI

Control Fish

	Av.L(mm)	Av.W(g)	Mortality	C. of C.	H/crit	Conversion Rate
Start	96.5	10.7	—	1.18	—	—
Month 1	107	17.3	268	1.41	37.5	1.08
2	122	26.1	108	1.44	45.5	1.18
3	135.5	37.0	107	1.48	41.5	1.31
4	155.5	50.5	74	1.48	41.0	2.09
5	158	54.8	49	1.38	41.0	3.83
6	161.5	59.0	85	1.40	42.5	3.70
7	166	60.8	27	1.33	39.0	4.21

Test Fish

Start	101.5	13.6	—	1.30	—	—
Month 1	113	20.4	618	1.41	39.0	1.35
2	126	28.0	106	1.43	43.0	1.54
3	140	41.1	214	1.50	43.5	1.21
4	150.5	47.1	201	1.38	39.5	5.41
5	154.5	49.8	116	1.35	38.0	5.76
6	156.5	51.9	113	1.35	40.0	6.27
7	159.5	53.3	46	1.31	40.5	4.18

SECTION C—CENSUS WORK ON FISH MOVEMENTS

1. (i) Upstream movements

(a) Timing and numbers

Despite improved returns of 2-sea-winter fish to many rivers in Ireland during 1978, the returns through the Trust's traps were lower than those of the previous three years and were composed largely of small summer fish (2+ sea winters). Only one spring fish was recorded in May (Mill Race trap) whilst the remaining salmon (18 in July, 9 in August and 3 in September) were (mostly) small summer fish. The total of 31 was disease-free, however, and there were no indications of an early summer outbreak of UDN as was noted in 1975-'77.

Water levels in the Mill Race and Salmon Leap were low during April, May and June, and this may have contributed to the absence of an early spring fish run. Grilse were seen to be present in Lough Furnace from early June onwards but the first grilse was not recorded in the traps until June 28, following a rise in water levels to low-flood conditions. The run of grilse in July was poor, although water levels for upstream migration were adequate, except for the period July 10—21. Two major floods in August resulted in slightly better numbers of grilse moving upstream, particularly through the Salmon Leap trap but the overall total of 249 by the end of August was the lowest yet recorded.

Although September was a wet month, relatively few grilse were in evidence, confirming the low stock level thought to be present in Lough Furnace and only 83 grilse were counted upstream, followed by a further 37 in October and 6 in November. It was noticeable that after July, less than one-third of the remaining run of grilse were counted through the Mill Race trap. The reason for this is not known but may be due, in part, to the observed presence of one or more otters which hunted the Mill Race (including the trap and the resting pool) on a regular basis.

The overall escapement to Lough Feeagh of 375 wild grilse (excluding 14 previously-spawned fish), represents a disastrously low stock level and is less than two-thirds that of 1977, itself the lowest escapement over the previous eight years, since full records became available in 1970.

As will become apparent from succeeding sections of the Report, the low level of returning stocks of grilse was due to poor survival in the sea, resulting from heavy commercial exploitation.

Table VII gives the comparative escapements of salmon and grilse through the traps for the past nine years:—

Table VII

Year	Mill Race		Salmon Leap		Total	
	Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
1970	0	468	0	620	0	1088
71	4	354	0	386	4	740
72	3	1024	18	345	21	1369
73	15	954	8	722	23	1676
74	14	351	11	504	25	855
75	15	308	37	516	52	824
76	10	257	40	540	50	797
77	12	253	31	354	43	607
78	5	94	26	281	31	375

Table VIII shows the monthly percentages of the combined total run of grilse through the traps, compared with the five-year average for 1970-74 and the actual figures for 1975, 1976 and 1977. Figures in parentheses for 1978 are the actual monthly counts of grilse:—

Table VIII

	1970-74	1975	1976	1977	1978
May	—	—	4.8	—	—
June	5.8	13.7	41.8	2.0	3.2 (12)
July	18.9	8.6	13.7	35.2	27.6 (103)
August	26.8	7.0	—	16.6	35.7 (134)
September	25.5	49.9	13.8	32.0	22.5 (83)
October	17.6	19.7	22.3	13.7	9.4 (37)
November	4.8	0.7	3.0	0.5	1.6 (6)
December	0.6	0.4	0.6	—	—

It is too soon, as yet, to observe any marked trend in the timing of grilse runs into freshwater but there is a tendency for the later-running grilse (October and November) to be fewer in number with a consequent enhancement of the values for the July and August proportions.

(b) Net-marked grilse

Net-marks were observed on 8% of the grilse recorded in June, 22% in July, 11% in August and 2% in September. These values are very similar to those obtained in previous years.

(c) Spawning escapement

No UDN was observed among early-running fish in 1978, either salmon or grilse. No wild fish were used for hatchery purposes, as the run of grilse was known to be insufficient for natural spawning purposes. As in the 1976/77 season, salmon

ova surplus to the Trust's requirements were hatched and planted out by Burrishoole fishery staff, to augment the natural reproduction. Some 100,000 fry were released in tributaries of Lough Feeagh where this is assumed to have increased the spawning escapement for 1977 by 25 female fish. Releases of surplus parr in 1978 were confined to Lough Furnace tributaries, where they would not affect the smolt run through the traps in 1979.

Table IX

	Wild and previously spawned grilse	Wild salmon	Reared fish
Counted through traps	389	31	164
Rod catch, L Feeagh	19	1	0
Taken for hatchery use	0	0	102
Escapement	370	30	62
Maximum spawning stock : 462			

The comparative figures for previous years are as follows:—

	Maximum escapement		Reared fish component	
1970	1136	13,900	900	236
71	609	14,631	558	51
72	1654	13,515	1277	377
73	1522	14,681	1495	27
74	708	11,268	700	8
75	842	9972	795	47
76	(i) 736	14,650	721	15
77	(ii) 632	16,136	619	13
78	462	6,323	400	62
	750	9,998	750	

(i) includes 11 females whose progeny was planted out in 1977

(ii) includes 25 females whose progeny was planted out in 1978

(d) Survival from brood year ova to smolts and grilse

The count of wild grilse in 1978 represents those fish which were derived from the 1974 brood year. The spawning escapement for that year (shown in Table IX) was 708, including only 8 grilse derived from reared smolts, the remainder having been used in hatchery operations. Thus the maximum escapement was 708 and the minimum was 700. A range of 50—55% females in this escapement and a range of 4000—4115 ova per female was used in the calculations to give average and minimum values for ova deposition during the winter of 1974—75. (For original data pertaining to these estimates, see Ann. Rep. XIX (1974), Section 7(a)v.).

The resultant grilse total of 390 is the trap count of upstream-migrating fish (389), with the addition of rod-caught wild grilse from Lough Furnace (15) and the subtraction of previously-spawned wild fish (14).

Table X

Survival from ova to grilse

Spawning escapement	700 to 708
No of females	350 to 389
Ova deposition	1,400,000 to 1,600,735
No of smolts produced	6323
Survival (ova to smolt)	0.45 to 0.40%
Survival (smolts to grilse)	6.2%
No of returning grilse	390
Survival rate to grilse per 1000 ova	0.28 to 0.24
Survival to grilse per grilse female	1.11 to 1.00

Comparable estimates are now available from five brood-year-classes:—

Table XI

Brood-year-class	Survival rates ova to smolts	Survival rates to grilse per 1000 ova	Survival rate to grilse per grilse female
1970	0.44—0.63%	0.36—0.52	1.48—2.06
1971	0.72—0.89%	0.67—0.76	2.83—3.29
1972	0.39—0.57%	0.24—0.35	0.97—1.39
1973	0.47—0.54%	0.19—0.22	0.80—0.89
1974	0.40—0.45%	0.24—0.28	1.00—1.11

The survival rates from ova to smolts of the 1974 brood-year-class were lower than normal, confirming the deleterious effect of the summer drought in 1976. This would appear to have been confined largely to the 1+ salmon parr population of 1976, in that survival figures for the succeeding brood-year-class to the smolt stage (0.52—0.62%) indicate that 0+ fish in 1976 were little affected.

The survival rate per female grilse spawner to grilse offspring showed very little improvement in 1978, when only half the necessary complement of grilse offspring returned from the sea. This decrease in the return to fresh water has been apparent for the past three years and is due to over-exploitation of limited stocks, particularly by coastal drift-nets.

(ii) Downstream movements

(a) Smolts: Timing and numbers

Very few salmon smolts were noted in either trap until April 22, when the average water temperature in the Mill Race reached 7.5°C. This late migration time was due to the slow warm-up of the water, following temperatures of less than 3°C in late February. A similar delayed smolt migration was noted in 1977.

Only 407 smolts were counted downstream in April and the main run (of almost 7500) in May took place predominantly at the Mill Race, due to sustained low water levels. Migration had ceased at the Mill Race by June 20 but over 100 further smolts were counted at the Salmon Leap during July with occasional, fully-silvered fish in August and September. In this late run (July—September). at the

Salmon Leap, 11 fin-clipped smolts were recorded, where similar marks would not have been noticed in the main run, among large numbers of unmarked smolts. These fin-clipped smolts were survivors of 5142 yearling parr, planted out on May 10, 1977 in the headwaters of the fishery system. As noted in the preceeding section (I(i)(d), the survival rate from egg deposition to smolts in 1978 showed a marked improvement to 0.52—0.62%, in the absence of any severe climatic conditions during 1977. The smolt total of 9998 was almost 60% better than that of 1977 but remained well below the 5-years average of 13,224 for the years 1972—76.

(b) Survival of salmon smolts

The following values were derived from the known numbers of salmon smolts counted through the traps each year and the total stock of returning wild adults in the two succeeding years. The total stock is calculated from the count of wild maiden grilse through the traps, plus the rod-catch of wild grilse on Lough Furnace and the trap catch of wild two-sea-winter fish in the following year. Table XII shows these values for the years 1970 to 1978 and the relevant survival rates from the smolt stage:—

Table XII

	Trap count	Furnace Rod catch	2SW fish	Total	Relevant smolt total	% Survival
1970	1088	236	5	1329	12-14,000	9.5-11.0*
71	740	49	21	810	14,637	5.5
72	1369	144	23	1536	13,915	11.0
73	1676	92	25	1793	14,081	12.7
74	855	78	52	985	11,282	8.7
75	824	104	50	978	9,972	9.8
76	797	88	41	926	14,650	6.3
77	599	69	31	699	16,136	4.3
78	375	15	N/A	390	6,323	6.2**

* Smolt count not accurate in 1969

** Survival to grilse only (small spring and summer fish not due until 1979)

The survival rate of smolts to the grilse stage showed a slight improvement in 1978, due, it is thought, to a lessening in the degree of exploitation by coastal nets in August, as a result of the low overall grilse stock level at that time.

(c) Tagging of wild smolts

As a conservation measure no wild smolts were tagged for the second year in succession. A second recapture was reported from the batch of 147 smolts tagged in May, 1976. This fish was a grilse and had been caught off the south-west coast of Ireland in 1977 but the tag had not been noticed until the fish was removed from cold store in September, 1978.

Details:—

Tagged May 14, 1976: 14.5cm. Recaptured July 1977: wt 2.73kg

Both this and the other recapture from this batch of smolts were taken in the Co. Kerry area, this extreme southerly displacement of wild fish being unusual.

(d) **Salmon kelts**

Table XIII

	Counted through traps	
December 1977	12	
January 1978	42	
February	21	
March	107	
April	48	
May	20	
June	1	
Total	251	(comprising 173 females and 78 males)

The overall survival to the kelt stage fro the original spawning escapement increased to 41% (251/607) where this was due to a much improved survival of male fish in 1978, the proportion of males rising to 31%. Kelt tagging commenced in late December and 70% of the downstream run was tagged, with 14% noted as being lightly marked by fungus when tagged. Comparable data for the years 1974 to 1978 are given in Table XIV.

Table XIV

	1974	1975	1976	1977	1978
% healthy kelts in kelt run	64	72	68	78	70
% males in kelt population	9	23	14	19	31
% lightly marked	40	16	20	15	14
% survival from escapement	29	33	23	29	41
% recaptures in 1st year	7.3	7.0	6.7	7.9	10.9

As usual, the majority (63%) of the kelt run was caught in the downstream trap at the Salmon Leap, despite low water levels in April and May. (Note that one kelt left fresh water on June 3, as the first fresh grilse were appearing in Lough Furnace.)

There were 19 recaptures (10.9%) of tagged kelts in 1978, as short-absence, previously-spawned grilse. This figure represents a slight improvement on the previous four years. Of the 19 recaptures, 14 were taken in the upstream traps and 5 by outside nets, including 4 from drift-nets (2 off Donegal, 1 off N. Mayo and 1 off Connemara) and 1 from a draft-net operating in the common estuary of Newport and Burrishoole rivers.

The 11 female previous spawners contributed some 5% of the female spawning population and their mean growth increment in the sea was 7.4cm over a mean absence period of 155 days.

A further example of a long-absence, previously-spawned grilse was recorded in 1978:—

Tagged as a grilse kelt	: SLA 133	: 19.4.77	: 65.0cm
Recaptured	:	: 3.7.78	: 95.0cm

This was an extremely large growth increment over the 14½ months absence period and it was calculated that this female weighed from 8.6—10.2kg (19—22lb) on return. It is unlikely that such a fish would be classified as a previously-spawned grilse in the absence of full details of its life-history. The recapture rate for kelts tagged in 1977 now stands at 7.9%.

(e) Ulcerative Dermal Necrosis (Salmon Disease) 1977/1978 spawning season

The incidence of UDN noted among kelts declined slightly again in the 1977/78 season, despite a large increase in the number of males surviving spawning, among whom UDN has been most prevalent in the past. The proportion of infected fish in the kelt total was highest in 1974, at 57%, declining steadily in ensuing years to 23% in 1978.

Although many more males survived spawning and migrated out to sea, the majority of them were marked, to a greater or lesser degree by fungus associated with UDN, in the months of December, January and February.

1978/79 season

No UDN was noted during the early summer run of grilse and of the five kelts counted downstream in December, 3 were severely marked by fungus.

Broodstock (total 102) were maintained wholly in a freshwater holding pond in 1978 and by mid-December, 1 male and 2 females had died with fungus infection. Light UDN infection was noted among some of the males at this time and affected fish were released into brackish water at weekly intervals thereafter. Of 17 lightly affected fish transferred to a brackish-water pond in mid-December, only 1 fish died and the others showed partial or complete recovery. Routine injections of oxytetracycline were given to the broodstock, when handled.

2. REARED SALMON

(i) Upstream movements

The return from reared smolts improved slightly in 1978, to an overall recapture rate of just over 1.0%, compared with 0.6% in 1977. This level of return continues to be very disappointing however and future research work should be aimed at establishing:—

(i) The level of contribution of reared smolts to the commercial netting effort, particularly that of drift nets and local estuarine nets,

(ii) Any physiological differences that exist between reared and wild smolts at migration time,

(iii) The degree of latent infection in reared smolts by bacterial and viral diseases, including impairment of kidney function.

As in 1977, the returns from 1+ smolts (1.09%) were better than those from 2+ smolts (0.91%), whilst in the ten years 1966—75, the returns from 2+ smolts were almost twice those from 1+ smolts.

No recaptures were made from fish which escaped from sea-cages in 1977 although in 1978, one group of reared smolts was fed for ten days in a sea-cage, prior to release.

There was one recapture as a small spring fish from a batch of 1+ smolts released in 1976 and one recapture as a grilse from a small batch of "giant" smolts released in 1977. There were no previous spawners among the 182 recaptures in 1978 and one small (46.0cm) fish caught in September could not be allocated to a smolt group as no scales were available and the brand mark was missing. It could have been a pre-grilse from a giant smolt released in 1978 or could have been derived from a planting of fin-clipped parr. One rod-caught fish was unrelatable to a smolt batch.

Table XV below, shows the various batches of smolts and the recaptures, from releases in 1976 and 1977:—

Table XV

	Smolt age	Year of release	Number released	Brand	Returned as— G	2SW	% recapture
1	1+	1976	6077	U	42	1	0.70
2	1+	1977	11062	Θ	121	N/A	1.09
3	1+	1977	1009	L	8	N/A	0.79
4	2+	1977	5384	X	49	N/A	0.91
5	2+	1977	467	XX	1	N/A	0.21

The fish in group 5 were the giant smolts referred to above, which had undertaken a sea-type growth in their second year in fresh water, having been under-size smolts in 1976. These giant smolts seldom give any returns as adults but have returned occasionally as pre-grilse after 4—6 months in the sea.

The 182 recaptures were made in the following ways:—

Mill Race trap	:	59
Salmon Leap trap	:	105
Furnace rod-catch	:	4
Feeagh rod-catch	:	1
Outside nets	:	13

All the outside net recaptures came from a draft-net operating in the joint estuary of Newport and Burrishoole Rivers, during the period late June to late July. No fin-clipped or branded fish were reported from local drift-net landings but only occasional checks were made.

Rod-caught recaptures were small in number, being a reflection of the low stock level and low overall catch. The 4 fish caught on Lough Furnace represented 21% of the rod-catch on that lake and with the one fish from Lough Feeagh, reared fish constituted 12.5% of the total rod-catch.

Of the 164 fish passed through the traps, 102 (52 females) were used in hatchery operations, being retained in a holding pond either on their initial or subsequent appearances in the traps. The proportion of fish which did not return downstream (in an attempt to home on their rearing-point) was higher than usual but

there was no indication that these fish died from UDN infection. The return of kelts in 1979 will give an indication of whether these fish survived to spawn. The apparent contribution to natural spawning stock may have been due to a reduced level of homing behaviour, since over 63% of the fish used the Salmon Leap passage to fresh water, instead of 90% using the Mill Race (where they were reared) as was the case from 1970-74. (See Ann. Rep. XVII, 1972, for more detailed explanation of "multiple return" and homing behaviour).

There was one example of a mild condition of impacted vertebrae among the reared fish in 1978, which is said to be due to dietary deficiency. Legibility of brand marks improved and only 20% had obscure or missing marks.

The average size of reared grilse also improved in 1978, with an overall mean length of 64.6cm. There was no significant difference between grilse derived from 1+ or 2+ smolts but the females were smaller (62.0cm) compared with the males (66.8cm). At a Coefficient of Condition of 1.1, the average weight of reared grilse was 2.94kg (6.47lb.) with females at 2.6kg (5.76lb.) and males at 3.28kg (7.21lb.). The sex ratio of returning grilse was 51 females to 49 males.

The reared grilse were about a month later than wild grilse in moving upstream to fresh water, with the usual high proportion of fish running in October and low proportion in June and July:—

Table XVI

	Wild fish %	Reared fish %
June	3.1	—
July	27.2	1.2
August	36.5	31.7
September	21.9	24.4
October	9.8	32.3
November	1.5	9.1
December	—	1.2

The relative survival rates of smolts released in 1977 may be compared with those of previous years in Table XVII below:—

Table XVII

Year	Smolts released	Number recaptured	% 2+ smolts	% 1+ smolts
1966	9764	62	0.62	0.83
1967	10256	194	1.87	1.09
1968	14260	490	4.41	2.91
1969	17317	654	5.20	4.02
1970	16637	312	3.64	1.25
1971	10219	136	1.27	1.65
1972	10237	682	7.00	4.08
1973	7906	117	1.55	0.85
1974	5479	60	1.10	1.08
1975	10206	354	4.18	0.80
1976	15674	253	1.62	1.60
1977	15278	102	0.48	0.79
1978	17922	182	0.91	1.07

These figures refer to return to the river and make no allowance for the unreported proportion of adults which is taken by commercial nets, where fin-clips and brand marks largely go unnoticed.

Excluding previous spawners, these fish can be divided into the following categories:—

Smolt parentage	Returned as grilse	2 SW fish	Pre-grilse
2 SW	183 (87%)	27 (13%)	0
Grilse	3227 (98.3%)	55 (1.7%)	5
2 SW x grilse	147 (96.1%)	6 (3.9%)	0

N.B.—"Pre-grilse" are fish which return to fresh water after less than a year in the sea, usually during the summer following release as smolts. 2 SW fish includes both small spring and summer fish.

(ii) Downstream movements

All reared smolts were transferred to release ponds prior to the downstream movement of wild smolts. 2+ smolts were branded as two batches, in early March and early April, with 1+ smolts being branded from mid-April onwards. One group of 1+ smolts was left unbranded, but having the adipose fin removed, to check on any gross differential mortality between branded and unbranded fish. Marks used in 1978 were:—

2+ grilse smolts : 9104 : Adipose finclip + Brand S
1+ grilse smolts : 4758 : Adipose finclip only
1+ grilse smolts : 2486 : Adipose finclip + Brand T
1+ grilse smolts : 878 : Adipose finclip + Brand K

Totals: 9104 x 2+smolts, 8122 x 1+smolts.

3. SEA TROUT

(i) Upstream movements

(a) Timing and numbers

The sea trout run declined again in 1978, to a total of 1730, some 78% of the total in 1977. This decline can be related to the decreased survival from fresh-run fish to the kelt stage, as occurred also in 1977. (See Section 3(ii)(c). Virtually no sea trout were recorded in either trap until June 27, where this was due, in part, to low water levels throughout most of the month. However, it has been noted that in years when sea trout were present in good numbers early in the season, low water levels did not prevent a sizeable upstream movement. Thus it is probable that the late onset of the run in 1978 was also related to the lower numbers present in Lough Furnace earlier in June.

The bulk of the run took place in July, as usual, and as for the salmon, the majority of the fish were counted through the Salmon Leap trap. Finnock (0+ sea

years) were noted as early as June 30 and then ran steadily throughout July, August and September. The estimated finnock total of 384 showed a decline to 22% of the total sea trout population, compared with 33% and 45% in 1977 and 1976, respectively. Some correlation seems to be emerging between the number of smolts migrating in the spring and the number of finnock returning during the following summer, in that the smaller the smolt total, the fewer the finnock. Further studies on smolt age composition and age structure of the adult population are necessary.

The totals for upstream migrating sea trout, counted through the traps from 1970 onwards, are as follows:—

Table XVIII

Year	Mill Race	Salmon Leap	Total
1970	885	359	1244
1971	889	518	1407
1972	1799	426	2225
1973	1596	1248	2844
1974	1658	1271	2929
1975	1651	1697	3348
1976	894	2408	3302
1977	731	1481	2212
1978	427	1303	1730 (including 384 finnock)

The preponderance of trap recaptures at the Salmon Leap is governed partially by water levels but can be linked also with improvement works carried out in 1972 and the removal of the old Eel Weir and rock cill in 1975. The average run through the Salmon Leap for the three years 1970—72 was 28% of the total, compared with 46% for 1973—75 and 72% for 1976—78.

The timing of the sea trout run as monthly totals was normal, as is shown in Table XIX, which compares the monthly proportions of the 1978 run with those of the three previous years and the five-year average of 1970—74.

Table XIX

	1970-74	1975	1976	1977	1978
May	—	—	0.2	—	—
June	14.3	13.4	31.4	3.6	9.0
July	50.5	56.5	56.2	80.2	60.9
August	14.1	12.1	—	8.0	14.2
September	8.9	9.7	5.0	4.7	8.8
October	8.4	6.0	6.6	3.0	4.3
Novemebr	3.3	2.2	0.5	0.5	2.8
December	0.5	0.1	0.1	—	—

(b) Net-marked fish

The frequency of net-marks on the larger sea trout decreased in 1978 to only 1% in July, with only isolated examples thereafter in August and September.

(c) **Spawning escapement**

Table XX

Counted through traps	:	1730
Rod catch on Lough Feeagh	:	244
Maximum escapement	:	1486

The rod exploitation rate, at 14% of the upstream run, showed some improvement in 1978, but the maximum spawning escapement, as a result, declined to it's lowest value since 1971, as shown in Table XXI.

Table XXI

Year	Maximum spawning escapement
1970	1017
1971	1249
1972	1883
1973	2391
1974	2519
1975	3118
1976	3117
1977	1898
1978	1486

(ii) **Downstream movements**

(a) **Sea trout smolts**

The sea trout smolt run began in mid-March but only some 17% of the total had migrated by the end of April. The main run (62%) occurred in May, followed by an appreciable total through both traps in June. Occasional, late-running smolts were recorded at the Salmon Leap in July. The total of 3167 smolts was some 20% less than that of 1977 and was the lowest recorded since 1971. It is thought that this may be related to the 1976 drought as there is known to be an appreciable component of 3+ fish among the sea trout smolts, where these would have been 1+ years fish in the summer of 1976. The 1978 smolt run was the product of the 1974 and 1975 broodstock years which were excellent, so that low egg deposition levels were not responsible for the lowered smolt total.

Table XXII gives the sea trout smolt totals for the years 1970 to 1978:—

Table XXII

1970	3228
1971	2961
1972	5465
1973	6071
1974	4527
1975	3587
1976	5207
1977	3889
1978	3167

(b) **Autumn-migrating juvenile trout**

These fish are 1+ and 2+ trout, showing a definite downstream migration

pattern in the autumn and known to contribute, at least in part, to the finnock and sea trout production of succeeding years. The totals counted through the traps declined in 1978 but this was due, in part, to two periods in September and November, when the Mill Race screens had to be lifted, and the Salmon Leap trap was not fully operative, due to extremely high floods. (See Fig I).

Table XXIII

	Mill Race	Salmon Leap	Totals
September	154	631	785
October	198	662	860
November	168	559	727
December	65	166	231
Totals	585	2018	2603

Since the precise degree of involvment of autumn-migrating juveniles is not yet known, it has been assumed that all of them contribute to the sea trout recruitment. The following totals for annual recruitments were obtained by adding the smolt totals to that of the juveniles of the preceeding autumn, when they can be compared with the total runs of sea trout, including finnock: —

Table XXIV

Year	Smolt total	Autumn juveniles	Total recruitment	Sea trout run
1970	3228	N/A	3228+	1244
1971	2961	3128	6089	1407
1972	5465	3620	9085	2225
1973	6071	2124	8195	2844
1974	4527	2606	7133	2929
1975	3587	2703	6290	3348
1976	5207	4171	9378	3302
1977	3889	2947	6836	2212
1978	3167	3506	6673	1730

(c) Sea trout kelts

The bulk of the sea trout kelt run was fairly evenly divided among the three months of March, April and May in 1978 with later-running fish (May and June) more numerous than usual. Table XXV gives the timing of the kelt run, the fish being divided into "large" (over 30cm) and "small" classes, roughly delimiting finnock (0+ sea years) from older fish: —

Table XXV

Month	Large	Small	Total	"Marked"
November 1977	40	12	52	0
December	86	50	136	1
January 1978	37	29	66	5
February	14	7	21	0
March	164	100	264	0
April	165	115	280	0
May	93	112	205	0
June	16	17	33	0
Totals	615	442	1057	6 (0.6%)

The incidence of fungus infection among sea trout kelts was very low, where the number of "marked" fish in Table XXV above would seem to indicate that

fungus infection (allied with UDN) was an insignificant factor in the survival to the kelt stage.

Despite this, the survival of the large sea trout component in fresh water was much less than could be expected, although that of finnock increased, by comparison with 1977. Table XXVI compares the overall survival rates, for the years 1976—78, as well as the comparable rates for the two components (large and finnock) of the sea trout kelt population. Note that the escapement for 1977 has been reduced from 1981 to 1898, due to the downstream migration of 83 sea trout (large) in September and October, prior to spawning.

Table XXVI

	1976	1977	1978
Total kelts	2335 (75%)	1770 (57%)	1057 (56%)
Total escapement	3118	3117	1898
Large sea trout escapement	2183	1714	1224
Large sea trout kelts	1716 (79%)	1086 (63%)	615 (50%)
Finnock escapement	935	1403	674
Finnock kelts	619 (66%)	684 (49%)	442 (66%)

The survival of large sea trout whilst in fresh water has therefore decreased from 79%, to 63% to 50% over the past three years and in the absence of disease as a causal factor, it seems likely that, as suggested in 1977, the loss is due to illegal fishing activities. If the survival rate had been maintained at around 75%, a further 300 large sea trout would have been counted as kelts.

Only 6 tagged sea trout were recorded in the out-going kelts in 1978, 5 of which were tagged in 1975 and 1 in 1974. No tagged sea trout were noted in the upstream run.

4. EXPLOITATION RATES BY ROD FISHING

Records now exist of the rate of exploitation of stocks of wild and reared salmon and sea trout (confined to fly only) since 1970. Accurate assessments can be made for Lough Feeagh but the complication of unknown numbers of sea trout spawning in the streams flowing directly into Lough Furnace makes it impossible to attempt reliable estimates of the exploitation rate of sea trout in Lough Furnace. It should be noted that 235 sea trout were caught in Lough Furnace during 1978, most of which it can be assumed were destined to spawn in the Lough Furnace tributaries. (Se Frontispiece for geography of Burrishoole River system).

For salmon, the maximum rates are accurate, since they assume no spawning in Lough Furnace tributaries, but to arrive at the minimum rates, a tentative correction of 10% has been applied, which is a slight, deliberate over-estimation, as only one stream is involved and used only to a minor extent by spawning salmon.

Salmon derived from reared smolts are treated separately in Table XXVII below, which gives the comparative values for the years 1975—78 and the five-year average for 1970—74.

The "available" fish by October 12 includes all wild maiden and previously-spawned grilse counted through the traps by that date, plus the 2-sea-winter fish. The total stock of Loughs Feeagh and Furnace is the complete count for the year of wild fish (grilse and 2 SW) plus the rod-caught salmon and grilse from Lough Furnace.

Table XXVII

	1970-74	1975	1976	1977	1978
WILD SALMON					
Lough Feeagh					
"Available" fish by October 12	987	776	709	573	411
Rod catch	87	54	68	46	20
Exploitation rate %	11.3	7.0	9.6	8.0	4.9
WILD SALMON					
Loughs Feeagh and Furnace					
Total stock of wild fish	1265	928	885	668	435
10% addition for L Furnace residents	1392	1021	973	735	478
Total catch of wild fish	205	161	156	115	35
Minimum exploitation rate %	14.7	15.8	16.0	15.6	7.3
Maximum exploitation rate %	16.2	17.3	17.6	17.2	8.0
REARED SALMON					
Lough Feeagh					
"Available" fish by October 12	154	190	95	30	125
Rod catch	4	18	9	0	1
Exploitation rate %	2.6	9.5	9.5	0	0.8
REARED SALMON					
Loughs Feeagh and Furnace					
Total stock	261	280	262	102	164
Total rod catch	32	67	42	6	5
Exploitation rate %	12.3	24.0	16.0	5.9	3.0
SEA TROUT					
Lough Feeagh					
"Available' fish by October 12	1983	3173	3236	2169	1650
Rod catch	318	230	185	231	244
Exploitation rate %	16.0	7.2	~~5.7~~ 5·7	10.7	14.8

SUMMARY

The exploitation rate for wild salmon was the worst recorded since records began in 1970, at only about half the average rate for the years 1970—77. This was due to direct and indirect effects of the very small stock, in that fish were widely scattered in the two lakes, there was no accumulation of grilse in Lough Furnace, as occurs in years with good stock levels and the poor fishing results deterred many anglers, resulting in a low level of fishing effort.

Sea trout catches were also poor, in terms of numbers caught (56% of the average for 1970—77) but the exploitation rate for Lough Feeagh improved to a level close to that for the five-year average of 1970—74.

The exploitation rate of reared salmon was again poor, as in 1977, following two good years in 1975 and 1976. Only two reared salmon were present in Lough Feeagh until mid-August and most of the "available" fish were late-running.

The rod catch figures for the 1978 season (including wild and reared salmon) were as follows:—

	Salmon			Sea Trout		
	No.	Total wt	Av wt(lb)	No.	Total wt	Av wt(lb)
Lough Feeagh	21	113.9	5.4	244	199.9	0.82
Lough Furnace	19	106.8	5.6	235	192.7	0.82
Totals	40	220.7	5.5	479	392.6	0.82

The average weight of rod-caught salmon improved in 1978 but that of sea trout fell slightly, where the bulk of the catch was comprised of finnock (0+ sea years) which were themselves smaller than usual in 1978. For comparison, the catch figures, with average weights where available, are given in Table XXVIII below, for the period 1970—1978:—

Table XXVIII

	Salmon		Sea trout	
	No	Av wt (lb)	No	Av wt (lb)
1970	354	N/A	1155	N/A
1971	93	5.09	504	0.87
1972	335	N/A	839	N/A
1973	190	N/A	1045	N/A
1974	214	4.1	1292	1.00
1975	228	5.6	686	0.80
1976	198	5.4	560	0.95
1977	121	5.0	667	0.85
1978	40	5.4	479	0.82

5. SILVER EELS

The catch of silver eels was very much reduced in 1978, due to the main run escaping in late September, when the highest flood for 15 years put both downstream traps out of commission. There was a further very high flood in mid-November but, although the Mill Race trap was unable to be fished for 3 days, the indications were that very few eels migrated downstream on that flood. The total of 1412 eels (weighing approximately 145kg) was only about one-quarter of that of the previous year and the very low numbers caught during October confirms that the bulk of the run escaped in late September:—

	Mill Race	Salmon Leap	Totals
September	519	547	1066
October	53	32	85
November	158	84	242
December	3	16	19
Totals	733	679	1412

Comparative figures for previous years were:—

1971	2924	
1972	3144	
1973	5087	Five-year average : 4465
1974	4642	
1975	6530	
1976	4595	
1977	5362	
1978	1412	

Appendix I

BRACKISH WATER AND SEA CAGE OPERATIONS 1975—1977

J. P. Lawrie.

1) RESUMÉ

Pilot-scale operations from 1974-77 demonstrated a commercial feasability and this is being pursued by Curraun Fisheries Ltd., a wholly-owned subsidiary of Guinness Ireland Ltd. Progress has been encouraging during these pilot-scale operations and whilst a number of technical problems have been overcome (moorings, smolt transfer, husbandry, harvesting and packing etc.) others still remain.

These include such limiting factors as:—

(i) the incidence of furunculosis among the smolts, where a satisfactory solution is only likely to be found in the development of an immunisation technique.

(ii) the incidence of early maturation in the sea, where present stocks are almost 100% early grilse, each year, with no significant content of two-sea-winter fish. This limits both the fish size at sale and the period of marketing.

The importance of a suitable and sheltered site has been amply demonstrated and it is apparent that there is a scarcity of such sites along the Irish coastline. This may be overcome in the future by the development of new cage and mooring designs, allowing the use of more exposed sites.

A further general limiting factor is the guaranteed supply of healthy, economically-priced smolts. It is suggested that no large-scale salmon sea-farming enterprise can be undertaken without its own associated freshwater production unit or less ideally, a contracted supply of smolts from another source, preferably within 50 miles of the sea-site.

2. INSTALLATIONS

Construction of the brackish water rearing unit on a site adjacent to the existing Burrishoole Fishery boatshed, began in February, 1974, and was fully operational by March, 1975. The intake pipe from Lough Furnace was laid on the bottom of the lake to a distance of approximately 100m off shore. Since the water quality and salinity varied with depth, it was found necessary to raise the intake some 8m from the bottom, when it was then submerged to a depth of 5m. The intake was maintained at the required depth by submersed buoys initially but these proved unsatisfactory and they were replaced in 1975 with surface buoys, which worked well up to November 1977 when they broke loose in a storm, being replaced with an improved submersed buoy with a back-up surface buoy for safety. A 3m fibreglass pond was added to the complex in 1975 but the proposed covered broodstock pond was not constructed.

The sea-cages for the pilot scheme were the same type as those developed at Kames Bay, Argyll, selected after various other types had been inspected. These cages have a capacity of 80 cu. m., with two walkways enclosing the polystyrene block flotation, the corners being joined and reinforced by galvanised mild steel. The net cage itself was constructed of ½" knotless nylon netting, treated with bitumen preservative.

Three of these cages were purchased in early 1975 and moored in Rosbarnagh Bay (an inlet of Clew Bay, approximately 8m from the Salmon Research Trust freshwater installations). The three cages were linked together and moored off spring anchors (CQR anchors linked to heavy galvanised chain). This site proved unsuitably exposed to westerly gales, and the cages were towed to a more sheltered but shallower and smaller offshoot of the same bay in September 1975. During the summer of 1975 Bellacragher Bay (an offshoot of Blacksod Bay) was proposed as a permanent siting of the sea cages, being relatively sheltered, with deep water, and scope for commercial scale production. The three cages were moved to this site in December, and moored individually to spring anchorages. A further two cages were added in 1976. In 1977, 5 Kames-type cages were constructed, and new moorings laid, designed to allow the operator to walk from one cage to the next, with the 10 cages arranged as one block of 5 x 2.

Automatic feeders have been used on the sea-cages but were discarded in favour of hand-feeding, which has proved more efficient.

3. WATER AND WEATHER PARAMETERS

During the three years of production in the sea, weekly records were kept of water temperatures, salinity and dissolved oxygen, and a synopsis of the range of these parameters is given in Table 1.

Table 1

Cage Site/	Salinity (%)		Temperature (°C)		D.O. (ppm)	
Year	Min.	Max.	Min.	Max.	Min.	Max.
Rosbarnagh (Aug.-Dec. 1975)	25	32	8	18	—	—
Bellacragher Bay (Jan.-Dec. 1976)	25	35	4	20	6.3	10.6
Bellacragher Bay (1977)	21	33	4	18	7.2	10.7

In addition, winds of gale force and over and their directions were recorded (Beaufort scale) as they occurred at the sea cage sites. Figures for 1975 and 1976 are given in Table 2.

Table 2

Number of winds of gale force and over

	SE	S	SW	W	NW	N
1975 (May-Dec.)	5	2	8	1	1	2
1976	7	3	13	13	3	6

4. PUMPED BRACKISH WATER FROM LOUGH FURNACE

Pumping of brackish water to be used in experimental work on the acclimatisation of salmon and rainbow trout smolts and the holding of brood stock commenced in March 1975. Since it was already known that oxygen varied inversely and salinity and hydrogen sulphide directly with depth (Parker, 1973) it was essential that a take-off level be found that would give maximum salinity with minimum risk of H_2S poisioning. This was judged initially to be 6—7m below the lough surface. Pumping from this depth in the spring of 1975 gave a salinity of approximately 17‰and a reduced range of variation in water temperatures compared wth those of fresh water. Perceptible levels of H_2S were noted occasionally during this period, and analysis of the water revealed significant levels of free ammonia (0.120ppm). An aerator fitted to the delivery end of the pipeline ensured complete re-oxygenation of the pumped water and has worked satisfactorily to date. In April, 1976 the intake was raised approximately 2m in order to improve the unsatisfactory water quality, and although the salinity level fell to 13‰ the smell of H_2S was no longer perceptible and the free ammonia level dropped to 0.006ppm.

5. ACCLIMATISATION OF SALMON AND RAINBOW TROUT IN BRACKISH WATER AND THE HOLDING OF BROODSTOCK

Salmon Smolts

In 1975, 5827 salmon smolts were acclimatised to 17‰ salt water by mid-May and 4,235 smolts similarly in 1976, to 11‰ salt water, salinity levels having been increased by weekly increments of 3—5‰ from early April. No smolts were transferred directly from fresh to salt water in 1975 and 1976, so that the benefit of acclimatisation could not be assessed. In 1977, 4781 yearling smolts were acclimatised to 9‰ saltwater over the period April 3—May 26, and 4047 1+ smolts from the same population were transferred directly from freshwater to seawater, except that they were transported in brackish water. Post-transfer losses were 2.8% and 13.7% respectively, indicating that even relatively low level acclimatisation had been beneficial.

Rainbow Trout Smolts

Rainbow trout smolts were acclimatised to 12‰ in 1975 and 8‰ in 1977. In 1976, 300 0+ rainbow trout smolts (mean weight 73gm) were transferred directly from fresh to saltwater on September 25 with a post-transfer mortality of 26.7%. 2,000 0+ smolts from the same population were acclimatised to 13‰ saltwater over the 14 days prior to their transfer to the sea cages on October, 25. Post-transfer mortalities in this group were 1%.

6. BROODSTOCK

Broodstock in 1975 comprised only recaptures from sea-ranched salmon, but cage-reared rainbows were available in 1976 and cage-reared salmon were added in 1977. These elements of the broodstock were held in pumped brackish water (8—10‰ over the period from late September to stripping in December. The brackish water was effective in preventing fungal infection which, in previous years, caused heavy losses of sea-ranched broodstock (see Ann. Rep. Nos. XX, XXI and XXII for further details).

7. MORTALITIES IN SEAWATER

Salmon

Post transfer losses have been due almost entirely to stress-induced furunculosis resulting in maximum losses of 69.5% in one group of 1167 2+ smolts transferred to saltwater in May 1977 without prophylactic antibiotic treatment either prior to or following transfer. In general, losses have been much lower than this and have fallen each year from approximately 20% in 1975 to 8.5% in 1977. A 6.2% mortality in August 1977 was attributed to vibriosis and a similar but smaller mortality occurred during warm weather in 1976. Other losses (now attributed to proliferative kidney disease) occurred during the late spring of 1976 amongst the 1-sea-winter fish transferred from Rosbarnagh Bay to Bellacragher Bay in December, 1975.

8. RAINBOW TROUT

Post-transfer losses (October—December) in 0+ rainbow trout "smolt" populations have been consistently low (less than 1.6%) where acclimatisation has been carried out. Proliferative kidney disease in the 0+/0+ stocks, occurring during July and August was responsible for losses of 45% in 1976 and 7% in 1977, where the condition may have been aggravated by an unsatisfactory diet in 1976.

9. GROWTH IN SEAWATER

(All results refer to pelleted diets).

(i) Salmon

Examination and comparison of cage reared salmon scales with those of sea-ranched fish has shown that growth of sea-cage fish is less good, following transition from fresh to salt water, at the immediate post-smolt stage. This is thought to be largely the result of furunculosis infection associated with transfer stress. Growth in summer and early autumn has reached levels close to that in the wild, although winter growth has always been significantly less good. Spring growth is always good and in 1976 was superior to that achieved in the wild. The process of maturation, with cessation of feeding and darkening of the skin tends to begin earlier in sea-cage fish than in sea-ranched fish.

Specific examples of mean growth are:—

	May (smolt), gm	November	December	May—June (grilse) kg
1975 stock	40 (1+S)		330	1.02
1976 stock	82 (1+S)	540		1.41

1524 kg of fish were harvested in 1976 and 2593 kg in 1977.

(ii) Rainbow Trout

Although post-transfer losses of rainbow trout smolts have always been low, there is usually a considerable period (up to 30 days) of adjustment to the saltwater environment during which growth is poor. Growth during winter was probably slightly better in fresh water, but spring growth in the sea has been very rapid. The incidence of proliferative kidney disease has prevented their full growth potential from being realised. The 0+ smolts in 1975, transferred to saltwater in December of that year at an average weight of 124 gm, weighed 0.86kg (average) by the end of August 1976.

538 kg of fish were culled in 1976 and 915 kg in 1977.

Appendix II

FUTURE RESEARCH PROGRAMME

1. FOREWORD

Sir Richard Levinge, in the foreword to the Annual Report for the year 1976 has given details of the development of the Trust since its inception in 1955. He pointed out that the idea of the Trust originated with Sir Hugh Beaver, then Managing Director of Arthur Guinness, Son & Co. Ltd. The Company generously undertook to meet the major part of the capital expenditure and running costs during the early years of the Trusts life. A further example of the extreme generosity of the Company is the recent decision to transfer to the Trust the valuable fisheries of the Burrishoole River system, where the research programme has been carried out since 1955.

Following a review of the Trusts activities (at the request of the sponsors) and in recognition of the value of the work done so far, it has been decided that the work of the Trust should continue on a much expanded scale, under the joint sponsorship of the Minister for Fisheries and Forestry and Arthur Guinness, Son & Co. Ltd. The Trust is deeply appreciative of the continued support of its research programme by these two sponsors.

An outline of the proposed expanded research programme is given below.

2. INTRODUCTION

It was decided that the principal objective of future research should be to increase the numbers and viability of salmon and sea trout stocks in Irish waters, as a matter of urgency in the present crisis situation of current stock levels.

The proposed research programme is seen as a means of promoting the breeding and rearing of salmon and sea trout in their natural habitats and under controlled conditions, with a view to:

(i) maximising survival and growth in fresh and salt water;
(ii) minimising losses to the spawning escapement through disease, predation, exploitation, dietary deficiencies, competition, pollution, commercial netting, illegal fishing, etc and
(iii) achieving a net reproduction rate (female spawner to adult offspring) exceeding 2, instead of less than 1 as has been found from 1976 onwards.

The Trust will concentrate on such aspects of research as it is in the best position to undertake. In order to ensure effective co-operation with other relevant research bodies and to avoid unnecessary duplication, the programme has been initiated and will be reviewed in consultation with the Dept. of Fisheries and Forestry and in co-operation with other research agencies in Ireland and elsewhere.

3. SALMON PROGRAMME

Salmon smolt rearing

The scale of this operation in future will be maintained at a annual release of approximately 10,000 smolts, which will constitute an adequate sample. Larger scale releases would involve proportionately greater losses to commercial exploitation in the sea, without affecting relevant data on survival rates, time of return, etc.

Viability of reared smolts

Since the comparative survival rates of wild and reared smolts differ by a factor of up to 4: 1, it is imperative that considerable effort be expended on improving the viability of reared smolts. This will involve comparison of the relevant physiological and behavioural parameters in wild and reared smolts.

The actual costs of rearing smolts are unlikely to be reduced by new techniques or feed formulations so that a better economic return can be achieved only by increasing their viability. This has the effect of increasing the end-product in terms of adult salmon returning from the stocked smolts. Smolt viability can be assessed initially only by having the facilities for making an accurate count of returning adults. When viability parameters have been established, they can be used to estimate the likely returns of adults when stocking is carried out in the absence of full trapping facilities.

The importance of measuring restocking efforts in terms of adult salmon returns cannot be over-emphasised. Restocking effort cannot be measured in terms of numbers of fry or smolts released and it is obvious that much of this effort in the past has ben a complete waste of time and money.

Dietary trial work

The Trust has achieved a relatively high level of expertise in salmonid rearing work and this has been recognised by the increasing number of requests being received from commercial fish food firms to undertake trials of new formulations. The major protein component of fish food pellets is still fishmeal of various types and in view of the probable future scarcity and escalating price of this commodity, new food components, such as single-cell protein must be evaluated.

Other aspects of dietary trials will arise from the viability studies such as changes in mineral content, varying nutrient levels at different stages of the life-history, etc.

Disease studies

Apart from helping in the development of new techniques for the diagnosis of latent and active fish diseases, the major requirement of future research in this field is the development of effective immunisation techniques against the common bacterial diseases of furunculosis and vibriosis. The present programme of selecting parent fish with some degree of natural or acquired immunity will be continued, reinforced by actual determinations of the level of immunity present in broodstock. The incidence and severity of kidney impairment requires continued study, in

association with dietary research. It is contemplated that much, if not all of the disease studies will be carried out in association with other established research teams. The objective of the disease studies is to produce smolts which have no active or latent disease, since this is known to be a cause of major mortality during the first weeks of sea life, when the smolts are subjected to the heavy stress of an hyperosmotic environment.

Freshwater cage-rearing and imprinting studies

In any future large-scale smolt rearing projects, two of the limiting factors will be the gravity feed supply of adequate quantities of fresh water and the capital costs of pond-space to accommodate the yearling parr to 2+ smolt stage.

Since two years old smolts usually have a better survival rate in the sea, it will always be necessary to produce a proportion of smolts at this age in any smolt rearing installation. Except in the most favoured climatic areas of the country it will be impossible to produce an economic proportion of one year old smolts without increased energy costs and high levels of technology.

The emerging technique of rearing in cages (in fresh water) for the second year will be studied, as a means of effecting economies in smolt rearing costs and in the more efficient use of gravity-fed water supplies. Ancillary experimental work will be undertaken on the effectiveness of "imprinting" in cages, so as to enable fish reared to the pre-smolt stage in one location to be used for restocking a different river system, with the fair certitude of such stocked fish returning to the desired river, rather than to that in which they were reared. Cage rearing will also allow studies to be made of the effectiveness of delayed release on smolt survival, where the smolts could be fed before release, for varying periods of time in salt water.

Vulnerability of reared smolts to commercial exploitation

It is not known whether salmon from reared smolts are more vulnerable to commercial exploitation than those from wild smolts. Variations could exist as a result of physiological or behavioural differences between the two types of adults and there is evidence that the "reared" fish retains some element of "tameness" even after a year or more under natural conditions in the sea. It is proposed that a proportion of the Trust's reared smolt output be tagged with special apparatus which inserts a small magnetic particle into the nasal cartilage of the smolt. At the adult stage, this can be detected by a portable monitoring apparatus and on extraction, the coding of the particle enables specific batches to be indentified. This magnetic tag has the advantage of being no physical handicap to the fish (as is the case for external tags), and is seldom, if ever, shed from the fish. This type of tagging will be used to compare the differential mortality rates and distribution in "non-native" rivers of wild and reared smolts, as well as any differences that may occur among batches of reared smolts subjected to any of the programmes listed above. The monitoring apparatus is envisaged as being used by summer students at various important landing places such as Burtonport, Killybegs, Galway, Limerick, and those in North Mayo.

4. SEA TROUT PROGRAMME

Importance of sea trout research

Due to their growing importance to the summer (tourist) sport fishing and their relatively low level contribution to commercial exploitation by nets, more detailed research on sea trout is necessary. There has been virtually no serious or lasting attempt to rear sea trout smolts, anywhere in Ireland or Great Britain. Basic facts of sea trout biology still need to be established, such as:

(i) whether and when sea trout can be distinguished from the non-migratory brown trout;
(ii) whether the migratory urge is inherent or imposed by the environment;
(iii) whether the process of artificial rearing can inhibit the sea-going behaviour and
(iv) whether any genetic improvement is possible by line breeding, using eggs obtained from large sea-trout from foreign sources.

Separation of stocks of brown and sea trout

Material from wild and reared stocks of sea and brown trout available to the Trust will be used for electrophoretic analysis of proteins and enzymes, in order to attempt separation of stocks at a juvenile stage.

Sea trout rearing programme

This will be undertaken by the Trust following the proposed scaling-down of salmon smolt production. Yearling and 2-years old smolts will be reared initially since it is not certain that the migratory instinct is properly developed in 1+ smolts, which are seldom found in wild sea trout. Different feeding levels will be employed as the development of the migratory urge may be a function of population pressure, i.e. those fish with an inherent ability to migrate to sea may only do so if food is not plentiful.

Determination of homing ability

Apart from the initial migratory behaviour it is believed that the homing ability of sea trout is much less well developed than in salmon. This would have obvious effects on the suitability of sea trout for artificial rearing schemes except those undertaken by the State. Homing ability and possible "wandering" to non-native rivers should be tested initially with external tags, since fin-clipping and branding have been shown to be largely ineffective for sea trout recognition by fishermen. It is recognised that external tags will decrease survival rates but they will establish the basic facts of homing patterns and growth in the sea. Internal tags will be substituted at a later stage in the programme.

Autumn migrating trout

These are 1+ and 2+ trout which cannot be distinguished as either brown trout or sea trout and which migrate downstream through the Trusts traps during the months of September, October and November. The scale of this migration frequently approaches that of the definitive sea trout smolt migration in the spring and preliminary work has established that these fish contribute, to some degree, to the overall sea trout production. If the proposed electrophoretic analysis enables us

to distinguish sea trout from brown trout, the exact contribution of these migrants to the sea trout stock can be determined. In the meantime, further assessment work is necessary by means of external tagging.

Use of virgin lakes for sea trout rearing

Many sea trout fisheries along the west coast of Ireland possess small lakes, populated only by relict populations of "brown trout" and which are often inaccessible to upstream migrating fish. The value of these lakes as nursery areas for sea trout, planted as hatchery fry, for example, will be assessed. In particular, information is required on survival from fry to smolt stage under natural conditions and the later survival of these smolts to adults compared with that of hatchery reared smolts.

Virgin lakes can also be used for cake-rearing of yearling sea trout parr to the 2+ smolt stage, along the lines already suggested for salmon.

It may be necessary, at some stage, to grow a batch of sea trout smolts (derived from a mixed gene-pool) to adult size in a sea-cage, to obtain a large enough broodstock for the research work envisaged above.

5. CENSUS PROGRAMME

Facilities available and nature of results

The Trust is especially favourably placed in this aspect of research in that the present system of traps on the Mill Race and Salmon Leap enable all upstream and downstream migrants to be counted, with a high degree of accuracy. Data of high accuracy are available on such aspects as:—

(i) the survival from one generation of salmon to the next, where it has been shown that from 1976 onwards, the net reproduction rate (female spawner to adult offspring) is less than half that required for a self-sustaining population.

(ii) stage survival rates, such as egg to smolt, smolt to adult, spawner to kelt and kelt to 2nd spawner. This has enabled us to relate current poor returns to lowered survival in the sea (probably from commercial exploitation in the case of salmon) and to loss of spawning stock in fresh water (probably from illegal fishing) in the case of sea trout.

Use in other research programmes

All the proposals in the salmon and sea trout programmes detailed above require that differences in survival rates brought about by, for example, dietary changes or immunisation procedures, be monitored accurately. The Trust is therefore able to assess the value of this experimental work from returns through the traps, where this would be difficult, if not impossible elsewhere.

Continuing requirement for census work

Since the trapping facilities of the Trust are unique in Ireland and their results have wide applicability to at least the majority of west coast fishery systems, the

census work will be continued uninterrupted. The duplication of such trapping facilities in any other location would be a very costly undertaking and in the first instance could only be justified if a different salmon population, such as that of a predominantly spring fish river, were to be trapped for census work.

6 EEL RESEARCH

Silver eel trapping

In conjunction with the salmonid census work at the traps, silver eels are caught on their downstream migration in the autumn. It is proposed to continue the census work on migration times, production levels and average weights of silver eels and material will be made available to other workers in this field.

Elver trapping

Elver traps have been constructed on each bank of the Mill Race and it is proposed that two further traps be constructed at the Salmon Leap. By this means, the incoming elver run each year can be assessed and the elvers sold to more favourable locations for eel production. This will enable the Trust to follow the effect of elver culling on eel stocks, as well as possible effects on the population of salmon and trout by the creation of more "living space" and curtailment of possible competition and predation.

7. FIELD WORK

Restocking with salmon at different development stages

Very little reliable information is available on the relative merits of restocking methods involving eyed eggs, early feeding fry, yearlings or smolts, although this information is essential to the future management policies. In the first instance, survival to the smolt stage requires to be reliably assessed by planting with early feeding salmon fry, in the presence of a natural complement of trout and eels in the same stream. The survival will then be followed through the various stages by electro-fishing and checking the final production of smolts (as well as any downstream migration of pre-smolt juveniles) by means of a trap.

These studies are difficult by their very nature, which explains why relatively little reliable information is available. The Cottage River at Treanlaur would serve as a suitable experimental stream, although being a mountain stream, it is subject to flash floods with extensive leaf detritus. Considerable background information is available for this stream, it has a good site for a downstream trap and most importantly, the old laboratory (on the bank of this stream) will serve as an accommodation and study base for personnel involved.

If the project is to be successful, the trap must be well designed and constructed as this should be a continuing project, using different restocking techniques in different imposed environments in the stream.

Re-afforestation and salmonid habitat

Considerable disquite has been voiced recently over the possible effects of re-afforestation on salmonid nursery streams. Adverse effects arise mainly from the drainage which precedes re-afforestation and the associated scouring and siltation, but other environmental effects include the reduction of pH of the water in coniferous forest areas and the effects of forest spraying.

The Trust carried out a survey of the Glenamong River and its valley in 1962 with the object of quantifying any changes that might occur from re-afforestation which was planned to begin in 1964. In fact, re-afforestation did not begin until 1974 and a new survey will begin in 1979 (with a view to preparing a programme of possible future research.)