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BRADAN na h-EIREANN
IONCORPORTHA

THE SALMON RESEARCH
TRUST OF IRELAND
INCORPORATED

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AGRICULTURE AND FISHERIES

ANNUAL REPORT

NUMBER XVII

FOR THE YEAR
ENDED 31st of
DECEMBER 1972

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(The Salmon Research Trust of Ireland Incorporated)

REPORT FOR THE YEAR ENDED 31st DECEMBER 1972

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FOREWORD :
AIMS AND OBJECTIVES

The overall objective of the Trust, founded in 1955, was to carry out fundamental research into factors which govern the development of stocks of salmon and sea trout in Irish waters. The primary aim was to study the question of whether grilse and salmon constitute genetically distinct stocks and to this end, the Trust has embarked upon a selective breeding programme, in which the progeny of various stocks or "races" of salmon were reared to the smolt stage.

Arising out of this, considerable attention has been paid to improvements in rearing techniques, including artificial food and feeding methods, as well as ancillary improvements in marking and release of reared smolts.

In order to assess the viability of these reared fish, it was necessary to be able to trap and count all returning adults and to this end, the Trust has constructed trapping facilities for both upstream and downstream migrants on the two routes into and out of Lough Feeagh. These installations also allow accurate census work to be carried out on the wild populations of salmon, sea trout and eels. Annual variations in spawning escapement, rod fishing efficiency, smolt production, smolt survival to the adult stage and kelt survival have been established by this means, since 1970. Information of this nature is the essential basis for rational management of Irish salmon fisheries.

In addition to the above, research of a more general biological nature has formed part of the Trust's programme, including biological productivity surveys, experiments on artificial restocking, competition and predation, as well as research work on peat silt pollution.

R. V. H. LEVINGE, Chairman

COMMITTEE OF MANAGEMENT

Dr. C. K. Mill, who served on the Committee of Management as a nominee of the Chairman of Arthur Guinness Son & Co. Ltd. since the formation of the Trust in 1955, and as Chairman since 1960, retired during the year. The Committee places on record their appreciation of the great services rendered to the Trust by Dr. Mill. Dr. I. R. Moore was appointed in his place. Sir Richard Levinge, who has also served on the Committee since the formation of the Trust was appointed Chairman. Miss Eileen Twomey was elected as an additional member of the Committee.

STAFF

Mr. A. F. Gibbons left the employment of the Trust with effect from January 31, 1972 after almost twelve years' service. The Committee of Management wishes to record its appreciation of Mr. Gibbons' work for the Trust, over this period.

Mr. Patrick Mulchrone was appointed as Field Assistant with effect from March 27, 1972.

A second night watchman was employed during the summer months to supplement the Trust staff on night duty at the Salmon Leap during periods of high water.

The two trainees sponsored by the Atlantic Salmon Research Trust completed their course in 1972, during the periods April 15 to May 30 and August 1 to September 30.

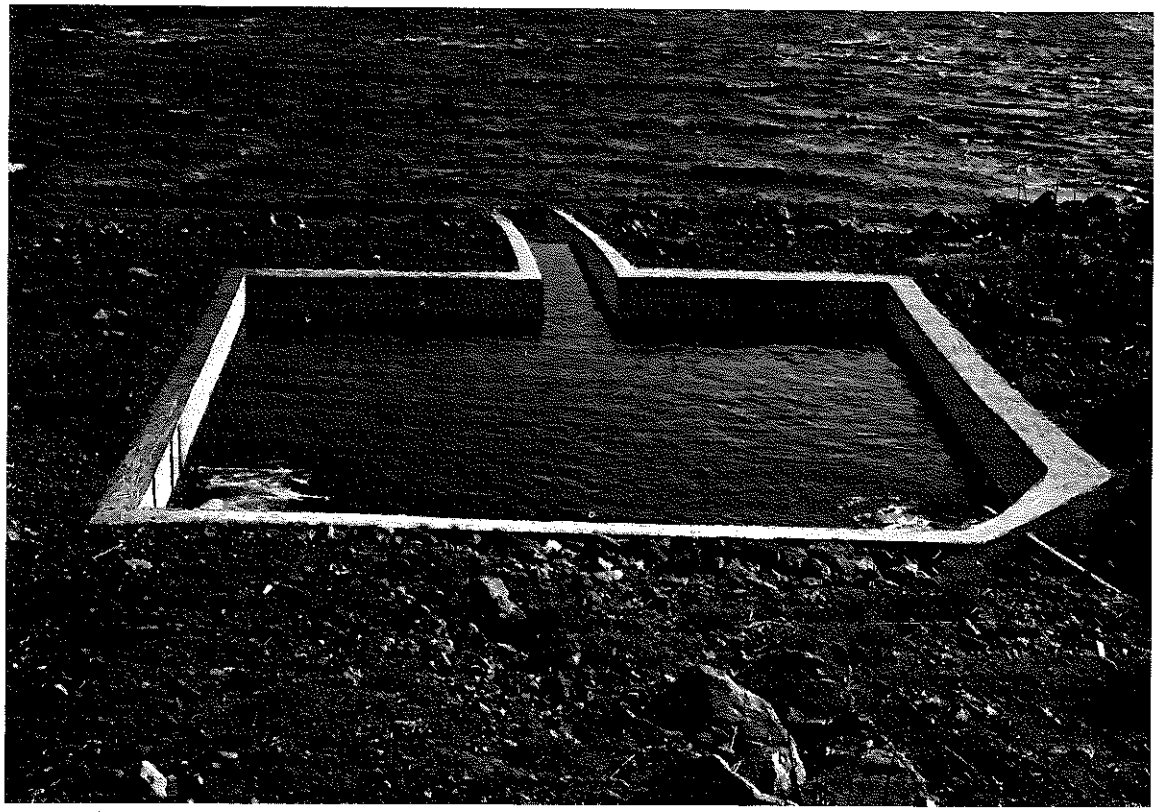
INSTALLATIONS

The stone facing of the concrete sides of the upper portion of the Denil pass and upstream trap at the Salmon Leap was completed early in 1972. The old watchman's hut (overlooking the lower portion of the Salmon Leap) was demolished and a new staff hut constructed at a lower level, involving the removal of about 20 cubic yards of soft rock. The hut was built with natural stone facing in order to harmonise with the surroundings and has been supplied with electricity by underground cable. A range of stone steps leads down to the hut from the level of the county road. The Lower Landing Hole of the Salmon Leap can now be watched much more effectively in times of flood, with the provision of a powerful floodlight mounted on the east wall of this hut, controlled from inside the hut.

The bungalow which serves as a residence for a member of the Trust's staff who is responsible for the Salmon Leap traps was completed and handed over by the contractors in mid-June. Since then, a fuel store has been built adjoining the bungalow, boundary walls and fencing have been erected, the site has been cleared, levelled and filled, where necessary, and retaining walls have been built for the steep earth banks to the rear and side of the bungalow site. A side entrance gate and path have been constructed and the car park areas in front of the bungalow and the upstream trap have been surfaced with tarmacadam. A small lawn and flower borders have been established around the house.

The work of lowering the cill of the upstream trap at the Salmon Leap was undertaken in the early summer, during a period of low water. This involved cutting out an area of concrete 5′ 3″ × 3′ 4″ × 9″ thick from the middle portion of the cill and refacing with 2″ of concrete, to increase the depth by 7″. The false floor of the trap was dismantled and the upstream third was then lowered by cutting and re-welding the support beams, so that fish no longer have to move up over a raised portion of the floor when being released. The concrete under the false floor had to be chiselled out to a depth of 4″ under the support beams so that the trap floor could be

PLATE I



New release pond at Furnace

lowered to accommodate the increased depth of the cill. A channel of 9″ depth was excavated from the cill, upstream to permanent deep water and the total effect has been a very considerable improvement both in migration of fish at low flows and in release of fish from the trap.

During 1971, it was observed that upstream migrating fish were experiencing some difficulty in negotiating a constricted portion of the Salmon Leap falls, where there was a steep, smooth slope of rock. Using compressed air drills, the constriction was widened and two channels were cut on either side of the rock slope. Both salmon and sea trout negotiated this area without apparent difficulty during the 1972 season.

Following construction of the new flood channel for the lower portion of the Mill Race by the County Council in 1971, one of the original smolt release ponds on the shore of Lough Furnace was demolished. A new and larger release pond (25′ × 20′ × 2′ 6″ deep) was built in the spring of 1972, having 2 × 4″ water supply pipes (approximately 150 gals/minute) and a 2′ wide channel exit with overspill weir. This pond proved successful in use for smolts released in May, 1972. (See Plate I.)

The upper 20 yards of the left bank of the Mill Race was widened by some 3 feet during the early Summer. The channel was not deepened however, so that although much more water passes down the Mill Race in flood conditions, the low water flow remains unchanged. The rubble dam of the resting pool below the upstream trap on the Mill Race was strengthened and capped with concrete, to prevent damage in the increased high water flows.

RAINFALL AND WATER TEMPERATURE

Precipitation was again below normal in 1972, following much the same pattern as the years 1969 and 1971. The total rainfall measured at Furnace (1,275·4 mm : 50·2″) was only 85% of the average over the past ten years and the monthly totals over the past five years are shown in Table I next page, for purposes of comparison.

Rainfall in the spring was normal but the summer months were generally dry, culminating in a precipitation of only 12·9 mm (0·5 in) in September. This is less than one-tenth of the average rainfall for the month and is the lowest monthly total noted since records began in 1960.

Water temperatures in the Mill Race are shown in Fig 1, the most noticeable feature being the effect of the long, cold spring weather which maintained relatively low water temperatures until early May. The temperature did not rise above 4°C until mid-March and reached 8°C by April 20, some three weeks later than in 1971. The absence of rainfall in the latter half of July contributed to a rise in water temperature from 13°C to 21°C over 7 days, this being the highest mean daily value yet recorded. Diurnal fluctuations at this time were of the order of 4 to 5°C, compared with normal values of 1 to fallen to 6°C, which is normal for that time of the year, compared with the rather warmer conditions in 1971.

The water levels in the Mill Race are shown in Fig. 1; from which it may be seen that the incidence of floods was normal during the first half of 1972, with adequate water for smolt and kelt migration, except for the last week of April. Low water conditions were experienced from mid-July to early August, inhibiting salmon movement upstream, whilst from August 20 until October 26, water levels remained at an abnormally low value, when the Salmon Leap was dry and the upstream trap at the Mill Race had to be closed. This was followed by a period of sustained high water until mid-December, including one heavy flood on November 8, which just overtopped the fish fence screens on the Mill Race. The sluice control arrangements at the Salmon Leap were fully able to cope with even this, the highest flood experienced for some years.

The usual meteorological records of air temperatures, rainfall, sunshine and barometric pressure were kept throughout the year.

FIG. 1

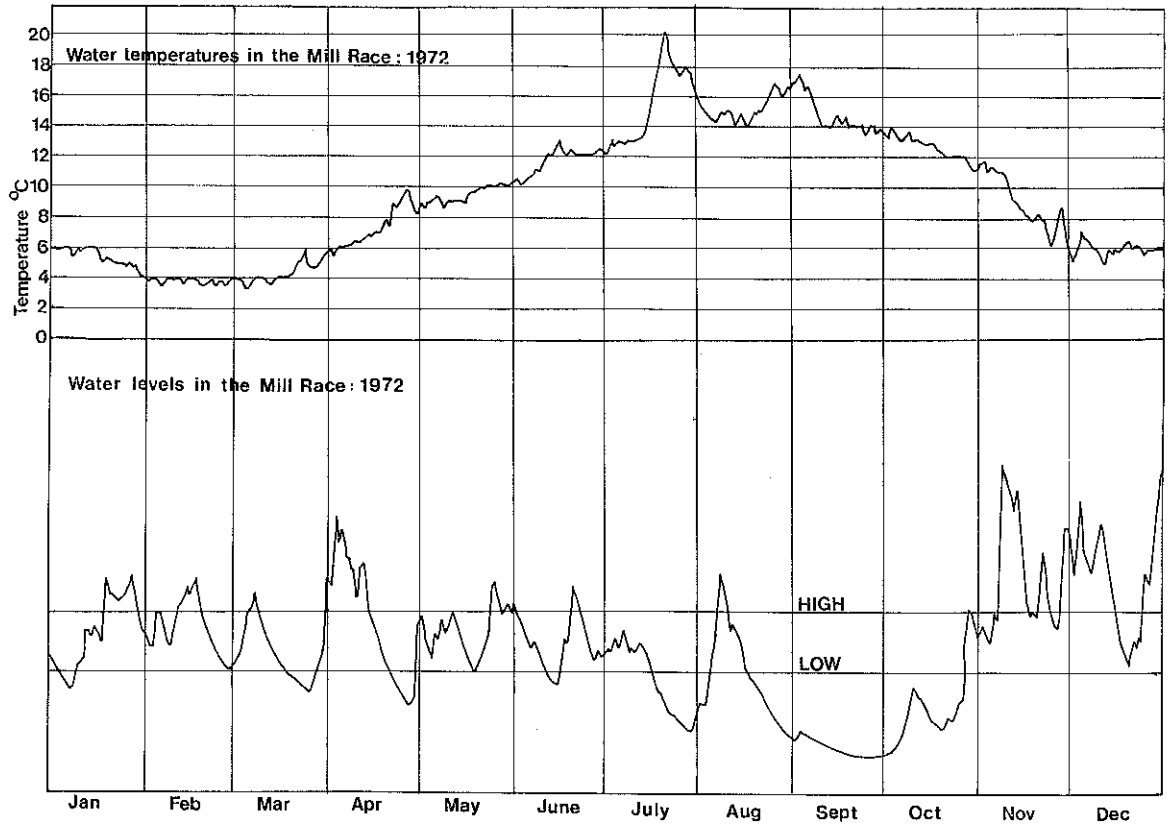


TABLE I — MONTHLY RAINFALL AT FURNACE (in mm) FOR THE YEARS 1968—72

Month	1968	1969	1970	1971	1972
January ...	199·7	140·1	68·2	130·1	109.7
February ...	50·2	98·6	267·0	134·3	98·4
March ...	134·9	62·7	141·9	90·0	139·8
April ...	64·2	84·7	150·2	33·8	140·8
May ...	85·8	57·1	44·1	59·6	141·2
June ...	65·5	110·4	57·3	114·7	92·4
July ...	51·1	43·1	128·1	51·2	49·8
August ...	168·6	79·3	116·1	77·1	69·3
September ...	164·9	63·3	175·6	86·3	12·9
October ...	183·6	105·7	225·2	112·1	59·7
November ...	163·9	187·6	199·8	211·9	191·9
December ...	149·4	178·3	82·1	73·2	169·5
Totals (mm.)	1,481·8	1,210·9	1,655·6	1,174·3	1,275·4
Totals (ins.)	58·3	47·7	65·2	46·2	50·2

REARING OF SALMON OF KNOWN PARENTAGE

(a) Grilse ova hatched in 1970

No. of ova, December 1969	: 38,000
Remaining stock at 31/12/70	: 9,758
No. of 1+ smolts released in 1971	: 1,567
Mark : Brand "H" + adipose fin-clip	
No. of parr remaining, June 1971	: 3,910
No. of parr remaining, January 1972	: 3,665
No. of 2+ smolts released, April 1972 (90·6% survival over 2nd year)	: 3,544
Mark : Brand "Z" + adipose fin-clip	

"Fungus" disease appeared in December, 1971, causing losses of 82 fish in that month and 64 in January, 1972. Thereafter, this disease almost disappeared and only 57 further losses occurred up to release in April.

These 2+ smolts were the product of the total stock of 1+ parr in June 1971, and the smallest were not discarded, as in previous years. Their average size at release was 17·2 cm, ranging from 14·0 to 22·5 cm. No "giant" smolts were recorded, due to losses from disease of small 1+ smolts retained.

None of the 2+ smolts released in 1972 showed any trace of "fungus" disease, as has been the case in the past three years and almost all the smolts had migrated to sea within one week of being placed in the release pond.

(b) Grilse ova hatched in 1971

No. of ova, December 1970	: 84,650
Remaining stock at 31/12/71	: 20,184
No. of 1+ smolts released in 1972	: 4,362 (23·1%)
Mark : Brand "7" + adipose fin-clip (reared parentage)	
Brand "B" + adipose fin-clip (wild parentage)	
Remaining 1+ parr, April 1972	: 14,550
Remaining 1+ parr, July 1972	: 3,373

Losses were light from January to mid-April (4·8% of the stock) but from then on, the same disease as has been noted over the past four years reappeared among the yearling parr and quickly reached epidemic proportions. The disease outbreak coincided with the first relatively rapid rise in water temperature, allied with falling water levels (see Fig. 1), at a time when the shallow waters of Lough Feeagh and the Mill Race support a dense growth of filamentous algae. It should be noted too, that the disease is at its worst during the period of natural smolt migration, when the wild fish may be acting as carriers of an endemic disease organism. The presence of large numbers of these fish each day in the Mill Race, where the water supply is drawn for the rearing ponds, could well increase the infectivity rate to the epidemic level.

Over 60% of the losses occurred during May when apparently well-grown, unblemished fish were dying at the rate of over 500 per day, for a short period. The total loss over the period of 12 weeks was 76·8% of the stock.

As in previous years, there were no common signs of disease among the dead fish and indeed, most fish were unmarked. No bacterial disease organism could be ascribed to the majority of the fish although cultures of **Aeromonas liquifaciens** and **Pseudomonas fluorescens** were obtained from some fish specimens examined at the Fish Pathology Unit of the Department of Agriculture and Fisheries Veterinary Research Laboratory at Abbotstown, Co. Dublin. This would suggest an epidemic of haemorrhagic septicaemia, which can be acute, rapidly fatal and with few gross signs of disease. Some investigators believe this condition to be triggered off by environmental conditions, rendering fish susceptible to **Aeromonas** and/or **Pseudomonas** infections. It should be noted too, that the fish have to be graded in April, to remove 1+ smolts and handling stress is also cited as contributing to infection.

Both bacterial strains showed disc sensitivity to chloramphenicol and terramycin and these antibiotics were fed singly and together during May but without noticeable effect until mid-June.

Measures proposed for the possible prevention of a recurrence of this epidemic in 1973 include early prophylactic dosage with antibiotics, early grading and thinning out of the pond population, as well as supplemental aeration during the hours of darkness.

The 1+ smolts comprised two batches, where one was derived from "reared" parents and the other from "wild" parents. The smolt transformation rate was 27% in the "reared" batch and 19% in the "wild" batch, constituting the only real difference between the two groups. Their relative performances over the year in growth and mortality rates were very similar.

As noted above, only 3,373 yearlings were available for rearing on to the 1+ smolt stage and these quickly settled down after being transferred to 25m ponds on July 15. The "fungus" disease appeared in one of the three ponds in September and October but did not spread to the others. By December 31, a total of 267 fish (7·9%) had died and the disease had reappeared

in all three ponds from December 20. Growth was below normal over the summer and autumn, with the fish reaching an average length of 15·0 cm by the end of the year.

(c) Grilse ova hatched in 1972

No. of ova, December 1971	: 88,800
No. of ova, February 1972 (by transfer to commercial hatchery)	: 61,600
No. of fry, July 1, 1972	: 29,707
No. of parr, December 31, 1972	: 23,334

The hatchery stock of ova was obtained exclusively from line-bred grilse, which were maintained as separate family groups. Considerable differences were observed, both in the fertility of the ova and the viability of the alevins. One batch of 2,650 ova from a small female was discarded at the stage when they should have been "eyed", due to a very low fertilisation rate (less than 5%). Later, a further batch of 4,550 fry failed completely to adjust to artificial food, becoming emaciated "pinheads" and eventually dying off.

Washing and shocking of the eyed ova was carried out after 50 days' incubation and hatching commenced some 20 days later. Losses were normal up to the early feeding stage (approximately 140 days' incubation) at 15%, but might have been better had not some trouble been experienced with the centre floor drains of the 2′ 6″ ponds. These were covered by fine mesh (1 mm) screens and the outlet pipe raised so that theoretically, all the waste water passed through the high level overflows on the side walls of the tanks. In practice, however, there was a very slight seepage through these floor drains and this was quite enough to induce newly-hatched alevins to congregate on the fine mesh screens. Their yolk-sacs became enmeshed in the screen and close to 1,000 alevins were lost as a result, before the screens were closed off completely by aluminium plates. These were removed only when the yolk-sacs had been absorbed, at the swim-up fry stage.

During the early-feeding period in May and June, losses were heavier than normal, due to repeated infections with bacterial gill disease and fin-rot. This may have been due, in part, to less successful early feeding with a cheaper pellet food used in place of the normal starter food which was unavailable in 1972.

Both flumes and tanks in the hatchery were fitted with automatic feeders; those for the 12 flumes were powered by a tilting siphon as opposed to the automatic electrical timing of the feeders for the 9 tanks.

The fry were moved to outdoor ponds from the end of July to early September, the more backward fry being maintained longest in the hatchery. Some bacterial gill disease was still present in August but during the next three months, the mortalities were confined to the smallest specimens which contracted tail rot. In December, however, losses from "fungus" disease started to occur amongst the largest grade under-yearling salmon and their total was reduced by over 400 fish from this cause. It is unlikely that there will be more than 4,000 yearling smolts from the total population of 23,000 and this underlines the generally unsatisfactory growth rate in 1972. There have been no changes in food or feeding techniques so that it would appear that the progeny of grilse derived from one-year-old smolts may not be as successful under present rearing conditions as those from the 2+ smolt-grilse of earlier years. Ova were taken from both parent types in December, 1972, in order to compare their respective performances.

The average length of 19,000 small grade yearlings at the end of 1972 was 6·3 cm and that of the 4,000 large-grade was 8·7 cm. Survival from the stock of 61,600 ova is shown below as monthly losses, totals and percentage survival :

TABLE II

	Stock	Losses	Percentage Survival
Original stock	61,600	—	
December 1971	60,281	1,319 (Fertilisation losses)	97·9
January 1972	56,750	3,531 (Washing and shocking)	92·1
February	55,953	797 (Hatching)	90·8
March	54,236	1,717 (Outlet screen losses)	88·0
April	52,343	1,893	85·0
May	43,594	8,749 (Early feeding losses)	70·8
June	34,718	8,876 (Bacterial gill disease)	56·4
July	29,707	5,011	48·2
August	26,627	3,080	43·2
September	25,718	909	41·8
October	25,228	490	41·0
November	24,286	942	39·5
December	23,314	972	37·9

(d) Swedish sea trout, hatched in 1972

No. of eyed ova, February 1972	: 19,960
No. of fry, July 1, 1972	: 15,389
Sold to Spiddal River, October 1972	: 2,000
No. of parr remaining, Dec. 31, 1972	: 6,177

A consignment of ova from the Ems River in Sweden was received on February 24 and laid down in the hatchery flumes, after disinfection. Hatching occurred within four days of arrival and was accompanied by an above-average mortality, due possibly to the change in their environmental temperature. Some three weeks after hatching, large numbers of deformed alevins were removed from the flumes, the deformities consisting largely of "corkscrew" bodies and less severe lordosis effects. The survivors came on to the feeding stage with little trouble and were noticeably easier to accustom to artificial food than were salmon.

They were moved to outdoor ponds on June 30, by which time the total mortality rate had reached 22·9%. From July 20 one of the four batches in ponds developed a mounting mortality rate from a condition previously unseen, in which one eye only exhibited exophthalmos, eventually bursting and causing death of the affected fish. The condition was not caused by infra-ocular gas bubbles nor by parasite attack. This condition persisted until mid-August and as it decreased in intensity in the original batch, a second batch became affected. Here again, the condition ran its course until mid-September despite varied treatments, whilst the two remaining batches showed no signs of the condition throughout the period.

The fish were graded in late September and 2,000 small-grade fish were sold to the proprietors of Spiddal River, Co. Galway. Little trouble was experienced with the remaining fish until late December when 1,300 fish were killed by an accidental overdose of Malachite Green. The total surviving at the end of the year was : 3,140 large-grade fish : average length 8·3 cm 3,037 small-grade fish : average length 6·8 cm

(e) Hatchery operations in 1972

Hatchery stocks of ova were selected from two types of reared grilse in 1972. This was to enable comparisons to be made between fertility, fecundity, growth and survival of the progenies of grilse from 2+ smolts and grilse from 1+ smolts, respectively, selected on the basis of cold-brand marks from the trap catch. Parent fish were retained in holding pens from early October onwards, utilising as many as possible of the early-run fish which had been allowed through the traps to Lough Feeagh and which were engaging in a return migration, having passed downstream again after their initial upstream migration. (This phenomenon is discussed at more length on page 30.)

Stripping of ripe female fish began on December 4 and continued at weekly intervals until December 19. In all, 31 females were stripped, giving a total of 128,600 ova, which probably will be reduced at the eyed stage to approximately 80,000.

As might be expected, the larger grilse from 2+ smolts had higher fecundity values than those from 1+ smolts. Comparative values were as follows :

TABLE III

	1+ smolt/grilse	2+ smolt/grilse
No. of fish (females)	17	14
No. of fl. oz. produced	392	436
No. of ova produced	64,600	64,000
No. of ova per fish	3,800	4,570
No. of fl. oz. per fish	23	31
No. of ova per fl. oz.	165	147
Average weight of fish	5·25 lbs. 2·38 kg.	6·0 lbs. 2·72 kg.
No. of ova per lb. wt.	724	762
No. of ova per kg./wt.	1,593	1,676

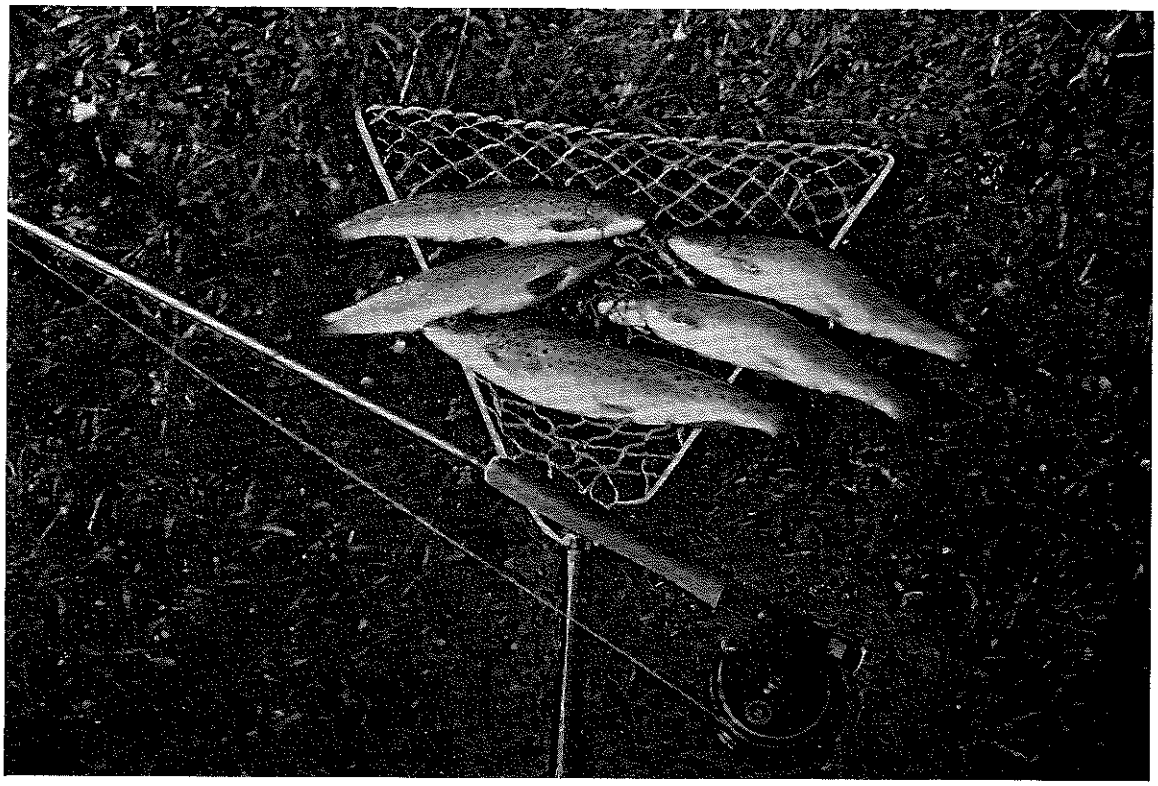
The size of ova was very variable in the 1+ smolt/grilse, ranging between 147—201 per fl. oz. (averaging 165 or 4,687 per litre). Those from the 2+ smolt/grilse were larger and much less variable, ranging between 139—159 per fl. oz. (averaging 147 or 4,176 per litre). All values were recorded after the fertilised ova had been allowed to swell for 30 minutes in water.

SALMON AND SEA-TROUT HYBRIDS

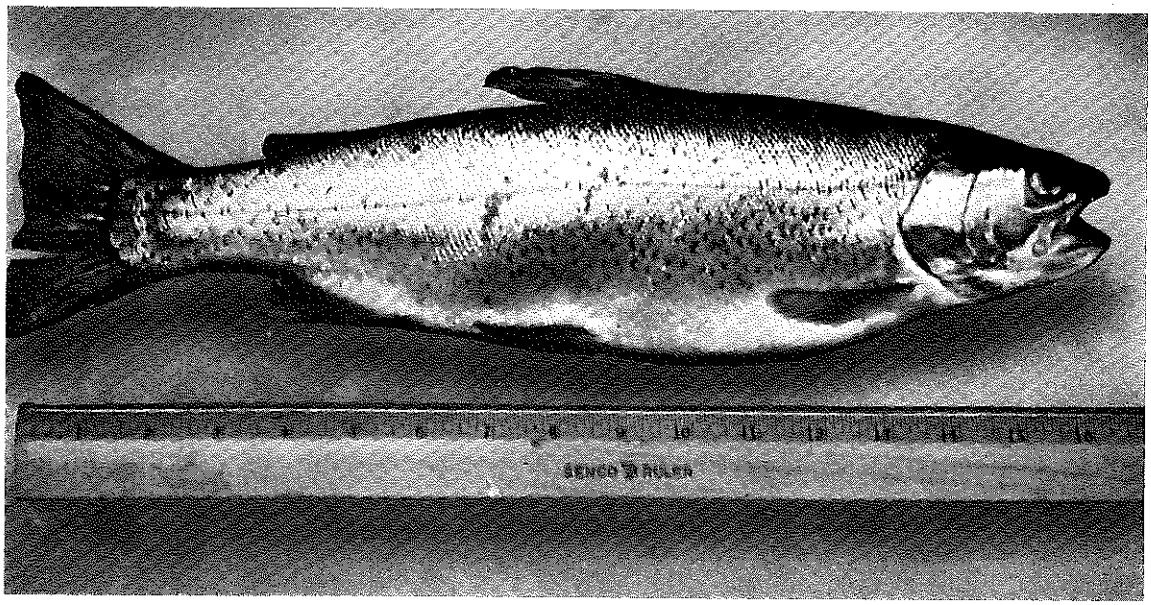
Ballinlough, the experimental land-locked lake used for field trials on the hybrids, was stocked with fingerling rainbow trout in November, 1970. The rod-fishing on this lake was opened to local anglers, free-of-charge, in May 1972. Good bags of rainbow trout were made, when the fish averaged $1\frac{1}{2}$—2 lbs (0·68—0·91 kg) in weight at 2 years of age. Upwards of 200 rainbows were recorded as having been caught but the actual total was almost certainly greater. (See Plate II.)

An interesting feature of the rod catch was the reappearance of occasional hybrids, in the proportion of about 1 hybrid to 8 rainbows. These fish were thought to have died out, in that none were caught in 1970 but this may have been due to their small numbers in an environment with a rich food supply. The addition of 2,000 rainbow trout to the lake presumably encouraged a more active, foraging behaviour among the hybrids. They averaged $3\frac{1}{2}$ lbs (1·59 kg) in weight, with occasional specimens of over 4 lbs. Scale samples showed them to be aged 5+ years, having been released as 0+ fish in 1967.

PLATE II



2+ years hybrids (1965) from Ballinlough, 12·0″ average length.



2+ years rainbow trout (1972) from Ballinlough, 16·0″ in length.

EXPERIMENTAL REARING TECHNIQUES

(a) Warmed water for incubation and early feeding

This project was sponsored by the Atlantic Salmon Research Trust with the object of increasing the annual proportion of 1+ smolts in the population by reducing the incubation time and promoting active early feeding by warming the water.

The installation was tested first in late December, 1971 when the ambient water temperature fell below 8°C. The mixing valve was then seen to be subject to over-compensation, causing unacceptable variations in the temperature of the outflowing water. The fitting of new thermostatic controls had no effect on this malfunction, when a small movement of this large valve from the "closed" position to the "slightly open" position resulted in too large a volume of heated water (60°C) entering the system, with subsequent overload of the sensor system, causing a cyclical variation between too cold (ambient) and too warm (25°C) temperatures.

The consultants then recommended installing a by-pass mixing valve and thermostat between the heat-exchanger and the boiler so that the water in the former could not increase in temperature above 20°C. When, after long delays, this was completed and tested, the system still failed to operate satisfactorily and the fault was traced, eventually, to the motor of the by-pass valve having been incorrectly wired. As a result of all the faults and delays in rectification, the apparatus was not functional until May, 1972 when the need for it had passed.

A recording thermograph was installed on the warm-water pipeline in the hatchery in August, 1972 and the installation restarted on December 8, 1972. Within 24 hours, the main circulating pump for the boiler/heat exchanger unit had burned out and a replacement had not arrived by the end of the year.

(b) Experimental incubation trays

The new model incubation unit supplied by Grice & Young Ltd. for the 1971/72 season had an expanded metal ova tray, improved diffuser mesh and completely airtight joints. It functioned well throughout the incubation season and alevins were retained in the ova tray for 2 weeks after hatching. Losses throughout the period were slightly less than the average for conventional baskets.

(c) Marking techniques

Cold-branding, in conjunction with clipping of the adipose fin was used for all hatchery-reared smolts in 1972, results to date having confirmed that this is the cheapest and quickest form of batch-identification for smolts.

The grilse returning from the 1971 releases of smolts were marked with "V" and "H" brands, for 2+ and 1+ smolts respectively. These marks were not read as easily as the "X" and "O" marks of the previous year and it would appear that the widest possible divergence in form of brand-mark should be employed when different batches of fish are to return in the same year. In particular, the best contrast is obtained from brands employing curved lines (e.g. "O", "8", "C", etc.) with those employing straight lines ("X", "II", "Z", etc.).

Brand-marks were not noted on a number of the rod-caught specimens, but this was not due to difficulty in distinguishing the brand. Discounting the rod-caught fish and those that were fin-clipped Adipose and Dorsal (no brand), there were 27 doubtful brand marks among 559 trap-caught specimens, giving 95·2% readability. In each case, the parentage was determined eventually, by scale-reading. It should be noted that 1+ smolts branded "O" in 1970 were recaptured as 2-sea-winters fish in 1972, with the brand-mark still perfectly distinct, although slightly larger than on grilse.

Other forms of marking in use during 1972 include :

(i)	Floy gun tags for upstream-migrating fresh salmon and grilse.
(ii)	"Needle and thread" tags (Lea and flat plastic) for salmon and sea trout kelts.
(iii)	Double-wire tags for salmon kelts.

The speed and ease of attachment of Floy tags makes them highly suitable for tagging fresh-run salmon, where handling stress must be avoided. As in previous years, however, up to 10% of the fish lost their tags completely, within three months of tagging whilst others were noted with the T-bar and strap in position but with the coloured plastic tube missing. The tagging guns "misfire" occasionally, when the strap and tube are cut off the T-bar during application. The problem of tags pulling out is thought to be largely a question of experience in tagging procedure when the needle should be thrust fully home under the dorsal fin and the tag released without moving the point of the needle. Any movement of the needle tip gives a wound space in which the T-bar can later move and become dislodged.

In the tagging of salmon kelts with "needle and thread" tags during 1972, there were 4

recaptures out of 35 kelts as short-absence previous spawners (11·5%) compared with 8 recaptures from 25 kelts (32·0%) tagged with the double wire technique. This reverses the results obtained in 1970 and 1971, when the polyethylene thread tags were slightly more successful, but the numbers involved in the 1972 taggings were too small for the result to have much significance.

FISH MOVEMENTS

This section deals with the results of census work on upstream and downstream migrants, when 1972 was the third year in which a complete count was possible, following construction of the Salmon Leap installations in 1969.

(a) Upstream
(i) Salmon and grilse

The run of wild spring fish improved again in 1972 with a total of 21 fish which, whilst still very far short of the numbers of spring fish known to enter the fishery system some 15 to 20 years ago, represents the best escapement over the past ten years. The Salmon Leap provided 18 out of 21 recaptures, beginning on May 2 when the water temperature had reached 9°C and continuing until early June. The run started during the first period of high water following 2 weeks of low water levels.

The first wild grilse appeared on May 26 at the Mill Race, followed by 10 further fish at the Salmon Leap during the remainder of the month. Water levels fell away during the first 17 days of June, with only 10 fish being recorded at the Mill Race during this period but a small flood on June 18 initiated a run of 53 fish at the Salmon Leap and 66 fish at the Mill Race.

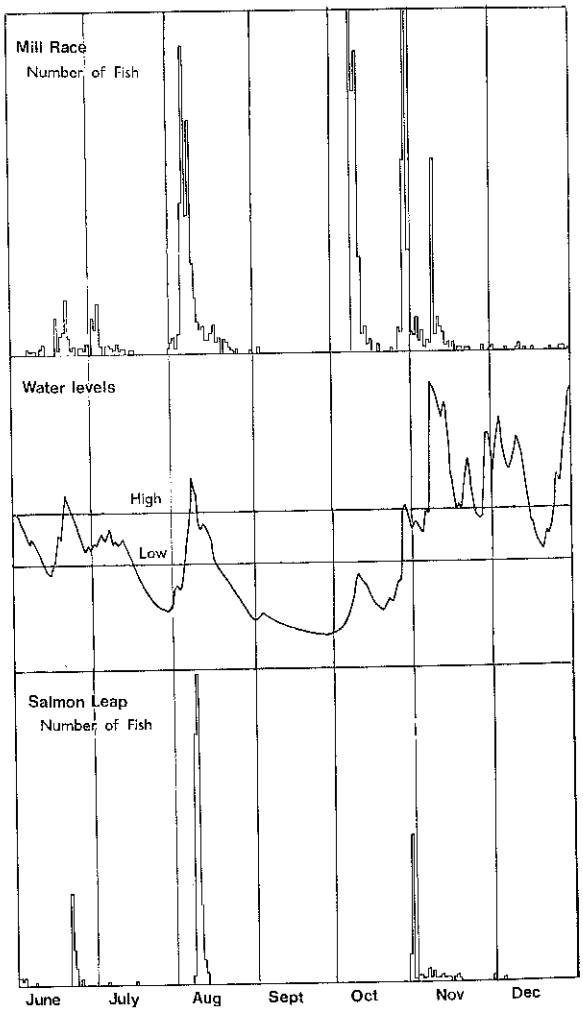
The Salmon Leap was dry for 18 days during the second part of July but grilse ran through the Mill Race until July 17, ceasing thereafter until August 1. There was insufficient water in the Salmon Leap until August 7 but in the ensuing 6 days, 215 grilse were counted through. The Mill Race had adequate water for fish passage from August 1 to 26, in which time 333 passed through the trap.

An almost complete stasis in salmon movement occurred throughout September at both traps, due to very low water conditions and this persisted at the Salmon Leap until October 29. Water levels in the Mill Race rose on October 9 to give barely adequate running conditions and in three days, 114 fish were counted through. This run was maintained during the following 5 days in falling water conditions but stopped again from October 17 until October 27. The Salmon Leap returned to operational level on October 29 and thereafter, high water conditions persisted for the remainder of the year, with almost 60 further fish being counted at the Salmon Leap and 254 at the Mill Race. It should be noted that these figures refer to wild grilse only and do not take into account the additional 606 grilse derived from reared smolts which were also counted through the traps.

The total run of 1,369 wild grilse through the traps is the best recorded during the three years of full operation of both traps and almost certainly constitutes the heaviest run of grilse to reach fresh water over the past fifteen years. All the smolts giving rise to this run were trapped, counted and released at the two trap sites, proving that careful handling at this delicate stage need not have a detrimental effect on returns. Indeed, it may be beneficial to some degree, in that smolts are released in batches, usually twice but occasionally three or four times each day. This mode of migration into Lough Furnace seems much less likely to encourage heavy concentrations of bird or fish predators at the mouths of the Mill Race and Salmon Leap than is a steady trickle of smolts over each 24 hours.

The grilse total at the Mill Race was almost three times that of the Salmon Leap but this disparity was due to the low water conditions

FIG. 2



that prevailed until the end of October. The lowering of the cill of the upstream trap at the Salmon Leap and the changes made in the last remaining difficult portion of the ascent have improved the speed and ease with which fish moved through the Salmon Leap in 1972. The widening of the mouth of the Mill Race also contributed to the increased proportion of fish counted there, in that it now carries more water in all but low water conditions.

The effect of water height is shown in Fig. 2 and confirms the conclusions drawn in 1971 i.e. that salmon movement upstream is possible over a much wider range of water height in the Mill Race and that the water level must rise above the "High" line in Fig. 2 before salmon are induced to tackle the falls of the Salmon Leap.

The figures for comparative escapements of spring fish and grilse through the Mill Race over the thirteen years period 1959—71 were given in **Ann. Rep.** XVI, 19. These comparisons now lack some relevance in view of the complete census that has been possible since 1970, when the trend towards reduced numbers of spring fish and increased numbers of grilse can be seen from the two five-year and the one four-year averages :

TABLE IV

	Spring fish	Grilse
5 year average 1959—63	17	233
5 year average 1964—68	6	321
4 year average 1969—72	3	688

Table V gives the comparative escapements of wild salmon and grilse through both traps for the years 1970 to 1972.

TABLE V

Year	Mill Race		Salmon Leap		Total	
	Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
1970	0	468	0	620	0	1,088
1971	4	354	1	386	5	740
1972	3	1,024	18	345	21	1,369

Table VI compares the monthly percentages of wild grilse counted through the Mill Race trap only, over the past three years, with the average values for the two five-year periods 1960—64 and 1965—69.

TABLE VI

	1960—64	1965—69	1970	1971	1972
June	16·8	11·6	8·1	2·8	7·2
July	24·2	18·9	16·0	16·7	6·2
August	34·4	29·8	27·1	11·9	32·5
September	13·8	21·4	43·6	35·6	0·2
October	3·3	10·4	3·6	22·3	42·7
November	4·2	3·3	1·3	10·2	9·9
December	3·3	4·6	0·3	0·5	1·3

There has been a continuing trend towards lateness of the grilse run but annual variations in water levels, month by month, tend to lend false emphasis to values such as that of October, 1972 which was inflated by the lack of running water in September. The trend becomes more obvious when the percentages of runs for three periods (June and July; August, September and October; November and December) are compared for the two five-year and the three-year period.

TABLE VII

	1960—64	1965—69	1970—72
June and July	41·0	30·5	19·0
August, September and October	51·5	61·6	73·1
November and December	7·5	7·9	7·9

The fluctuations in monthly proportions of the total at the Salmon Leap are even more pronounced as a result of variations in water levels but the proportions of the total run at both traps (expressed as percentages) over the past three years bear comparison :

TABLE VIII

	1970	1971	1972
June	3·5	6·2	10·7
July	7·5	8·2	4·8
August	19·9	6·2	40·0
September	60·9	26·8	0·2
October	6·7	42·7	35·0
November	1·4	9·6	8·3
December	0·1	0·3	1·0

From this it may be judged that the early running grilse were more numerous in 1972, in that the large proportion of fish noted in August undoubtedly contained an element which would have run in July had water levels been adequate.

(ii) Sea trout

The escapement of sea trout through the traps to Lough Feeagh improved very considerably in 1972, with a combined total of 2,225 compared with 1,407 in 1971. This represents an increase of 58% in numbers but was due largely to a heavy run of finnock in late July, arising from the above-normal production of sea trout smolts counted during the Spring. (See (b) (iii), page 24.)

Almost 60% of the total was counted through the Mill Race trap during July, the run maintaining itself even during the period of very low water experienced at the end of the month. Accurate figures for the proportion of finnock are not available but is estimated at approximately 900 out of the 2,225 total. As with the salmon, upstream migration was impossible during September and the relatively high proportion of the run counted during October was a consequence of this delay. Again in 1972, the early run of sea trout in June was very small but was due to the comparatively late downstream migration of both smolts and kelts.

The total count of sea trout through the Mill Race trap over the past 13 years was given in **Ann. Rep.** XVI, 21. The years 1959—63 and 1964—68 have now been grouped as 5-year averages, for comparison with the past 4 years, in Table IX below :

TABLE IX

	1959—63	1964—68	1969	1970	1971	1972
Total count	1,548	1,345	1,484	885	889	1,799
Count in June	303	527	349	243	58	57
Count in July	1,019	622	607	450	461	1,287

Table X compares the average monthly proportions of the sea trout run in the Mill Race for the two 5-year periods 1959—63 and 1964—68, with the values for the past four years (expressed as percentages) :

TABLE X

	1959—63	1964—68	1969	1970	1971	1972
June	21·7	38·8	23·5	27·5	6·5	3·2
July	64·3	45·5	40·9	50·8	51·9	71·5
August	8·2	7·7	16·5	11·4	14·5	14·4
September	2·2	3·7	11·1	5·6	12·6	0·2
October	1·3	2·4	5·8	2·8	10·3	8·6
November	2·0	1·4	1·6	1·8	3·4	1·7
December	0·3	0·5	0·6	0·1	0·8	0·4

During three years 1970—72, total counts of sea trout entering Lough Feeagh have been possible, utilising the results from both the Mill Race and the Salmon Leap traps. It should be noted, however, that some very small finnock (10—12 ins.) can pass through the bars of the fish fence at the Mill Race in moderate to high water. Table XI gives the monthly percentages of the combined total count for the past 3 years, for comparison with Table X above :

TABLE XI

	1970	1971	1972
June	19·6	13·2	4·0
July	44·2	32·9	62·2
August	13·8	11·6	18·7
September	14·2	17·3	0·1
October	5·2	19·0	10·6
November	2·4	5·5	4·0
December	0·6	0·5	0·4

(iii) Spawning escapement to Lough Feeagh

(a) Salmon

TABLE XII

	Wild	Reared
Counted through traps	1,390	606
Rod catch in Feeagh	110	12
Taken for hatchery use	24	217
Escapement	1,256	377
Potential spawning stock = 1,633		

The sex ratio for grilse entering Lough Feeagh has been found to be 55 : 45 females to males, on average.

(b) Sea trout

TABLE XIII

Counted through traps	2,225
Rod catch on Lough Feeagh	342
Escapement	1,883

Approximately one-third of these fish were finnock (0+ sea years) of which perhaps only 25% of the females will spawn.

Note that the above figures refer only to spawning escapements into Lough Feeagh. They do not represent the total spawning escapements of the fishery system, when a relatively small number of salmon and a fair number of sea trout are known to spawn in small streams which flow directly into Lough Furnace.

Table XIV shows the spawning escapements of wild salmon and sea trout into Lough Feeagh, from 1970 :

TABLE XIV

	1970	1971	1972
Wild salmon	1,011	552	1,256
Sea trout	1,017	1,249	1,883

(b) Downstream

(i) Salmon smolts

The first salmon smolts were noted at the Salmon Leap on April 8, followed on April 9 at the Mill Race. They moved downstream on a falling flood and when the temperature of the water had reached 7·0°C. The numbers of migrants during April were small at both traps, due to a period of low water from April 21—29 but adequate water levels were restored by a small flood on April 30 and continued without further check until mid-June. The higher water levels at the end of April brought down large numbers of smolts and the peak of smolt migration through both traps was from April 30 to May 14. Another smaller peak occurred from May 22—25 during a further small flood.

It has become apparent that downstream migrants favour the Salmon Leap passage in all but low water conditions so that it was not surprising that 76% of the total run occurred at the Salmon Leap in 1972, when adequate water levels prevailed over almost all the season for salmon smolt migration.

The total of 14,081 salmon smolts represents a very slight increase over that of 1971 (13,915) but was not as high as in 1970 (14,637). However, it is interesting that smolt production over three years has differed by less than 5% in any one year.

(ii) Survival of salmon smolts

The 13,915 smolts in 1971 gave rise to 1,369 grilse counted through the traps in 1972, to which must be added a further 144 that were caught by rod-fishermen on Lough Furnace before their upstream migration to Lough Feeagh. This gives a survival rate from smolt to grilse of 10·9%. The figure of 5·2% which was calculated as the survival from smolt to grilse for 1970/71 must now be increased to 5·5% by the addition of 21 spring fish counted through the traps in 1972. Only a tentative assessment was possible for the 1969/70 returns, due to a small, uncounted escapement of smolts at the Salmon Leap whilst the trapping installations were being constructed. In tabular form, the results for smolt survival are as follows :

TABLE XV

	Smolt numbers	Returning Salmon	% Survival
1969	12,000—14,000 (estd.)	1,288	10·9
1970	14,637	811	5·5
1971	13,915	1,513	9·2—10·7

This effectively illustrates the overriding importance of the unknown factors in the sea life of post-smolts which affect the survival to the adult stage.

(iii) Sea trout smolts

Sea trout smolts appeared first on March 30, in both traps, some 10 days earlier than the salmon smolts, on a rising flood and at a water temperature of 6°C. The run was steady throughout April, except at the end of the month when the Salmon Leap experienced low water. The peaks of the runs occurred from April 30 to May 4 and again from May 8—14 and, as with the salmon smolts, the bulk of the run (80%) was counted at the Salmon Leap. The combined total of 5,465 was almost twice as large as in 1971 and may have been due to a number of potential 2+ smolts having been held up by low water in 1971, migrating as 3+ smolts in 1972. It was noticeable that many of the smolts were larger than normal in 1972 and there was a heavy run of finnock (0+ sea years) during the summer following smolt descent.

TABLE XVI—SALMON AND SEA TROUT SMOLTS, 1972

	Mill Race		Salmon Leap	
	Salmon	Sea Trout	Salmon	Sea Trout
March	—	20	—	119
April	568	521	654	1,420
May	3,025	498	9,370	2,758
June	91	29	373	100
Totals	3,684	1,068	10,397	4,397
Total salmon	14,081			
Total sea trout	5,465			

Records of full census work on sea trout (as fresh fish, kelts and smolts) are not yet sufficient for any firm conclusions to be drawn on the relative survival rates. From a study of three years' results, it is tentatively proposed that the run of fresh fish in any one year is the result of 45—55% survival of the kelts and 15—25% survival of the smolts. This assumes a fair degree of homing behaviour for sea trout, which is borne out by tagging results.

(iv) Kelts : 1971—72 spawning season

(a) Salmon

TABLE XVII

	Counted through traps
November/December	37
January	32
February	9
March	31
April	13
Total	122
	comprising 101 females : 21 males

The salmon kelt run was fairly equally divided between the two traps, 52 having been counted at the Mill Race and 70 at the Salmon Leap. Tagging commenced in mid-January, 1972, comprising 60 healthy wild kelts, the remainder being released due to moderate or severe fungus infestation. A further 5 fish were released as second-spawners, already bearing tags.

There were 12 recaptures from the 60 tagged kelts (20%) as fresh fish in the summer and autumn of 1972, of which 4 were returned from the North Mayo drift nets. Tags with double-wire attachments were more successful

than those with double-thread attachments (32·0% cf. 11·4%), reversing the results from 1971.

The known spawning escapement in 1971 was 552 and from previous observations, the sex ratio may be assumed to have been approximately 55 females : 45 males. The overall realistic survival to the healthy kelt stage was 16·3%, comprising approximately 26% of the females but only 2% of the males. This constitutes a reduction of over 50% in the survival rates, compared with 1971.

There were 10 recaptures of previous spawners in 1972 (all females and including 2 long-absence, previously-spawned grilse) among the 1,369 wild fish counted through the upstream traps. If this incoming run is assumed to have consisted of approximately 821 females and 548 males, the 10 female previous spawners then constituted only 1·2% of the total female population. No male kelts were tagged in 1972.

The average absence period of the 8 fish recaptured in the traps was 200 days, ranging from 131 to 298 days : (cf. 199 days in 1971 and 165 days for the years 1962-68). The average growth increment of these fish was 6·2 cm (2·4 inches) which was similar to that of 1971 (6·4 cm). Again, there was no evidence of any selectivity by the returning fish for the migration route they had used as kelts, when 5 out of the 8 used the Mill Race route, only 3 of which had been tagged there.

(b) Sea trout

The first sea trout kelts appeared in both downstream traps on November 3, 1971, continuing until mid-May, 1972. The peak of the run was later than usual, coinciding with the first major flood of the year, in April. A number of fungused kelts were noted in November, December and January, amounting to 18·8% of the total run in those 3 months but only 4·8% of the overall run.

The total count was 1,604, comprising of 1,087 at the Salmon Leap and 517 at the Mill Race, and of these over 700 were small specimens of less than 30 cm in length. The kelt run again exceeded the calculated escapement by 28·4%, very similar to the result in 1971 of 26·1%. This is thought to be due to the escape of small sea trout through the bars of the fish fence on their upstream migration but may be compounded by the difficulty of distinguishing a large sea trout smolt of 25 cm from a finnock kelt of 25 cm.

Tagging of kelts commenced on January 15 and overall a total of 510 fish of over 30 cm in length were tagged with flat plastic tags attached by polyethylene thread. There were 132 recaptures during the following summer, giving a recapture rate of 25·9%, made up of 109 out of 390 from the Salmon Leap (39·1%) and 27 out of 120 (22·5%) at the Mill Race. These figures are similar to those obtained in 1971 where the reason for the increased recapture rate from the Salmon Leap is not yet known.

The technique for detecting these small tags on trout in the upstream traps would appear to be improving, in that only 2 recaptures were made as kelts in November and December and 2 other fish were caught on the rod in Lough Feeagh without having been noted in the traps. One recapture was rod-caught on Lough Furnace and 2 others were caught in coastal drift-nets.

The lack of water in the Salmon Leap during July demonstrated that sea trout are non-selective in their choice of migration route into Lough Feeagh, in that they take the easiest available route :

25 fish from Mill Race taggings :
16 returned to Mill Race
9 returned to Salmon Leap
102 fish from Salmon Leap taggings :
83 returned to Mill Race
19 returned to Salmon Leap

The average growth increment during the sea life in 1972 was 4·2 cm (126 returns) and the average absence period in the sea was 124 days. This is a shorter period than in 1971 (155 days) and the fish made similar growth (3·8 cm in 1971).

(c) Recaptures of fish tagged prior to the 1971—72 season

(i) Salmon

There were three further recaptures during 1972 of grilse kelts, tagged in 1971, increasing the overall recapture rate to 11·0%. One fish was missed on its upstream migration through the traps and was recaptured as a kelt. Two further fish were examples of "long-absence, previously-spawned grilse", in that they had spent slightly over a full year in the sea before returning in the spring of the year following descent as kelts. Details are as follows :

SL 384	Tagged 2/3/71, length 60·1 cm	Recapt. 10/4/72 (kelt)	66·6 cm
SL 351	Tagged 22/2/71, length 60·5 cm	Recapt. 15/5/72 (fresh)	79·2 cm
SL 453	Tagged 29/3/71, length 58·1 cm	Recapt. 28/5/72 (fresh)	69·8 cm

(ii) Sea trout

Of the 177 tagged sea trout counted upstream in 1971 (excluding those known to have been killed by rod-fishing) 87 (approximately 50%) were recaptured as kelts in 1972. At the same time, a further 35 kelts were recaptured bearing tags that had been missed in the upstream traps in the previous summer. This underlines the difficulty of spotting these small tags (which are often obscured by algal growth), when the fish are not handled in the upstream traps. The recapture of the 35 additional tagged kelts suggests that up to 70 may have been missed during the upstream run when the true return of sea trout kelts tagged in 1971 would range from 43·6% to 50·6%.

Thus 122 kelts bearing 1971 series tags were released from the downstream traps in 1972 and of these, 23 (18·9%) were recaptured as fresh fish, for a second time. This somewhat lower recapture rate for second-return fish is to be expected, both from the natural mortality of older fish and from increased risk of tag loss. An interesting feature of these returns has been the complete absence of returns in 1972 from fish that were not seen as fresh fish or kelts in 1971/72. None of the fish had missed spawning for one year nor had any fish "wandered" to another river system in 1971 and returned home in 1972.

(iii) Silver eels

Due to the extraordinarily dry autumn weather, no silver eels were able to migrate downstream until mid-October, whilst the bulk of the catch was made in November. The modified trap chamber at the Salmon Leap worked satisfactorily but the overall catch was 25% down on that of 1971. Details of the catch are as follows :

	Mill Race	Salmon Leap
September	0	0
October	588	132
November	727	1,581
December	12	104
Totals	1,327	1,817

The total of 3,144 was estimated to weigh about 264 kg (580 lbs).

(iv) Autumn migrating trout

These fish were also prevented from moving downstream in September, due to low water and the totals for the remainder of the year were 33% down on those of 1971. This may well have an effect on the recruitment of sea trout stocks in 1973 since it is known that a fair proportion of these fish are potential sea trout smolts.

	Mill Race	Salmon Leap
September	0	0
October	95	411
November	270	991
December	107	250
Totals	472	1,652

A very small number of fungused specimens were noted during the last week of December but the disease was much less prevalent than in 1971.

SMOLT TAGGING AND MARKING

The tags and marks used on various categories of fish in 1972 were as follows :

Type of fish	Number	How marked
2+ grilse smolts	3,544	Brand mark "Z" + adipose fin-clip
1+ grilse smolts ("reared" parentage)	2,656	Brand mark "7" + adipose fin-clip
1+ grilse smolts ("wild" parentage)	1,706	Brand mark "B" + adipose fin-clip
Wild salmon smolts (Demonstration purposes)	40	Dark Green SRT, double thread (2101—2139)
Total salmon smolts released :	7,906	

RECAPTURES FROM TAGGING OF WILD SEA TROUT SMOLTS

In addition to the 6 finnock recaptured from the tagging of 500 wild sea trout smolts, a further 9 were recaptured as finnock kelts in 1972, having been missed in the upstream traps in 1971. One further fish returned as a maiden 1+ sea years specimen in 1972 and one of the finnock kelt recaptures returned for the second time in July. The 16 recaptures bring the survival rate of these wild sea trout smolts to 3·2%. Details of these recaptures are as follows :

TABLE XVIII

No.	Tagged	Length	Recaptured	Length	Incr.
1008	14/5/71	23·0 cm	4/4/72 (kelt)	29·8 cm	6·8 cm
1112	17/5/71	20·0 cm	20/4/72 (kelt)	26·5 cm	6·5 cm
1148	17/5/71	21·0 cm	8/4/72 (kelt)	26·6 cm	5·6 cm
1176	17/5/71	17·5 cm	9/4/72 (kelt)	27·2 cm	9·7 cm
1202	17/5/71	23·0 cm	3/4/72 (kelt)	31·6 cm	8·6 cm
"	"	"	5/7/72 (fresh)	37·7 cm	6·1 cm
1211	17/5/71	18·5 cm	30/3/72 (kelt)	27·2 cm	9·7 cm
1226	17/5/71	19·0 cm	3/4/72 (kelt)	28·6 cm	9·6 cm
1377	22/5/71	21·5 cm	8/4/72 (kelt)	27·7 cm	6·2 cm
1477	24/5/71	22·0 cm	8/4/72 (kelt)	28·2 cm	6·2 cm
1138	17/5/71	22·0 cm	3/7/72 (fresh)	31·9 cm	9·9 cm

7.9

RECAPTURES OF REARED FISH

(a) Salmon

Reared smolts released in 1971 gave an excellent return as grilse in 1972, when 682 recaptures were made from a total release of 10,237 smolts.

The returning reared fish in 1972 may be divided into the following categories :

(i)	**2+ smolts, grilse parentage, released in 1971, branded "V"**	
	Smolt total : 7,653. Returns as maiden grilse :	527 : 6·87%
(ii)	**2+ smolts, grilse parentage, released in 1971, fin-clipped Adipose/Dorsal**	
	Smolt total : 1,017. Returns as maiden grilse :	81 : 7·96%
(iii)	**1+ smolts, grilse parentage, released in 1971, branded "H"**	
	Smolt total : 1,567. Returns as maiden grilse :	62 : 3·96%
(iv)	**1+ smolts, grilse parentage, released in 1970, branded "O"**	
	Smolt total : 4,547. Returns as maiden grilse :	75 : 1·65%
	Returns as small spring fish :	6 : 0·13%
	Returns as small summer fish :	1 : 0·02%
	Returns as grilse after 2nd smolt year in wild :	1 : 0·02%
	Total :	83 : 1·82%
(v)	**2+ smolts, grilse parentage, released in 1970, branded "X"**	
	Smolt total : 2,997. Returns as maiden grilse :	38 : 1·27%
	Returns as small spring fish :	1 : 0·03%
	Total :	39 : 1·30%
(vi)	**Previous spawners**	
	(1) 1+ smolt, branded "O", returned first as maiden grilse in 1971.	
	(2) 2+ smolt, fin-clipped, returned first as maiden grilse in 1971.	

It would appear that the survival rate of reared smolts in the sea is closely linked with the factors that affect wild smolts, as would be expected, except that adverse conditions have a more pronounced effect on the artificially reared fish. This is borne out by comparing the results over the past two years, when similar numbers of smolts were released. In 1971, only 136 recaptures were made from 10,219 smolts in a year when the natural smolt survival rate was 5·2%. In 1972, 680 recaptures were made from 10,237 smolts when the natural smolt survival rate was 10·9%. Thus the reared smolt survival increased by five times when the wild smolt survival increased two-fold. Undoubtedly, there are other factors involved, such as the degree of infection by "fungus" disease among the reared smolts and their size and condition but it seems probable that the controlling influence is exerted by unknown factors in the post-smolt life. The high return rate in 1972 has effectively dispelled earlier fears about the possible inadequacy of a cheaper brand of pellet food in current use, compared with that of earlier years.

A further interesting feature of these returns is the probable involvement of a selective breeding factor, in that the parents of the 2+ smolts which returned as grilse in 1972 and of the 1+ smolts which returned as grilse in 1971 were part of the 1968 grilse brood stock, themselves a successful year-class. The policy of continued breeding from selected parents which have themselves survived artificial rearing conditions and subsequent sea life, would appear to be having an effect, although the period of four years between successive generations tends to obscure the results.

The 682 recaptures were made in the following ways :

520 in the Mill Race trap
87 in the Salmon Leap trap
73 by rod-fishing on Lough Furnace
1 found dead at Salmon Leap, killed by otter
1 found dead (stranded) in release pond

The contribution of 73 fish to the rod catch on Lough Furnace formed a significant proportion (33·6%) of the total on that lake for the season, when appreciable numbers were caught in late June and from mid-August onwards.

The reared fish released into Lough Feeagh from the traps behaved in their customary dour

fashion and only 10 were caught (2·6%) of the 385 released by October 14. That this was due to their being in an "unsettled" state, having passed their homing point, was demonstrated by a recurrence of their habit of leaving Lough Feeagh by migrating down the Salmon Leap and migrating back up the Mill Race again, into Lough Feeagh, often as many as four times. In addition, the rod catch of wild fish on Lough Feeagh is always twice as large, pro rata of the population, even though all these fish have also passed through the traps. In 1972, 11·4% of the available population of wild fish was caught on Lough Feeagh.

Table XIX below gives details of the multiple return habit of these reared grilse, when it can be seen that almost three-quarters of the fish which migrated up the Mill Race were counted down through the Salmon Leap, bearing a Floy tag. A smaller proportion of the fish which originally migrated up the Salmon Leap exhibited this behaviour, due perhaps to their having a slightly less well-developed homing mechanism. When the fish showing tag remnants or tag scars were added to the overall total of downstream-migrating fish, it was found that 449 of the original 607 upstream migrants (74%) exhibited this behaviour.

The return of these fish to Lough Furnace was delayed by low water during September and October and from then on, many of them were retained for experimental and commercial hatchery purposes. The figures for second upstream recaptures (and subsequent appearances) do not reflect either the true frequency of this behaviour or the survival of the fish undergoing these multiple returns.

A number of fish were recorded as moving up and down-stream on 3 occasions and one fish was seen for the fourth time as a kelt. As in previous years, the early running fish exhibit the greatest frequency of multiple returns since late in the season, the spawning urge becomes stronger than the homing mechanism.

TABLE XIX—MULTIPLE RETURN BEHAVIOUR IN REARED GRILSE

	Mill Race	Salmon Leap
Up, 1st time	520	87
Down, 1st time	369	48
Up 2nd time	181	20
Down, 2nd time	75	4
Up, 3rd time	20	—
Down, 3rd time	5	—
Up, 4th time	2	—
Down, 4th time	1	—

Possibly the most interesting result of the selective breeding programme was the recapture of 8 spring fish, of which 6 were derived from 1+ grilse parentage smolts, branded in 1970 and 1 from a 2+ smolt also branded in 1970. One uncertain brand mark could not be identified by scale reading because every scale in the small sample was unreadable, due to regenerated centres. However, it was of reared parentage (Adipose fin-clip) and was a maiden small spring fish.

This is the first occasion on which true spring fish have been recorded from smolts whose parents and grandparents were grilse. There have been 26 previous recaptures of small summer fish from grilse smolts and one further example was recorded in 1972 but spring fish have been recorded heretofore, only from spring fish parentage smolts.

A maiden grilse was also recorded from an "O" brand 1+ smolt, released in 1970 but this was due to the smolt having remained for a further year in fresh water, after release.

Of the 670 maiden grilse derived from grilse parentage smolts, 62 returned from a release of 1,567 1+ smolts (4·0%) and 608 from 8,670 2+ smolts (7·0%). The 2+ smolts were released as two batches, one of which was fin-clipped "Adipose/Dorsal" and gave 81 returns from 1,017 smolts (8·0%). The other batch of 7,653 smolts were branded "V" and gave 527 returns (6·9%). This constitutes the best results to date for 2+ smolts, when the previous highest returns were in 1969, at 5·21%, which included both grilse and small summer fish recaptures. The 1+ smolts were only fractionally better than a comparable group of fish in 1969, which gave 3·94% returns.

There was one maiden grilse of reared parentage, the brand mark of which was indecipherable; the smolt life could not be determined from the scales because the scale centres were unreadable. This fish has been omitted from the records.

SUMMARY

Thus, the returns in 1972 constituted an encouraging reversal of the downward trend in % recapture rates of the past two years :

Smolt type	1968	1969	1970	1971	1972
2+ grilse	4·41	5·20	3·04	1·27	7·00
1+ grilse	2·91	4·02	1·25	1·65	3·96

The total of reared fish recaptures now stands at 2,645, starting in 1962, as follows :

TABLE XX

Year	Smolts released	Number recaptured	Year	Smolts released	Number recaptured
1962	8,000	12	1968	14,260	490
1963	9,420	51	1969	17,317	654
1964	4,787	19	1970	16,637	312
1965	6,630	33	1971	10,219	136
1966	9,764	62	1972	10,237	682
1967	10,250	194			

The 2,645 recaptures can be divided into the following categories, where the term two-sea-winter fish includes both small spring and small summer fish, whilst previous spawners have been excluded :

TABLE XXI

Smolt Parentage	Returned as : Grilse	2-sea-winter-fish	Pre-grilse
Spring fish	184 (86%)	30 (14%)	0
Grilse	2,168 (98%)	34 (2%)	4
Spring fish × grilse	147 (97%)	4 (3%)	0

The sex ratios of reared grilse in 1972 reverted nearer to the normal, compared with 1971 when a large proportion of the potential male smolts died of "fungus" disease at the precocious male parr stage. In 1972 the 1+ smolts-grilse gave a 63 : 37 ratio of females to males whilst those from 2+ smolts were in a 59 : 41 ratio. In the former group, the ratio of males decreased as the season advanced whilst in the latter group there was no apparent difference. (See Table XXIII.)

Male fish became larger than the females as the season advanced and were also larger in an overall calculation :

	1+ smolt grilse	2+ smolt grilse
Males	65·8 cm	64·5 cm
Females	59·5 cm	63·7 cm

The size of the complete sample of reared fish in 1972 fell slightly, compared with earlier years, at 63·8 cm.

This was due to a proportion of the fish exhibiting foreshortening of the caudal peduncle, giving a "stumpy" compacted appearance to the fish. The remainder of the body was completely normal and the affected fish were vigorous and in good condition. Scale-reading disclosed that smolt growth was apparently normal but that the growth rate increased only very slowly during the first summer in the sea. Altogether, 66 fish (approximately 10%) were noted with this condition, equally divided between males and females and as between grilse derived from 1+ and 2+ smolts. The cause is unknown but it seems as likely to be due to conditions in freshwater life as to conditions in the sea. There have been reports of a similar condition in the U.S.A. which was attributed to sub-lethal dosages of poly-chorinated hydrocarbons.

By contrast, there were records of some 56 grilse (8·2%) mostly males, measuring over 70 cm in length, up to a maximum of 77·6 cm. At their average Coefficient of Condition of 1·05, these large fish would weigh between 3·6 and 4·9 kg. (7·90—10·75 lbs).

The average Coefficient of Condition for the rod-caught specimens was 1·00, slightly less than in previous years when it has ranged between 1·02 and 1·05.

Table XXIII gives the sex ratios and lengths of grilse derived from both 1+ and 2+ smolts during the seven months of the season :

TABLE XXII

Year	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Mean length (cm)	59·2	54·9	58·2	61·7	63·0	63·5	64·1	64·5	64·4	63·8

TABLE XXIII

Month	1+ smolts				2+ smolts			
	% Male	% Female	Length Males cm	Length Females cm	% Male	% Female	Length Males cm	Length Females cm
June	—	100	—	61·5	59	41	61·7	64·0
July	—	—	—	—	44	56	61·7	66·0
August	44	56	64·8	64·3	49	51	61·9	63·7
Sept.	—	100	—	64·8	59	41	63·4	63·1
October	39	61	65·3	60·9	35	65	66·0	63·6
November	25	75	73·8	62·1	41	59	67·3	63·6
December	—	—	—	61·3	—	100	—	64·5

The time of appearance of reared grilse in the traps shows the same general pattern as that of the wild fish but with a shift of emphasis towards the later months of the season. This is thought to be due to the reared grilse not having the same stimulus as wild fish to enter Lough Feeagh, since the Mill Race water entering Lough Furnace constitutes their homing point. Table XXIV gives the relevant proportions of wild and reared fish counted through the traps during the seven months of the season :

TABLE XXIV

	Wild fish	Reared fish
June	10·7%	2·0%
July	4·8	0·5
August	40·0	29·2
September	0·2	—
October	35·0	53·8
November	8·3	14·0
December	1·0	0·5

(b) Other species

No returns were made from the 1,500 1+ Polish sea trout smolts, or the 4,277 1+ Arctic char released in 1971. It is assumed that any surviving char have adopted a non-migratory habit in a lacustrine environment but the absence of returns from the sea trout smolts is disquieting.

Sea trout of Swedish origin that were being reared in 1972 are to be retained to the 2+ smolt stage, in case the development of a homing mechanism takes two years in these fish instead of one year as in salmon smolts.

ULCERATIVE DERMAL NECROSIS (SALMON DISEASE)

(a) 1971/72 Spawning season

The overall incidence of affected kelts in the downstream traps was higher in the 1971/72 season than in previous years since 1969, when UDN was first confirmed among late-running grilse and kelts. In addition, the mortality among spawning fish and during their subsequent mending was also greater, as evidenced by the survival rate of 22% of the spawning escapement to the kelt stage, compared with 40% in the previous year.

There were very few survivors of the wild male spawning population and none from mid-January onwards were judged healthy enough for tagging as kelts. The full results for incidence of infected kelts is given in Table XXV together with the comparable results for the two preceding seasons.

TABLE XXV

	UDN infection in downstream migrating salmon kelts		
	% infection	% infection	% infection
Month	**1969/70**	**1970/71**	**1971/72**
November	0	20	10
December	70	58	40
January	70	55	69
February	20	7	30
March	0	5	0
April	0	0	7
% of total run	21	21	32

Sea trout also showed an increase in the degree of infection in the 1971/72 season. In the previous season, only 4 out of 1,283 showed any lesions and/or fungus but this rose to 78 out of 1,604 (5%) in the 1971/72 season. The infection was greatest during the early part of the kelt run and in February, March and April, the condition had largely disappeared.

TABLE XXVI

	UDN infection among sea trout kelts in 1971/72
Month	**% infection**
November	18
December	22
January	15
February	0
March	4
April	0
% of total run	4·8

The fungused condition of juvenile trout migrating downstream in the early winter was first noted in November and December, 1971. The external signs exactly paralleled those of the "fungus" disease among hatchery reared salmon parr, where the caudal and pectoral regions exhibit heavy fungal growths. The incidence of infection increased from 7% in December, 1971 to over 20% in January, 1972 but declined thereafter. The overall incidence of infection was 8·1%.

(b) 1972/73 Spawning season

No signs of UDN lesions or fungus infection were seen among upstream migrating fish in 1972. Hatchery parent stock was retained in holding ponds from mid-October and UDN infection was not noted until December 18, although any fish exhibiting abrasions of the head or fins were painted with concentrated Malachite Green at regular intervals. Altogether, almost 200 salmon were held without appreciable loss at the experimental and commercial hatcheries until the end of December. After the fish were stripped, they were released immediately into the brackish water of Lough Furnace. As in other years, a small proportion of both males and females migrated back into Lough Feeagh, through the Mill Race, as spent fish.

UDN infection was seen among kelts caught in the downstream traps from December 5 but did not become widespread until December 17. The incidence of infection was 32% of all fish seen in the downstream traps during the month, including both ripe grilse and spent kelts.

The first signs of infection among sea trout kelts coming downstream was seen on December 4 and during the remainder of the month, 14 affected fish were noted out of a total of 193 (7·3%). This infection was much less severe in intensity and later in appearance than in the preceding season.

Juvenile trout were similarly less severely affected by the "fungus" disease, which did not appear until December 24. Only 7 examples out of 122 were noted after that date.

Although the degree of infection among salmon and trout has been less severe during late 1972 than in the previous year, it would be premature to assume that the eventual effect on kelt survival will also be less pronounced.

EFFICIENCY OF ROD FISHING

Records now exist of the rate of exploitation of stocks of wild and reared salmon, as well as sea trout by rod fishing over the past three years. Accurate assessments can be made for Lough Feeagh but the unknown factor of the numbers of salmon and sea trout spawning in the streams flowing in Lough Furnace render it necessary to make an estimate of the minimum overall rate of exploitation. The maximum rates are correct and tentative correction values for Lough Furnace residents have been included. Grilse derived from reared smolts are treated separately in Table XXVII below, are treated comparable values for 1970 and 1971.

TABLE XXVII

	1970	1971	1972
Wild Salmon			
Lough Feeagh			
"Available" wild fish by October 12	961	546	1,033
Rod catch	72	33	118
Rate of exploitation of stock	7·5%	6·0%	11·4%
Loughs Feeagh and Furnace			
Total stock of wild fish	1,352	790	1,373
Estimated Correction for Lough Furnace Residents	1,502	890	1,523
Total rod catch of wild fish	309	75	335
Maximum rate of exploitation	22·9%	9·5%	24·4%
Minimum rate of exploitation	20·6%	8·4%	22·0%
Reared salmon			
Lough Feeagh			
"Available" fish by October 12	216	66	385
Rod catch	5	3	10
Rate of exploitation of stock	2·3%	4·5%	2·6%
Loughs Feeagh and Furnace			
Total stock	312	136	682
Total rod catch	45	11	83
Rate of exploitation of stock	14·4%	8·1%	12·2%
(Note the low exploitation rate of reared salmon, compared with wild salmon, in Lough Feeagh.)			
Sea Trout			
Lough Feeagh			
"Available" fish by October 12	1,194	1,246	1,977
Rod catch	225	158	342
Rate of exploitation of stock	18·8%	12·7%	17·3%

Due to the difficulty of forming a reliable estimate of the numbers of sea trout which spawn in any one year in the small streams flowing into Lough Furnace, no attempt has been made to define the overall exploitation rates of sea trout for the complete fishery system.

It can be seen that rod fishing for salmon in 1972 was good, when the rate of exploitation of the stock by this means was the best for the years 1970 to 1972. The sea trout exploitation rate did not equal that of 1970 but was higher than that of 1971.

SPONSORED RESEARCH

Mr. Miles Parker of Trinity College, Dublin, who is investigating nutrition of **Neomysis integer** in Lough Furnace was given a grant by the Trust for this research, together with facilities at the Trust Laboratory. Some of the results obtained so far are described in Appendix I.

Two vacation research students (Miss Mary Stewart and Mr. John Field, Trinity College, Dublin) were employed during the summer months on a study of plankton of Lough Feeagh, and the report of Miss Stewart on her work is included here as Appendix II. Mr. Field has submitted an extensive report on "Diurnal fluctuations in the zooplankton of Lough Feeagh" which has been deposited in the Library of the Trust, where it may be consulted by other research workers, on request. It is hoped that a condensed version of this report will be available for publication in the Annual Report for 1973.

GENERAL

Dr. Went and Dr. Piggins attended meetings of the Salmon Research Group held in Weymouth and Wareham in April and in London in November. Dr. Piggins attended the Fish Disease Symposium organised by the European Inland Fisheries Advisory Commission of F.A.O. and Organisation International des Epizooties held in Amsterdam in April. He also attended an Atlantic Salmon Workshop, sponsored by the U.S. Department of the Interior, Fish and Wildlife Service, in Boston, Mass. This, in turn, was followed by a meeting of the Scientific Advisory Group of the International Atlantic Salmon Foundation in Florida.

In September, Dr. Went and Dr. Piggins attended a three-day Symposium on Atlantic Salmon, sponsored by the International Atlantic Salmon Foundation and the Atlantic Salmon Research Trust, held in St. Andrews, N.B., where they acted as Session Chairmen.

Dr. Piggins then travelled to Seattle, Washington on a study tour of fishery installations, as the guest of Dr. Lauren Donaldson, of the College of Fisheries, University of Washington.

Dr. Went and Dr. Piggins also attended the London Conference of the Salmon and Trout Association in November.

PUBLICATIONS

D. J. PIGGINS

"Cold branding as a smolt marking technique". **J. Inst. Fish. Mgmt. 1972** (3) 9—11.

ACKNOWLEDGEMENTS

The Committee expresses its appreciation to the Minister for Agriculture and Fisheries, and to the staff of his Department for their valuable assistance during 1972.

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APPENDIX I

THE AVAILABILITY OF ORGANIC NUTRIENTS IN LOUGH FURNACE IN RELATION TO THE POPULATION OF NEOMYSIS INTEGER

A Preliminary Report by Miles Parker and Brian West (Zoology Department, Trinity College, Dublin)

The objectives of this project are to determine the distribution or organic compounds of potential nutrient value to invertebrates in Lough Furnace, and to relate this to the feeding and distribution of one important component of the invertebrate biomass, **Neomysis integer.**

Most of the work so far has been directed towards selecting and developing suitable techniques of sampling and analysis which can be operated without extensive technical assistance. Satisfactory methods for determination of protein and fat remain to be perfected : low concentrations and technical problems such as the presence of polyphenolic compounds render most assay techniques unsuitable. A quantitative sampler has been built for catching mysids and regular sampling has commenced.

Preliminary results are summarised below. They constitute simply a progress report, and will be proved normal or exceptional on the basis of more thorough investigations.

Physical characteristics

Lough Furnace is completely covered by a layer of fresh water, approximately one metre deep, which flows in from the Salmon Leap, the Mill Race and the Yellow River and out at the weirs. At the bottom of the lake, below 5m. depth, is a pool of salt water, the salinity of which varies according to its position in the lake. At the north end it is about 19·5‰; in the main bowl it rises to 22·5‰; and in the deep area of Fahy's Angle it attains 23·75‰. Between the salt and fresh layers is a halocline, approximately 4m. deep. In areas where the water depth is between 1 and 5m the halocline is cut off short at the appropriate depth; thus, in 3·5m of water at Ros na Mulraigh there is a layer of fresh water 1m. deep, and the salinity rises over the next 2·5m to about 15‰.

At the same depth as the halocline is an inverted thermocline. A constant 10 to 12°C is maintained by the dense salt waters below 5m, while the temperature of the less dense surface layer fluctuates according to the season.

There is a sharp cut off in oxygen concentration at the bottom of the halocline, from 70—80% saturation down to 30% or less over a depth of 1m. This drops further to 5—10% near the bottom.

The fresh water inflow is slightly acidic (pH 6·5); there is an abrupt rise towards the bottom of the halocline to pH 6·8.

This data suggests that the salt water pool at the bottom of the lake is seldom replenished, and may even be stagnant.

Nutrient distribution

Particulate material (that collected by a Watman GF/C filter) increases in quantity from about 1·5mg (dry weight) per litre on the surface to about 20mg per litre at the bottom of the halocline. The values remain similar below this point, rising again only at the mud-water interface.

"Colloidal" materials (those passing through a Watman 0·5—0·8 µm GF/C filter but trapped by a Millipore 0·025 µm filter) varied between 10 and 200mg dry weight) per litre. There appears to be a general fall-off of these materials as the salinity increases.

Carbohydrate values for samples taken in January 1973 are summarised below (Values in ug/l) :

	Particulate	"Colloidal"	Soluble
Surface	100	600	2,400
Below halocline	25	50	1,200

Acknowledgement

We would like to thank the Salmon Research Trust for a grant towards travel expenses and the cost of minor equipment, and for the use of their facilities. The help of various members of the Trust's staff is gratefully acknowledged.

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APPENDIX II

A PRELIMINARY SURVEY OF THE ZOOPLANKTON OF LOUGH FEEAGH

By Mary Stewart

Introduction

This report deals with a survey of the zooplankton of Lough Feeagh, made with the object of investigating how the fauna varies both qualitatively and quantitatively over a year.

The results presented here cover the period January—September 1972 : samples collected during the remainder of the year will be analysed later.

Methods

Samples were collected from the Mill Race, one of the two outflows of Lough Feeagh. A plankton net (18″ diameter, 60 meshes per inch) was suspended in the stream for approximately 6½ hours once a week (though not at 7 day intervals). The samples thus obtained were fixed in 5% formalin. The water temperature and flow rate were also recorded. (See Fig. 1 of Report.) Dates of sampling are shown in Table I.

Sub-samples of around two hundred individuals were taken from each sample. The organisms were identified, using the literature cited in the bibliography, and counted; the relative number expressed as percentages was calculated for each species. The relative proportions of zooplankton and other drift were gauged subjectively and crude values for the total volume of zooplankton in each sample were obtained from this data and the volume of total drift which was measured in a graduated cylinder.

Results

I. The species present

Table II lists all the animals found in the sub-samples, and the numbers of each species found. The species were divided into lake plankton (P) and others (NP), consisting mainly of drift from the Mill Race, which comprised an insignificant proportion of the total.

Of the planktonic forms the Cladocera were most abundant, **Daphnia hyalina** being the dominant species. Both **Bosmina corregoni** and **B. longirostris** were identified, but were considered together for convenience : as such they make up an important part of the Cladocera fauna, of which **Diaphanosoma brachyurum** is the only other major member.

Unfortunately the Rotifers, which made up more than one-third of the organisms examined, could not be identified, though a colonial species, thought to be **Conochilis** sp., and a distinctly spiny form, thought to be a species of **Notholca** were noted.

In the Copepoda, Calanoids were more numerous than Cyclopoids. Very few mature adults of either were found and those were identified as **Diaptomus gracilis** and **Cyclops strenuus abyssorum.**

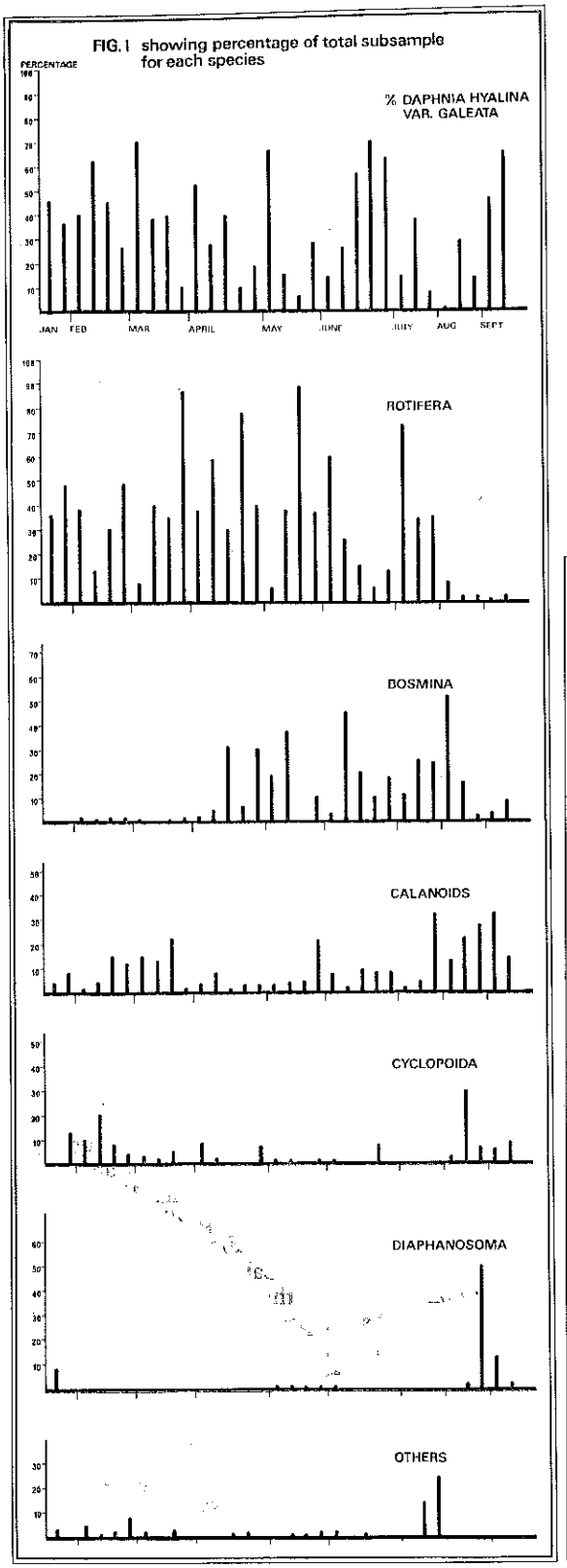
II. Seasonal variation in plankton composition

In terms of the percentage composition of the zooplankton **Daphnia hyalina** and Rotifers are the most important organisms (Fig. 1), with **Daphnia** leading in January and February, and alternating with the Rotifers from March to July before the latter gradually fade in importance in August and September. Maximum numbers of these organisms, on the other hand, are found during the spring bloom in April and May (Fig. 2). **Bosmina** spp. is virtually absent until mid-April, but at times in April, May, June and August it makes up a large percentage of the total (Fig. 1). It is most numerous during the spring bloom in April (Fig. 2).

As a percentage of the zooplankton Calanoids are most important in February and March and from July to September (Fig. 1). However, these peaks do not show up distinctly in the histograms of abundance (Fig. 2) indicating that in absolute terms the Calanoids do not form a major contribution to the zooplankton.

The peaks for percentage Cyclopoids in the plankton occur in February and in August, though they never exceed 30% of the total (Fig. 1). As with Calanoids, their absolute numbers are insignificant (Fig. 2).

In one sample taken at the end of August, **Diaphanosoma brachyurum** made up 50% of the total catch, equivalent to a value of 1·8 on the scale of relative numbers or organisms. For the rest of the year it is insignificant or absent and its



results are not plotted on Fig. 2. In Fig. 1 "others" includes all species not considered above. There is one peak of 24% in July but they are otherwise insignificant. Again the absolute values are so low as to be negligible.

III. Seasonal variations in plankton volume

The rise and fall of the volume of plankton (Fig. 3) cannot be attributed solely to water flow rate or temperature. It can be seen that at certain times (Fig. 1 of Report) for example in April when the water flow decreases, the plankton volume increases.

From January to March when the water temperature is low the plankton volume seems to be related to the flow rate. When the temperature

FIG. 2

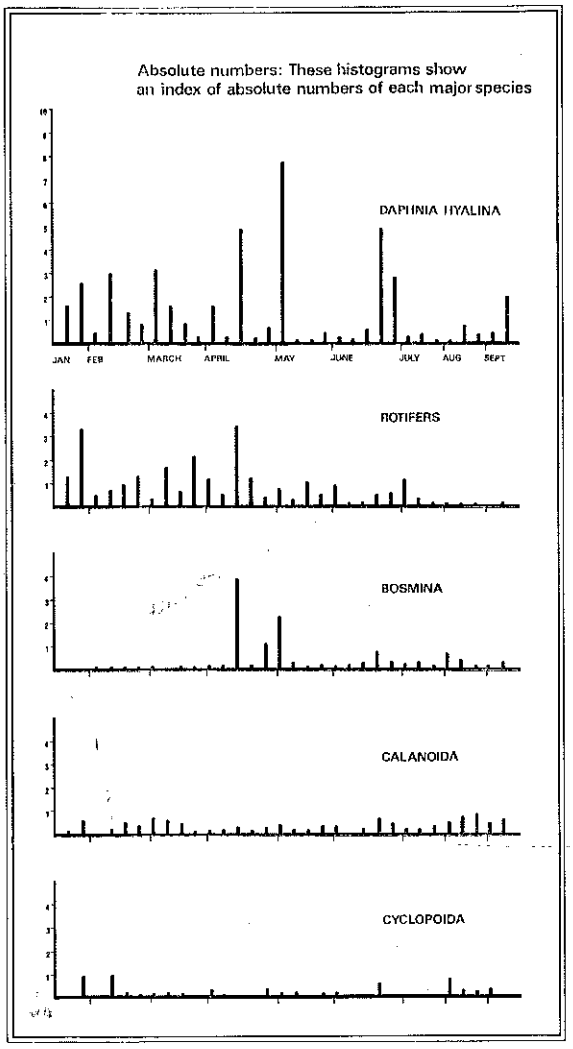
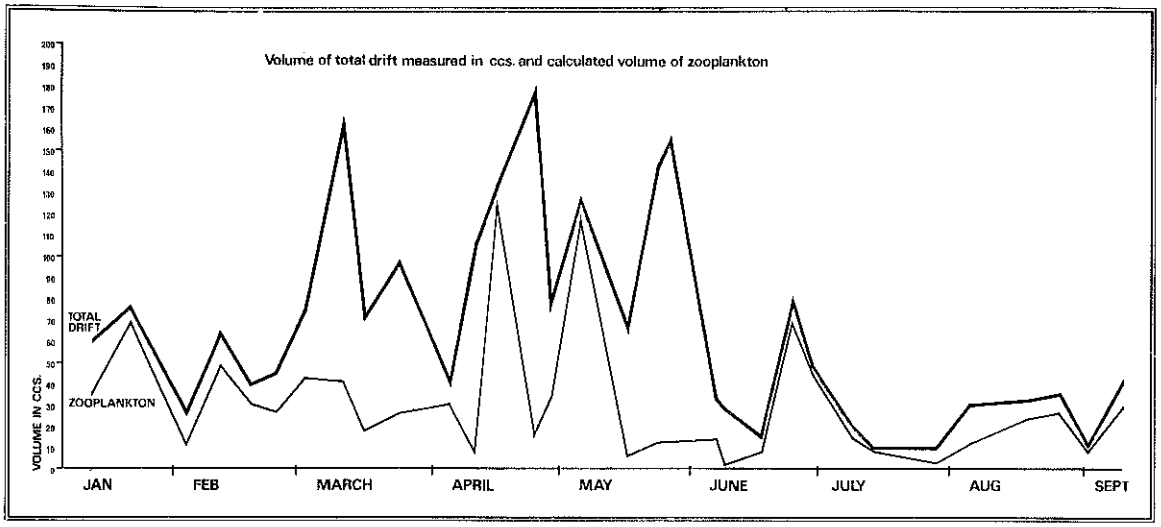


FIG. 3



rises in April the spring bloom occurs and the plankton volume increases, despite the reduction in flow rate. A notable feature of this sudden increase is that it is followed by an equally sudden decrease, then another increase at the beginning of May. Thereafter the volume of plankton remains low until the end of June, when there is a sudden brief increase. The plankton does not increase again until August. The low levels of plankton in July coincide with an extremely high water temperature of 21°C and a reduced flow rate. The rise in August coincides with a rise in flow rate and a drop in temperature.

This pattern is repeated in September : rise in temperature, low flow rate, low plankton, followed by drop in temperature, higher flow rate, and larger volume of plankton.

These variations in the volume of plankton are reflected in the diagrams of relative abundance of the dominant species (Fig. 2).

Summary

Daphnia hyalina and Rotifers are the most important constituents of the plankton, and though Rotifers are more numerous, **Daphnia** spp. make up the greatest biomass. Three main peaks of plankton occur : in April, in May, and again in June.

Plankton volume seems related to flow rate from January to March. Later in the year high temperatures (18°C or more) cause severe reductions in the volume of plankton.

Acknowledgements

I would like to thank Dr. D. J. Piggins for his help and advice during the practical part of this survey and Mr. A. B. West for help and criticism during the preparation of the report. I would also like to thank Mrs. G. Walsh-Kemmis for her assistance with identifications.

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TABLE I—SAMPLING DATES

January 12, 21.
February 3, 11, 18, 24.
March 2, 11, 16, 24.
April 4, 10, 15, 22, 28.
May 5, 16, 23, 26.
June 6, 8, 17, 24, 29.
July 8, 13, 28.
August 5, 19, 26.
September 1, 7.

TABLE II—A LIST OF ALL THE SPECIES ENCOUNTERED DURING THE SURVEY, AND THE NUMBER OF SPECIMENS EXAMINED
(P = Planktonic; NP = Non-planktonic)

ORGANISM	Number	Habit
COELENTERATA		
Hydra sp.	55	NP
ROTIFERA		
Conochilis sp. (?)	249	P
Notholca sp. (?)	710	P
Unidentified	1,879	P
ANNELIDA		
Nais sp.	1	NP
CRUSTACEA		
Cladocera :		
Daphnia hyalina var. galeata Sars.	2,709	P
Bosmina corregoni var. obtusirostris (Sars) / **B. longirostris** (O. F. Müller)	962	P
Leptodora kindti (Focke)	11	P
Polyphemus pediculus (L.)	3	P
Bythotrephes longimanus Leydig	31	P
Diaphanosoma brachyurum Lieven	229	P
Alonopsis elongata Sarso	12	P
COPEPODA		
Cyclops strenuus var. abyssorum Sars	15	P
Unidentified Cyclopoids	285	P
Diaptomus gracilis Sars.	29	P
Unidentified Calanoids	685	P
MALACOSTRACA		
Gammarus sp.	1	NP
Asellus meridianus Racovitza	1	NP
INSECTA		
Baetis rhodani (Pict.)	2	NP
Ephemerella ignita (Poda)	5	NP
Chaoborus sp.	2	NP
Unidentified Collembola	2	NP
HYDRACARINA		
Unidentified	36	NP
Total ...	7,914	

IONTAOBHAS TAIGHDE BRADAN
na h-EIREANN IONCORPORTHA

(THE SALMON RESEARCH TRUST OF
IRELAND INCORPORATED)

STATEMENT OF ACCOUNTS
AND
BALANCE SHEET

FOR YEAR ENDED 31st DECEMBER 1972

IONTAOBHAS TAIGHDE BRADAN na h-EIREANN IONCORPORTHA
(THE SALMON RESEARCH TRUST OF IRELAND INCORPORATED)

Revenue Account for the year ended 31st December 1972

1971 £	1971 £		£	£
		Income		
7,500		Income under Covenant by Arthur Guinness Son & Co. Ltd.		8,245
3,555		Contribution receivable from Department of Agriculture and Fisheries		5,000
210		Interest on 5% Transport Stock		210
62		Deposit Interest		65
105		Rent Receivable		105
597		Profit on Sale of Motor Car		—
—		Fees for Student Training		200
—		Sales of Fish		60
12,029				13,885
		Less : Expenditure		
		Administration Expenses		
	754	Travelling Expenses	579	
	151	Rent	391	
	50	Audit Fee	50	
	265	Insurances	284	
	27	Repairs and Maintenance of Property	—	
	40	Subscriptions	47	
	69	Sundry Expenses	140	
	396	Motor Expenses	446	
	772	Printing Annual Report	850	
		Depreciation :		
	500	Motor Car and Van	500	
	20	Furniture and Fittings	27	
	3,044		3,314	
		Scientific Expenses		
	4,421	Salaries and Wages	4,119	
	746	Fish Rearing and Ova	595	
	640	Laboratory Expenses	716	
	1,021	Consumable Stores and Equipment	621	
		Depreciation :		
	326	Plant and Scientific Equipment	332	
	51	Hatchery and Fish Pond	50	
	415	Development and Works	415	
10,664	7,620		6,848	10,162
1,365		Surplus for the year		3,723

I. R. MOORE
A. E. J. WENT
} Members of the Committee of Management

SALMON DISEASE RESEARCH

Revenue Account for the year ended 31st December 1972

1971		
£	**Income**	£
715	Income under Covenant by Arthur Guinness Son & Co. Ltd.	715
39	Deposit Interest receivable	14
754		729
	Expenditure	
76	Travelling Expenses	173
678	Surplus for the year	556

I. R. MOORE
A. E. J. WENT
} Members of the Committee of Management

BALANCE SHEET

As at 31st December 1972

1971				
	Fixed Assets	Cost	Depreciation	Net
£		£	£	£
527	Hatchery and Fish Pond	1,015	538	477
317	Plant and Scientific Equipment	2,766	2,730	36
55	Furniture and Fittings	534	344	190
1,923	Motor Car and Van	2,503	1,080	1,423
25,525	Development Work	31,406	4,960	26,446
30	Fishery Rights	30	—	30
28,377		38,254	9,652	28,602
	Quoted Investment			
4,034	£4,200 5% Transport Stock 1970/75 ... ... (Market Value £3,696—1971 £3,780)			4,034
	Current Assets			
	Due by Department of Agriculture and Fisheries :			
3,555	Salmon Research Trust		3,000	
573	Sundry Debtors		646	
17	Cash at Bank : Salmon Research Trust ...	304		
28	Salmon Disease Research	64		
			368	
	Cash on Deposit :			
263	Salmon Research Trust ...	1,264		
578	Salmon Disease Research	329	1,593	
5,014			5,607	
	Less : Current Liabilities			
1,387	Salmon Research Trust	676		
45	Salmon Disease Research	—		
			676	
1,432				
3,582	**Net Current Assets**			4,931
35,993				37,567

BALANCE SHEET (Continued)
As at 31st December 1972

1971			
	Represented by		
£	Revenue Accounts	£	£
	Salmon Research Trust:		
	Balance 1st January 1972	15,260	
15,260	Add Surplus for 1972	3,723	
			18,983
	Deduct Salmon Disease Research:		
	Balance 1st January 1972 (Deficit)	(162)	
	Less Surplus for 1972	556	
(162)			394
15,098			19,377
	Income Under Covenant Received in Advance		
4,785	Salmon Research Trust		4,840
16,110	Loans from Arthur Guinness Son & Co. Ltd. ...		13,350
35,993			37,567

I. R. MOORE
A. E. J. WENT
} Members of the Committee of Management

The Company is entitled to the income under Covenants from Arthur Guinness Son & Co. Ltd., as follows:
(i) £715 per annum for 7 years from 19/7/66
(ii) £1,300 per annum for 10 years from 1/8/70
(iii) £7,000 per annum for 7 years from 1/8/72

AUDITOR'S REPORT

I have examined the foregoing Balance Sheet and Revenue Accounts of the Company and have obtained all the information and explanations which I considered necessary. In my opinion proper books of account have been kept by the Company and the Balance Sheet and Revenue Accounts, which are in agreement therewith, give, in the manner prescribed by the Companies Act 1963, a true and fair view of the Company's affairs at 31st December 1972 and of the Surpluses on the respective Revenue Accounts for the year ended on that date.

Gardner House
Ballsbridge
Dublin 4
21st March 1973

G. W. O'BRIEN
Chartered Accountant
Public Auditor