



Sampling Fish for the Water Framework Directive

Rivers 2012

**South Western River
Basin District**



Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Rivers in the South Western River Basin District, 2012

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1. INTRODUCTION

Fish stock surveys were undertaken in 58 river sites throughout Ireland during the summer of 2012 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). Five of these surveys were carried out at river sites in the South Western River Basin District (SWRBD) in September 2012 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. As 2012 is the fifth year of the rivers sampling programme, many of the sites surveyed this year are repeat surveys of those carried out in 2009. As a result, surveys this year can be compared with surveys from before to determine whether the status of our rivers is improving or deteriorating.

This report summarises the results of the 2012 fish stock survey carried out on each site in the SWRBD, as part of the Water Framework Directive surveillance monitoring programme.

2. STUDY AREA

Five river sites were surveyed in three river catchments within the SWRBD during 2012: the Argideen, Adrigole and Blackwater catchments. The sites ranged in surface area from 430m² for the Argideen and Adrigole Rivers to 3910m² for the Awbeg River (Table 2.1). 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 SWRBD is shown in Figure 2.1.

Table 2.1. Location and codes of river sites surveyed for WFD surveillance monitoring, SWRBD 2012

River	Site name	Catchment	Site Code	Waterbody code
SWRBD Wadeable sites				
Adrigole	0.5km d/s of Glashduff confl. _A	Adrigole	21A010150A	SW_21_8052
Argideen	Ballinoroher Ford _B	Argideen	20A020150B	SW_20_2251
SWRBD Non-Wadeable sites				
Awbeg (Buttevant)	Kilcummer Br. _A	Blackwater	18A051300A	SW_18_2677
Bride (Waterford)	Footbr. N of Ballynella _A	Blackwater	18B050500A	SW_18_2778
Bride (Waterford)	Footbr. N of Ballynella _B	Blackwater	18B050500B	SW_18_2778

Table 2.2. Details of river sites surveyed for WFD surveillance monitoring, SWRBD 2012

River	Upstream catchment (km ²)	Wetted width (m)	Surface area (m ²)	Mean depth (m)	Max depth (m)
SWRBD Wadeable sites					
Adrigole (0.5km d/s of Glashduff confl. _A)	26.28	10.75	430	0.30	0.58
Argideen (Ballinoroher Weir _A)	82.41	12.65	430	0.32	0.62
SWRBD Non-Wadeable sites					
Awbeg (Buttevant) (Kilcummer Br. _A)	350.44	19.17	3910	0.49	1.25
Bride (Waterford) (Footbr. N of Ballynella _A)	226.78	20.17	3126	0.60	1.03
Bride (Waterford) (Footbr. N of Ballynella _B)	227.01	15.50	2806	0.67	1.07

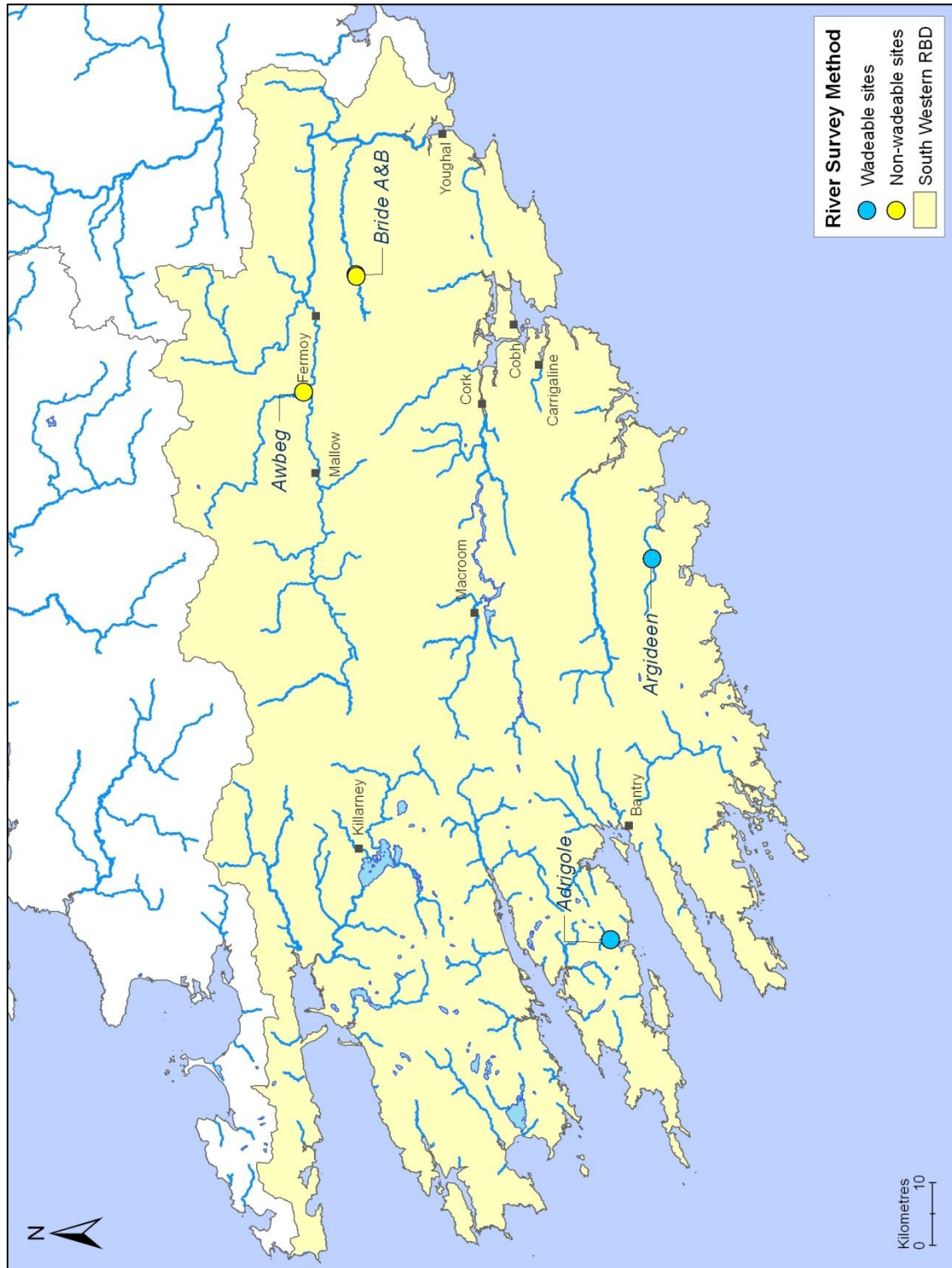


Fig. 2.1. Location map of river sites surveyed throughout the SWRBD for WFD fish surveillance monitoring 2012

3. METHODS

Electric-fishing is the method of choice for the surveillance monitoring of fish in rivers and to obtain a representative sample of the fish assemblage for each survey site. This technique complies with European Committee for Standardisation (CEN) guidelines for fish stock assessment in wadeable rivers (CEN, 2003). At each site, the sample stretch was isolated where possible using stop nets, with one to three fishings carried out using bank-based or boat-based electric fishing units. Each site ideally contained all habitat types, including riffle, glide and pool. A suite of physical and chemical parameters were also recorded.

Fish from each pass were sorted and processed separately. During processing, the species of each fish was identified, with its length and weight measured. Sub-samples were sometimes taken 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 ageing analyses, scales were taken from fish greater than 8.0cm for salmonids and most non-native fish species. After processing, fish were held in large bins of oxygenated water until they were fully recovered, before returning them to the water.

For various reasons, including river width and flow rate, stop nets could not be deployed at every site, thus making three fishing passes impractical. 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.

A subsample of the dominant fish species was aged (five fish from each 1cm size class). Fish scales were aged using a microfiche reader. 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 and L2 is the mean length at the end of the second winter, etc.).

4. RESULTS

4.1 River surveys

4.1.1 The Adrigole River

One site was electric fished on the Adrigole River as part of the WFD surveillance monitoring programme in rivers 2012. The survey site was located approximately 2km north of Adrigole, Co. Cork (Fig. 4.1; Plate 4.1). Three electric-fishing passes were conducted using two bank-based electric fishing units on the 11th of September 2012, along a 40m length of channel. Glide dominated the habitat, while the substrate was a mix of boulder, cobble, gravel and sand. The vegetation at this site was dominated by bryophytes, with a diverse number of aquatic and semi-aquatic mosses and liverworts present.



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



Plate 4.1. The Adrigole River at Adrigole, Co. Cork

Three fish species were recorded in the Adrigole River site (Table 4.1). Salmon was the most abundant species, followed by brown trout and eels.

Table 4.1. Density of fish (no./m²), Adrigole River site (fish density has been calculated as minimum estimates based on one fishing)

Common name	2012		
	0+	1+ & older	Total minimum density
Salmon	0.130	0.000	0.130
Brown trout	0.019	0.040	0.058
European eel	-	-	0.023
All Fish	-	-	0.212

Brown trout captured during the 2012 survey ranged in length from 5.9cm to 18.0cm (mean = 11.9cm) (Fig. 4.2). Three age classes (0+, 1+ and 2+) were present, accounting for 36%, 45% and 18% of the total brown trout catch respectively.

Salmon captured during the 2012 survey ranged in length from 5.4cm to 9.6cm (mean = 7.5cm) (Fig. 4.3). Only one age class (0+) was present.

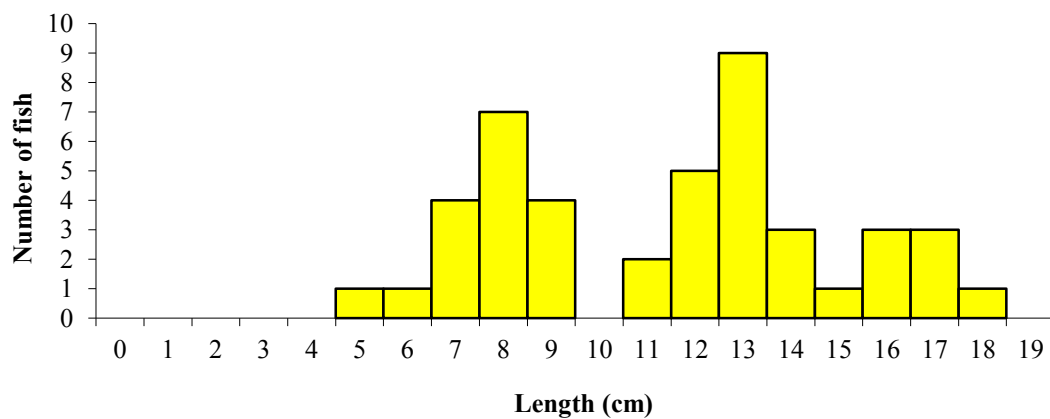


Fig. 4.2. Length frequency distribution of brown trout in the Adrigole River site, September 2012 (n = 44)

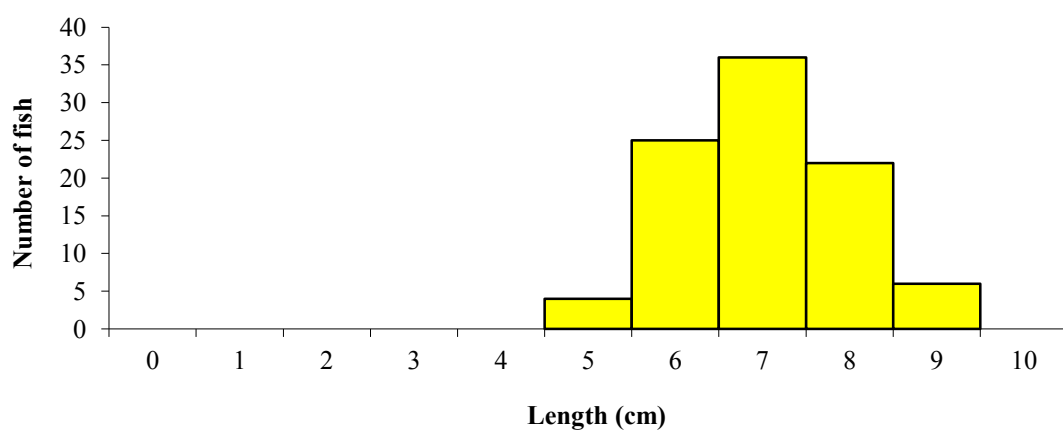


Fig. 4.3. Length frequency distribution of salmon in the Adrigole River site, September 2012 (n = 93)

4.1.2 The Argideen River

One site was electric fished on the Argideen River as part of the WFD surveillance monitoring programme in rivers 2012. The survey site was located downstream of a ford and footbridge, approximately 5km northeast of Clonakilty, Co. Cork (Fig. 4.4; Plate 4.2). Three electric-fishing passes were conducted using three bank-based electric fishing units on the 11th of September 2012, along a 34m length of channel. Glide dominated the habitat, while the substrate consisted mostly of cobble. The vegetation at this site was dominated by bryophytes, with a diverse range of mosses and liverworts present.

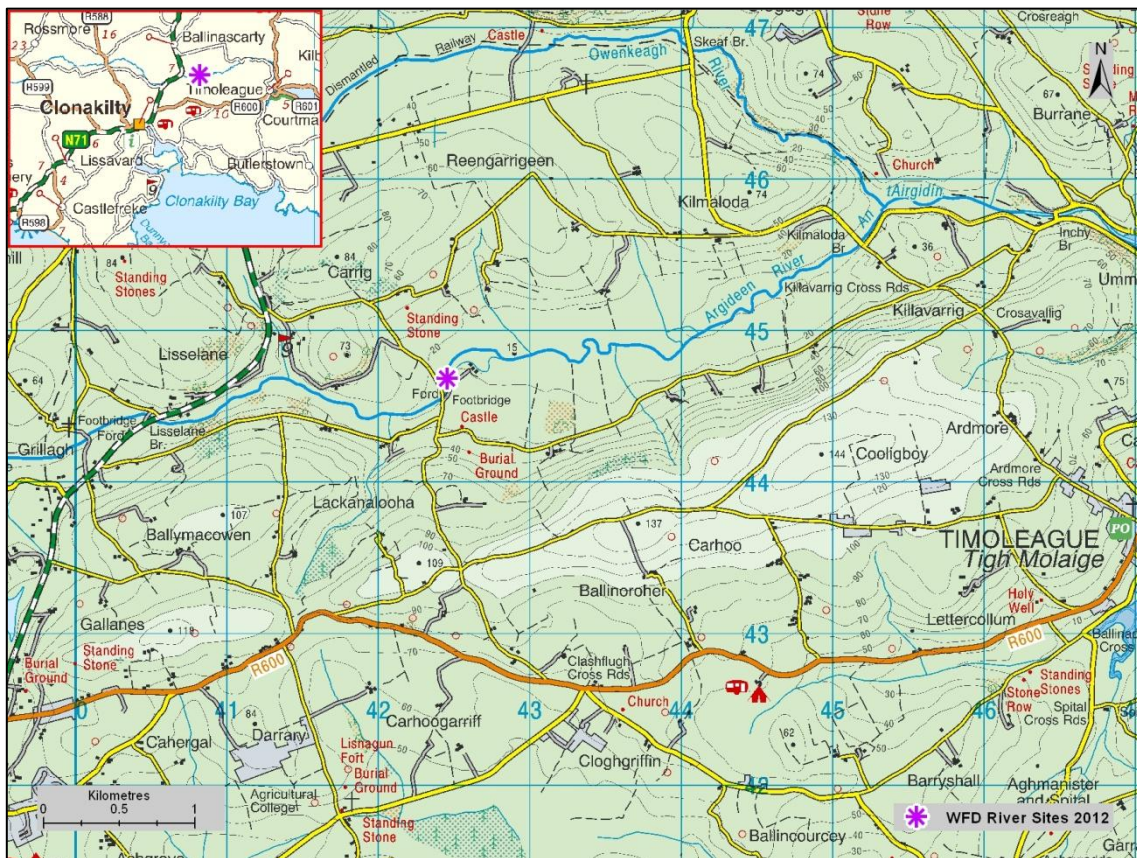


Fig. 4.4. Location of the Argideen River surveillance monitoring site



Plate 4.2. The Argideen River near Clonakilty, Co. Cork

A total of six fish species were recorded in the Argideen river site (Table 4.2). Salmon was the most abundant species, followed by eels, brown trout, minnow, stone loach and flounder.

Table 4.2. Density of fish (no./m²), Argideen River site (fish density has been calculated as minimum estimates based on one fishing)

Common name	2012		
	0+	1+ & older	Total minimum density
Salmon	0.067	0.153	0.221
European eel	-	-	0.065
Brown trout	0.007	0.037	0.044
Minnow	-	-	0.019
Stone loach	-	-	0.019
Flounder	-	-	0.002
All Fish	-	-	0.370

Brown trout captured during the 2012 survey ranged in length from 7.4cm to 20.3cm (mean = 13.0cm) (Fig. 4.5). Three age classes (0+, 1+ and 2+) were present, accounting for 14%, 62% and 24% of the total brown trout catch respectively.

European eels captured during the 2012 survey ranged in length from 8.0cm to 37.8cm (mean = 17.6cm) (Fig. 4.6).

Salmon captured during the 2012 survey ranged in length from 4.5cm to 14.9cm (mean = 8.5cm) (Fig. 4.7). Two age classes (0+ and 1+) were present, accounting for approximately 37% and 63% of the total salmon catch respectively.

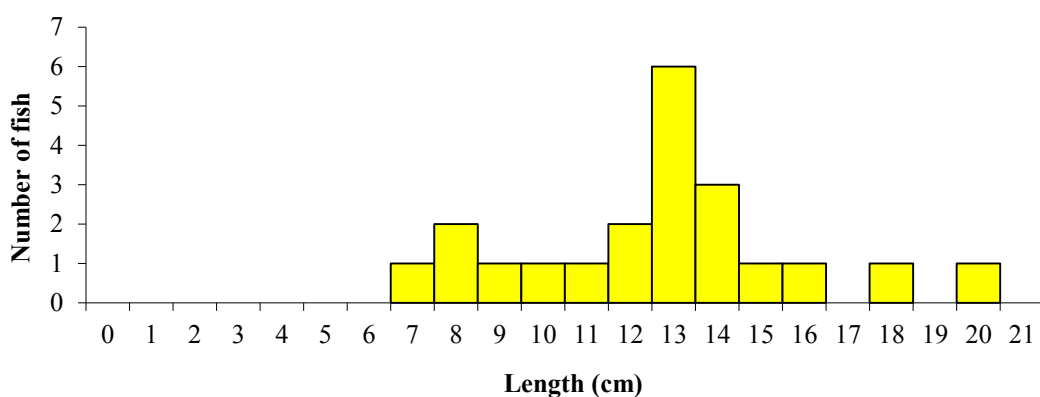


Fig. 4.5. Length frequency distribution of brown trout in the Argideen River site, September 2012 (n = 21)

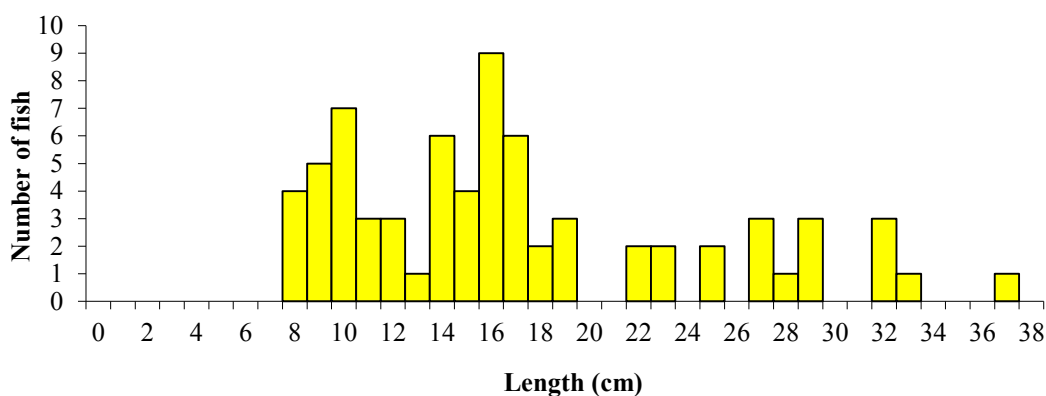


Fig. 4.6. Length frequency distribution of European eels in the Argideen River site, September 2012 (n = 71)

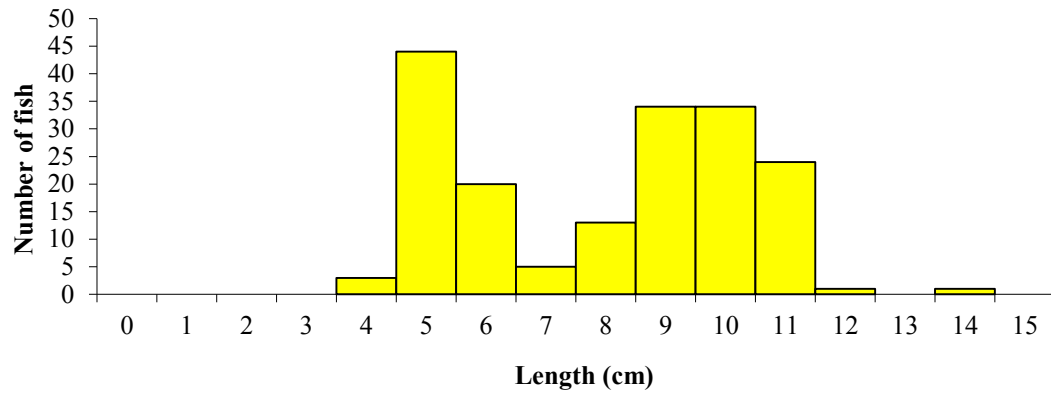


Fig. 4.7. Length frequency distribution of salmon in the Argideen River site, September 2012 (n = 179)

4.1.3 The River Bride

Two sites were electric fished on the River Bride as part of the WFD surveillance monitoring programme in rivers 2012; the Bride upstream of the footbridge at Ballynella (Site A) and the Bride downstream of the footbridge at Ballynella (Site B) (Fig. 4.8).

Site A was located upstream of a ford and foot bridge near Ballynella, approximately 3km east of Castlelyons, Co. Cork (Fig. 4.8; Plate 4.3). One electric-fishing pass was conducted using three boat-based electric fishing units on the 18th of September 2012, along a 155m length of channel. Glide dominated the habitat, while the substrate consisted largely of cobble.

Site B was located further downstream of the first site, downstream of the ford and footbridge near Ballynella (Fig. 4.8; Plate 4.4). One electric-fishing pass was conducted using three boat-based electric fishing units on the 18th of September 2012, along a 181m length of channel. Glide dominated the habitat, while the substrate consisted mostly of gravel.

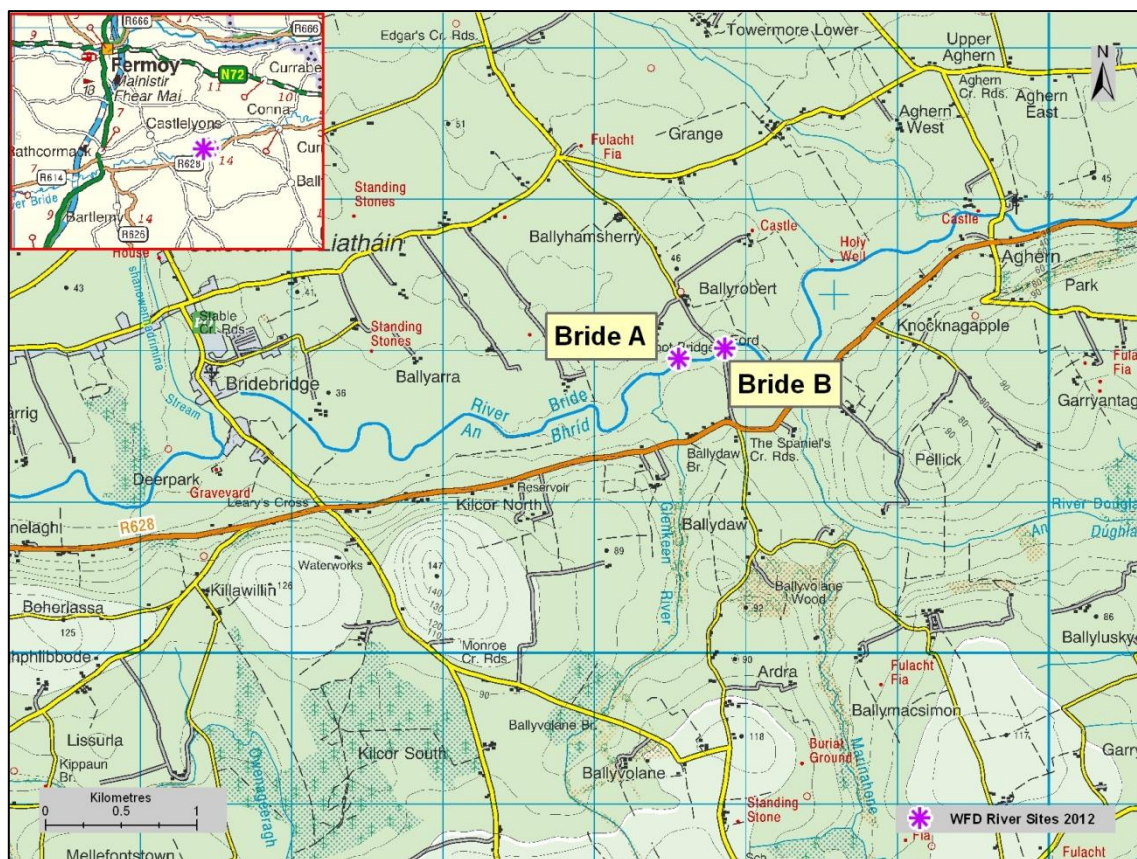


Fig. 4.8. Location of the River Bride surveillance monitoring sites



Plate 4.3. The River Bride upstream of the bridge at Ballynella, Co. Cork (Site A)



Plate 4.4. The River Bride downstream of the footbridge at Ballynella, Co. Cork (Site B)

River Bride (Site A)

A total of six fish species (sea trout are included as a separate ‘variety’ of brown trout) were recorded in the River Bride Site A (Table 4.3). Brown trout was the most abundant species, followed by salmon, sea trout, juvenile lamprey, European eels and stone loach.

Table 4.3. Density of fish (no./m²), River Bride (Ballynella, Site A) (fish density has been calculated as minimum estimates based on one fishing)

Common name	2009			2012		
	0+	1+ & older	Total minimum density	0+	1+ & older	Total minimum density
Brown trout	0.0004	0.016	0.017	0.001	0.052	0.053
Salmon	0.004	0.014	0.019	0.005	0.013	0.018
Sea trout	-	-	0.0002	-	-	0.001
Lamprey juvenile	-	-	-	-	-	0.0003
European eel	-	-	0.001	-	-	0.0003
Stone loach	-	-	0.001	-	-	0.0003
All Fish	-	-	0.037	-	-	0.073

Brown trout captured during the 2012 survey ranged in length from 6.5cm to 41.7cm (mean = 18.6cm) (Fig. 4.9). Five age classes (0+, 1+, 2+, 3+ and 4+) were present, accounting for approximately 2%, 50%, 45%, 2% and 1% of the total brown trout catch respectively. Brown trout captured during the 2009 survey ranged in length from 7.3cm to 30.0cm (mean = 18.0cm). Four age classes were present (0+, 1+, 2+ and 3+), accounting for approximately 3%, 64%, 30% and 4% of the brown trout catch respectively.

Salmon captured during the 2012 survey ranged in length from 6.0cm to 15.0cm (mean = 10.7cm) (Fig. 4.10). Two age classes (0+ and 1+) were present, accounting for approximately 27% and 73% of the salmon catch respectively. Salmon captured during the 2009 survey ranged in length from 5.5cm to 14.1cm (mean = 10.9cm). Two age classes (0+ and 1+) were also present, accounting for approximately 24% and 76% of the salmon catch respectively.

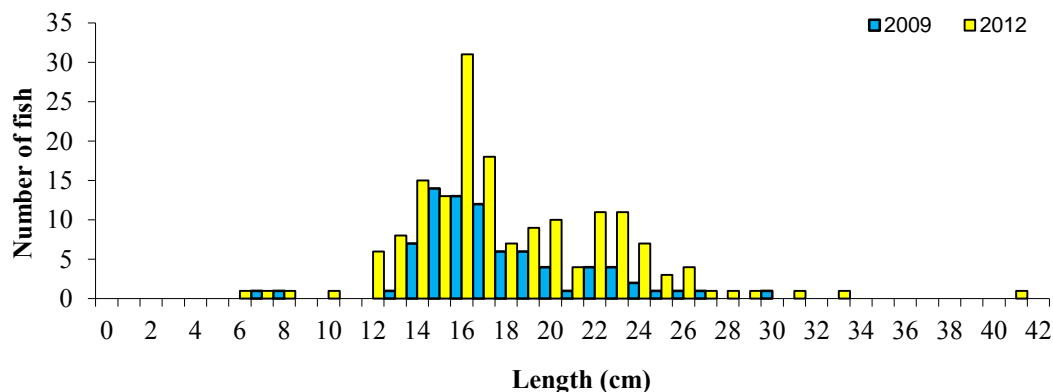


Fig. 4.9. Length frequency distribution of brown trout in the River Bride, Site A, July 2009 (n = 80) and September 2012 (n = 167)

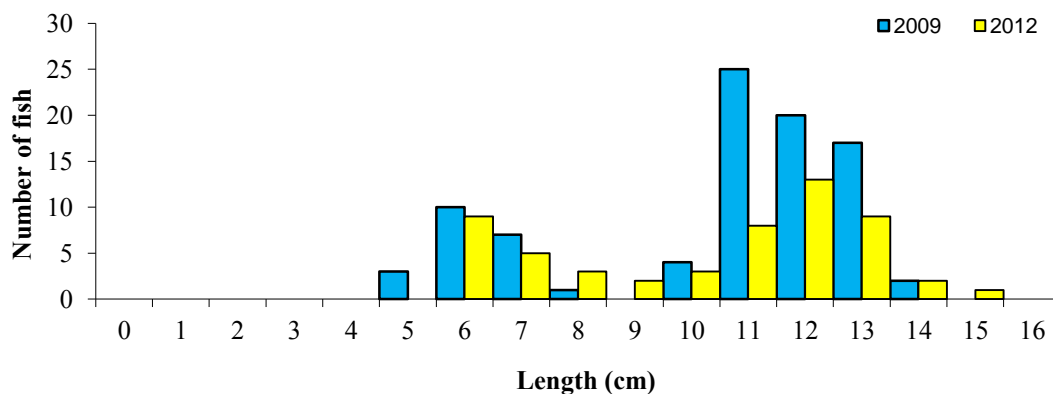


Fig. 4.10. Length frequency distribution of salmon in the River Bride Site B, July 2009 (n = 89) and September 2012 (n = 55)

River Bride (Site B)

A total of three species (sea trout are included as a separate ‘variety’ of brown trout) were recorded in the River Bride, Site B (Table 4.4). Brown trout was the most abundant species, followed by salmon and sea trout.

Table 4.4. Density of fish (no./m²), River Bride (d/s of footbridge site) (fish density has been calculated as minimum estimates based on one fishing)

Common name	2012		
	0+	1+ & older	Total minimum density
Brown trout	0.0004	0.057	0.057
Salmon	0.007	0.019	0.026
Sea trout	-	-	0.0004
All Fish	-	-	0.083

Brown trout captured during the 2012 survey ranged in length from 10.3cm to 33.5cm (mean = 18.1cm) (Fig. 4.11). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for 1%, 50%, 47% and 2% of the total brown trout catch respectively.

Juvenile salmon captured during the 2012 survey ranged in length from 5.6cm to 14.0cm (mean = 11.3cm). Two juvenile age classes (0+ and 1+) were present, accounting for approximately 28% and 72% of the total salmon catch respectively (Fig. 4.12).

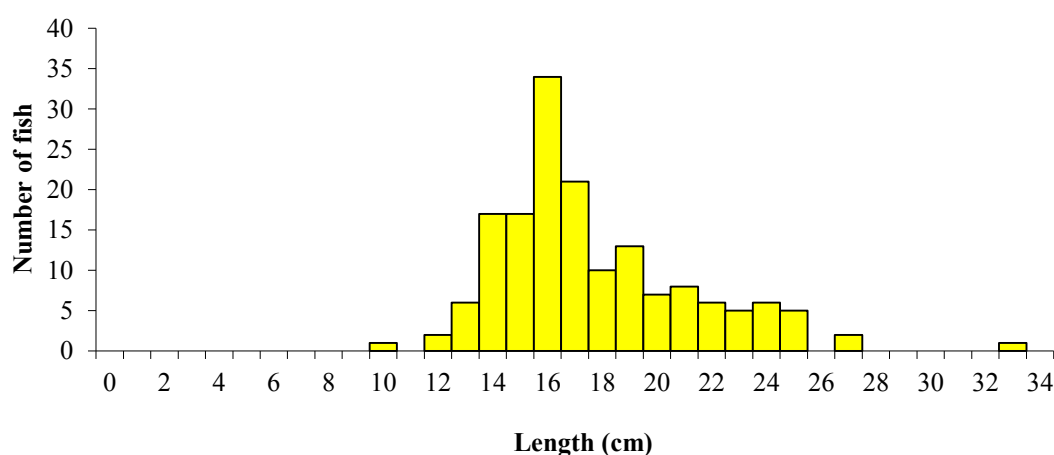


Fig. 4.11 Length frequency distribution of brown trout in the River Bride (d/s of footbridge) site, September 2012 (n = 161)

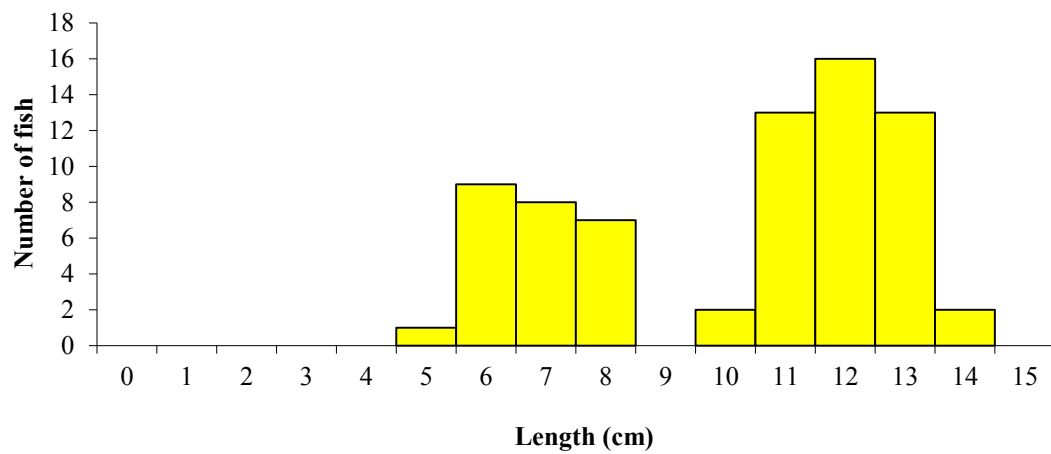


Fig. 4.12. Length frequency distribution of salmon in the River Bride (d/s of footbridge) site, September 2012 (n = 71)

4.1.4 The Awbeg River

One site was electric fished on the Awbeg River as part of the WFD surveillance monitoring programme in rivers 2012. The survey site was located downstream of Kilcummer Bridge near the confluence with the River Blackwater, approximately 2km south of Castletownroche, Co. Cork (Fig. 4.13; Plate 4.5). One electric-fishing pass was conducted using three boat-based electric fishing units on the 19th of September 2012, along a 204m length of channel. Glide dominated the habitat, while the gravel was the most abundant substrate. Vegetation at this site consisted of a small number of aquatic bryophytes, as well as a number of emergent bank-side species.

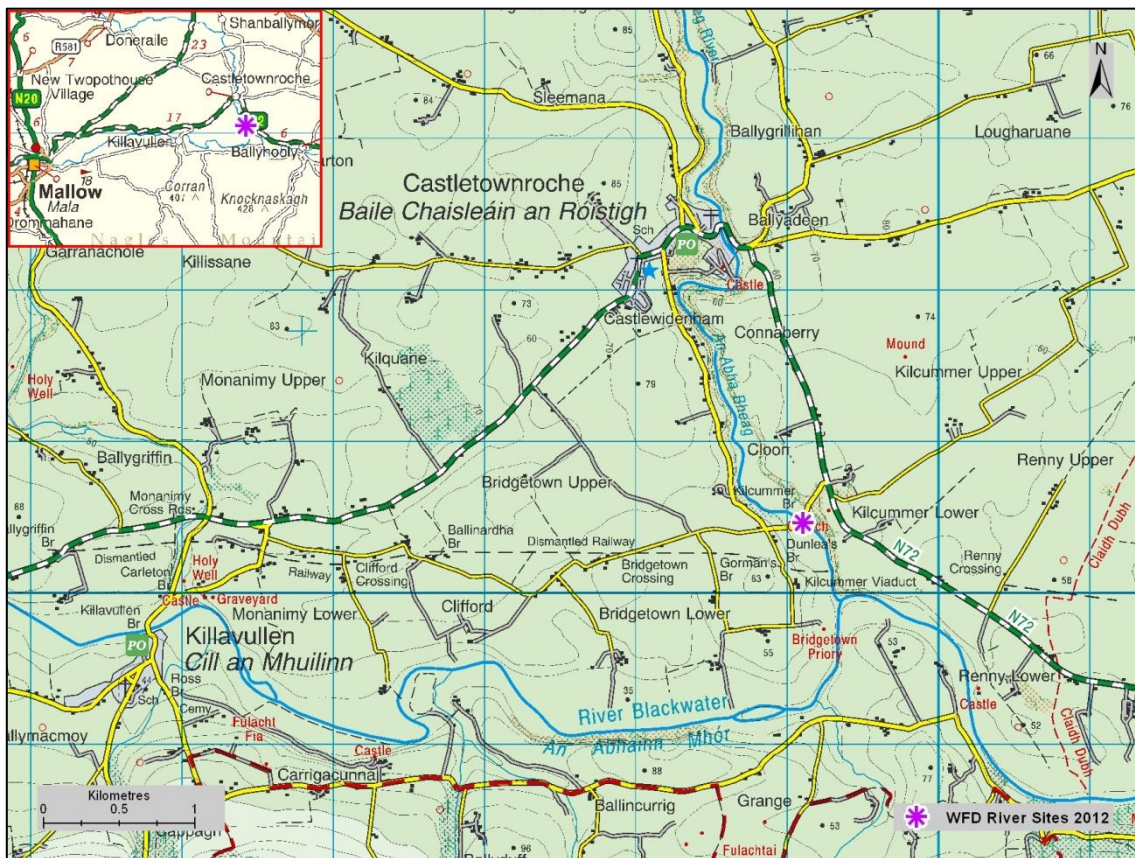


Fig. 4.13. Location of the Awbeg River surveillance monitoring site



Plate 4.5. The Awbeg River at Kilcummer Bridge, Co. Cork

A total of five fish species were recorded in the Awbeg River site (Table 4.5). Salmon was the most abundant species, followed by brown trout, eels, lamprey and stone loach.

Table 4.5. Density of fish (no./m²), Awbeg River site (fish density has been calculated as minimum estimates based on one fishing)

Common name	2009			2012		
	0+	1+ & older	Total minimum density	0+	1+ & older	Total minimum density
Salmon	0.002	0.021	0.023	0.004	0.016	0.020
Brown trout	0.000	0.012	0.012	0.000	0.017	0.011
European eel	-	-	0.002	-	-	0.003
Lamprey juvenile	-	-	-	-	-	0.001
Stone loach	-	-	0.0003	-	-	0.0003
Dace	-	-	0.001	-	-	-
All Fish	-	-	0.037	-	-	0.035

Brown trout captured during the 2012 survey ranged in length from 8.5cm to 31.5cm (mean = 19.1cm) (Fig. 4.14). Three age classes (1+, 2+ and 3+) were present, accounting for 34%, 49% and

16% of the total brown trout catch respectively. Brown trout captured during the 2009 survey ranged in length from 12.0cm to 34.2cm (mean = 18.7cm). Four age classes were present (1+, 2+, 3+ and 4+), accounting for approximately 36%, 50%, 11% and 2% of the brown trout catch respectively.

Salmon captured during the 2012 survey ranged in length from 5.5cm to 14.8cm (mean = 10.8cm) (Fig. 4.15). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 19%, 77% and 4% of the total salmon catch respectively. Salmon captured during the 2009 survey ranged in length from 5.0cm to 13.6cm (mean = 10.6cm). Two age classes (0+ and 1+) were present, accounting for approximately 90% and 10% of the salmon catch respectively.

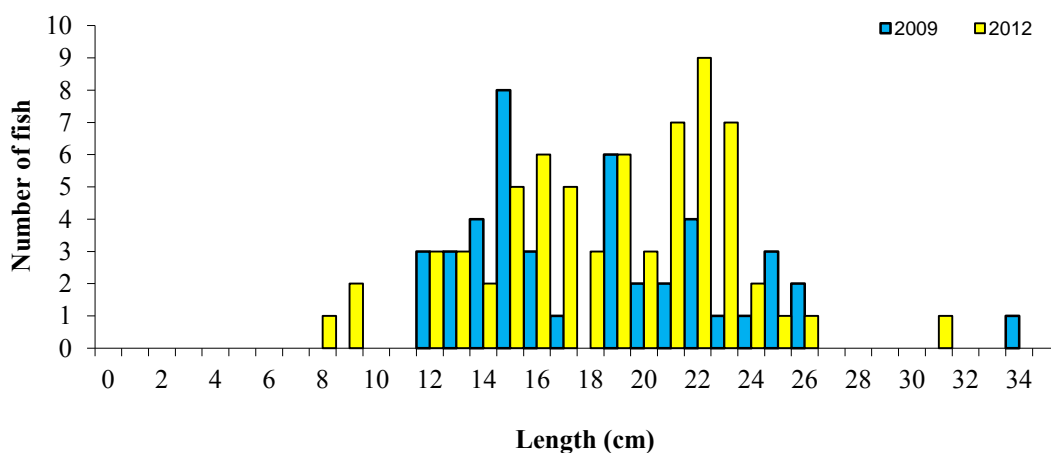


Fig. 4.14. Length frequency distribution of brown trout in the Awbeg River site, July 2009 (n = 44) and September 2012 (n = 67)

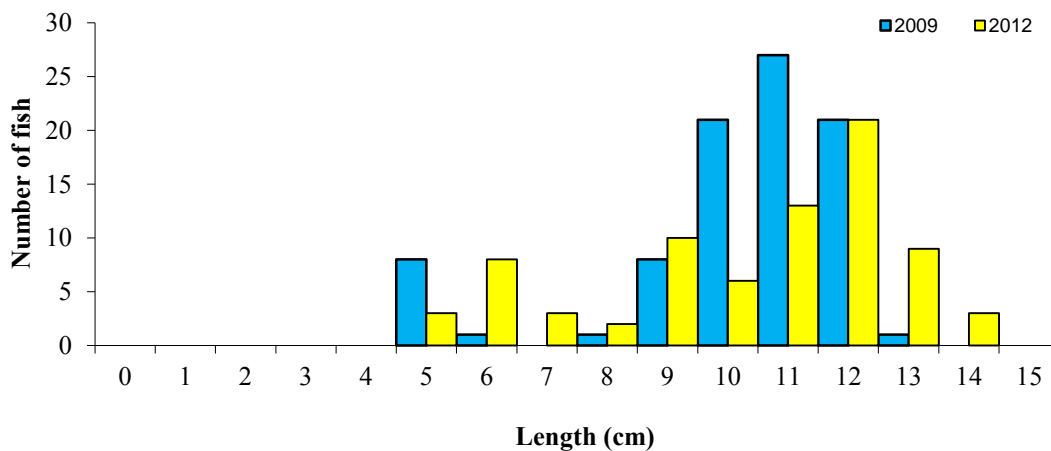


Fig. 4.15. Length frequency distribution of salmon in the Awbeg River site, July 2009 (n = 88) and September 2012 (n = 78)

4.2 Community structure

4.2. Species distribution

A total of eight fish species (including sea trout) were recorded within the five SWRBD sites surveyed during 2012 (Fig.4.16). Brown trout and salmon were the most common fish species, occurring at all sites surveyed, followed by eels, stone loach, lamprey and sea trout. Flounder and minnow only occurred at one site each.

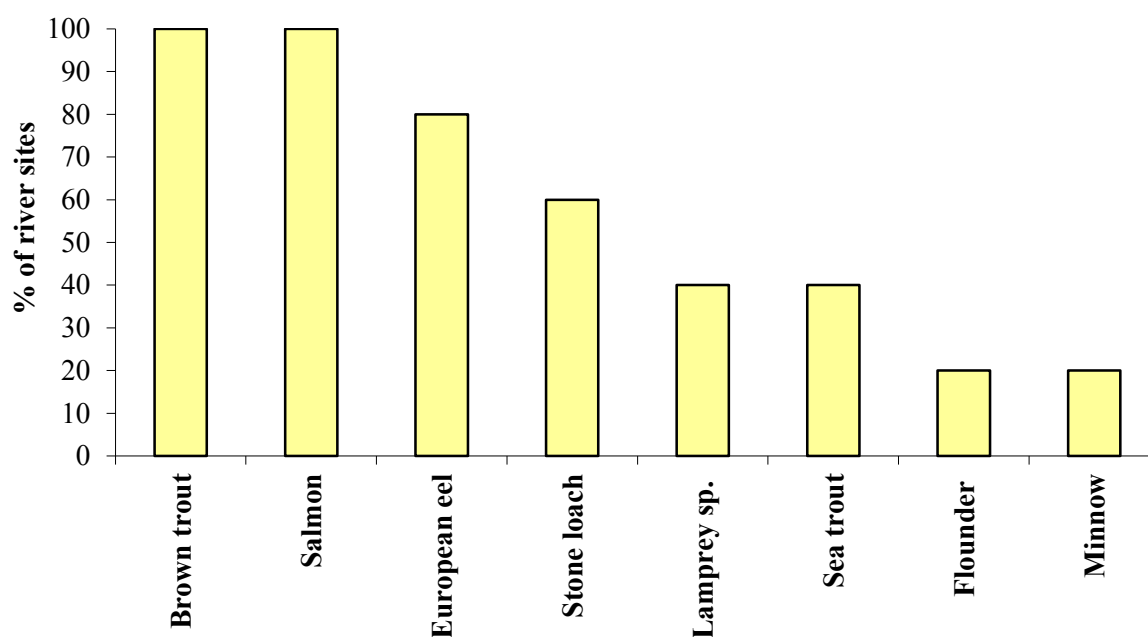


Fig. 4.16. Percentage of sites where each fish species was recorded in the SWRBD for WFD SM monitoring 2012

4.3 Age and growth

Growth rates based on back-calculated length-at-age data were analysed for brown trout and salmon in each river site surveyed in the SWRBD during 2012.

The mean back-calculated length-at-age data for brown trout in the SWRBD are shown in Figure 4.17 and Appendix 1. Brown trout were recorded in all five sites, with each site containing brown trout aged 1+ or older. Ages ranged from 0+ to 4+, with fish aged 1+ and 2+, comprising the most abundant age classes within the region. The largest brown trout recorded in the SWRBD in 2012 was caught in the River Bride (Site A), which measured 41.7cm in length, weighed 781g and was aged 4+. 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. Using this method, the growth rate could only be reliably estimated from fish at sites where individual fish were 2+ or older and where sufficient numbers were caught. Growth was considered slow in the Adrigole, Argideen and Awbeg River sites and fast in both River Bride sites (Appendix 1).

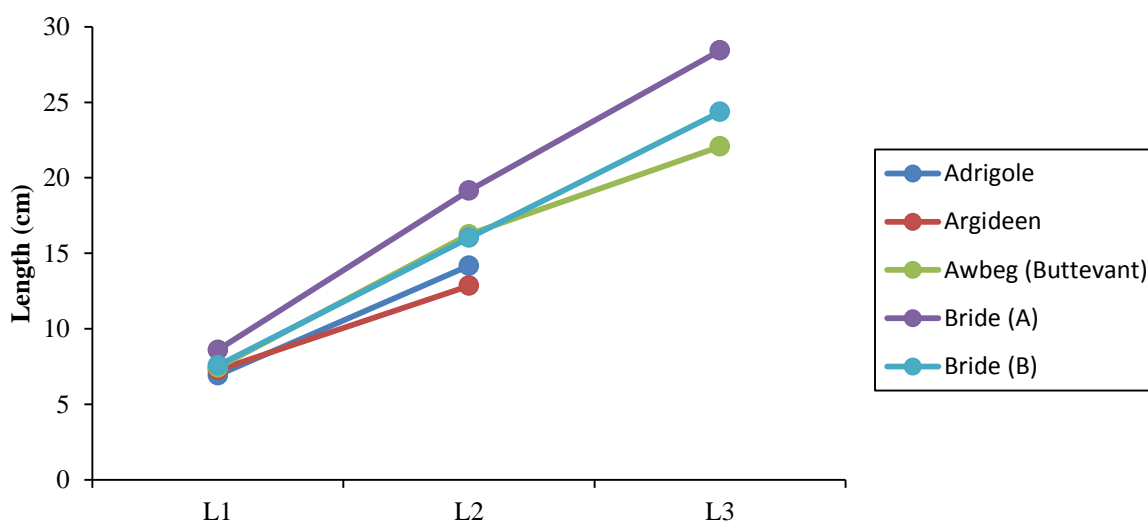


Fig. 4.17. Back calculated length-at-age for brown trout in each river, WFD surveillance monitoring 2012

The mean back-calculated length-at-age data for salmon in the SWRBD are shown in Figure 4.18 and Appendix 2. Salmon were recorded in all five river sites and ranged in age from 0+ to 2+, with 1+ the most abundant age class. The largest juvenile salmon recorded in the SWRBD during 2012 was caught in the River Bride (Site A), which measured 15.0cm, weighed 33.0g and was aged 1+.

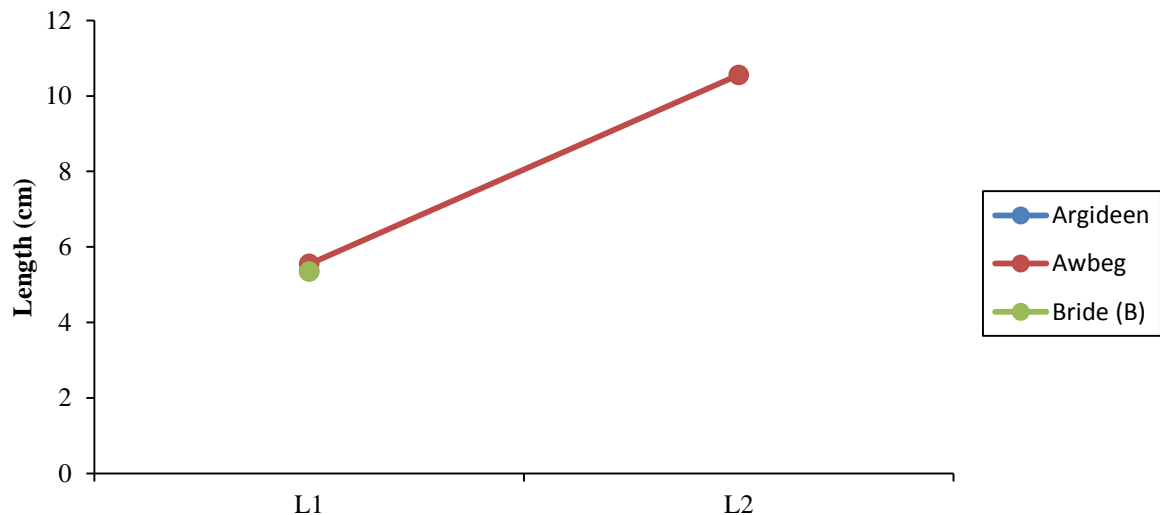


Fig. 4.18. Back calculated length-at-age for salmon in each river, WFD surveillance monitoring 2012

Sea trout were only recorded in the two River Bride sites and in low numbers. Their mean back-calculated length-at-age data is shown in appendix 3. Sea trout ageing was carried out as described in Poole (2010). One fish was aged 1.1+, a one year old smolt that spent one full year at sea and returned to the river the following year. No spawning mark was present. This fish is also known as a 1sw (sea winter) maiden, (total age 2+). Two fish were aged as 2.0+, a 2-year smolt, that returned to freshwater after only a few months at sea, also known as a “finnock” (total age 2+). Finally another fish was aged as 3.0+, a 3-year old smolt that returned to freshwater after only a few months at sea (finnock, total age 3+).

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 District Management Plans. Following an approach similar to that developed by the Environment Agency in England and Wales, the Fisheries Classification Scheme 2 (FCS2) has been 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 contributed data to be used in the model, which was developed under the management of the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER). This method is a geostatistical model based on Bayesian probabilities, that makes probabilistic comparisons of observed fish counts with expected (predicted) fish counts under reference (un-impacted conditions). This classification system generates Ecological Quality Ratings (EQRs) between 1 and 0 for each site, corresponding to the five different ecological status classes of High, Good, Moderate, Poor and Bad. Confidence levels are then assigned to each class and represented as probabilities. The confidence level for a site is expressed as the probability of that site being assigned to each different status class, with the highest class probability being the overall classification.

Using this tool and expert opinion, each site surveyed in 2012 was assigned a draft fish classification status (Table 4.6). All five were classified as Good. When comparing the status this year with that from previous years (2009 only), both repeat sites, the Awbeg River and River Bride showed no change from before.

Table 4.6. Ecological status of sites surveyed in the SWRBD for surveillance monitoring 2012
(figures in brackets indicate confidence of site status being correct)

River	Site Code	Site name	Previous ecological status	Ecological status 2012
SWRBD Wadeable sites				
Adrigole	21A010150A	0.5km d/s of Glashduff confl._A	N/A	Good (71%)
Argideen	20A020150B	Ballinoroher Ford_B	N/A	Good
SWRBD Non-Wadeable sites				
Awbeg (Buttevant)	18A051300A	Kilcummer Br._A	Good (2009)	Good (98%)
Bride (Waterford)	18B050500A	Footbr. N of Ballynella_A	Good (2009) (97%)	Good (92%)
Bride (Waterford)	18B050500B	Footbr. N of Ballynella_B	N/A	Good (94%)

5. DISCUSSION

A total of eight fish species (sea trout are included as a separate ‘variety’ of trout) were recorded during the 2012 WFD surveillance monitoring programme for fish in rivers within the SWRBD. Brown trout and salmon were the most commonly encountered species, recorded in all five sites, followed by European eels and stone loach. The River Bride, Site A was the most diverse site surveyed within the SWRBD for the Water Framework Directive in 2012, with a total of six species (including sea trout) present. The sites that recorded the lowest species diversity in this region were the Adrigole River and River Bride, Site B, with a total of three species. The greatest abundances of brown trout were recorded in the two River Bride sites (Site A and Site B respectively), while for salmon, the highest abundance was recorded in the Argideen River.

Following the methods of Kennedy and Fitzmaurice (1971), brown trout growth rate was estimated for each site. Growth was slow in the Adrigole, Argideen and Awbeg Rivers, and fast in both of the River Bride sites.

The Fish Classification Scheme 2 (FCS2) tool for assessing the ecological status of rivers has been recently developed for the Republic of Ireland which is compliant with the requirements of the WFD. Using this tool and expert opinion, each site surveyed in 2012 has been assigned a draft fish classification status. All sites surveyed in the SWRBD were assigned a classification of at least Good status.

6. REFERENCES

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APPENDIX 1

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

River		L1	L2	L3	Growth category
Adrigole River	Mean	6.93	14.18		Slow
	S.D.	1.54	1.18		
	S.E.	0.34	0.48		
	n	21	6		
	Min	4.20	11.86		
	Max	9.14	15.02		
Argideen River	Mean	7.27	12.85		Slow
	S.D.	1.35	2.75		
	S.E.	0.36	1.23		
	n	14	5		
	Min	5.70	9.29		
	Max	9.71	16.43		
Awbeg River (Buttevant)	Mean	7.43	16.25	22.07	Slow
	S.D.	1.70	2.63	0.97	
	S.E.	0.26	0.53	0.44	
	n	44	25	5	
	Min	4.01	10.67	20.90	
	Max	11.00	20.63	23.55	
Bride (Site A)	Mean	8.60	19.15	28.43	Fast
	S.D.	1.87	2.94	n/a	
	S.E.	0.66	1.04	n/a	
	n	8	8	1	
	Min	6.55	15.34	28.43	
	Max	11.09	25.29	28.43	
Bride (Site B)	Mean	7.57	16.03	24.36	Fast
	S.D.	1.51	3.86	n/a	
	S.E.	0.21	0.68	n/a	
	n	52	32	1	
	Min	4.51	8.27	24.36	
	Max	10.25	21.96	24.36	

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
Argideen River	Mean	5.35	
	S.D.	1.01	
	S.E.	0.22	
	n	21	
	Min	3.36	
	Max	7.16	
Awbeg River (Buttevant)	Mean	5.55	10.56
	S.D.	1.22	1.27
	S.E.	0.24	0.74
	n	27	3
	Min	3.98	9.44
	Max	7.92	11.95
Bride (Site B)	Mean	5.35	
	S.D.	0.79	
	S.E.	0.16	
	n	23	
	Min	4.11	
	Max	7.00	

APPENDIX 3

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

River		L1	L2	L3
Bride (Waterford) (Site A)	Mean	9.04	22.69	
	S.D.	3.44	6.13	
	S.E.	2.43	4.34	
	n	2	2	
	Min	6.61	18.36	
	Max	11.47	27.03	
Bride (Waterford) (Site B)	Mean	6.67	18.17	22.72
	S.D.	3.12	11.93	n/a
	S.E.	2.20	8.44	n/a
	n	2	2	1
	Min	4.46	9.74	22.72
	Max	8.87	26.61	22.72



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