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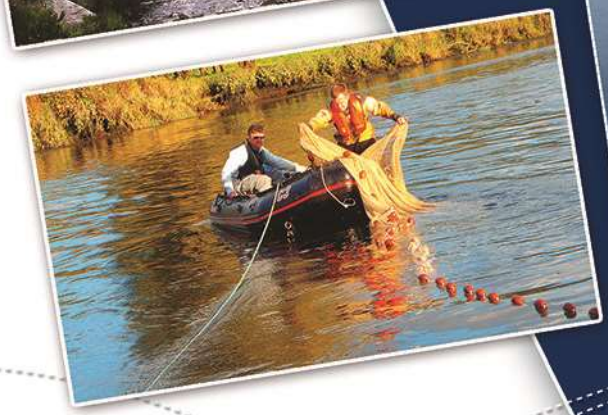

Sampling Fish for the Water Framework Directive

Summary Report 2014

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INLAND FISHERIES IRELAND

Sampling Fish for the Water Framework Directive - Summary Report 2014

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Inland Fisheries Ireland CEO's Statement

The Water Framework Directive (WFD) was introduced in December 2000 with the broad aims of providing a standardised approach to water resource management throughout Europe and promoting the protection and enhancement of healthy aquatic ecosystems. The Directive, transposed into Irish Law in December 2003, requires Member States to protect those water bodies that are already of Good or High ecological status and to restore all water bodies that are degraded, in order that they achieve at least Good ecological status by 2015.

Inland Fisheries Ireland is responsible for monitoring fish for the Water Framework Directive. The dedicated WFD staff based at IFI Headquarters work closely with colleagues within Inland Fisheries Ireland and with staff from other national agencies, academic institutions and our parent Department, the Department of Communication, Energy and Natural Resources.

During 2014, the WFD surveillance monitoring programme was again influenced by the difficult circumstances surrounding the current economic climate. The recruitment embargo in particular has had a significant impact, with reduced staff numbers limiting the ability to complete surveys on larger sites and in many transitional water bodies; however, despite this, concerted efforts by the WFD team in IFI HQ, along with the help of many staff from the regional IFI offices, has ensured that the key objectives were still met and are summarised in this report.

I am delighted to have such an experienced, dedicated and talented team of scientists working in IFI; however, it is gratefully acknowledged that without the support and commitment of the management and staff in the IFI regional offices during 2014, it would not have been possible to complete many of the key objectives reported in this document.

I would like to congratulate all who have contributed to the significant level of work which was undertaken in 2014 under the Water Framework Directive fish surveillance monitoring programme, the key elements of which are reported in this document, and wish them continued success in 2015.

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Dr Ciaran Byrne
CEO, Inland Fisheries Ireland

October 2015

Foreword

Welcome to Inland Fisheries Ireland's Sampling Fish for the Water Framework Directive – Summary Report 2014.

Inland Fisheries Ireland has been assigned the responsibility by the Environmental Protection Agency (EPA) for delivering the fish monitoring element of the WFD in Ireland. Surveillance monitoring sites are set out in the WFD Monitoring Programme published by the EPA in 2006 (EPA, 2006) and the fish monitoring requirements are extensive, with over 300 water bodies, encompassing rivers, lakes and transitional waters, being surveyed in a three year rolling programme. Although the surveillance monitoring programme for rivers and transitional waters was delayed by one year, the subsequent years have seen a huge effort by the team of scientists within IFI to achieve the three year goals (2007 – 2009 and 2010 – 2012) and I'm delighted to report a total of 70 lakes, 72 transitional waters and 137 river sites were surveyed in the first surveillance monitoring cycle and a total of 78 lakes, 30 transitional waters and 166 river sites were surveyed in the second surveillance monitoring cycle.

The first year of the third three year cycle began in 2013 with 63 river sites, 24 lakes and ten transitional water bodies successfully surveyed throughout the country. The second year of the third three year cycle began in 2014 with another extensive surveillance monitoring programme; 70 river sites, 26 lakes and seven transitional water bodies were surveyed throughout the country. All fish have been identified, counted and a representative sub-sample has been measured, weighed and aged. A further sub-sample of fish was retained for laboratory analysis of stomach contents, sex and parasitism. Once fieldwork finished in October, IFI WFD staff spent the winter months processing this large volume of fish samples.

All water bodies surveyed have been assigned a draft ecological status class (High, Good, Moderate, Poor or Bad) and these results have been submitted to the EPA for inclusion in River Basin Management Plans (RBMP). Future information from ongoing surveillance monitoring will evaluate the effectiveness of programmes of measures set out in these RBMPs.

The data collected during the first eight years of surveillance monitoring for the WFD not only fulfils legislative requirements, but provides an invaluable source of information on fish species distribution and abundance for managers, legislators, angling clubs, fishery owners and other interested parties. Detailed reports for each water body surveyed in 2014 are available on the WFD fish website (www.wfdfish.ie). The huge amount of data generated has been collated and a new GIS database has been developed to store and display this information. An interactive WFD fish survey map viewer is also available on the WFD fish website, containing fish survey data collected since

2007. Data from the 2014 surveillance monitoring programme will be available on this map viewer in due course.

In addition to the above, the IFI WFD team are also providing fish samples to IFI National Eel Monitoring Programme and the National Bass Programme whilst also collaborating with other IFI projects, e.g. the EU Habitats Directive project in relation to endangered fish species (pollan/char).

Lastly I would like to thank all those that contributed to this report, to congratulate them on the work completed and to wish them every success in the year ahead.

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Dr Cathal Gallagher,
Head of Function, Research & Development

Inland Fisheries Ireland,
October 2015

Executive Summary

Inland Fisheries Ireland has been assigned the responsibility by the EPA of delivering the fish monitoring requirements of the WFD in Ireland. Over 300 water bodies, encompassing rivers, lakes and transitional waters are required to be surveyed in a three year rolling programme. In 2014, a comprehensive fish surveillance monitoring programme was conducted with 26 lakes, 70 river sites and seven transitional water bodies successfully surveyed throughout the country.

All surveys were conducted using a suite of European standard methods; electric-fishing is the main method used in rivers and a range of different net types are used in lakes and transitional waters. This report summarises the main findings of the 2014 surveillance monitoring programme and highlights the current status of each water body in accordance with the fish populations present.

Twenty-six lakes were surveyed during 2014, with a total of 19 fish species (sea trout are included as a separate 'variety' of trout) and two types type of hybrids being recorded. Eel was the most common fish species recorded, occurring in 25 out of the 26 lakes surveyed (96.2%). This was followed by brown trout, perch, roach and pike which were present in 80.8%, 65.4%, 42.3% and 38.5% of lakes respectively. In general, salmonids were the dominant species in the north, west and south-west of the country. Sea trout were captured in seven lakes in the north-west, west and south-west; Lough Beagh, Glencullin Lough, Carrowmore Lake, Lough Brin, Lough Caragh, Upper Lake and Lough Leane. Arctic char were recorded in six lakes in the south-west, north-west and west; Lough Acoose, Lough Caragh, Lough Leane, Lough Beagh, Lough Melvin and Lough Talt. Perch, followed by roach were the most widely distributed, non-native species recorded during the 2014 surveillance monitoring programme, with perch being present in 17 lakes and roach being present in 11 of the 26 lakes surveyed.

All lakes surveyed during 2014 have been assigned a draft ecological status using the Fish in Lakes tool (FIL2) (Kelly *et al*., 2012b) based on the fish populations present. Five lakes were classified as High, eleven were classified as Good, six was classified as Moderate, three were classified as Poor and two were classified as Bad ecological status. The geographical variation in ecological status reflects the change in fish communities of upland lakes with little human disturbance, to the fish communities of lowland lakes subject to more intensive anthropogenic pressures.

A total of 70 river sites (or 50 waterbodies) were surveyed during 2014 using boat-based electric-fishing gear for the non-wadeable sites and hand-set electric-fishing gear for the wadeable sites. A total of 14 fish species (sea trout are included as a separate 'variety' of trout) and one type of hybrid (roach x bream) were recorded. Brown trout was the most common fish species recorded, being

present in 95.7% of sites surveyed, followed by salmon (77.1%), European eel (55.7%), stone loach (50.0%), minnow, and three-spined stickleback (38.6%), lamprey sp. (34.3%), roach (22.9%), perch (18.6%), pike (14.3%), gudgeon (12.9%), sea trout (11.3%), flounder (10.0%), dace (5.7%) and roach x bream hybrids (1.4%). Brown trout and salmon population densities were greater in wadeable streams, sampled using bank-based electric-fishing gear, when compared to the deeper rivers surveyed using boat-based gear. This is mainly due to the preference for large numbers of juvenile salmonids to inhabit shallow riffle areas.

An ecological status classification tool for fish in Irish rivers 'FSC2 Ireland' (SNIFFER, 2011) along with expert opinion, was used to classify all river sites surveyed during 2014; two river sites were classified as Poor, 25 were classified as Moderate, 38 were classified as Good and three were classified as High. Two sites were not classified.

Seven transitional water bodies were surveyed during 2014. These included four water bodies on the Shannon estuary (ShIRBD) and three on the Slaney estuary in the SERBD. A total of 50 fish species (sea trout are included as a separate 'variety' of trout) were recorded across the seven water bodies. The highest number of species recorded in any single water body was 29, recorded in the Lower Shannon Estuary, while the lowest number was five, recorded in the North Slob Channels. Flounder and sand goby were the most widespread species and were recorded in all seven water bodies, whereas sprat were the most abundant species. Some important angling species documented during these surveys included brown trout, European sea bass, salmon, sea trout, pollack and conger eel.

An ecological classification tool (Transitional Fish Classification Index – TFCI) for fish in transitional waters was used to assign ecological status to each transitional water body (Coates *et al*., 2007). One water body was classified as Bad, three as Moderate and three as Good; however when the classification tool was used to classify the whole transitional water instead of individual waterbodies, both achieved Good status.

Project Personnel

This report was written and researched by Dr. Fiona Kelly, Ms. Lynda Connor, Dr. Ronan Matson, Ms. Emma Morrissey, Mr. Rory Feeney, Mr. John Coyne and Mr. Kieran Rocks, Inland Fisheries Ireland (IFI), under the direction of Dr. Cathal Gallagher, Head of Research and Development as part of the Water Framework Directive (WFD) Fish Monitoring Programme, 2013 to 2015. Ms. Laura Walsh, Ms. Ruth Hanniffy, Ms. Róisín O'Callaghan and Ms. Sinead O'Reilly assisted with fieldwork, laboratory work and data analyses.

Acknowledgements

The authors wish to gratefully acknowledge the help and co-operation of the Regional Directors and their staff from the seven regional IFI river basin district offices and also all their colleagues in IFI, Citywest.

Cooperation and assistance from the Department of Culture, Arts and Leisure (DCAL) and the Agri-Food and Biosciences Institute for Northern Ireland (AFBINI) on cross border surveys is also gratefully acknowledged.

The authors would like to thank all land owners who provided site access for surveys. Many angling clubs also kindly supported the surveys (including the Glenbeg Angling Club in County Kerry, the Garrison and Lough Melvin Anglers Association and the Lough Owel anglers) and their help is also gratefully acknowledged. Mr. Michael Wade from Delphi Fishery, Co. Mayo and Mr. Roderick Perceval, Templehouse, Co. Sligo provided access to their respective fisheries and their help is gratefully acknowledged. The authors would also like to thank National Parks and Wildlife service (NPWS) and their staff in Glenveagh and Killarney National Parks for facilitating access and providing assistance during the Lough Barra, Lough Beagh, Lough Leane and Upper Lake Killarney surveys.

About Inland Fisheries Ireland

Inland Fisheries Ireland is responsible for the protection, management and conservation of the inland fisheries resource across the country. Ireland has over 70,000 kilometres of rivers and streams and 144,000 hectares of lakes all of which fall under the jurisdiction of IFI. The agency is also responsible for sea angling in Ireland.

Inland Fisheries Ireland has strong regional structures responsible for each River Basin District (RBD), with the IFI headquarters in Citywest, Dublin 24 operating alongside seven regional offices; IFI, Dublin; IFI, Clonmel; IFI, Macroom; IFI, Limerick; IFI, Ballina; IFI, Galway and IFI, Ballyshannon.

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1. INTRODUCTION

In December 2000, the European Union introduced the Water Framework Directive (WFD) (2000/60/EC) as part of a new standardised approach for all Member States to manage their water resources and to protect aquatic ecosystems. The fundamental objectives of the WFD, which was transposed into Irish Law in December 2003 (Water Regulations S.I. No. 722 of 2003), are to protect and maintain the status of waters that are already of good or high quality, to prevent any further deterioration and to restore all waters that are impaired so that they achieve at least good ecological status by 2015 or by the respective extended deadlines (refer to the River Basin Management Plans at www wfdireland.ie).

A key step in the WFD process is for EU Member States to assess the health of their surface waters through national monitoring programmes. Monitoring is the main tool used to classify the status (high, good, moderate, poor or bad) of each water body (section of a river or other surface water). Once each country has determined the current status of their water bodies, ongoing monitoring then helps to track the effectiveness of measures needed to clean up water bodies and achieve good status. The responsibility for monitoring fish has been assigned to Inland Fisheries Ireland (IFI) by the EPA (EPA, 2006). A national fish stock surveillance monitoring programme has been conducted since 2007 at specified locations over a three year rolling cycle. The monitoring programme includes over 300 sites, encompassing rivers, lakes and transitional waters (estuaries and lagoons) and provides information on the status of fish species present in these water bodies as well as on their abundance, growth patterns, and population demographics.

The WFD fish surveillance monitoring programme in 2014 has been extensive and 70 river sites, 26 lakes and seven transitional water bodies were successfully surveyed nationwide. A team of IFI staff carried out the monitoring surveys (scientists from the Research and Development section of IFI HQ in conjunction with staff from the IFI river basin district offices). The surveys were conducted using a suite of European standard methods; electric fishing is the main survey method used in rivers, with various netting techniques being used in lakes and estuaries. Field survey work was conducted from June to October, which is the optimum time for sampling fish in Ireland.

This report summarises the main findings of the fish stock surveys in all water bodies (lakes, rivers and transitional waters) surveyed during 2014 and reports the current ecological status of the fish stocks in each.

Detailed reports on all water bodies surveyed are available to download on the dedicated WFD fish website (www.wfdfish.ie).

2. STUDY AREA

2.1 Lakes

Twenty-six lakes (27 lake water bodies), ranging in size from 24.5ha (Lough Brin) to 16,561ha (Lough Corrib), were surveyed between June and October 2014. The selection of lakes surveyed encompassed a range of lake types (10 WFD designated typologies) (EPA, 2005; Appendix 1) and trophic levels, and were distributed throughout four different RBDs (Table 2.1, Fig. 2.1).

Seven lakes were surveyed in the South Western River Basin District (SWRBD) (Lough Acoose, Lough Caragh, Lough Allua, Glenbeg Lough, Lough Leane, Upper Lake and Lough Brin). Five lakes were surveyed in the Shannon International River Basin District (ShIRBD), ranging in size from 64ha (Cavetown Lough) to 1808.2ha (Lough Sheelin). Seven lakes were surveyed in the North Western International River Basin District (NWIRBD), ranging in size from 36.2ha (Derrybrick Lough) to 2197ha (Lough Melvin) and seven lakes (eight water bodies) were surveyed in the Western River Basin District (WRBD), ranging in size from 34.1ha (Glencullin Lough) to 16,561ha (Lough Corrib). Summary details of all lakes surveyed in 2014 are shown in Table 2.1.

Table 2.1. Summary details of lakes surveyed for the WFD fish surveillance monitoring programme, June to October 2014 (* indicates cross border lakes)

Lake name	Water body code	Catchment	Easting	Northing	WFD Typology	Area (ha)	Mean depth (m)	Max depth (m)
SWRBD								
Acoose	SW_22_208	Caragh	75602	85287	4	66.3	>4.0	19
Allua	SW_19_4	Lee	118989	65591	4	135.9	4.0	28.4
Brin	SW_21_402	Blackwater	78334	77451	3	24.5	5.9	13
Caragh	SW_22_207	Caragh	71986	90432	4	488.7	11.0	39
Glenbeg	SW_21_444	Coastal	70632	53003	4	66.2		32
Leane	SW_22_185	Laune	93171	88660	8	1944.3	13.0	60
Upper Lake Killarney	SW_22_186	Laune	90931	82113	4	166.7	14.5	36
ShIRBD								
Cavetown	SH_26_705	Shannon Upr	183228	297430	10	64.0	<4	20
Meelagh	SH_26_711	Shannon Upr	189093	312025	6	115.7	<4	14
O'Flynn	SH_26_693	Suck	158361	279690	10	136.9	4.5	14.5
Owel	SH_26_703	Inny	240155	258633	8	1017.6	>4	22
Sheelin	SH_26_709	Inny	244291	283941	12	1808.2	4.4	15
NWIRBD								
Barra	NW_38_84	Gweebarra	193447	411876	4	62.5	4.4	12
Beagh	NW_38_80a	Lackagh	202074	421485	4	259.0	9.2	46.5
Corglass	NW_36_655	Erne	234842	308823	9	34.3	1.6	6
Derrybrick	NW_36_400	Erne	234514	312044	9	36.2	2.1	5
Fern	NW_39_13	Leannan	218292	424349	6	181.0	2.0	3
Kiltooris	NW_38_47	Coastal	167183	396339	5	43.3	<4	14
Melvin*	NW_35_160	Drowes	189530	353752	8	2197.0	7.8	40
WRBD								
Gill	WE_35_158	Garavogue	175363	333545	8	1375.3	>4	31
Carrowmore	WE_33_1914	Owenmore	83597	327913	6	911.2	<4	2.5
Easky	WE_35_136	Easky	144396	323036	2	118.7	3.0	10.5
Glencullin	WE_32_487	Bundorragha	81952	269647	1	34.1	<4	13
Corrib Lower	WE_30_666a	Corrib	127105	236016	10	5042.0	<4	6.8
Corrib Upper	WE_30_666b	Corrib	113819	248676	12	11519.0	>4	42
Talt	WE_34_405	Moy	139683	315172	8	96.9	>4	40
Templehouse	WE_35_157	Ballysadare	161565	317148	10	118.6	2.6	5.3

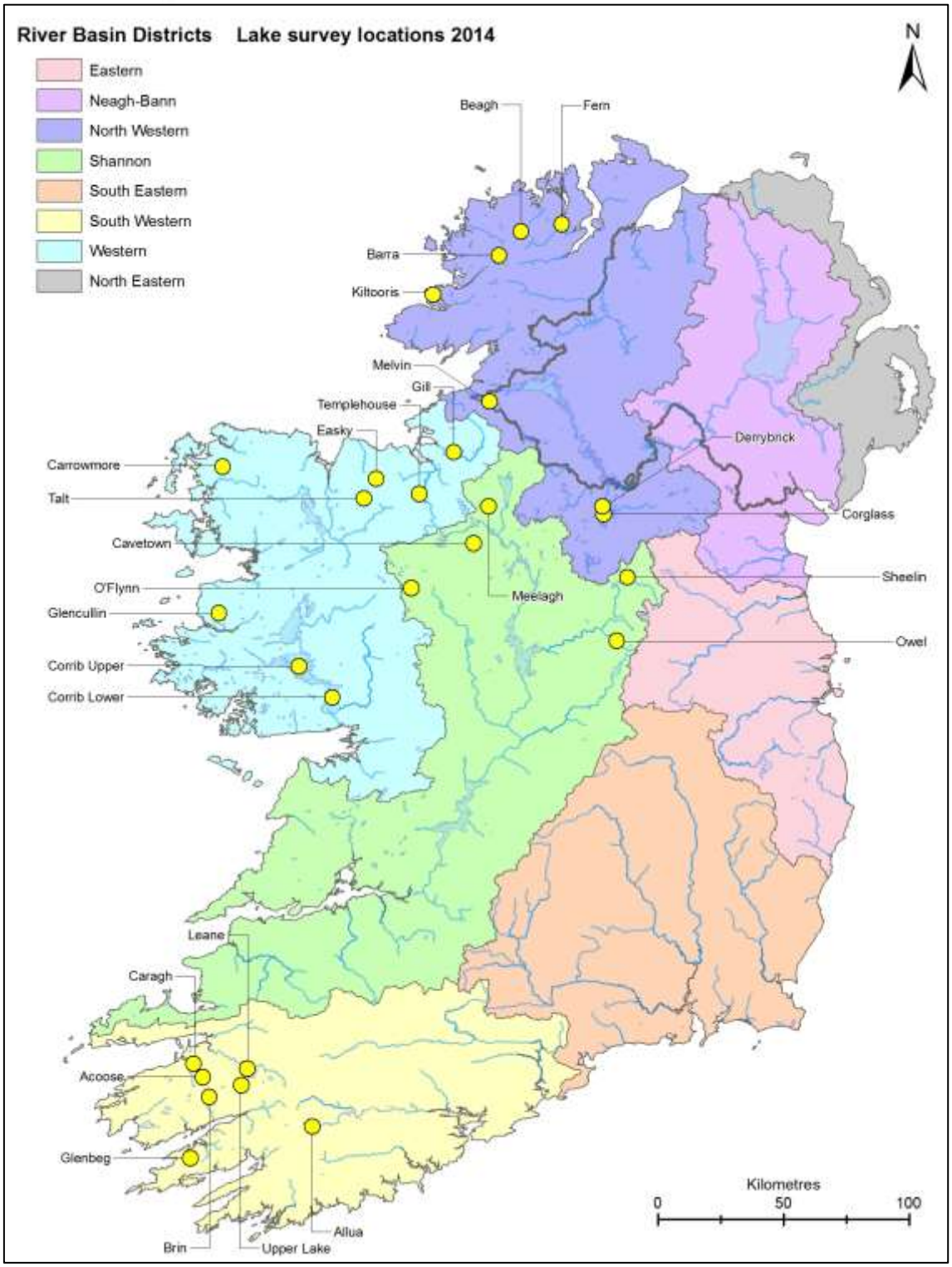

Fig. 2.1. Location of the 26 lakes surveyed for the WFD fish surveillance monitoring programme, June to October 2014

2.2 Rivers

Seventy river sites (or 50 waterbodies), ranging in surface area from 114m^2 (Tobercurry River (Moy River_C), WRBD) to 2,420m^2 (River Nore (Kilmacshane_A), SERBD), were surveyed between the 30th of June and 25th of September 2014. Catchments encompassing each river water body were classified according to size as follows; <10km^2, <100km^2, <1,000km^2 and <10,000km^2. Sites were distributed throughout all seven RBDs within the Republic of Ireland (Table 2.2, Table 2.3 and Fig. 2.2).

Six river sites were surveyed in the ERBD with surface areas ranging from 295m^2 (Dargle River to 5,179m^2 (River Liffey at Lucan). Only the River Liffey and River Boyne were deep enough to require the use of boat based electric-fishing equipment. Three river sites were surveyed in the NBIRBD, with surface areas ranging from 358m^2 (White River) to 1050 m^2 (River Dee). Only the river Dee was surveyed using boats. Five river sites were surveyed in the NWIRBD, with surface areas ranging from 210m^2 (Cronaniv Burn (Dunlewy Lough_A)) to 393m^2 (Swanlinbar River). All of these were wadeable. Twenty-five sites were surveyed in the SERBD, nine of these were wadeable and 16, non-wadeable. Sites ranged in size from 150m^2 (River Duag (Br. u/s Ballyporeen_B)) to 19,445m^2 (River Nore (Brownsbarn Br._A)). Nine sites were surveyed in the ShIRBD, ranging in size from 126m^2 (Inny River (Oldcastle_A)) to 11,883m^2 (River Brosna (Pollagh_A)). Five sites were wadeable and four non-wadeable. Six river sites were surveyed in the SWRBD (all wadeable), ranging in surface area from 156m^2 (Glashaboy River (Ballyvorisheen Br._B)) to 461m^2 (Sullane River). Finally 16 sites were surveyed in the WRBD (five wadeable and 11 non-wadeable), with surface areas ranging from 114m^2 (Tobercurry River (Moy River_C)) and 7,840m^2 (Ballysadare River (Ballysadare Br._A). Summary details of each site's location and physical characteristics are given in Tables 2.2 and 2.3.

Table 2.2. Location and codes of river sites surveyed for the WFD fish surveillance monitoring programme, June to September 2014

River	Site name	Catchment	Site code	Waterbody code
ERBD (Wadeable sites)				
Dargle River	Bahana_A	Dargle	10D010005A	EA_10_1148
Dodder, River	Bohernabreena_A	Liffey	09D010100A	EA_09_1656
Dodder, River	Mount Carmel_A	Liffey	09D010680A	EA_09_587
Vartry River	Newrath Br._A	Vartry	10V010300A	EA_10_1601
ERBD (Non-wadeable sites)				
Boyne, River	Boyne Br._A	Boyne	07B040200A	EA_07_990
Liffey, River	Lucan Br._A	Liffey	09L012100A	EA_09_1870_5
NBIRBD (Wadeable sites)				
Blackwater (Monaghan), River	Corvally_A	Blackwater	03B010680A	GBNI1NB030307099
White River (Louth)	Coneyburrow Br._B	Dee	06W010500B	NB_06_550
NBIRBD (Non-wadeable sites)				
Dee, River	Burley Br._A	Dee	06D010600A	NB_06_50
NWIRBD (Wadeable sites)				
Cronaniv Burn	Dunlewy Lough_A	Clady	38C060100A	NW_38_800
Cronaniv Burn	Dunlewy_A	Clady	38C060120A	NW_38_800
Swanlinbar River	Carpark_A	Erne	36S010290A	NW_36_18
Swilly, River	Altadush_A	Swilly	39S020030A	NW_39_2208
Swilly, River	Swilly Br._A	Swilly	39S020050A	NW_39_1508
SERBD (Wadeable sites)				
Derry River	Balisland Br._A	Slaney	12D020710A	SE_12_2095
Derry River	Ballyknocker_A	Slaney	12D020570A	SE_12_2095
Duag, River	Br. u/s Ballyporeen_B	Suir	16D030100B	SE_16_639
Duag, River	Kilnamona_A	Suir	16D030080A	SE_16_639
Duncormick River	Railway_B	Duncormick	13D010350B	SE_13_745
Mahon, River	Seafield House_A	Mahon	17M010350A	SE_17_825
Mahon, River	Pumphouse Weir_A	Mahon	17M010340A	SE_17_825
Owenduff River	Rathnageeragh_A	Owenduff	13O010060A	SE_13_754
Urrin River	Buck's Br._B	Slaney	12U010200B	SE_12_2605
SERBD (Non-wadeable sites)				
Aherlow River	Killardy Br._A	Suir	16A010900A	SE_16_540
Aherlow River	Old Cappa Br._A	Suir	16A010800A	SE_16_540
Anner River	Drummon Br._A	Suir	16A020600A	SE_16_2342
Anner River	Killusty_A	Suir	16A020770A	SE_16_2342
Ara River	Bansha_A	Suir	16A030520A	SE_16_2303
Ara River	Lisheen_A	Suir	16A030720A	SE_16_2303
Barrow, River	Pass Br._B	Barrow	14B011000B	SE_14_196_1
Multeen River	Ballygriffin Br._A	Suir	16M021100A	SE_16_3825
Nore, River	Brownsbarn Br._A	Nore	15N012400A	SE_15_1994_7
Nore, River	Kilmacshane_A	Nore	15N012410A	SE_15_1994_7
Nore, River	Quakers Br._A	Nore	15N010300A	SE_15_1018

Table 2.2 ctn. Location and codes of river sites surveyed for the WFD fish surveillance monitoring programme, June to September 2014

River	Site name	Catchment	Site code	Waterbody code
Slaney, River	Bunclody_A	Slaney	12S021800A	SE_12_924_2
Slaney, River	Carhill_A	Slaney	12S021700A	SE_12_924_2
Suir, River	Kilsheelan Br._A	Suir	16S022700A	SE_16_4181_5
Suir, River	Knocknageragh Br._A	Suir	16S020200A	SE_16_3997
Suir, River	Poulakerry_A	Suir	16S022710A	SE_16_4181_5
SHIRBD (Wadeable sites)				
Deel (Newcastlewest), River	Ballygulleen_A	Shannon Est Sth	24D020340A	SH_24_863
Deel (Newcastlewest), River	Balliniska_A	Shannon Est Sth	24D020400A	SH_24_863
Inny River	Oldcastle_A	Inny	26I010100A	SH_26_2060
Smearlagh River	Feale R. confl_A	Feale	23S020700A	SH_23_373
Smearlagh River	Rathea_A	Feale	23S020500A	SH_23_373
SHIRBD (Non-wadeable sites)				
Brosna, River	Pollagh_A	Shannon Lwr	25B090760A	SH_25_681
Feale, River	Duagh Ho_A	Feale	23F010500A	SH_23_2941
Feale, River	Sluicequarter_A	Feale	23F010450A	SH_23_2941
Inny River	Shrule Br._A	Inny	26I011350A	SH_26_883
SWRBD (Wadeable sites)				
Finisk River	Modelligo Br._A	Blackwater	18F020300A	SW_18_2774
Funshion, River	Brackbaun Br._A	Blackwater	18F050030A	SW_18_11
Funshion, River	Kilbeheny_A	Blackwater	18F050065A	SW_18_11
Glashaboy River	Ardnabricka_A	Glashaboy	19G010270A	SW_19_755
Glashaboy River	Ballyvorisheen Br._B	Glashaboy	19G010200B	SW_19_755
Sullane River	Sullane Br._A	Lee	19S020300A	SW_19_915
WRBD (Wadeable sites)				
Bundorragha River	Rock Pool_A	Bundorragha	32B010160A	WE_32_1767
Demesne River	Curraghcreen_A	Nanny	30N010080A	WE_30_1128
Owennaglogh	Tawnynoran_A	Bundorragha	32B010130A	WE_32_378
Tobercurry River	Moy River_C	Moy	34T020200C	WE_34_2633
Tobercurry River	Tullanaglug_A	Moy	34T020150A	WE_34_2633
WRBD (Non-wadeable sites)				
Ballysadare River	Ballysadare Br._A	Ballysadare	35B050100A	WE_35_2107
Ballysadare River	Oakwood_A	Ballysadare	35B050070A	WE_35_2107
Bonet River	Dromahaire Br._A	Garvogue	35B060600A	WE_35_3842
Bonet River	Castle_A	Garvogue	35B060600B	WE_35_3842
Clare, River	Corrofin Br._A	Corrib	30C010800A	WE_30_258_3
Clare, River	Kiltroge Castle Br._A	Corrib	30C011150A	WE_30_258_5
Nanny (Tuam), River	Weir Br._A	Corrib	30N010300A	WE_30_1128
Owenmore River (Sligo)	Unshin R. confl_A	Ballysadare	35O060900A	WE_35_2107
Owenmore River (Sligo)	Waterfall_A	Ballysadare	35O060830A	WE_35_2107
Robe River	Akit Br._A	Corrib	30R010600A	WE_30_3370_3
Robe River	Friarsquarter_A	Corrib	30R010590A	WE_30_3370_3

Table 2.3. Physical characteristics of river sites surveyed for the WFD fish surveillance monitoring programme, June to September 2014

River	Site name	Catchment area (km^2)	Width (m)	Surface area (m^2)	Mean depth (m)	Max depth (m)
ERBD (Wadeable sites)						
Dargle River	Bahana_A	12.92	7.98	295	0.12	0.32
Dodder, River	Bohernabreena_A	31.82	7.32	315	0.19	0.59
Dodder, River	Mount Carmel_A	93.22	9.68	358	0.19	0.45
Vartry River	Newrath Br._A	102.98	7.72	324	0.22	0.48
ERBD (Non-wadeable sites)						
Boyne, River	Boyne Br._A	60.31	3.85	516	0.49	0.79
Liffey, River	Lucan Br._A	1102.06	20.80	5179	0.65	1.50
NBIRBD (Wadeable sites)						
Blackwater (Monaghan), River	Corvally_A	143.28	10.33	413	0.37	0.90
White River (Louth)	Coneyburrow Br._B	55.13	7.95	358	0.34	0.58
NBIRBD (Non-wadeable sites)						
Dee, River	Burley Br._A	175.52	7.00	1050	0.95	1.40
NWIRBD (Wadeable sites)						
Cronaniv Burn	Dunlewy Lough_A	6.88	4.66	210	0.19	0.36
Cronaniv Burn	Dunlewy_A	15.08	8.48	356	0.20	0.48
Swanlinbar River	Carpark_A	21.55	8.55	393	0.23	0.59
Swilly, River	Altadush_A	11.83	4.88	224	0.19	0.55
Swilly, River	Swilly Br._A	18.93	5.78	260	0.15	0.34
SERBD (Wadeable sites)						
Derry River	Balisland Br._A	136.25	10.92	469	0.21	0.36
Derry River	Ballyknocker_A	124.98	12.45	498	0.25	0.59
Duag, River	Br. u/s Ballyporeen_B	16.44	3.33	150	0.18	0.29
Duag, River	Kilnamona_A	13.72	4.86	204	0.12	0.36
Duncormick River	Railway_B	36.40	4.43	199	0.24	0.56
Mahon, River	Seafield House_A	90.79	12.72	572	0.24	0.76
Mahon, River	Pumphouse Weir_A	90.78	9.37	337	0.28	0.64
Owenduff River	Rathnageeragh_A	51.07	5.79	232	0.31	0.76
Urrin River	Buck's Br._B	42.22	7.13	321	0.18	0.53
SERBD (Non-wadeable sites)						
Aherlow River	Killardy Br._A	272.55	14.33	3512	0.71	1.20
Aherlow River	Old Cappa Br._A	174.09	13.75	2310	0.81	1.46
Anner River	Drummon Br._A	81.05	6.50	1281	0.52	1.20
Anner River	Killusty_A	136.23	7.92	831	0.45	0.73
Ara River	Bansha_A	74.63	7.50	788	0.48	0.73
Ara River	Lisheen_A	86.12	4.75	599	0.52	0.80
Barrow, River	Pass Br._B	1125.58	32.17	11677	0.53	0.75
Multeen River	Ballygriffin Br._A	174.82	12.67	2191	0.28	1.12
Nore, River	Brownsbarn Br._A	2419.32	34.60	19445	1.31	2.60
Nore, River	Kilmacshane_A	2420.09	34.63	11357	1.07	2.24
Nore, River	Quakers Br._A	84.27	6.50	1508	0.64	1.40

Table 2.3 ctn. Physical characteristics of river sites surveyed for the WFD fish surveillance monitoring programme, June to September 2014

River	Site name	Catchment area (km^2)	Width (m)	Surface area (m^2)	Mean depth (m)	Max depth (m)
Slaney, River	Bunclody_A	848.1	25.92	6065	0.85	1.49
Slaney, River	Carhill_A	847.38	26.50	3763	0.92	2.00
Suir, River	Kilsheelan Br._A	2636.56	48.50	15666	0.82	1.31
Suir, River	Knocknageragh Br._A	94.13	6.07	607	0.37	0.63
Suir, River	Poulakerry_A	2637.04	42.20	9031	0.74	1.25
SHIRBD (Wadeable sites)						
Deel (Newcastlewest), River	Ballygulleen_A		8.03	362	0.14	0.32
Deel (Newcastlewest), River	Balliniska_A	152.66	8.03	362	0.29	0.60
Inny River	Oldcastle_A	13.18	3.15	126	0.30	0.58
Smearlagh River	Feale R. confl_A	128.66	10.67	427	0.21	0.86
Smearlagh River	Rathea_A	92.95	10.25	410	0.11	0.28
SHIRBD (Non-wadeable sites)						
Brosna, River	Pollagh_A	845.00	25.83	11883	0.97	1.50
Feale, River	Duagh Ho_A	477.51	24.67	6315	0.32	0.81
Feale, River	Sluicequarter_A	472.07	17.83	2247	0.25	0.54
Inny River	Shrule Br._A	1128.26	18.67	7093	0.59	1.10
SWRBD (Wadeable sites)						
Finisk River	Modelligo Br._A	65.48	9.87	444	0.12	0.39
Funshion, River	Brackbaun Br._A	16.19	8.25	371	0.15	0.27
Funshion, River	Kilbeheny_A	49.22	7.43	335	0.17	0.35
Glashaboy River	Ardnabricka_A	22.16	4.80	216	0.18	0.46
Glashaboy River	Ballyvorisheen Br._B	15.43	3.47	156	0.13	0.32
Sullane River	Sullane Br._A	109.85	10.23	461	0.29	0.59
WRBD (Wadeable sites)						
Bundorragha River	Rock Pool_A	44.99	12.26	466	0.38	0.63
Demesne River	Curraghcreen_A	4.54	5.98	239	0.23	0.67
Owennaglogh	Tawnynoran_A	11.59	7.84	314	0.16	0.40
Tobercurry River	Moy River_C	24.73	2.53	114	0.12	0.24
Tobercurry River	Tullanaglug_A	21.98	3.36	134	0.13	0.30
WRBD (Non-wadeable sites)						
Ballysadare River	Ballysadare Br._A	641.88	24.50	7840	2.25	2.50
Ballysadare River	Oakwood_A	635.45	28.00	5824	2.17	2.50
Bonet River	Dromahaire Br._A	292.20	21.30	6433	1.50	2.00
Bonet River	Castle_A	289.95	21.30	3046	1.50	2.00
Clare, River	Corrofin Br._A	704.28	19.00	6118	1.27	1.70
Clare, River	Kiltroge Castle Br._A	1072.68	14.60	3519	0.75	1.00
Nanny (Tuam), River	Weir Br._A	36.74	6.25	719	0.98	1.20
Owenmore River (Sligo)	Unshin R. confl_A	416.25	23.33	3360	0.92	2.00
Owenmore River (Sligo)	Waterfall_A	410.17	23.50	4207	1.24	1.40
Robe River	Akit Br._A	253.75	17.00	7599	2.20	2.50
Robe River	Friarsquarter_A	253.72	7.40	1036	1.33	1.50

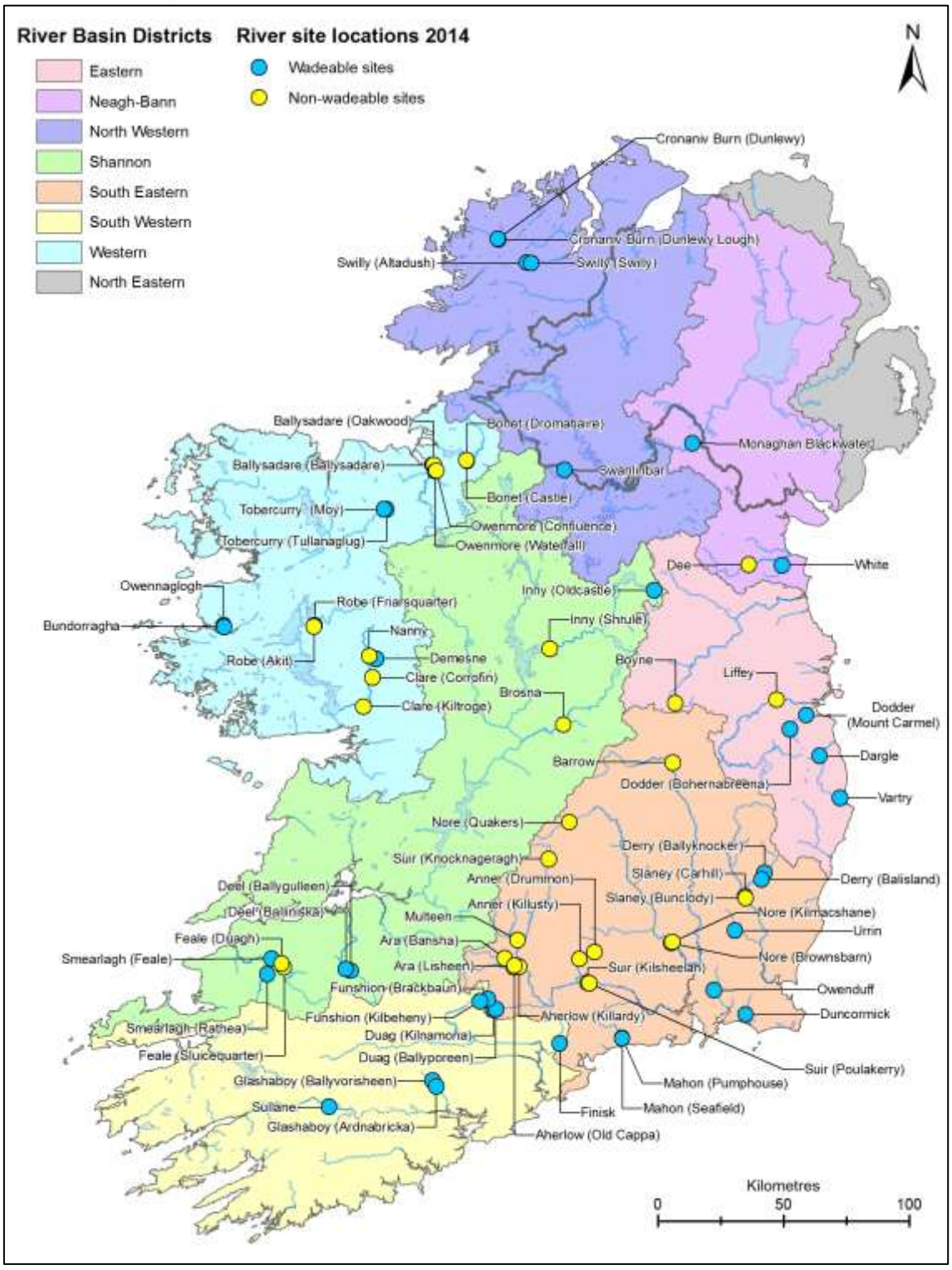

Fig. 2.2. Location of the 70 river sites surveyed for the WFD fish surveillance monitoring programme, July to September 2014

2.3 Transitional waters

Seven transitional water bodies were surveyed in 2014, four on the Shannon system (including the River Fergus) and three on the River Slaney (including the North Slob Channel (Table 2.4 and Fig. 2.3).

The largest water body surveyed was the Lower Shannon Estuary, with a surface area of 123.08km^2, while the smallest was the North Slob Channels, a small lagoon draining into Wexford Harbour, with a surface area of only 0.37km^2.

Table 2.4.Transitional water bodies surveyed for the WFD fish surveillance monitoring programme, October 2014

Water body	MS Code	Easting	Northing	Type	Area (km^2)
North Slob Channels	SE_040_0100	307472	124835	Lagoon	0.37
Slaney Estuary, Lower	SE_040_0200	303790	124978	Transitional water	18.35
Slaney Estuary, Upper	SE_040_0300	297785	135653	Freshwater tidal	0.81
Shannon Estuary, Lower	SH_060_0300	116583	152260	Transitional water	123.08
Shannon Estuary, Upper	SH_060_0800	143538	159394	Transitional water	39.51
Limerick Dock	SH_060_0900	157383	157267	Freshwater tidal	2.49
Fergus Estuary	SH_060_1100	132035	165677	Transitional water	64.75

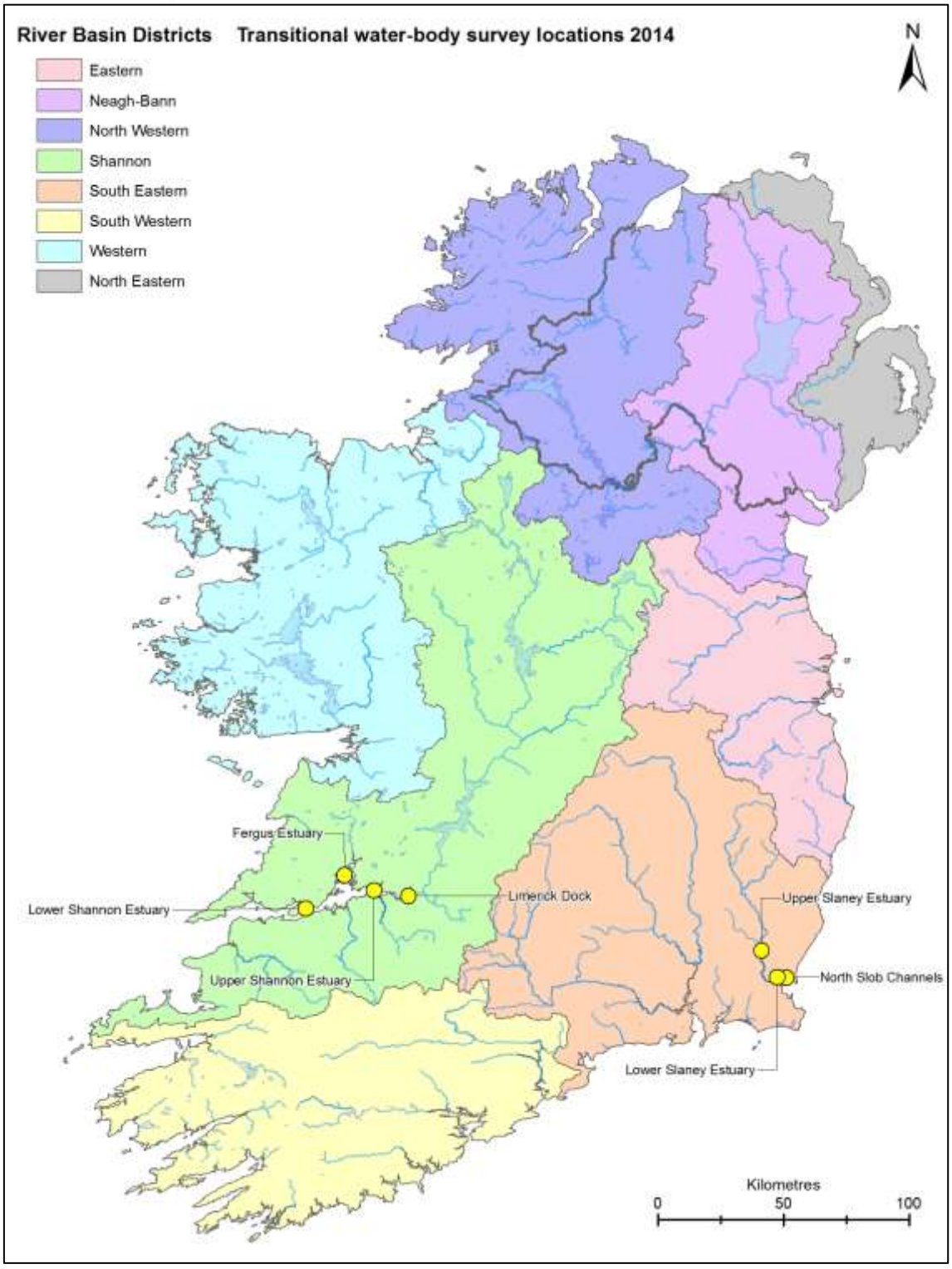

Fig. 2.3. Location of the seven transitional water bodies surveyed for the WFD fish surveillance monitoring programme, October 2014

3. METHODS

All surveys were conducted using a suite of European standard methods (CEN, 2003; CEN, 2005a; CEN, 2005b). Electric fishing is the main survey method used in rivers, while a multi-method netting approach is used in both lakes and transitional waters. Details of these methods are outlined below.

3.1 Lakes

3.1.1 Survey methodology

Lake water bodies were surveyed using a netting method developed and tested during the NSSHARE Fish in Lakes Project in 2005 and 2006 (Kelly *et al*., 2007b and 2008a). The method is based on the European CEN standard for sampling fish with multi-mesh monofilament survey gill nets (12 panel, 5-55mm mesh size) using a stratified random sampling design (CEN, 2005b) (Plate 3.1); however, the netting effort has been reduced (approx. 50%) for Irish lakes in order to minimise damage to fish stocks. Each lake was divided into depth strata (0-2.9m, 3-5.9m, 6-11.9m, 12-19.9m, 20-34.9m, 35-49.9m, 50-75m, >75m) and random sampling was then conducted within each depth stratum (CEN, 2005b). Surface floating multi-mesh monofilament survey gill nets (Plate 3.2), large mesh single panel benthic braided single panel survey gill nets (62.5mm mesh knot to knot) and fyke nets (one unit comprised of three fyke nets; leader size 8m x 0.5m) are also used to supplement the CEN standard gill netting effort. .

Survey locations were randomly selected using a grid placed over a map of the lake; however, when a repeat survey was undertaken, nets were deployed in the same locations as were randomly selected in the previous survey. A handheld GPS was used to mark the precise location of each net. The angle of each gill net in relation to the shoreline was randomised. Nets were set over night, and all lake surveys were completed between June and early October.

3.1.2 Processing of fish

All fish were counted, measured and weighed on site (Plate 3.3). Scales were removed from salmonids, roach, rudd, tench, pike and bream. Samples of some fish species were returned to the laboratory for further analysis, e.g. age analysis using char/eel otoliths and perch opercular bones. Stomach contents and sex were determined for any fish retained.

3.1.3 Water chemistry

Conductivity, pH, temperature and dissolved oxygen depth profiles were measured on site using a multiprobe. A Secchi disc was used to measure water clarity.

Plate 3.1. Retrieving a monofilament multi-mesh CEN standard survey gill net on Carrowmore Lake, Co. Mayo

Plate 3.2. A surface floating monofilament multi-mesh CEN standard survey gill net on Lough Brin, Co. Kerry

Plate 3.3. Processing the nets and fish on Lough Easky, Co. Sligo

3.2 Rivers

Electric fishing is the method of choice to obtain a representative sample of the fish assemblage in river sites. A standard methodology was developed by Inland Fisheries Ireland for the WFD fish surveillance monitoring programme (CFB, 2008a), in compliance with the European CEN standard for fish stock assessment in wadeable rivers (CEN, 2003). Environmental and abiotic variables were also measured on site. A macrophyte survey was also carried out at selected wadeable sites. Surveys were conducted between July and September (to facilitate the capture of juvenile salmonids) and when stream and river flows were moderate to low.

3.2.1 Survey methodology

Each site was sampled by depletion electric fishing (where possible) using one or more anodes depending on the width of the site. Sampling areas were isolated using stop nets. On a few occasions, stop-nets were substituted with instream hydraulic or physical breakpoints, such as well-defined shallow riffles or weirs. Where possible, three electric fishing passes were conducted at each site.

In small wadeable channels (<0.5-0.7m in depth), bank-based equipment, consisting of landing nets with integrated anodes connected to control boxes, cathodes and portable generators were used to sample in an upstream direction (Plate 3.4a). In larger, deeper channels (>0.5-1.5m), fishing was carried out from a flat-bottomed boat(s) in a downstream direction using a generator, control box, a pair of anodes and a cathode (Plate 3.4b). A representative sample of all habitats was sampled (i.e. riffle, glide, pool).

Plate 3.4. Electric fishing with (a) bank-based electric fishing equipment (River Duag at Ballyporeen) and (b) boat-based electric fishing equipment (Aherlow River at Old Cappa Br.)

Fish from each pass were sorted and processed separately. Captured fish were measured and weighed, with scales removed from a subsample for age analysis (Plate 3.5). All fish were held in a large bin of oxygenated water after processing until they were fully recovered, before being returned to the river.

For various reasons, including weather, river width and the practicalities of using stop-nets, three electric fishing passes were not possible or practical at all sites. Therefore, in order to draw comparisons between sites, fish densities were calculated using data from the first electric fishing pass only.

Plate 3.5. Processing fish for length, weight and scale samples

3.2.2 Habitat assessment

An evaluation of habitat quality is critical to any assessment of ecological integrity and a habitat assessment was performed at each site surveyed. Physical characterisation of a stream includes documentation of general land use, a description of the stream origin and type, a summary of riparian vegetation and measurements of instream parameters such as width, depth, flow and substrate (Barbour *et al*., 1999).

At each site, the percentage of overhead shade, substrate type and instream cover were visually assessed. Wetted width and depth were also measured throughout the stretch. The width was recorded at six transects, with five depths at intervals along each. The percentage of riffle, glide and pool was estimated in each reach surveyed. Conductivity, temperature, salinity, pH and dissolved

oxygen were also recorded at each site using a multiprobe. A summary of environmental and abiotic variables were recorded, showing the range amongst all river sites surveyed, is shown in Table 3.1.

Table 3.1. Environmental and abiotic variables recorded for all river sites surveyed for WFD fish surveillance monitoring in 2014

Environmental / abiotic variable	Min	Mean	Max	Footnote
River reach sampled				
Length fished (m)	35	121.34	562	1
Mean depth (m)	0.04	0.50	2.25	2
Max depth (m)	0.08	0.88	2.6	3
Wetted width (m)	2.53	12.23	48.50	4
Surface area (m^2)	102.67	2309.26	19445.20	5
Shade	0	-	3	6
Instream cover	0	18.30	90	7
Bank slippage	0	-	1	8
Bank erosion	0	-	1	8
Fencing (RHS & LHS)	0	-	1	8
Trampling (RHS & LHS)	0	-	1	8
Water level	1	-	2	9
Velocity	1	-	4	10
Conductivity @ 25^0c (µS/cm)	46.00	360.50	686.10	-
Water temperature (^{o}c)	10.68	15.67	21.40	-
pH	6.61	7.84	8.73	-
Dissolved oxygen (mg/l)	6.10	10.14	13.94	-
Dissolved oxygen (%)	57.00	98.82	137.80	-
Flow type (%)				
Riffle	0	24.82	90	7
Glide	10	58.25	100	7
Pool	0	16.93	60	7
Substrate type (%)				
Bedrock	0	0.77	25	7
Boulder	0	9.09	50	7
Cobble	0	45.05	80	7
Gravel	0	24.08	75	7
Sand	0	11.93	70	7
Mud/silt	0	9.34	100	7

***Footnotes*:**

1. Measured over length of site fished
2. Mean of 30 depths taken at 5 transects through the site
3. Measured at deepest point in stretch fished
4. Mean of 6 widths taken at 6 transects
5. Calculated from length and width data
6. Shade due to tree cover, estimated visually at the time of sampling (0-none, 1-light, 2-medium, 3-heavy)
7. Percentage value, estimated visually at the time of sampling
8. Bank slippage, bank erosion, fencing estimated visually at time of sampling (presence or absence recorded as 1 or 0)
9. Water level, estimated visually at time of sampling-3 grades (1-low, 2-normal & 3-flood)
10. Velocity rating, estimated visually at time of sampling-5 ratings given (1-very slow, 2-slow, 3-moderate, 4-fast, 5-torrential)

3.3 Transitional waters

Transitional waters (estuaries/lagoons) are an interface habitat, where freshwater flows from rivers and mixes with the tide and salinity of the sea. As such, they provide a challenging habitat to survey due to their constantly changing environmental conditions. In every 24 hour period, the tidal level rises and falls twice, subjecting extensive areas to inundation and exposure.

3.3.1 Survey methodology

The standard method for sampling fish in transitional waters in Ireland for the WFD monitoring programme (CFB, 2008b) is a multi-method approach using various netting techniques. Sampling methods include:

- Beach seining using a 30mx3m fine-mesh (10mm) net to capture fish in littoral areas with 30m guide ropes. The bottom, or lead line, has lead weights attached to the net in order to keep the lead line in contact with the sea bed.
- Beam trawling for specified distances (100-200m) in open water areas
- Fyke nets set overnight in selected areas

3.3.1.1 Beach Seining

Beach seining is conducted using a four-person team; two staff on shore and two in a boat. Sampling stations are selected to represent the range of habitat types within the site, based on such factors as exposure/orientation, shoreline slope and bed type. The logistics of safe access to shore and feasibility of unimpeded use of the seine net are also considered. All beach seine nets were set from a boat with the two guide ropes held on shore, while the boat followed an arc until the net was fully deployed (Plates 3.6 and 3.7).

3.3.1.2 Fyke netting

Fyke nets, identical to those used for lake surveys (one unit comprised of 3 fyke nets; leader size 8m x 0.5m) are the standard fyke nets used to sample fish in transitional waters (Plate 3.8). Each fyke net unit is weighted by two anchors to prevent drifting and a marker buoy is attached to each end. Nets were deployed overnight to maximise fishing time in different types of habitats, i.e. rocky, sandy and weedy shores.

Plate 3.6. Beach seining: net deployed from a boat

Plate 3.7. Beach seining: hauling the net towards shore

Plate 3.8. Fyke net being hauled onto a rigid inflatable boat (RIB)

3.3.1.3 Beam trawl

Beam trawling enables sampling of littoral and open water habitats where the bed type is suitable. The beam trawl used for IFI's WFD transitional water fish sampling measures 1.5m x 0.5m in diameter, with a 10mm mesh bag, decreasing to 5mm mesh at the cod end (Plate 3.9). A 1.5m metal beam ensures the net stays open while towing, with small floats on the top line and 3m of light chain on the bottom line. A 1m bridle is attached to a 20m tow rope and the net is towed by a boat.

Trawls were conducted over transects of 200m in length with the start and finish recorded on a handheld GPS. After each trawl the net was hauled aboard and the fish were processed.

Plate 3.9. Setting a beam trawl for a transitional water survey

3.3.2 Processing of fish

At the completion of each seine net haul, fyke net (overnight setting) and beam trawl transect, the fish were carefully removed from the nets and placed into clean water. One field team member examined each fish whilst the other recorded date set, time set, date out, transitional water name, grid reference, net information (type), number of each species and individual fish length. Once processing was complete the majority of fish were returned to the water alive. Representative sub-samples of a number of abundant fish species were measured (fork length) to the nearest millimetre. Any fish species that could not be identified on site were preserved in ethanol or frozen and taken back to the IFI laboratory for identification.

3.3.3 Additional information

Information on bed type and site slope was recorded by visual assessment at each beach seine sample station, based on the dominant bed material and slope in the wetted area sampled. Three principal bed types were identified (gravel, sand and mud). Shoreline slopes were categorized into three groups: gentle, moderate and steep. Salinity and water temperature were also recorded at all beach seine sampling stations. A handheld GPS was used to mark the precise location of each sampling station.

3.4 Ageing of fish

A subsample of the dominant fish species from rivers and lakes were aged (three fish from each 1cm class). Fish scales were read using a microfiche reader. Perch opercular bones were prepared by boiling, cleaning and drying, before ageing them using a binocular microscope/digital camera system with Image Pro Plus software (Plate 3.10). Char otoliths were cleared in 70% ethanol and aged using a binocular microscope (Plate 3.11). Eel otoliths were prepared by the method of 'cutting and burning' and then subsequently aged using a binocular microscope/digital camera system with Image Pro Plus software (Plate 3.12). Back calculated lengths at age were determined in the laboratory.

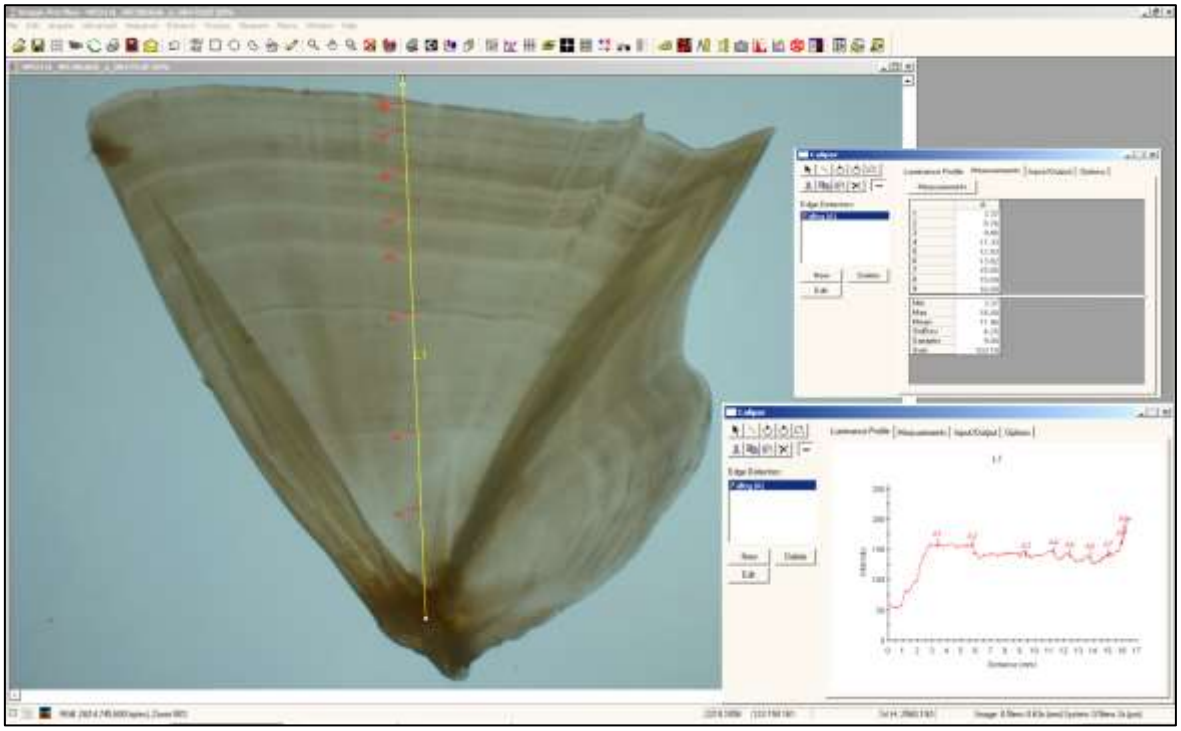

Plate 3.10. Opercular bone aging using binocular microscope/digital camera system with Image Pro Plus software (an 8+ perch from Lough Corrib Upper)

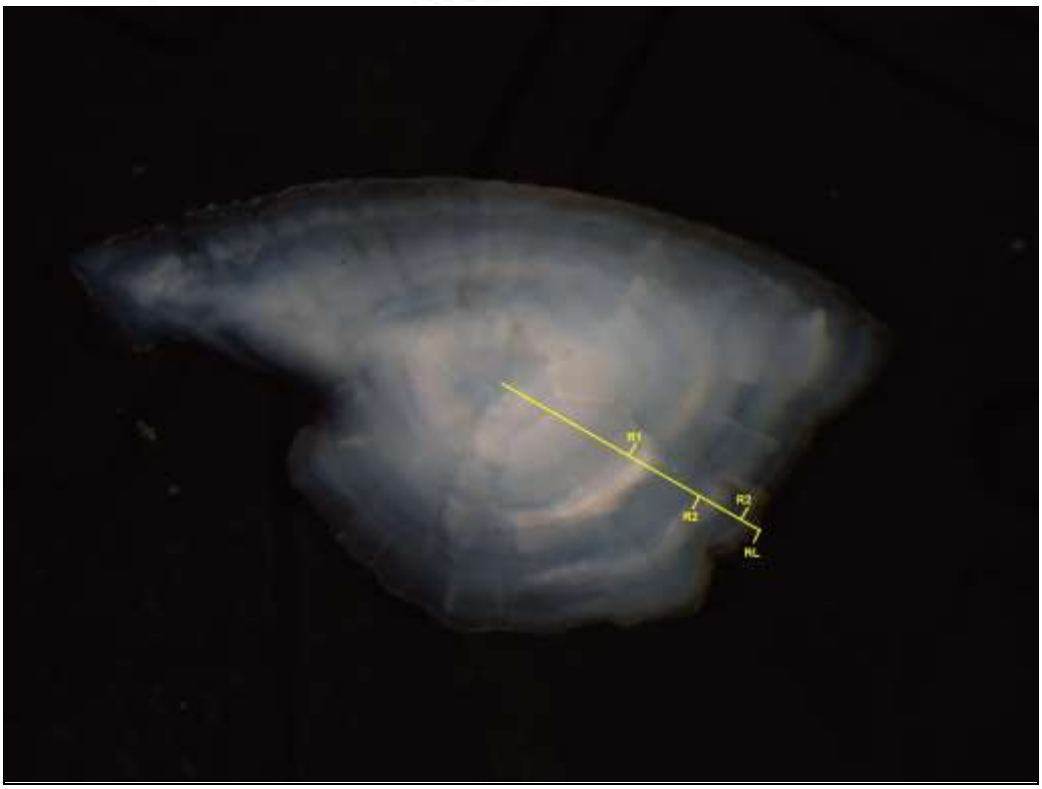

Plate 3.11. Char otolith (3+) from Lough Caragh, Co. Kerry

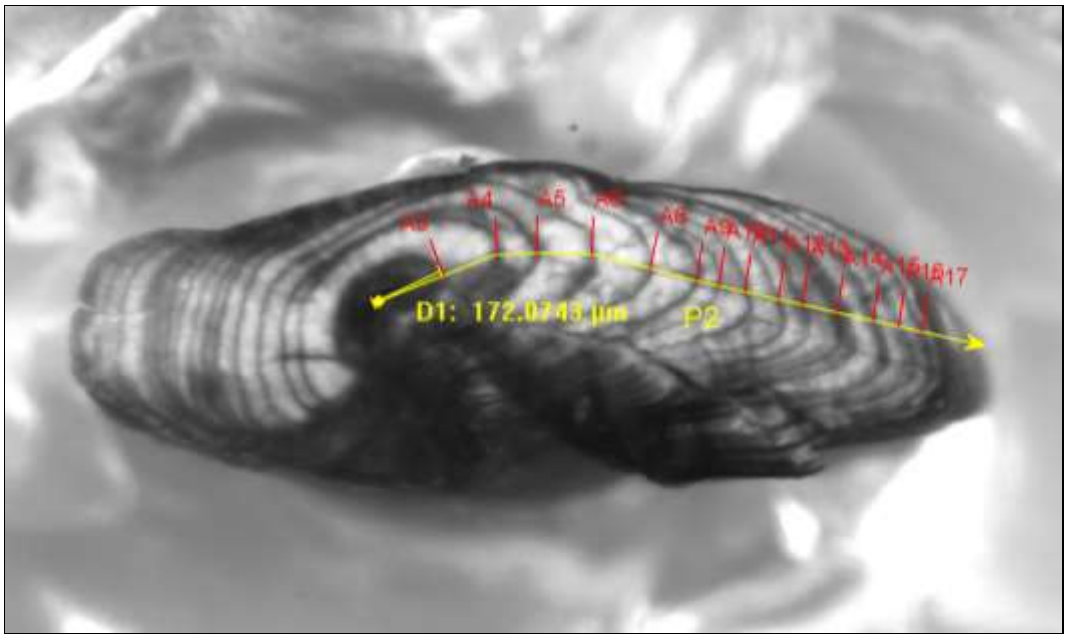

Plate 3.12. Eel otolith (13+) from Lough Corrib (female yellow eel, 48.9cm, 1800g)

3.5 Quality assurance

CEN (2005a) recommends that all activities undertaken during the standard fish sampling protocol (e.g. training of the lakes team, handling of equipment, handling of fish, fish identification, data analyses, and reporting) should be subjected to a quality assurance programme in order to produce consistent results of high quality. A number of quality control procedures have been implemented for the current programme. All IFI WFD staff have been trained in electric fishing techniques, fish identification, sampling methods (including gill netting, seine netting, fyke netting and beam trawling), fish ageing, data analyses, off road driving and personal survival techniques.

There is a need for quality control for fish identification by field surveyors, particularly in relation to hybrids of coarse fish. Samples of each fish species (from the three water body types) were retained when the surveyor was in any doubt in relation to the identity of the species, e.g. rudd and/or roach hybrids. There is also a need for quality control when ageing fish; therefore every tenth scale or other ageing structure from each species was checked in the laboratory by a second biologist experienced in age analysis techniques.

Further quality control measures are continually being implemented each year in relation to standardising data analyses, database structure and reporting. All classification tools for fish are continually being developed and outputs from these were intercalibrated across Europe.

3.6 Biosecurity - disinfection and decontamination procedures

One of the main concerns when carrying out surveillance monitoring surveys for the WFD is to consider the changes which can occur to the biota, as a consequence of spreading unwanted non-native species, such as the zebra mussel. Procedures are required for disinfection of equipment in order to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by Inland Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff on the IFI WFD team when moving between water bodies (Plate 3.13).

Plate 3.13. Disinfection procedure (steam washing) of a boat being moved between water bodies

3.7 Hydroacoustic technology: new survey method development

Hydroacoustics (or echo sounding) is the use of sound energy to remotely gather information from a water body by transmitting a pulse of sound into the water and assessing the position and strength of the returning echo. Hydroacoustic surveys have become a very useful tool in freshwater fish stock assessment, providing invaluable information on fish abundance, size distribution, spatial distribution and behaviour, whilst limiting the destructive use of gill nets.

One of the most valuable uses for hydroacoustic surveys in lakes is the targeted approach of assessing populations of indicator species or species at risk, such as Arctic char or pollan, which tend to inhabit the deeper areas of lakes. Hydroacoustics can be used effectively to locate shoals of deep water fish and targeted ground-truth netting can then be used for species identification. Abundance estimates can subsequently be calculated from the acoustic data. Furthermore, the spatial distribution and size distribution of species of interest can also be assessed.

Further development in both hydroacoustic technology and survey methodology will see hydroacoustics play an increasing role in future WFD monitoring within IFI. Hydroacoustic technology will also continue to be used to support other important work within IFI, including assessing the population status of priority species such as pollan, Killarney shad and Arctic char.

Experimental hydroacoustic surveys were carried out in 2014 on Lough Caragh, Lough Allen, Lough Melvin, Lough Beagh and Lough Leane. These surveys were carried out as part of an Irish Research Council funded Ph.D. which aims to incorporate hydroacoustic technology into the existing standard sampling protocols used to assign ecological and conservation status for the Water Framework Directive and Habitats Directive for conservation and endangered fish species. The experimental surveys concentrated on the deeper sections of the lakes (depth >12m) and covered *circa* 228km of hydroacoustic transects. Separate reports will be available in due course.

Initial results show: Lough Allen has a large population of pelagic fish, dominated by pollan and juvenile perch, an example of an echogram showing a pollan shoal from Lough Allen is shown in Figure 3.1; Lough Leane continues to sustain a good population of Killarney shad; Lough Beagh has a healthy Arctic char population; Loughs Melvin and Caragh continue to sustain small Arctic char populations that are at risk.

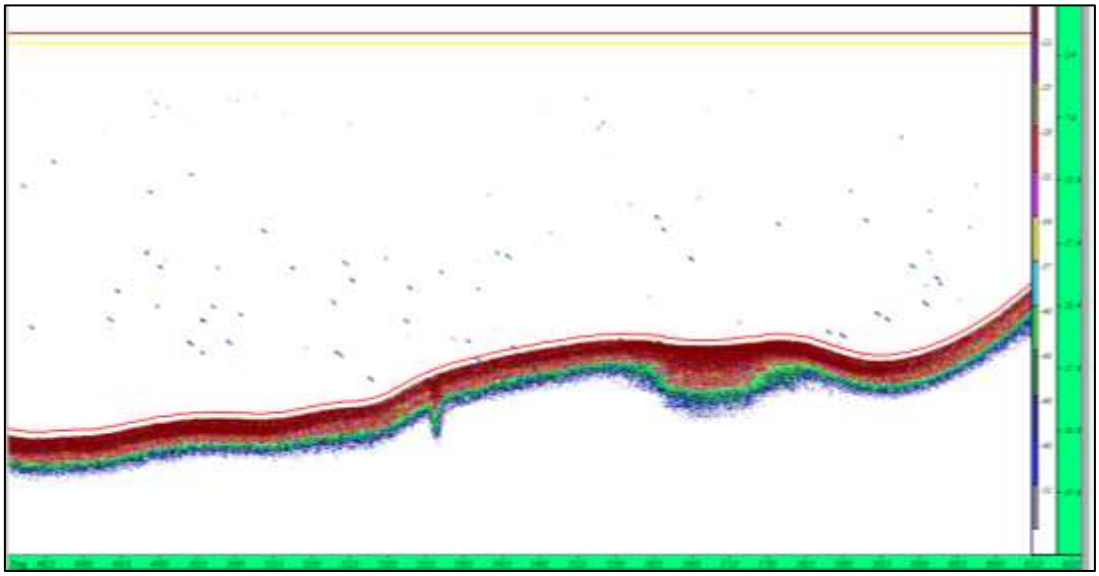

Fig. 3.1. Example of an echogram showing a pollan shoal from Lough Allen during post-processing

Ongoing cooperation with other Member States in developing the CEN standard will help to progress this work. IFI staff participated in an intercalibration exercise of echosounders for monitoring fish in deep lakes in Lake Windermere, England in November 2011 in conjunction with other Member States (Winfield *et al.,* 2012). This intercalibration exercise contributed to the endorsement of the CEN standard '*EN 15910, Water quality - Guidance on the estimation of fish abundance with mobile hydroacoustic methods'*. Work continues on this unique dataset and IFI staff attended an

International workshop dedicated to the intercalibration of hydroacoustic methods for WFD fish monitoring in Thonon-les-Bains, France in June 2014.

4. RESULTS

4.1 Lakes

4.1.1 Fish species composition and species richness

A total of 19 fish species (sea trout are included as a separate "variety" of trout) and two types of hybrids were recorded across the lakes surveyed during 2014 (Table 4.1). Eel was the most common fish species recorded, occurring in 25 of the 26 lakes surveyed (96.2%). This was followed by brown trout, perch, roach and pike which were present in 80.8%, 65.4%, 42.3% and 38.5% of lakes respectively (Table 4.1 and Fig. 4.1).

Table 4.1. List of fish species recorded in the 26 lakes surveyed during 2014

	Scientific name	Common name	Number of lakes	% of lakes
	NATIVE SPECIES (Group 1)			
1	*Anguilla anguilla*	Eel	25	96.2
2	*Salmo trutta*	Brown trout	21	80.8
3	*Salmo salar*	Juvenile salmon	9	34.6
3	*Salmo salar*	Adult salmon	7	26.9
4	*Gasterosteus aculeatus*	Three-spined stickleback	7	26.9
5	*Salmo trutta*	Sea trout*	6	23.1
6	*Salvelinus alpinus*	Char	6	23.1
7	*Alosa fallax killarnensis*	Killarney Shad	1	3.9
8	*Platichthys flesus*	Flounder	1	3.9
9	*Pungitius pungitius*	Nine-spined stickleback	1	3.9
	NON NATIVE SPECIES (influencing ecology) (Group 2)			
10	*Perca fluviatilis*	Perch	17	65.4
11	*Rutilus rutilus*	Roach	11	42.3
12	*Esox lucius*	Pike	10	38.5
13	*Abramis brama*	Bream	5	19.2
14	*Phoxinus phoxinus*	Minnow	3	11.5
15	*Oncorhynchus mykiss*	Rainbow trout	1	3.9
	NON NATIVE SPECIES (generally not influencing ecology) (Group 3)			
16	*Scardinius erythropthalmus*	Rudd	5	19.2
17	*Tinca tinca*	Tench	4	15.4
18	Gobio gobio	Gudgeon	1	3.9
19	*Barbatula barbatula*	Stone loach	1	3.9
	Hybrids			
	Rutilus rutilus x Abramis brama	Roach x bream hybrid	7	26.9
	Rutilus rutilus x Scardinius erythropthalmus	Roach x rudd hybrid	3	11.5

*Sea trout are included as a separate "variety" of trout

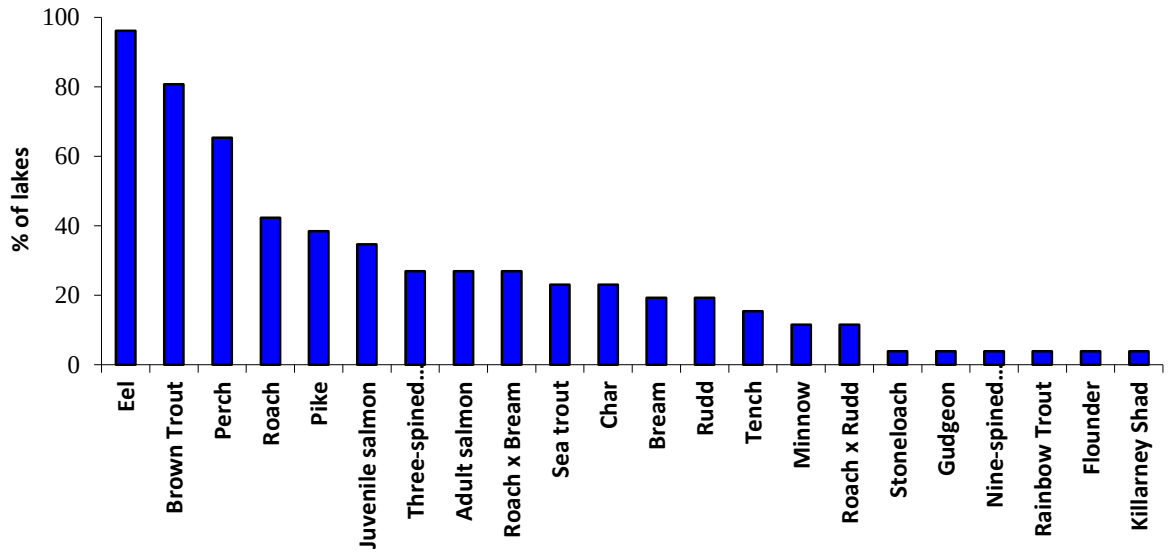

Fig. 4.1.Percentage of lakes surveyed for WFD fish surveillance monitoring during 2014 containing each fish species

Fish species richness (excluding hybrids) ranged from three species on Glenbeg Lough, Co. Cork, Kiltooris Lough, Co. Donegal, Lough Barra, Co. Donegal and Lough Easky, Co. Sligo to a maximum of ten species on Lower Lough Corrib, Co. Galway (Table 4.2, Fig. 4.2). The highest number of native species (six species) was recorded in Lough Leane, Co. Kerry. Native species (Group 1) were present in all lakes surveyed, Group 2 species were present in 20 lakes and Group 3 species were present in seven lakes (Table 4.2).

Table 4.2. Fish species richness in the 26 lakes surveyed for WFD fish monitoring during 2014

Lake	Species richness	No. native species (Group 1)	No. non-native species (Group 2)	No. non-native species (Group 3)
Corrib (Lower)	10	5	3	2
Leane	9	6	1	2
Allua	8	2	4	2
Corrib (Upper)	8	4	4	0
Upper Lake	7	4	1	2
Beagh	6	5	1	0
Caragh	6	5	1	0
Carrowmore	6	5	1	0
Gill	6	2	4	0
Melvin	6*	4	1	1
Owel	6	2	3	1
Cavetown	5	1	4	0
Corglass	5	1	3	1
Fern	5	4	1	0
Meelagh	5	1	4	0
O'Flynn	5	2	3	0
Sheelin	5	2	3	0
Talt	5	4	1	0
Glencullin	5	5	0	0
Acoose	4	4	0	0
Derrybrick	4	1	3	0
Brin	4	3	1	0
Templehouse	4	1	3	0
Glenbeg	3	3	0	0
Kiltooris	3	3	0	0
Barra	3	3	0	0
Easky	3	3	0	0

* Nine species if trout segregated into ferox, gillaroo and sonaghan

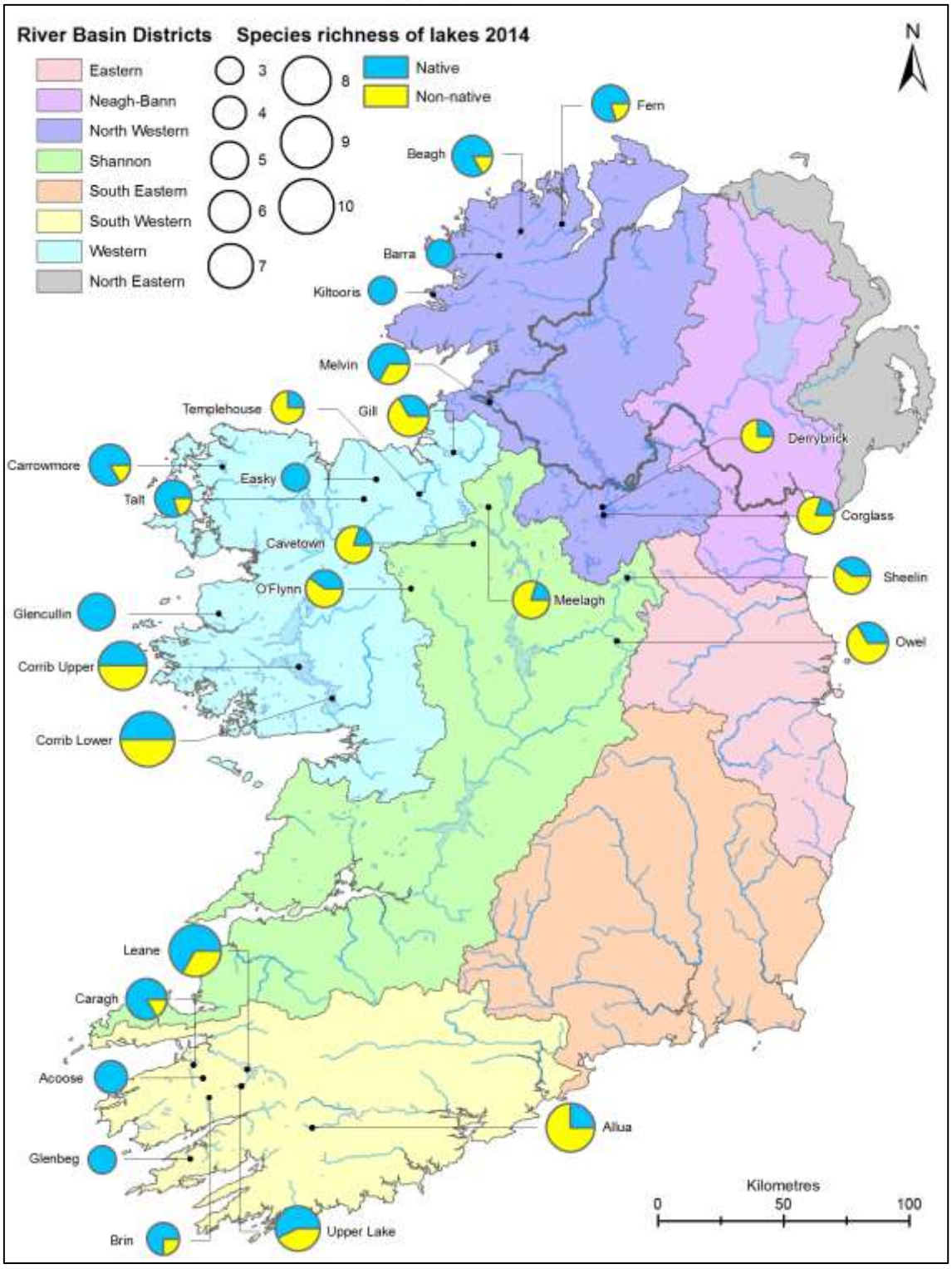

Fig. 4.2. Fish species richness in the 26 lakes surveyed for WFD fish monitoring during 2014

4.1.2 Fish species distribution

The distribution and abundance of each fish species amongst all lakes surveyed during 2014 is shown in Figures 4.3 to 4.15. The size of the circles indicates mean catch per unit effort (CPUE - mean number of fish per metre of net). Details of the presence/absence of each species in each lake are also given in Appendix 2.

Eels were widely distributed, being present in 25 out of 26 lakes surveyed (Fig. 4.3). In general, salmonids were more abundant towards the north-western, western and south-western areas of the country (Figs. 4.4 to 4.7). Sea trout were present in six lakes in the south-west, west and north-west, Upper Lake, Lough Caragh, Lough Brin, Glencullin Lough, Carrowmore Lake and Lough Beagh (Fig. 4.5). Juvenile salmon were recorded in nine lakes (Lough Fern, Lough Beagh, Lough Barra, Lough Easky, Carrowmore Lake, Glencullin Lough, Lough Corrib Upper, Lough Acoose and Glenbeg Lough) and adult salmon in eight lakes (Lough Fern, Lough Melvin, Carrowmore Lake, Lough Corrib Upper, Lough Corrib Lower, Lough Caragh, Lough Leane and Upper Lake) (Fig. 4.6). Arctic char were recorded in six lakes in the NWIRBD and SWRBD (Lough Beagh, Lough Melvin, Lough Talt, Lough Caragh, Lough Acoose and Lough Leane) (Fig. 4.7). Three-spined stickleback were also mainly restricted to the west and north-west of the country, being present in two lakes in the WRBD, four in the NWIRBD and one lake in the ShIRBD (Fig. 4.8).

The native Irish lake fish fauna has been augmented by the introduction of a large number of non-native species, introduced either deliberately, accidentally or through careless management, e.g. angling activities, aquaculture and the aquarium trade. Many non-native species have become established in the wild, the most widespread including pike, perch, roach, rudd and bream. The status of these species varies throughout Ireland, with much of the north-west and many areas in the west, south-west and east of Ireland still free from these species (Figs. 4.9 to 4.15). Perch, followed by roach, then pike were the most widely distributed non-native species recorded during the 2014 surveillance monitoring programme, with perch (Fig. 4.9) being present in 18 lakes and roach (Fig. 4.11) being present in 12 of the 26 lakes surveyed. Pike were captured in eleven lakes (two in the WRBD, two in the NWIRBD, one in the SWRBD and six in the Roscommon/Cavan area) (Fig. 4.10). Rudd were recorded in five lakes (three lakes within the SWRBD, one lake in the NWIRBD and one in the WRBD) (Fig. 4.12). Bream were recorded in five lakes, and roach x bream hybrids were recorded in eight lakes (Figs. 4.14). Tench were recorded in four lakes.

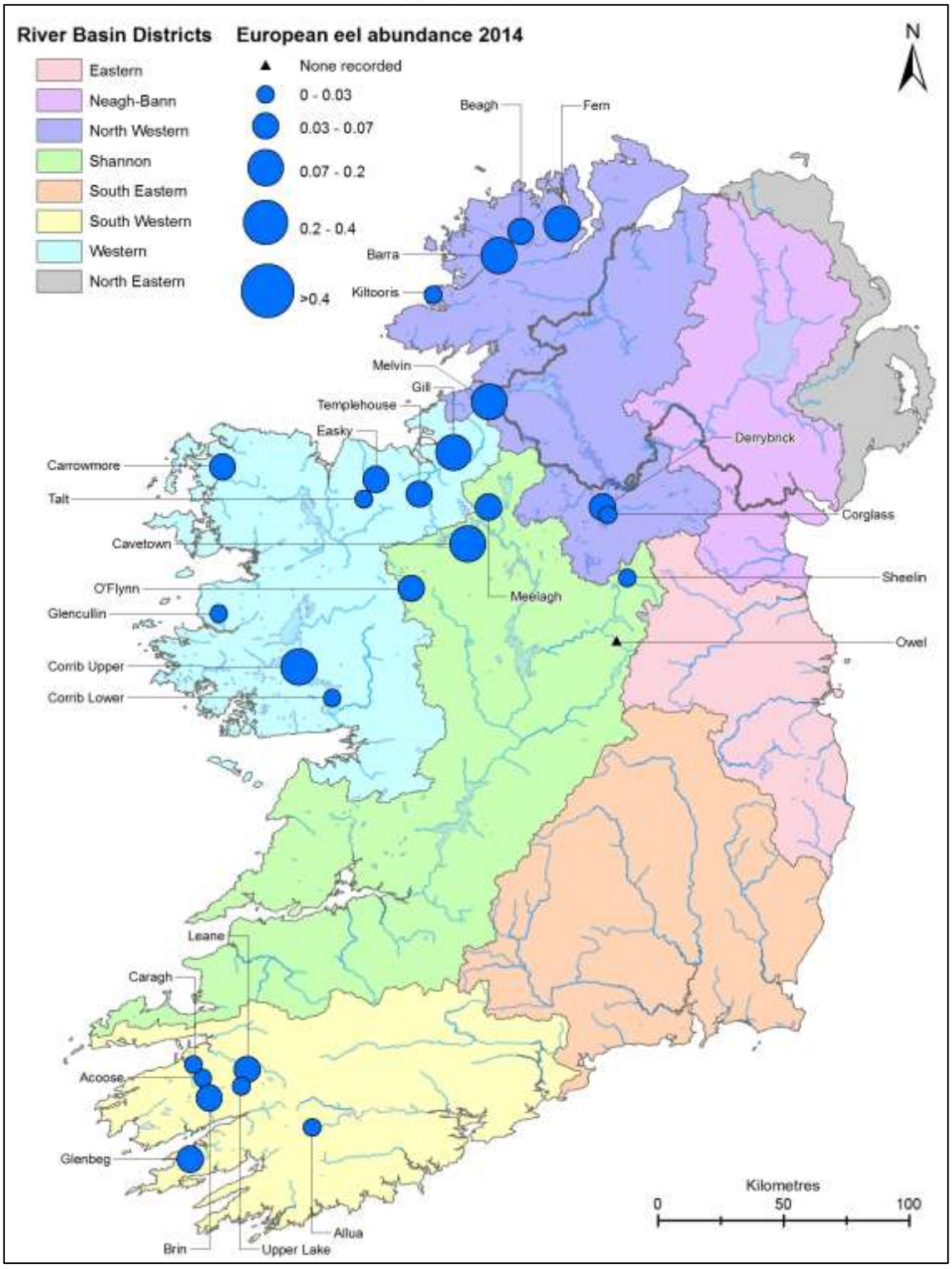

Fig. 4.3. Eel distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

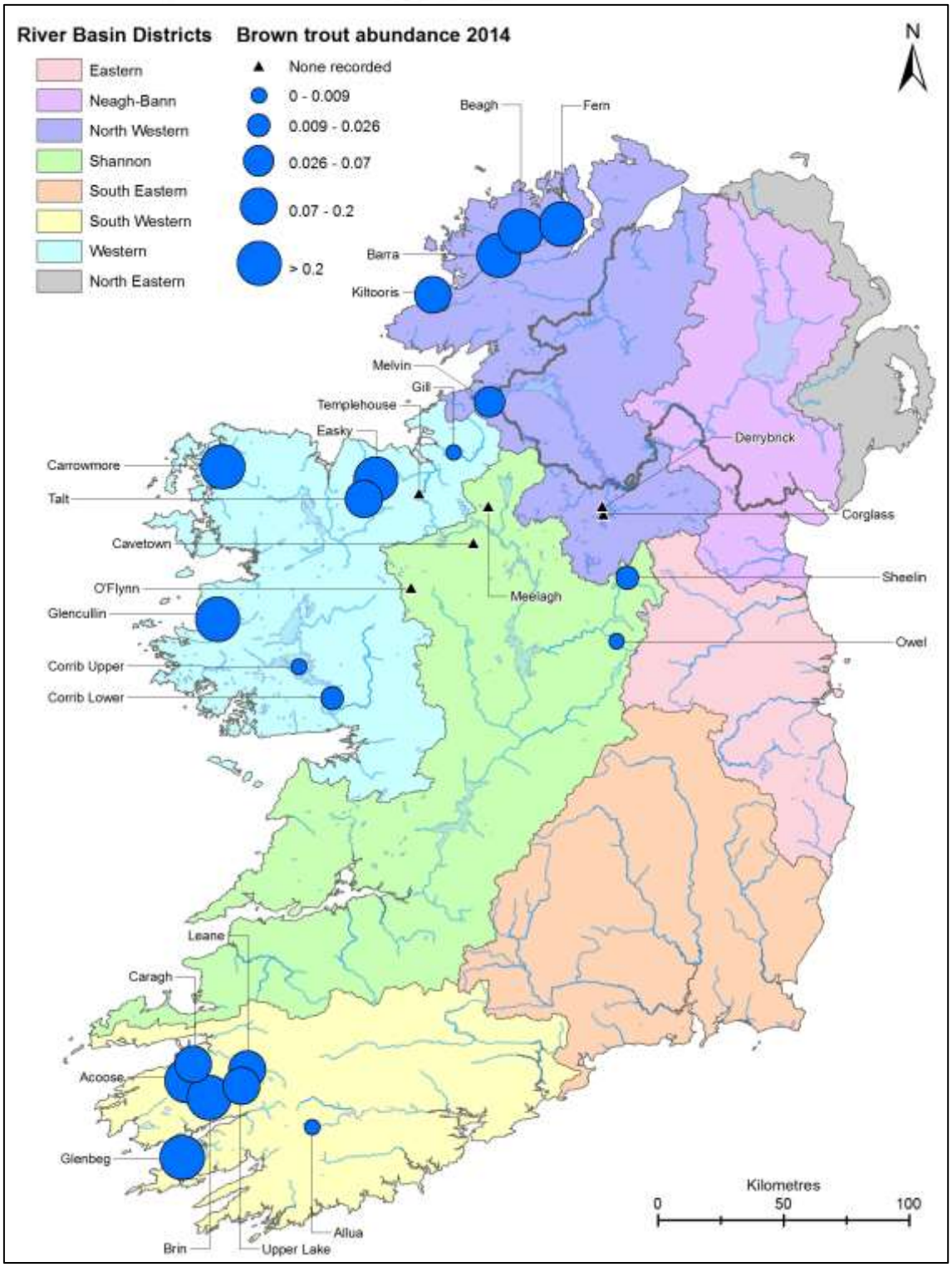

Fig. 4.4. Brown trout distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

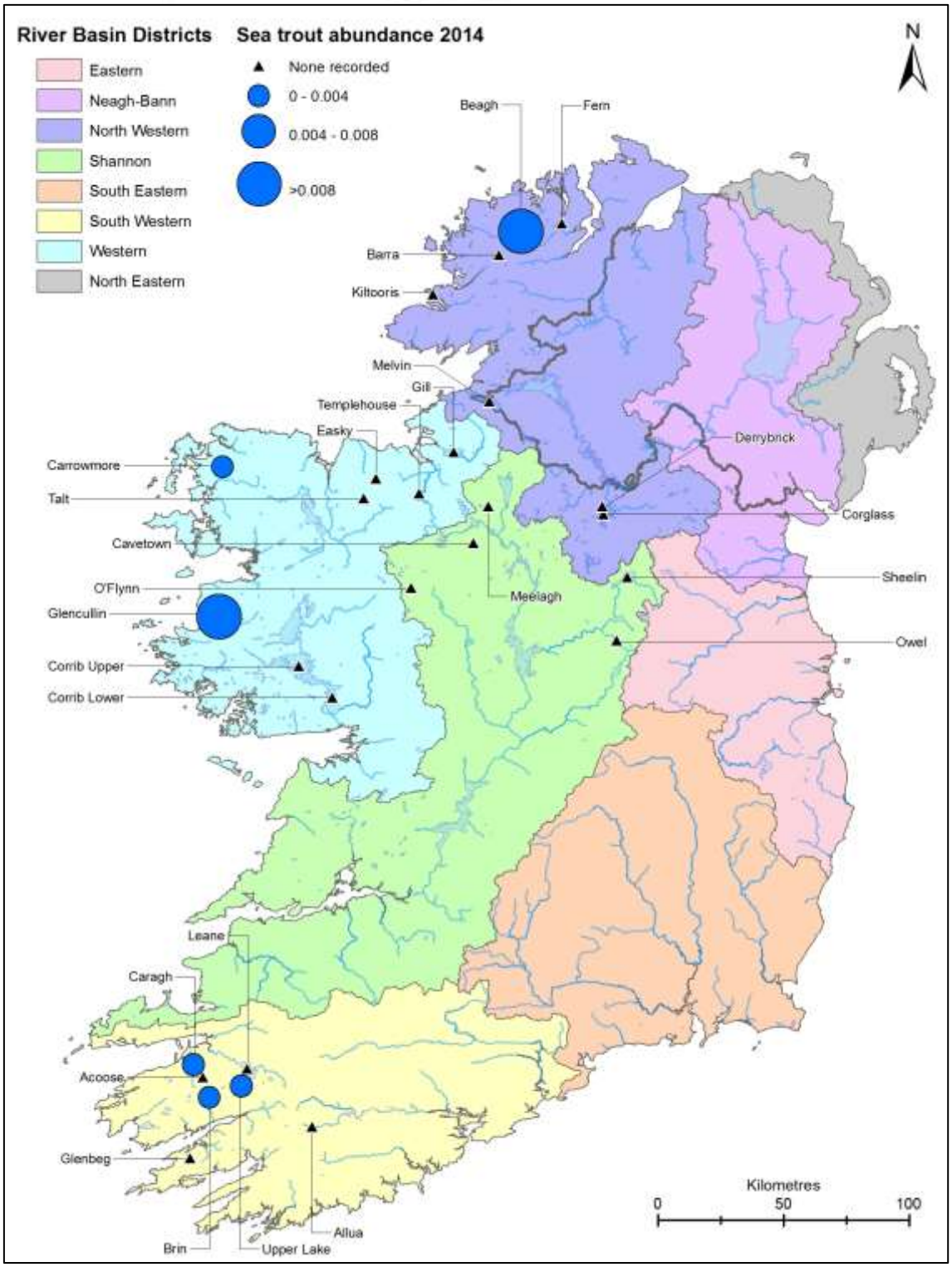

Fig. 4.5. Sea trout distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

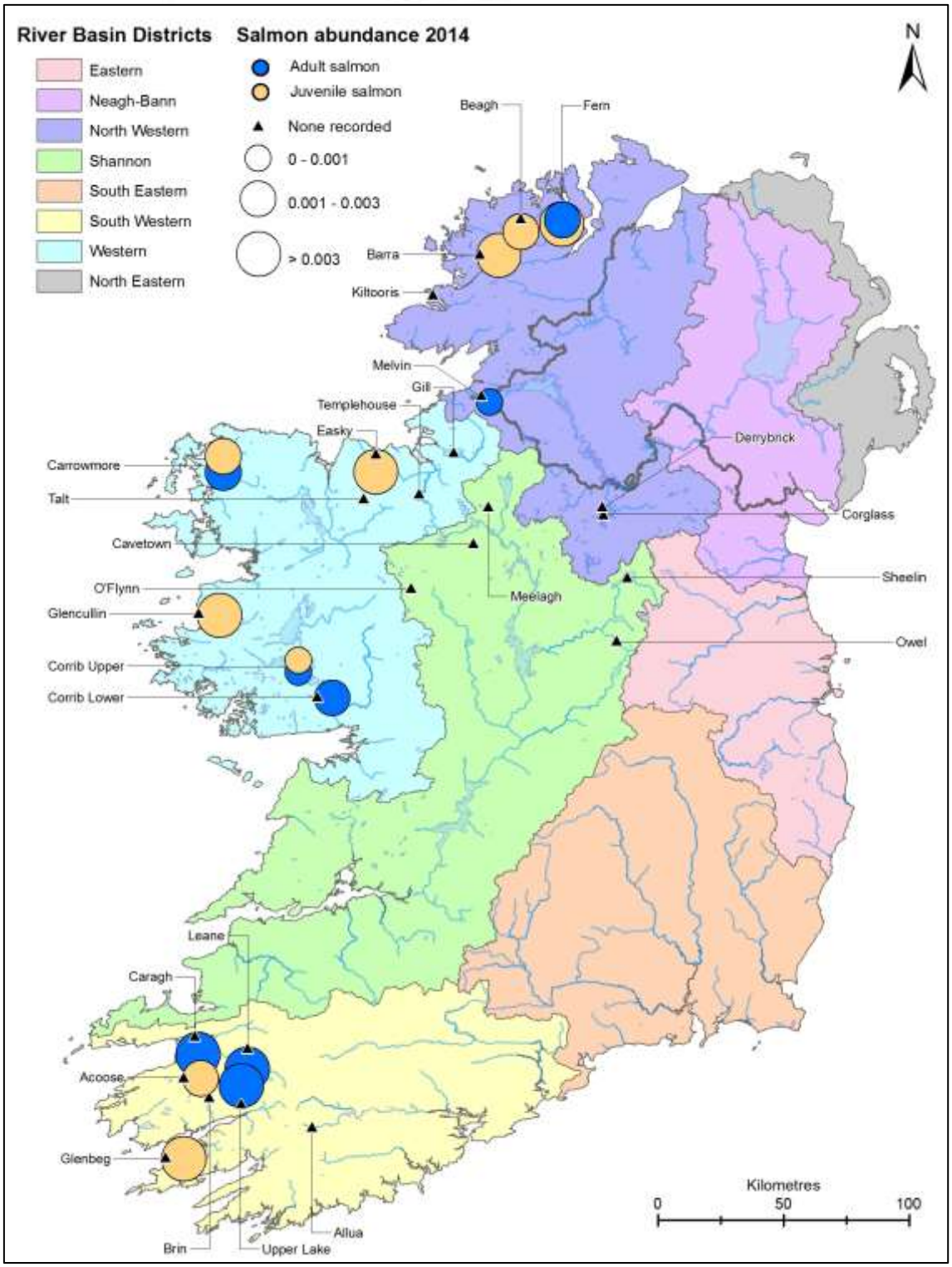

Fig. 4.6. Salmon distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

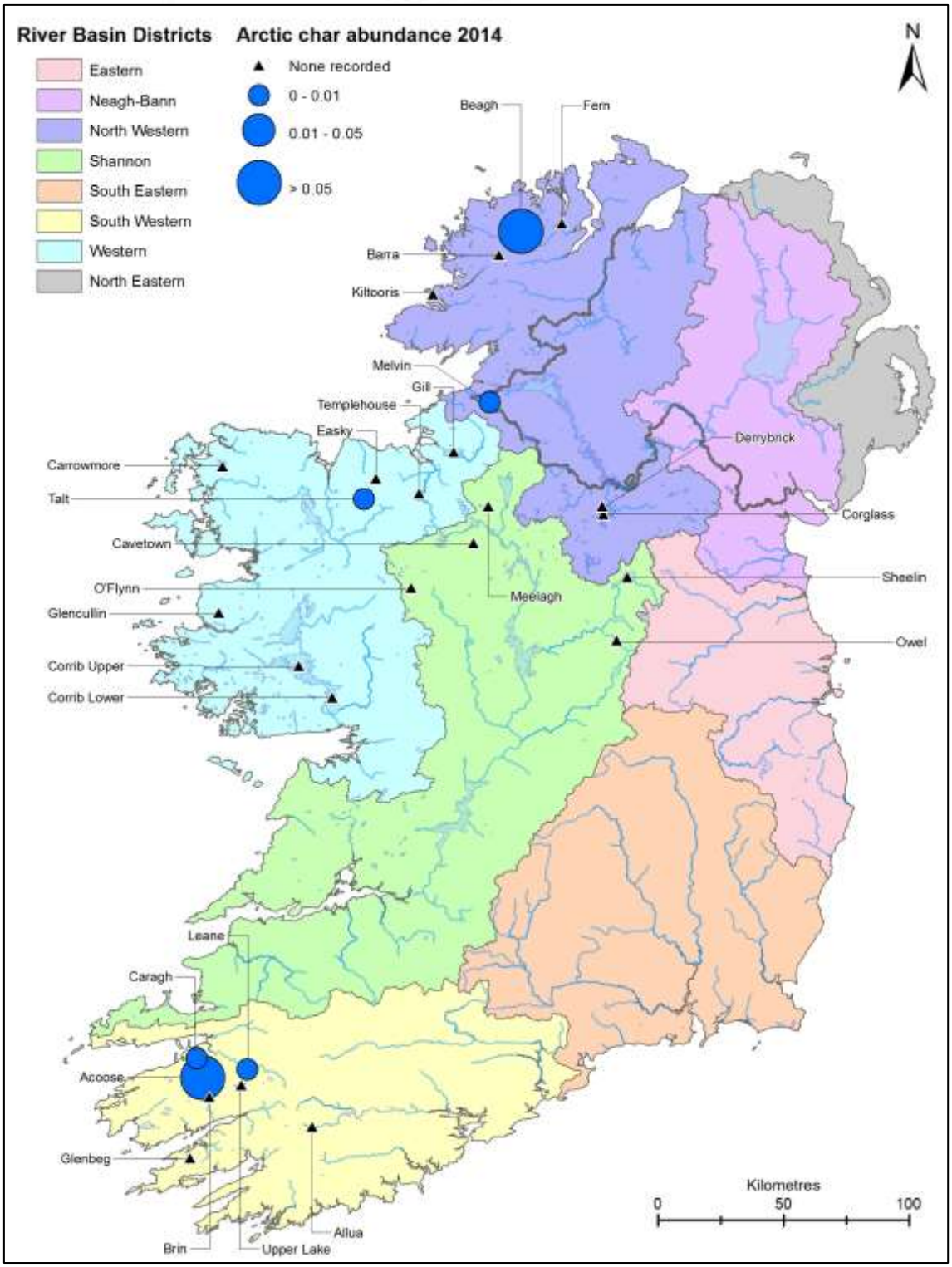

Fig. 4.7. Char distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

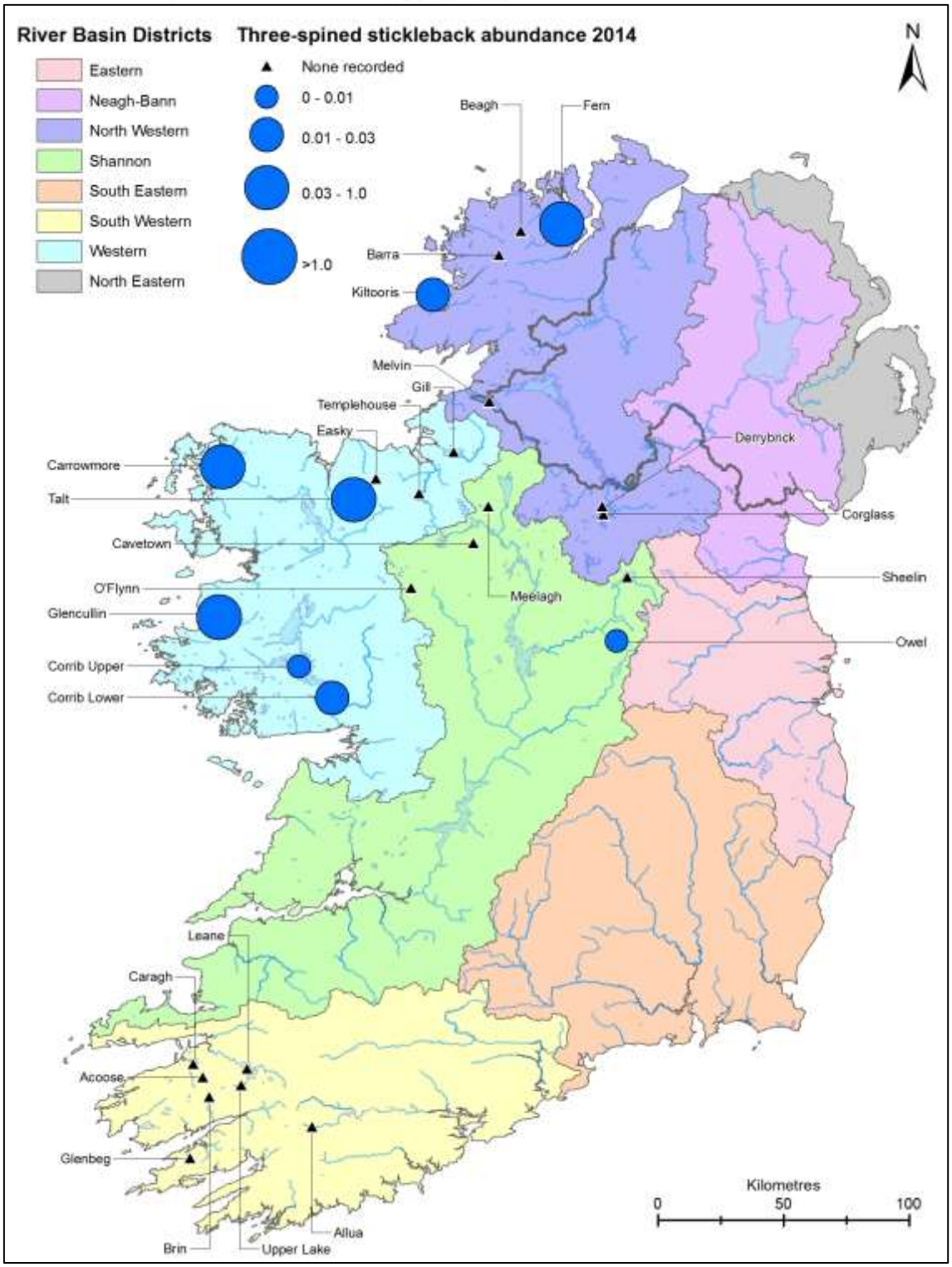

Fig. 4.8. Three-spined stickleback distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

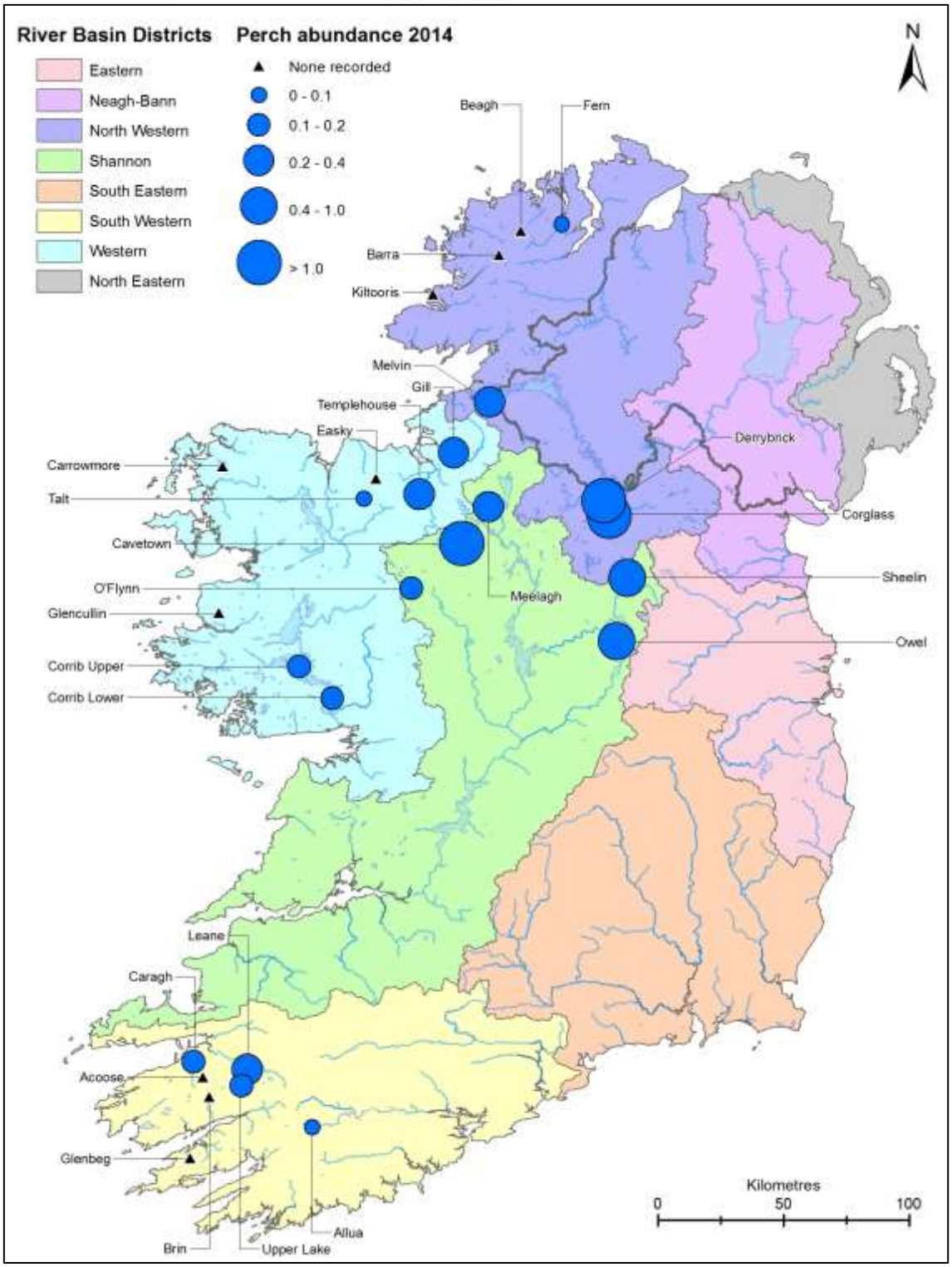

Fig. 4.9. Perch distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

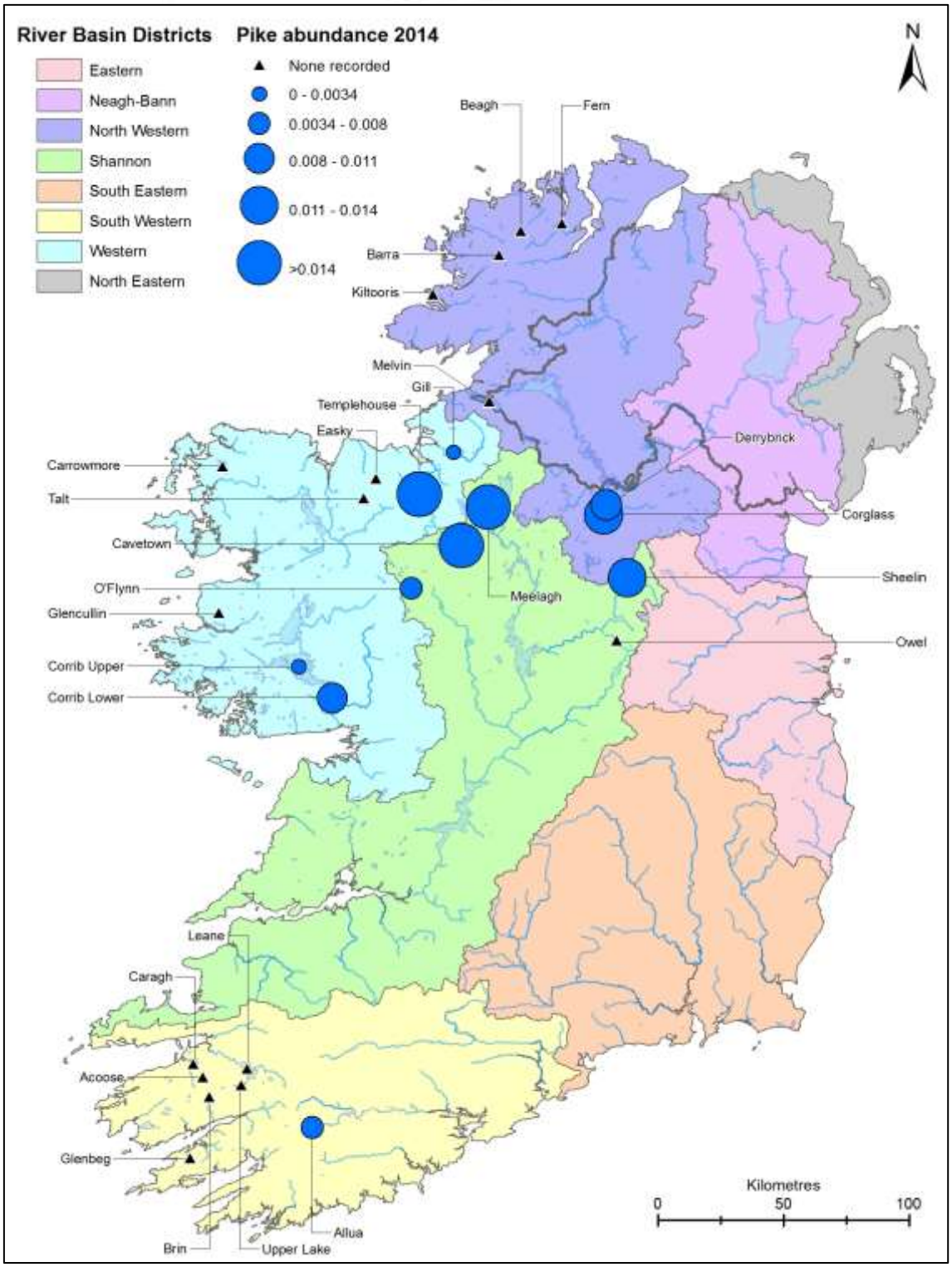

Fig. 4.10. Pike distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

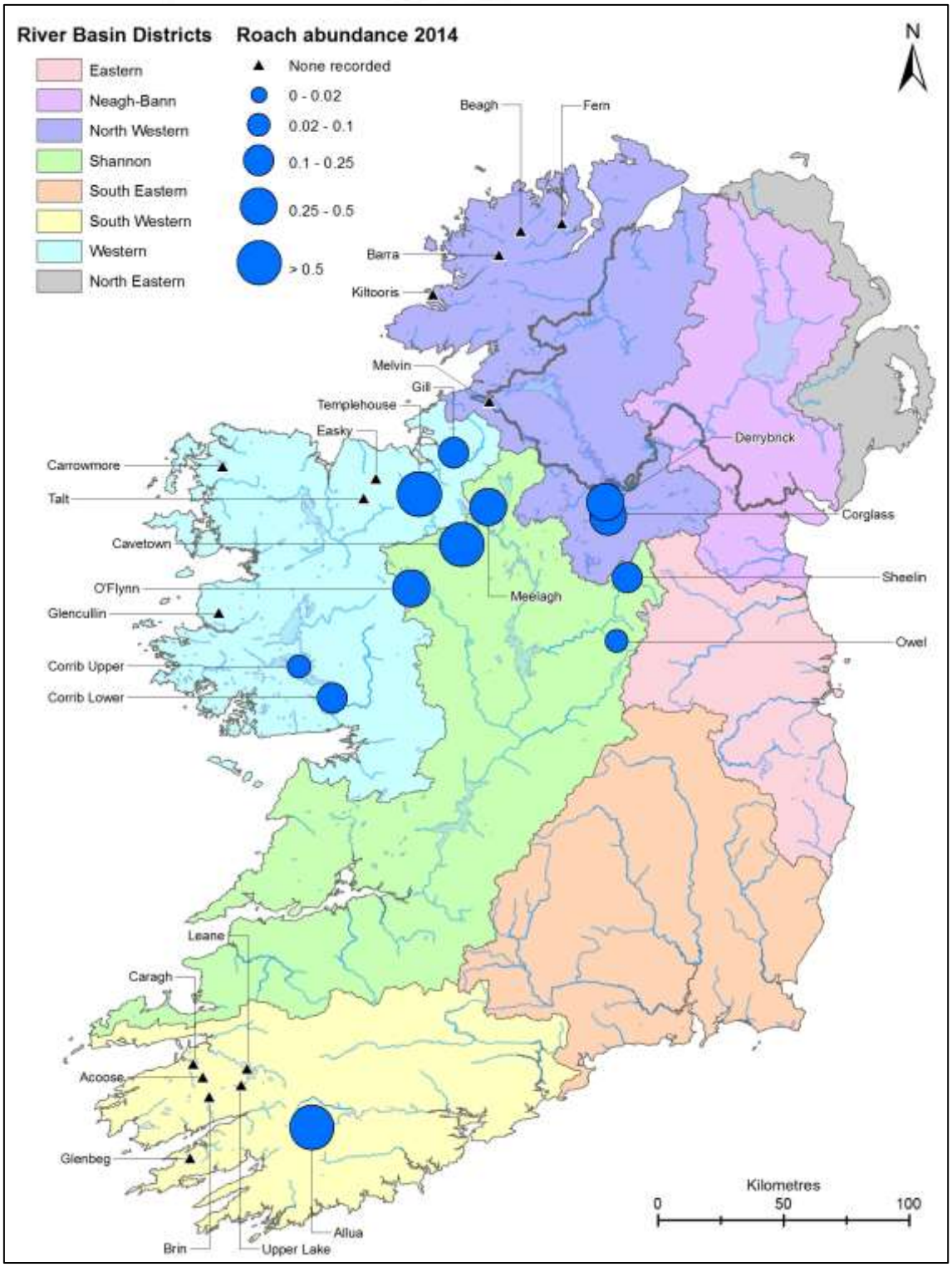

Fig. 4.11. Roach distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

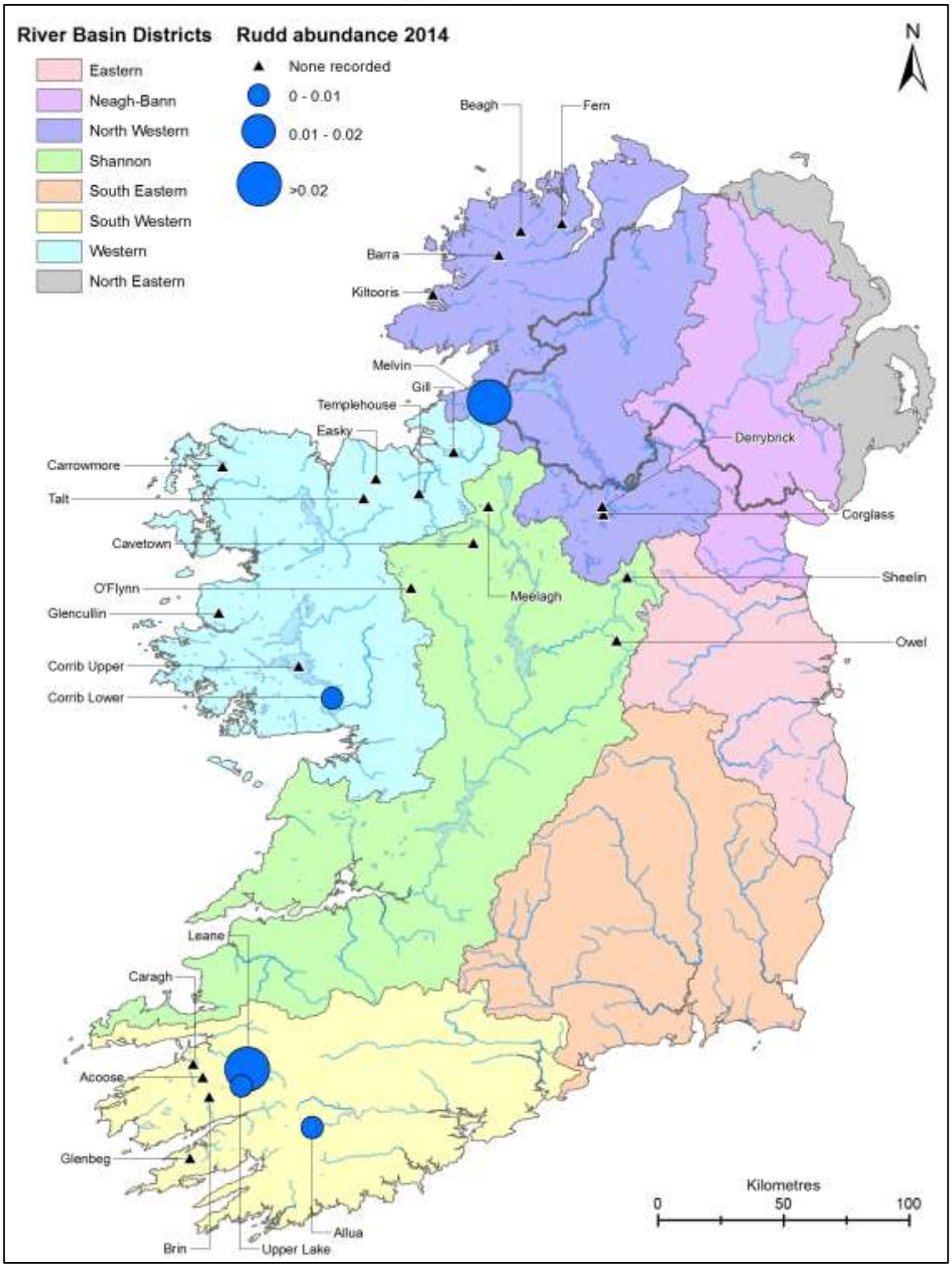

Fig. 4.12. Rudd distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

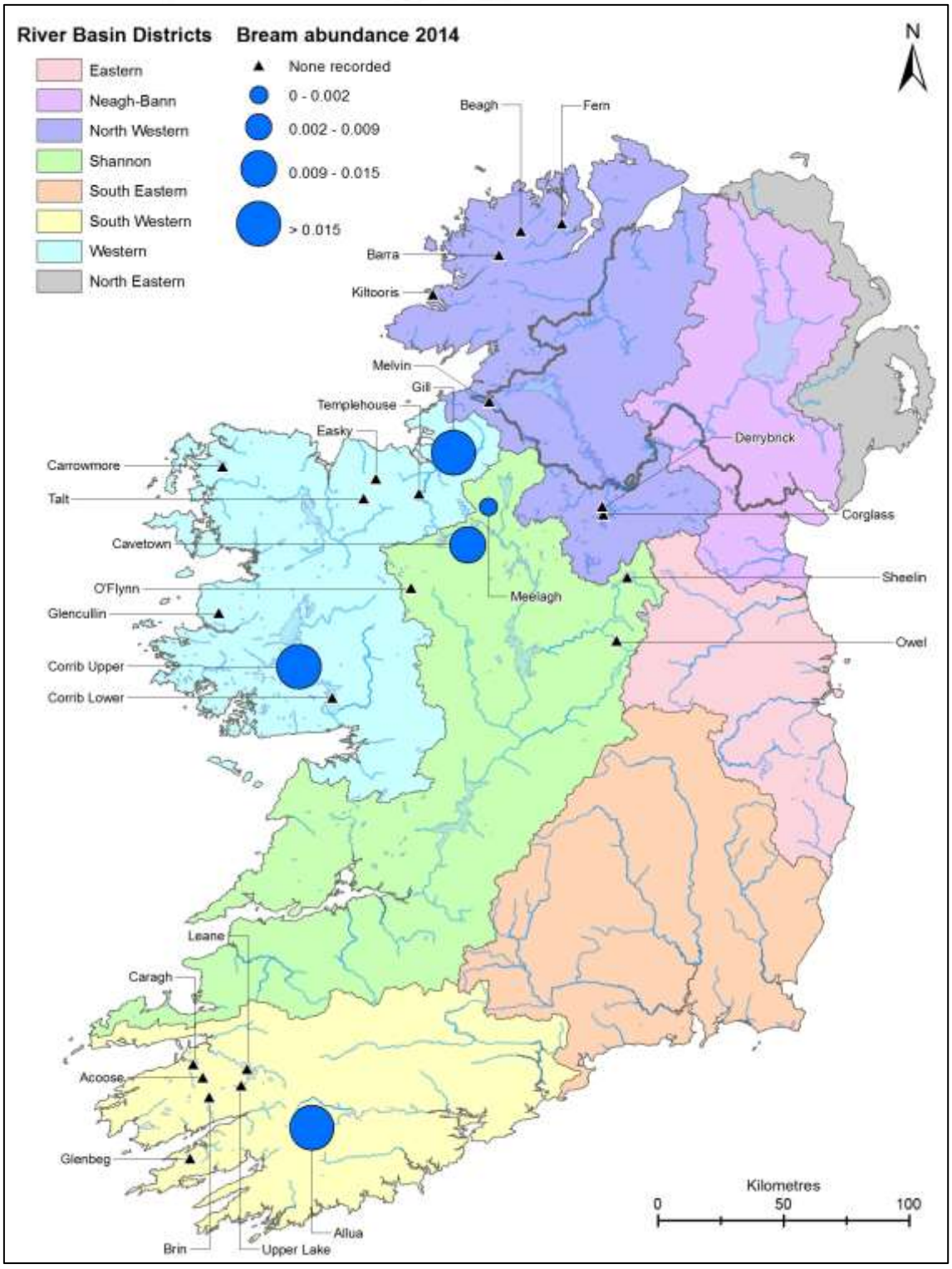

Fig. 4.13. Bream distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

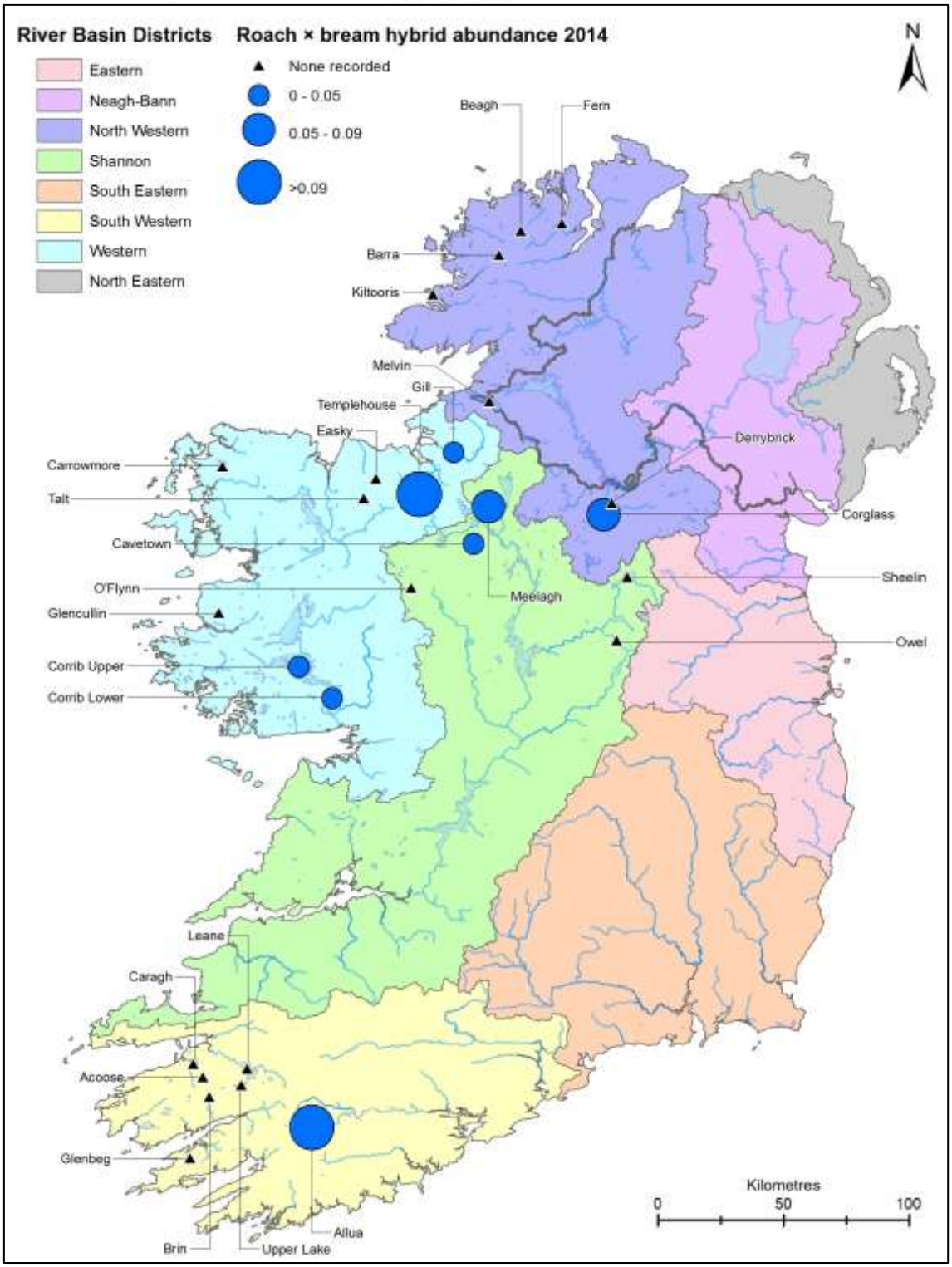

Fig. 4.14. Roach × bream hybrid distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

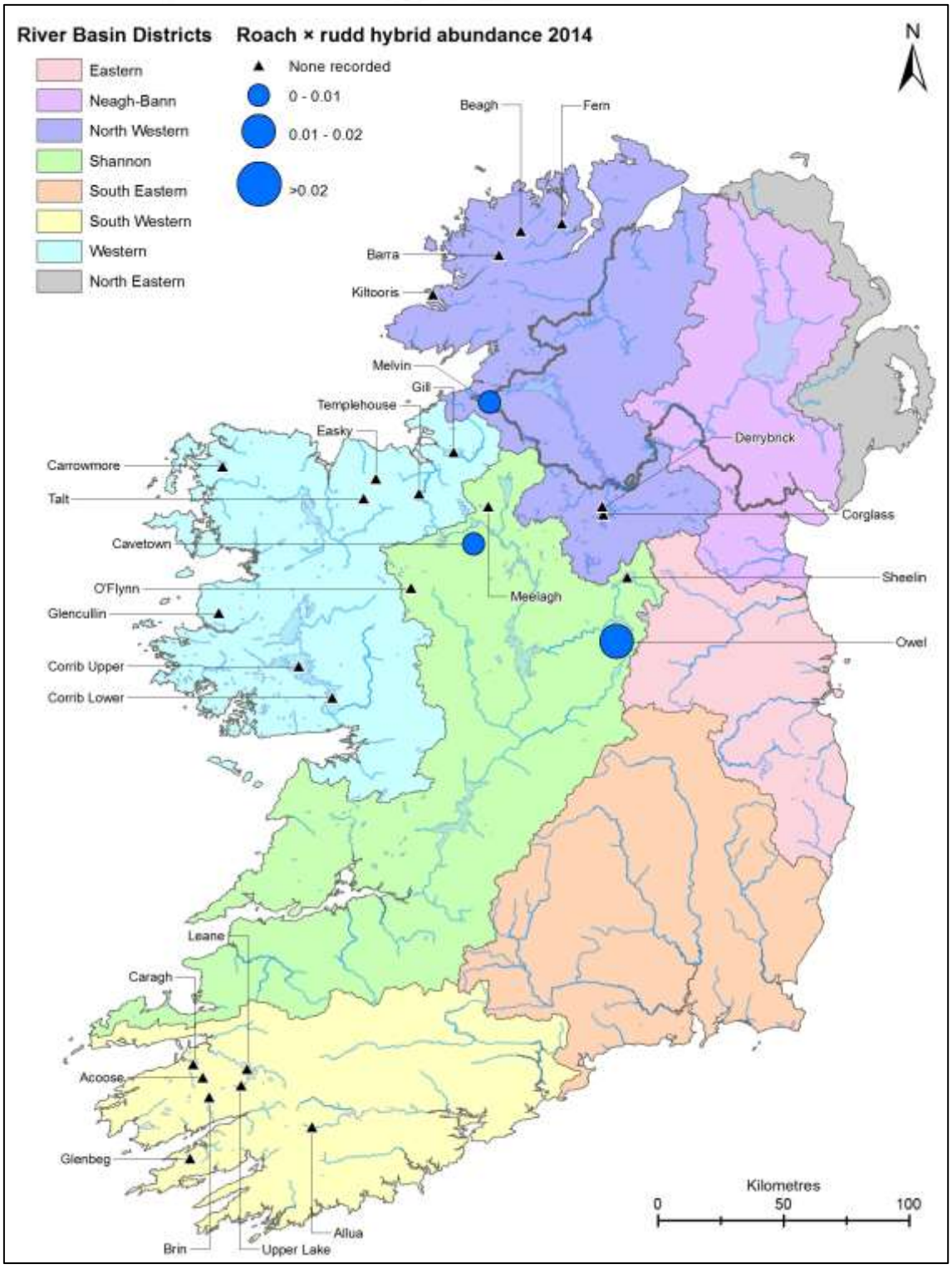

Fig. 4.15. Roach × rudd hybrid distribution and abundance (CPUE) in lakes surveyed for WFD fish monitoring during 2014

4.1.3 Fish abundance and biomass

The highest abundance and the highest biomass of eels amongst all lakes surveyed during 2014 were recorded in Upper Lough Corrib (a high alkalinity lake in Co. Galway/Mayo) (Figs. 4.15 and 4.16).

The highest abundance of brown trout was recorded in Lough Beagh (a low alkalinity lake in Co. Donegal) and the highest biomass of brown trout was recorded in Lough Fern (a moderate alkalinity lake in Co. Donegal) (Figs. 4.17 and 4.18).

Sea trout abundance and biomass was highest in Glencullin Lough (a low alkalinity lake in Co. Mayo) amongst all lakes surveyed (Figs. 4.19 and 4.20).

Lough Acoose (a low alkalinity lake in Co. Kerry) had the highest abundance and the highest biomass of Arctic char (Figs. 4.21 and 4.22).

Derrybrick Lough (a high alkalinity lake in Co. Cavan) had the highest perch abundance and the highest perch biomass was recorded in Lough Sheelin (a high alkalinity lake in Co. Cavan/Co. Westmeath) (Figs. 4.23 and 4.24).

Templehouse Lake (a high alkalinity lake in Co. Sligo) had the highest roach abundance and biomass (Figs. 4.25 and 4.26).

Lough Meelagh (a moderate alkalinity lake in Co. Roscommon) had the highest pike abundance and the highest pike biomass was recorded in Corglass Lough (a high alkalinity lake in Co. Cavan) (Figs. 4.27 and 4.28).

Bream abundance and biomass was highest in Lough Allua (a low alkalinity lake in Co. Cork) and Cavetown Lough respectively (a high alkalinity lake in Co. Leitrim) (Figs. 4.29 and 4.30).

Lough Melvin (a moderate alkalinity lake in Co. Leitrim/Co. Fermanagh) had the highest rudd abundance and the highest biomass amongst the five lakes where the species was recorded (Figs. 4.31 and 4.32).

Three-spined stickleback abundance and biomass was highest in Carrowmore Lake (a moderate alkalinity lake in Co. Mayo) (Figs. 4.33 and 4.34).

The highest abundance of roach x bream hybrids was recorded in Lough Allua (a low alkalinity lake in Co. Cork) and the highest biomass of roach x bream hybrids was in Templehouse Lake (a high alkalinity lake in Co. Sligo) (Figs. 4.35 and 4.36).

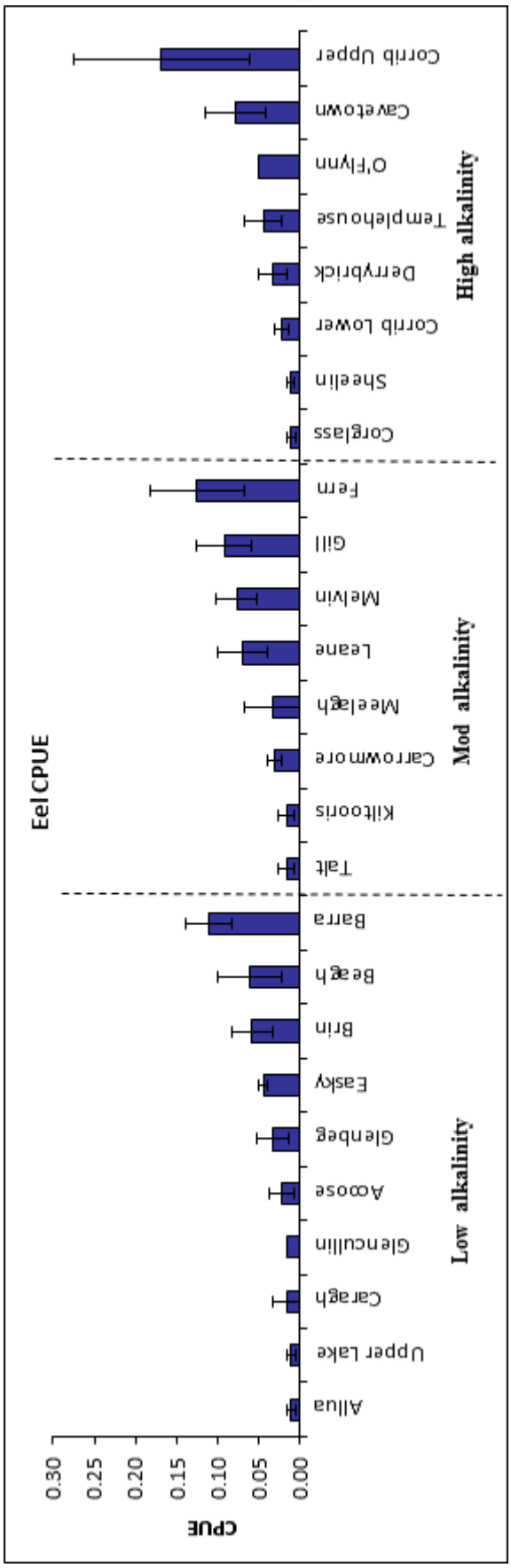

Fig. 4.15. Eel abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

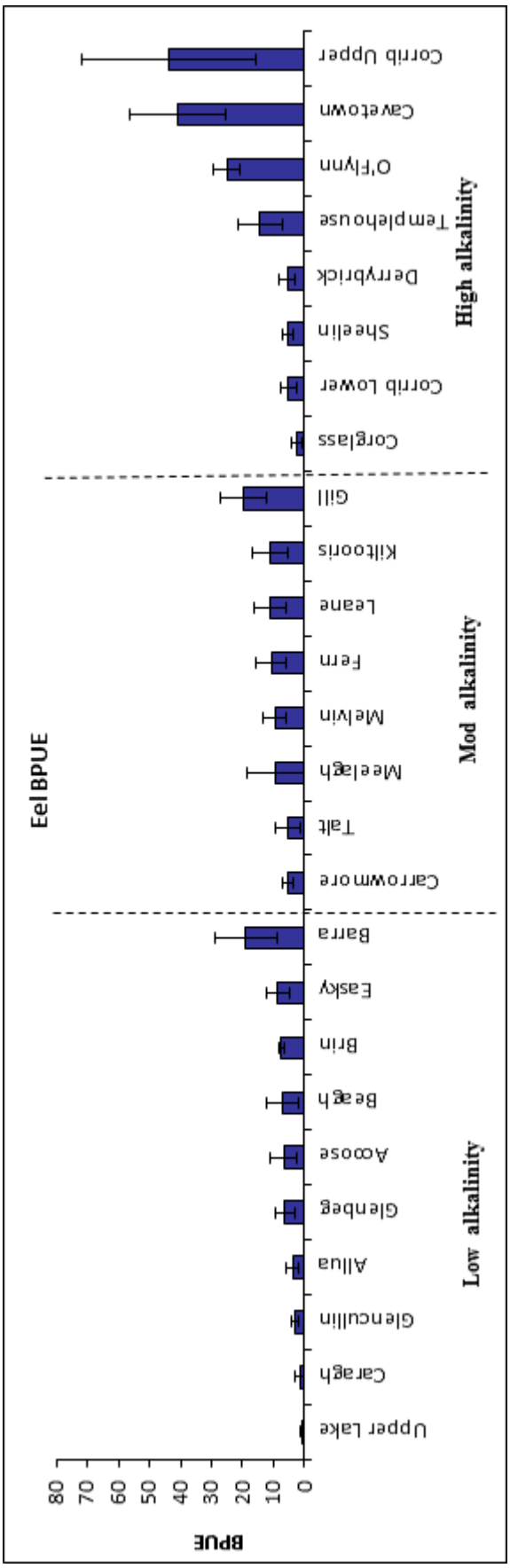

Fig. 4.16. Eel biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

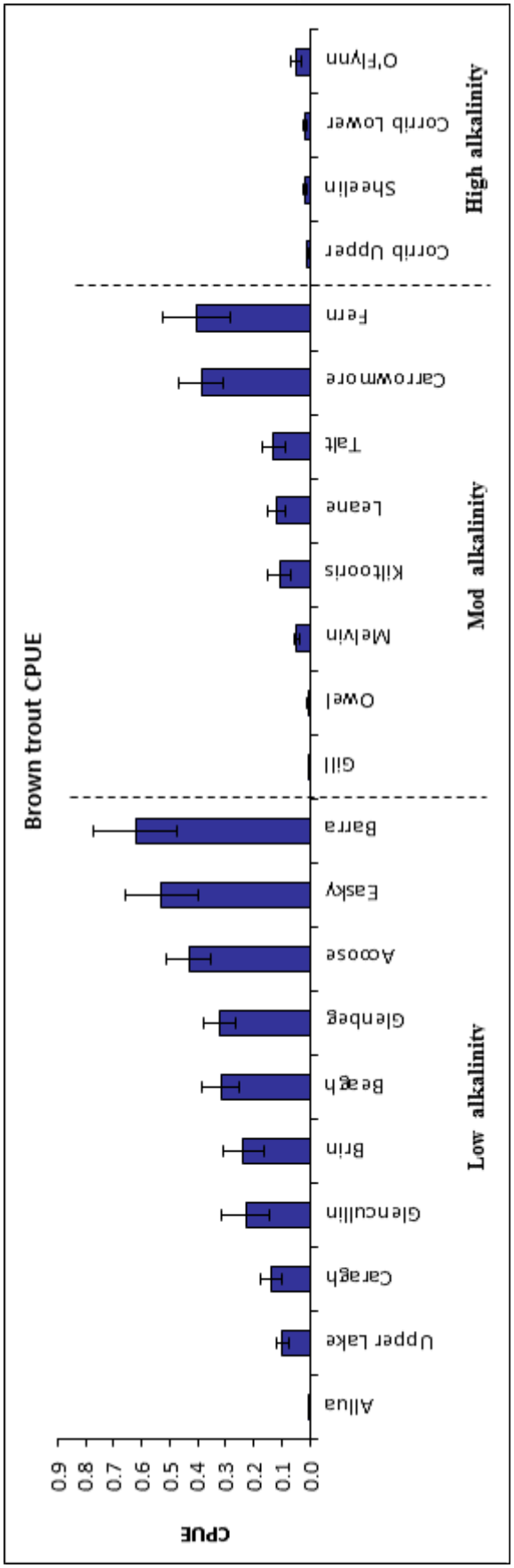

Fig. 4.17. Brown trout abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

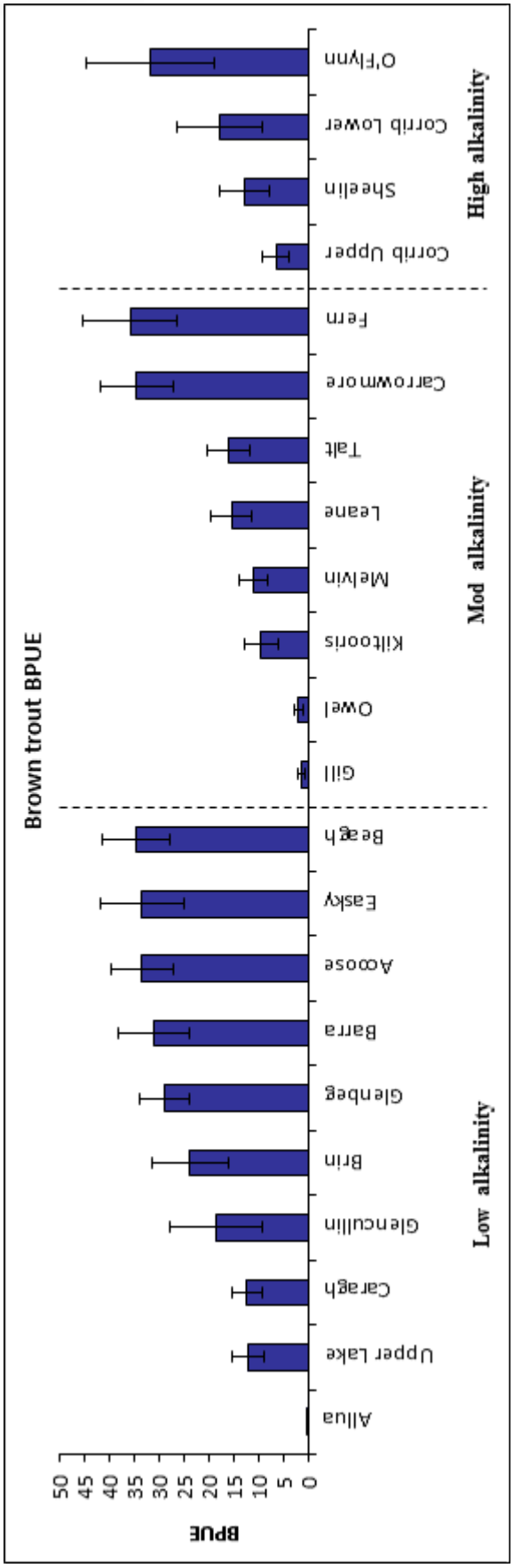

Fig. 4.18. Brown trout biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

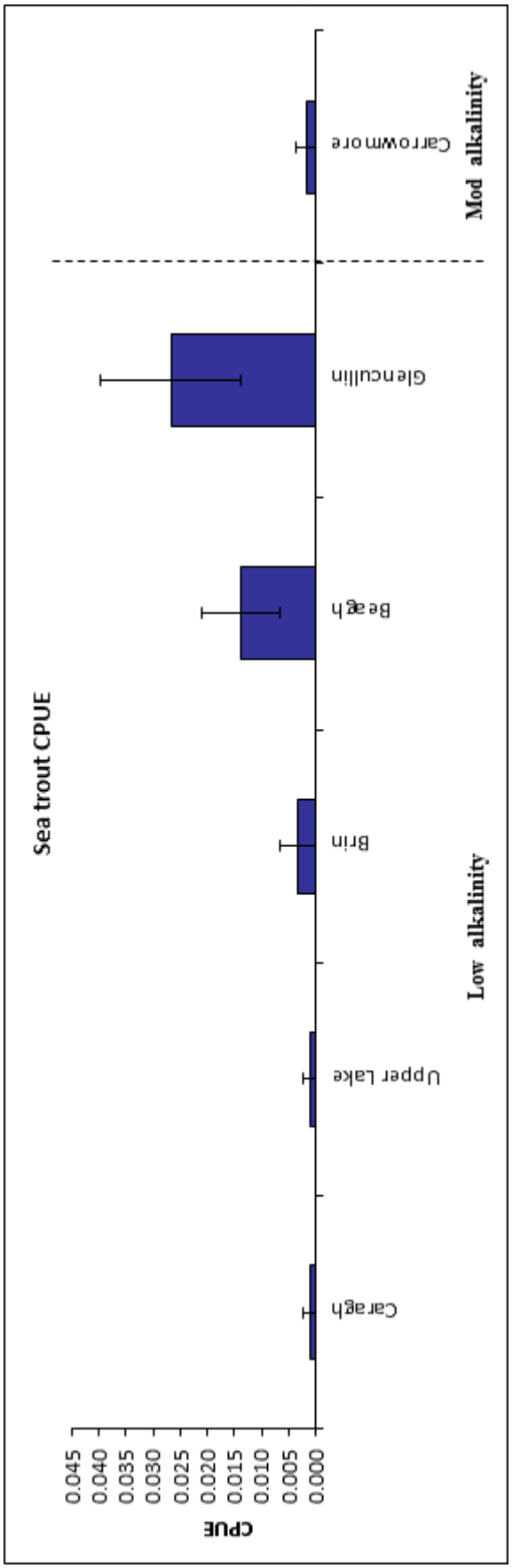

Fig. 4.19. Sea trout abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

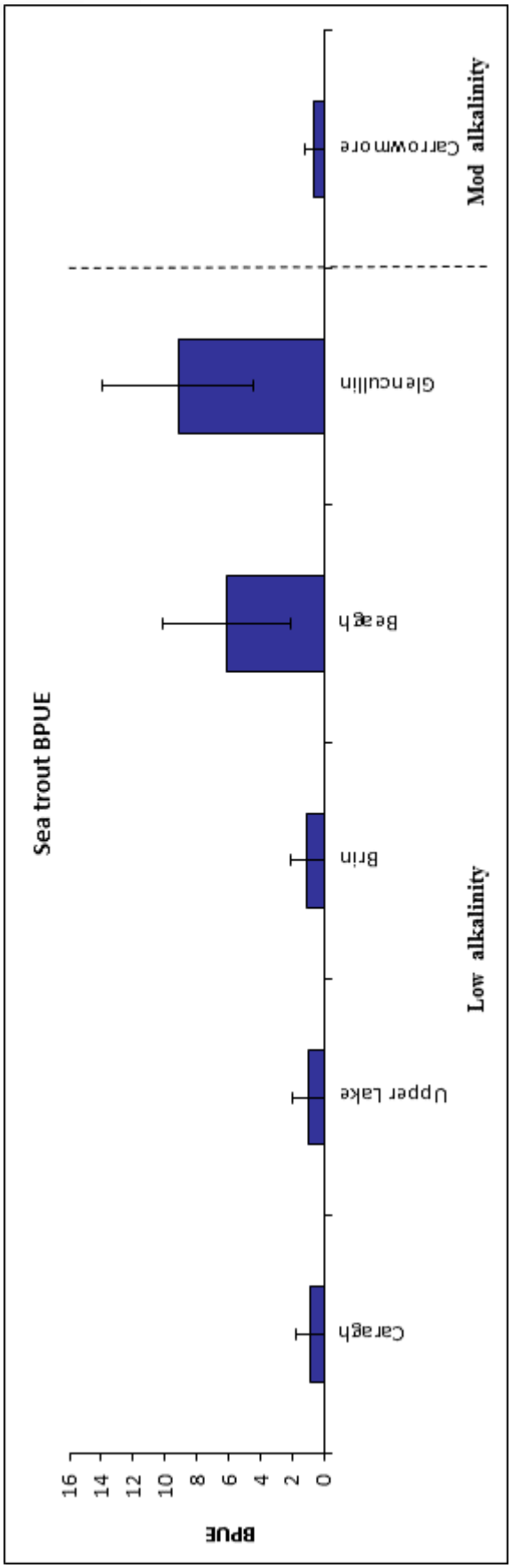

Fig. 4.20. Sea trout biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

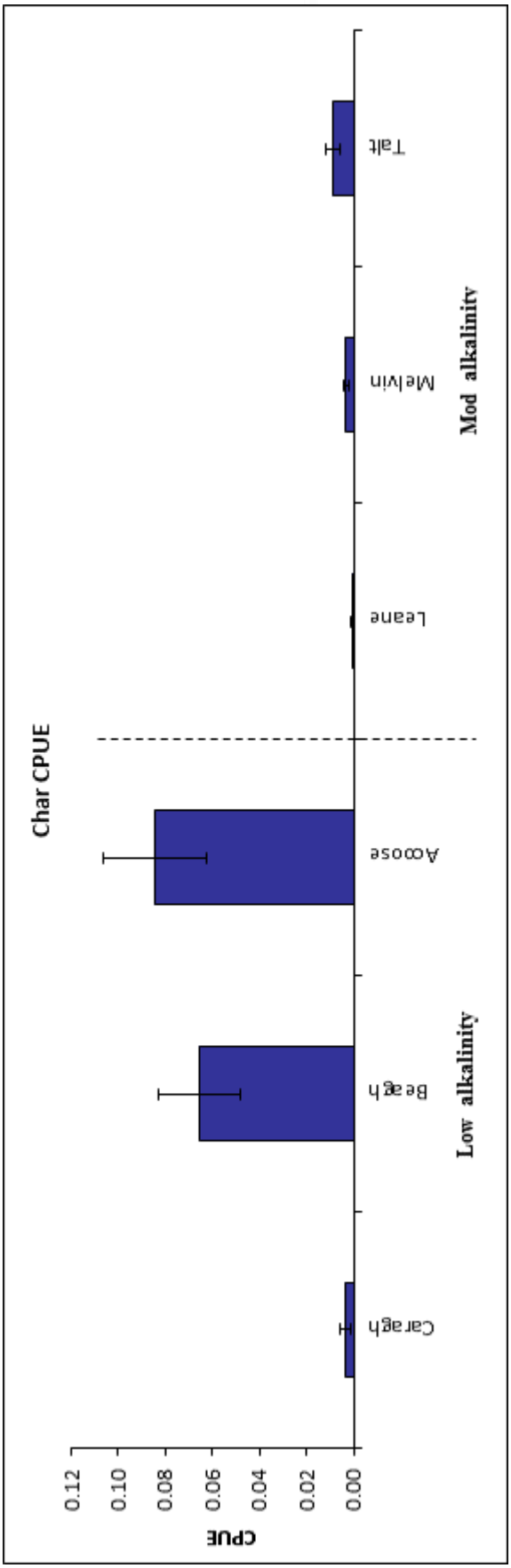

Fig. 4.21. Char abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

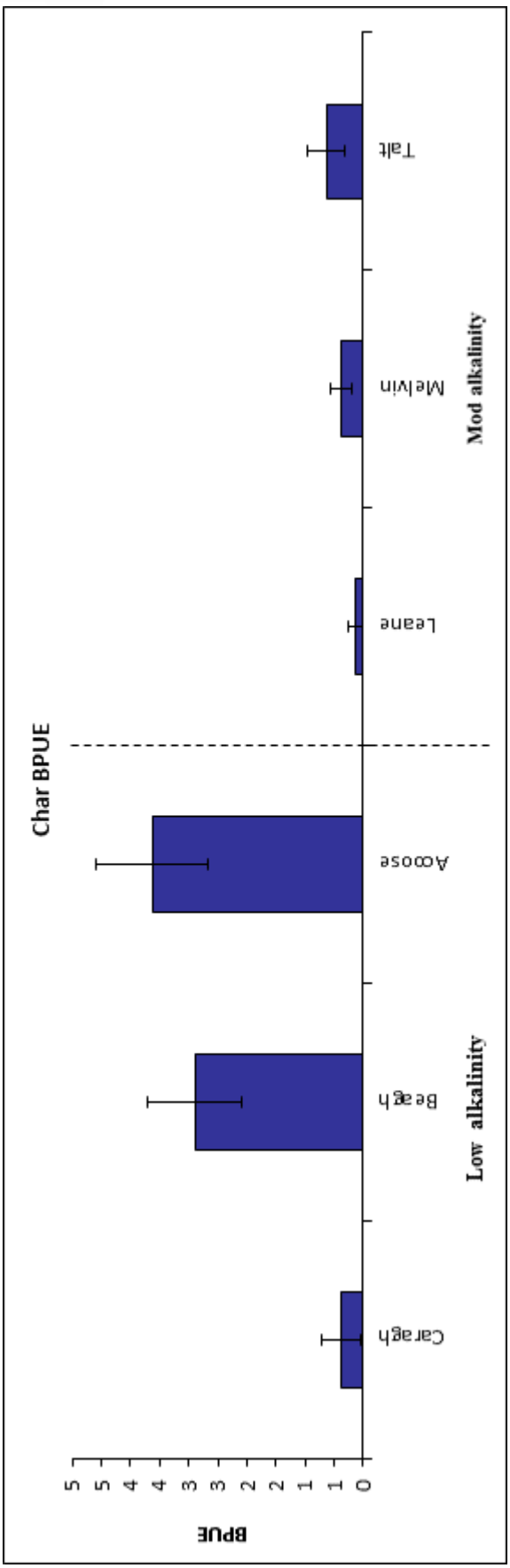

Fig. 4.22. Char biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

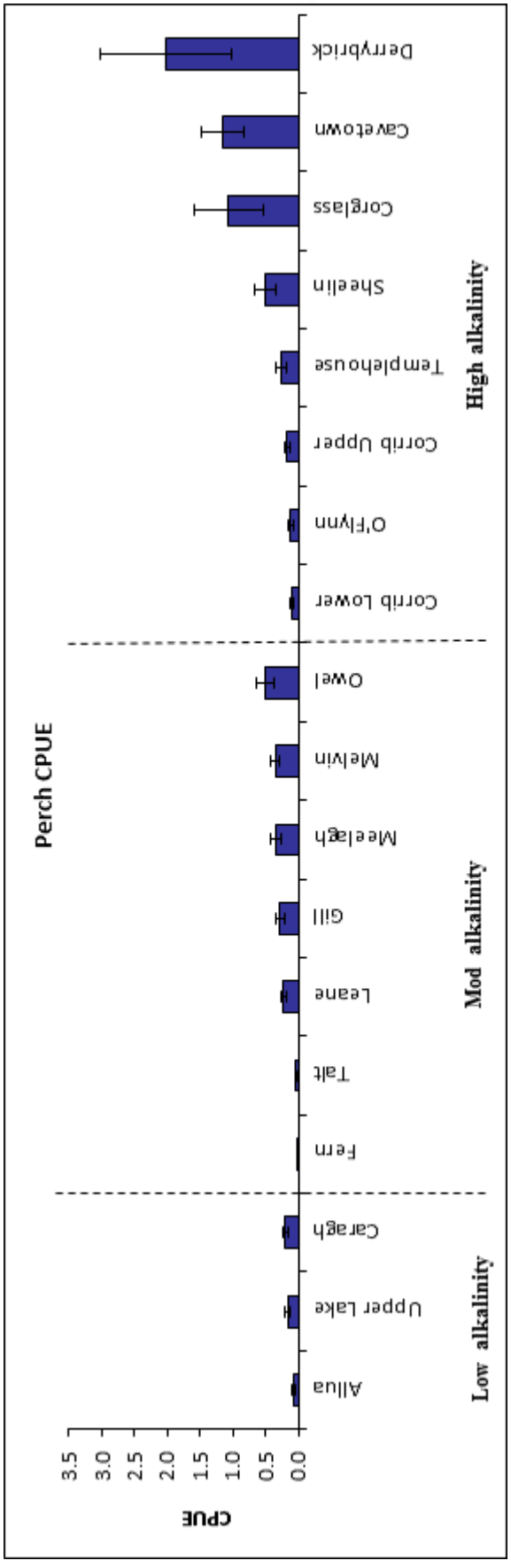

Fig. 4.23. Perch abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

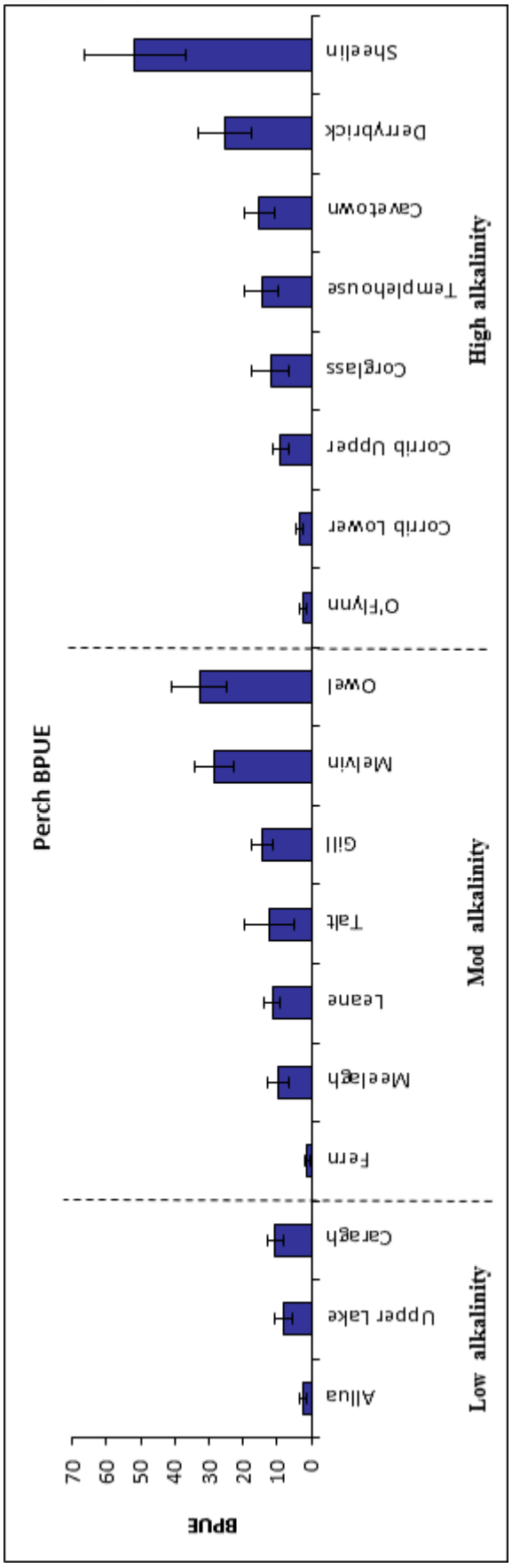

Fig. 4.24. Perch biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

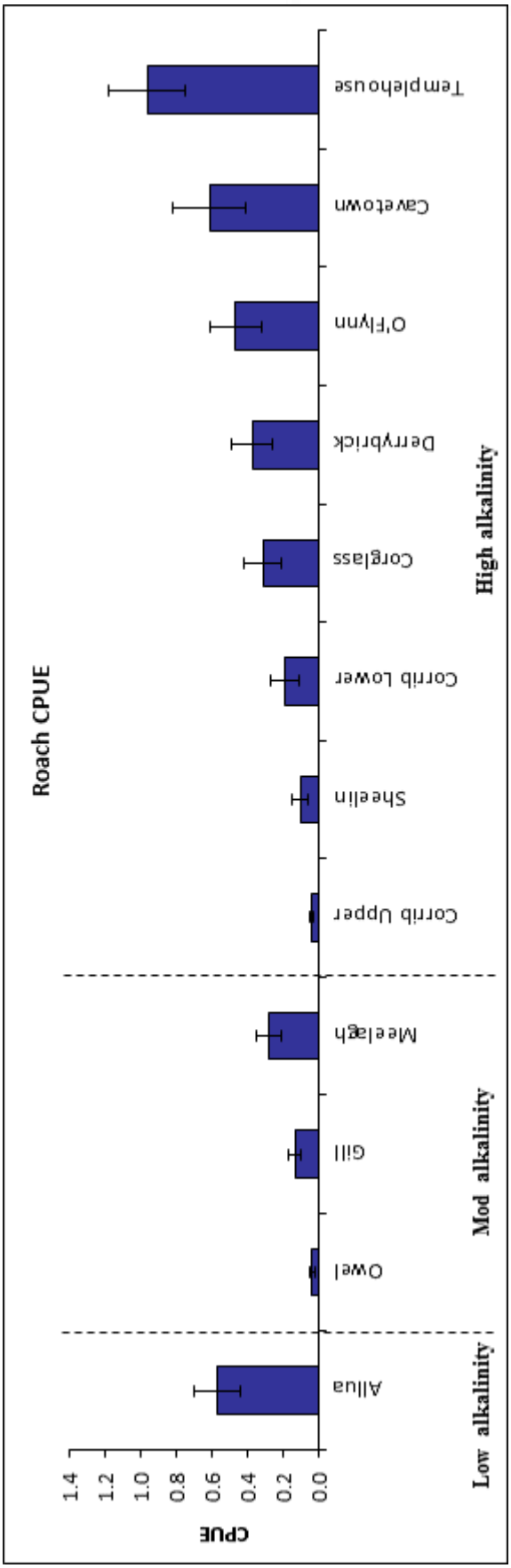

Fig. 4.25. Roach abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

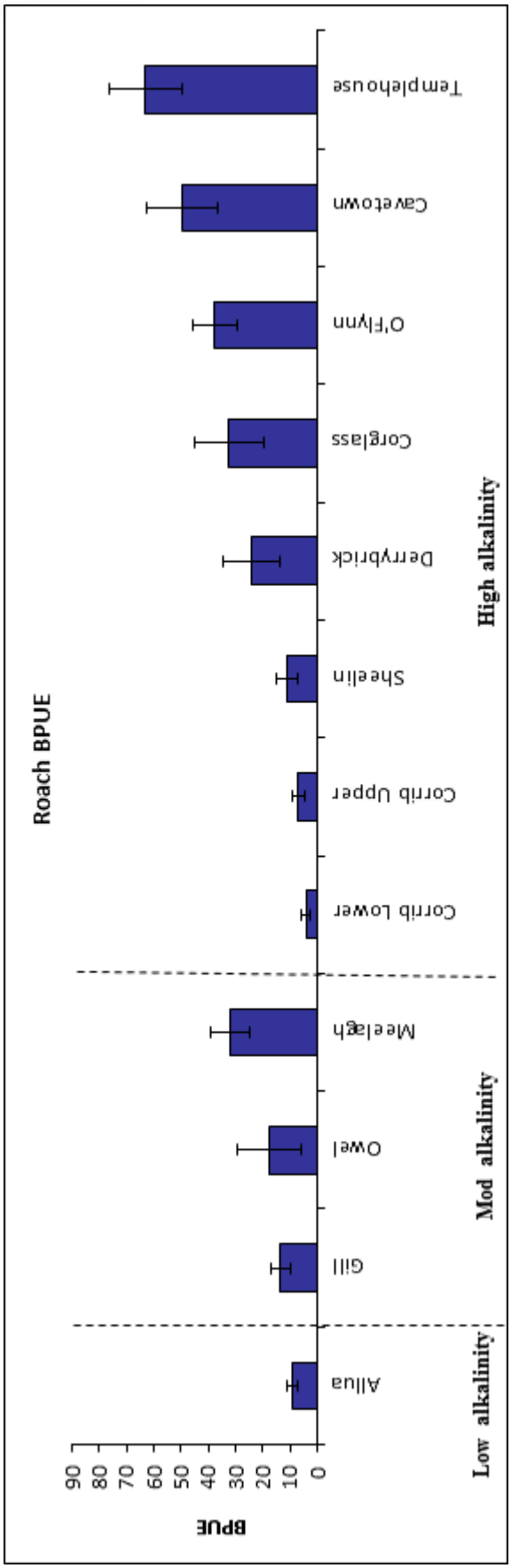

Fig. 4.26. Roach biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

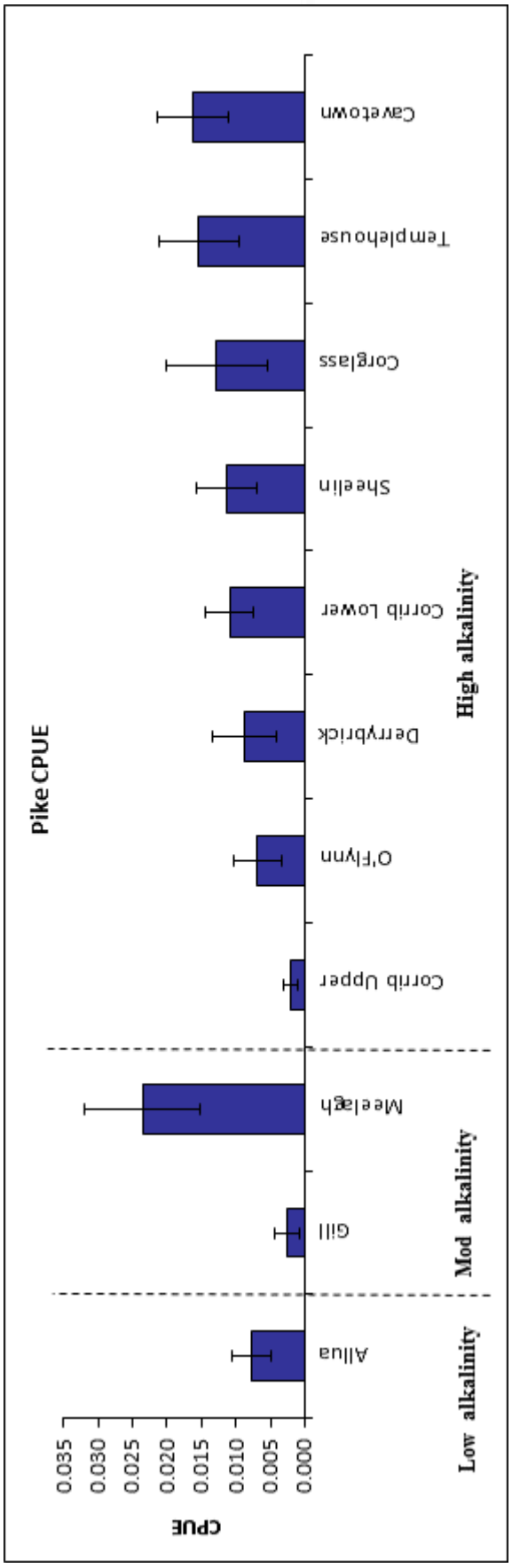

Fig. 4.27. Pike abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

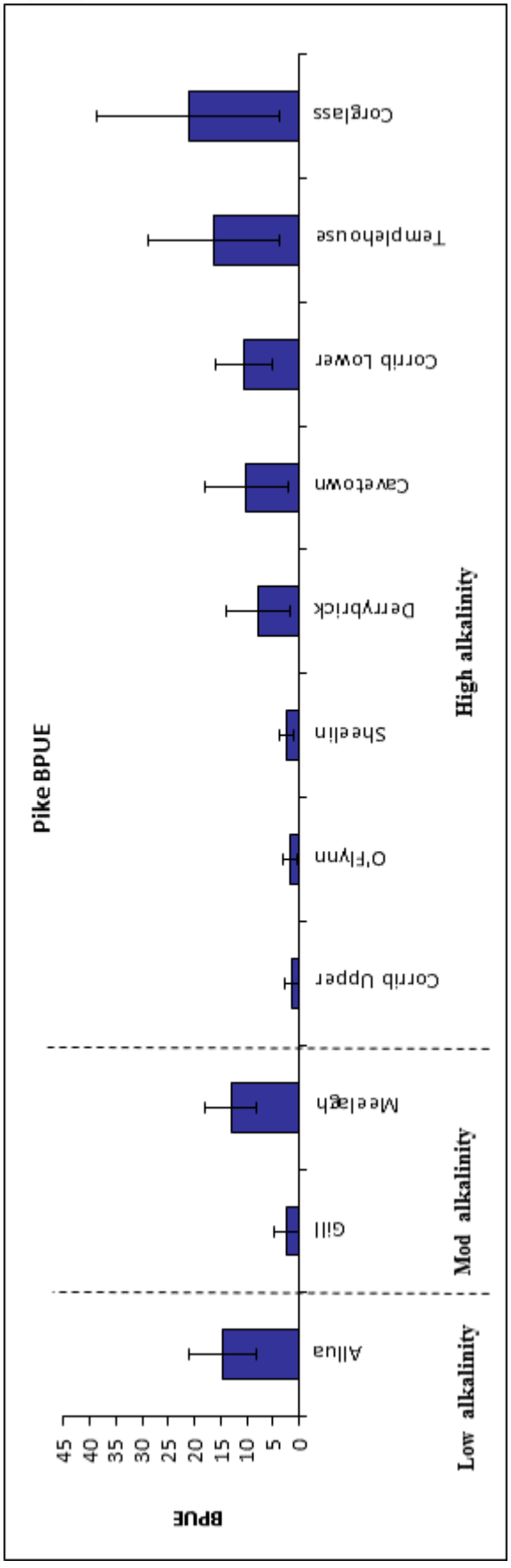

Fig. 4.28. Pike biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

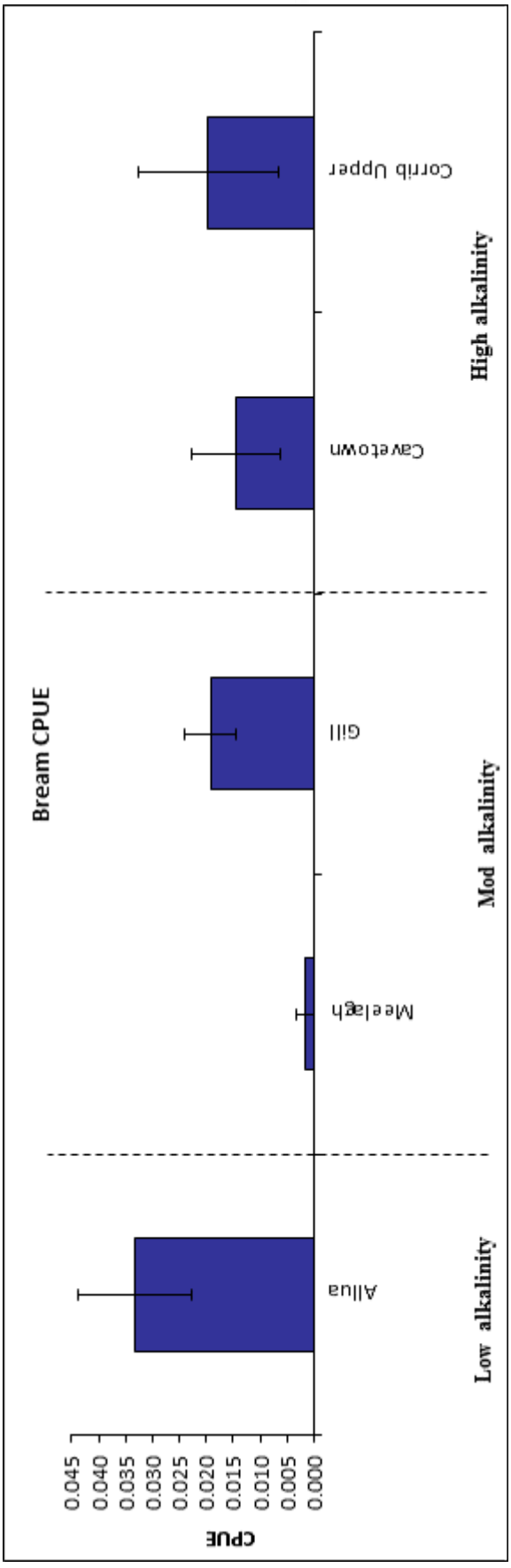

Fig. 4.29. Bream abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

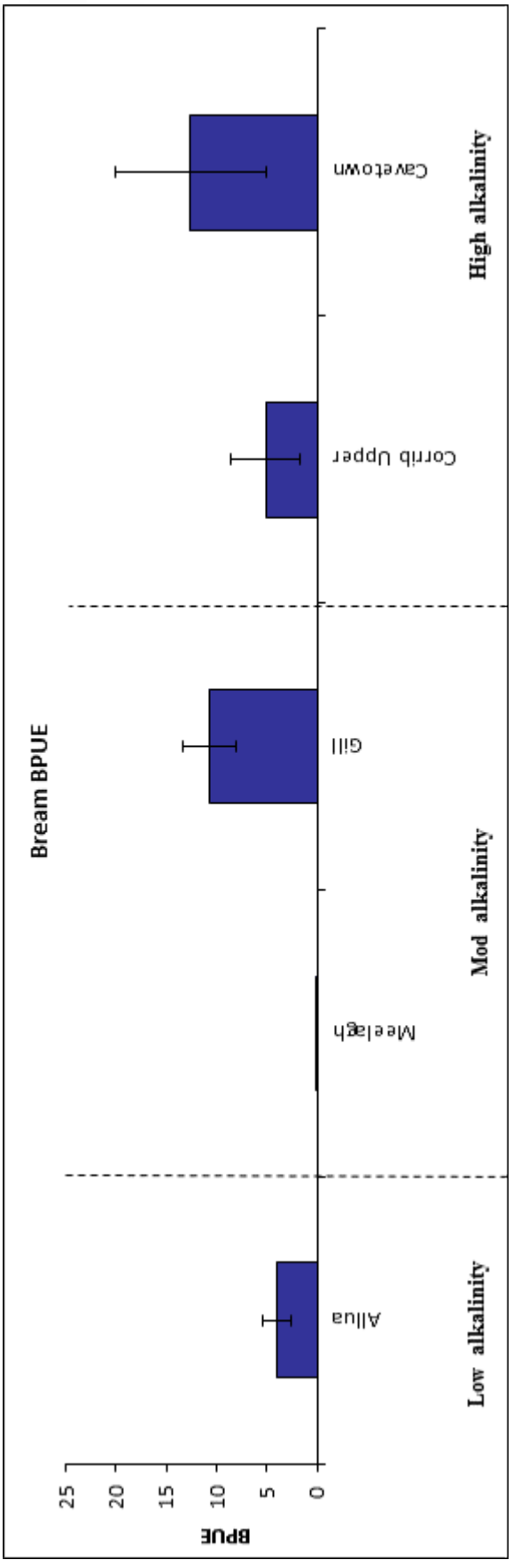

Fig. 4.30. Bream biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

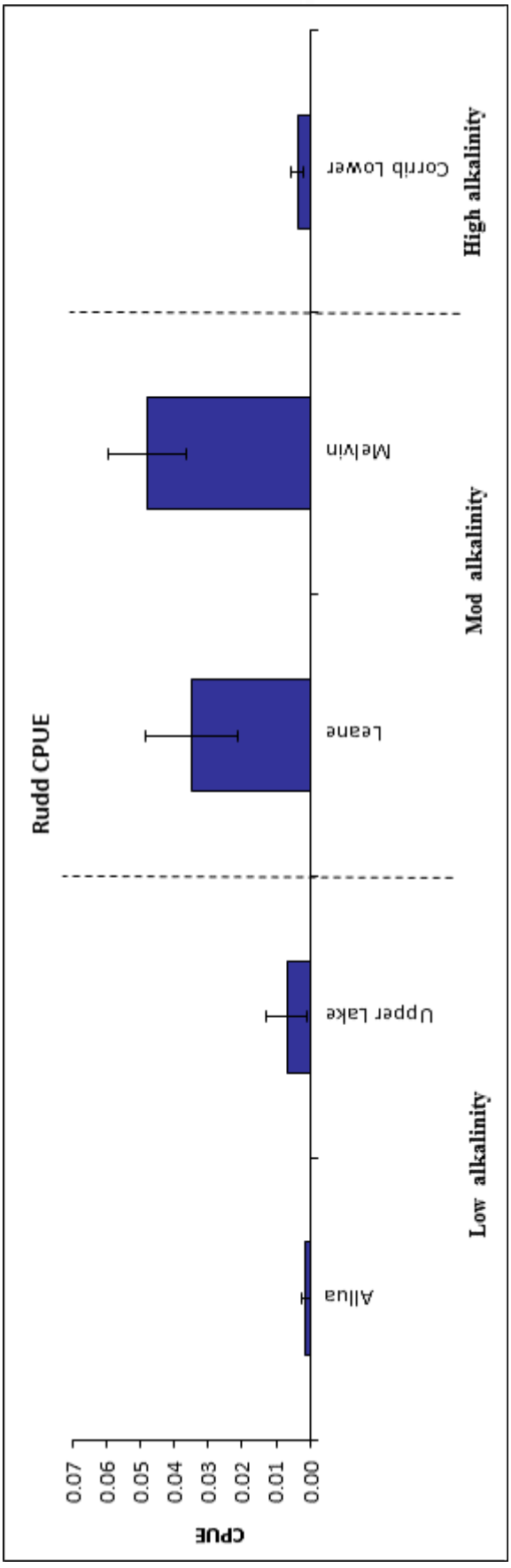

Fig. 4.31. Rudd abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

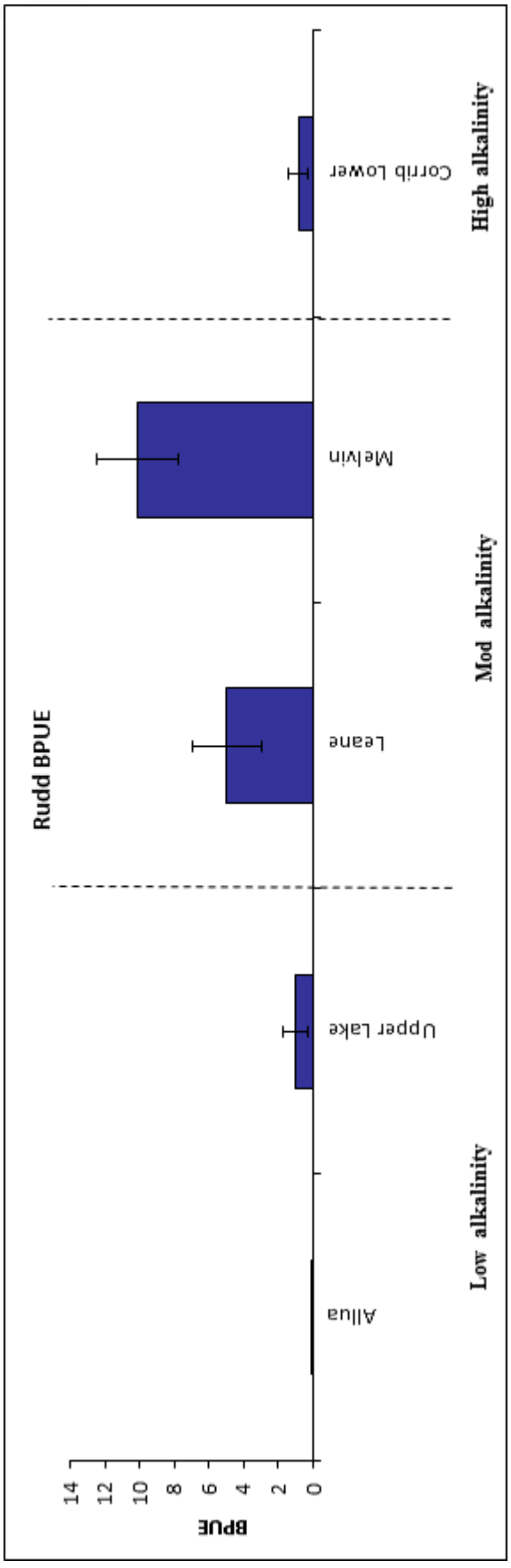

Fig. 4.32. Rudd biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

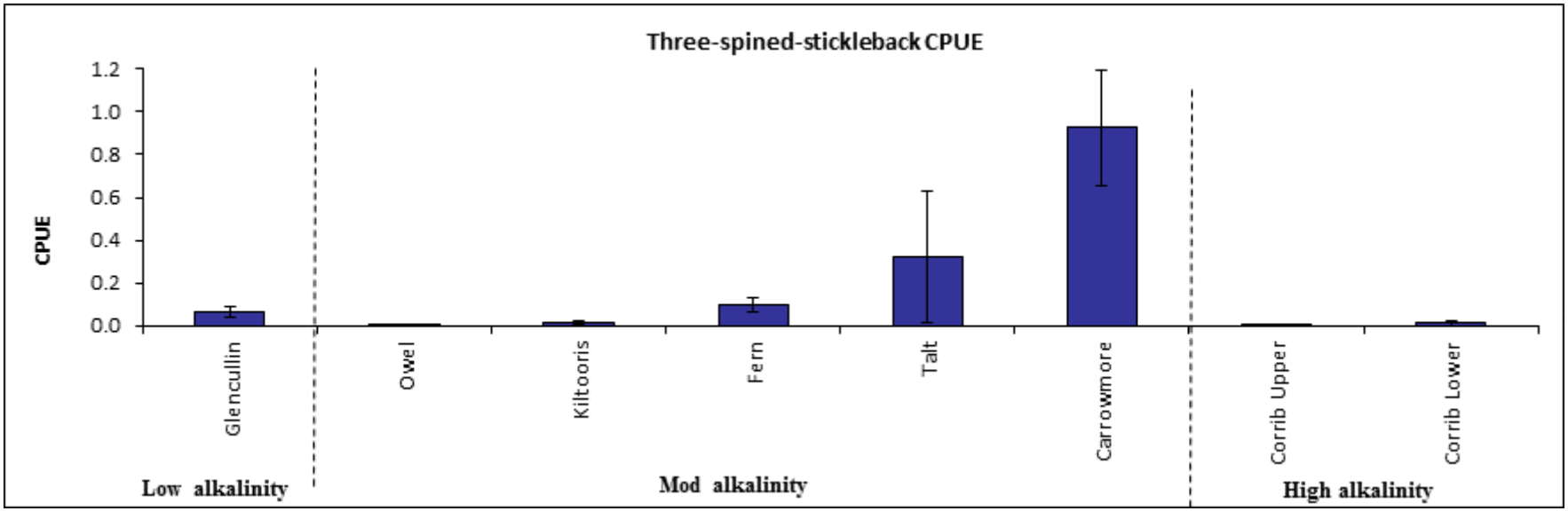

Fig. 4.33. Three-spined stickleback abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

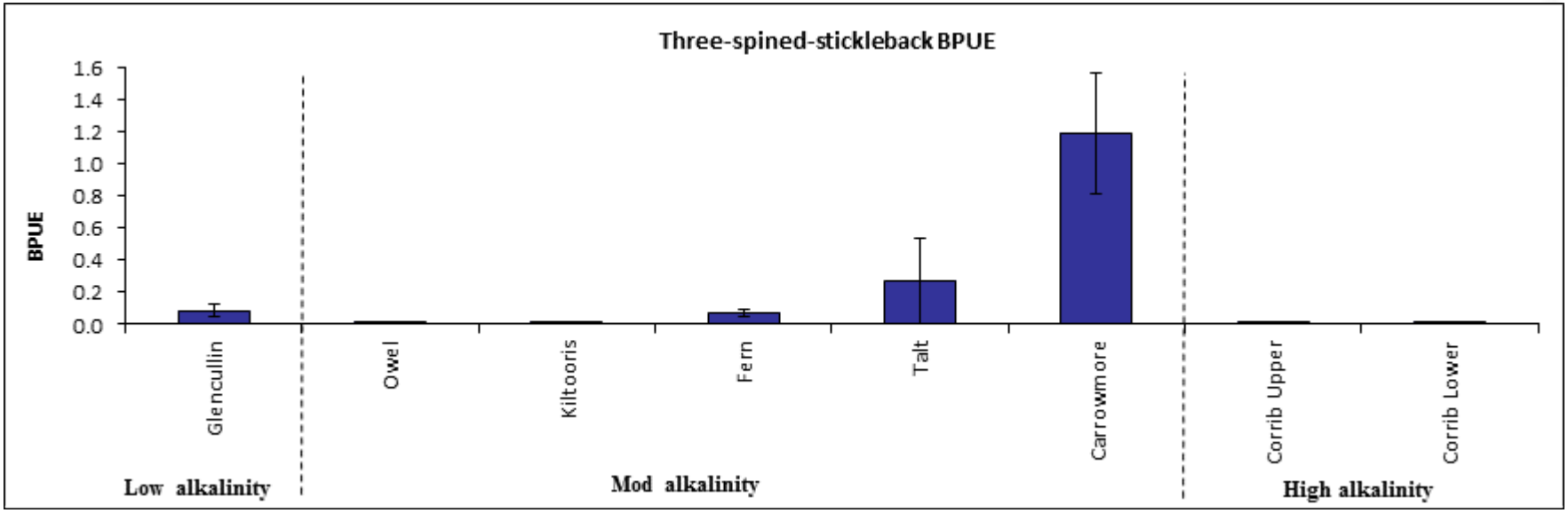

Fig. 4.34. Three-spined stickleback biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

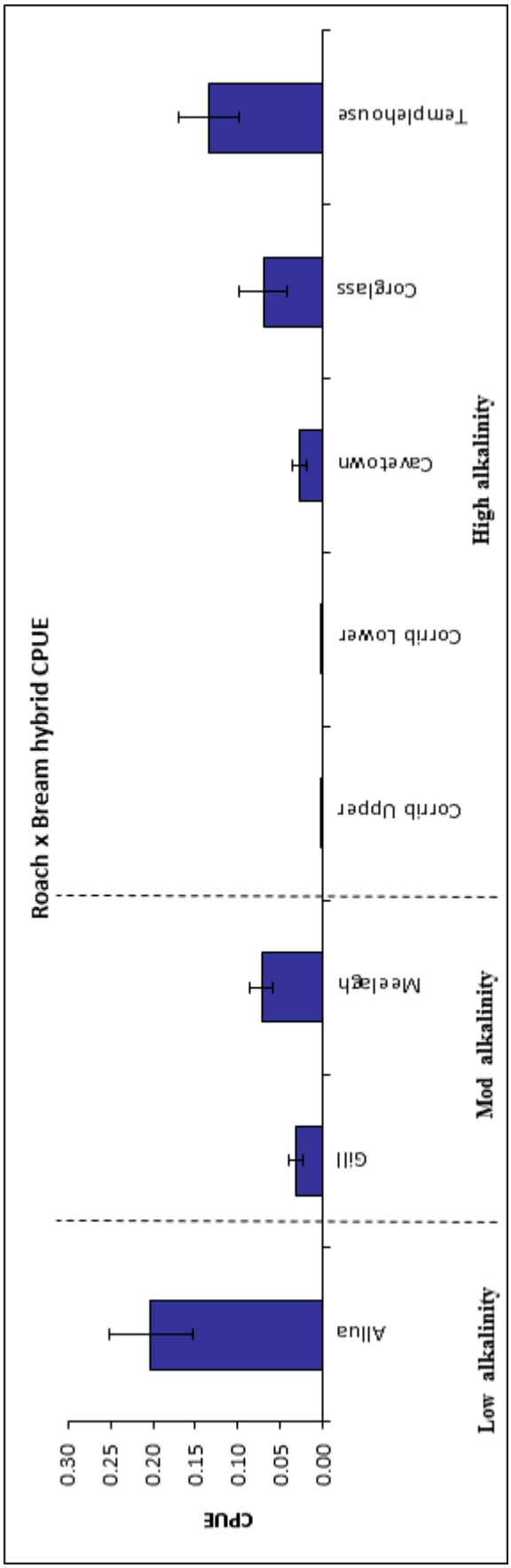

Fig. 4.35. Roach x Bream abundance (CPUE – mean (±SE) no. fish/m net) in lakes surveyed for WFD fish monitoring 2014

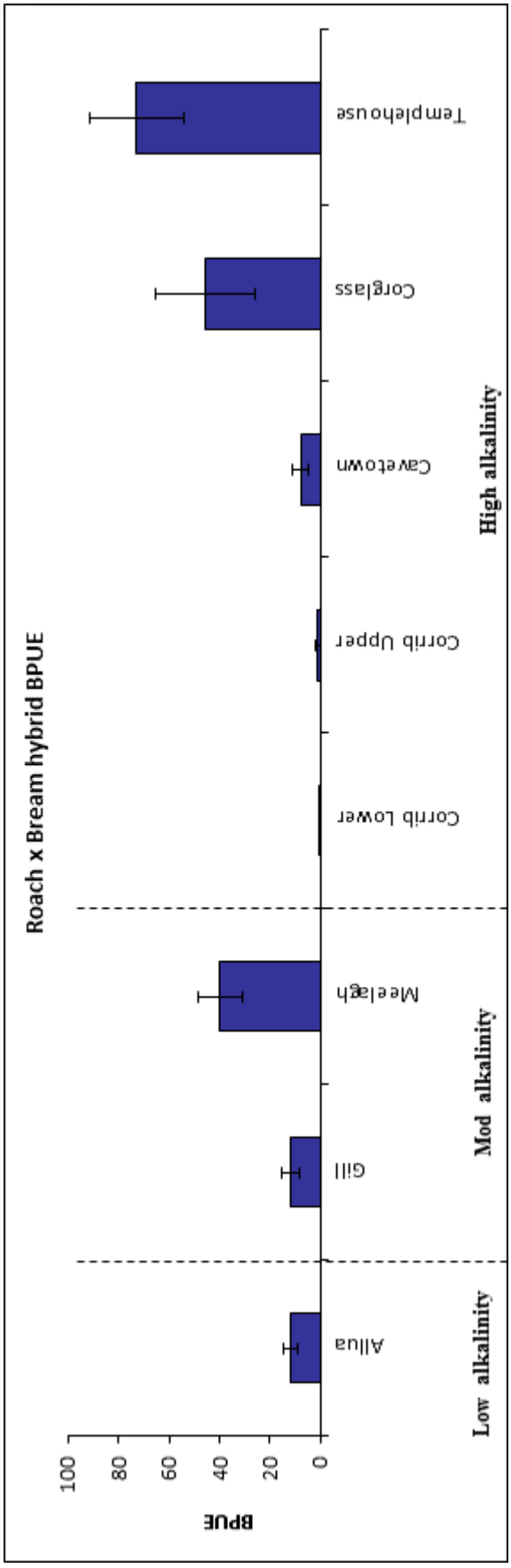

Fig. 4.36. Roach x Bream biomass (BPUE – mean (±SE) weight (g) fish/m net) in lakes surveyed for WFD fish monitoring 2014

4.1.4 Fish Growth

4.1.4.1 Growth of brown trout, perch and roach

Scales from 858 brown trout (21 lakes), 610 roach (12 lakes) and 127 rudd (four lakes), otoliths from approximately 84 char (five lakes) and opercular bones from 849 perch (17 lakes) were examined for age and growth analysis. Mean lengths at age (L1 = back calculated length at the end of the first winter, etc.) for the three dominant species; brown trout, perch and roach were back-calculated and growth curves plotted (Figs. 4.37 to 4.39). Details of back calculated mean lengths at age for brown trout, perch and roach can be found in each individual lake report from 2014 (Kelly *et. al.,* 2015a-z). Brown trout from Lough Sheelin showed the fastest growth at L4, while the slowest were trout from Loughs Brin and Barra (Fig. 4.37). Perch (L4) from Lough Sheelin and Lough Talt and roach (L4) from Derrybrick Lough and Lough O'Flynn showed the fastest growth rates (Fig. 4.38 and Fig 4.39).

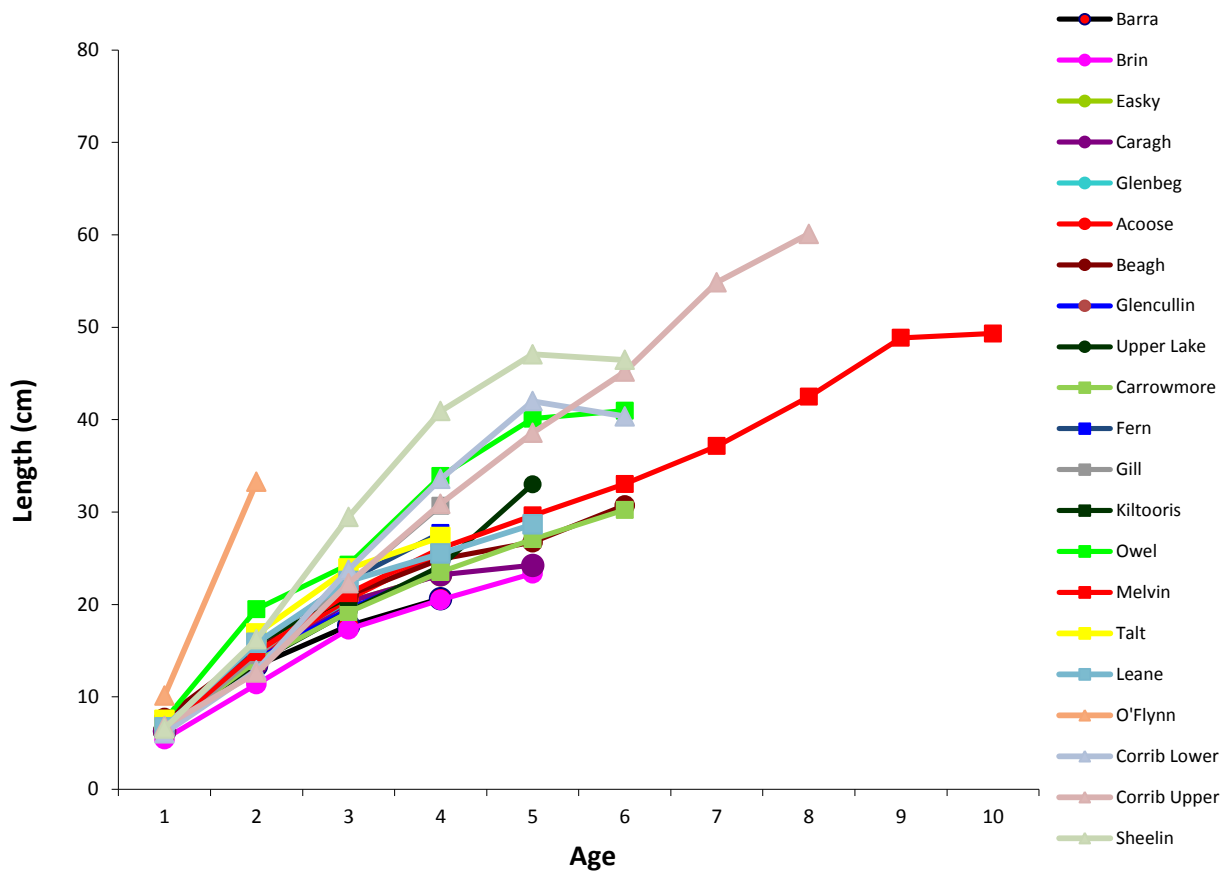

Fig. 4.37. Mean lengths at age of brown trout in lakes surveyed for WFD fish monitoring 2014 (note: circles indicate low alkalinity lakes, squares indicate moderate alkalinity lakes and triangles indicate high alkalinity lakes)

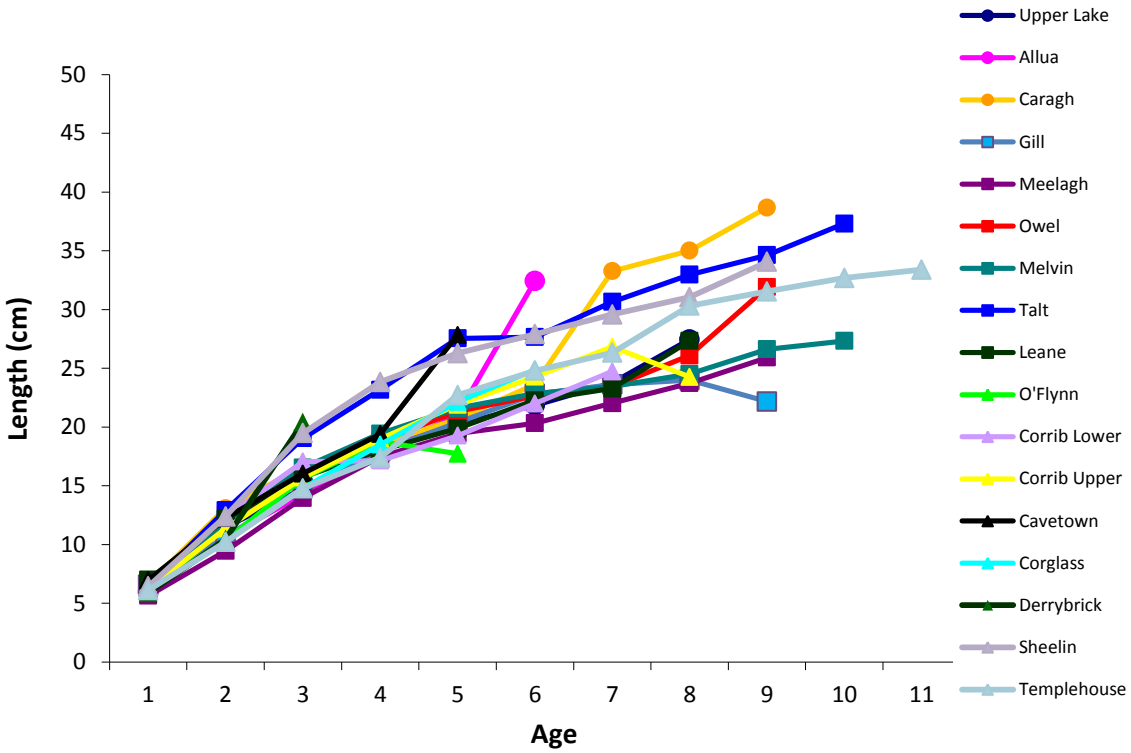

Fig. 4.38. Mean lengths at age of perch in lakes surveyed for WFD fish monitoring 2014 (note: circles indicate low alkalinity lakes, squares indicate moderate alkalinity lakes and triangles indicate high alkalinity lakes)

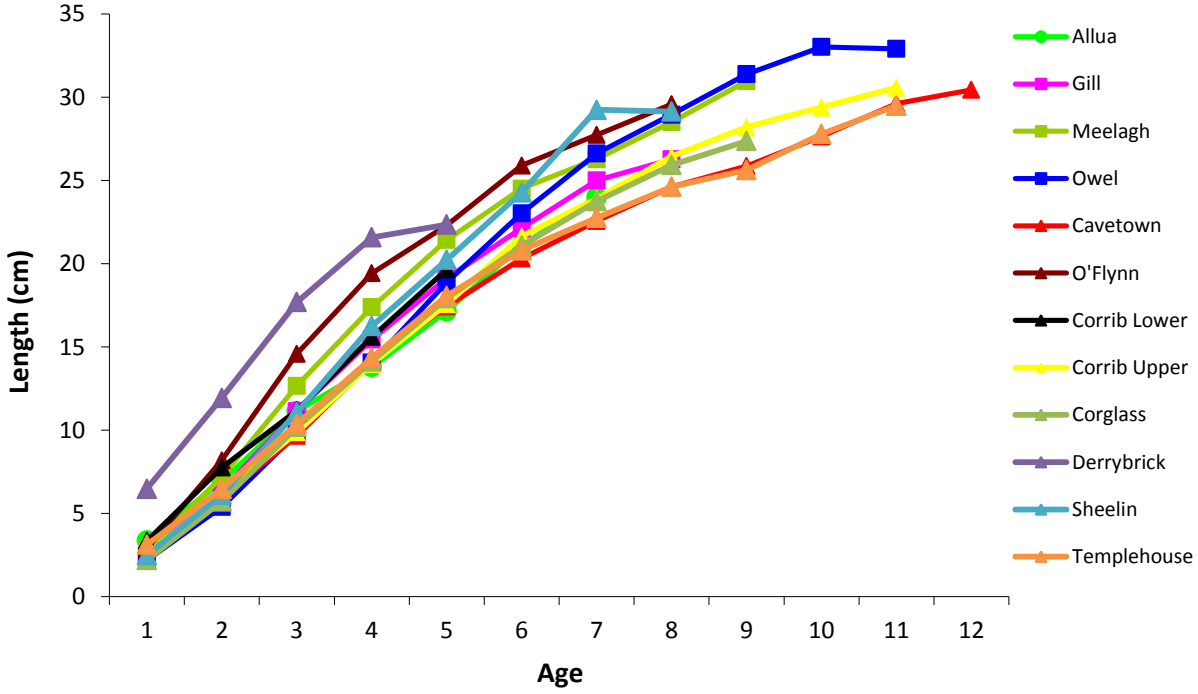

Fig. 4.39. Mean lengths at age of roach in lakes surveyed for WFD fish monitoring 2014 (note: squares indicate moderate alkalinity lakes and triangles indicate high alkalinity lakes)

4.1.4.2 Growth of brown trout in low, moderate and high alkalinity lakes

Brown trout from high alkalinity lakes surveyed during 2014 displayed a faster mean growth rate than those from moderate and low alkalinity lakes (Fig. 4.40). Moderate alkalinity lakes had a significantly faster growth rate than the low alkalinity lakes at L2, L3 and L4 (t-test=-2.68798, df=11, P<0.05, t-test=-3.41235, df=13, P<0.05 and t-test=-3.13343, df=8, P<0.05) (Fig. 4.40). The high alkalinity lakes also had a significantly faster growth rate than the low alkalinity lakes at L3 and L4 (Mann Whitney U=0, n1=9, n2=3, P<0.05 and Mann Whitney U=0, n1=8, n2=3, P<0.05). High alkalinity lakes also had a significantly faster growth rate than the moderate and low alkalinity lakes at L5 (t-test=-2.8992, df=4, P<0.05, t-test=-4.7706, df=4, P<0.05) (Fig. 4.40)

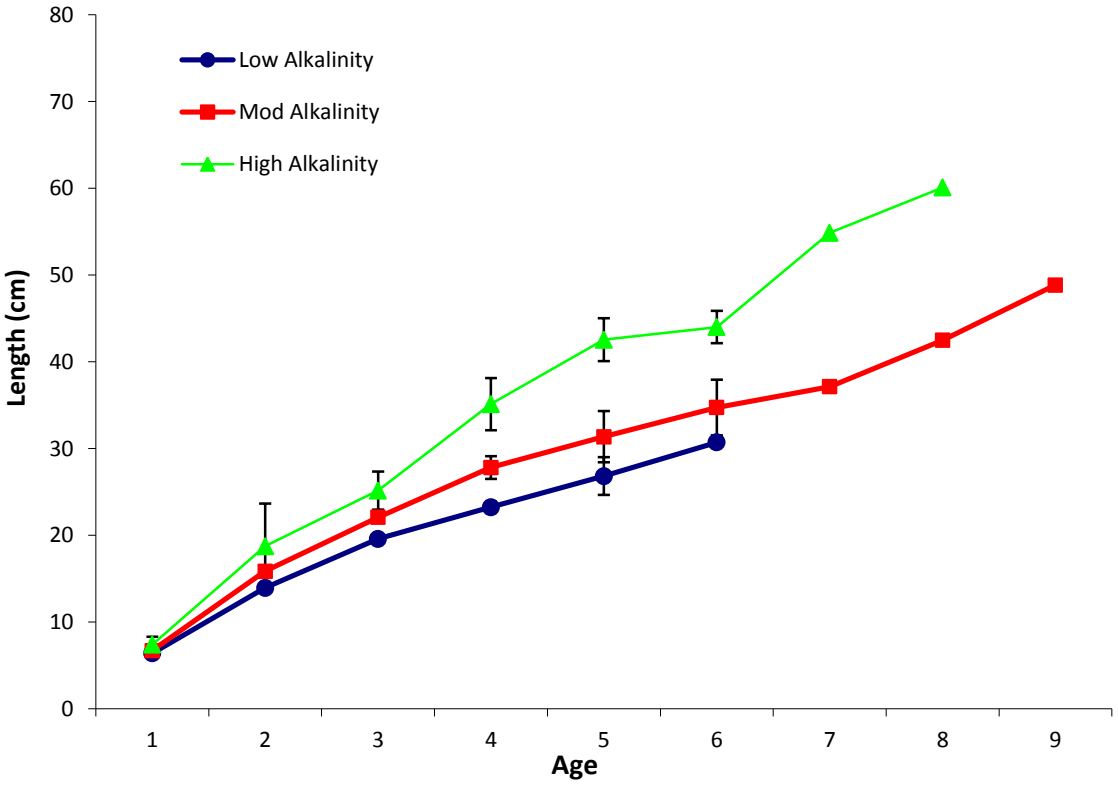

Fig 4.40. Mean (±SE) lengths at age of brown trout in lakes surveyed for WFD fish monitoring 2014

Kennedy and Fitzmaurice (1971) related brown trout growth rates to alkalinity, classifying the growth of brown trout in lakes into the following four categories based on the mean length at the end of the fourth year (L4):

1) very slow – mean L4 = 20–25cm

2) slow – mean L4 = 25–30cm

3) fast – mean L4 = 30–35cm

4) very fast – mean L4 = 35–40cm

This classification was applied to the brown trout captured from 17 lakes during 2014; eight were classified as very slow, five were classified as slow, three were classified as fast and one was classified as very fast (Table 4.3). Trout from Lough O'Flynn, Lough Allua, Lough Fern, Glenbeg Lough and Kitooris Lough were not classified as there were no/not enough four year old fish captured on these lakes to accurately assign a growth category.

Table 4.3. Categories of growth of trout in lakes as per Kennedy and Fitzmaurice (1971)

Very slow	Slow	Fast	Very fast
Barra	Acoose	Corrib Upper	Sheelin
Brin	Melvin	Corrib Lower	
Carrowmore	Talt	Gill	
Easky	Leane		
Caragh	Owel		
Beagh			
Glencullin			
Upper Lake			

4.1.4.3 Growth of non-native fish species in low, moderate and high alkalinity lakes

Both perch and roach were recorded in low, moderate and high alkalinity lakes. Overall, the mean length at age up to L5/6 of both perch and roach were slightly higher in the moderate alkalinity and high alkalinity lakes than in the low alkalinity lakes; however, there were no significant differences found (Fig. 4.41 and Fig. 4.42).

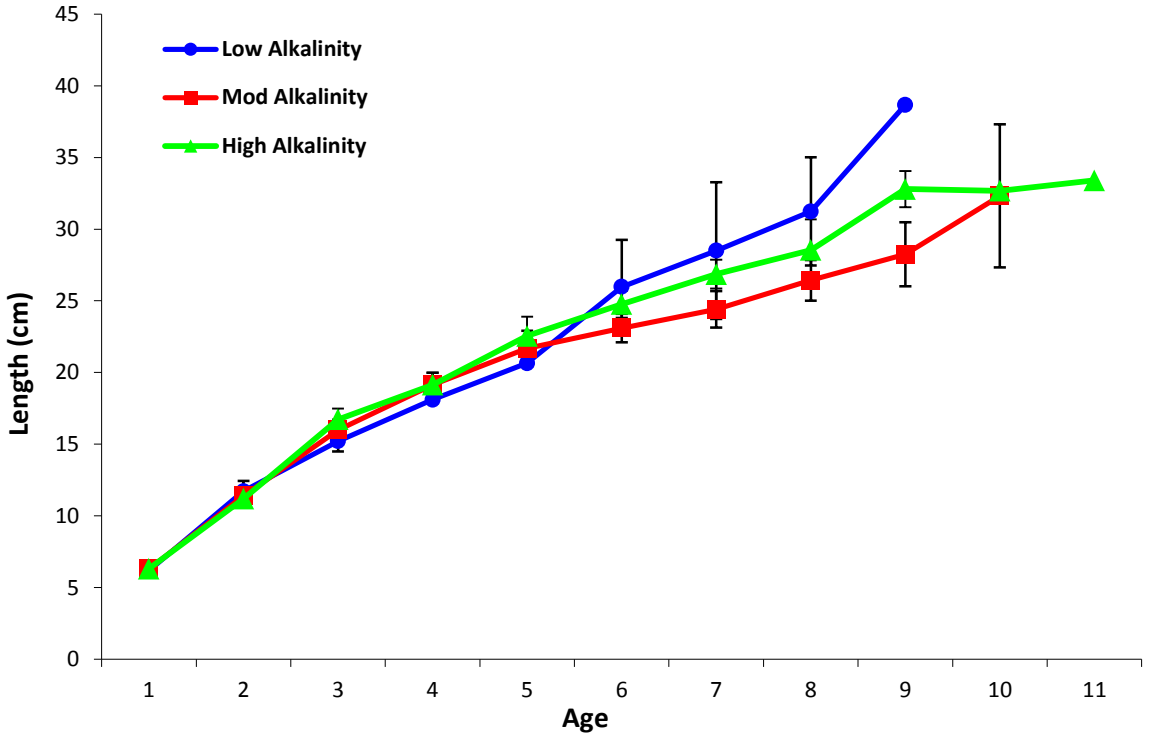

Fig 4.41. Mean (±SE) length at age of perch in lakes surveyed for WFD fish monitoring 2014

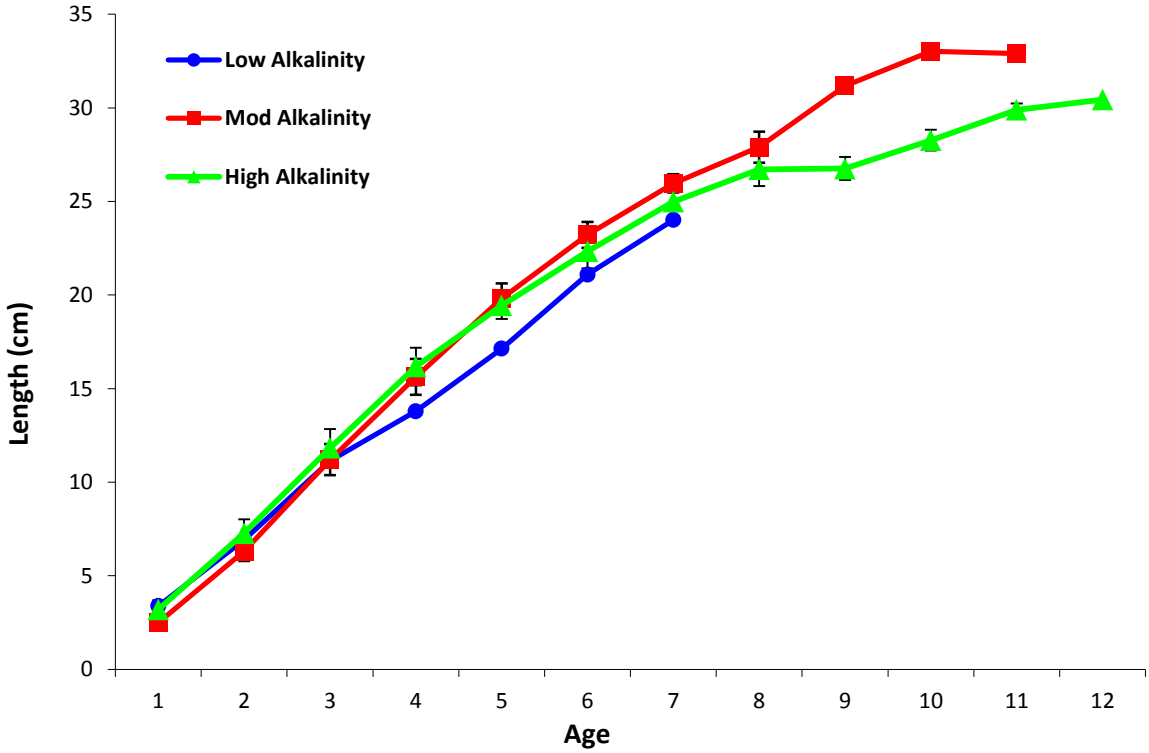

Fig 4.42. Mean (±SE) length at age of roach in lakes surveyed for WFD fish monitoring 2014

4.1.5 Ecological status - Classification of lakes using 'FIL2'

An essential step in the WFD monitoring process is the classification of the ecological status of lakes, which in turn will assist in identifying the objectives that must be set in the individual River Basin Management Plans (RBMPs).

The Fish in Lakes ecological classification tool (FIL2) assigns lakes in Ecoregion 17 (Ireland) to ecological status classes ranging from High to Bad using fish population parameters relating to species composition, abundance and age structure (Kelly *et al*., 2012b). FIL2 has been successfully intercalibrated in a cross Europe exercise (EC, 2013) and Olin *et al*., 2014). It combines a discriminant analysis model, providing a discrete assessment of status class with an ecological quality ratio (EQR) model, providing WFD compliant quantitative ecological quality ratios between 0 and 1 (Kelly *et al*., 2012b).

All 26 lakes surveyed during 2014 were assigned a draft ecological status class using the FIL2 ecological classification tool, together with expert opinion; five were classified as High, eleven were classified as Good, six were classified as Moderate, three were classified as Poor and two were classified as Bad ecological status (Table 4.4, Figure 4.43). The full output from the FIL2 ecological classification tool is given in Appendix 3.

Table 4.4. Classification of lakes using the Fish in Lakes (FIL2) classification tool

Lake	FIL2 Typology	Ecological Status Class* (FIL2 Tool + expert opinion)
Brin	1	High
Caragh	2	High
Glenbeg	2	High
Glencullin	1	High
Kiltooris	1	High
Acoose	2	Good
Barra	1	Good
Beagh	2	Good
Carrowmore	1	Good
Corrib Upper	4	Good
Easky	1	Good
Fern	1	Good
Gill	4	Good
Leane	2	Good
Melvin	2	Good
Talt	4	Good
Cavetown	4	Moderate
Corrib Lower	3	Moderate
Derrybrick	3	Moderate
Owel	4	Moderate
Sheelin	3	Moderate
Upper Lake Killarney	2	Moderate
Allua	2	Poor
Meelagh	3	Poor
O' Flynn	3	Poor
Corglass	3	Bad
Templehouse	3	Bad

**Ecological status is subject to change upon review*

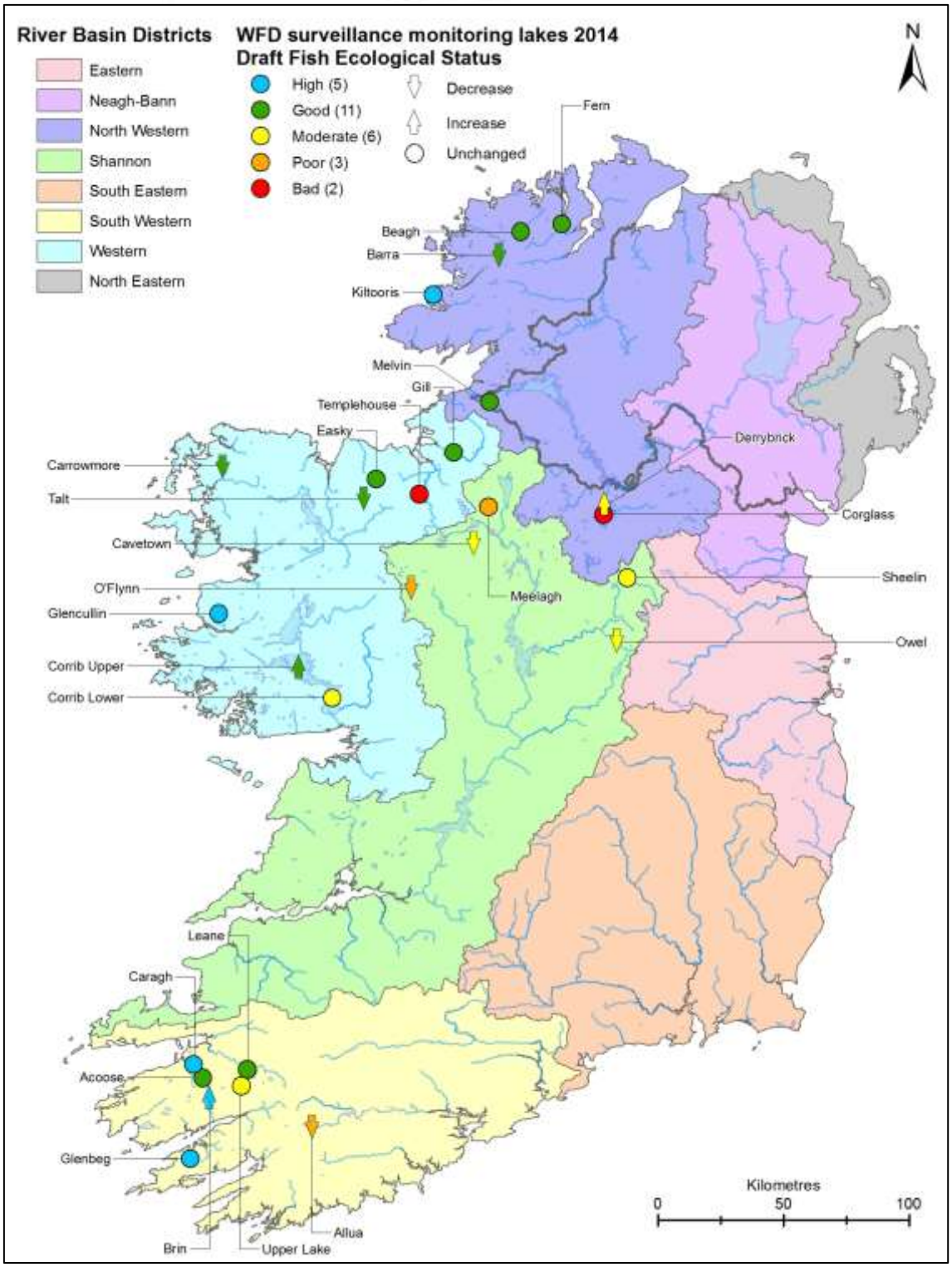

Fig. 4.43. Ecological classification of lakes surveyed during 2014 using the FIL2 ecological classification tool (the five symbol colours on the map indicate ecological status from high to bad, the arrow symbols indicate an increase or decrease in ecological status since 2011, the circular symbols indicate no change in status since 2011)

4.2 Rivers

4.2.1 Fish species composition and species richness

A total of 14 fish species (sea trout are included as a separate 'variety' of brown trout) and one hybrid were recorded within the 70 sites (50 waterbodies) surveyed during 2014 (Table 4.5). Brown trout was the most widespread species occurring in 67 sites (95.7%) of the sites surveyed, followed by salmon (78.6%), European eel (55.7%), stone loach (50%), minnow (38.6%), three-spined stickleback (38.6%), lamprey sp. (34.3%), roach (22.9%), perch (18.6%), pike (14.3%), gudgeon (12.9%), sea trout (11.4%), flounder (10%), dace (5.7%) and roach x bream hybrids (1.4%) (Table 4.5 and Fig. 4.44).

Table 4.5. List of fish species recorded in the 70 river sites surveyed during 2014

	Scientific name	Common name	Number of river sites	% river sites
	NATIVE SPECIES (Group 1)			
1	*Salmo trutta*	Brown trout	67	95.7
2	*Anguilla anguilla*	Eel	39	55.7
3	*Salmo salar*	Salmon	55	78.6
4	*Gasterosteus aculeatus*	Three-spined stickleback	27	38.6
5	*Lampetra* sp.	Lamprey sp.	24	34.3
6	*Platichthys flesus*	Flounder	7	10.0
8	*Salmo trutta*	Sea trout *	8	11.4
	NON NATIVE (influencing ecology) (Group 2)			
9	*Barbatula barbatula*	Stone loach	35	50.0
10	*Phoxinus phoxinus*	Minnow	27	38.6
11	*Perca fluviatilis*	Perch	13	18.6
12	*Rutilus rutilus*	Roach	16	22.9
13	*Esox lucius*	Pike	10	14.3
14	*Leuciscus leuciscus*	Dace	4	5.7
	Rutilus rutilus x Abramis brama	Roach x bream hybrid	1	1.4
	NON NATIVE SPECIES (generally not influencing ecology) (Group 3)			
16	*Gobio gobio*	Gudgeon	9	12.9

*sea trout are included as a separate "variety" of trout

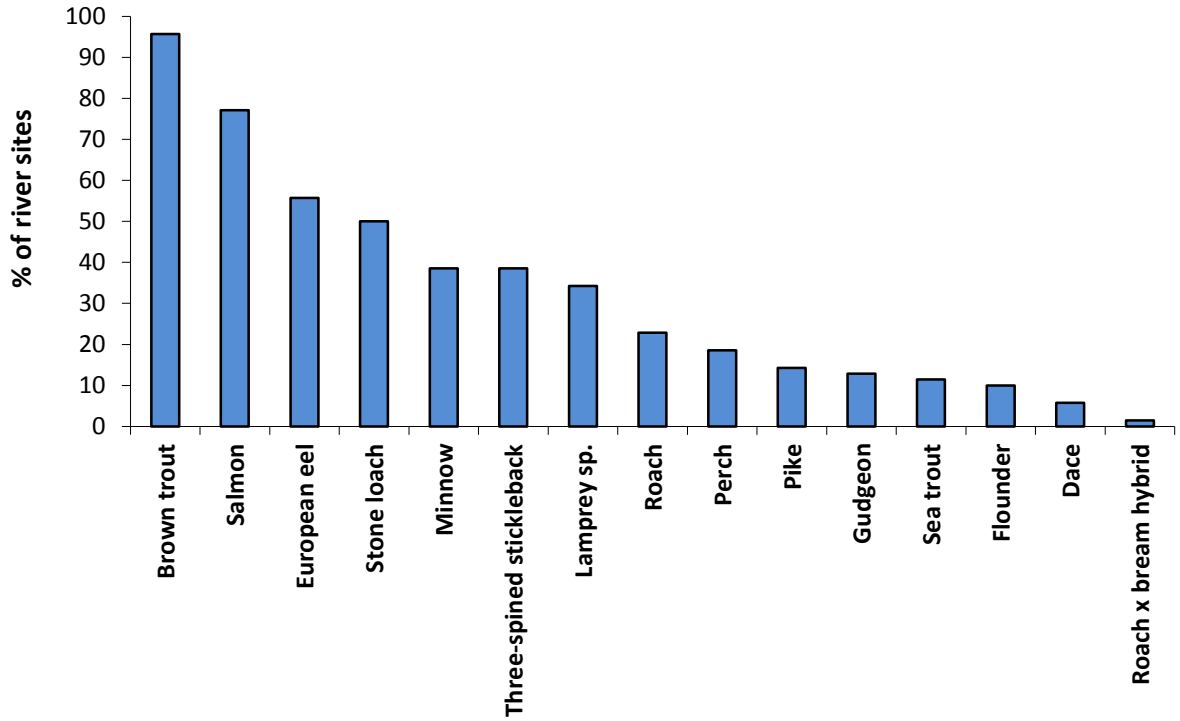

Fig. 4.44. Percentage of sites where each fish species was recorded (total of 70 river sites surveyed) during WFD surveillance monitoring 2014

Fish species richness (including sea trout and hybrids) ranged from one species in the Ballysadare River (Oakwood_A), Dargle River (Bahana_A) and River Swilly (Altadush_A) sites, while the highest species richness was recorded at the Barrow (Pass Br._B), Co. Kildare, with a total of 11 (Table 4.6 and Fig. 4.45). Native species were present in all of the sites surveyed. Nineteen of the 70 sites contained exclusively native species (27%). The maximum number of native species captured in any site was six and this was recorded in multiple sites (Table 4.6). Group 2 species (non-native species influencing ecology) were present at 50 sites. The maximum number of non-native species recorded at any one site was seven, recorded at the River Barrow (Pass Br._B). One Group 3 species (gudgeon) was present among the river sites surveyed, recorded at nine sites.

Table 4.6. Species richness in each river site surveyed for WFD fish monitoring 2014

Site	RBD	Species richness	No. native species (Group 1)	No. of Non-native species (Group 2)	No. of non-native (Group 3)
Wadeable Sites					
Derry (Ballyknocker_A)	SERBD	8*	6	2	0
Vartry (Newrath Br._A)	ERBD	7*	6	1	0
Smearlagh (Ford u/s Feale R confl (LHS)_A)	SHIRBD	7*	6	1	0
White (Louth)(Coneyburrow Br._B)	NBIRBD	6	4	2	0
Owenduff (Rathnageeragh_A)	SERBD	6	5	1	0
Derry (Balisland Br._A)	SERBD	6	4	2	0
Mahon (ENE of Seafield House_A)	SERBD	6	6	0	0
Mahon (Pumphouse Weir_A)	SERBD	6	6	0	0
Dodder (Mount Carmel Hospital_A)	ERBD	5	3	2	0
Blackwater (Monaghan)(Corvally_A)	NBIRBD	5	3	1	1
Duag (Br. u/s Ballyporeen_B)	SERBD	5	4	1	0
Duag (Kilnamona_A)	SERBD	5	4	1	0
Duncormick ((W) Br. nr Duncormick Rly St_B)	SERBD	5*	4	1	0
Deel (Newcastlewest)(Br. near Balliniska_A)	SHIRBD	5	3	2	0
Finisk (Modelligo Br._A)	SWRBD	5	4	1	0
Glashaboy (Ardnabricka_A)	SWRBD	5	4	1	0
Sullane (Sullane Br._A)	SWRBD	5	3	2	0
Swanlinbar (Swanlinbar Br. (Carpark)_A)	NWIRBD	4	4	0	0
Deel (Newcastlewest)(Ballygulleen_A)	SHIRBD	4	2	2	0
Glashaboy (Ballyvorisheen Br._B)	SWRBD	4	3	1	0
Tobercurry (Br. just u/s Moy River_C)	WRBD	4	3	1	0
Dodder (D/s Piperstown Stream, Bohernabreena_A)	ERBD	3	2	1	0
Swilly (Swilly Br. (near Breenagh)_A)	NWIRBD	3	3	0	0
Urrin (Buck's Br._B)	SERBD	3	3	0	0
Smearlagh (Rathea_A)	SHIRBD	3	3	0	0
Funshion (Brackbaun Br._A)	SWRBD	3	3	0	0
Funshion (Kilbeheny_A)	SWRBD	3	3	0	0
Bundorragha (Rock Pool_A)	WRBD	3	3	0	0
Demesne (Curraghcreen_A)	WRBD	3	3	0	0
Owennaglogh (Tawnynoran_A)	WRBD	3	3	0	0
Tobercurry (Tullanaglug_A)	WRBD	3	3	0	0
Cronaniv Burn (Br. u/s Dunlewy Lough_A)	NWIRBD	2	2	0	0
Cronaniv Burn (Dunlewy_A)	NWIRBD	2	2	0	0
Inny (Br. 1 km S of Oldcastle_A)	SHIRBD	2	2	0	0
Dargle (Bahana_A)	ERBD	1	1	0	0
Swilly (Altadush_A)	NWIRBD	1	1	0	0

*Sea trout and roach x bream #hybrids are included within this table

Table 4.6 ctn. Species richness in each river site surveyed for WFD fish monitoring 2014

Site	RBD	Species richness	No. native species (Group 1)	No. of Non-native species (Group 2)	No. of non-native (Group 3)
Non-wadeable sites					
Barrow (Pass Br._B)	SERBD	10	3	7	1
Slaney (Bunclody_A)	SERBD	9*	5	3	1
Nore (Brownsbarn Br._A)	SERBD	9*	6	3	0
Suir (Poulakerry_A)	SERBD	9	6	3	0
Brosna (0.5km NW of Pollagh_A)	SHIRBD	9	3	5	1
Liffey (Lucan Br._A)	ERBD	8	4	3	1
Nore (Kilmacshane_A)	SERBD	8*	5	3	0
Inny (Shrule Br._A)	SHIRBD	8	2	5	1
Robe (Akit Br._A)	WRBD	8	3	5	0
Suir (Kilsheelan Br._A)	SERBD	7	5	2	0
Slaney (Carhill_A)	SERBD	6*	3	2	1
Anner (Drummon Br._A)	SERBD	6	5	1	0
Ballysadare (Ballysadare Br._A)	WRBD	6	3	3	0
Clare (Corrofin Br._A)	WRBD	6	2	4	0
Clare (Kiltroge Castle Br._A)	WRBD	6	3	3	0
Owenmore (Sligo)(300 m u/s Unshin River confl_A)	WRBD	6	2	4	0
Owenmore (Sligo)(Waterfall_A)	WRBD	6	3	3	0
Aherlow (Killardy Br._A)	SERBD	5	2	3	0
Ara (Lisheen_A)	SERBD	5	3	2	0
Multeen (Ballygriffin Br._A)	SERBD	5	4	1	0
Nore (Quakers Br._A)	SERBD	5	3	2	0
Feale (Br. ENE of Duagh Ho_A)	SHIRBD	5	4	1	0
Bonet (1.8 km d/s Dromahaire Br._A)	WRBD	5	2	2	1
Dee (Burley Br._A)	NBIRBD	4	2	2	0
Anner (Killusty_A)	SERBD	4	3	1	0
Ara (Bansha_A)	SERBD	4	3	1	0
Feale (Sluicequarter_A)	SHIRBD	4	3	1	0
Boyne (Boyne Br._A)	ERBD	3	2	1	0
Suir (Knocknageragh Br._A)	SERBD	3	2	1	0
Bonet (Castle_A)	WRBD	3	2	0	1
Robe (Friarsquarter_A)	WRBD	3	1	2	0
Aherlow (Old Cappa Br._A)	SERBD	2	2	0	0
Nanny (Tuam)(u/s Weir Br._A)	WRBD	2	1	1	0
Ballysadare (Oakwood_A)	WRBD	1	0	0	0

*Sea trout and roach x bream

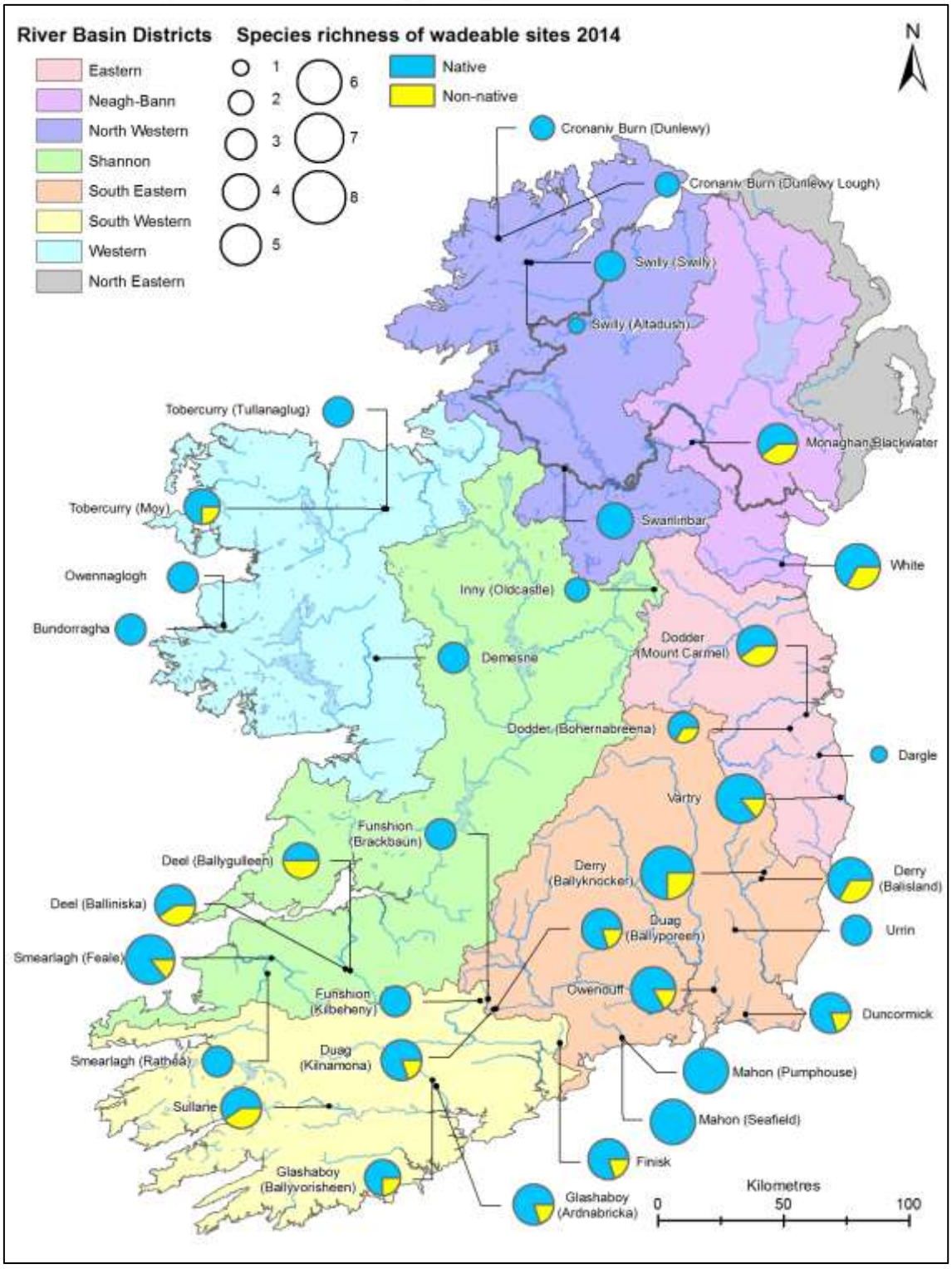

Fig. 4.45. Fish species richness at wadeable river sites surveyed using boat based electric-fishing equipment for WFD fish monitoring 2014

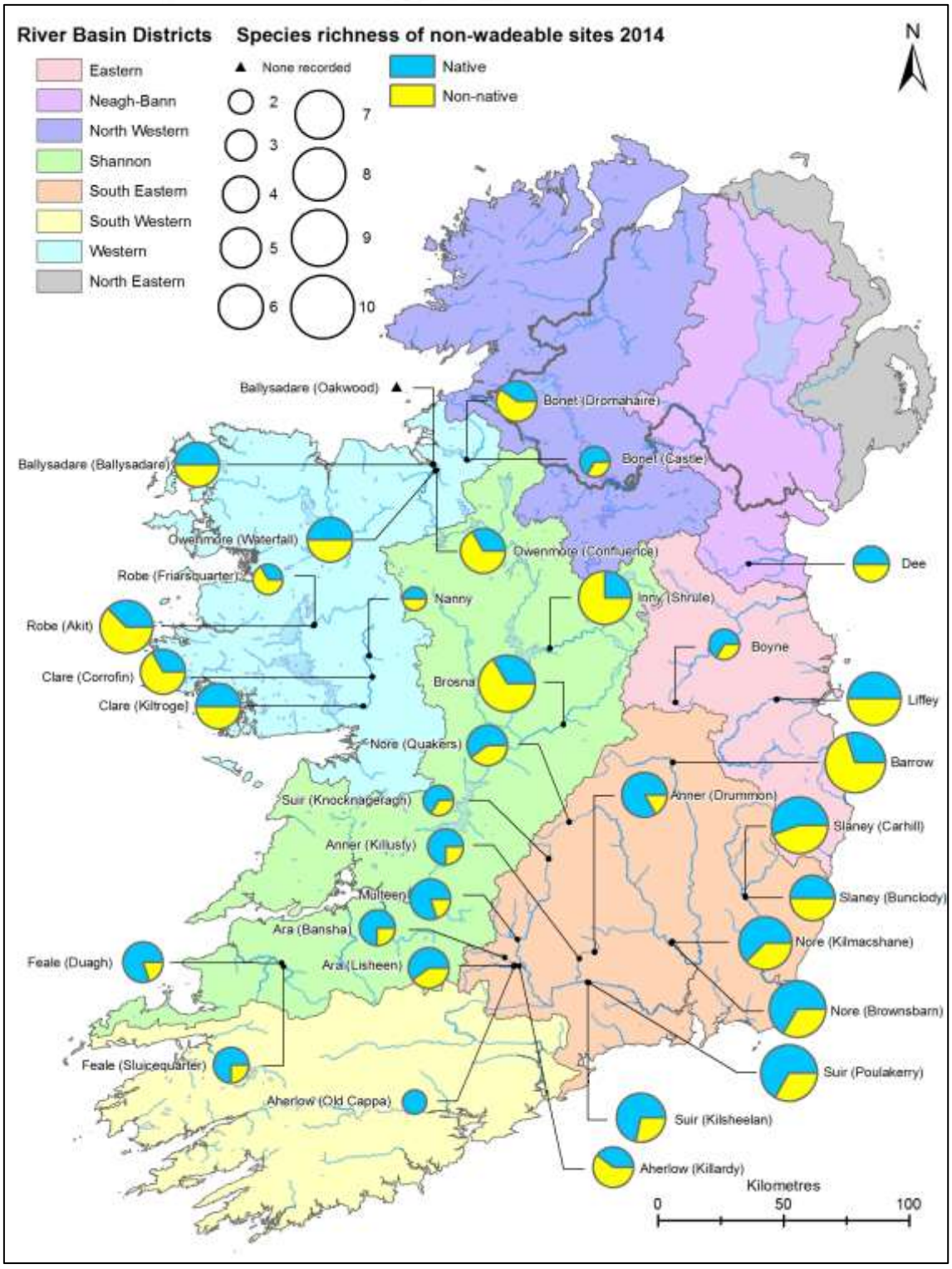

Fig. 4.46. Fish species richness at non-wadeable river sites surveyed using handset electric-fishing equipment for WFD fish monitoring 2014

4.2.2 Fish species distribution and abundance

Brown trout were the most widely distributed species among river sites surveyed in 2014, being recorded in 67 of the 70 sites. Brown trout fry (0+) were present in 43 sites (Fig. 4.47 and Fig. 4.48), while older brown trout (1+ and older) were encountered in 67 sites (Fig. 4.49 and Fig. 4.50). Brown trout fry (0+) densities were generally higher in the small shallower wadeable streams than in the non-wadeable deeper rivers. In wadeable streams, the highest densities of brown trout fry (0.190 fish/m^2) and 1+ and older (0.311 fish/m^2) were recorded in the Inny River (Oldcastle_B)(ShIRBD) and Duncormick River (Duncormick Rly St_B)(SERBD) sites respectively. In non-wadeable rivers sites, the highest densities of both brown trout fry (0+) (0.002 fish/m^2) and 1+ and older (0.104 fish/m^2) were captured in the River Suir at Kilsheelan Bridge and Knocknageragh Bridge respectively, both within the SERBD.

Sea trout were only recorded in eight river sites (Fig. 4.51 and Fig. 4.52) in 2014. The highest abundance of sea trout (0.015 fish/m^2) was recorded on the Vartry River (Newrath Br._A).

Salmon were also widely distributed throughout the country, being present in 55 sites. Salmon fry (0+) were recorded in 44 sites (Fig. 4.53 to Fig. 4.56), while older salmon (1+ & older) were recorded in 49 sites (Fig. 4.53 to Fig. 4.56). Abundance of salmon followed a similar trend to that of brown trout, where fry (0+) densities were generally more abundant in shallow wadeable streams, than in non-wadeable deeper channels, sampled with boat based electric-fishing equipment. In wadeable streams, the highest densities of fry (0+) (0.302 fish/m^2) and 1+ and older fish (0.237 fish/m^2) were recorded in the Smearlagh River (Rathea_A) (ShIRBD) and Tobercurry River (Br. just u/s Moy River_C) (WRBD) sites respectively. For non-wadeable streams, the highest densities of salmon fry (0+) (0.027 fish/m^2) and 1+ and older fish (0.045 fish/m^2) were captured in the Anner River (Drummon Br._A) (SERBD) and River Feale (Sluicequarter_A) (ShIRBD) respectively.

Eels were present in 39 river sites (Fig. 4.57 and Fig. 4.58). The highest eel density was recorded in the River Mahon (0.044 fish/m^2) (SERBD). Higher eel densities were recorded in wadeable sites when compared to non-wadeable sites.

Flounder were recorded in only seven sites (Fig. 4.59 and Fig. 4.60), with their highest density recorded in the River Mahon (Pumphouse Weir_A) (SERBD) (0.163 fish/m^2).

Three-spined stickleback were distributed throughout the country, being captured in a total of 27 sites (Fig. 4.63 and Fig. 4.64). Their highest density (0.112 fish/m^2) was recorded in the White River (Coneyburrow Br._A) (NBIRBD).

Juvenile lamprey were recorded in 24 river sites (Fig. 4.65 and Fig. 4.66), with their highest density (0.060 fish/m^2) recorded in the Glashaboy River (Ardnabricka_A) (SWRBD). Stone loach were recorded in 35 sites throughout the country (Fig. 4.67 and Fig. 4.68). Their highest density (0.066 fish/m^2) was recorded in the River Deel (Newcastlewest, Ballyguleen_A) (ShIRBD). Minnow were recorded in 27 river sites (Fig. 4.69 and Fig. 4.70), with their greatest density (0.877 fish/m^2) also recorded in the River Deel (Newcastlewest, Ballyguleen_A) (ShIRBD).

Dace were captured at four sites (Fig. 4.69 and Fig. 4.70). Their highest density was recorded in River Barrow (Pass Br._B) (0.014 fish/m^2).

Roach were recorded in 16 river sites (Fig. 4.73 and Fig. 4.74). The greatest density of roach (0.028 fish/m^2) was recorded in the River Brosna (0.5km NW of Pollagh_A) (ShIRBD). Roach x bream hybrids were only recorded in the River Barrow at Pass Br. and only a single individual was recorded.

Gudgeon were recorded in nine river sites (Fig. 4.75 and Fig. 4.76), with the Monaghan Blackwater (Corvally_A) (NBIRBD) recording the highest density (0.005 fish/m^2).

Perch were recorded in 13 sites (Fig. 4.77 and Fig. 4.78). Their highest density (0.007 fish/m^2) was recorded in the River Inny (Shrule Br._A) (ShIRBD).

Pike were captured at ten river sites (Fig. 4.79 and Fig. 4.80). The River Barrow (Pass Br._A) (SERBD) recorded the highest density (0.002 fish/m^2).

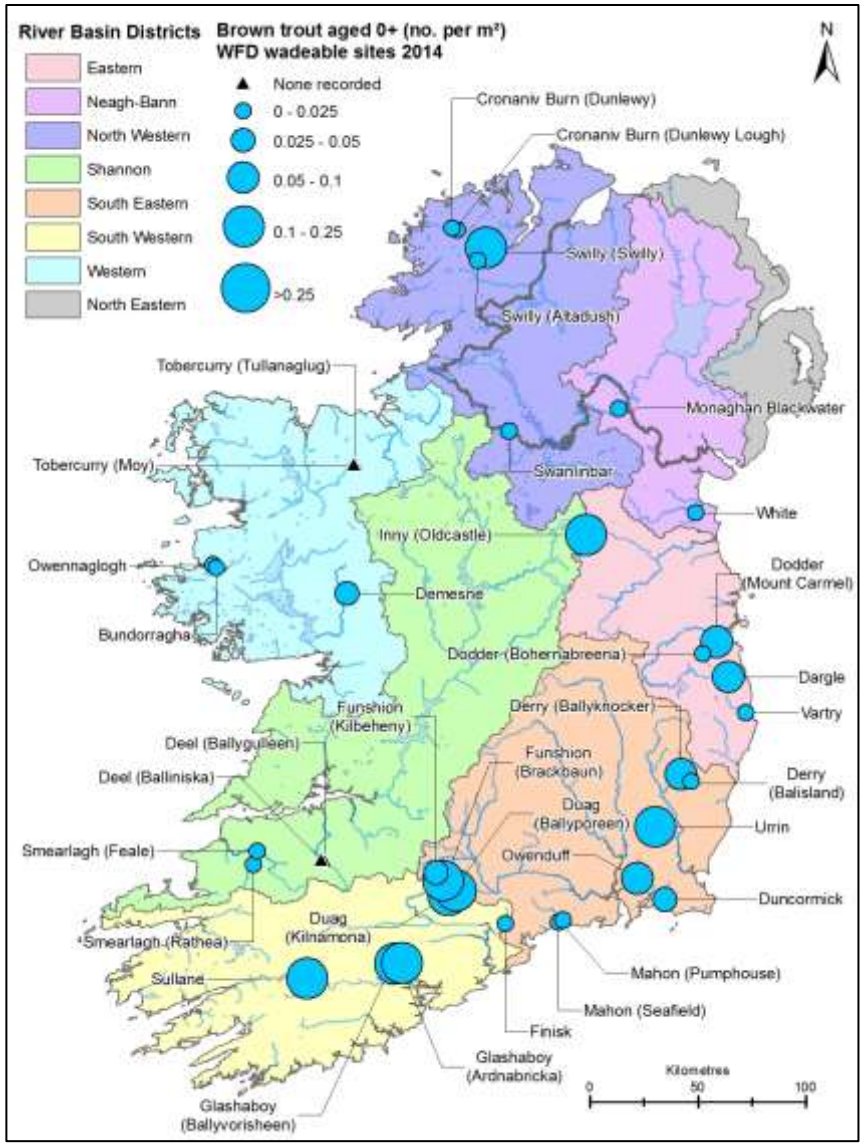

Fig. 4.47. Distribution and abundance of 0+ brown trout at wadeable river sites surveyed for WFD fish monitoring 2014

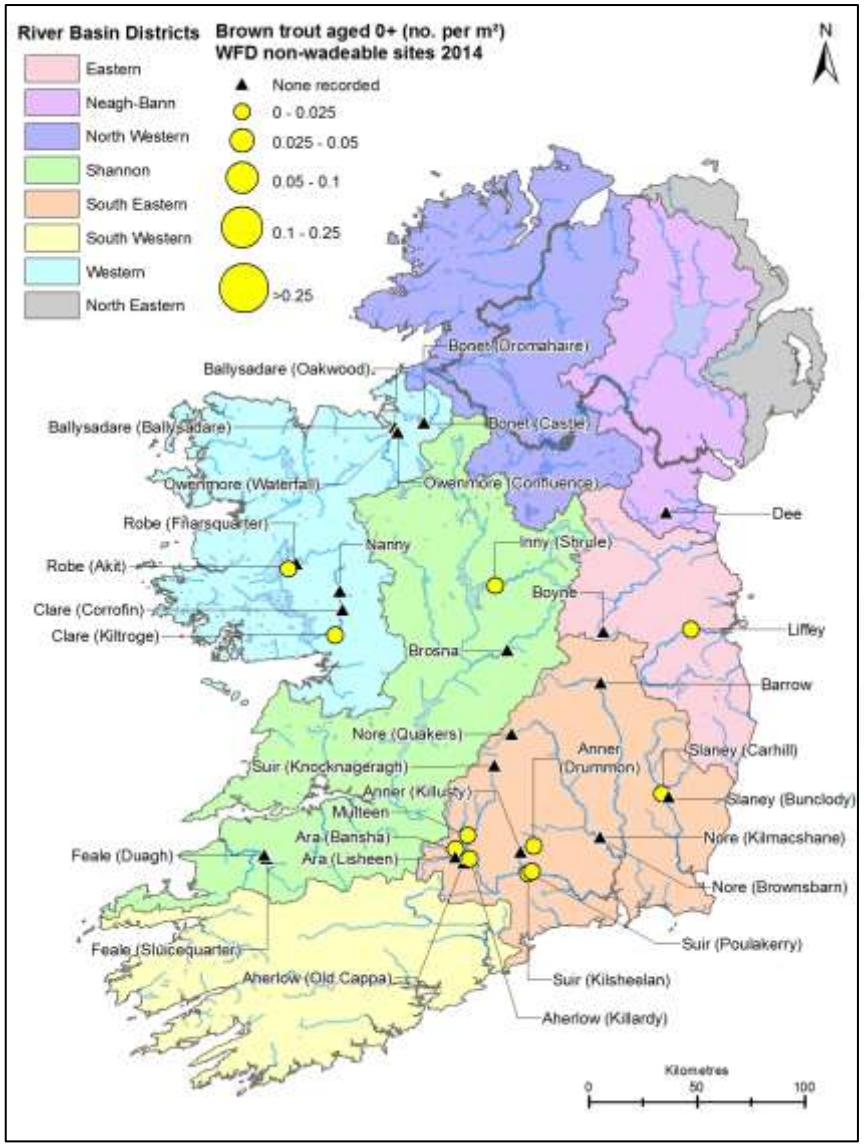

Fig. 4.48. Distribution and abundance of 0+ brown trout at non-wadeable river sites surveyed for WFD fish monitoring 2014

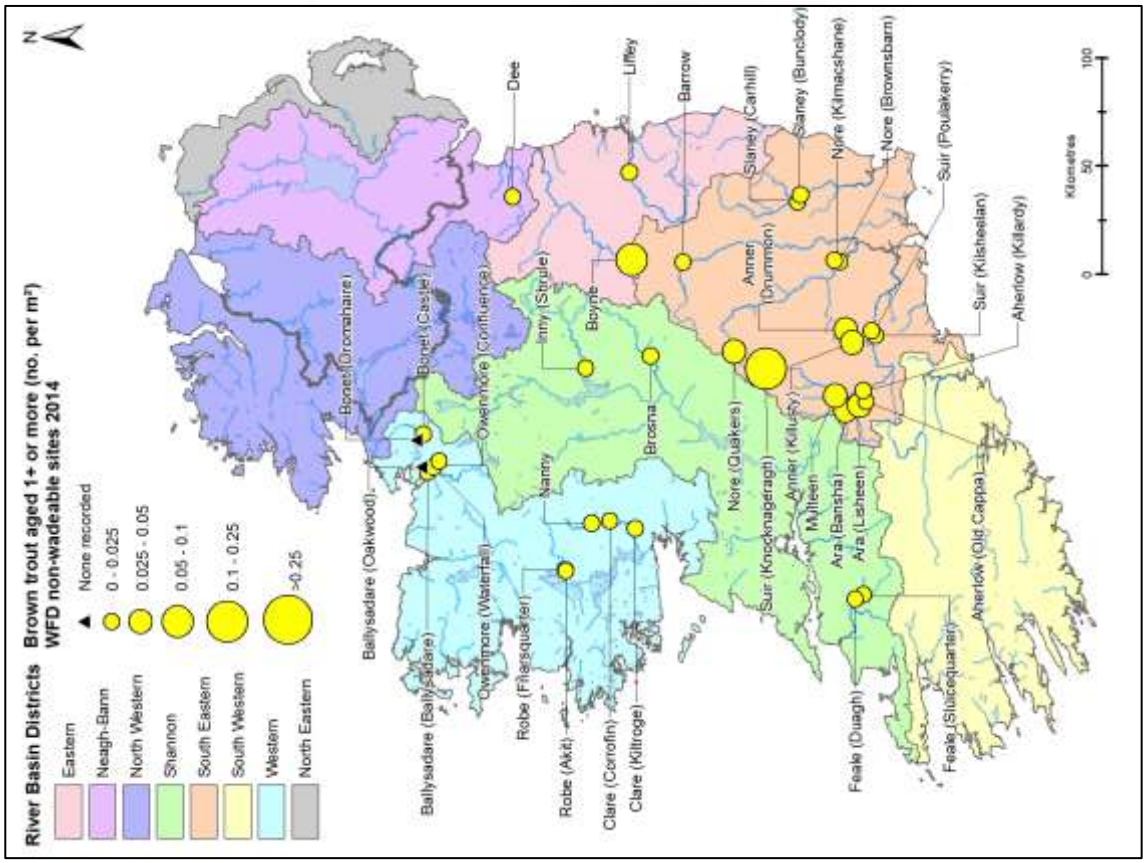

Fig. 4.50. Distribution and abundance of 1+ or older brown trout at non-wadeable river sites surveyed for WFD fish monitoring 2014

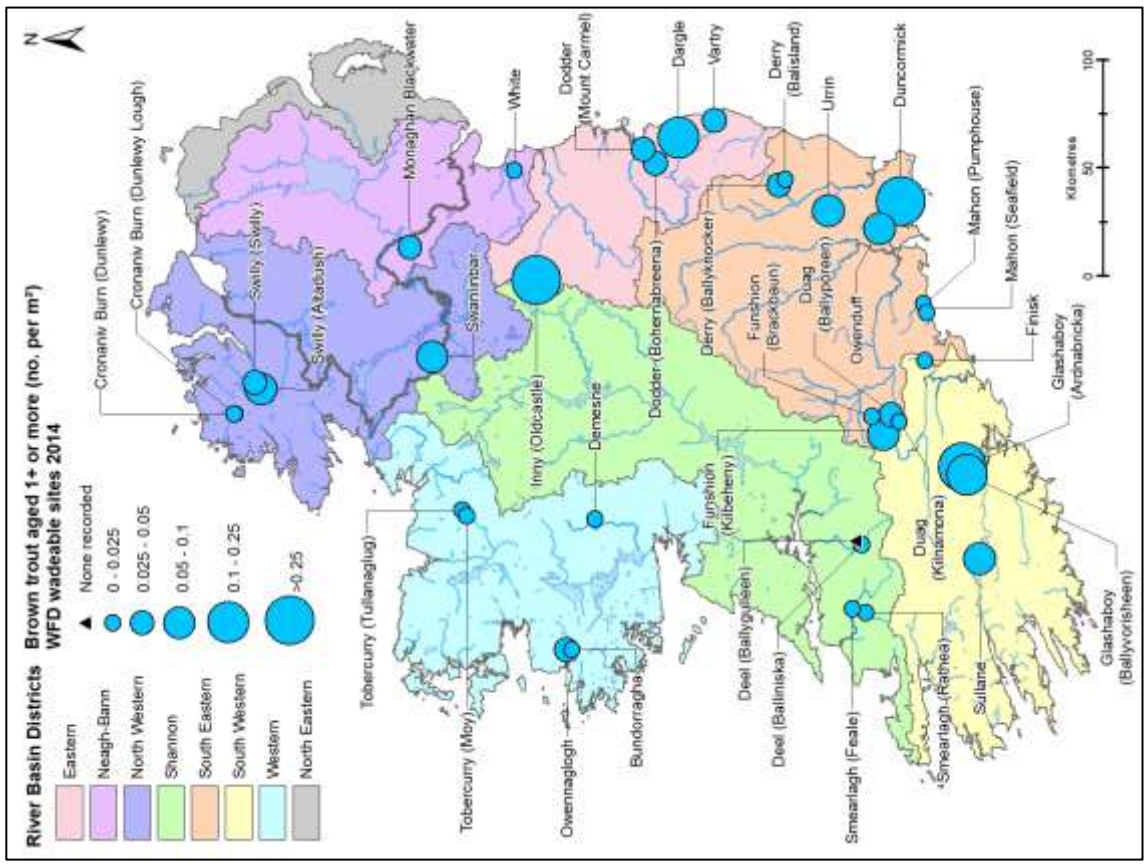

Fig. 4.49. Distribution and abundance of 1+ or older brown trout at wadeable river sites surveyed for WFD fish monitoring 2014

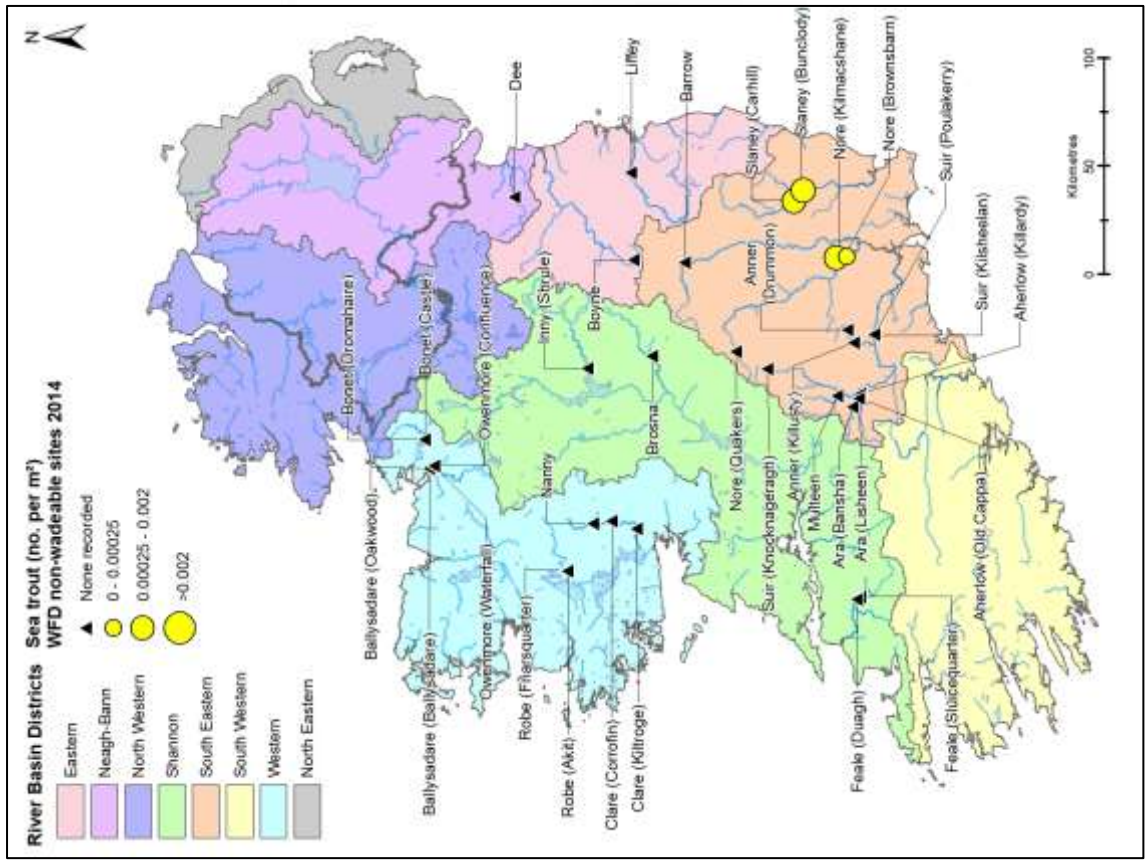

Fig. 4.52. Distribution and abundance of sea trout at non-wadeable river sites surveyed for WFD fish monitoring 2014

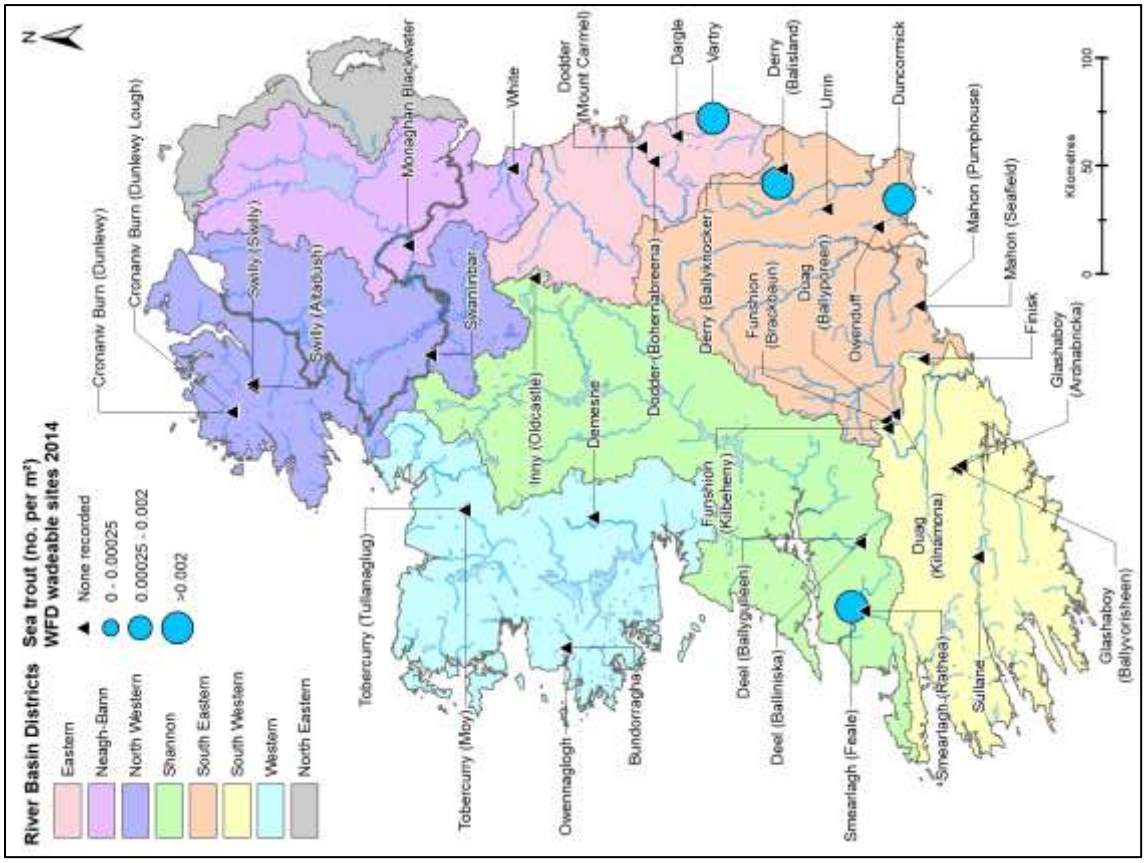

Fig. 4.51. Distribution and abundance of sea trout at wadeable river sites surveyed for WFD fish monitoring 2014

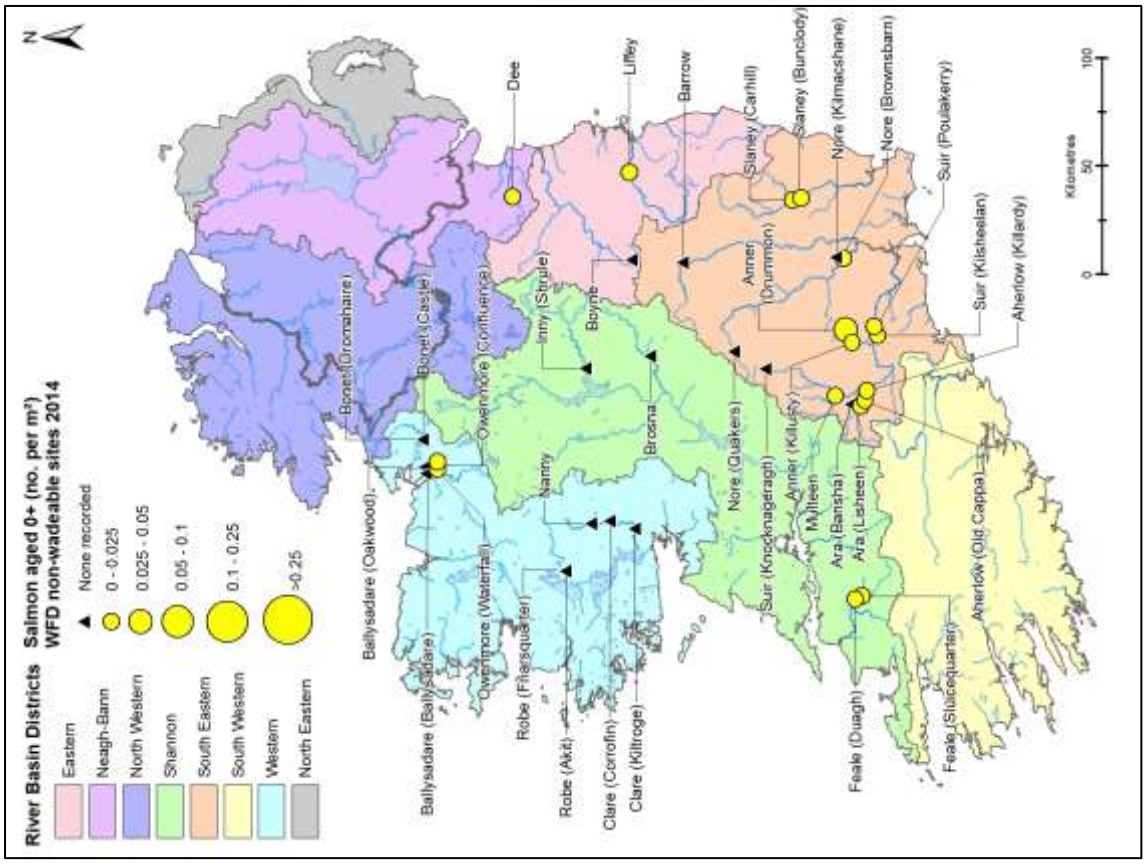

Fig. 4.54. Distribution and abundance of 0+ salmon at non-wadeable river sites surveyed for WFD fish monitoring 2014

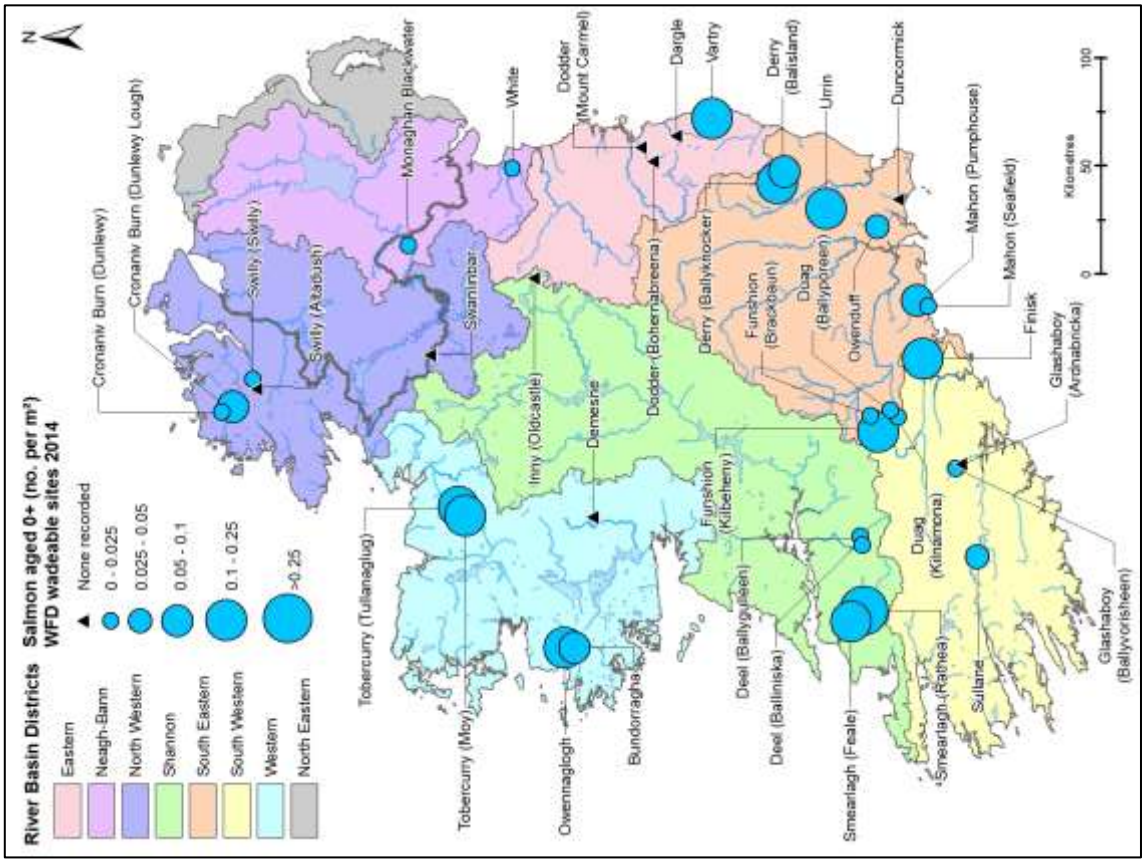

Fig. 4.53. Distribution and abundance of 0+ salmon at wadeable river sites surveyed for WFD fish monitoring 2014

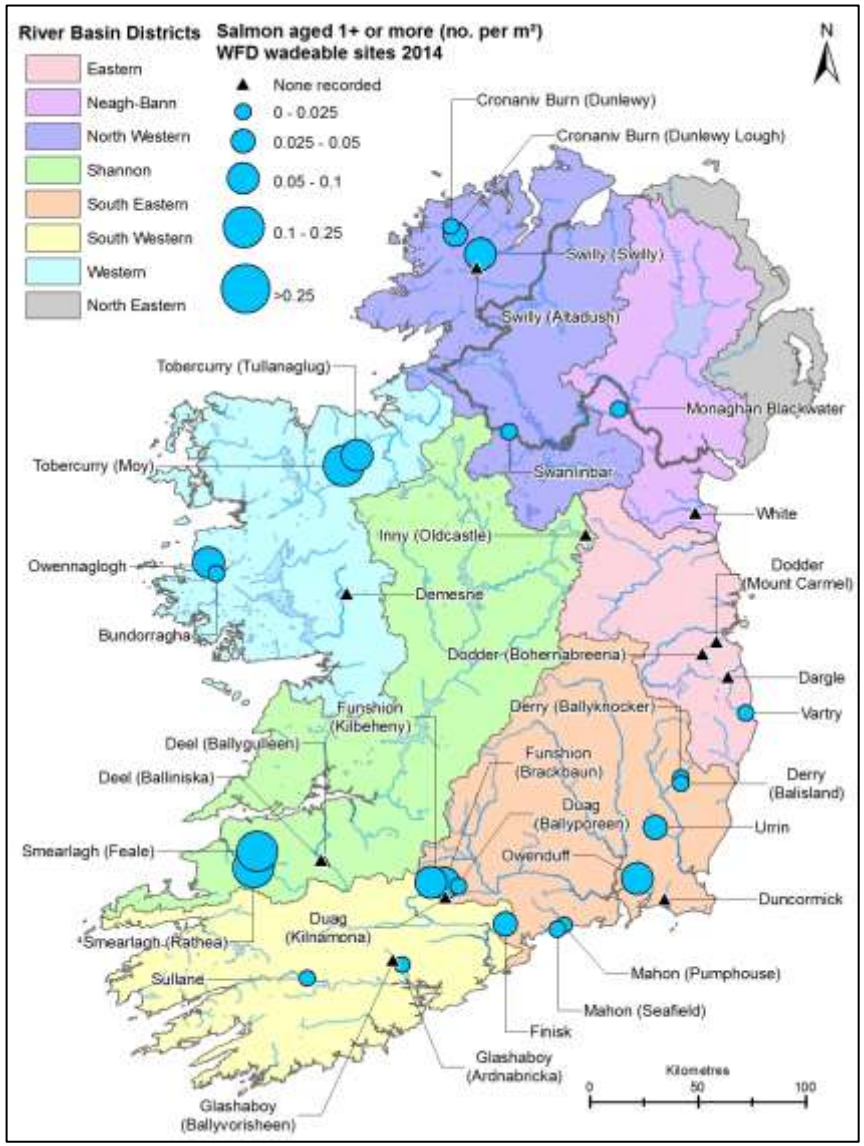

Fig. 4.55. Distribution and abundance of 1+ or older salmon at wadeable river sites surveyed for WFD fish monitoring 2014

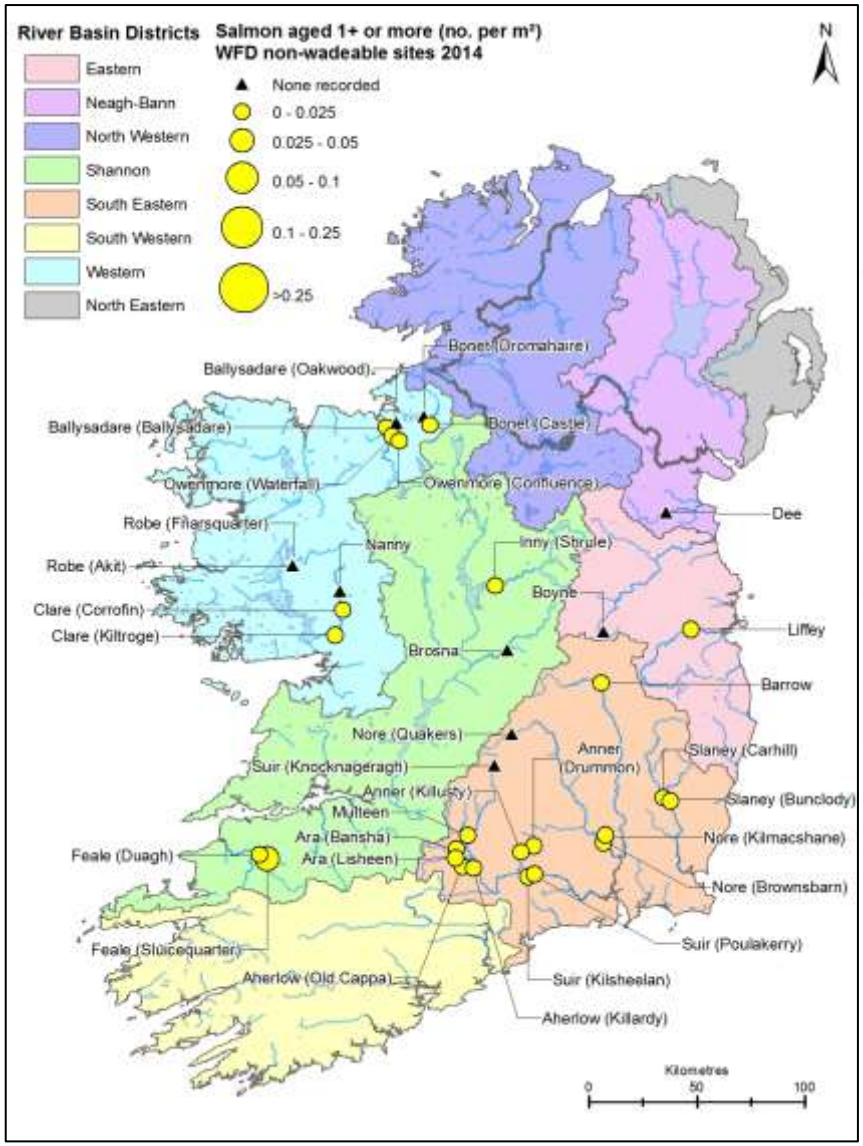

Fig. 4.56. Distribution and abundance of 1+ or older salmon at non-wadeable river sites surveyed for WFD fish monitoring 2014

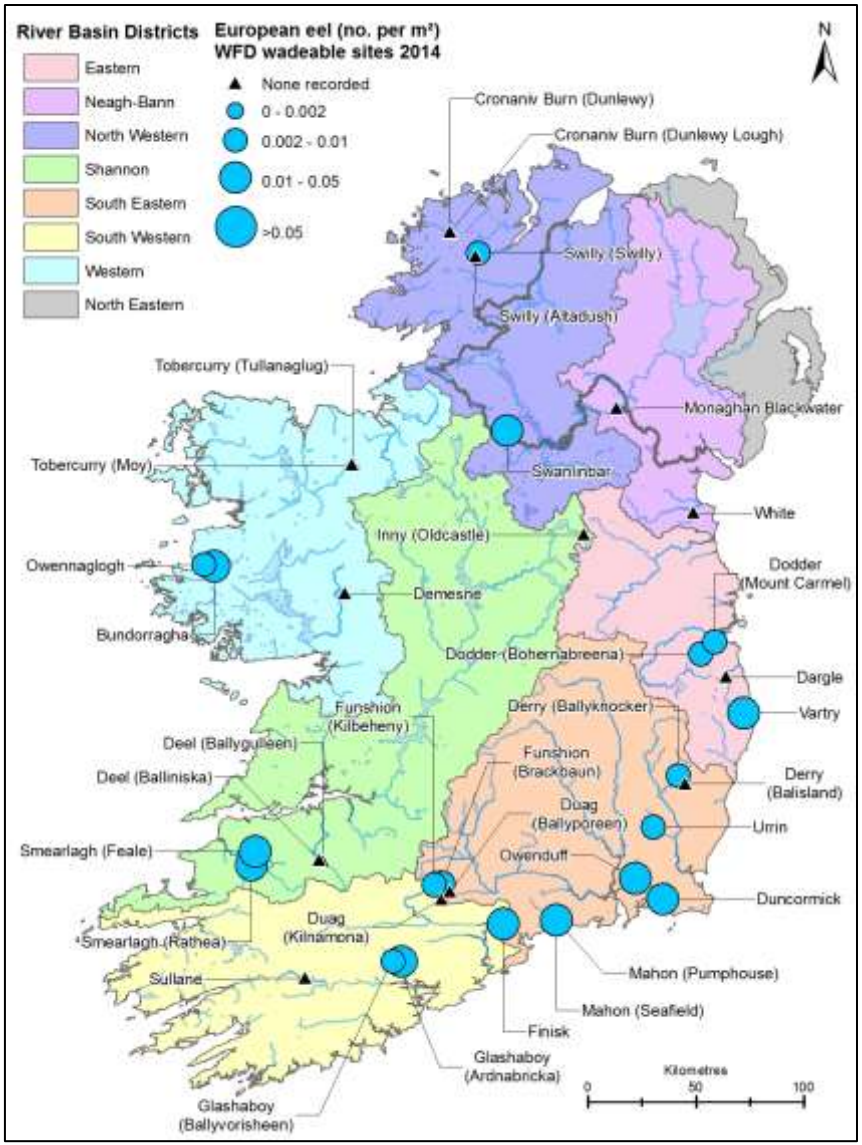

Fig. 4.57. Distribution and abundance of European eel at wadeable river sites surveyed for WFD fish monitoring 2014

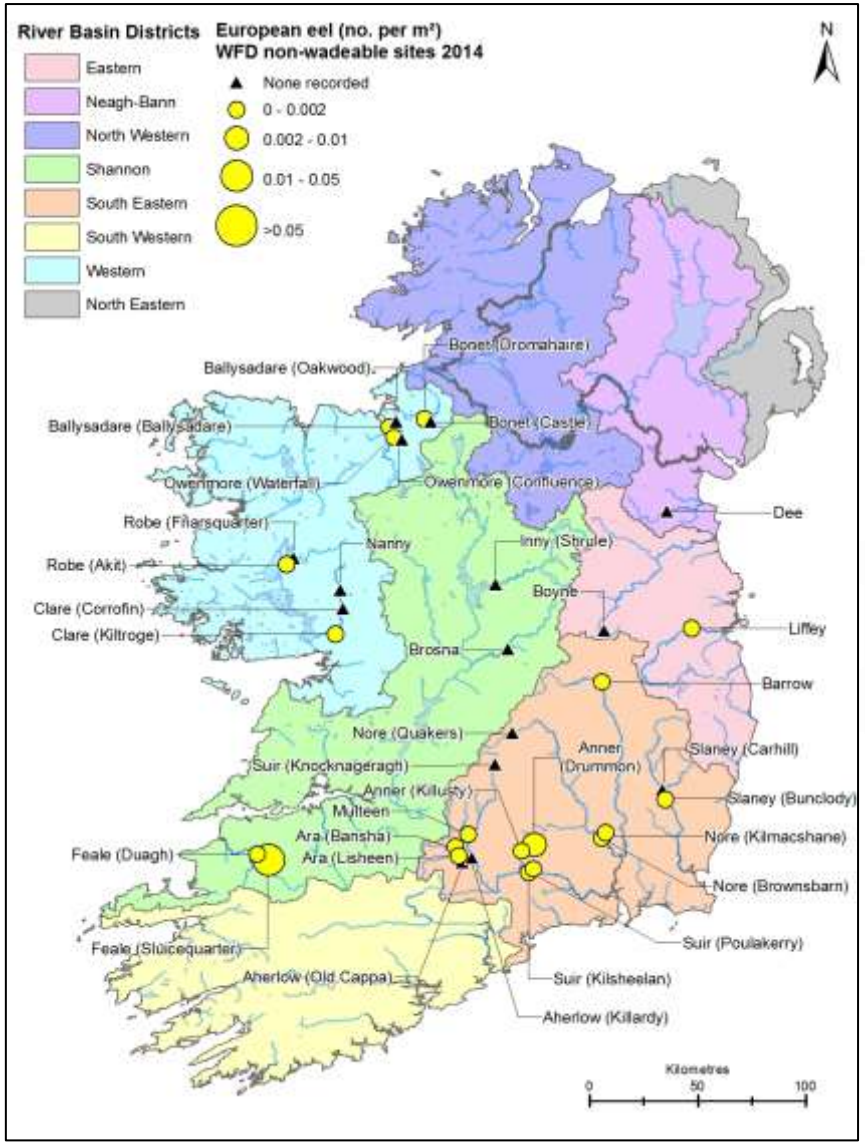

Fig. 4.58. Distribution and abundance of European eel at non-wadeable river sites surveyed for WFD fish monitoring 2014

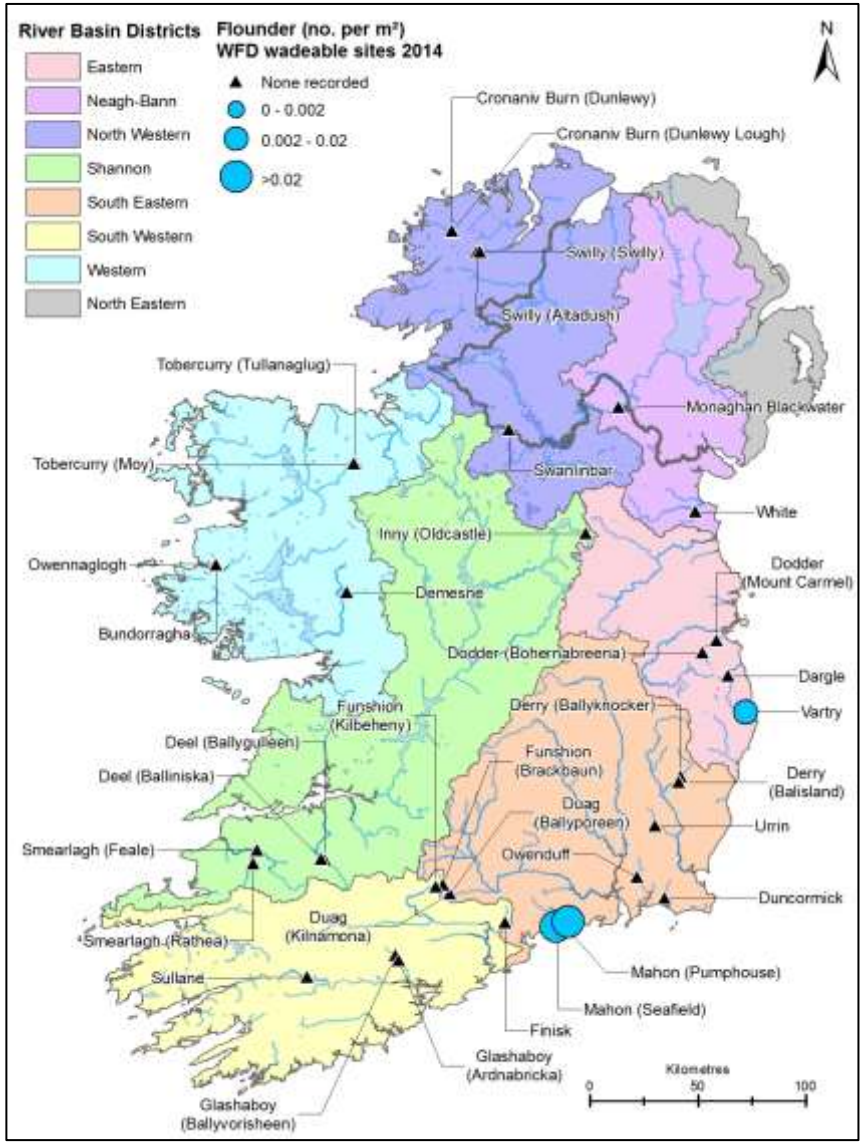

Fig. 4.59. Distribution and abundance of flounder at wadeable river sites surveyed for WFD fish monitoring 2014

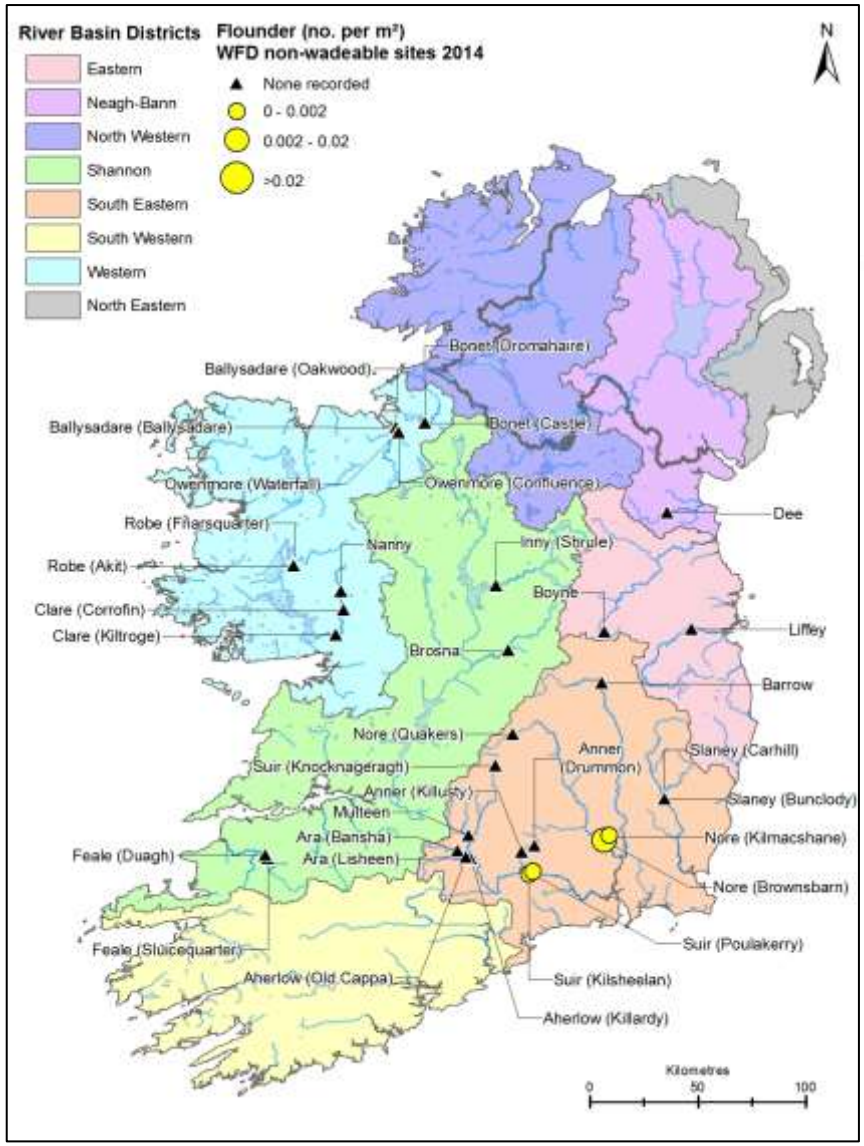

Fig. 4.60. Distribution and abundance of flounder at non-wadeable river sites surveyed for WFD fish monitoring 2014

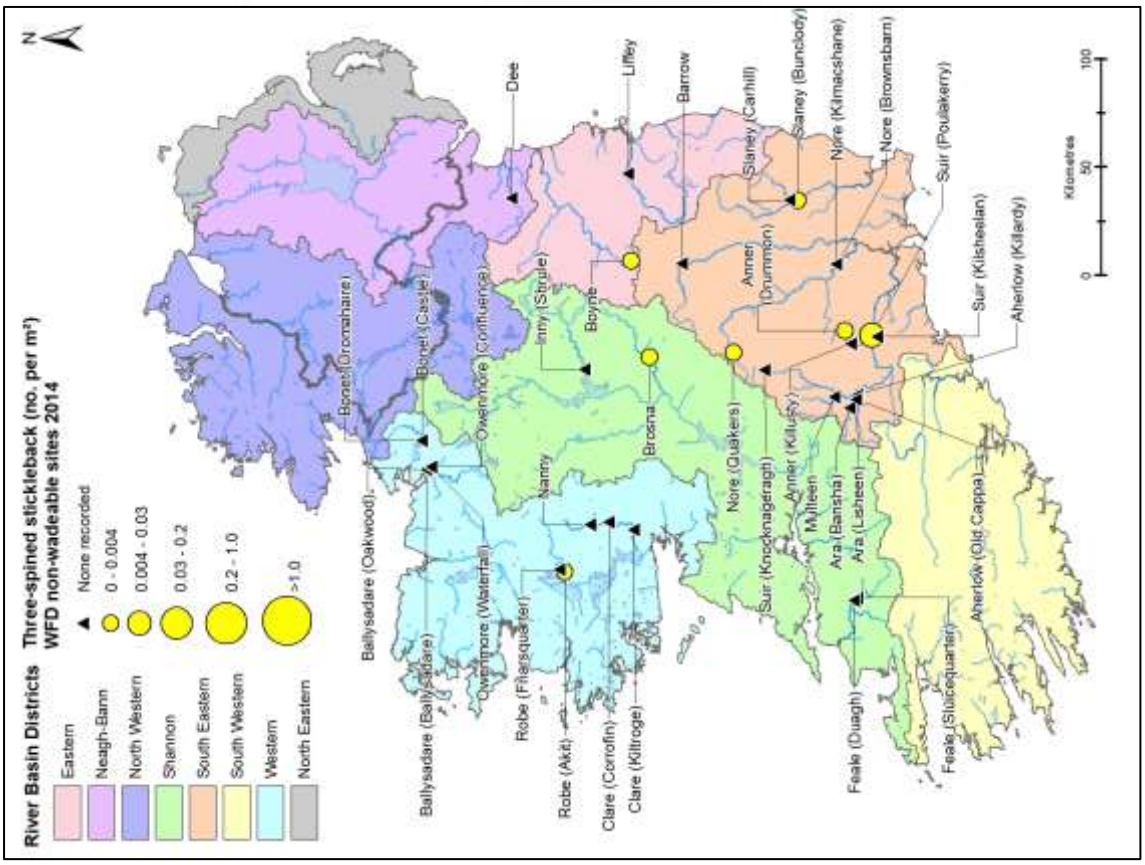

Fig. 4.62. Distribution and abundance of three-spined stickleback at non-wadeable river sites surveyed for WFD fish monitoring 2014

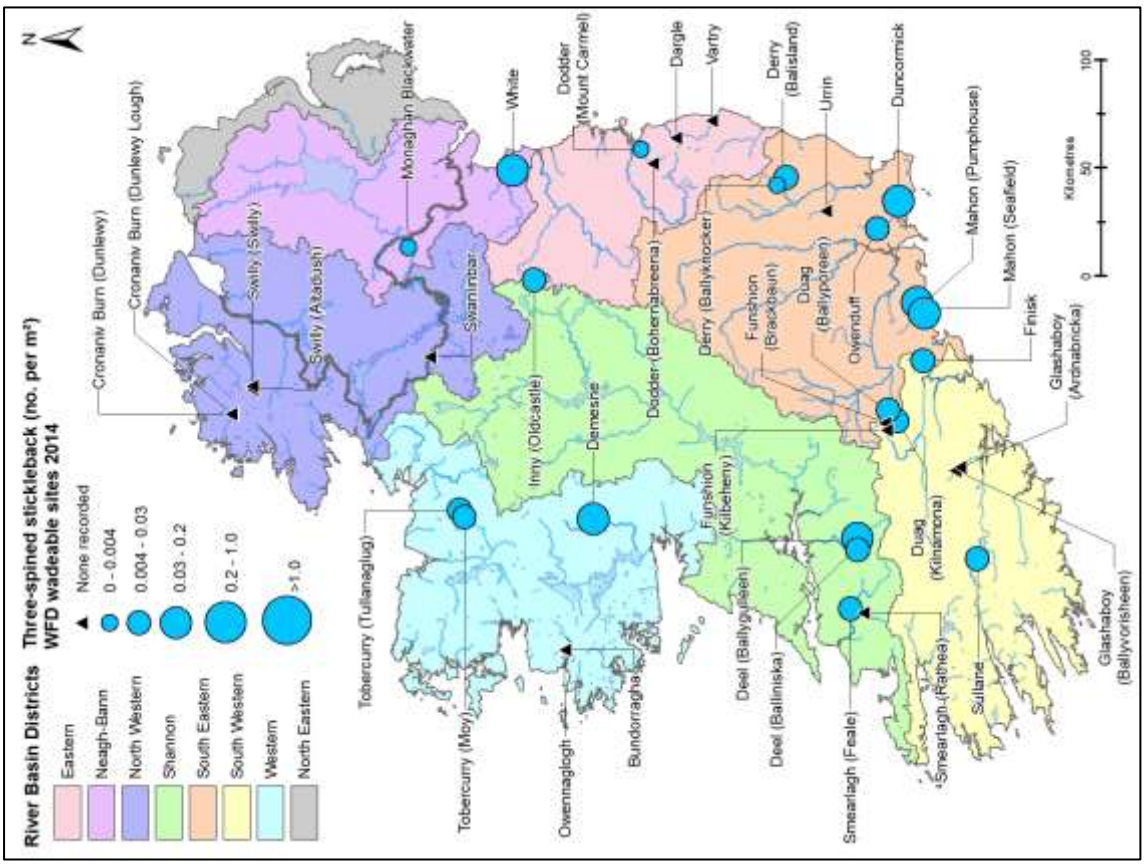

Fig. 4.61. Distribution and abundance of three-spined stickleback at wadeable river sites surveyed for WFD fish monitoring 2014

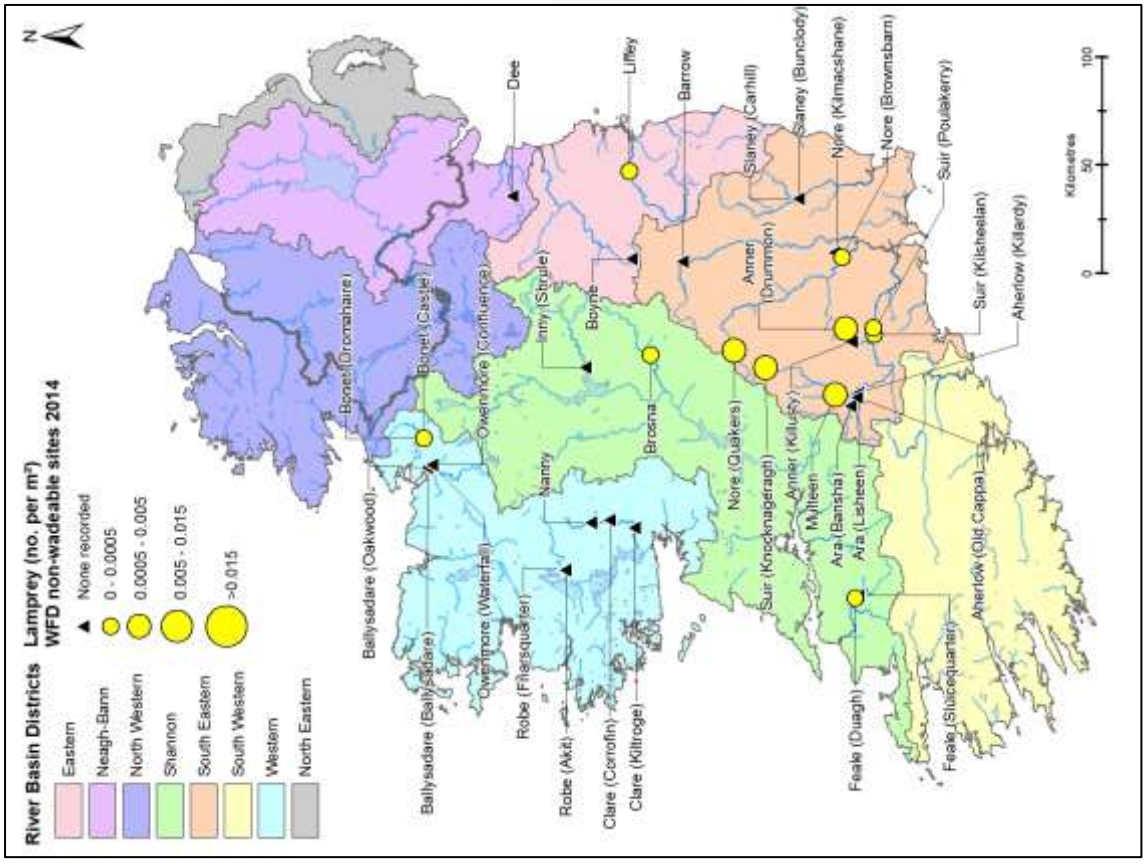

Fig. 4.66. Distribution and abundance of lamprey at non-wadeable river sites surveyed for WFD fish monitoring 2014

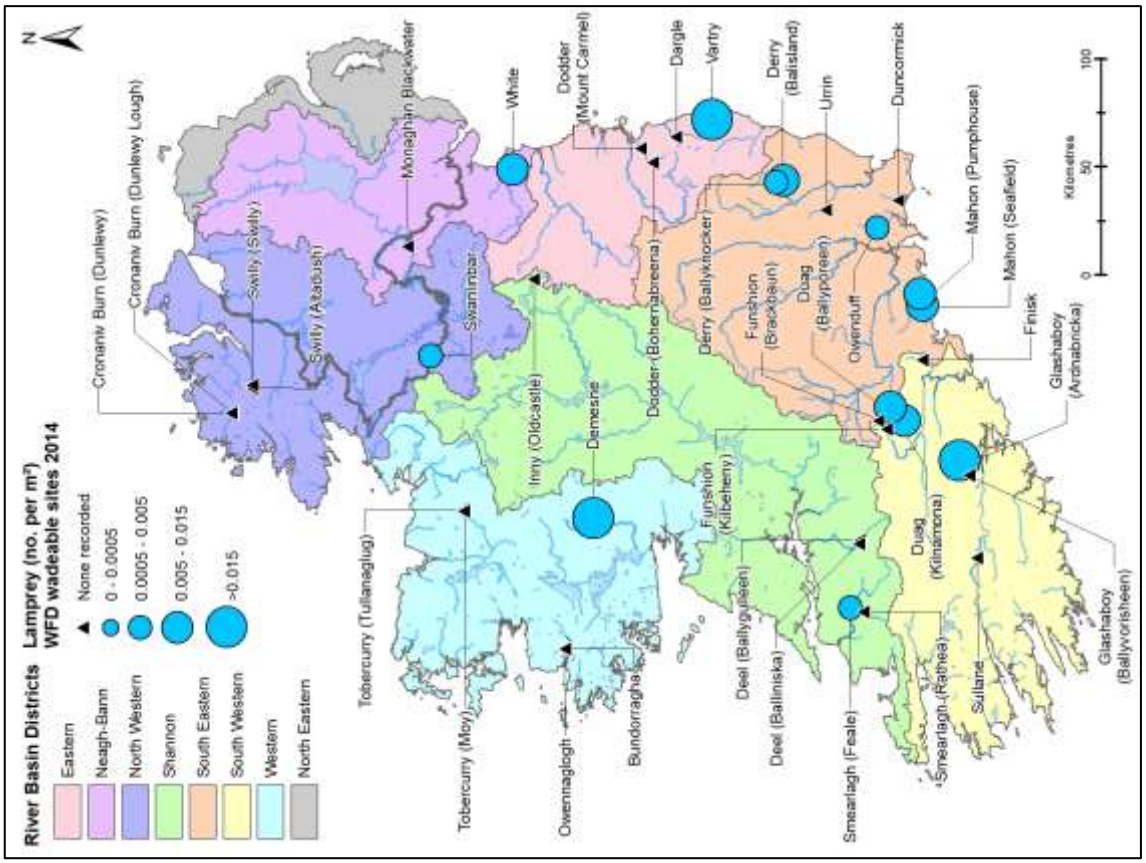

Fig. 4.65 Distribution and abundance of lamprey at wadeable river sites surveyed for WFD fish monitoring 2013

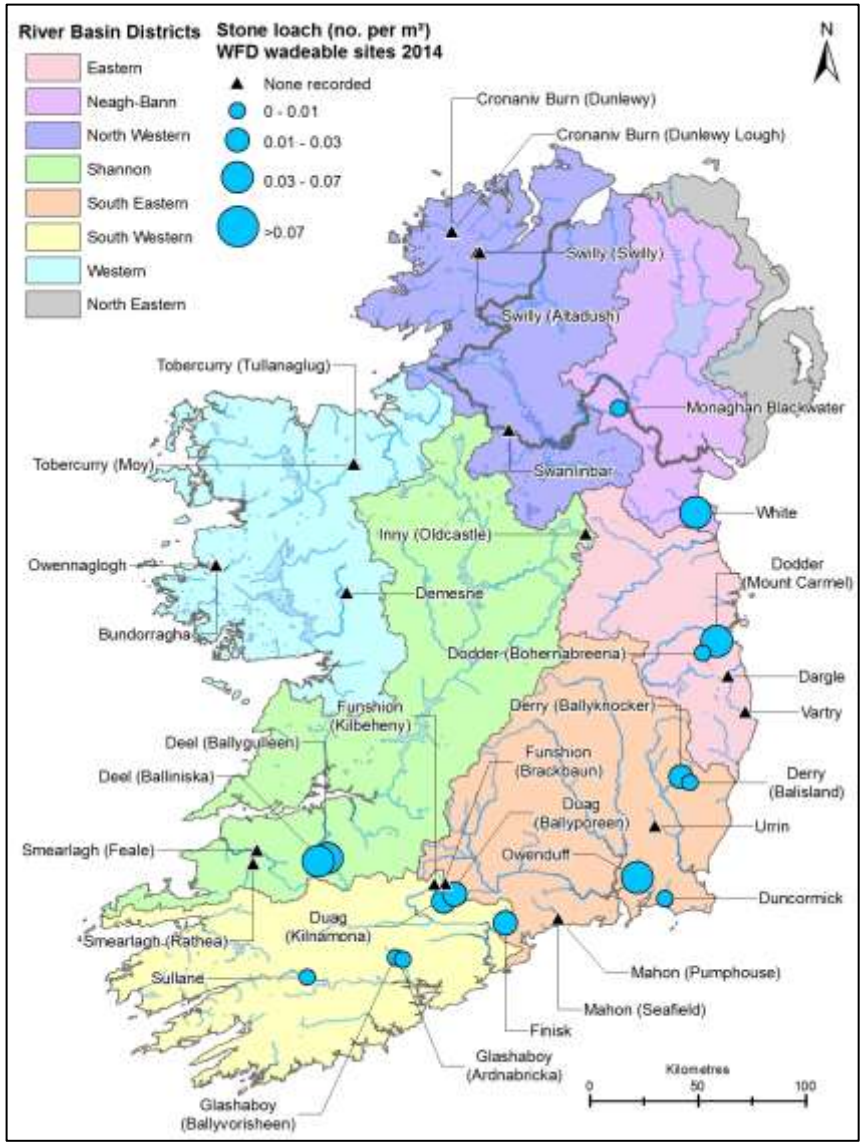

Fig. 4.67. Distribution and abundance of stone loach at wadeable river sites surveyed for WFD fish monitoring 2014

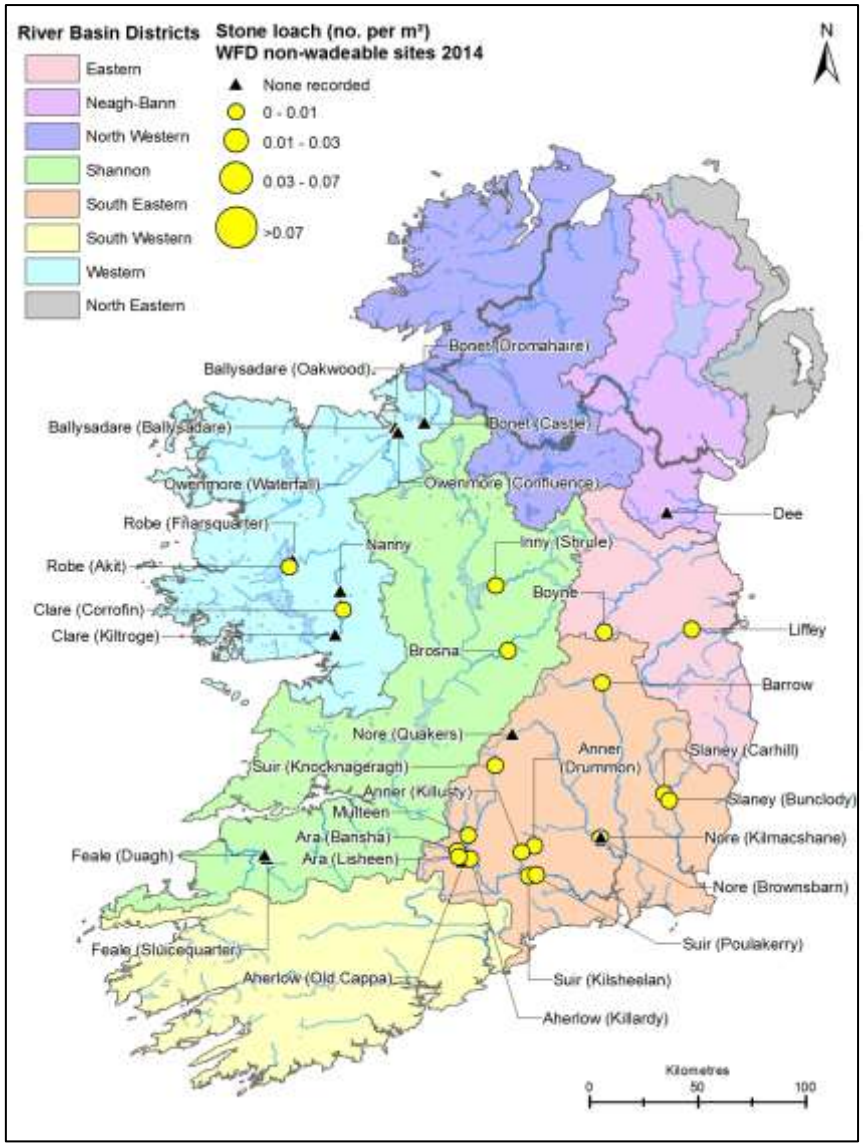

Fig. 4.68. Distribution and abundance of stone loach at non-wadeable river sites surveyed for WFD fish monitoring 2014

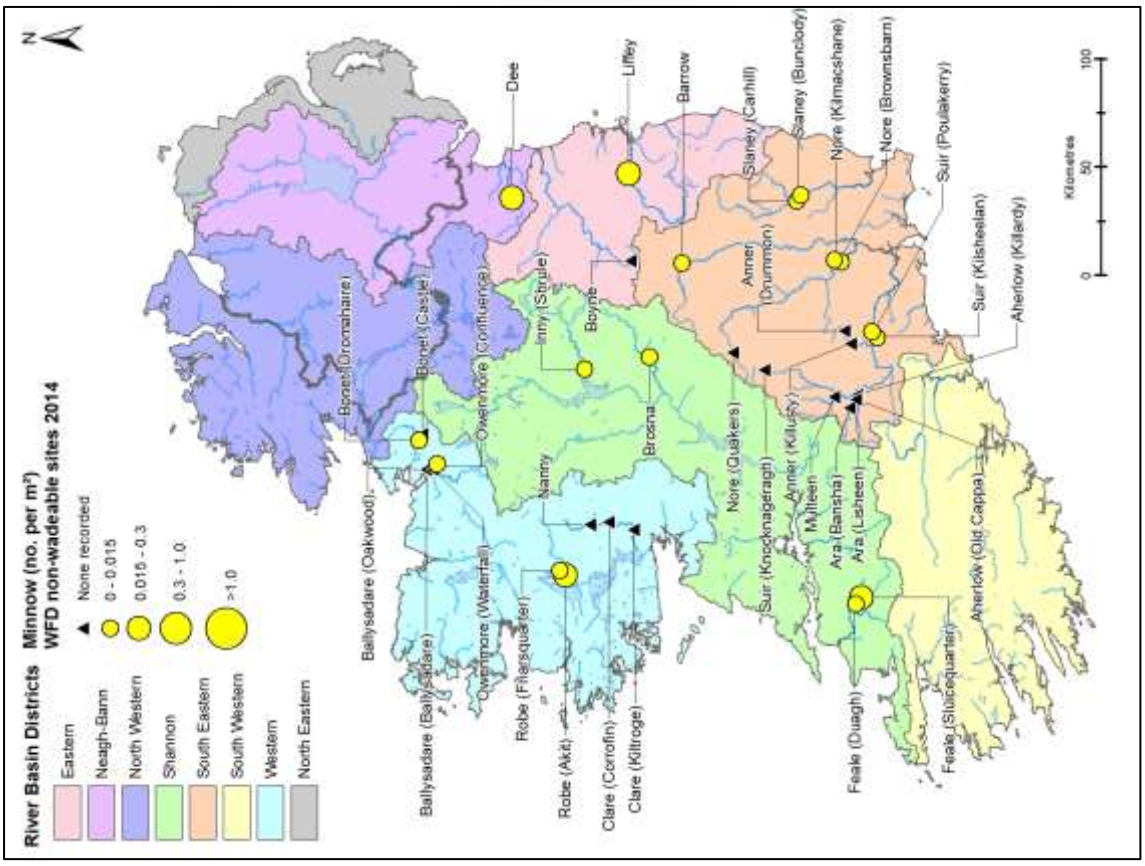

Fig. 4.70. Distribution and abundance of minnow at non-wadeable river sites surveyed for WFD fish monitoring 2014

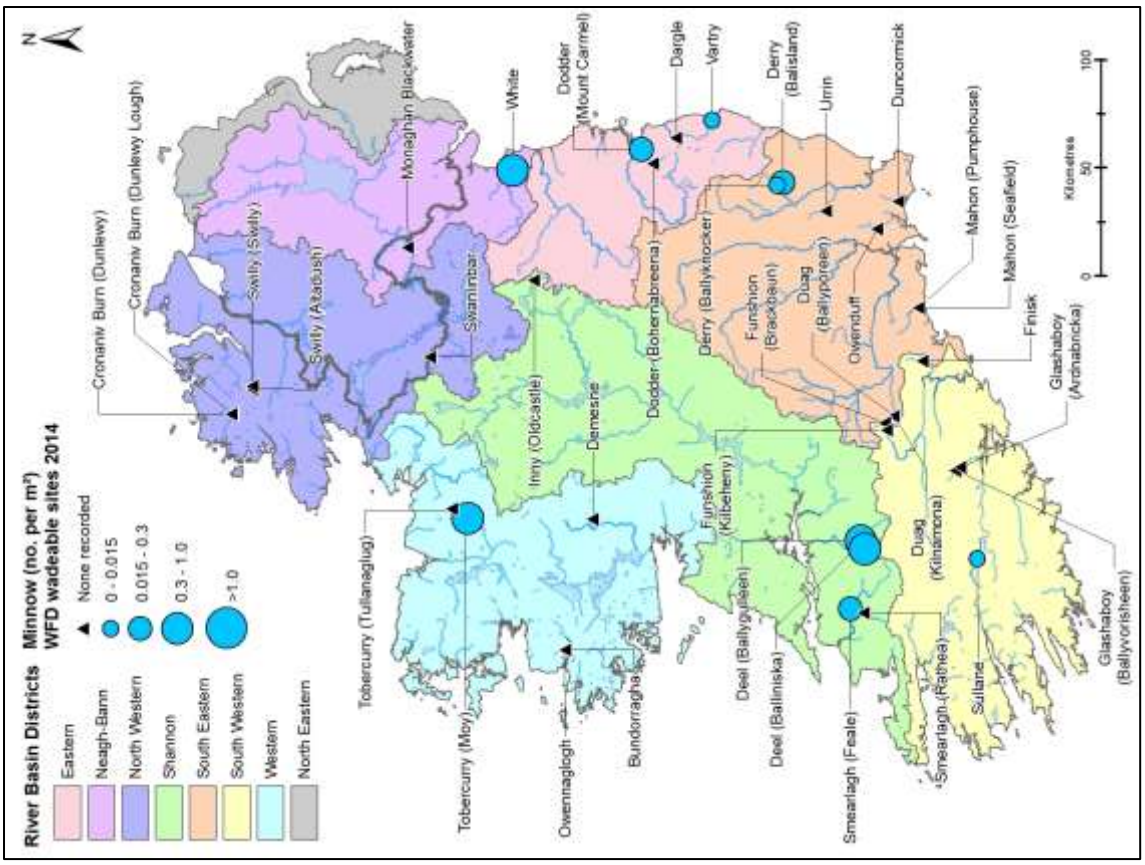

Fig. 4.69 Distribution and abundance of minnow at wadeable river sites surveyed for WFD fish monitoring 2014

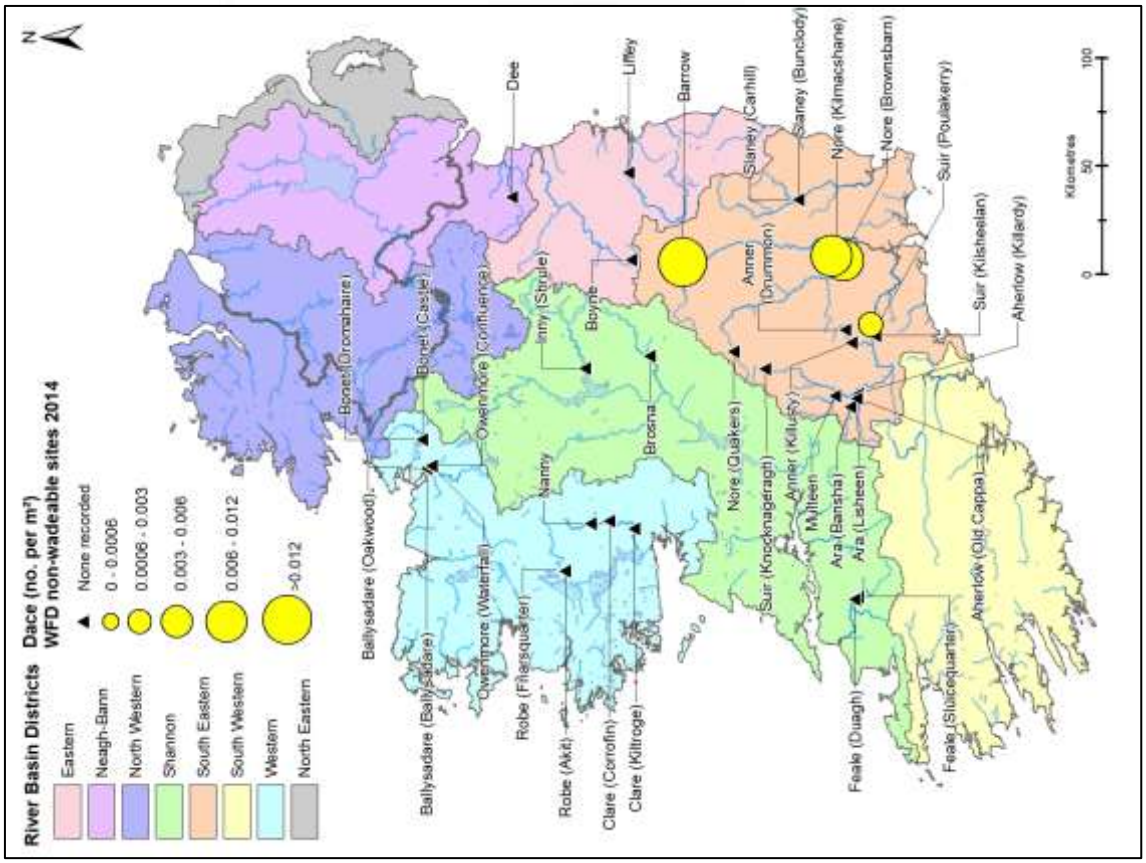

Fig. 4.72. Distribution and abundance of dace at non-wadeable river sites surveyed for WFD fish monitoring 2014

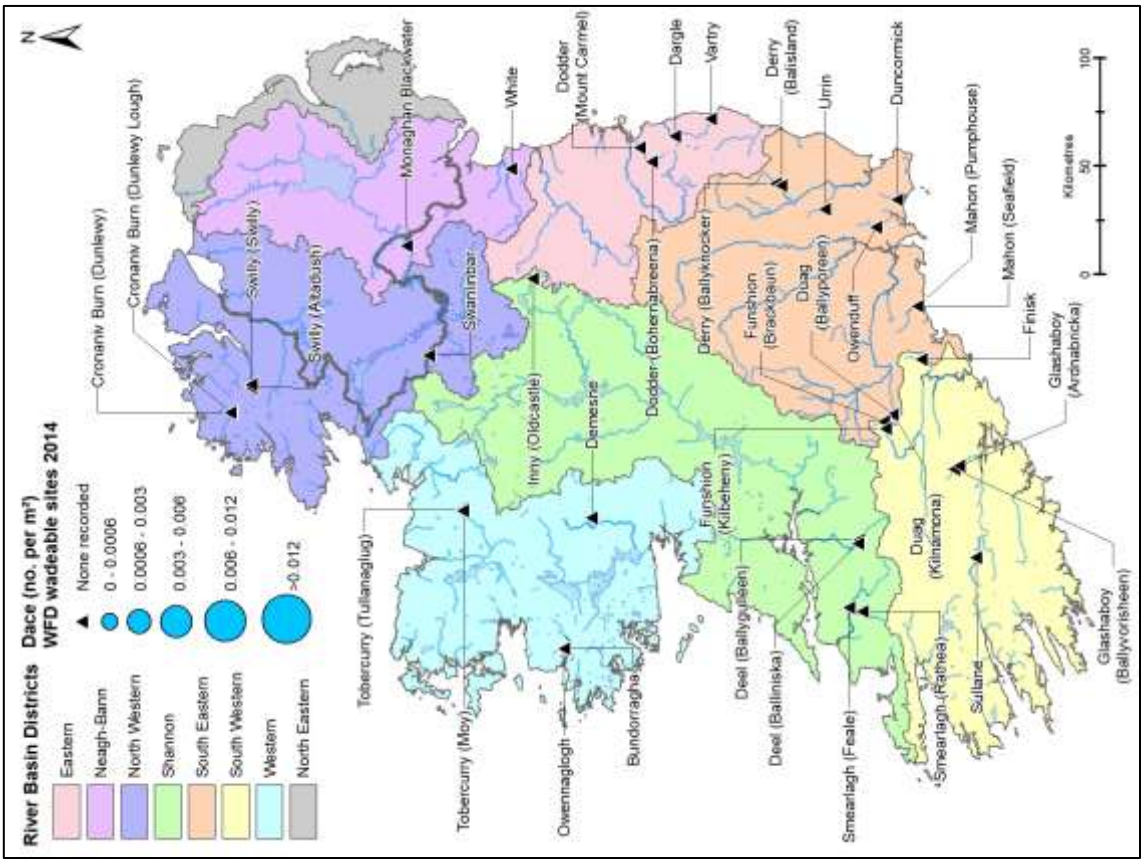

Fig. 4.71. Distribution and abundance of dace at wadeable river sites surveyed for WFD fish monitoring 2014

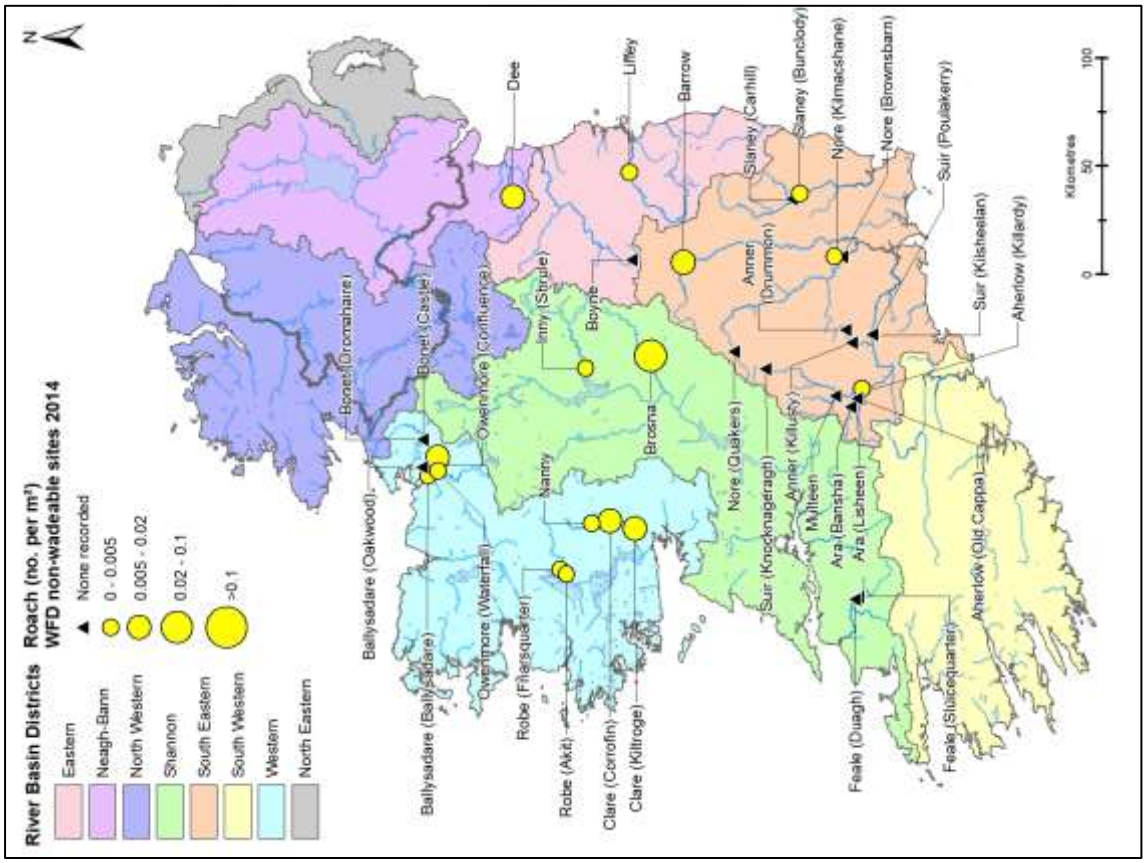

Fig. 4.74. Distribution and abundance of roach at non-wadeable river sites surveyed for WFD fish monitoring 2014

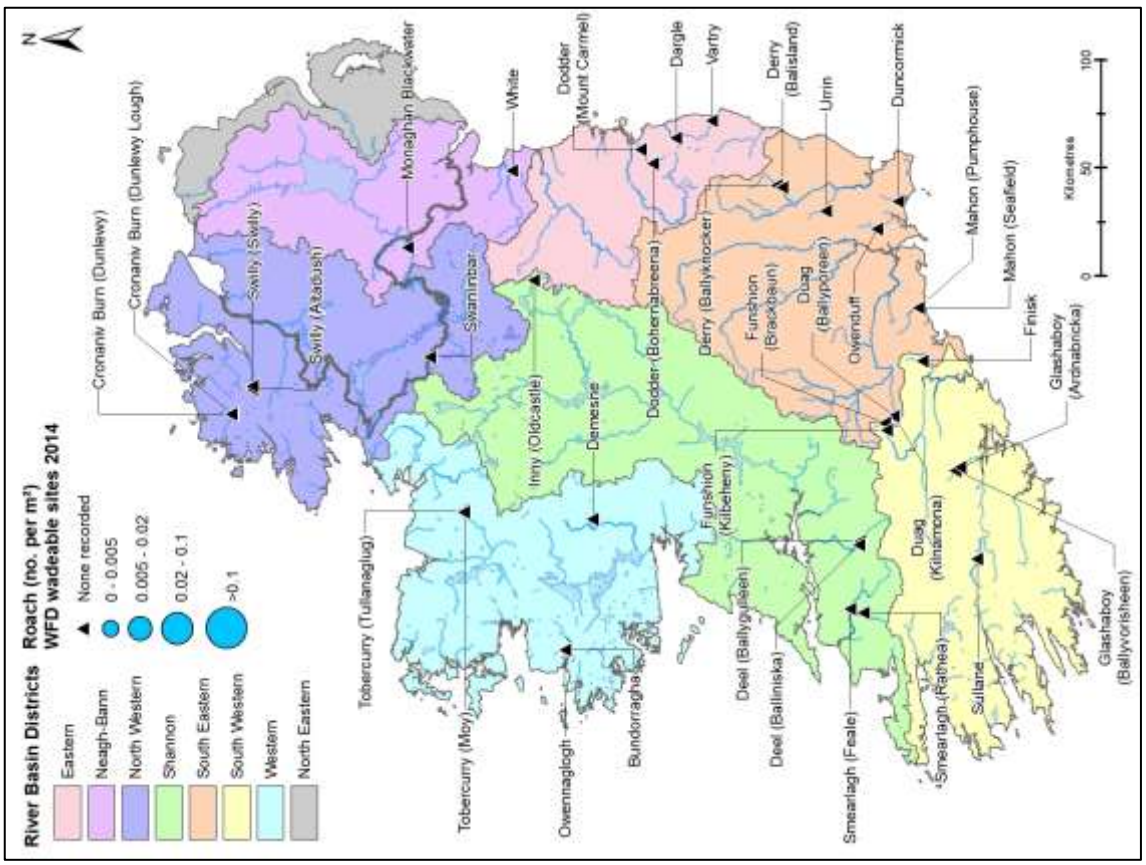

Fig. 4.73. Distribution and abundance of roach at wadeable river sites surveyed for WFD fish monitoring 2014

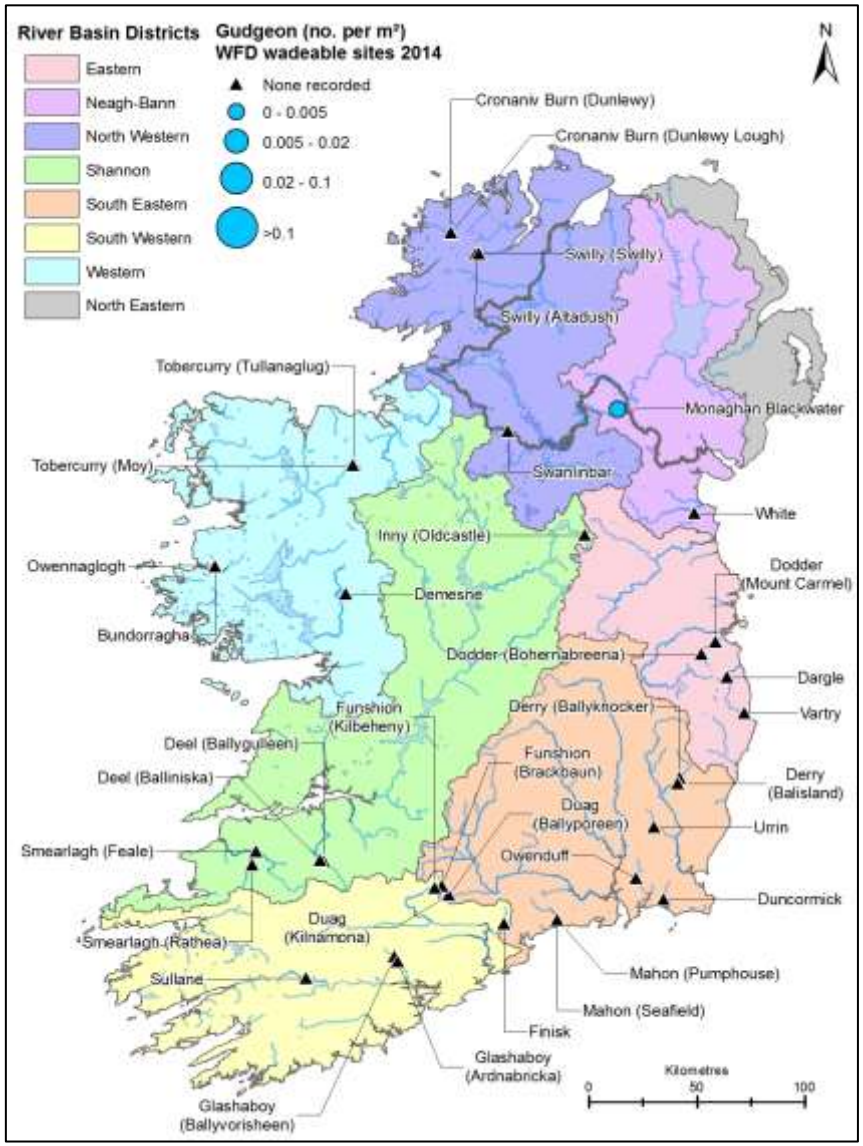

Fig. 4.75. Distribution and abundance of gudgeon at wadeable river sites surveyed for WFD fish monitoring 2014

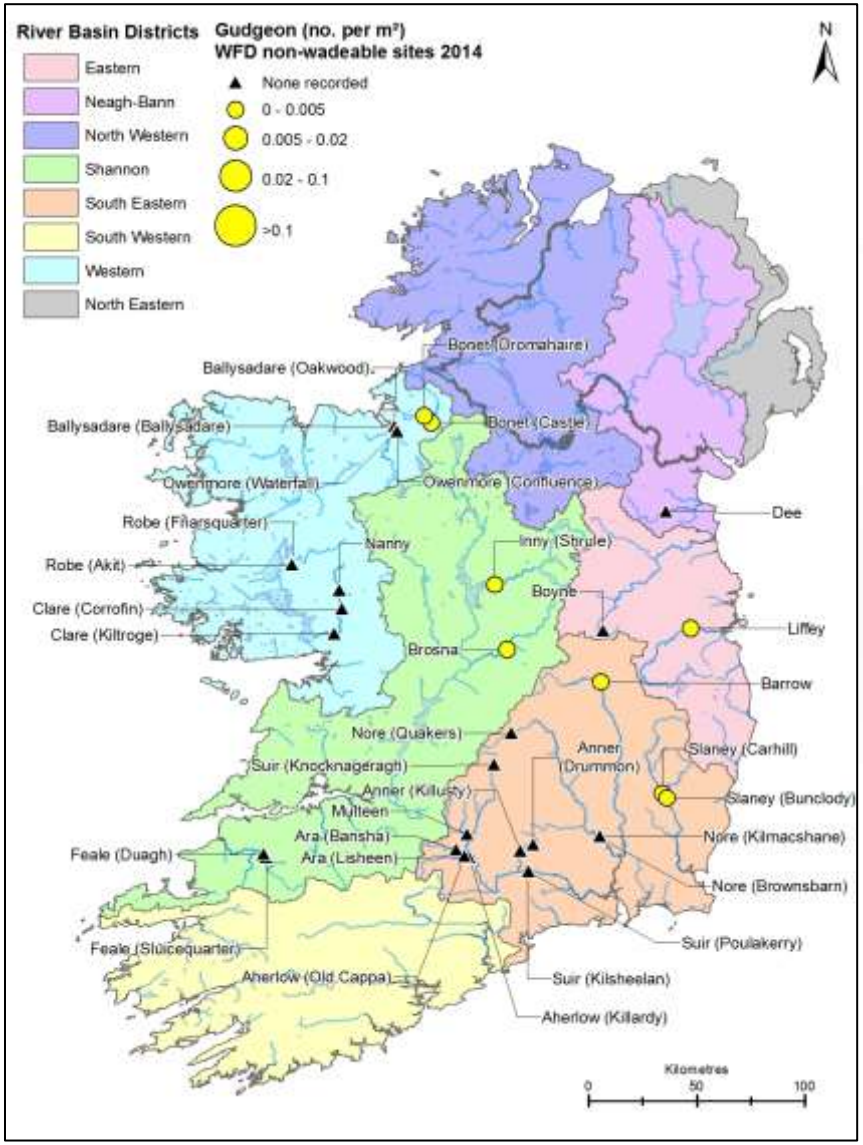

Fig. 4.76. Distribution and abundance of gudgeon at non-wadeable river sites surveyed for WFD fish monitoring 2014

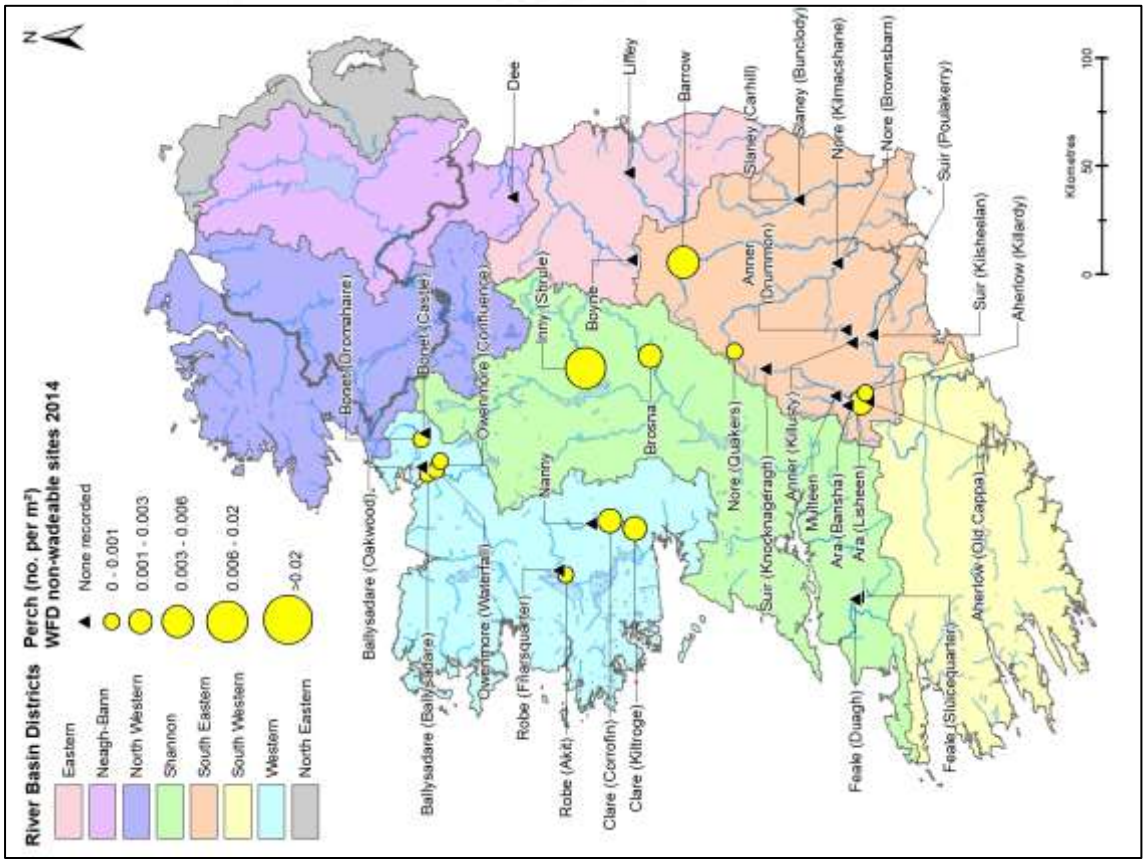

Fig. 4.78. Distribution and abundance of perch at non-wadeable river sites surveyed for WFD fish monitoring 2014

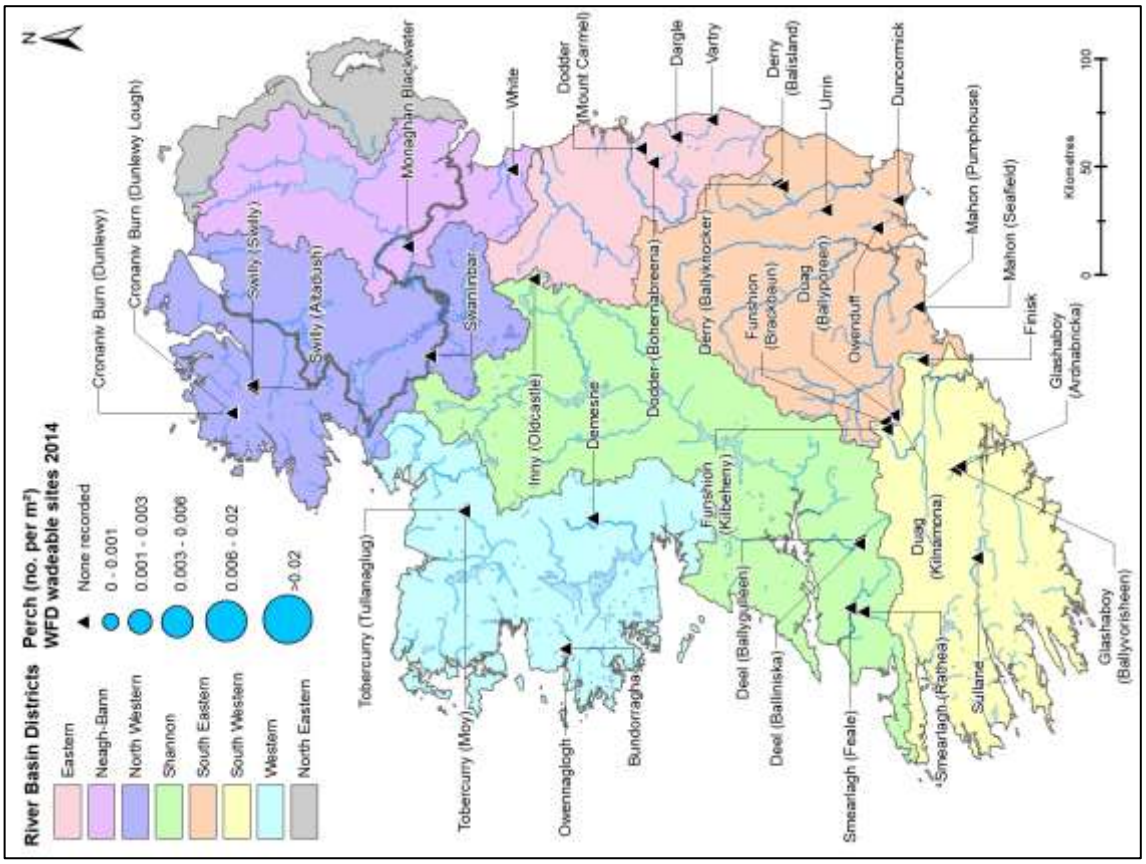

Fig. 4.77. Distribution and abundance of perch at wadeable river sites surveyed for WFD fish monitoring 2014

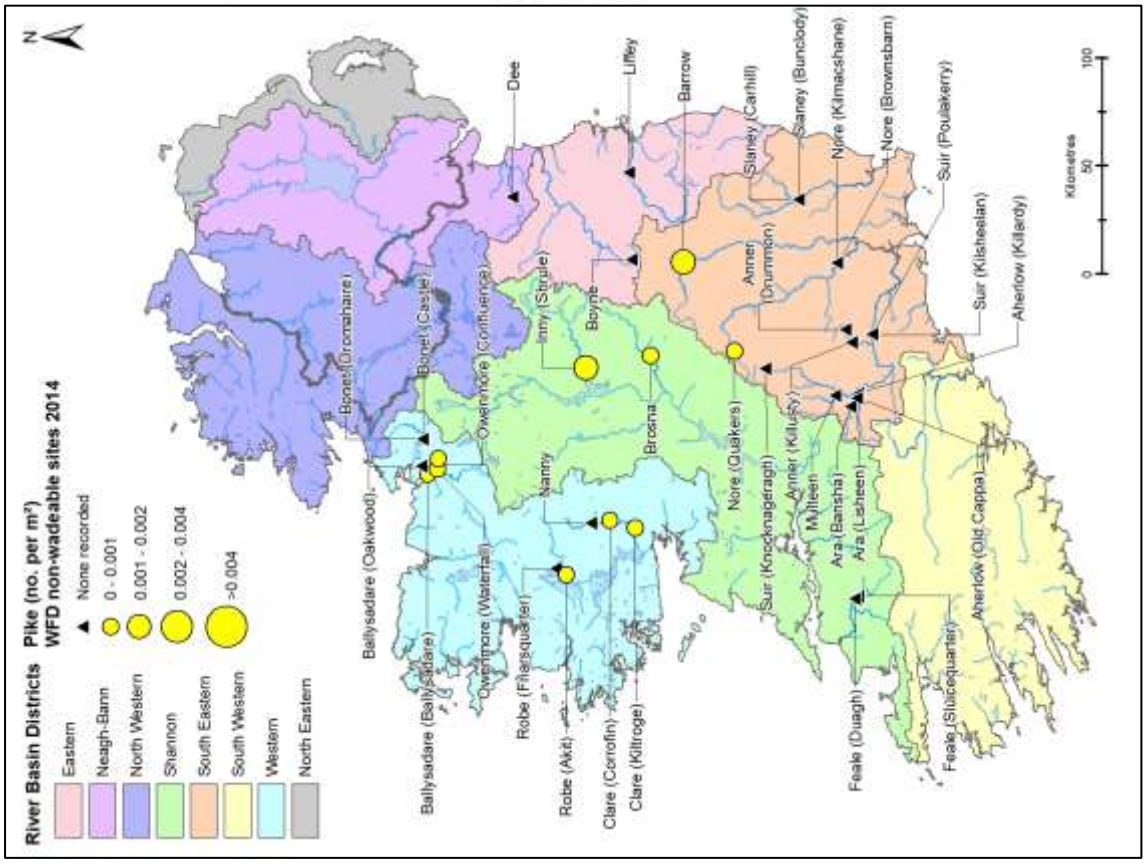

Fig. 4.80. Distribution and abundance of pike at non-wadeable river sites surveyed for WFD fish monitoring 2014

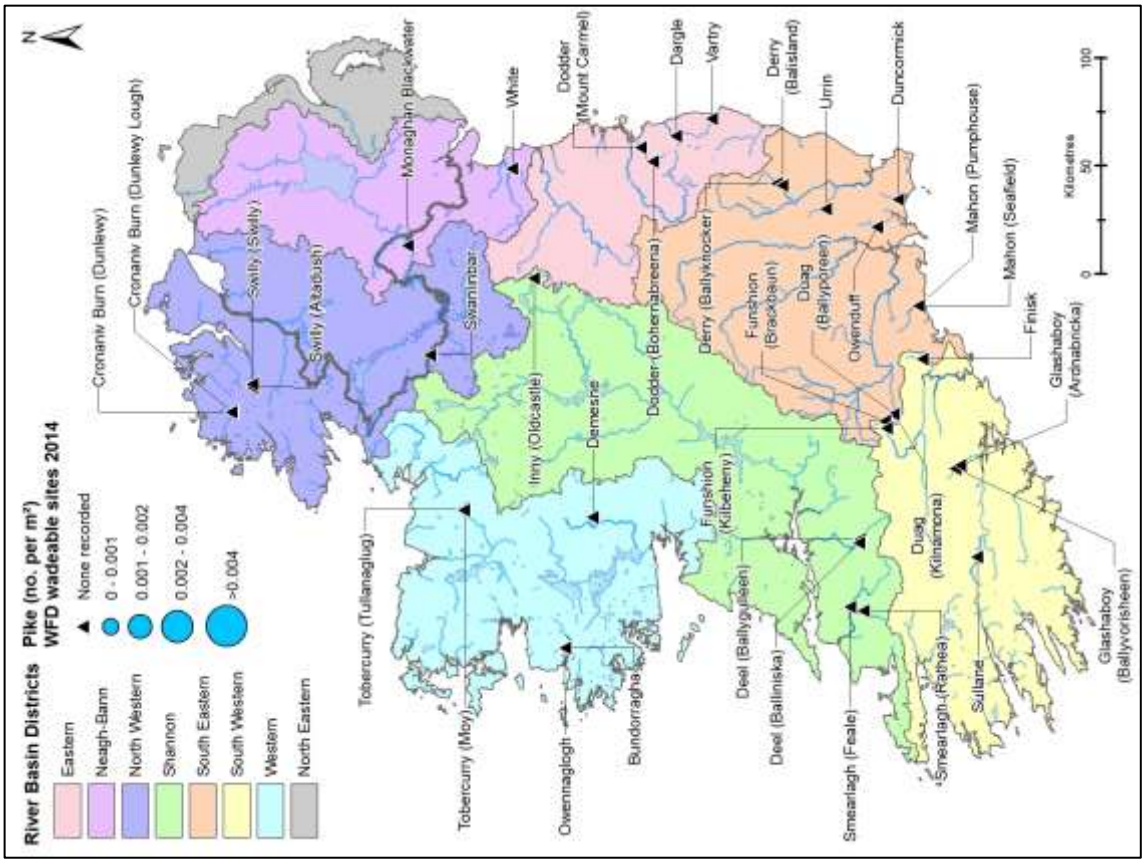

Fig. 4.79. Distribution and abundance of pike at wadeable river sites surveyed for WFD fish monitoring 2014

4.2.3 Fish growth in rivers

Scales from a total of 1,693 brown trout, 670 salmon, 212 roach, 36 pike, 105 dace, 41 sea trout and one roach x bream hybrid were examined for age and growth analysis. Where large numbers of any species were captured at a site, scales were analysed from a sub-sample of three fish within each 1cm size class.

4.2.3.1 Growth of brown trout

Brown trout at each river site were assigned growth categories based on a new growth classification scheme using length at age data from multiple years (L1, L2, L3 and L4) (Tables 4.7 and 4.8) (Matson and Kelly, *in prep*.). Length at age data for each site was compared using Table 4.7 below to ascertain which growth category it fit into most appropriately. Some sites couldn't be determined due to insufficient data. Where there was overlap between two categories, a mixed category was used (Table 4.7 and 4.8).

Table 4.7. Categories of growth for brown trout at different ages

Growth Category	L1	L2	L3	L4
Very Slow	<5	<10	<14.5	<20
Slow	5 to 5.5	10 to 12	14.5 to 18	20 to 24
Moderate	5.5 to 9	12 to 18.5	18 to 24.5	24 to 32
Fast	9 to 10	18.5 to 21.5	24.5 to 29.5	32 to 36.5
Very Fast	>10	>21.5	>29.5	>36.5

Table 4.8. Categories of brown trout growth in the WFD river sites surveyed in 2014

River	Growth category	River	Growth category
Ballysadare (Ballysadare Br._A)	N/A	**Duncormick ((W) Br. nr Duncormick Rly St_B)**	Moderate
Clare (Corrofin Br._A)	N/A	**Feale (Br. ENE of Duagh Ho_A)**	Moderate
Robe (Friarsquarter_A)	N/A	**Feale (Sluicequarter_A)**	Moderate
Tobercurry (Br. just u/s Moy _C)	N/A	**Finisk (Modelligo Br._A)**	Moderate
Tobercurry (Tullanaglug_A)	N/A	**Funshion (Kilbeheny_A)**	Moderate
Cronaniv Burn (Br. u/s Dunlewy Lough_A)	Very Slow	**Glashaboy (Ardnabricka_A)**	Moderate
Cronaniv Burn (Dunlewy_A)	Very Slow	**Glashaboy (Ballyvorisheen Br._B)**	Moderate
Funshion (Brackbaun Br._A)	Very Slow	**Mahon (ENE of Seafield House_A)**	Moderate
Inny (Br. 1 km S of Oldcastle_A)	Very Slow	**Mahon (Pumphouse Weir_A)**	Moderate
Dargle (Bahana_A)	Very Slow/Slow	**Multeen (Ballygriffin Br._A)**	Moderate
Owennaglogh (Tawnynoran_A)	Very Slow/Slow	**Nanny (Tuam) (u/s Weir Br._A)**	Moderate
Bundorragha (Rock Pool_A)	Slow	**Nore (Brownsbarn Br._A)**	Moderate
Swanlinbar (Swanlinbar Br. (Carpark)_A)	Slow/Moderate	**Nore (Kilmacshane_A)**	Moderate
Swilly (Swilly Br. (near Breenagh)_A)	Slow/Moderate	**Nore (Quakers Br._A)**	Moderate
Aherlow (Killardy Br._A)	Moderate	**Owenduff (Rathnageeragh_A)**	Moderate
Aherlow (Old Cappa Br._A)	Moderate	**Owenmore (Sligo) (Waterfall_A)**	Moderate
Anner (Drummon Br._A)	Moderate	**Robe (Akit Br._A)**	Moderate
Anner (Killusty_A)	Moderate	**Slaney (Bunclody_A)**	Moderate
Ara (Bansha_A)	Moderate	**Slaney (Carhill_A)**	Moderate
Ara (Lisheen_A)	Moderate	**Smearlagh (Ford u/s Feale R confl (LHS)_A)**	Moderate
Barrow (Pass Br._B)	Moderate	**Smearlagh (Rathea_A)**	Moderate
Blackwater (Monaghan)(Corvally_A)	Moderate	**Suir (Kilsheelan Br._A)**	Moderate
Bonet (Castle_A)	Moderate	**Suir (Knocknageragh Br._A)**	Moderate
Boyne (Boyne Br._A)	Moderate	**Suir (Poulakerry_A)**	Moderate
Brosna (0.5km NW of Pollagh_A)	Moderate	**Sullane (Sullane Br._A)**	Moderate
Dee (Louth)(Burley Br._A)	Moderate	**Swilly (Altadush_A)**	Moderate
Deel (Newcastlewest)(Br. near Balliniska_A)	Moderate	**Urrin (Buck's Br._B)**	Moderate
Demesne (Curraghcreen_A)	Moderate	**Vartry (Newrath Br._A)**	Moderate
Derry (Balisland_A)	Moderate	**White (Louth) (Coneyburrow Br._B)**	Moderate
Derry (Ballyknocker_A)	Moderate	**Clare (Kiltroge Castle Br._A)**	Moderate/Fast
Dodder (Bohernabreena_A)	Moderate	**Inny (Shrule Br._A)**	Moderate/Fast
Dodder (Mount Carmel Hospital_A)	Moderate	**Liffey (Lucan Br._A)**	Moderate/Fast
Duag (Br. u/s Ballyporeen_B)	Moderate	**Owenmore (Sligo)(Unshin confl_A)**	Moderate/Fast
Duag (Kilnamona_A)	Moderate		

River sites where 1+ and older brown trout were recorded were divided into three categories based on their alkalinity (low = <35 mgCaCO$_3$ l^{-1}, moderate = 35 - 100 mgCaCO$_3$ l^{-1}, and high > 100 mgCaCO$_3$ l^{-1}). Eighteen river sites were characterised as low alkalinity, 12 as moderate alkalinity and 37 as high alkalinity. Statistical analysis revealed that there was a significant difference across alkalinity groups for L1 (Kruskal-Wallis, H=9.168, df=2, p<0.05), with the Low and High categories being significantly different (Mann-Whitney Pairwise, P<0.01) (Fig. 4.81). For L2, there was a difference across the three alkalinity groups (ANOVA, F=87.2, df=2, p<0.001, and again the Low and High categories were significantly different (Tukey's Pairwise, p<0.001). For L3 there was also a difference across the alkalinity groups (Kruskal-Wallis, H=20.04, p<0.001). Mann-Whitney Pairwise tests revealed the differences to be between the Low and High (p<0.001) and Moderate and High groups (p<0.001). For L4, there was no significant difference found across the three alkalinity groups but this may have been due to insufficient data. Fish of this age are rarely captured during the WFD river surveys. Insufficient data was available to test differences between L5 in each alkalinity type.

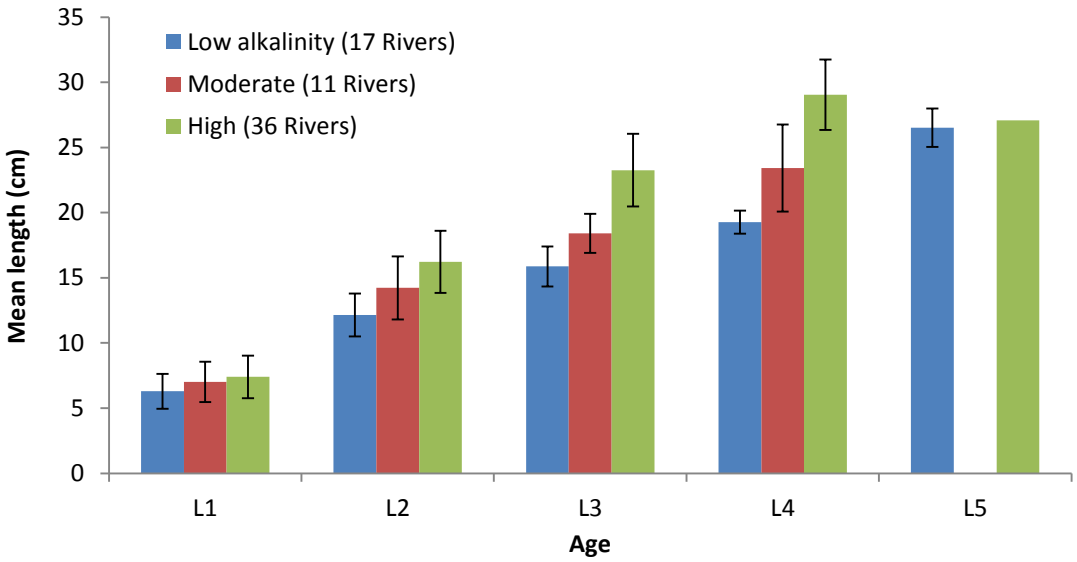

Fig. 4.81. Mean (±S.D.) back calculated lengths at age for brown trout in rivers within each alkalinity class

4.2.4 Ecological status – Classification of rivers using 'FCS2 Ireland'

An ecological classification tool for fish in rivers (FCS2 Ireland) was developed in 2011 for Ecoregion 17 (Republic of Ireland and Northern Ireland), along with a separate version for Scotland to comply with the requirements of the WFD (SNIFFER, 2011). The tool works by comparing various fish community metric values within a site (observed) to those predicted (expected) for that site under reference (un-impacted) conditions using a geo-statistical model based on Bayesian probabilities. The resulting output is an Ecological Quality Ratio (EQR) between 1 and 0, with five class boundaries defined along this range, corresponding to the five ecological status classes of High, Good, Moderate, Poor and Bad. Confidence levels are assigned to each class and represented as probabilities. This tool has successfully completed the recent EU wide intercalibration exercise in order to standardise results across Europe (EC, 2013). FCS2 Ireland has been used, along with expert opinion, to classify the 70 river sites surveyed during 2014. Expert opinion is essential to this process as it considers other factors not built into the tool, such as the occurrence of fish kills and the presence of invasive species.

The ecological status of three sites (4.3%) was classed as High, 38 (54.3%) as Good, 25 (35.7%) as Moderate and two (2.9%) as Poor (Table 4.9 & Fig. 4.82.). Two sites (2.9%) were not classified. When comparing the status this year with that from previous years, there was an improvement in ecological status at the River Nore (Quakers Br._A) from moderate to Good and the River Vartry (Newrath Br._A) from Good to High; however, there was a deterioration in ecological status at four sites: the Aherlow River (Killardy Br._A), the River Feale (Br. ENE of Duagh Ho_A, the Owenmore River (300 m u/s Unshin River confl_A) and the River Suir (Knocknageragh Br._A). All other sites that were previously surveyed remained unchanged (Table 4.9).

Table 4.9. Ecological status of river sites surveyed for fish in 2014 using the FCS2 Ireland classification tool*

RBD	River (Site)	2008	2009	2010	2011	2012	2013	2014
ERBD	Boyne (Boyne Br._A)		G	M				M
	Dargle (Bahana_A)					G		G
	Dodder (Bohernabreena_A)				G		M	M
	Dodder (Mount Carmel Hospital_A)				M		M	M
	Liffey (Lucan Br._A)		G					G
	Vartry (Newrath Br._A)	G					G	H
NBIRBD	Blackwater (Monaghan)(Corvally_A)							M
	Dee (Burley Br._A)		M					M
	White (Coneyburrow Br._B)					M	P	P
NWIRBD	Cronaniv Burn (Br. u/s Dunlewy Lough_A)	H			H			H
	Cronaniv Burn (Dunlewy_A)							G
	Swanlinbar (Swanlinbar Br. (Carpark)_A)				G			G
	Swilly (Altadush_A)							G
	Swilly (Swilly Br. (near Breenagh)_A)	G			G			G
SERBD	Aherlow (Killardy Br._A)			G				M
	Aherlow (Old Cappa Br._A)							M
	Anner (Drummon Br._A)	G						G
	Anner (Killusty_A)							G
	Ara (Bansha_A)							G
	Ara (Lisheen_A)							G
	Barrow (Pass Br._B)					G		G
	Derry (Balisland Br._A)							M
	Derry (Ballyknocker_A)							H
	Duag (Br. u/s Ballyporeen_B)	G			M			M
	Duag (Kilnamona_A)							M
	Duncormick (Duncormick Rly St_B)	M			M			M
	Mahon (ENE of Seafield House_A)	G						G
	Mahon (Pumphouse Weir_A)							G
	Multeen (Ballygriffin Br._A)					G		G
	Nore (Brownsbarn Br._A)					G		G
	Nore (Kilmacshane_A)							G
	Nore (Quakers Br._A)	M		M				G
	Owenduff (Rathnageeragh_A)							G
	Slaney (Bunclody_A)							M
	Slaney (Carhill_A)							M

Table 4.9 continued. Ecological status of river sites surveyed for fish in 2014 using the FCS2 Ireland classification tool

RBD	River (Site)	2008	2009	2010	2011	2012	2013	2014
SERBD	Suir (Kilsheelan Br._A)			G				G
	Suir (Knocknageragh Br._A)	M		G				M
	Suir (Poulakerry_A)							G
	Urrin (Buck's Br._A)	G						G
ShIRBD	Brosna (0.5km NW of Pollagh_A)	M						M
	Deel (Ballygulleen_A)							P
	Deel (Br. near Balliniska_A)	M			M			M
	Feale (Br. ENE of Duagh Ho_A)	H						G
	Feale (Sluicequarter_A)							G
	Inny (Br. 1 km S of Oldcastle_A)	G		G				G
	Inny (Shrule Br._A)	M						M
	Smearlagh (Ford u/s Feale R confl (LHS)_A)	G						G
	Smearlagh (Rathea_A)							G
SWRBD	Finisk (Modelligo Br._A)			G				G
	Funshion (Brackbaun Br._A)		G					G
	Funshion (Kilbeheny_A)							G
	Glashaboy (Ardnabricka_A)							G
	Glashaboy (Ballyvorisheen Br._B)	G			G			G
	Sullane (Sullane Br._A)							G
WRBD	Ballysadare (Ballysadare Br._A)			G				N/A
	Ballysadare (Oakwood_A)							N/A
	Bonet (1.8 km d/s Dromahaire Br._A)			M				M
	Bonet (Castle_A)							M
	Bundorragha (Rock Pool_A)							G
	Clare (Corrofin Br._A)			M				M
	Clare (Kiltroge Castle Br._A)			M				M
	Demesne (Curraghcreen_A)							M
	Nanny (u/s Weir Br._A)		M					M
	Owenmore (Sligo) (Unshin River confl_A)			H				G
	Owenmore (Sligo)(Waterfall_A)							G
	Owennaglogh (Tawnynoran_A)							G
	Robe (Akit Br._A)			M				M
	Robe (Friarsquarter_A)							M
	Tobercurry (Br. just u/s Moy River_C)				G			G
	Tobercurry (Tullanaglug_A)							G

**Ecological status is ubject to change upon review*

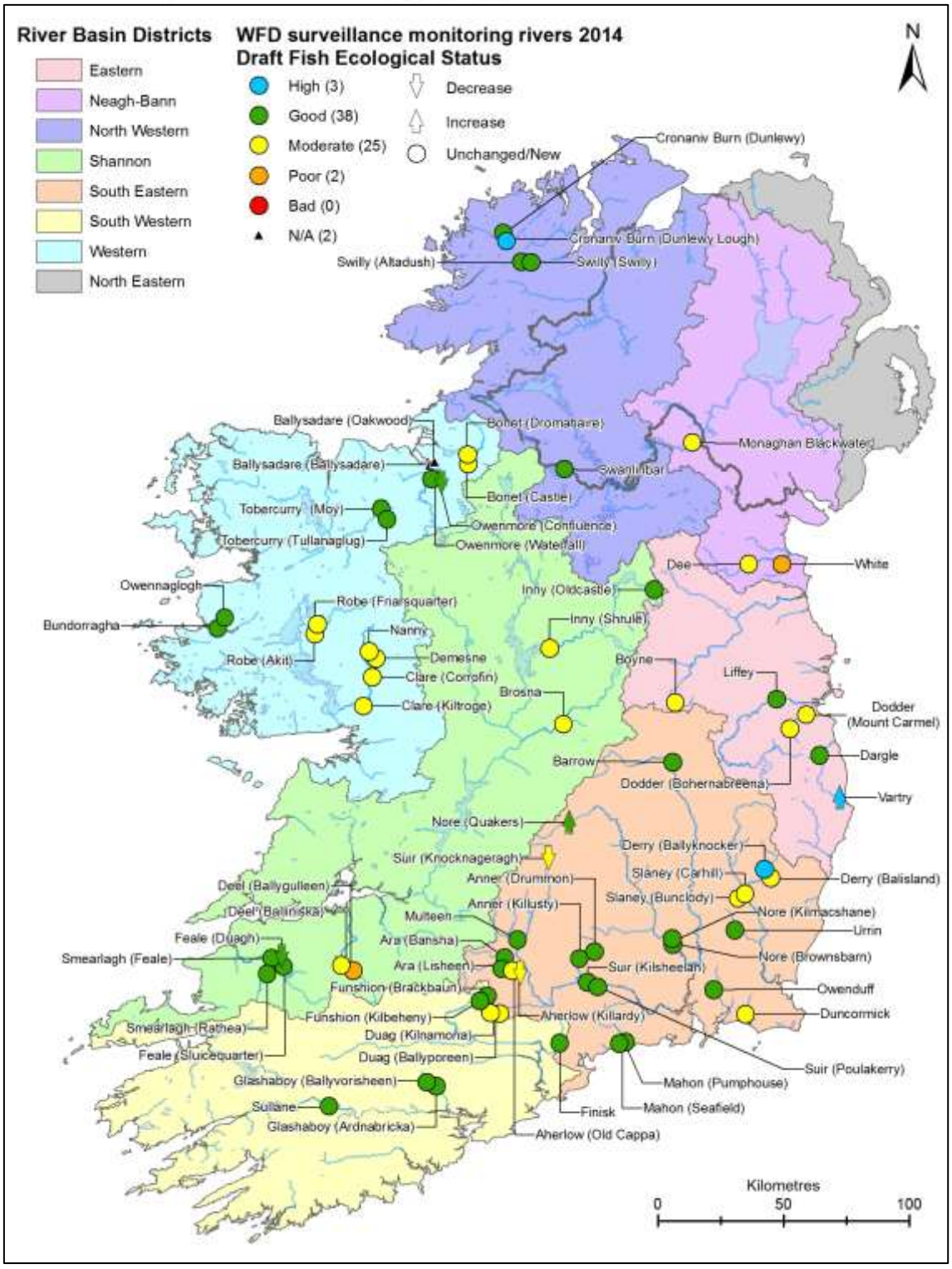

Fig. 4.82. Classification of river sites using the FCS2 Ireland classification tool (the five symbol colours on the map indicate ecological status from high to bad, the arrow symbols indicate an increase or decrease in ecological status since previous survey, the circular symbols indicate no change in status since previous survey or new sites surveyed)

4.3 Transitional waters

4.3.1 Fish species composition and richness

The WFD requires that information be collected on the composition and abundance of fish species in transitional waters. These waters have been exploited by fish over a long evolutionary period, with many fish species availing of the highly productive nature of transitional waters for all or part of their life cycle. Fish species in transitional waters can be grouped into a number of different guilds depending on their life history (euryhaline, diadromous, estuarine, marine and freshwater). Some fish species are migratory, travelling through estuaries from the sea to reach spawning grounds in freshwater (e.g. salmon and lamprey), or migrating downstream through estuaries as adults to spawn at sea (e.g. eels).

Seven transitional water bodies were surveyed during 2014: four water bodies within the Shannon Estuary system (ShIRBD) and three water bodies within the Slaney Estuary system (SERBD) (Table 4.10). The Lower Shannon Estuary was the most diverse water body surveyed, with a total of 29 species of fish present (Table 4.10). The Lower Shannon Estuary was the largest water body surveyed and as such, it can be expected to have a greater variety of habitat and a greater amount of marine species present. In both transitional waters surveyed, the water bodies higher up towards the freshwater riverine section of each estuary tended to have less species, reflecting the poorer diversity of species present in freshwater. The North Slob Channels was the least diverse water body surveyed, which is a characteristic feature of many coastal lagoons, where freshwater species are limited by high salinity and marine species are limited by restricted connectivity to the sea.

Table 4.10. Species richness and most abundant species present in each transitional water body surveyed during 2014

Water body	Type	Species richness	Most abundant species
Shannon Estuary, Lower	Transitional water	29	Sprat
Shannon Estuary, Upper	Transitional water	22	Flounder
Fergus Estuary	Transitional water	19	Sprat
Slaney Estuary, Lower	Transitional water	18	Sprat
Limerick Dock	Freshwater tidal	13	Flounder
Slaney Estuary, Upper	Freshwater tidal	11	Minnow
North Slob Channels	Lagoon	5	Three-spined stickleback

Note: *sea trout are included as a separate “variety” of trout

A total of 50 fish species (sea trout are included as a separate “variety” of trout) were recorded in the seven transitional water bodies surveyed during 2014 (Table 4.11).

Table 4.11. Species present in seven transitional water bodies surveyed during 2014

	Scientific name	Common name	Number of transitional water bodies	% transitional water bodies
1	*Platichthys flesus*	Flounder	7	100
2	*Pomatoschistus minutus*	Sand goby	7	100
3	*Anguilla anguilla*	European eel	6	86
4	*Gasterosteus aculeatus*	Three-spined stickleback	6	86
5	*Osmerus eperlanus*	Smelt	5	71
6	*Pleuronectes platessa*	Plaice	5	71
7	*Sprattus sprattus*	Sprat	5	71
8	*Atherina presbyter*	Sand smelt	4	57
9	*Chelon labrosus*	Thick-lipped grey mullet	4	57
10	*Ciliata mustela*	Five-bearded rockling	4	57
11	*Dicentrarchus labrax*	European sea bass	4	57
12	*Agonus cataphractus*	Pogge	3	43
13	*Merlangius merlangus*	Whiting	3	43
14	*Solea solea*	Common sole	3	43
15	*Spinachia spinachia*	Fifteen-spined stickleback	3	43
16	*Syngnathus rostellus*	Nilsson's pipefish	3	43
17	*Trisopterus luscus*	Bib	3	43
18	*Eutrigla gurnardus*	Grey gurnard	2	29
19	*Lampetra sp.*	Lamprey sp.	2	29
20	*Limanda limanda*	Dab	2	29
21	*Phoxinus phoxinus*	Minnow	2	29
22	*Pollachius virens*	Coalfish (Saithe)	2	29
23	*Salmo trutta*	Brown trout	2	29
24	*Scomber scombrus*	Mackerel	2	29
25	*Solea lascaris*	Sand sole	2	29
26	*Trisopterus minutus*	Poor cod	2	29
27	*Barbatula barbatula*	Stone loach	1	14
28	*Callionymus lyra*	Common dragonet	1	14
29	*Conger conger*	Conger eel	1	14
30	*Crenilarus melops*	Corkwing wrasse	1	14
31	*Gaidropsarus vulgaris*	Three-bearded rockling	1	14
32	*Gobius paganellus*	Rock goby	1	14
33	*Gobiusculus flavescens*	Two-spotted goby	1	14
34	*Labrus bergylta*	Ballan wrasse	1	14
35	*Lampetra fluviatilis*	River lamprey	1	14
36	*Leuciscus leuciscus*	Dace	1	14
37	*Mullus surmuletus*	Striped red mullet	1	14
38	*Perca fluviatilis*	Perch	1	14
39	*Pollachius pollachius*	Pollack	1	14
40	*Pomatoschistus microps*	Common goby	1	14
41	*Raja clavata*	Thornback ray	1	14

Table 4.11 ctn. Species present in seven transitional water bodies surveyed during 2014

	Scientific name	Common name	Number of transitional water bodies	% transitional water bodies
42	*Rutilus rutilus*	Roach	1	14
43	*Salmo salar*	Salmon	1	14
44	*Salmo trutta*	Sea trout	1	14
45	*Scardinius erythrophthalmus*	Rudd	1	14
46	*Scophthalmus rhombus*	Brill	1	14
47	*Scyliorhinus canicula*	Lesser spotted dogfish	1	14
48	*Syngnathus acus*	Greater pipefish	1	14
49	*Taurulus bubalis*	Long-spined sea scorpion	1	14
50	*Trachurus trachurus*	Atlantic horse mackerel/Scad	1	14

4.3.2 Fish species distribution

A large number of juvenile and immature fish were captured within the seven sites surveyed, indicating the essential nursery function of these transitional water bodies e.g. flounder, plaice, European sea bass, thick-lipped grey mullet and sprat. Important angling species were also recorded across the seven water bodies, including, brown trout, sea trout, salmon, European sea bass, pollack, and conger. Among the angling species recorded in 2014 was a thornback ray, which was captured in Ballylongford Bay in the Lower Shannon Estuary (Plate 3.14).

Plate 3.14. Thornback ray caught in 2014

Different fish species were captured using the three different netting methods of beach seine net, fyke net and beam trawl net, giving some insight as to their distribution within each water body. Flounder was the most widespread species and was recorded at 53.4% of net locations surveyed, followed by sand goby (34.4%) and sprat (24.9%). The most abundant species was sprat, accounting for 70.8% of all fish recorded in 2014, followed by minnow (6.5%) and sand goby (5.3%). The enormous numbers of sprat recorded relative to other species highlights the abundance of juveniles of this schooling species in inshore waters. Juvenile thick-lipped grey mullet and European sea bass were most prevalent at beach seine sites. Eight fish species were caught using all three methods. Ten species were captured only in fyke nets, nine species were captured only in beach seines and four species were captured only in beam trawls. Overall, 90% of fish were captured by beach seines, 8% by beam trawls and 2% by fyke nets.

In addition to the required fish metrics (fish species composition and abundance), the WFD also requires Member States to report on the presence/absence of type-specific disturbance sensitive or indicator species. Of particular importance are the diadromous or migratory fish species such as eel, salmon, sea trout, lampreys, smelt and shad. Six of the water bodies surveyed during 2014 are incorporated in the series of Special Areas of Conservation (SACs) designated nationally. Migratory species that were recorded during these surveys include the European eel and the Atlantic salmon, which are respectively listed as “critically endangered” and “vulnerable” in the Red List for Amphibians, Reptiles and Fish (King *et al*., 2011), as well as river lamprey, sea trout and smelt. During 2014, eels were recorded in low numbers in all but one transitional water body surveyed, the Lower Shannon Estuary. Data from these WFD surveys is also used to support the National Eel Management Plan (O’Leary *et al.*, 2012).

4.3.3 Ecological status - Classification of transitional waters using 'TFCI'

An essential step in the WFD monitoring process is the classification of the status of transitional waters, which in turn will assist in identifying the objectives that must be set in the individual River Basin Management Plans. An extensive number of IFI surveys completed throughout Ireland has provided a valuable dataset which has been amalgamated with data collected by the Northern Ireland Environment Agency (NIEA) and used to develop a classification tool for fish in transitional waters - the 'Transitional Fish Classification Index' or TFCI-Irl. The tool uses the Index of Biotic Integrity (IBI) approach broadly based on that developed both for South African waters and the UK, with a total of ten metrics used in the index calculation (Harrison and Whitfield, 2004; Coates *et al*., 2007). The TFCI-Irl has been successfully intercalibrated in a Europe-wide exercise (EC, 2013). However, a new improved classification tool known as the Estuarine Multi-metric Fish Index (EMFI) was developed in 2013 and this will replace or complement the TFCI-Irl tool once it's successfully intercalibrated against other European classification tools (Harrison and Kelly, 2013).

The status classifications for 2014 and for surveys conducted in previous years (2008 and 2009) were calculated for each water body and for the whole estuary using the latest version of the TFCI-Irl tool. Using the TFCI-Irl, one water body was classified as Bad, three as Moderate and three as Good ; however, when all waterbodies surveyed within an estuary were combined and status calculated both estuaries were assigned Good status (Table 4.12, Fig. 4.83).

Table 4.12. Draft fish Ecological Status Classification of transitional water bodies surveyed during 2014 using the Transitional Fish Classification Index (TFCI-Irl)

Water body	Type	Previous Ecological Status		
		2008	2009	2014
North Slob Channels	Lagoon		Poor	Bad
Slaney Estuary, Lower	Transitional water		Good	Good
Slaney Estuary, Upper	Freshwater tidal		Poor	Moderate
Slaney Estuary	**All**			**Good**
Shannon Estuary, Lower	Transitional water	Good		Moderate
Shannon Estuary, Upper	Transitional water	Moderate		Good
Limerick Dock	Freshwater tidal	Moderate		Moderate
Fergus Estuary	Transitional water	Moderate		Good
Shannon Estuary	**All**			**Good**

***** Ecological status is subject to change upon review

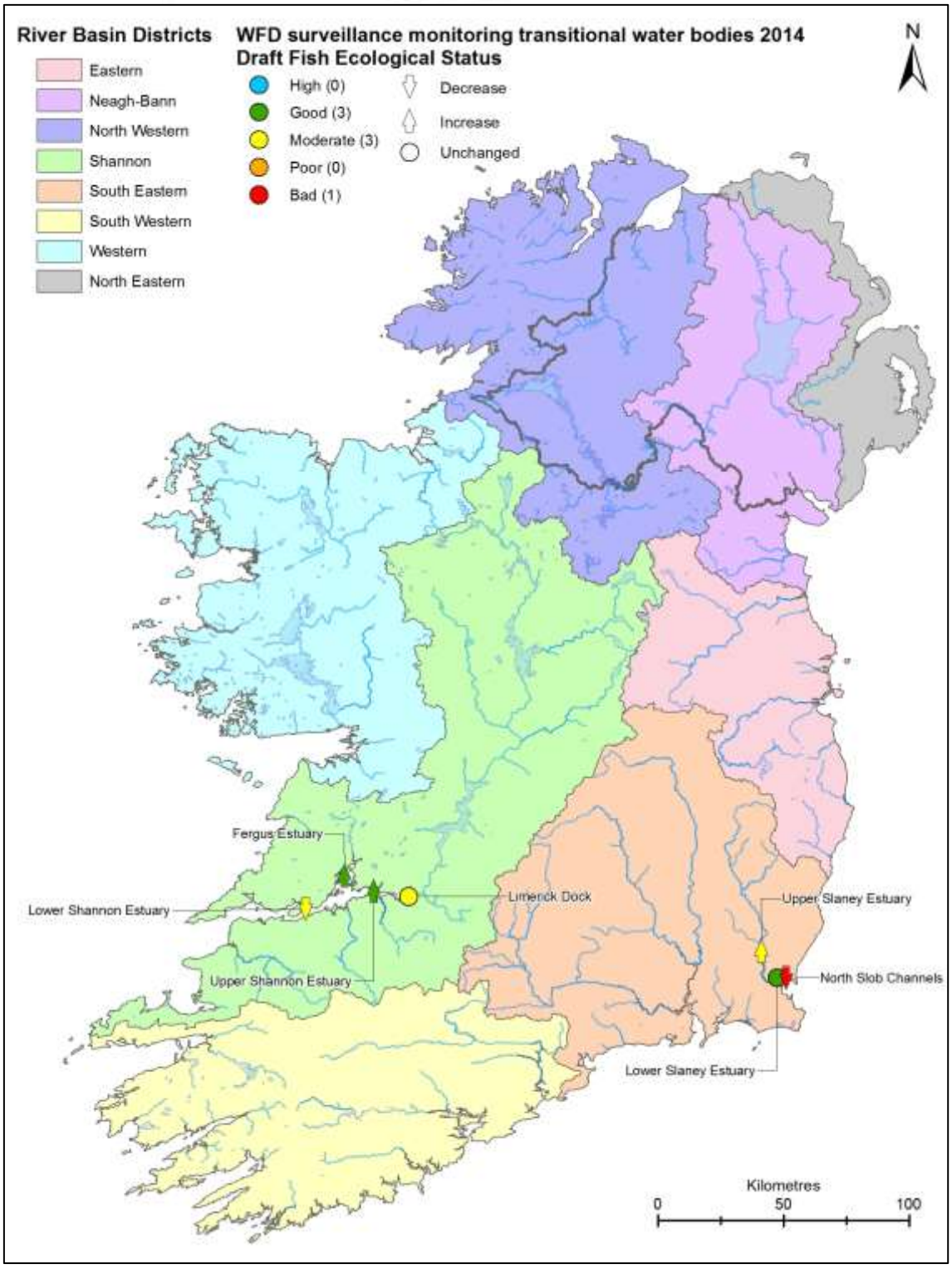

Fig. 4.83 Draft fish Ecological Status Classification of transitional water bodies surveyed during 2014 using the Transitional Fish Classification Index (TFCI-Irl) (*see text re. whole estuary classification)

5. DISCUSSION

5.1 Species richness

A total of 19 fish species (sea trout are included as a separate "variety" of trout) were recorded in the 26 lakes surveyed during the 2014 WFD surveillance monitoring season. Roach x bream and roach x rudd hybrids were also recorded. European eels, followed by brown trout and perch were the three most widely distributed species recorded during 2014. The maximum number of fish species recorded in any lake waterbody was ten (Lower Lough Corrib, WRBD and Lough Leane, SWRBD), with a mixture of native and non-native fish species being captured in these lakes.

A total of 14 fish species (including sea trout) and one type of hybrid were recorded in the 70 river sites surveyed during the 2014 WFD surveillance monitoring season. Brown trout, salmon and European eel and were the most widely distributed fish species recorded during 2014. The maximum number of fish species recorded in any one river site was 11 (including one hybrid) in the River Barrow (Pass Br._B).

A total of 50 fish species (including sea trout) were recorded in the seven transitional waterbodies surveyed during the 2014 WFD surveillance monitoring season.

5.2 Distribution of native species

Brown trout occur in almost every rivulet, brook, stream and river in Ireland (Kennedy and Fitzmaurice, 1971). This is reflected in the 2014 fish surveillance monitoring programme for rivers, in which 67 out of 70 (95.7%) of river sites surveyed contained brown trout. Brown trout were also recorded in 21 out of 26 (80.8%) of lakes surveyed, mainly being absent in lakes where non-native fish dominated. These values for brown trout prevalence are similar to previous work carried out in Irish lakes and rivers (Kelly *et al*., 2007a and 2007c, Kelly *et al*., 2008a and 2008b and Kelly *et al*., 2009, 2010, 2011, 2012a, 2013 and 2014).

Salmon and eels occur in every water body in Ireland to which they can gain access (Moriarty and Dekker, 1997; McGinnity *et al.,* 2003). Eels were recorded in 25 out of 26 (96.2%) lakes surveyed and 39 out of 70 (55.7%) river sites. Salmon were recorded in 54 (77.1%) river sites and in 13 (50%) of the lakes surveyed. Salmon are not often captured in lake surveys due to the transient nature of their life cycle.

Arctic char were recorded in six lakes during 2014 (Lough Acoose, Lough Caragh, Lough Leane, Lough Beagh, Lough Melvin and Lough Talt), however, numbers were low in some of them. Although historically present in Lough Allua, Lough Easky, Lough Egish, Lough Owel and Lough Corrib, no char

specimens were captured in 2011 or 2014 in these lakes, suggesting the local extinction of the species in these lakes. A number of char populations have become extinct over the last 30 years and this has been attributed mainly to deterioration in water quality or acidification (Igoe *et al.*, 2005).

The absence of native species such as trout, salmon and char within specific catchments is related to various factors, including deterioration in water quality, the presence of impoundments preventing fish passage, drainage and modification of river morphology, habitat deterioration and translocation and competition from non-native species.

5.3 Distribution of non-native fish species

The status of non-native species varies throughout Ireland. Data collected for the WFD to date confirms that many areas of the north-west, west and south-west are the last areas of the country to which these non-native species have not yet been translocated. Non-native fish species were present in 20 out of the 26 lakes surveyed during 2014. Overall, the majority of high alkalinity lakes (in parts of the midlands, west, south-west and the north-west) exhibited higher species richness than low alkalinity lakes, reflecting the presence of non-native species in these lakes. Non-native species were also present in 50 out of the 70 river sites surveyed. In previous years, rivers located in the northern portion of the ShIRBD often tended to have higher species richness levels, due to the presence of non-native species (Kelly *et al*., 2009, 2010, 2011, 2012a, 2013 and 2014) and this was also evident in the rivers sampled in 2014. Non-native freshwater species were also present in four of the seven transitional water bodies surveyed: roach dace and perch were recorded in Limerick Dock, minnow in the Lower Slaney Estuary, minnow and stone loach in the Upper Slaney Estuary and rudd in the North Slob Channels.

Pike, perch and roach are three of the most common non-native fish species recorded in Irish waters. In 2014, these species were recorded in a cluster of lakes mainly in counties Cork, Cavan, Roscommon, Galway, Sligo and Weatmeath during 2014. Many river sites within the SERBD and WRBD also had these species present.

The presence of abundant populations of non-native fish species can be an indicator of ecosystem health as many of these species are more tolerant to water pollution than native species such as salmon, trout and char. Researchers have found a general trend of increasing species richness, abundance and biomass among tolerant non-native species that corresponds with deteriorating water quality in both lakes and rivers (Kelly *et al*., 2007a and 2007c and Kelly *et al*., 2008b). Salmonids were the dominant fish species in ultraoligo/oligotrophic lakes. This dominance

decreases and changes to a population dominated by non-native fish species as trophic status increases; however, this change is only observed in water bodies where non-native fish species are present to begin with (Kelly *et al*., 2008b).

5.4 Fish growth

Age and growth analysis of fish captured during WFD fish monitoring in 2014 demonstrated that there was a large variation in the growth of the four most dominant fish species amongst both lakes and rivers, with alkalinity being one of the main factors influencing growth.

Brown trout from high alkalinity and moderate alkalinity lakes surveyed during 2014 displayed a slightly faster mean growth rate than those from low alkalinity lakes. Brown trout had a significantly faster growth rate at the end of year 2, 3 and 4 in the moderate alkalinity lakes than the low alkalinity lakes. Those in the high alkalinity lakes had a significantly faster growth rate than the low alkalinity lakes at the end of year 3 and 4. Five year old brown trout had significantly faster growth rate in the high alkalinity lakes than the moderate and low alkalinity lakes. Both perch and roach were recorded in low, moderate and high alkalinity lakes. Overall, the mean growth rate of one to five/six year old perch and roach were slightly higher in the moderate and high alkalinity lakes than in the low alkalinity lakes; however, these weren't significantly different.

Brown trout in rivers exhibited similar growth patterns, with the mean lengths at age of brown trout in high alkalinity rivers generally being higher than those in moderate or low alkalinity rivers. This follows a similar trend to previous years, where brown trout captured in upland or more acidic areas were generally slower growing than, those observed in more productive, lowland regions (Kelly *et al*., 2009, 2010, 2011, 2012a, 2013 and 2014).

Growth of brown trout in Irish lakes is known to be influenced by a number of factors (Kennedy and Fitzmaurice, 1971; Everhart, 1975):

1. The type of streams in which the trout spawn and the length of time the young trout spend in it
2. The shape of the growth curve after the first three years of life
3. The age at which the trout are cropped by anglers
4. Food availability (amount and size)
5. The number of fish using the same food resource
6. Temperature, oxygen and other water quality factors

Alkalinity is also known to have an influence on the growth rate of fish in both lakes and rivers (e.g. Kelly *et al*., 2008, 2009, 2010, 2011, 2012a and 2013). In waters deficient in calcium, the diversity, abundance and biomass of both molluscs (Hincks and Mackie, 1997 and Mellina and Rasmussen, 1994) and macroinvertebrates (Koetsier *et al*., 1996) can be limited. Therefore, alkalinity and calcium can directly affect the fauna present and subsequent availability of food for fish populations. In Irish lakes there appear to be few exceptions to the rule that the more alkaline the water, the faster the brown trout growth rate. In general, the average size of brown trout caught by anglers in any given water body, is related to the rate of growth in that water body (Kennedy and Fitzmaurice, 1971), with anglers recording larger fish from the water bodies with faster growth rates. Exceptions to this rule usually involve major differences in stock density between small lakes, with consequent differences in the amount of food available to individual fish (Kennedy and Fitzmaurice, 1971). There is some evidence to suggest that, in low alkalinity lakes, growth is faster when the conductivity is high (usually because of maritime influence) than where the conductivity is very low (Kennedy and Fitzmaurice, 1971). Furthermore, in less productive lakes, trout are slow growing, relatively short-lived and less selective in their feeding than in richer waters.

Stock density (e.g. overstocking) can also have an effect on the growth of brown trout. In small lakes, overstocking becomes a problem, particularly if spawning facilities are extensive but food limited. A study of 14 lakes in the Rosses, Co. Donegal in 1966 demonstrated the inverse relationship between stock density and growth rate (Kennedy and Fitzmaurice, 1971).

The amount of food available is another factor which influences the rate of growth of brown trout in lakes. From a biological perspective, it is a waste of energy for fish to seek foods which are small, scarce and hard to catch (Kennedy and Fitzmaurice, 1971). If fish are to grow well, they must be able to obtain large amounts of suitable food organisms of suitable size, and with a minimum search effort. This is possible when there are large standing crops of suitable foods which are never fully grazed (Kennedy and Fitzmaurice, 1969).

5.5 Ecological status classifications

An essential step in the WFD process is the ecological classification of the status of lakes, rivers and transitional waters, which in turn will assist in identifying the objectives that must be set in the individual River Basin District Management Plans.

The Fish in Lakes ecological classification tool (FIL2) assigns lakes in Ecoregion 17 (Ireland) to ecological status classes ranging from High to Bad using fish population parameters relating to

species composition, abundance and age structure (Kelly *et al*., 2012b). FIL2 has been successfully intercalibrated in a cross Europe exercise (EC, 2013). It combines a discriminant analysis model, providing a discrete assessment of status class with an ecological quality ratio (EQR) model, providing WFD compliant quantitative ecological quality ratios between 0 and 1 with 95% confidence intervals (Kelly *et al*., 2012b). This classification tool (FIL2) was successfully intercalibrated with other European Member States during 2011 and used to assign ecological status classes to lakes surveyed from 2008-2012 (EC, 2013 and Olin *et al*., 2014). Of the 26 lakes surveyed during 2014, five were classified as High, eleven were classified as Good, six was classified as Moderate, three were classified as Poor and two were classified as Bad ecological status in terms of fish. The geographical variation in ecological status reflects the change in fish communities in response to pressure; from upland lakes with little human disturbance dominated by intolerant fish communities (salmonids) to lowland lakes subject to more intensive anthropogenic pressures dominated by tolerant fish species such as perch, roach and bream.

The WFD classification tool for fish in rivers, known as Fisheries Classification Scheme Two - Ireland Version (FCS2-Ireland) (SNIFFER, 2011) 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 resulting output is an Ecological Quality Ratio (EQR) between 1 and 0, with five class boundaries defined along this range corresponding to the five ecological status classes of High, Good, Moderate, Poor and Bad. Confidence levels are assigned to each class and represented as probabilities. The tool has been successfully intercalibrated in a project to standardise ecological status classifications across Europe (EC, 2013). Two rivers sites were classed as High status, 39 as Good status, 25 as Moderate status and two as Poor status. There was an improvement in ecological status at a site on the River Nore and a Site on the Vartry river; however there was a deterioration in ecological status at five sites. All other sites that were previously surveyed remained unchanged.

The Transitional Fish Classification Index (TFCI-Irl) has also been developed for the island of Ireland (Ecoregion 1) using Northern Ireland Environment Agency (NIEA) and IFI data and is broadly based on the tool developed both for South African waters and the UK, with a total of ten metrics used in the index calculation (Harrison and Whitfield, 2004; Coates *et al*., 2007).. The TFCI-Irl has been successfully intercalibrated in a Europe-wide exercise (EC, 2013). However, a new improved classification tool known as the Estuarine Multi-metric Fish Index (EMFI) was developed in 2013 and this will replace the TFCI-Irl once it's successfully intercalibrated against other Eurpopean classification tools (Harrison and Kelly, 2013).

The seven transitional water bodies surveyed in 2014 were assigned a draft ecological classification using the TFCI. One water body was assigned Bad status, three were classed as Moderate status and three were classed as Good status. When all waterbodies surveyed within an estuary were combined and status recalculated both estuaries were assigned Good status

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APPENDIX 1

Biologically verified typology for lakes in the Republic of Ireland

Type	Alkalinity	Depth	Size
1	Low (<20mg/l CaCO3)	Shallow mean depth <4m (<12m)	Small <50 ha
2	Low (<20mg/l CaCO3)	Shallow (mean depth <4m(>12m)	Large >50 ha
3	Low (<20mg/l CaCO3)	Deep mean depth >4m (<12m)	Small <50 ha
4	Low (<20mg/l CaCO3)	Deep (mean depth >4m(>12m)	Large >50 ha
5	Moderate (20-100 mg/l CaCO3)	Shallow mean depth <4m (<12m)	Small <50 ha
6	Moderate (20-100 mg/l CaCO3)	Shallow (mean depth <4m(>12m)	Large >50 ha
7	Moderate (20-100 mg/l CaCO3)	Deep mean depth >4m (<12m)	Small <50 ha
8	Moderate (20-100 mg/l CaCO3)	Deep (mean depth >4m(>12m)	Large >50 ha
9	High (>100mg/l CaCO3)	Shallow mean depth <4m (<12m)	Small <50 ha
10	High (>100mg/l CaCO3)	Shallow (mean depth <4m(>12m)	Large >50 ha
11	High (>100mg/l CaCO3)	Deep mean depth >4m (<12m)	Small <50 ha
12	High (>100mg/l CaCO3)	Deep (mean depth >4m(>12m)	Large >50 ha
13	Some lakes >300m altitude		

APPENDIX 2

Presence/absence of each species captured in each lake during 2014

Lake	Three-spined stickleback	Nine-spined stickleback	Flounder	Killarney Shad	Sea trout	Char	Salmon	Brown Trout	Eel	Stoneloach	Minnow	Perch	Pike	Roach	Bream	Rainbow Trout	Gudgeon	Tench	Rudd	Roach x Bream	Roach x Rudd
Acoose						x	x	x	x												
Allua								x	x			x	x	x	x		x		x	x	
Barra							x	x	x												
Beagh					x	x	x	x	x		x										
Brin					x			x	x		x										
Caragh					x	x	x	x	x			x									
Carrowmore	x				x		x	x	x		x										
Cavetown									x			x	x	x	x					x	x
Corglass									x			x	x	x				x		x	
Corrib (Lower)	x	x					x	x	x	x		x	x	x					x	x	
Corrib (Upper)	x						x	x	x			x	x	x	x					x	
Derrybrick									x			x	x	x							
Easky							x	x	x												
Fern	x						x	x	x			x									
Gill								x	x			x	x	x	x					x	
Glenbeg							x	x	x												
Glencullin	x				x		x	x	x												
Kiltooris	x							x	x												
Leane			x	x		x	x	x	x			x						x	x		
Meelagh									x			x	x	x	x					x	
Melvin						x	x	x	x			x							x		x
O'Flynn								x	x			x	x	x							
Owel	x							x				x		x		x		x			x
Sheelin								x	x			x	x	x							
Talt	x					x		x	x			x									
Templehouse									x			x	x	x						x	
Upper Lake					x		x	x	x			x						x	x		

APPENDIX 3

Output from the FIL2 ecological classification tool

Lake	FIL2 Typology	EQR	EQR Lower 95% C.I.	EQR Upper 95% C.I.	Ecological Status Class	Final Ecological Status Class (with expert opinion)
Brin	1	0.877	0.818	0.918	High	High
Caragh	2	0.803	0.716	0.868	High	High
Glenbeg	2	0.771	0.703	0.827	High	High
Glencullin	1	0.789	0.721	0.844	High	High
Kiltooris	1	0.838	0.781	0.883	High	High
Acoose	2	0.751	0.657	0.826	Good	Good
Barra	1	0.696	0.618	0.764	Good	Good
Beagh	2	0.734	0.610	0.830	Good	Good
Carrowmore	1	0.669	0.585	0.744	Good	Good
Corrib Upper	4	0.851	0.649	0.947	High	Good
Easky	1	0.584	0.499	0.665	Good	Good
Fern	1	0.731	0.664	0.788	Good	Good
Gill	4	0.709	0.516	0.848	Good	Good
Leane	2	0.460	0.334	0.592	Good	Good
Melvin	2	0.575	0.388	0.742	Good	Good
Talt	4	0.748	0.567	0.871	Good	Good
Cavetown	4	0.429	0.127	0.794	Moderate	Moderate
Corrib Lower	3	0.471	0.340	0.606	Moderate	Moderate
Derrybrick	3	0.511	0.426	0.595	Moderate	Moderate
Owel	4	0.454	0.262	0.661	Moderate	Moderate
Sheelin	3	0.485	0.322	0.650	Moderate	Moderate
Upper Lake Killarney	2	0.481	0.367	0.597	Moderate	Moderate
Allua	2	0.229	0.106	0.425	Poor	Poor
Meelagh	3	0.162	0.122	0.211	Poor	Poor
O' Flynn	3	0.247	0.181	0.328	Poor	Poor
Corglass	3	0.068	0.047	0.098	Bad	Bad
Templehouse	3	0.021	0.013	0.034	Bad	Bad

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