Western River Basin District Rivers

Sampling Fish for the Water Framework Directive - Rivers 2008 & 2009

The Central and Regional Fisheries Boards

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1. INTRODUCTION

Fish stock surveys were undertaken in 54 river sites throughout Ireland during the summer of 2009 as part of the programme for sampling fish for the Water Framework Directive (WFD). These surveys are required by both national and European law, with Annex V of the WFD stipulating 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). Seven of the 54 surveys were carried out at river sites in the Western River Basin District between July and early September 2009 by staff from the Central Fisheries Board (CFB), Western Regional Fisheries Board (WRFB), North Western regional Fisheries Board (NWRFB) and Shannon Regional Fisheries Board (ShRFB) (Table 2.1, 2.2 and Fig. 2.1). Although fish survey work has been carried out in Ireland in the past, no project to date has been as extensive as the current on-going monitoring programme in providing data appropriate for WFD compliance. Continued surveying of these and additional river sites will provide a useful baseline and time-series dataset for future monitoring of water quality. This in turn will provide information for River Basin District managers to compile and implement programmes of measures to improve degraded water bodies.

The fisheries service in Ireland is currently undergoing a major organisational transition. This follows the recent government plan for the rationalisation of state agencies outlined in the 2009 budget. The eight separate fisheries organisations, comprising the Central Fisheries Board (CFB) and seven Regional Fisheries Boards (RFBs) are set to merge into one single entity and become Inland Fisheries Ireland (IFI). As a result of these changes, the previous administrative zones, the RFBs, will be realigned along the boundaries of River Basin Districts (RBDs) and will in some cases transcend international boundaries. Previous WFD fish surveys were reported based on the seven different RFBs; however, reporting will now reflect these new administrative changes and will group water bodies according to River Basin Districts.

Up until 2010 the Western Regional Fisheries Board (WRFB) and North Western Regional Fisheries Board (NWRFB) occupied the majority of Counties Galway, Mayo and Sligo as well as certain sections within other neighbouring counties. The Western River Basin District (WRBD) covers most of this area; however, it also includes some of the old Shannon Regional Fisheries Board (SHRFB) in Co. Clare and Co. Galway.

The WRBD (Fig. 2.1) stretches along 2,700km of coastline from County Sligo in the north to Co. Clare in the south. Although it shares borders with two international river basin districts (NWIRBD and SHIRBD), the WRBD is situated entirely within the Republic of Ireland. Many offshore islands are included within this district, along with numerous Special Areas of Conservation. Some of Ireland's largest lakes are within the WRBD, including Lough Corrib, Lough Mask and Lough Conn.

These lakes separate areas dominated by peat and forestry in the west from karst limestone areas to the east (WRBD, 2010).

This report summarizes the main findings of the fish stock surveys in the seven river water bodies surveyed in the WRBD during 2009 and reports the current status of the fish stocks in each. The single survey conducted in the WRFB during 2008 (Bunowen River) is also reported on here.

2. STUDY AREA

Seven river sites were surveyed in five river catchments during 2009; the Ballysadare, Corrib, Dunneill, Easkey and Kinvarra catchments. This report also includes the only WRBD site surveyed in 2008; the Bunowen River (Louisburgh), which is situated in the Bunowen catchment. The sites ranged in surface area from 270m^2 for the Black River to 2,520m^2 for the Bunowen River and were divided into two categories for reporting purposes, i.e. hand-set and boat sites.

Summary details of each site's location and physical characteristics are given in Tables 2.1 and 2.2, and the distribution of sites throughout the WRBD is shown in Figure 2.1.

Table 2.1. Location and codes of river sites surveyed for WFD surveillance monitoring, 2008-2009

River	Site name	Catchment	Site Code	Waterbody code
WRBD Hand-set sites				
Black	Bridge at Kilshanvy	Corrib	IE30B020100	WE_30_2928
Dunneill	Donaghintraine Br.	Dunneill	IE35D060200	WE_35_1430
Gowlan	Ford u/s of Easky River confl.	Easkey	IE35G030100	WE_35_1187
Owenbrin	Bridge u/s of Lough Mask	Corrib	IE30O010200	WE_30_1063
Owendalulleegh	Bridge SE of Killafeen	Kinvarra	IE29O011000	WE_29_150
Unshin	d/s of Riverstown Br.	Ballysadare	IE35U010200	WE_35_2178
WRBD Boat sites				
Bunowen	Tully Br.	Bunowen	IE32B030100	WE_32_3740
Nanny	u/s of Weir Br.	Corrib	IE30N010300	WE_30_1128

Table 2.2. Details of river sites surveyed for WFD surveillance monitoring, 2008-2009

River	Upstream catchment (km^2)	Wetted width (m)	Surface area (m^2)	Mean depth (m)	Max depth (m)
WRBD Hand-set sites					
Black	3.12	6.43	270	0.23	0.41
Dunneill	24.35	7.75	504	0.25	0.57
Gowlan	17.00	6.63	550	0.39	0.81
Owenbrin	23.82	11.53	519	0.21	0.54
Owendalulleegh	90.48	10.58	476	0.26	0.53
Unshin	76.24	8.23	329	0.40	0.61
WRBD Boat sites					
Bunowen	28.11	12.6	2520	0.69	12.60
Nanny	36.74	6.33	727	0.73	1.05

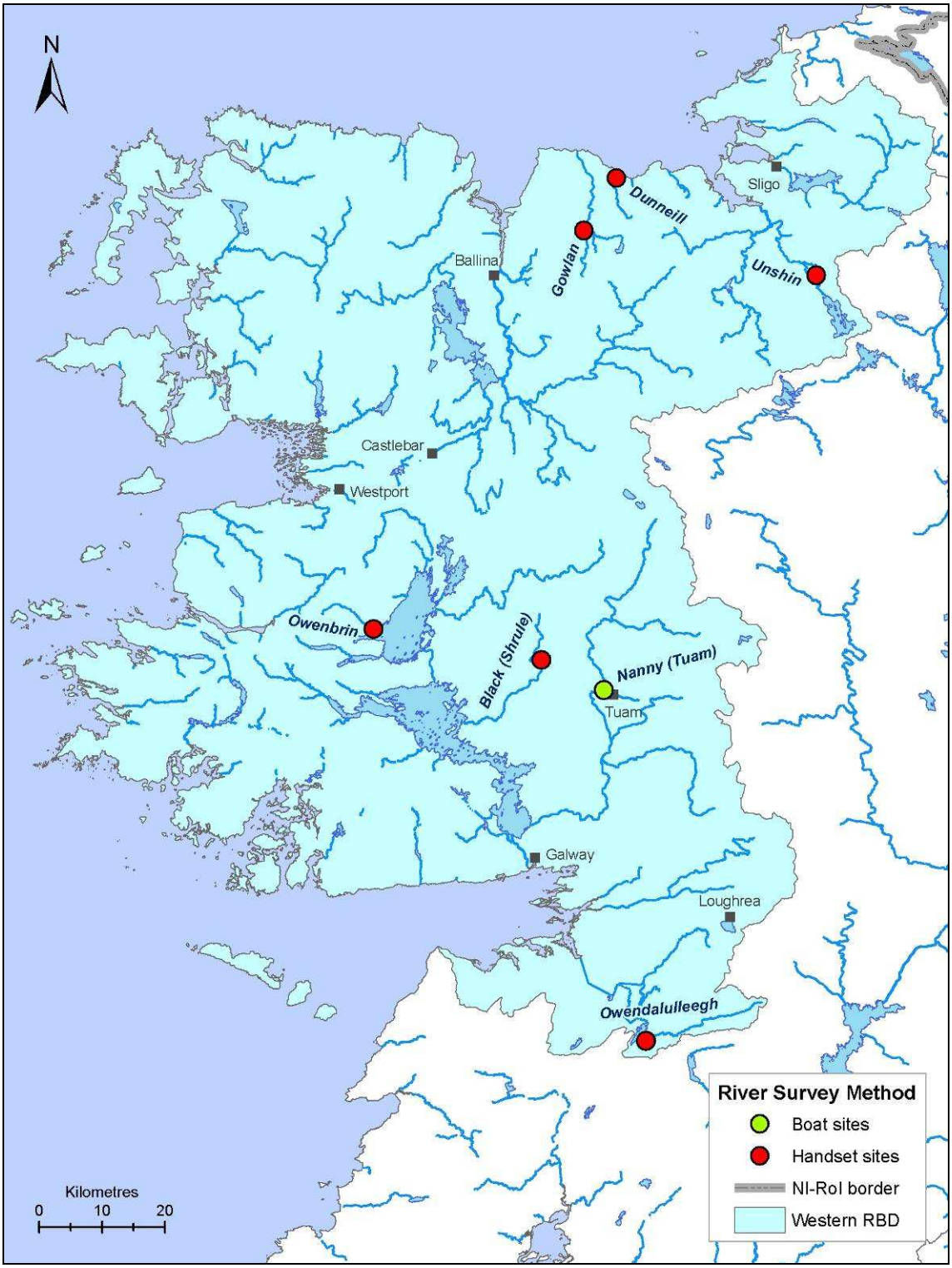

Fig. 2.1. Location map of river sites surveyed throughout the WRBD for WFD fish surveillance monitoring 2009

3. METHODS

Electric-fishing (Plates 3.1 and 3.2) is the method of choice for surveillance monitoring of fish in rivers to obtain a representative sample of the fish assemblage at each sampling site. This 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 were taken, along with a multi-habitat kick-sample of macroinvertebrates. Macrophyte surveys were carried out on selected wadeable streams.

Fish from each pass were sorted and processed separately. During processing, the species of each fish was identified and its length and weight were measured; sub-samples were measured when large numbers of fish were present. For the purpose of species identification, river lamprey (*Lampetra fluviatilis*) and brook lamprey (*Lampetra planeri*) were treated as one. Sea trout and brown trout were listed separately. For aging analyses, scales were taken from fish greater than 8.0cm for salmonids and most non-native fish species. These fish were held in a large bin of oxygenated water after processing until they were fully recovered and were then returned to the water. Opercular bones were taken from perch for ageing. Samples of European eels were retained for further analysis.

For various reasons, including river width and the practicalities of using stop-nets, three fishing passes were not possible or practical at all sites. Therefore, in order to draw comparisons between sites, fish densities were calculated using data from the first fishing pass only. The number captured in the first pass was divided by the total area surveyed to give a density for each species. When a species was absent in the first pass, but subsequently captured in a second or third pass, the value from the first pass where that species was captured was used to calculate the density.

A subsample of the dominant fish species were aged (five fish from each 1cm size class). Fish scales were aged using a microfiche, and opercular bones were aged using an Olympus SZX10 microscope/digital camera system. Growth rates were determined by back-calculating lengths at the end of each winter (e.g. L1 is the mean length at the end of the first winter, L2 is the mean length at the end of the second winter, etc.).

Plate 3.1. Electric fishing using hand-set units on the Glashaboy River (SWRBD)

Plate 3.2. Electric fishing using boat-based units on the Nenagh River (SHIRBD)

4. RESULTS

4.1 Wadeable hand-set sites

4.1.1 The Black River (Shrule)

Plate 4.1. The Black River at Kilshanvy Bridge, Co. Galway

The Black River (Plate 4.1) is a small stream that flows along the border of Co. Galway and Co. Mayo. It rises in Co. Mayo approximately 8km north-east of Kilmaine and flows southwards through the village of Shrule, before reaching the north-east shore of Lough Corrib 3km west of Ower at the Galway–Mayo border. Drainage work damaged this river in the late 1960s, but subsequent rehabilitation works have improved conditions, enabling it to hold good stocks of brown trout downstream of Shrule (O'Reilly, 2009). Some of the lower stretches of the Black River are within the Lough Corrib Special Area of Conservation (SAC), which includes several inflowing rivers that are important for salmon (NPWS, 2005a).

The survey site was located just upstream of Kilshanvy Bridge (Fig. 4.1). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 1st of July 2009 along a 42m length of river channel. The mean wetted width of the stretch surveyed was 6.4m and the mean depth was 23.0cm. This stretch was characterised mostly by glide and pool habitats over a substrate of

cobble. Low levels of shading enabled the growth of a rich selection of macrophyte vegetation, including submerged, emergent and floating species. Small amounts of filamentous green algae were also recorded. A total wetted area of 270m^2 was surveyed.

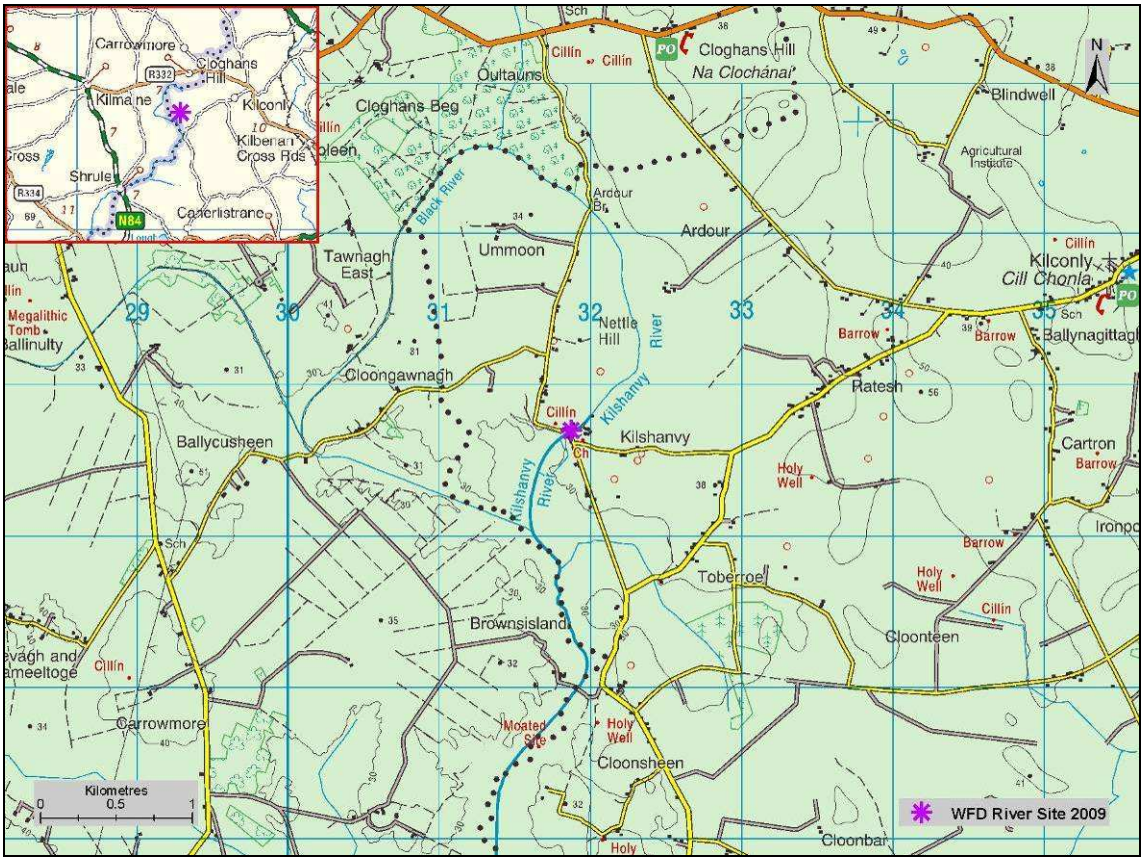

Fig. 4.1. Location of the Black River surveillance monitoring site

A total of four fish species were recorded in the Black River site. Brown trout was the most abundant species, followed by salmon, three-spined stickleback and European eel (Table 4.1). Nine-spined stickleback (*Pungitius pungitius*) were also observed at the site but were not captured during sampling.

Table 4.1. Density of fish (no./m^2), Black River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo trutta	Brown trout	0.1148	0.1000	0.2147
Salmo salar	Salmon	0.0074	0.0629	0.0703
Gasterosteus aculeatus	Three-spined stickleback	-	-	0.0296
Anguilla anguilla	European eel	-	-	0.0074
All fish	All fish	-	-	0.3221

Brown trout ranged in length from 3.6cm to 25.4cm (Fig. 4.2). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 54%, 45% and 1% of the total brown trout catch respectively. Mean brown trout L1 and L2 were 7.9cm and 20.2cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is very fast according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

Salmon ranged in length from 7.6cm to 13.5cm (Fig. 4.3). Three age classes (0+, 1+ and 2+) were present, accounting for 8%, 84% and 8% of the total salmon catch respectively. Mean salmon L1 and L2 were 5.1cm and 9.7cm respectively (Appendix 2).

Three-spined stickleback ranged in length from 3.5cm to 6.6cm (Fig. 4.4). European eels ranged in length from 48.2cm and 51.7cm.

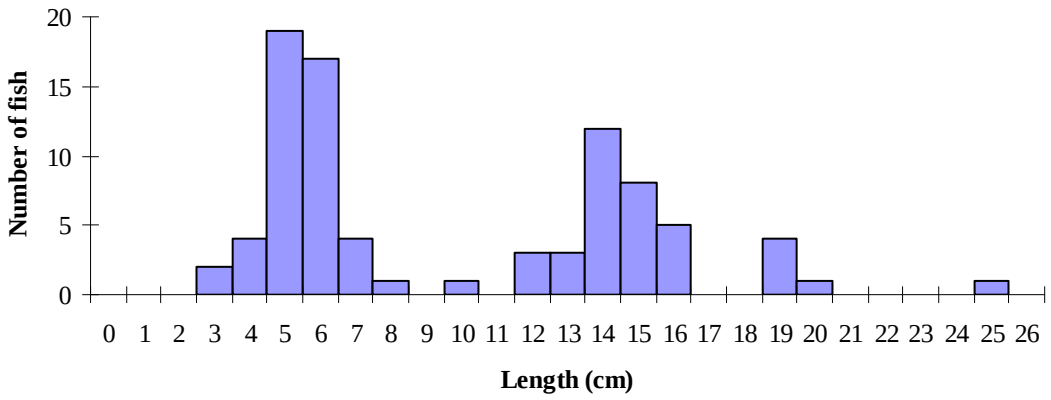

Fig. 4.2. Length frequency distribution of brown trout in the Black River site, July 2009 (n = 85)

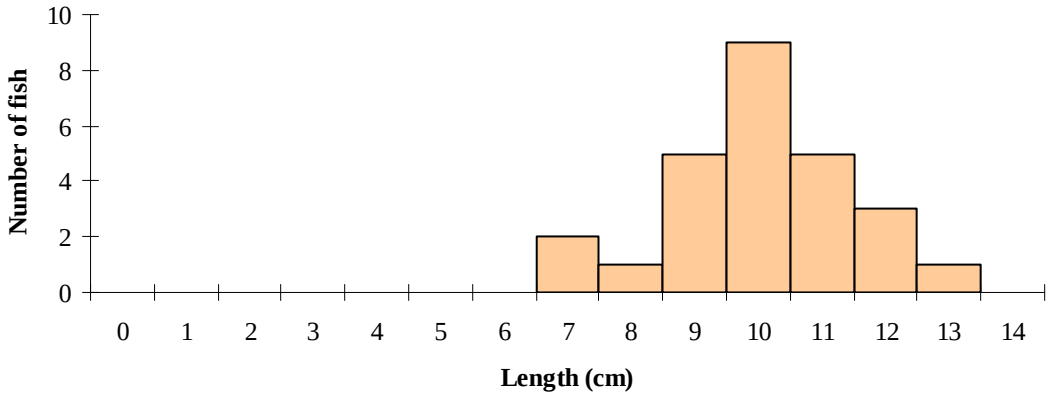

Fig. 4.3. Length frequency distribution of salmon in the Black River site, July 2009 (n = 26)

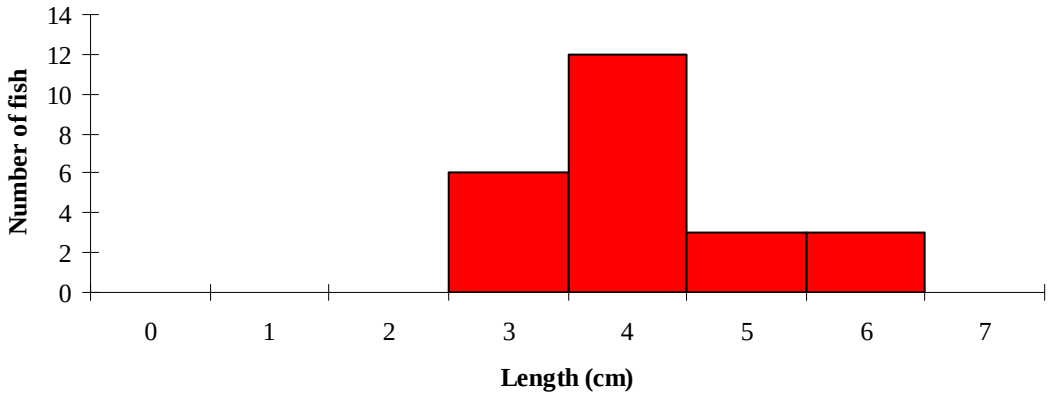

Fig. 4.4. Length frequency distribution of three-spined stickleback in the Black River site, July 2009 (n = 24)

4.1.2 The Dunneill River

Plate 4.2. The Dunneill River near Dromore West, Co. Sligo

The Dunneill River (Plate 4.2) is a small stream in north-west Co. Sligo. It rises in the Ox Mountains and flows northwards through Dromore West before reaching the sea a few kilometres west of Sligo Bay.

The Dunneill River survey site was located just upstream of Donaghintraine Bridge, beside a scenic walkway and just downstream of the confluence with the Carrowcor River (Fig. 4.5). Three electric-fishing passes were conducted using three bank-based electric-fishing units on the 15th of July 2009 along a 65m length of river channel. The stretch surveyed had a mean wetted width of 7.8m and a mean depth of 25.0cm. The habitat was dominated by riffle and glide, whilst cobble was the dominant substrate. Mosses and liverworts, common in shaded, rocky streams such as this, dominated the macrophyte vegetation. A total wetted area of 504m^2 was surveyed.

Fig. 4.5. Location of the Dunneill River surveillance monitoring site

Two fish species were recorded in the Dunneill River site (Table 4.5). Brown trout was the most abundant species, followed by European eel.

Table 4.2. Density of fish (no./m^2), Dunneill River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo trutta	Brown trout	0.0417	0.0357	0.0774
Anguilla anguilla	European eel	-	-	0.0337
All fish	All fish	-	-	0.1112

Brown trout ranged in length from 5.2cm to 17.9cm (Fig. 4.6). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 60%, 34% and 6% of the total brown trout catch respectively. Mean brown trout L1 and L2 were 7.1cm and 14.3cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is slow according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

European eels ranged in length from 10.1cm to 34.6cm (Fig. 4.7).

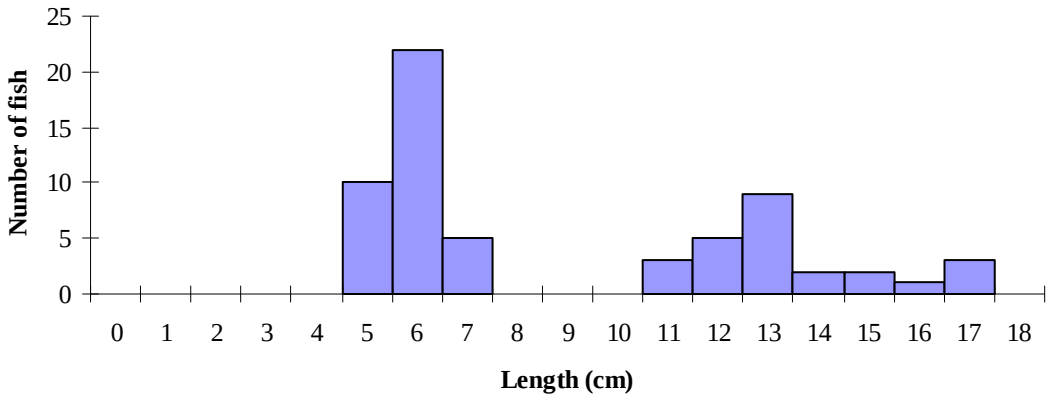

Fig. 4.6. Length frequency distribution of brown trout in the Dunneill River site, July 2009 (n = 62)

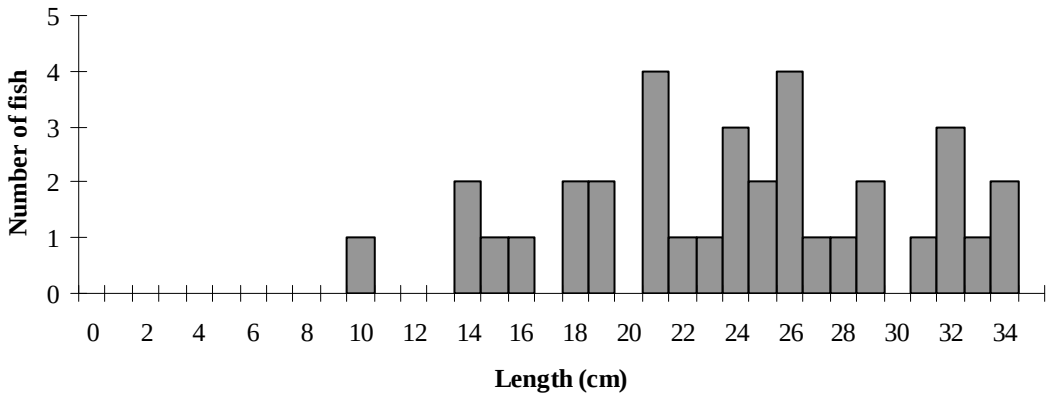

Fig. 4.7. Length frequency distribution of European eels in the Dunneill River site, July 2009 (n = 35)

4.1.3 The Gowlan River

Plate 4.3. The Gowlan River, Co. Sligo

The Gowlan River (Plate 4.3) is located in Co. Sligo and is a tributary of the Easky River. It rises in the Ox Mountains along the borders of Co. Sligo and Co. Mayo and flows northwards, reaching the sea near Easky. Although the Gowlan itself is a small stream that probably holds little interest for the angling community, it is a tributary of the Easky, a renowned salmon and sea trout fishery.

The Gowlan River survey site was located approximately 1.5km upstream of the Easky River confluence (Fig. 4.8). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 14th of July 2009 along an 83m length of river channel. The stretch surveyed had a mean wetted width of 6.6m and a mean depth of 39.0cm. Pools were the dominant habitat type over a substrate composed of mainly cobble. Vegetation surrounding the site was characteristic of upland rocky streams and included various rushes and grasses as well as mosses. A total wetted area of 550m^2 was surveyed.

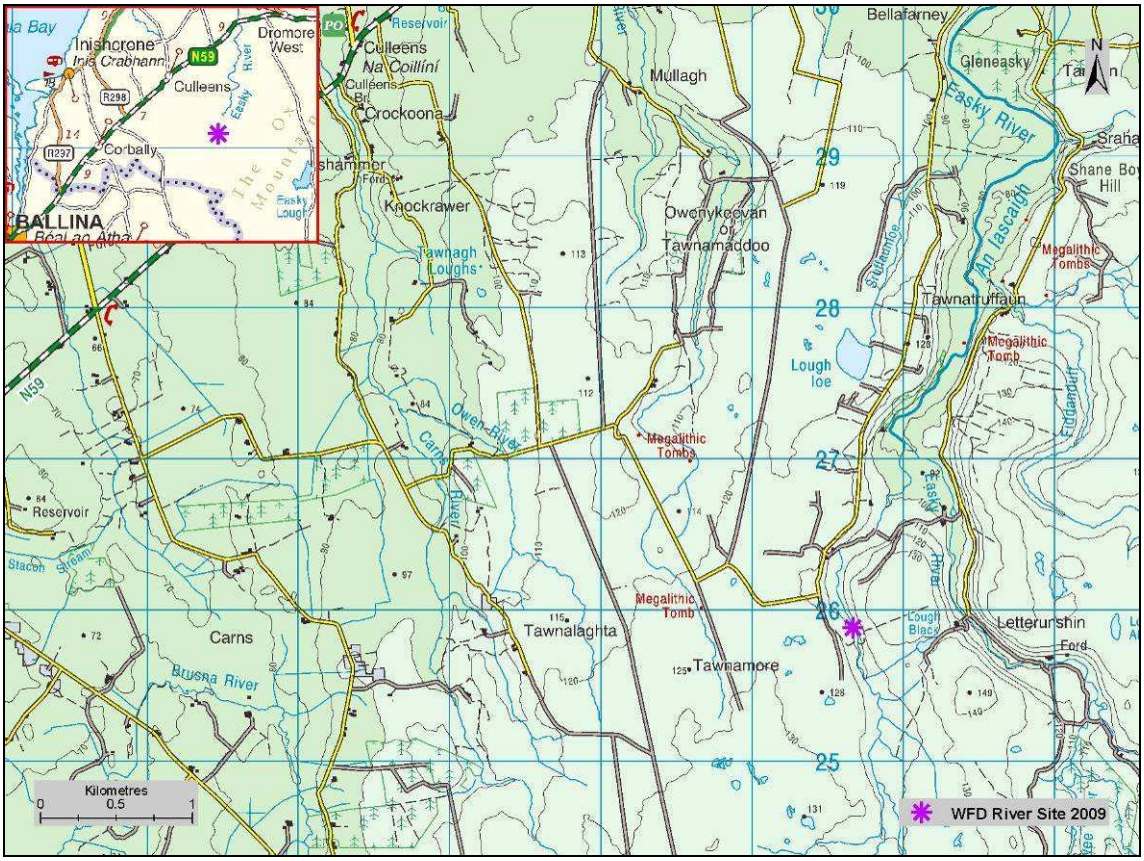

Fig. 4.8. Location of the Gowlan River surveillance monitoring site

Two fish species were recorded in the Gowlan River site as well as sea trout, which are treated here as a separate 'variety' of trout. Salmon was the most abundant species, followed by brown trout and sea trout.

Table 4.3. Density of fish (no./m^2), Gowlan River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo salar	Salmon	0.0509	0.1073	0.1582
Salmo trutta	Brown trout	0.0145	0.0200	0.0346
Salmo trutta	Sea trout	-	-	0.0018
All fish	All fish	-	-	0.1946

Brown trout ranged in length from 4.8cm to 29.1cm (Fig. 4.9). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 40%, 49%, 8% and 3% of the total brown trout catch respectively. Mean brown trout L1, L2 and L3 were 7.6cm, 14.4cm and 23.6cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is slow according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

Salmon ranged in length from 2.9cm to 16.4cm (Fig. 4.10). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 33%, 66% and 1% of the total salmon catch respectively. Mean salmon L1 and L2 were 5.1cm and 14.2cm respectively (Appendix 2).

One sea trout measuring 25.5cm in length, 224.0g in weight and aged 2+ was also recorded.

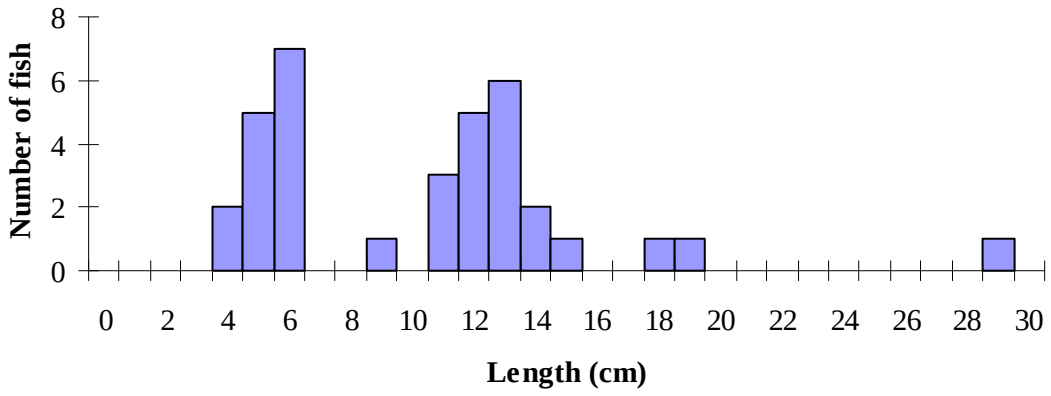

Fig. 4.9. Length frequency distribution of brown trout in the Gowlan River site, July 2009 (n = 35)

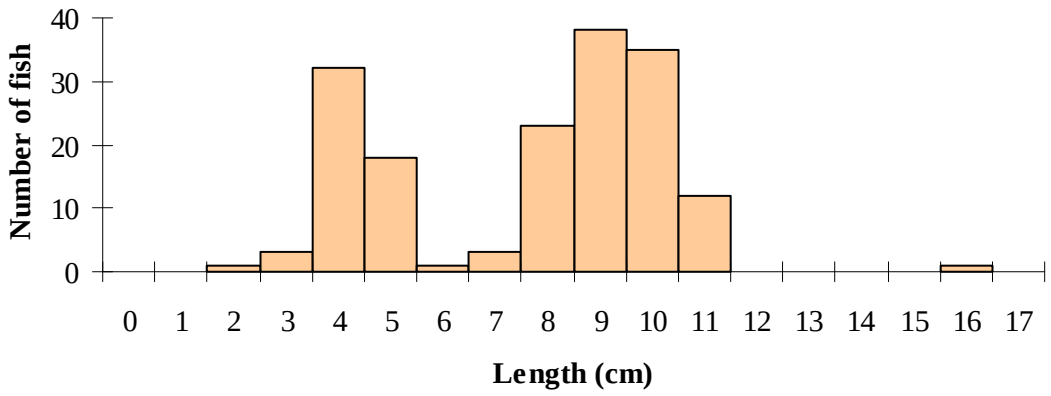

Fig. 4.10. Length frequency distribution of salmon in the Gowlan River site, July 2009 (n = 167)

4.1.4 The Owenbrin River

Plate 4.4. The Owenbrin River near Killateeaun, Co. Mayo

The Owenbrin River (Plate 4.4) is a small stream in Co. Mayo that flows into Lough Mask. It rises in the Partry Mountains and runs south-eastwards for approximately 13km before entering the lake. The survey site was located near Killateeaun, approximately 7km south-west along the R300 from Toormakeady, Co. Mayo (Fig. 4.11). An interesting feature of the Owenbrin system is a delta of coarse, sandy sediment that the river has formed at its mouth in Lough Mask (NPWS, 2004).

Three electric-fishing passes were conducted using three bank-based electric-fishing units on the 2nd of July 2009 along a 45m length of river channel. The mean wetted width of the stretch surveyed was 11.5m and the mean depth was 21.0cm. Pool and riffle were the dominant habitat types, whilst cobble was the dominant substrate type present. Macrophyte vegetation was relatively scarce at this site and included mostly riparian species commonly found in upland and peatland areas. A total wetted area of 519m^2 was surveyed.

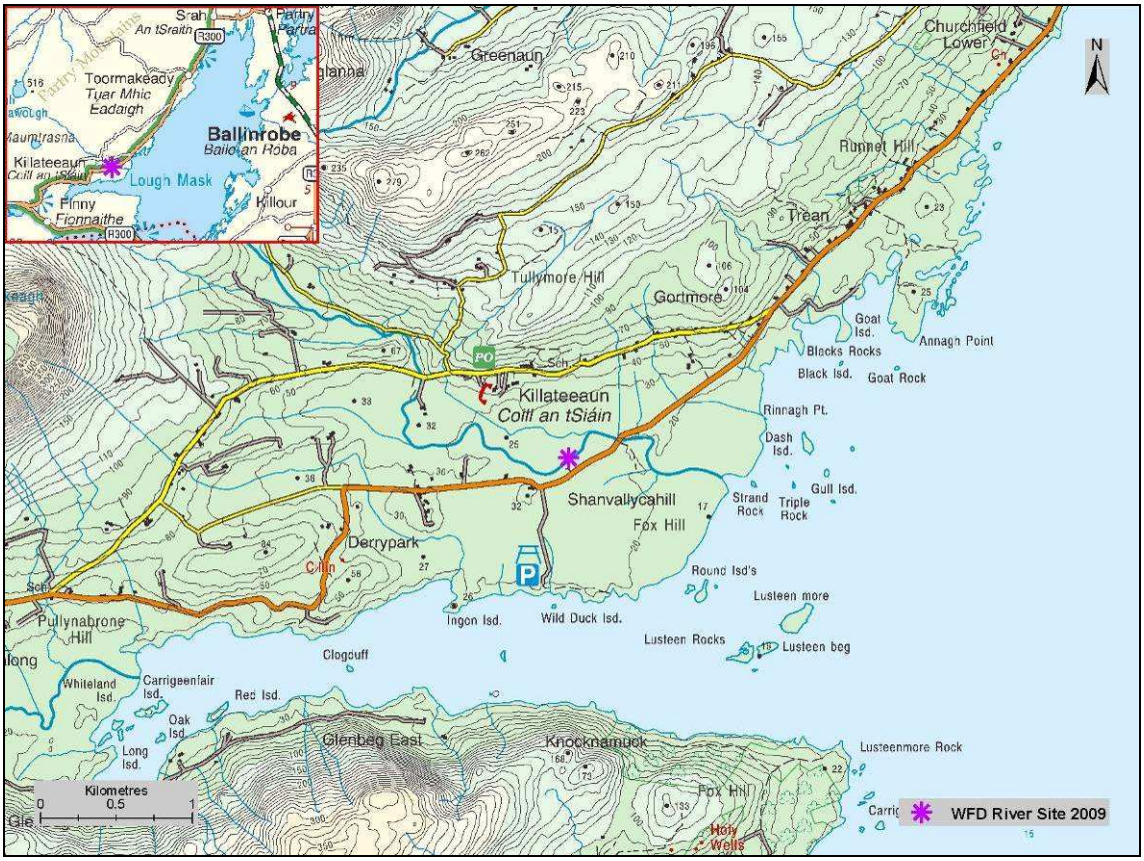

Fig. 4.11. Location of the Owenbrin River surveillance monitoring site

A total of five fish species were recorded in the Owenbrin River site. Minnow was the most abundant species, followed by brown trout, stone loach, perch and salmon (Table 4.11).

Table 4.4. Density of fish (no./m^2), Owenbrin River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Phoxinus phoxinus	Minnow	-	-	0.4008
Salmo trutta fario	Brown trout	0.0674	0.0058	0.0732
Barbatula barbatula	Stone loach	-	-	0.0135
Perca fluviatilis	Perch	-	-	0.0019
Salmo salar	Salmon	-	0.0019	0.0019
All fish	All fish	-	-	0.4913

Minnow ranged in length from 2.0cm to 7.2cm (Fig. 4.12). Brown trout ranged in length from 2.3cm to 11.2cm (Fig. 4.13). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 85%, 13% and 2% of the total brown trout catch respectively. Mean brown trout L1 and L2 were 4.4cm and 8.0cm respectively (Appendix 1). This indicates that growth of brown trout in this river

site is very slow according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

Stone loach ranged in length from 4.1cm to 8.4cm. A single perch measuring 7.6cm and a single salmon parr measuring 10.3cm and aged 1+ were also recorded.

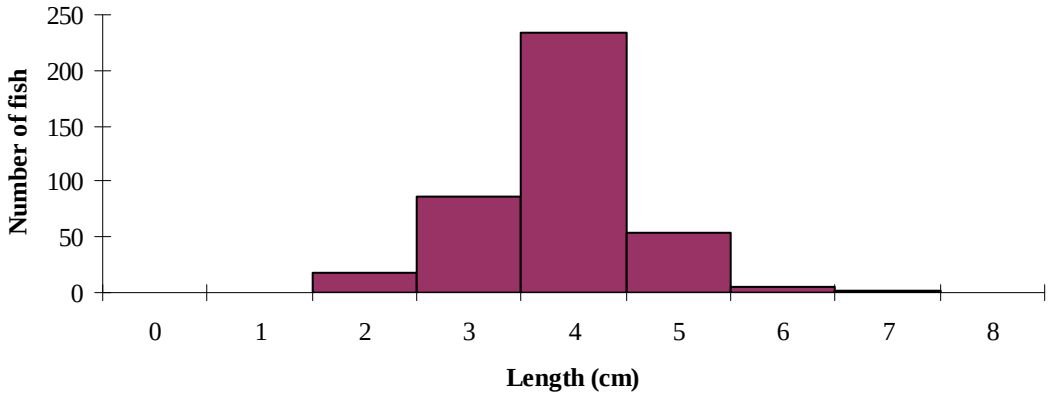

Fig. 4.12. Length frequency distribution of minnow in the Owenbrin River site, July 2009 (n = 401)

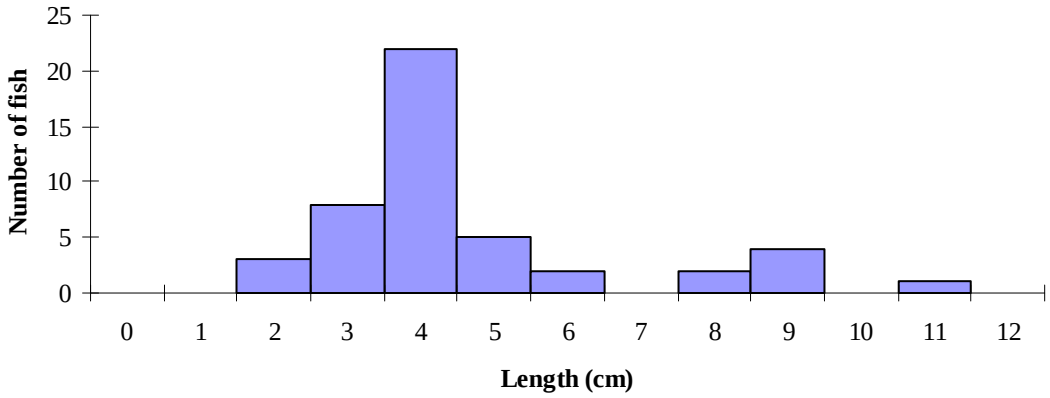

Fig. 4.13. Length frequency distribution of brown trout in the Owenbrin River site, July 2009 (n = 47)

4.1.5 The Owendalulleegh River

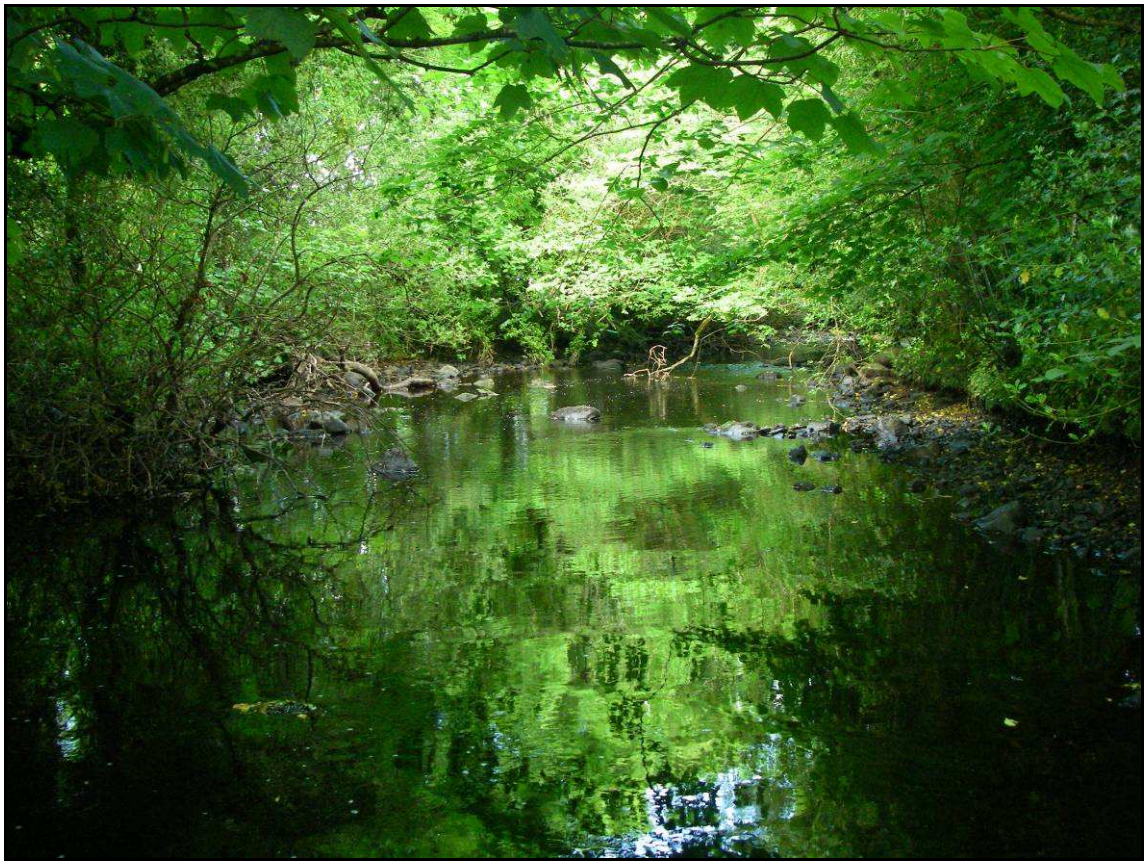

Plate 4.5. The Owendalulleegh River near Lough Cutra, Co. Galway

The Owendalulleegh River (Plate 4.5) rises in the Slieve Aughty Mountains and runs westwards until it reaches Lough Cutra. It leaves Lough Cutra as the Beagh River and twists its way through Gort and a series of underground channels before reaching the sea at Kinvarra. The Owendalulleegh historically contained good stocks of brown trout; however, a series of landslides at Derrybrien in Co. Galway in 2003 damaged the river and may have killed up to 100,000 fish. Furthermore, resulting water pollution and siltation has probably affected spawning since then (ShRFB, 2003).

The Owendalulleegh River contains an interesting feature in the form of an unusual delta of old willow-dominated wet woodland developed behind vegetated sand bars, lying at its mouth on Lough Cutra. The survey site was located approximately 1km upstream of where the river enters Lough Cutra, near Gort in Co. Galway (Fig. 4.14).

Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 11th of August 2009 along a 45m length of river channel. The mean wetted width of the stretch surveyed was 10.6m and the mean depth was 26.0cm. This stretch was characterized by glide as the main habitat

over a substrate of predominantly cobble and gravel. The site was heavily shaded with a macrophyte composition of mainly mosses and liverworts. A total wetted area of 476m^2 was surveyed.

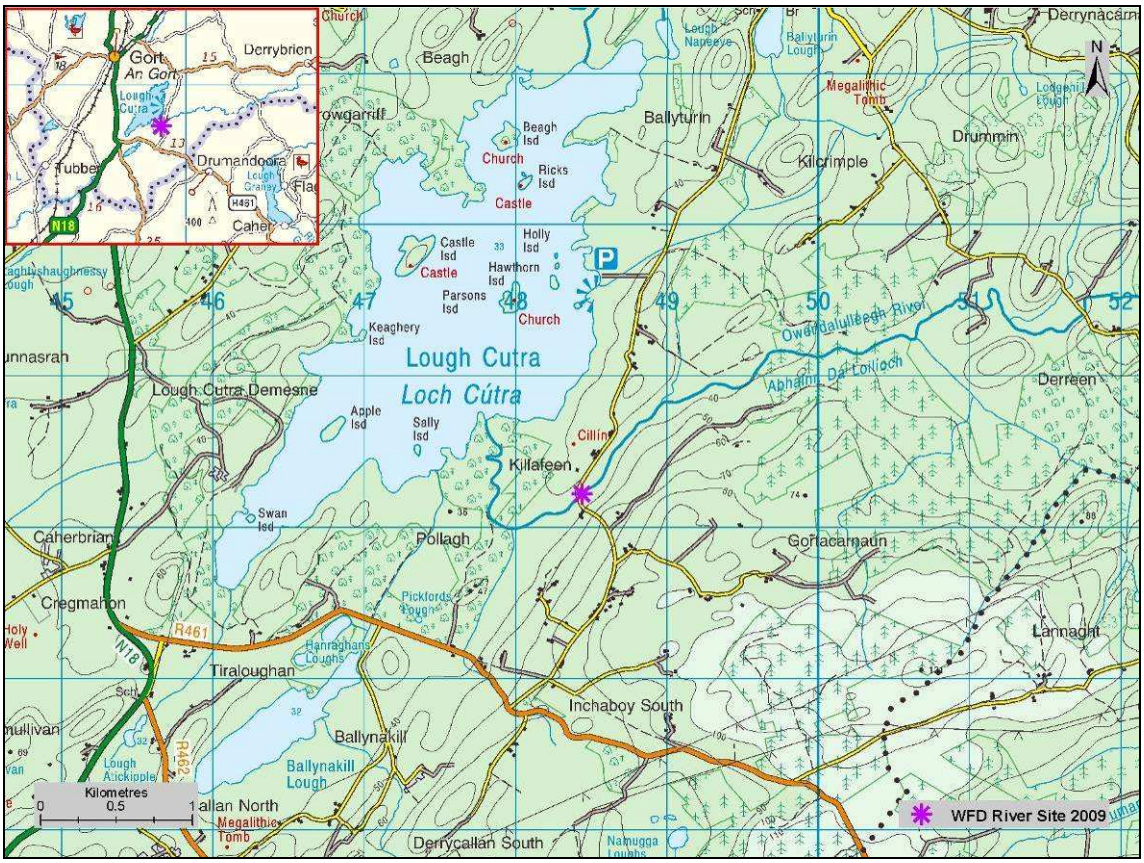

Fig. 4.14. Location of the Owendalulleegh River surveillance monitoring site

A total of six fish species were recorded in the Owendalulleegh River site. Brown trout was the most abundant species, followed by stone loach, European eel, gudgeon, juvenile lamprey and perch (Table 4.5).

Table 4.5. Density of fish (no./m^2), Owendalulleegh River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo trutta	Brown trout	0.0147	0.0525	0.0672
Barbatula barbatula	Stone loach	-	-	0.0147
Anguilla anguilla	European eel	-	-	0.0084
Gobio gobio	Gudgeon	-	-	0.0042
Lampetra sp.	Lamprey sp.	-	-	0.0021
Perca fluviatilis	Perch	-	-	0.0021
All fish	All fish	-	-	0.0987

Brown trout ranged in length from 5.7cm to 29.6cm (Fig. 4.15). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 24%, 35%, 39% and 2% of the total brown trout catch respectively. Mean brown trout L1, L2 and L3 were 8.6cm, 16.0cm and 25.1cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is fast according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

European eels ranged in length from 21.9cm to 47.6cm.

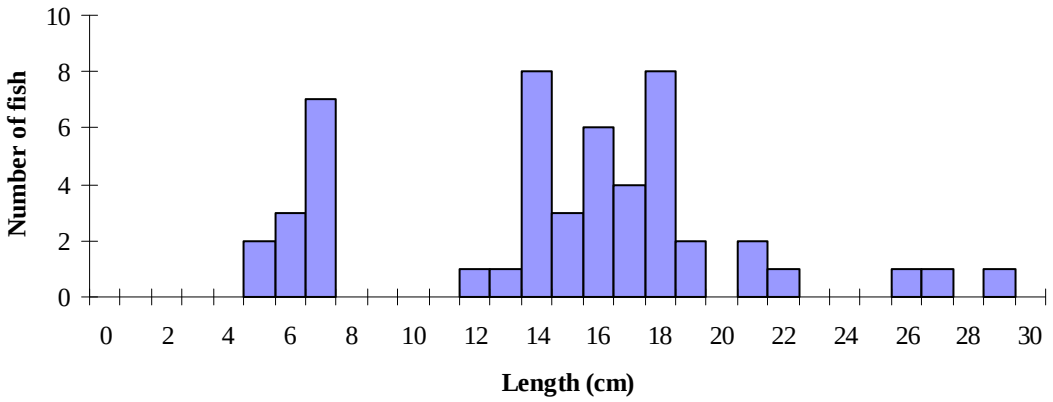

Fig. 4.15. Length frequency distribution of brown trout in the Owendalulleegh River site, August 2009 (n = 51)

4.1.6 The Unshin River

Plate 4.6. The Unshin River near Riverstown, Co. Sligo

The Unshin River (Plate 4.6) begins as the outflow of Lough Arrow, which is fed by a series of tributaries flowing into it from the Bricklieve Mountains, the Curlew Mountains and other surrounding hills. The Unshin River flows north-westwards through Riverstown and Collooney, where it joins the Owenmore River to become the Ballysadare River, subsequently entering the sea at Ballysadare Bay. Brown trout fishing is known to be good in some stretches (O'Reilly, 2009). The survey site was located 2km south-east of Riverstown (Fig. 4.16). The entire river is a candidate SAC as an example of a pristine river. The SAC also contains floating river vegetation and alluvial wet woodlands, both of which are Annex I priority habitats, and populations of salmon and otter, both of which are Annex II species (NPWS, 2005b).

One electric-fishing pass (only one pass was completed due to adverse weather conditions) was conducted using three bank-based electric-fishing units on the 13th of July 2009 along a 40m length of river channel. The mean wetted width of the stretch surveyed was 8.2m and the mean depth was 40.0cm. Glide and pool were the dominant habitat types present, over a substrate composed of mainly gravel and sand.

There was a good diversity of macrophyte vegetation within the channel. Mosses were scattered throughout the middle of the stream, while the margins contained numerous emergent species. Various floating species were also present within the channel. A total wetted area of 329m^2 was surveyed.

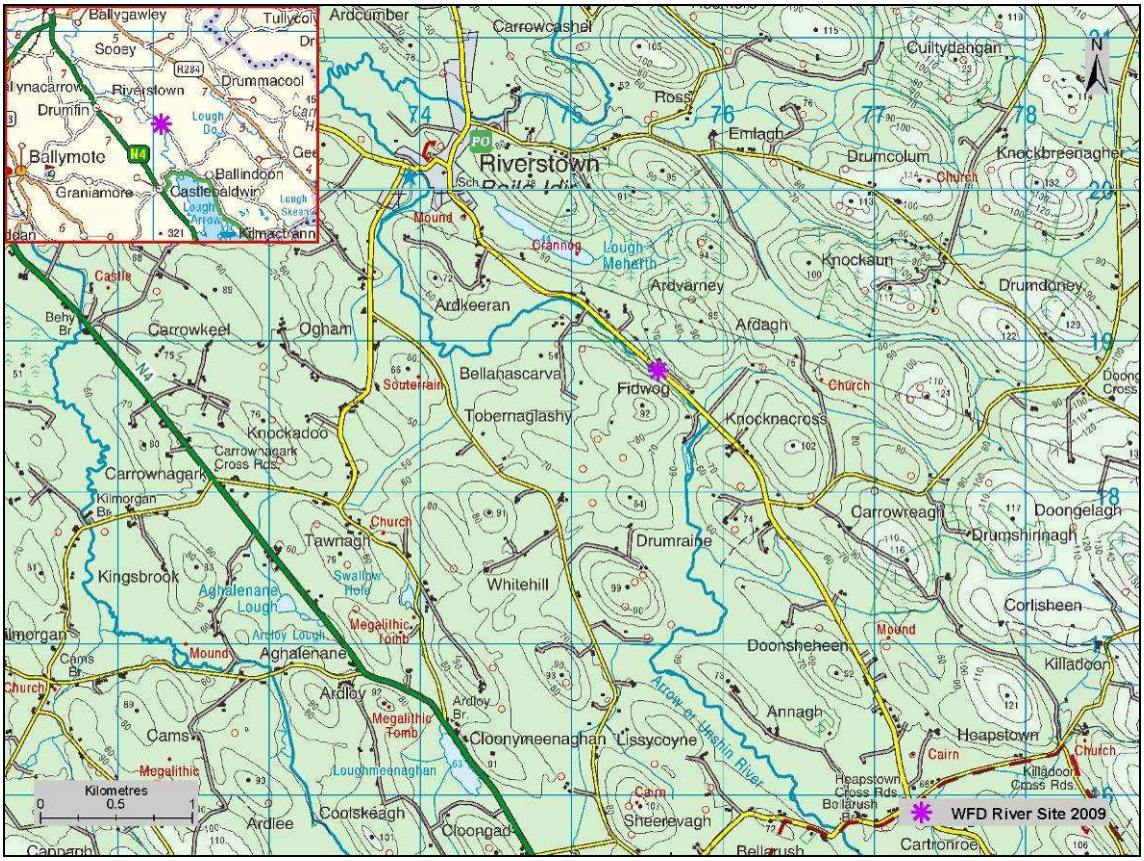

Fig. 4.16. Location of the Unshin River surveillance monitoring site

A total of five fish species were recorded in the Unshin River site (Table 4.6). Salmon was the most abundant species, followed by brown trout, minnow, perch and pike.

Table 4.6. Density of fish (no./m^2), Unshin River (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo salar	Salmon	0.2763	0.1366	0.4130
Salmo trutta	Brown trout	0.0364	0.0213	0.0577
Phoxinus phoxinus	Minnow	-	-	0.0121
Perca fluviatilis	Perch	-	-	0.0091
Esox lucius	Pike	-	-	0.0030
All fish	All fish	-	-	0.4949

Salmon ranged in length from 3.6cm to 13.6cm (Fig. 4.17). Two age classes (0+ and 1+) were present, accounting for approximately 67% and 33% of the total salmon catch respectively. Mean salmon L1 was 4.5cm (Appendix 2).

Brown trout ranged in length from 4.6cm to 22.4cm (Fig. 4.18). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 63%, 32% and 5% of the total brown trout catch respectively. Mean brown L1 and L2 were 5.1cm and 18.2cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is fast according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

Small numbers of minnow, small perch and a single pike measuring 28.2cm were also recorded.

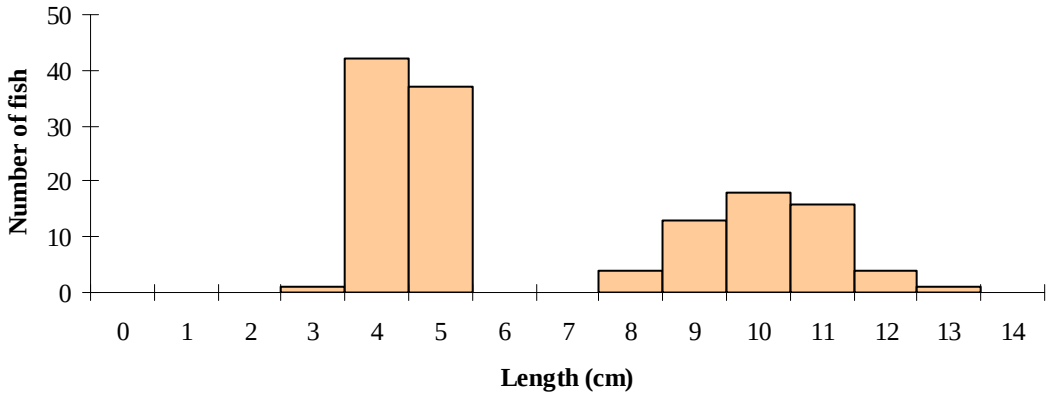

Fig. 4.17. Length frequency distribution of salmon in the Unshin River site, July 2009 (n = 136)

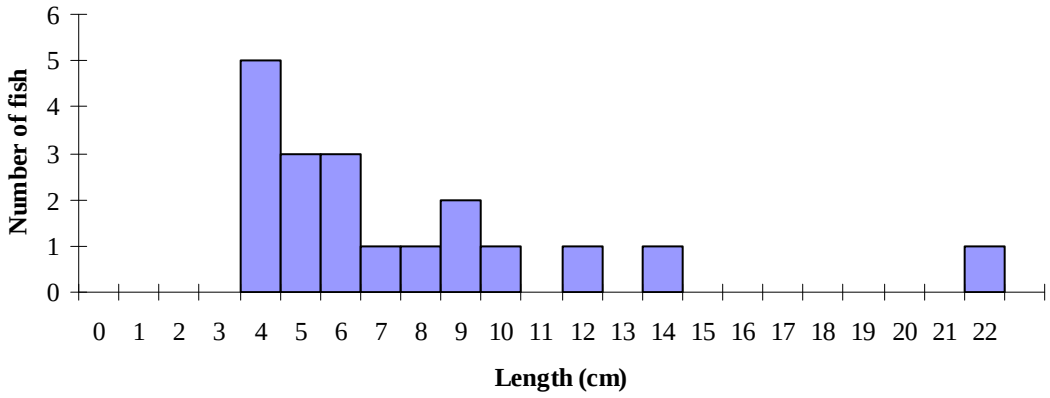

Fig. 4.18. Length frequency distribution of brown trout in the Unshin River site, July 2009 (n = 19)

4.2 Boat sites

4.2.1 The Bunowen River (Louisburgh)

Plate 4.7. The Bunowen River at Tully Bridge

The Bunowen River (Plate 4.7) is located in south-west Mayo. It rises in the Sheeffry Hills and flows north-westwards through Louisburgh before entering the sea at Clew Bay. It is popular among anglers for salmon and sea trout fly fishing. The source of the river lies within the Mweelrea/Sheefry/Erriff Complex, an extremely large SAC that contains many EU Habitats Directive Annex I priority habitats, including floating river vegetation, upland and lowland oligotrophic lakes and dystrophic lakes. Salmon, freshwater pearl mussel and otters are among the Annex II species found in this SAC (NPWS, 2005c).

One electric-fishing pass was conducted using two boat-based electric-fishing units on the 2nd of October 2008 along a 200m stretch of river channel. The stretch surveyed had a mean wetted width of 12.6m and a mean depth of 69.0cm. The site was dominated by boulders, with stretches of cobble and gravel, and the habitat consisted mainly of riffle and glide. Trees provided moderate shading along the river bank. A total wetted area of 2,520m^2 was surveyed.

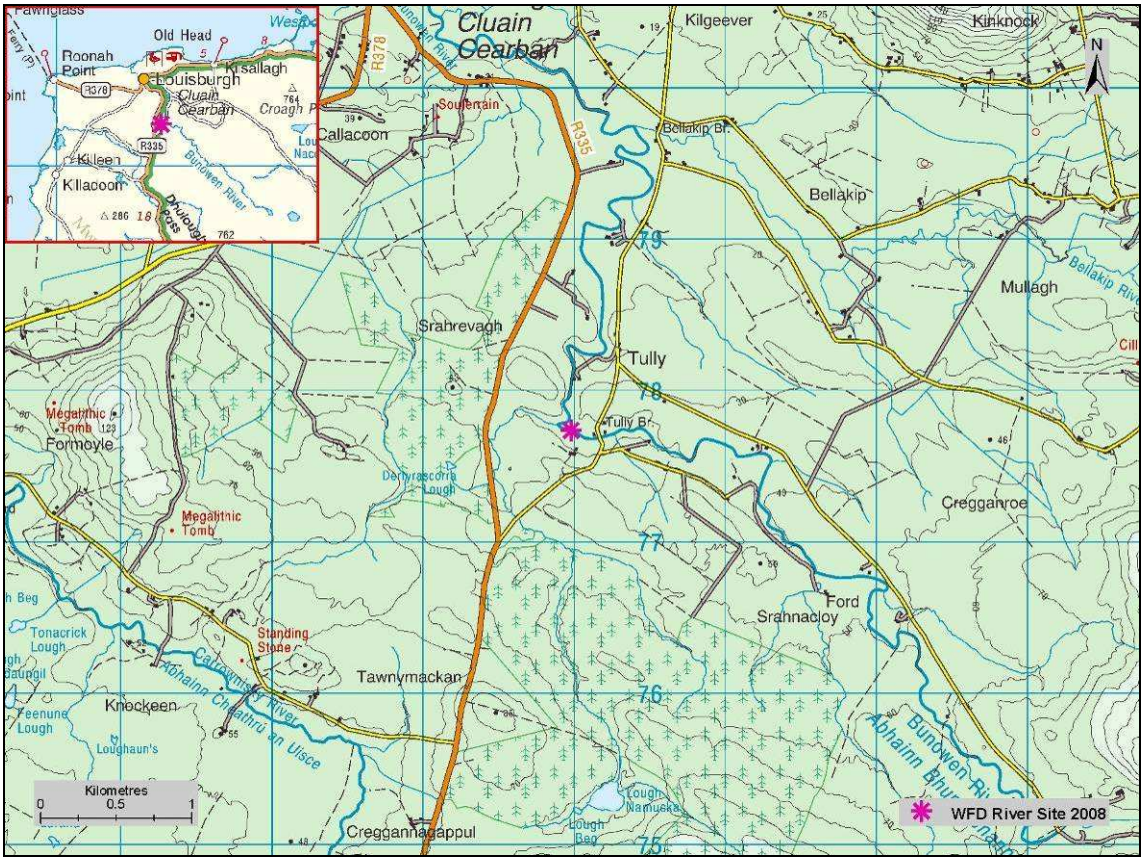

Fig. 4.19. Location of the Bunowen River surveillance monitoring site

A total of three fish species were recorded in the Bunowen River site as well as sea trout, which are treated here as a separate 'variety' of trout. Salmon was the most abundant species, followed by sea trout and brown trout (Table 4.7).

Table 4.7. Density of fish (no./m^2), in the Bunowen River site (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo salar	Salmon	0.0032	0.0048	0.0079
Salmo trutta	Sea trout	-	-	0.0024
Salmo trutta	Brown trout	-	0.008	0.0008
All fish	All fish	-	-	0.0756

Salmon ranged in length from 4.8 cm to 11.8cm (Fig. 4.20). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 40%, 50% and 10% of the total salmon catch respectively. Mean salmon L1 and L2 was 4.7cm and 7.9cm respectively (Appendix 2).

Two brown trout were captured, measuring 17.2cm and 20.8cm. Six sea trout, ranging from 27.6cm to 41.9cm, were also recorded. Mean brown trout L1 and L2 were 6.1cm and 14.4cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is slow according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971). Mean sea trout L1, L2 and L3 were 9.4cm, 18.1cm and 33.8cm respectively.

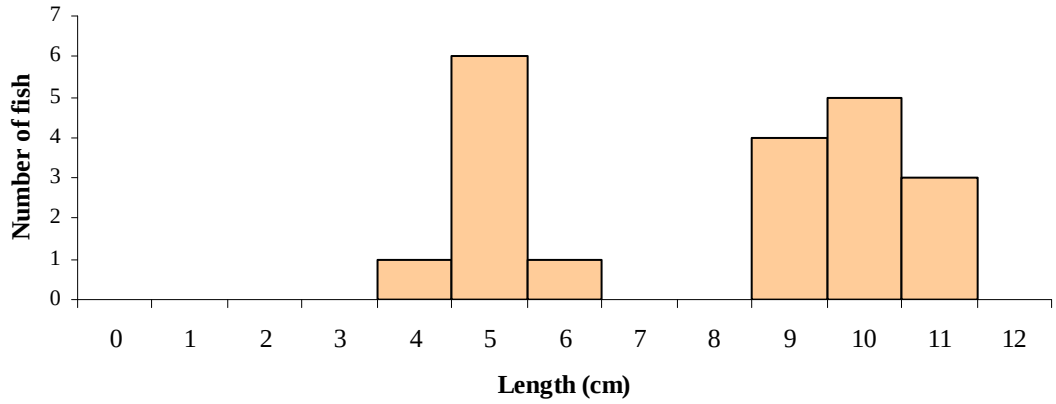

Fig. 4.20. Length frequency distribution for salmon in the Bunowen River, October 2008 (n = 20)

4.2.2 The River Nanny (Tuam)

Plate 4.8. The River Nanny upstream of its confluence with the Clare River, Co. Galway

The River Nanny (Plate 4.8) is a short tributary of the Clare River in Co. Galway. It rises approximately 7km east of Tuam and flows through the town itself before reaching the Clare River 1km downstream. The River Nanny is a small tributary and is likely to hold relatively low interest to the angler; however the Clare River is considered an excellent angling water and holds good stocks of salmon and brown trout (O'Reilly, 2009). As a tributary of Lough Corrib, the River Nanny is included within the Lough Corrib SAC, which includes several inflowing rivers that are important for salmon (NPWS, 2005a).

The survey site was located upstream of a bridge on farmland approximately 75m from the Clare River confluence (Fig. 4.21). Three electric-fishing passes were conducted using one boat-based electric-fishing unit on the 3rd of July 2009 along a 115m length of river channel. The mean wetted width of the stretch surveyed was 6.3m and the mean depth was 73.0cm. Pool was the dominant habitat type, whilst mud and silt were the dominant substrate types. Macrophyte vegetation included a variety of emergent, floating and submerged species. A total wetted area of 727m^2 was surveyed.

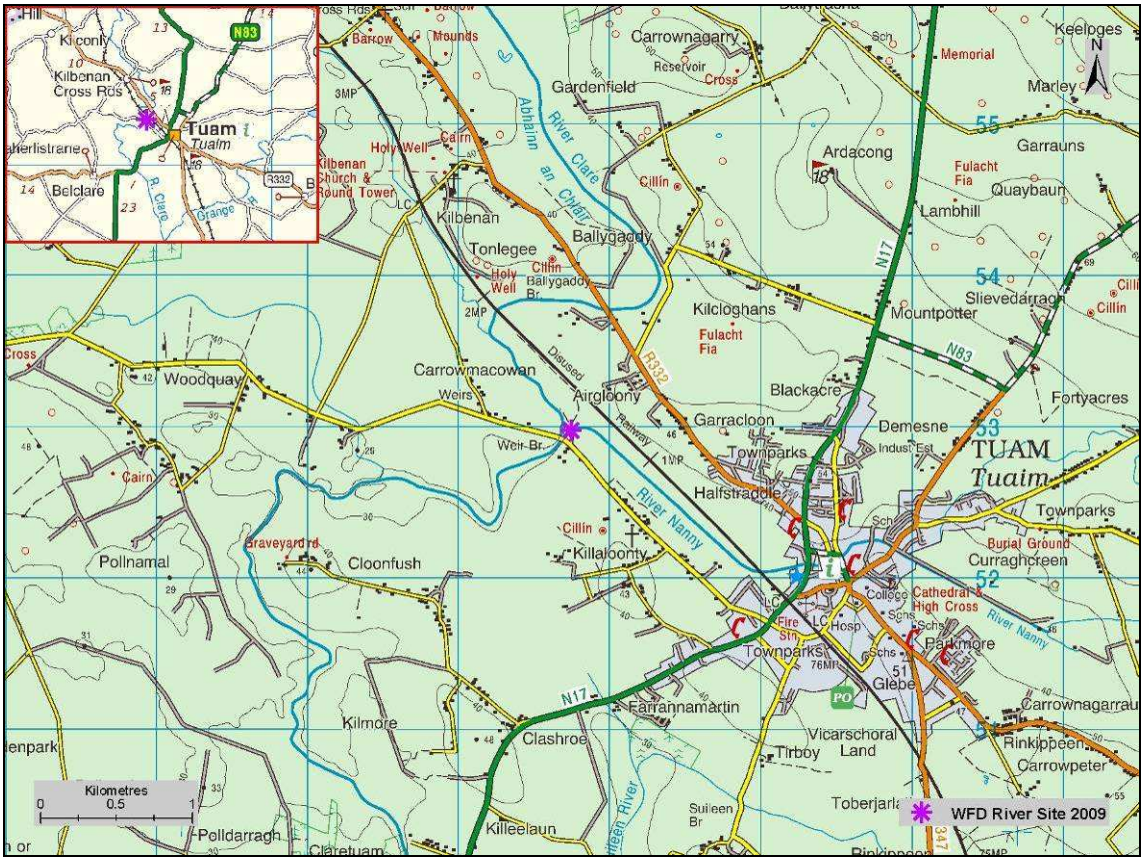

Fig. 4.21. Location of the River Nanny surveillance monitoring site

A total of five fish species were recorded in the River Nanny site. Brown trout was the most abundant species, followed by perch, pike, stone loach and salmon (Table 4.8).

Table 4.8. Density of fish (no./m^2), River Nanny (Tuam) (fish density has been calculated as minimum estimates based on the first fishing)

Species name	Common name	0+	1+ & older	Total minimum density
Salmo trutta	Brown trout	0.0014	0.0646	0.0660
Perca fluviatilis	Perch	-	-	0.0041
Esox lucius	Pike	-	-	0.0027
Barbatula barbatula	Stone loach	-	-	0.0014
Salmo salar	Salmon	-	0.0014	0.0014
All fish	All fish	-	-	0.0756

Brown trout ranged in length from 5.1cm to 37.9cm (Fig. 4.22). Six age classes (0+ to 5+) were present, accounting for approximately 2%, 29%, 51%, 14%, 3% and 1% of the total brown trout catch respectively. Mean brown trout L1, L2, L3, L4 and L5 were 9.1cm, 20.7cm, 27.1cm, 30.1cm and 35.8cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is fast

according to the classification of brown trout growth in rivers described by Kennedy and Fitzmaurice (1971).

A single salmon parr measuring 10.6cm in length and aged 2+ was also recorded, along with two pike measuring 23.4cm and 29.4cm in length.

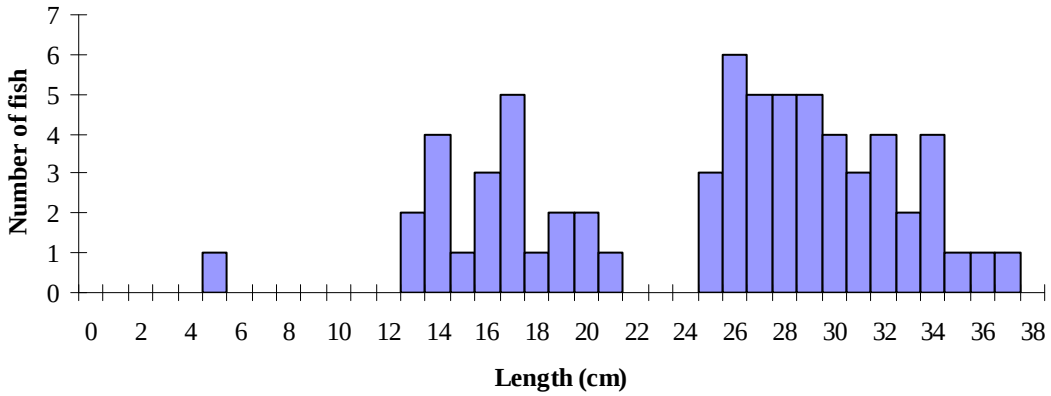

Fig. 4.22. Length frequency distribution of brown trout in the River Nanny (Tuam), July 2009 (n = 66)

4.3 Community structure

4.3.1 Species richness and composition

A total of 10 fish species (sea trout are included as a separate 'variety' of trout) were recorded within the eight WRBD sites surveyed (Fig.4.23). Brown trout was the most widespread fish species, occurring in all sites surveyed. This was followed by salmon (75% of sites), perch (50%), European eel (38%) and stone loach (38%). Minnow, pike and sea trout were each recorded at two sites (25%), and gudgeon, three-spined stickleback and lamprey were each recorded at only one site (13%).

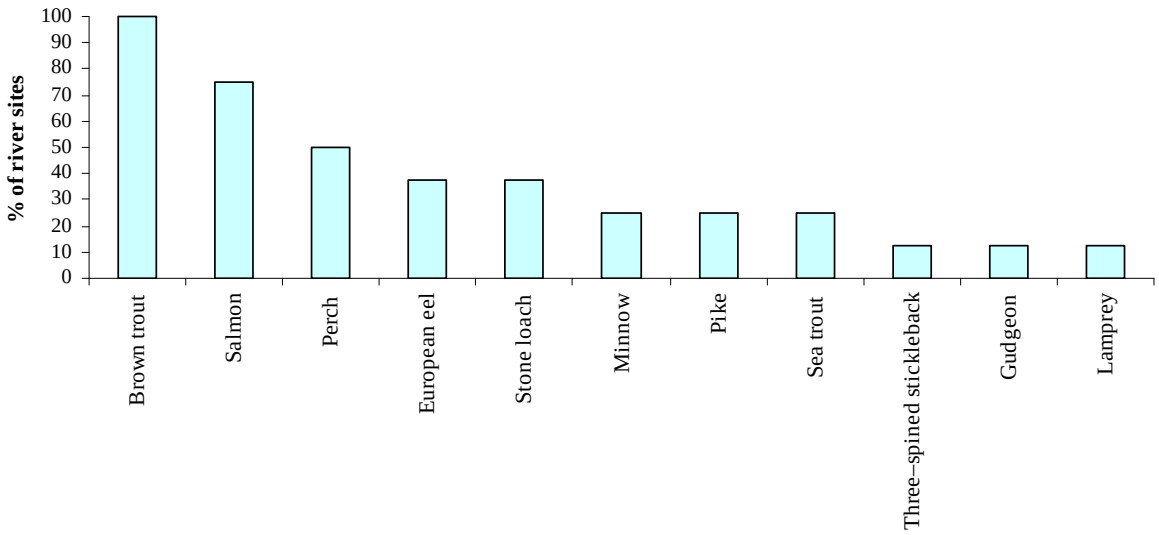

Fig. 4.23. Percentage of sites where each fish species was recorded in the WRBD for WFD SM monitoring 2009

Fish species richness for each site within the WRBD is shown in Table 4.9 below. Species richness ranged from two species in the Dunneill River to a maximum of six species recorded in the Owendalulleegh River. Kelly *et al*., (2008) classified fish species in Ireland into three groups. Group 1 – native species (e.g. salmonids, three-spined stickleback, lamprey and eel) were present at all sites surveyed, Group 2 – non-native species that influence ecology (e.g. pike, perch, minnow and stoneloach) were recorded in four of the sites and Group 3 – non-native species that generally don't influence ecology (e.g. gudgeon) were recorded at only one site.

Table 4.9. Species richness at each river site surveyed in the WRBD, July to October 2009

Site	Species richness	No. native species (Group 1)	No. non-native species (Group 2)	No. non-native species (Group 3)
		HAND-SET SITES		
Owendalulleegh	6	3	2	1
Owenbrin	5	2	3	0
Unshin	5	2	3	0
Black	4	4	0	0
Gowlan	2	2	0	0
Dunneill	2	2	0	0
		BOAT SITES		
Nanny	5	2	3	0
Bunowen	2	2	0	0

4.3.2 Species abundance and distribution

Abundance and distribution maps for the most common fish species recorded within the WRBD are shown below in Figures 4.24 to 4.47. Recorded fish densities are generally much higher in surveys using hand-set electric-fishing gear than in those conducted with boat-based electric-fishing gear. This is primarily due to the tendency for younger trout and salmon to utilise shallow, riffle areas as nursery habitat and may also be due to the difference in sampling efficiency of the two methods. As such, population densities recorded for each species using the two methods are displayed on separate maps. For comparative purposes, densities from surveys conducted during 2008 are also displayed.

Brown trout were the most widely distributed species in the WRBD, occurring in all sites. The highest densities of both brown trout fry (0+) (0.001 fish/m^2, Fig. 4.24) and 1+ and older brown trout (0.06 fish/m^2, Fig. 4.26) amongst boat sites was in the River Nanny. The highest densities of both brown trout fry (0+) (0.12 fish/m^2, Fig. 4.25) and 1+ and older brown trout (0.1 fish/m^2, Fig. 4.27) amongst hand-set sites was in the Black River (Shrule). In 2009, sea trout (Fig. 4.28 & Fig. 4.29) were only recorded in the Gowlan River, whereas in 2008, they were recorded in the Bunowen and the Glenamoy Rivers.

Salmon were present in six of the sites surveyed. The highest salmon fry (0+) density (0.003 fish/m^2, Fig. 4.30) amongst boat sites was in the Bunowen River, whilst the highest salmon parr (1+ and older) density (0.001 fish/m^2, Fig. 4.32) amongst boat sites was in the River Nanny. The highest densities of both salmon fry (0+) (0.28 fish/m^2, Fig. 4.31) and salmon parr (1+ and older) (0.14 fish/m^2, Fig. 4.33) amongst hand-set sites was in the Unshin River.

Of the remaining native species captured, European eels were recorded in three sites (Fig. 4.34 & Fig. 4.35), whereas three-spined stickleback (Fig. 4.36 & Fig. 4.37) and lamprey (Fig. 4.38 & Fig. 4.39) were recorded at only one site each. Stone loach were recorded in three sites (Fig. 4.40 & Fig. 4.41). Perch were present in four sites (Fig. 4.42 & Fig. 4.43), whilst pike (Fig. 4.44 & Fig. 4.45) and

minnow (Fig. 4.46 & Fig. 4.47) each occurred in two sites. Gudgeon were only present in one site (the Owendalulleeagh River).

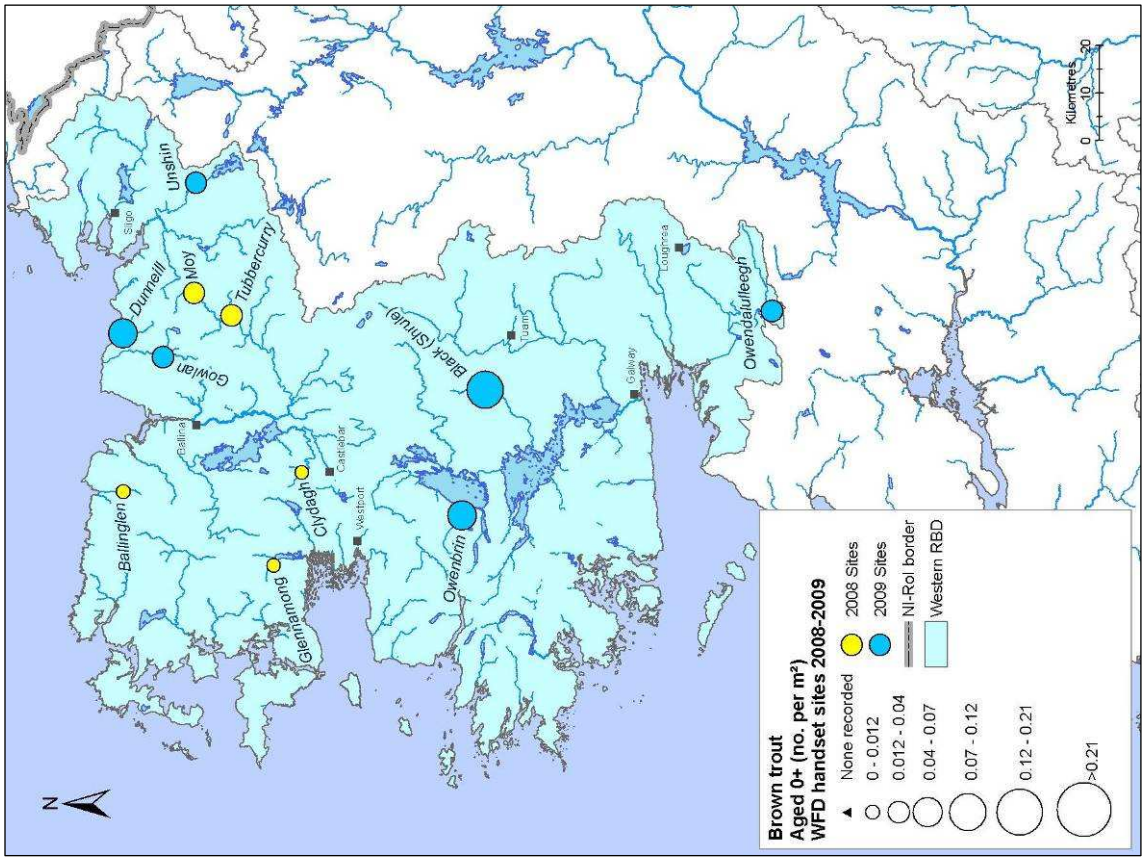

Fig. 4.25. Distribution map for 0+ brown trout in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

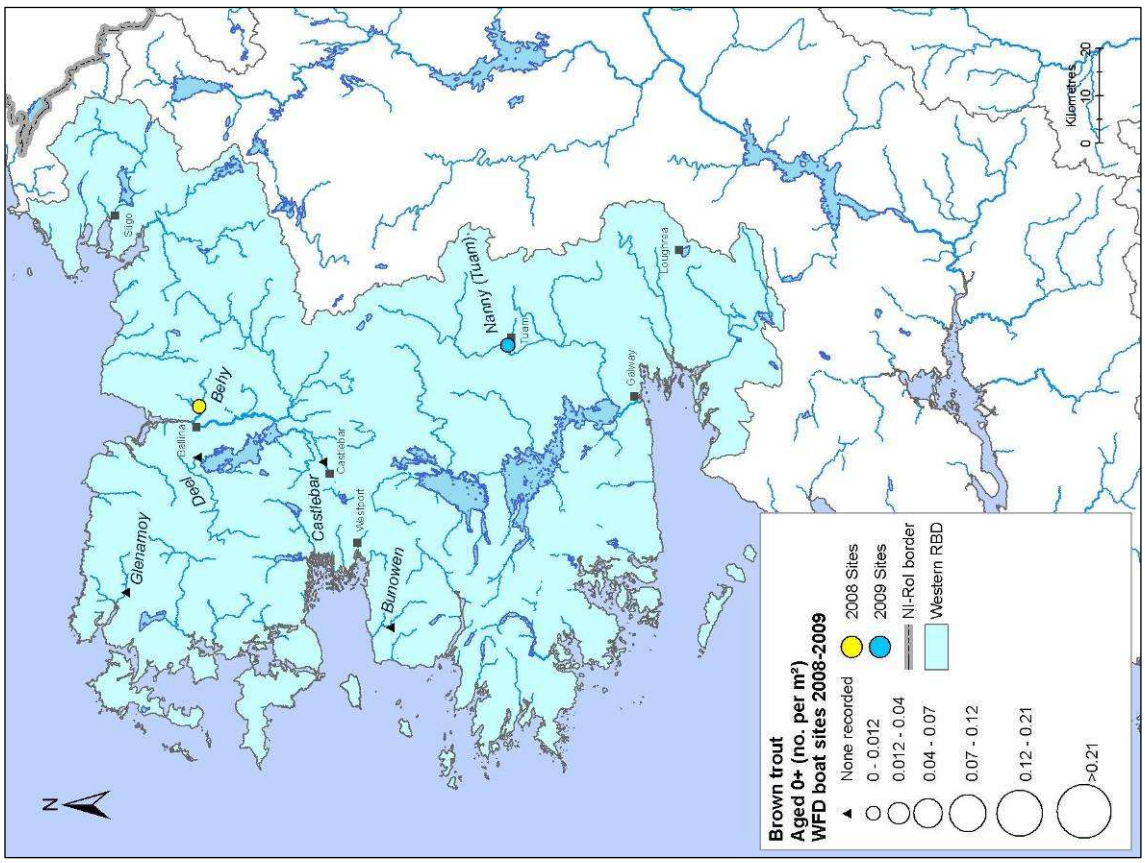

Fig. 4.24. Distribution map for 0+ brown trout in the WRBD boat sites surveyed for WFD monitoring 2008–2009

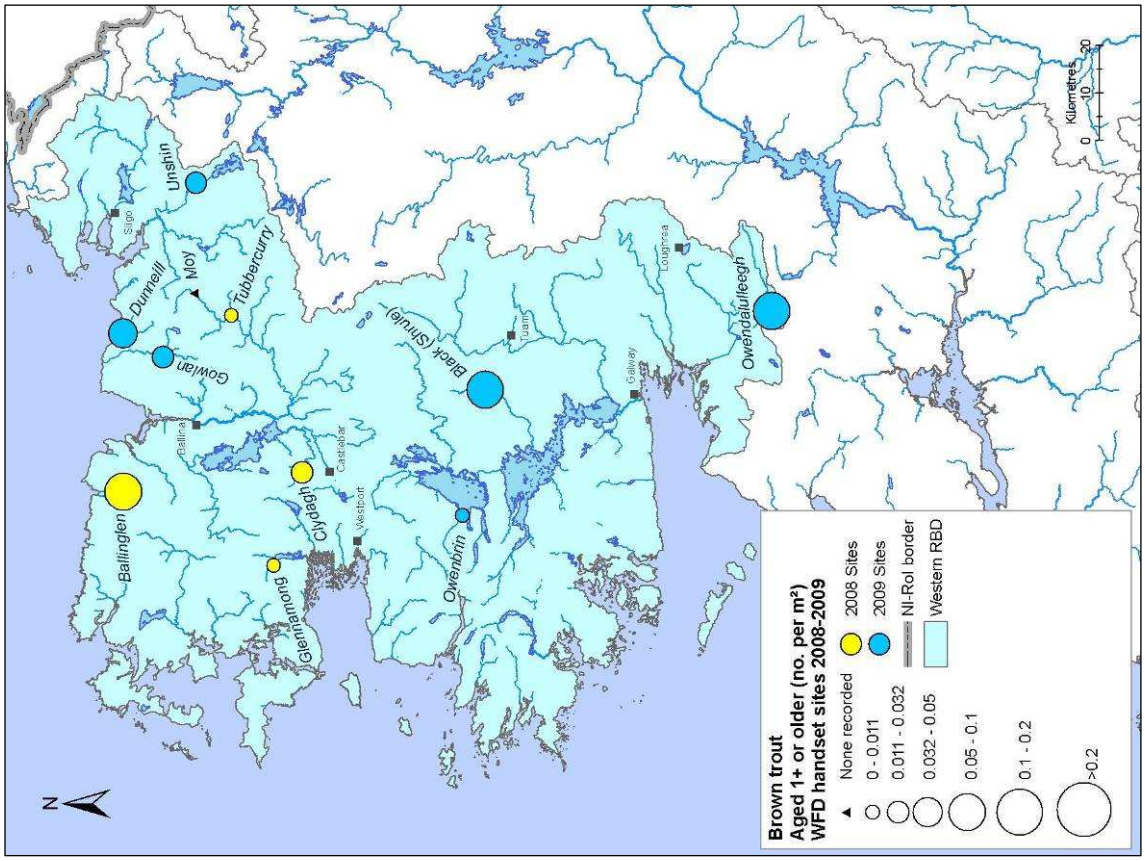

Fig. 4.27. Distribution map for 1+ or older brown trout in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

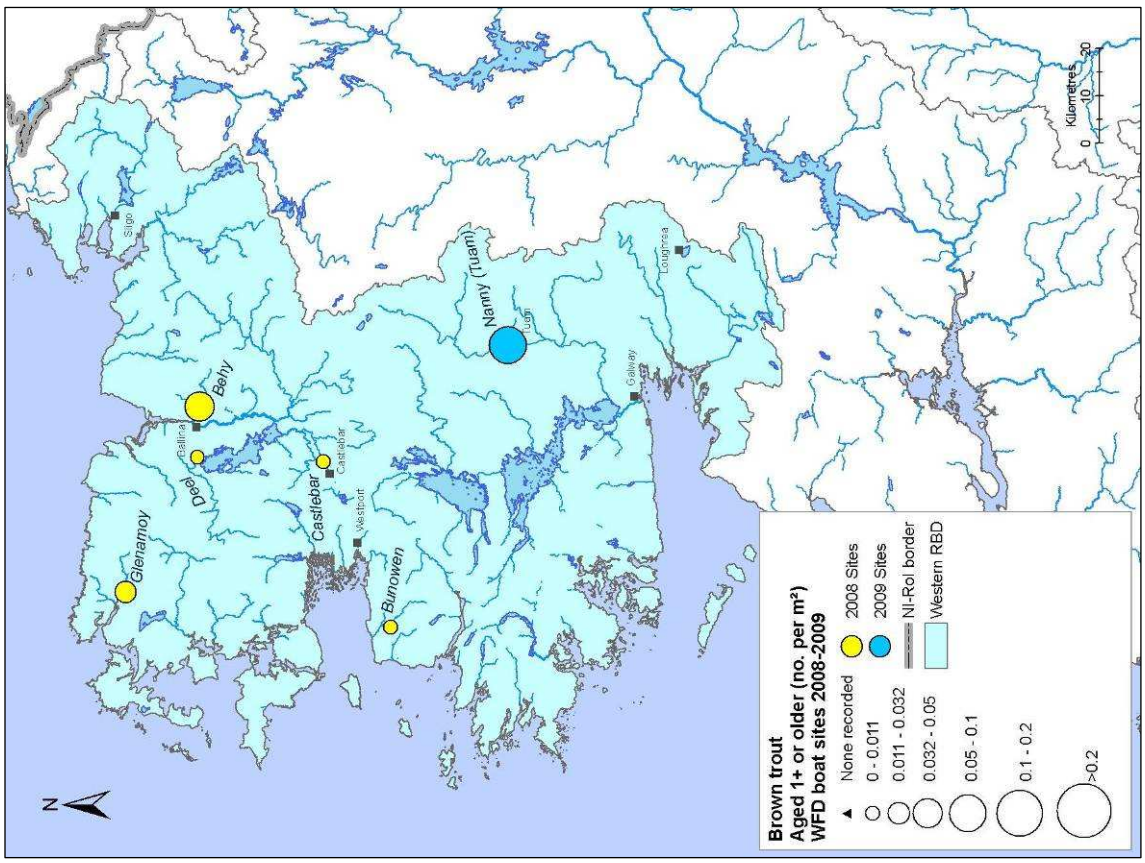

Fig. 4.26. Distribution map for 1+ or older brown trout in the WRBD boat sites surveyed for WFD monitoring 2008–2009

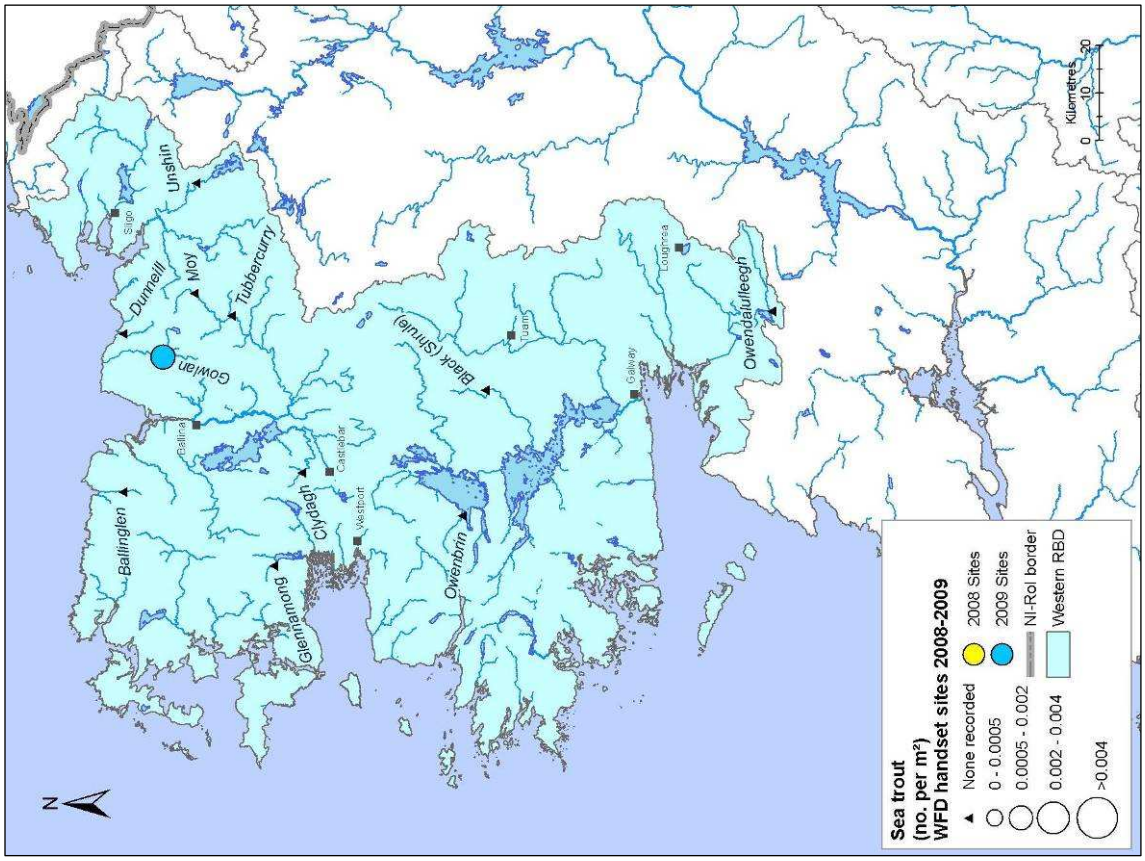

Fig. 4.29. Distribution map for sea trout in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

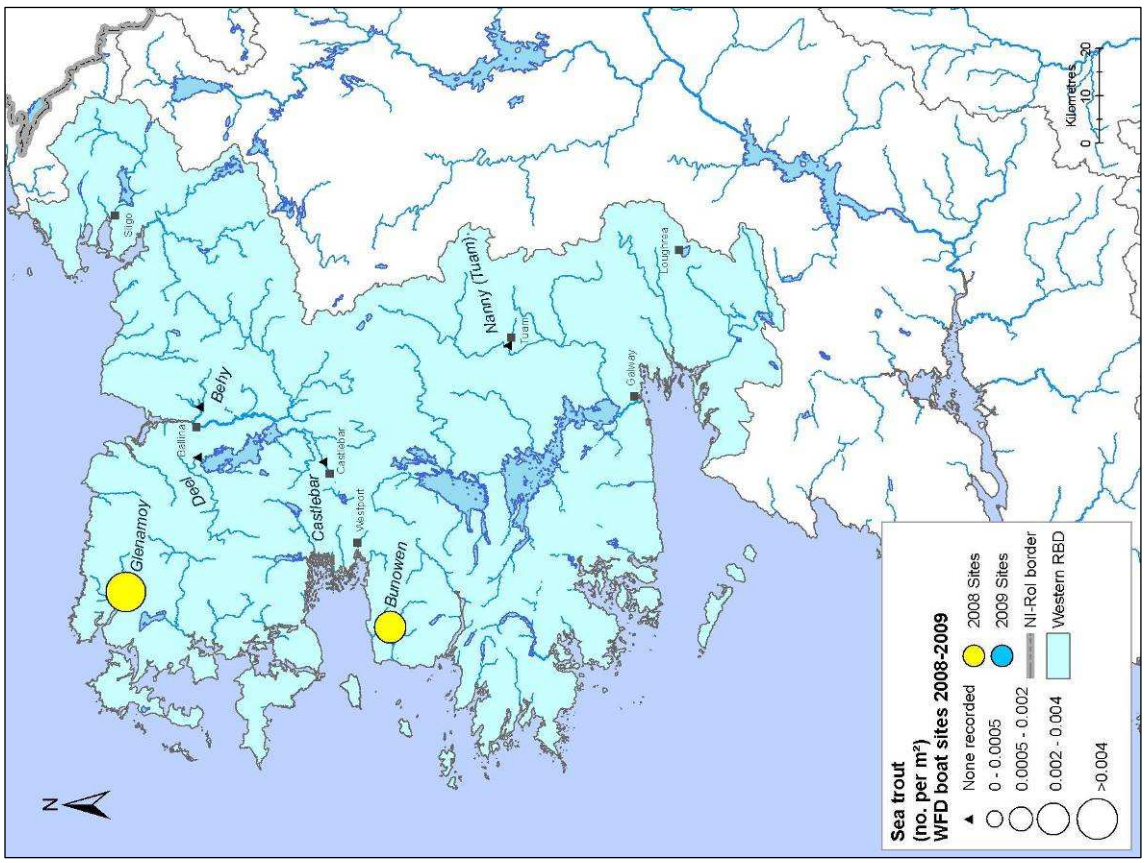

Fig. 4.28. Distribution map for sea trout in the WRBD boat sites surveyed for WFD monitoring 2008–2009

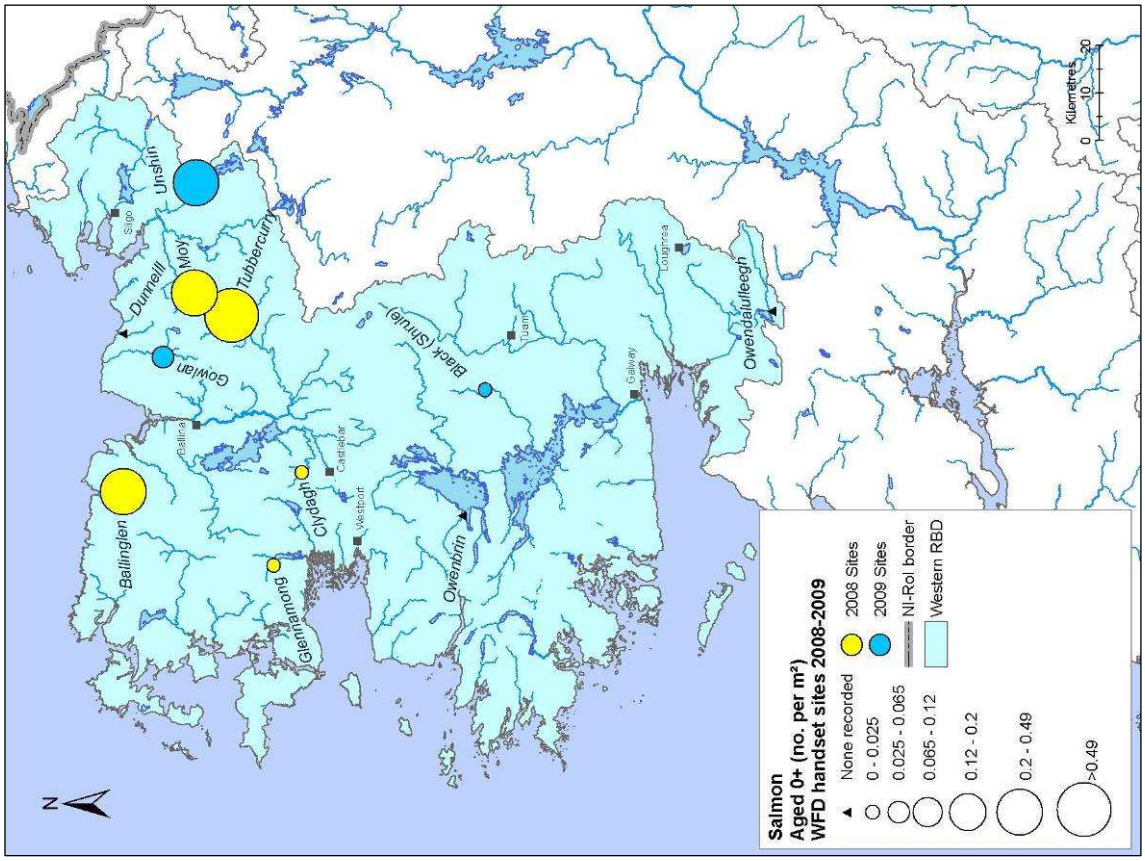

Fig. 4.31. Distribution map for 0+ salmon in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

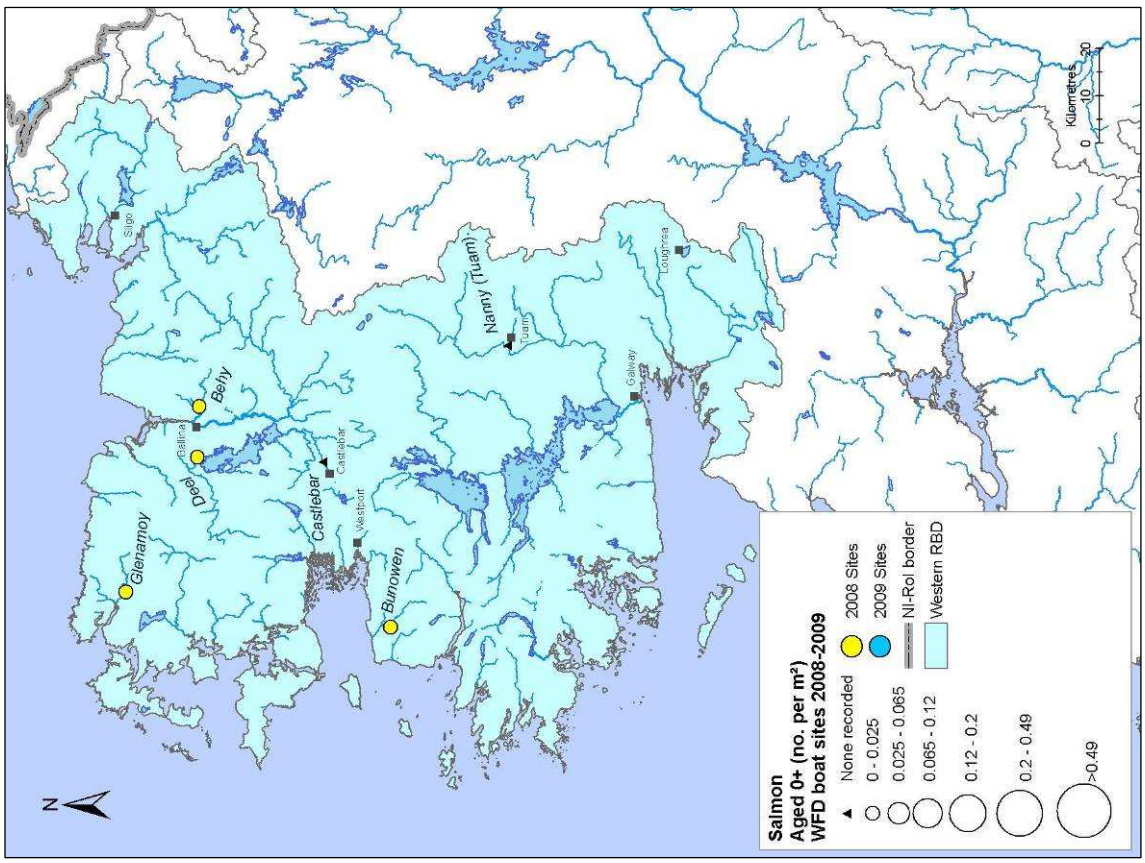

Fig. 4.30. Distribution map for 0+ salmon in the WRBD boat sites surveyed for WFD monitoring 2008–2009

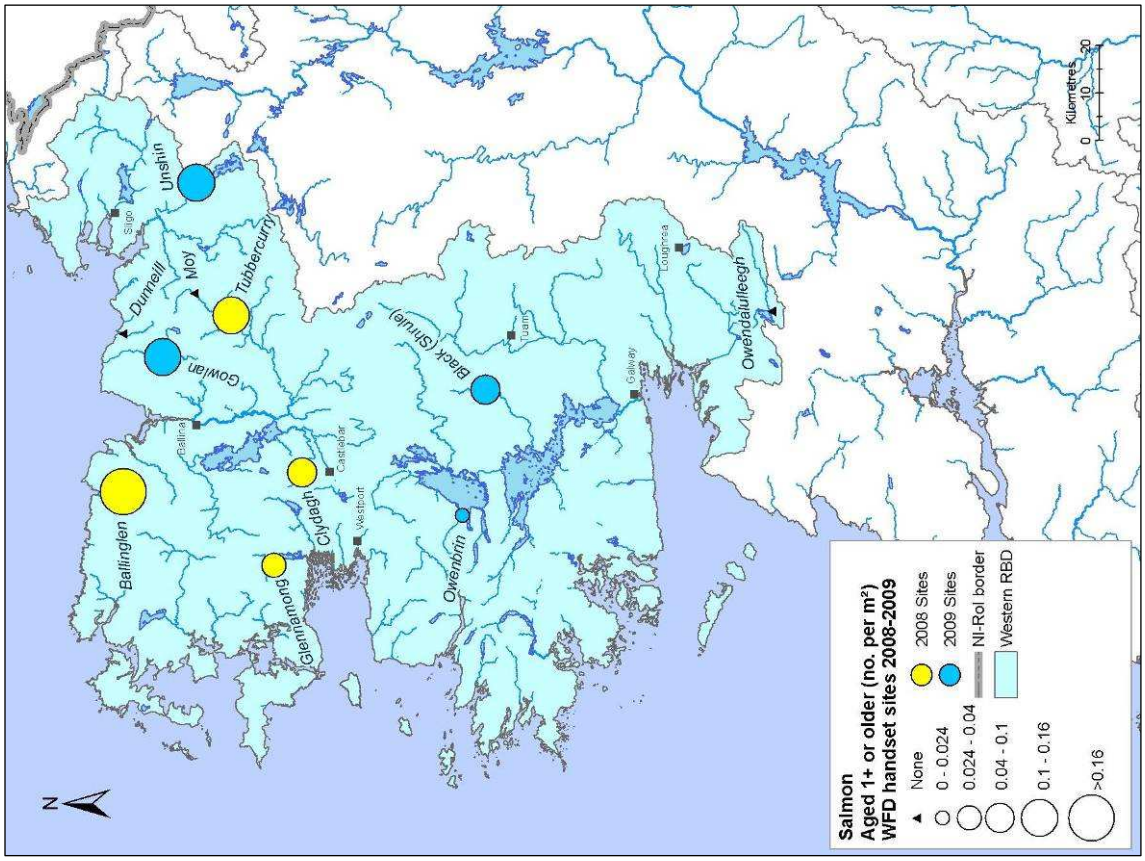

Fig. 4.33. Distribution map for 1+ or older salmon in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

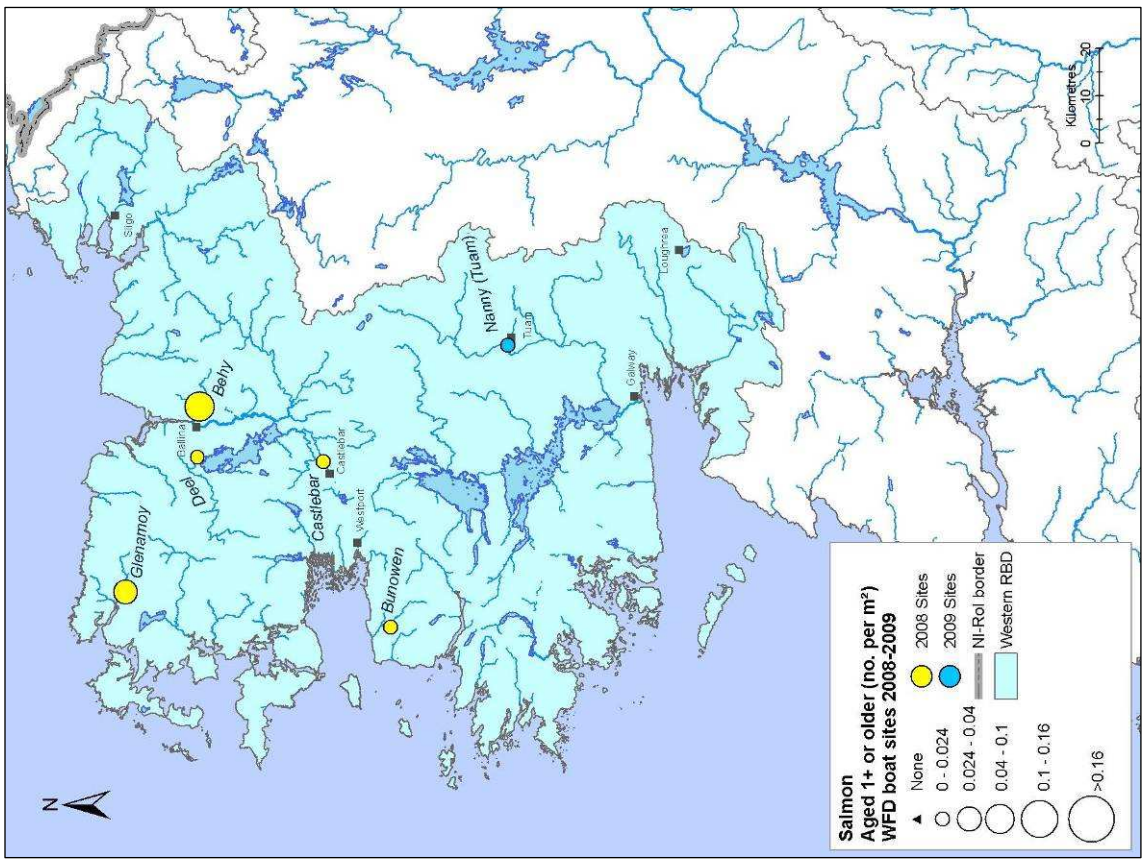

Fig. 4.32. Distribution map for 1+ or older salmon in the WRBD boat sites surveyed for WFD monitoring 2008–2009

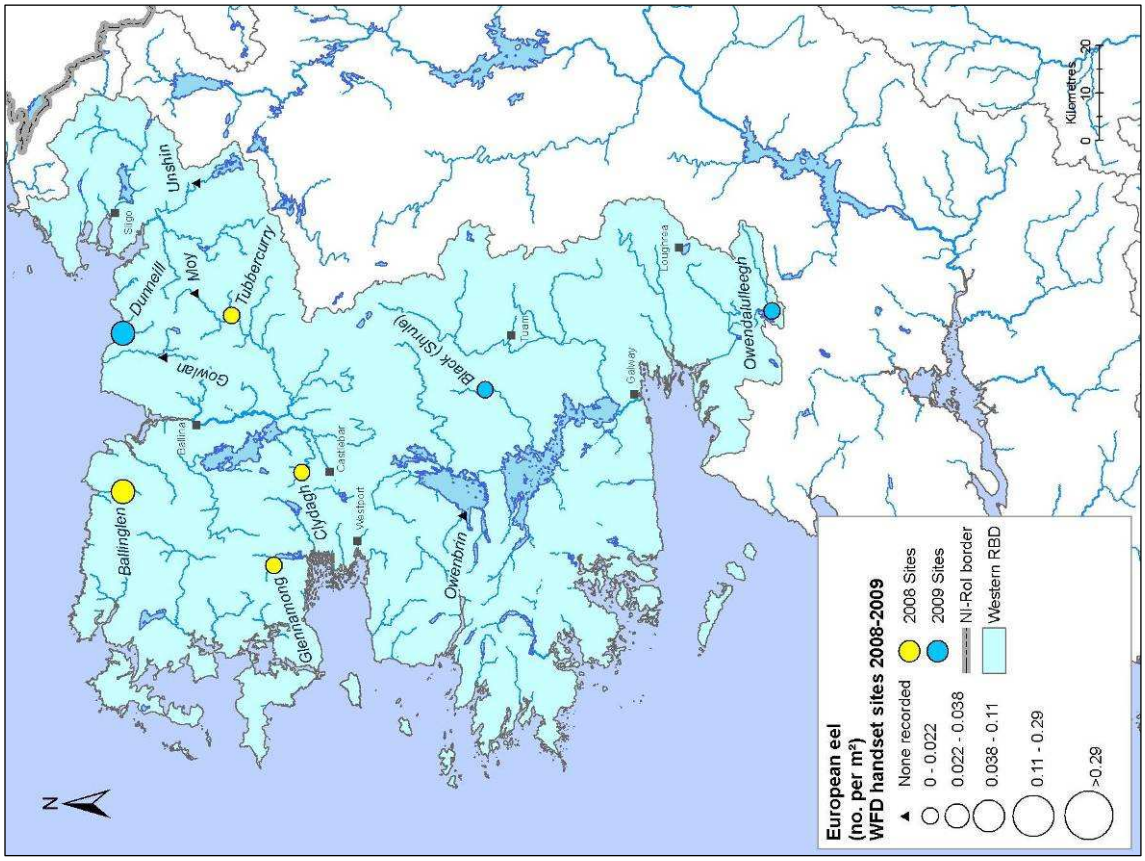

Fig. 4.35. Distribution map for European eel in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

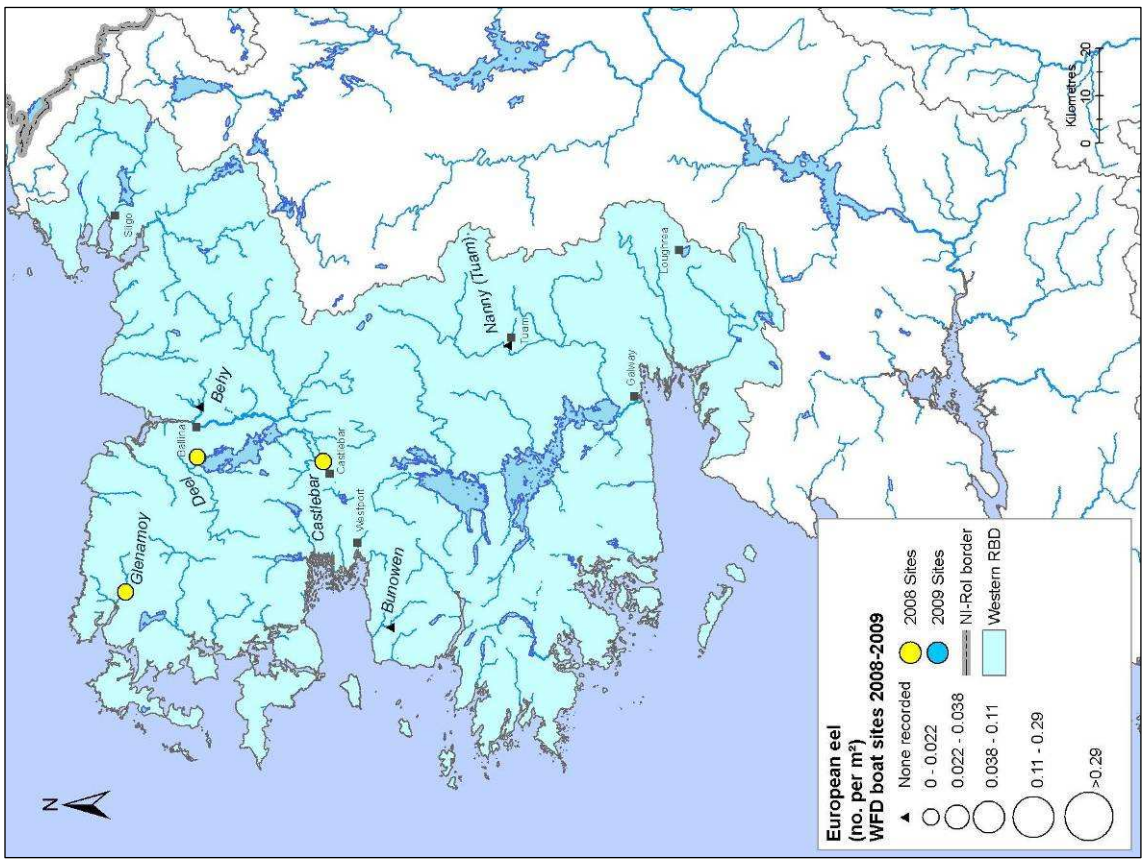

Fig. 4.34. Distribution map for European eel in the WRBD boat sites surveyed for WFD monitoring 2008–2009

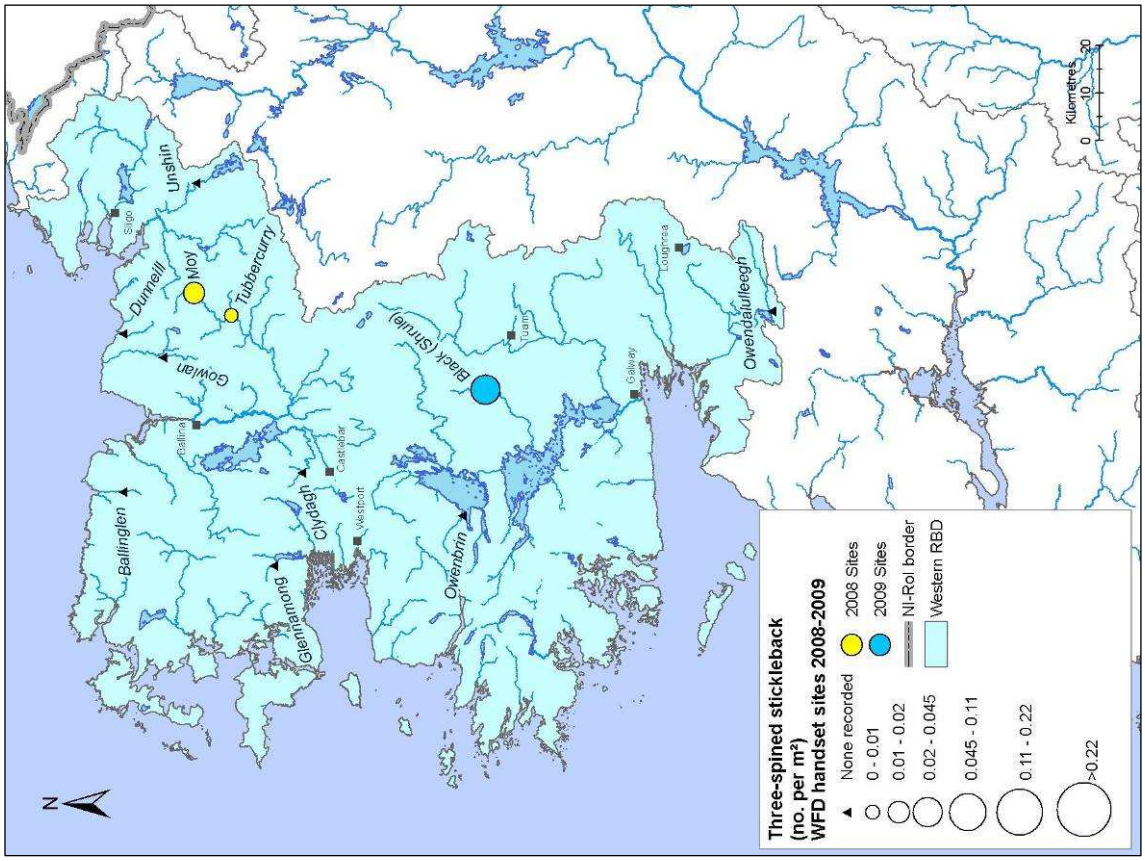

Fig. 4.37. Distribution map for three-spined stickleback in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

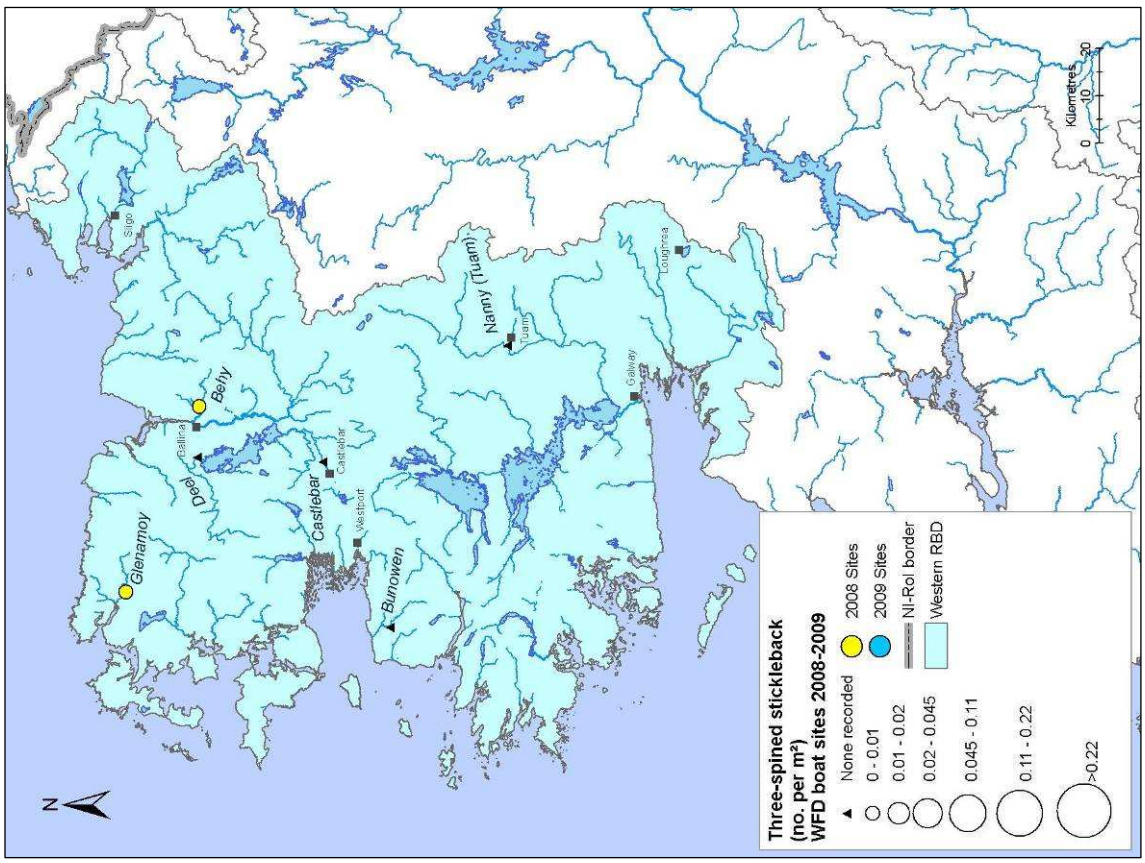

Fig. 4.36. Distribution map for three-spined stickleback in the WRBD boat sites surveyed for WFD monitoring 2008–2009

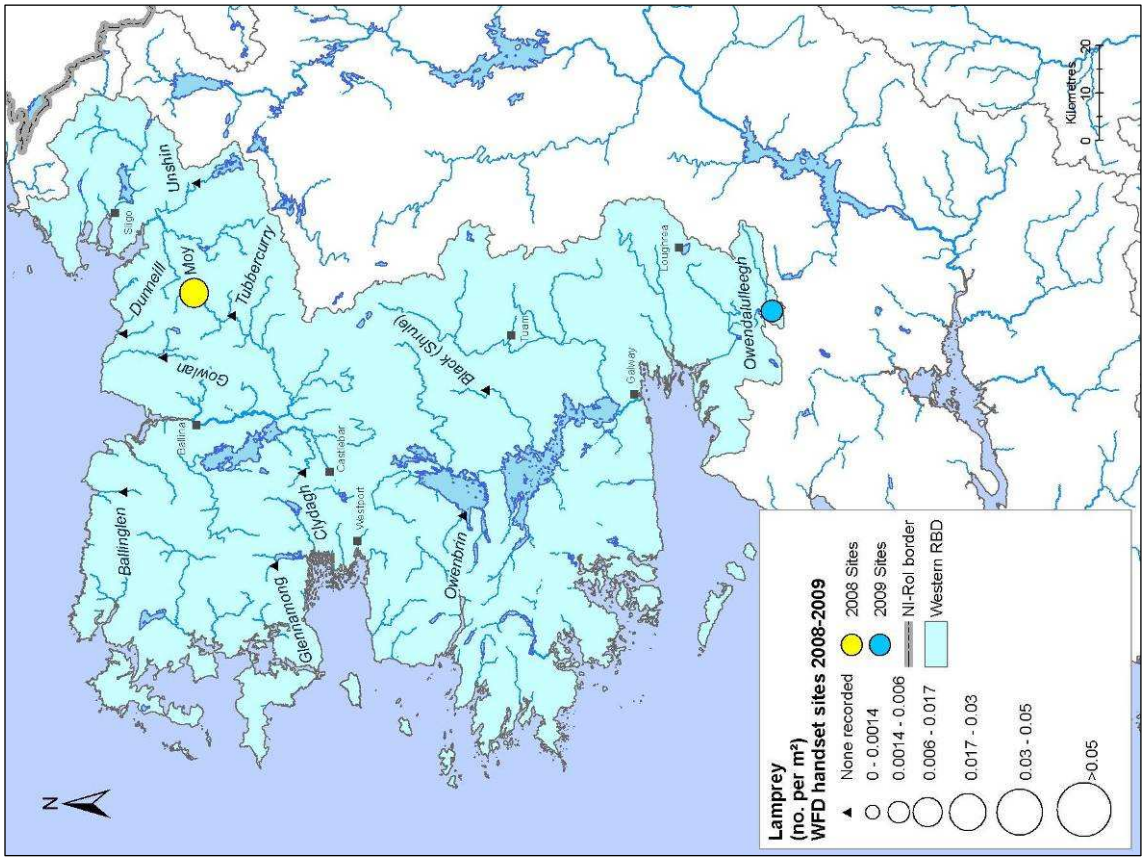

Fig. 4.39. Distribution map for lamprey in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

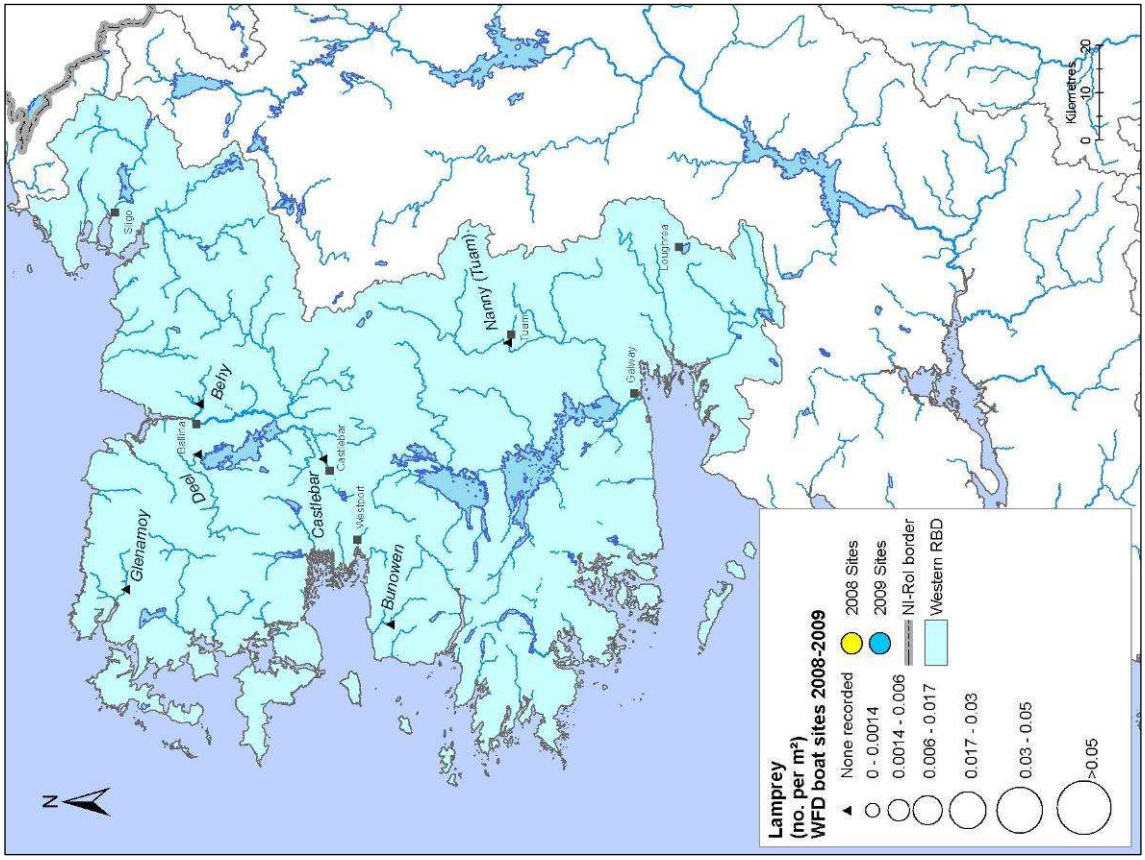

Fig. 4.38. Distribution map for lamprey in the WRBD boat sites surveyed for WFD monitoring 2008–2009

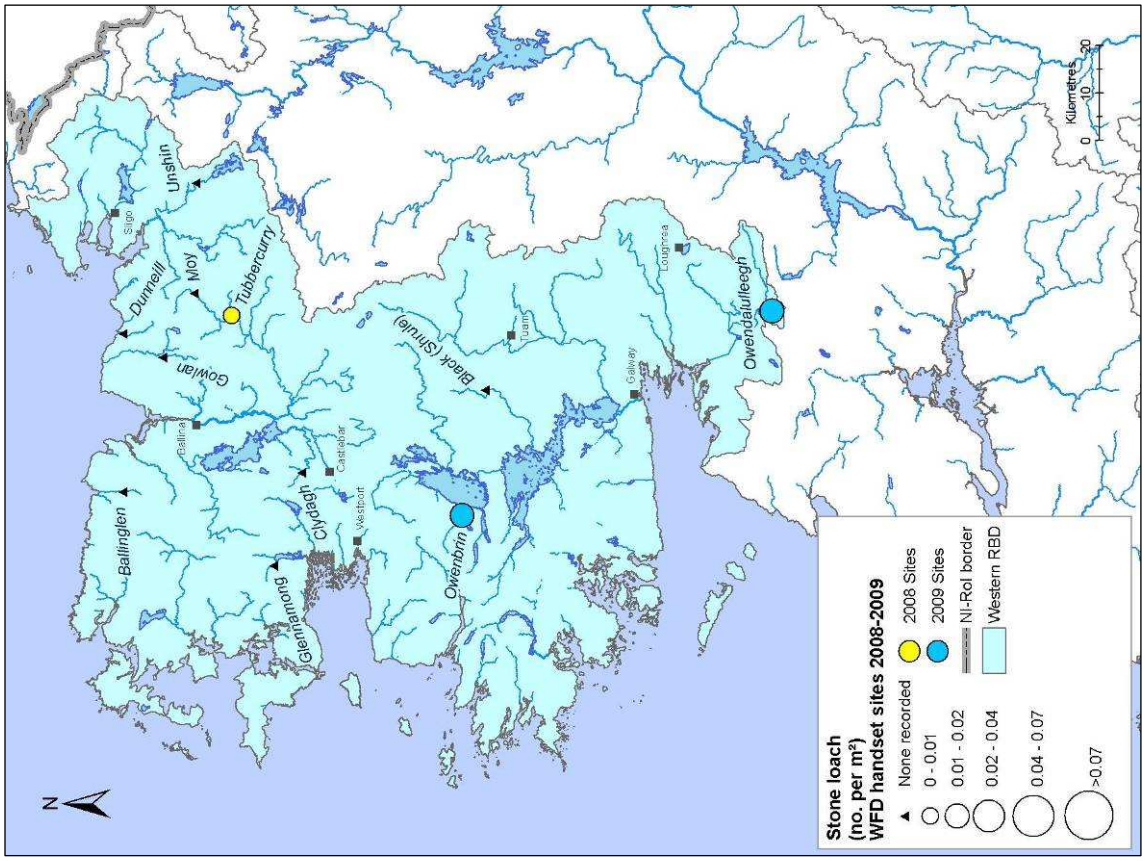

Fig. 4.41. Distribution map for stone loach in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

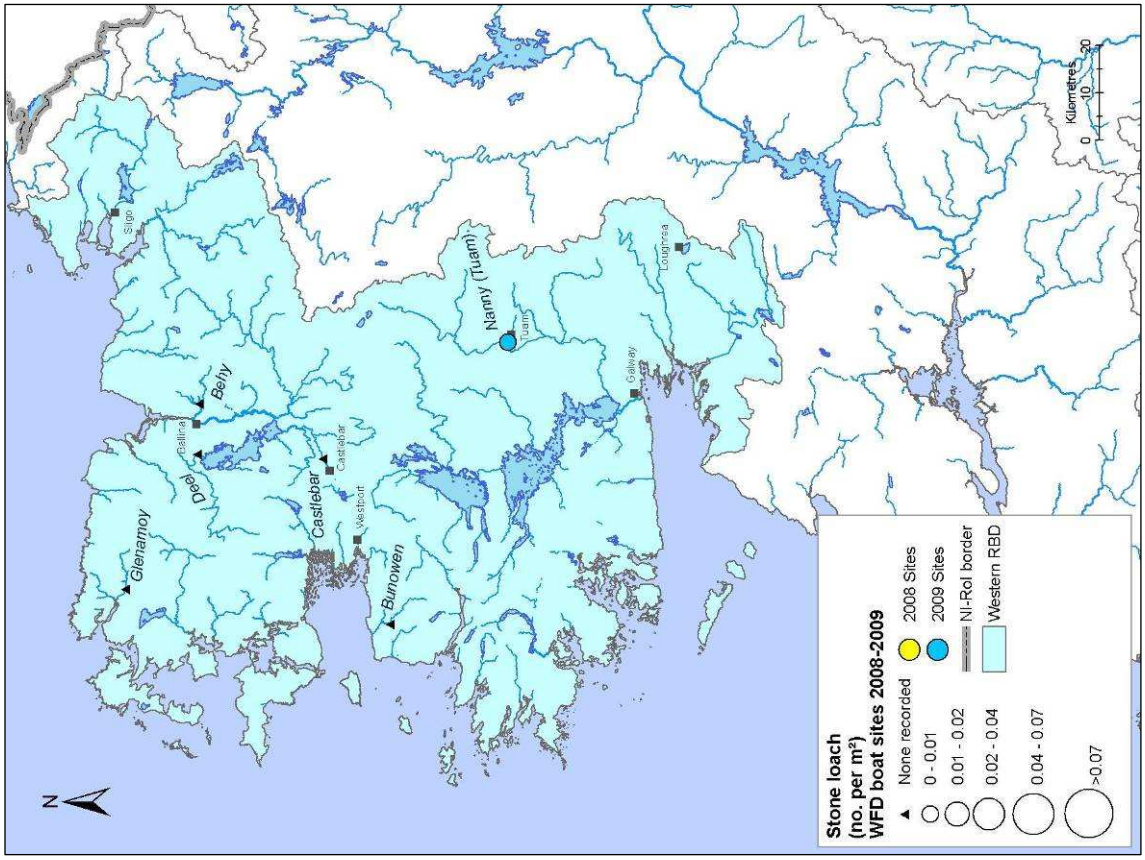

Fig. 4.40. Distribution map for stone loach in the WRBD boat sites surveyed for WFD monitoring 2008–2009

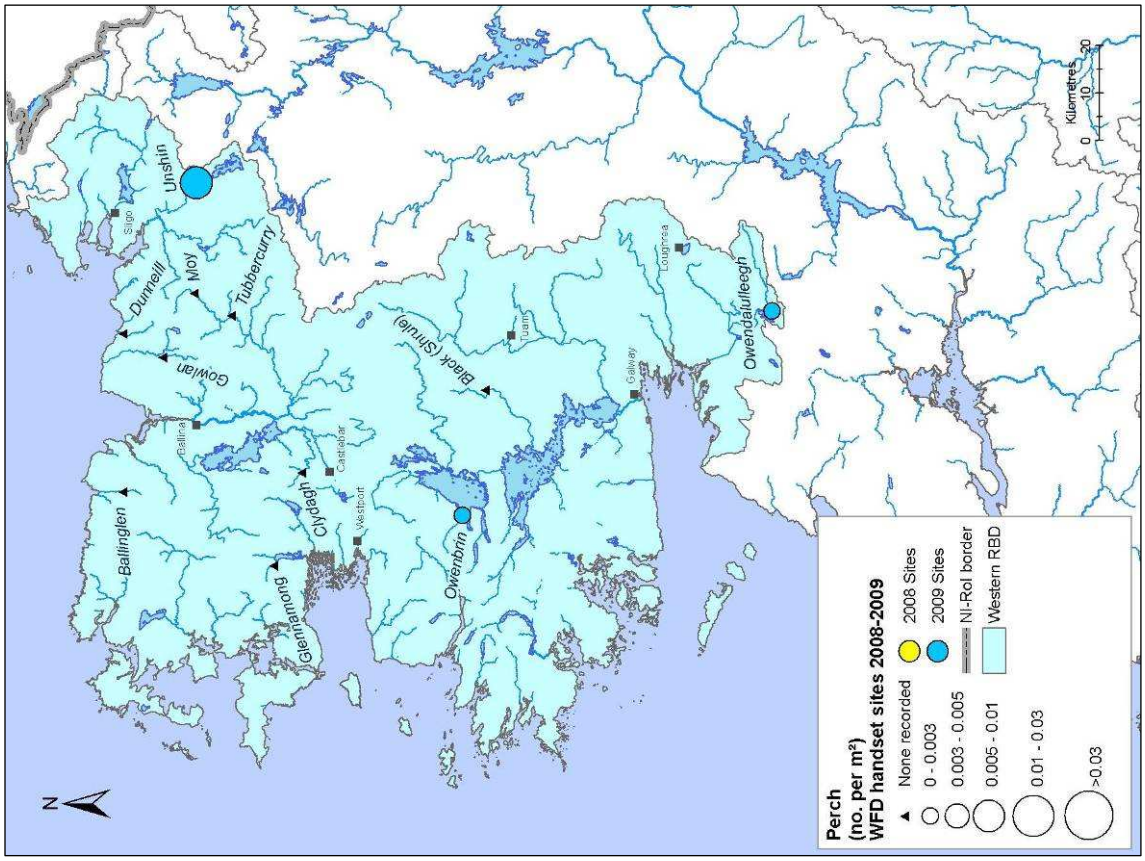

Fig. 4.43. Distribution map for perch in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

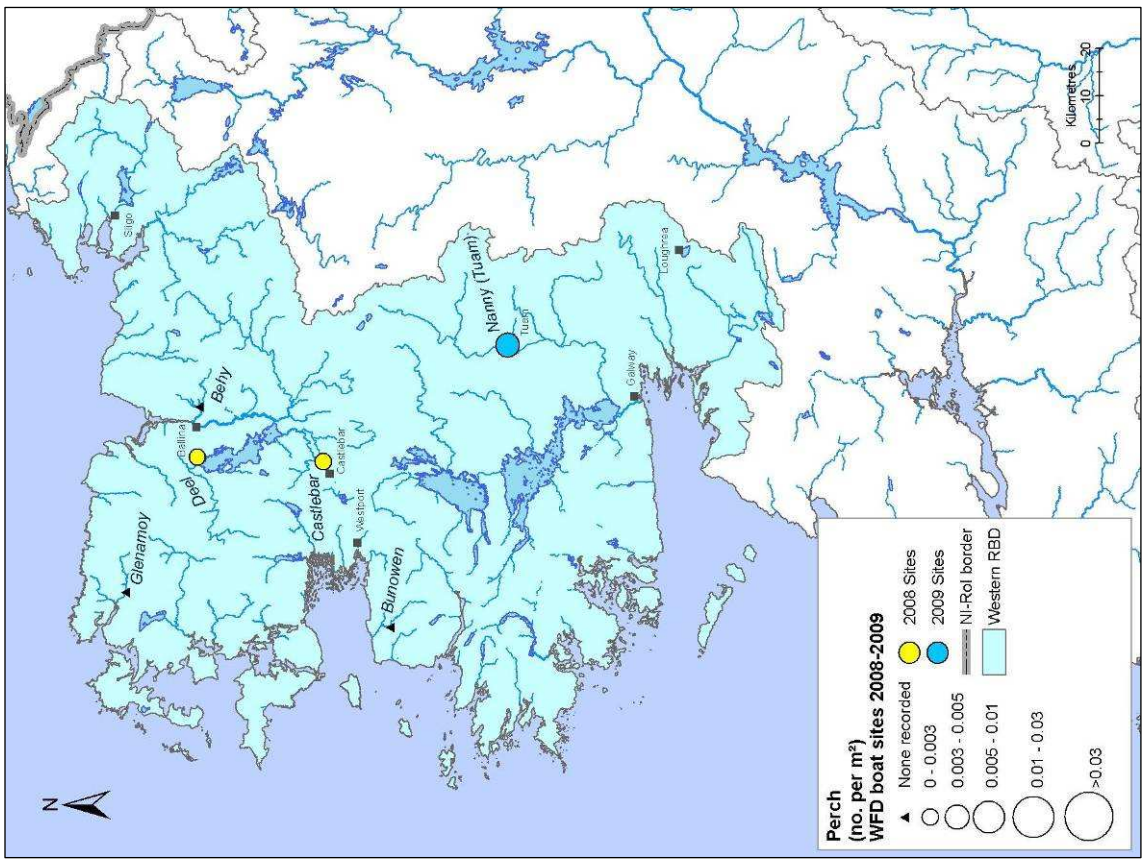

Fig. 4.42. Distribution map for perch in the WRBD boat sites surveyed for WFD monitoring 2008–2009

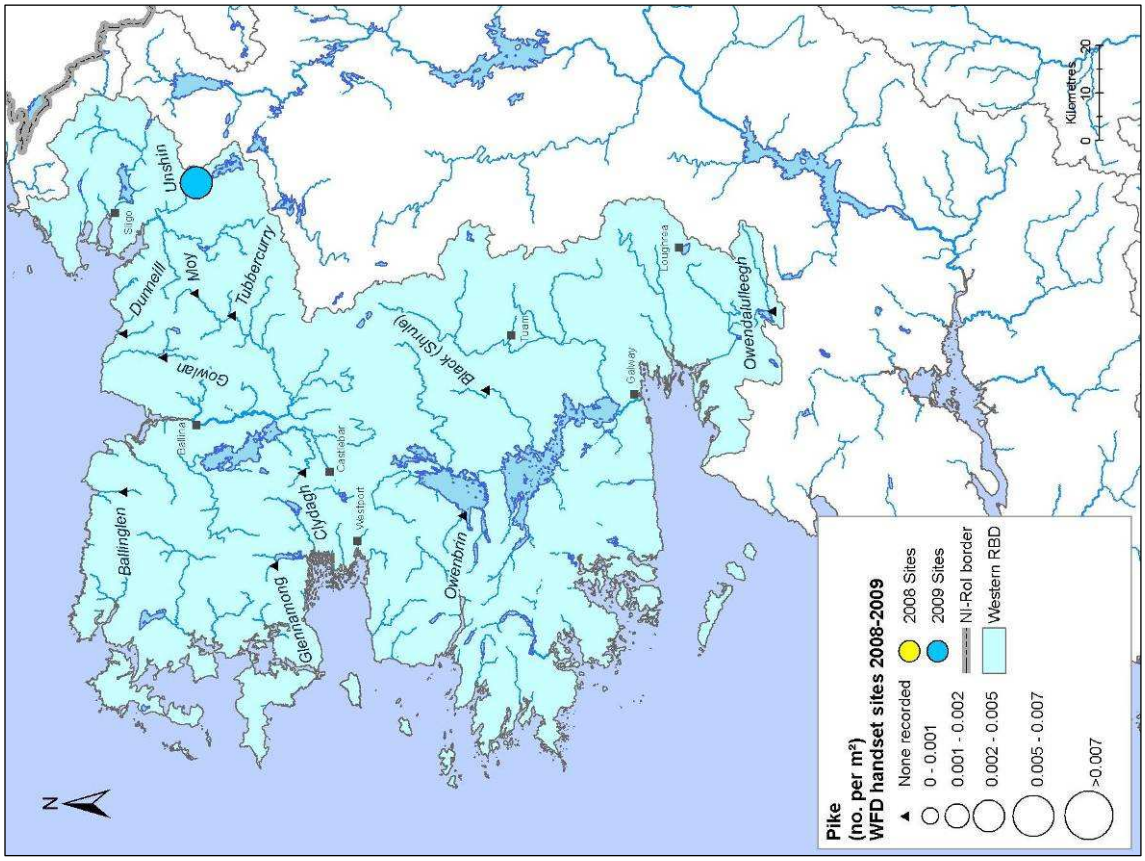

Fig. 4.45. Distribution map for pike in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

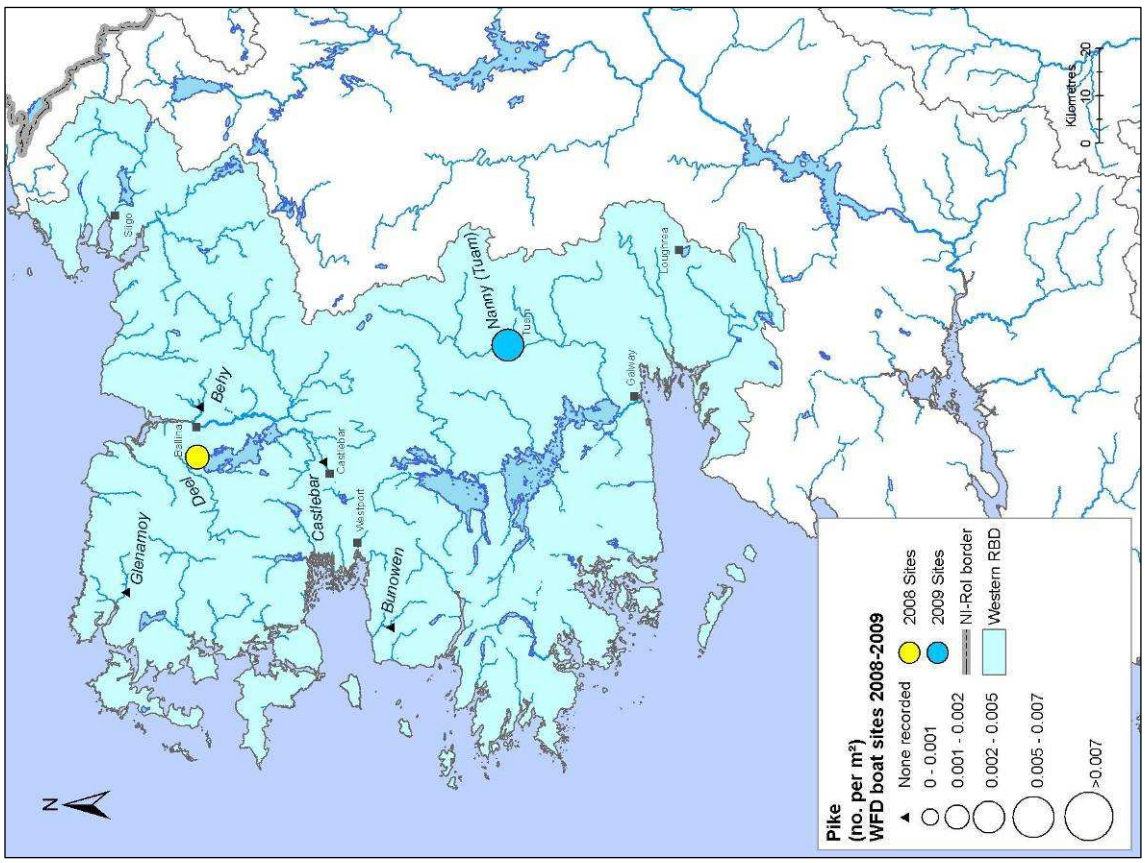

Fig. 4.44. Distribution map for pike in the WRBD boat sites surveyed for WFD monitoring 2008–2009

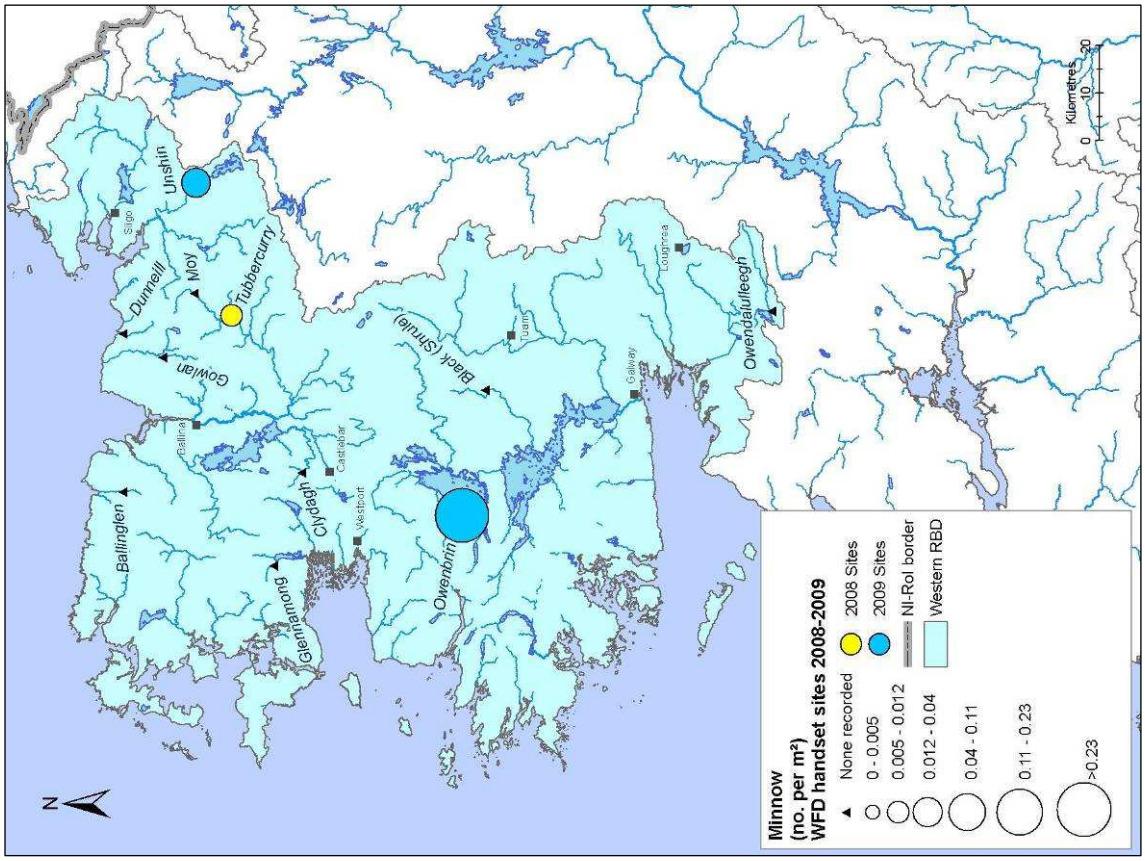

Fig. 4.47. Distribution map for minnow in the WRBD hand-set sites surveyed for WFD monitoring 2008–2009

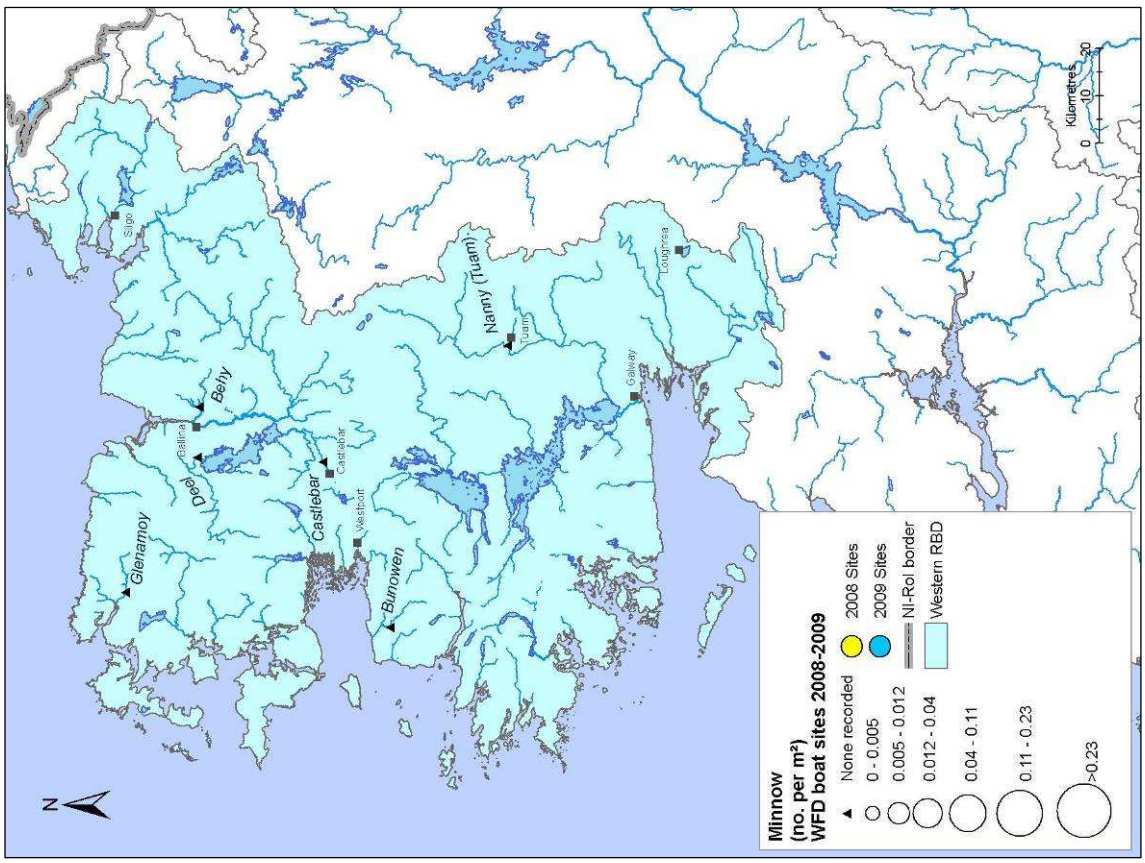

Fig. 4.46. Distribution map for minnow in the WRBD boat sites surveyed for WFD monitoring 2008–2009

4.3.3 Growth rates of brown trout and salmon

Age and growth of fish were determined for brown trout and salmon, which were the dominant fish species at most sites. Brown trout ages ranged from 0+ to 5+, with 0+ and 1+ being the dominant age classes at most sites. The largest brown trout recorded (5+, length 37.9cm, weight 0.68kg) was captured in the River Nanny. Salmon were recorded in three age classes; 0+, 1+ and 2+, with those in the 0+ and 1+ age classes the most common. No adult salmon were recorded, and the largest salmon parr was an individual from the Gowlan River, measuring 16.4cm in length.

Length-at-age analyses and growth curves are presented for brown trout (Fig. 4.48 and Appendix 1) and salmon (Fig. 4.49 and Appendix 2). 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 brown trout in Irish streams and rivers. Growth was classified as very slow in the Owenbrin River, slow in the Bunowen, Dunneill and Gowlan Rivers, fast in the River Nanny, Owendalulleegh and Unshin Rivers and very fast in the Black River. The River Nanny exhibited the highest mean brown trout L1, whereas brown trout in the Owenbrin River had the lowest mean L1.

Although salmon appear to show the fastest relative growth rate in the Gowlan River (Fig. 4.49), the L2 value is based on only a single fish, therefore no such reliable conclusions can be drawn (Appendix 2).

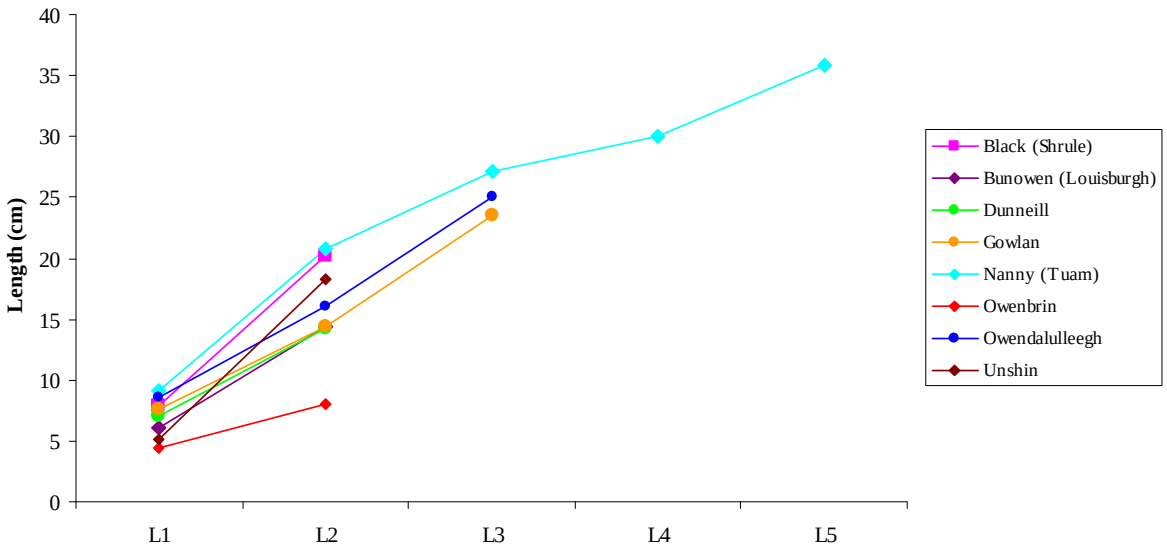

Fig. 4.48. Back calculated lengths for brown trout in each river, WFD surveillance monitoring 2009

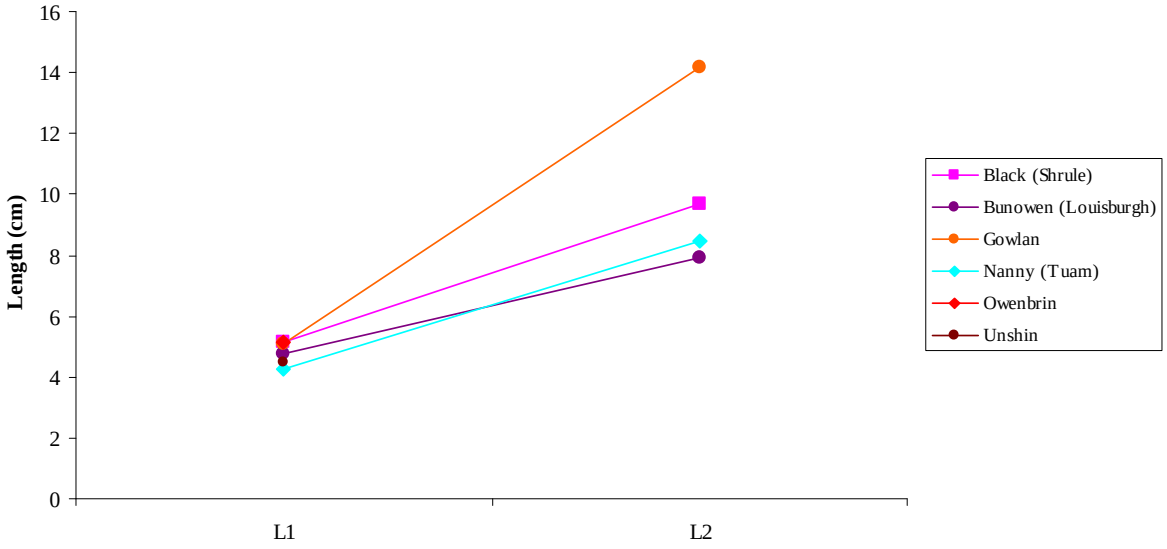

Fig. 4.49. Back calculated lengths for salmon in each river, WFD surveillance monitoring 2009

5. DISCUSSION

A total of 11 fish species (sea trout are included as a separate variety of trout) were recorded in the WRBD during the 2009 WFD surveillance monitoring program. This was slightly lower than the number of species captured in other RBDs and can largely be attributed to the absence of certain non-native fish species, such as bream, roach and dace, which are present in other regions. The main summary report provides results for the whole country (Kelly *et al*., 2010).

Individual sites within this region also tended to have lower total species counts when compared with rivers in some of the other regions. The most diverse site in this survey was the Owendalulleegh River with a total of six species. The Dunneill was the least diverse with only two species present. Such a low species diversity is commonly found around Ireland in small wadeable streams that contain only native fish species (Kelly *et al*., 2009).

Brown trout were the most widely distributed species in the WRBD, occurring in all eight sites. The highest density of brown trout was recorded in the Black River (Shrule). Sea trout were only recorded in the Gowlan River during 2009. Salmon were present in six of the sites surveyed, including the Owenbrin River – a tributary of Lough Mask. The highest salmon density was recorded in the Unshin River in Co. Sligo. Perch were present in four sites, whereas European eels were only recorded in three sites. A number of other species, including three-spined stickleback, gudgeon and lamprey, were only present in one site each.

Ireland's indigenous fauna has come under increasing threat from non-native introductions. Invasions by non-native species represent one of the greatest threats to natural biodiversity, second only to habitat destruction (Scalera and Zaghi, 2004). Non-native and invasive species can transform ecosystems, threatening both indigenous and high conservation status species (Stokes *et al*., 2006), with impacts including displacement through competition for space and food. Direct impacts through predation are also evident (Barton and Heard, 2005).

Non-native fish species were recorded in four of the eight sites surveyed in the WRBD. Eno *et al*. (1997) differentiate between both non-native and alien species, with the former being those that have established themselves and the latter being those that have not established themselves and cannot do so without some sort of human intervention. Rivers containing only native fish species were the Black (Shrule), Gowlan, Dunneill and Bunowen. Kelly *et al*. (2008) categorised non-native species in Ireland into two categories (Group 2, which are those that influence the ecology, and Group 3, which are those that generally have no influence on the ecology). Four Group 2 species (minnow, perch, pike and stone loach) and one Group 3 species (gudgeon) were recorded in the WRBD region.

Following the methods of Kennedy and Fitzmaurice (1971), brown trout growth was classified as very slow in the Owenbrin River; slow in the Bunowen, Dunneill and Gowlan Rivers, fast in the River Nanny, the Owendalulleegh, and the Unshin Rivers; and very fast in the Black River.

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. No fish classification method currently exists in Ireland for classifying river water quality based on fish populations. Currently, ecological status classifications are based on expert opinion using information collected during a project to investigate the relationship between fish stocks, ecological quality ratings (Q-values), environmental factors and degree of eutrophication (Kelly *et al*., 2007c). An ecological classification tool, however, is being developed for the Republic of Ireland and Northern Ireland, along with a separate version for Scotland to comply with the requirements of the WFD. Agencies throughout each of the three regions have contributed data to be used in the model, which is being developed under the management of the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER). It was recommended during the earlier stages of this project that an approach similar to that developed by the Environment Agency in England and Wales (FCS2) be used. This scheme works by comparing various fish community metric values within a site (observed) to those predicted (expected) for that site under reference (un-impacted) conditions using a geo-statistical model based on bayesian probabilities. The proposed method will provide an Ecological Quality Ratio (EQR) between 1 and 0 for all sites. Five class boundaries will be defined along this range, to correspond with the five ecological status classes of High, Good, Moderate, Poor and Bad. Confidence levels will then be assigned to each class and represented as probabilities. Work on the rivers classification tool is still ongoing and is due for completion in mid-2010.

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APPENDIX 1

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

River		L1	L2	L3	L4	L5	Growth category
Black	Mean	7.9	20.2				Very fast
	S.D.	1.7	n/a				
	S.E.	0.3	n/a				
	n	28	1				
	Range min.	4.3	20.2				
	Range max.	11.5	20.2				
Bunowen (Louisburgh)	Mean	6.06	14.40				Slow
	S.D.	1.04	1.25				
	S.E.	0.74	0.88				
	n	2	2				
	Range min.	5.32	13.51				
	Range max.	6.79	15.28				
Dunneill	Mean	7.1	14.3				Slow
	S.D.	1.3	2.1				
	S.E.	0.3	1.5				
	n	17	2				
	Range min.	4.2	12.8				
	Range max.	9.9	15.8				
Gowlan	Mean	7.6	14.4	23.6			Slow
	S.D.	1.3	2.0	n/a			
	ST error	0.3	1.0	n/a			
	n	20	4	1			
	Range min.	4.7	12.7	23.6			
	Range max.	9.7	16.2	23.6			
Nanny (Tuam)	Mean	9.1	20.7	27.1	30.1	35.8	Fast
	S.D.	1.8	2.8	3.2	3.3	n/a	
	S.E.	0.2	0.4	0.9	1.9	n/a	
	n	60	42	12	3	1	
	Range min.	5.6	13.2	20.8	26.4	35.8	
	Range max.	13.6	27.3	31.1	32.6	35.8	
Owenbrin	Mean	4.4	8.0				Very slow
	S.D.	0.5	n/a				
	S.E.	0.2	n/a				
	n	6	1				
	Range min.	3.8	8.0				
	Range max.	5.0	8.0				

APPENDIX 1 continued

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

River		L1	L2	L3	L4	L5	Growth category
Owendalulleegh	Mean	8.6	16.0	25.1			Fast
	S.D.	1.7	3.2	n/a			
	S.E.	0.3	0.8	n/a			
	n	32	18	1			
	Range min.	4.7	11.0	25.1			
	Range max.	11.4	23.8	25.1			
Unshin	Mean	5.1	18.2				Fast
	S.D.	1.0	n/a				
	S.E.	0.4	n/a				
	n	6	1				
	Range min.	4.0	18.2				
	Range max.	6.4	18.2				

APPENDIX 2

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

River		L1	L2
Black	Mean	5.1	9.7
	S.D.	0.6	0.5
	S.E.	0.1	0.3
	n	24	2
	Range min.	4.1	9.3
	Range max.	6.5	10.0
Bunowen (Louisburgh)	Mean	4.74	7.91
	S.D.	0.58	0.18
	S.E.	0.17	0.13
	n	12	2
	Range min.	3.49	7.78
	Range max.	5.30	8.04
Gowlan	Mean	5.1	14.2
	S.D.	0.8	n/a
	S.E.	0.2	n/a
	n	26	1
	Range min.	3.8	14.2
	Range max.	7.8	14.2
Nanny (Tuam)	Mean	4.2	8.5
	S.D.	n/a	n/a
	S.E.	n/a	n/a
	n	1	1
	Range min.	4.2	8.5
	Range max.	4.2	8.5
Owenbrin	Mean	5.2	
	S.D.	n/a	
	S.E.	n/a	
	n	1	
	Range min.	5.2	
	Range max.	5.2	
Unshin	Mean	4.5	
	S.D.	0.8	
	S.E.	0.2	
	n	16	
	Range min.	3.5	
	Range max.	6.7	

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