Neagh-Bann International River Basin District Rivers

Sampling Fish for the Water Framework Directive - Rivers 2009

The Central and Regional Fisheries Boards

ACKNOWLEDGEMENTS

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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 of 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). Three of the 54 surveys were carried out at river sites in the Neagh-Bann International River Basin District (NBIRBD) between August and September 2009 by staff from the Central Fisheries Board and Eastern Regional Fisheries Board (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 Eastern Regional Fisheries Board (ERFB) stretched from Co. Monaghan in the north, down as far as Co. Wexford in the south. The Eastern River Basin District (ERBD) covers most of this area but loses certain catchments in Co. Louth, Co. Monaghan and north Co. Meath to the NBIRBD.

The NBIRBD is one of three international river basin districts on the island of Ireland. Most of its area, some 6,000km^2, is situated within Northern Ireland while the remainder (2,000km^2) is situated within the Republic of Ireland. The NBIRBD has the smallest stretch of coastline among all eight RBDs throughout Ireland (north and south). This includes the Bann Estuary at Port Stewart to the north and Carlingford Lough to the south. Only 200km^2 of marine waters belong to this RBD, however it does contain Ireland's largest lake, Lough Neagh. All of County Armagh is contained within the NBIRBD, along with parts of Derry, Antrim, Down, Tyrone, Fermanagh, Monaghan, Cavan, Lough and Meath. In the Bann Valley to the north, there is rich agricultural land which is

used mainly for livestock grazing, while the south contains the drumlin counties of Cavan and Monaghan. Over half a million people live within this RBD, with most living in the major towns, including Armagh, Ballymena, Dundalk, Monaghan and Newry. The NBIRBD shares similar pressures to most other RBDs, including drinking water supply and wastewater treatment but also contains some very heavily modified surface waters. These have been altered for various activities such as, navigation, flood defence and land drainage (NBIRBD, 2009).

This report summarizes the main findings of the fish stock surveys in the three river water bodies surveyed in the NBIRBD during 2009 and reports on the current status of the fish stocks in each.

2. STUDY AREA

Three river sites were surveyed within two river catchments: the Dee and the Piedmont catchments. The sites ranged in surface area from 184m^2 in the Big River to 1,050m^2 in the River Dee 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 NBIRBD is shown in Figure 2.1.

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

River	Site name	Catchment	Site Code	Waterbody code
NBIRBD Hand-set sites				
Big	Ballygoly Bridge	Piedmont	IE06B010100	NB_06_642
White	Coneyburrow Bridge	Dee	IE06W010500	NB_06_550
NBIRBD Boat sites				
Dee	Burley Bridge	Dee	IE06D010600	NB_06_50

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

River	Upstream catchment (km^2)	Wetted width (m)	Surface area (m^2)	Mean depth (m)	Max depth (m)
NBIRBD Hand-set sites					
Big	10.58	4.28	184	0.25	0.38
White	55.13	5.99	264	0.27	0.66
NBIRBD Boat sites					
Dee	175.52	7.00	1050	0.95	1.40

Fig. 2.1. Location map of river sites surveyed throughout the NBIRBD for WFD fish 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. 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, juvenile river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*) and sea lamprey (*Petromyzon marinus*) were recorded as 'Lamprey sp.'. 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.

In order to draw comparisons between sites, fish densities were calculated using data from the first fishing pass, as three fishing passes were not possible or practical at all sites. The number captured in the first pass was divided by the total area surveyed to give a minimum population density for each species.

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 was 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 Big River (Louth)

Plate 4.1. The Big River site upstream of Ballygoly Bridge near Carlingford, Co. Louth

The Big River (Plate 4.1) is one of two main tributaries of the Castletown River near Carlingford in north-east Co. Louth. Unlike its name suggests it is a relatively small stream that flows for approximately 7.0km until it reaches the Castletown River, only 2.5km from where it enters the sea.

The survey site was located just upstream of Ballygoly Bridge, near Carlingford, Co. Louth (Fig. 4.1). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 28th of July 2009 along a 43m length of channel. Ample light and a suitable substrate proved hospitable to numerous mosses and liverworts within the channel. The mean wetted width of channel surveyed was 4.3m and the mean depth was 25.0cm. The habitat consisted mainly of glide, with a substrate of cobble and gravel. A total wetted area of 184m^2 was surveyed.

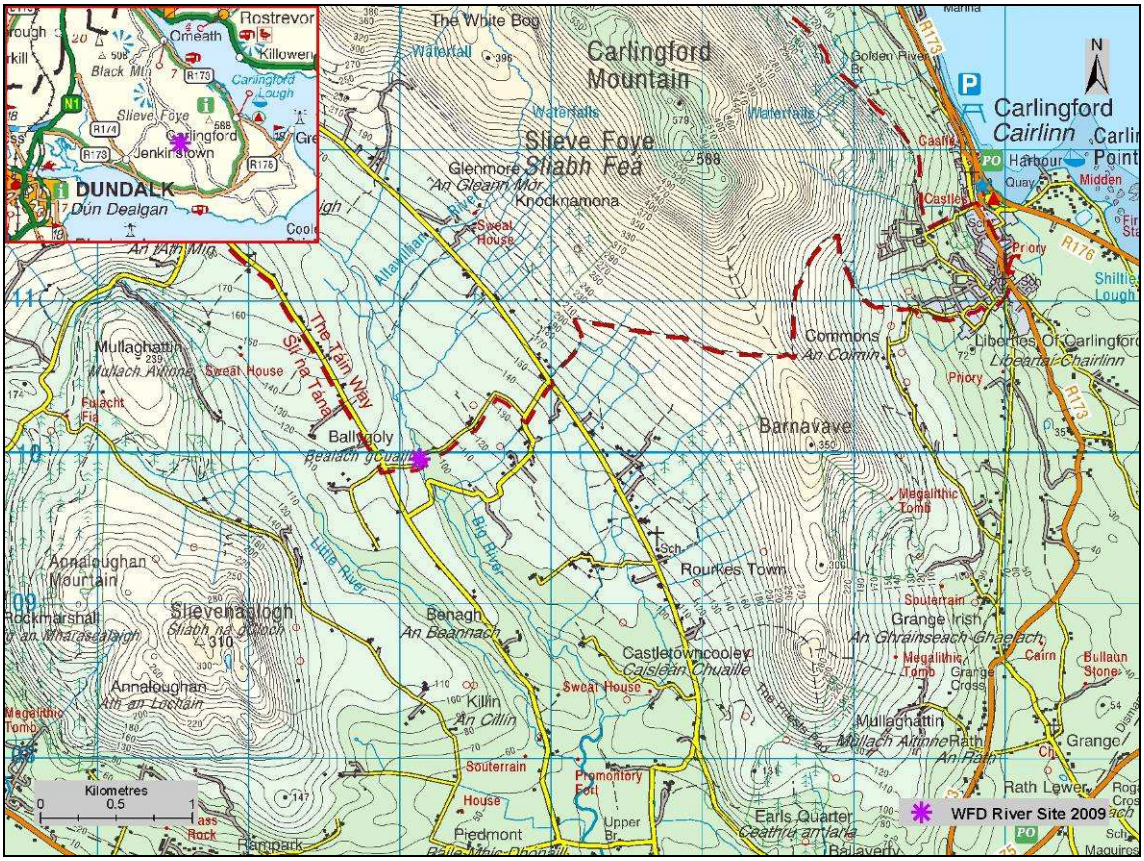

Fig. 4.1. Location of the Big River surveillance monitoring site

There were only two fish species recorded in the Big River site. Brown trout was the most abundant, followed by European eel (Table 4.1).

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

Scientific name	Common name	0+	1+ & older	Total minimum density
Salmo trutta	Brown trout	0.0923	0.3040	0.3963
Anguilla anguilla	European eel	-	-	0.0054
All fish	All fish	-	-	0.4018

Brown trout ranged in size from 4.5cm to 19.6cm (Fig. 4.2). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 31%, 46%, 22% and 1% of the total brown trout catch respectively. Mean brown trout L1, L2 and L3 were 5.3cm, 9.9cm and 13.2cm respectively (Appendix 1). This indicates a very slow rate of growth for brown trout in this river site according to the classification scheme of Kennedy and Fitzmaurice (1971).

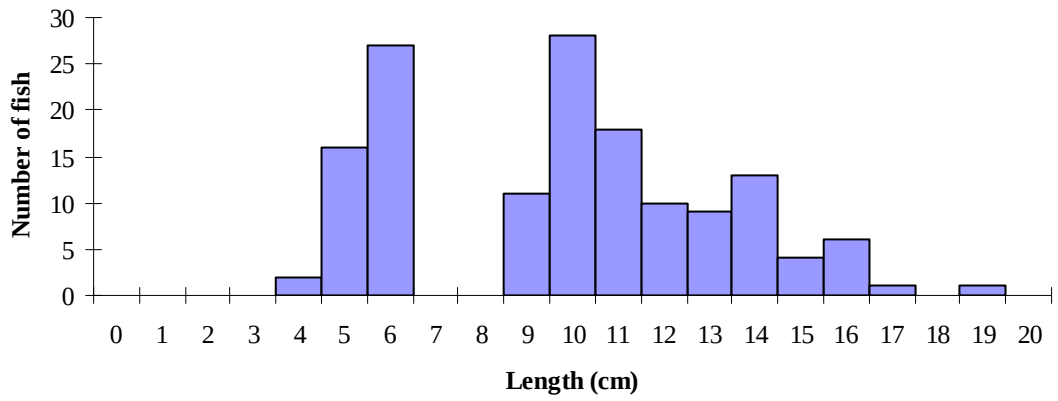

Fig. 4.2. Length frequency distribution of brown trout in the Big River site, July 2009 (n = 146)

4.1.2 The White River (Louth)

Plate 4.2. The White River upstream of Coneyburrow Bridge near Dunleer, Co. Louth

The White River (Plate 4.2) is a tributary of the River Dee. It rises in the hills south of Dunleer, Co. Louth, and flows northwards to join with the River Dee near Drumcar.

The survey site was located upstream of Coneyburrow Bridge, approximately 1km north of Dunleer (Fig. 4.3). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 28th of July 2009 along a 44m length of channel. Green filamentous algae were common within the channel along with various other common riparian species along the bank side. The stretch surveyed had a mean wetted width of 6.0m and an mean depth of 27.0cm. The dominant habitat was glide, and the substrate consisted of mostly cobble and gravel. A total wetted area of 264m^2 was surveyed.

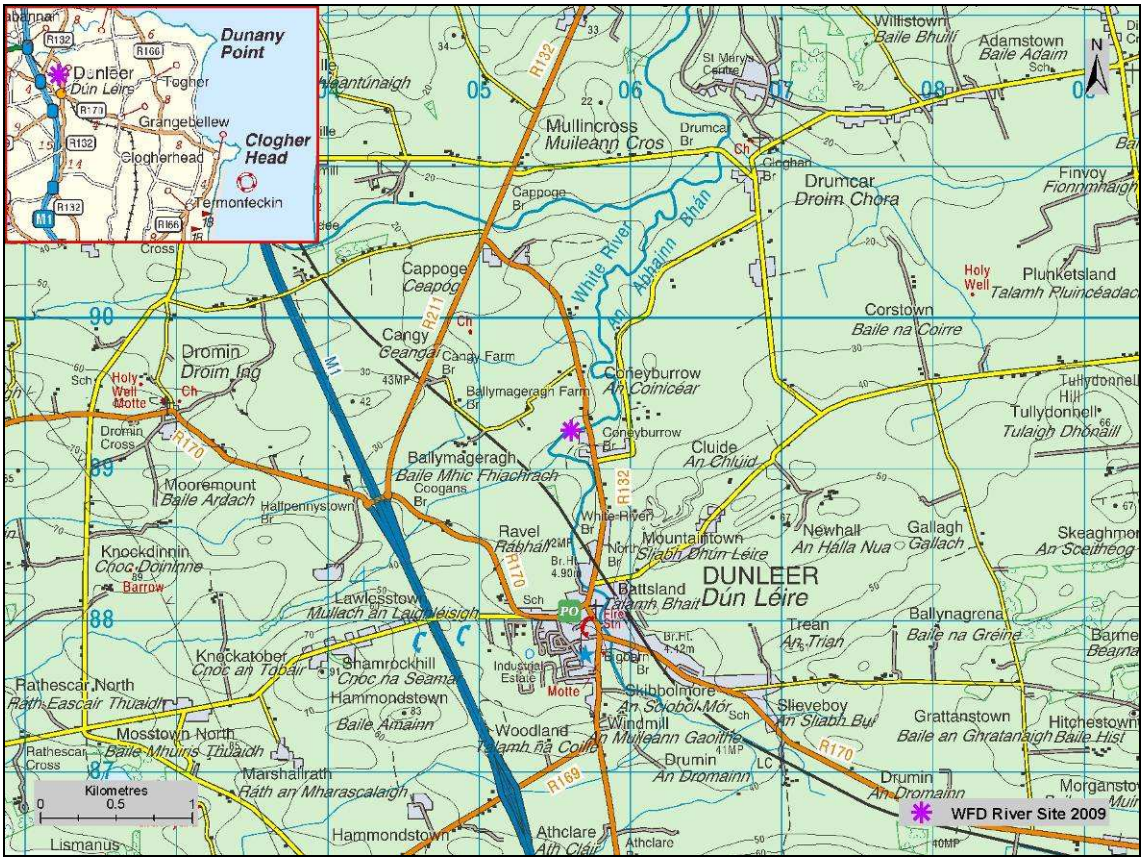

Fig. 4.3. Location of the White River surveillance monitoring site

A total of six fish species were recorded in the White River site. Stone loach was the most abundant species, followed by brown trout, minnow, salmon, European eel and three-spined stickleback (Table 4.2).

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

Scientific name	Common name	0+	1+ & older	Total minimum density
Barbatula barbatula	Stone loach	-	-	0.1897
Salmo trutta	Brown trout	0.0948	0.0228	0.1176
Phoxinus phoxinus	Minnow	-	-	0.0986
Salmo salar	Salmon	0.0455	0.0152	0.0607
Anguilla anguilla	European eel	-	-	0.0152
Gasterosteus aculeatus	Three-spined stickleback	-	-	0.0038
All fish	All fish	-	-	0.4855

Stone loach ranged in length from 5.4cm to 8.9cm (Fig. 4.4).

Brown trout ranged in length from 6.1cm to 34.1cm (Fig. 4.5). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 83%, 2%, 11% and 5% of the total brown trout catch respectively. Mean brown trout L1, L2 and L3 were 7.4cm, 13.9cm and 23.9cm respectively (Appendix 1). This indicates a slow rate of growth for brown trout in this river site according to the classification scheme of Kennedy and Fitzmaurice (1971).

Salmon ranged in length from 5.2cm to 13.8cm (Fig. 4.6). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 83%, 14% and 3% of the total salmon catch respectively. Mean salmon L1 and L2 were 5.6cm and 10.4cm respectively.

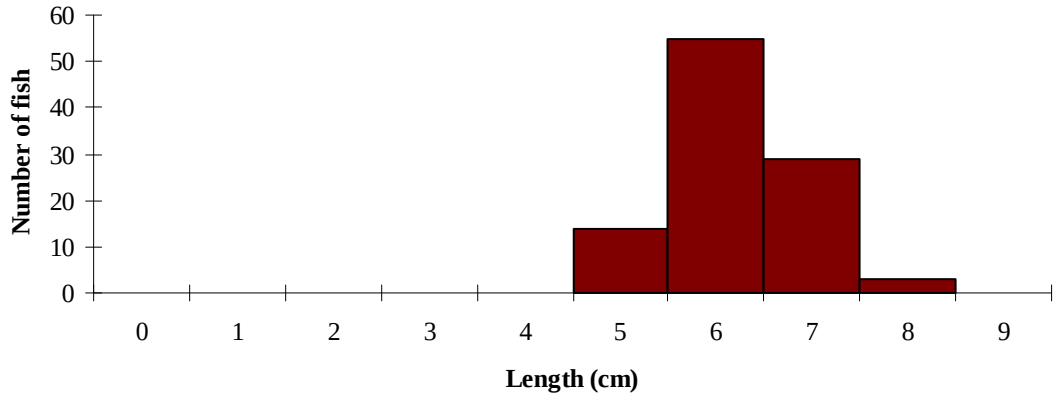

Fig. 4.4. Length frequency distribution of stone loach in the White River, July 2009 (n = 101)

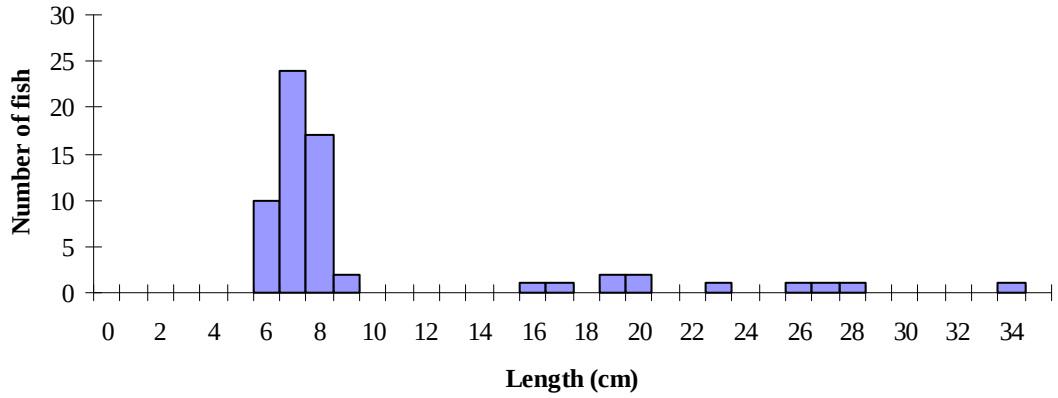

Fig. 4.5. Length frequency distribution of brown trout in the White River, July 2009 (n = 64)

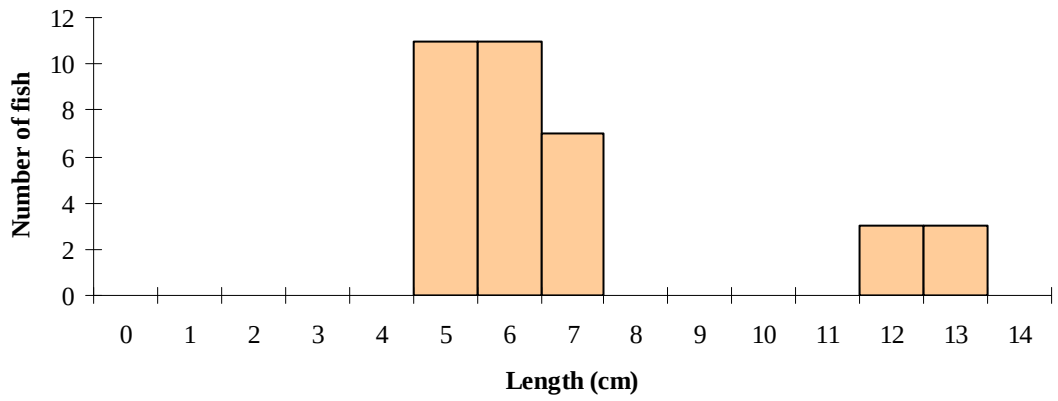

Fig. 4.6. Length frequency distribution of salmon in the White River, July 2009 (n = 35)

4.2 Boat sites

4.2.1 The River Dee

Plate 4.3. The River Dee at Burley Bridge near Ardee, Co. Louth

The River Dee (Plate 4.3) rises near Bailieborough, in the hills between Co. Meath and Co. Cavan. It is joined by a number of smaller streams such as the White and Corkey Rivers from the south and Garra River from the north. It flows in an easterly direction through the town of Ardee, Co. Louth and reaches the sea at Linns, just south of Castlebellingham. The River Dee is known to contain good stocks of salmon, brown trout and sea trout but access to some of these fisheries is difficult due to the high and steep banks, a result of arterial drainage in the 1950's (O'Reilly, 2009; ERFB, 2010).

The survey site was located downstream of Burley Bridge between Mandistown and Ballygowan, Co. Meath (Fig. 4.7). Three electric-fishing passes were conducted using two boat-based electric-fishing units on the 11th of August 2009 along a 150m length of channel. The mean wetted width of the surveyed stretch was 7.0m and the mean depth was 95.0cm. The habitat consisted entirely of glide over a mixed substrate of mud, silt, cobble and sand. Various common reeds and pondweeds were present within the channel. A total wetted area of 1050m^2 was surveyed.

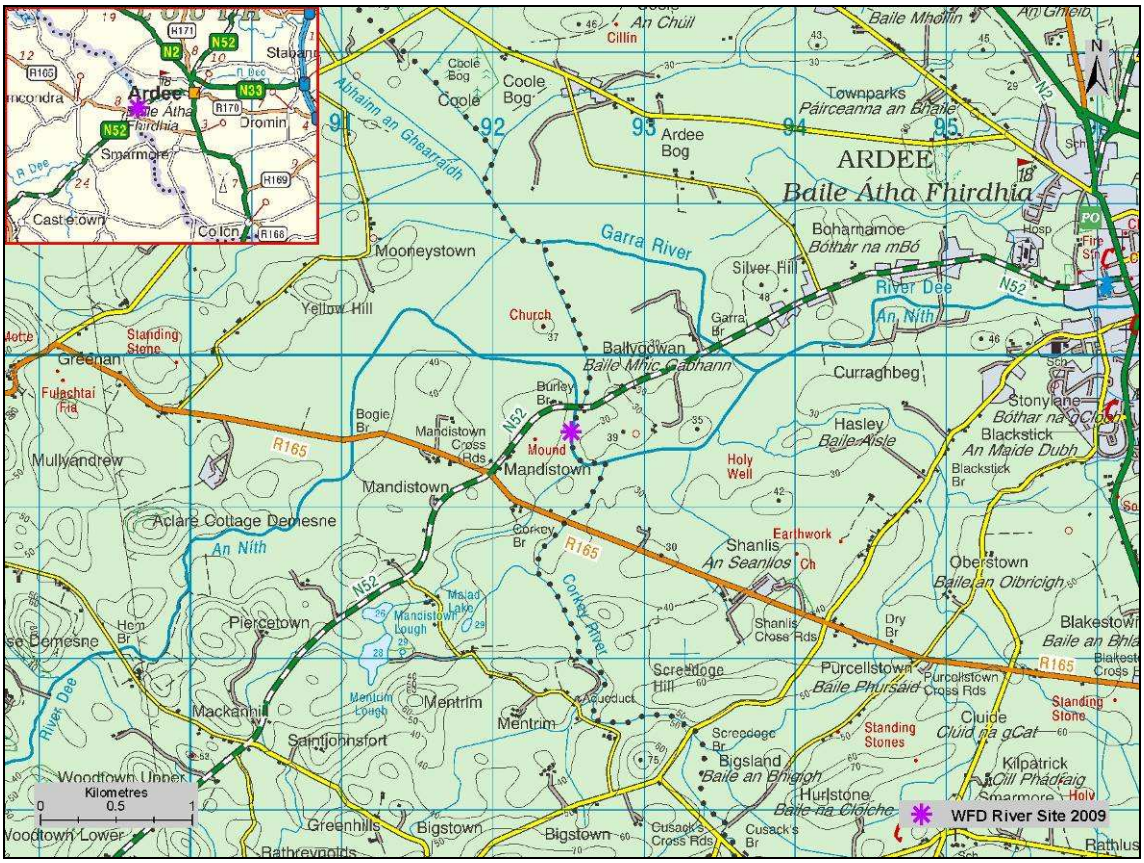

Fig. 4.7. Location of the River Dee surveillance monitoring site

A total of eight fish species were recorded in the River Dee site. Three-spined stickleback was the most abundant species, followed by brown trout, roach, salmon, stone loach, gudgeon, minnow and European eel (Table 4.3).

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

Scientific name	Common name	0+	1+ & older	Total minimum density
Gasterosteus aculeatus	Three-spined stickleback	-	-	0.0162
Salmo trutta	Brown trout	-	0.0114	0.0114
Rutilus rutilus	Roach	-	-	0.0105
Salmo salar	Salmon	0.0010	0.0029	0.0038
Barbatula barbatula	Stone loach	-	-	0.0029
Gobio gobio	Gudgeon	-	-	0.0019
Phoxinus phoxinus	Minnow	-	-	0.0019
Anguilla anguilla	European eel	-	-	0.0010
All fish	All fish	-	-	0.0495

Three-spined stickleback ranged in length from 2.6cm to 5.3cm (Fig. 4.8).

Brown trout ranged in length from 15.3 to 30.6cm (Fig. 4.9). Two age classes (1+ and 2+) were present, accounting for approximately 67% and 33% of the total brown trout catch respectively. Mean brown trout L1 and L2 were 9.0cm and 19.4cm respectively (Appendix 1), indicating a fast rate of growth for brown trout in this river site according to the classification scheme of Kennedy and Fitzmaurice (1971).

Roach ranged in length from 1.8cm to 18.5cm (Fig. 4.10). Four age classes (0+, 2+, 3+ and 4+) were present.

Salmon ranged in length from 5.5cm to 12.5cm. Two age classes (0+ and 1+) were present, accounting for approximately 80% and 20% (one individual) of the total salmon catch respectively. Mean salmon L1 was 5.1cm (Appendix 2).

Minnow ranged in length from 3.3cm to 5.7cm (Fig. 4.11). Two European eels were recorded, measuring 23.0cm and 31.5cm in length.

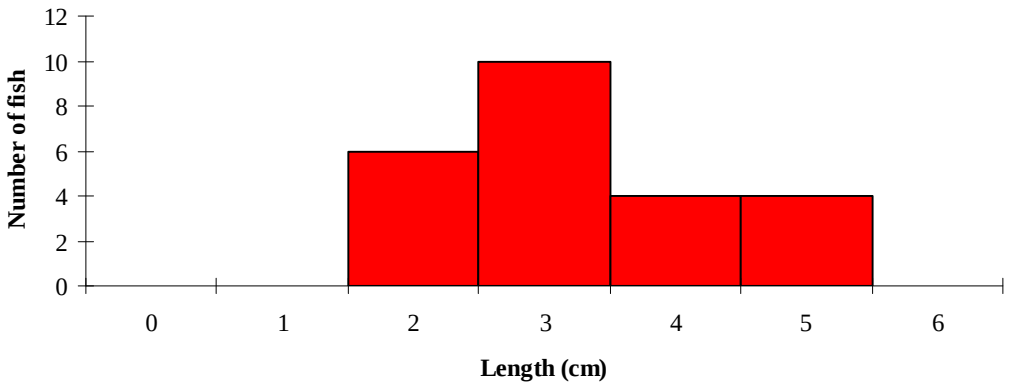

Fig. 4.8. Length frequency distribution of three-spined stickleback in the River Dee, August 2009 (n = 24)

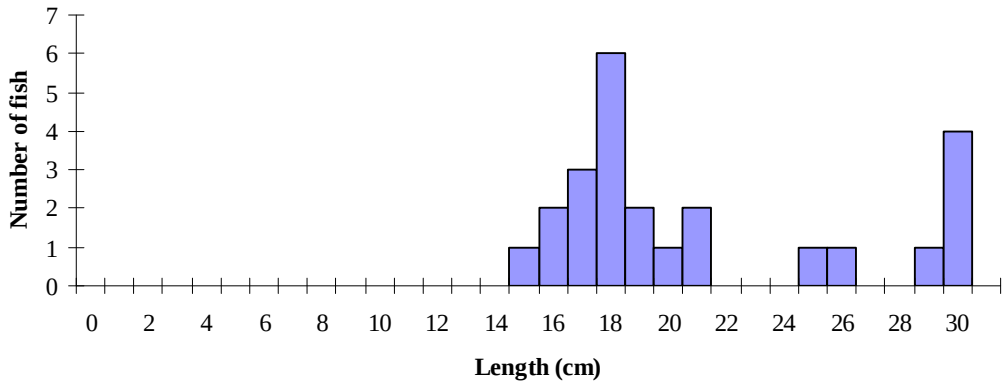

Fig. 4.9. Length frequency distribution of brown trout in the River Dee, August 2009 (n = 24)

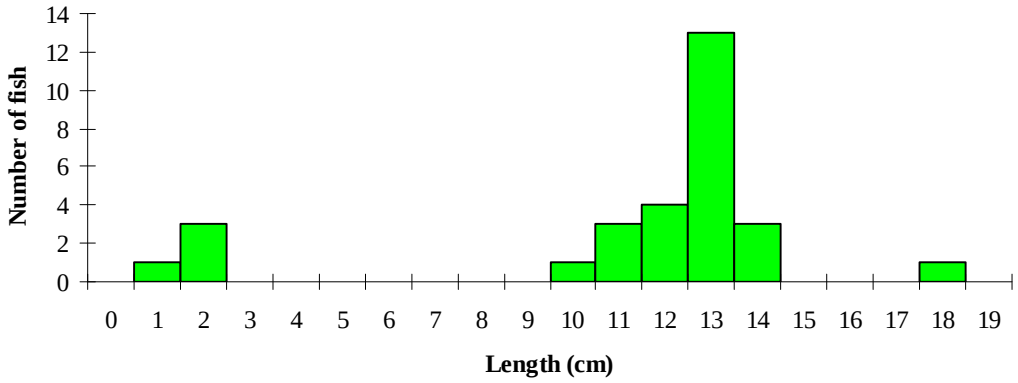

Fig. 4.10. Length frequency distribution of roach in the River Dee, August 2009 (n = 29)

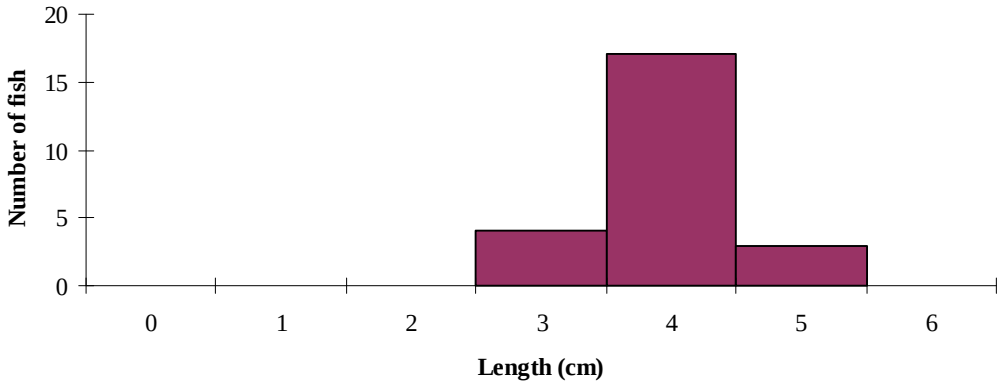

Fig. 4.11. Length frequency distribution of minnow in the River Dee, August 2009 (n = 24)

4.3 Community structure

4.3.1 Species richness and composition

A total of eight fish species were recorded within the three NBIRBD sites surveyed. Brown trout and European eel were the two most common species, occurring at all sites surveyed. This was followed by three-spined stickleback (67%), minnow (67%), salmon (67%) and stone loach (67%). Gudgeon and roach were only recorded at one site each (Fig.4.12).

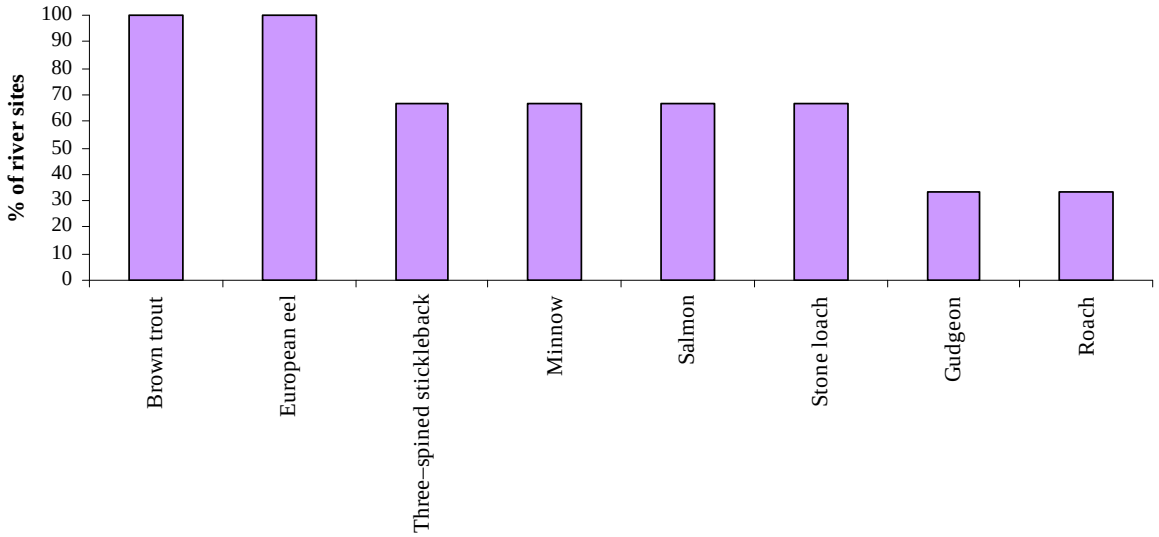

Fig. 4.12. Percentage of sites where each fish species was recorded in the NBIRBD for WFD SM monitoring 2009

Species richness ranged from two species recorded in the Big River to a maximum of eight species captured in the River Dee (Table 4.4). Kelly *et al*., (2008) classified fish species in Ireland into three groups. Group 1 – native species (e.g. salmonids, three-spined stickleback and eel) were present in all sites surveyed. Group 2 – non-native species that influence ecology (e.g. roach, minnow and stone loach) were recorded in two of the sites surveyed, and Group 3 – non-native species that generally don't influence ecology (e.g. gudgeon) were recorded in one site.

Table 4.4. Species richness at each river site surveyed in the NBIRBD, 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		
White (Louth)	6	4	2	0
Big (Louth)	2	2	0	0
		BOAT SITES		
Dee	8	4	3	1

4.3.2 Species abundance and distribution

Abundance (minimum population density) and distribution maps for the most common fish species recorded within the NBIRBD are shown in Figures 4.13 to 4.30. 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 present in all three sampling sites. No brown trout fry (0+) were captured at the only boat-surveyed site, the River Dee (Fig. 4.13). The highest density of brown trout fry (0+) were recorded on the hand-set surveyed White River (Louth) (0.1 fish/m^2) (Fig. 4.14) which was also among the sites containing the highest brown trout fry densities recorded across all of the surveillance monitoring sites surveyed during 2009 (Kelly *et al*., 2010). The density of 1+ or older brown trout in the only boat site (River Dee) (0.01 fish/m^2) is shown in Figure 4.15. The Big River exhibited the highest density of 1+ or older brown trout (0.30 fish/m^2) among the two hand-set sites (Fig. 4.16). This was also the highest brown trout 1+ or older density recorded amongst any surveillance monitoring sites surveyed during 2009 (Kelly *et al*., 2010).

Salmon were captured in two sites, the White River and the River Dee. The boat-fished River Dee contained lower densities of both salmon fry (0+) (0.004 fish/m^2) and 1+ and older salmon (0.003 fish/m^2) (Fig. 4.17 and Fig. 4.19) than the White River. The White River exhibited salmon fry (Fig. 4.18) and parr (1+ and older) (Fig. 4.20) densities of 0.05 fish/m^2 and 0.02 fish/m^2 respectively.

European eels were also present in all three sites. The lowest density was in the boat site, the River Dee (0.001 fish/m^2) (Fig. 4.21). The White River (0.02 fish/m^2) (Fig. 4.22) exhibited the highest density among the two hand-set sites.

Three-spined stickleback (Fig. 4.23 and Fig. 4.24), minnow (Fig. 4.25 and Fig. 4.26) and stone loach (Fig. 4.27 and Fig. 4.28) were all present in the River Dee and White River but absent from the Big River. Gudgeon (Fig. 4.29 and Fig. 4.30) were recorded only in the River Dee.

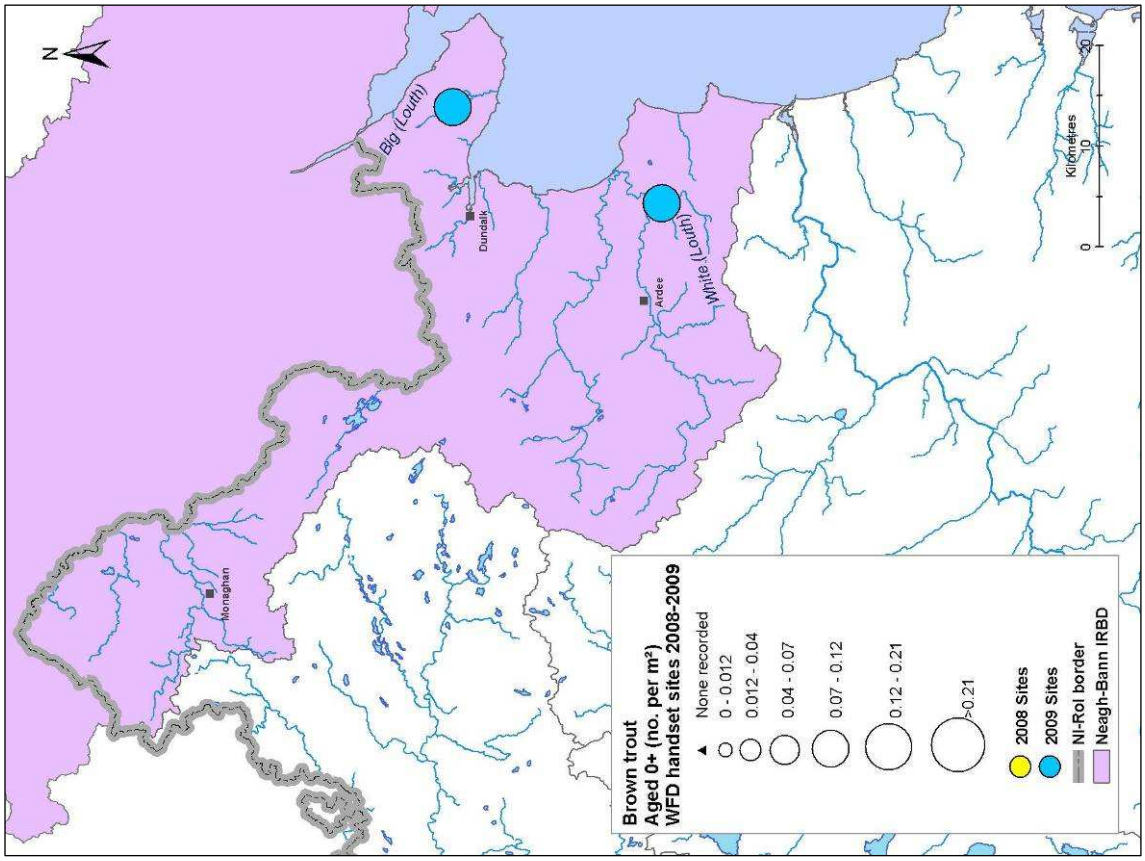

Fig. 4.14. Distribution map of 0+ brown trout in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

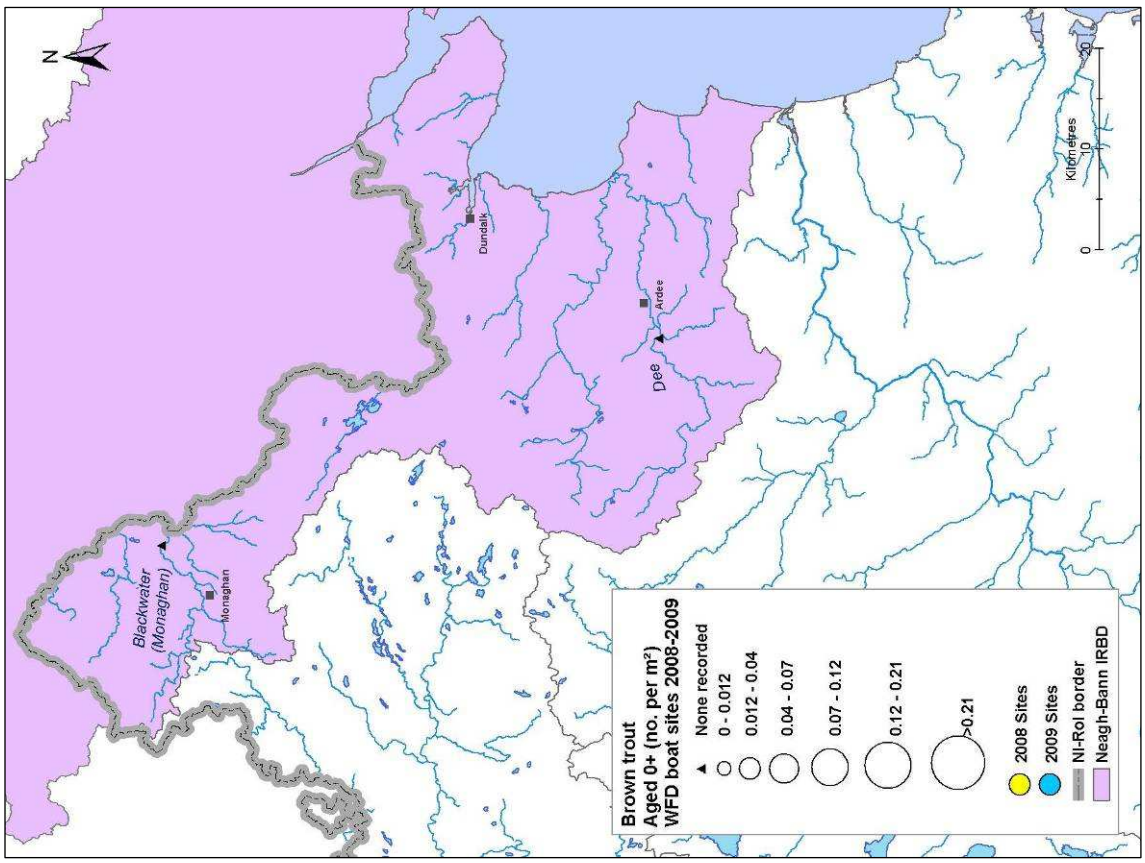

Fig. 4.13. Distribution map of 0+ brown trout in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

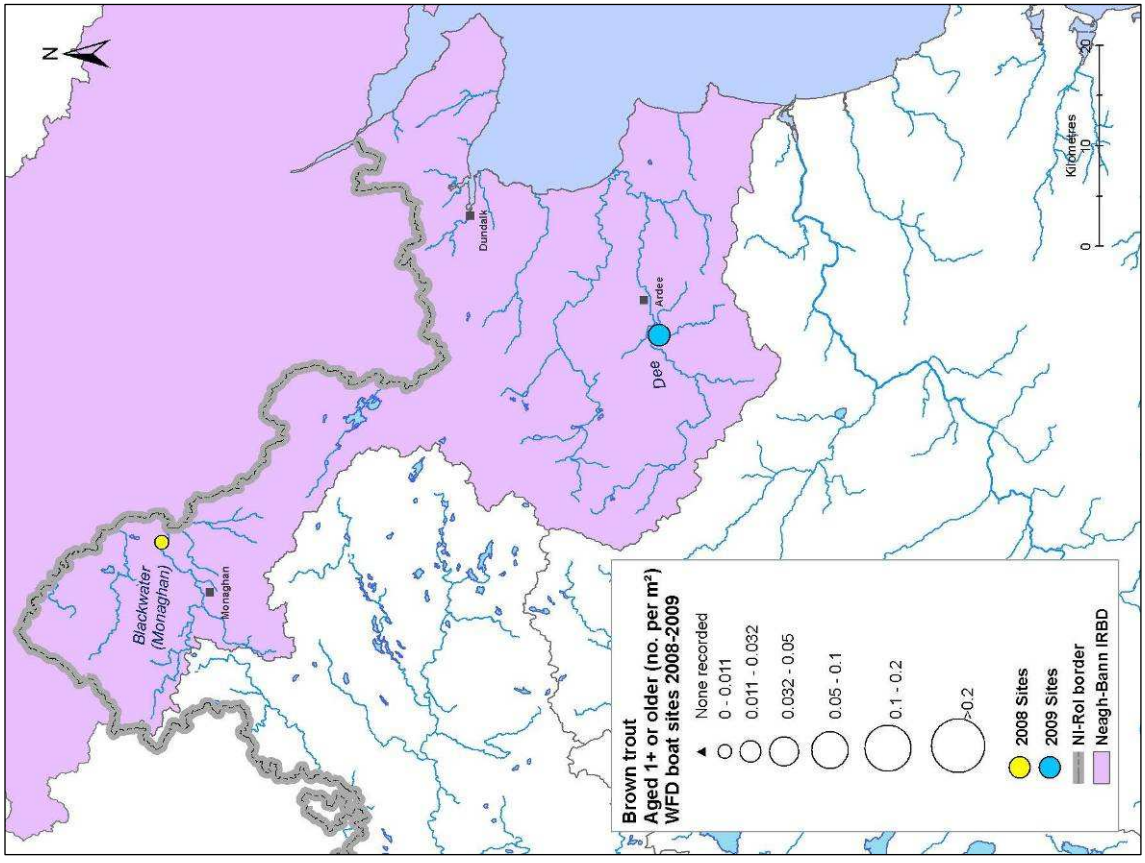

Fig. 4.15. Distribution map of 1+ or older brown trout in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

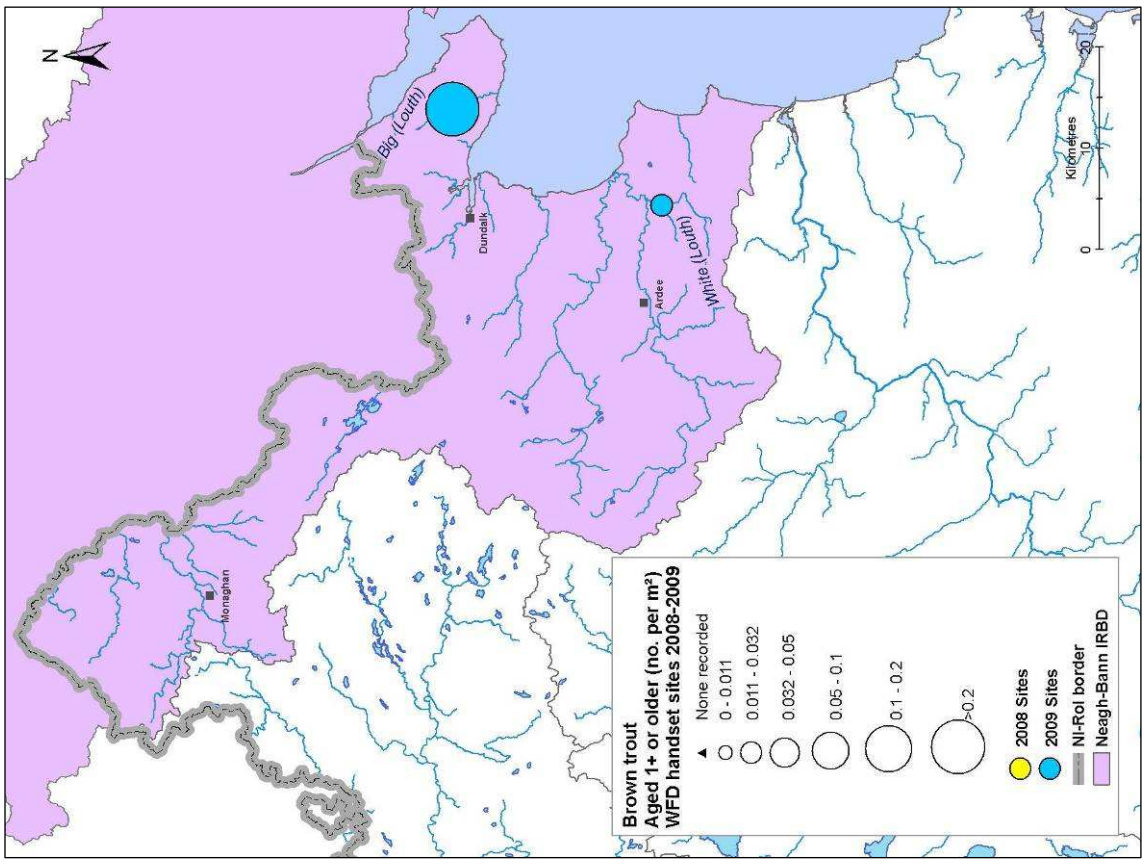

Fig. 4.16. Distribution map of 1+ or older brown trout in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

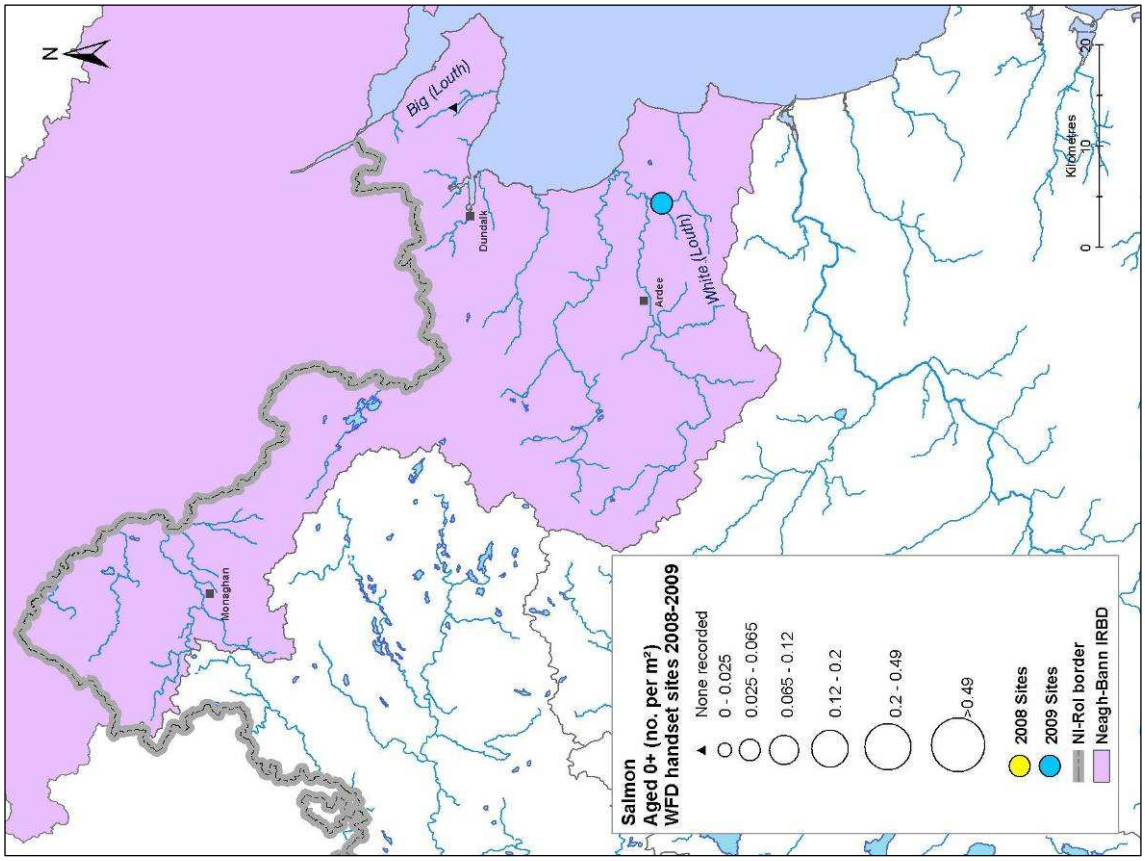

Fig. 4.18. Distribution map of 0+ salmon in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

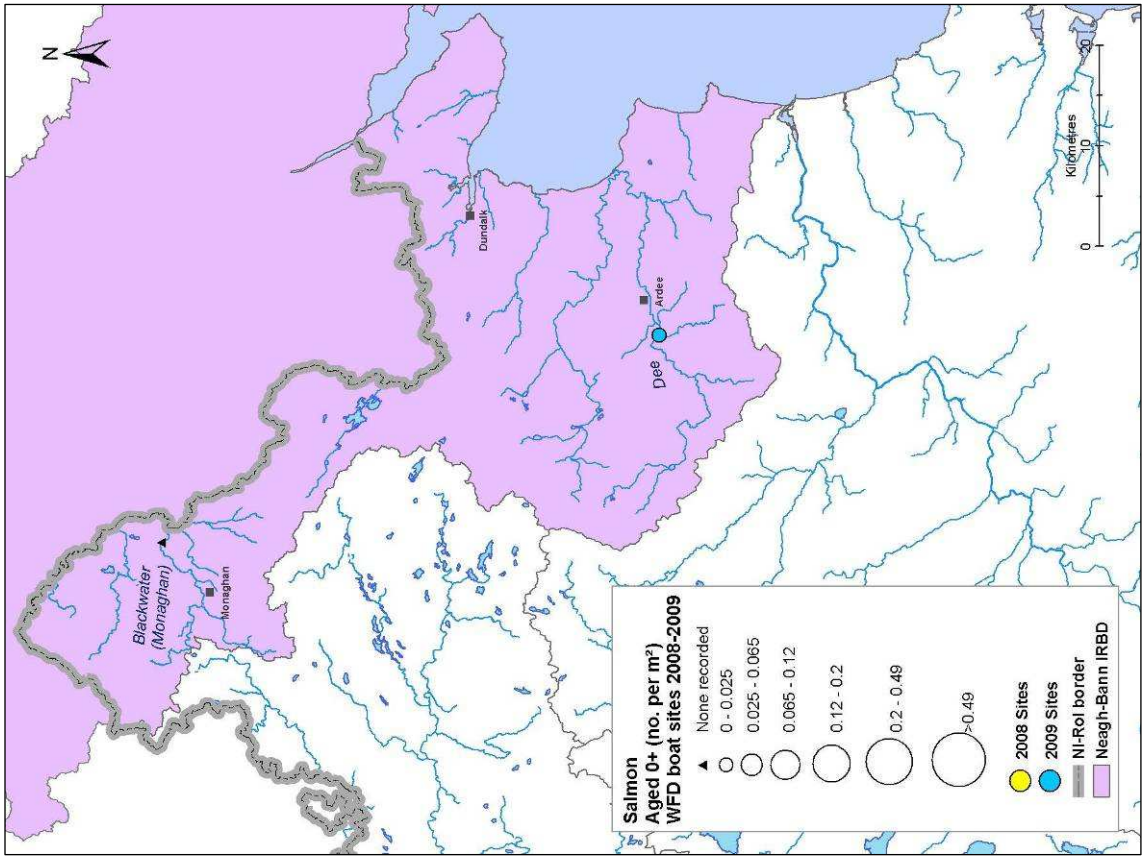

Fig. 4.17. Distribution map of 0+ salmon in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

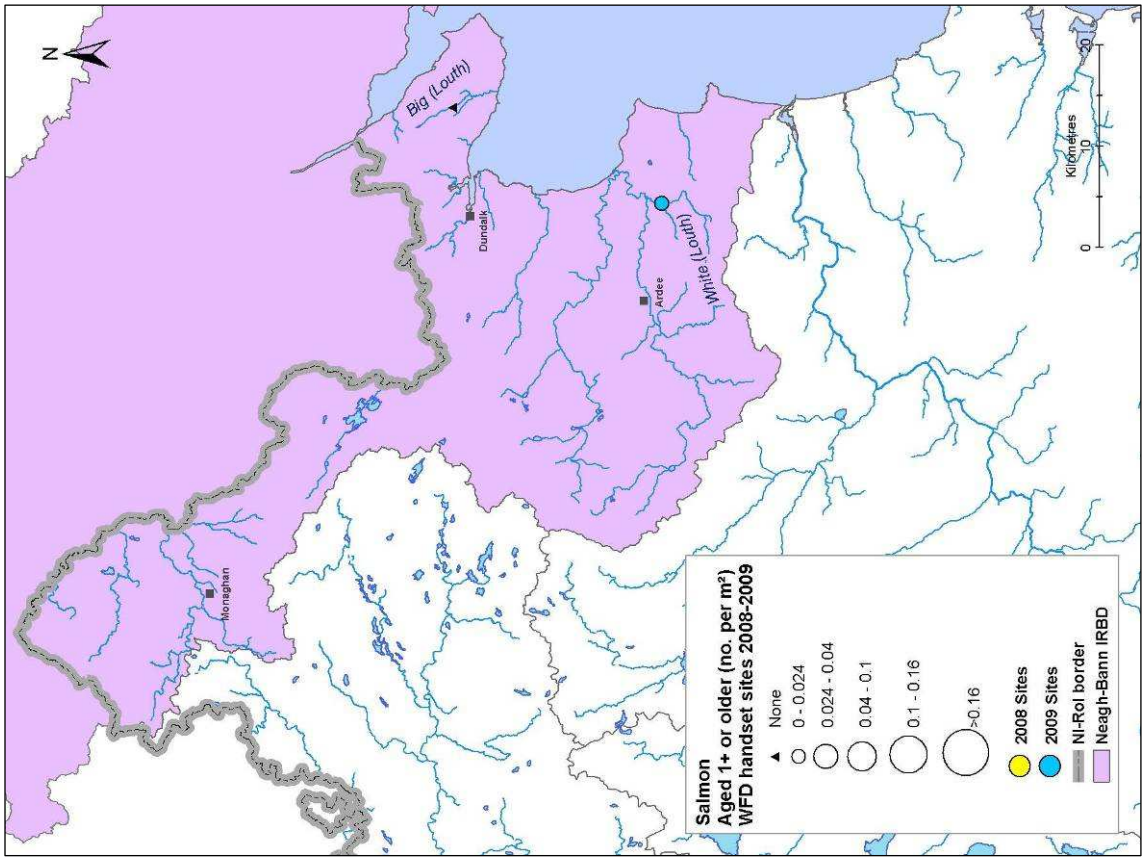

Fig. 4.20. Distribution map of 1+ or older salmon in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

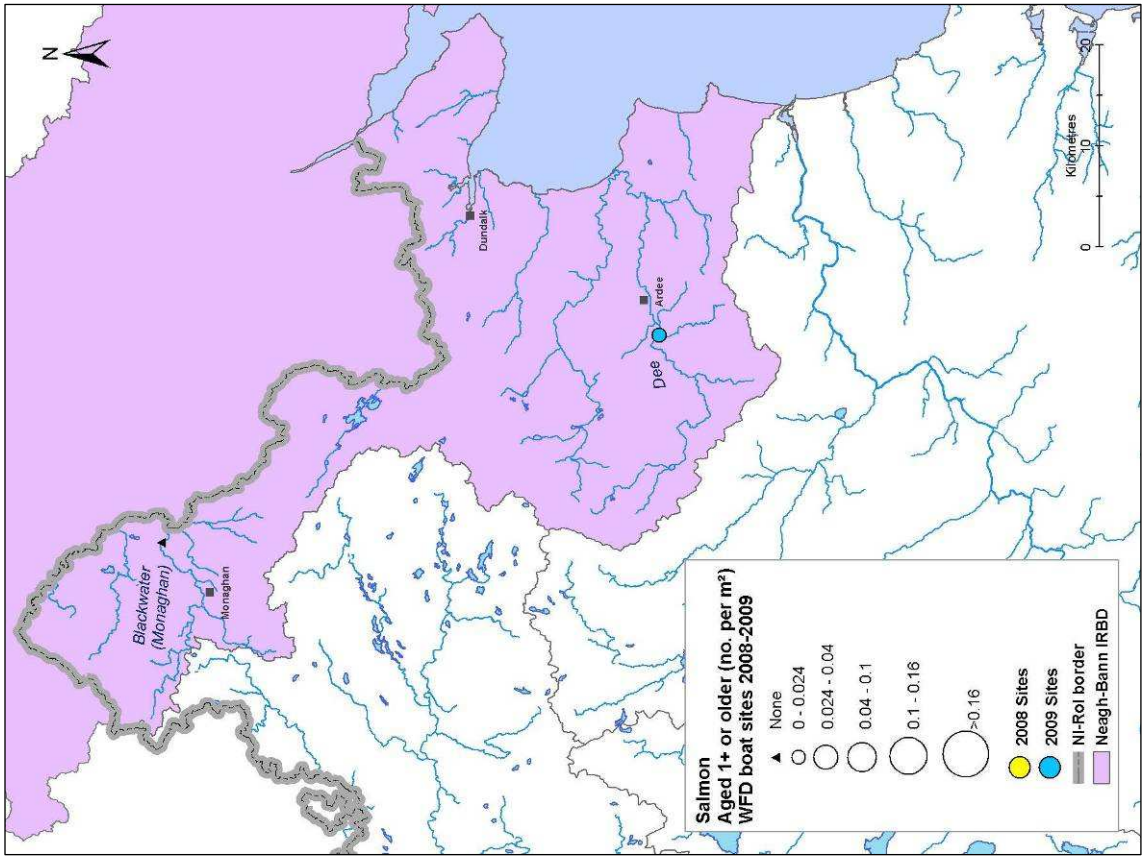

Fig. 4.19. Distribution map of 1+ or older salmon in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

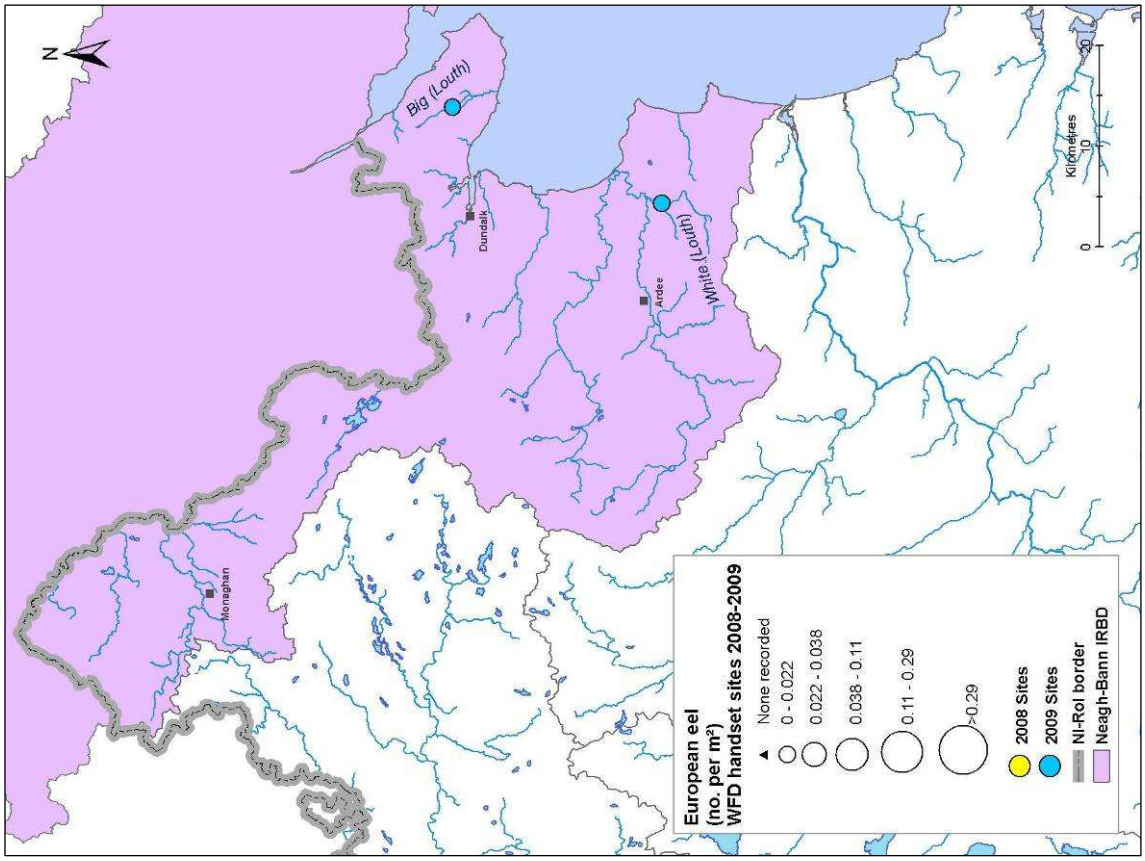

Fig. 4.22. Distribution map of European eel in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

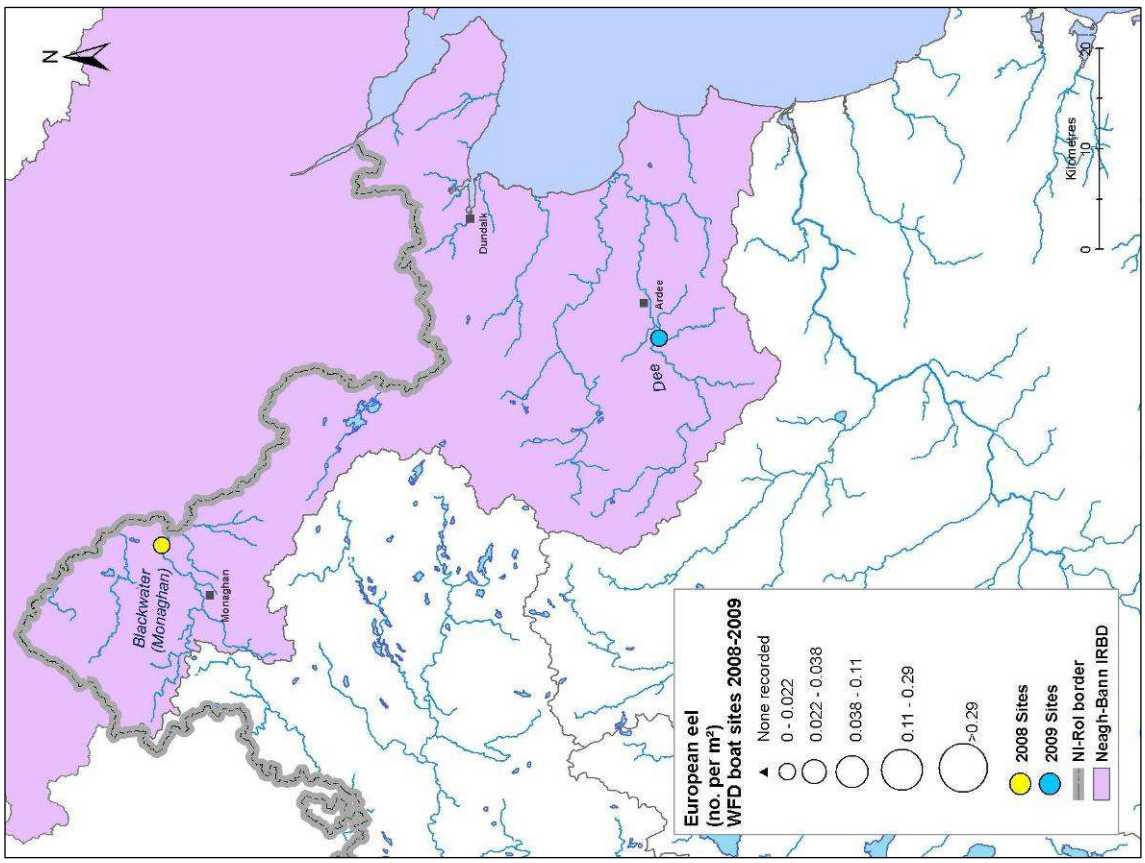

Fig. 4.21. Distribution map of European eel in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

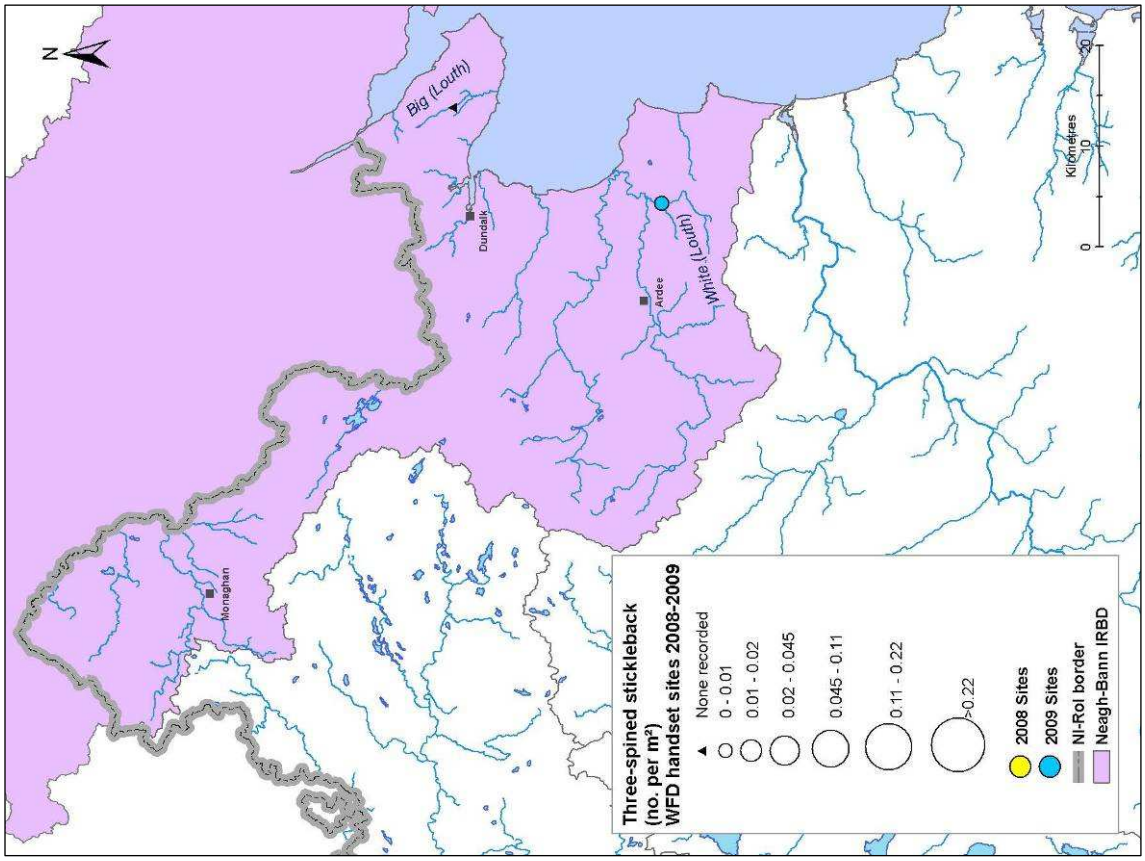

Fig. 4.24. Distribution map of three-spined stickleback in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

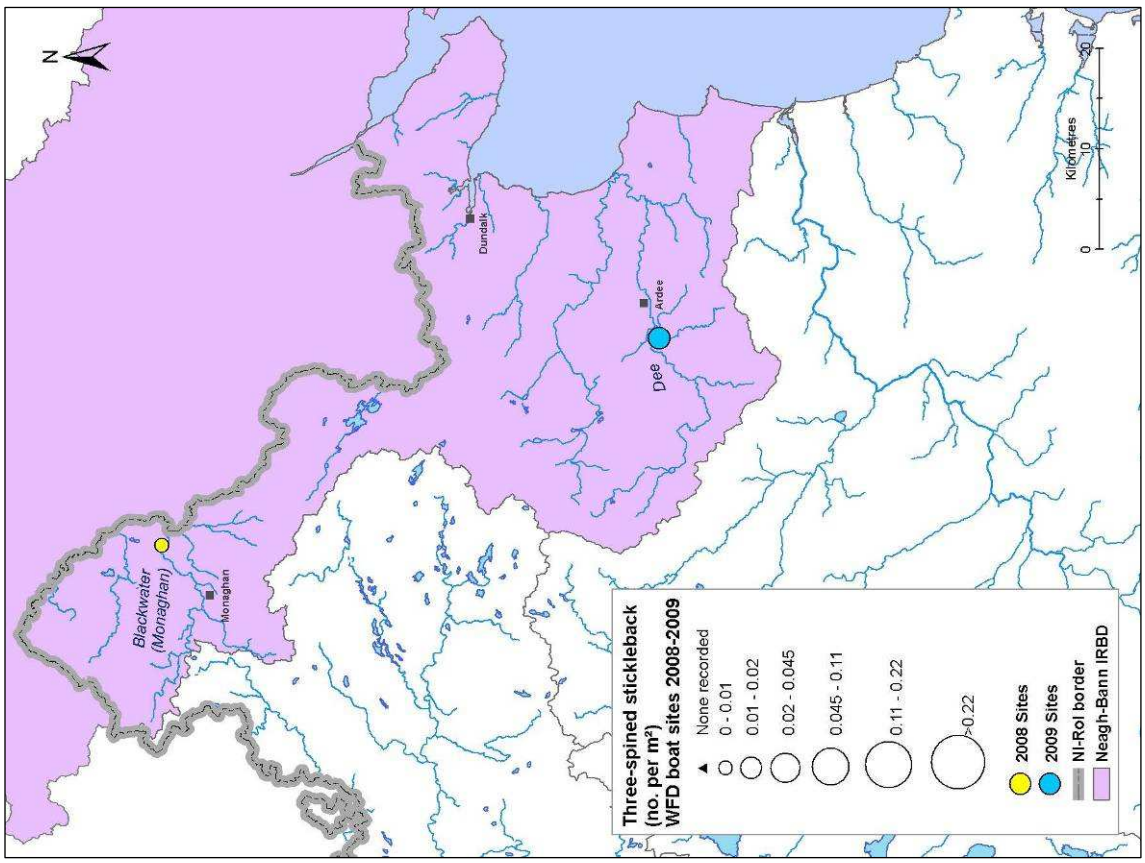

Fig. 4.23. Distribution map of three-spined stickleback in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

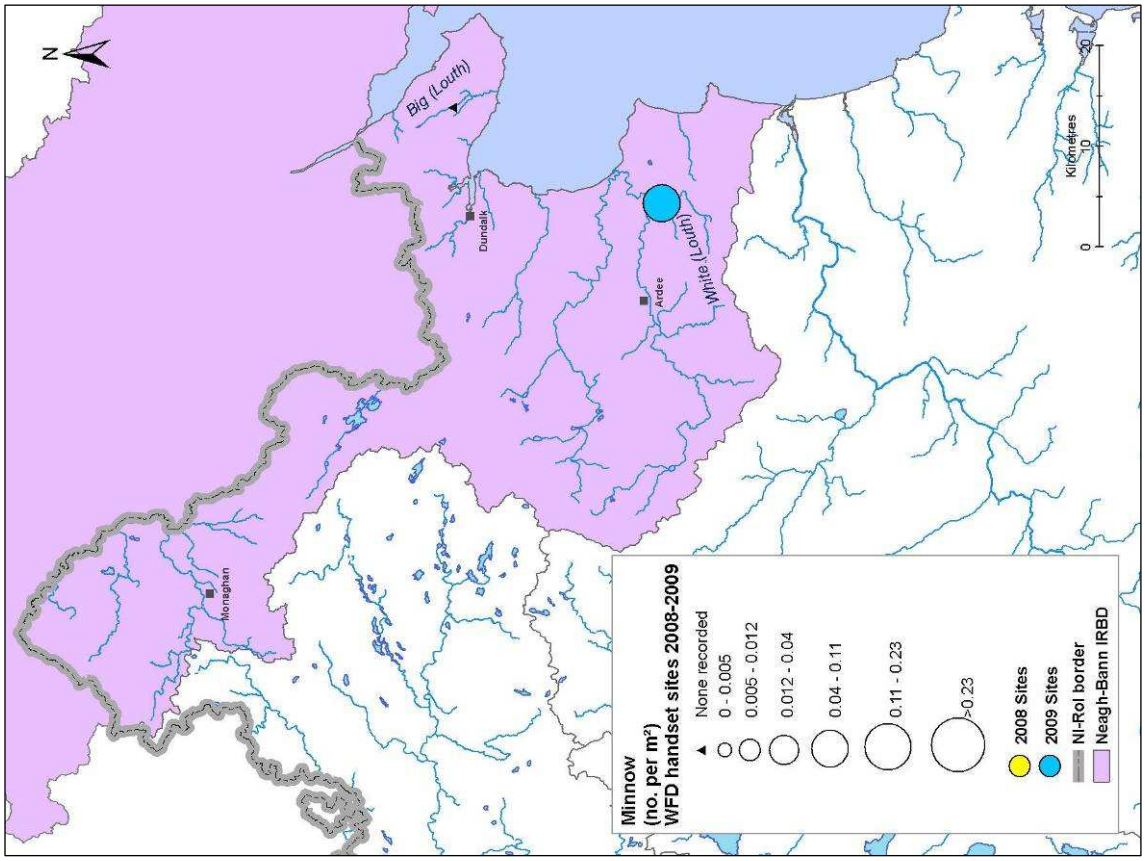

Fig. 4.26. Distribution map of minnow in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

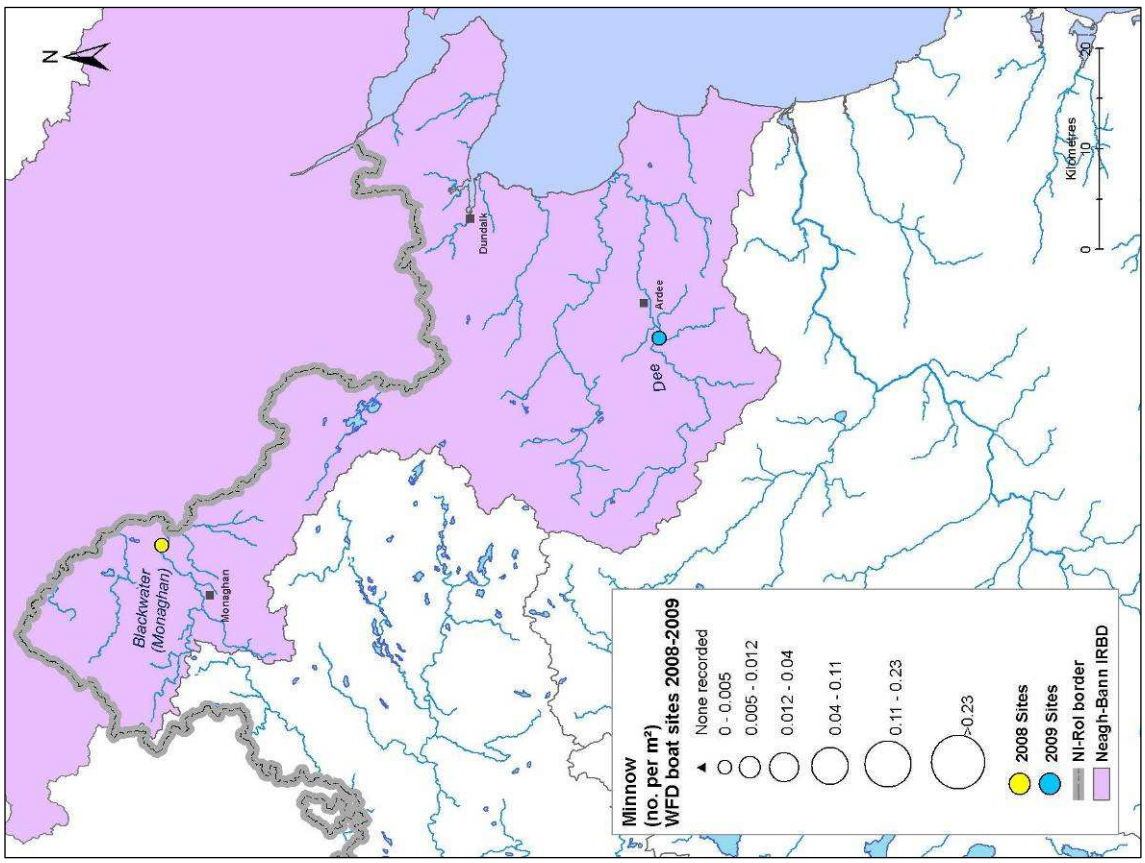

Fig. 4.25. Distribution map of minnow in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

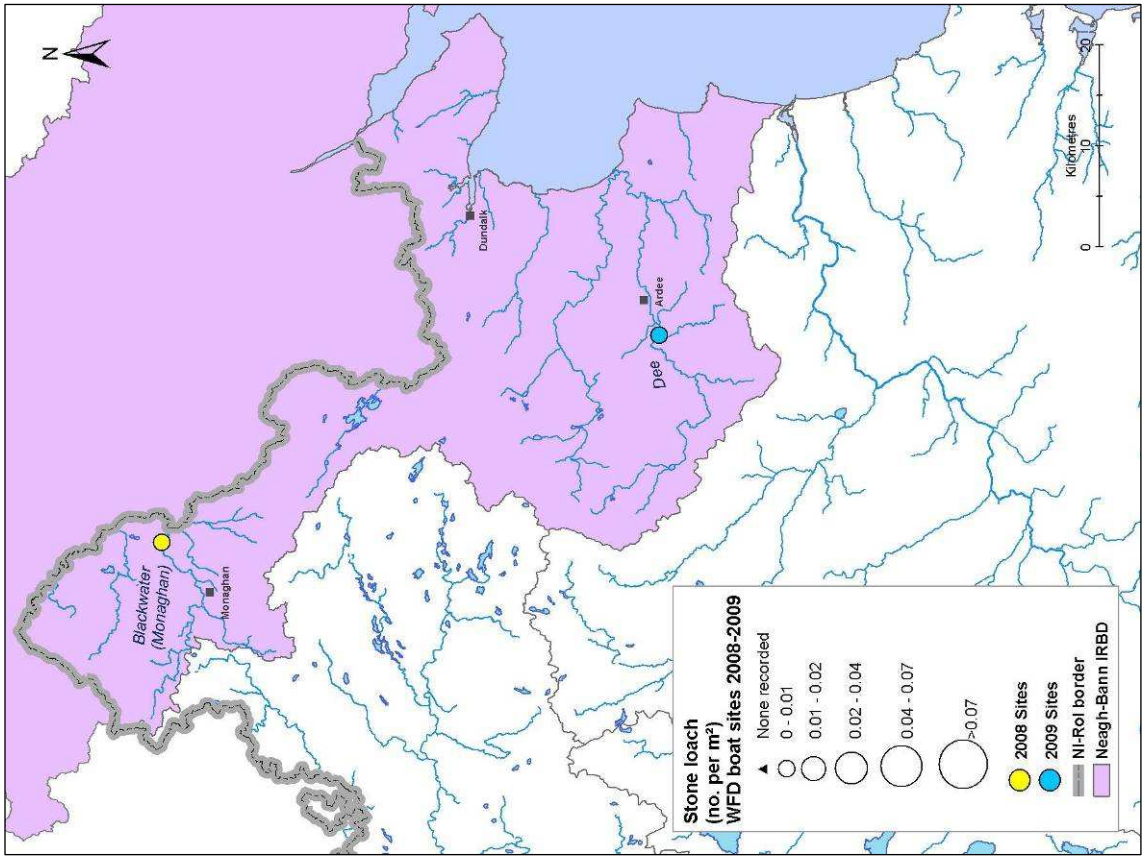

Fig. 4.27. Distribution map of stone loach in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

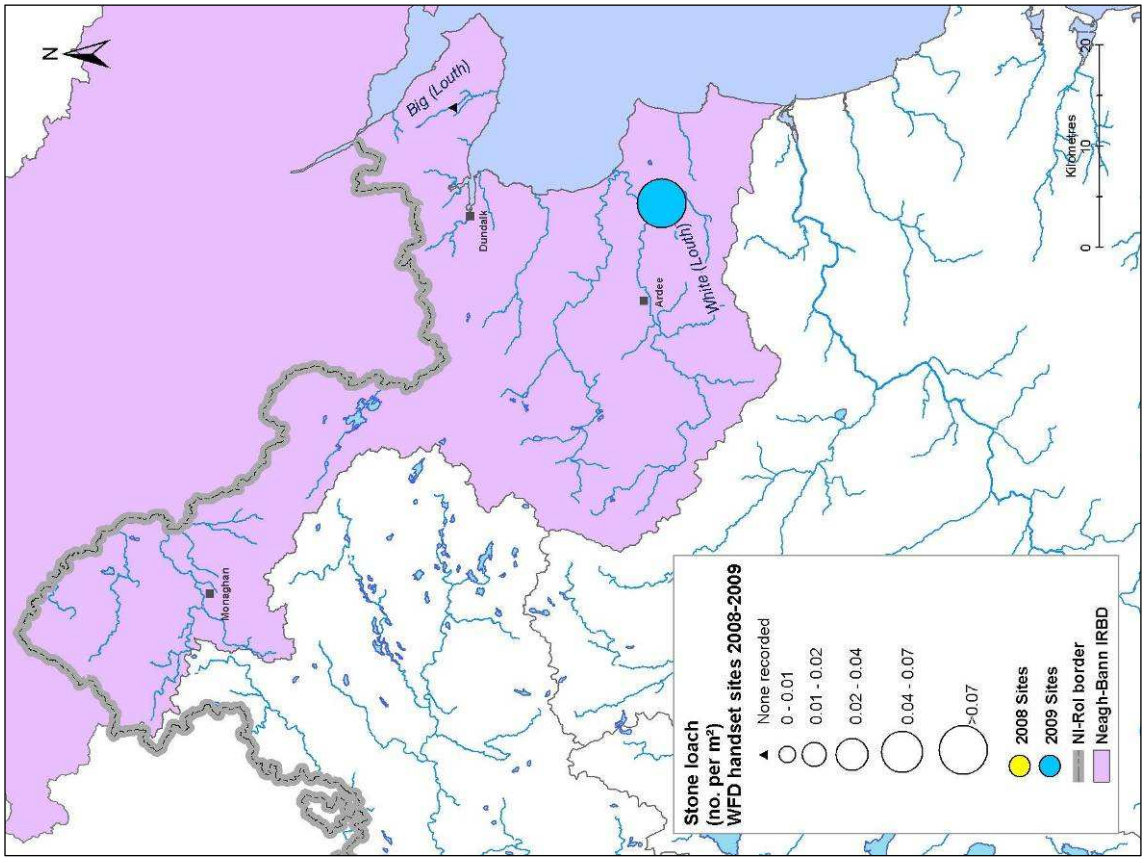

Fig. 4.28. Distribution map of stone loach in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

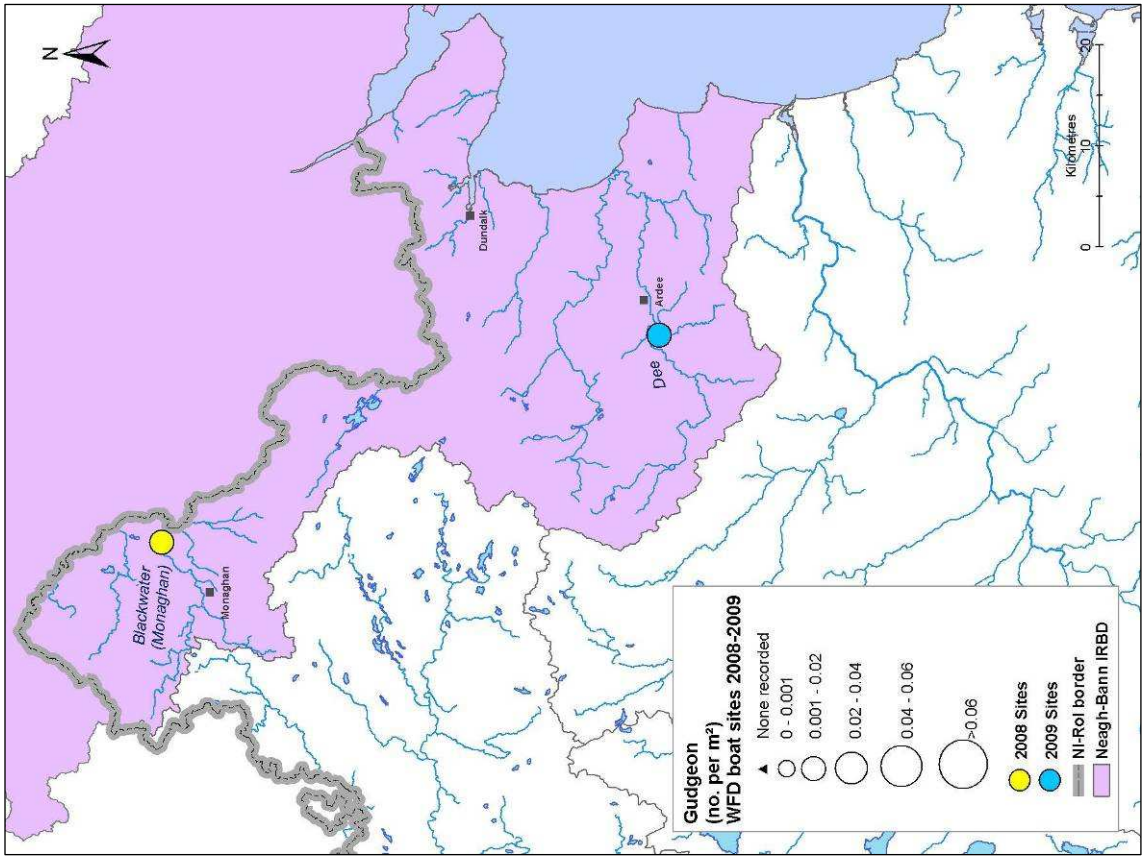

Fig. 4.29. Distribution map of gudgeon in the NBIRBD boat sites surveyed for WFD monitoring 2008–2009

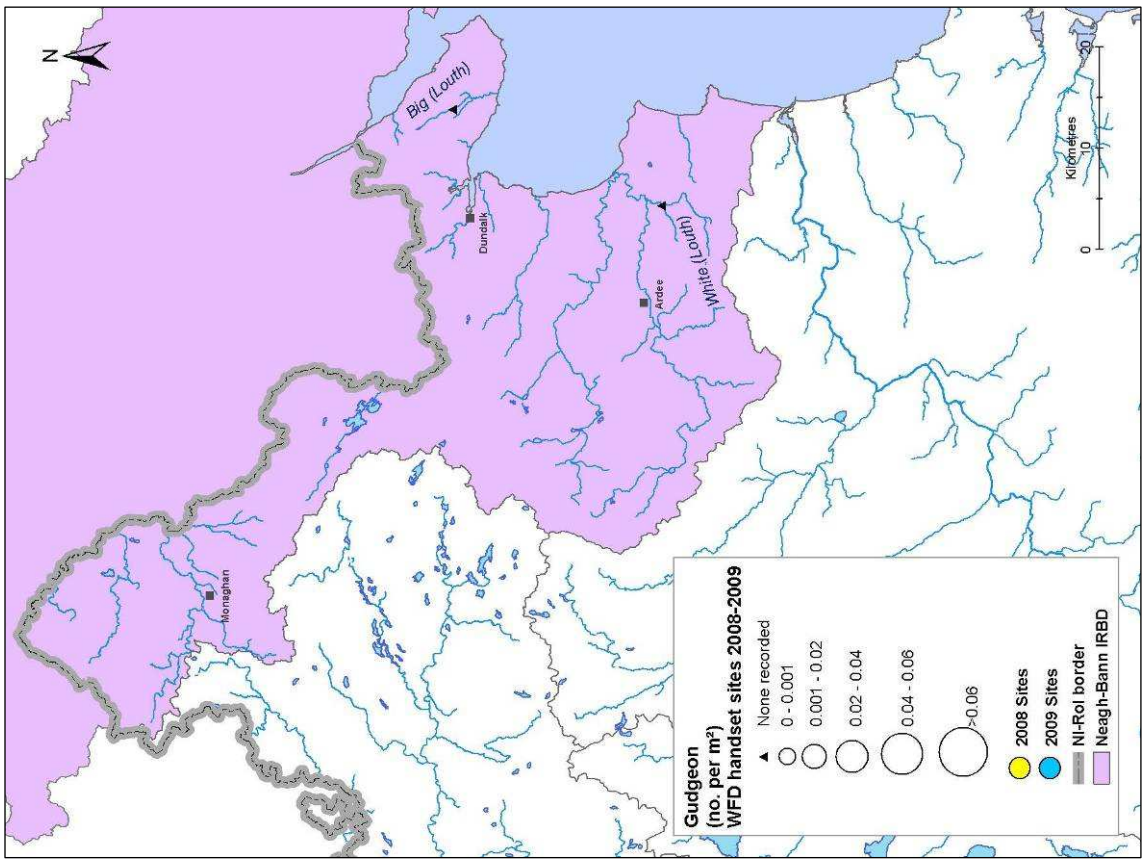

Fig. 4.30. Distribution map of gudgeon in the NBIRBD hand-set sites surveyed for WFD monitoring 2008–2009

4.3.3 Age and growth of brown trout and salmon

Age and growth of fish were determined for brown trout and salmon (where present) in each river site. Brown trout ages ranged from 0+ to 3+, with 0+ and 1+ being the dominant age classes. The largest brown trout (length 34.1cm and weight 0.49kg) recorded during the survey was captured on the White River. The largest juvenile salmon recorded was also captured in the White River, measuring 13.8cm and weighing 38.5g.

Length-at-age analyses and growth curves are presented for brown trout (Fig. 4.31 and Appendix 1) recorded in the three river sites surveyed. 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 Big River, slow in the White River and fast in the River Dee. Insufficient numbers of salmon were caught at these sites to enable a comparison of their growth rates.

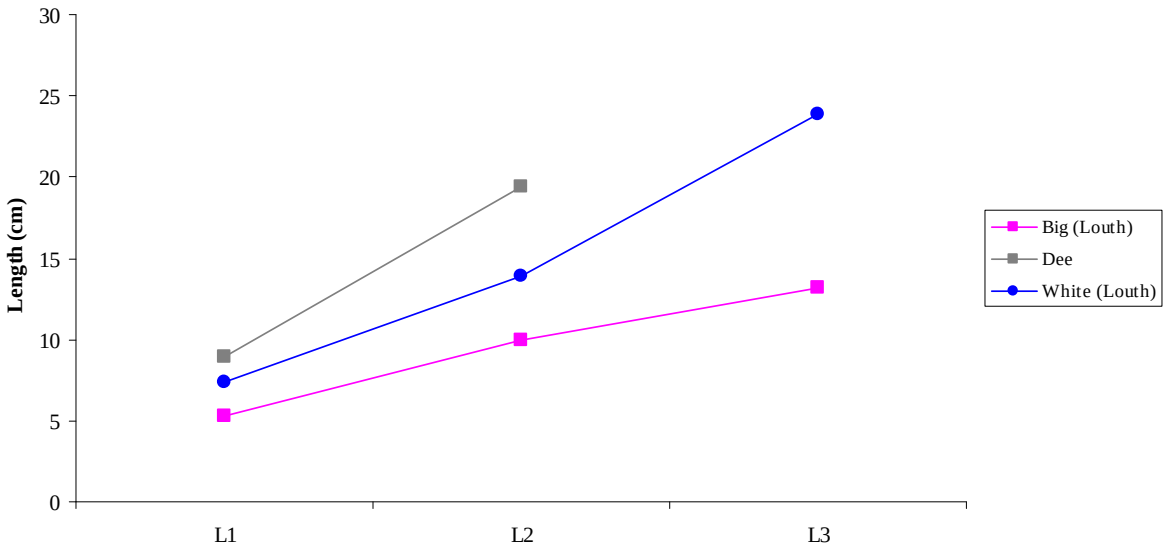

Fig. 4.31. Back calculated lengths for brown trout in each river, WFD surveillance monitoring 2009

5. DISCUSSION

A total of eight fish species were recorded within the NBIRBD during the 2009 sampling program. This was lower than any of the other RBDs. However, there were only three rivers sampled within the NBIRBD and these were all relatively close to each other. In comparison, the SERBD exhibited the greatest species diversity, with a total of 14 species recorded. The main summary report for 2009 (Kelly *et al*., 2010) provides information on species composition, richness and distribution for the whole country.

The River Dee site was the most diverse of the three sites surveyed within the NBIRBD in terms of fish species richness, with eight species recorded. The highest species diversity recorded in any site throughout the country was eleven and this only occurred in one site within the SERBD where there was a high number of non-native fish present. The Big River site had the lowest species diversity within the NBIRBD, with only two species present. Such a low diversity is common in small wadeable streams throughout Ireland that contain only native fish species (Kelly *et al*., 2009).

Brown trout and European eels were present in all three sampling sites. The Big and White Rivers contained some of the highest brown trout densities amongst all river sites surveyed throughout the country during 2009. Three spined-stickleback, minnow and stone loach were all present in two sites (River Dee and White River), while gudgeon and roach were only recorded in one site (River Dee).

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 two of the three rivers surveyed in the NBIRBD. Eno *et al*. (1997) differentiate between 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. The Big River site was the only river that didn't contain any non-native species. 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). Three Group 2 species (minnow, roach and stone loach) and one Group 3 species (gudgeon) were recorded within the NBIRBD region.

Following the methods of Kennedy and Fitzmaurice (1971), brown trout growth was classified as very slow in the Big River, slow in the White River and fast in the River Dee. Insufficient numbers of salmon were caught at these sites to enable a comparison of their growth.

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 each site. 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	Growth category
Big	Mean	5.3	9.9	13.2	Very slow
	S.D.	0.6	0.8	n/a	
	S.E.	0.1	0.2	n/a	
	n	33	14	1	
	Range min.	4.0	8.9	13.2	
	Range max.	6.3	12.1	13.2	
Dee	Mean	9.0	19.4		Fast
	S.D.	1.3	3.0		
	S.E.	0.3	1.1		
	n	23	8		
	Range min.	6.4	13.8		
	Range max.	12.0	22.0		
White	Mean	7.4	13.9	23.9	Slow
	S.D.	1.8	3.6	3.2	
	S.E.	0.6	1.3	2.2	
	n	9	8	2	
	Range min.	5.4	10.8	21.7	
	Range max.	10.2	21.4	26.1	

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
Dee	Mean	5.1	
	SD	1.4	
	ST error	0.7	
	n	4	
	Range min.	3.7	
	Range max.	7.0	
White	Mean	5.6	10.4
	SD	1.3	n/a
	ST error	0.6	n/a
	n	5	1
	Range min.	4.4	10.4
	Range max.	7.9	10.4

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