



Sampling Fish for the Water Framework Directive

Rivers 2010

**South Western
River Basin District**



Iascach Intíre Éireann
Inland Fisheries Ireland

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the help and co-operation of the regional director Dr. Patrick Buck and staff from IFI Macroom as well as various other offices throughout the region. The authors also gratefully acknowledge the help and cooperation of colleagues in IFI Swords.

We would like to thank the landowners and angling clubs that granted us access to their land and respective fisheries.

Furthermore, the authors would like to acknowledge the funding provided for the project from the Department of Communications, Energy and Natural Resources for 2010.

PROJECT STAFF

| | |
|---|---|
| Project Director/Senior Research officer: | Dr. Fiona Kelly |
| Project Manager: | Dr. Andrew Harrison |
| Research Officer: | Dr. Ronan Matson |
| Research Officer: | Ms. Lynda Connor |
| Technician | Mr. Rory Feeney |
| Technician: | Ms. Emma Morrissey |
| Technician: | Ms. Róisín O’Callaghan |
| Technician: | Mrs. Ciara Wögerbauer |
| Technician / Fisheries Assistant: | Ms. Gráinne Hanna |
| GIS Officer: | Mr. Kieran Rocks |
| Fisheries Assistant: | Mr. Kevin Gallagher (Oct 2010 – Dec 2010) |

The report includes Ordnance Survey Ireland data reproduced under OSI Copyright Permit No. MP 007508.

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.
© Ordnance Survey Ireland, 2010*

TABLE OF CONTENTS

| | |
|---|-----------|
| 1. INTRODUCTION..... | 4 |
| 2. STUDY AREA..... | 5 |
| 3. METHODS..... | 7 |
| 4. RESULTS..... | 9 |
| 4.1 Wadeable sites..... | 9 |
| 4.1.1 <i>The Cumberagh River</i> | 9 |
| 4.1.2 <i>The River Dalua</i> | 12 |
| 4.1.3 <i>The Finisk River</i> | 15 |
| 4.1.4 <i>The River Lee (Inchinossig)</i> | 18 |
| 4.1.5 <i>The Licky River</i> | 21 |
| 4.1.6 <i>The Owenreagh River</i> | 24 |
| 4.2. Non-wadeable sites..... | 27 |
| 4.2.1 <i>The River Blackwater (Lismore)</i> | 27 |
| 4.2.2 <i>The River Blackwater (Nohaval)</i> | 32 |
| 4.2.3 <i>The River Funshion</i> | 35 |
| 4.2.4 <i>The River Lee (Lee Fields)</i> | 38 |
| 4.2.5 <i>The Owvane River</i> | 42 |
| 4.3 Community structure..... | 45 |
| 4.3.1 <i>Species richness and composition</i> | 45 |
| 4.3.2 <i>Species abundance and distribution</i> | 46 |
| 4.3.3 <i>Age and growth of brown trout and salmon</i> | 61 |
| 4.4 Ecological status..... | 63 |
| 5. DISCUSSION..... | 64 |
| 6. REFERENCES..... | 66 |
| APPENDICES..... | 68 |

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). Eleven of the 43 surveys were conducted at river sites in the South Western River Basin District (SWRBD) between June and August 2010 by staff from Inland Fisheries Ireland (IFI) (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 SWRBD is mainly composed of Counties Cork and Kerry, but also contains parts of Limerick, Tipperary and Waterford (Fig. 2.1). It has a total land area of 11,000km², equating to nearly a sixth of the entire country, along with 4,000km² of marine waters. Expanding urban areas and agriculture are among the greatest pressures in the region, particularly in the eastern areas, while the western half contains some of Ireland's most scenic and popular tourist locations. Cork City is the largest urban area within this district and is the main centre for industry. A growing population in the region is putting ever increasing pressure on water supplies and wastewater treatment facilities (SWRBD, 2009).

This report summarizes the main findings of the fish stock surveys in the eleven river sites surveyed in the SWRBD during 2010 and reports on the current ecological status of the fish stocks in each.

2. STUDY AREA

Eleven river sites were surveyed in five river catchments within the SWRBD: the Munster Blackwater, Cumberagh, Lee, Laune and Owvane catchments. Sites ranged in surface area from 284m² for the Cumberagh River to 23,975m² for the River Lee (Lee Fields). (Table 2.2) 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, 2010

| River | Site name | Catchment | Site Code | Waterbody code |
|---------------------------------|--|------------|------------|----------------|
| SWRBD Wadeable sites | | | | |
| Cumberagh | Footbridge u/s Owengarriff confl | Cumberagh | 21C040600F | SW_21_6162 |
| Dalua | Ford and footbridge | Blackwater | 18D010200F | SW_18_394 |
| Finisk | Modelligo Bridge | Blackwater | 18F020300F | SW_18_2774 |
| Lee | Inchinossig Bridge | Blackwater | 19L030100F | SW_19_928 |
| Licky | Bridge NE of Glenlicky | Lee | 18L010100F | SW_18_2819 |
| Owenreagh | Bridge u/s Upper Lake | Laune | 22O030400F | SW_22_2703 |
| SWRBD Non-wadeable sites | | | | |
| Blackwater | Lismore Bridge | Blackwater | 18B022600F | SW_18_2755 |
| Blackwater | Nohaval Bridge | Blackwater | 18B020200F | SW_18_450 |
| Funshion | Bridge u/s Blackwater River confluence | Blackwater | 18F051100F | SW_18_1836 |
| Lee | Lee Fields | Lee | 19L030700F | SW_19_1663 |
| Owvane | Lisheen / Piersons Bridge (LHS) | Owvane | 21O070400F | SW_21_8048 |

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) |
|---------------------------------|---------------------------------------|------------------|--------------------------------|----------------|---------------|
| SWRBD Wadeable sites | | | | | |
| Cumberagh (u/s Owengarriff) | 19.8 | 6.32 | 284 | 0.27 | 0.59 |
| Dalua (Ford) | 86.6 | 10.78 | 485 | 0.21 | 0.51 |
| Finisk (Modelligo) | 65.5 | 12.10 | 545 | 0.12 | 0.27 |
| Lee (Inchinossig) | 31.8 | 9.33 | 411 | 0.26 | 0.71 |
| Licky (Glenlicky) | 24.9 | 6.63 | 318 | 0.18 | 0.38 |
| Owenreagh (u/s Upper Lake) | 64.0 | 23.88 | 1075 | 0.16 | 0.66 |
| SWRBD Non-wadeable sites | | | | | |
| Blackwater (Lismore) | 2381.8 | 42.20 | 15530 | 1.83 | 3.00 |
| Blackwater (Nohaval) | 89.0 | 10.17 | 2033 | 0.23 | 0.57 |
| Funshion (u/s confluence) | 380.5 | 11.50 | 3151 | 1.07 | 1.50 |
| Lee (Lee Fields) | 1184.0 | 45.67 | 23975 | 1.25 | 2.00 |
| Owvane (Lisheen) | 71.6 | 16.50 | 4340 | 0.56 | 1.70 |

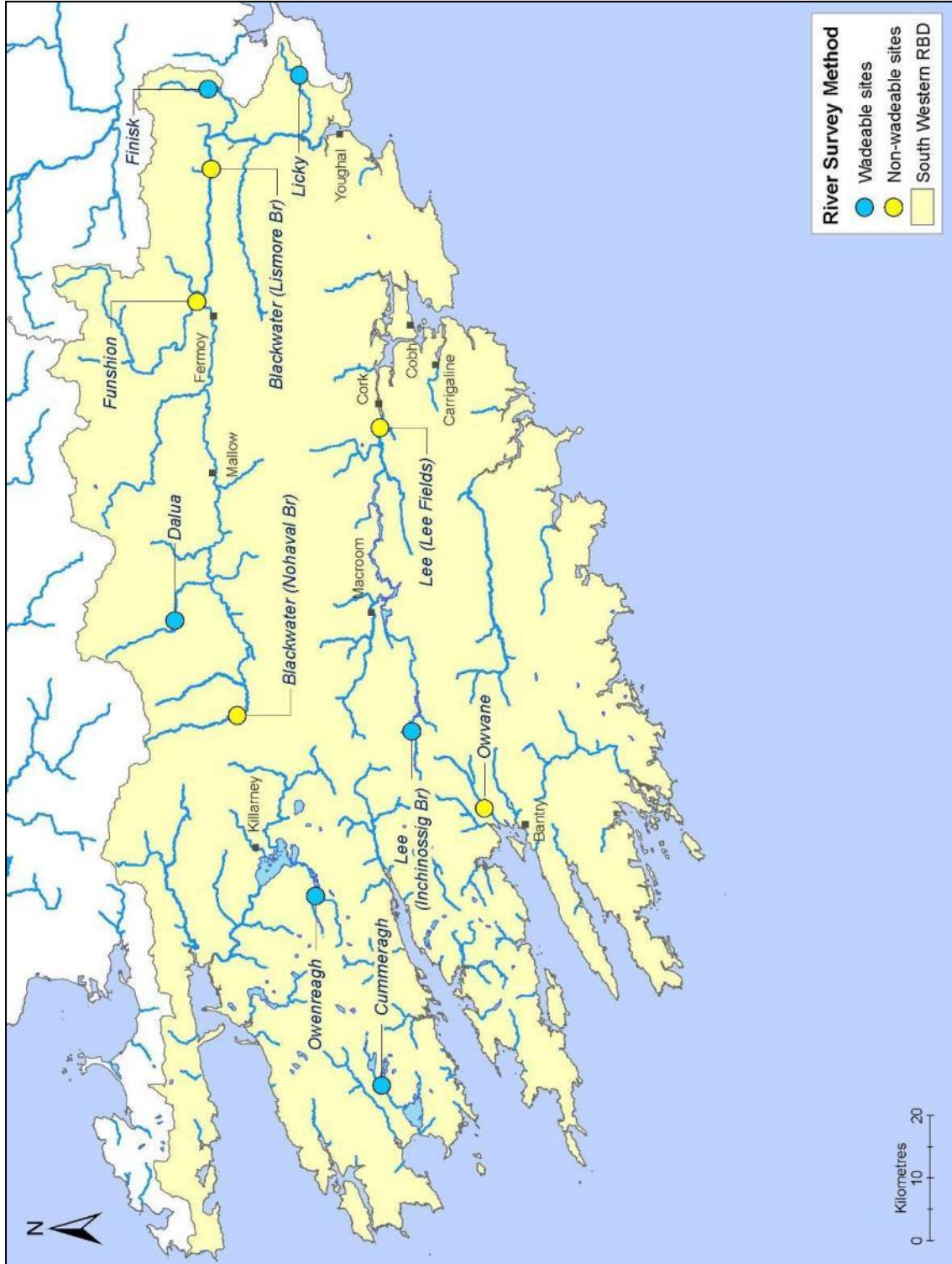


Fig. 2.1. Location map of river sites surveyed throughout the SWRBD for WFD fish surveillance monitoring 2010

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 hand-set 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 Cumberagh River*



Plate 4.1. The Cumberagh River, downstream of Derriana Lough, Co. Kerry

The Cumberagh River is located in Co. Kerry (Plate 4.1, Fig. 4.1). It rises as a series of streams in the southern end of the Macgillicuddy's Reeks, flowing into Derriana Lough. It then flows into Lough Currane and onwards into the sea near Waterville. Fishing for grilse and sea trout are considered to be relatively good in this river (O' Reilly, 2002).

The Cumberagh River flows through the Killarney National Park, Macgillicuddy's Reeks and Caragh River Catchment Special Area of Conservation (SAC), which is notable for its yew wood, alluvial woodland and blanket bog habitats, all of which are listed in Annex I of the Habitats Directive (NPWS, 2006). This SAC also protects species listed in Annex II of the same Directive, including salmon, river, brook and sea lamprey and Killarney shad (NPWS, 2006).

The survey site was located approximately 9km north-west of Waterville (Fig. 4.1). Three electric-fishing passes were conducted using three bank-based electric-fishing units on the 4th of August 2010

along a 45m length of channel. The mean wetted width of the survey site was 6.3m and the mean depth was 27.0cm. A total wetted area of 284m² was surveyed. Riffle, glide and pool were all evenly mixed throughout the channel, with a substrate of mainly cobble and gravel. There was a wide variety of macrophyte vegetation present at the site, including bryophytes and emergent species.

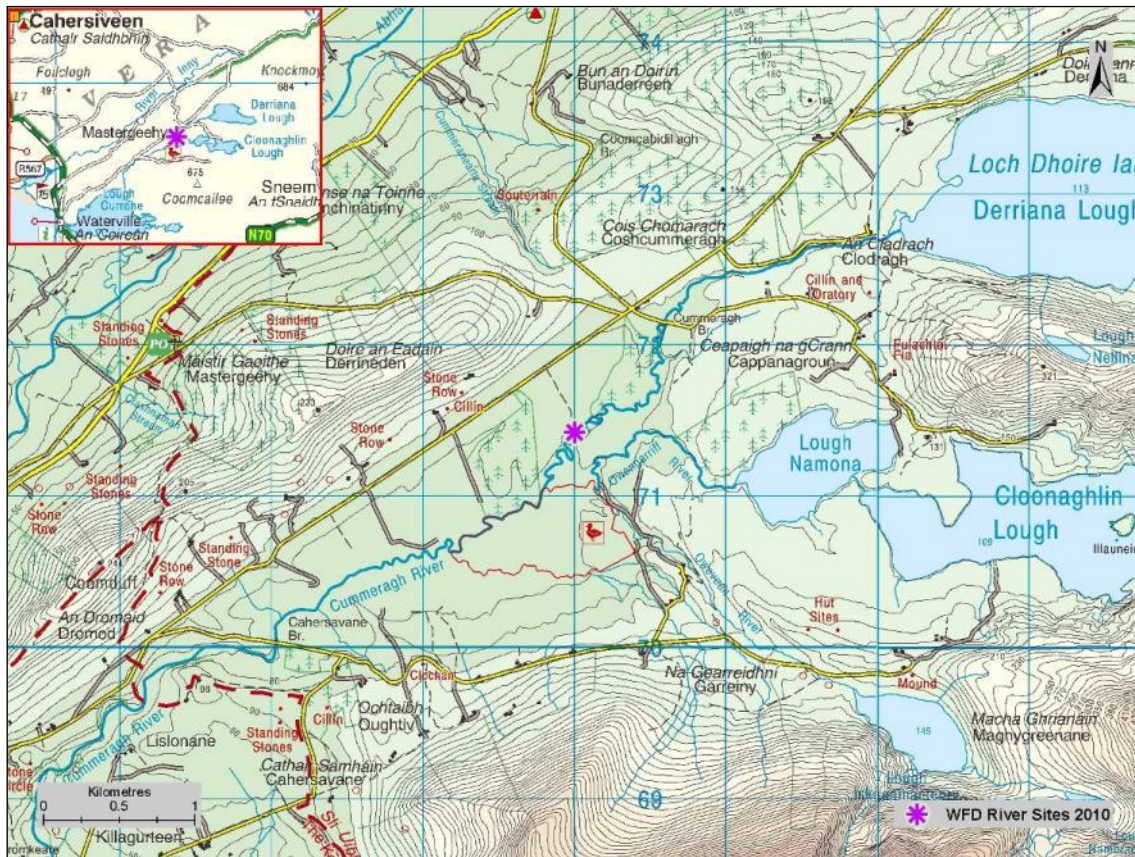


Fig. 4.1. Location of the Cumberagh River surveillance monitoring site

A total of five species (sea trout are included as a separate ‘variety’ of trout) were recorded in the Cumberagh River site. Salmon was the most abundant species, followed by brown trout, three-spined stickleback, sea trout and eel (Table 4.1).

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

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|-------|------------|-----------------------|
| <i>Salmo salar</i> | Salmon | 0.475 | 0.091 | 0.566 |
| <i>Salmo trutta fario</i> | Brown trout | 0.144 | 0.014 | 0.158 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.148 |
| <i>Salmo trutta trutta</i> | Sea trout | - | - | 0.007 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.004 |
| All Fish | All Fish | - | - | 0.880 |

Salmon ranged in length from 2.4cm to 11.8cm (Fig. 4.2). Two age classes (0+ and 1+) were present, accounting for approximately 85% and 15% of the total salmon catch respectively. The mean salmon L1 was 4.4cm (Appendix 2).

Brown trout ranged in length from 3.5cm to 13.9cm (Fig. 4.3). Two age classes (0+ and 1+) were present, accounting for approximately 89% and 11% of the total brown trout catch respectively. The mean brown trout L1 was 4.8cm (Appendix 1).

Three-spined stickleback ranged in length from 1.3cm to 5.9cm. Two sea trout were recorded, measuring 30.4cm and 42.6cm in length and aged 2.1+ and 1.2+SM respectively. One eel measuring 16.7cm in length was also captured.

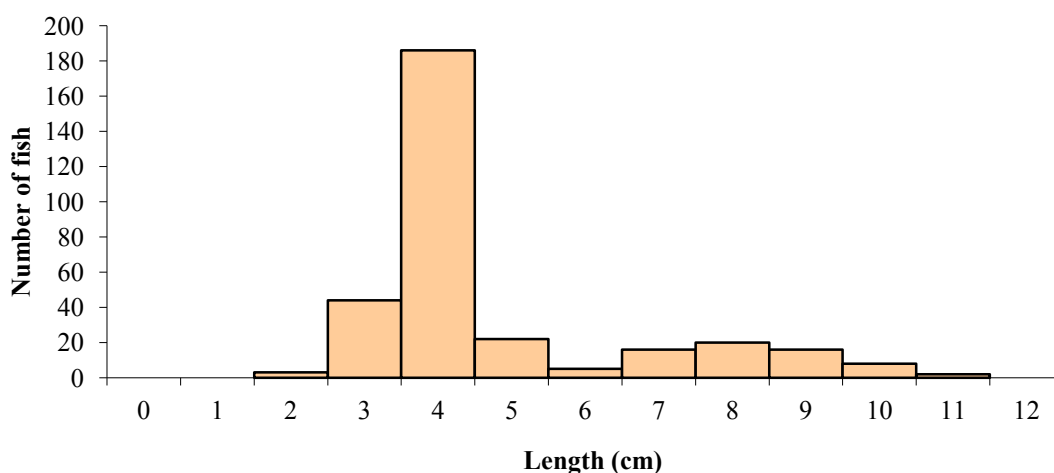


Fig. 4.2. Length frequency distribution of salmon in the Cumberagh River site, August 2010 (n = 322)

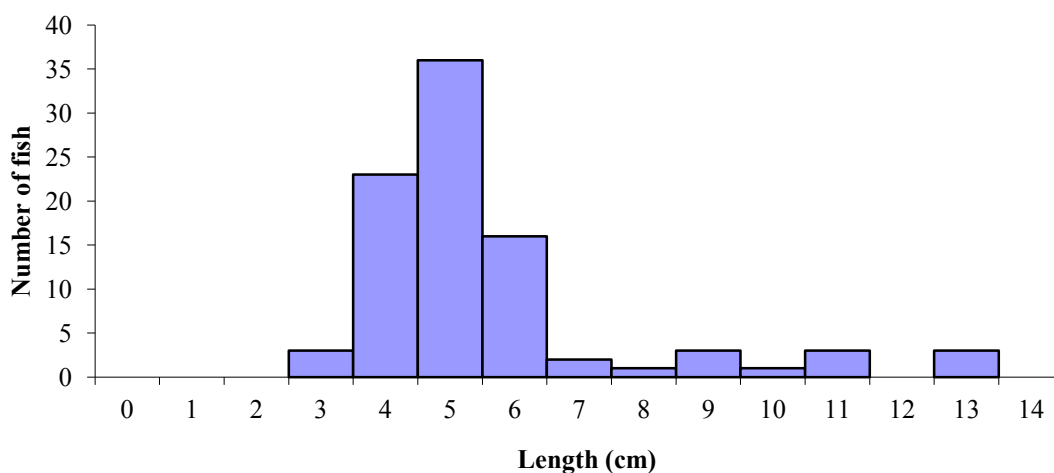


Fig. 4.3. Length frequency distribution of brown trout in the Cumberagh River site, August 2010 (n = 91)

4.1.2 The River Dalua



Plate 4.2. The River Dalua at the footbridge south of Liscongill, Co. Cork

The River Dalua rises in north-west Co. Cork, approximately 10km north of Newmarket (Plate 4.2, Fig. 4.5). It flows in a south-easterly direction towards Kanturk, where it joins the River Allow. The River Allow then continues for approximately 5km before joining the Munster Blackwater.

The River Dalua, along with most of the major tributaries of the River Blackwater, is located within the Blackwater River (Cork/Waterford) SAC. This SAC is noted for its alluvial wet woodland and yew wood, both of which are listed in Annex I of the Habitats Directive. Several species listed in Annex II of the Habitats Directive are also present, including sea, river and brook lamprey, freshwater pearl mussel, twaite shad, salmon, crayfish and otter (NPWS, 2007).

The survey site was located approximately 3km south of Newmarket near a ford and foot bridge (Fig. 4.4). Three electric-fishing passes were conducted using three bank-based electric-fishing units on the 5th of July 2010 along a 45m length of channel. The mean wetted width of the stretch surveyed was 10.8m and the mean depth was 21.0cm. A total wetted area of 485m² was surveyed. Riffle and glide were the dominant habitats, with a substrate of mainly cobble. The site was heavily shaded.

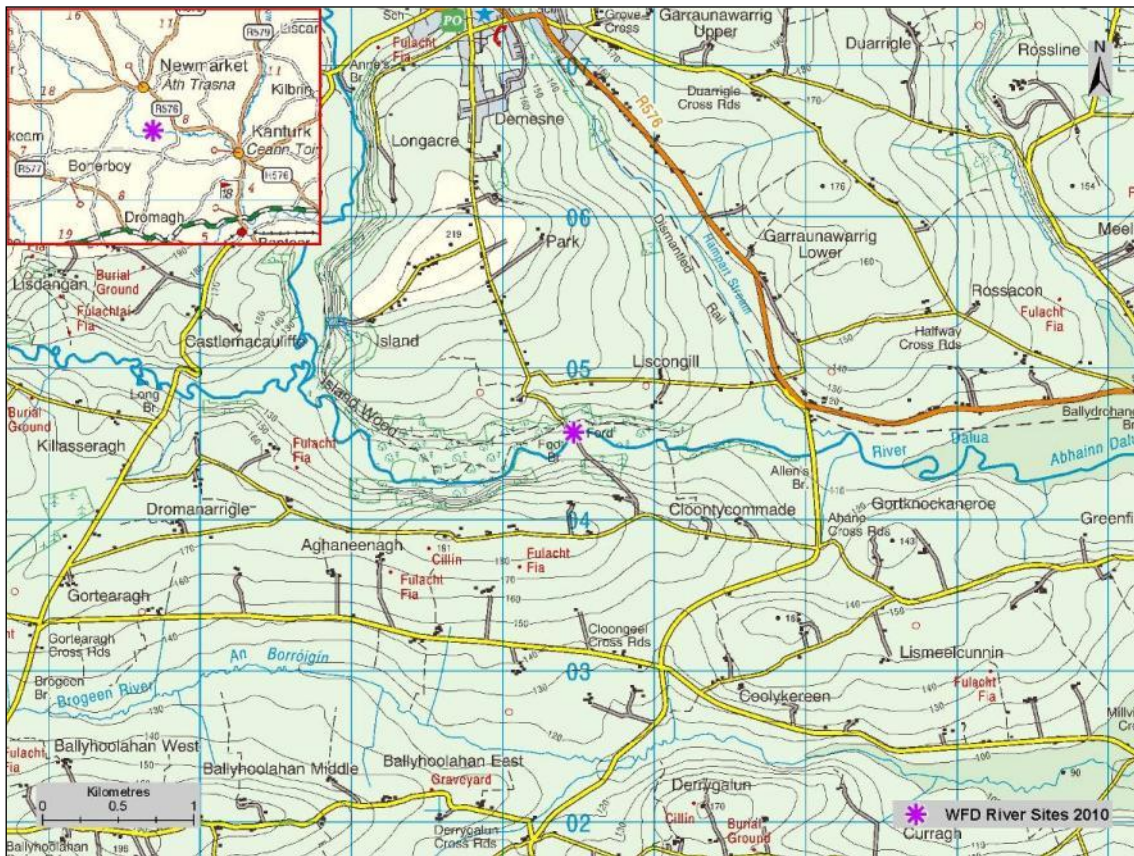


Fig. 4.4. Location of the River Dalua surveillance monitoring site

A total of five fish species were recorded in the River Dalua site. Salmon was the most abundant species, followed by brown trout, minnow, eel and lamprey (Table 4.2).

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

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|---------------------------|-------------|-------|------------|-----------------------|
| <i>Salmo salar</i> | Salmon | 0.435 | 0.194 | 0.629 |
| <i>Salmo trutta fario</i> | Brown trout | - | 0.035 | 0.035 |
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.014 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.008 |
| <i>Lampetra</i> sp. | Lamprey sp. | - | - | 0.004 |
| All Fish | All Fish | - | - | 0.686 |

Salmon ranged in length from 2.4cm to 16.9cm (Fig. 4.5). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 71%, 27% and 2% of the total salmon catch respectively. The mean salmon L1 and L2 were 4.7cm and 8.9cm respectively (Appendix 2).

Brown trout ranged in length from 9.7cm to 22.5cm (Fig. 4.6). Three age classes (1+, 2+ and 3+) were present, accounting for approximately 70%, 26% and 4% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 7.2cm, 14.2cm and 18.3cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Minnow ranged in length from 1.4cm to 4.4cm, eels from 14.6cm to 32.6cm and lamprey from 12.8cm to 13.2cm.

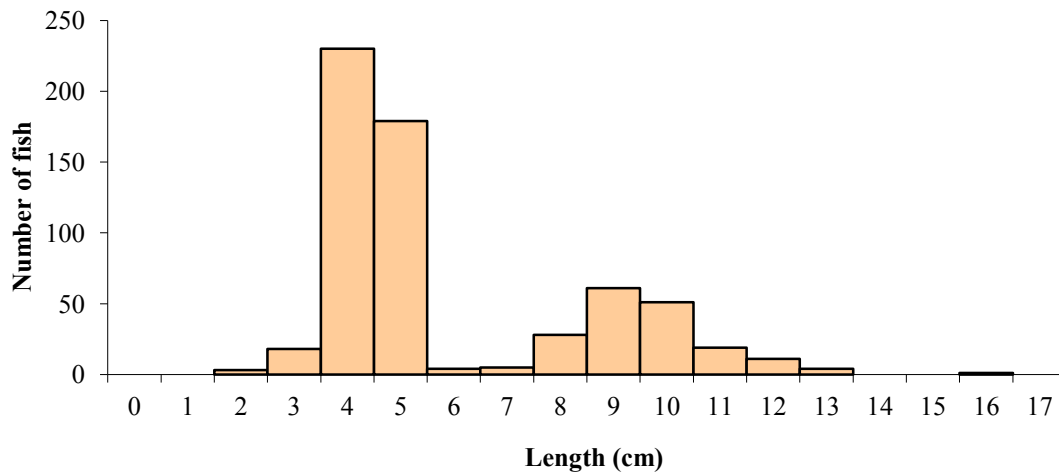


Fig. 4.5. Length frequency distribution of salmon in the River Dalua site, July 2010 (n = 614)

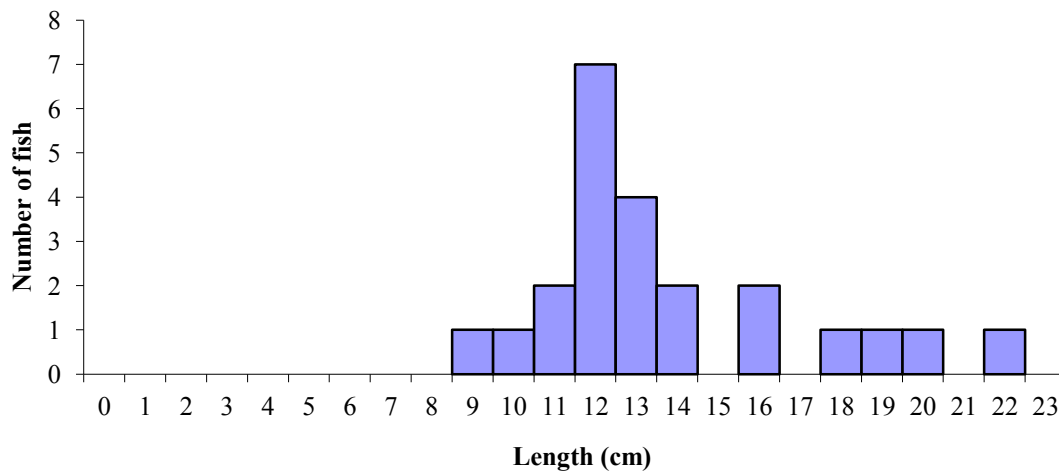


Fig. 4.6. Length frequency distribution of brown trout in the River Dalua site, July 2010 (n = 23)

4.1.3 The Finisk River



Plate 4.3. The Finisk River at Modelligo Bridge, Co. Waterford

The Finisk River rises between the Knockmealdown and Monavullagh Mountains in Co. Waterford (Plate 4.3, Fig. 4.7). It flows in a south-westerly direction before joining the River Blackwater approximately 3km south of Cappoquin.

This site, along with most of the major tributaries to the River Blackwater, is located within the Blackwater River (Cork/Waterford) SAC. This SAC is noted for its alluvial wet woodland and yew wood, both of which are listed in Annex I of the Habitats Directive. Several species listed in Annex II of the Directive are also present, including sea, river and brook lamprey, freshwater pearl mussel, twaite shad, salmon, crayfish and otter (NPWS, 2007).

The survey site was located downstream of Modelligo Bridge, approximately 6km east of Cappoquin (Fig. 4.7). Three electric-fishing passes were conducted using three bank-based electric-fishing units on the 7th of July 2010 along a 45m length of channel. The mean wetted width of the stretch surveyed was 12.1m and the mean depth was 12.0cm. A total wetted area of 545m² was surveyed. Riffle and glide were the dominant habitats present, with a substrate of cobble and gravel. The macrophyte vegetation present included a number of bryophytes and emergent species, as well as filamentous green algae.

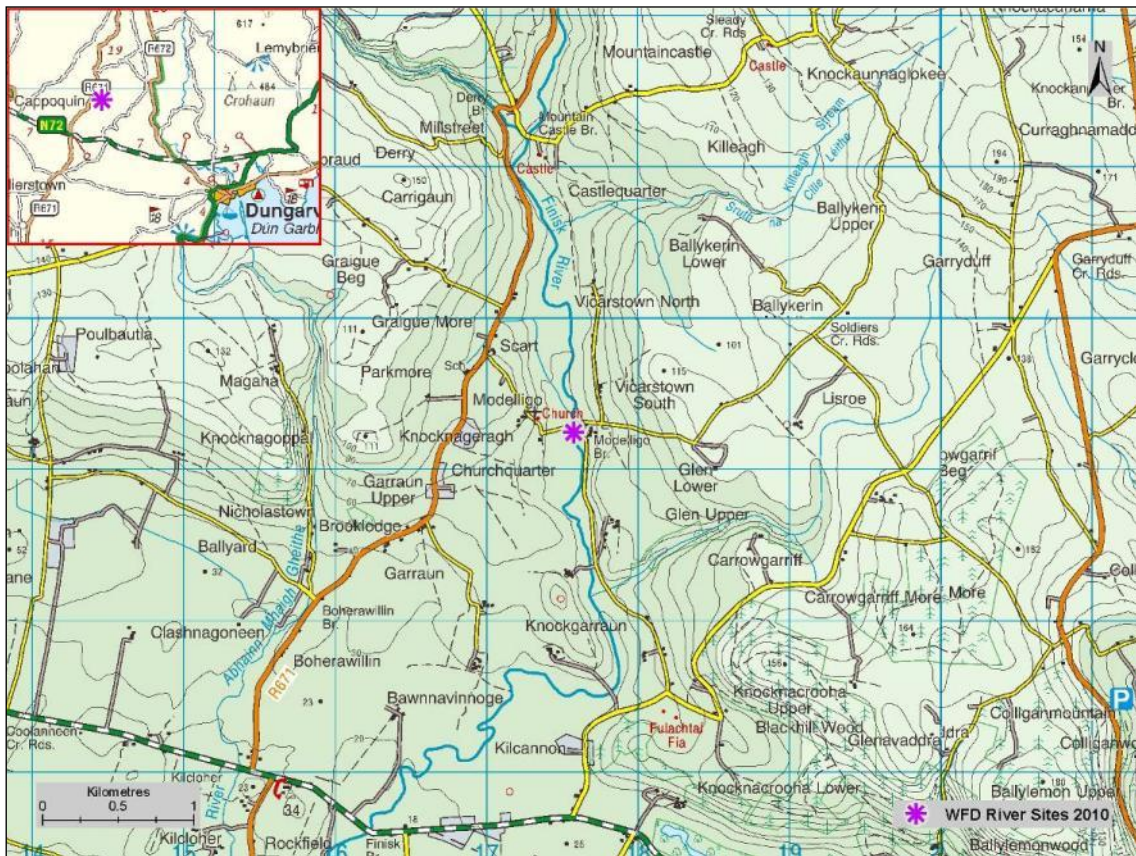


Fig. 4.7. Location of the Finisk River surveillance monitoring site

A total of four fish species were recorded in the Finisk River site. Salmon was the most abundant species, followed by brown trout, eels and lamprey (Table 4.3).

Table 4.3. Minimum density of each fish species (no./m²) captured on the Finisk River site, July 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|---------------------------|-------------|-------|------------|-----------------------|
| <i>Salmo salar</i> | Salmon | 0.439 | 0.180 | 0.619 |
| <i>Salmo trutta fario</i> | Brown trout | 0.004 | 0.009 | 0.013 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.004 |
| <i>Lampetra sp.</i> | Lamprey sp. | - | - | 0.002 |
| All Fish | All Fish | - | - | 0.637 |

Salmon ranged in length from 4.1cm to 14.0cm (Fig. 4.8). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 77%, 23% and 0.1% of the total salmon catch respectively. The mean salmon L1 and L2 were 5.5cm and 10.0cm respectively (Appendix 2).

Brown trout ranged in length from 4.9cm to 19.5cm. Three age classes (0+, 1+ and 2+) were present, accounting for approximately 27%, 64% and 9% of the total brown trout catch respectively. The mean brown trout L1 and L2 were 8.8cm and 17.9cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘fast’ according to the classification scheme of Kennedy and Fitzmaurice (1971). Eels ranged in length from 16.0cm to 24.0cm, while the only lamprey recorded measured 13.5cm.

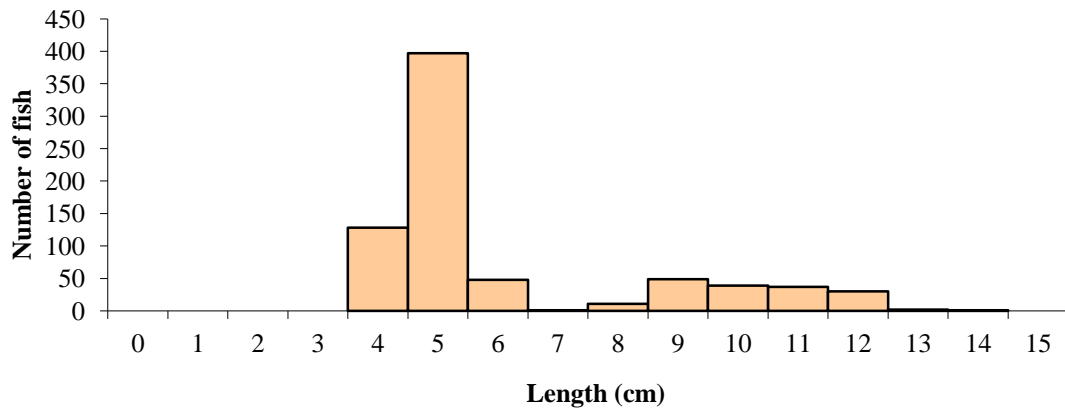


Fig. 4.8. Length frequency distribution of salmon in the Finisk River site, July 2010 (n = 743)

4.1.4 The River Lee (Inchinossig)



Plate 4.4. The River Lee at Inchinossig Bridge, Co. Cork

The River Lee rises in the Shehy Mountains near Gouganebarra, Co. Cork. It drains Gouganebarra Lake and flows eastwards through Ballingearry, Lough Allua and Cork City before entering the sea at Cork Harbour (Plate 4.4, Fig. 4.9). The River Lee hydroelectric power station was built in the 1950s by constructing two large dams, which resulted in the flooding of the Lee valley and the creation of the Inniscarra Reservoir. This has since resulted in damage to the river as a fishery by creating a barrier to fish migration (O'Reilly, 2002).

The survey site was located upstream of Inchinossig Bridge outside the village of Ballingearry in Co. Cork (Fig. 4.9). This site was surveyed previously for WFD fish surveillance monitoring in September 2008 (Kelly *et al*, 2009a). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 26th of July 2010 along a 44m length of channel. The mean wetted width of the stretch surveyed was 9.3m and the mean depth was 26.0cm. A total wetted area of 411m² was surveyed. Riffle was the dominant habitat present, with a substrate of mainly cobble, gravel and sand.



Fig. 4.9. Location of the River Lee (Inchinossig) surveillance monitoring site

A total of nine fish species were captured in the River Lee (Inchinossig) site. Minnow was the most abundant species, followed by brown trout, three-spined stickleback, lamprey, roach, gudgeon, eels, pike and stone loach (Table 4.4).

Table 4.4. Minimum density of each fish species (no./m²) captured on the River Lee (Inchinossig) site, July 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|-------|------------|-----------------------|
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.110 |
| <i>Salmo trutta fario</i> | Brown trout | 0.075 | 0.007 | 0.083 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.044 |
| <i>Lampetra</i> sp. | Lamprey sp. | - | - | 0.017 |
| <i>Rutilus rutilus</i> | Roach | - | - | 0.002 |
| <i>Gobio gobio</i> | Gudgeon | - | - | 0.002 |
| <i>Esox lucius</i> | Pike | - | - | 0.002 |
| <i>Barbatula barbatula</i> | Stone loach | - | - | 0.002 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.002 |
| All Fish | All Fish | - | - | 0.261 |

Brown trout ranged in length from 4.8cm to 25.7cm (Fig. 4.10). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 78%, 16%, 5% and 1% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 7.7cm, 14.2cm and 21.0cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Minnow ranged in length from 4.2cm to 7.7cm, three-spined stickleback from 2.0cm to 5.0cm, lamprey from 5.8cm to 11.5cm and roach from 5.2cm to 7.1cm. Two eels measuring 56.5cm and 58.7cm were also recorded, as well as single individuals from other species including , gudgeon (11.7cm), pike (17.6cm) and stone loach (7.9cm).

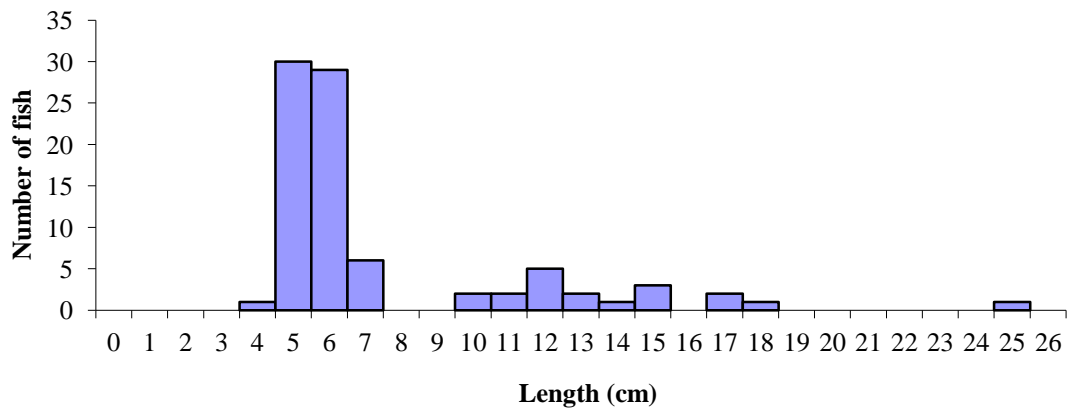


Fig. 4.10. Length frequency distribution of brown trout in the River Lee (Inchinossig) site, July 2010 (n = 85)

4.1.5 The Licky River



Plate 4.5. The Licky River, northwest of Youghal, Co. Cork

The Licky River rises approximately 6km south of Dungarvan in Co. Waterford (Plate 4.5, Fig. 4.11). It flows in a south-westerly direction, joining the River Blackwater approximately 9.5km north of Youghal.

This site, along with most of the major tributaries to the River Blackwater, is located within the Blackwater River (Cork/Waterford) SAC. This SAC is noted for its alluvial wet woodland and yew wood, both of which are listed in Annex I of the Habitats Directive. Several species listed in Annex II of the Directive are also present, including sea, river and brook lamprey, freshwater pearl mussel, twaite shad, salmon, crayfish and otter (NPWS, 2007).

The survey site was located upstream of a small bridge, west of Kiely's Cross Roads which is situated approximately half way between Dungarvan and Youghal (Fig. 4.11). Three electric-fishing passes were conducted using two bank-based electric-fishing units on the 7th of July 2010 along a 48m length of channel. The mean wetted width of the stretch surveyed was 6.6m and the mean depth was 18.0cm. A total wetted area of 318m² was surveyed. Riffle was the dominant habitat present, with a substrate of mainly gravel and cobble. Bryophyte vegetation was abundant throughout this site.

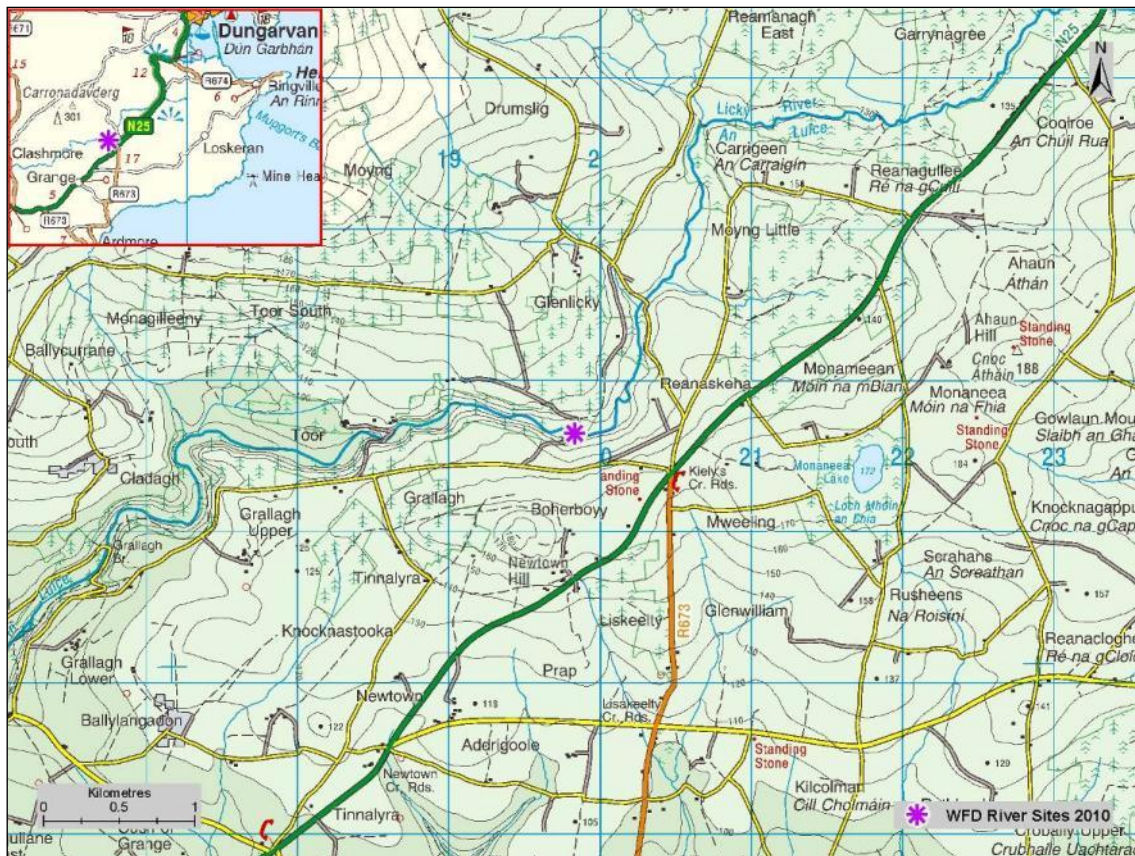


Fig. 4.11. Location of the Licky River surveillance monitoring site

A total of three fish species were captured in the Licky River site. Brown trout was the most abundant species, followed by salmon and eels (Table 4.5).

Table 4.5. Minimum density of each fish species (no./m²) captured on the River Licky site, July 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|---------------------------|-------------|-------|------------|-----------------------|
| <i>Salmo trutta fario</i> | Brown trout | 0.006 | 0.082 | 0.088 |
| <i>Salmo salar</i> | Salmon | 0.009 | 0.025 | 0.035 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.016 |
| All Fish | All Fish | - | - | 0.138 |

Brown trout ranged in length from 5.3cm to 18.8cm (Fig. 4.12). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 14%, 67% and 19% of the total brown trout catch respectively. The mean brown trout L1 and L2 were 7.1cm and 13.2cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Salmon ranged in length from 4.6cm to 11.9cm (Fig. 4.13). Two age classes (0+ and 1+) were present, accounting for approximately 32% and 68% of the total salmon catch respectively. The mean salmon L1 was 5.5cm (Appendix 2).

Seventeen eels ranging in length from 9.2cm to 32.5cm were also recorded.

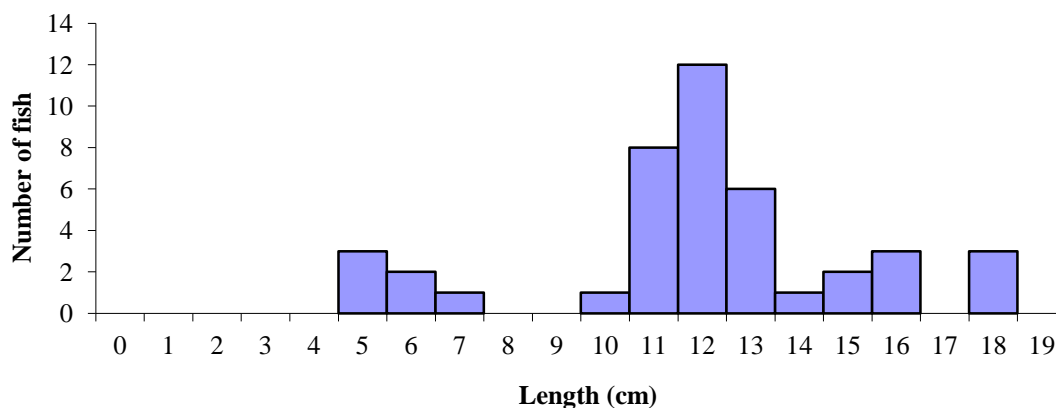


Fig. 4.12. Length frequency distribution of brown trout in the River Licky site, July 2010 (n = 42)

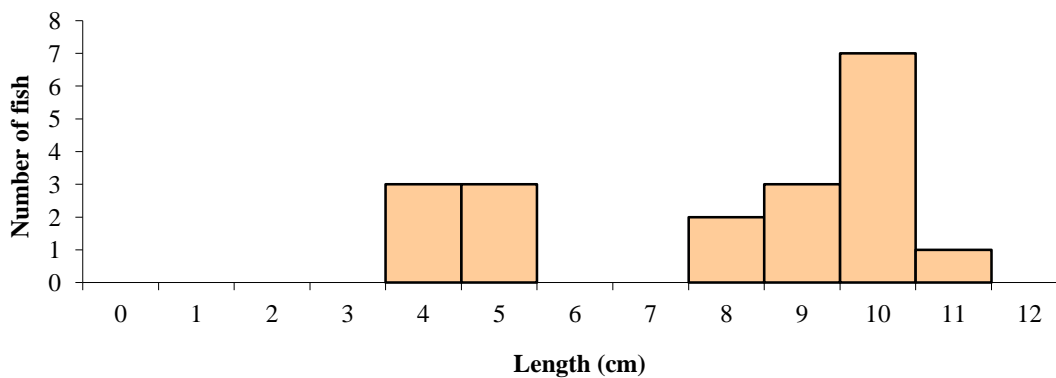


Fig. 4.13. Length frequency distribution of salmon in the River Licky site, July 2010 (n = 19)

4.1.6 The Owenreagh River



Plate 4.6. The Owenreagh River, upstream of Lord Brandon's Cottage, Co. Kerry

The Owenreagh River is located in Co. Kerry (Plate 4.6, Fig. 4.14). It rises in the Macgillycuddy's Reeks and flows in a north-easterly direction towards the confluence with the Gearhameen River and eventually the Upper Lake of Killarney National Park.

The Owenreagh River flows through the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment Special Area of Conservation (SAC), which is notable for its yew wood, alluvial woodland and blanket bog habitats, all of which are listed in Annex I of the Habitats Directive (NPWS, 2006). This SAC also protects species listed in Annex II of the Directive, including salmon, river, brook and sea lamprey, and Killarney shad (NPWS, 2006). The river is one of the 27 sub-basins which have been designated as a SAC for the freshwater pearl mussel.

The survey site was located beside Lord Brandon's Cottage at the mouth of the Black Valley, approximately 1km west of the Upper Lake (Fig. 4.14). This site was surveyed previously for WFD fish surveillance monitoring in September 2008 (Kelly *et al*, 2009a). Three electric-fishing passes were conducted using four bank-based electric-fishing units on the 3rd of August 2010 along a 45m length of channel. The mean wetted width of the stretch surveyed was 23.9m and the mean depth was 16.0cm. A total wetted area of 1,075m² was surveyed. Riffle, glide and pool were all evenly

represented, with a substrate of mainly cobble. Vegetation was relatively sparse throughout this site, with bryophytes dominating the flora present.

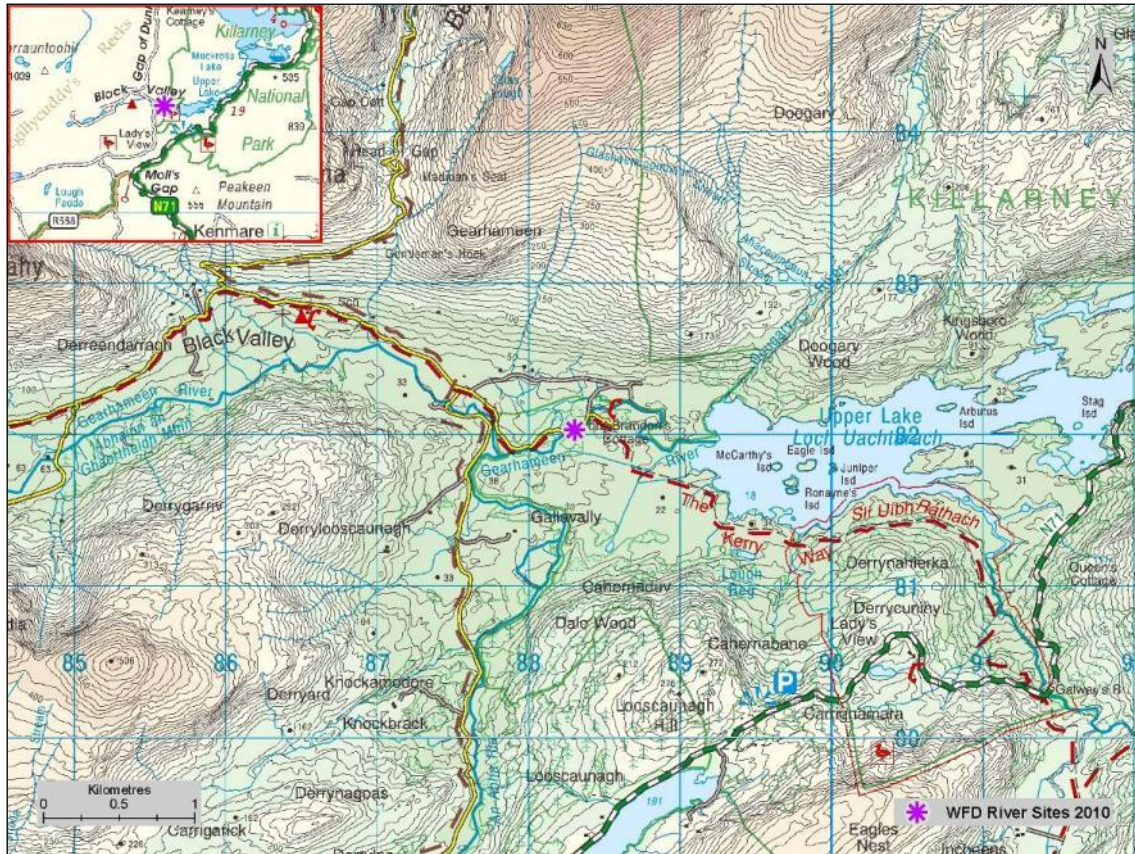


Fig. 4.14. Location of the Owenreagh River surveillance monitoring site

A total of four fish species were captured in the Owenreagh River site. Minnow was the most abundant species, followed by salmon, eels and brown trout (Table 4.6).

Table 4.6. Minimum density of each fish species (no./m²) captured on the Owenreagh River site, July 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|---------------------------|-------------|-------|------------|-----------------------|
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.140 |
| <i>Salmo salar</i> | Salmon | 0.009 | 0.011 | 0.020 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.012 |
| <i>Salmo trutta fario</i> | Brown trout | 0.007 | 0.002 | 0.008 |
| All Fish | All Fish | - | - | 0.181 |

Salmon ranged in length from 4.2cm to 12.1cm (Fig. 4.15). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 36%, 60% and 4% of the total salmon catch respectively. The mean salmon L1 and L2 were 4.1cm and 7.1cm respectively (Appendix 2).

Brown trout ranged in length from 4.8cm to 23.4cm (Fig. 4.16). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 73%, 7%, 13% and 7% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 4.2cm, 14.7cm and 21.1cm, respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Minnow ranged in length from 2.1cm to 7.0cm. Nineteen eels ranging in length from 12.6cm to 35.4cm were also captured.

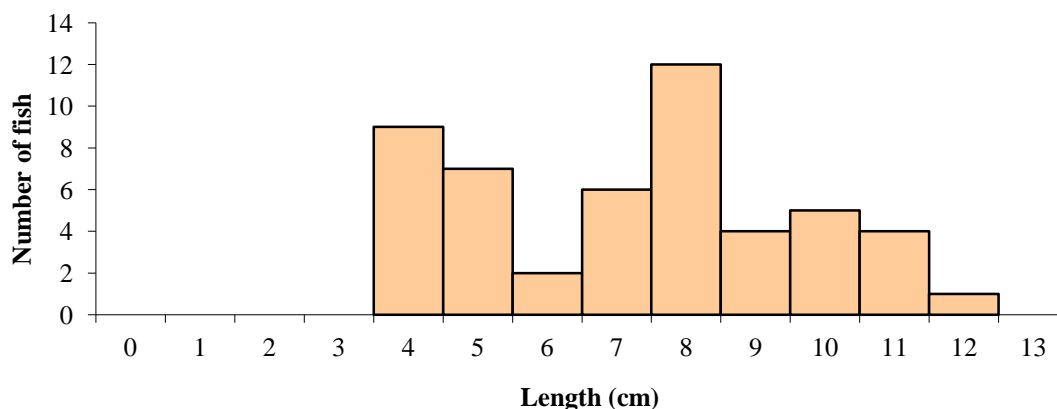


Fig. 4.15. Length frequency distribution of salmon in the Owenreagh River site, August 2010 (n = 50)

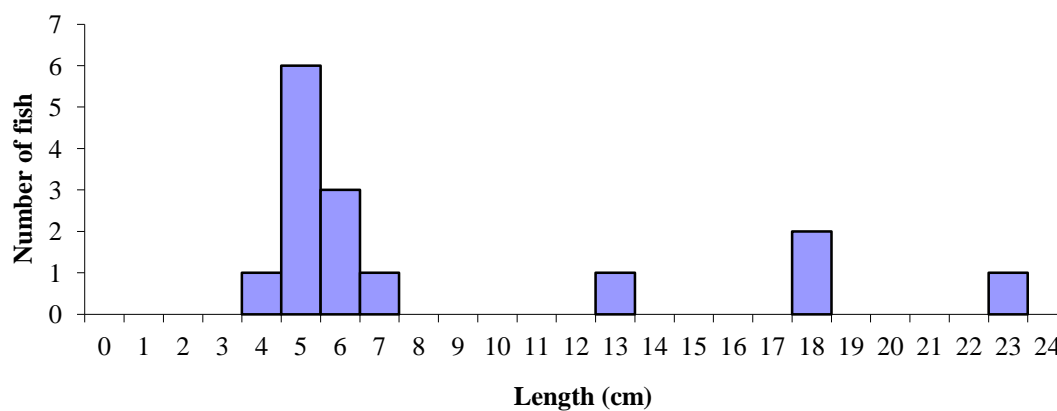


Fig. 4.16. Length frequency distribution of brown trout in the Owenreagh River site, August 2010 (n = 15)

4.2. Non-wadeable sites

4.2.1 *The River Blackwater (Lismore)*



Plate 4.7. The River Blackwater at Lismore Castle, Co. Waterford

The River Blackwater is one of Munster's largest rivers (Plate 4.7, Fig. 4.17). It rises in the Derrynasaggart Mountains and flows eastwards through Mallow and Fermoy, widening near Cappoquin, before heading south to enter the sea at Youghal Harbour. Fishing in the Munster Blackwater is considered to be relatively good for salmon, brown trout and sea trout. Good runs of salmon throughout the year provide sport for anglers. Brown trout, however, have been noted as quite small within this river (O'Reilly, 2009). Another significant fish species present in this river is the dace, which was first introduced into the River Blackwater in 1889. Dace formed a stable population in the River Blackwater for almost 100 years, but since the early 1990s, they have spread from the River Blackwater into several other catchments, where they are considered invasive. Furthermore, there is evidence that they have a negative impact on native salmonids by competing for food and breeding habitat (Caffrey *et al.*, 2007).

This site, along with most of the River Blackwater main channel, is located within the Blackwater River (Cork/Waterford) SAC (see section 4.1.2 for description). Just upstream of the survey site is

the Blackwater Callows SPA. This is a narrow strip of land bordering the river which is prone to flooding but considered important for various aquatic plant and bird species (NPWS, 2005).

The survey site was located upstream of Lismore Bridge in the picturesque village of Lismore, Co. Waterford (Fig. 4.17). One electric-fishing pass was conducted using four boat-based electric-fishing units on the 3rd of June 2010 along a 368m length of channel. The mean wetted width of the stretch surveyed was 42.2m and the mean depth was 200.0cm. A total wetted area of 15,530m² was surveyed. Glide was the only habitat present at this site, with a mixed substrate of mainly bedrock, boulder and cobble.

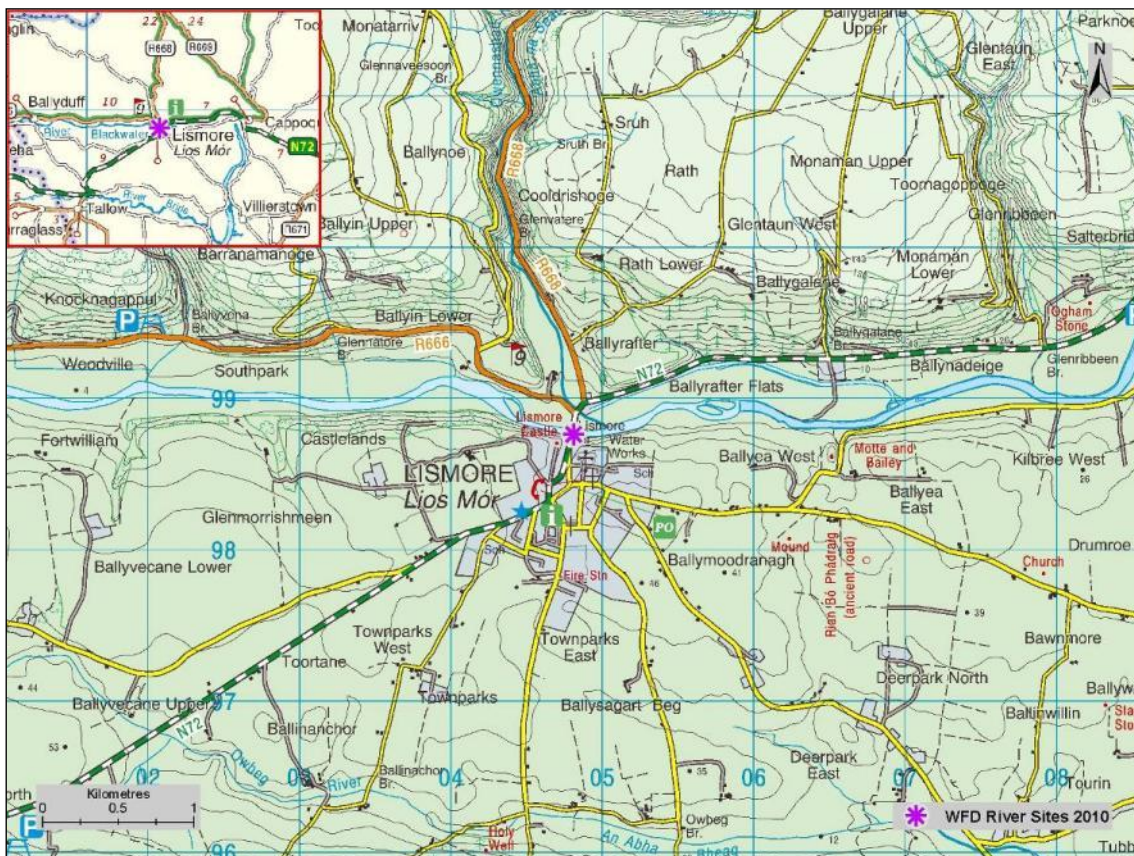


Fig. 4.17. Location of the River Blackwater (Lismore) surveillance monitoring site

A total of ten fish species were recorded in the River Blackwater (Lismore) site. Salmon was the most abundant species, followed by flounder, eel, dace, stone loach, minnow, gudgeon, roach, lamprey and three-spined stickleback (Table 4.7).

Table 4.7. Minimum density of each fish species (no./m²) captured on the River Blackwater (Lismore) site, June 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|--------|------------|-----------------------|
| <i>Salmo salar</i> | Salmon | 0.0001 | 0.0052 | 0.0053 |
| <i>Platichthys flesus</i> | Flounder | - | - | 0.0029 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.0015 |
| <i>Leuciscus leuciscus</i> | Dace | - | - | 0.0009 |
| <i>Barbatula barbatula</i> | Stone loach | - | - | 0.0006 |
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.0005 |
| <i>Gobio gobio</i> | Gudgeon | - | - | 0.0003 |
| <i>Rutilus rutilus</i> | Roach | - | - | 0.0001 |
| <i>Lampetra</i> sp. | Lamprey sp. | - | - | 0.0001 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.0001 |
| All Fish | All Fish | - | - | 0.0123 |

Juvenile salmon ranged in length from 4.5cm to 12.3cm (Fig. 4.18). Two age classes (0+ and 1+) were present in the juvenile salmon population, accounting for approximately 2% and 98% of the total juvenile salmon catch respectively. The mean salmon L1 was 5.0cm (Appendix 2). In addition, two adult salmon measuring 43.7cm and 71.0cm were also captured. These were both aged 2.2+ and 2.1+ respectively.

The abundance of flounder captured in the survey of the River Blackwater (Lismore) site reflects its proximity to the tidal limit of the Blackwater, which is approximately 1km downstream of Lismore. Flounder ranged in length from 8.5cm to 20.6cm (Fig. 4.19).

Eels ranged in length from 12.8cm to 57.0cm (Fig. 4.20). Dace ranged in length from 9.5cm to 25.3cm (Fig. 4.21). Four age classes (1+, 2+, 3+ and 5+) were present, accounting for approximately 14%, 57%, 21% and 7% of the total dace catch respectively.

Flounder ranged in length from 6.9cm to 13cm, gudgeon from 9.1cm to 12.7cm, lamprey from 5.5cm to 7.1cm and stone loach from 7.5cm to 9.6cm. Other species recorded included, two lamprey measuring 13.7cm and 14.5cm, two roach measuring 6.5cm and 9.5cm and two three-spined sticklebacks measuring 1.0cm and 1.5cm.

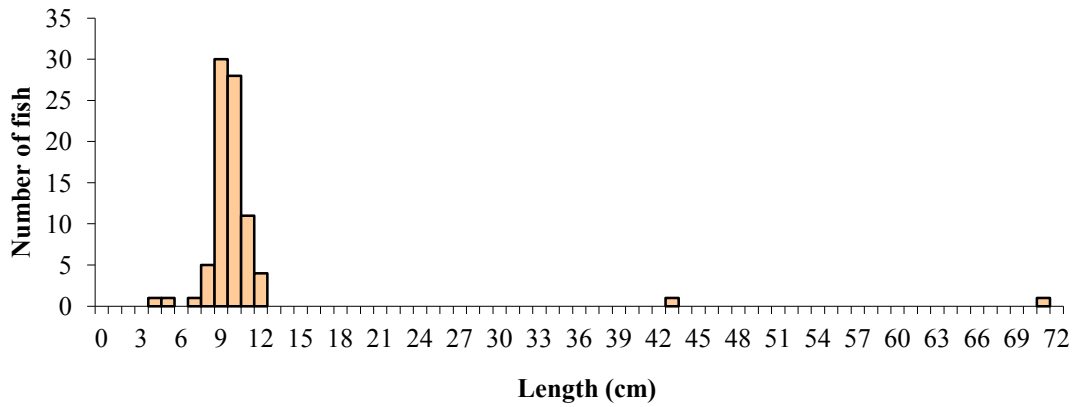


Fig. 4.18. Length frequency distribution of salmon in the River Blackwater (Lismore) site, June 2010 (n = 83)

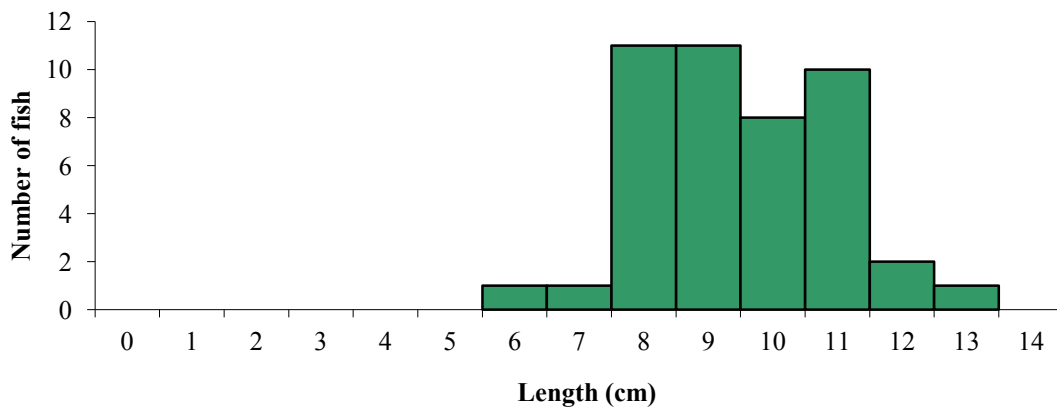


Fig. 4.19. Length frequency distribution of flounder in the River Blackwater (Lismore) site, June 2010 (n = 45)

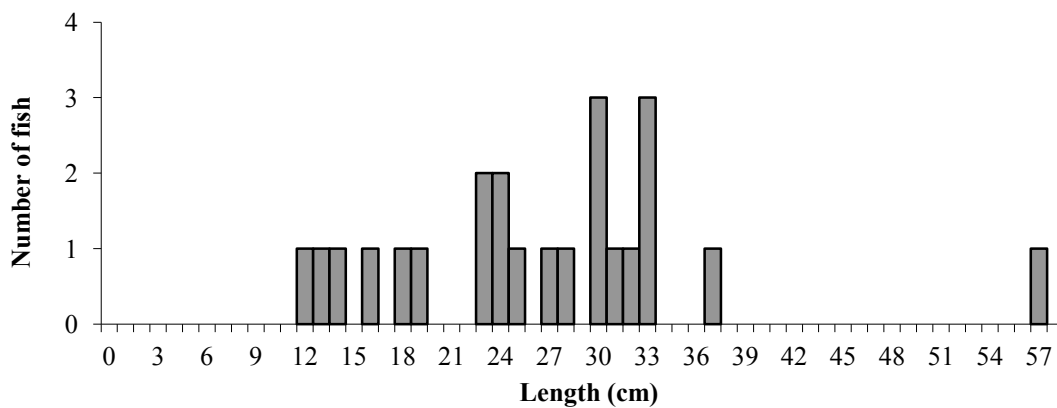


Fig. 4.20. Length frequency distribution of eels in the River Blackwater (Lismore) site, June 2010 (n = 23)

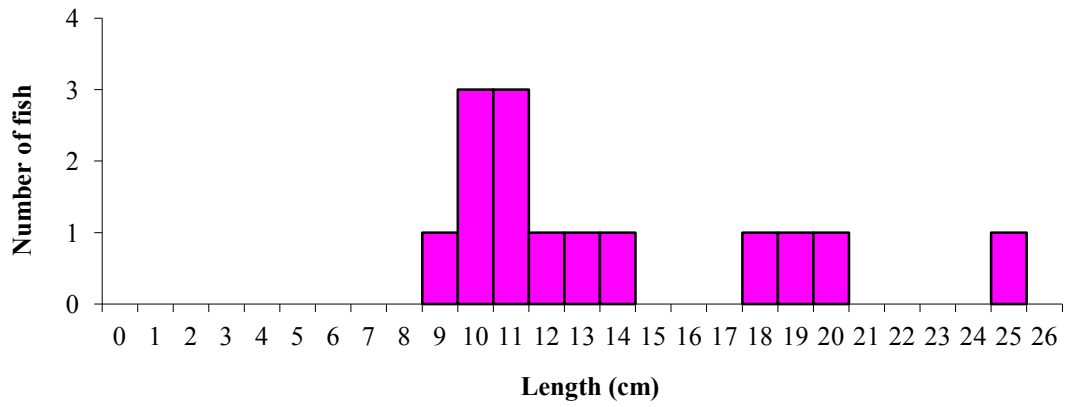


Fig. 4.21. Length frequency distribution of dace in the River Blackwater (Lismore) site, June 2010 (n = 14)

4.2.2 The River Blackwater (Nohaval)



Plate 4.8. The River Blackwater upstream of Nohaval Bridge, Cork/Kerry border

The River Blackwater (see section 4.2.1 for description), was also surveyed at Nohaval Bridge on the Cork/Kerry border, approximately 11km north-west of Millstreet.

This site is located within the Blackwater River (Cork/Waterford) SAC, which is noted for its alluvial wet woodland and yew wood, both of which are listed in Annex I of the Habitats Directive. Several species listed in Annex II of the Directive are also present, including sea, river and brook lamprey, freshwater pearl mussel, twaite shad, salmon, crayfish and otter (NPWS, 2007).

The survey site was located approximately 1.5km north of Rathmore Village, along the border of Counties Cork and Kerry (Plate 4.8, Fig. 4.22). This site was surveyed previously for WFD fish surveillance monitoring in July 2009 (Kelly *et al*, 2010a). One electric-fishing pass was conducted using four boat-based electric-fishing units on the 3rd of June 2010 along a 368m length of channel. The mean wetted width of the surveyed stretch was 10.2m and the mean depth was 200.0cm. A total wetted area of 15,530m² was surveyed. The habitat was dominated by glide, with a mixed substrate of bedrock, boulder, cobble and gravel.



Fig. 4.22. Location of the River Blackwater (Nohaval) surveillance monitoring site

A total of seven fish species were recorded in the River Blackwater (Nohaval) site. Brown trout was the most abundant species, followed by salmon, minnow, stone loach, three-spined stickleback, lamprey and eels (Table 4.8).

Table 4.8. Minimum density of each fish species (no./m²) captured on the River Blackwater (Nohaval) site, June 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|-------|------------|-----------------------|
| <i>Salmo trutta fario</i> | Brown trout | 0.001 | 0.042 | 0.043 |
| <i>Salmo salar</i> | Salmon | 0.009 | 0.029 | 0.038 |
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.017 |
| <i>Barbatula barbatula</i> | Stone loach | - | - | 0.003 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.002 |
| <i>Lampetra</i> sp. | Lamprey sp. | - | - | 0.001 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.001 |
| All Fish | All Fish | - | - | 0.106 |

Brown trout ranged in length from 4.2cm to 27.5cm (Fig. 4.23). Four age classes (0+, 1+, 2+ and 3+) were present, accounting for approximately 3%, 67%, 28% and 2% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 8.2cm, 16.1cm and 21.1cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Salmon ranged in length from 5.1cm to 16.7cm (Fig. 4.24). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 37%, 61% and 2% of the total salmon catch respectively. The mean salmon L1 and L2 were 5.1cm and 9.1cm respectively (Appendix 2).

Other species recorded included, minnow ranging in length from 1.9cm to 8.4cm, stone loach from 2.8cm to 10.9cm, three-spined stickleback from 2.5cm to 3.5cm, lamprey from 10.0cm 14.1cm and eels from 34.5cm to 41.6cm.

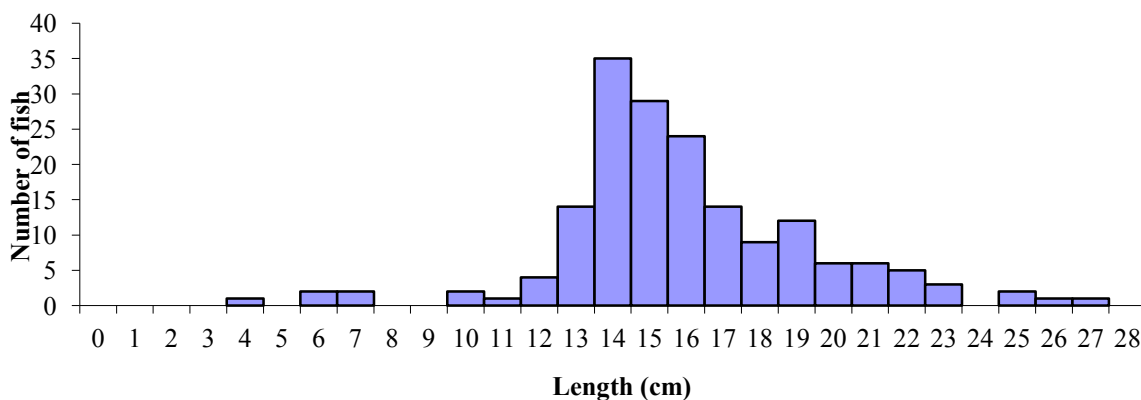


Fig. 4.23. Length frequency distribution of brown trout in the River Blackwater (Nohaval) site, August 2010 (n = 173)

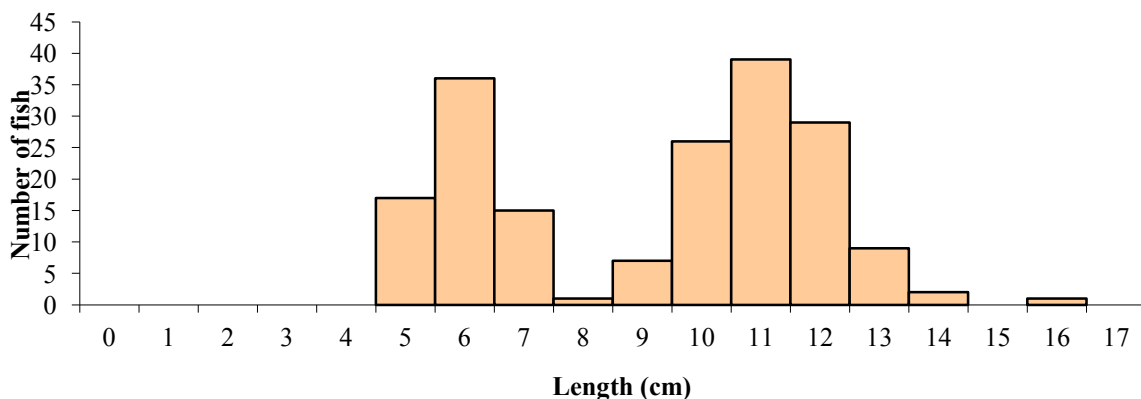


Fig. 4.24. Length frequency distribution of salmon in the River Blackwater (Nohaval) site, August 2010 (n = 182)

4.2.3 The River Funshion



Plate 4.9. The River Funshion 1km upstream of the River Blackwater confluence

The River Funshion is a tributary of the Munster Blackwater (Plate 4.9, Fig. 4.25). It rises in the Galty Mountains along the border of Counties Limerick and Tipperary and flows south-west towards Kildorrery, Co. Cork, before eventually joining the River Blackwater, south of Kilworth, Co. Cork. Brown trout fishing is popular along this river (O'Reilly, 2009).

The survey site was located downstream of Kilworth, approximately 1km upstream of the Blackwater confluence (Fig. 4.25). One electric-fishing pass was conducted using two boat-based electric-fishing units on the 11th of August 2010 along a 274m length of channel. The mean wetted width of the surveyed stretch was 11.5m and the mean depth was 107.0cm. A total wetted area of 3,151m² was surveyed. The habitat was dominated by glide, while the substrate was a mixture of cobble, gravel, sand, mud and silt.

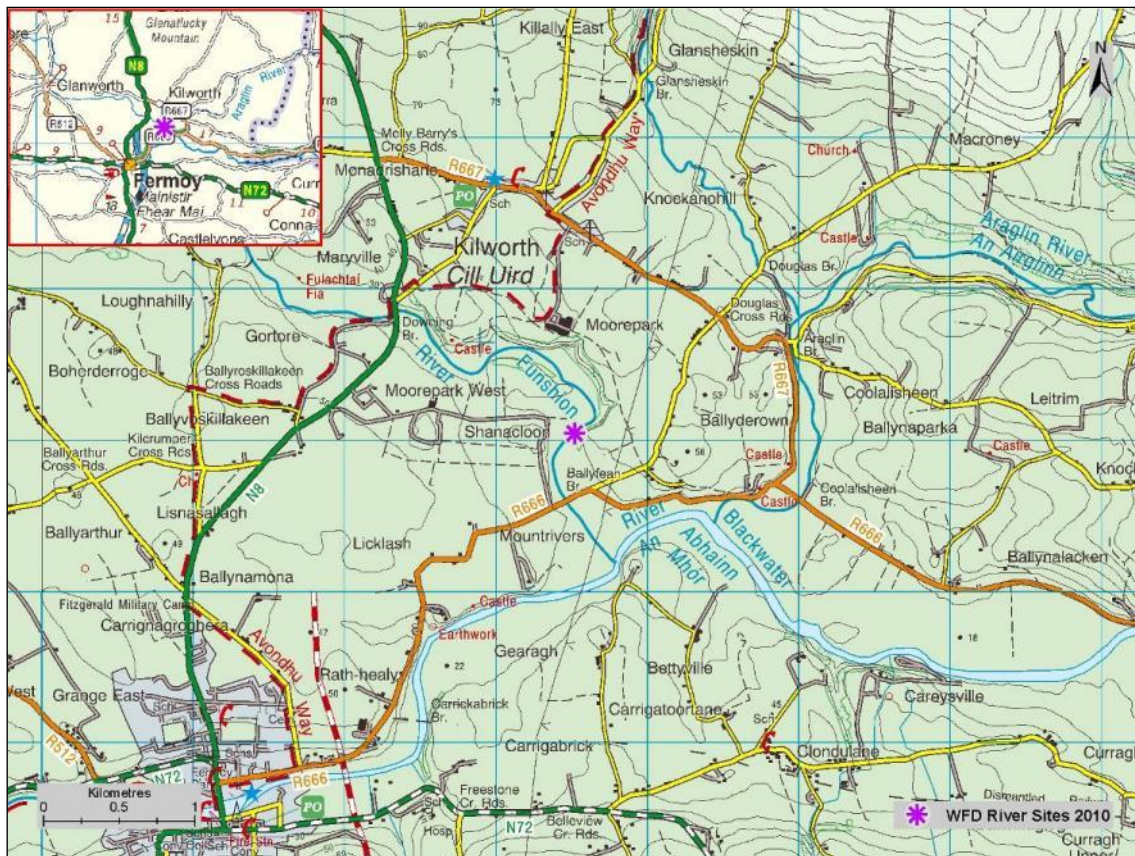


Fig. 4.25. Location of the River Funshion surveillance monitoring site

A total of eight fish species were recorded in the River Funshion site. Salmon was the most abundant species, followed by brown trout, stone loach, three-spined stickleback, eels, dace, minnow and lamprey (Table 4.9).

Table 4.9. Minimum density of each fish species (no./m²) captured on the River Funshion site, August 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|-------|------------|-----------------------|
| <i>Salmo salar</i> | Salmon | 0.003 | 0.028 | 0.031 |
| <i>Salmo trutta fario</i> | Brown trout | - | 0.010 | 0.010 |
| <i>Barbatula barbatula</i> | Stone loach | - | - | 0.005 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.004 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.003 |
| <i>Leuciscus leuciscus</i> | Dace | - | - | 0.001 |
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.001 |
| <i>Lampetra sp.</i> | Lamprey sp. | - | - | 0.001 |
| All Fish | All Fish | - | - | 0.057 |

Salmon ranged in length from 5.6cm to 14.6cm (Fig. 4.26). Two age classes (0+ and 1+) were present, accounting for approximately 10% and 90% of the total salmon catch respectively. The mean salmon L1 was 5.2cm (Appendix 2).

Brown trout ranged in length from 14.1cm to 30.6cm (Fig. 4.27). Three age classes (1+, 2+ and 3+) were present, accounting for approximately 30%, 39% and 30% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 6.8cm, 14.6cm and 20.7cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Other species recorded included stone loach ranging from 6.8cm to 10.3cm in length, three-spined stickleback ranging from 2.4cm to 4.0cm, eels from 9.1cm to 36.1cm, dace from 8.6cm to 9.1cm, and minnow from 4.8cm to 5.6cm. Two lamprey were also captured measuring 8.6cm and 10.8cm.

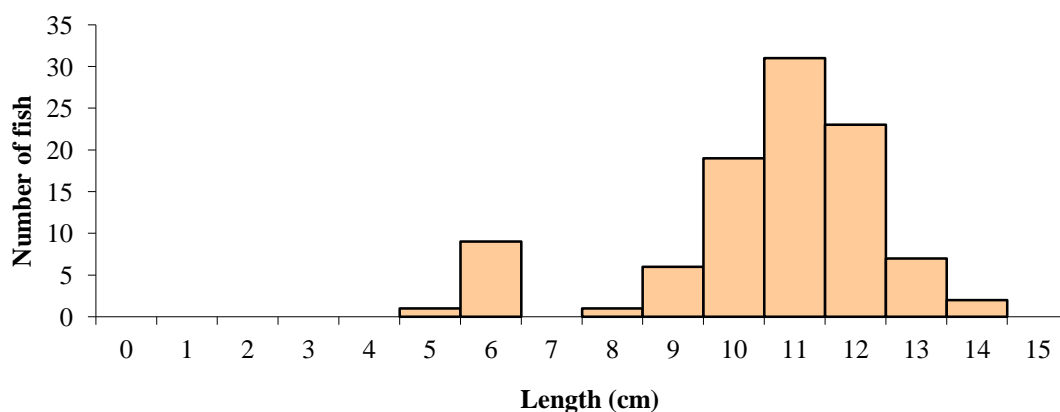


Fig. 4.26. Length frequency distribution of salmon in the Funshion River, August 2010 (n = 99)

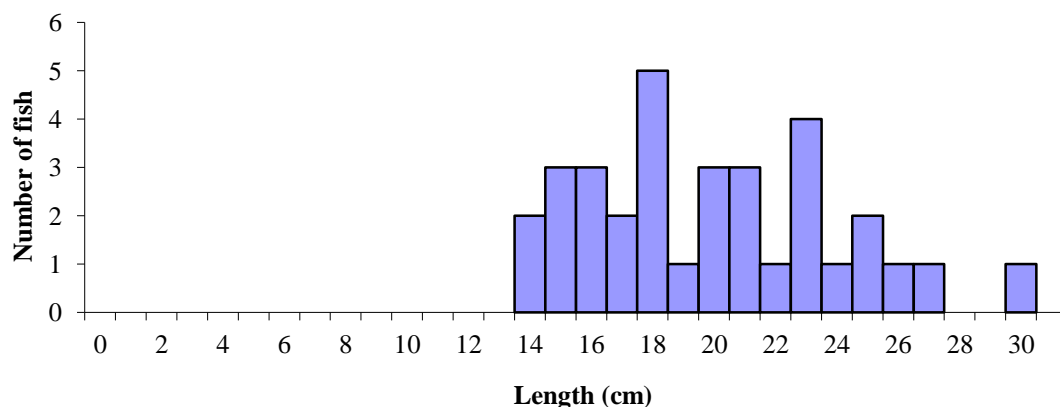


Fig. 4.27. Length frequency distribution of brown trout in the Funshion River, August 2010 (n = 33)

4.2.4 The River Lee (Lee Fields)



Plate 4.10. The River Lee at Lee Fields, Co. Cork

The River Lee (see Section 4.1.4 for description) was also surveyed near Cork City in an area surrounded by parkland.

The survey site was located along the Lee Fields, downstream of Leemount Bridge and approximately 3km west of Cork City centre (Plate 4.10, Fig. 4.28). One electric-fishing pass was conducted using four boat-based electric-fishing units on the 4th of June 2010 along a 525m length of channel. The mean wetted width of the stretch surveyed was 45.7m and the mean depth was 125.0cm. A total wetted area of 15,530m² was surveyed. Glide was the only habitat present, with a substrate of mainly cobble and gravel. Sand and silt were also abundant along the banks.

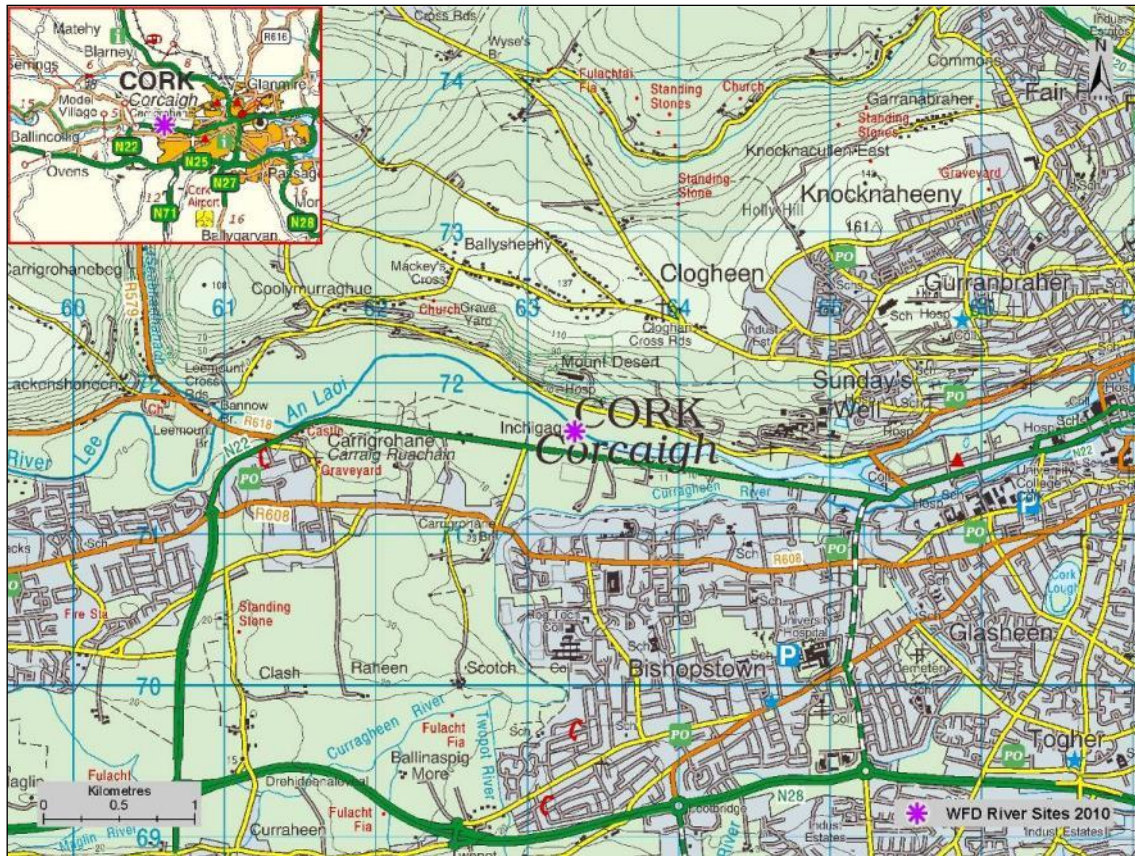


Fig. 4.28. Location of the River Lee (Lee Fields) surveillance monitoring site

A total of eight fish species were recorded in the River Lee (Lee Fields) site. Lamprey was the most abundant species, followed by eels, three-spined stickleback, salmon, stone loach, gudgeon, brown trout and minnow (Table 4.10).

Table 4.10. Minimum density of each fish species (no./m²) captured on the River Lee (Lee Fields) site, June 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|-------------------------------|--------------------------|---------|------------|-----------------------|
| <i>Lampetra sp.</i> | Lamprey sp. | - | - | 0.00405 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.00246 |
| <i>Gasterosteus aculeatus</i> | Three-spined stickleback | - | - | 0.00071 |
| <i>Salmo salar</i> | Salmon | 0.00033 | 0.00025 | 0.00058 |
| <i>Barbatula barbatula</i> | Stone loach | - | - | 0.00038 |
| <i>Gobio gobio</i> | Gudgeon | - | - | 0.00029 |
| <i>Salmo trutta fario</i> | Brown trout | 0.00000 | 0.00025 | 0.00025 |
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.00004 |
| All Fish | All Fish | - | - | 0.00876 |

Juvenile lamprey ranged in length from 4.2cm to 14.9cm (Fig. 4.29). Eels ranged in length from 9.1cm to 56.8cm (Fig. 4.30).

Salmon ranged in length from 3.4cm to 9.8cm (Fig. 4.31). Two age classes (0+ and 1+) were present, accounting for approximately 57% and 43% of the total salmon catch respectively. The mean salmon L1 was 5.0cm (Appendix 2).

Six brown trout were recorded, ranging in length from 10.5cm to 25.4cm. Three age classes (1+, 2+ and 3+) were present, accounting for approximately 67%, 17% and 17% of the total brown trout catch respectively. The mean brown trout L1, L2 and L3 were 7.0cm, 16.0cm and 21.8cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Other species recorded included three-spined stickleback ranging in length from 4.5cm to 6.2cm, stone loach from 4.6cm to 10.6cm and gudgeon from 5.1cm to 12.6cm. A single minnow was recorded, measuring 3.6cm.

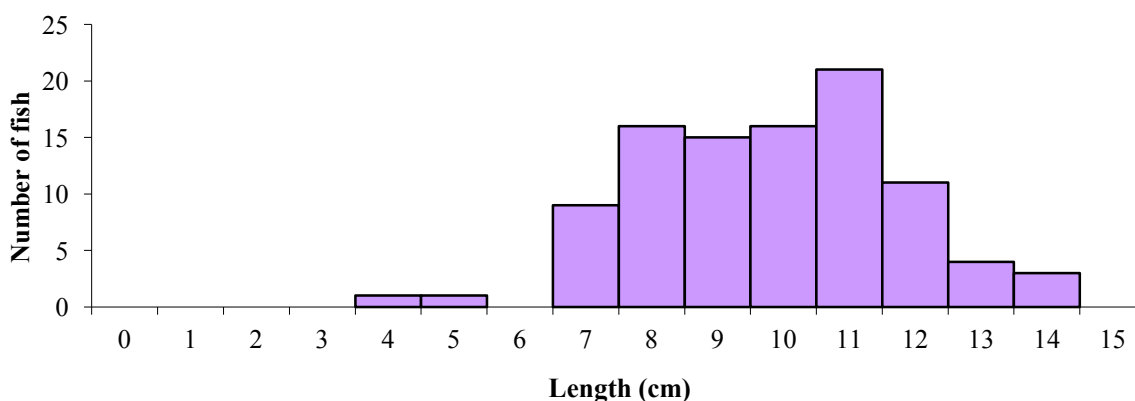


Fig. 4.29. Length frequency distribution of juvenile lamprey in the River Lee (Lee Fields) site, June 2010 (n = 97)

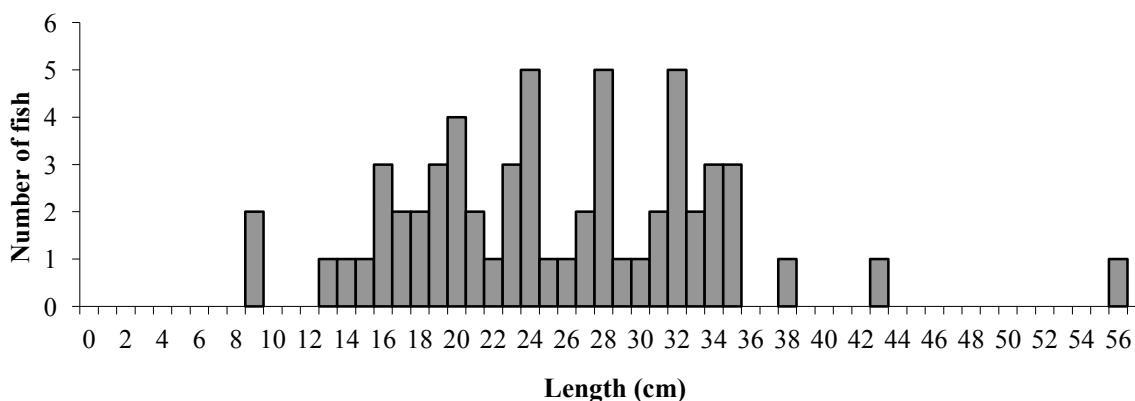


Fig. 4.30. Length frequency distribution of eels in the River Lee (Lee Fields) site, June 2010 (n = 59)

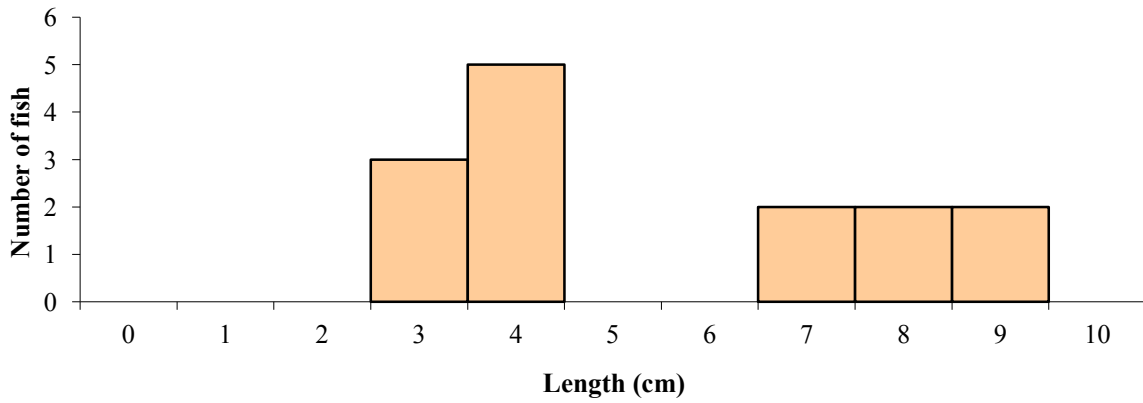


Fig. 4.31. Length frequency distribution of salmon in the River Lee (Lee Fields) site, June 2010 (n = 14)

4.2.5 The Owvane River



Plate 4.11. The Owvane River, upstream of Pierson's bridge, Co. Cork

The Owvane River rises in the Shehy Mountains in Co. Cork. It flows in a south-westerly direction for approximately 16km before entering the sea near Ballylicky. Although grilse and sea trout are present in this river, its reputation as a fishery has declined in recent years due to a drainage scheme carried out a number of years ago (O'Reilly, 2002).

The survey site was located at Pierson's Bridge, between Ballylicky and Kealkill in Co. Cork, approximately 3km from Bantry Bay (Plate 4.11, Fig. 4.32). Three electric-fishing passes were conducted using two boat-based electric-fishing units on the 27th of July 2010 along a 263m length of channel. The mean wetted width of the stretch surveyed was 16.5m and the mean depth was 56.0cm. A total wetted area of 4,340m² was surveyed. Glide was the main habitat type present, with a substrate of mainly gravel.

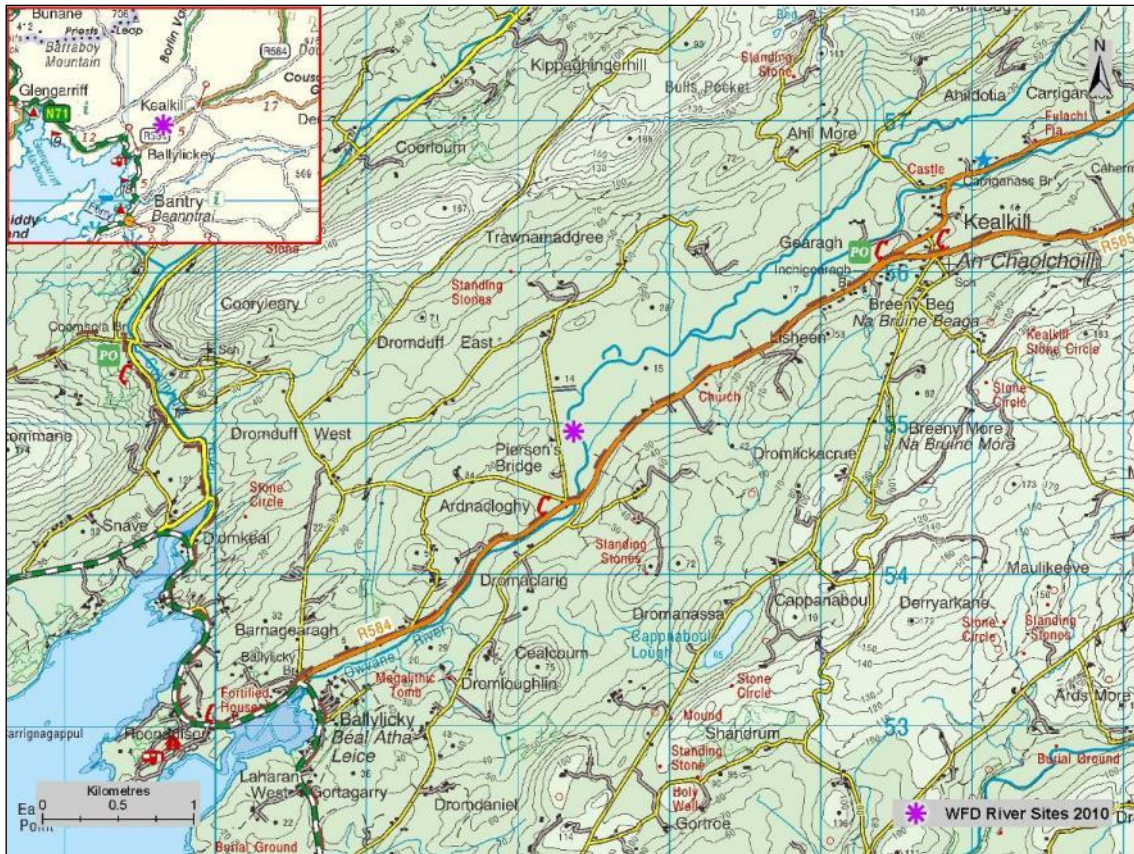


Fig. 4.32. Location of the Owvane River surveillance monitoring site

A total of five fish species (sea trout are included as a separate ‘variety’ of trout) were recorded in the Owvane River site. Minnow was the most abundant species, followed by salmon, brown trout, sea trout and eels (Table 4.11).

Table 4.11. Minimum density of each fish species (no./m²) captured on the Owvane River site, July 2010

| Scientific name | Common name | 0+ | 1+ & older | Total minimum density |
|----------------------------|-------------|---------|------------|-----------------------|
| <i>Phoxinus phoxinus</i> | Minnow | - | - | 0.00599 |
| <i>Salmo salar</i> | Salmon | 0.00069 | 0.00046 | 0.00046 |
| <i>Salmo trutta fario</i> | Brown trout | - | 0.00046 | 0.00046 |
| <i>Salmo trutta trutta</i> | Sea trout | - | 0.00046 | 0.00046 |
| <i>Anguilla anguilla</i> | Eel | - | - | 0.00023 |
| All Fish | All Fish | - | - | 0.00714 |

Minnow ranged in length from 1.5cm to 7.4cm (Fig. 4.33).

Salmon ranged in length from 4.8cm to 12.0cm (Fig. 4.34). Three age classes (0+, 1+ and 2+) were present, accounting for approximately 14%, 81% and 5% of the total salmon catch respectively. The mean salmon L1 and L2 were 4.7cm and 8.5cm respectively (Appendix 2).

Four brown trout were recorded, ranging in length from 11.6cm to 17.4cm. Two of these fish were aged 1+ and two were aged 2+. The mean brown trout L1 and L2 and were 6.7cm and 12.6cm respectively (Appendix 1). This indicates that the rate of growth for brown trout in this river is ‘very slow’ according to the classification scheme of Kennedy and Fitzmaurice (1971).

Two sea trout were recorded, both aged 2.1+ and measuring 50cm and 53cm in length. Four eels ranging in length from 19.7cm to 34.2cm were also recorded.

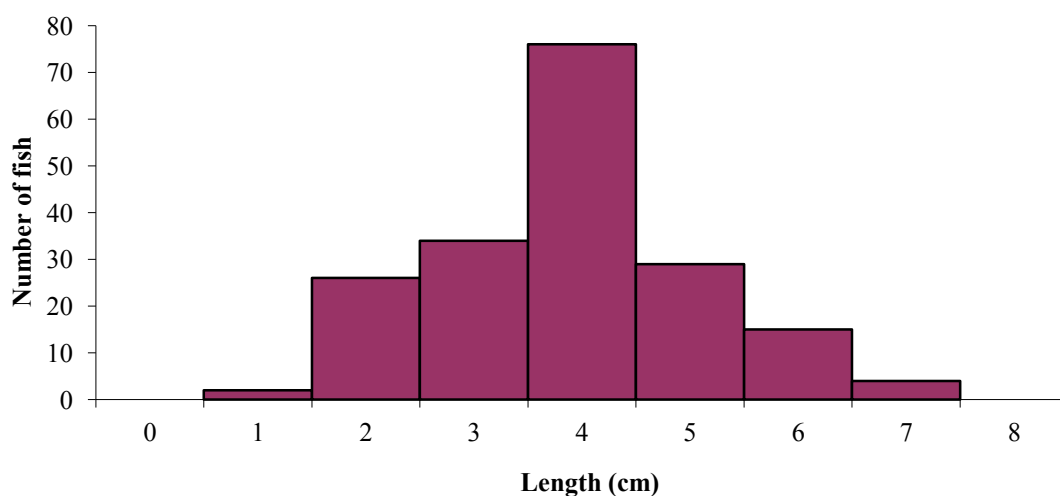


Fig. 4.33. Length frequency distribution of minnow in the Owvane River, July 2010 (n = 186)

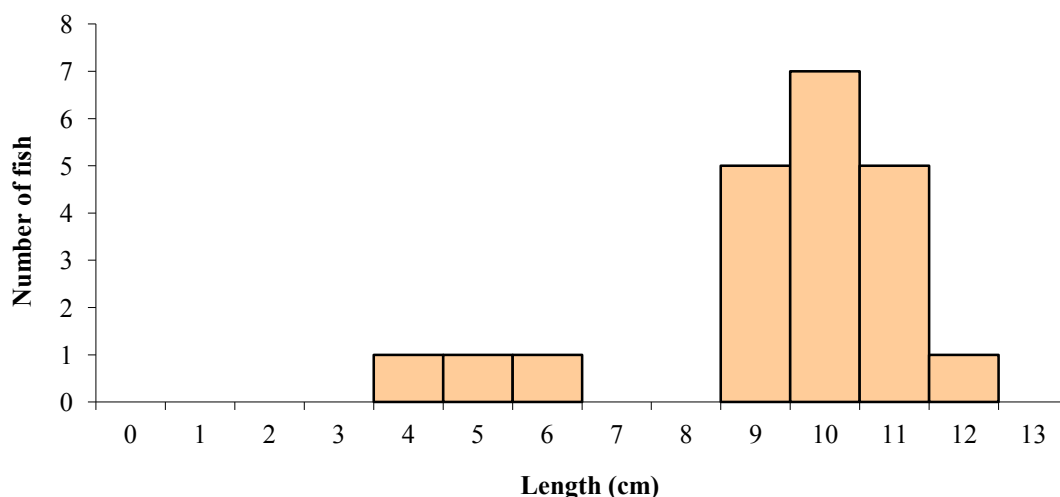


Fig. 4.34. Length frequency distribution of salmon in the Owvane River, July 2010 (n = 186)

4.3 Community structure

4.3.1 Species richness and composition

A total of 13 fish species (sea trout are included as a separate ‘variety’ of trout) were recorded within the 11 SWRBD sites surveyed (Fig. 4.35). Eel was the most common fish species, occurring at all sites within the region. This was followed by brown trout (91%), salmon (91%), lamprey (64%), minnow (64%), three-spined stickleback (55%), stone loach (45%), gudgeon (27%), dace (18%), roach (18%) and sea trout (18%). Flounder and pike were only recorded in one site each.

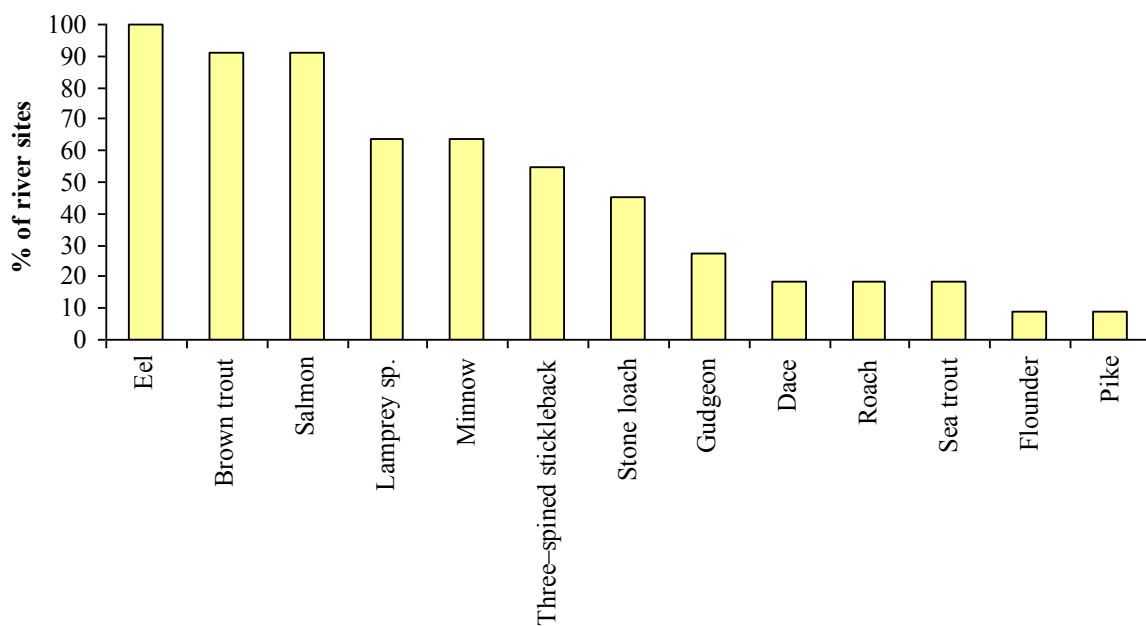


Fig. 4.35. Percentage of sites where each fish species was recorded in the SWRBD for WFD SM monitoring 2010

Species richness ranged from three species in the River Licky to a maximum of ten species in the River Blackwater at Lismore Bridge (Table 4.12). Kelly *et al.* (2008) classified fish species in Ireland into three groups. Group 1 - native species (e.g. salmonids, three-spined stickleback, lamprey and eel) were present at all sites surveyed. Group 2 - non-native species that influence ecology (e.g. dace, roach, minnow, stone loach) were recorded in all sites except for the Licky River and Cumberagh River. Group 3 - non-native species that generally don't influence ecology (e.g. gudgeon) were recorded in three sites: River Lee (Inchinossig), River Lee (Lee Fields) and River Blackwater (Lismore).

Table 4.12. Species richness at each river site surveyed in the SWRBD, June to August 2010

| Site | Species richness | No. native species (Group 1) | No. non-native species (Group 2) | No. non-native species (Group 3) |
|-----------------------|------------------|------------------------------|----------------------------------|----------------------------------|
| HAND-SET SITES | | | | |
| Cummeragh | 5* | 5 | 0 | 0 |
| Dalua | 5 | 4 | 1 | 0 |
| Finisk | 4 | 4 | 0 | 0 |
| Lee (Inchinossig) | 9 | 3 | 5 | 1 |
| Licky | 3 | 3 | 0 | 0 |
| Owenreagh | 4 | 3 | 1 | 0 |
| BOAT SITES | | | | |
| Blackwater (Lismore) | 10 | 5 | 4 | 1 |
| Blackwater (Nohaval) | 7 | 5 | 2 | 0 |
| Funshion | 8 | 5 | 3 | 0 |
| Lee (Lee fields) | 8 | 4 | 3 | 1 |
| Owvane (Cork) | 5* | 4 | 1 | 0 |

* Sea trout are counted as a separate variety of brown trout

4.3.2 Species abundance and distribution

Abundance (minimum population density) and distribution maps for the most common fish species recorded within the SWRBD during 2010 are shown below in Figures 4.36 to 4.50. 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.* 2010; Kelly *et al.* 2011). This is primarily due to the tendency for juvenile trout and salmon to utilise shallow, riffle areas as nursery habitat, whereas older salmonids utilise glide and pool areas and require larger territories, 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 occurred in ten of the 11 sites surveyed within the SWRBD during 2010. Fry (0+) densities were generally higher in wadeable sites, whilst the densities of 1+ and older fish were greater in the non-wadeable sites. The greatest densities of brown trout fry for the non-wadeable and wadeable sites were 0.001 fish/m² (River Blackwater at Nohaval) and 0.144 fish/m² (Cummeragh River) respectively (Fig. 4.36). For 1+ and older fish, the highest densities were recorded in the River Blackwater (Nohaval) and Licky River with values of 0.042 fish/m² and 0.082 fish/m² respectively (Fig. 4.37). Sea trout were recorded in both the Owvane (0.001 fish/m²) and Cummeragh Rivers (0.007 fish/m²) (Fig. 4.38).

Salmon were also recorded in ten of the 11 sites surveyed during 2010. As expected there were generally greater densities of fry in the wadeable sites and greater densities of 1+ and older fish in the non-wadeable sites. The greatest densities of fry (0+) for the non-wadeable and wadeable sites were 0.009 fish/m² (River Blackwater at Nohaval) and 0.475 fish/m² (Cummeragh River) respectively (Fig.

4.39). For 1+ and older fish the highest densities were recorded in the River Blackwater (Nohaval) and Dalua River with values of 0.029 fish/m² and 0.194 fish/m² respectively (Fig. 4.40).

European eels were also well distributed throughout the SWRBD, occurring in all 11 sites (Fig. 4.41). Of the remaining species captured, lamprey (Fig. 4.42) and minnow (Fig. 4.43) were recorded in seven sites, three-spined stickleback in six sites (Fig. 4.44), stone loach in five sites (Fig. 4.45), gudgeon in three sites (Fig. 4.46), dace (Fig. 4.47) and roach (Fig. 4.48) in two sites and both flounder (Fig. 4.49) and pike (Fig. 4.50) in one site only.

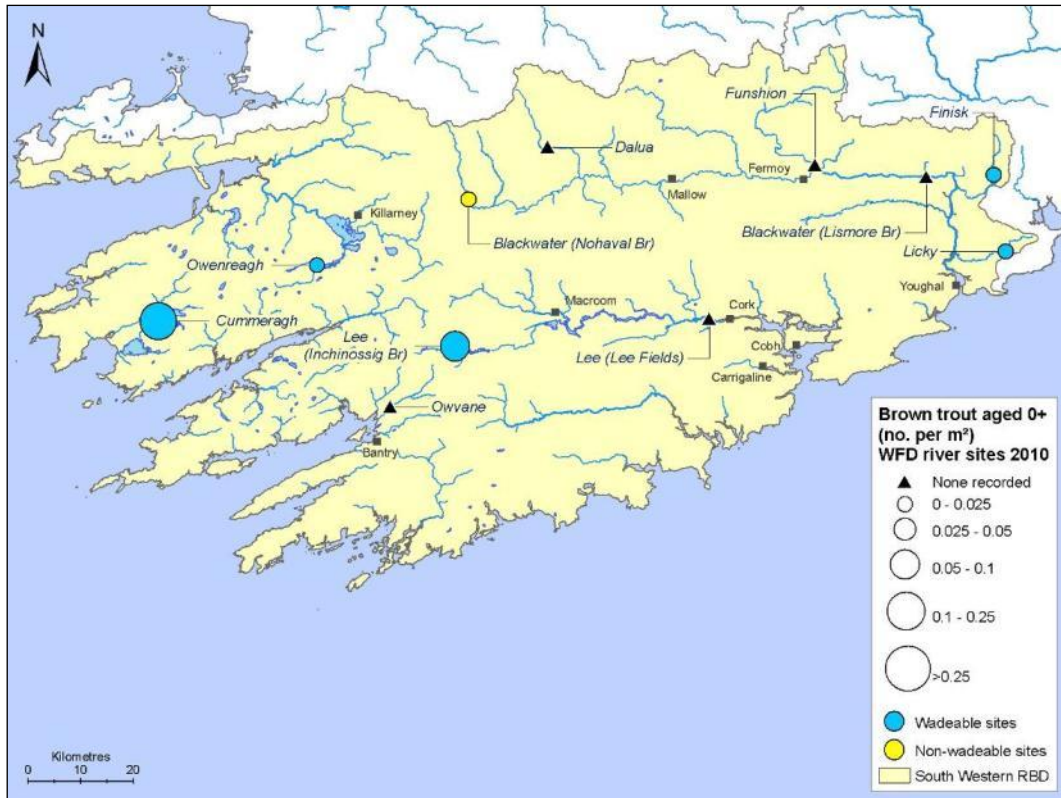


Fig. 4.36. Distribution of 0+ brown trout in the SWRBD, WFD monitoring 2010

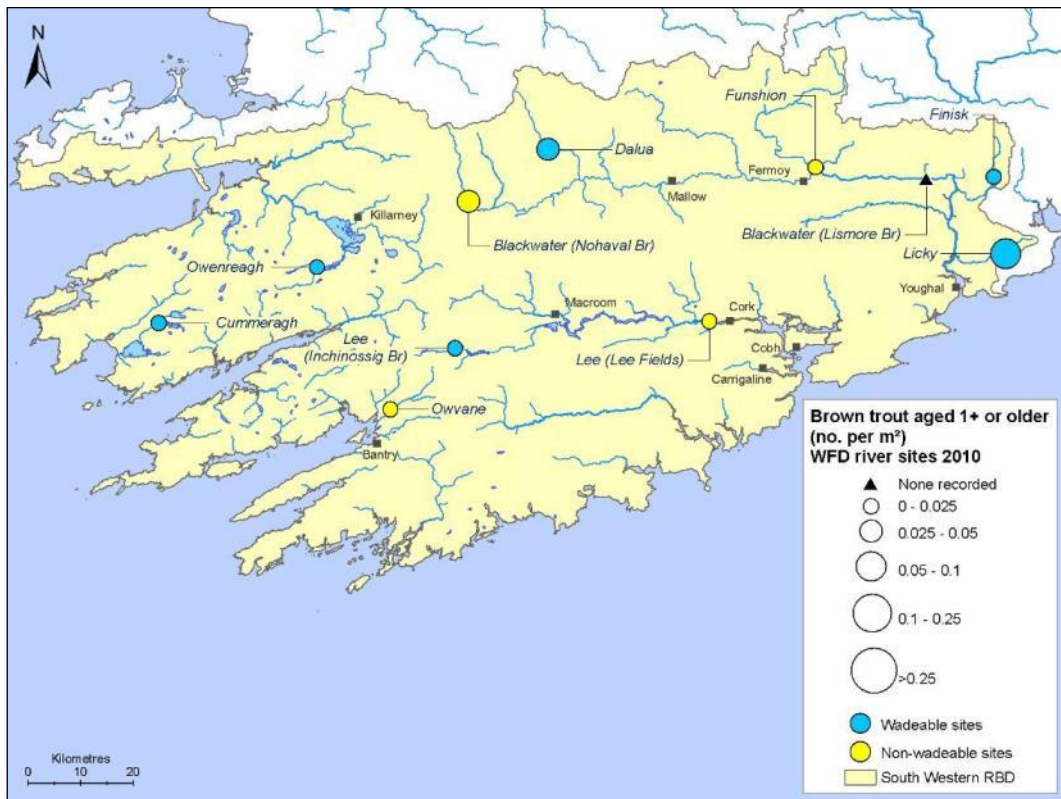


Fig. 4.37. Distribution of 1+ or older brown trout in the SWRBD, WFD monitoring 2010

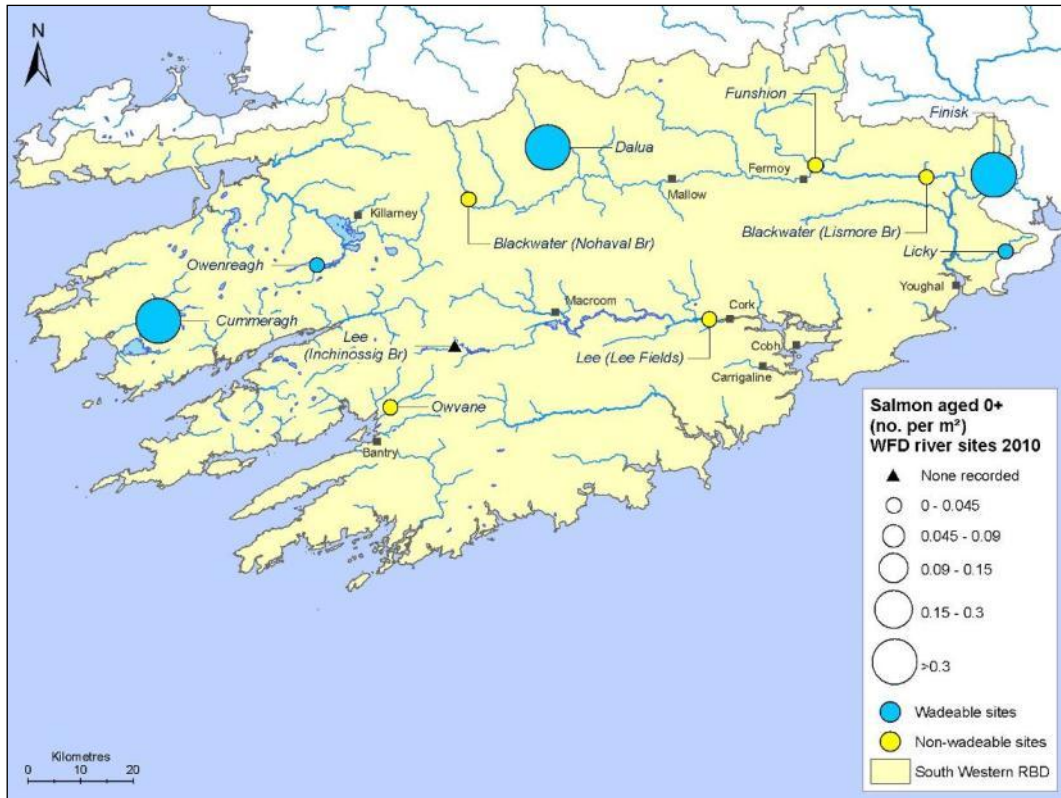


Fig. 4.39. Distribution of 0+ salmon in the SWRBD, WFD monitoring 2010

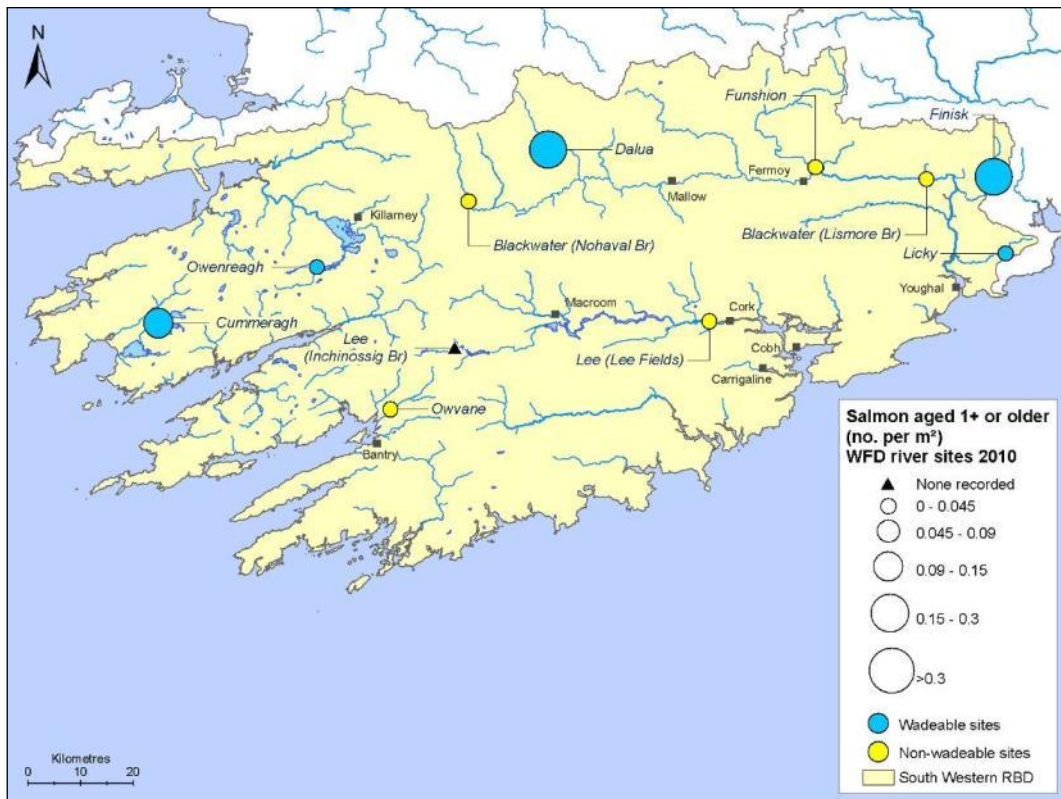


Fig. 4.40. Distribution of 1+ or older salmon in the SWRBD, WFD monitoring 2010

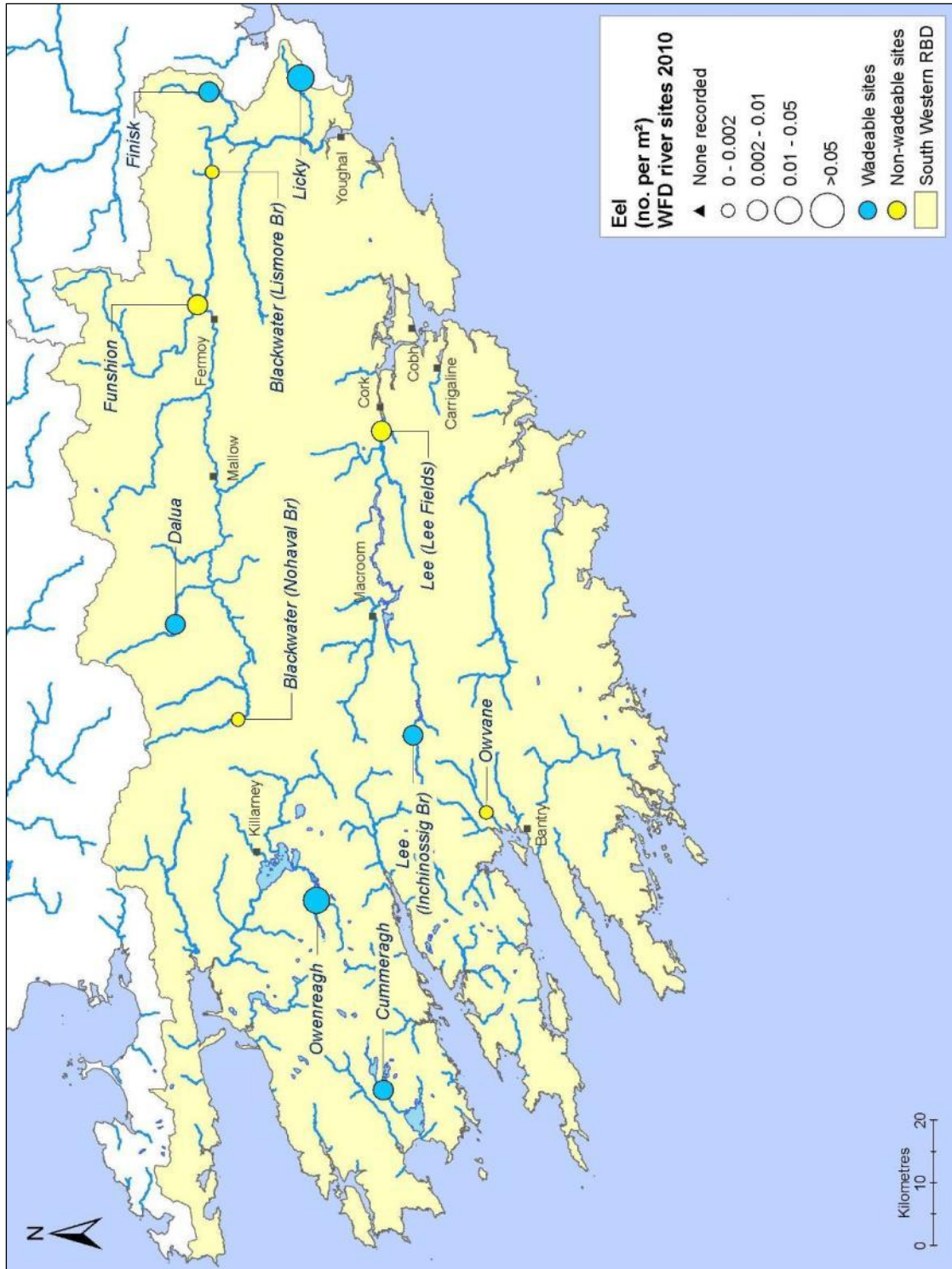


Fig. 4.41. Distribution map of eel in the SWRBD, WFD monitoring 2010

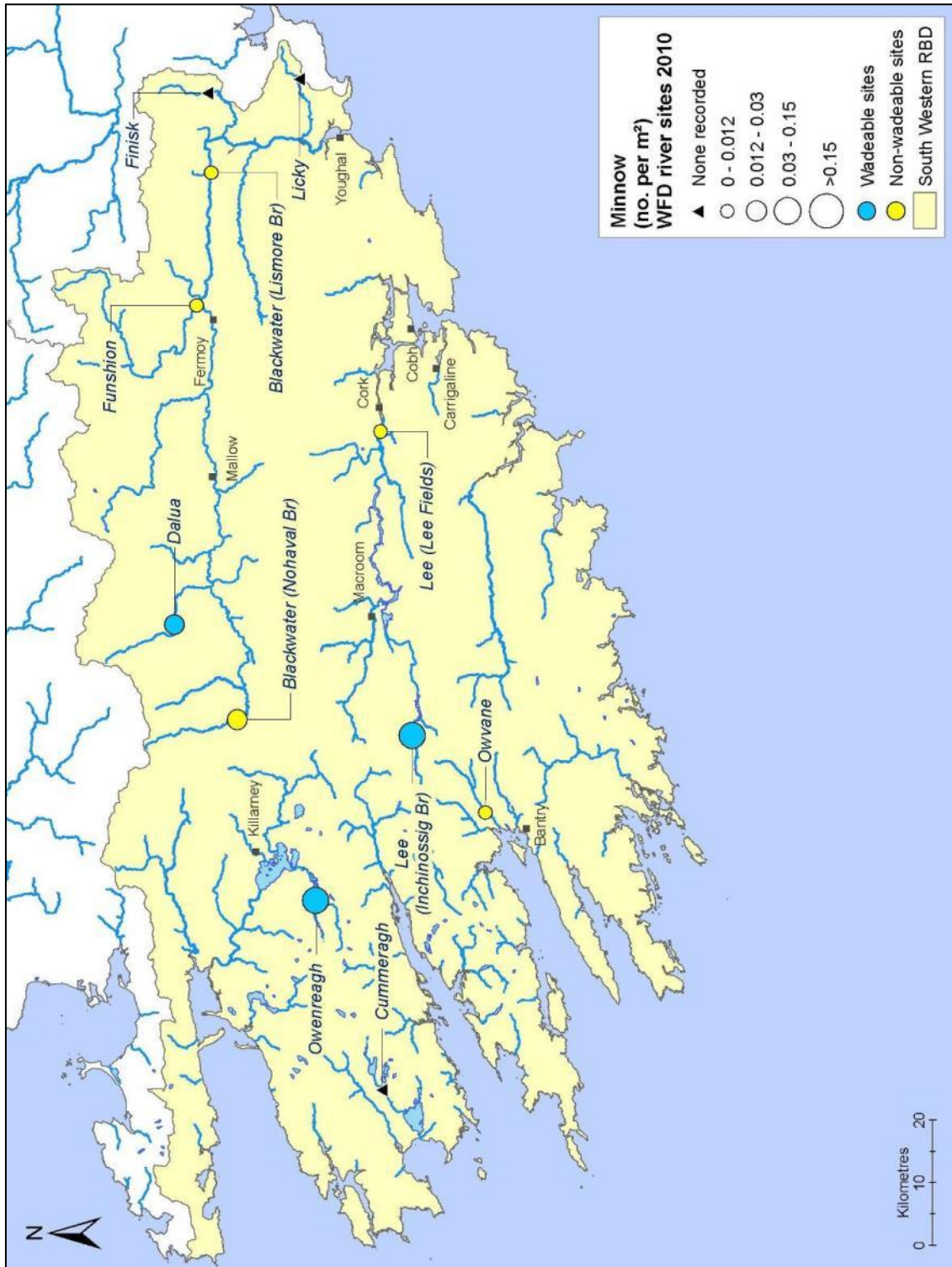
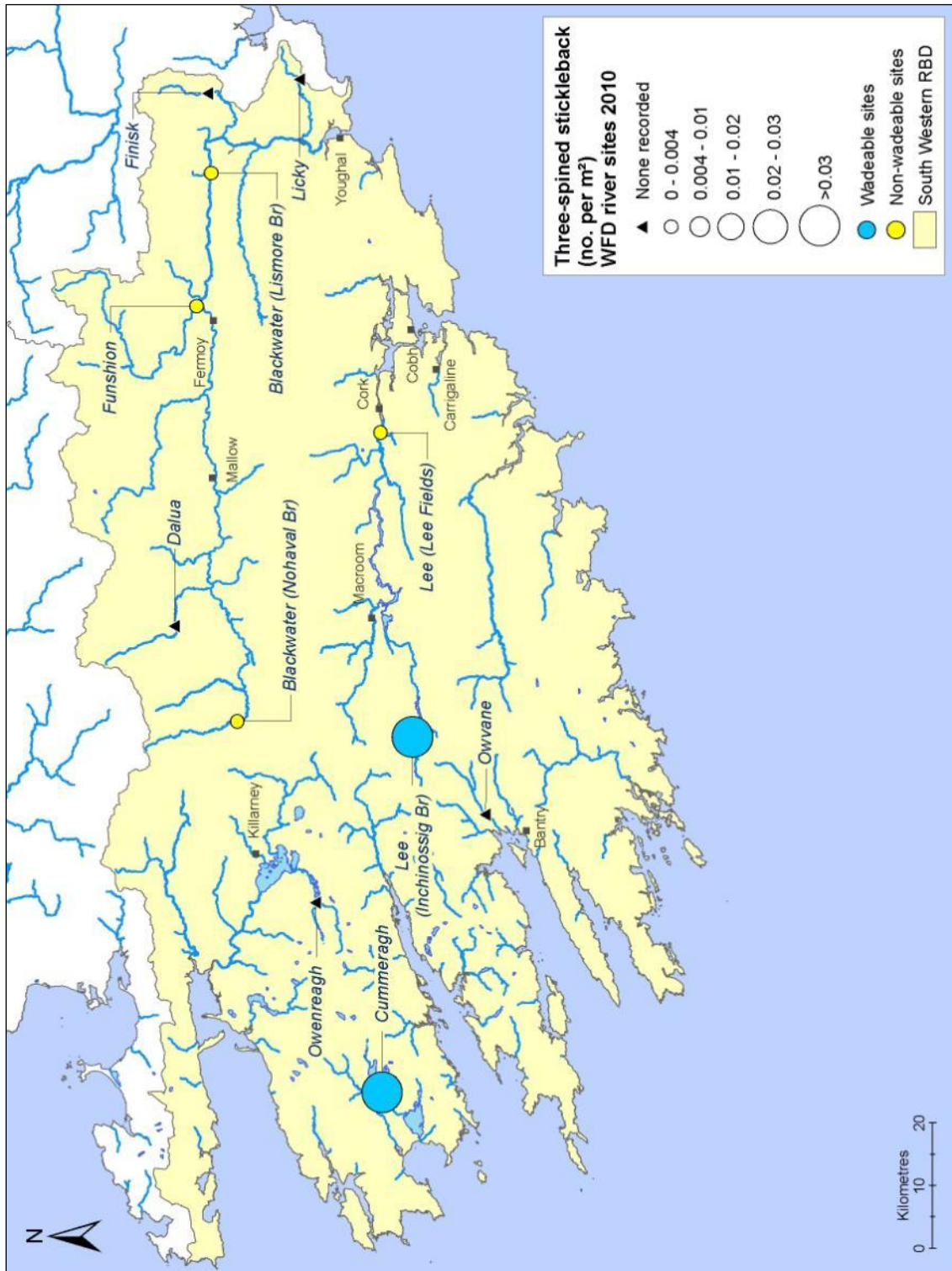


Fig. 4.42. Distribution map of minnow in the SWRBD, WFD monitoring 2010



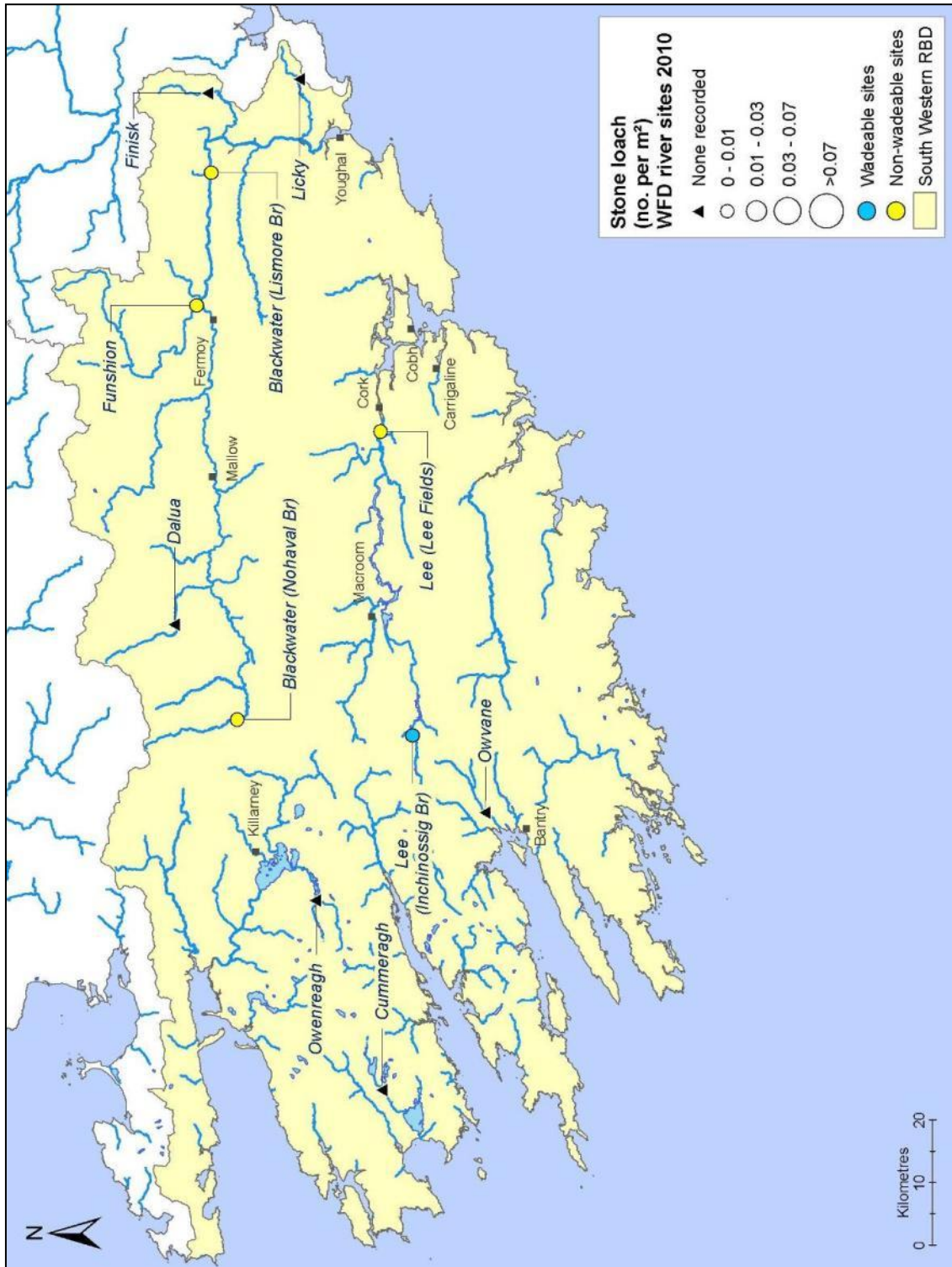


Fig. 4.45. Distribution map of stone loach in the SWRBD, WFD monitoring 2010

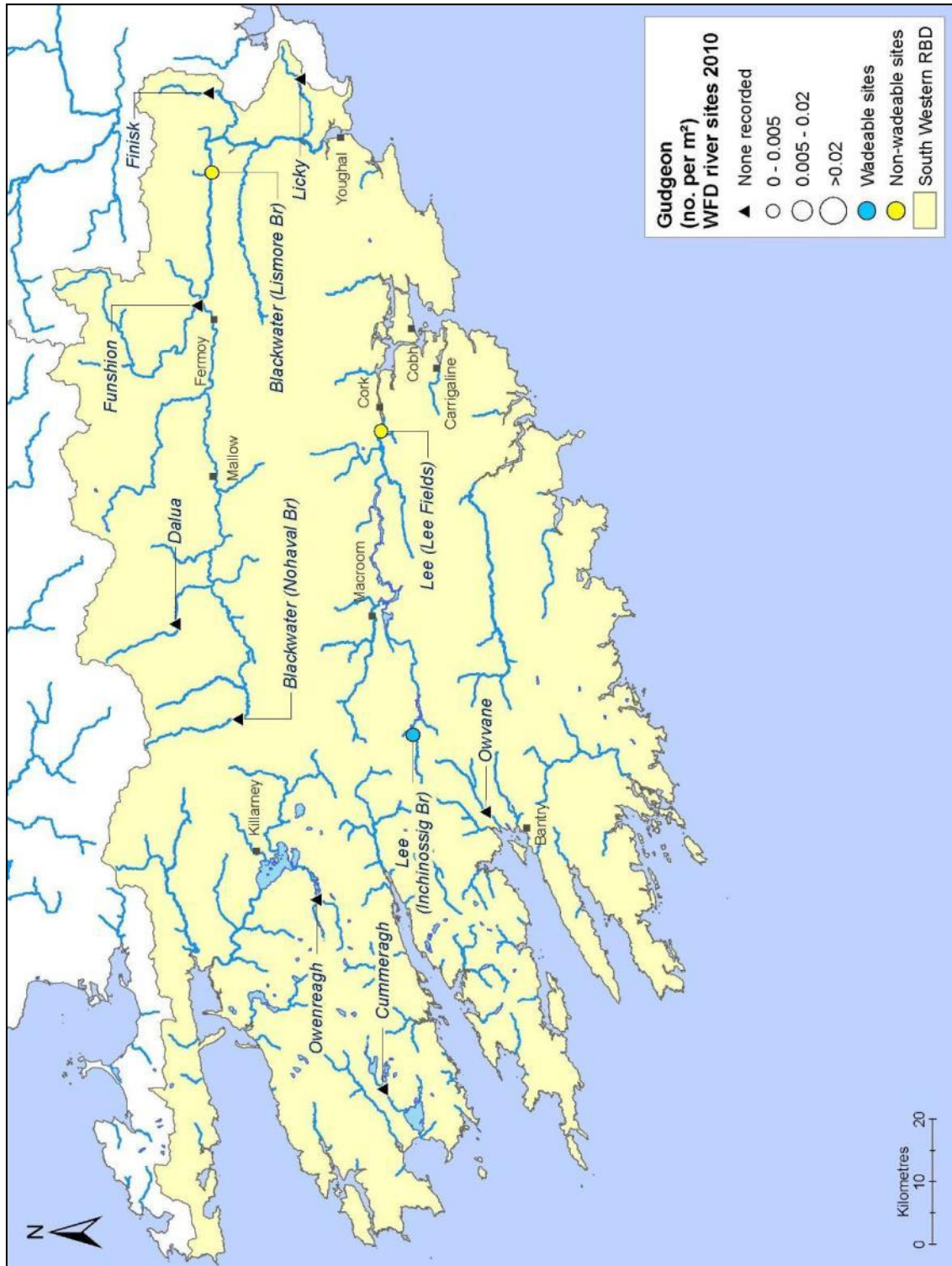


Fig. 4.46. Distribution map of gudgeon in the SWRBD, WFD monitoring 2010

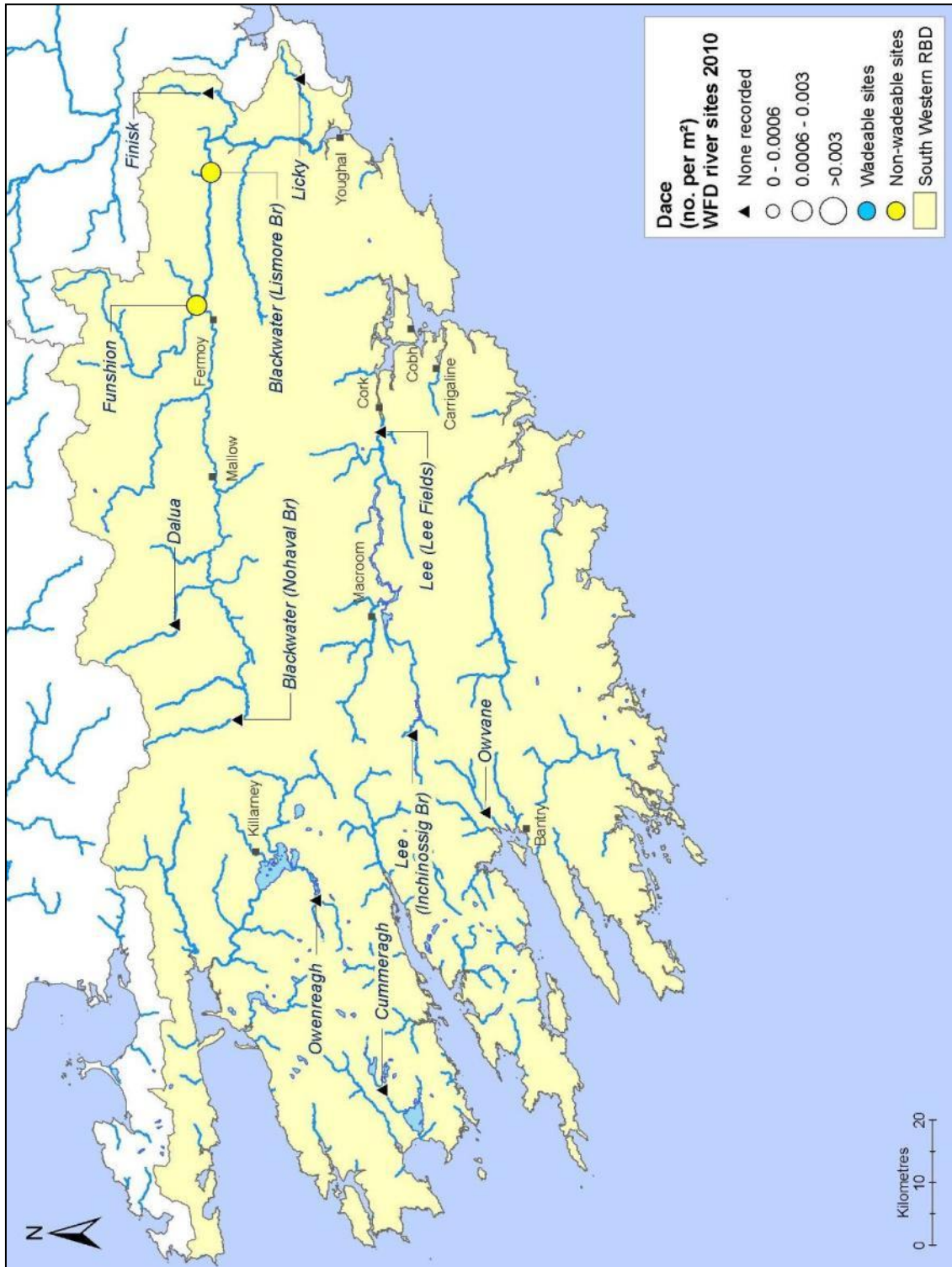


Fig. 4.47. Distribution map of dace in the SWRBD, WFD monitoring 2010

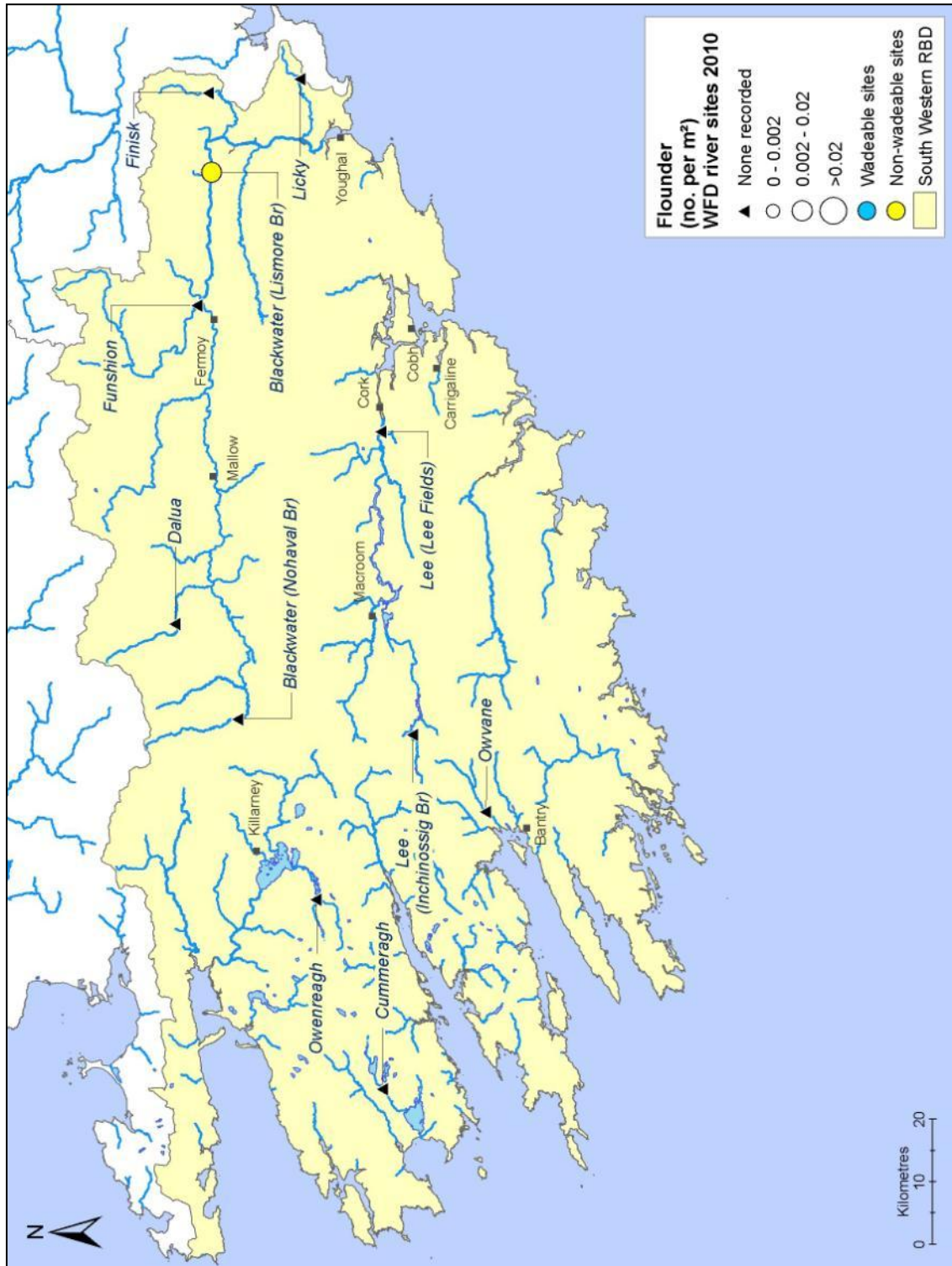


Fig. 4.49. Distribution map of flounder in the SWRBD, WFD monitoring 2010

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 (Fig. 4.51) and salmon (Fig. 4.52) in each river site surveyed in the SWRBD during 2010.

Brown trout ranged in age from 0+ to 3+. The largest brown trout recorded in the SWRBD during 2010 was captured in the Funshion River, measuring 30.6cm in length, 374g in weight and was aged 3+. 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. Accordingly, the growth of brown trout was classified as ‘very slow’ in the Ovwane site, ‘slow’ in the Blackwater (Nohaval), Dalua, Funshion, Lee (Inchinossig), Lee (Lee Fields) and Owenreagh sites and ‘fast’ in the Finisk site (Appendix 1).

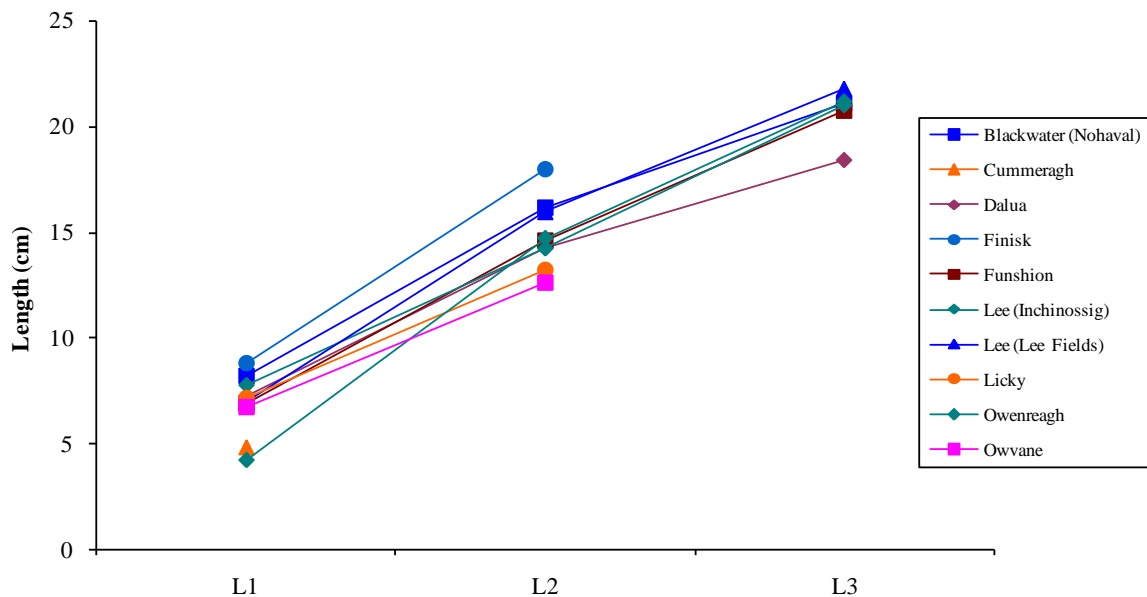


Fig. 4.51. Back calculated length-at-age for brown trout in each river site, WFD surveillance monitoring 2010

Juvenile salmon ranged in age from 0+ to 2+. The largest juvenile salmon recorded in the SWRBD during 2010 measured 16.9cm in length. Two adult salmon were captured in the Blackwater (Lismore) site, measuring 43.7cm and 71.0cm; these two fish were aged 2.2+ and 2.1+ respectively. Both of these adult salmon are omitted from figure 4.52. The mean L1 of all salmon ranged from 4.1cm in the Owenreagh site to 5.5cm in the Finisk site. The mean L2 ranged from 7.1cm in the Owenreagh site to 12.1cm in the Blackwater (Lismore) site (Appendix 2).

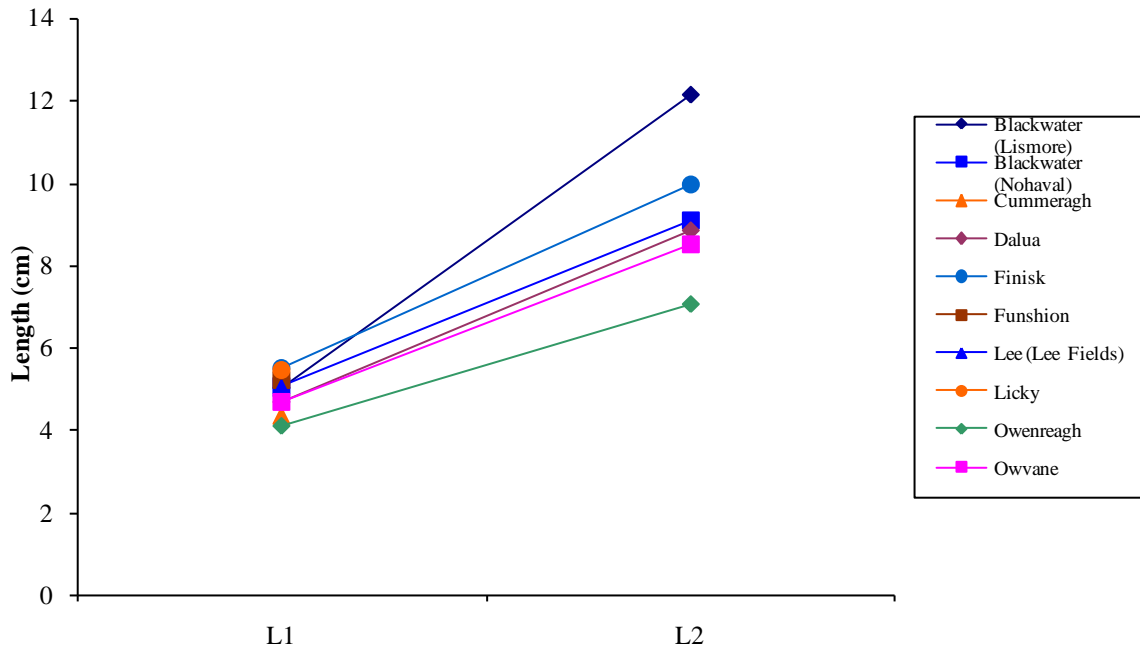


Fig. 4.52. Back calculated length-at-age for salmon in each river site, WFD surveillance monitoring 2010

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 each of the three regions have contributed data which was used in the model development. The classification tool is similar to that developed by the Environment Agency in England and Wales (Fisheries Classification Scheme 2, or 'FCS2'). The tool (FCS2 Ireland) 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 4.13). All sites surveyed in the SWRBD have been assigned a classification of at least Moderate status, with two sites (Cummeragh and Blackwater at Nohaval Bridge) achieving High status (Table 4.13).

Table 4.13. Fish ecological status of sites surveyed in the SWRBD for surveillance monitoring 2010

| River | Site code | Site name | Fish ecological status 2010 | Previous fish ecological status (2008-2009) |
|---------------------------------|------------|--------------------------------|-----------------------------|---|
| SWRBD Wadeable sites | | | | |
| Cummeragh | 21C040400F | U/s Owengarriff confluence | High | - |
| Dalua | 18D010200F | Ford and footbridge | Good | - |
| Finisk | 18F020300F | Modelligo Br. | Good | - |
| Lee | 19L030100F | Inchinossig Br. | N/A | Good |
| Licky | 18L010100F | Br. NE of Glenlicky | Moderate | - |
| Owenreagh | 22O030400F | Br. u/s Upper Lake | Good | Good |
| SWRBD Non-wadeable sites | | | | |
| Blackwater (Munster) | 18B022600F | Lismore Br. | Moderate | - |
| Blackwater (Munster) | 18B020200F | Nohaval Br. | High | Good |
| Funshion | 18F051100F | Br u/s Blackwater R confluence | Good | - |
| Lee | 19L030800F | Lee Fields. | Moderate | - |
| Owvane (Cork) | 21O070400F | Lisheen / Piersons Br. | N/A | - |

5. DISCUSSION

A total of 13 fish species (sea trout are included as a separate ‘variety’ of trout) were recorded during the 2010 sampling program within the SWRBD. This was the highest species diversity recorded for any region throughout the country and equal to the number recorded in the Western River Basin District (WRBD), where there was also a high number of non-native species present in certain rivers. 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).

The River Blackwater (Lismore) was the most diverse site surveyed within the SWRBD during 2010, with a total of 10 species recorded. It was also the most diverse site surveyed throughout the entire country. The River Licky exhibited the lowest species diversity in the SWRBD, with a total of three species recorded. Low species diversity is common in rivers throughout Ireland that contain only native fish species, a trait common in many rivers along the south western coast of Ireland (Kelly *et al.*, 2009, Kelly *et al.*, 2010, Kelly *et al.*, 2011).

Eel was the most commonly encountered species within the SWRBD, being recorded in all 11 sites, whilst brown trout and salmon were captured in ten sites each. The greatest abundances of brown trout and salmon were recorded in the River Blackwater (Nohaval) and River Blackwater (Lismore) respectively, whilst the Cumberagh and Owvane Rivers were the only sites in the SWRBD where sea trout were recorded.

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). 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.

Six non-native fish species were recorded in the SWRBD during 2010. Only the Cumberagh, Finisk and Licky Rivers, contained exclusively native species.

Following the methods of Kennedy and Fitzmaurice (1971), the growth of brown trout was classified as ‘very slow’ in the Owvane site, ‘slow’ in the Blackwater (Nohaval), Dalua, Funshion, Lee (Inchinossig), Lee (Lee Fields) and Owenreagh sites and ‘fast’ in the Finisk site (Appendix 1). This prominence of the ‘very slow’ and ‘slow’ categories is unsurprising, given that Kennedy and Fitzmaurice (1971) found that, in general, the growth of brown trout is positively related to the

alkalinity of a river. All rivers surveyed in the SWRBD, with the exception of the Funshion, were categorised as having have a low or moderate 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. All sites surveyed in the SWRBD have been assigned a classification of at least Moderate status, with two sites (Cummeragh River and River Blackwater at Nohaval) achieving High status. Of the two sites that were previously surveyed, only the River Blackwater (Nohaval Br.) recorded a change in ecological status (from Good to High), with the Owenreagh River remaining the same (Moderate).

6. REFERENCES

- Barton, E. and Heard, J. (2005) Alien, Non-native and Invasive Marine Species. *Marine Life Topic Note. The Marine Biological Association of the United Kingdom*. Available at: http://www.marlin.ac.uk/PDF/MLTN_alien_non_natives.pdf
- Caffrey, J.M., Hayden, B. and Walsh, T. (2007) *Dace (Leuciscus leuciscus L.): an Invasive Fish Species in Ireland*. Irish Freshwater Fisheries, Ecology and Management Series No. 5. CFB.
- CEN (2003) *Water Quality — Sampling of Fish with Electricity*. European Standard. Ref. No. EN 14011:2000.
- Council of the European Communities (2000) Establishing a framework for Community action in the field of water policy. Directive of the European Parliament and of the Council establishing a framework for community action in the field of water policy (2000/60/EC). *Official Journal of the European Communities*, **43**, 1-73.
- Eno, N.C., Clark, R.A. and Sanderson, W.G. (1997) *Non-Native Marine Species in British Waters: a Review and Directory*. Peterborough: Joint Nature Conservation Committee.
- Kelly, F., Harrison, A., Connor, L., Allen, M., Rosell, R. and Champ, T. (2008) *North South Shared Aquatic Resource (NS Share) Lakes Project: FISH IN LAKES*. Task 6.9: Classification tool for Fish in Lakes Final Report. Available at: www.nsshare.com
- Kelly, F., Connor, L., Wightman, G., Matson, R., Morrissey, E., O’Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2009a) *Sampling Fish for the Water Framework Directive – Rivers 2008 SWRFB*. Central and Regional Fisheries Boards.
- Kelly, F., Connor, L., Wightman, G., Matson, R., Morrissey, E., O’Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2009b) *Sampling Fish for the Water Framework Directive - Summary Report 2008*. Central and Regional Fisheries Boards.
- Kelly, F., Connor, L., Wightman, G., Matson, R., Morrissey, E., O’Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2010a) *Sampling Fish for the Water Framework Directive – Rivers 2009 SWRBD*. Central and Regional Fisheries Boards.
- Kelly, F.L., Harrison, A.J., Connor, L., Matson, R., Wightman, G., Morrissey, E., O’Callaghan, R., Feeney, R., Hanna, G., Wogerbauer, C. and Rocks, K. (2010b) *Sampling fish for the Water Framework Directive – Summary report 2009*. Central Fisheries Board.
- Kelly, F., Harrison, A., Connor, L., Matson, R., Morrissey, E., Feeney, R., Wogerbauer, C., O’Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland.

- Kennedy, M. and Fitzmaurice, P. (1971) Growth and food of Brown Trout *Salmo Trutta* (L.) in Irish Waters. *Proceedings of the Royal Irish Academy*, **71 (B) (18)**, 269-352.
- NPWS (2005) *Blackwater Callows SPA. Site Synopsis, Site code: 004094.*
<http://www.npws.ie/media/npwsie/content/images/protectedsites/sitesynopsis/SY004094.pdf>
- NPWS (2006) *Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment. Site Synopsis, Site code: 000365.*
<http://www.npws.ie/media/npwsie/content/images/protectedsites/sitesynopsis/SY000365.pdf>
- NPWS (2007) *Blackwater River (Cork/Waterford) SAC. Site synopsis, site code: 002170.*
<http://www.npws.ie/media/npwsie/content/images/protectedsites/sitesynopsis/SY002170.pdf>
- O'Reilly, P. (2002) *Rivers of Ireland, a Flyfisher's Guide* (5th Edition). Merlin Unwin Books, Shropshire, UK.
- O'Reilly, P. (2009) *Rivers of Ireland, a Flyfisher's Guide* (7th Edition). Merlin Unwin Books, Shropshire, UK.
- Scalera, R. and Zaghi, D. (2004) *Alien species and nature conservation in the EU. The role of the LIFE program.* LIFE focus, 56 pp., European Commission, Luxembourg. Available at: http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/alienspecies_en.pdf
- Stokes, K., O'Neill, K. and McDonald, R.A. (2006) *Invasive species in Ireland.* Report to Environment and Heritage Service and National Parks and Wildlife Service, 151 pp., Quercus, Queens University Belfast, Environment and Heritage Service Belfast and National Parks and Wildlife Service Dublin. Available at: http://www.npws.ie/en/media/Media,3701_en.pdf
- SWRBD (2009) *South Western River Basin District – River Basin Management Plan (2009-2015).* South Western River Basin District.

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 |
|-----------------------------|------|------|------|------|----|-----------------|
| Blackwater (Nohaval) | Mean | 8.2 | 16.1 | 21.1 | | Slow |
| | S.D. | 1.9 | 2.7 | 2.2 | | |
| | S.E. | 0.2 | 0.5 | 1.1 | | |
| | n | 57 | 32 | 4 | | |
| | Min | 4.8 | 8.7 | 19.0 | | |
| | Max | 13.7 | 20.7 | 23.9 | | |
| Cummeragh | Mean | 4.8 | | | | n/a |
| | S.D. | 0.8 | | | | |
| | S.E. | 0.3 | | | | |
| | n | 10 | | | | |
| | Min | 3.7 | | | | |
| | Max | 6.0 | | | | |
| Dalua | Mean | 7.2 | 14.2 | 18.3 | | Slow |
| | S.D. | 1.9 | 2.2 | n/a | | |
| | S.E. | 0.4 | 0.8 | n/a | | |
| | n | 21 | 7 | 1 | | |
| | Min | 4.4 | 10.1 | 18.3 | | |
| | Max | 12.5 | 16.6 | 18.3 | | |
| Finisk | Mean | 8.8 | 17.9 | | | Fast |
| | S.D. | 0.8 | n/a | | | |
| | S.E. | 0.3 | n/a | | | |
| | n | 8 | 1 | | | |
| | Min | 7.6 | 17.9 | | | |
| | Max | 9.9 | 17.9 | | | |
| Funshion | Mean | 6.8 | 14.6 | 20.7 | | Slow |
| | S.D. | 1.6 | 2.8 | 2.1 | | |
| | S.E. | 0.3 | 0.6 | 0.7 | | |
| | n | 30 | 21 | 9 | | |
| | Min | 4.5 | 9.7 | 18.2 | | |
| | Max | 10.6 | 19.0 | 23.4 | | |
| Lee (Inchinossig) | Mean | 7.7 | 14.2 | 21.0 | | Slow |
| | S.D. | 1.4 | 2.1 | n/a | | |
| | S.E. | 0.3 | 0.9 | n/a | | |
| | n | 19 | 5 | 1 | | |
| | Min | 4.4 | 11.2 | 21.0 | | |
| | Max | 9.8 | 16.7 | 21.0 | | |
| Lee (Lee Fields) | Mean | 7.0 | 16.0 | 21.8 | | Slow |
| | S.D. | 2.2 | 6.2 | n/a | | |
| | S.E. | 0.9 | 4.4 | n/a | | |
| | n | 6 | 2 | 1 | | |
| | Min | 4.6 | 11.5 | 21.8 | | |
| | Max | 10.8 | 20.4 | 21.8 | | |

APPENDIX 1 continued

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

| River | | L1 | L2 | L3 | L4 | Growth category |
|----------------------|------|-----------|-----------|-----------|-----------|------------------------|
| Licky | Mean | 7.1 | 13.2 | | | Slow |
| | S.D. | 1.6 | 1.8 | | | |
| | S.E. | 0.3 | 0.6 | | | |
| | n | 25 | 8 | | | |
| | Min | 3.4 | 10.3 | | | |
| | Max | 10.0 | 15.1 | | | |
| Owenreagh | Mean | 4.2 | 14.7 | 21.1 | | Slow |
| | S.D. | 0.7 | 1.3 | n/a | | |
| | S.E. | 0.4 | 0.8 | n/a | | |
| | n | 4 | 3 | 1 | | |
| | Min | 3.5 | 13.8 | 21.1 | | |
| | Max | 5.3 | 16.2 | 21.1 | | |
| Owvane (Cork) | Mean | 6.7 | 12.6 | | | Very slow |
| | S.D. | 1.3 | 3.8 | | | |
| | S.E. | 0.6 | 2.7 | | | |
| | n | 4 | 2 | | | |
| | Min | 5.0 | 9.9 | | | |
| | Max | 7.9 | 15.3 | | | |

APPENDIX 2

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

| River | Reader | L1 | L2 | L3 | L4 |
|-----------------------------|--------|-----|------|------|------|
| Blackwater (Lismore) | Mean | 5.0 | 12.1 | 41.8 | 36.2 |
| | S.D. | 1.2 | 1.7 | 20.5 | n/a |
| | S.E. | 0.2 | 1.2 | 14.5 | n/a |
| | n | 32 | 2 | 2 | 1 |
| | Min | 2.8 | 10.9 | 27.3 | 36.2 |
| | Max | 7.8 | 13.4 | 56.2 | 36.2 |
| Blackwater (Nohaval) | Mean | 5.1 | 9.1 | | |
| | S.D. | 1.2 | 0.0 | | |
| | S.E. | 0.2 | 0.0 | | |
| | n | 25 | 2 | | |
| | Min | 3.2 | 9.1 | | |
| | Max | 7.0 | 9.1 | | |
| Cummeragh | Mean | 4.4 | | | |
| | S.D. | 1.0 | | | |
| | S.E. | 0.2 | | | |
| | n | 23 | | | |
| | Min | 2.9 | | | |
| | Max | 6.7 | | | |
| Dalua | Mean | 4.7 | 8.9 | | |
| | S.D. | 1.0 | 0.8 | | |
| | S.E. | 0.2 | 0.3 | | |
| | n | 29 | 7 | | |
| | Min | 2.5 | 8.1 | | |
| | Max | 6.9 | 10.3 | | |
| Finisk | Mean | 5.5 | 10.0 | | |
| | S.D. | 1.1 | n/a | | |
| | S.E. | 0.2 | n/a | | |
| | n | 30 | 1 | | |
| | Min | 3.6 | 10.0 | | |
| | Max | 8.0 | 10.0 | | |
| Funshion | Mean | 5.2 | | | |
| | S.D. | 1.2 | | | |
| | S.E. | 0.2 | | | |
| | n | 27 | | | |
| | Min | 3.2 | | | |
| | Max | 7.9 | | | |
| Lee (Lee Fields) | Mean | 5.0 | | | |
| | S.D. | 0.7 | | | |
| | S.E. | 0.3 | | | |
| | n | 5 | | | |
| | Min | 4.1 | | | |
| | Max | 5.7 | | | |

APPENDIX 2 continued

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

| River | | L1 | L2 | L3 | L4 |
|----------------------|------|-----------|-----------|-----------|-----------|
| Licky | Mean | 5.5 | | | |
| | S.D. | 1.3 | | | |
| | S.E. | 0.4 | | | |
| | n | 10 | | | |
| | Min | 4.0 | | | |
| | Max | 7.9 | | | |
| Owenreagh | Mean | 4.1 | 7.1 | | |
| | S.D. | 0.8 | 0.6 | | |
| | S.E. | 0.2 | 0.4 | | |
| | n | 20 | 2 | | |
| | Min | 2.7 | 6.7 | | |
| | Max | 5.4 | 7.5 | | |
| Owvane (Cork) | Mean | 4.7 | 8.5 | | |
| | S.D. | 1.0 | n/a | | |
| | S.E. | 0.2 | n/a | | |
| | n | 17 | 1 | | |
| | Min | 3.4 | 8.5 | | |
| | Max | 6.7 | 8.5 | | |



**Inland Fisheries Ireland
Swords Business Campus,
Swords,
Co. Dublin,
Ireland.**

**Web: www.fisheriesireland.ie
Email: info@fisheriesireland.ie
Tel: +353 1 8842 600
Fax: +353 1 8360 060**