



ANNUAL REPORT

No. 46

Burrishoole Catchment Monitoring and Fish Rearing

Report for the year ended 31st December 2000

**This report follows in sequence from
the Annual Reports of the Salmon Research Agency of
Ireland Incorporated and The Salmon Research Trust of Ireland
Incorporated**

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Marine Institute – Newport Research Facility
Report for the year ending 31st December 2000

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SUMMARY

1. The Salmon Research Agency merged with the national Marine Institute on the 1st July 1999 forming the nucleus for the new Salmon Management Services Division. This report provides a continuation of the data records for the Burrishoole facilities.
2. The total rainfall recorded in Furnace was 1833.2 mm in 2000, the third wettest year since 1977 when records began and above the annual average.
3. The Sea Trout Broodstock Programme (EU TAM) produced some 8.3 million green ova, of which 6.6 million were distributed as eyed ova to nine hatcheries throughout Connemara and the fry have been stocked into 23 sea trout fisheries throughout the region. The distributed ova were hatched in satellite hatcheries and a combination of unfed fry, first feeding fry and parr were stocked into the recipient fisheries. Such stocked fry will subsequently migrate as one, two, three and four year old smolts. Introductions of fry from 1995 to 2000 will produce smolts from 1997 through to the year 2004. As the adult broodstock had come to the end of their viable egg producing lives, these were culled after the 1999/2000 stripping season. No broodstock are now on hand and the cage sites have been closed.
4. The total release of microtagged salmon smolts, of Burrishoole reared origin, into L. Furnace amounted to 24,800.
5. In association with Cong, Delphi and Parteen hatcheries the SRA/MI co-ordinated the sale of 1.4 million salmon ova to Germany for the *Rhine 2000* Programme.
6. A total of 568 wild grilse were recorded moving upstream through the permanent traps during the season. The number of spring fish recorded in the upstream traps was 6. The total run of wild grilse, including the Lough Furnace rod catch, was 574.
7. A total of 5,791 wild salmon smolts were recorded in the downstream trap in 2000. The return to freshwater of the Burrishoole reared grilse recorded was 2.9%. The wild grilse return, at 8.1%, was higher than that recorded in 1999 (5.1%).
8. The ova to smolt survival at 0.53 – 0.61, was the second highest recorded during the '90's.
9. A total of 111 wild sea trout and a further 63 non-silvered trout migrated upstream through the traps in 2000. Of the sea trout, 45 were adults and 66 (76.5%) were finnock. The 2000 smolt run amounted to 769 smolts. The total run of reared smolts was 10.
10. The percentage of smolts returning as finnock in the same year has historically ranged from 11.4% to 32.4%. In 1989 it collapsed to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's between 4 & 10%, rising to 16.7% in 1999 – the highest return rate since 1986. Finnock return in 2000 was at 9.4%.
11. Silver eel trapping was continued in 2000. The run was similar to that in 1999 with 56% of the migration in September and 32% in October. The total run amounted to 2631.
12. A total of 199 salmon were caught in the Burrishoole Fishery in 2000. The catch consisted of 70 wild fish and 129 reared salmon. Of the 70 wild fish caught, 64 were returned alive to the water and 6 were killed. There was a minimum of 40 sea trout caught on Lough Furnace and returned alive. The exploitation rate on wild salmon decreased from 24% in 1995 to 8.6% in 1996, when catch and release as encouraged. In 1997, when catch and release was mandatory, exploitation fell to 4.6%. Exploitation decreased further to 2.1% in 1998, 1.1% in 1999 and 1.0% in 2000. The % angling success has ranged from 29.7% in 1996 to 7.6% in 1999 and it was 12.1% in 2000.

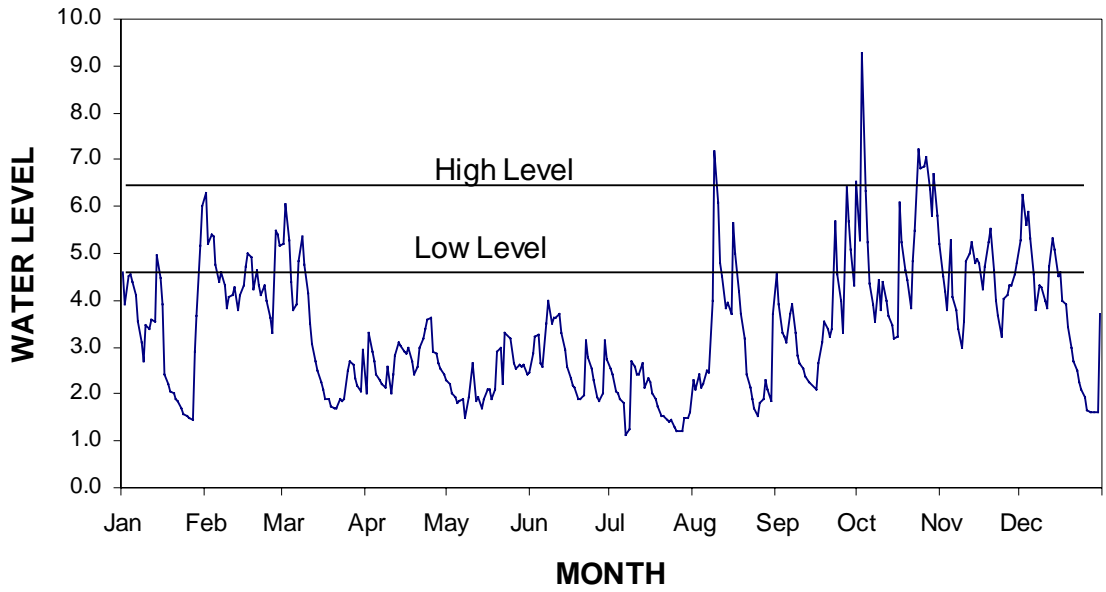
1 INTRODUCTION

The Salmon Research Agency merged with the Marine Institute on the 1st July 1999. The staff of the Agency were absorbed into the new Salmon Management Services Division of the Institute and the research facilities at Furnace have been undergoing upgrading and improvement. The core monitoring work of the Agency will continue but its unique experimental facilities, both in relation to aquaculture and wild fisheries, will be fully utilised within the context of the Institute's recently published Research, Technology, Development and Innovation Strategy. The merger has resulted in an increased national role for the work of the Agency and a consolidation of the trap and laboratory facilities at Newport.

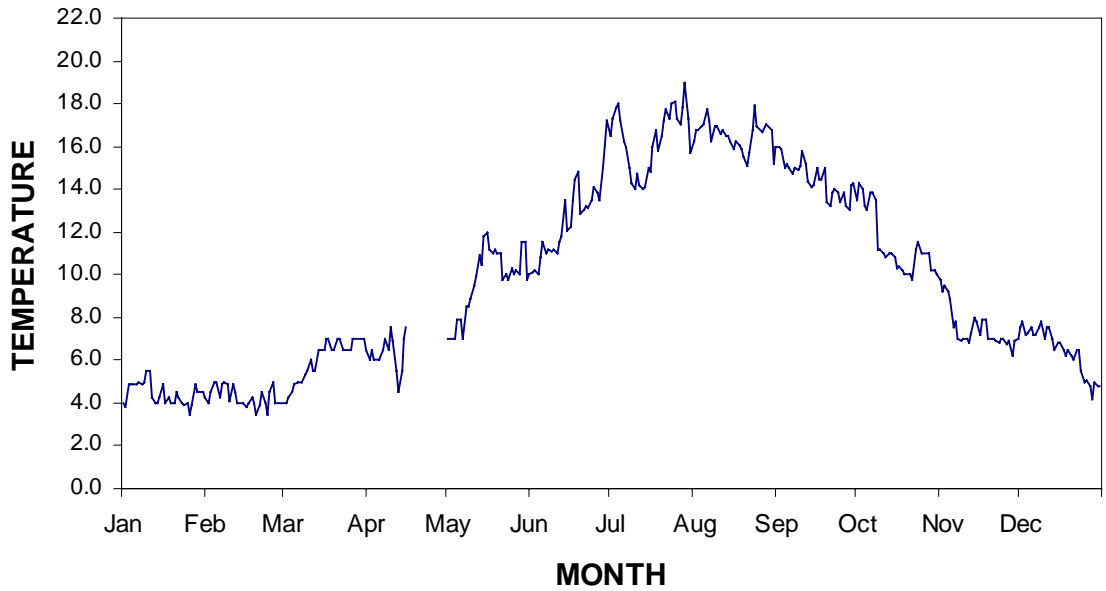
This report follows on from the annual reports of the Salmon Research Trust and the Salmon Research Agency in creating a unique record of fish rearing and wild fish census data for the past 30 years.



MILL RACE WATER LEVEL, 2000



MILL RACE WATER TEMPERATURE, 2000



2 METEOROLOGICAL DATA

Daily meteorological data were collected during 2000. The monthly rainfall figures for 1997, 1998, 1999 and 2000 are given in Table 1, along with the annual totals for 1977 to 2000. Months of high rainfall in 2000 were February, August, October and November with low summer rainfall in May, June and July. The total rainfall was 1833.2 mm in 2000, the third wettest year since 1977 when records began and above the annual average.

Table 1. Monthly rainfall totals (mm) for 1997, 1998, 1999 and 2000 and the annual totals for 1977 to 2000.

Month	1997	1998	1999	2000	Year	Total
January	27.5	165.6	232.7	133.2	1977	1579.7
February	200.8	132.9	169.1	223.6	1978	1592.2
March	89.0	126.0	112.8	123.2	1979	1653.3
April	42.7	97.0	148.0	115.9	1980	1792.1
May	99.9	66.5	83.3	80.2	1981	1646.8
June	80.0	151.2	75.2	87.4	1982	1609.6
July	124.2	145.2	93.3	56.6	1983	1495.9
August	106.7	238.4	145.0	182.9	1984	1556.6
September	123.8	96.0	195.6	150.0	1985	1584.1
October	96.9	231.8	113.7	299.8	1986	1886.9
November	130.8	181.6	213.3	211.7	1987	1373.6
December	229.3	198.7	367.1	168.7	1988	1715.2
					1989	1583.9
					1990	1805.9
					1991	1549.6
					1992	1771.1
					1993	1473.4
					1994	1757.1
					1995	1382.5
					1996	1286.6
					1997	1351.6
					1998	1830.9
					1999	1949.1
					2000	1833.2

Water levels in 2000 were generally high in February and March and levels from August on were also high with a drop in September. Levels were low and steady through April to early August. Water temperatures fell to a minimum of 3.5°C in January. The temperature remained fairly steady through February and rose in March to 7°C, before rising through a series of peaks to a maximum of 19°C in late July. Temperature began dropping steadily for the rest of the year from the end of July.

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- Murphy, T.M., Cotter, D., & Wilkins, N.P. (2000). Histological studies on the gonads of triploid and diploid Atlantic salmon (*Salmo salar* L.). *In: Proceedings of the 6th International Symposium on Reproductive Physiology of Fish, Bergen 1999* (B. Norberg, O.S. Kjesbu, G.L. Taranger, E. Andersson, S.O. Stefansson, eds.) Bergen 2000, p.200.
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- Whoriskey F. Jr. & Whelan K.F. (2000) (Eds.) Managing Wild Atlantic Salmon. New Challenges – New Techniques. *Proceedings of the 5th Atlantic Salmon Symposium, September 1997, Galway, Ireland.* Atlantic Salmon Federation, US / Atlantic Salmon Trust, UK. 244pp.

4 SEA TROUT BROODSTOCK PROGRAMME

Since 1989, many sea trout stocks in the Galway/south Mayo region declined to a critical level and urgent action was needed to save the genetic integrity of these stocks. A full description of the sea trout broodstock programme initiated in 1991 was given in the 1995 Annual Report.

In 1993, the Dept. of the Marine and the Salmon Research Agency initiated the Connemara Broodstock bank, based on the Burrishoole Reconditioning Programme and the Norwegian Gene Bank concept, in an attempt to collect, ongrow and protect a core broodstock of native sea trout in a fully marine situation. The first phase incorporated two separate but related strategies: the ongrowing to maturation of F1 sea trout parr/smolts and reconditioning and ongrowing wild sea trout kelts and finnock from four donor fisheries; Burrishoole, Erriff, Costello and Crumlin. This programme received from Údarás na Gaelteachta and the EU Tourism Operational Programme for Fisheries. The programme produced some 8.3 million green ova, of which 6.6 million were distributed as eyed ova to nine hatcheries throughout Connemara and the fry have been stocked into 23 sea trout fisheries throughout the region. The distributed ova were hatched in the satellite hatcheries and a combination of unfed fry, first feeding fry and parr were stocked into the recipient fisheries. Such stocked fry will subsequently migrate as one, two, three and four year old smolts. Introductions of fry from 1995 to 2000 will produce smolts from 1997 through to the year 2004.

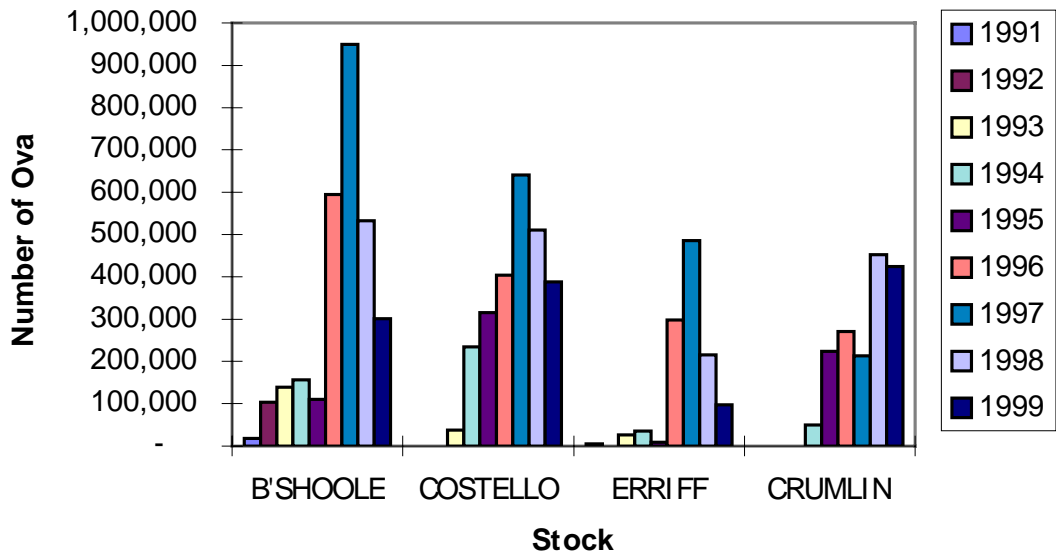
Smolts migrating to sea between 1997 and 2004 will return as finnock and adult trout up to sea age 5 from 1997 through to 2009. The main ova production in the wild is by one and two sea winter fish returning to the fishery, some three to six years after being introduced as 0+ age fry. Data from the Burrishoole trap has shown freshwater survival to the smolt stage to be excellent and the number and quality of the migrating smolts has also been excellent.

Progress in 2000

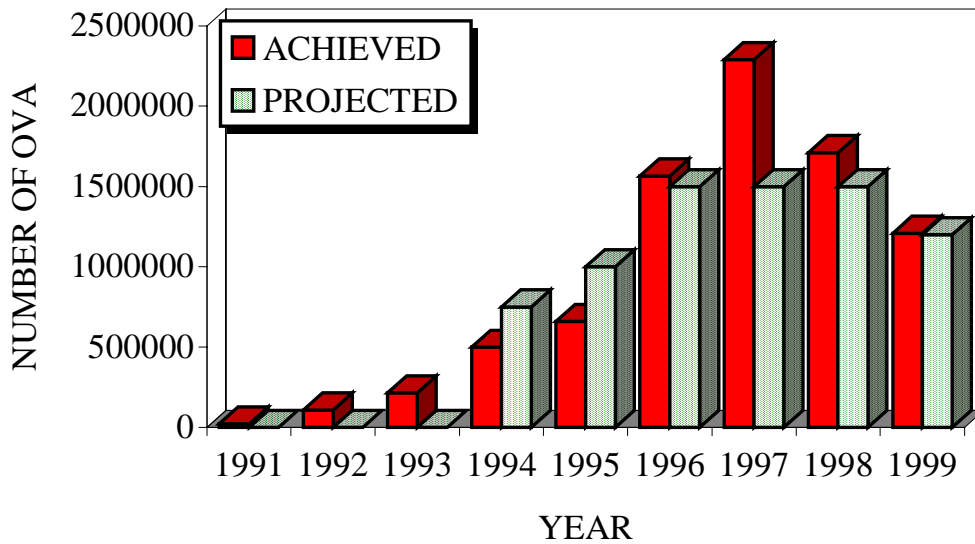
All stocks performed well during 1999 with no significant problems occurring either in the sea or in freshwater. Stripping in 1998 yielded 1.7 million green ova and 1.4 million were stocked into the nine satellite hatcheries in Connemara. In 1999, the target of 1.2 million was again met with a final total of 1.2 million ova stripped and some 1.1 million eyed ova were distributed to seven hatcheries in Connemara.

The funding through the EU TAM programme came to an end in December 1998 and the 1999/2000 programme was funded through contributions from the Marine Institute, the Central and Regional Fisheries Boards and private fishery owners. With the culmination of the programme in 2000 the broodstock were culled after the stripping season in 1999 and the cage sites have been closed.

Green ova produced annually by each stock



SEA TROUT OVA PRODUCTION FROM BROODSTOCK BANK



5 SALMONID REARING

5.1 Salmon Stocks 1999

Growth and survival was good in all stocks. Stress testing was carried out in March 2000 and proved negative for *A. salmonicida*.

(i) Ranching

The total release of microtagged smolts of ranched Burrishoole grilse origin was 24,800. Smolts were released as three groups, averaging 76g in weight.

A further 24,100 smolts were released as five 'experimental' groups. The groups were part of a preliminary study using line bred, multi-sea winter and grilse stocks of Shannon origin (see salmon stocks 2000). Groups averaging 73 - 88g in weight, were differentially microtagged and branded.

(ii) Aquaculture

An estimated 49,950 vaccinated salmon smolts, averaging 62g, were successfully transferred to a commercial sea farm on 7th April 2000.

5.2 Salmon Stocks 2000

Burrishoole grilse stock, commercial 2SW Icelandic stock and 'experimental' stocks were hatched in 2000. Experimental groups consisted of crosses between line bred grilse and multi-sea winter Shannon stocks from Parteen hatchery. The return behaviour of these groups will be compared.

Growth and survival was satisfactory throughout the year. Grading was carried out from July to September and all commercial pre-smolts were vaccinated (Norvax Compact 4) during October and November. Photoperiod was manipulated in a group of upper mode Icelandic salmon parr to produce 34,800 S 1/2 smolts, which were transferred to a commercial salmon farm in December 2000. Potential S1 Icelandic smolts were used in a field trial to test the efficacy and safety of vaccination with Norvax Mono PD vaccine.

Stocks remaining in December 2000 were 25,700 Burrishoole grilse, 28,300 commercial 2SW and 51,000 'experimental' ranch stocks.

5.3 Salmon Stocks 2001 (Grilse ova laid down in 2000)

Broodstock were stripped in December and early January. An estimated 735,000 green ova were produced by 175 hens. The average fecundity value was 4,200 per female.

Broodstock condition was good throughout the holding period. Fish were tested by the Marine Institute Fish Health Unit in December and subsequently salmon ova were certified disease free. Ova quality and survival was good.

In association with Cong, Delphi and Parteen hatcheries, the SMSD co-ordinated the sale of 1.4 million ova to Germany for the Rhine programme. SMSD exported 622,500 and retained 40,500 eyed ova.

5.4 Rainbow Trout 2000

An estimated 9,600 rainbow trout (Sea Stream stock) were stocked into Ballinlough Fishery, from August to October. Stock remaining on site in December 2000 was 1400.

5.5 EU Triploid Programme

The programme (AIR CT94 2216) *Minimising the interaction of cultured and wild fish: a comprehensive evaluation of the use of sterile, triploid, Atlantic salmon* aimed to evaluate the comparative biology of diploid and triploid Atlantic salmon in terms of their performance in fresh and sea water culture, behaviour on release, product quality, potential for somatic growth, exercise physiology and disease resistance. The SMSD was contracted by the National University of Ireland, Galway to assess the comparative performance of diploid and triploid salmon as cultured stocks and the environmental impact of triploid salmon through tagging and release studies.

A supplementary 'environmental impact' report on the 1998/1999 return data was presented to the EU in 2000.

6 SALMON CENSUS PROGRAMME

6.1 Wild Salmon and Grilse

A total of 568 wild grilse were recorded moving upstream through the permanent traps during the season (Table 2). The run commenced in May and there was a late run at the end of the year with fish recorded during December and January 2001 (Table 3). The main upstream migration was recorded in the Salmon Leap trap with 446 wild grilse and 122 in the Mill Race trap.

The number of spring fish recorded was 6.

The retained rod catch of wild grilse on Lough Furnace was 6 fish. Therefore, the total wild grilse return, including the Furnace rod catch and the upstream count, was **574**.

Table 2. Monthly wild grilse totals for the Salmon Leap and Mill Race traps.

	Mill Race	Salmon Leap	Total
May	4	0	6
June	66	85	132
July	2	172	224
August	31	76	85
September	5	42	48
October	5	6	6
November	0	1	1
December	2	0	0
January 2001	7	0	7
Total	122	446	568

Table 3. Monthly proportions (%) of wild grilse run 1990 –'00.

	1996	1997	1998	1999	2000
May	1.3	1.0	0.0	1.2	1.8
June	10.0	11.9	30.7	26.3	31.5
July	29.6	32.0	44.6	44.6	4.9
August	23.5	21.1	8.7	16.9	45.1
September	6.1	23.0	4.4	9.6	11.6
October	28.7	9.0	10.9	1.2	3.5
November	0.8	2.1	0.8	0.2	0.0
December	0.0	0.0	0.0	0.0	0.4
January 2001	0.0	0.0	0.0	0.0	1.2

Daily rainfall levels were generally low during the summer months, however very high rainfall levels were recorded for short periods and the peak of the upstream migration occurred following a period of heavy rainfall during in July.

Table 4. Wild salmon and grilse totals in upstream traps 1970-2000

Year	Total Salmon	Total Grilse
1970-74	14	1145
1975-79	36	703
1980-84	35	449
1985-89	22	492
1990-94	16	421
1995	15	582
1996	18	409
1997	6	538
1998	4	516
1999	16	502
2000	6	568

6.2 Net marked fish in upstream traps

Net marks were observed on both wild and reared grilse between June and September (Table 5). As in recent years the net marks were not severe and resulted in minor dorsal damage.

Table 5. Percentage Occurrence of Net Marks on Wild and Reared Grilse

	Wild Grilse	Reared Grilse
May	0.0	100.0
June	18.8	35.0
July	23.1	60.0
August	7.6	0.7
September	3.8	4.3
October	0.0	2.6
November	0.0	0.0
December	0.0	0.0

6.3 Wild Spawning Stock

The spawning stock represents the number of fish available for spawning. It is calculated by subtracting rod caught fish and downstream-displaced fish as well as losses due to poaching, disease and predation, which have been estimated at 5% for wild fish and 10% for reared fish.

The maximum spawning escapement in 2000 comprised of 567 fish (Table 6). The estimate spawning stock of fish, once mortalities were removed, was 521 (Table 7). The reared component of the spawning stock (40) was 7%, which is a decrease from 11.3% recorded the previous year . The reared component was minimised by transferring reared fish from the upstream traps back to Furnace. Between June and August reared fish from the upstream traps were floy tagged and transported from the traps and released into Lough Furnace. In addition some reared fish were culled and used as replacement fish for the rod fishery.

All experimental reared fish identified by freeze brand marks in the upstream traps were culled.

Table 6. Spawning escapement 1970 - 2000

	Maximum spawning escapement	Wild fish component	Reared component
1970-74	1126	986	140
1975-79	725	683	42
1980-84	474	430	44
1985-89	662	428	232
1990-94	603	348	254
1995	464	376	102
1996	594	355	239
1997	494	466	28
1998	498	456	42
1999	547	485	62
2000	567	527	40

Table 7. Spawning stock of salmon and grilse

	Wild grilse(1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	568	6	95
Rod Feeagh*	--	--	--
Culled	--	--	0
Broodstock	5	--	0
Estimated mortis.	28	--	4
Displacement	8	--	51
Spawning stock	521	6	40

* No angling on L. Feeagh during 2000.

6.4 Survival of Ova to Grilse

The relevant brood year for the 2000 grilse was 1996 with ova hatch in 1997 and smolt migration in 1999 (Table 8). As in previous years, it has been assumed for the purpose of estimating survival that ranched grilse spawned naturally. Specific data are not available on differential survival rates of wild and ranched stocks spawned in the wild. All relevant calculations are based on parameters set out in the Ann. Rep. No. 19, 1974.

Table 8. Survival ova to grilse

Spawning escapement in 1996	594
No. of females	297 - 327
Ova deposition	1,188,000 – 1,345,605
No. of smolts in traps 1999	7197
No. of smolts released	7118
Survival ova to smolt	0.61 - 0.53
No. returning grilse 2000	574
Survival smolt to grilse	8.1%
Survival to grilse per grilse female	1.9 – 1.8

6.5 Ova to Smolt Survival

The survival of ova to smolt was the second highest recorded during the 1990s. It decreased from 0.93 in 1995, which was the highest recorded during the 1990s, to 0.61 (Table 9).

The survival of smolt to grilse increased from 5.7% to 8.1%. However the survival to grilse per grilse female was below the value required to sustain the population of four years earlier.

Table 9. Comparative data for the five-year averages from 1970 - 1989 and the values for the individual brood years from 1990 onwards.

Brood year-class	% survival rates ova to smolt	survival rates to grilse per grilse female spawner
1970-74	0.48 - 0.62	1.4 - 1.7
1975-79	0.63 - 0.73	1.5 - 1.7
1980-84	0.61 - 0.69	1.7 - 1.9
1985-89	0.44 - 0.45	1.4 - 1.5
1990	0.47 - 0.54	1.8 - 2.0
1991	0.47 - 0.53	1.8 - 2.0
1992	0.48 - 0.54	1.3 - 1.5
1993	0.39 - 0.45	1.5 - 1.6
1994	0.36 - 0.41	1.3 - 1.4
1995	0.83 - 0.93	1.9 - 2.1
1996	0.53 - 0.61	1.8 - 1.9

6.6 Wild Salmon Smolts

A total of 5791 wild salmon smolts were recorded in the downstream traps during 2000. The run commenced on the 20th March in the Mill Race trap. The main peak occurred on May 21st when a total of 1775 (30.7%) wild smolts were recorded in the downstream traps. By the end of May 96.5% of the total run, which ended in August, was recorded (Table 10).

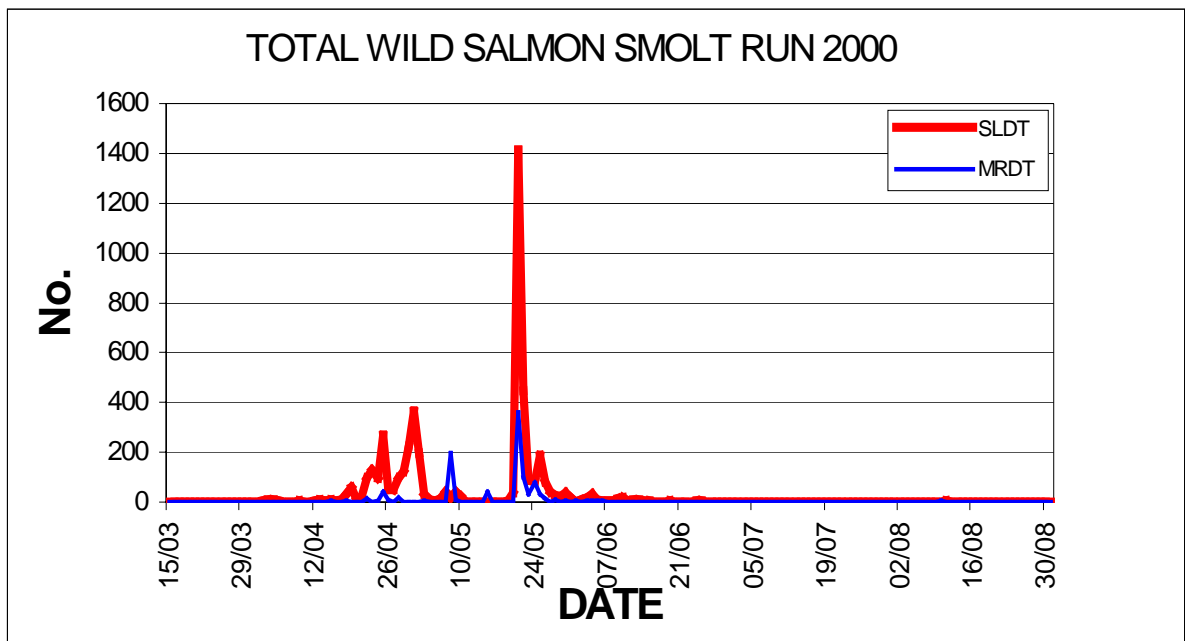


Table 10. Numbers of wild salmon smolts counted in 2000.

MONTH	SLDT	MRDT	TOTAL
March	4	1	5
April	1342	109	1451
May	3244	887	4131
June	158	27	185
July	2	0	2
August	10	7	17
September	0	0	0
TOTAL	4760	1031	5791

Table 11. Annual numbers of wild salmon smolt recorded in downstream traps

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
5968	3794	6926	5429	5971	5998	6148	6331	9588	7197	5791
						5854*	5960*	8937*	7118*	5689*

*Number of smolts released to sea from traps when mortalities and samples were deducted.

6.7 Wild Salmon Kelts

The wild kelt run commenced in December 1999 and the peak of the run occurred during March 2000 (Table 12). As in recent years the kelts recorded in the downstream traps were in very good condition. The percentage survival from the spawning stock was 62.1%.

Table 12. Numbers of wild salmon kelts counted in 2000.

	SLDT	MRDT	TOTAL
Dec '99	3	0	3
January '00	22	2	24
February	59	7	66
March	135	6	141
April	63	0	63
May	4	0	4
Total	286	15	301

Table 13. Comparison of annual kelt runs:

	A	B	C	D	E
1975-79	75	18	14.0	30.0	8.1
1980-84	82	18	6.7	48.7	9.7
1985	94	26	3.0	56.0	7.7
1986	93	31	3.4	55.3	9.2
1987	68	15	10.8	22.6	9.7
1988	88	24	4.6	55.0	8.7
1989	96	11	3.7	27.0	6.6
1990	94	35	5.6	48.6	7.6
1991	98	39	3.4	82.3	9.7
1992	92	39	7.0	59.3	6.9
1993	83	5	3.2	52.7	7.4
1994	91	37	4.7	64.3	1.6
1995	74	28	18.3	59.9	2.3
1996	88.1	27	10.1	53.1	4.0
1997	93.7	33.5	6.3	58.9	*
1998	94.3	30.8	5.7	67.6	*
1999	90.6	38.5	4.5	76.0	*
2000	92.5	44.5	5.5	62.1	*

A = % healthy kelts in kelt run

B = % males in kelt run

C = % lightly marked

D = % survival from wild spawning escapement

E = % recapture of previously spawned grilse in first year

7 REARED SALMON CENSUS PROGRAMME

7.1 Coastal Returns

Coastal returns

Exploitation by nets if NCFM is included*	85.0%
Survival to the coast*	8.6%
Survival to the river*	2.3%

*Provisional

7.2 Return rate of reared and wild grilse

The total return of reared salmon during 2000 to the Burrishoole trapping facilities and rod fishery was 1385 fish. Of these a total of 1185 were cored and microtags were recovered from 1169 fish (Table 14). The microtag results show that the returns consisted of 9 2sw Burrishoole fish and 545 Burrishoole grilse. In addition 614 grilse from an experimental programme were also identified.

A total of 545 fish were identified by microtag as returns from the release of 22,532 ranched Burrishoole smolts in 1999. This represents 46.6% of the total number of microtag identified. If it is assumed that the 217 (1385-1168) fish not identified by microtag also consisted of 46.6% Burrishoole ranched grilse the total return of the ranched Burrishoole stock during 2000 was 646 fish (545 + 101). Therefore the percentage return to freshwater in 2000 was 2.9% from the total number of smolts released. If the actual number of smolts migrating to sea, which takes into account freshwater mortality in Lough Feeagh, is used the survival to freshwater is 3.2%.

The return to freshwater at 2.9% is an increase from 0.8% in 1999. There was also a corresponding increase in the survival of wild fish to freshwater which increased from 5.7% to 8.1% for the same period.

7.3 Recapture of Reared 2SW Fish

A total of 9 2 SW reared Burrishoole stock were identified by microtag during 2000. All of the returns were from smolts released in Lough Furnace in 1998. The largest of these fish weighed 7.1kg and 86.4cm and was recorded in the Salmon Leap trap during August.

7.4 Smolt releases 2000

A total of 24,807 reared smolts of Burrishoole origin consisting of three microtag groups were released during 2000 (Table 15). Two microtag groups were released directly into L. Furnace and a third group was transferred to the Burrishoole estuary for release.

Table 14. Microtag Recoveries in Freshwater 2000.

Microtags	Tag Code	Release Year	Type
0	204704	1998	RANCH
1	204705	1998	RANCH
1	204701	1998	RANCH
3	204706	1998	RANCH
4	204707	1998	RANCH
106	194727	1999	RANCH
87	194715	1999	RANCH
153	14701	1999	RANCH
199	184738	1999	RANCH
15	174749	1999	Experimental
129	194709	1999	Experimental
163	184750	1999	Experimental
268	184748	1999	Experimental
38	194722	1999	Experimental
1	194724	1999	Experimental

Table 15. Burrishoole smolts released in 2000.

Release Date	28/4/00	2/5/00	2/5/00
Release Site	Furnace	Furnace	Estuary
No. Released	8887	7946	7974
Weight (g)	79	73.5	75.8
Length (cm)	19	18.8	19
Condition Factor	1.1	1.1	1.1
Microtag Code	14771	14769	14770

8 WILD SEA TROUT CENSUS PROGRAMME

The sea trout research and monitoring programmes were continued in 2000.

8.1 Upstream Movements: Timing and Numbers

A total of 111 wild silvered sea trout and a further 63 non-silvered trout migrated upstream through the traps in 2000. Of the silvered trout, 45 were adults and 66 (60%) were finnock. The numbers are compared with other years in Table 16. Of the total run of migratory trout (174), 36% were non-silvered. For the purposes of this report, the non-silvered trout are not included with the sea trout. Table 16 shows clearly that the numbers of sea trout have not recovered in the Burrishoole system and have shown a ten-fold drop since the 1970s.

Table 16. Annual runs of sea trout recorded in the traps.

YEAR	MILL RACE	SALMON LEAP	TOTAL	Amended Total
1970-74	1365	762	2127	
1975-79	829	1775	2604	
1980-84	458	780	1238	1719 *
1985-89	386	590	978	
1990-94	134	72	206	
1995-99	86	91	177	

1985	479	976	1465	
1986	277	1110	1387	
1987	528	422	950	
1988	497	366	863	
1989	147	77	225	
1990	101	54	155	
1991	180	162	342	
1992	123	28	151	
1993	130	43	173	
1994	136	74	210	
1995	90	90	180	
1996	112	85	197	
1997	65	72	137	
1998	56	50	106	
1999	107	157	264	
2000	33	78	111	

* See Table 34, Ann. Rep. XXX (1985); p. 43.

The timing of the sea trout run in 2000 and in previous years, expressed in monthly percentages, is given in Table 17. The highest proportion of sea trout, both finnock and adults, moved upstream in August. Few sea trout moved upstream in July due to low water levels.

Table 17. Timing of the Burrishoole sea trout run (in monthly percentages).

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000
May	-	0.2	0.5	0.1	3.1	0.9
June	13.1	24.6	9.4	8.4	8.6	7.2
July	54.4	44.9	62.2	55.0	42.4	9.0
August	15.8	10.3	18.4	16.5	19.3	72.9
September	7.6	14.8	3.7	8.5	9.8	7.2
October	6.4	3.5	4.1	7.9	12.2	1.8
November	2.4	1.5	1.5	2.9	4.3	-
December	0.3	0.2	0.2	0.7	0.7	-

8.2 Spawning Escapement

With the continuation of the catch and release bye-law into the 1999 fishing season, no sea trout were reported killed by anglers on L. Feeagh in 1999. Using the upstream fish counts through the traps, the total maximum spawning escapement of migratory trout to the L. Feeagh catchment was 174, of which 63 were non-silvered sea trout (Table 18). This was the lowest overall spawning escapement ever recorded.

Table 18. Annual spawning escapement of sea trout into freshwater.

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000
Max. Escap,	2090	1146	906	231	289	174
Revised		1622				

8.3 Reared Adults

This was the seventh year that a return of finnock occurred derived from the sea trout rearing programme. A total return of 6 tagged or marked trout was recorded in the upstream traps in 2000, the lowest return of the programme. These were broken down into 1 finnock, 1 one sea winter, 3 older sea trout and one unsilvered trout.

8.4 Downstream Movements, Sea Trout Smolts

The 2000 smolt run amounted to 769 smolts, of which 705 were released to the wild (Table 19). The main smolt run in 2000 occurred in two major peaks primarily related to increases in water level (Fig. 1).

Table 19. Monthly numbers of Burrishoole sea trout smolts recorded through the traps.

	Salmon Leap	Mill Race	Total	%
January	2	0	2	0.3
February	18	1	19	2.5
March	37	0	37	4.8
April	389	4	393	51.1
May	271	21	292	38.0
June	24	0	24	3.1
July	2	0	2	0.3
Total	743	26	769	
Number Released			705	

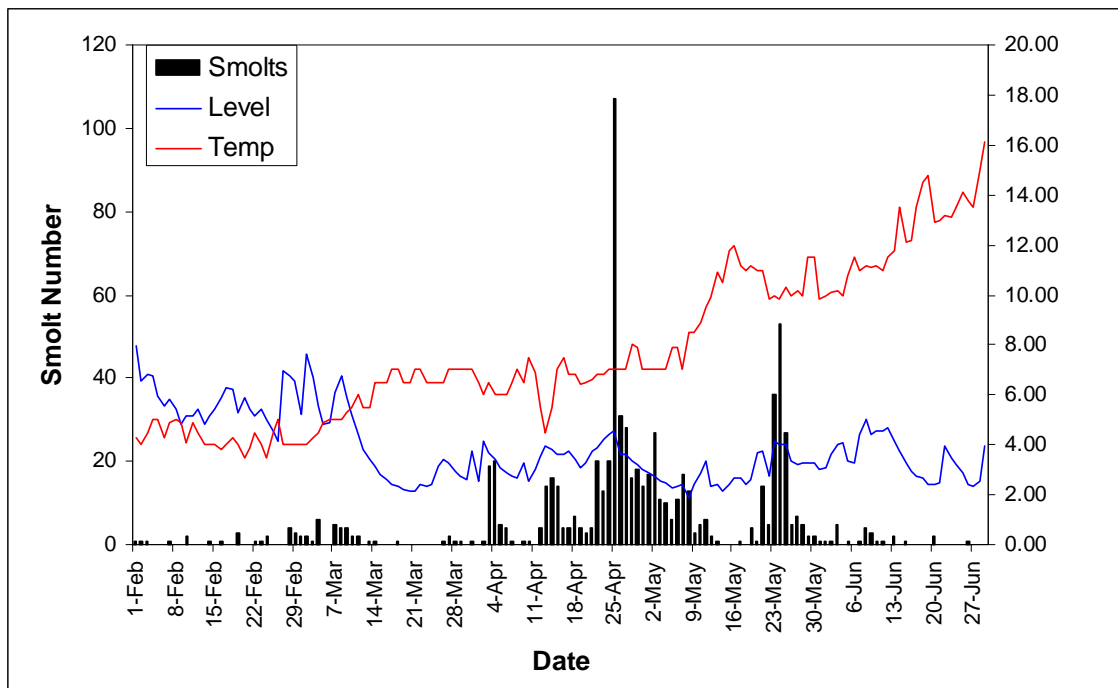


Fig. 1. Timing of the Burrishoole 2000 wild sea trout smolt migration with daily rainfall (mm) and temperature.

Table 20. Annual sea trout smolt numbers in Burrishoole for 1970 to 2000.

	1970-79	1980-84	1985-89	1990-94	1995	1996	1997	1998	1999	2000
Number	4176	4038	4119	1531	1821	1300	817	1608	1260	769

LENGTH

The length distribution for the 2000 wild sea trout smolts is given in Figure 2. The wild smolts had an average length of 21.1 cm and ranged from 14.6 cm to 30.8 cm in length with a modal length of 21 cm. The distribution of wild smolt lengths in 2000 was significantly higher than in 1999 ($P>0.002$) probably indicating a greater proportion of three year olds in the 2000 migration.

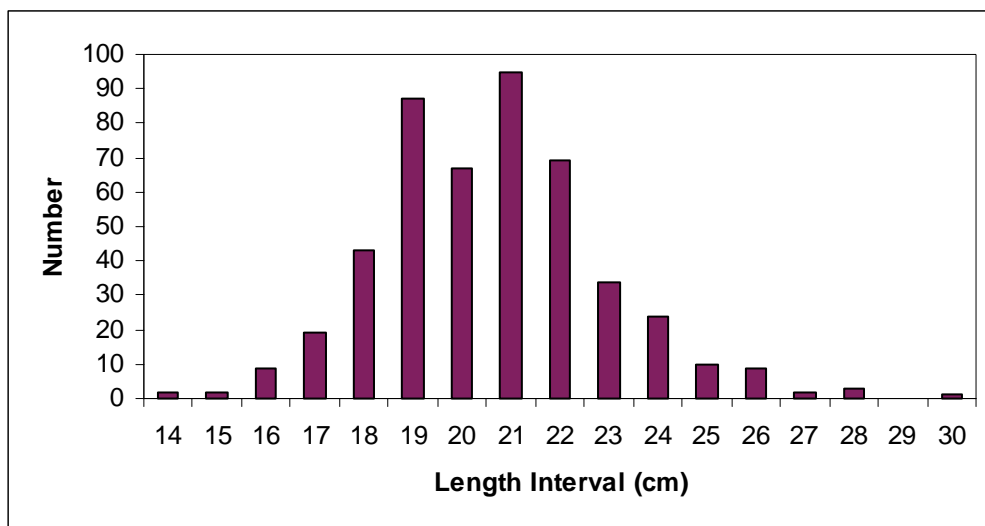


Fig. 2. Length distribution for smolts in the Burrishoole system, 2000 (n=476).

8.5 Reared Smolts NUMBER

Sea trout parr were stocked into L. Feeagh, as 0+ autumn parr and 1+ spring parr, between 1993 and 1998 (Table 21). These fish were the progeny of the reconditioned broodstock collected from the catchment in 1991 and 1992. Ten such stockings took place. Smolts derived from these stocked parr have been counted through the traps, largely as two and three year olds, since spring 1994 (Table 22).

A total of 10 smolts from released parr were counted through the traps in 2000; all of these were released downstream, considerably fewer than the 227 in 1999. All reared smolts were measured and identified where possible using elastomer marks and VI tags.

Of the parr released in autumn 1993 and 1994, a total smolting rate of 13.4% was achieved (Table 22). This included four year classes of smolts from three different timed stockings. As these fish were micro-tagged it was not possible to separate the different age classes making up the separate annual runs of smolts. Of the 1994/'95 releases of elastomer marked fish, a total smolting rate of the five year classes of 15.4% was recorded.

The parr released in 1996 achieved a smolting rate of 14% in 1997 increasing to 17.6% by 1999. The highest smolting as 1 year old smolts occurred in 1997 with some 10% migrating from the 1997 release of VI tagged parr. This increased to 28% in 1998 and 28.9% in 1999. Some 12% of the 1998 release were recorded as 1+ smolts increasing to 23% in 1999 with a total smolting rate of 23.5% by 2000.

It is thought that the increase in smolting rate observed in the latter years was related to the size at release of the parr. This will be investigated further.

Table 21. Details of sea trout progeny released in the Burrishoole catchment.

Release Date	Number Released	Age	Tag	Details
Spring 1993 18/3/93	6463	1+	M. Tag	L. Feeagh Release
Autumn 1993 10/11/93	3602	0+	M. Tag	L. Feeagh Release
Spring 1994 29/3/93	4723	1+	M. Tag	L. Feeagh Release
Spring 1994 7/4/93	909	1+	M. Tag /Caudal PJ	L. Avoher Release
Autumn 1994 9/12/94	7114	0+	Elastomer L. Eye Yellow	L. Feeagh Release Large Grade
Spring 1995 29/3/95	8234	1+	Elastomer R. Eye Yellow	L. Feeagh Release All-Female Progeny
Spring 1995 30/3/95	8566	1+	Elastomer L. Eye Red	L. Feeagh Release Medium/Large Grade
Spring 1996 29/4/96	4705	1+	Elastomer R. Eye Red	L. Feeagh Release
Spring 1997 1/4/97	4250	1+	Soft VI Tag Red & Green	L. Feeagh Release
Spring 1998 23/3/98	1578	1+	Soft VI Tag Red & Orange	L. Feeagh Release

INSERT LANDSCAPE TABLE 22

8.6 Autumn Migrating Smolts

These are juvenile trout (*Salmo trutta* L.) which generally move downstream through the traps from August to December. It is not clear whether these are true sea trout or part of the resident trout stock, should a difference exist.

A total of 418 trout entered the traps between July and December 2000 and January 2001 (Table 23). The percentage of 0+ trout that migrated in 2000 was 47.8% (Table 24). It is not known exactly what proportion of the 0+ trout are trapped because the downstream trap grids are not so fine as to prevent some from escaping.

Table 23. Numbers of migrating autumn juvenile trout in the Burrishoole fish traps, to the end of December 1999.

Month	0+	1+
July	0	0
August	10	18
September	119	142
October	56	49
November	0	0
December	1	2
January 2001	14	7
Total	200	218
Overall Total		418

Table 24. Percentage of 0+ juvenile trout amongst trapped autumn migrating trout.

1982	50.0
1983	N/A
1984	55.8
1985	30.3
1986	16.1
1987	35.3
1988	60.9
1989	37.2
1990	35.2
1991	26.0
1992	38.2
1993	27.6
1994	16.8
1995	25.3
1996	34.0
1997	18.7
1998	33.5
1999	42.0
2000	47.8

8.7 Total Recruitment

The 0+ autumn trout will not be large enough to become sea trout smolts in the following spring. The remainder, predominantly 1+ years old, could contribute to the overall recruitment of sea-run trout the following year. The exact proportion of 1+ autumn trout that become smolts in any given year is not known.

It is only since 1982 that the proportion of 0+ trout amongst the autumn migration has been estimated. Thus the figures for total recruitment up to this time are over-estimated (Table 25). From 1982, total recruitment was calculated by adding the number of sea trout smolts produced in any one year to the total of 1+ autumn trout the previous year (Table 26). The assumption is made that all the 1+ autumn trout will become sea trout smolts and that no 0+ trout from the two years previous will be recruited as smolts.

Table 25. Estimates of total migrant trout recruitment up to 1981.

YEAR	SMOLT TOTAL	AUTUMN TROUT (preceding year)	TOTAL RECRUITMENT
1970-74	4450	2870	6746
1975-79	4314	3186	7489
1980	2337	2351	4688
1981	6710	2631	9341

Table 26. Estimates of total migrant trout recruitment from 1982.

YEAR	SMOLT TOTAL	AUTUMN TROUT 1+ & Older (preceding year)	TOTAL RECRUITMENT
1982	3907	1300*	5207*
1983	4852	1109	5961
1984	2383	1200*	3583*
1985	4238	611	4894
1986	3454	1472	4926
1987	3371	1726	5097
1988	4290	949	5239
1989	3179	556	3735
1990	2022	634*	2656*
1991	2137	636	2773
1992	1936	234	2170
1993	1720	183	1903
1994	1127	306	1433
1995	1821	282	2103
1996	1300	336	1636
1997	817	513	1330
1998	1608	717	2325
1999	1260	644	1904
2000	769	358	1127

* estimated

8.8 Marine Survival

WILD

An estimate of sea trout survival to first return to freshwater can be more accurately calculated by the use of trap census data rather than rod catch returns of tagged or marked fish. Small numbers of stray fish are captured in other systems and it is not known whether these fish would have returned to their natal systems to spawn. Finnock are known to wander between river systems and are therefore not as reliable for assessing survival.

The pattern of marine survival found is similar whether the number of smolts is used or the combined total recruitment of smolts and autumn 1+ trout. The percentage of smolts that return as finnock in the same year historically ranged from 11.4% to 32.4% (Fig. 5). In 1988 it fell below the previous recorded minimum to 8.5% and in 1989 to a minimum of 1.5%. There has been a saw-tooth pattern of finnock return in the 1990's rising to 16.7% in 1999 – the highest return rate since 1986. Finnock return in 2000 was at 9.4%.

The total survival of smolts to the first return to freshwater as finnock in the same year and one year old sea trout in the following year (always an over-estimate as a proportion of finnock re-entering freshwater in year 1 return as sea trout in year 2 (Mills et al, 1990)) also shows a drop in survival from 1987 to 1989 (Fig. 6).

Historically, the total survival to first return ranged from 19% to 66%. This collapsed to 1.8% in 1989 but rose to 12.1% in 1990. However, little further improvement was recorded in 1991 (12.8%). Marine survival fell to the second lowest level in 1992 but returned to 13.1% for the 1993 year class of smolts. There was a further increase in 1994 to 18.2% but a drop in 1995 to 8.1%. There were marginal improvements again in 1996 (12.8%) and 1997 (13.3%), a drop to 8.3% in the 1998 year class and a marked improvement in the 1999 year class where marine survival was 20%, the highest in recorded in 12 years and within the pre-collapse historical range.

REARED TROUT

Percentage return and marine survival data for the reared trout are given for smolt to finnock and one sea winter returns (Table 27) as well as smolt to total return including unsilvered upstream migrants (Table 28). The data for autumn downstream migrants are not included in the report.

Return as finnock ranged from 1.4% in 1995 to 7.5% in 1997 and 7.7% in 1994. The 1997 figure was similar to the return of wild smolt. One year old 'smolt' failed to return in 1995 and 1996 but there were improvements in 1997 and 1998 with 2% and 0.5% respectively returning first time.

Table 13 gives the smolt return as 0+ sea age (silver and brown) and to total return as 0+ & 1+ trout from each annual smolt run derived from released parr. The total return of trout from each smolt run has ranged from 4.8% to 16.4%. This is an improvement on returns for previous releases of ranched sea trout smolts where return rates averaged 0-10% (Mills, Piggins & Cross 1990).

Table 27. Smolt return as silvered finnock and to total return as silvered trout (in bold) from each annual smolt run derived from released parr; number of smolts given in parentheses.

Year of Return	Year of Smolt Migration (Ages 1+ to 4+)						
	1994 (897)	1995 (1458)	1996 (2752)	1997 (1497)	1998 (1175)	1999 (222)	2000 (10)
1994	7.7%						
1995	11.0%	1.4%					
1996		2.3%	2.7%				
1997			3.4%	7.5%			
1998				8.1%	2.9%		
1999					3.7%	5.0%	
2000						5.4%	10%

Table 28. Smolt return as 0+ sea age (silver and brown) and to total return as 0+ & 1+ trout (in bold) from each annual smolt run derived from released parr; number of smolts given in parentheses.

Year of Return	Year of Smolt Migration (Ages 1+ to 4+)					
	1994 (897)	1995 (1458)	1996 (2752)	1997 (1497)	1998 (1175)	1999 (222)
1994	10.1%					
1995	14.1%	3.6%				
1996		4.8%	3.9%			
1997			4.9%	14.6%		
1998				16.4%	5.8%	
1999					8.3%	14.0%

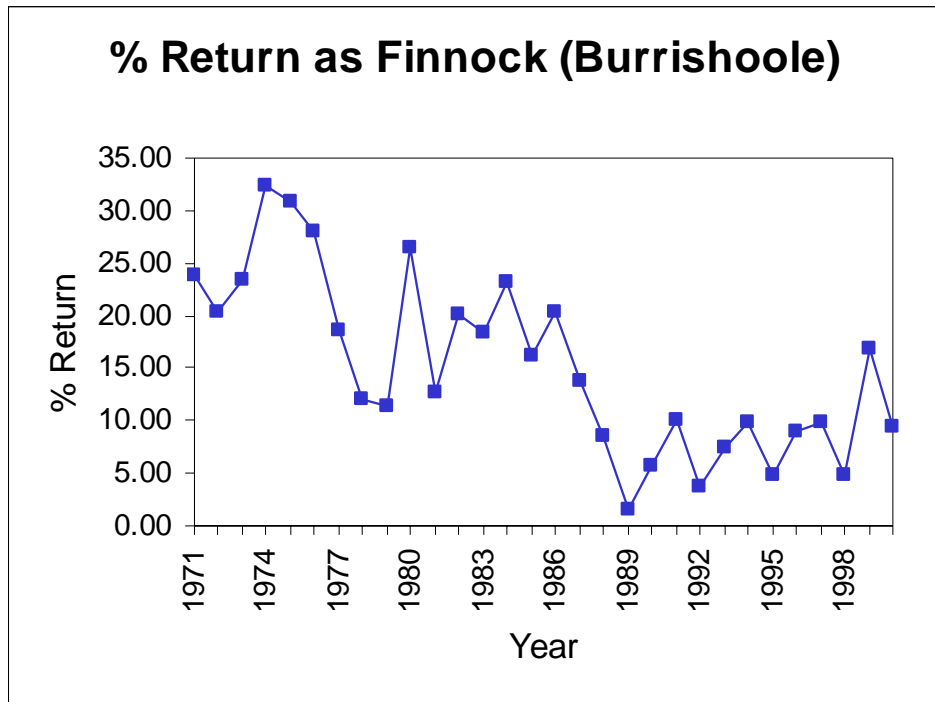


Fig. 5. Annual percentage return of smolts returning as finnock to the Burrishoole system.

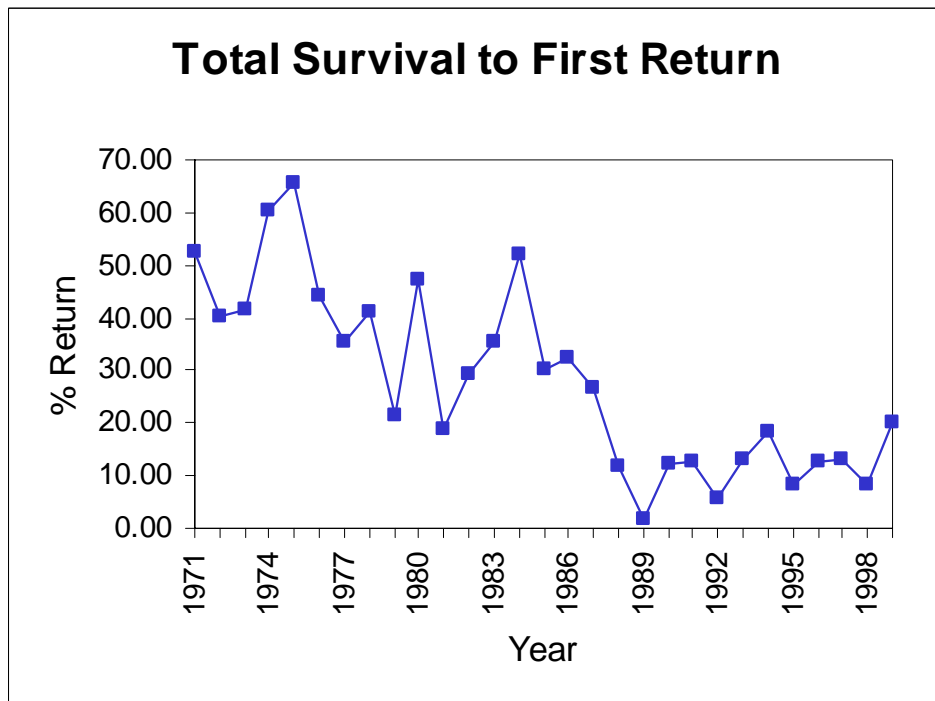


Fig. 6. Annual marine survival of smolts to first return (as finnock and 1+ sea trout) to the Burrishoole system.

8.9 Sea Trout Kelts

Table 29. Timing and numbers of sea trout kelts for the 1999/2000 season.

Month	Large	Small	Total
October	1	2	3
November	7	16	23
December	15	35	50
January	8	7	15
February	11	19	30
March	15	18	33
April	4	23	27
May	1	3	4
Total	62	123	185

The freshwater survival of kelts is given in Table 30. In some years, the number of kelts migrating downstream has exceeded the number of upstream migrants. This occurred in the early '80s when the screen allowed finnock to escape. This was rectified. More recently, the difficulty in separating small finnock and large smolts has led once again to a discrepancy as shown in Table 30. In addition to the size overlap, trout counted upstream as unsilvered migrants may be counted downstream as silvered kelts, causing difficulties in calculating survival estimates.

Since 1987, only one survival rate has been given for all sizes as it has been shown that a proportion (at least 33%) of the sea trout population may overwinter in freshwater. These fish do not spawn and continue to grow. There is also the additional complication of larger smolts and reduced sea growth mentioned above. Thus the comparisons of the proportion of fish in different year classes between the upstream migrants of one year and the downstream migrants of the next are invalidated.

Table 30. Annual survival rate to sea trout kelt, as % of the upstream escapement of the previous year.

Year	Larger (> 30.0 cm)	Small (< 30.0 cm)
1976	79	66
1977	63	45
1978	50	66
1979	33	107*
1980	50	82
1981	44	345*
1982	53	203*
1983	63	177*
1984	74	210*
1985	70	98
1986	66	72
1987		58.7% (combined)
1988		65.5% "
1989		68.7% "
1990		79.0% " *
1991		98.7% " *
1992		89.5% " *
1993		96.7% " *
1994		104.6% " *
1995		96.2% " *
1996		127.7% " *
1997		97.0% " *
1998		140.1% " *
1999		110.4% " *
2000		70.1% "

* Years when the number of finnock kelts counted downstream exceeded the number counted upstream during the previous season.

9 SILVER EEL CENSUS PROGRAMME

Silver eel trapping was continued in 2000. The run timing was similar to that in 1999 with 55% of the migration in September and 32% in October (Table 31). The total run amounted to 2631. As in other years, the highest proportion of the total catch (93%) was made in the Salmon Leap trap. Some flooding of the trap at the Salmon Leap occurred due to unusually high water levels.

Table 31. Timing and numbers of the 2000 silver eel run.

	Salmon Leap	Mill Race	Total	%
June	2	0	2	0.1
July	2	2	4	0.2
August	132	38	170	6.4
September	1402	58	1460	55.5
October	761	93	854	32.4
November	112	3	115	4.4
December	26	0	26	1.0
Total	2437	194	2631	

Sampling of individual eels (n=342) gave an average length of 46.5 cm (range: 25.0 – 84 cm) and an estimated weight of 212 g (Table 32). These data were similar to those collected in 1998 & 1999.

Catches of silver eel between the years 1971 (when records began) and 1982 averaged 4,400, fell to 2,200 between 1983 and 1989 and increased again to above 3,000 in the '90s (Fig. 1). There was an above average catch in 1995, possibly contributed to by the exceptionally warm summer. The average weight of the eels in the catches has been steadily increasing from 95 g in the early 1970s to 215 g in the 1990s (Fig. 6).

Table 32. Comparative data for the silver eel runs since 1971.

YEARS	NUMBER SAMPLED	AV. WT. (gm)
1971 - '75	4465	84
1976 - '80	4023	115
1981 - '85	2678	171
1986 - '90	11658	196
1986	1856	194
1987	2713	195
1988	3283	206
1989 *	685	254
1990	3121	176
1991	266	246
1992	523	186
1993	181	260
1994	468	220
1995	2003	225
1996	1172	184
1997	1022	238
1998	845	208
1999	577	220
2000	342	212

* Incomplete due to flood damage

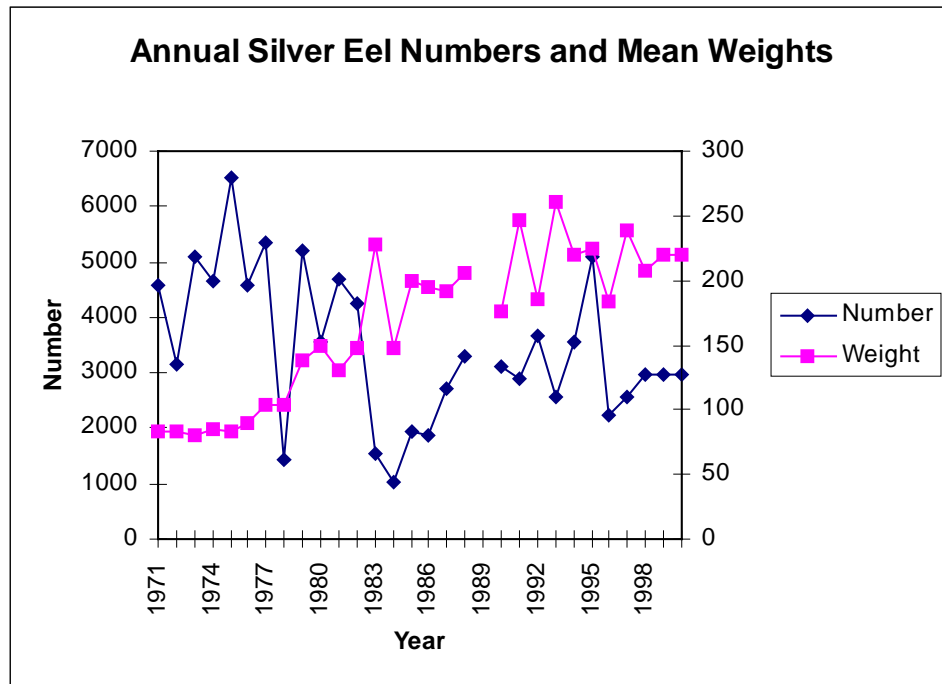


Fig. 6. Annual number and mean weight of silver eels trapped in the downstream traps.

10 FISHERY REPORT - CATCH DATA

10.1 Numbers and Average weight of Rod Catch

A total of 199 salmon were caught in the Burrishoole Fishery in 2000. The catch consisted of 70 wild fish and 129 reared fish. Of the wild fish 64 were released and 6 killed.

Regulations remained in place whereby all rod caught sea trout were returned alive. The total trout rod catch was 40 fish.

The average weight of wild grilse was 1.8kg (n = 5) and the average length was 55.3cm (n=5).

The average weight of reared fish was 2.1kg (n=126), the heaviest reared fish was an V-inverted branded fish at 4.5kg.

10.2 Timing of Catch and Rod Effort

Angling was again confined to Lough Furnace during 2000, as Lough Feeagh remained closed as a conservation measure. The majority of both wild and reared fish were caught during June and July. The highest rod effort occurred during July with a total of 290 rod days.

Table 33. Wild and reared salmon rod catch and rod effort (hours) for the 2000 season.

	SALMON CATCH		EFFORT/
	WILD	REARED	HRS.
JUNE	30	29	1951
JULY	30	77	2321
AUGUST	5	13	530
SEPTEMBER	5	10	467
Total	70	129	5269

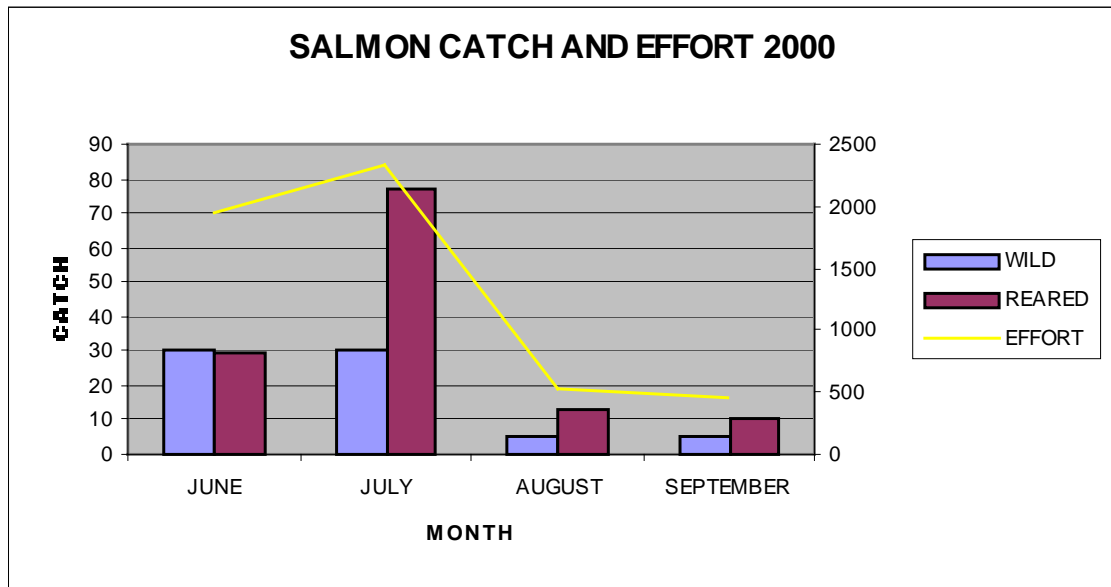


Fig. 7. Wild and reared salmon rod catch and rod effort (hours) for the 2000 season.

10.3 Exploitation Rates of Rod Fishery

Rod exploitation rates for Lough Furnace and Lough Feeagh from 1980 to 1996 are shown in Table 34. From 1997 onwards due to the continuing low stock level of wild fish, anglers were requested to return wild fish alive to the water. Injured wild fish were permitted to be retained, therefore the rod catch consists of a total catch which includes released fish and a retained catch which are fish that have been killed. From 1997 onwards Lough Feeagh was closed to angling. Exploitation rates are only available for Lough Furnace for these years.

Voluntary catch and release was introduced in 1995 and the exploitation rate for wild fish in that year was 24%. With the introduction of mandatory catch and release exploitation rates fell to 4.6% in 1997, 2.1% in 1998 and 1.1 in 1999. There was a further decrease in 2000 with an exploitation rate of 1.0%.

The exploitation rate on reared fish at 10.3% was an increase from 8.9% the previous year.

Table 34. Rod Fishing Exploitation Rates (1985-2000)

	1985 -89	1990 -94	1995	1996	1997	1998	1999	2000	
WILD SALMON									
Lough Feeagh									
"Available" fish by end of fishing season	493	400	235*	167	*	*	*	*	
Total rod catch	43	35	30	11					
Rod catch retained			29	8					
Angling success % ¹	-	-	12.8	6.6					
Exploitation rate % ²	8.1	8.8	12.3	4.8					
WILD SALMON									
Loughs Feeagh & Furnace									
Total stock of wild fish + 10% addition for	548		449	475	406	544	520	524	580
L. Furnace population	603		494	523	447	598	572	576	638
Total catch of wild fish	84		70	141	119	125	80	40	70
Rod catch retained				114	35	25	11	6	6
Max. angling success %	--			29.7	29.3	23.0	15.4	7.6	12.1
Min. exploitation rate	13.7		14.2	21.8	7.8	4.2	1.9	1.0	0.9
Max. exploitation rate	15.1		15.6	24.0	8.6	4.6	2.1	1.1	1.0
REARED SALMON									
	1985 -89	1990 -94	1995	1996	1997	1998	1999	2000	
Lough Feeagh									
"Available" fish by end of fishing season	659	606	49	150*	*	*	*	*	
Rod catch	43	25	3	1					
Exploitation rate %	6.3	4.1	6.1	0.7					
Loughs Feeagh & Furnace									
Total stock	948	858	889	1032	848	1682	395	1257	
Total rod catch	117	108	185	176	93	560	35	129	
Exploitation rate %	12.1	12.6	20.8	17.1	11.0	33.3	8.9	10.3	
WILD SEA TROUT									
Lough Feeagh									
"Available" fish by end of fishing season	919	196	108	82*	*	*	*	*	
Rod catch	74	31	6	5					
Exploitation rate %	6.4	15.8	5.6	6.1					

* No Fishing on Feeagh

10.4 Angling Success

The rod catch of both wild and reared fish increased during 2000 from the previous year. The wild catch increased from 40 to 70 fish and the reared catch increased from 35 to 129. The angling success and the exploitation rates also show an increase for the same period. The angling success increased from 7.6% to 12.1% while the exploitation rate for reared fish increased from 8.9% to 10.3%.

The greater number of fish available to the fishery during 2000 together with reasonable fishing conditions resulted in a greater catch per unit effort than in 1999. During 1999 the lowest catch per unit effort was recorded in recent years. The CPUE in 2000 increased from 0.09 in 1999 to 0.3 (Table 35).

Table 35. Catch per unit effort (CPUE) and effort per unit catch (EPUC) for the Burrishoole Fishery

YEAR	L. FURNACE				L. FEEAGH			
	SALMON		SEA TROUT		SALMON		SEA TROUT	
	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC	CPUE	EPUC
'80-'84	0.13	9.92	0.85	1.35	0.23	4.47	0.63	2.10
'85-'89	0.24	4.89	0.46	5.09	0.24	4.57	0.29	70.30
'90-'95	0.20	6.10	0.17	16.80	0.20	5.40	0.10	14.0
'96	0.22	4.4	0.10	10.5	0.83	1.2	0.30	2.9
'97	0.17	6.0	0.10	9.6	-----	-----	-----	-----
'98	0.44	2.3	0.08	13.2	-----	-----	-----	-----
'99	0.09	10.8	0.05	20.8	-----	-----	-----	-----
'00	0.30	3.31	0.06	16.5	-----	-----	-----	-----