



Sampling Fish for the Water Framework Directive

Rivers 2010

Eastern River Basin District



Iascach Intíre Éireann
Inland Fisheries Ireland

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1. INTRODUCTION

Fish stock surveys were undertaken in 43 river sites throughout Ireland during the summer of 2010 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). Two of the 43 surveys were conducted at river sites in the Eastern River Basin District (ERBD) between June and July 2010 by staff from Inland Fisheries Ireland (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 (RBD) managers to compile and implement programmes of measures to improve degraded water bodies.

The ERBD covers a land area of approximately 6,300km² and a sea area of approximately 350km² (Fig. 2.1). It comprises mainly the north-eastern part of Leinster, with a coastline of approximately 130km, stretching from south Co. Louth to north Wexford. Despite being much smaller than some of the other river basin districts, it contains the largest population of any. Approximately 1.6 million people live within the area, with most residing in the Greater Dublin area and its commuter belt. There are four hydrometric areas within the ERBD, with the main river systems including the Boyne, the Nanny-Delvin, the Liffey and the Avoca/Vartry. The largest lake within this district is Poulaphuca Reservoir, located in County Wicklow. Most of the land area within the ERBD is used for agriculture, with approximately 75% of the entire district used for this purpose (ERBD, 2009).

This report summarizes the main findings of the fish stock surveys in the two river water bodies surveyed in the ERBD during 2010 and reports on the current ecological status of the fish stocks in each.

2. STUDY AREA

Two river sites were surveyed in two river catchments: the Avoca and Boyne catchments. The sites were divided into two categories for reporting purposes: wadeable sites, which were surveyed with bank-based electric fishing units, and non-wadeable sites, which were surveyed with boat-based electric fishing units.

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 ERBD is shown in Figure 2.1.

Table 2.1. Location and codes of river sites surveyed for WFD surveillance monitoring, 2010

River	Site name	Catchment	Site Code	Waterbody code
ERBD Wadeable sites				
Avonbeg	Greenan Br.	Avoca	10A040800F	EA_07_990
ERBD Non-wadeable sites				
Boyne	Boyne Br.	Boyne	07B042200F	EA_10_99

Table 2.2. Details of river sites surveyed for WFD surveillance monitoring, 2010

River	Upstream catchment (km ²)	Wetted width (m)	Surface area (m ²)	Mean depth (m)	Max depth (m)
ERBD Wadeable sites					
Avonbeg	72.1	8.12	381	0.31	0.56
ERBD Non-wadeable sites					
Boyne	60.3	8.00	936	1.00	1.00



Fig. 2.1. Location map of river sites surveyed throughout the ERBD for WFD fish surveillance monitoring, 2010

3. METHODS

Electric-fishing 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 (Plates 3.1 and 3.2). This technique complies with European Committee for Standardisation (CEN) guidelines for fish stock assessment in wadeable rivers (CEN, 2003). At each site, where possible, the stretch sampled was isolated using stop nets and one to three fishing passes were conducted using bank-based electric fishing units or boat-based electric fishing units. Each survey encompassed all habitat types: riffle, glide and pool. A number of physical habitat variables were measured at each site. Water samples for chemical analyses were also taken, along with a multi-habitat kick-sample of macroinvertebrates. Macrophyte surveys were conducted on a selected number of wadeable streams.

Fish from each pass were sorted and processed separately. Fish were identified and lengths and weights were recorded; sub-samples were measured when large numbers of fish were present. For the purpose of species identification, where recorded, 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 recorded separately. For aging analyses, scales were taken from salmonids and most non-native fish species greater than 8.0cm in length. These fish were held in a large bin of oxygenated water after processing until they were fully recovered before being returned to the water. When present in a survey, a sub-sample of perch were retained for aging using opercular bones.

Three fishing passes were not possible or practical at all sites. Therefore in order to standardise abundance estimates across all sites, fish densities were calculated using data from the first fishing pass only. The number captured in the first fishing pass was divided by the total area surveyed to give a minimum population density for each species.

A sub-sample 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 bank-based units on the Owenriff River (WRBD)



Plate 3.2. Electric-fishing using boat-based units on the River Shannon (Clonmacnoise)

4. RESULTS

4.1 Wadeable sites

4.1.1 *The Avonbeg River*



Plate 4.1. The Avonbeg River at Greenan Bridge, Co. Wicklow

The Avonbeg River rises in Camenabologue Mountain, approximately 3km north of Lugnaquilla Mountain in Co. Wicklow (Plate 4.1, Fig. 4.1). It flows in a south-easterly direction through Glenmalure Valley and continues south until it joins the Avonmore River, to become the Avoca River at the Meeting of the Waters. While not a major fishery, the Avonbeg River is known to contain large stocks of small trout (O' Reilly, 2002).

The source of the Avonbeg River is located within the Wicklow Mountains Special Area of Conservation (SAC), which is dominated by heath, blanket bog and upland grassland habitats, over bedrock of predominantly granite. The rivers draining this SAC are generally acidic, oligotrophic and often peaty, especially during floods (NPWS, 2001 and 2004).

The survey site was located just upstream of Greenan Bridge in Greenan, approximately 3km north-west of Ballinaclash (Fig 4.1). Three electric-fishing passes were conducted using two bank-based

electric fishing units on the 28th of June 2010, along a 47m length of channel. The mean wetted width of the channel was 8.1m and the mean depth was 31cm. A total wetted area of 381m² was surveyed. Riffle, glide and pool were evenly represented at this site, with a substrate of mainly boulder and cobble. The survey site was heavily shaded, with dense tree cover along both banks. The macrophyte vegetation was dominated by bryophytes, both on the bank side and on rocks within the channel. Significant amounts of green filamentous algae were also present in the channel.

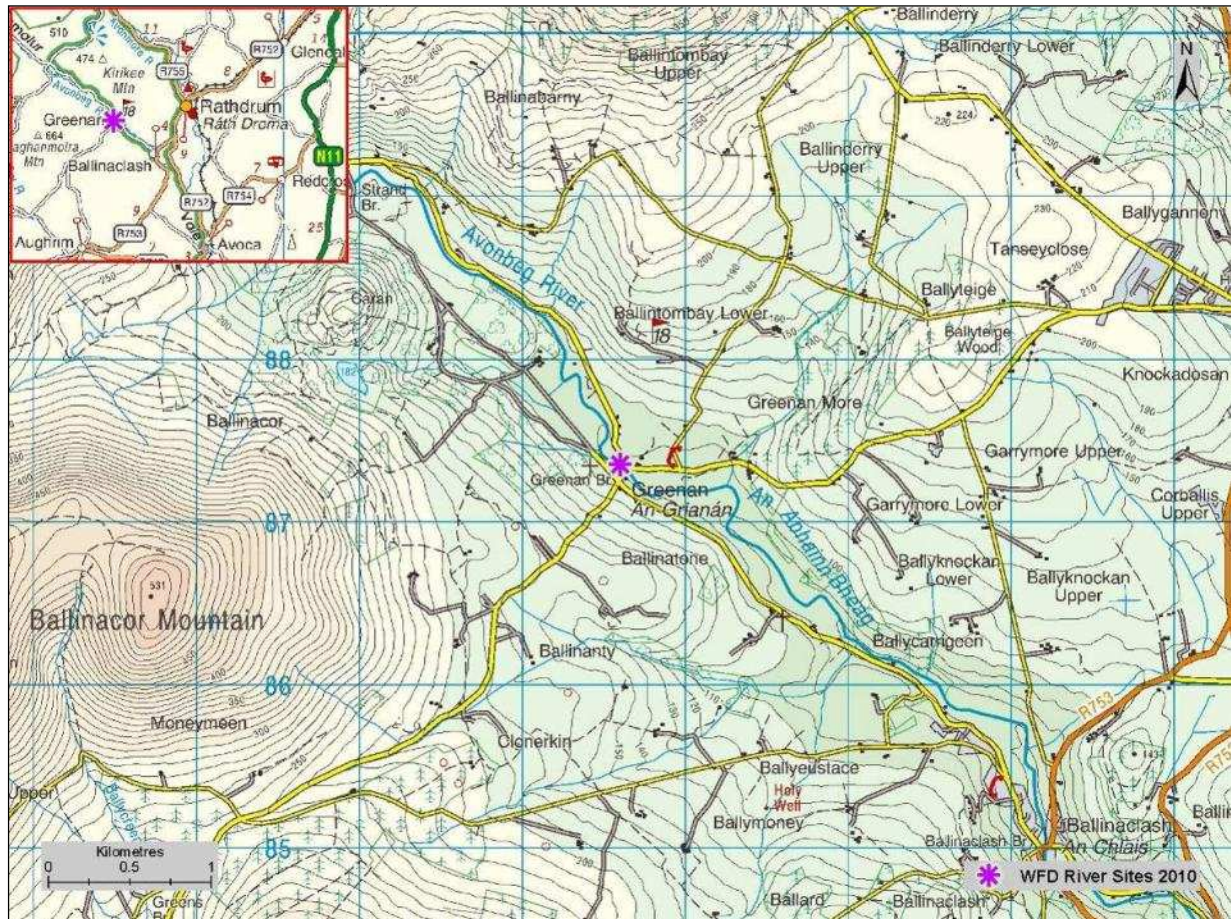


Fig. 4.1. Location of the Avonbeg River surveillance monitoring site

A total of three fish species were recorded on the Avonbeg River site. Salmon was the most abundant species, followed by brown trout and eels (Table 4.1).

Table 4.1. Minimum density of each fish species (no./m²) captured on the Avonbeg River site, June 2010

Scientific name	Common name	0+	1+ & older	Total minimum density
<i>Salmo salar</i>	Salmon	0.003	0.087	0.089
<i>Salmo trutta fario</i>	Brown trout	-	0.016	0.016
<i>Anguilla anguilla</i>	Eel	-	-	0.003
All Fish	All Fish	-	-	0.105

Salmon ranged in length from 4.5cm to 12.7cm (Fig. 4.2). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 2%, 94% and 4% of the total salmon catch respectively. The mean salmon L1 and L2 were 4.6cm and 9.0cm respectively (Appendix 2).

Brown trout ranged in length from 7.4cm to 17.4cm (Fig. 4.3). Three age classes (1+, 2+ and 3+) were present, accounting for approximately 73%, 20% and 7% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 5.7cm, 10.8cm and 14.4cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is ‘very slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

A single eel measuring 27.5cm in length was also recorded.

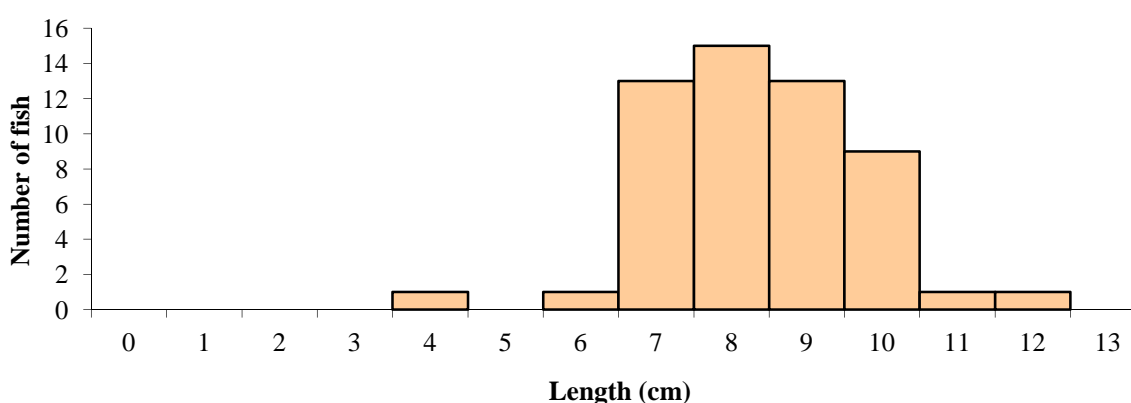


Fig. 4.2. Length frequency distribution of salmon in the Avonbeg River site, June 2010 (n = 54)

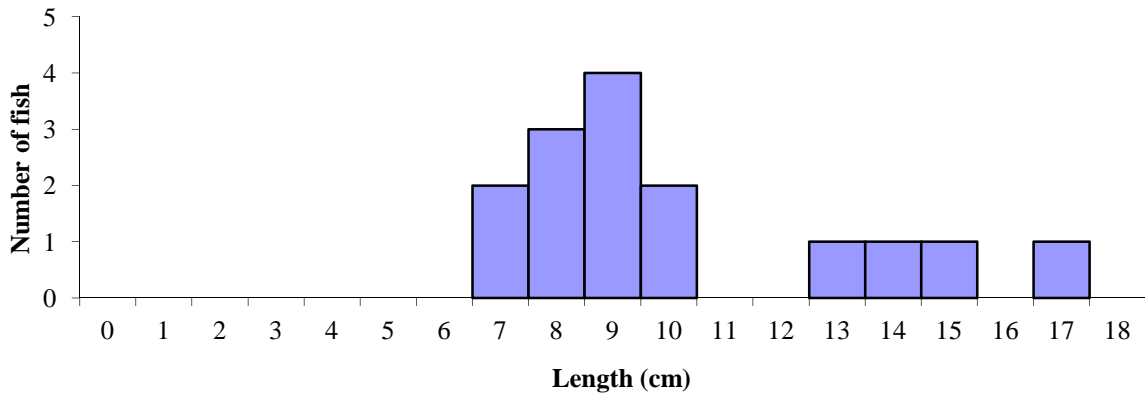


Fig. 4.3. Length frequency distribution of brown trout in the Avonbeg River site, June 2010 (n = 15)

4.2 Non-wadeable sites

4.2.1 *The River Boyne (Boyne Br.)*



Plate 4.2. The River Boyne site at Boyne Bridge near Edenderry, Co. Offaly

The River Boyne rises in Co. Kildare in an area of flat agricultural land approximately 8.5km west of Edenderry (Plate 4.2, Fig. 4.4). It flows along the border of Co. Kildare and Co. Offaly before entering Co. Meath. The River Boyne drains land predominantly used for agriculture and flows through several towns, including Trim, Navan and Slane, before finally reaching the sea just east of Drogheda in Co. Louth. The River Boyne and its tributaries provide one of Ireland's best game fisheries and offers good opportunities for brown trout, salmon and sea trout angling (O'Reilly, 2009; ERFB, 2010). An arterial drainage scheme was undertaken in the Boyne catchment by the Office of Public Works (OPW), on the main channel and tributaries upstream of Navan, between 1969 and 1985 to provide flood relief (O'Grady, 1991). Some stretches of the main channel (including this site) and its tributaries, including the surveyed stretch are still subject to regular channel maintenance by the OPW (O'Grady, 1991 and Kelly *et al.*, 2010).

The survey site was located close to the river's source, approximately 1.5km north of Edenderry (Fig. 4.4). Three electric-fishing passes were conducted using one boat-based electric-fishing unit on the 10th of July 2010 along a 117m length of channel. The site was previously surveyed in August 2009 by Inland Fisheries Ireland (previously the Central and Regional Fisheries Boards) (Kelly *et al.*, 2010a). The mean wetted width of the channel was 8.0m and the mean depth was 100cm. A total wetted area of 936m² was surveyed. Emergent macrophyte vegetation was abundant throughout this stretch, while submerged and floating species were also present.

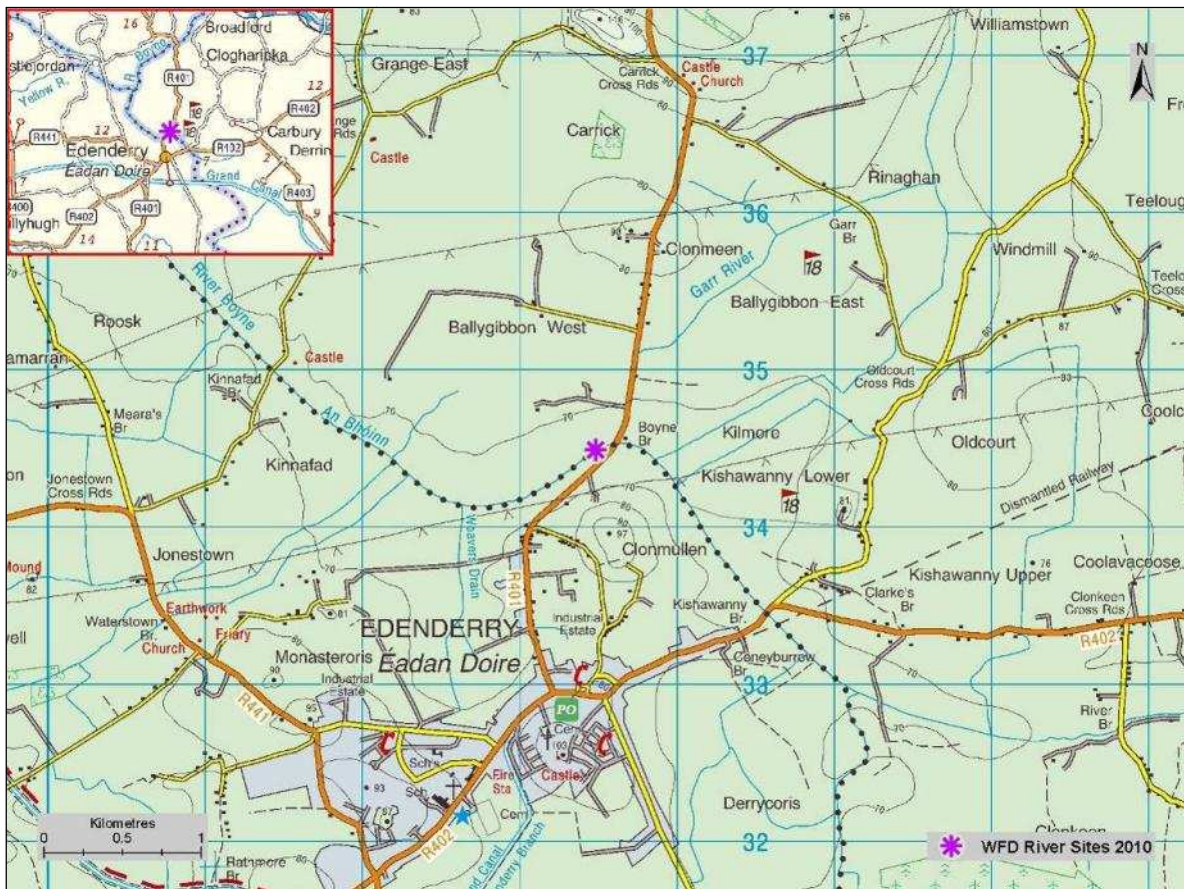


Fig. 4.4. Location of the River Boyne (Boyne Br.) surveillance monitoring site

Three fish species were recorded in the River Boyne at Boyne Bridge. Brown trout was the most abundant species, followed by three-spined stickleback and minnow (Table 4.2).

Table 4.2. Minimum density of each fish species (no./m²) captured on the River Boyne site (Boyne Br.), July 2010

Scientific name	Common name	0+	1+ & older	Total minimum density
<i>Salmo trutta fario</i>	Brown trout	0.00107	0.04915	0.05021
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	-	-	0.00427
<i>Phoxinus phoxinus</i>	Minnow	-	-	0.00214
All Fish	All Fish	-	-	0.05662

Brown trout ranged in length from 6.0cm to 27.7cm (Fig. 4.5). Five age classes (0+, 1+, 2+, 3+ and 4+) were present, accounting for approximately 3%, 43%, 41%, 10% and 3% of the total brown trout catch respectively. The mean brown trout L1, L2, L3 and L4 were 7.3cm, 14.6cm, 19.8cm and 24.2cm respectively (Appendix 1). This indicates that growth of brown trout in this river site is 'slow' according to the classification scheme of Kennedy and Fitzmaurice (1971). Previously (2009) the trout from this site were categorised as fast using the same method.

Other species recorded included, three-spined stickleback ranging in length from 1.0cm to 4.6cm and two minnow measuring 4.6cm and 5.5cm in length.

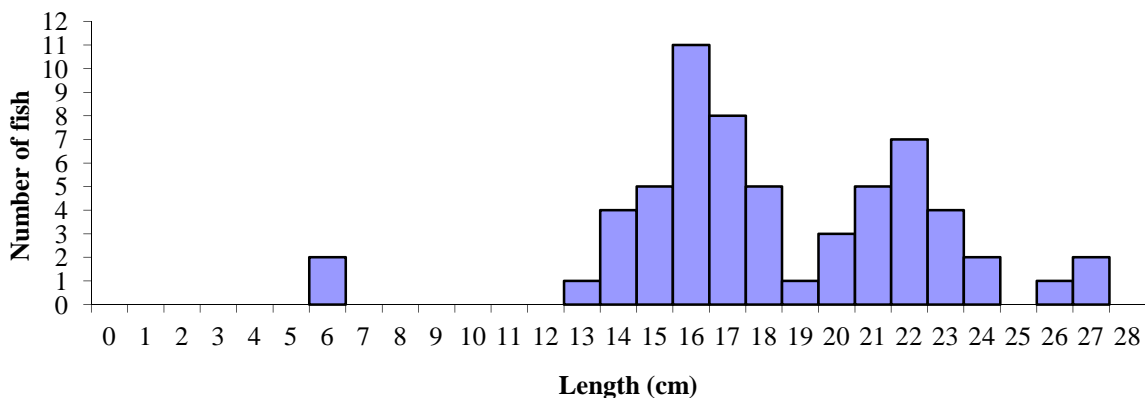


Fig. 4.5. Length frequency distribution of brown trout in the River Boyne (Boyne Br.), July 2010 (n = 61)

4.3 Community structure

4.3.1 Species richness and composition

A total of five fish species were recorded within the two ERBD sites surveyed during 2010 (Fig. 4.6). Brown trout was the most common fish species recorded, occurring at both sites. Eels, salmon, three-spined stickleback and minnow, each occurred at only one site.

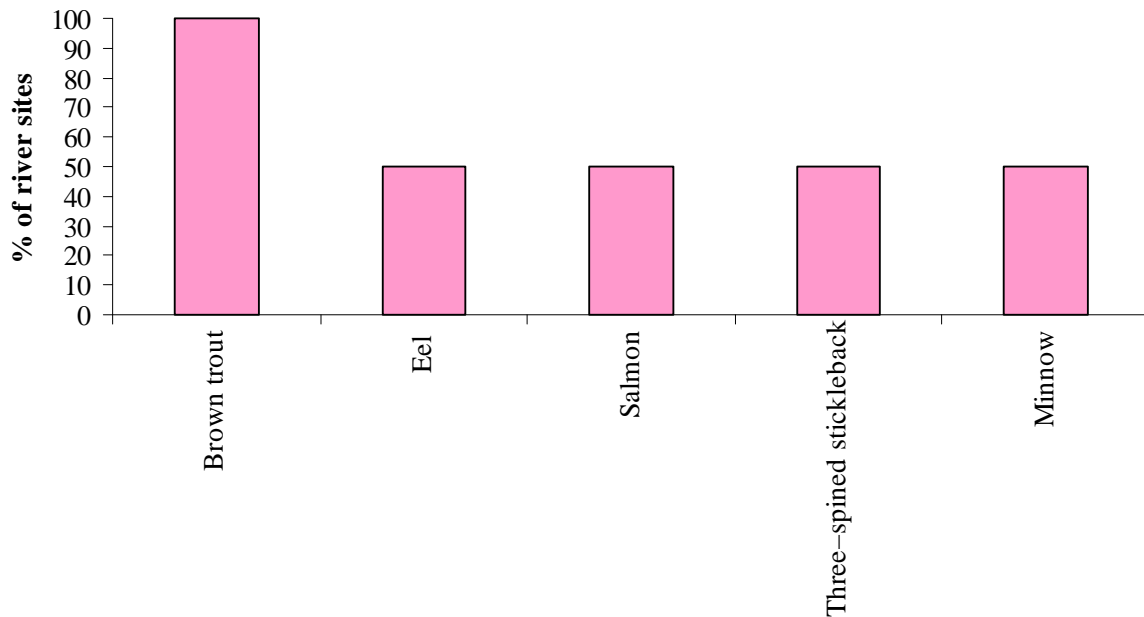


Fig. 4.6. Percentage of sites where each fish species was recorded in the ERBD for WFD SM monitoring 2010

Three fish species were recorded at each site (Table 4.3). Kelly *et al.* (2008) classified fish species in Ireland into three groups: Group 1 - native species (e.g. salmonids, three-spined stickleback, lamprey, eel and flounder); Group 2 - non-native species that influence ecology (e.g. perch, roach, minnow, and stone loach); and Group 3 - non-native species that generally do not influence ecology (e.g. gudgeon). Group 1 species were present at both sites surveyed, whereas Group 2 species were only recorded in the River Boyne. Group 3 species were not recorded in either site.

Table 4.3. Species richness at each river site surveyed in the ERBD, June to July 2010

Site	Species richness	No. native species (Group 1)	No. non-native species (Group 2)	No. non-native species (Group 3)
ERBD Wadeable Sites				
Avonbeg	3	3	0	0
ERBD Non-wadeable Sites				
Boyne (Boyne Br.)	3	2	1	0

4.3.2 Species abundance and distribution

Abundance (minimum population density) and distribution maps for the most common fish species recorded within the ERBD during 2010 are shown below in Figures 4.7 to 4.13. Recorded fish densities are generally higher in wadeable sites surveyed with bank-based electric-fishing gear than in non-wadeable sites surveyed with boat-based electric-fishing gear (Kelly *et al.*, 2009; Kelly *et al.* 2010b; Kelly *et al.* 2011). This is primarily due to the tendency for juvenile trout, salmon and other species to utilise shallow, riffle areas as nursery habitat, along with the difference in sampling efficiency of the two methods. As such, population densities recorded for each species using the two methods are displayed as separate colours on each map.

Brown trout were recorded at both sites. Brown trout fry (0+) were only recorded in the River Boyne site (0.001 fish/m²) (Fig. 4.7). Individuals aged 1+ and older were recorded in both sites, with densities of 0.049 fish/m² in the River Boyne site and 0.016 fish/m² in the Avonbeg River site (Fig. 4.8).

Salmon were only recorded in the Avonbeg River site, with densities of 0.003 fish/m² and 0.087 fish/m² for fry (0+) and parr (1+ and older) respectively (Fig. 4.9 and Fig. 4.10).

Among the other species recorded in the ERBD in 2010, eels were present in the Avonbeg River site (Fig. 4.11), whereas three-spined stickleback (Fig. 4.12) and minnow (Fig. 4.13) were present in the River Boyne site.

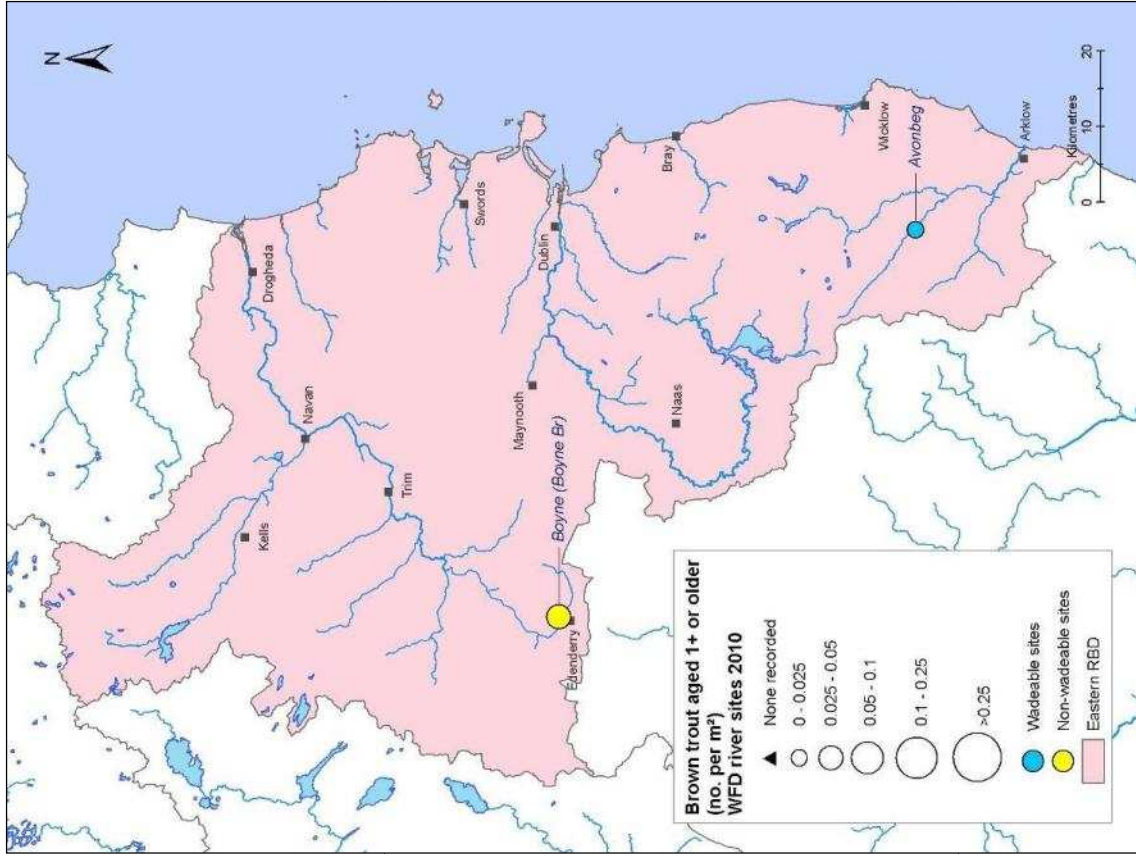


Fig. 4.8. Distribution map of 1+ or older brown trout in the ERBD, WFD surveillance monitoring 2010

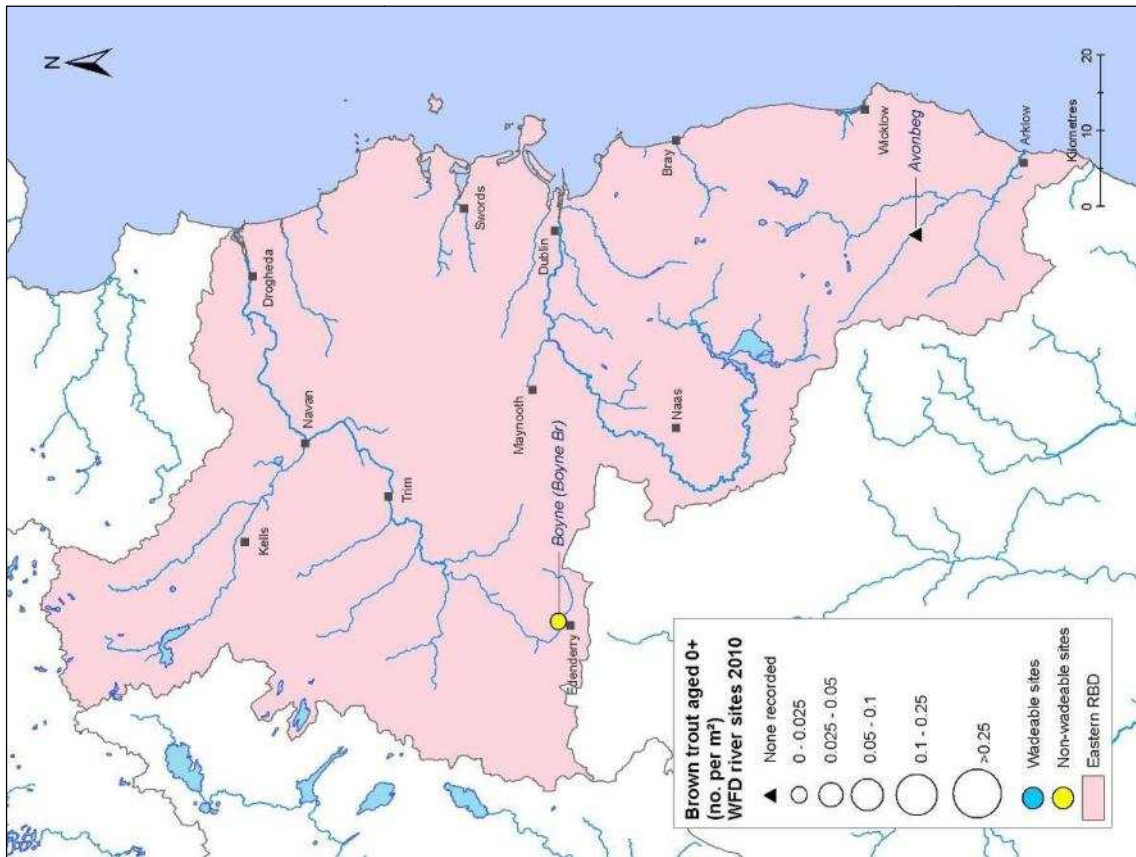


Fig. 4.7. Distribution map of 0+ brown trout in the ERBD, WFD surveillance monitoring 2010

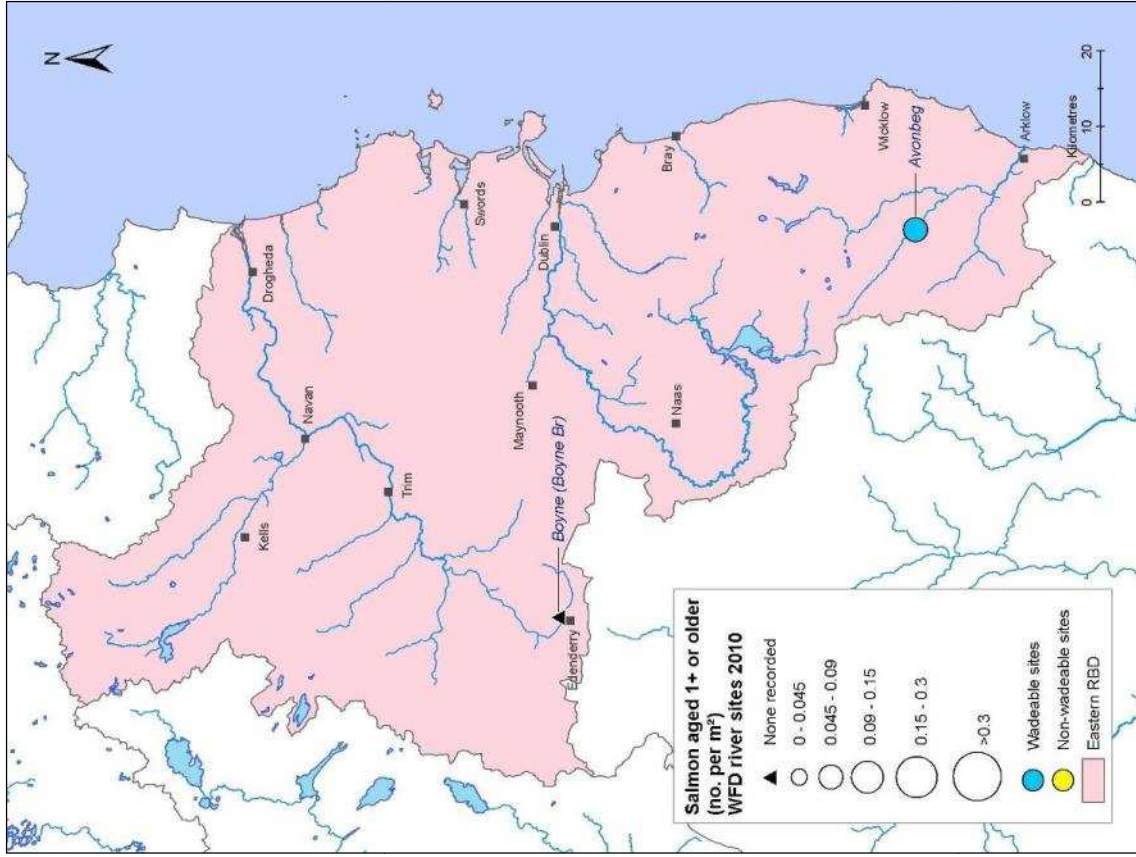


Fig. 4.10. Distribution map of 1+ or older salmon in the ERBD, WFD surveillance monitoring 2010

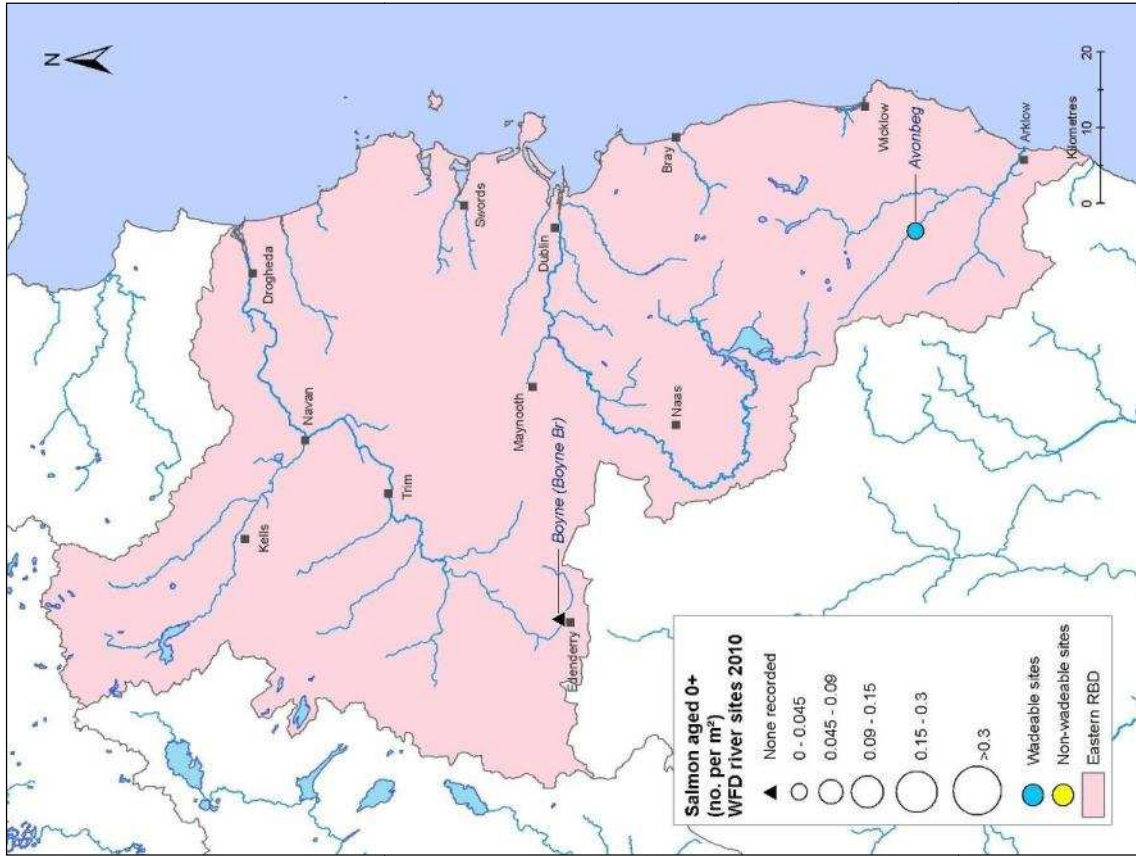


Fig. 4.9. Distribution map of 0+ salmon in the ERBD, WFD surveillance monitoring 2010

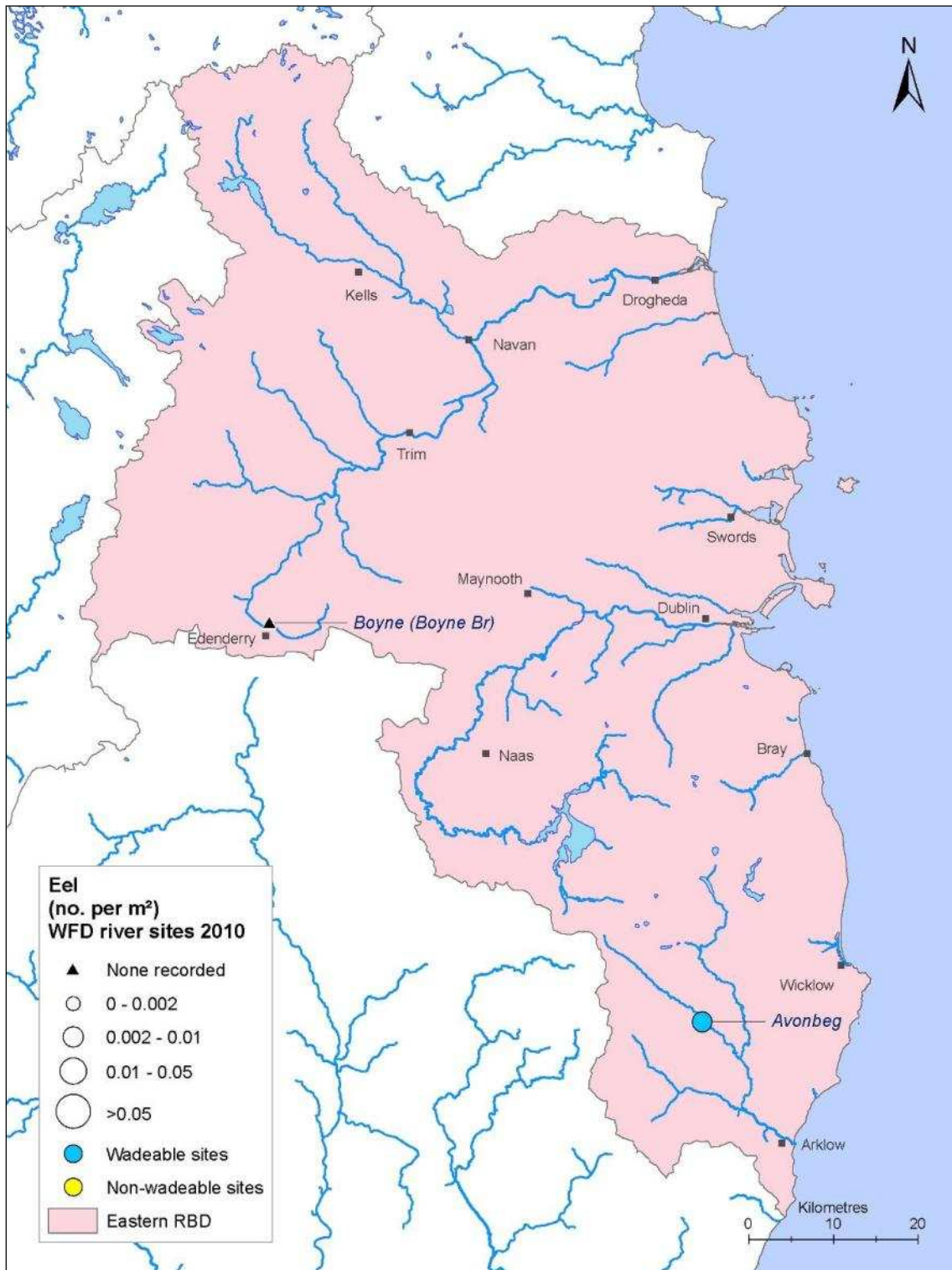


Fig. 4.11. Distribution map of eel in the ERBD, WFD surveillance monitoring 2010

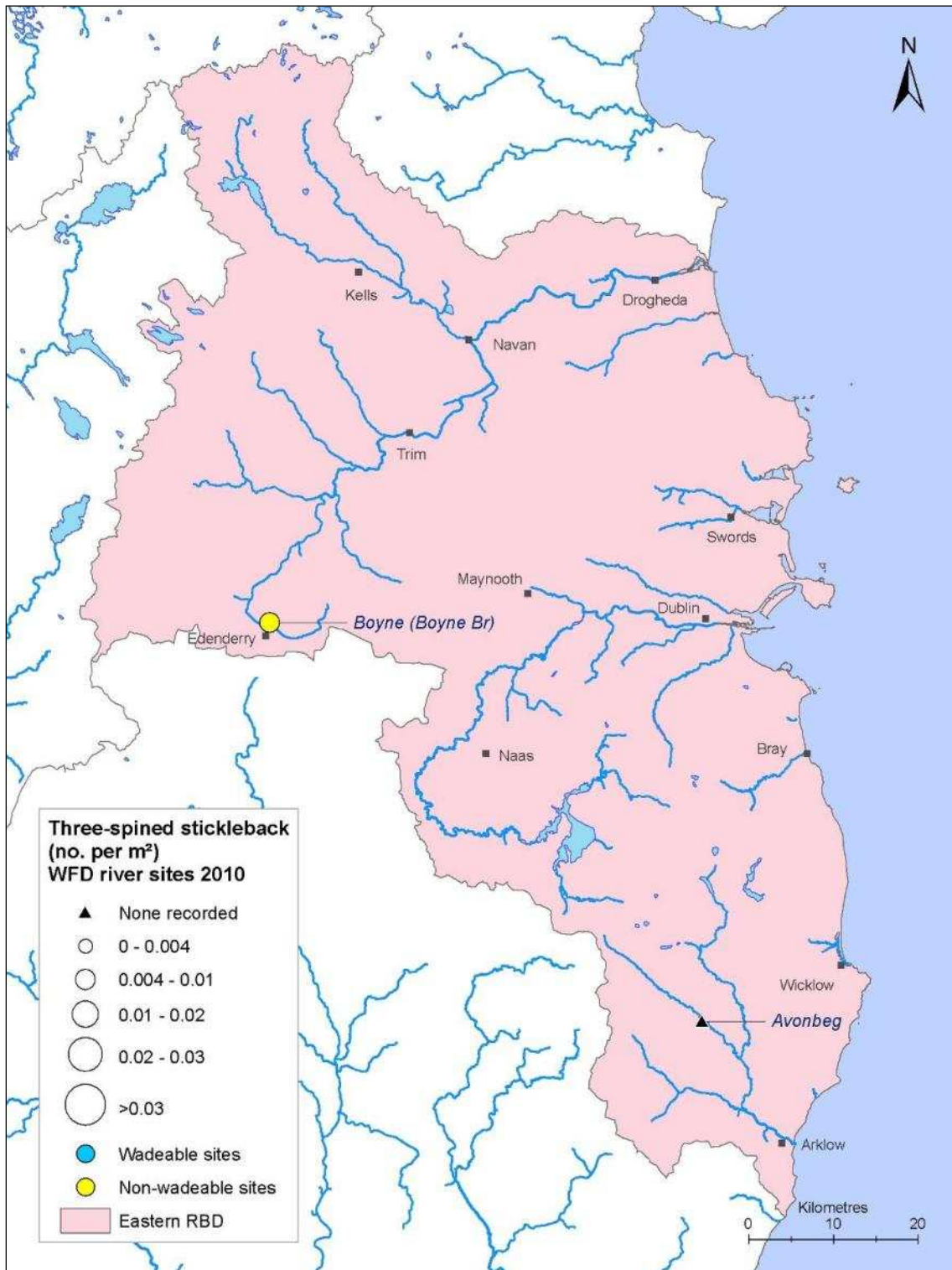


Fig. 4.12. Distribution map of three-spined stickleback in the ERBD, WFD surveillance monitoring 2010

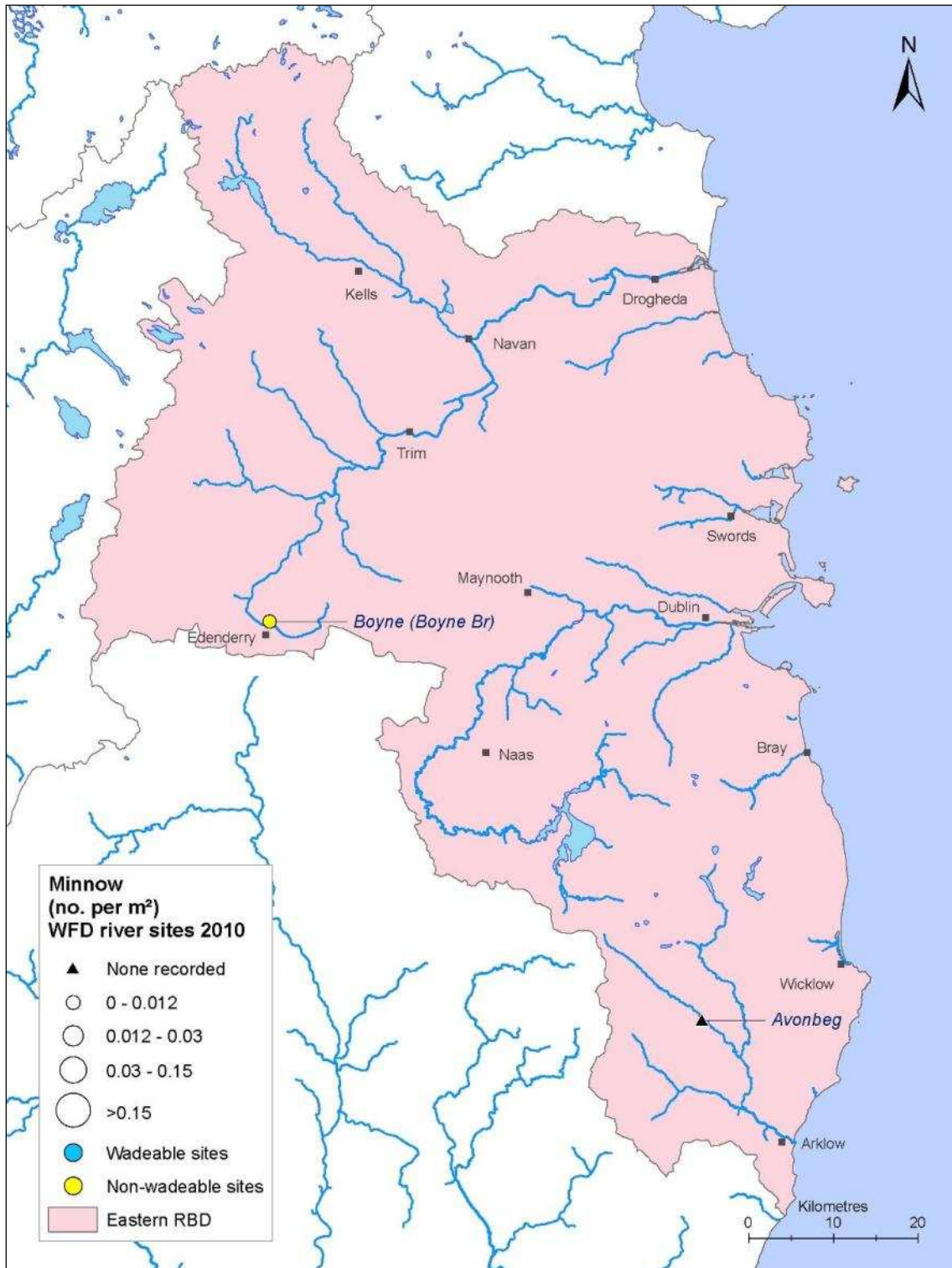


Fig. 4.13. Distribution map of minnow in the ERBD, WFD surveillance monitoring 2010

4.3.3 Age and growth of brown trout and salmon

Growth rates based on back-calculated length-at-age data were analysed for brown trout and salmon in each river site surveyed in the ERBD during 2010. Brown trout were recorded in both the Avonbeg River and the River Boyne sites, whereas salmon were only recorded in the Avonbeg River site.

Brown trout ranged in age from 0+ to 4+, with 1+ fish being the most abundant age class at both sites. The largest brown trout recorded in the ERBD in 2010 was captured in the River Boyne site (Boyne Br.), measuring 27.7cm in length, 262g in weight and was aged 4+. The brown trout at each river site were assigned growth categories as described by Kennedy and Fitzmaurice (1971), who examined the relationship between alkalinity and growth of brown trout in Irish streams and rivers. Brown trout growth was classified as ‘very slow’ in the Avonbeg site and ‘slow’ in the Boyne (Boyne Br.) site (Fig. 4.14, Appendix 1).

Three age classes of salmon were recorded in the Avonbeg River site: 0+, 1+ and 2+, with 1+ fish being the most abundant age class.

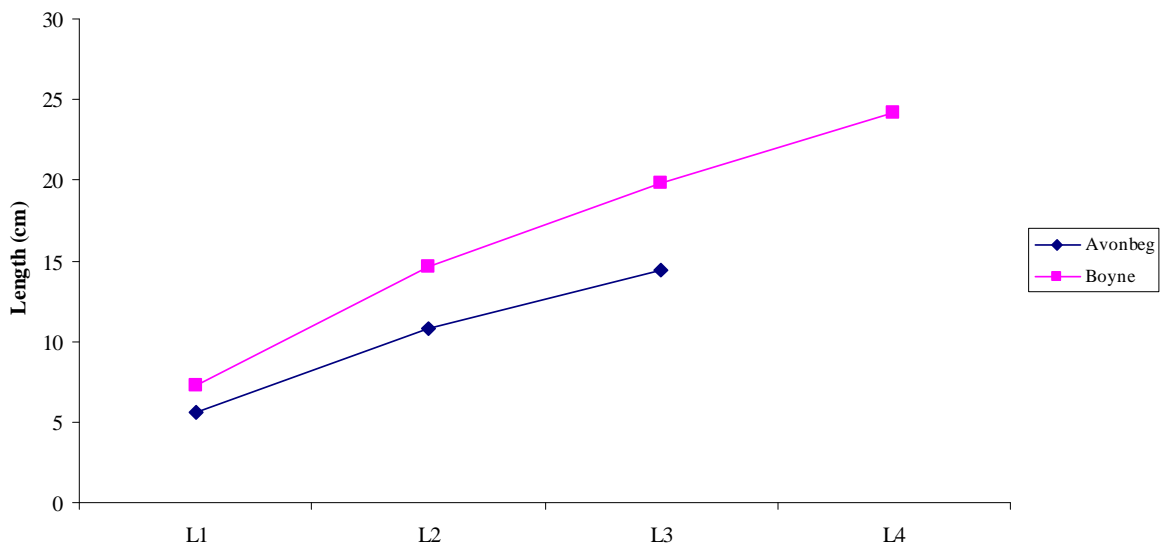


Fig. 4.14. Mean back calculated length-at-age data for brown trout in each river, WFD surveillance monitoring 2010

4.4 Ecological status

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 Management Plans.

An ecological classification tool for fish in rivers has recently been developed for Ecoregion 17 (Republic of Ireland and Northern Ireland), along with a separate version for Scotland to comply with the requirements of the WFD. Agencies throughout the two regions have contributed data which was used in the model development for Ecoregion 17. 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 (Fisheries Classification Scheme 2, or ‘FCS2’) be used. This approach has broadly been followed and improved to develop the new classification tool – ‘FCS2 Ireland’. The tool 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 resultant output is an Ecological Quality Ratio (EQR) between 1 and 0, with five class boundaries defined along this range corresponding with the five ecological status classes of High, Good, Moderate, Poor and Bad. Confidence levels are assigned to each class and represented as probabilities.

Using FCS2 Ireland, along with expert opinion, each river site surveyed during 2010 has been assigned a draft fish ecological status class (Table 4.4). The Avonbeg River was assigned a draft classification of “Good”, while the River Boyne at Boyne Bridge was assigned a class of “Moderate”. The Boyne site was previously classified as “Good” (2009), indicating some level of deterioration over the past year (Kelly *et al*, 2010a).

Table 4.4. Ecological status, based on the fish populations present, of sites surveyed in the ERBD for WFD surveillance monitoring 2010

River	Site code	Site name	Ecological status
ERBD Wadeable sites			
Avonbeg	10A040600F	Greenan Br.	Good
ERBD Non-wadeable sites			
Boyne	07B040200F	Boyne Br.	Moderate

5. DISCUSSION

A total of five fish species were recorded during the 2010 monitoring program within the ERBD. The highest species diversity recorded within any region throughout Ireland during 2010 was thirteen species. This was observed in both the Western and South Western River Basin Districts (WRBD and SWRBD), which contained a high number of non-native fish species. Information on fish species richness, composition, distribution and abundance throughout the whole country can be found in the WFD summary report for 2010 (Kelly *et al.*, 2011).

Both river sites surveyed within the ERBD had the same species richness, with a total of only three species present. The highest species diversity recorded in any site throughout the country was ten, occurring in one site within the SWRBD (River Blackwater at Lismore), where there was a high number of non-native species present. Low species diversity is common in rivers throughout Ireland that contain only native fish species (Kelly *et al.*, 2009; Kelly *et al.*, 2010b; Kelly *et al.*, 2011). Both sites surveyed in the ERBD during 2010 contained only native species, with the exception of minnow which were recorded in the River Boyne site.

Brown trout was the only species present in both sites surveyed within the ERBD during 2010, whilst all other species, including eels, salmon, three-spined stickleback and minnow were recorded in one site only. The greatest abundance of brown trout was recorded in the Avonbeg River site.

In a similar trend to that observed in 2008 (Kelly *et al.*, 2009), the growth of brown trout in the sites surveyed within the ERBD in 2010 corresponded to the work of Kennedy and Fitzmaurice (1971), who found that, in general, the growth of brown trout is positively related to the alkalinity of a river. The growth of brown trout was classified as 'very slow' in the Avonbeg River site, a small channel which has a low alkalinity, and as 'slow' in the River Boyne (Boyne Br.) site, a deeper stretch which has a higher alkalinity.

Using the recently completed ecological classification tool for fish in rivers (FCS2 Ireland), along with expert opinion, each river site surveyed during 2010 has been assigned a draft ecological status classification based on the fish populations present. The Avonbeg River and River Boyne sites have been assigned an ecological status of Good and Moderate respectively. The River Boyne site has displayed a change in ecological status from Good to Moderate since the 2009 survey.

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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	Growth category
Avonbeg	Mean	5.7	10.8	14.4		Very slow
	S.D.	0.7	1.5	n/a		
	S.E.	0.2	0.8	n/a		
	n	12	3	1		
	Min	4.5	9.9	14.4		
	Max	7.0	12.5	14.4		
Boyne	Mean	7.3	14.6	19.8	24.2	Slow
	S.D.	1.4	3.5	1.9	0.1	
	S.E.	0.2	0.6	0.7	0.1	
	n	50	32	8	2	
	Min	4.5	9.0	16.0	24.1	
	Max	10.1	19.9	22.8	24.3	

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
Avonbeg	Mean	4.6	9.0
	S.D.	1.1	0.1
	S.E.	0.2	0.1
	n	19	2
	Min	3.3	8.9
	Max	7.6	9.1



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