

NRFB Rivers



Sampling Fish for the Water Framework Directive - Rivers 2008



The Central and Regional
Fisheries Boards

PROJECT PERSONNEL

This report was written and researched by Dr. Fiona Kelly, Dr. Ronan Matson, Mr. Glen Wightman, Ms. Lynda Connor, Mr. Rory Feeney, Ms. Emma Morrissey, Ms. Róisín O’Callaghan, Ms. Gráinne Hanna, Mr. Kieran Rocks and Dr. Andrew Harrison, Central Fisheries Board, under the direction of Dr. Cathal Gallagher, Director of Research and Development as part of the Water Framework Directive Fish Surveillance Monitoring Programme, 2007 to 2009.

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1. INTRODUCTION

Fish stock surveys were undertaken in 83 rivers throughout Ireland during the summer of 2008 as part of the programme for sampling fish for the Water Framework Directive. Twelve of these sites were located within the Northern Regional Fisheries Board (NRFB) and were surveyed between July and early October 2008 by staff from the Central Fisheries Board (CFB) and the Northern Regional Fisheries Board (NRFB). The sites were selected based on criteria set down by the Environmental Protection Agency. These surveys are required by both Irish and European law (Council of the European Communities, 2000). Annex V of the European Water Framework Directive (WFD) stipulates that rivers are included within the monitoring programme and that the composition, abundance and age structure of fish fauna are examined (Council of the European Communities, 2000). Although fish survey work has been carried out in Ireland in the past, no project to date has been as extensive as the present study in providing data appropriate for WFD compliance. Continued surveying of these and additional river sites will provide a useful baseline in the future for monitoring water quality.

The NRFB has an area of approximately 6,200 km² and encompasses all of County Donegal as well as parts of Cavan, Leitrim, Longford, Monaghan and Sligo. Donegal accounts for most of the region's entire coastline, with Leitrim also having a small section. The total shoreline measures nearly 1100 km. This region has an abundance of lakes, especially around the Erne system in north County Cavan. The largest lakes in the region are Lough Melvin in Co. Leitrim and Lough Oughter in County Cavan. The main river in the region is the River Erne. Major urban centres within the region include, Ballyshannon, Bundoran and Letterkenny. Agriculture is one of the main pressures on water quality within the region.

This report summarizes the main findings of the fish stock surveys in the 12 river waterbodies surveyed in the NRFB during 2008 and reports the current status of the fish stocks in each of these.

2. STUDY AREA

Twelve river sites, in eight river catchments (Erne, Clonmany, Burnfoot, Clady, Leannan, Owentocker, Swilly and Eany Water) were surveyed. Sites ranged in surface area from 177m² (Ballyhallan River) to 6023.7m² (Eany Water). These sites were categorised into two catchment size classes - <100km² and <1000km² (Table 2.1 and Fig. 2.1) and were divided into two categories for reporting purposes, i.e. hand-set and boat sites.

Table 2.1. List of river sites surveyed for WFD surveillance monitoring in the NRFB, June to September 2008, details of catchment area (km²), wetted width, surface area (m²), mean depth (m) and max depth (m) are included

Site	Catchment	Easting	Northing	Catchment Size (km ²)	Width (m)	Area (m ²)	Mean Depth (m)	Max Depth (m)
Hand-set sites								
Ballyhallan	Clonmany	236980	446116	<10	3.93	177.00	0.12	0.17
Burnfoot	Burnfoot	237968	423697	<100	4.49	247.04	0.26	0.36
Cronaniv Burn	Clady	193084	418695	<10	5.89	265.20	0.18	0.26
Gliskeelan	Leannan	205202	417317	<100	5.07	228.30	0.34	0.47
Owentocker	Owentocker	173264	390635	<100	9.39	422.70	0.31	0.50
Swanlinbar	Erne	219707	327158	<100	19.20	348.75	0.24	0.39
Swilly	Swilly	206003	409202	<100	7.13	320.96	0.25	0.58
Waterfoot	Erne	208490	365177	<100	8.63	397.13	0.35	0.46
Boat sites								
Annalee	Erne	240252	310333	<1000	16.20	2565.80	0.55	0.72
Dromore	Erne	271456	320753	<100	5.34	801.00	0.79	1.00
Eany Water	Eany Water	183866	381481	<100	22.31	6023.70	0.72	1.63
Erne (Belturbet)	Erne	236083	316934	<10000	19.20	5587.20	0.55	0.75

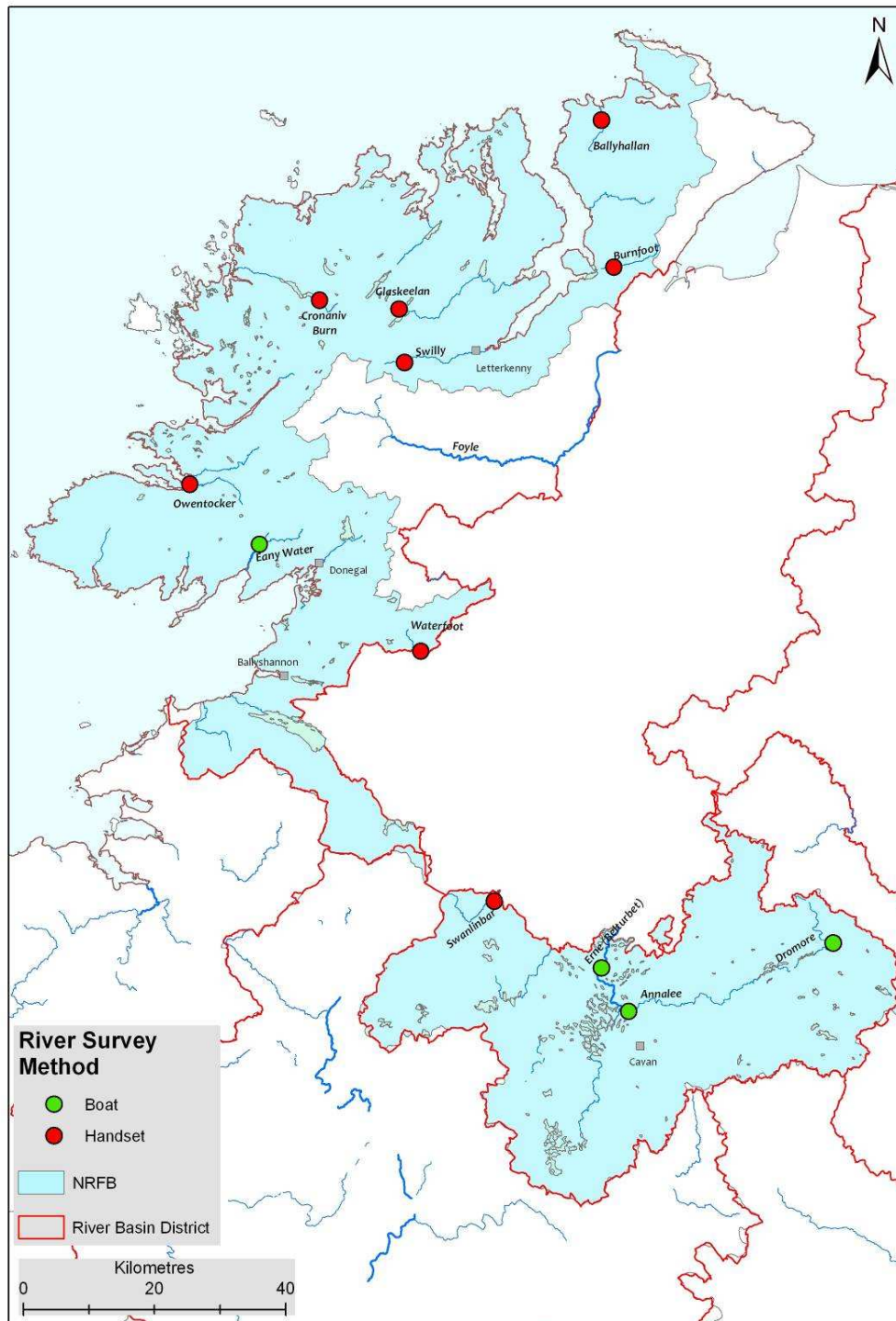


Fig. 2.1. Location map of river sites surveyed throughout the NRFB for WFD surveillance monitoring 2008

3. METHODS

Electric fishing is the method of choice for surveillance monitoring of fish in rivers in order to obtain a representative sample of the fish assemblage at each sampling site. The technique complies with European Committee for Standardisation (CEN) guidelines for fish stock assessment in wadeable rivers (CEN, 2003). At each site the stretch sampled was isolated, where possible, using stop nets and one to three fishings were carried out using bank-based electric fishing units (hand-sets) or boat-based electric fishing units carried in flat-bottomed boats. Each site ideally included all habitat types: riffle, glide and pool. At each site, a number of physical habitat variables were measured, water samples for chemical analyses and a multihabitat kick sample for macroinvertebrates were taken, and a macrophyte survey was conducted.

Fish captured in each fishing occasion were sorted and processed separately. During processing, the species of each fish was identified and its length and weight were measured; sub-samples were weighed when large numbers of fish were present. For species identification, river lamprey (*Lampetra fluviatilis*) and brook lamprey (*Lampetra planeri*) were treated as a single species. Scales were taken from salmonids greater than 8.0cm and from most coarse fish species. Opercular bones were used to age perch captured. All fish were held in a large bin of oxygenated water after processing until they were fully recovered and were then returned to the water. Samples of eels were retained for further analysis.

A subsample of the dominant fish species were aged (five fish from each 1cm size class). Fish scales were aged using a microfiche reader. Opercular bones were aged using an epidioscope and an Olympus microscope (SZX10)/digital camera system. Growth rates were determined by back-calculating lengths at the end of each winter, L1 being the mean length at the end of the first winter, etc.



Plate 3.1: Electric fishing in a small wadeable stream using bank based units

4. RESULTS

4.1 Wadeable hand-set sites

4.1.1 The Ballyhallan River



Plate 4.1. The Ballyhallan River, upstream of the Clonmany confluence

The Ballyhallan River (Plate 4.1) is located on the Inishowen Peninsula in Co. Donegal. It rises in the mountains south of Clonmany and flows for only a short distance before reaching the sea at Tullagh Bay. A 45m stretch of channel was surveyed on the 9th of September 2008 on the downstream side of the bridge located upstream of the Clonmany River confluence (Fig. 4.1). Three fishings were carried out using one

bank based electric fishing unit. The site was dominated by cobble and gravel and had habitat consisting mainly of riffle and glide. Trees provided heavy shading to the channel, while there was little instream vegetation. The aquatic vegetation was mostly composed of bryophytes such as *Fontinalis antipyretica*, *Rhynchostegium riparioides* and *Chiloscyphus polyanthus*. The mean width of the channel at the site was 3.93m and the mean depth was 0.12m. The wetted area sampled totalled 177m².

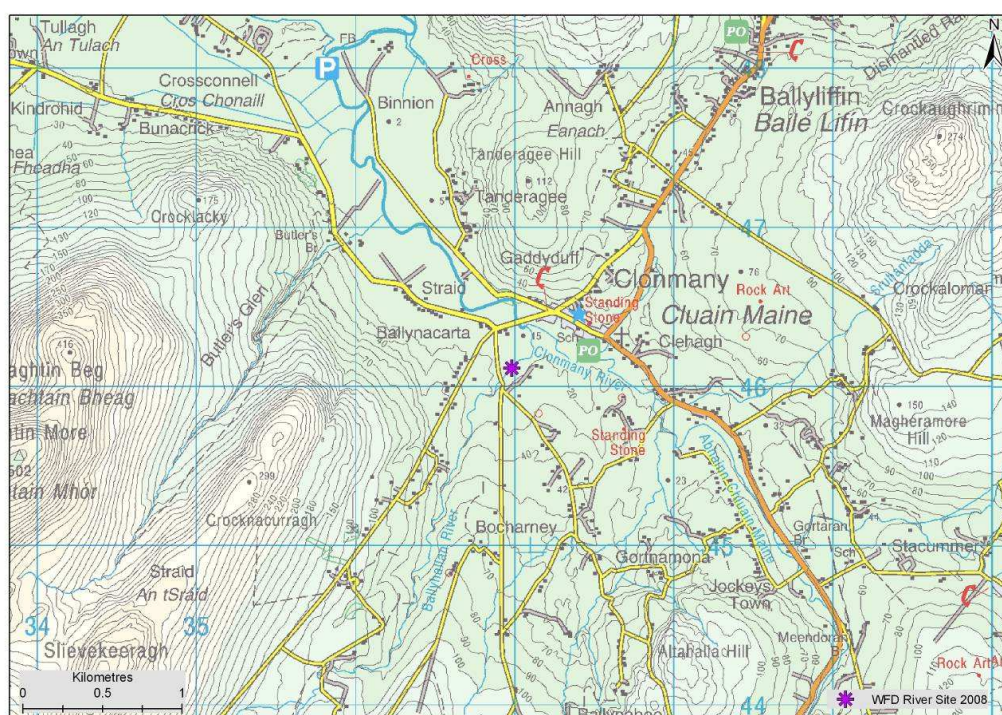


Fig. 4.1. Location of the Ballyhallan River surveillance monitoring site 2008

Three fish species were recorded in the Ballyhallan River during the survey (Table 4.1). Salmon were the most abundant species, followed by brown trout.

Table 4.1. Density of fish (no./m²), Ballyhallan River site (fish density has been calculated as minimum estimates based on 3 fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.2938	0.2881	0.5819
<i>Salmo trutta</i>	Brown trout	0.2147	0.1299	0.3446
<i>Anguilla anguilla</i>	Eel	-	-	0.0735
All fish	All fish	-	-	1.000

Salmon ranged in length from 3.6cm to 12.4cm (Fig. 4.2). Two age classes, 0+ and 1+ were present in the population and these accounted for 48% and 52%, respectively. The mean L1 for salmon in the Ballyhallan River was 4.51cm (Appendix 2).

Brown trout ranged in length from 4.4cm to 15.4cm (Fig. 4.3). Three age classes were deemed to be present in the population, 0+, 1+ and 2+. These accounted for 36%, 64% and 16% of the trout population, respectively. The mean L1 for brown trout was 5.73cm (Appendix 1). Brown trout in the Ballyhallan River were classified as very slow growing, based on the criteria described by Kennedy and Fitzmaurice (1971).

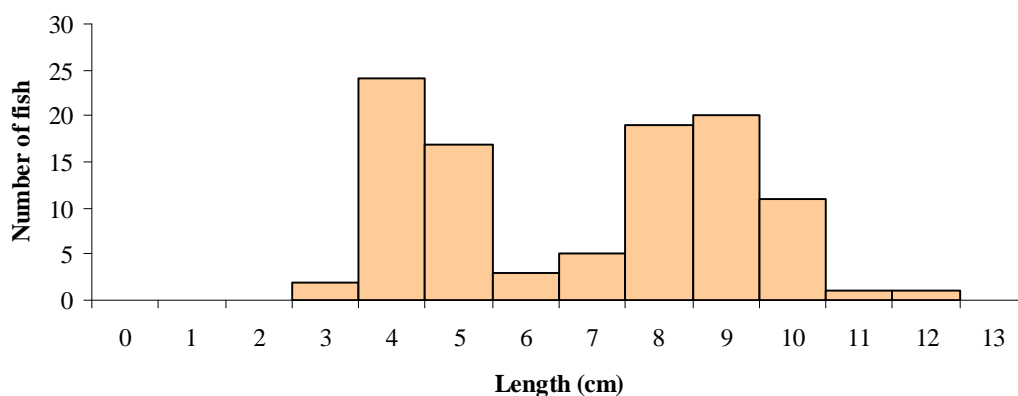


Fig. 4.2. Length frequency distribution for salmon, Ballyhallan River, September 2008 (n = 103)

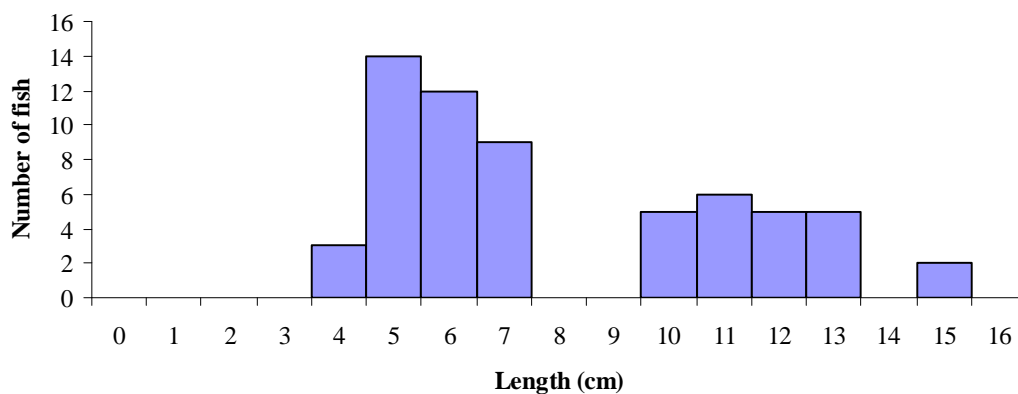


Fig. 4.3. Length frequency distribution for brown trout, Ballyhallan River, September 2008 (n = 61)

4.1.2 The Burnfoot River



Plate 4.2. The Burnfoot River site, downstream of the bridge in Burnfoot

The Burnfoot (Plate 4.2) is a small river, located at the southern end of the Inishowen Peninsula. It rises near the village of Muff on the Donegal/ Derry border and flows westwards across the peninsula, to reach the sea at Lough Swilly (Fig. 4.4). The site itself was in relatively poor condition at the time of sampling with a strong smell of sewage. A 55m stretch of channel was surveyed on the 10th of September 2008 on the downstream side of the bridge in Burnfoot (Fig. 4.4). Three fishings were carried out using two bank based electric fishing units. The site substrate was dominated by sand and gravel, while the habitat mainly consisted of glide and riffle with some pools. Trees in this urban setting provided light shade. Macrophytes included *Fontinalis antipyretica*, *Callitriche* sp. and *Potamogeton natans*. The mean width of the channel was 4.49m and the mean depth was 0.26m. The total wetted area sampled was 247.04m².

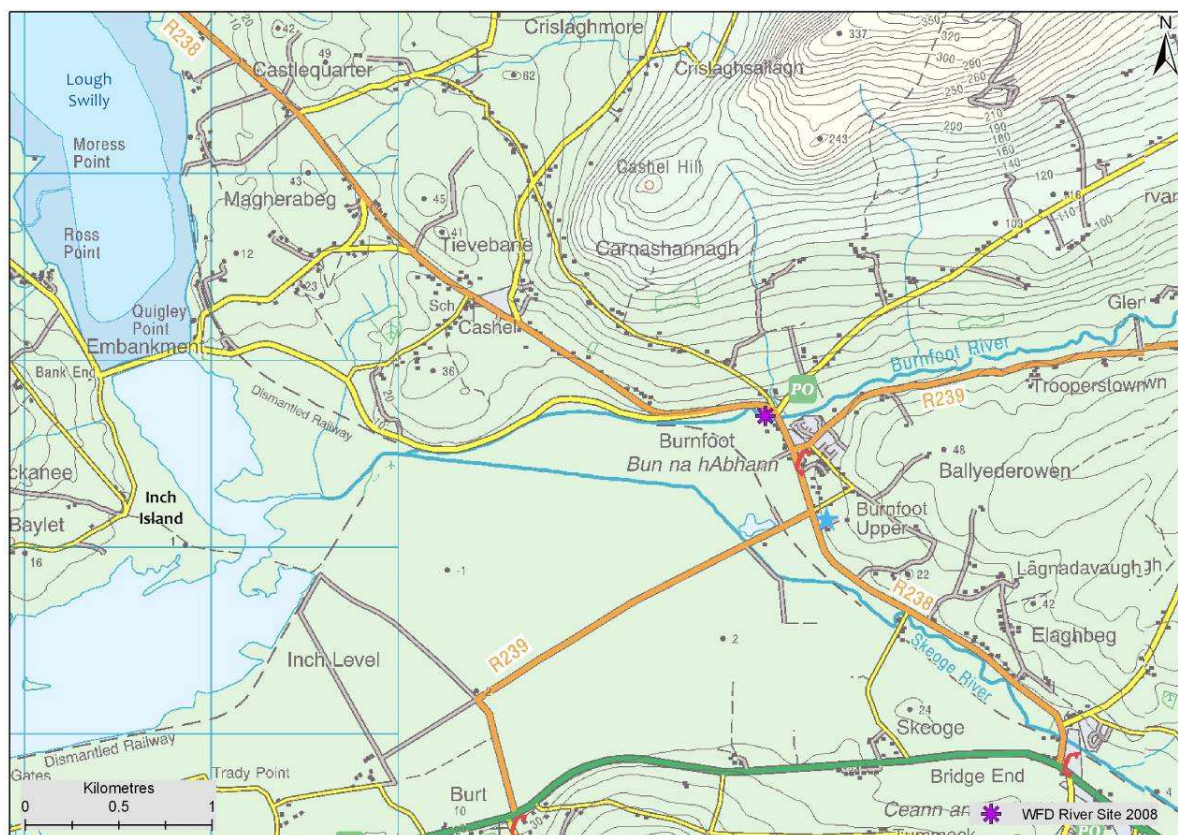


Fig. 4.4. Location of the Burnfoot River surveillance monitoring site 2008

Five species of fish were recorded in the Burnfoot River (Table 4.2). Brown trout were the most common species, followed by 3-spined stickleback.

Table 4.2. Density of fish (no./m²) in the Burnfoot River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo trutta</i>	Brown trout	0	0.4412	0.4412
<i>Gasterosteus aculeatus</i>	3-Spined stickleback	-	-	0.2186
<i>Lampetra</i> spp.	Lamprey	-	-	0.1417
<i>Salmo salar</i>	Salmon	0	0.1133	0.1133
<i>Anguilla anguilla</i>	Eel	-	-	0.0364
All fish	All fish	-	-	0.9513

Brown trout ranged in length from 5.6cm to 21.6cm (Fig. 4.5). Three age classes were confirmed to be present in the population, 1+, 2+ and 3+. These accounted for 96%, 3% and 1% of the trout population,

respectively. The mean L1 for brown trout in the Burnfoot River was 5.31cm, L2 was 11.22cm and the L3 was 13.26cm (Appendix 1). Brown trout in the Burnfoot River were classified as very slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

3-spined stickleback ranged in length from 2.4cm to 5.5cm (Fig. 4.6). A distinct peak in the population is evident at the 3cm age class. Lamprey ranged in length from 6.7cm to 16.6cm (Fig. 4.7).

Salmon ranged in length from 5.6cm to 8.9cm (Fig. 4.8). Only a single one year old salmon was present at the site. The mean L1 was 3.60 cm (Appendix 2).

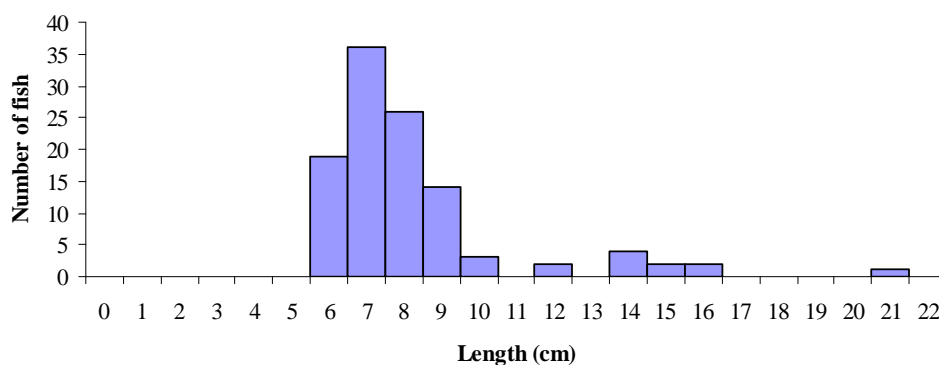


Fig. 4.5. Length frequency distribution for brown trout in the Burnfoot River, September 2008 (n = 109)

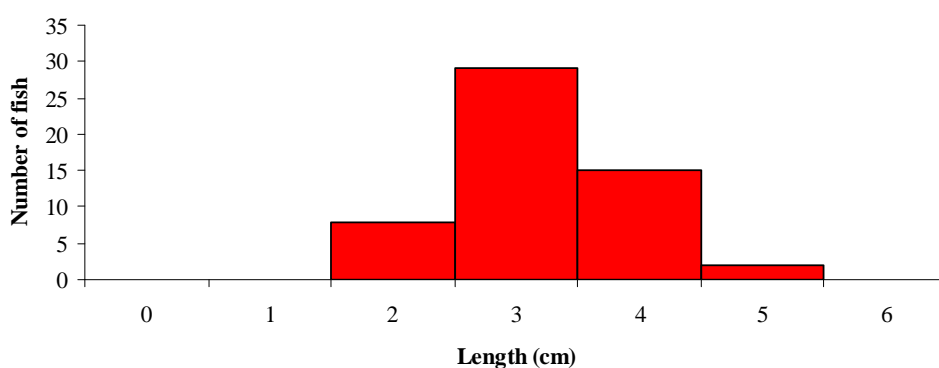


Fig. 4.6: Length frequency distribution for 3-spined stickleback in the Burnfoot River, September 2008 (n = 54)

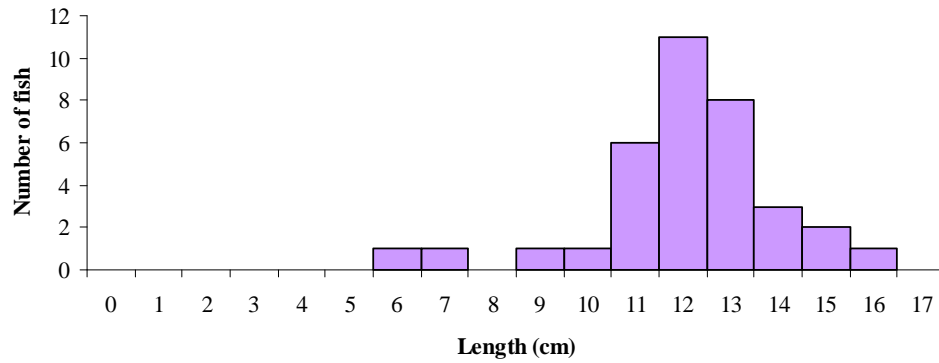


Fig. 4.7: Length frequency distribution for lamprey in the Burnfoot River, September 2008 (n = 35)

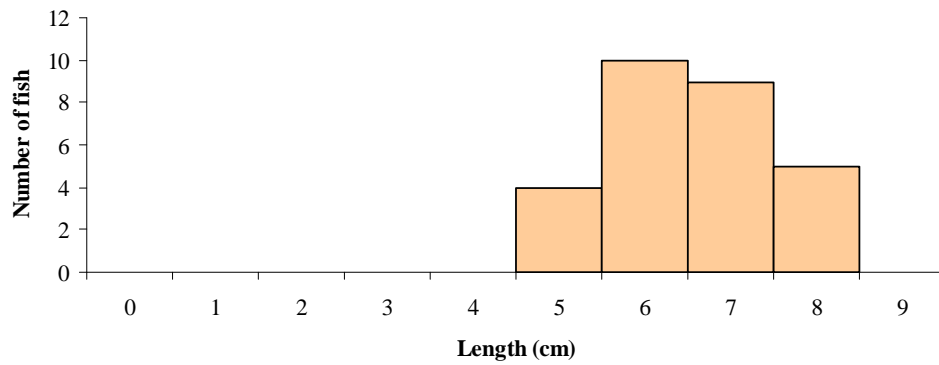


Fig. 4.8: Length frequency distribution for salmon in the Burnfoot River, September 2008 (n = 28)

4.1.3 The Cronaniv Burn River



Plate 4.3. The Cronaniv Burn upstream of Dunlewy Lough

The Cronaniv Burn (Plate 4.3) rises in the Derryveagh Mountains, County Donegal. It flows north westwards into Dunlewy Lough and continues through Lough Nacung towards Gweedore (Fig. 4.9). It reaches the sea at Bunbeg approximately five kilometres west of Gweedore.

This survey was conducted on the 18th of September 2008 along a 100m stretch of channel (Fig. 4.9) was fished three times using two bank based electric fishing units. The site had a mixed substrate of cobble, boulder and gravel. The habitat was predominately glide with a mix of riffle and pool. Due to the surrounding bog there were no tall trees and subsequently no shading. The macrophytes present were characteristic of upland and nutrient poor conditions and included, *Juncus bulbosus*, *Ranunculus flammula*, *Pellia epiphylla* and *Myriophyllum verticillatum*. There was also a high amount of algae covering the rocks. The mean width of the channel was 5.89m and the mean depth was 0.18m. The total wetted area sampled was 265.2m².



Fig. 4.9. Location of the Cronaniv Burn surveillance monitoring site 2008

Salmon and brown trout were the only fish species present in the Cronaniv Burn and of the two, salmon were more common.

Table 4.3. Density of fish (no./m²) in Cronaniv Burn site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.0943	0.1659	0.2602
<i>Salmo trutta</i>	Brown trout	0.0226	0.0113	0.0339
All fish	All fish	-	-	0.2941

Salmon ranged in length from 3.8cm to 12.6cm (Fig. 4.10) with a mean length of 6.4cm. Three age classes were present in the population, 0+, 1+ and 2+ and these accounted for 36%, 52% and 12% of the trout population, respectively. The mean L1 for salmon was 3.88cm and the L2 was 7.12cm (Appendix 2).

Brown trout at the site ranged in length from 4.1cm to 14cm, with a mean length of 6.5cm. The mean length at L1 was 3.50cm and L2 was 11.0 cm (Appendix 1). Brown trout were classified as very slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

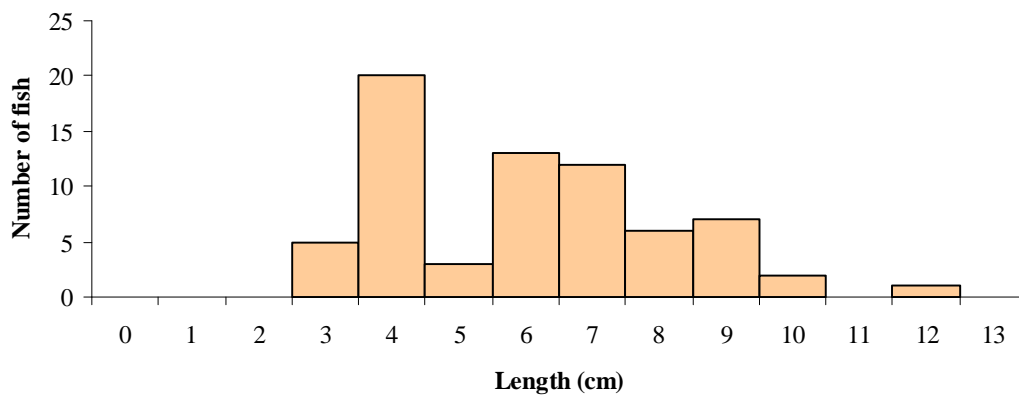


Fig. 4.10. Length frequency distribution for salmon in the Cronaniv Burn River September 2008
(n = 69)

4.1.4 The Glaskeelan River



Plate 4.4. The Glaskeelan River downstream of the bridge west of Roshin

The Glaskeelan River (Plate 4.4) rises in the Derryveagh Mountains in Glenveagh National Park, County Donegal. It flows south eastwards into Gartan Lough and joins the Leannan River, which ultimately enters the sea at Lough Swilly near Rathmelton. The site is situated in the Cloghernagore Bog and Glenveagh National Park SAC. The river is one of the 27 sub-basins which have been designated as a SAC for the freshwater pearl mussel.

A stretch of river channel 45m in length was surveyed on the 18th of September 2008, downstream of the bridge located west of Roshin (Fig. 4.11). Three fishings were carried out using two bank based electric fishing units. The site substrate was predominantly cobble and boulder with a mixture of gravel and fine silt. The habitat was mixed with glide, riffle and some pools. Due to the boggy nature of the surrounds, there were only a few trees providing light shade. The aquatic vegetation present included *Racomitrium aciculare*, *Potamogeton polygonifolius* and *Ranunculus flammula*. The mean width of the channel was 5.07m and the mean depth was 0.34m. The wetted area sampled totalled 228.3m².



Fig. 4.11. Location of the Glaskeelan River surveillance monitoring site 2008

There were only two species of fish recorded in the Glaskeelan River. Salmon were the most abundant, followed by brown trout.

Table 4.4. Density of fish (no./m²) in Glaskeelan River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.1752	0.2760	0.4512
<i>Salmo trutta</i>	Brown trout	0.0482	0.0745	0.1227
All fish	All fish	-	-	0.5738

Salmon ranged in length from 3.0cm to 11.7cm (Fig. 4.12) and had a mean length of 6.9cm. Three age classes were present in the population, 0+ fish accounted for approximately 38% of the population. The mean L1 and L2 was calculated to be 4.65cm and 7.68cm respectively (Appendix 2).

Brown trout ranged in length from 3.9cm to 18.4cm (Fig. 4.13) with a mean length of 9cm. Four age classes were present in the population, 0+, 1+, 2+ and 3+. These accounted for 39%, 39%, 18% and 4% of the trout population, respectively. The mean length at L1, L2 and L3 for brown trout in the Glaskeelan River was 5.25cm, 10.17cm and L3 15.71cm, respectively (Appendix 1). Brown trout were classified as very slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

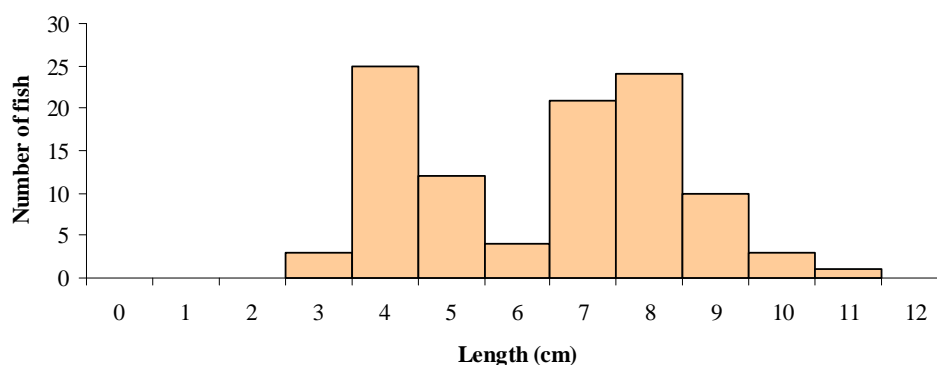


Fig. 4.12. Length frequency distribution for salmon in the Glaskeelan River September 2008
(n = 103)

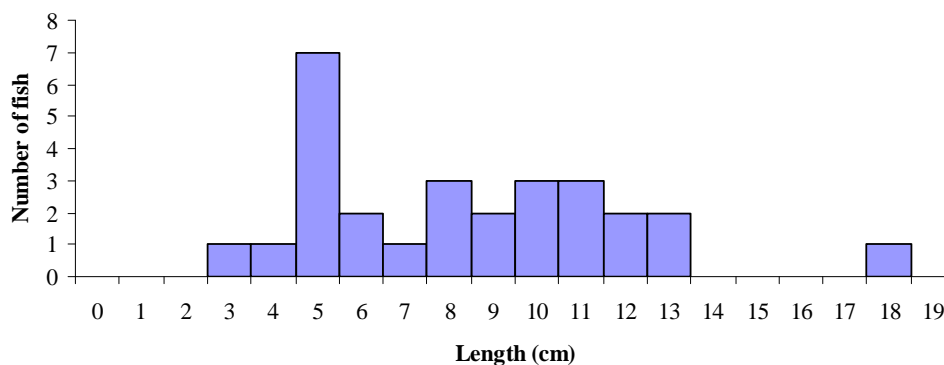


Fig. 4.13. Length frequency distribution for brown trout in the Glaskeelan River September 2008
(n = 28)

4.1.5 The Owentocker River



Plate 4.5. The Owentocker River downstream of the main bridge in Ardara

The Owentocker River (Plate 4.5) rises in the Blue Stack Mountains in Co. Donegal. It is a small spate river that drains the mountains as it flows westwards through Ardara into Loughros More Bay.

A 45m stretch of channel was surveyed on the 17th of September downstream of the main bridge in Ardara (Fig. 4.14). Three fishings were carried out using three bank based electric fishing units. The site was dominated by cobble with a mixture of some boulders, gravel and bedrock. The habitat mainly consisted of riffle with some glide and pools. Trees along the river bank provided heavy shading to the channel. The existing vegetation was mainly composed of mosses such as *Fontinalis antipyretica*, *Rhynchostegium riparioides*, *Hygrohypnum* sp, *Pellia* spp. and *Scapania undulata*. The mean channel width and depth was 9.39m and 0.31m respectively. The total wetted area was 422.7m².



Fig. 4.14. Location of the Owentocker River surveillance monitoring site 2008

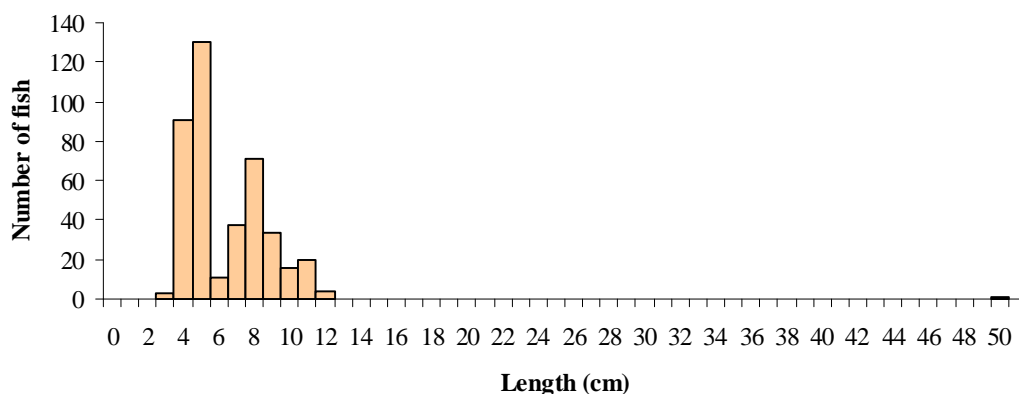
Three fish species were recorded in the Owentocker River. Salmon were the most abundant species encountered, followed by brown trout.

Table 4.5. Density of fish (no./m²) in the Owentocker River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.5559	0.4329	0.9889
<i>Salmo trutta</i>	Brown trout	0.0071	0.0166	0.0237
<i>Anguilla anguilla</i>	Eel	-	-	0.0166
All fish	All fish	-	-	1.029

Salmon ranged in length from 3.2cm to 50.4cm (Fig. 4.15). Four age classes were deemed to be present in the population; 0+, 1+, 2+ and 4+. These accounted for 56%, 36%, 7% and >1% of the salmon population, respectively. The mean L1, L2, L3, L4 for salmon in the river was 4.46 cm, 8.8cm, 32.9cm and 44.0 cm, respectively (Appendix 2).

Length measurements for brown trout ranged from 4.6cm to 24.4cm, with a mean length of 14.3cm. The mean length at L1, L2 and L3 was 6.93cm, 14.10cm and 17.74cm respectively (Appendix 1). Brown trout were classified as slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).



**Fig. 4.15. Length frequency distribution for salmon in the Owentocker River September 2008
(n = 418)**

A small number of fish within the site had noticeable skin (fungal) infections (Plate 4.6). A fungal infection, like that seen on fish in the Owentocker river, is usually associated with fish that have been subjected to some stress or who have a pre-existing infection or injury and is more commonly observed in aquarium or fish farm fish.



Plate 4.6. A salmon with a fungal infection across its body.

4.1.6 The Swanlinbar River



Plate 4.7. The Swanlinbar River downstream of the Swanlinbar Bridge

The Swanlinbar River (Plate 4.7) rises in the Cuilcagh Mountains of northwest Co. Cavan. It flows north eastwards across the border into Co. Fermanagh and joins with Upper Lough Erne.

A 45m stretch of channel was surveyed on the 16th of September 2008 on the downstream side of the Swanlinbar Bridge (Fig. 4.16). Three fishings were carried out using three bank based electric fishing units. The site was dominated by cobble and boulder and had a habitat consisting mainly of glide with some riffle and pools. The site itself was only lightly shaded by trees. The macrophytes recorded at the site included *Chiloscyphus polyanthus*, *Rhynchostegium riparioides*, *Conocephalum conicum*, *Fontinalis antipyretica* and *Pellia endiviifolia*. The mean width of the river was 7.75m and depth was 0.24m. The wetted area sampled was 348.75m².

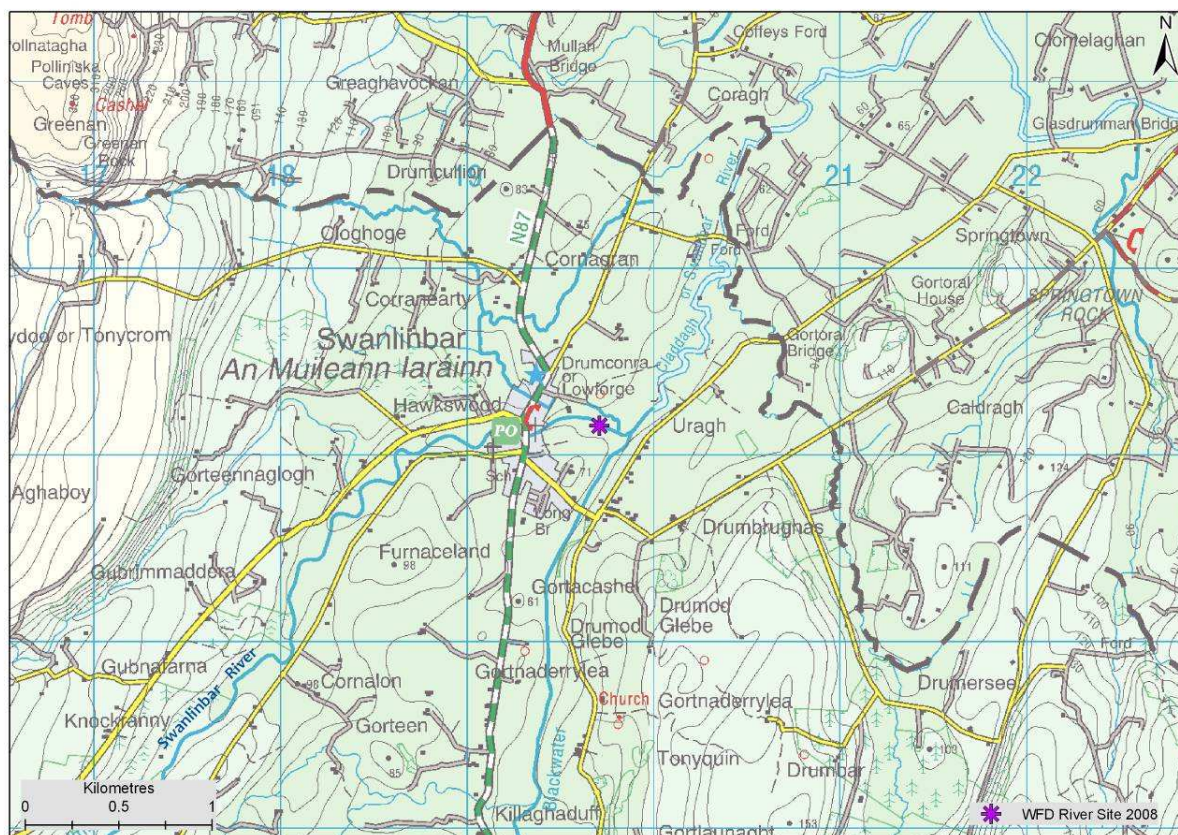


Fig. 4.16. Location of the Swanlinbar River surveillance monitoring site 2008

Five species of fish were present in the Swanlinbar River (Table 4.6). Brown trout were the most abundant species present, followed by salmon.

Table 4.6. Density of fish (no./m²) in the Swanlinbar River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo trutta</i>	Brown trout	0.1950	0.0602	0.2552
<i>Salmo salar</i>	Salmon	0.0029	0.1405	0.1434
<i>Anguilla anguilla</i>	Eel	-	-	0.0115
<i>Gasterosteus aculeatus</i>	3-Spined stickleback	-	-	0.0086
<i>Lampetra</i> spp.	Lamprey	-	-	0.0029
All fish	All fish	-	-	0.4215

Brown trout ranged in length from 5.9cm to 20.8cm (Fig. 4.17) with a mean length of 9.14cm. Three age classes were deemed to be present in the population, 0+, 1+ and 2+ and these accounted for 76%, 21%,

and 2% of the trout population, respectively. The mean L1 for brown trout was 6.68cm and the L2 was 15.72cm (Appendix 1). Brown trout in the Swanlinbar River were classified as slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

Salmon (stocked) ranged in length from 7.1cm to 13.4cm (Fig. 4.18) with a mean length of 11.2cm. Two age classes were present in the population, 0+ and 1+. These accounted for <1% and 99% of the salmon population, respectively. The mean L1 for salmon in the Swanlinbar River was 4.96 cm (Appendix 2).

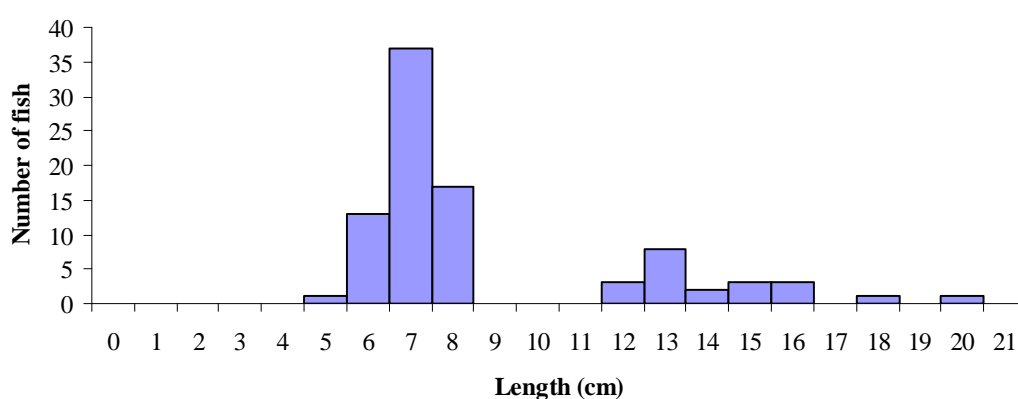


Fig. 4.17. Length frequency distribution for brown trout in the Swanlinbar River September 2008 (n = 89)

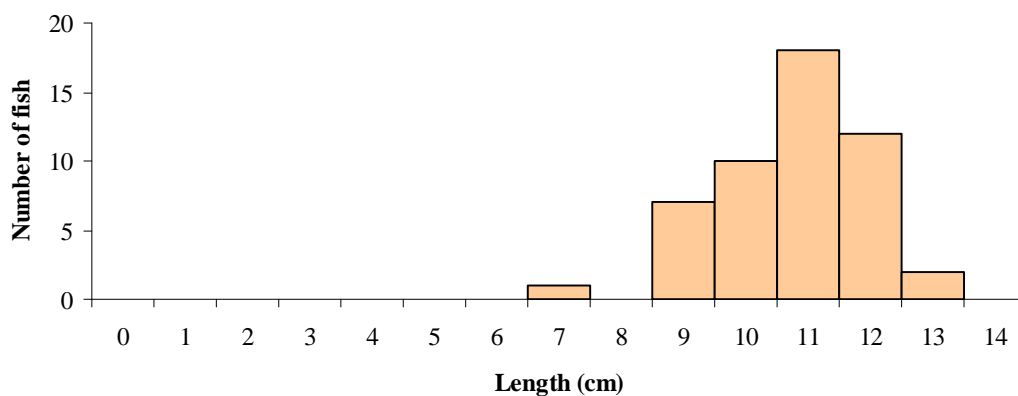


Fig. 4.18. Length frequency distribution for salmon in the Swanlinbar River September 2008 (n = 50)

4.1.7 The Swilly River



Plate 4.8. The Swilly River downstream of the Swilly Bridge near Breenagh

The Swilly (Plate 4.8) is a spate river in Co. Donegal that rises in the mountains approximately 15 kilometres west of Letterkenny. It flows eastwards towards Letterkenny, draining mountains and farmland along the way, before eventually reaching the sea at Lough Swilly. A 45m stretch of channel was surveyed on the 19th of September 2008 on the downstream side of the Swilly Bridge near Breenagh (Fig. 4.19). Three fishings were carried out using two bank based electric fishing units. The site substrate was very mixed with cobble, gravel, boulder, sand and silt, all occurring in significant proportions. The prevalent habitat in the site was riffle with some glide and pools. Trees also provided some light shading. The instream vegetation was mostly bryophytes including *Fontinalis antipyretica*, *Rhynchostegium riparioides*, *Racomitrium aciculare* and *Chiloscyphus polyanthos*. The site sampled had a mean width of 7.13m and depth of 0.25m. The total wetted area fished was 320.96m².

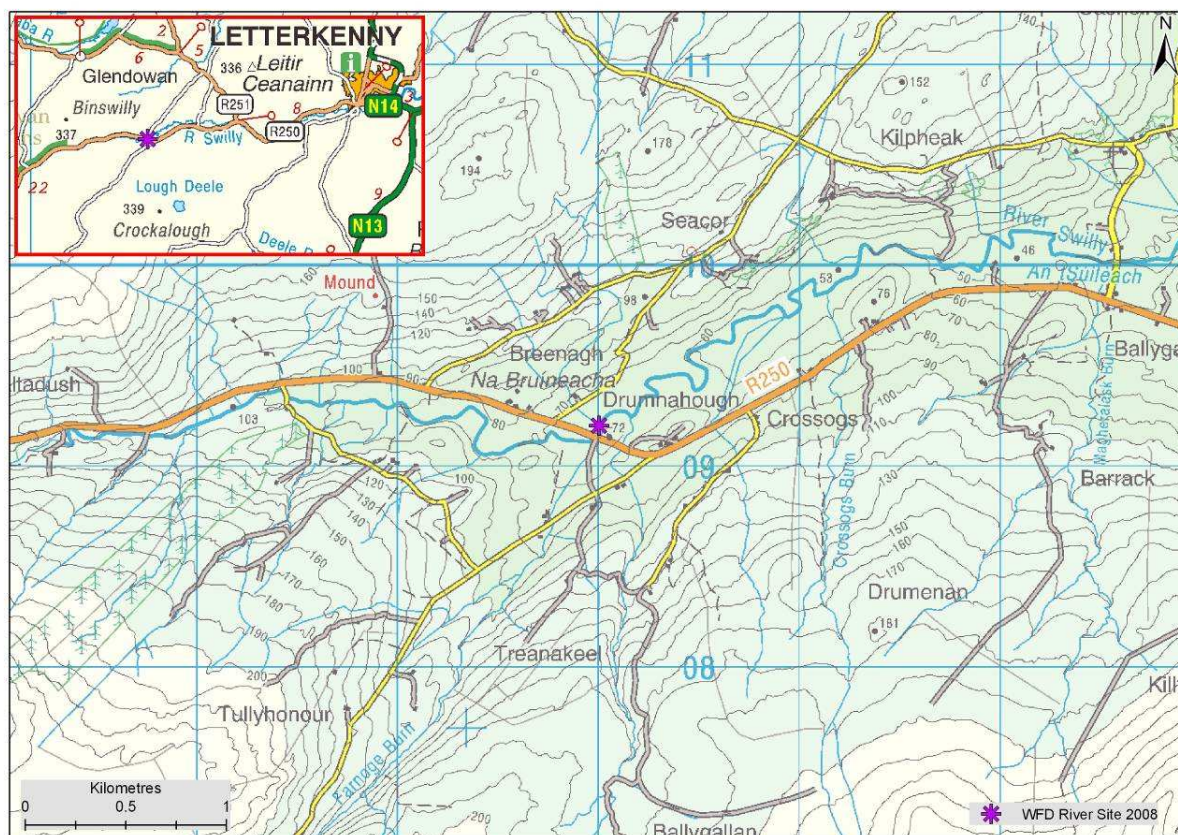


Fig. 4.19. Location of the Swilly River surveillance monitoring site 2008

There were four fish species recorded in the Swilly River. The most abundant species encountered was salmon, followed by brown trout.

Table 4.7. Density of fish (no./m²) in the Swilly River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.0841	0.0779	0.1620
<i>Salmo trutta</i>	Brown trout	0.0530	0.0654	0.1184
<i>Lampetra</i> spp.	Lamprey	-	-	0.0374
<i>Anguilla anguilla</i>	Eel	-	-	0.0062
All fish	All fish	-	-	0.3240

Salmon ranged in length from 4.5cm to 10.5cm (Fig. 4.20) with a mean length of 7.2cm. Two age classes were present in the population, 0+ and 1+, and these accounted for 52%, and 48% of the salmon population, respectively. Salmon on the Swilly River had a mean L1 of 4.85cm (Appendix 2).

Brown trout ranged in length from 5.1cm to 22.5cm (Fig. 4.21) with a mean length of 10.3cm. Four age classes were present in the population, 0+, 1+, 2+ and 3+. These accounted for 45%, 32%, 22% and <1% of the trout population, respectively. The mean length at L1, L2 and L3 was 6.62cm, 12.24cm and 20.89cm, respectively (Appendix 1). Brown trout were classified as very slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

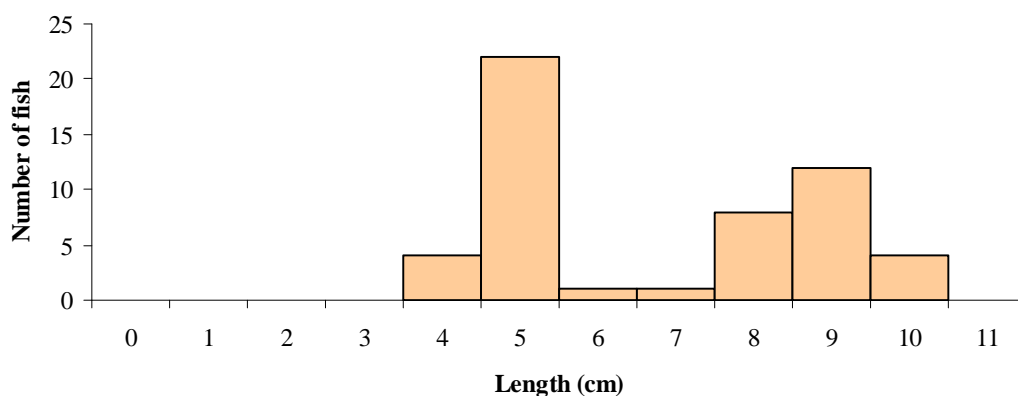


Fig. 4.20. Length frequency distribution for salmon in the Swilly River September 2008 (n = 52)

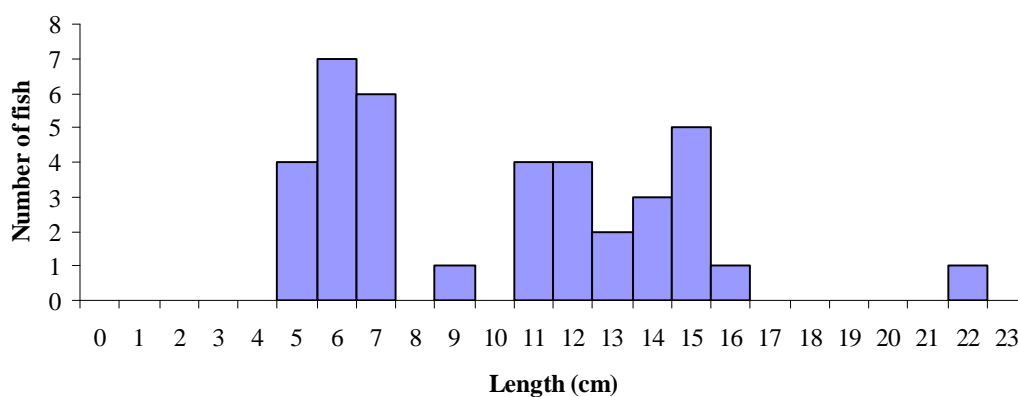


Fig. 4.21. Length frequency distribution for brown trout in the Swilly River September 2008 (n = 38)

4.1.8 The Waterfoot River



Plate 4.9. The Waterfoot River upstream of Letter Bridge

The Waterfoot River (Plate 4.9) rises with a series of small streams and lakes along the Donegal and Fermanagh border. It flows eastwards between the two counties before reaching Lower Lough Erne near the village of Pettigoe.

A 46m stretch of channel was surveyed on the 17th of September upstream of Letter Bridge (Fig. 4.22). The Waterfoot River was fished three times using three bank based electric fishing units. The site consisted mainly of glide over a substrate of gravel and cobble. A mixture of aquatic macrophytes was present and included species such as *Glyceria fluitans*, *Iris pseudacorus*, *Juncus bulbosus* and *Chiloscyphus polyanthus*. Land use on both banks was dominated by pasture and trees provided medium shading. The mean width of the river was 8.63m and the mean depth was 0.35m. The total area sampled was 397.13m².



Fig. 4.22. Location of the Waterfoot River surveillance monitoring site, 2008

Salmon were the most abundant fish species encountered in the Waterfoot, followed by brown trout (Table 4.8). Some of the salmon captured within this river were greenish in colour, which may be due to stocking activities within the channel.

Table 4.8. Density of fish (no./m²) in the Waterfoot River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.2845	0.0755	0.3601
<i>Salmo trutta</i>	Brown trout	0.0630	0.0151	0.0781
<i>Phoxinus phoxinus</i>	Minnow	-	-	0.0453
<i>Gasterosteus aculeatus</i>	3-spined stickleback	-	-	0.0453
<i>Lampetra</i> spp.	Lamprey	-	-	0.0126
All fish	All fish	-	-	0.5414

Salmon (stocked) ranged in length from 4.9cm to 12.1cm (Fig. 4.23) and the mean length was 7.0cm. Three age classes were deemed to be present in the population. Salmon fry (0+) were the dominant age class accounting for 79% of the population. Salmon parr (1+) accounted for 18% of the population and

3% of the population were aged 2+. The mean L1 for salmon in the Waterfoot River was 5.03cm (Appendix 2).

Brown trout ranged in length from 5.2cm to 15.4cm (Fig. 4.24), with a mean length of 7.7cm. Three age classes were present in the population, 0+, 1+ and 2+. These accounted for 70%, 29%, and 1% of the trout population, respectively. The mean length of brown trout at L1 was 5.74cm and L2 was 9.68cm (Appendix 1). Brown trout were classified as very slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

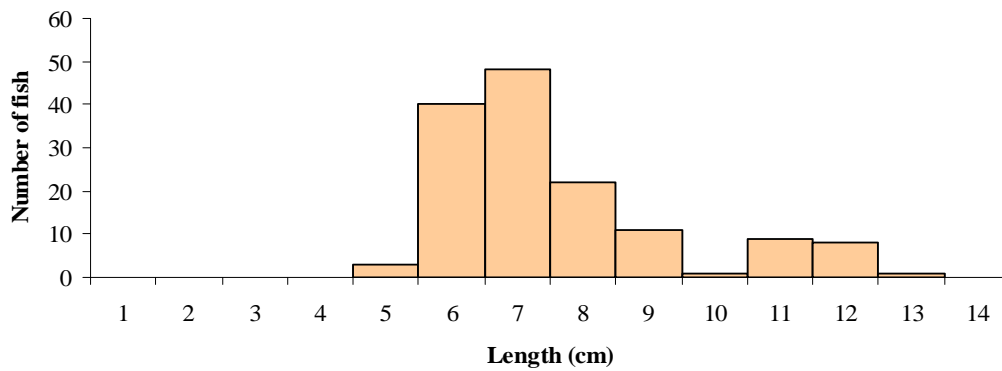


Fig. 4.23. Length frequency distribution for salmon in the Waterfoot River, September 2008
(n = 143)

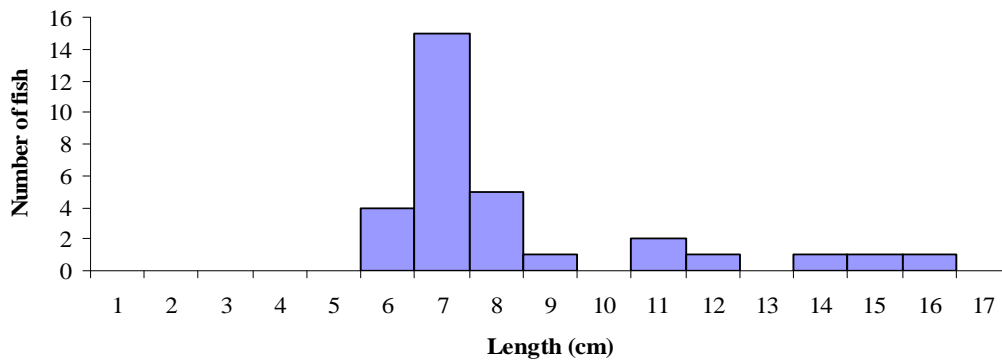


Fig. 4.24. Length frequency distribution for brown trout in the Waterfoot River, September 2008, (n = 31)

4. 2 Boat sites

4.2.1 The Annalee River



Plate 4.10. The Annalee River downstream of the Cavan River confluence.

The Annalee River (Plate 4.10) rises near Shercock in Co. Cavan. It is a long and windy river with a large catchment. It drains the hilly lands of Co. Monaghan and Co. Cavan before entering a complex system of lakes on the Erne system near Butler's Bridge. With pollution and the introduction of roach, trout numbers were once in decline but have recovered quite well, making this a good fly-fishing river (O'Reilly, 2002). A 164m stretch of channel was surveyed on the 2nd of July 2008, 0.2 kilometres downstream of the Cavan River confluence (Fig. 4.25). Three fishings were carried out using three boat based electric fishing units. The site was dominated by cobble and boulder and had habitat consisting mainly of glide. Land use on both banks was deciduous woodland however; due to the river width the site only experienced medium shading. The mean channel width was 16.2m and the mean depth was 0.55m. The total wetted area sampled was 2656.8m².

Perch ranged in length from 6.0cm to 20cm (Fig. 4.27). Age class range for the perch population was from 1+ to 5+. The mean L1 recorded was 6cm (Appendix 5). Gudgeon ranged in length from 6cm to 12.5cm (Fig. 4.28).

Length measurements for brown trout ranged from 16.4cm to 26cm (Fig. 4.29) with a mean length of 20.6cm. Two age classes were present in the population of brown trout, 1+ and 2+, and these each accounted for 50% of the population. The mean length at L1 was 7.35cm and was 15.3 cm at L2 (Appendix 1). Brown trout in the Annalee were classified as slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

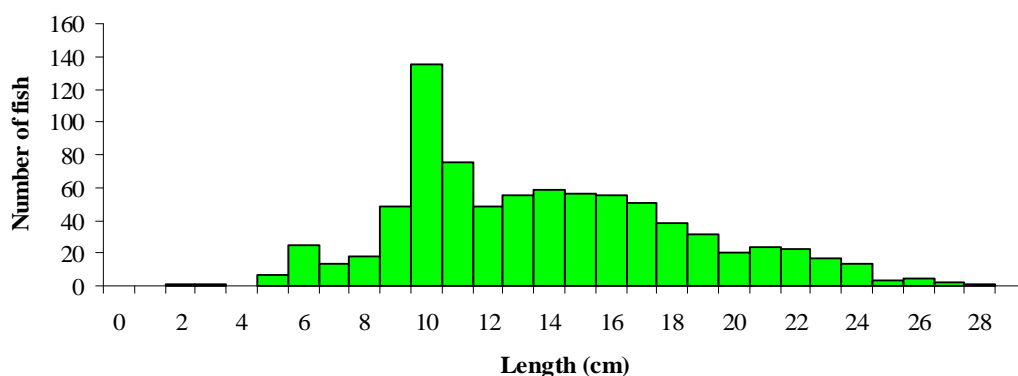


Fig. 4.26. Length frequency distribution for roach in the Annalee River, July 2008 (n = 825)

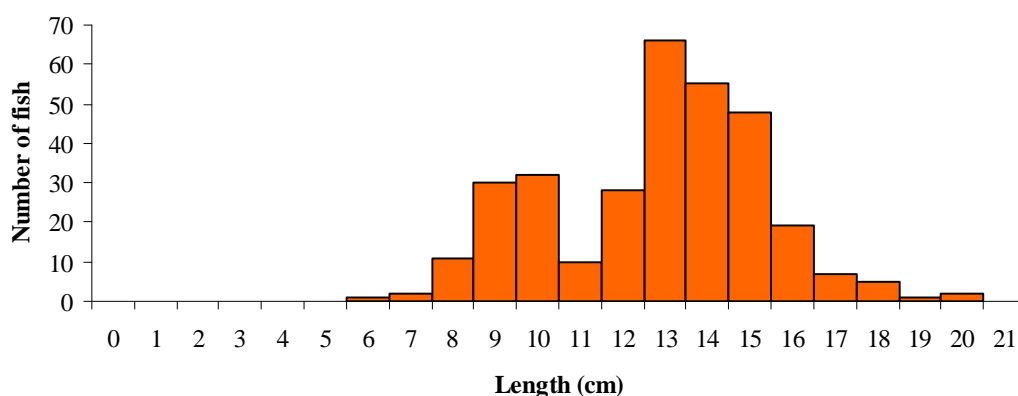


Fig. 4.27. Length frequency distribution for perch in the Annalee River, July 2008 (n = 317)

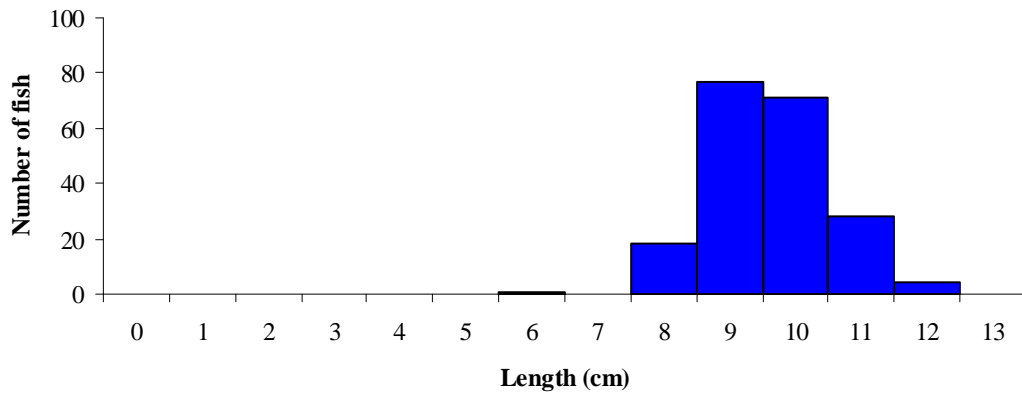


Fig. 4.28. Length frequency distribution for gudgeon in the Annalee River, July 2008 (n = 199)

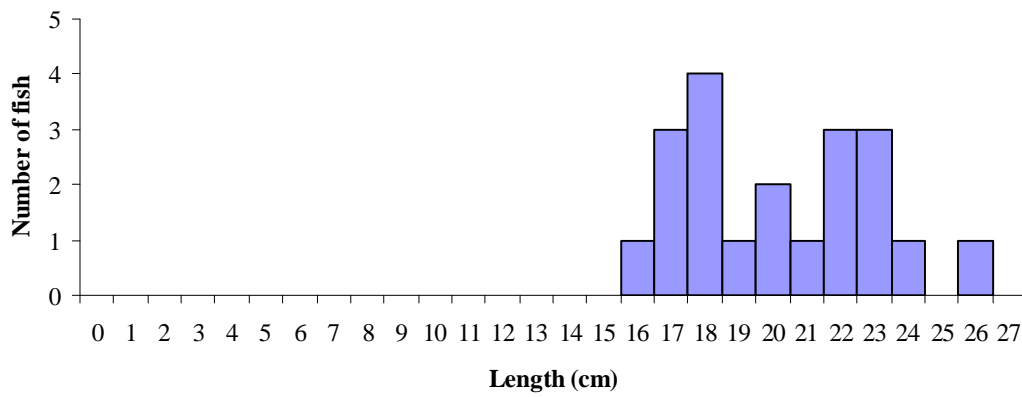


Fig. 4.29. Length frequency distribution for brown trout in the Annalee River, July 2008 (n = 20)

4.2.2 The Dromore River



Plate 4.11. The Dromore River upstream of the bridge in Ballybay

The Dromore River (Plate 4.11) rises near Ballybay in Co. Monaghan and travels south westwards through Cootehill, Co. Cavan before joining with the Annalee, north of Tullyvin. It is popular with both coarse and trout anglers (O'Reilly, 2002).

A 150m stretch of channel was surveyed on the 1st of July 2008 upstream of the bridge in Ballybay (Fig. 4.30). Three fishings were carried out using one boat based electric fishing unit. The site substrate was mud and silt and steep banks provide medium shading. The channel had a mean width of 5.34m and depth of 0.79m, totalling a wetted area of 801m².

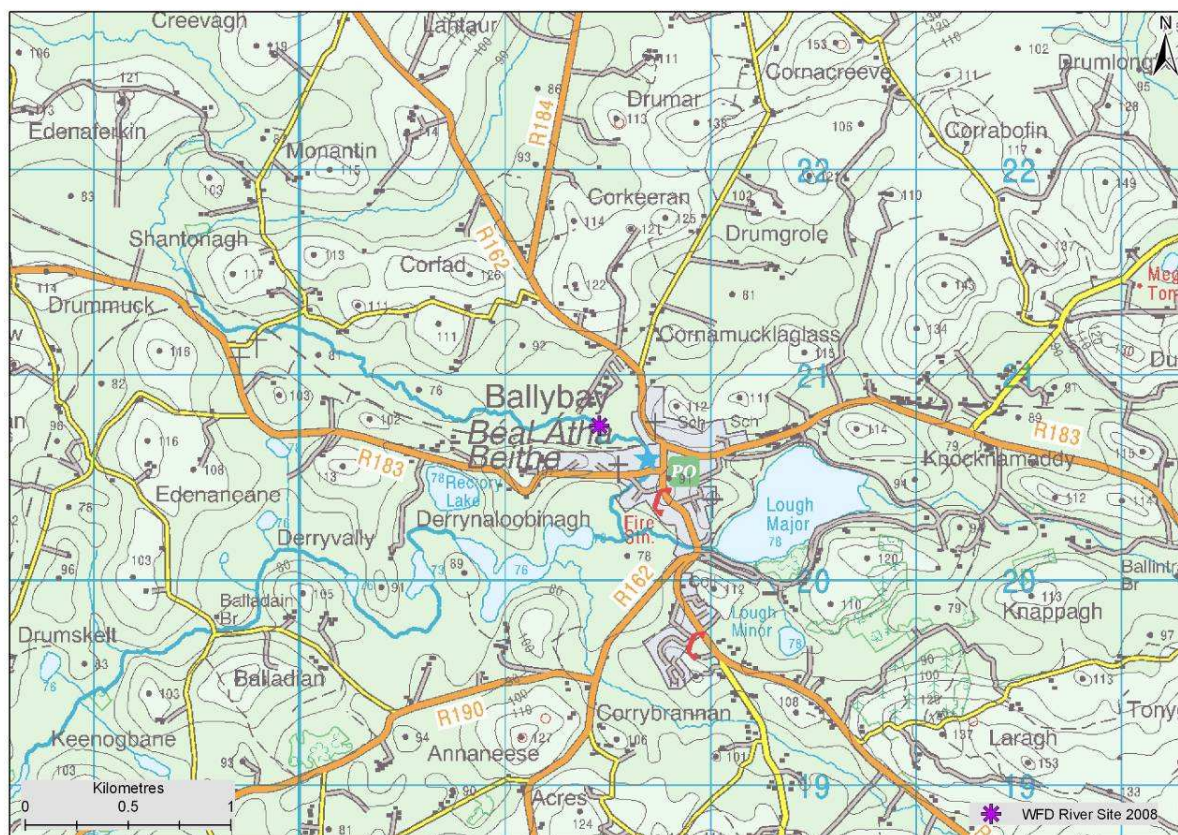


Fig. 4.30: Location of the Dromore River surveillance monitoring site 2008

Six species of fish were recorded in the Dromore River during the survey (Table 4.10). Roach was the most abundant species, followed by brown trout.

Table 4.10. Density of fish (no./m²) in the Dromore River site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Rutilus rutilus</i>	Roach	-	-	0.1436
<i>Perca fluviatilis</i>	Perch	-	-	0.0237
<i>Salmo trutta</i>	Brown trout	0.0000	0.0112	0.0112
<i>Esox lucius</i>	Pike	-	-	0.0038
<i>Gobio gobio</i>	Gudgeon	-	-	0.0025
<i>Anguilla anguilla</i>	Eel	-	-	0.0013
All fish	All fish	-	-	0.1860

Roach ranged in length from 4.0cm to 22.1cm (Fig. 4.31) and in age from 1+ to 5+. The mean L1 for roach in the Dromore River was 1.94cm (Appendix 3).

Brown trout ranged in length from 2.5cm to 52.2cm, with a mean length of 37.7cm. Fish were captured across age groups 2+, 3+ and 4+, with 50% of the fish aged 4+. The mean L1 for brown trout was 8.57cm (Appendix 1). Brown trout were classified as very fast growing based on the criteria described by Kennedy and Fitzmaurice (1971).

Perch ranged in length from 10.0cm to 15.0cm and two age classes were identified in the population, 1+ and 2+. These accounted for 1% and 99% of the population, respectively. The mean L1 recorded was 6.21 cm (Appendix 5).

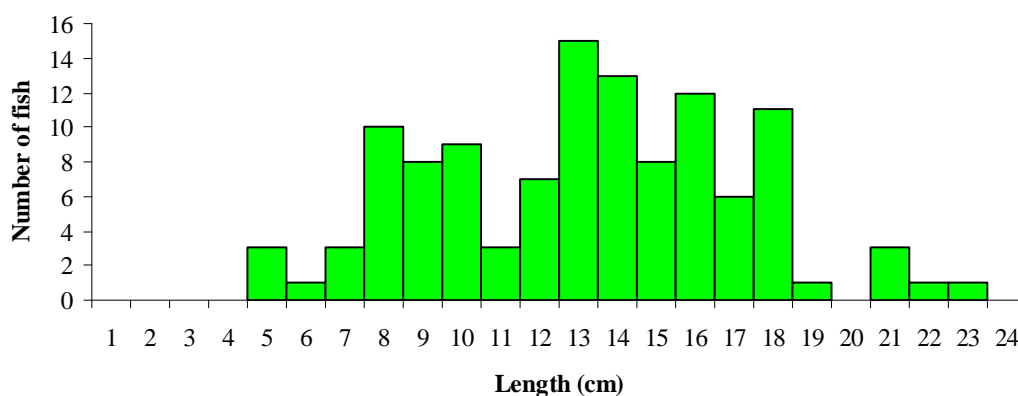


Fig. 4.31. Length frequency distribution for roach in the Dromore River, July 2008 (n = 115)

4.2.3 The Eany Water



Plate 4.12. The Eany Water downstream of the Eany Beg Confluence

The Eany Water (Plate 4.12) rises in the Blue Stack Mountains of Co. Donegal and runs south westwards, eventually reaching the sea at Inver Bay. It is a spate river that can rise and fall quite quickly and is popular for salmon fishing (O'Reilly, 2002). A 270m stretch of channel was surveyed on the 8th of July 2008 downstream of a bridge, which was located downstream of the Eany Beg - Eany More confluence (Fig. 4.32). Three passes were carried out using two boat based electric fishing units. The site consisted of mainly riffle and pool, over a substrate which was predominately gravel and cobble. There was pasture on both banks and negligible shade was provided to the site. The site had an average width of 22.3m and depth of 0.72m. The total wetted area was 6,023.7m².

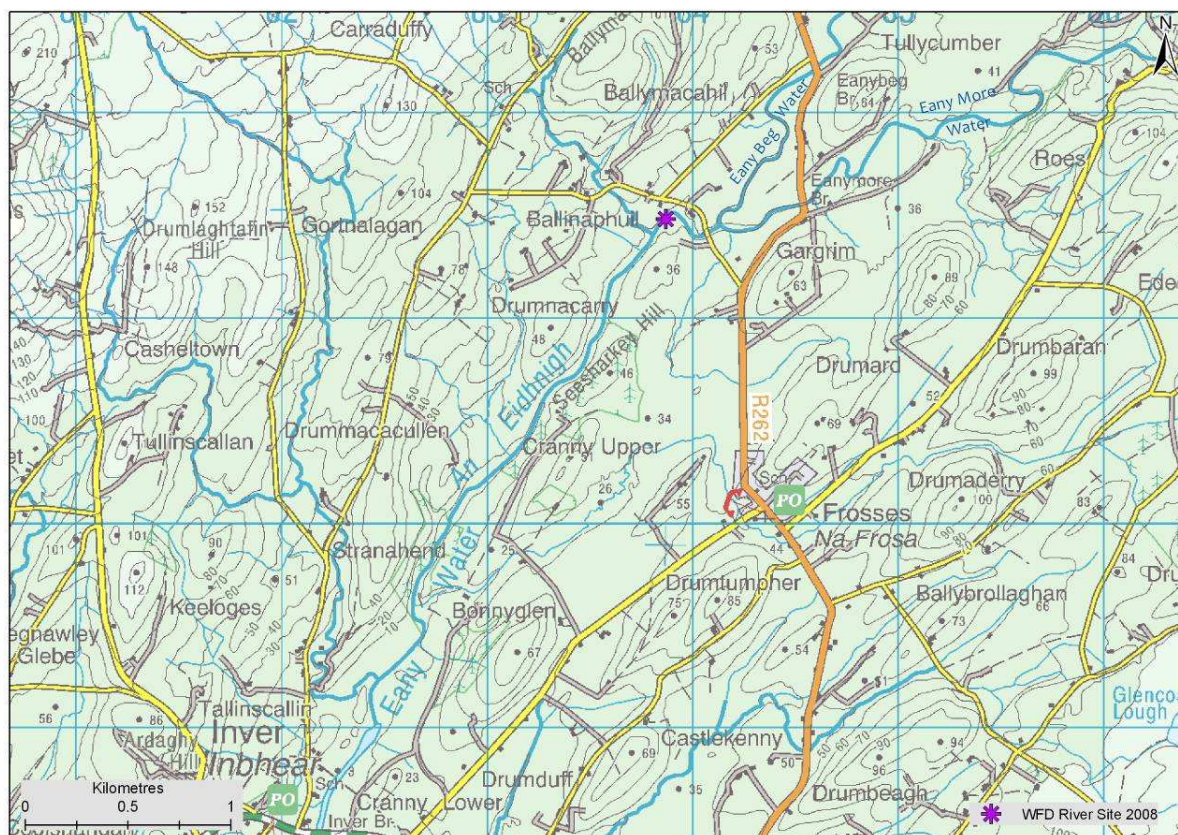


Fig. 4.32. Location of the Eany Water surveillance monitoring site 2008

Three species of fish were recorded in the Eany during the survey (Table 4.11). Salmon were the most abundant species, followed by eel.

Table 4.11. Density of fish (no./m²) in the Eany Water site (fish density has been calculated as minimum estimates based on three fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Salmo salar</i>	Salmon	0.0061	0.0085	0.0146
<i>Anguilla anguilla</i>	Eel	-	-	0.0008
<i>Salmo trutta</i>	Brown trout	0.0000	0.0005	0.0005
All fish	All fish	-	-	0.0159

Salmon ranged in length from 3.3cm to 11.4cm (Fig. 4.33) and the mean length was measured at 8.1cm. Three age classes were present in the population, 0+, 1+ and 2+. These accounted for 42%, 56%, and 2% of the salmon population, respectively. The mean L1 and L2 were 4.65cm and 7.70cm, respectively.

A small number of brown trout were captured with lengths ranging from 16.0cm to 19.3cm. All brown trout captured were all aged 2+. The mean length of brown trout at L1 was 5.86cm and the L2 measured 13.7cm (Appendix 1). Brown trout were classified as slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

Eel lengths ranged from 20.0cm to 53.5cm.

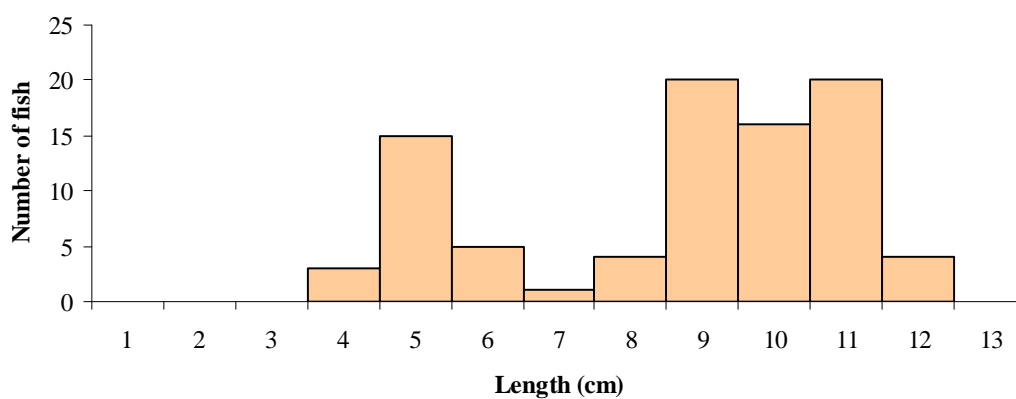


Fig. 4.33. Length frequency distribution for salmon in the Eany Water July 2008 (n = 88)

4.2.4 The River Erne at Belturbet



Plate 4.13. The River Erne upstream of the bridge at Kilconny, Belturbet

The River Erne (Plate 4.13) rises just south of the village of Stradone near Cootehill in Co. Cavan. It has a very large catchment and drains many lakes including Upper and Lower Lough Erne. It travels for approximately 100 kilometres, eventually reaching Donegal Bay near Ballyshannon. A 291m stretch of river was surveyed on the 30th of June 2008 on the upstream side of the Bridge at Kilconny, Belturbet (Fig. 4.34). Two fishings were carried out using two boat based electric fishing units. The mean width of the channel was 19.2m and the mean depth was 0.55m, giving a total wetted area of 5,587.2m².

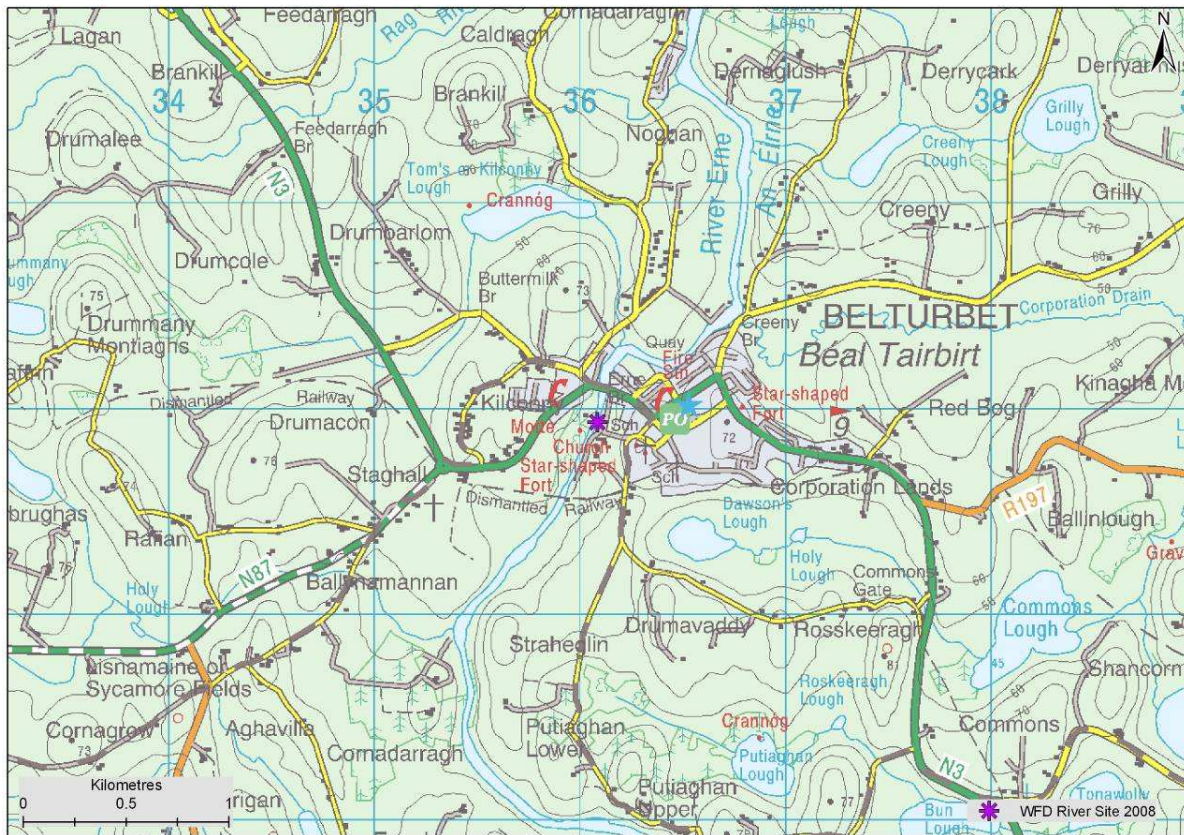


Fig. 4.34. Location of the River Erne surveillance monitoring site 2008

Six fish species were recorded during the survey in the River Erne (Table 4.12). Roach were the most abundant species encountered, followed by perch.

Table 4.12. Density of fish (no./m²) in the River Erne site (fish density has been calculated as minimum estimates based on two fishings)

Species name	Common name	0+	1+ & older	Total density
<i>Rutilus rutilus</i>	Roach	-	-	0.0689
<i>Perca fluviatilis</i>	Perch	-	-	0.0100
<i>Salmo trutta</i>	Brown trout	0.0000	0.0077	0.0077
<i>Anguilla anguilla</i>	Eel	-	-	0.0036
<i>Gobio gobio</i>	Gudgeon	-	-	0.0030
<i>Esox lucius</i>	Pike	-	-	0.0016
All fish	All fish	-	-	0.0949

Roach ranged in length from 2.0cm to 26.1cm. Age classes present ranged from 0+ to 7+. Roach aged 3+ and 2+ made up 30% and 25% of the population, respectively. The mean L1 was 2.22cm (Appendix 3).

The length frequency distributions for brown trout are compiled in Fig. 4.36. Lengths recorded for brown trout ranged from 13.2cm to 28.2cm, with a mean length of 22.1cm. Three age classes were present in the population, 1+, 2+ and 3+ and these accounted for 1%, 41% and 51% of the brown trout population, respectively. Mean length at L1, L2 and L3 were 6.63cm, 14.86cm and 21.86cm, respectively (Appendix 1). Brown trout in the Erne were classified as slow growing based on the criteria described by Kennedy and Fitzmaurice (1971).

Perch at the site ranged in length from 3.0cm to 22.0cm, with a mean length of 13cm. Fish were captured across four age groups: 1+, 2+, 3+ and 4+. Fish, which were aged 2+ and 3+, made up 32% and 36% of the population, respectively. Mean length of perch at L1, L2, L3 and L 4 was 6.0 cm, 10.42 cm, 13.36 cm and 19.91 cm, respectively (Appendix 5).

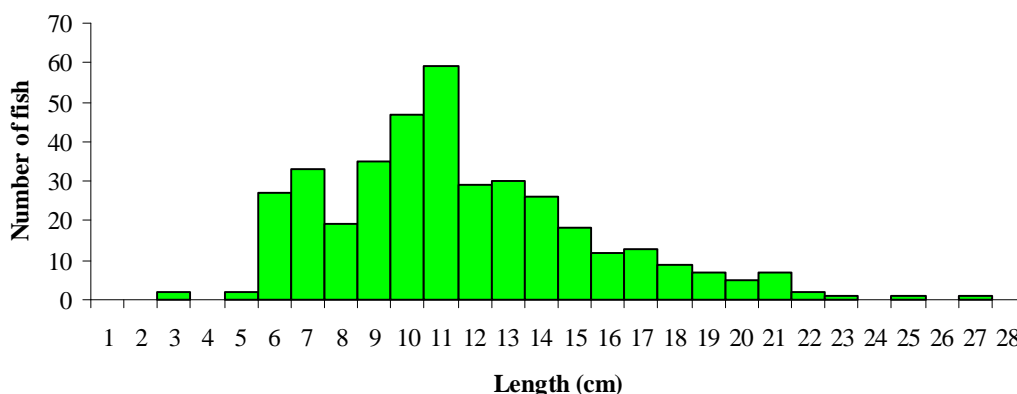


Fig. 4.35. Length frequency distribution for roach in the River Erne June 2008 (n = 385)

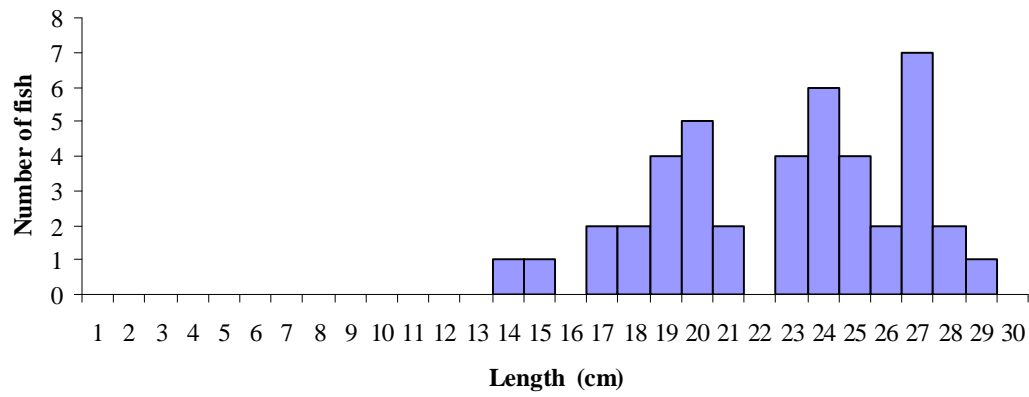


Fig. 4.36. Length frequency distribution for brown trout in the River Erne June 2008 (n = 43)

4.3 Community structure

4.3.1 Species richness and composition

A total of 12 fish species were recorded within the 12 river sites surveyed in the NRFB in 2008. Brown trout were the most widespread species and were also the only species to occur at all the sites surveyed. Salmon and eel occurred in 75% each of sites surveyed, while minnow, bream and roach x bream hybrids occurred in only 8% of sites (Fig. 4.37).

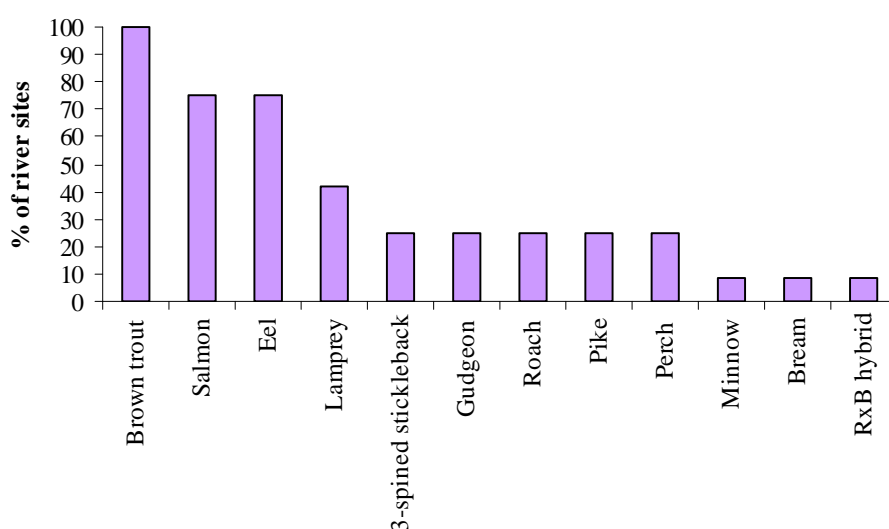


Fig. 4.37. Percentage of sites where each fish species was present (total of 12 NRFB river sites surveyed) for WFD SM monitoring 2008

Fish species richness ranged from two species at two river sites (Cronaniv Burn and Glaskeelan) to a maximum of eight species at one site (Annalee) (Table 4.13). Native fish species (group 1 – brown trout, salmon, eel, etc.) were prevalent in the sites surveyed in Donegal (Table 4.13). Non-native species were mainly absent from these sites, however they were present in the river sites located in the Cavan/Monaghan area (Table 4.13). Kelly *et al* (2008) give an explanation of the different fish groups.

Table 4.13. Species richness at each river sites surveyed in the NRFB, July to October 2008

Site	Species richness	No. native species (Group 1)	No. non-native species (Group 2)	No. non-native species (Group 3)
Hand-set sites				
Burnfoot	5	5	0	0
Swanlinbar	5	5	0	0
Waterfoot	5	4	1	0
Swilly	4	4	0	0
Ballyhallan	3	3	0	0
Owentocker	3	3	0	0
Cronaniv Burn	2	2	0	0
Gliskeelan	2	2	0	0
Boat sites				
Annalee	8	3	4	1
Dromore	6	2	3	1
Erne (Belturbet)	6	2	3	1
Eany Water	3	3	0	0

4.3.2 Species abundance and distribution

The distribution maps for all species encountered within the NRFB are shown below in Figs. 4.38 to 4.48. Brown trout and salmon are split up into two maps to show, fry (0+) and older fish ($\geq 1+$).

Both salmonid groups showed a good distribution throughout the northern part of the region for both fry (0+) and older ($\geq 1+$) fish (Figs. 4.38 to 4.41). In the most southerly sites of Co. Cavan and Monaghan, however, they were not as well represented. Brown trout aged 1+ were recorded in the Erne, Dromore and Annalee but 0+ brown trout and both 0+ and 1+ salmon were absent at these sites.

The highest densities of brown trout fry recorded were on the Ballyhallan (0.21 fish/m²) followed by the Swanlinbar river (0.19 fish/m²) (Fig. 4.38). The Burnfoot (0.44 fish/m²) followed by the Ballyhallan site (0.13 fish/m²) recorded the highest densities of 1+ and older brown trout (Fig. 4.39).

Salmon fry (0+) and parr were captured at nine sites surveyed. Highest densities of salmon were recorded on the Owentocker (fry = 0.56 fish/m² and parr = 0.43 fish/m²) (Fig. 4.40 and 4.41).

Eel (Fig. 4.42) were present throughout the region, but displayed a greater abundance in sites closer to the coast, such as Ballyhallan and Burnfoot (Fig. 4.42). Lamprey (Fig. 4.43), although distributed throughout the region, were only present in certain rivers. 3-spined stickleback (Fig. 4.44) were recorded in three rivers, the Burnfoot, Waterfoot and Swanlinbar.

Non-native fish species including gudgeon (Fig. 4.45), roach (Fig. 4.46), pike (Fig. 4.47) and perch (Fig. 4.48) were only present within a few sites: The Annalee, Dromore and Erne. Of the three rivers, the

Annalee river site recorded the highest density of roach (0.31 fish/m²), perch (0.12 fish/m²) and pike 0.005 fish/m²). These rivers were located furthest to the south, in the Erne catchment.

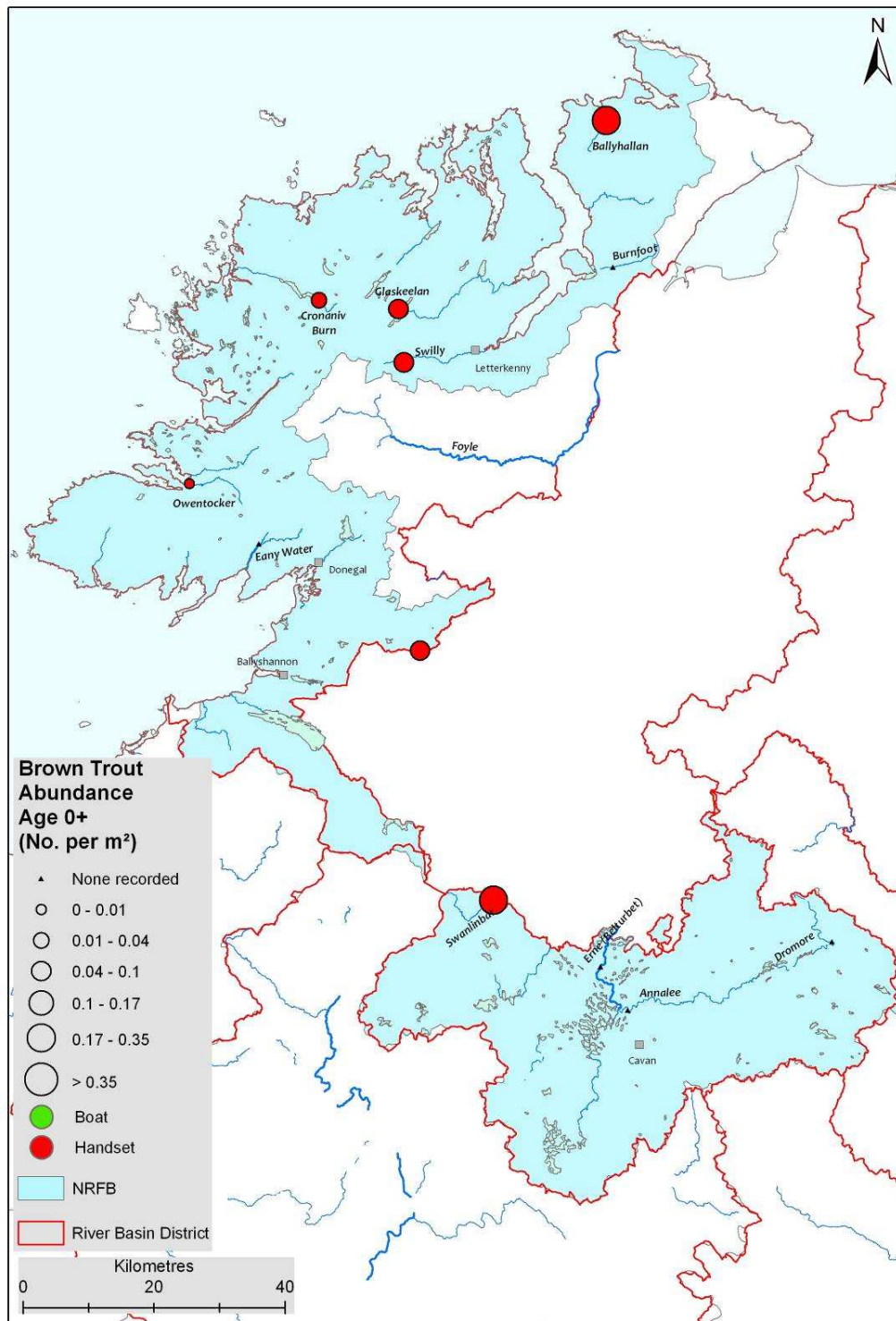


Fig. 4.38. Distribution map for 0+ brown trout in the NRFB, WFD surveillance monitoring 2008

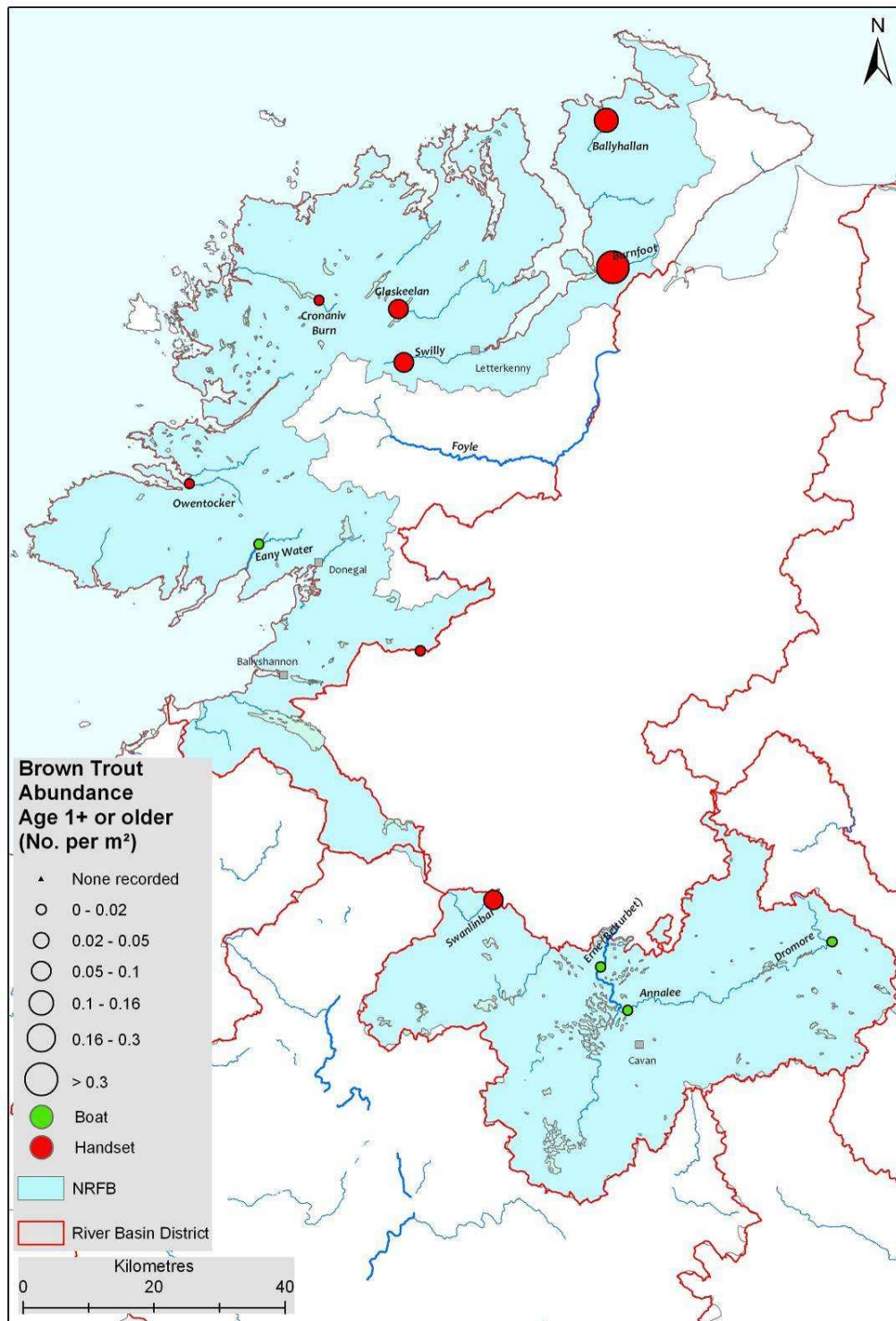


Fig. 4.39. Distribution map for 1+ brown trout in the NRFB, WFD surveillance monitoring 2008

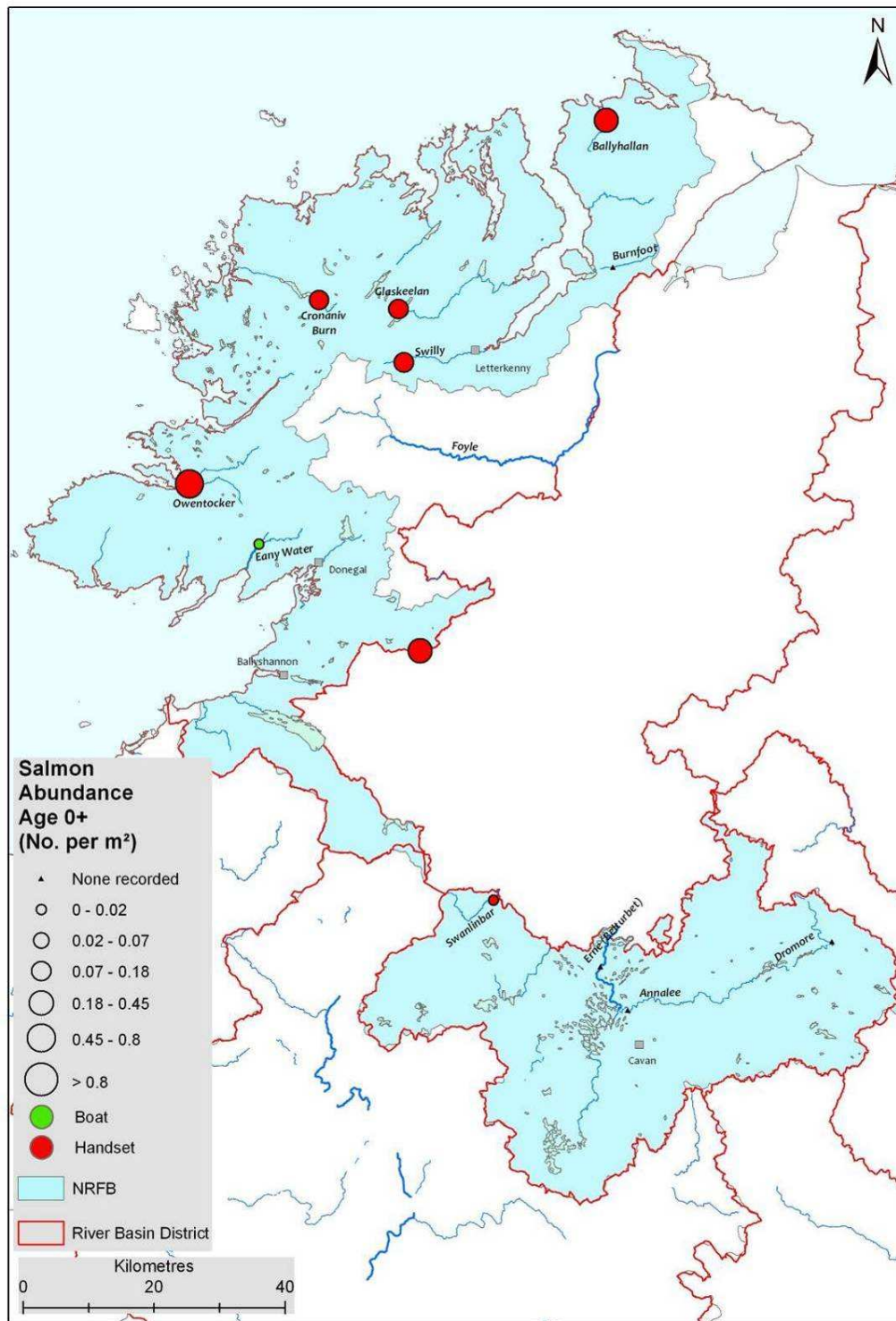


Fig. 4.40. Distribution map for 0+ salmon in the NRFB, WFD surveillance monitoring 2008

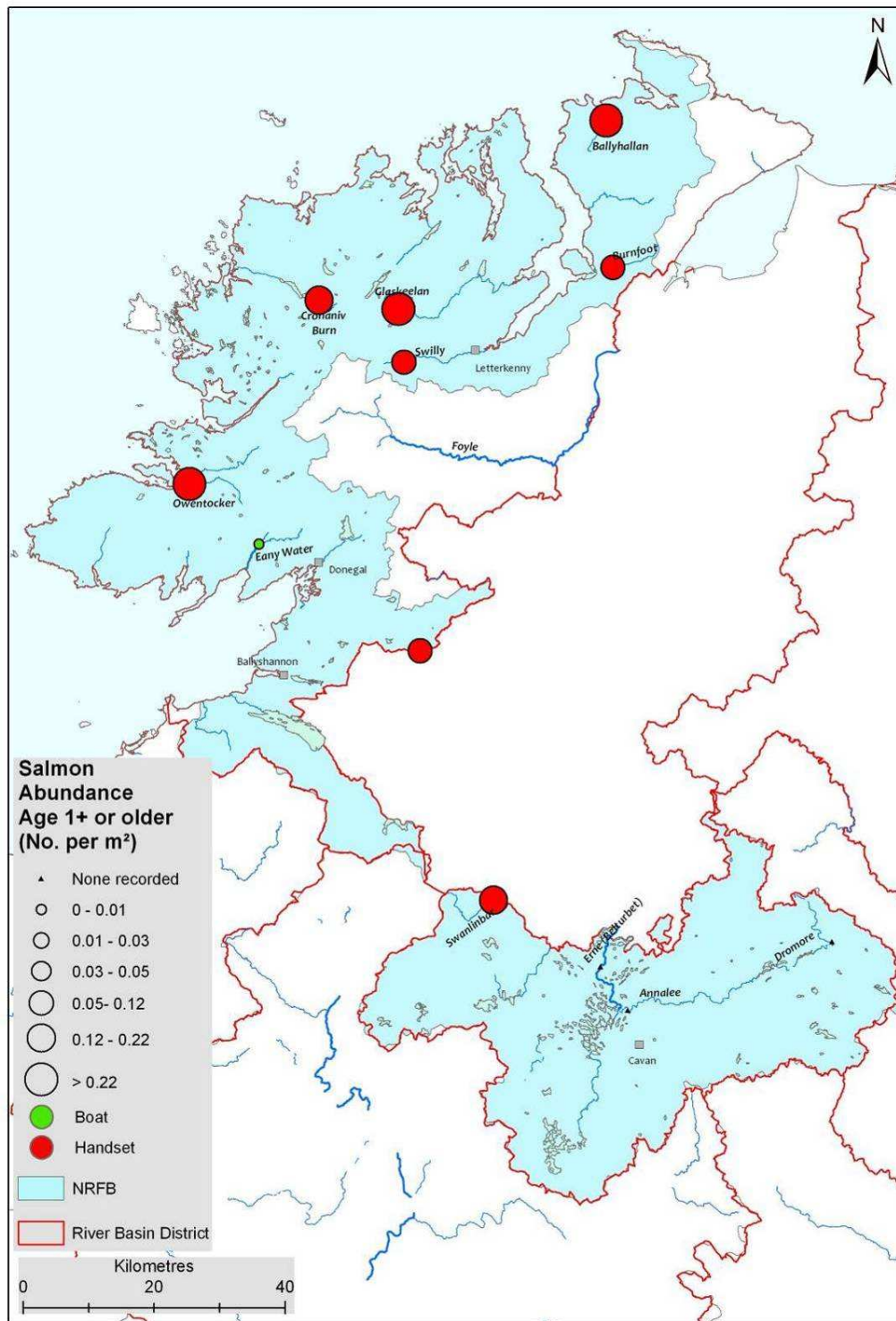


Fig. 4.41. Distribution map for 1+ salmon in the NRFB, WFD surveillance monitoring 2008

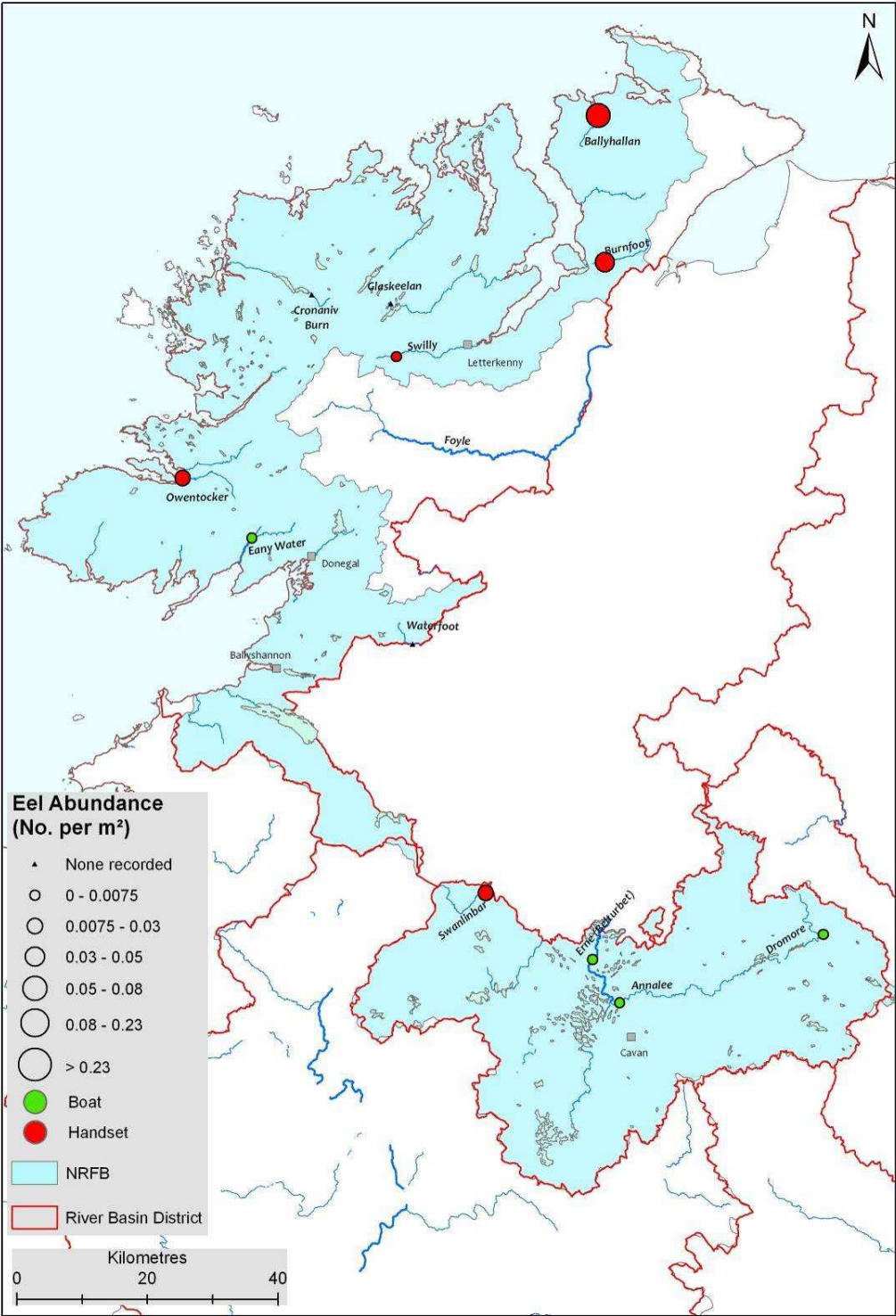


Fig. 4.42. Distribution map for eel in the NRFB, WFD surveillance monitoring 2008

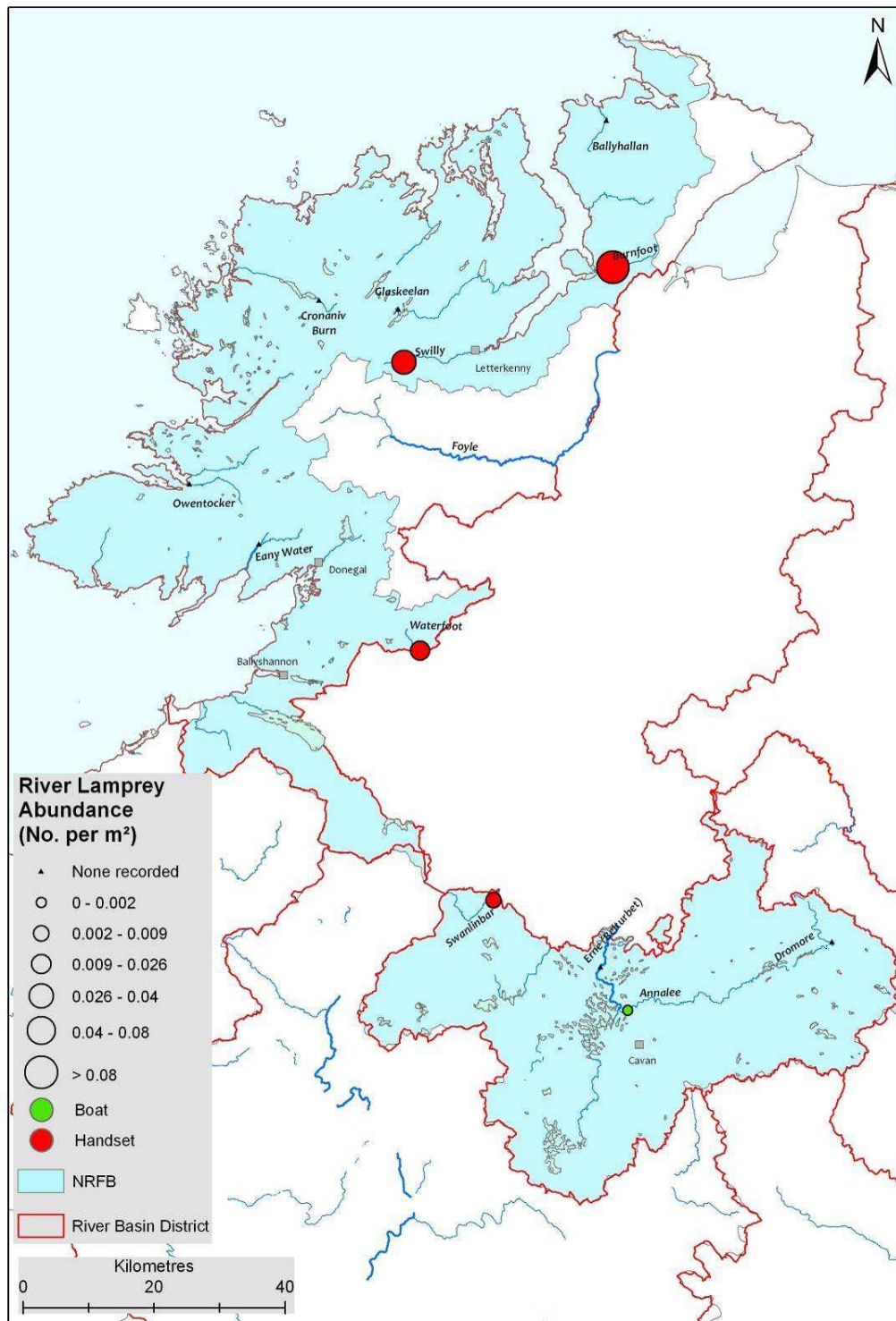


Fig. 4.43. Distribution map for lamprey in the NRFB, WFD surveillance monitoring 2008

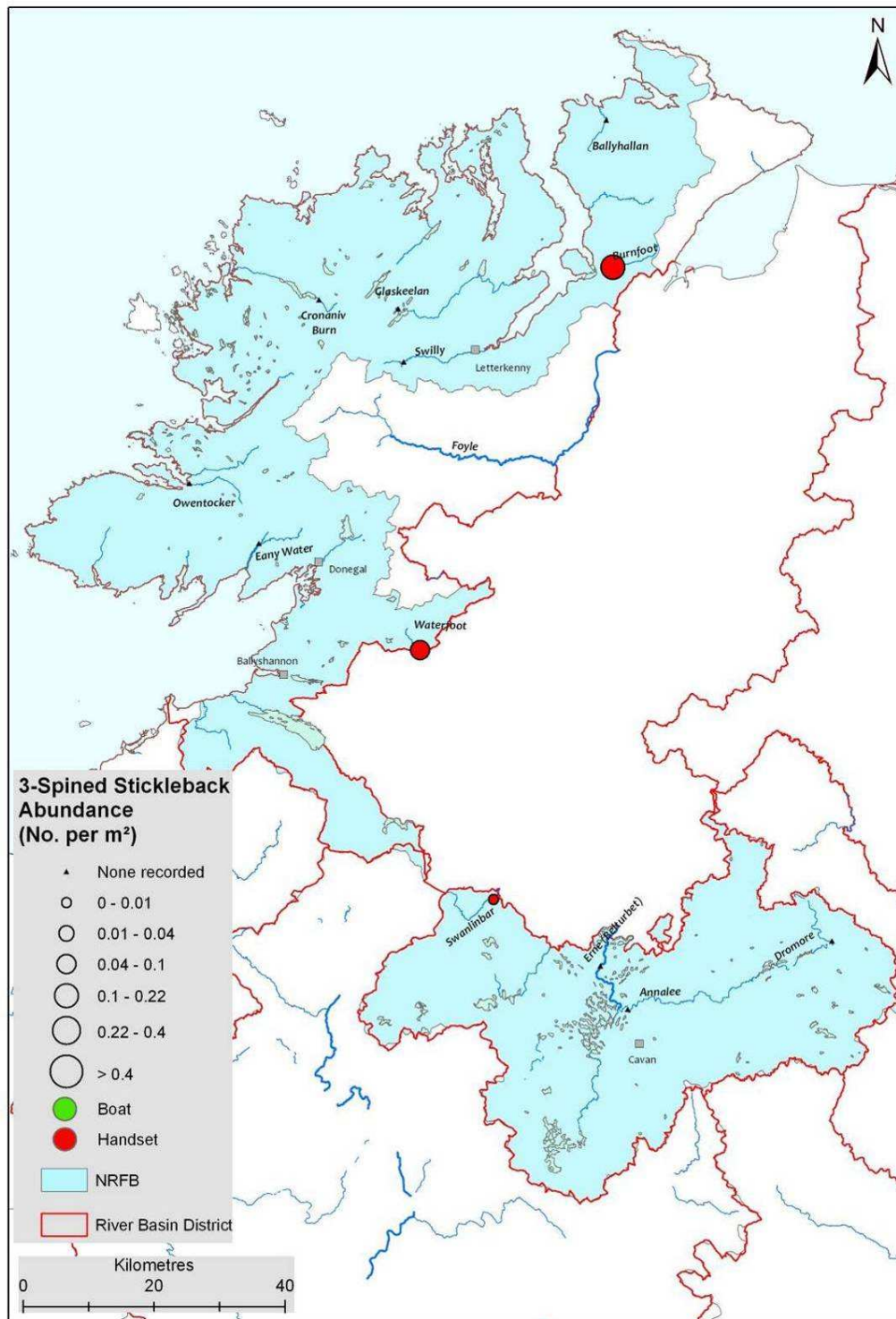


Fig. 4.44. Distribution map for 3-spined stickleback in the NRFB, WFD surveillance monitoring 2008

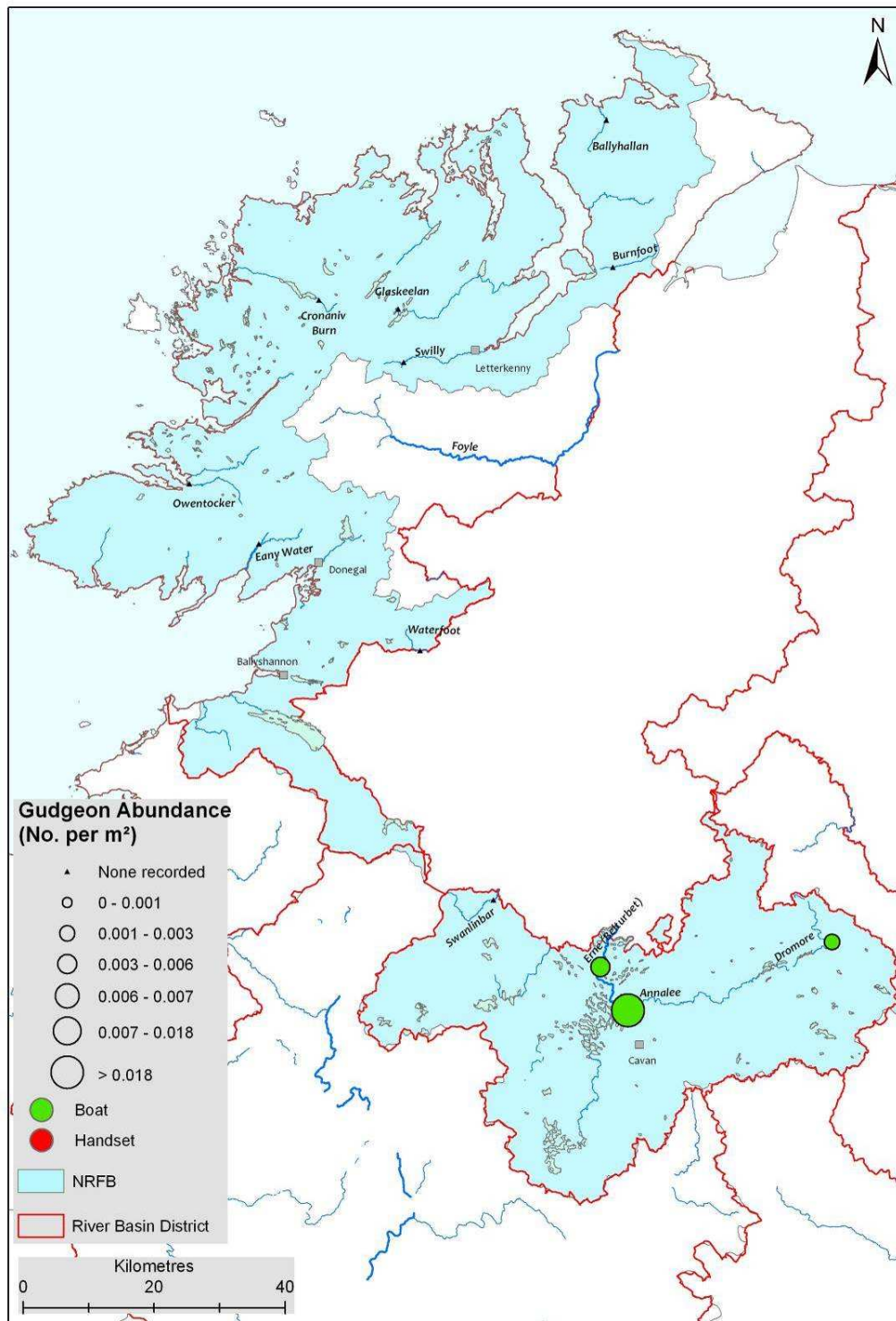


Fig. 4.45. Distribution map for gudgeon in the NRFB, WFD surveillance monitoring 2008

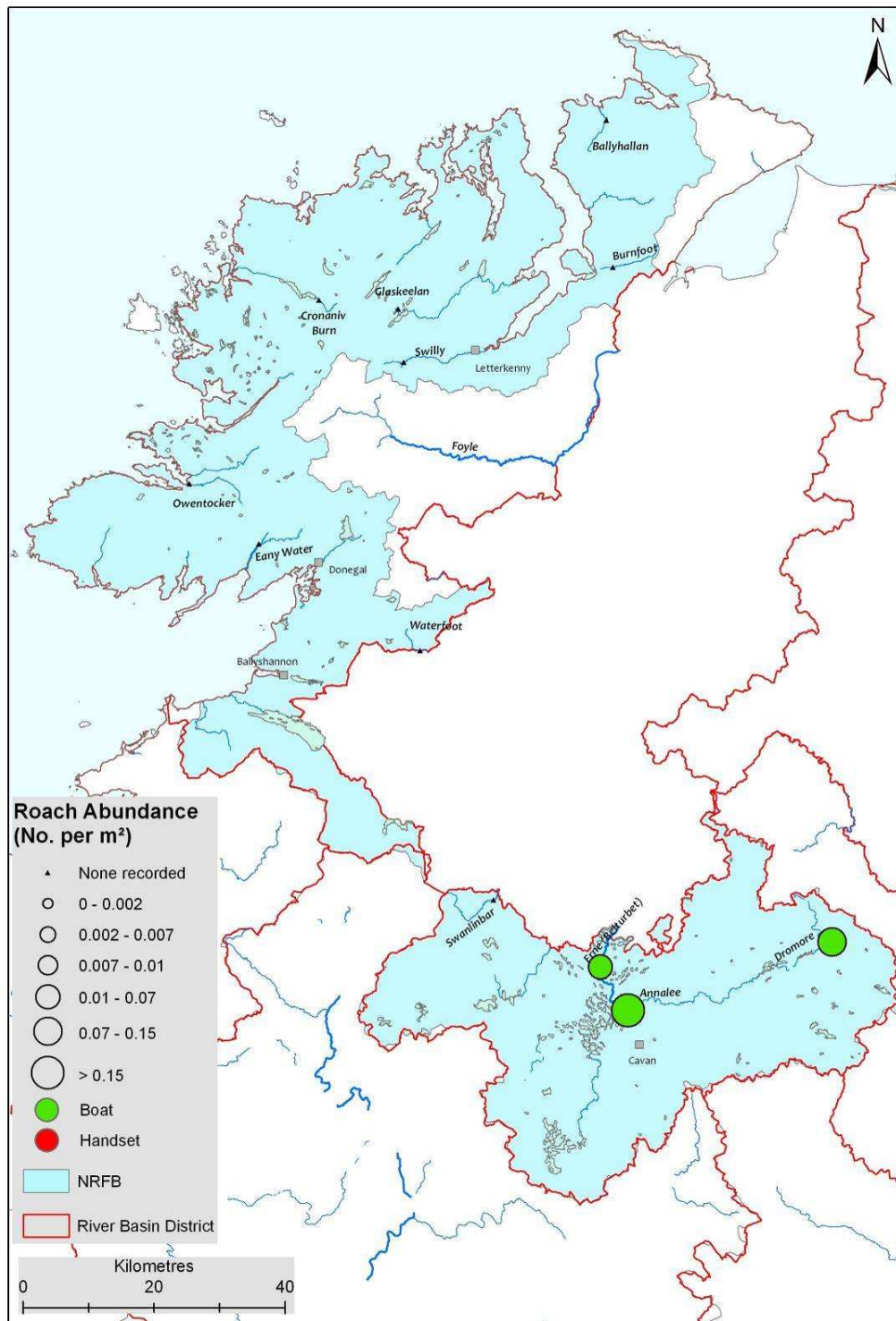


Fig. 4.46. Distribution map for roach in the NRFB, WFD surveillance monitoring 2008

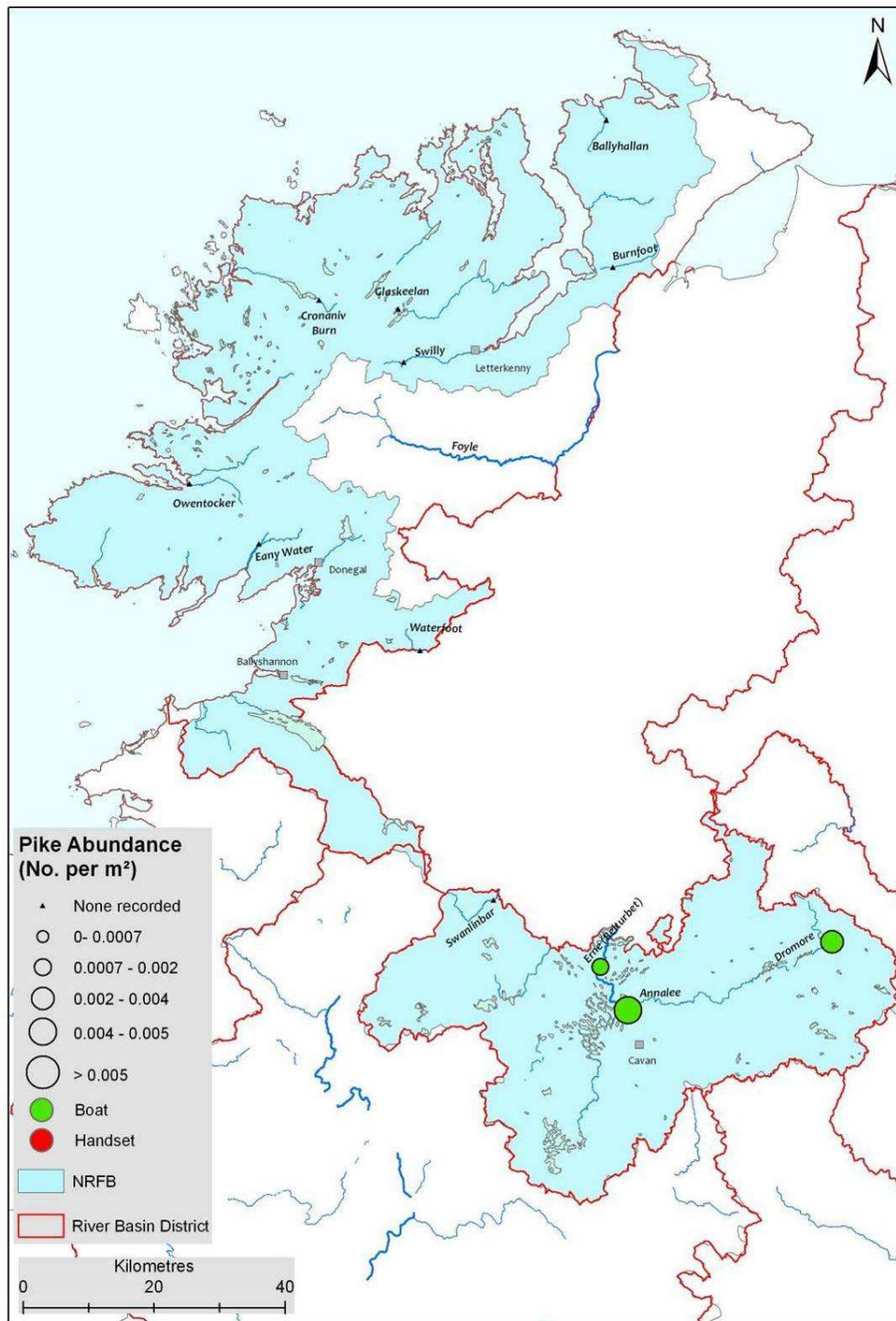


Fig. 4.47. Distribution map for pike in the NRFB, WFD surveillance monitoring 2008

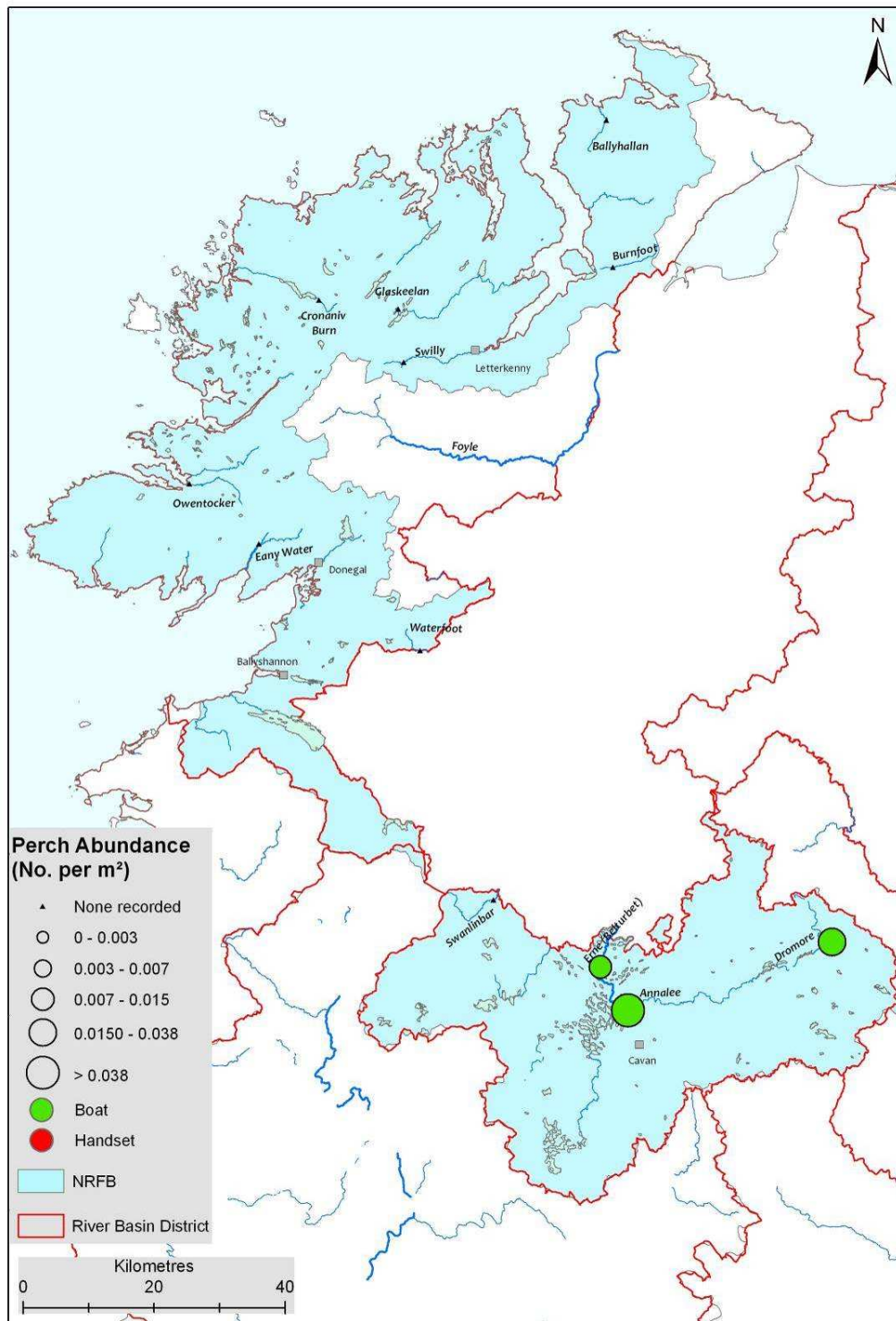


Fig. 4.48. Distribution map for perch in the NRFB, WFD surveillance monitoring 2008

4.3.3 Growth of selected fish species

Age and growth of fish were determined for the dominant fish species on each river site, comprising a range of age groups (from 0+ to 4+ depending on species). Brown trout ages ranged from 0+ to 4+ with 0+ and 1+ being the dominant age classes at most sites. The largest brown trout (length 50.3cm and weight 1.79kg) recorded during the survey was captured on the River Liffey site at Kilcullen.

Length at age analyses and growth curves are presented for brown trout and salmon recorded at the twelve river sites surveyed in the NRFB during 2008 (Figs. 4.49 and Appendix 1). The brown trout at each river site were assigned growth categories described by Kennedy and Fitzmaurice (1971), who examined the relationship between alkalinity and growth of trout in Irish streams and rivers. Growth was classified as very slow in the Ballyhallan, Burnfoot, Cronaniv Burn, Glaskeelan, Swilly and Waterfoot, slow in the Annalee, Eany Water, Erne and Owentocker, and very fast in the Dromore. The Dromore was also the only river in which brown trout aged up to 4+ were captured. Fish aged up to 3+ were recorded in the Burnfoot, Erne, Glaskeelan, Owentocker and Swilly rivers.

A single adult salmon was recorded in the Owentocker river, whereas only juvenile salmon were captured in other rivers in the region. Juvenile salmon aged up to 2+ were recorded in the Cronaniv Burn, Eany Water, Glaskeelan, and Waterfoot, and juvenile salmon were aged up to 1+ in the remaining rivers. The L1 of juvenile salmon in the region ranged from 3.6 cm to 5.0 cm. The growth rate of juvenile salmon up to age 2+ is greatest in the Owentocker and appears to be broadly similar across other rivers in the region (Fig. 4.50 and Appendix 2).

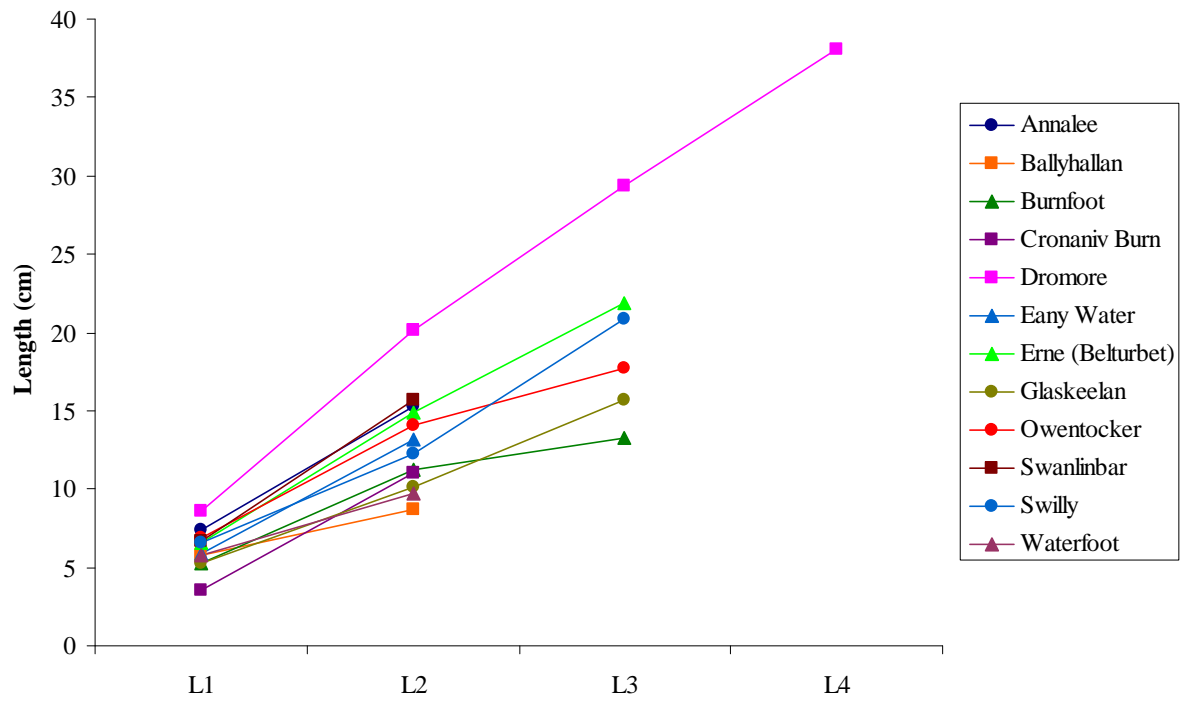


Fig. 4.49. Back calculated lengths of brown trout in each river.

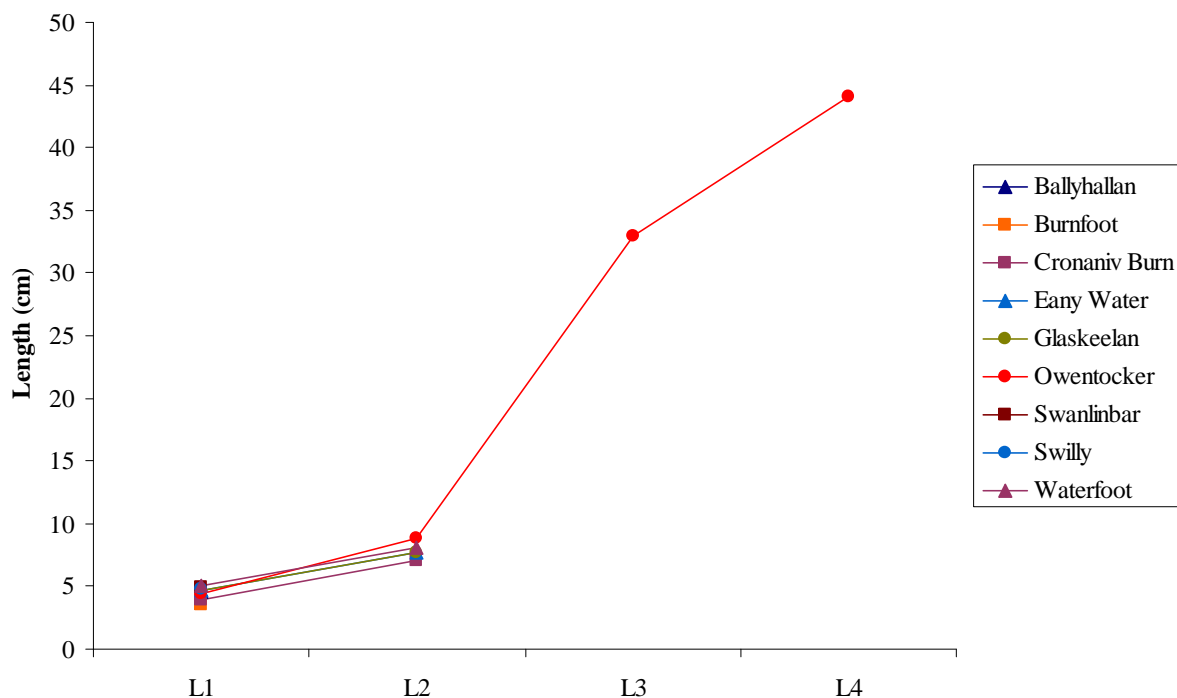


Fig. 4.50: Back calculated lengths of salmon in nine rivers within the NRFB.

Roach in the Annalee and the Erne had broadly similar rates of growth, but roach in the Dromore grew more slowly. Roach were aged up to 5+ in the Dromore, 7+ in the Erne and 9+ in the Annalee (Fig. 4.51 and Appendix 3).

All pike captured in the Dromore were aged 0+, and the oldest pike caught was a 6+ fish taken from the Erne River at Belturbet. The growth of pike in the Erne river was slightly faster than those from the Annalee river (Fig. 4.52).

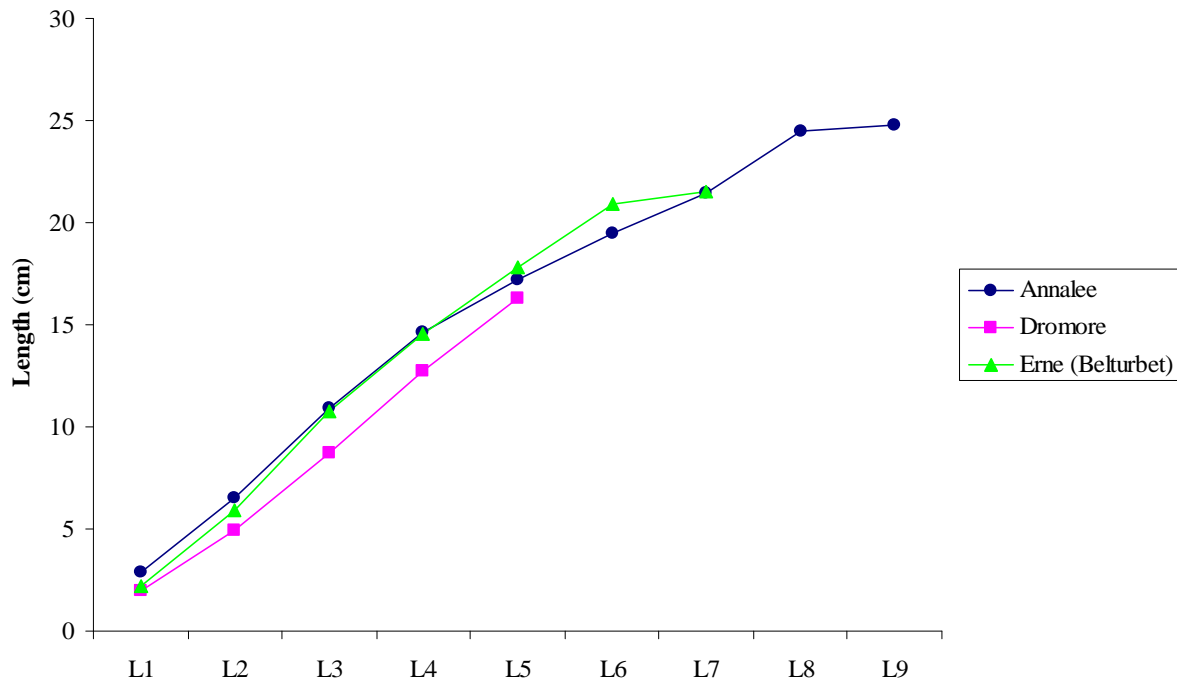


Fig. 4.51. Back calculated lengths of roach in three rivers within the NRFB.

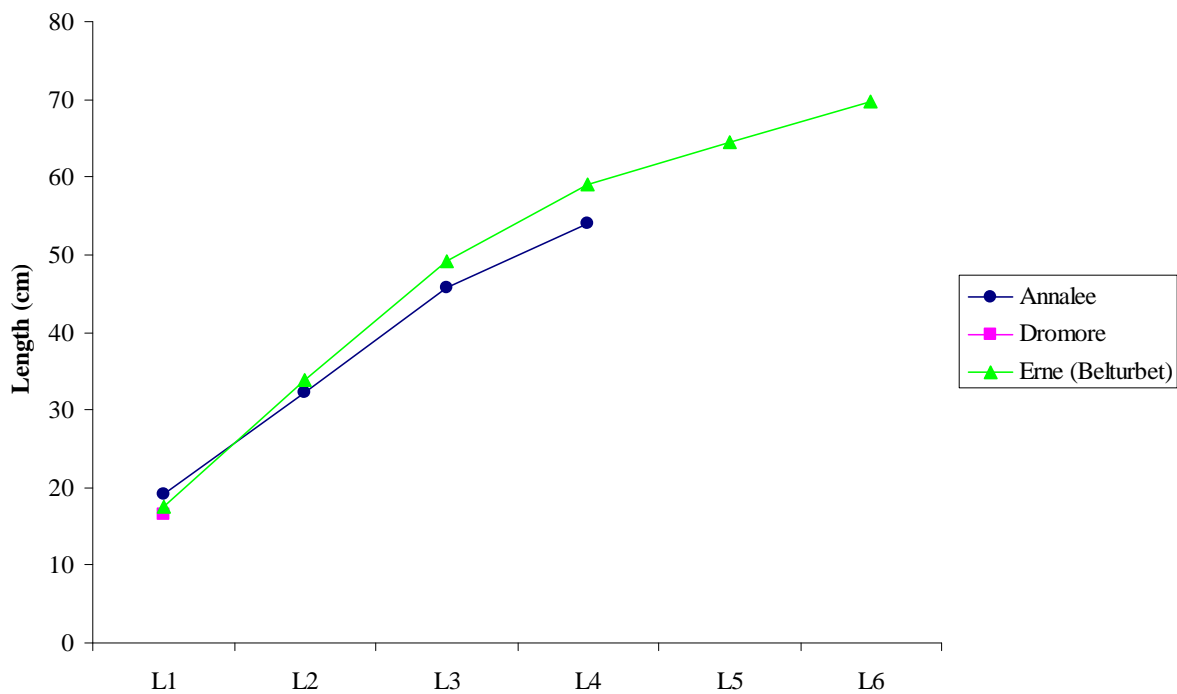


Fig. 4.52. Back calculated lengths of pike in three rivers within the NRFB.

Growth rates of perch were similar in all three rivers until the age of 2+ (Fig. 4.53 and Appendix 5). In the Annalee and the Erne, growth was similar until the age of 3+. Only a single 4+ fish was present in the Erne, which perhaps accounts for the marked divergence in growth rates beyond the age of 3+.

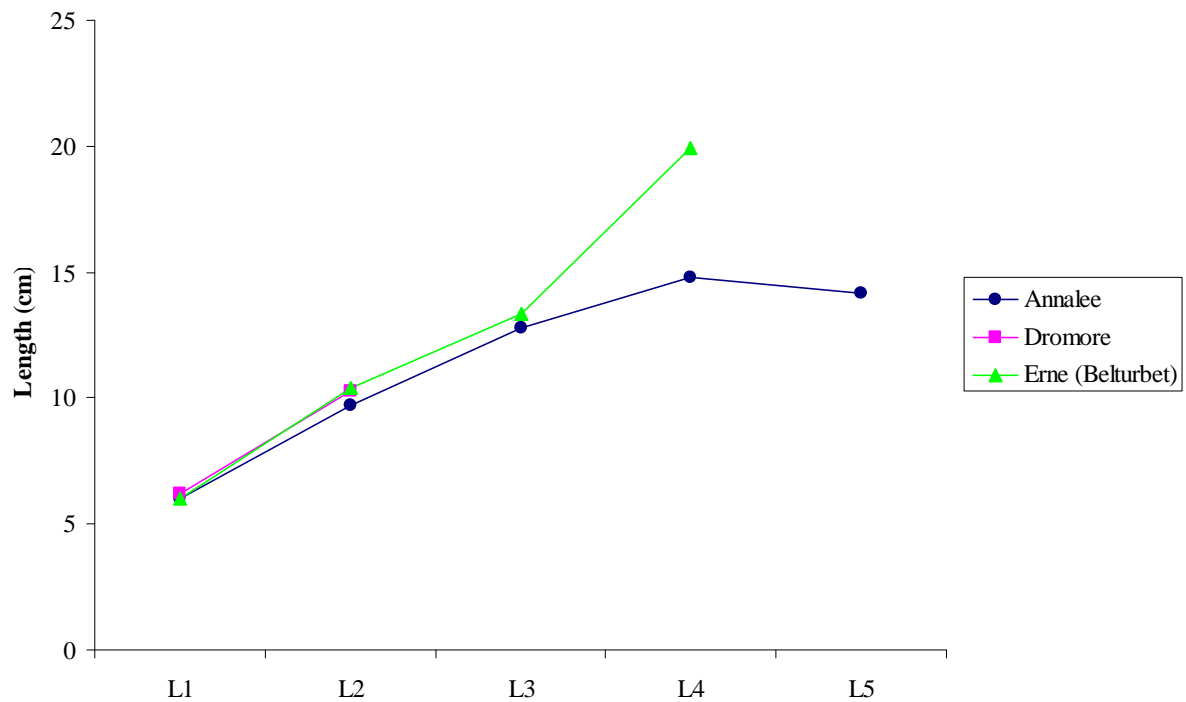


Fig. 4.53. Back calculated lengths for perch in each river.

5. DISCUSSION

There were 11 species of fish recorded during the 2008 WFD rivers sampling program in the NRFB, and roach×bream hybrids were also present. Brown trout were the most widespread species and occurred in all sites surveyed. Salmon and eel were the next most common species appearing in 75% of sites each. The Annalee River was the most diverse site, having eight fish species (including non-native species) present, while the Cronaniv Burn and Glaskeelan had the lowest diversity with only two species (native species only) being recorded.

The highest densities brown trout fry in the NRFB sites surveyed during 2008 were observed on the Ballyhallan river, followed by the Swanlinbar river, whereas the Burnfoot followed by the Ballyhallan recorded the highest densities of 1+ and older brown trout. Brown trout fry and 1+ and older brown trout were present in 58 and 79 respectively of the 83 river sites surveyed during 2008 for WFD SM monitoring. Of these, trout fry abundance from the Ballyhallan and Swanlinbar were ranked fifth and sixth highest of all sites surveyed and the Burnfoot recorded the highest density of 1+ and older fish (Kelly *et al.*, 2009).

Highest densities of salmon in the NRFB rivers surveyed were recorded on the Owentocker river (fry – 0.56 fish/m² and parr - 0.43 fish/m²). Salmon fry and parr were recorded on 47 and 78 respectively of the 83 sites surveyed during 2008 and of these densities from the Owentocker site were high in comparison to many of the other sites surveyed (density of salmon fry were fifth highest and density of salmon parr were the highest of any site surveyed during 2008) (Kelly *et al.*, 2009).

Eel were present throughout the sites surveyed, but displayed a greater abundance in sites closer to the coast, such as Ballyhallan and Burnfoot. Other fish species (non-native), such as gudgeon, roach, pike and perch were only present in the three sites in the Cavan Monaghan area. These results suggest that the rivers surveyed for the WFD to date in the Donegal part of the NRFB are still relatively free of non-native species but these species may become more of a concern in the future due to the effects of climate change.

There were similar trends in age and growth for brown trout in the NRFB as in the rest of the country. Larger rivers and those with higher levels of alkalinity generally had faster growth rates than the smaller streams (Kelly *et al.*, 2009). Some of the largest trout within the region were seen in the Dromore River in Co. Monaghan and of the 12 sites, this one also had the fastest growth. Elsewhere in the region, however, and especially in the smaller streams such as the Burnfoot and Ballyhallan, growth was quite slow. Pike, perch and roach all appeared to grow generally faster in the Erne than in any of the other three rivers where they were present.

An essential step in the WFD process is the classification of the ecological status of lakes, rivers and transitional waters, which in turn will assist in identifying objectives that must be set in the individual River Basin District Management Plans. There is currently no WFD compliant classification tool for fish in Irish rivers. However; a new project (WFD68) has been initiated (summer 2009) through the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) to develop a rivers fish classification tool for ROI, NI and Scotland and is due for completion in May 2010. Ecological status classes will therefore be calculated once this tool has been developed.

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Appendix 1

Summary of the growth of brown trout in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4	Growth category
Annalee	Mean	7.35	15.33			Slow
	SD	1.73	3.12			
	n	20	11			
	Range min.	4.81	9.65			
	Range max.	10.72	19.52			
Ballyhallan	Mean	5.73	8.68			Very slow
	SD	0.98	1.11			
	n	23	3			
	Range min.	4.08	7.98			
	Range max.	7.81	9.96			
Burnfoot	Mean	5.31	11.22	13.26		Very slow
	SD	0.92	1.11	n/a		
	n	25	5	1		
	Range min.	4.21	9.42	13.26		
	Range max.	7.69	12.40	13.26		
Cronaniv Burn	Mean	3.50	11.00			Very slow
	SD	0.83	n/a			
	n	3	1			
	Range min.	2.77	11.00			
	Range max.	4.40	11.00			
Dromore	Mean	8.57	20.17	29.35	38.08	Very fast
	SD	2.49	4.39	7.19	6.86	
	n	9	9	7	5	
	Range min.	5.70	10.85	17.73	33.29	
	Range max.	13.38	27.44	40.15	50.19	
Eany Water	Mean	5.86	13.17			Slow
	SD	1.72	2.08			
	n	3	3			
	Range min.	4.04	11.22			
	Range max.	7.46	15.35			
Erne (Belturbet)	Mean	6.63	14.86	21.86		Slow
	SD	1.17	2.75	1.75		
	n	43	39	21		
	Range min.	4.20	10.48	17.97		
	Range max.	8.63	21.18	25.22		
Glaskeelan	Mean	5.25	10.17	15.71		Very slow
	SD	1.02	1.00	n/a		
	n	13	5	1		
	Range min.	3.59	8.93	15.71		
	Range max.	6.54	11.69	15.71		

Appendix 1 continued

Summary of the growth of brown trout in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4	Growth category
Owentocker	Mean	6.93	14.10	17.74		Slow
	SD	2.09	1.19	n/a		
	n	6	4	1		
	Range min.	4.55	12.73	17.74		
	Range max.	9.60	15.60	17.74		
Swanlinbar	Mean	6.68	15.72			Slow
	SD	1.18	1.51			
	n	20	2			
	Range min.	4.47	14.65			
	Range max.	8.99	16.79			
Swilly	Mean	6.62	12.24	20.89		Very slow
	SD	1.38	1.08	n/a		
	n	20	9	1		
	Range min.	3.73	11.03	20.89		
	Range max.	8.60	14.46	20.89		
Waterfoot	Mean	5.74	9.68			Very slow
	SD	1.10	n/a			
	n	6	1			
	Range min.	4.66	9.68			
	Range max.	7.58	9.68			

Appendix 2

Summary of the growth of salmon in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4
Ballyhallan	Mean	4.51			
	SD	0.73			
	n	23			
	Range min.	3.17			
	Range max.	6.04			
Burnfoot	Mean	3.60			
	SD	0.39			
	n	4			
	Range min.	3.03			
	Range max.	3.90			
Cronaniv Burn	Mean	3.88	7.12		
	SD	1.26	1.05		
	n	15	11		
	Range min.	2.09	5.91		
	Range max.	6.21	9.77		
Eany Water	Mean	4.65	7.70		
	SD	0.89	n/a		
	n	17	1		
	Range min.	3.15	7.70		
	Range max.	5.90	7.70		
Glaskeelan	Mean	4.65	7.68		
	SD	0.88	1.02		
	n	21	6		
	Range min.	3.11	5.94		
	Range max.	6.14	9.00		
Owentocker	Mean	4.46	8.80	32.93	44.02
	SD	0.85	1.84	n/a	n/a
	n	31	13	1	1
	Range min.	3.06	6.51	32.93	44.02
	Range max.	7.25	12.77	32.93	44.02
Swanlinbar	Mean	4.96			
	SD	1.11			
	n	31			
	Range min.	2.48			
	Range max.	7.11			

Appendix 2 continued

Summary of the growth of salmon in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4
Swilly	Mean	4.85			
	SD	0.57			
	n	21			
	Range min.	3.42			
	Range max.	6.31			
Waterfoot	Mean	5.03	8.12		
	SD	1.04	0.48		
	n	19	3		
	Range min.	3.54	7.67		
	Range max.	7.56	8.63		

Appendix 3

Summary of the growth of roach in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4	L5	L6	L7	L8	L9
Annalee	Mean	2.90	6.53	10.93	14.59	17.20	19.50	21.47	24.49	24.75
	SD	0.74	1.39	1.69	1.39	1.42	1.32	1.51	2.10	n/a
	n	84	79	68	41	30	23	14	3	1
	Range min.	2.03	4.09	7.55	10.68	14.71	17.68	18.97	23.16	24.75
	Range max.	5.25	11.00	14.82	17.78	19.96	22.26	24.85	26.90	24.75
Dromore	Mean	1.94	4.91	8.72	12.75	16.25				
	SD	0.70	1.19	1.53	1.78	1.69				
	n	46	43	37	19	4				
	Range min.	1.15	3.13	5.54	10.48	14.14				
	Range max.	4.16	8.31	12.26	17.46	17.73				
Erne (Belturbet)	Mean	2.22	5.88	10.73	14.53	17.83	20.91	21.51		
	SD	0.48	1.19	1.75	1.30	1.42	1.70	n/a		
	n	37	36	33	21	11	3	1		
	Range min.	1.37	3.53	7.81	12.17	15.88	19.31	21.51		
	Range max.	3.57	9.21	14.32	17.55	21.19	22.70	21.51		

Appendix 4

Summary of the growth of pike in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4	L5	L6
Annalee	Mean	19.18	32.19	45.79	53.97		
	SD	1.85	3.02	5.88	n/a		
	n	11	10	3	1		
	Range min.	16.51	28.08	39.01	53.97		
	Range max.	22.60	37.70	49.26	53.97		
Dromore	Mean	16.45					
	SD	3.39					
	n	2					
	Range min.	14.06					
	Range max.	18.85					
Erne (Belturbet)	Mean	17.53	33.92	49.19	59.06	64.58	69.79
	SD	2.00	4.11	5.41	2.72	n/a	n/a
	n	9	8	6	4	1	1
	Range min.	14.18	27.81	39.89	56.96	64.58	69.79
	Range max.	20.09	39.40	55.98	62.98	64.58	69.79

Appendix 5

Summary of the growth of perch in the NRFB rivers (L1=back calculated length at the end of the first winter etc.)

River		L1	L2	L3	L4	L5
Annalee	Mean	6	9.71	12.8	14.82	14.15
	SD	0.92	1.54	2.05	1.87	
	n	39	33	13	9	1
	Range min.	3.33	6.48	10.06	11.72	
	Range max.	8.11	12.5	15.81	17.55	
Dromore	Mean	6.21	10.27			
	SD	0.94	1.16			
	n	15	14			
	Range min.	5	8.49			
	Range max.	8.31	12.41			
Erne (Belturbet)	Mean	6	10.42	13.36	19.91	
	SD	0.77	1.06	2.56		
	n	15	13	6	1	
	Range min.	4.44	8.59	9.69		
	Range max.	7.1	12.65	17.27		

**The Central Fisheries Board
Swords Business Campus,
Swords,
Co. Dublin,
Ireland.**

**Web: www.wfdfish.ie
www.cfb.ie
Email: info@cfb.ie
Tel: +353 1 8842600
Fax: +353 1 8360060**



**The Central and Regional
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