Newport Research Facility

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Report for the year ended 31st December 2005

This report follows in sequence from the Annual Reports of the Salmon Research Agency of Ireland Inc. and the Salmon Research Trust of Ireland Inc.

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SUMMARY

1. The Salmon Research Agency of Ireland merged with the national Marine Institute on the 1st July 1999 into Aquaculture & Catchment Management Services. This report provides a continuation of the data records for the Burrishoole facilities.

2. The total rainfall recorded in Furnace was 1608.2 mm in 2005 – Months of relatively high rainfall in 2005 were January, April and August with low rainfall in March, June and July.

3. The total release of microtagged salmon smolts of Burrishoole reared origin into L. Furnace amounted to 34,400. Smolts were released as eight groups (10 codes), ranging in mean weight from 57g to 78g.

4. The MI co-ordinated the sale of 173,000 salmon ova to Germany for the Rhine Rehabilitation Programme and 80,000 to Denmark.

5. A total of 532 wild grilse were recorded moving upstream through the permanent traps during the season. The number of spring fish recorded in the upstream traps was 9. The total run of wild grilse, including the Lough Furnace rod catch, was 533.

6. Returning adults were checked for net mark damage; the highest monthly incidence was 19% (n=372) of wild grilse and 39% (n=498) of reared grilse had net marks recorded.

7. A total of 7261 wild salmon smolts were recorded in the downstream traps in 2005. The wild grilse return was 5.8%. The return to freshwater of the Burrishoole reared grilse recorded was 1.8 – 2.3%.

8. The ova to smolt survival at 1.1–1.3% and to grilse per grilse female was 2.6–2.9%

9. A total of 15 wild sea trout and a further 86 non-silvered trout migrated upstream through the traps in 2005. Of the sea trout, 4 were adults and 11 (73%) were finnock. The 2005 smolt run amounted to 777 smolts.

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 2005 was at 1.5%.

11. Silver eel trapping continued with the total run, largely from September to November, amounting to 2593.

12. A total of 55 salmon were caught in the Fishery in 2005. The catch consisted of 27 wild fish and 28 reared salmon. Of the 27 wild fish caught, 26 were returned alive to the water and one was killed. There was a minimum of 16 sea trout caught on L. Furnace and returned alive.

13. Invertebrate surveys were carried out in 2005 on the Owengarve and Burrishoole catchments.

1. INTRODUCTION

The Salmon Research Agency merged with the national Marine Institute on the 1st July 1999. The staff of the Agency were absorbed into the Aquaculture and Catchment Management Services group of the Institute and the research facilities at Furnace have undergone a programme of 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 Institutes 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 represents a continuation of the Annual Reports published by the Salmon Research Agency of Ireland. The data presented creates a unique record of fish rearing and wild fish census data for the past 35 years. This data is an essential component in the local, regional and national management of salmon, sea trout and eel and is becoming ever more valuable in the light of increasing pressures on natural stocks, such as exploitation, habitat degradation and global climate change scenarios. The fish monitoring facilities in Newport, along with the reared and ranched salmon stocks held in Burrishoole, are also essential for the evaluation of novel enhancement techniques, alternative stocks and ranching and evaluation of interactions between farmed, ranched and wild strains.

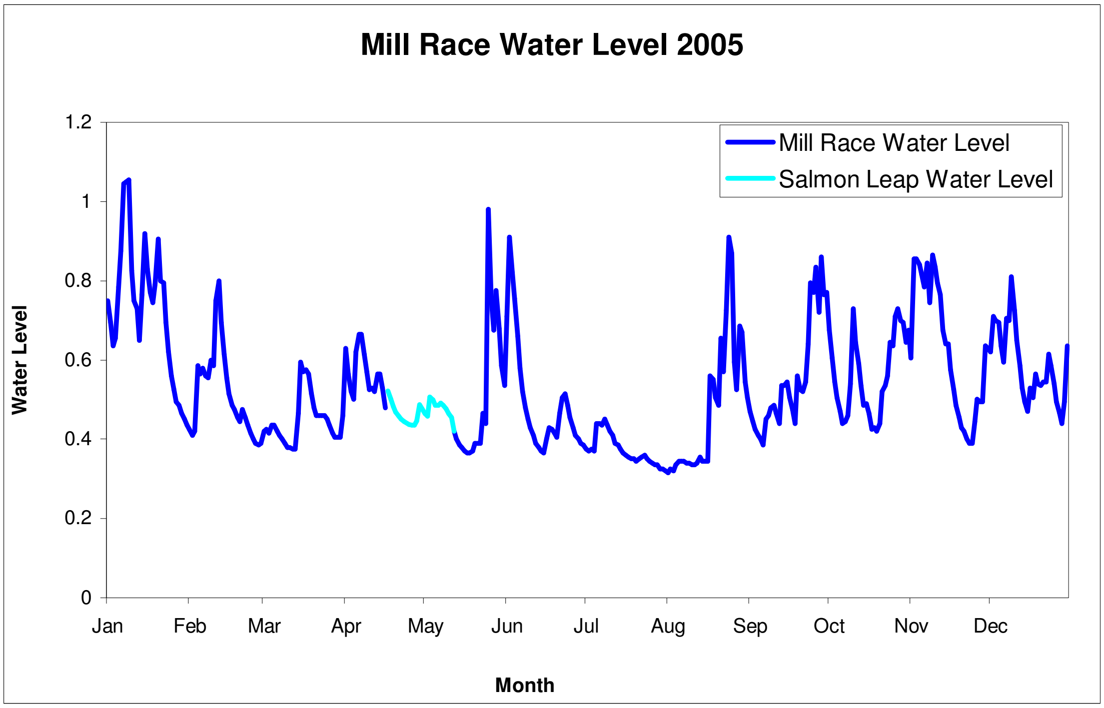


Fig. 2.1. Water levels recorded at mid-night for the Mill Race using an OTT Orphimedes automatic water level recorder. The Salmon Leap water level (light blue line) was used during a break in the MR data in April/May.

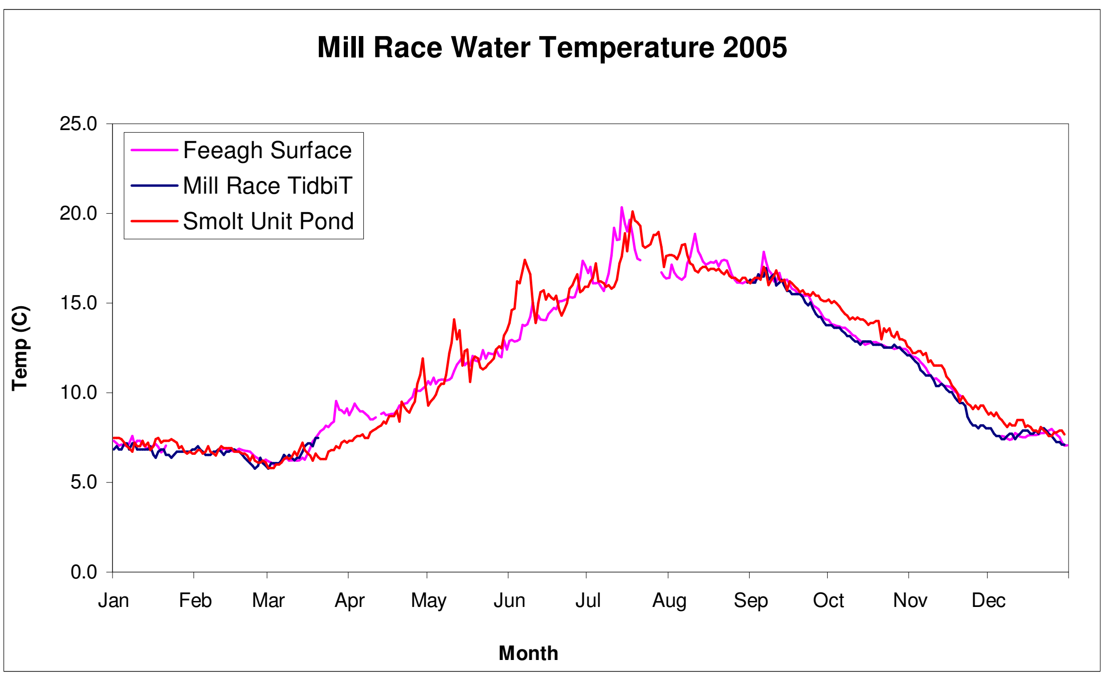


Fig. 2.2. Water temperatures recorded, by TidbiT data logger at mid-night for the Mill Race, at midnight for the lake surface (1m) and at 09.00 in the smolt unit ponds.

2 ENVIRONMENTAL DATA

2.1 Mill Race Data

Daily meteorological data were collected during 2005 at the manual Met Station in Furnace. The monthly rainfall figures for 2002, 2003, 2004 and 2005 are given in Table 2.1, along with the annual totals for 1977 to 2005. Months of relatively high rainfall in 2005 were January, April and August with low rainfall in March, June & July. The total rainfall was 1608.2 mm in 2005.

Table 2.1. Monthly rainfall totals (mm) for the Furnace Station in 2002, 2003, 2004 and 2005 and the annual totals for 1977 to 2005.

Month	2002	2003	2004	2005	Year	Total
January	163.8	130.7	186.8	286.2	1977	1579.7
February	261.2	90.4	71.9	104.5	1978	1592.2
March	97.4	90.2	123.8	76.8	1979	1653.3
April	111.5	66.2	117.1	124.8	1980	1792.1
May	118.9	168.8	82.0	140.0	1981	1646.8
June	152.0	72.7	111.3	97.1	1982	1609.6
July	78.5	102.0	104.0	44.0	1983	1495.9
August	115.8	53.5	102.6	132.2	1984	1556.6
September	38.6	96.6	198.6	123.6	1985	1584.1
October	203.9	110.7	192.8	133.9	1986	1886.9
November	230.3	194.8	114.2	182.3	1987	1373.6
December	144.0	146.6	236.2	162.8	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
					2001	1298.7
					2002	1715.9
					2003	1353.2
					2004	1641.3
					2005	1608.2

Water Level: Difficulties were experienced in 2003 with the automatic water level chart recorder. An OTT Orphimedes automatic water level recorder was installed in late January 2004 and data was recorded from early February '04. Water levels are recorded every 15 minutes and are presented in Figure 2.1 recorded at 23.45 hrs. This approximates to the previous mid-night readings from the chart recorder.

Water Temperature: In 2004, a TidbiT temperature logger was installed along with the chart recorder and this records water temperature every 30 minutes. The midnight chart recorded temperature is presented in Figure 2.2 along with the temperature logger data, recorded at 23.30 hrs. Some discrepancies were evident between the two recorders and the chart recorder was decommissioned at the end of the year. Problems were experienced with the TidbiT between mid-March and early September, so the Feeagh surface temperature from the AWQMS station and the Smolt Unit temperatures were included in Fig. 2.2 for comparison.

Water temperatures (recorded at midnight) fell to a minimum of 5.8°C in late February. There was a steady increase in temperature from early March, to a maximum of 20.4°C (Feeagh surface) and 20.1°C (Smolt Unit pond) in mid July. Temperature began dropping steadily for the rest of the year from mid-July back to a minimum of 7.1 °C in late December. Temperature in December was over two degrees warmer than that in 2003 and similar to 2004.

2.2 Catchment Programme

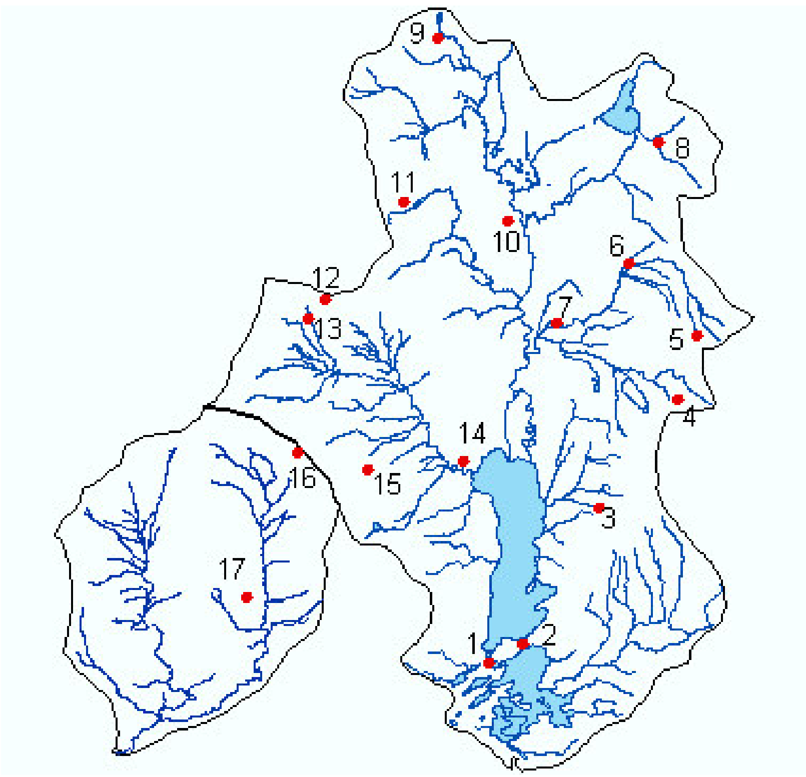
In recent years, the combined effect of extreme weather events, with impacts of land use, has had a significant effect on the erosion rates recorded in many upland areas. Since 1995 the Marine Institute has installed a series of automatic monitoring stations to monitor these impacts, and to attempt to quantify the transport of suspended sediments in the Burrishoole catchment. These automatic stations, funded under EU LIFE programmes, include a lake station (AWQMS – installed under EU LIFE 93), which has various meteorological instruments included with a suite of underwater temperature and water chemistry sensors, and three river stations, (ARMS – installed under EU LIFE 98), which are equipped with sensors for measuring water temperature, water level, pH, conductivity, dissolved oxygen, and turbidity. The automatic monitoring stations are also equipped with a telemetry system for relaying high-resolution data back to the laboratory.

In addition the Institute has also deployed additional core-funded instrumentation in the catchment. These include seventeen data-logging rain gauges in the Burrishoole and Owengarve catchments (Figure 2.3) and two in the Owenduff catchment, which will assist in building up a detailed profile of precipitation in a mountainous catchment. Figure 2.5 shows annual total rainfall for the same stations for 2005. Even allowing for days when the gauges were not operating (Table 2.2), the data clearly show the considerable variation in recorded rainfall between locations within relatively short geographic distances.

Also deployed within the catchment are a series of OTT Orphimedes water level recorders which measure water level at fifteen-minute intervals. These data can be used to calculate water volumes on an hourly or daily basis. An important feature of the monitoring network is the ability to simultaneously collect data from river, lake, and climatic instruments. The continuing integration of this data with ongoing fish population surveys is an important component of the research programme.

A water level recorder and a rain gauge were installed in the Owengarve catchment, adjacent to Burrishoole, as part of a joint programme with Coillte. Coillte began harvesting timber from the Glendahurk valley in 2004 and this monitoring provided baseline data pre-harvest. It is also planned to replant with a considerable proportion of native trees and the Institute will monitor the future changes in the flow regime.

Table 2.2 summarises rainfall for 19 rain gauges. The data include the maximum daily rainfall recorded at each site. The maximum figures recorded were 98.6 mm at the Glenamong 1 gauge, 58.6mm at Glenamong 2 and 62.4 mm at the Glenamong 4 gauge, all on the 6th Jan 2005, 64.6 mm in the Srahrevagh 1 on the 14th Jan 2005 and 59.4mm in the Namaroon gauge on the 11th Feb. Considerable variation in daily and annual rainfall was recorded between rain gauge sites The table (Table 2.2) also notes the number of days each unit did not sample due to technical problems. Figure 2.4 shows the rainfall totals for the nineteen rain gauges.



1.	Salmon Leap	10.	Altahoney	19.	Glenadeegan
2.	Mill Race	11.	Maumaratta		
3.	Buckogh	12.	Glenamong 1		
4.	Lodge	13.	Glenamong 2		
5.	Srahrevagh 1	14.	Glenamong 3		
6.	Srahrevagh 2	15.	Glenamong 4		
7.	Srahrevagh 3	16.	Ridge		
8.	Gaulaun	17.	Glendahurk		
9.	Namaroon	18.	Tarsaghaun		

Figure 2.3. Rain gauge sites in the Burrishoole and Owengarve systems. 18 & 19 not on map.

Table 2.2. Summary rainfall data for 19 rain gauge stations in the Burrishoole, Owengarve and Owenduff catchments.

Date	Total sum	mean daily rainfall	blanks	Max	dry days	wet days
Altahoney	848.8	5.2	203	48.2	36	126
Namaroon	2164.6	6.3	23	59.4	73	269
Buckogh	1537.2	5.1	64	52.2	75	226
Gaulaun	1357.9	5.1	97	36.8	44	224
Glenamong 1	1300.8	5.5	130	98.6	42	193
Glenamong 2	1956	5.4	0	58.6	59	306
Glenamong 3	1826.4	5.0	0	47	91	274
Glenamong 4	2540.2	7.0	0	62.4	75	290
Glendahurk	1511	5.2	77	50.4	63	225
Ridge	1514.3	4.4	19	59.6	80	266
Maumaratta	1706	5.5	54	34.4	61	250
Srahrevagh 1	1679.8	4.6	0	64.6	82	283
Srahrevagh 2	1622.6	5.0	39	39.6	61	265
Srahrevagh 3	1685.6	4.6	0	34.4	66	299
Lodge	1842.6	5.0	0	45.6	69	296
Salmon Leap	1432.6	3.9	0	36.6	85	280
Mill Race	1417.1	3.9	0	37.3	86	279
Tarsaghaun	1140.8	4.5	110	36	37	218
Glenadeegan	1575.5	4.3	0	45.2	71	294

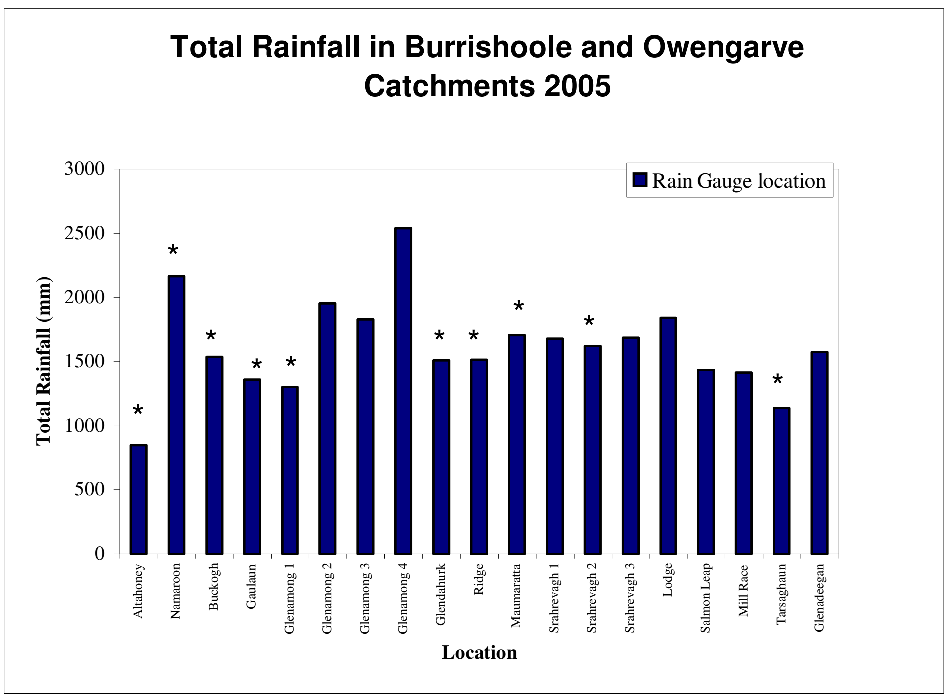


Figure 2.4. Rainfall totals for 19 rain gauge sites in the Burrishoole, Owengarve and Owenduff catchments for 2005. Asteriks mark incomplete data series – see Table 2.2.

3 SALMONID REARING

3.1 Salmon Stocks 2004

3.1.1 Ranching

The total release of microtagged smolts of ranched Burrishoole grilse origin was 45,000. One group of 10,600 vaccinated (Norvac Compact 4) pre-smolts was released into the River Suir at a site near Clonmel, County Tipperary, on 18th March 2005, with a view to monitoring the distribution of grilse recoveries around the coast in 2006. Burrishoole core groups and three experimental groups, comprising 10 tag codes, were released into Lough Furnace on 28th April 2005. The total release in Burrishoole, Newport, was 34,400 salmon smolts averaging 57 – 78 grams.

Ongoing experimental programmes included the use of 'SLICE', to protect smolts against lice infestation during the first weeks at sea and thereby investigate if lice infestations are a significant factor in early marine mortality of Irish salmon smolts. A group of precocious male parr, which were identified during tagging, were also differentially tagged and released as smolts.

In a demonstration project with MariCal Inc., based in Maine USA, a field study was undertaken to evaluate the ocean survival of matched control and SeaReady™ Atlantic salmon smolts. The SeaReady™ process was created to improve the seawater transfer characteristics of commercial salmon smolt, independent of the ambient hatchery water chemistry conditions. It is based on knowledge of how ion sensing receptor proteins called Calcium Receptor proteins (CaR's) 'sense' seawater while remaining in fresh water. During the 'treatment' period of five weeks, fish samples were taken at intervals from control and treated groups, to provide a physiological and biochemical assessment of changes produced during the SeaReady™ treatment. Individual fish were sampled for gill histology, gill Na^+ K^+ ATPase activity and plasma sodium and chloride concentrations.

The impact of atrazine on the behaviour of hatchery-reared smolts during their emigration from Lough Furnace and into the coastal zone was studied in a collaborative programme with CEFAS. Atrazine is a widely applied herbicide used mainly to control grass and broadleaf weeds and is known to modify parr-smolt transformation and olfactory function in adult salmon. Smolts were exposed to an environmental concentration of atrazine within the hatchery, tagged with miniature coded acoustic transmitters and their subsequent movements together with a control group were monitored through Lough Furnace and into the marine environment using an array of strategically positioned acoustic receivers. In addition, the physiological status of separate groups of smolts was measured to determine the impact of atrazine exposure on hypoosmoregulatory capability and survival in saltwater. The study was undertaken between 19th April and 27th May 2005. Salmon smolts from the SeaReady™ group, described above, were also included in this tracking programme.

3.1.2 Aquaculture

An estimated 66,600 vaccinated salmon smolts of Scottish origin, averaging 85g, were successfully transferred to a commercial sea farm (West Cork) in March 2005. Smolts had been double vaccinated in November 2004 using Norvax Compact 4 and Mono PD vaccines, as part of an ongoing programme to evaluate Norvax mono PD vaccine.

8,600 vaccinated (Norvax Compact 4) smolts of Burrishoole origin, averaging 62g, were transferred to a site in Connemara in April 2005, as part of an MI Pancreas Disease research programme.

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3.2 Salmon Stocks 2005

Burrishoole grilse, experimental (wild/ranch/Owenmore groups) and commercial 2SW Scottish stocks were hatched in 2005. Growth and survival was satisfactory throughout the year. Grading was carried out in July and August and commercial pre-smolts were vaccinated with Norvax Compact 4 in October/November 2005. A group of Burrishoole S1/2 smolts was produced by photoperiod manipulation and 5,800 smolts were transferred to a commercial sea farm (Connemara) in November 2005.

Stocks remaining in December 2005 were, 35,800 comprising experimental groups, 40,000 Burrishoole grilse and 62,100 commercial 2 sea-winter stocks.

3.3 Salmon Stocks 2006 (Grilse ova laid down in 2005)

Salmon broodstock held in L. Furnace from late September, sustained significant damage due to seals during October. It was necessary to cull 15% of the caged stock due to the severity of wounds and the remaining fish, though damaged, were transferred to the broodstock pond, where recovery was good. An estimated 278 broodstock were held and stripped from late November to early January. The majority of microtags were read on the day of stripping and 26 broodstock (18 male, 8 female) were identified as Shannon grilse (ova and milt from these fish were excluded from the programme). Shannon stock had been cold branded as pre-smolts, in order to distinguish them from Burrishoole stock and to facilitate their removal as grilse from the traps.

An estimated 378,800 green ova were produced by 110 Burrishoole hens. The average fecundity value was 3,470 per female. In addition, 8 Burrishoole wild hens and 6 males were used to produce a group of wild Burrishoole stock for a ranching study, which aims to compare the relative fitness of Burrishoole ranch and wild populations. The average fecundity for wild females was 2,600 per female. An estimated surplus of 10,000 wild unfed fry were stocked into L. Feeagh at the Salmon Leap.

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.

The Marine Institute ACMS exported 173,000 eyed ova to Germany and 80,000 ova to Denmark. 65,000 Burrishoole ova, derived from 110 females, were retained in the hatchery. 27,000 ova were surplus to requirements.

3.4 Rainbow Trout 2005

An estimated 9,900 0+ rainbow trout (Seven Springs NI) were stocked into Ballinlough Fishery, from September to November 2005. Two thousand trout were retained in December 2005 for stocking in 2006.

3.5 Sea lice vaccine research programme

The Faculty of Veterinary Medicine UCD was awarded funding for the project ' Novel Vaccines for the Control of Sea Lice on Salmonids' through the NDP Marine RTDI Fund for collaborative research with ACMS Aquaculture Section. The objectives of this project are to identify and isolate novel sea lice vaccine candidates and to undertake studies that will identify parameters associated with immunological resistance to infection in vaccinated fish. Gut specific or secreted antigens will be targeted for vaccines since the gut represents the interface between parasite and host. In ectoparasitic infections, these molecules are responsible for the disease-associated pathology. The research programme consists of a number of work packages: identification of vaccine candidates, fish vaccination, sealice culture, infectivity trials and immunological studies.

The fish production and vaccination component of this research programme will be carried out using freshwater rearing facilities in Furnace. In 2005, 868 salmon pre-smolts were vaccinated in early March 2005 using three antigens. Vaccinated and control groups of salmon smolts were transferred to two locations (Doughill and Clew Bay) for infectivity trials in April 2005.

3.6 DIT Research programme

M.Sc. Studentship studies continued with Dublin Institute of Technology, to investigate biochemical changes in Atlantic salmon mucus proteins and their role during the smolting period.

Klaartje Verbeken B.Sc. completed the Technological Sector Research: Strand 1 funded project (2003-2005) 'Biochemical studies of Atlantic salmon (*Salmo salar*) skin mucus proteins during smoltification (2003, 2004)' and was awarded M.Phil. 2005.

DIT was awarded additional funding (Technological Sector Research: Strand 1) to continue proteomic research on Atlantic salmon during the smoltification period and the scope of the research was extended to include disease. The project is entitled 'Development of diagnostic test systems for determination of Atlantic salmon (*Salmo salar*) key developmental and disease states' and involves collaboration with MEFS. Proteomic studies on the skin mucus proteins of Atlantic salmon affected by pancreas disease started in 2005.

3.7 Molecular biology of the Atlantic salmon

This three year study (2003 – 2006) aims to characterise gene expression profiles during the key life stages of Atlantic salmon, particularly smoltification and maturation, using functional genomics tools. In partnership with the Molecular Biology Group, National University of

Ireland Galway, ACMS provides materials and services in support of this programme, which is funded by the HEA programme for research in third level institutions (PRTLI).

In 2005, the construction of cDNA libraries using Suppression Subtraction Hybridisation and differential screening using microarray analysis was ongoing, using tissue samples collected in 2004. Candidate genes identified from the microarray data were analysed using Real Time PCR.

3.8 Salmon smolt tracking in the wild

Over the last twenty years in the north Atlantic, scientists and fishermen alike have noted a severe drop in the overall marine survival of some stocks, particularly those from the more southerly countries in the range. The cause of this decline is unknown, but may include climatic and oceanic factors. Relatively little is known about the salmon's life at sea, particularly off the west coast of Ireland. In 2004, the Institute, in conjunction with CEFAS UK, commenced a programme of estuarine tracking of salmon smolts in L. Furnace and Newport Bay using acoustic technology, and this was further developed in 2005 with a move into open sea with receivers located at north Clare Island/Achill Beg. These trials showed that salmon smolts could be successfully tracked in open sea and that detection rates were relatively high. It is hoped that this study will form the basis for further research on the coastal movements and survival of juvenile salmon and sea trout.

Acoustic Vemco "pinger" transmitters were inserted into 40 (2004) and 54 (2005) reared salmon smolts in April each year and these fish were released into the northern end of Lough Furnace along with the normal releases of reared smolts on the 29th April (2004) and 28th April (2005) (Fig. 3.1). Automated receivers, mounted on dan buoys, were located in the Burrishoole estuary (2004 & 2005), inner Clew Bay (2005) and in the Achillbeg/Clare Island area (2005) (Fig. 3.1). The automated receivers were downloaded on a regular basis, between late-April and early June. Average swimming speeds for fish swimming between Rosmore and Clare Island, a distance of 25km, were approximately 0.5 m/sec or 1.5 km/hr.

A preliminary analysis of the data has indicated relatively good survival of fish through the various zones of the bay with at least 65% of the released smolts being recorded at Clare Island (Table 3.1). Additional fish may have escaped through south of the island undetected. The movement patterns and speed of swimming appeared to be influenced by tide and time of day/night and the smolts appeared to use various channels out between the islands.

In 2004, 85% of the fish released in L. Furnace were detected at the Rosmore receiver. Movement was largely random with respect to time of day but seaward movement within the tidal estuary was predominantly during the ebbing tide. In 2005, fish were found to move predominantly by day and on an ebbing tide. It is intended to jointly publish the findings from these studies.

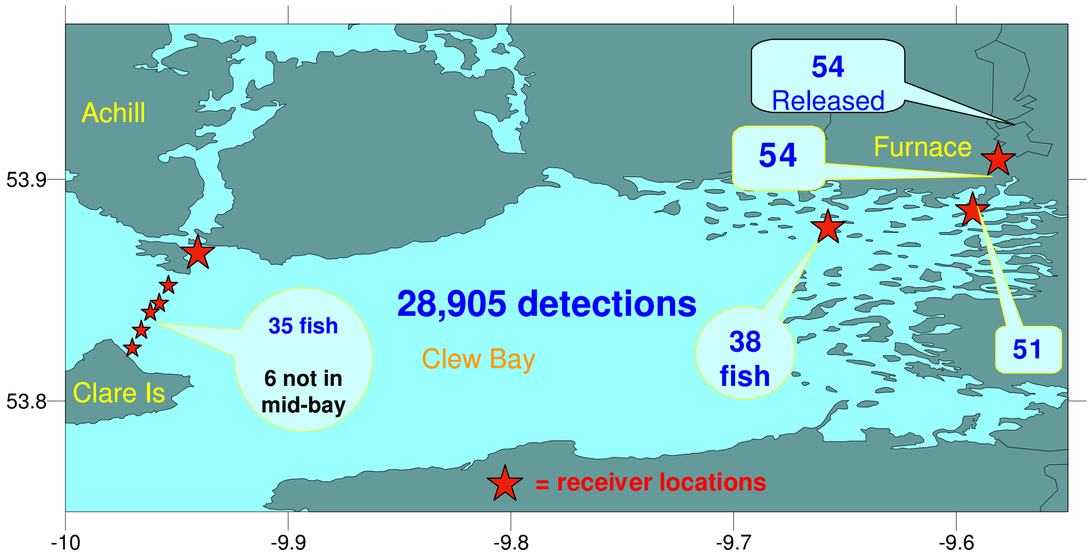

Figure 3.1. Map showing the location of release of 54 smolts in 2005, the positions of the receivers and the numbers of fish detected at each area of the bay.

Table 3.1. The numbers of smolts released into L. Furnace and the number (and % of the number released) detected at each location.

Year	Number Released	Furnace	Rosmore	Inner Bay	Clare Is. AchillBeg
2004 **%**	40	35 88%	34 85%	-	-
2005 **%**	54	54 100%	51 94%	38 + 6* 71% : 81%*	35 65%

4 SALMON CENSUS PROGRAMME

4.1 Wild Salmon and Grilse

A total of 532 wild grilse were recorded moving upstream through the permanent traps during the season (Table 4.1 & 4.3). The run commenced in May and was completed in December. The main upstream grilse migration was recorded in the Salmon Leap trap with 459 grilse, compared to 73 grilse in the Mill Race trap.

The total number of spring fish recorded in the upstream traps was 9.

The retained rod catch of wild grilse on Lough Furnace was 1 fish. Therefore, the total wild grilse return, including the Furnace rod catch and the upstream count, was **533**.

Water levels were high at the end of May and beginning of June and 24.3% of the total upstream migration was recorded by the end of June (Table 4.2). From mid June to mid August water levels were generally low, 13.2% of the run was recorded in July compared to 41% the previous year. Increased rainfall from mid August resulted in 39.1% of the run being recorded during August and water levels remained high.

Table 4.1. Monthly wild grilse totals for the Salmon Leap and Mill Race traps.

	Mill Race	Salmon Leap	Total
May	2	0	2
June	15	112	127
July	3	67	70
August	13	195	208
September	21	58	79
October	5	24	29
November	13	3	16
December	1	0	1
Total	73	459	532

Table 4.2. Monthly proportions (%) of wild grilse run 2001 –'05**.**

	2001	2002	2003	2004	2005
May	0	0.9	0.9	0.0	0.4
June	60.1	53.4	10.7	36.0	23.9
July	20.7	32.3	49.8	41.0	13.2
August	11.1	7.3	11.4	9.8	39.1
September	0.8	0.3	8.6	10.9	14.8
October	5.2	4.9	10.8	1.0	5.5
November	1.1	0.6	7.7	0.7	3.0
December	1.1	0.3	0.0	0.5	0.2

Table 4.3. Wild salmon and grilse totals in upstream traps 1970-2005

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
2001	6	368
2002	2	648
2003	18	544
2004	28	580
2005	9	532

4.2 Net marked fish in upstream traps

The highest levels of net marks were recorded during July with 19.3% of wild fish and 38.9% of reared fish with net marks (Table 4.4). The average percentage occurrence of net marks was higher on reared fish, 14.9%, compared to 12.2% for wild fish.

Table 4.4. Percentage Occurrence of Net Marks on Wild and Reared Grilse

	Wild Grilse n = 372	Reared Grilse n = 498
May	0.0	0.0
June	14.4	23.2
July	19.3	38.9
August	10.3	20.6
September	10.3	9.2
October	5.9	12.1
November	0.0	0.0
December	0.0	0.0

4.3 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 decreased from 554 in 2004 to 503 in 2005. (Table 4.5). The reared component of the spawning stock (31) increased from 4.7% the previous year to 6.2% in 2005.

Table 4.5. Spawning escapement 1970 - 2005

	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
2001	370	349	21
2002	570	562	8
2003	517	506	11
2004	554	528	26
2005	503	472	31

4.3.1 Wild salmon broodstock stripped December 2005

During 2005 a total of 39 wild fish, 24 from the upstream traps and 15 from the downstream traps, were transferred to the broodstock ponds. They consisted of 18 wild hens and 21 wild cocks. Although some of these fish were returned to the catchment, see following paragraph, for the purpose of calculating the wild spawning stock they have been deducted, 24 as broodstock and the remaining 15 are included with the displaced fish (see also Table 4.6).

On 6.12.05, 16 wild cocks were used to produce a batch of ranch x wild ova for Germany and were retained. On 12.12.05 wild salmon females were examined for ripeness – 10 hens were unripe and were returned to the catchment (Black River Bridge) together with 9 of the larger cocks. 8 females and 9 males were retained.

On 15.12.06 8 wild females were stripped and after a few days recovery were released into L. Furnace. In addition 1 spent female was found with ranch females and was also released into Furnace. A total of 10 males were released into L Feeagh, 9 on 15.12.06 and 1 on 4.01.06

Table 4.6. Spawning stock of salmon and grilse

	Wild grilse(1SW) & previously spawned grilse	Wild Salmon (2SW)	Ranched fish released upstream
Counted in trap	532	9	95
Rod Feeagh*	--	--	--
Culled	0	--	0
Broodstock	24	--	0
Estimated morts.	25	0	3
Displacement	20	0	61
Spawning stock	**463**	**9**	**31**

* No angling on L. Feeagh during 2005.

4.4 Survival from Ova to Grilse

The relevant brood year for the 2005 grilse was 2001 with ova hatch in 2002 and smolt migration in 2004 (Table 4.7). 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 4.7. Survival from ova to grilse

Spawning escapement in 2001	370
No. of females	185 - 204
Ova deposition	740,000 – 839,460
No. of smolts in traps 2004	9316
No. of smolts released	9121
Survival ova to smolt	1.1 – 1.3
No. returning grilse 2005	533
Survival smolt to grilse	5.8%
Survival to grilse per grilse female	***2.6 – 2.9***

4.5 Ova to Smolt Survival

The survival of ova to smolt ranged from 1.3 to 1.1 which was higher than previously recorded. This may be related to the low spawning escapement recorded in 2001 leading to a relaxing of density dependent processes. A similar phenomenon may have been observed for the sea trout stock where an increase in ova to smolt survival was observed after the sea trout collapse in the 1990s (Poole *et al*., 2007).

The survival of smolt to grilse increased from 6.5% in 2003 to 8.2% in 2004 but fell to 5.8% in 2005.

The survival to grilse per grilse female was higher than recorded in previous years, which was just above the value required to sustain the population of four years earlier.

Table 4.8. 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
1997	0.52 – 0.59	1.4 – 1.5
1998	0.58 – 0.60	2.4 – 2.6
1999	0.79 – 0.70	1.8 – 2.0
2000	0.56 – 0.64	1.9 – 2.1
2001	1.10 - 1.30	2.6 – 2.9

4.6 Wild Salmon Smolts

A total of 7261 wild salmon smolts were recorded in the downstream traps during 2005 (Tables 4.9 & 4.10). This was a reduction of over 2000 smolts from the total of 9316 smolts recorded in 2004. However, it was similar to the 2003 count of 7248 smolts.

Unlike the smolt run in 2004, which had two main peaks of migration, the 2005 run was spread over several weeks (Fig. 4.1). This resulted in 84.3% of the run being recorded over a period of 25 days between 15th April and 9th May. The percentage of the run recorded in the Mill Race decreased from 295 (2701) in 2004 to 6.1% (443). There was one peak in the migration in the Mill Race which was recorded on 7th May.

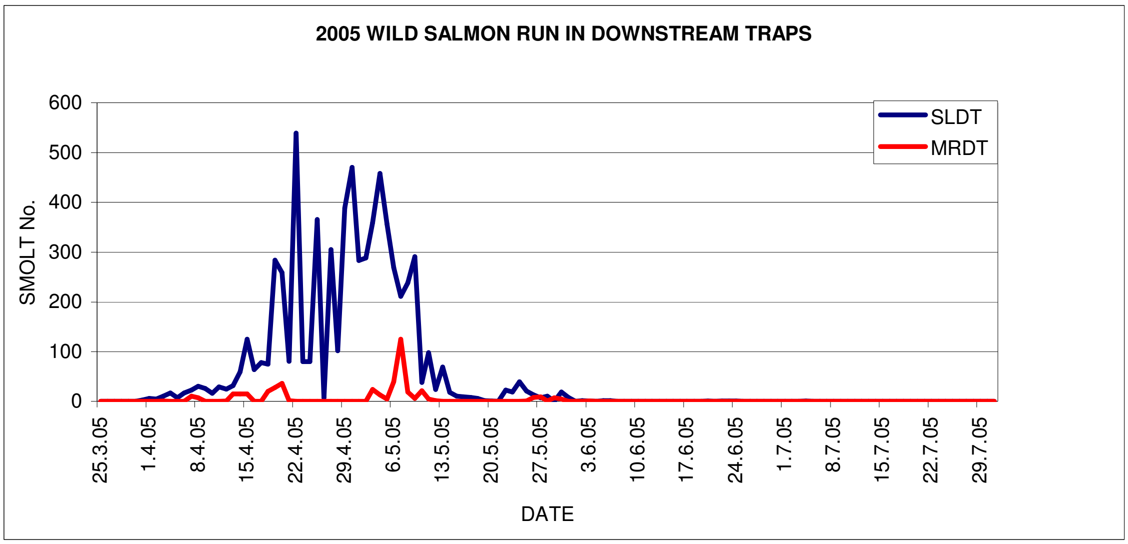

Figure 4.1. Timing of the 2005 wild salmon smolt run in the Salmon Leap & Mill Race traps.

Table 4.9. Numbers of wild salmon smolts counted in 2005.

MONTH	SLDT	MRDT	TOTAL
March	3	0	0
April	3606	151	2602
May	3197	291	6513
June	11	1	184
July	1	0	15
August	0	0	2
September	0	0	0
October	0	0	0
TOTAL	6818	443	7261

Table 4.10. Annual numbers of wild salmon smolt recorded in downstream traps

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
5998	6148	6331	9588	7197	5791	6466	8627	7248	9316	7261
	5854*	5960*	8937*	7118*	5689*	6387*	8423*	7081*	9121*	7030*

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

4.7 Wild Salmon Kelts

The wild kelt run commenced in December 2004 and the peak of the run occurred during March 2005, when 50.2% of the total run was recorded. (Table 4.11).

The downstream survival from the spawning stock to kelt increased from 53.2% in 2004 to 57.6% in 2005 (Table 4.12).

Table 4.11. Numbers of wild salmon kelts counted in 2005.

	SLDT	MRDT	TOTAL
Dec ’04	9	6	15
January ‘05	22	8	30
February	43	2	45
March	154	0	154
April	62	1	63
May	0	0	0
Total	290	17	307

Table 4.12. 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	*
2001	97.0	38.5	2.8	72.5	*
2002	91.3	40.9	7.8	49.6	*
2003	95.5	37.0	3.5	42.3	*
2004	89.9	36.3	9.0	53.2	*
2005	83.3	35.5	15.3	57.6	*

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

5. REARED SALMON CENSUS PROGRAMME

5.1 Coastal Returns

Details of coastal returns of Burrishoole fish are available in the Marine Institute 'National Report for Ireland - The 2005 Salmon Season' report.

5.2 Return rate of reared grilse

The total adult return of reared fish to Burrishoole in 2005 was 952 fish, comprising both Burrishoole ranch and experimental Shannon stocks. The Burrishoole returns consisted of 2 core release groups used to determine the return rate to freshwater for the Burrishoole ranching programme. In addition returns were also recorded from experimental Burrishoole ranch groups which were used for specific experiments, see the rearing section of the 2004.

Microtag readings were obtained from 756 of the total of 952 reared fish recorded in Burrishoole in 2005. A total of 153 (20.2%) fish were identified as Burrishoole control ranch grilse, equivalent to a return rate to freshwater of **1.8**% from a release of 8233 core Burrishoole ranch smolts in 2004. This is assumed as a minimum return rate as microtags were not retrieved from all returning adult fish. A maximum return rate is calculated by assuming that 20.2% of the 196 fish not identified by microtags were core returns giving an additional 40 fish. Therefore the maximum return was 193 fish, **2.3**%.

5.3 Recapture of Reared 2SW Fish

A total of 51 multi sea winter fish were identified by microtag and the majority of these (42) were of Shannon stock released from Burrishoole. The remaining fish were identified as Burrishoole stock used in two separate experiments, one using an endocrine disrupter and the second a sea lice vaccine. One fish was also identified as a stray not released from Burrishoole (Invermore).

5.4 Smolt Releases 2005

A total of 44,982 Burrishoole smolts were released in 2005. One group of 10,603 smolts was transferred and released in the river Suir and the remaining 34,379 smolts were released from Burrishoole. The smolts released from Burrishoole consisted of 20,945 smolts released as part of the ongoing ranching programme and 3,258 precocious parr.

In addition 10,176 smolts consisting of two microtag groups, one of which had been treated with MARICAL, and one that had been treated with a lice prevention treatment, SLICE, were also released. For further details on the MARICAL and SLICE experiment, see section 3.1.1.

NB: Note that unlike recent years no Shannon stock was released from Burrishoole during 2005.

Table 5.1. Burrishoole smolts released in 2005.

Group ID	Tag Code	Mean Wt	Mean Length	No. Released
Marical	44778	65.8	17.9	6090
Core	44779	68.3	18.1	5971
Core	44714	65.6	17.9	4124
Core	44706 44733	66.9	17.9	3644
East Coast	44780	47.0	15.8	10,603*
Core	54702	69.2	18.1	4039
Core	24710 174749	78.3	18.8	3167
Slice	44724	72.9	18.3	4086
Precocious	44713	56.9	16.9	3258

** Released at R. Suir*

6 WILD SEA TROUT CENSUS PROGRAMME

The sea trout research and monitoring programmes were continued in 2005.

6.1 Upstream Movements: Timing and Numbers.

A total of 15 wild silvered sea trout and a further 86 non-silvered trout migrated upstream through the traps in 2005. Of the silvered trout, 4 were adults and 11 (73%) were finnock. The numbers are compared with other years in Table 6.1. Of the total run of migratory trout (101), 85% were non-silvered. For the purposes of this report, the non-silvered trout are not included with the sea trout. Table 6.1 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. The sea trout count for 2005 was the lowest ever recorded.

Table 6.1. 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	
2001	31	58	89	
2002	26	89	115	
2003	45	33	78	
2004	26	64	90	
2005	5	10	15	

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

The timing of the sea trout run in 2005, and in previous years, expressed in monthly percentages, is given in Table 6.2. The highest proportion of sea trout, both finnock and adults, moved upstream in June and August. The brown trout moved upstream throughout the period with peaks in August and September. It was notable that brown trout moved in October to December when silvered trout were not recorded.

Table 6.2. Timing of the Burrishoole sea trout run (in monthly percentages). (n = no. of sea trout).

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04 (483)	2005 (15)	BT 2005 (86)
May	-	0.2	0.5	0.1	3.1	2.0	6.7	4.7
June	13.1	24.6	9.4	8.4	8.6	16.7	26.7	10.5
July	54.4	44.9	62.2	55.0	42.4	37.5	0.0	4.7
August	15.8	10.3	18.4	16.5	19.3	26.4	60.0	43.0
September	7.6	14.8	3.7	8.5	9.8	5.7	6.7	12.8
October	6.4	3.5	4.1	7.9	12.2	10.2	0.0	9.3
November	2.4	1.5	1.5	2.9	4.3	1.5	0.0	10.5
December	0.3	0.2	0.2	0.7	0.7	0.0	0.0	4.7

6.2 Spawning Escapement

With the continuation of the catch and release bye-law into the 2005 fishing season and the closure of L. Feeagh to angling, no sea trout were reported killed by anglers on L. Feeagh in 2005. Using the upstream fish counts through the traps, the total maximum spawning escapement of migratory trout to the L. Feeagh catchment was 101, of which 86 were non-silvered sea trout.

Table 6.3. Annual spawning escapement of sea trout into freshwater.

	1970-'79	1980-'84	1985-'89	1990-'94	1995-'99	2000-'04	2005
Max. Escap	2090	1146	906	231	289	156	101
Revised		1622					

6.3 Downstream Movements, Sea Trout Smolts

The 2005 smolt run amounted to 777 smolts, of which 759 were released to the wild (Table 6.4). A few smolts were recorded in January and in mid-March. The main migration occurred in April and May and was strongly regulated by water level (Fig. 6.1). The 2005 smolt run continued the trend of low numbers of smolts (Table 6.5).

Table 6.4. Monthly numbers of Burrishoole sea trout smolts recorded through the traps.

	Salmon Leap	Mill Race	Total	%
January	3	0	3	0.4
February	0	0	0	0.0
March	27	0	27	3.5
April	399	7	406	52.2
May	314	16	330	42.5
June	10	0	10	1.3
July	1	0	1	0.1
Total	754	23	777	
Number Released Downstream			759	

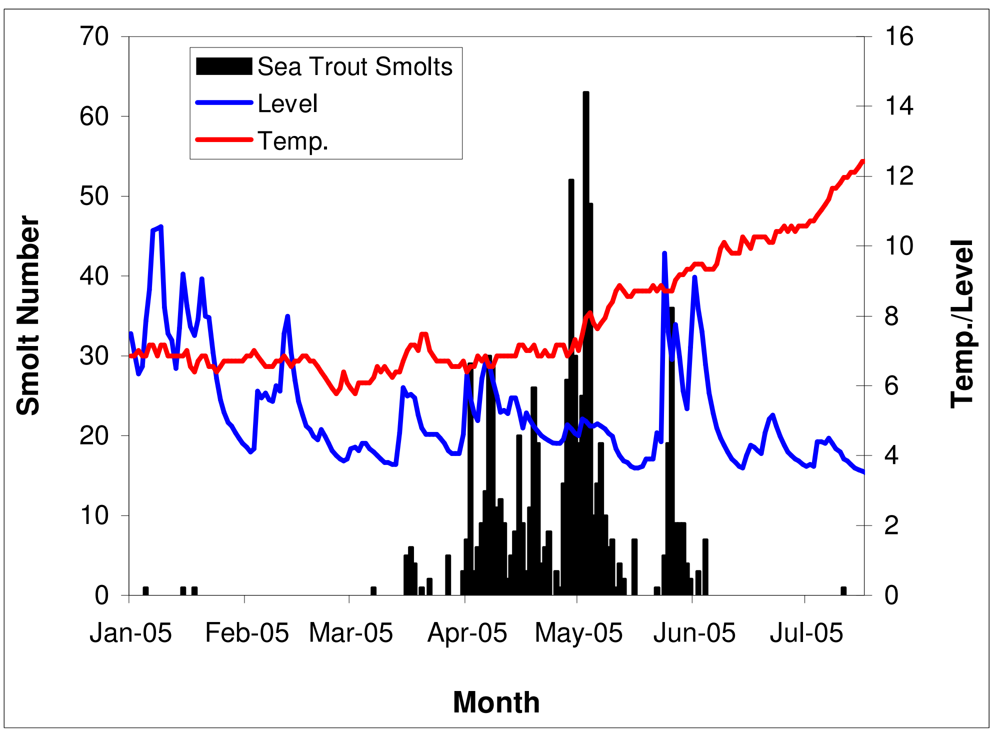

Fig. 6.1. Timing of the 2005 wild sea trout smolt migration with daily water level (m x 10) and temperature (^{0}C).

Table 6.5. Annual sea trout smolt numbers in Burrishoole for 1970 to 2005.

	1970-79	1980-84	1985-89	1990-94	1995-99	2000	2001	2002	2003	2004	2005
Number	4176	4038	4119	1531	1361	769	530	1272	787	723	777

A total of 434 wild smolts were measured in 2005. Length measurements were taken to facilitate an estimated age breakdown of the smolt run. The estimated statistics for the 2005 smolts were, mean length of 20.7 cm and a range from 14.5 to 30.0 cm and the length frequency is presented in Figure 6.2. This gave an estimated age of 67.3% 2 year old and 32.7% 3 year olds.

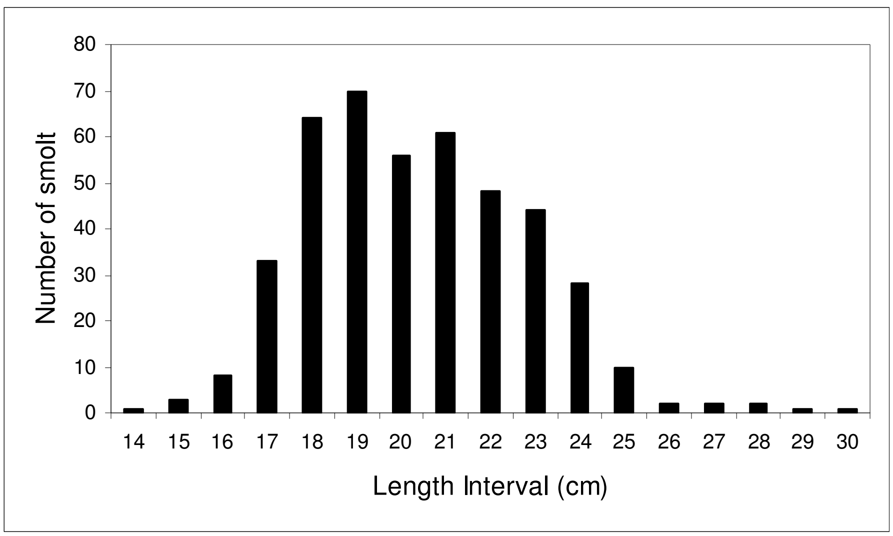

Fig. 6.2. Length distribution for smolts in the Burrishoole system, 2005 (n=434).

6.4 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. These runs of trout would appear to becoming more prolonged with substantial numbers of un-silvered 0+ and 1+ trout continuing to migrate downstream in the early months of the year.

A total of 400 trout entered the traps between July and December 2005 and up to May 2006 (Table 6.6) – less than half of the pervious year. The percentage of 0+ trout that migrated over the period was 37.3% (Table 6.7).

Table 6.6. Numbers of migrating autumn juvenile trout in 2005, to the end of May 2006.

	0+		1+		Total	
Month	SL	MR	SL	MR	SL	MR
July	0	0	0	0	0	0
August	3	0	57	2	60	2
September	20	2	50	5	70	7
October	44	5	37	5	81	10
November	15	1	35	3	50	4
December	20	1	23	1	43	2
January 2006	8	2	11	1	19	3
February 2006	9	1	5	0	14	1
March 2006	5	0	6	2	11	2
April 2006	8	2	1	1	9	3
May 2006	3	0	6	0	9	0
Total	135	14	231	20	366	34
Overall Total	149		251		400	

Table 6.7. Percentage of 0+ juvenile trout amongst trapped autumn migrating trout.

Year	% 0+	Year	% 0+
1982	50.0	1996	34.0
1983	N/A	1997	18.7
1984	55.8	1998	33.5
1985	30.3	1999	42.0
1986	16.1	2000	47.8
1987	35.3	2001	56.3
1988	60.9	2002	32.8
1989	37.2	2003	48.9
1990	35.2	2004	35.5
1991	26.0	2005	37.3
1992	38.2		
1993	27.6		
1994	16.8		
1995	25.3		

6.5 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 6.8).

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 6.9). 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. The fate of 1+ unsilvered juveniles migrating downstream in January to May is unknown but it would seem unlikely that these will contribute to the 2 year old spring smolt migration.

Table 6.8. 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 6.9. 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
2001	530	218	748
2002	1272	910	2100
2003	787	976	1763
2004	723	426	1149
2005	777	590	1367

* estimated

6.6 Marine Survival

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. 6.3). 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. This increase was not, however, sustained in subsequent years and there was a collapse in 2005 down to 1.5%. This was associated with the heaviest infestations of sea lice observed in the Burrishoole area since 1992.

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. 6.4).

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 recorded in 12 years and within the pre-collapse historical range.

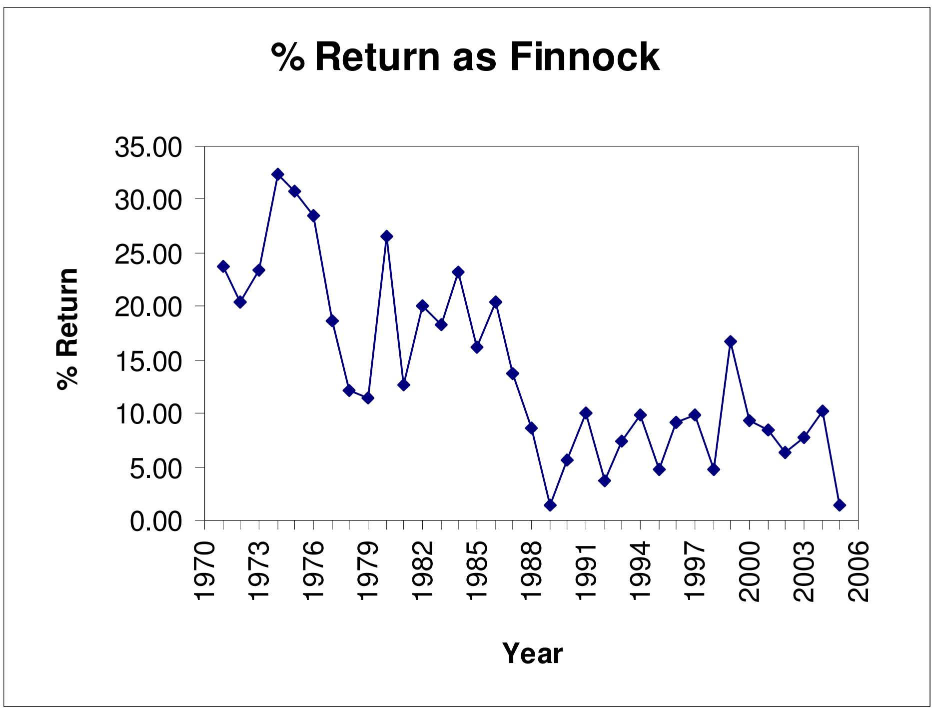

Fig. 6.3. Annual percentage return of smolts returning as finnock to the Burrishoole system.

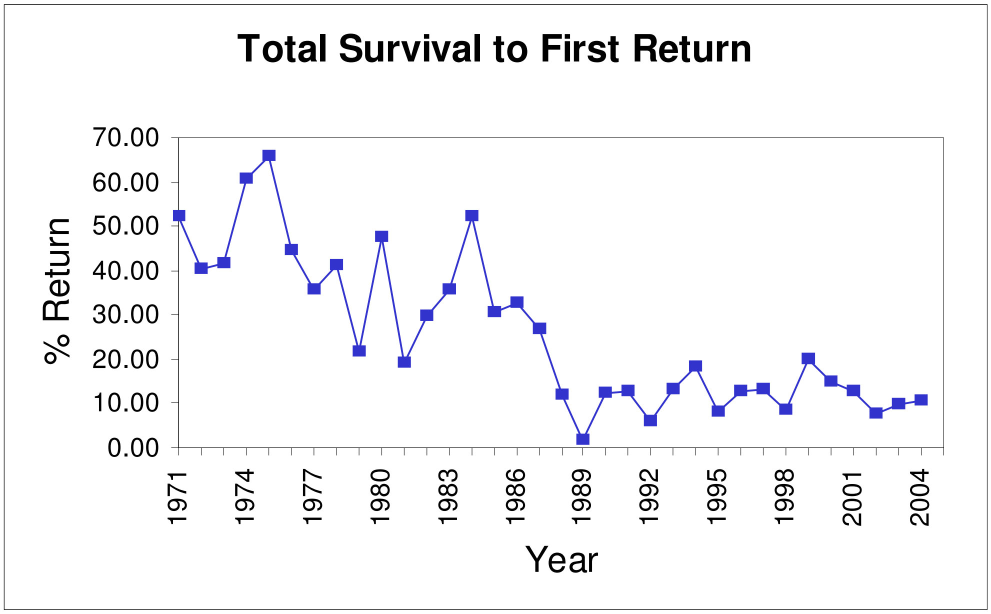

Fig. 6.4. Annual marine survival of smolts to first return (as finnock and 1+ sea trout) to the Burrishoole system.

6.7 Sea Trout Kelts

Table 6.10 gives the numbers of sea trout and brown trout kelts, both spawned and immature, counted downstream in the winter of 2004 and spring of 2005.

Table 6.10. Timing and numbers of sea trout kelts for the 2004/2005 season.

Month	Large ST	Small ST	BT	Total ST	Total Trout
October '04	0	12	9	12	21
November	2	9	9	11	20
December	5	31	28	36	64
January '05	2	5	30	7	37
February	2	4	19	6	25
March	5	13	27	18	45
April	4	28	10	32	42
May	1	2	5	3	8
June	0	3	5	3	8
Total	21	107	142	128	270

The freshwater survival of kelts is given in Table 6.11. 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 15. In addition to the size overlap, trout counted upstream as unsilvered migrants may be counted downstream as silvered kelts, causing difficulties in making 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 over-winter 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 6.11. 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% "	
2001	82.0% " *	
2002	129.6% " *	
2003	66.1% "	
2004	120.5% "*	
2005	142.2% "*	

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

7 SILVER EEL CENSUS PROGRAMME

Silver eel trapping was continued in 2005. The run timing was similar to 2004 with the main run in September, October and November (Table 7.1). Figure 7.1 shows the daily counts of silver eels in relation to changes in water level. The main runs of eels were closely related to increases in level and also coincided with the darker lunar phases.

The total run amounted to 2593 eels. As in other years, the highest proportion of the total catch (85%) was made in the Salmon Leap trap.

Table 7.1. Timing and numbers of the 2005 silver eel run.

	Salmon Leap	Mill Race	Total	%
June	3	0	3	0.1
July	4	0	4	0.2
August	151	72	223	8.6
September	664	142	806	31.1
October	814	100	914	35.2
November	515	71	586	22.6
December	37	9	46	1.8
Jan. 2006	11	0	11	0.4
Feb. 2006	0	0	0	0.0
Total	2199	394	2593	

Sampling of individual eels (n = 587) gave an average length of 48.8 cm (range: 27.3 – 99.6 cm) and an average weight of 237 g (Table 7.2). The length frequency distribution is presented in Figure 7.2.

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. 7.3). There was an above average catch in 1995, possibly contributed to by the exceptionally warm summer. The catch in 2001 of 3875 eel was the second highest recorded since 1982. 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. 7.3).

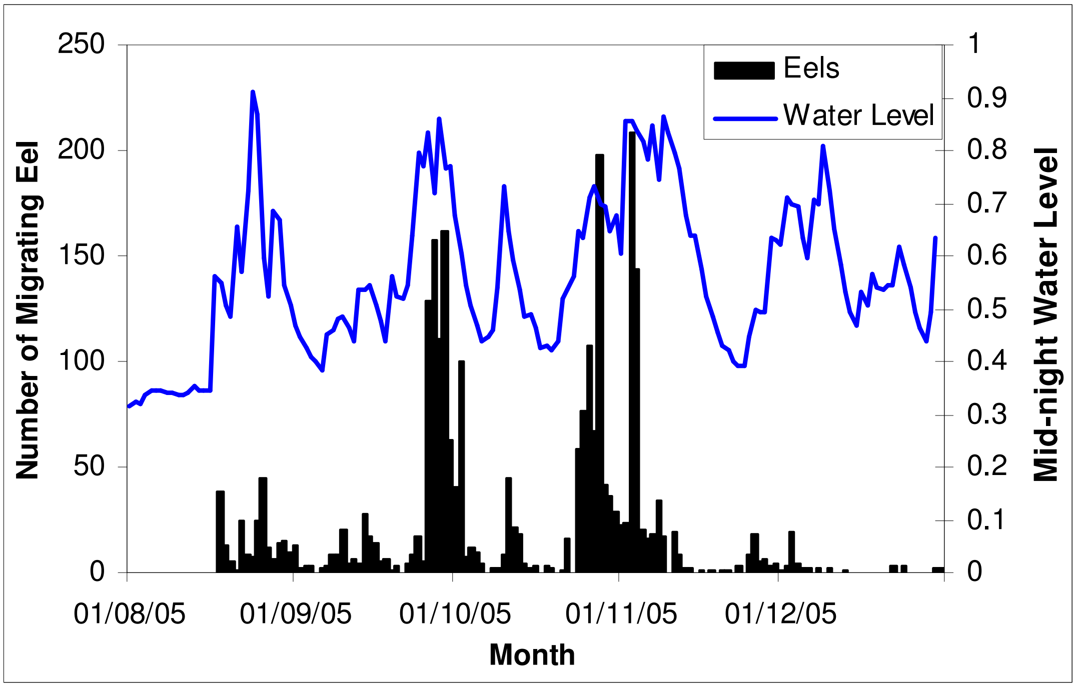

Fig. 7.1. Daily counts of downstream migrating silver eel and mid-night water levels.

Table 7.2. Comparative data for the silver eel runs since 1971

Years	Number Sampled	Mean. Weight (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
2001	850	238
2002	732	207
2003	650	177
2004	382	216
2005	587	237

* Incomplete due to flood damage

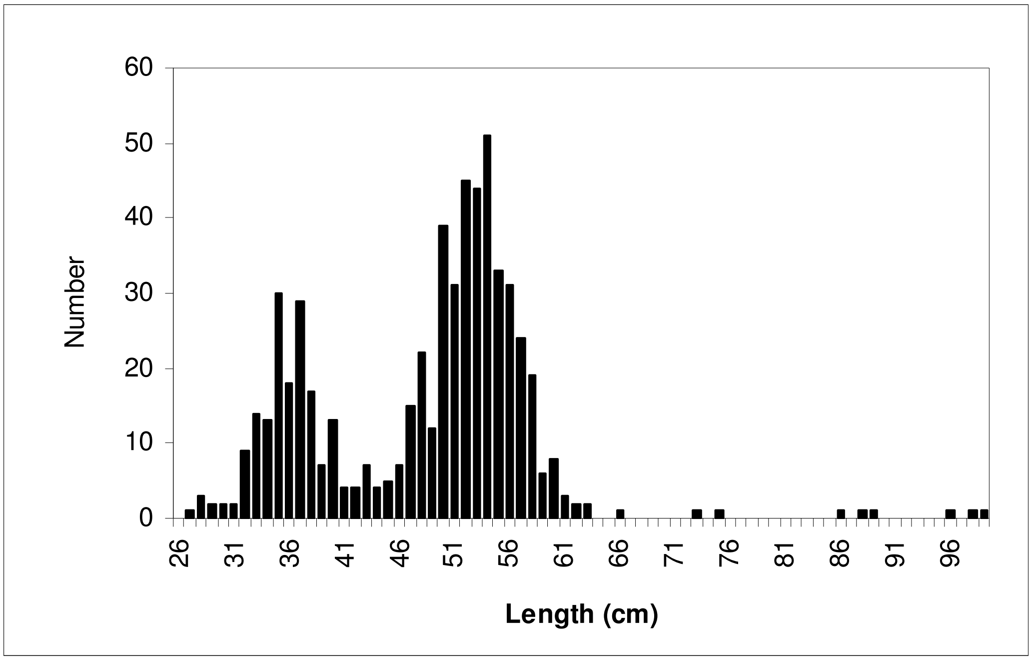

Fig. 7.2. Length frequency of silver eels trapped in the downstream traps, 2005 (n=587).

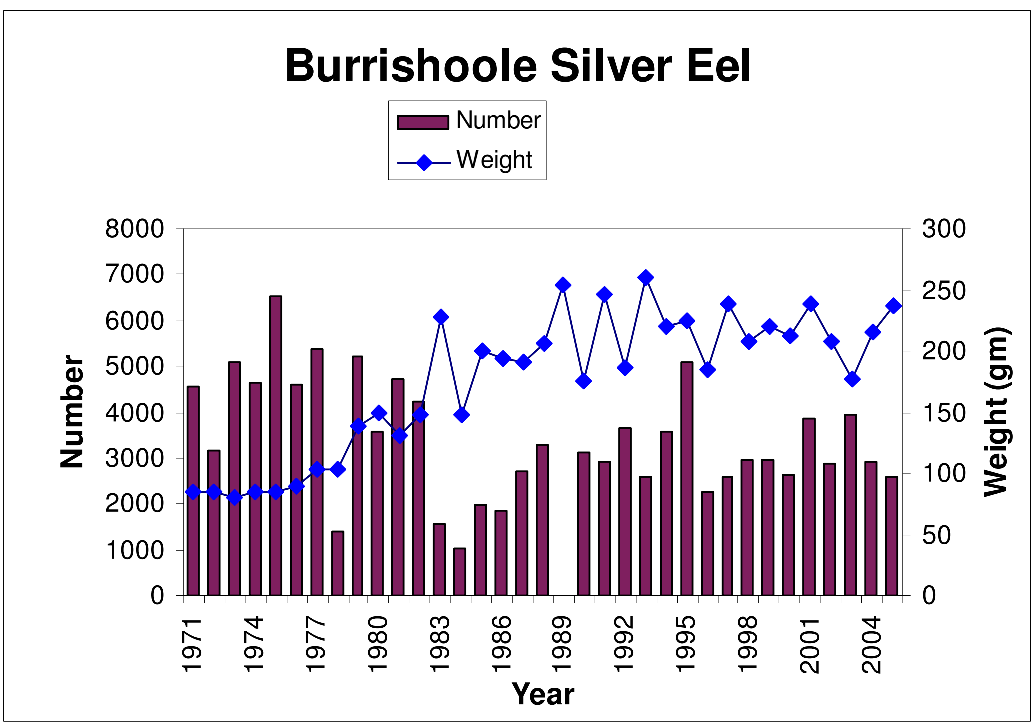

Fig. 7.3. Annual number and mean weight of silver eels trapped in the downstream traps.

8 FISHERY REPORT - CATCH DATA

8.1 Numbers and Average weight of Rod Catch

A total of 55 salmon were caught in the Burrishoole Fishery in 2005. The catch consisted of 28 reared fish and 27 wild fish. For conservation purposes 26 of the wild fish were returned alive.

The average weight of reared fish was 2.1kg (n=27); the heaviest reared fish 3.1 kg. No lengths or weights are available for wild fish.

The total trout rod catch was 16 fish. Regulations remained in place whereby all rod caught sea trout were returned alive.

8.2 Timing of Catch and Rod Effort

Angling was again confined to Lough Furnace during 2005, as Lough Feeagh remained closed as a conservation measure to protect the wild stocks of salmon and sea trout.

Although rod effort on Lough Furnace has shown an increase in recent years, (183-rod days in 2002 to 338 rod days in 2004), it decreased to 208-rod days during 2005. One rod day is the equivalent of an eight hour day (Table 8.1).

The overall salmon catch was down from 74 in 2004 to 55 in 2005. The lower catch in 2005 was likely to be a consequence of the reduced rod effort. In turn the reduced rod effort was likely to have been influenced by a reduced availability of fish due their late arrival in home waters. There was a perception among anglers that few fish were present in the lake during the early part of the season. The highest rod catch and effort occurred during July.

Table 8.1. Wild and reared salmon rod catch and rod effort (hours) for the 2005 season.

	SALMON CATCH		EFFORT/ HRS.
	WILD	REARED	
May	0	0	0
June	0	1	271
July	21	18	850
August	3	4	307
September	0	5	238
Total	27	28	1666

8.3 Exploitation Rates of Rod Fishery

Rod exploitation rates for Lough Furnace and Lough Feeagh from 1990 to 1996 are shown in Table 8.2. From 1997 onwards Lough Feeagh was closed to angling. Exploitation rates are only available for Lough Furnace since 1997. The cessation of angling on Lough Feeagh was due to the continuing low stock level of wild fish. No sea trout angling was permitted on L. Feeagh either since 1997.

Anglers fishing on Lough Furnace were requested to return wild fish alive to the water. Injured or damaged wild fish were permitted to be retained; therefore, the rod catch on Lough Furnace consists of a total catch which includes released fish and a retained catch which are fish that have been killed.

Table 8.2. Rod Fishing Exploitation Rates (1999-2005)

	1999	2000	2001	2002	2003	2004	2005
WILD SALMON							
Lough Feeagh							
"Available" fish by end of fishing season	*	*	*	*	*	*	*
Total rod catch							
Rod catch retained							
Angling success %[1]							
Exploitation rate %[2]							
WILD SALMON							
Loughs Feeagh & Furnace							
Total stock of wild fish	524	580	375	651	565	610	542
+ 10% addition for L. Furnace population	576	638	413	716	622	671	596
Total catch of wild fish	40	70	17	12	37	10	27
Rod catch retained	6	6	1	1	3	2	1
Max. angling success %	7.6	12.1	4.5	1.8	6.5	1.6	5.0
Min. exploitation rate	1.0	0.9	0.2	0.14	0.5	0.3	0.2
Max. exploitation rate	1.1	1.0	0.3	0.15	0.5	0.3	0.2
REARED SALMON	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Lough Feeagh							
"Available" fish by end of fishing season	*	*	*	*	*	*	*
Rod catch							
Exploitation rate %							
Loughs Feeagh & Furnace							
Total stock	395	1257	834	860	1178	902	952
Total rod catch	35	129	43	10	22	64	28
Exploitation rate %	8.9	10.3	5.2	1.2	1.9	7.1	2.9
WILD SEA TROUT							
Lough Feeagh							
"Available" fish by end of fishing season	*	*	*	*	*	*	*
Rod catch							
Exploitation rate %							

* No Fishing on Feeagh

8.4 Angling Success

The total number of wild salmon caught was 27 of which 1 fish was retained. The policy of catch and release is continuing to maintain a low exploitation of wild fish in the fishery.

The CPUE for salmon was slightly higher in 2005 than in 2004, in spite of the drop in effort (Table 8.3).

Table 8.3. 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	2.1
'85-'89	0.24	4.89	0.46	5.09	0.24	4.57	0.29	70.3
'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	-	-	-	-
‘01	0.15	6.7	0.12	8.4	-	-	-	-
’02	0.12	8.3	0.07	15.3	-	-	-	-
’03	0.13	7.6	0.06	17.7	-	-	-	-
’04	0.22	4.6	0.16	6.3	-	-	-	-
’05	0.26	3.8	0.08	13.0	-	-	-	-

Appendix 1.

Macroinvertebrate Survey of rivers in the Burrishoole and Owengarve catchments, 2005.

Elvira de Eyto

Introduction

This is the third annual report (data collected in 2005) on the macroinvertebrate biological monitoring of the Burrishoole catchment, which started in 2003. The research facility in Furnace is ideally placed for the collection and analysis of data applicable to the long term monitoring of lotic and lentic freshwater habitats and there is already a long history of invertebrate sampling in the Burrishoole catchment. In 2003, we implemented a formal, consistent monitoring plan, which will be continued long term to enable annual trends in water quality to be captured.

The main land uses in the Burrishoole catchment are forestry and agriculture. The agriculture is mainly hillside subsistence farming, with large numbers of mountain sheep. About 18% of the Burrishoole catchment and 7% of the Owengarve catchment is under active coniferous forestry plantations, which were planted in batches starting in the 1970's. The base geology on the west side of the Burrishoole catchment (Glenamong, Altahoney and Maumaratta subcatchments) is predominantly quartzite/schist, making them acidic in nature, with poor buffering capacity. On the east side of the catchment (Rough, Lodge, Goulaun and Cottage subcatchments), the geology is much more complex and while there is also quartzite/schist, it is interspersed with veins of volcanic rock, dolomite, wacke and pure schist, which means that the buffering capacity is higher as is the aquatic production. The Owengarve catchment is split in half with quartzite/schist in the northern half, and sandstone in the southern half (Fig. 1).

Methods

Macroinvertebrate samples were sampled in May 2005 from two sites in each of the main Burrishoole subcatchments, and two sites in the Owengarve catchment (Fig. 2). Three replicate 1ft sq surber samples were taken from riffle / stony areas. Samples were stored in >70% IMS and sorted and identified using standard keys in the laboratory. Data was collated at both taxa and order level and was collated with data from 2003 and 2004. Biotic indices (ASPT, BMWP, Q index, No. of taxa, No. of EPT taxa, acidity index) were also calculated for each site.

Results and discussion

A total of 1241 individual macroinvertebrates, representing 62 taxa, were sorted and identified from the 2005 samples. The number of taxa is similar to that found in 2003 (62) but lower that the number of taxa found in 2004 (Table 1). The average number of animals per sample ranged from 6 ± 0.6 (s.d) in Glenamong site A to 52 ± 29 in Glenthomas. As with 2003 and 2004, higher densities of animals were generally found in the Rough, Lodge and Goulaun rivers (Fig. 3), although it should be noted that 2004 had significantly higher abundances that both 2003 and 2005. Highest numbers of taxa were sampled from the Cottage, Lodge and Rough rivers (Fig. 4). As in previous years, the macroinvertebrates on the Burrishoole and Owengarve catchments are dominated by Ephemeroptera, Diptera, Plecoptera, Coleoptera and Trichoptera (Fig. 5).

The use of biotic indices helps to condense all the taxa and assemblage information into single values, and indices were calculated for the three years data to date (2003-2005). Several of these indices are specifically designed to monitor nutrient enrichment (Q index, ASPT, BMWP) (Hawkes, 1997; McGarrigle *et al.*, 2002) while the acidity index is used to monitor acidification (Henrikson and Medin, 1986). The Shannon diversity index gives a overall view of the diversity at each site (Fig. 6), and ranged between 1.2 and 3.2 within our sampling sites. The number of EPT taxa (Ephemeroptera, Plecoptera and Trichoptera), which are indicative of high water quality ranged from 5 to 15 in 2005 (Fig. 7) and was highest in sites in the Cottage, Rough and Lodge rivers. The BMWP (Biological Monitoring Working Party) score ranged from 46 to 104 in 2005 (Fig. 8). A BMWP score of greater than 100 are associated with clean rivers, while heavily polluted rivers would score less than 10, so the BMWP scores for our sampling sites suggest that our rivers are not been impacted by nutrient enrichment. The ASPT scores (which are calculated by dividing the BMWP score by the number of taxa, to standardise for sample size) ranged from 3 to 5.1 (Fig. 9), and was generally much lower than in the previous two years. The BMWP, ASPT and Q index (rivers were either 3, ¾ or 4 – Fig. 10)) generally do not tell us much about our rivers, except to show that nutrient enrichment is not really an issue at the moment in these rivers. A more insightful index is the acidity index, which is calculated using several metrics related to acid sensitive species, and general macroinvertebrate diversity. The acidity index ranged from 0 to 9 in 2005 (Fig. 11) and the index is consistent within sites sampled across the three years. This indicates that this index is quite robust. The Altahoney and Maumaratta have the lowest values in all years, indicating that the macroinvertebrates assemblages in these rivers are a very good reflection of the acid nature of the water. The acidity index ranges from 0-10, and the Swedish EPA recommends that a river that is unaffected by acidity (in reference conditions) would have an acidity score of at least 6. Some of the rivers in the Burrishoole and Owengarve catchments are well below this, and while it is largely a reflection of the underlying geology, it seems likely that the very low scores (1-3) are as a result of the impact of forestation. The low value of the acidity index at the bottom of the Goulaun river (3 at Goulaun A – bottom, 7 at Goulaun B - top) is cause for concern.

Summary

In summary, this third years data (2005) has confirmed many of the patterns found in 2003 and 2004, and highlights the benefit of using general biotic indices to summarise the complex assemblage data. It is recommended that the acidity index be calculated in the future to assess the changes that clearfelling and reafforestation of the catchment are likely to bring. While the other biotic indices (Q index, BMWP etc) do not appear to have provide much information at the moment, it is still worthwhile calculating them for each years data to track environmental changes in the coming decades.

Acknowledgements

Thanks to Elizabeth Ryder, Douglas Jones and Cara Guilfoyle for sorting and identifying samples, and helping with sampling.

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Table 1. Macroinvertebrate taxa sampled from the Burrishoole and Owengarve catchments, 2003-2005

Order	Taxa	2003	2004	2005
Total Taxa		**62**	**84**	**62**
Acari	Hydracarina	x	x	x
Amphipoda	Gammarus duebenii	x	x	x
Coleoptera	Coleoptera			x
	Dryopidae		x	
	Dytiscidae	x	x	
	Elmis aenea	x	x	x
	Esolus parallelepipedus	x	x	x
	Gyrinidae		x	
	Helodidae	x	x	x
	Hydraenidae	x		x
	Hydroporinae		x	x
	Hygrobiidae		x	
	Limnius volckmari	x	x	x
	Oulimnius tuberculatus	x	x	x
	Stenelmis canaliculata		x	
Collembola	Collembola	x	x	
Diptera	Chironomidae	x	x	x
	Chironominea	x	x	x
	Culicidae	x	x	x
	Dicranota	x	x	x
	Diptera	x		x
	Orthocladinae	x	x	x
	Ptychopteridae		x	
	Simulidae	x	x	x
	Tabanidae		x	x
	Tanypodinae	x	x	x
Ephemeroptera	Baetis atrebatinus	x		
	Baetis rhodani	x	x	x
	Caenidae			x
	Caenis macrura	x		
	Caenis rivulorum	x	x	
	Caenis horaria		x	
	Centrophilum luteolum		x	x
	Ecdyonurus	x		
	Ecdyonurus insignis	x	x	
	Ecdyonurus dispar		x	x
	Ecdyonurus torrentis			x
	Ecdyonurus venosus	x	x	x
	Ephemerella ignita	x	x	x
	Ephemerella notata		x	x
	Ephemeroptera			x
	Heptagenia			x
	Heptagenia lateralis	x	x	x
	Heptagenia sulphurea		x	
	Heptagenidae		x	

Table 1. (Cont.)

Order	Taxa	2003	2004	2005
Ephemeroptera	Leptophlebia	x	x	
	Rhithrogena germanica			x
	Rhithrogena semicolorata	x	x	x
Hemiptera	Veliidae		x	
Hirudinea	Hirudinea		x	
Mollusca	Ancylus fluviatilis	x		x
	Hydrobia ulvae	x		
	Pisidium			x
	Potamopyrgus jenkinsi	x	x	
Odonata	Anisoptera			x
Oligochaete	Oligochaete	x	x	x
Ostracoda	Ostracoda		x	
Platyhelminthes	Platyhelminthes	x		
Plecoptera	Amphinemura sulciollis	x	x	x
	Chloroperla torrentium	x	x	x
	Diura bicaudata	x		
	Isoperla grammatica	x	x	x
	Leuctra hippopus	x	x	x
	Leuctra inermis	x	x	
	Leuctra fusca		x	x
	Nemoura cinerea		x	
	Perla bipunctata		x	
	Perlodes microcephala		x	
	Perlodidae		x	
	Plecoptera			x
Trichoptera	Athripsodes		x	
	Beraeidae	x		
	Cheumatopysche lepida		x	
	Cyrnus trimaculatus	x		
	Diplectrona felix	x	x	
	Ecnomus tenellus		x	
	Economidae	x		x
	Glossosoma	x	x	
	Glossosoma boltani	x		
	Glossosomatidae		x	x
	Holocentropus dubius	x	x	x
	Hydropsyche contubernalis	x	x	
	Hydropsyche siltalai	x	x	x
	Hydropsychidae			x
	Hydroptila	x	x	x
	Lepidostomatidae		x	
	Limnephilidae		x	x
	Lype phaeopa	x	x	
	Metalype fragilis	x	x	x
	Odontocerum albicorne		x	
	Philopotamidae			x
	Philopotamus montanus	x	x	

Table 1. (Cont.)

Order	Taxa	2003	2004	2005
Trichoptera	Phryganea			x
	Phryganeidae			x
	Plectrocnemia	x	x	
	Polycentropidae		x	x
	Polycentropus flavomaculatus	x	x	x
	Polycentropus kingi	x	x	
	Polycentropus irroratus		x	
	Psychomyia pusilla	x	x	x
	Psychomyidae	x	x	x
	Rhyacophilidae			x
	Rhyacophila dorsalis	x	x	x
	Rhyacophila munda		x	
	Sericostomatidae		x	
	Silo pallipes	x	x	x
	Tinodes dives		x	
	Tinodes muculicornis		x	
	Tinodes waeneri		x	
	Trichoptera	x	x	x

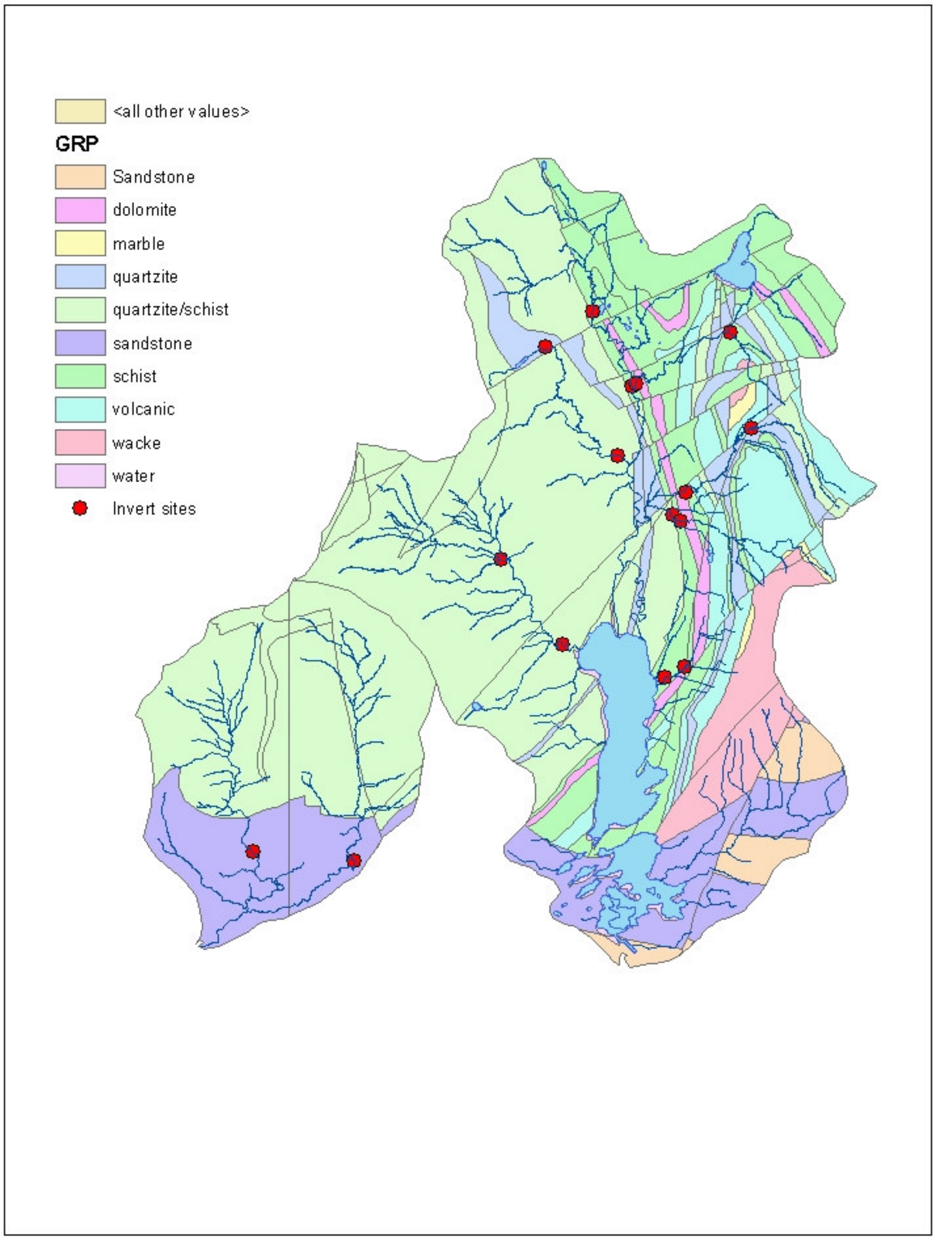

Figure 1. Geology of the Burrishoole and Owengarve catchments, and position of macroinvertebrate sampling sites.

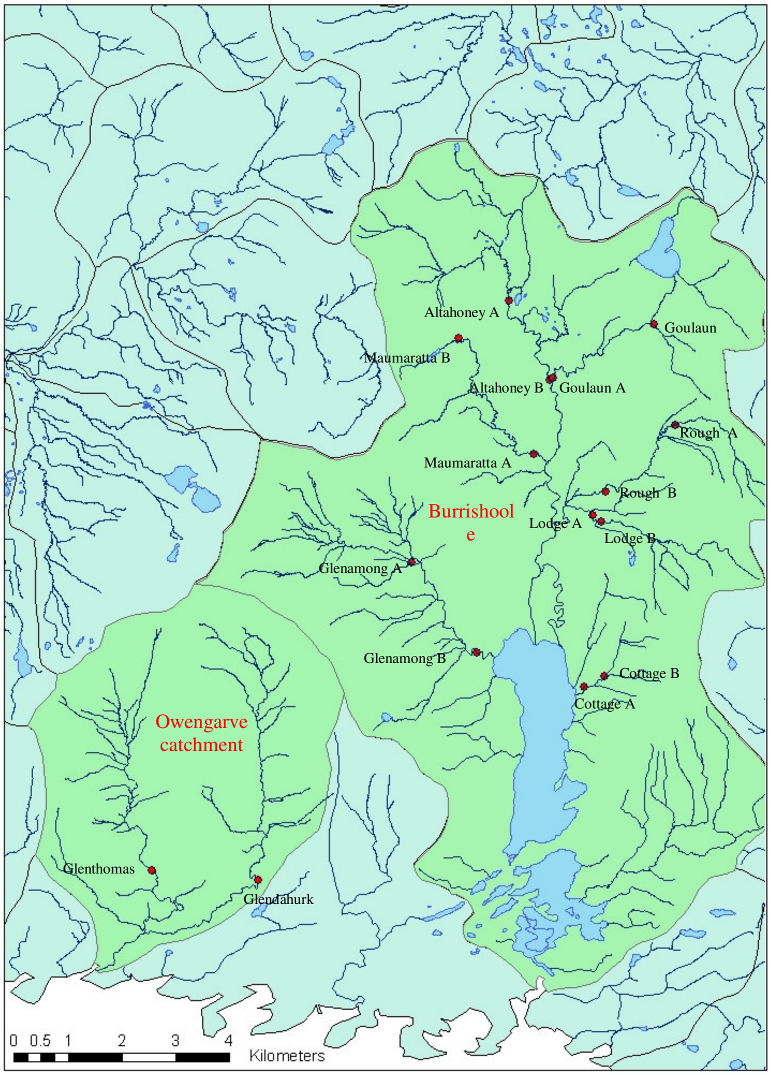

Figure 2. Macroinvertebrate sampling sites in the Burrishoole and Owengarve catchments included in the biological monitoring programs 2003-2005.

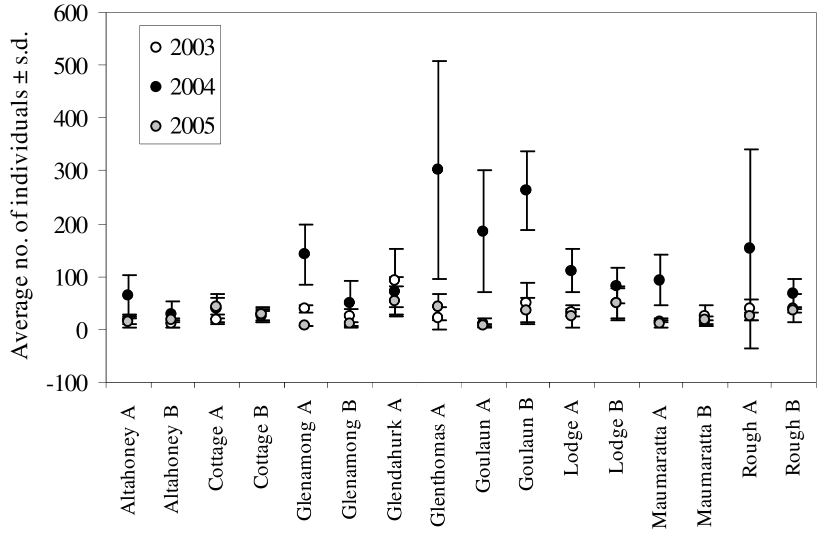

Figure 3. Average number ± s.d. of macroinvertebrates found in a 1ft sq surber sample in the Burrishoole and Owengarve catchments 2003-2005.

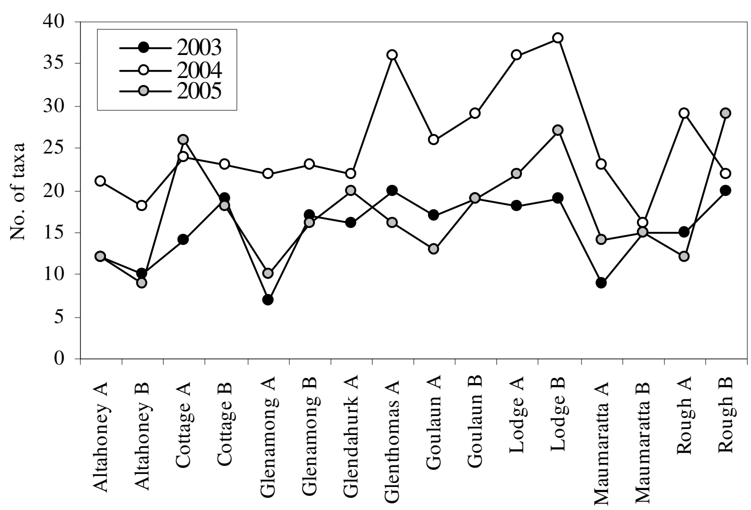

Figure 4. Number of macroinvertebrate taxa found in 1ft sq surber samples in the Burrishoole and Owengarve catchments 2003-2005.

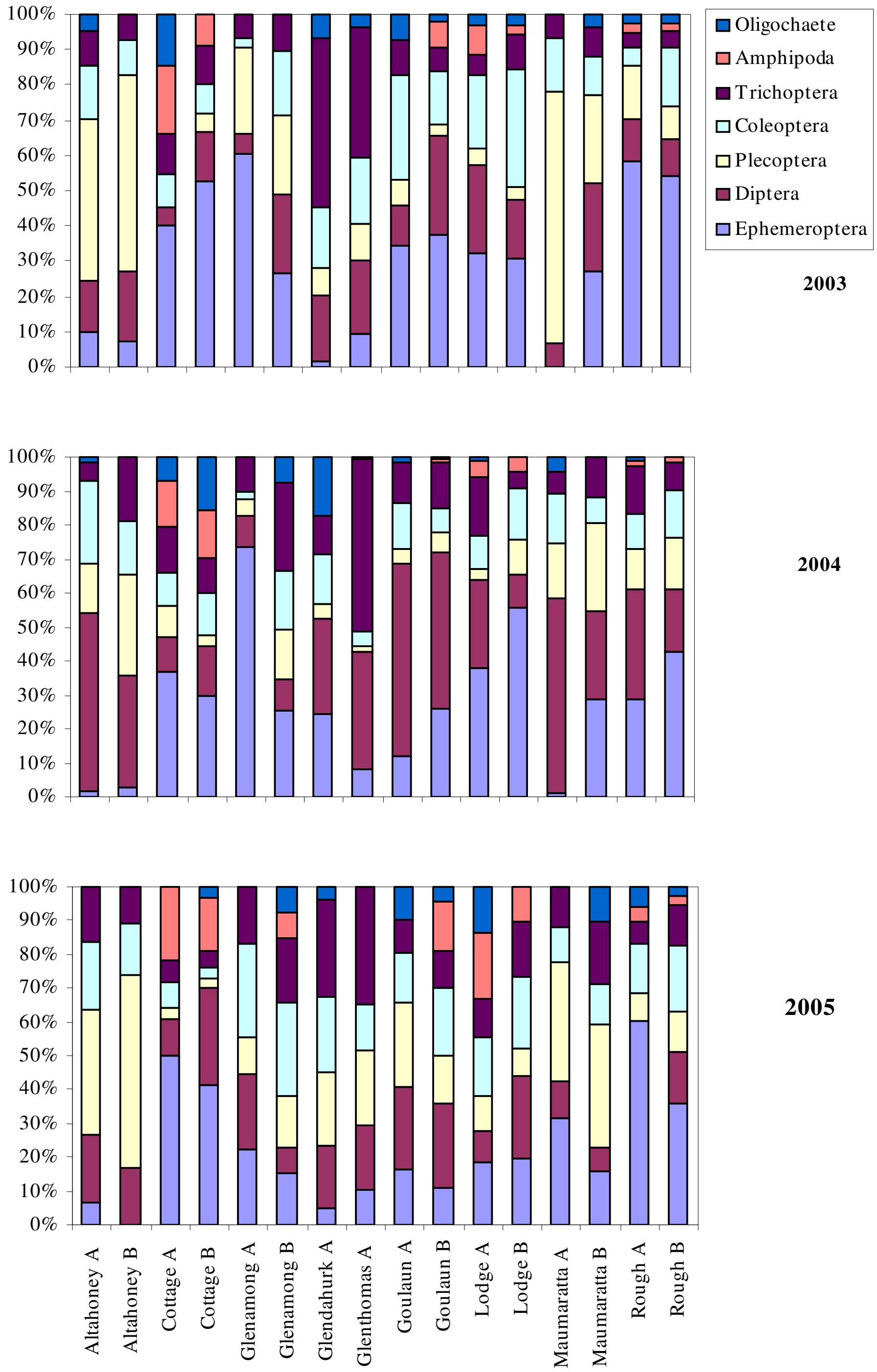

Figure 5. Proportional abundances of the most common orders of macroinvertebrates found in the Burrishoole & Owengarve catchments, sampled in 2003 (top), 2004 (middle) and (2005) bottom.

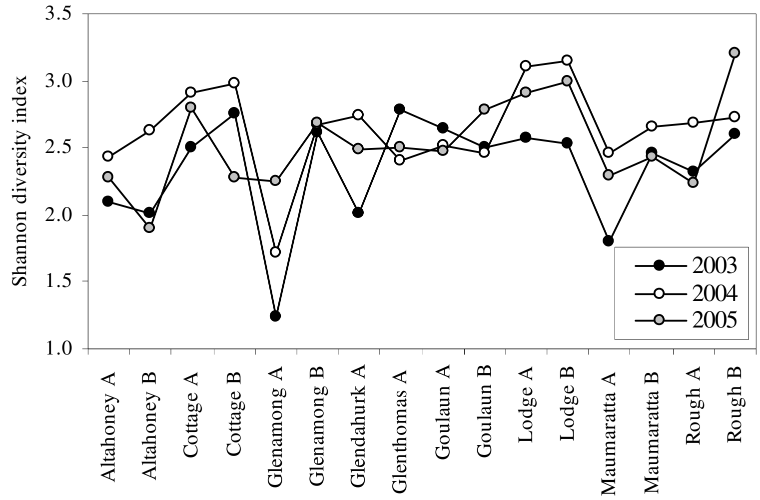

Figure 6. Shannon diversity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

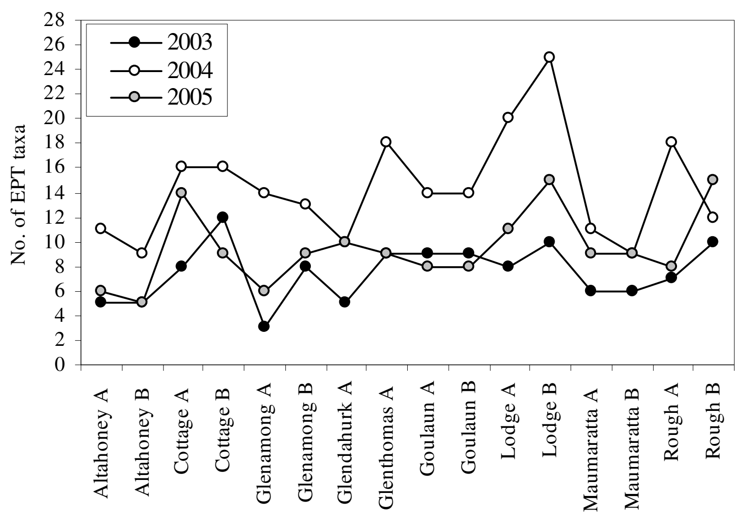

Figure 7. Number of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

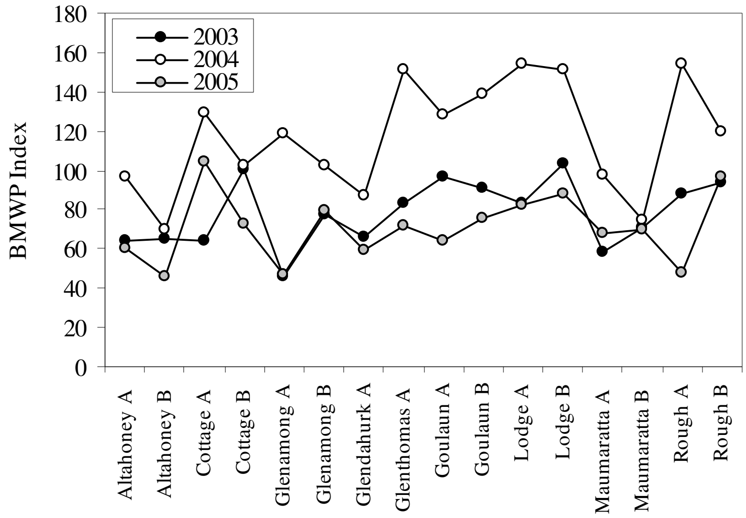

Figure 8. BMWP calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005

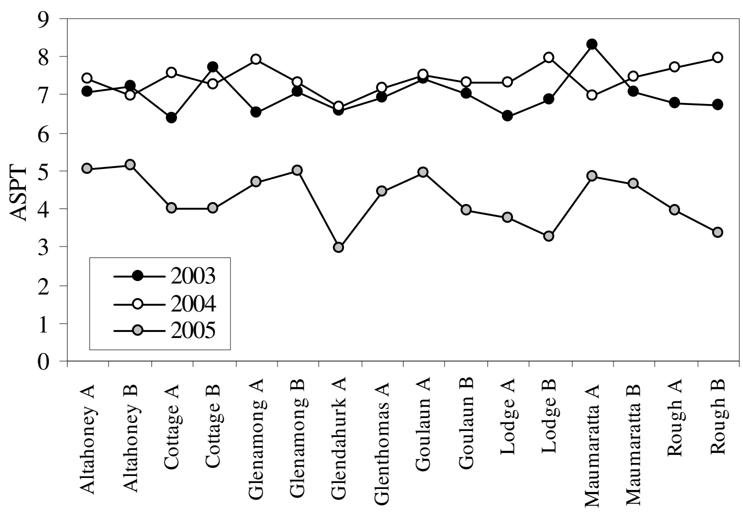

Figure 9. ASPT calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005

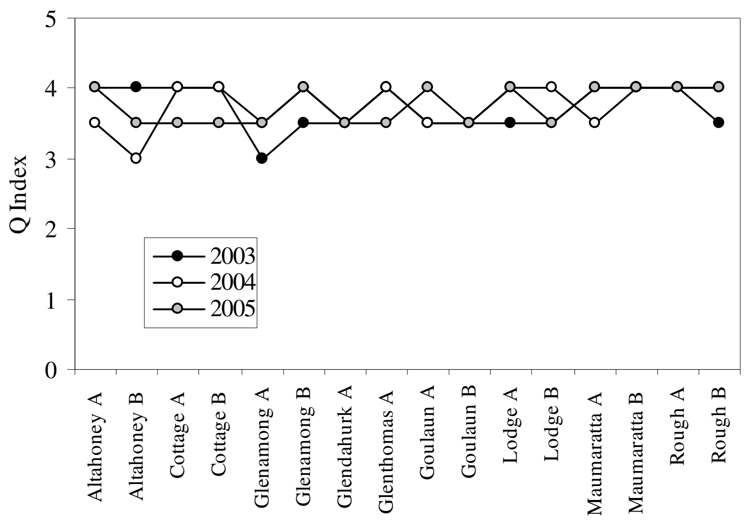

Figure 10. Q index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.

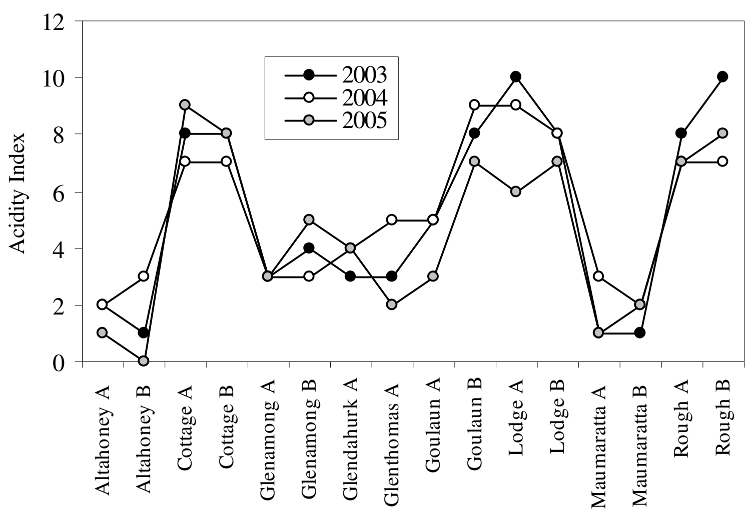

Figure 11. SI acidity index calculated for macroinvertebrates sampled from the Burrishoole and Owengarve catchments 2003-2005.