Sampling Fish for the Water Framework Directive Summary Report

2022

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Iascach Intíre Éireann
Inland Fisheries Ireland

Sampling Fish for the Water Framework Directive -

Summary Report 2022

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Project Personnel

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Executive summary

Inland Fisheries Ireland has been assigned the responsibility by the Environmental Protection Agency of delivering the fish monitoring requirements for the Water Framework Directive (WFD) in Ireland. In 2022, 24 lakes, 169 river sites and 12 transitional water bodies were surveyed as part of the national IFI fish surveillance monitoring programme.

All surveys were conducted using a suite of European standard methods, including a range of different net types to sample lakes and transitional waters, and electrofishing methods to sample rivers.

A total of 16 species (sea trout are included as a separate "variety" of trout) and three cyprinid hybrids were captured across the lakes surveyed in 2022. European eel had the widest distribution, with perch the most abundant species. The FIL2 ecological classification tool was used together with expert opinion to assign fish ecological status to each lake surveyed. Five lakes were assigned a status of High; eight as Good; five as Moderate; two as Poor and four as Bad. All lakes had been surveyed previously, and when compared to previous results, 14 lakes had an unchanged ecological status, four showed improved status and six had deteriorated.

Sixteen fish species (sea trout are counted as a separate "variety" of trout) and two cyprinid hybrids were recorded across 169 river sites surveyed in 2022, with brown trout the most frequently encountered species, occurring in 120 out of 169 sites. The FCS2-Ireland ecological classification tool was used together with expert opinion to assign ecological status to each river site. A total of three sites were classified as High status, 31 as Good, 83 as Moderate, 41 as Poor and three as Bad. Eight sites were unclassified, following a sense check using expert opinion. Of the 169 sites assigned an ecological fish status in 2022, 53 had previously been surveyed and classified. Of these, the status of 41 sites remained the same between surveys, while five sites deteriorated and seven improved.

A total of 33 species of fish were captured in the twelve transitional waterbodies surveyed in 2022. Sand goby was the most widely distributed species, occurring in all 12 waterbodies. The Estuarine Multimetric Fish Index (EMFI) ecological classification tool, together with expert opinion was used to assign ecological status to each transitional waterbody surveyed. One transitional waterbody was classified as Good status and eleven as Moderate. All 12 waterbodies had previously been surveyed and classified. Two sites remained the same between surveys, while ten waterbodies deteriorated.

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 protect aquatic ecosystems. The WFD was transposed into Irish Law in December 2003 (Water Regulations S.I. No. 722 of 2003).

The fundamental objective of the WFD is to protect and maintain the status of waters that are already of good or high quality, to prevent any further deterioration, to restore all waters that are impaired so that they achieve at least good ecological status, and to ensure long term sustainable use.

River Basin Management Plans (RBMPs) are required under the WFD and set out the government's approach to protect national waters through *Programmes of Measures* for each six-year cycle of the directive. The first RBMP cycle ran from 2009-2014, and the second from 2015-2021. Ireland is currently into its third RBMP cycle, which began in 2022 and will end in 2027.

A key step in the WFD process is for EU Member States to assess the health of their surface waters through national monitoring programmes. Classification tools are the main instruments used to assess status in five discrete bands (High, Good, Moderate, Poor or Bad) for each waterbody (a predefined section in a river, or other surface water). Once each country has determined the current status of their waterbodies, ongoing monitoring helps to track the effectiveness of measures needed to improve them and achieve at least good status. The responsibility for monitoring fish has been assigned to Inland Fisheries Ireland (IFI) by the EPA (EPA, 2006 and 2021a). A national fish stock surveillance monitoring programme has been conducted since 2007 at specified locations. This surveillance monitoring programme encompasses lakes, rivers and transitional waters (freshwater tidal river reaches, estuaries and lagoons) and provides information on species composition, abundance and age structure (e.g., growth patterns, and population demographics). The river fish monitoring programme has also been updated recently to follow an index catchment approach that will provide a more comprehensive overview of the health of fish stocks in each catchment for IFI, the EPA and other stakeholders (Matson *et al*., 2021). For transitional waters the programme will be similarly updated to rationalise monitoring activity and to include waterbodies with substantive deterioration in status.

A team from IFI carried out the 2022 monitoring programme using a suite of European standard methods. Electrofishing was the main survey method used in rivers, with various netting techniques used for both lakes and transitional waters. Field survey work was carried out between June and October (inclusive), the optimum timeframe for sampling fish in Ireland. This included lake surveys

between June and September, rivers between July and September and transitional waters between September and October.

This report summarises the main findings of these surveys and reports on the current ecological status and fish stocks in each. Detailed reports on all waterbodies surveyed are available to download from the *Research* section of the IFI corporate website (https://www.fisheriesireland.ie/what-we-do/research/water-framework-directive-fish-monitoring-programme) or from the dedicated WFD fish website (www.wfdfish.ie).

Plate 1.1 Lough Conn, Co. Mayo (WRBD) surveyed in 2022 as part of the WFD fish monitoring programme

2. STUDY AREA

Inland Fisheries Ireland is organised into six River Basin Districts (RBDs), the Eastern RBD (ERBD), Southeastern RBD (SERBD), Southwestern RBD (SWRBD), Western RBD (WRBD), Shannon RBD (SHRBD) and Northwestern RBD (NWRBD). Surveys were carried out in all six RBDs during 2022 (Fig. 2.2). For ease of navigation through this report, results are presented as surveillance monitoring (SM) or additional value (AV) sites (Fig. 2.2). Additional value sites were surveyed as part of the National Research Survey Programme (NRSP), to provide baseline and comparative survey information for its own purposes, as well as a range of other IFI projects and programmes. These results are also included in this report to provide a more comprehensive overview of fish ecological status in each waterbody or catchment.

2.1 Lakes

Twenty-four lakes were surveyed between the 7th of June and the 5th of October 2022. Five lakes were in the NWRBD, fourteen in the WRBD, three in the SHRBD and two in the ERBD (Fig. 2.2). In total, 17 of the lakes surveyed were surveillance monitoring waterbodies (SM). These SM waterbodies are normally surveyed on a three-year rolling cycle as part of the WFD programme, but there are some exceptions to this rule that have been agreed with the Environmental Protection Agency (Table 4.2, Fig. 2.2).

Three lakes (Ballyquirke Lake, Glasshouse Lake and Lough Bridget were surveyed as part of IFI's ongoing coarse fish programme and the WFD operational monitoring programme. Three lakes, Lough Conn, Lough Ree and Lough Mask, were surveyed as part of IFI's WFD operational monitoring programme. One lake, Lough Eske was surveyed as part of IFI's Arctic char conservation research project and IFI's WFD operational monitoring programme. These seven lakes are presented as additional value (AV) sites (Table 4.2, Fig. 2.2).

2.2 Rivers

A total of 169 river sites were surveyed between the 4th of July and the 30th of September 2022. Fig 2.1 shows the number of overall surveys carried out in each RBD.

Physical parameters such as river width and mean depth determine the method and type of electrofishing equipment to be used. Narrow, shallow rivers are surveyed using wadeable electrofishing, while wide deep rivers require boat-based methods. Of the sites surveyed, 135 were wadeable and 34 sites were non-wadeable.

A total of 42 WFD Surveillance Monitoring sites (SM) were surveyed in 2022. The remaining 127 sites were added value (AV) sites. In 2022, 19 of these AV sites were located within surveillance monitoring waterbodies (AV/SM) (Table 4.5 and Fig. 2.2).

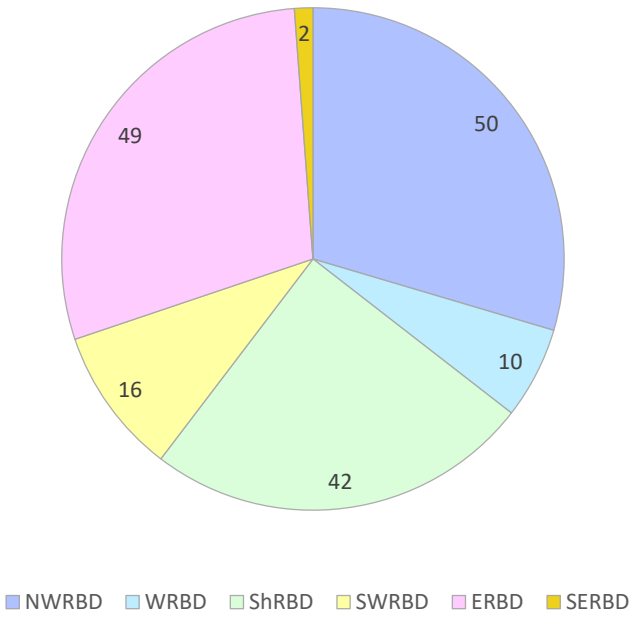

Figure 2.1. The number of river sites surveyed in each RBD in 2022

2.3 Transitional waters

Twelve transitional water bodies were surveyed between the 13th of September and the 19th of October 2022. Eight transitional water bodies were in the SERBD and four in the ERBD. (Table 4.7 and Fig. 2.2).

The eight waterbodies surveyed in the SERBD were the Barrow Upper Estuary, Barrow Nore Upper Estuary, Barrow Suir Nore Estuary, New Ross Port, Nore Estuary, Suir Upper Estuary, Suir Middle Estuary and the Suir Lower Estuary. All eight water bodies surveyed are on the WFD SM monitoring programme. These eight waterbodies, when merged, make up the Barrow Nore Suir Complex.

The four waterbodies surveyed in the ERBD during 2022 were the Boyne Estuary, Liffey Upper Estuary, Liffey Lower Estuary and the Tolka Estuary. Three of these waterbodies, the Liffey Upper and Lower Estuaries and the Tolka Estuary were surveyed as part of IFI's WFD operational monitoring programme and are reported as AV sites. These three waterbodies when merged, make up the Liffey-Tolka Complex. The Boyne Estuary is a WFD SM waterbody.

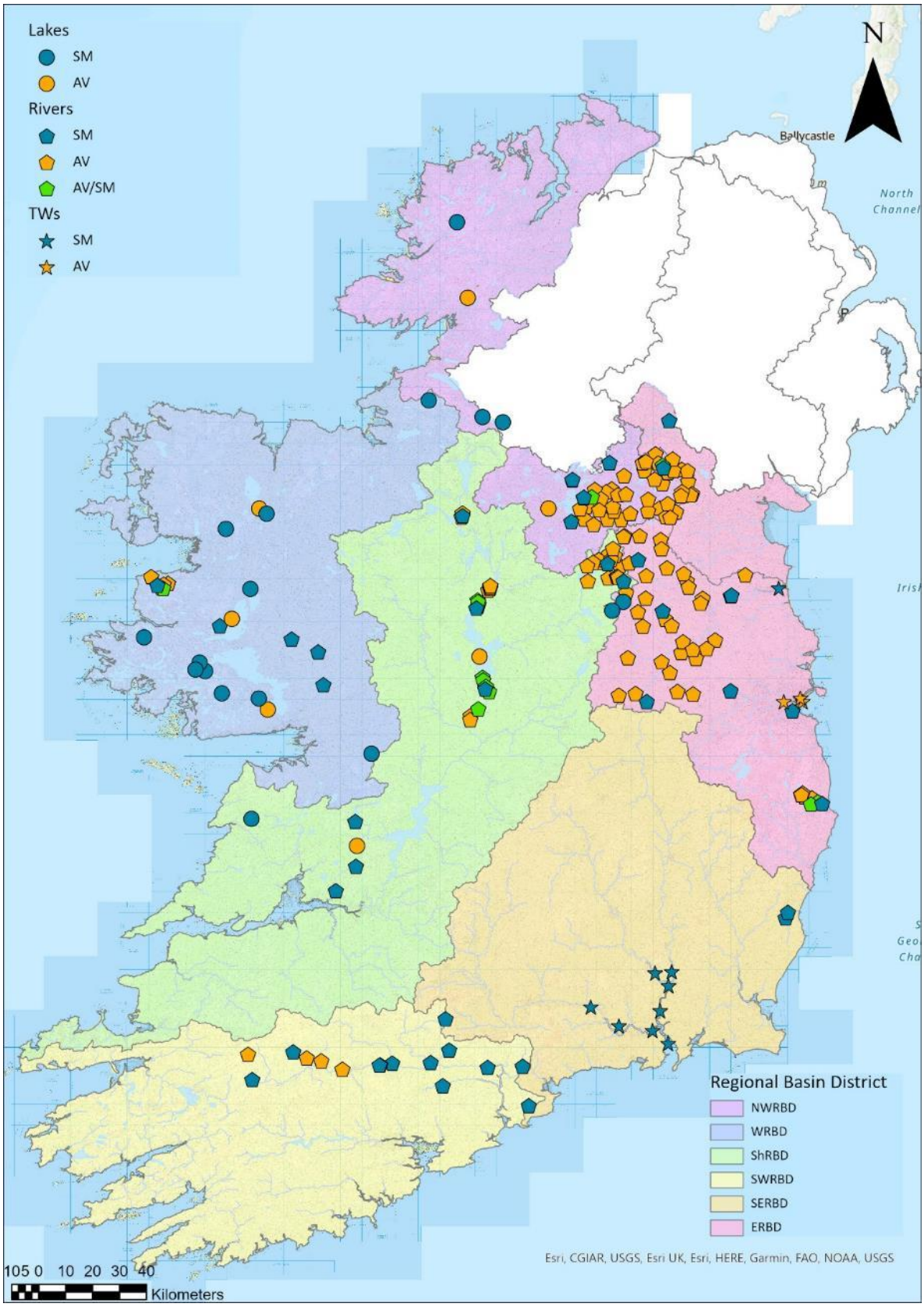

Figure 2.2. Location of WFD surveillance monitoring and additional value (AV, AV/SM) surveys carried out on lakes, rivers and transitional waters from June to October 2022

3. METHODS

All surveys were conducted using a suite of European standard methods (CEN, 2003; CEN, 2005a; CEN, 2015) and IFI standard operating protocols. Electrofishing is the main survey method used in rivers, while a multi-method netting approach is used in both lakes and transitional waters.

Procedures are required for disinfection of equipment to prevent dispersal and introduction of invasive aquatic species and other organisms to unimpacted waters. A standard operating procedure was compiled by Inland Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff when moving between water bodies.

3.1 Lakes

Lake water bodies were surveyed using a netting method developed and tested during the NSSHARE Fish in Lakes Project 2005-2006 (Kelly *et al*., 2007 a and b; Kelly *et al*., 2008) and updated during an IFI intercalibration exercise (Connor *et al.,* 2017). 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, 2015). However, the netting effort has been reduced (approximately 50%) for Irish lakes to minimise damage to fish stocks (Kelly *et al*., 2008). Each lake is 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), where appropriate, and random sampling conducted within each of these (CEN, 2015). Floating multi-mesh monofilament gill nets, fyke nets (one unit comprised of three fyke nets; leader size 8m x 0.5m) and single panel large mesh multifilament braided gill nets are also used to supplement the CEN standard gill netting effort.

All fish except for perch were measured and weighed on-site, and scales were removed from all brown trout, salmon, pike, roach, bream and roach x bream hybrids. Live fish were returned to the water whenever possible (i.e., when the likelihood of their survival was considered good). Samples of fish were retained for further analysis.

3.2 Rivers

Electrofishing is the method of choice to obtain a representative sample of fish in rivers. It is a well-established technique used by fishery biologists globally for sampling and is generally the most non-destructive, effective and cost-efficient method. This technique complies with European Committee for Standardisation (CEN) guidelines for fish stock assessment in rivers (CEN, 2003). In 2022 both wadable electrofishing and non wadeable boat-based electrofishing were used.

3.2.1 Wadeable electrofishing

Two methods of electrofishing were used to sample small wadeable channels (<0.5-0.7m in depth) in 2022. These were Area Delineated Electrofishing (ADEF) and Ten-minute timed electrofishing (TEF_{10}).

ADEF is the primary quantitative method used to sample surveillance monitoring sites. A wadeable electrofishing set consists of one portable generator (220/240V) or electrofishing backpack with an appropriate control unit (DC converter), a cathode and an anode. The number of sets used on each site is determined by the width of the site and varied between one and three sets. ADEF electrofishing involves between two and six operators depending on the number of sets used. Fishing is carried out by wading in an upstream direction, ensuring that the electrical field covers the entire width of the river. A representative sample of the pool-riffle-glide river continuum is desirable, however, at some locations, this habitat breakdown may not be available. Three fishing passes are typically conducted using this method, with stop-nets deployed upstream and downstream of the survey stretch to prevent loss or recruitment of fish between each pass.

The TEF_{10} electrofishing method is a qualitative procedure that supplements the ADEF method. TEF_{10} electrofishing generally involves two operators and is used to sample added value (AV) sites where the wetted width of the survey site is <10 metres. This rapid assessment method is quicker and less resource demanding than ADEF fishing and allows for a more comprehensive catchment-wide survey. The equipment used consists of one portable generator (220/240V) or electrofishing backpack with an appropriate control unit (DC converter), a cathode and an anode. No stop-nets are deployed. Electrofishing took place by wading upstream in a zigzag manner for exactly ten minutes at a steady pace (Matson *et al.,* 2018).

3.2.2 Non wadeable boat-based electrofishing

Two methods of electrofishing were used to sample non wadeable channels in 2022. These were ADEF using boat-based electrofishing equipment and systematic point abundance sampling using boom-boat based electrofishing equipment.

ADEF using boat-based electrofishing is carried out on larger, deeper channels (>0.5-1.5m). Typically, boat-based electrofishing is carried out from a flat-bottomed boat(s) in a downstream direction using a generator, control box, a pair of anodes and a cathode. The width of the channel determines how many boats should be used to sufficiently sample the site. Where a river is too wide for the number of boats or resources available are limited to cover the entire channel width, a partial survey may be undertaken along one bank in a parallel or staggered formation.

On the largest navigable channels (wide and deep), such as the River Shannon, specialised boom-boat electrofishing equipment are used. The boom-boat holds a large high-powered generator, a specialised high-voltage control box, a live well and two wide 'booms', which are deployed into the water to spread the electrical current (Plate 3.1). The sampling method (sPASE) involves moving upstream, collecting fish at numerous evenly distributed point samples (20m apart), along the right or left bank of the study site area. Upon arrival at a sampling point, the electrical power is activated for ten seconds. The catch per unit effort (number of activations per site) is determined by the total length of the site surveyed.

For the above methods, all fish were counted and measured on site.

An evaluation of river habitat quality is critical to any bioassessment survey; therefore, a simple habitat assessment was carried out at each site. General physical characteristics of the site were recorded, alongside parameters including river typology, land use, fish pressures, riparian and bank vegetation, instream features, habitat breakdown, flow type, and substrate. Wetted width and depth were typically measured using five transects across each site, with five depth intervals along each. Other physico-chemical parameters recorded, included water temperature (°C) and conductivity (µS/cm).

Plate 3.1 Boom-boat electrofishing on the River Shannon

3.3 Transitional waters

Transitional waters (freshwater tidal river reaches, estuaries and 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 25-hour period (approximately), the tidal level rises and falls twice, subjecting extensive areas to inundation and exposure.

Wightman *et al.* (2022), describes the multi-method approach, including the use of beach-seine netting, beam trawling and fykes netting, utilised by IFI staff to survey transitional waters in 2022.

3.4 Fish ecological status

An essential step in the WFD monitoring process is the classification of the ecological status of lakes, rivers and transitional waters. These assist in identifying the objectives that must be met in the individual River Basin Management Plans (RBMPs).

Three fish ecological classification tools have been developed to assign status to fish stocks in Irish lakes, rivers and transitional waters for WFD purposes. The Fish in Lakes (FIL2) ecological classification tool (Kelly *et al.,* 2012) was used to assign ecological status to lakes surveyed in 2022. An ecological classification tool for fish in rivers (Fisheries Classification Scheme 2) was modelled on that used by the Environmental Agency in the UK and re-developed in 2011 to assign ecological status to fish in rivers for the Republic of Ireland and Northern Ireland (FCS2-Ireland), along with a separate version for Scotland (SNIFFER, 2011). The Estuarine Multi-Metric Fish Index (EMFI) (Harrison and Kelly, 2013) developed in 2013 was used to assign status to transitional water bodies.

Plate 3.2 Processing fish samples on the River Blackwater in the SWRBD

4. RESULTS

4.1 Lakes

4.1.1 Fish species distribution and abundance

A total of 16 fish species (sea trout are counted as a separate "variety" of trout) and three cyprinid hybrids were recorded across the 24 lakes surveyed in 2022 (Table 4.1). Eels had the widest distribution, occurring in 19 lakes (79.1%). This was followed by brown trout and perch, recorded in 18 lakes (75.0%), roach in 14 (58.3%), pike in 13 (54.1%), tench in nine (37.5%), roach x bream hybrids, rudd and bream in eight (33.3%), salmon and three-spined stickleback in six (25.0%), sea trout in four (16.6%), Arctic char, gudgeon and rudd x roach hybrids in three (12.5%), minnow and nine-spined stickleback and rainbow trout in two (8.3%), and rudd x bream hybrids in one lake (4.1%). (Table 4.1).

Table 4.1. Fish species recorded in lakes surveyed in 2022

	Scientific name	Common name	Number of lakes	% of lakes
1	*Anguilla anguilla*	European eel	19	79.1
2	*Salmo trutta*	Brown trout	18	75.0
3	*Perca fluviatilis*	Perch	18	75.0
4	*Rutilus rutilus*	Roach	14	58.3
5	*Esox lucius*	Pike	13	54.1
6	*Tinca tinca*	Tench	9	37.5
7	*Rutilus rutilus* x *Abramis brama*	Roach X bream	8	33.3
8	*Scardinius erythrophthalmus*	Rudd	8	33.3
9	*Abramis brama*	Bream	8	33.3
10	*Salmo salar*	Atlantic salmon	6	25.0
11	*Gasterosteus aculeatus*	Three-spined stickleback	6	25.0
12	*Salmo trutta*	Sea trout*	4	16.6
13	*Salvelinus alpinus*	Arctic char	3	12.5
14	*Gobio gobio*	Gudgeon	3	12.5
15	*Scardinius erythrophthalmus* x *Rutilus rutilus*	Rudd X roach	3	12.5
16	*Phoxinus phoxinus*	Minnow	2	8.3
17	*Pungitius pungitius*	Nine-spined stickleback	2	8.3
18	*Oncorhynchus mykiss*	Rainbow trout	2	8.3
19	*Scardinius erythrophthalmus* x *Abramis brama*	Rudd X bream	1	4.1

*Note: *sea trout are counted as a separate "variety" of trout*.

Species abundance was recorded as Catch-Per-Unit-Effort (CPUE), which is the number of fish captured per metre of survey net (fish/m). Although a species may have been recorded in a lake, it might not have been in high abundance or dominant. The distribution and abundance of the most

common fish species captured amongst all lakes surveyed in 2022 is shown in Figures 4.4 to 4.16. In addition to the species displayed in the figures, sea trout were captured in four lakes, Lough Shindilla, Lough Kylemore, Beltra Lough in the WRBD and Lough Eske in NWRBD. Rudd x roach hybrids were captured in Loughs Cullin (WRBD), Bridget and Glasshouse (ShRBD). Nine-spined stickleback were captured in Loughs Mask and Rea (WRBD). Rainbow trout were captured in Lough Bane and Lough Lene (ERBD). Rudd x bream hybrids were captured in Glasshouse Lake (ShRBD).

Perch was the most abundant species captured during the 2022 survey season and the dominant species in 14 of the 24 lakes surveyed. The highest CPUE of perch was recorded in Lough Bane (1.709 fish/m of net) (Fig 4.8).

Roach was the next most abundant species recorded, being dominant in five of the 24 lakes surveyed. The highest CPUE for roach (1.098 fish/m of net) was recorded in Lough Bridget (Fig 4.9).

Brown trout was the dominant species in four lakes, with their highest CPUE (0.438 fish/m of net) recorded in Lough Barra (Fig 4.5).

Rudd was the dominant species in one lake, Lough Lickeen with a CPUE of 0.388 fish/m of net (Fig 4.13).

Plate 4.1 Setting a fyke net on Maumwee Lough in the WRBD

4.1.2 Fish ecological status classification in lakes

All 24 lakes surveyed in 2022 were assigned a draft fish ecological status using the FIL2 ecological classification tool, together with expert opinion. Five lakes were classified as High ecological status, eight as Good, five as Moderate, two as Poor and four as Bad (Table 4.2, Fig. 4.1 and 4.3).

Figure 4.1 Fish ecological status for lakes surveyed in 2022.

Of the 24 lakes surveyed in 2022, all 24 had previously been sampled and assigned a fish ecological status. Fourteen lakes (58.3%) had an unchanged ecological status, four (16.7%) showed an improvement in status, while the remaining six (25.0%) had deteriorated (Fig 4.2 and 4.3).

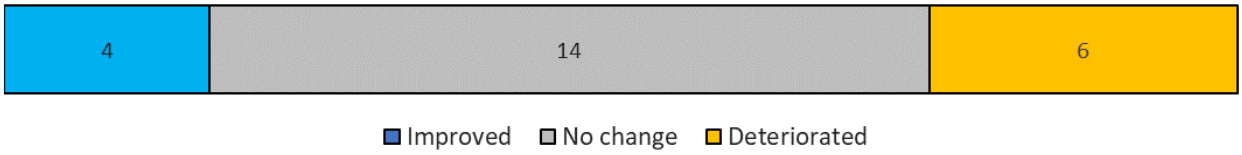

Figure 4.2 Change in fish ecological status for lakes surveyed in 2022.

Table 4.2 Summary details and fish ecological status of lakes surveyed for the WFD fish monitoring programme.

Lake name	WFD Code	Survey type	Catchment	FIL2 Typology	Area (ha)	Previous Status	2022 status
NWRBD							
Eske	NW_37_188	AV	Eask	2	386.9	G (2012)	High
Barra	NW_38_84	SM	Gweebarra	1	62.5	G (2019)	High
Macnean upper	NW_36_673	SM	Erne	2	326.8	G (2016)	Moderate
Macnean lower	NW_36_445	SM	Erne	1	456.0	B (2016)	Bad
Glasshouse	NW_36_615	AV	Erne	3	54.3	P (2017)	Bad
WRBD							
Mask	WE_30_665	AV	Corrib	4	8217.7	G (2019)	Good
Maumwee	WE_30_343	SM	Corrib	1	27.6	G (2013)	Good
Carra	WE_30_347	SM	Corrib	4	1564.4	G (2019)	Good
Kylemore	WE_ 32_509b	SM	Dawros	2	134.0	H (2019)	High
Conn	WE_34_406b	AV	Moy	4	4704.4	G (2016)	Good
Cullin	WE_34_406a	SM	Moy	3	1023.6	M (2018)	Good
Beltra	WE_32_452	SM	Newport	2	403.4	H (2016)	High
Ardderry	WE_ 31_76	SM	Coastal	1	81.0	G (2019)	Good
Shindilla	WE_ 31_171	SM	Coastal	2	65.6	H (2019)	High
Ross	WE_30_345	SM	Corrib	3	139.2	P (2016)	Poor
Lettercraffroe	WE_30_344	SM	Corrib	2	82.3	G (2019)	Good
Ballyquirke	WE_30_340	AV	Corrib	1	73.9	B (2016)	Bad
Rea	WE_29_194	SM	Kilcolgan	4	301.0	H (2016)	Moderate
Glenade	WE_35_156	SM	Garvogue	3	73.6	G (2016)	Moderate
SHRBD							
Ree	SH_26_750a	AV	Shannon	4	10020.4	P (2013)	Moderate
Bridget	SH_27_117	AV	Coastal	3	55.2	G (2017)	Moderate
Lickeen	SH_28_85	SM	Inagh	2	84.2	B (2016)	Bad
ERBD							
Bane	EA_07_270	SM	Boyne	3	75.4	G (2016)	Good
Lene	EA_07_274	SM	Boyne	4	416.2	M (2016)	Poor

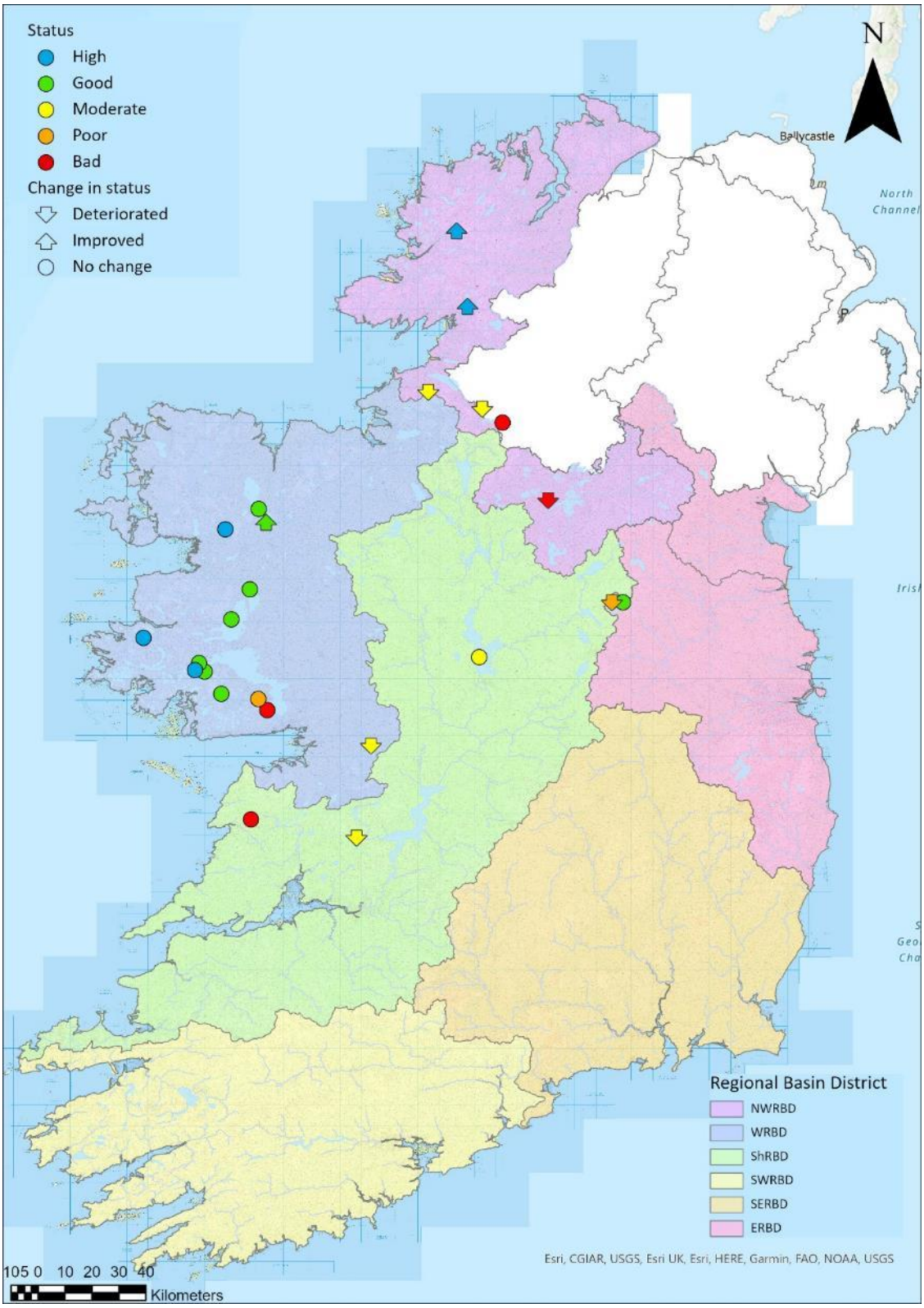

Figure 4.3. Fish ecological status for lakes surveyed in 2022.

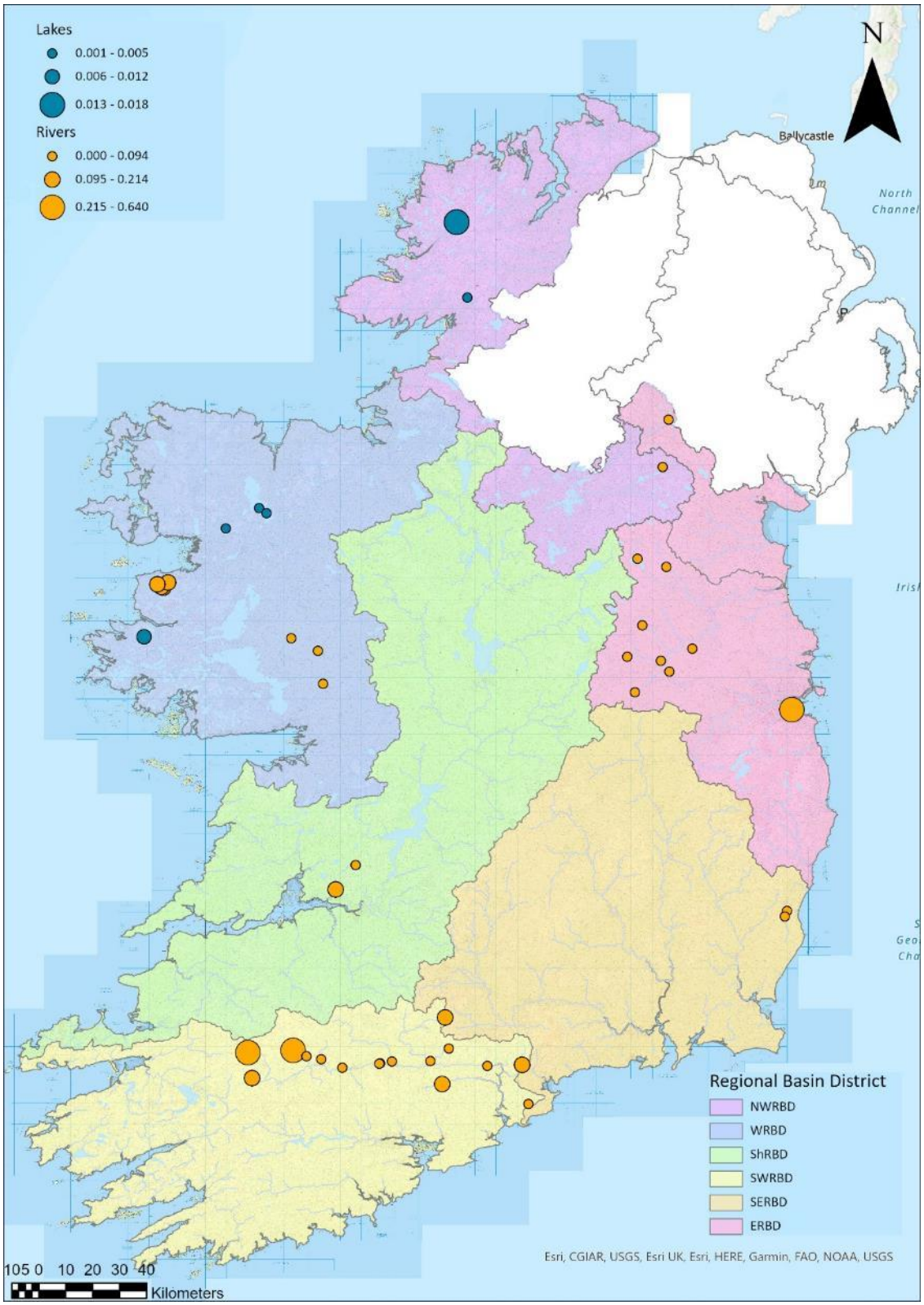

Figure 4.4. Atlantic salmon distribution and abundance in lakes (CPUE (no. fish/m net)) and rivers (density (no. fish/m^2)) surveyed in 2022 (CPUE and density are not comparable).

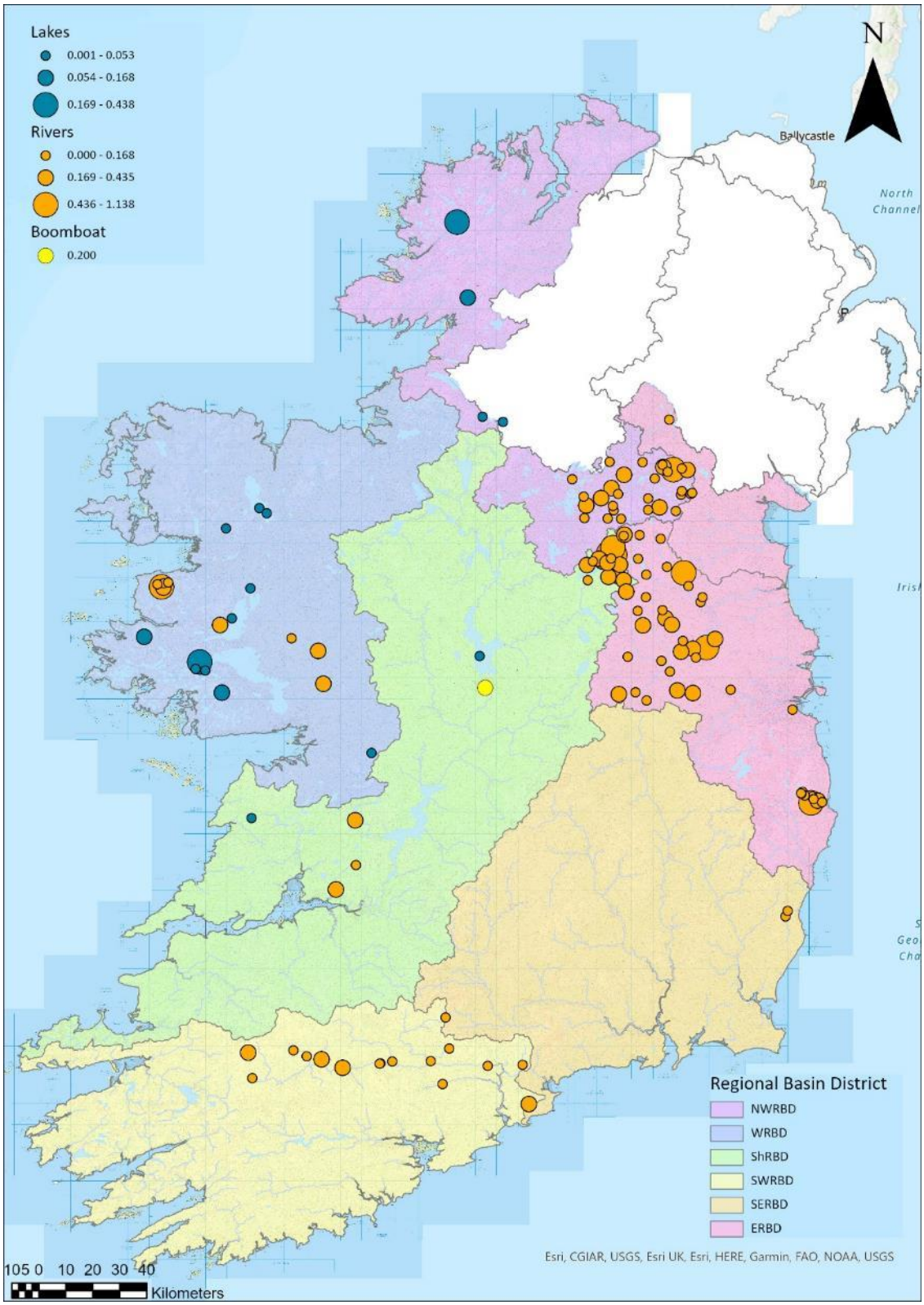

Figure 4.5. Brown trout distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable).

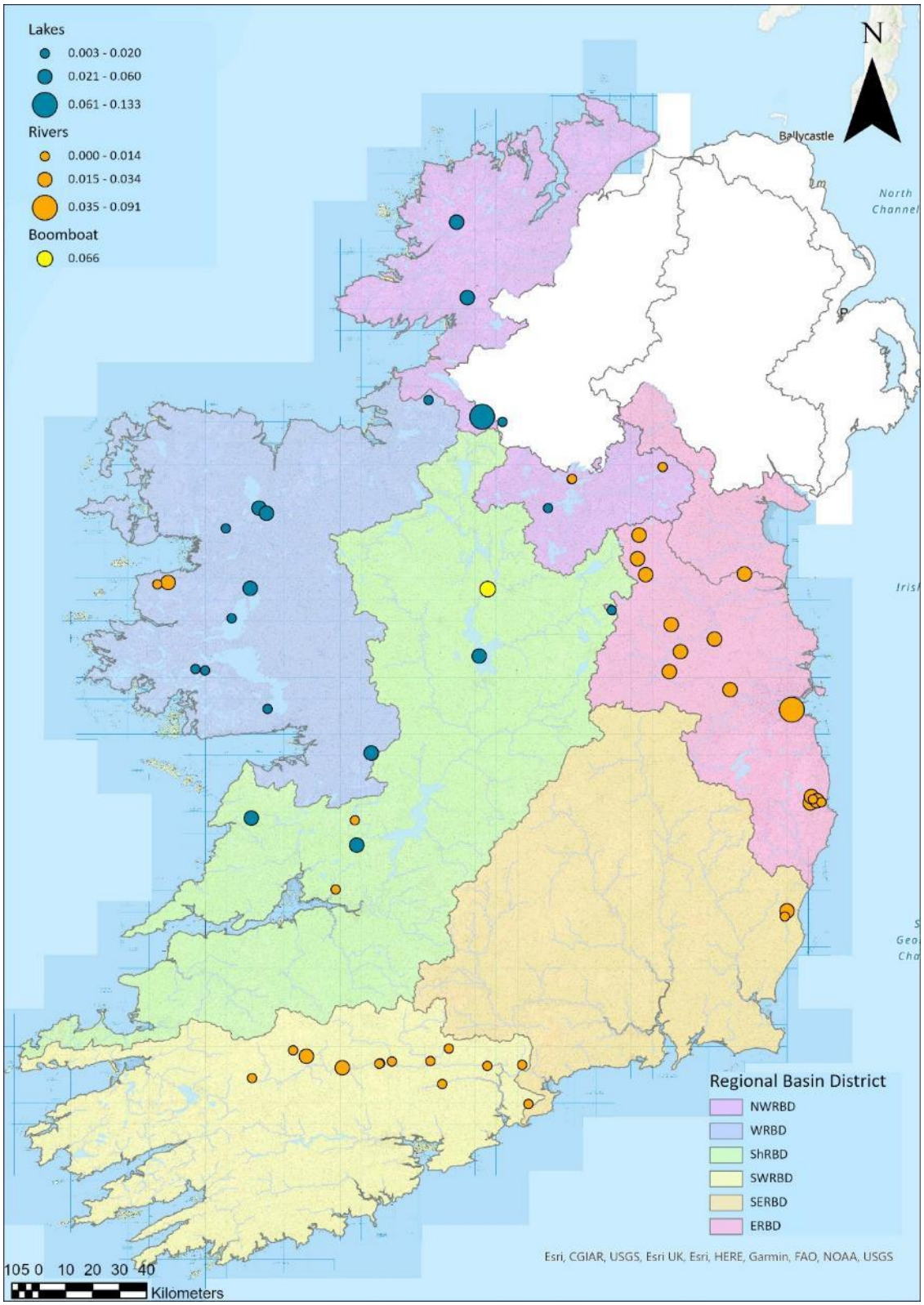

Figure 4.6. European eel distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable).

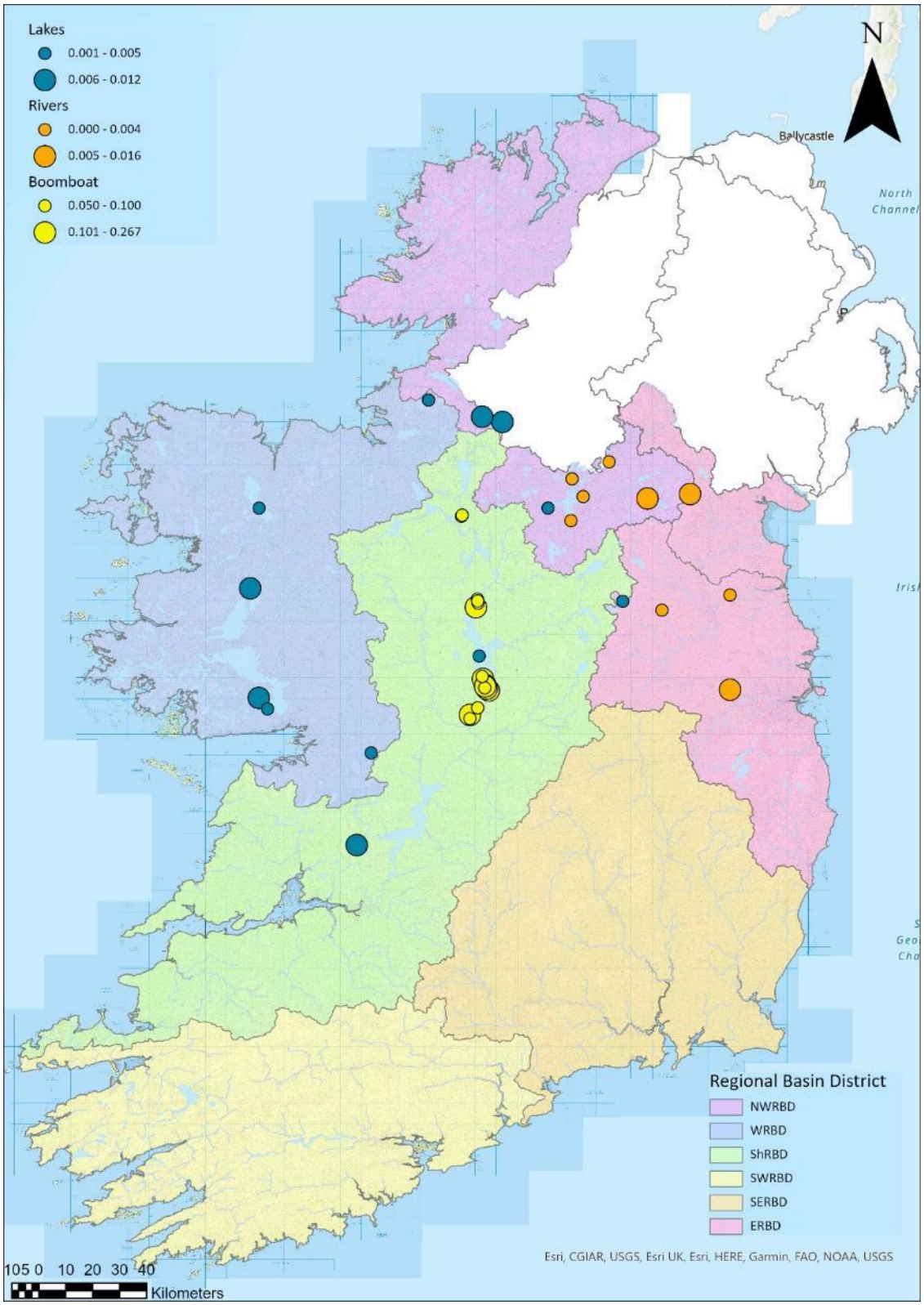

Figure 4.7. Pike distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable).

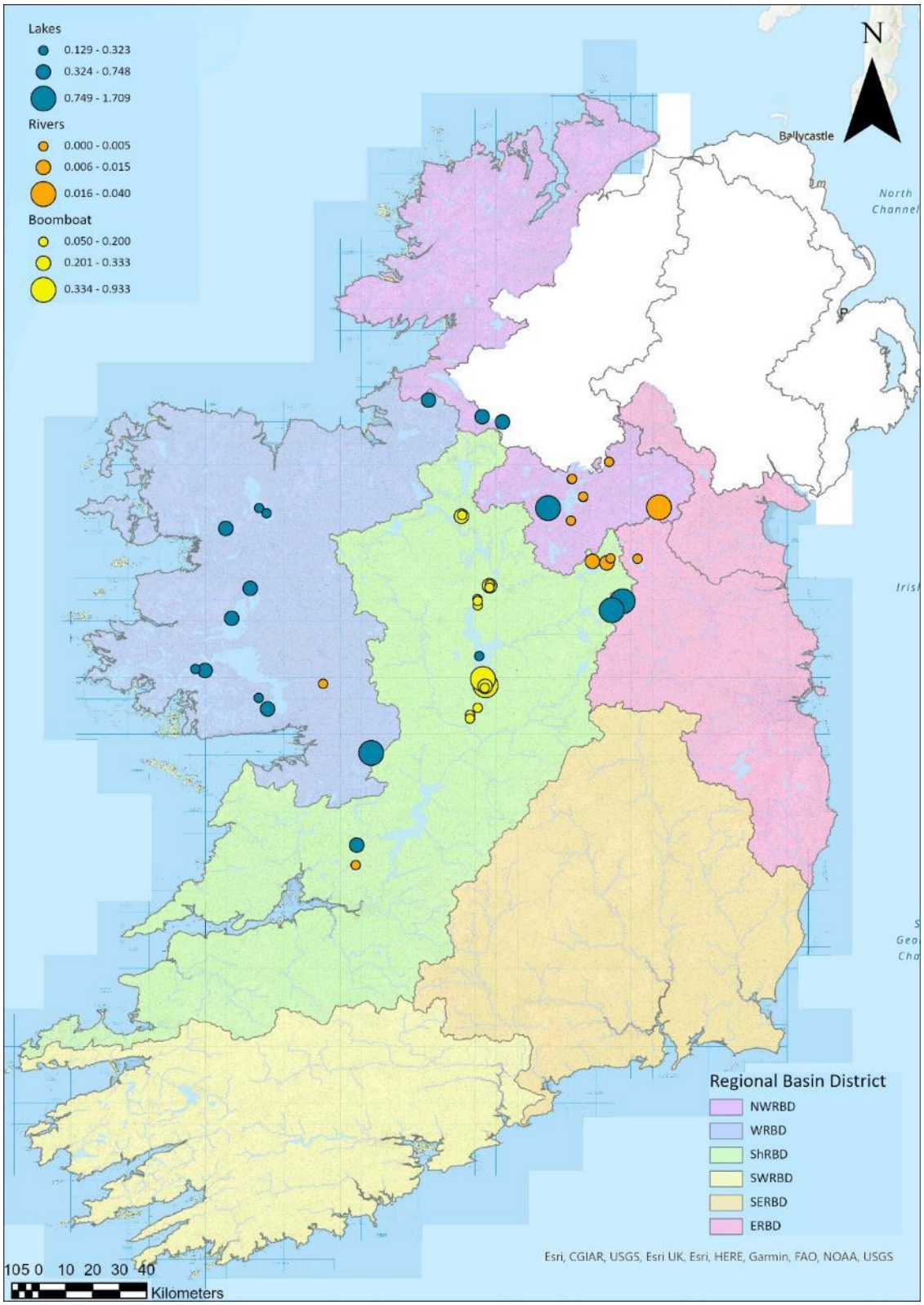

Figure 4.8. Perch distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable).

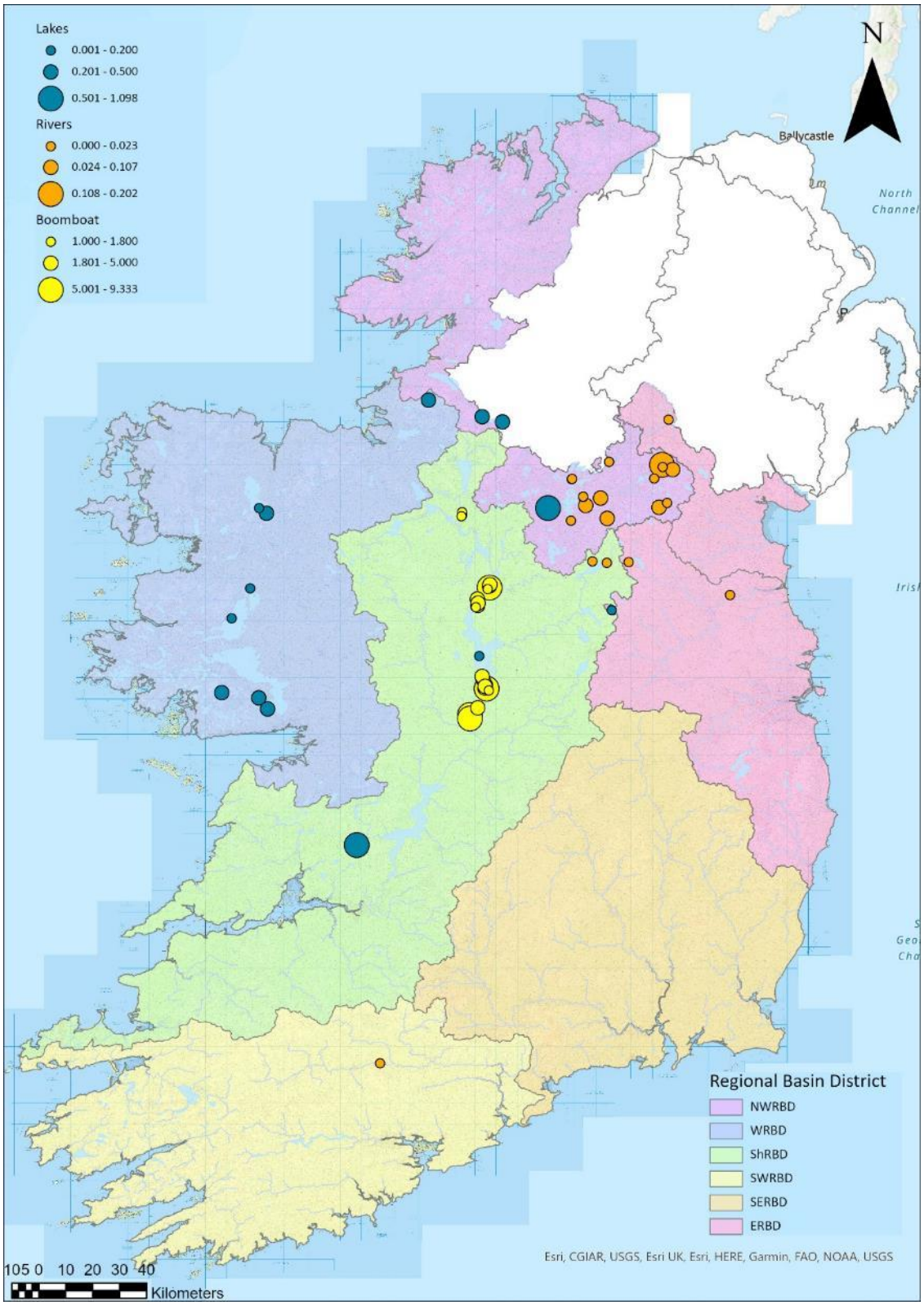

Figure 4.9. Roach distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable)

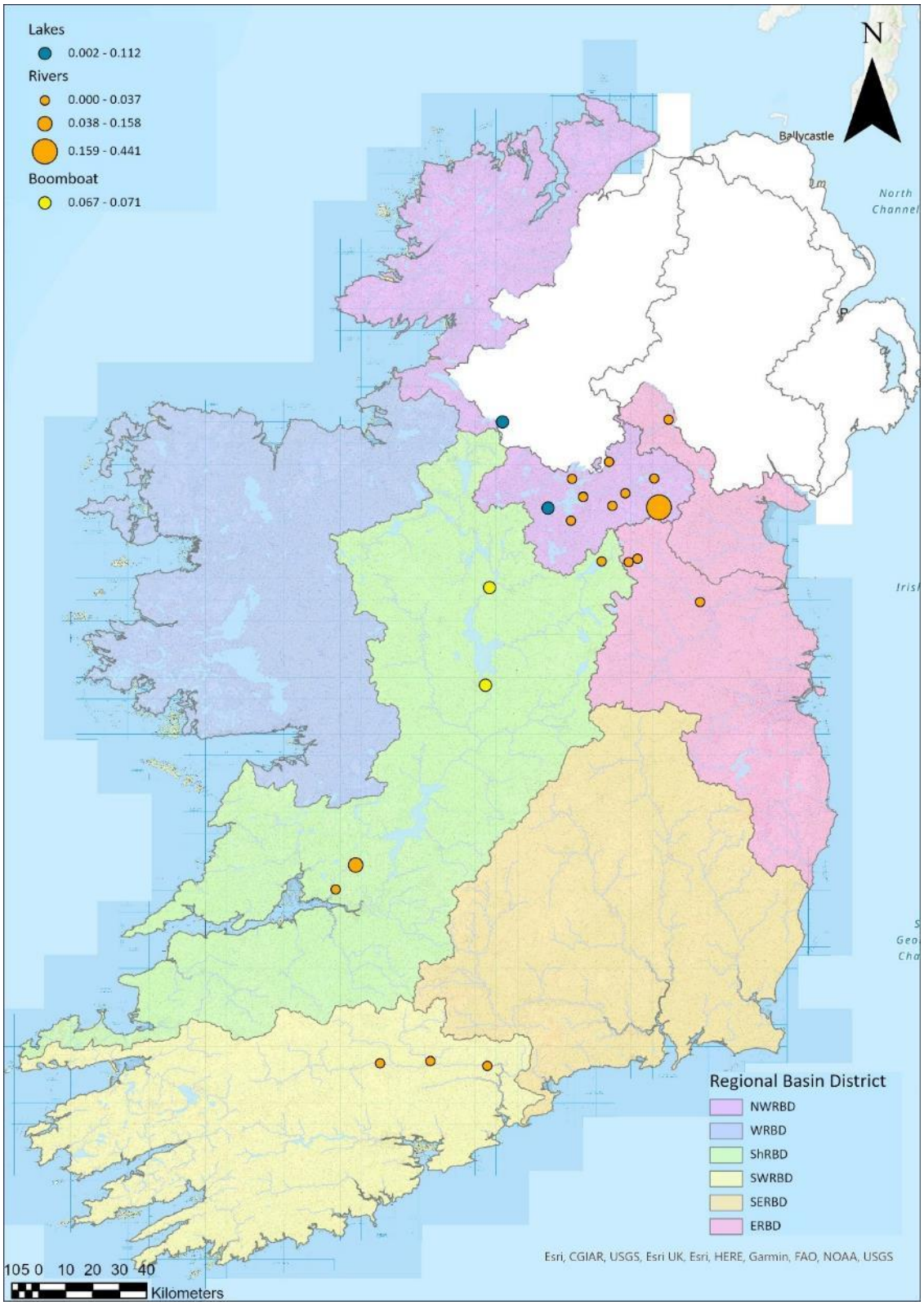

Figure 4.10. Gudgeon distribution and abundance in lakes (CPUE (no. fish/m net)), rivers (density (no. fish/m^2)) and boom-boat sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUE and density are not comparable).

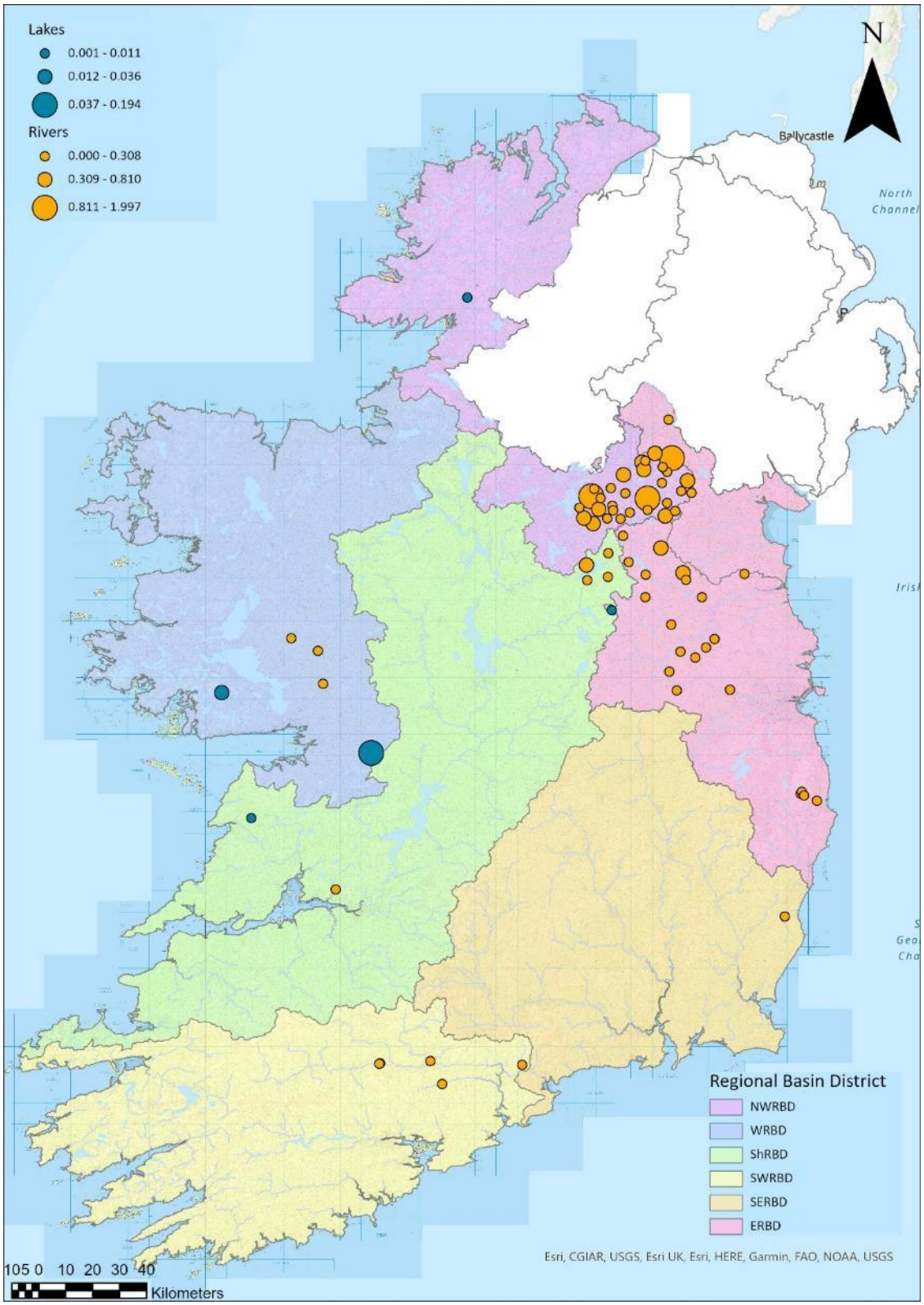

Figure 4.11. Three-spined stickleback distribution and abundance in lakes (CPUE (no. fish/m net)) and rivers (density (no. fish/m^2)) surveyed in 2022 (CPUE and density are not comparable).

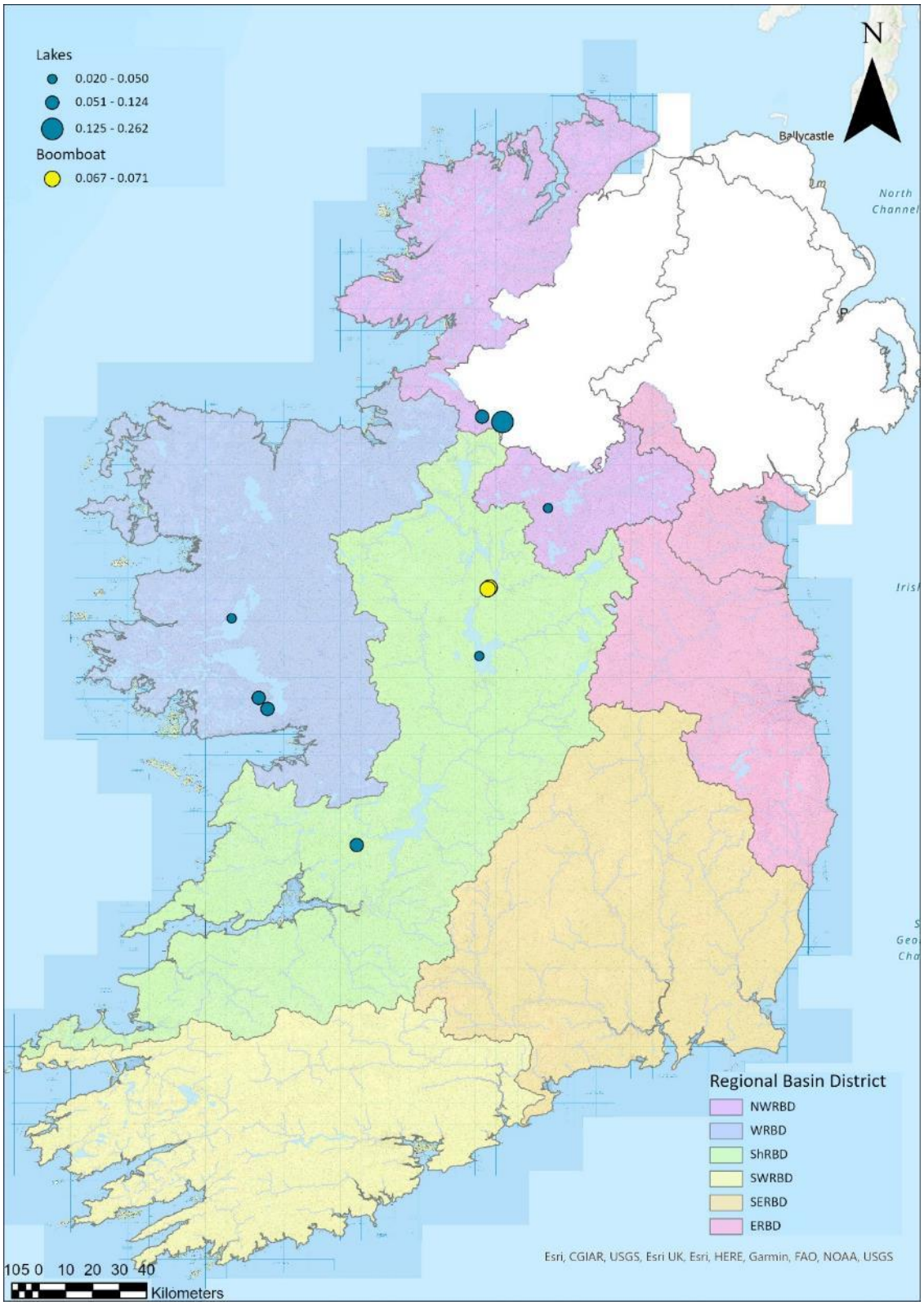

Figure 4.12. Roach X bream hybrid distribution and abundance in lakes (CPUE (no. fish/m net)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUEs are not comparable).

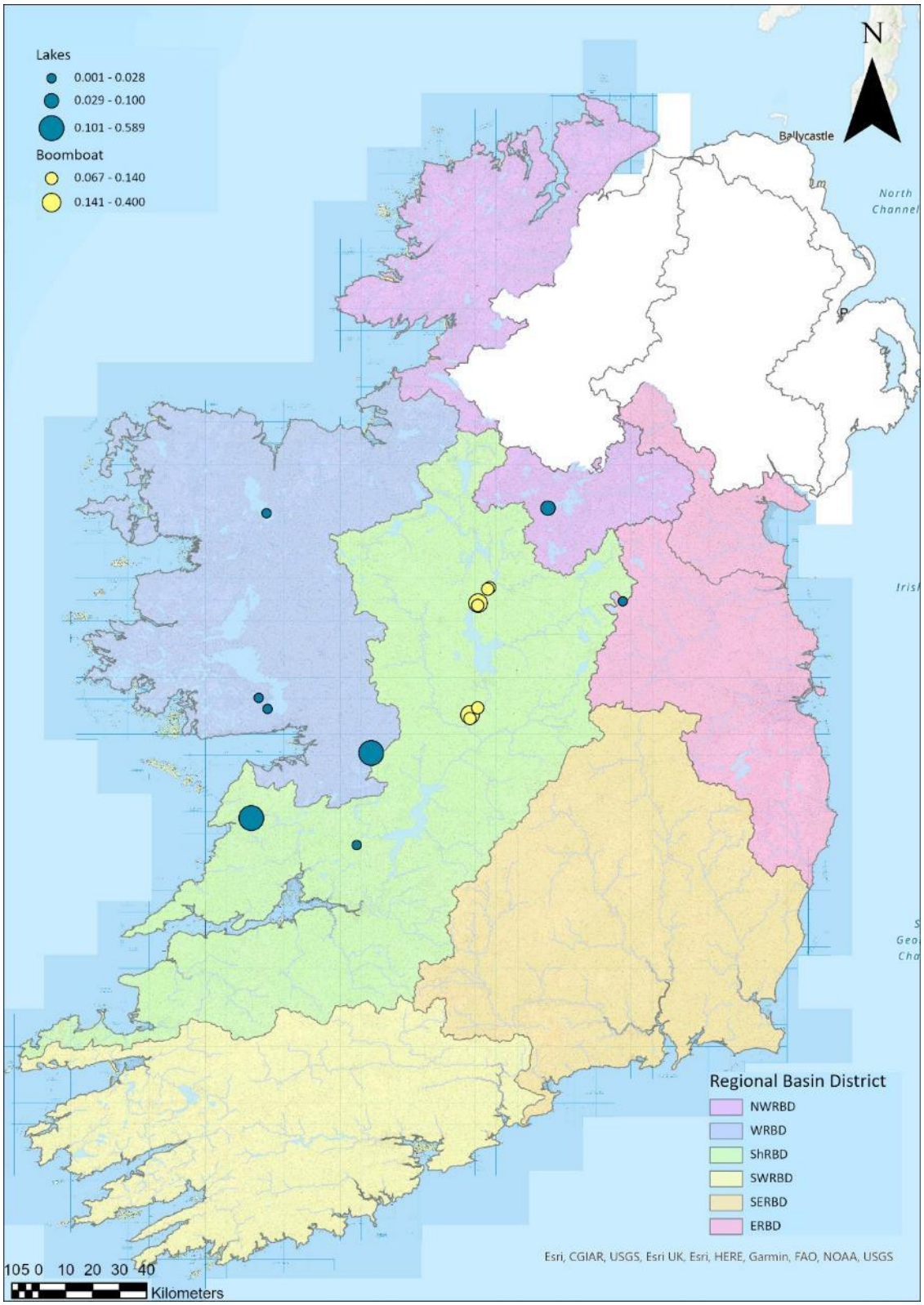

Figure 4.13. Rudd distribution and abundance in lakes (CPUE (no. fish/m net)) and boom-boat river sites (CPUE (no. fish per activation) surveyed in 2022 (CPUEs are not comparable)

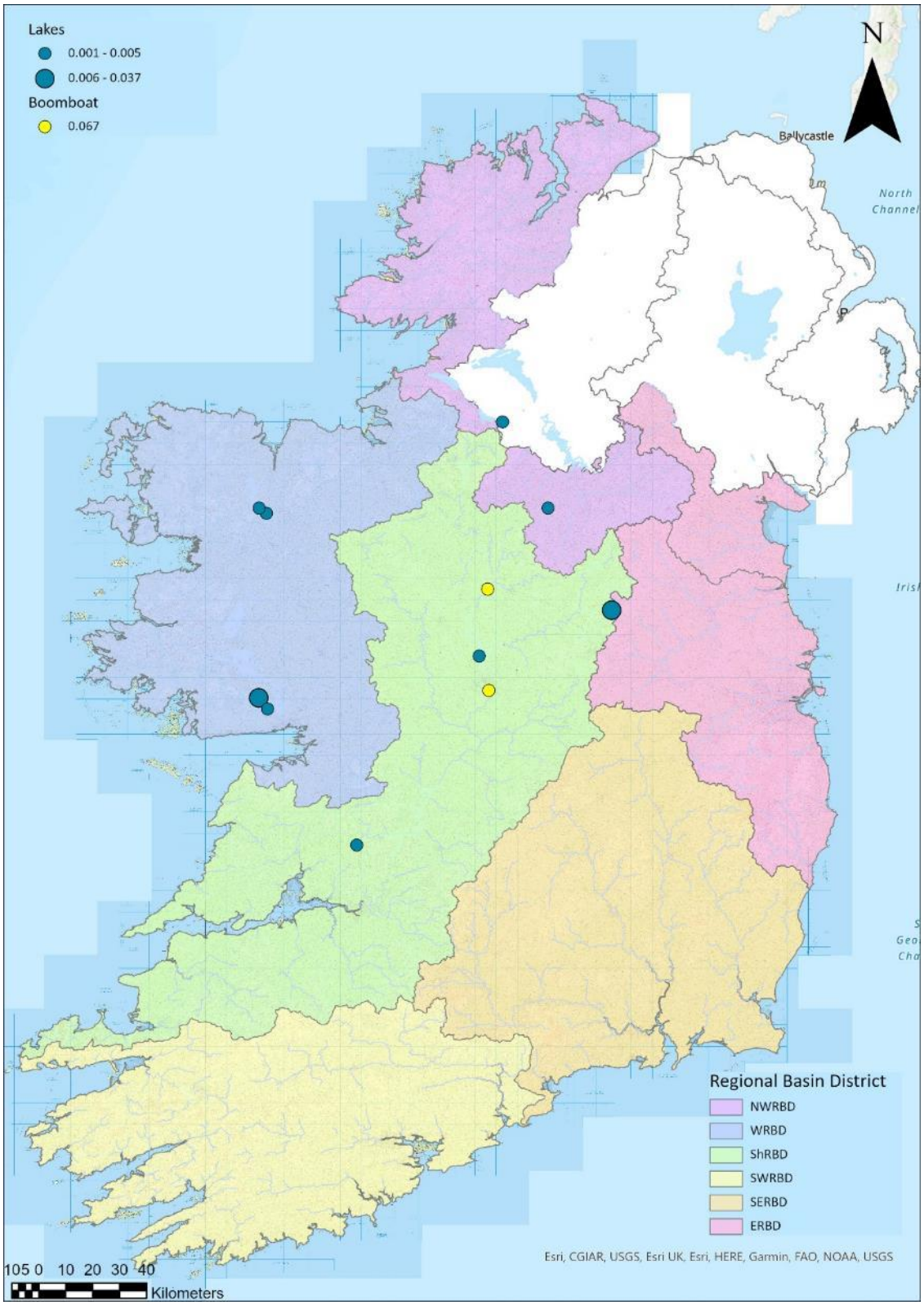

Figure 4.14. Tench distribution and abundance in lakes (CPUE (No. fish/m net)) and boom-boat river sites (CPUE (no. fish per activation)) surveyed in 2022 (CPUEs are not comparable).

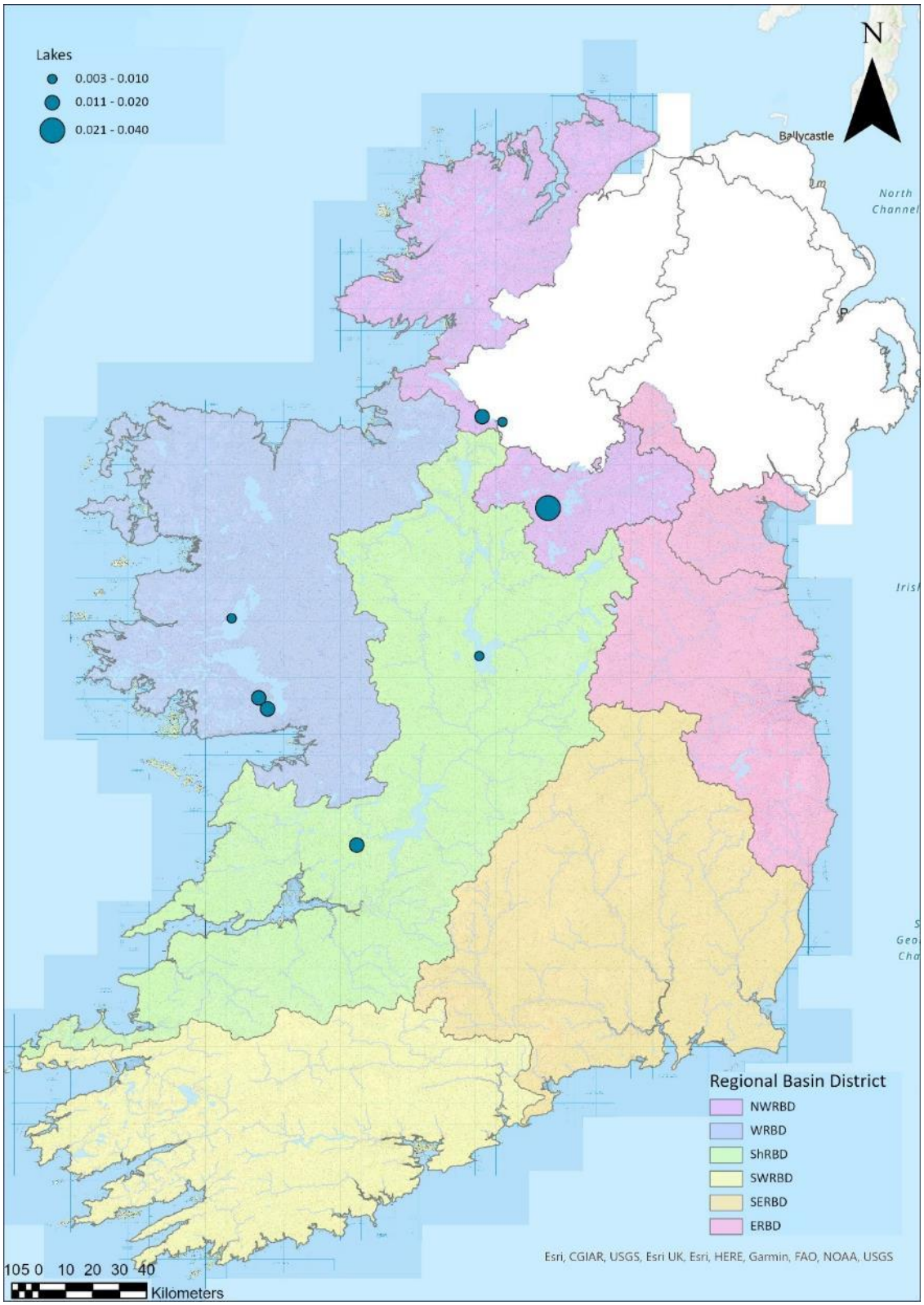

Figure 4.15. Bream distribution and abundance in lakes (CPUE (no. fish/m net)) surveyed in 2022.

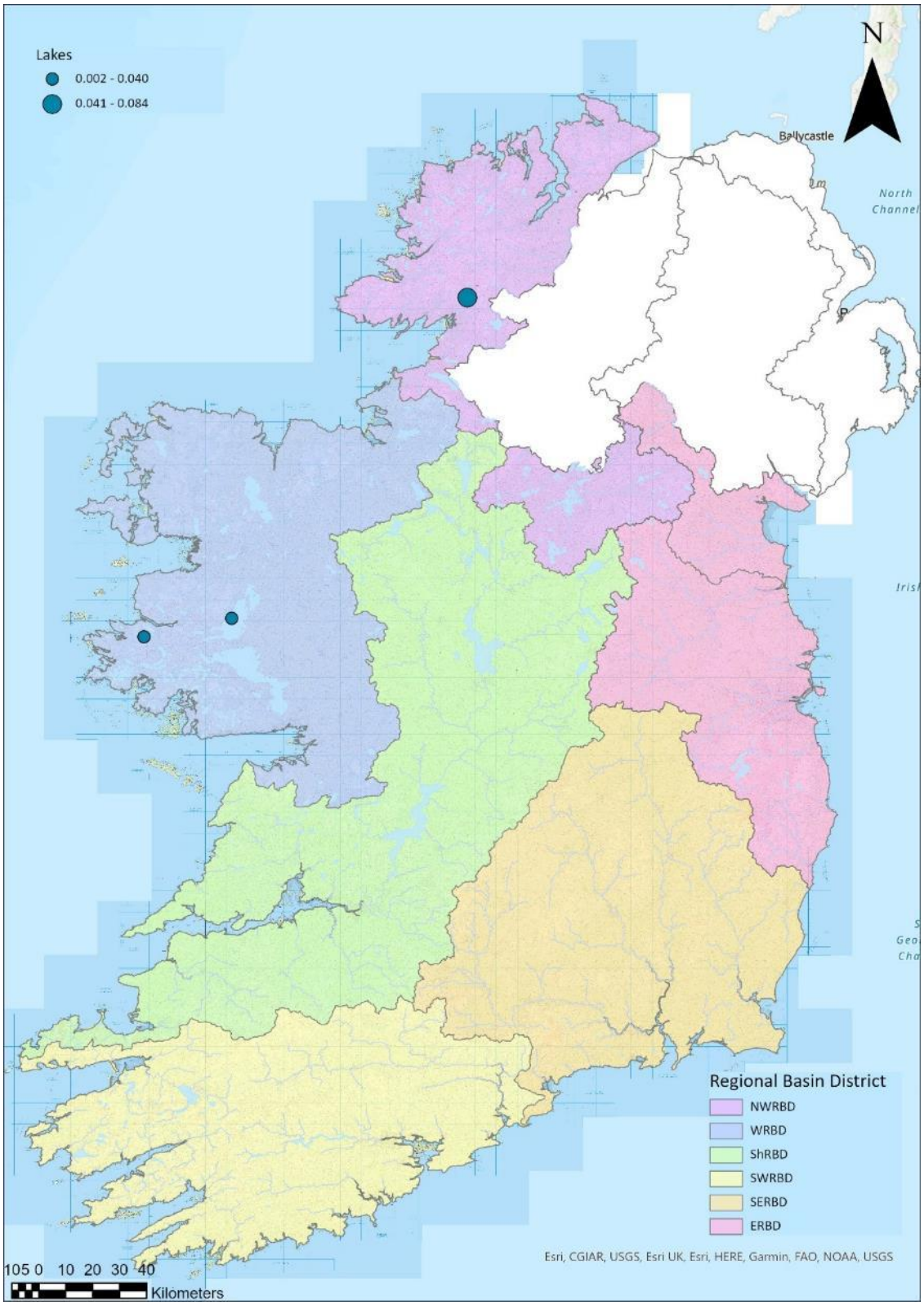

Figure 4.16. Arctic char distribution and abundance in lakes (CPUE (no. fish/m net)) surveyed in 2022.

4.2 Rivers

4.2.1 Fish species distribution and abundance

A total of 16 fish species (sea trout are counted as a separate "variety" of trout) and two cyprinid hybrids were recorded across the river sites surveyed in 2022 (Table 4.3). Brown trout had the widest distribution, occurring in 120 out of the 169 sites surveyed (71%), while salmon were recorded at 42 sites (24.9%) (Table 4.3).

Brown trout fry (0+) were recorded at 88 sites (52.1%), with 1+ and older individuals recorded at 107 sites (63.3%). Salmon fry (0+) were captured at 34 sites (20.1%) with 1+ and older individuals caught at 38 sites (22.5%).

Table 4.3. Fish species recorded in river sites surveyed in 2022 (age cohorts for brown trout and salmon are also shown)

	Scientific name	Common name	Number of river sites	% river sites
1	*Salmo trutta*	Brown trout (all age classes)	120	71.0
		Brown trout 0+	88	52.1
		Brown trout 1+ and older	107	63.3
2	*Salmo salar*	Salmon (all age classes)	42	24.9
		Salmon 0+	34	20.1
		Salmon 1+ and older	38	22.5
3	*Anguilla anguilla*	European eel	38	22.5
4	*Esox lucius*	Pike	25	14.8
5	*Perca fluviatillis*	Perch	28	16.6
6	*Phoxinus phoxinus*	Minnow	53	31.4
7	*Gasterosteus aculeatus*	Three-spined stickleback	68	40.2
8	*Barbatula barbatula*	Stone loach	45	26.6
9	*Lampetra sp.*	Lamprey sp.	23	13.6
10	*Rutilus rutilus*	Roach	43	25.4
11	*Gobio gobio*	Gudgeon	21	12.4
12	*Scardinius erythrophthalmus*	Rudd	7	4.1
13	*Leuciscus leuciscus*	Dace	3	1.8
14	*Salmo trutta*	Sea trout*	3	1.8
15	*Platichthys flesus*	Flounder	2	1.2
16	*Rutilus rutilus* x *Abramis brama*	Roach X bream	2	1.2
17	*Tinca tinca*	Tench	2	1.2
18	*Scardinius erythrophthalmus* x *Rutilus rutilus*	Rudd x roach	1	0.6

*Note: *sea trout are counted as a separate "variety" of trout.*

Plate 4.3 IFI's electrofishing boom-boat on the River Shannon in the ShRBD

The distribution and abundance of the most common fish species captured amongst all river sites surveyed in 2022 are shown in Figures 4.4 to 4.14 and 4.17 to 4.19. At wadable sites and at sites where boat-based electrofishing was used, abundance was recorded as fish density (number of fish/m^2). At sites where boom-boat electrofishing equipment was used, abundance was recorded as CPUE (number of fish captured per equipment activation). These two metrics are not directly comparable.

At sites where fish density was calculated, brown trout was the most abundant species recorded at 119 sites (Fig. 4.5). Drumroragh East on the Kildorough River, a tributary of the Mountnugent River, in the ShRBD, had the highest density recorded with 1.14 fish/m^2. This site also recorded the highest density of brown trout fry (0+) (0.96 fish/m^2). Glebe on the River Inny in the ShRBD, had the highest density of 1+ and older brown trout (0.40 fish/m^2).

The highest density of salmon, 0.64 fish/m^2, was found at Footbridge at Beaver Row site, on the River Dodder in the ERBD (Fig. 4.4). This site also recorded the highest density of 1+ and older salmon (0.16 fish/m^2). The highest density of salmon fry (0+) (0.55 fish/m^2) was recorded at the Ballydesmond site on the Blackwater (Munster) in the SWRBD.

Sea trout were recorded at three sites, two in the ERBD and one in the SWRBD. The highest eel density, 0.09 fish/m^2 was recorded on the River Dodder in the ERBD (Footbridge at Beaver Row) (Fig. 4.6). Flounder were captured at two sites, one site in the ERBD and one site in the SWRBD.

The highest lamprey density (brook and river lamprey) of 0.08 fish/m^2, was found at Magheraboy Lower on the Magheraboy River in the Inny sub catchment, in the ShRBD (Fig. 4.19). One sea lamprey was recorded at Newrath Bridge on the Vartry River in the ERBD.

The highest density of pike, 0.02 fish/m^2, was recorded at Kildare Bridge on the Rye Water in the ERBD (Fig. 4.7). Annafarney Bridge on the Annalee River, in the NWRBD recorded the highest density of perch, 0.04 fish/m^2 (Fig. 4.8). The highest density of roach 0.20 fish/m^2, was found in the NWRBD at Bluebell Nature Farm on the Dromore River (Fig. 4.9).

The highest density of minnow, 0.72 fish/m^2 was found at Clifferna North on the Larah River in the NWRBD. (Fig. 4.17). Three-spined stickleback recorded their highest density (1.99 fish/m^2) at Drumkeeran on the Killyvann River in the NWRBD (Fig. 4.11).

The highest density of stone loach, 0.88 fish/m^2 was found at Tatestown, on the Tatestown River, in the ERBD (Fig. 4.17). Annafarney Bridge on the Annalee River, in the NWRBD had the highest density of gudgeon, with 0.44 fish/m^2 recorded (Fig. 4.10).

Roach was the most widespread species recorded at sites surveyed using boom-boat electrofishing equipment. Roach were recorded at all 22 sites surveyed (Fig. 4.9). Roach was also the most abundant species at all sites, with a highest CPUE of 9.3 recorded at Creevagh on the River Shannon (Fig. 4.9).

In addition to the above, dace were recorded in low numbers at three sites, all within close proximity on the Blackwater (Munster) in the SWRBD. Rudd x roach hybrids and roach x bream hybrids were recorded at one and two sites respectively using boom-boat electrofishing equipment on the River Shannon in the ShRBD.

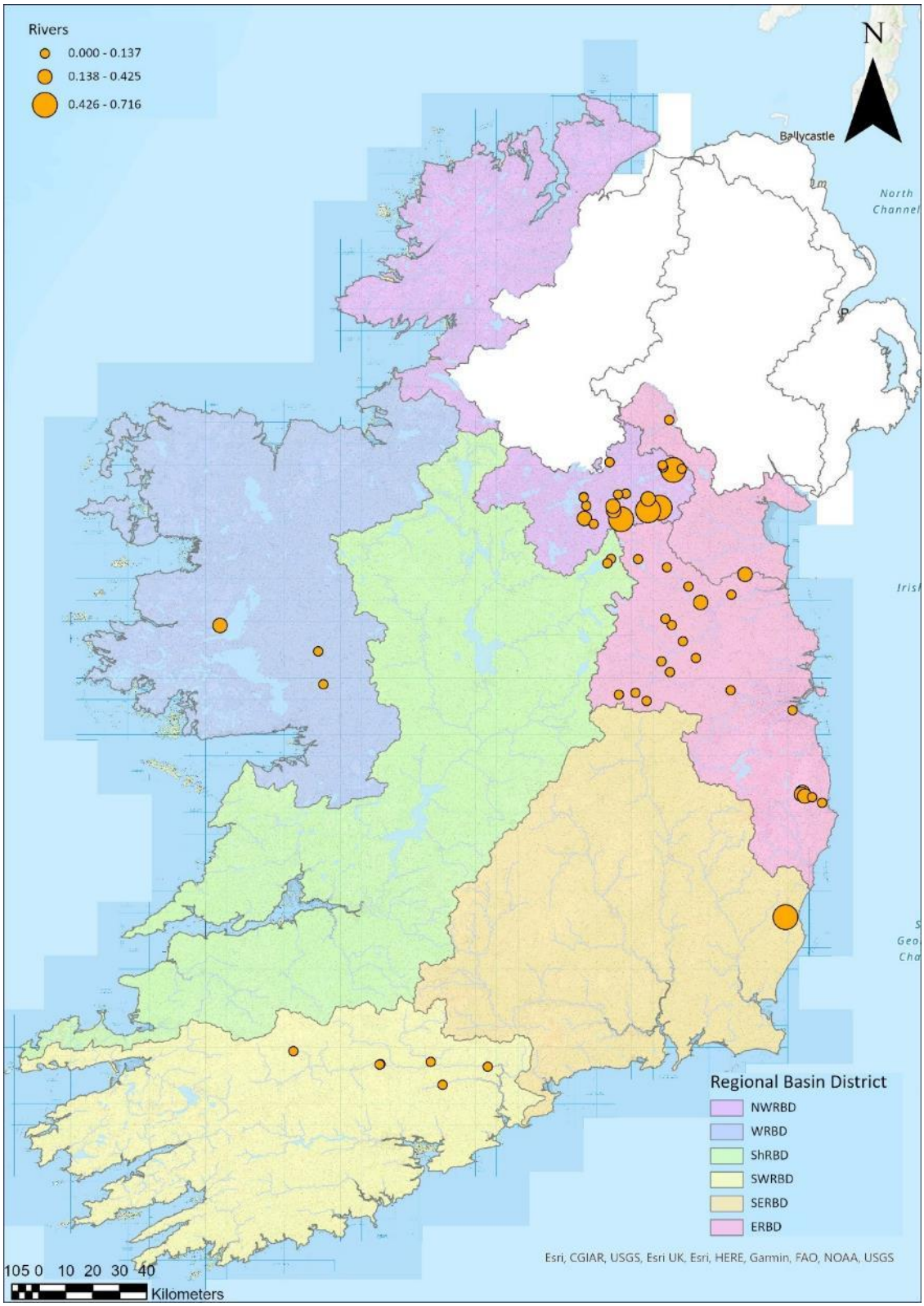

Figure 4.17. Minnow distribution and abundance in rivers (density (no. fish/m^2)) surveyed in 2022.

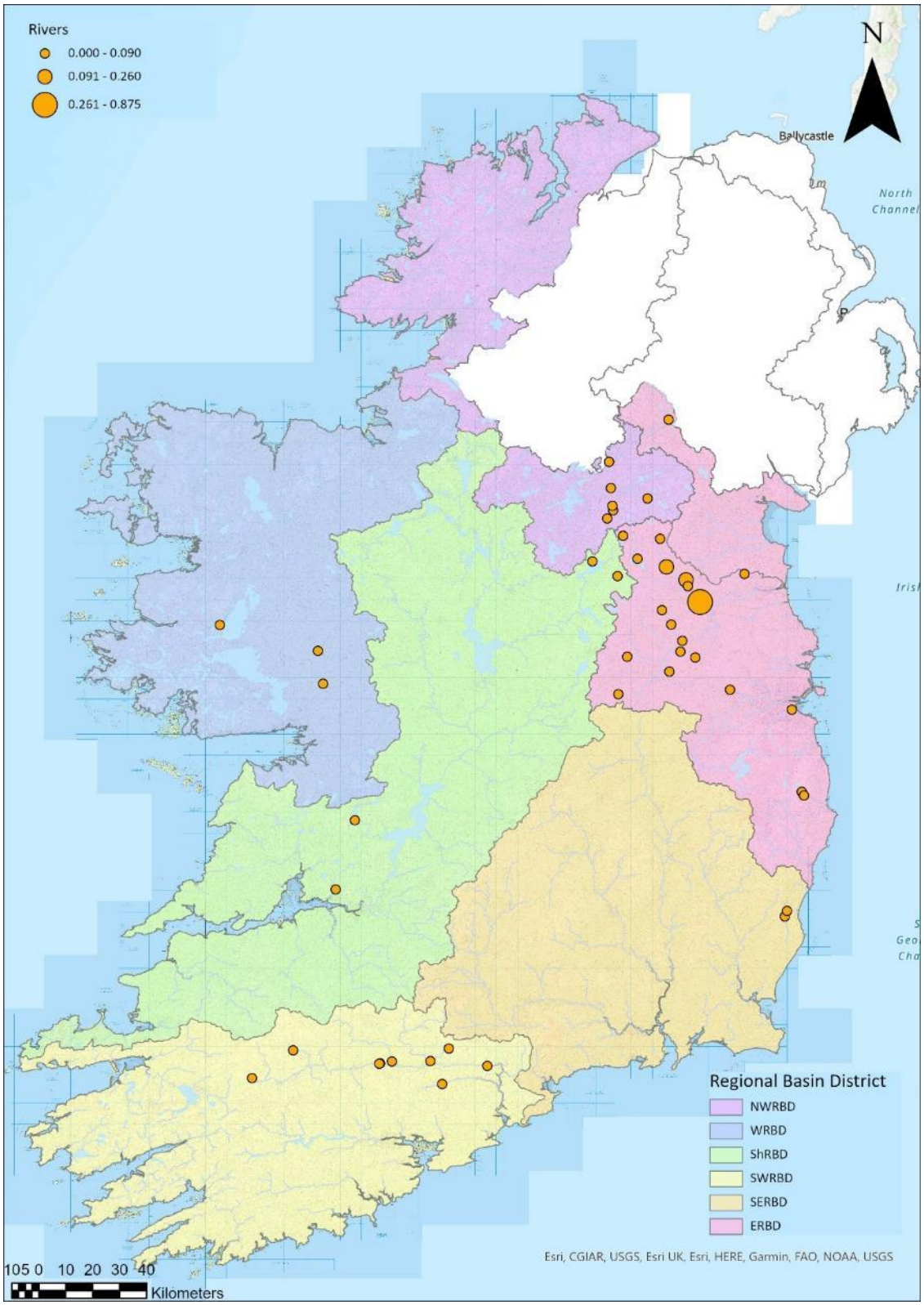

Figure 4.18. Stone loach distribution and abundance in rivers (density (no. fish/m^2)) surveyed in 2022.

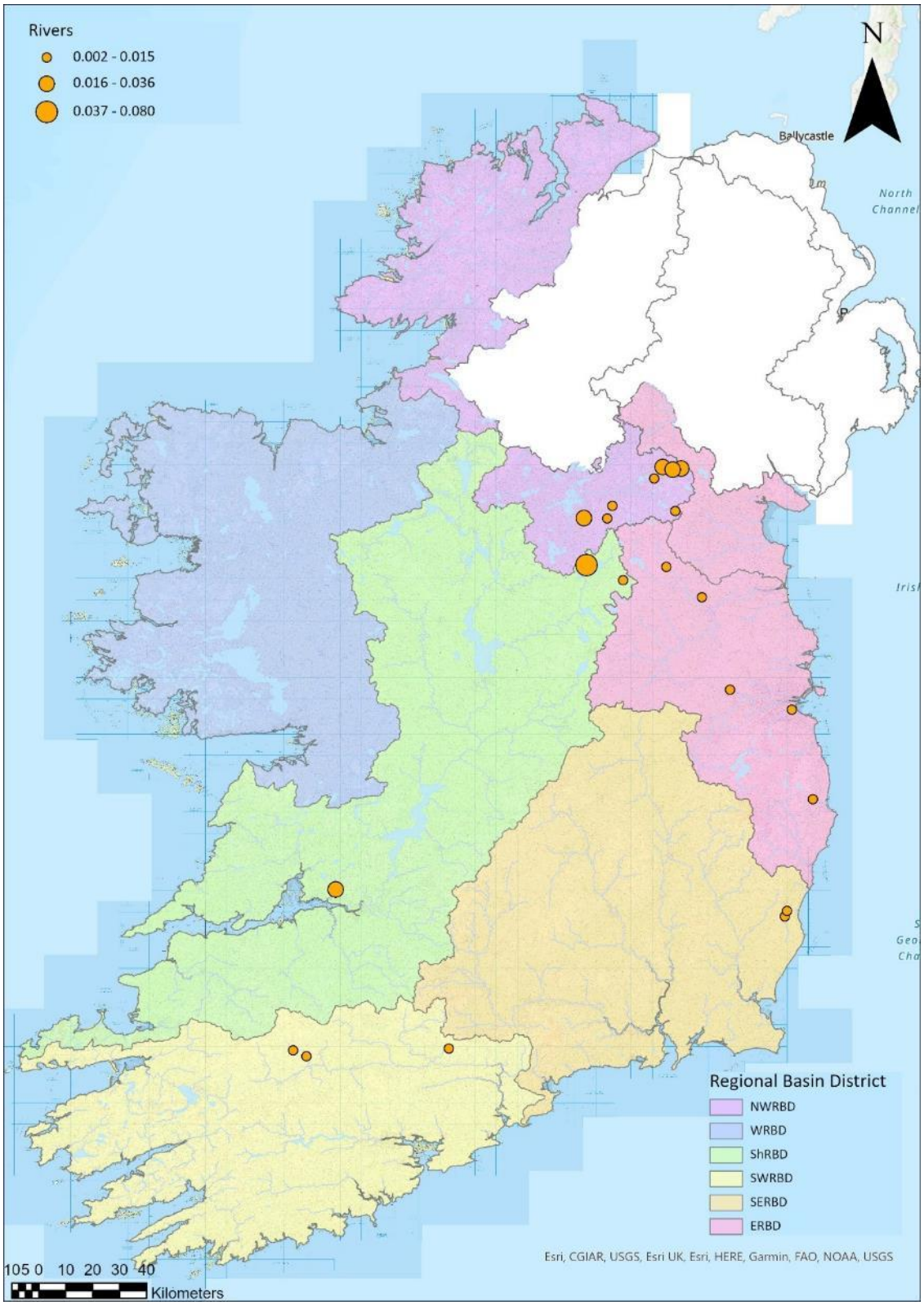

Figure 4.19. Lamprey sp. distribution and abundance in rivers (density (no. fish/m^2)) surveyed in 2022.

4.2.2 Fish ecological status in rivers

The FCS2-Ireland ecological classification tool was run on all 169 river sites surveyed in 2022, the results were then sense checked with expert opinion. In total, 161 sites were assigned a fish ecological status, while eight sites were unassigned. Three river sites were classified as High ecological status, 31 as Good, 83 as Moderate, 41 as Poor and three as Bad (Table 4.2, Figure 4.20 and 4.24).

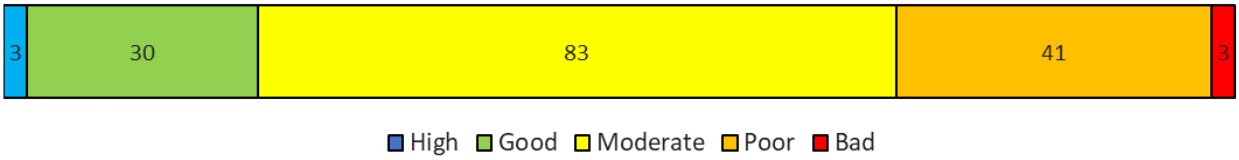

Figure 4.20. Fish ecological status for rivers surveyed in 2022.

Plate 4.4 Electrofishing on the Varty River Co. Wicklow in the ERBD.

A total of 42 sites surveyed were surveillance monitoring (SM) sites. In total, 36 SM sites were assigned an ecological status and six sites were unassigned. Of the sites classified, 16 were classified as having High or Good status (44.4%). The remaining 20 sites were classified as Moderate or Poor (55.6%). No SM sites were classified Bad in 2022 (Table 4.4; Fig. 4.21).

Figure 4.21. Fish ecological status for river sites surveyed in 2022.

Of the 127 AV sites, 125 were assigned an ecological status with two sites left unassigned. In total 18 of the AV sites were assigned a status of High or Good (14.4%). The remaining 107 sites were assigned a status of Moderate or worse (85.6%) (Table 4.4; Fig. 4.22).

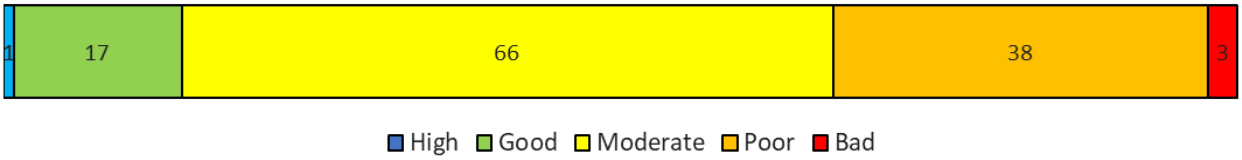

Figure 4.22. Fish ecological status for river sites surveyed in 2022.

Of the 161 sites assigned an ecological fish status in 2022, 54 sites had previously been surveyed and designated a status. Of these, the status of 41 (77.4%) sites remained the same between surveys, while five sites (9.4%) deteriorated, and seven sites (13.2%) improved (Fig. 4.23).

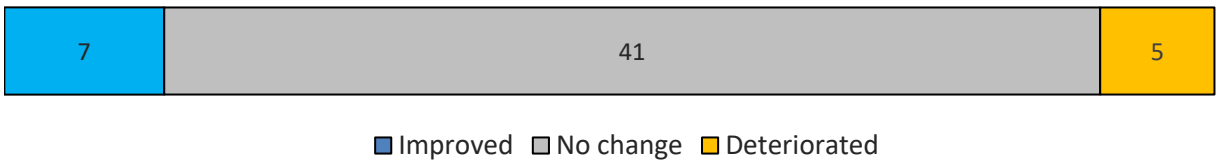

Figure 4.23. Trend in fish ecological status for river sites surveyed in 2022.

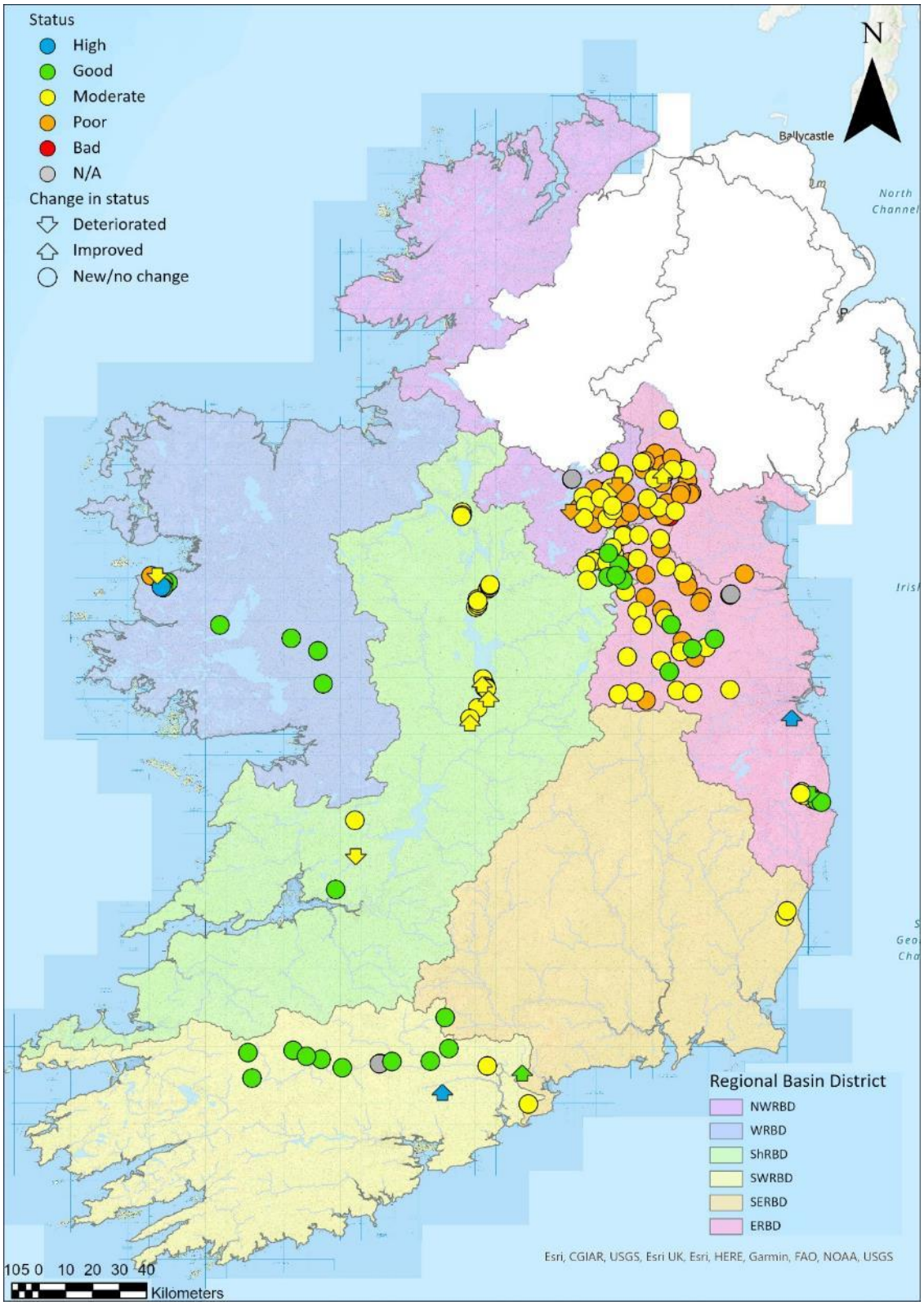

Figure 4.24 Ecological status of the 169 river sites surveyed during 2022 using the FCS2-Ireland ecological classification tool.

Table 4.4. Summary details of rivers sites surveyed and fish ecological status 2022.

Catchment	River	Site name	Survey type	Water body ID	Previous status	2022 Status
		NWRBD				
Erne/Annalee	Annalee	Annafarney Br.	AV	NW 36 1181	-	Moderate
	Annalee	Lisataggart	AV	NW 36 1947	-	Moderate
	Annalee	0.2km d/s Cavan R confl	SM	NW 36 2417	M (2016)	Moderate
	Bunnoe	Ardglushin	AV	NW 36 596	-	Moderate
	Bunnoe	Dianmore Br.	AV	NW 36 596	-	Moderate
	Bunnoe	Killygragy North	AV	NW 36 596	-	Moderate
	Bunnoe	Rossnaglogh East	AV	NW 36 596	-	Poor
	Cavan	Lisreagh South	AV	NW 36 1654	-	Poor
	Cavan	Carrickane	AV	NW 36 189	-	Moderate
	Cavan	Clonagonnell	AV	NW 36 1654	-	Moderate
	Cavan	Deredis Lower	AV/SM	NW 36 189	-	Poor
	Cavan	Shankill Substation	AV	NW 36 786	-	Poor
	Gortin	Tullyvin Br.	AV	NW 36 1478	-	Poor
	Killyvann	Drumkeeran	AV/SM	NW 36 2417	-	Poor
	Knappagh	Dunaree Latin	AV	NW 36 672	-	Poor
	Knappagh	Dunaree North	AV	NW 36 672	-	Poor
	Knappagh	ReaduffWest	AV	NW 36 684	-	Poor
	Knappagh	Tullyglass	AV	NW 36 1068	-	Poor
	Knockatee	Lisnacark	AV	NW 36 422	-	Moderate
	Larah	Clifferna North	AV	NW 36 228	-	Poor
	Larah	Larah Br.	AV	NW 36 228	M (2017)	Moderate
	Larah	McShanes Br.	AV	NW 36 228	M (2017)	Moderate
	Larah	Rathkenny Br.	AV	NW 36 228	M (2017)	Poor
	Latteriff	Kilcrossbeg	AV	NW 36 219	-	Poor
	Lough Dermot	Lisnadarragh	AV	NW 36 1181	-	Poor
	Madabawn	Corraneary Church	AV	NW 36 2024	-	Poor
	Madabawn	Madabawn Church	AV	NW 36 2024	-	Moderate
	Milltown	Tullybrick	AV	NW_36_219	-	Bad
	Plush	Drumliff East	AV	NW 36 1328	-	Poor
	Ratrussan	Hardware Shop	AV	NW 361557	-	Poor
	Ricehill	Drumlaunaght	AV	NW 36 189	-	Poor
	Stradone	Corrawillin	AV	NW 36 245	-	Moderate
	Tullaghaloyst	Coolcanadas_A	AV	NW_36_1522	-	Bad
Erne/Dromore	Annaneese	Corrybrannan	AV	NW 36 1691	-	Poor
	Avaghon Lake	Leagh	AV	NW 36 1762	-	Moderate
	Bannaghroe	Aghnaglogh East	AV	NW 36 30	-	Poor
	Cremoyle	Drumgavny	AV/SM	NW 36 30	-	Bad
	Dromore	Drummuck	SM	NW 36 30	P (2013)	Moderate
	Dromore	Knappagh	AV	NW 36 895	-	Moderate
	Dromore	Bluebell Nature Farm	AV/SM	NW 36 30	-	Poor
	Edenbrone	Anveyerg South	AV	NW 36 1762	-	Poor

Table 4.4 contd. Summary details of rivers sites surveyed and fish ecological status 2022

Catchment	River	Site name	Survey type	Water body ID	Previous status	2022 Status
		NWRBD				
Erne/Dromore	Major Lough	Killycrom	AV	NW 36 1443	-	Moderate
	Lisquigny	Tiromedan	AV	NW 36 1334	-	Poor
	Rockcorry	Cornawall East	AV	NW 36 237	-	Poor
	Rossollus	Cabragh South	AV	NW 36 1050	-	Poor
	Rossollus	Doonhamlet C. Centre	AV	NW 36 1050	-	Poor
Erne	Erne	Kilconny Belturbet (LHB)	SM	NW 36 2286	M (2013)	N/A
	Erne	Kilconny Belturbet (RHB)	SM	NW 36 2286	M (2013)	N/A
	Erne	Bellahillan Br.	SM	NW 36 1746	M (2013)	Poor
Finn	Monaghan	Cumber Br.	SM	NA	M (2013)	Moderate
		WRBD				
Bunowen	Bunowen	Tully Br.	SM	WE 32 3740	G (2012)	Moderate
	Bellakip	Cregganroe North	AV	WE 32 2323	-	Good
	Bellakip	Cartoor	AV	WE 32 3368	-	Good
	Castle	Carrowmore road	AV	WE 32 3759	-	Poor
	Srahnacloy	Srahnacloy Ford	AV/SM	WE 32 3740	-	High
	Tangincartoor	Srahnacloy West	AV/SM	WE 32 3740	-	Good
Clare	Abbert	Bridge at Bullaun	SM	WE 30 3424	G (2019)	Good
	Nanny Tuam	u/s Weir Br.	SM	WE 30 1128	G (2019)	Good
	Black Shrule	Br. at Kilshanvy	SM	WE 30 2928	G (2020)	Good
	Owenbrin	Br. u/s L. Mask	SM	WE 30 1063	G (2019)	Good
		ShRBD				
Broadford	Broadford	Br. u/s Doon Lough	SM	SH 27 287	G (2013)	Moderate
Gourna	Gourna	Br. u/s Owenogarney R confl	SM	SH 27 885	G (2008)	Good
Graney	Graney	Caher Br. S of L. Graney	SM	SH 25 2081	M (2020)	Moderate
Inny	Ballinrink	Ballinrink	AV	SH 26 2906	-	Good
	Bellsgrove	Kilnahard	AV	SH 26 3738	-	Moderate
	Crover	Crover	AV	SH 26 2660	-	Moderate
	Crover	Four Half Moons	AV	SH 26 2742	-	Moderate
	Inny	Br. 1 km S of Oldcastle	SM	SH 26 2060	G (2020)	Good
	Inny	Dairy farm	AV	SH 26 2664	G (2011)	Good
	Inny	Glebe	AV	SH 26 2664	M (2020)	Moderate
	Inny	Jobson's Br.	AV	SH 26 2664	-	Moderate
	Magheraboy	Magheraboy Lower	AV	SH 26 2660	-	Moderate
	Milbrook	Drumone	AV	SH 26 3091	-	Moderate
	Williamstown	Williamstown South	AV	SH 26 2926	-	Moderate
	Mountnugent	Kilnacrott	AV	SH 26 2742	-	Moderate
	Mountnugent	Mountnugent Br.	SM	SH 26 2742	M (2021)	Moderate
	Kildorough	Kildorough	AV	SH 26 2742	-	Moderate
	Kildorough	Drumroragh East	AV	SH 26 2742	-	Good
	Oldtully	Barconny	AV	SH 26 2984	-	Good
	Rassan	Rassan	AV	SH 26 2171	-	Moderate

Table 4.4 contd. Summary details of rivers sites surveyed and fish ecological status 2022

Sub catchment	River	Site name	Survey type	Water body ID	Previous status	2022 Status
		ShRBD				
Shannon	Cross	Br. u/s Shannon River	SM	SH 26 1448 2	M (2016)	Moderate
	Shannon canal	Athlone Canal	AV/SM	SH 26 1448 1	-	N/A
	Shannon upper	Cloonfad	AV	SH 26 3090	-	Moderate
	Shannon upper	Battle Br.	SM	SH_26_3090	N/A	Moderate
	Shannon upper	Caldragh	AV	SH 26 3090	M (2016)	Moderate
	Shannon upper	Kilnacarrow	AV/SM	SH 26 4162	M (2016)	Moderate
	Shannon upper	Ballyleague Br. Lanesboro A	SM	SH 26 750a	M (2016)	Moderate
	Shannon upper	Hillquarter	AV/SM	SH 26 1448 1	P (2016)	Moderate
	Shannon upper	Bogganfin	AV/SM	SH 26 1448 1	M (2016)	Moderate
	Shannon upper	Bunaribba	AV/SM	SH 26 1448 1	N/A	Moderate
	Shannon upper	Carrickynaghtan	AV/SM	SH 26 1448 2	M (2016)	Moderate
	Shannon upper	Carrickobreen	AV/SM	SH 26 1448 2	P (2016)	Moderate
	Shannon upper	Clonmacnoise Jetty	AV/SM	SH 26 1448 3	M (2016)	Moderate
	Shannon upper	Creevagh	AV	SH 26 1448 3	P (2016)	Moderate
	Shannon upper	Devenish Island	AV	SH 26 1448 3	-	Moderate
	Shannon upper	Tarmonbarry A	AV	SH 26 4162	-	Moderate
	Shannon upper	Tarmonbarry B	AV	SH 26 4162	-	Moderate
	Shannon upper	Tarmonbarry C	AV	SH 26 4162	-	Moderate
	Shannon upper	Tarmonbarry D	AV	SH 26 4162	-	Moderate
	Shannon upper	Lanesboro B	AV/SM	SH 26 4162	-	Moderate
	Shannon upper	Lanesboro C	AV/SM	SH 26 4162	-	Moderate
	Shannon upper	Lanesboro D	AV/SM	SH 26 4162	-	Moderate
		SWRBD				
Allow	Monvara	Monvara	AV	SW 18 2121	-	Good
Blackwater (Munster)/Araglin	Araglin	Elizabeth's Br.	SM	SW 18 1131	G (2013)	Good
	Awbeg	Bannagh Br.	AV	SW 18 1933	-	Good
	Blackwater	Nohaval Br.	SM	SW 18 450	G (2013)	Good
	Ballydesmond	Ballydesmond	AV	SW 18 450	-	Good
	Buttevant	Kilcummer Br.	SM	SW 18 2677	G (2012)	Good
	Finnow	Ballynafeaha	AV	SW 18 2610	-	Good
	Blackwater	Killavullen Br. (RHB)	SM	SW 18 2292 5	M (2013)	N/A
	Blackwater	Killavullen Br. (LHB)	SM	SW 18 2292 5	M (2013)	N/A
	Blackwater	Lismore Br. (RHB)	SM	SW 18 2755	M (2013)	Moderate
Bride-Waterford	Bride	Footbr. N of Ballynella	SM	SW 18 2778	G (2012)	High
Dalua	Dalua	Footbr. SW of Liscongill	SM	SW 18 394	G (2013)	Good
Finisk	Finisk	Modelligo Br.	SM	SW 18 2774	M (2017)	Good
Funshion	Funshion	Brackbaun Br.	SM	SW 18 11	G (2014)	Good
	Funshion	Br. u/s Blackwater R confl	SM	SW 18 1836	G (2013)	Good
Licky	Licky	Br. NE of Glenlicky	SM	SW 18 2819	M (2018)	Moderate

Table 4.4 contd. Summary details of rivers sites surveyed and fish ecological status 2022

Sub catchment	River	Site name	Survey type	Water body ID	Previous status	2022 Status
		ERBD				
Boyne/Athboy	Athboy	Br. nr Clonleasan Ho	SM	EA 07 971	P (2016)	Poor
	Athboy	Fordrath	AV	EA 07 971	-	Good
	Bunboggan	Bunboggan	AV	EA 07 971	M (2016)	Moderate
	Gibbonstown	Gibbonstown Br.	AV	EA 07 944	-	Poor
Boyne/Blackwater (Kells)	Assan	Assan Northwest	AV	EA 07 1222	-	Moderate
	Assan	Drummanduff	AV	EA 07 1221	-	Moderate
	B. Kells	Just u/s L. Ramor	SM	EA 07 1035	M (2021)	Moderate
	Cross water	Crosswater Br.	AV	EA 07 532	-	Poor
	Eighter	Eighter	AV	EA 07 991	-	Poor
	Moynalty	Gravelstown	AV	EA 07 1371	-	Poor
	Moynalty	Rossmeen	AV	EA 07 940	-	Poor
	Moynalty	Kilbeg Lower	AV	EA 07 1371	-	Moderate
	Moynalty	Ballynamona	AV	EA 07 1128	-	Moderate
	Seefin	Greaghadossan	AV	EA 07 931	-	Moderate
	Tatestown	Milestown	AV	EA 07 1563	-	Poor
	Tatestown	Tatestown	AV	EA 07 1563	-	Poor
Boyne	Barora	County Br.	AV	EA 07 940	-	Poor
	Barora	Millt5own Br.	AV	EA 07 909	-	Moderate
	Barora	Mullagh Br.	AV	EA 07 940	-	Moderate
	Boyne	Slane Castle Demesne (LHB)	SM	EA 07 1894 3	-	N/A
	Boyne	Slane Castle Slip (RHB)	SM	EA 07 1894 3	-	N/A
	Boyne	Boyne Br.	SM	EA 07 990	-	Poor
	Coolree	Kilmurray North	AV	EA 07 317	-	Moderate
	Deel	Mill Land South	AV	EA 07 1015	-	Moderate
	Deel Raharney	Ballyadams	AV	EA 07 1516	-	Moderate
	Knightsbrook	Dangan Southwest	AV	EA 07 908	-	Poor
	Knightsbrook	Knightsbrook	AV	EA 07 908	-	Good
	Longwood	Knockanally New Br.	AV	EA 07 981	-	Moderate
	Longwood	Longwood East	AV	EA 07 954	-	Good
	Mattock	Mattock GAA	AV	EA 07 1405	-	Poor
	Skane	Kilmessan Br.	AV	EA 07 1629	-	Good
	Stoneyford	Archerstown East	AV	EA 07 221	-	Moderate
	Stoneyford	Southhill East	AV	EA 07 248	-	Moderate
	Tremblestown	Kilnagross Br.	AV	EA 07 971	-	Poor
	Tromman	Boards Mill	AV	EA 07 1746	-	Moderate
	Yellow	Clonmore	AV	EA 07 235	-	Moderate
	Yellow	Garr Br.	AV	EA 07 1026	-	Moderate
Blackwater (Monaghan)	Blackwater	Newmills Br.	SM	NA	M (2008)	Moderate

Table 4.4 contd. Summary details of rivers sites surveyed and fish ecological status 2022

Sub catchment	River	Site name	Survey type	Water body ID	Previous status	2022 Status
		ERBD				
Liffey/Dodder	Dodder	Footbr. Beaver Row	SM	EA 09 587	M (2015)	High
Liffey/Rye Water	Rye Water	Kildare Br.	SM	EA 09 246	M (2018)	Moderate
Vartry	Carrick	Monduff	AV/SM	EA 10 1471	H (2019)	Good
	Tomdarragh	Tomdarragh Woods	AV	EA 10 1471	-	Moderate
	Tomdarragh	Tomdarragh	AV	EA 10 1471	M (2019)	Moderate
	Vartry	Annagolan Br.	AV	EA 10 1471	M (2019)	Moderate
	Vartry	Ashford Br.	AV/SM	EA 10 1471	G (2018)	Good
	Vartry	Clore	AV	EA 10 1471	N/A	N/A
	Vartry	Knockadreet	AV	EA 10 1471	M (2019)	Moderate
	Vartry	Newrath Br.	SM	EA 10 1601	N/A	Good
	Vartry	Nun's Cross Br.	AV	EA 10 1471	M (2019)	Moderate
		SERBD				
Slaney/Banoge	Banoge	Br. u/s Owenavorragh R confl	SM	SE 11 257	M (2020)	Moderate
Slaney/Owenavorragh	Owenavorragh	Br. N of Ballinamona	SM	SE 11 251	M (2020)	Moderate

4.3 Transitional waters

4.3.1 Fish species richness and distribution

Species richness, the number of species captured, is often used as an indicator of the health of transitional water bodies. A total of 33 species were captured across the 12 transitional waterbodies surveyed in 2022. There were 29 species captured in the Barrow-Nore-Suir complex, 15 species recorded in the Boyne Estuary and 14 species in the Liffey-Tolka complex (Table 4.5). Table 4.5 shows the species richness recorded at each transitional waterbody in 2022. Species richness ranged from six species in the Liffey Estuary Upper to 15 species in the Barrow Suir Nore Estuary (Figure 4.25).

Three species, sand goby, flounder and European eel were the most widely distributed species, recorded in all 12 waterbodies. Dace were the most dominant species captured in the Upper Barrow estuary. Sand goby was the commonest fish species in the Barrow-Nore Estuary Upper and Liffey Estuary Upper, while flounder was dominant in the Nore and Suir Estuary Upper. Sprat were dominant in the Barrow Suir Nore Estuary, New Ross Port and Boyne waterbodies (Table 4.5). While Lesser sand eel in the Liffey Estuary Lower and thick-lipped grey mullet in two Suir waterbodies were the dominant fish species (Middle and Lower) (Table 4.5).

4.3.2 Transitional water ecological status classification

All twelve transitional waters surveyed during 2022 were assigned a fish ecological status class using the Estuarine Multimetric Fish Index (EMFI) ecological classification tool (Harrison and Kelly, 2013), together with expert opinion (Table 4.5, Figure 4.26).

Of the eight waterbodies surveyed in the SERBD, seven were classified as Moderate, with only one, New Ross Port, assigned as Good (Table 4.5, Figure 4.26). All seven Moderate waterbodies in 2022 had deteriorated from Good in 2019, while New Ross Port remained unchanged.

The data from all eight waterbodies was merged to form the Barrow-Nore-Suir Complex. This data was then run through the EMFI classification tool. This combined site complex was assigned a status of Good for 2022. The Barrow-Nore-Suir Complex had also been previously assigned a Good status in 2019.

Of the four waterbodies surveyed in the ERBD, three (Boyne, Liffey Upper and Lower) were assigned a fish ecological status of Moderate in 2022. One waterbody, the Tolka estuary was assigned Good status (Table 4.5, Figure 4.26). The Boyne Estuary showed a decline in status, having previously been assigned Good in 2018. The Liffey Upper and Liffey Lower Estuaries remained the same, having also

been assigned Moderate status in 2010. The Tolka Estuary deteriorated, having previously been assigned a status of Good in 2010.

The data from the Liffey Upper, Liffey Lower and Tolka Estuary was merged to form the Liffey-Tolka Complex and also run through the EMFI classification tool. This complex was assigned a status of Good for 2022, showing no change from 2010.

Table 4.5 Species richness and fish ecological status of transitional waters surveyed in 2022.

Water body	WFD Code	Survey type	SR	Dominant species		Previous Status	2022 status
				Scientific name	Common name		
SERBD							
Barrow Estuary Upper	SE 100 0300	SM	14	*Leuciscus leuciscus*	Dace	G (2019)	Moderate
Barrow Nore Estuary Upper	SE 100 0250	SM	7	*Pomatoschistus minutus*	Sand goby	G (2019)	Moderate
Barrow Suir Nore Estuary	SE 100 0100	SM	15	*Sprattus sprattus*	Sprat	G (2019)	Moderate
New Ross Port	SE 100 0200	SM	13	*Sprattus sprattus*	Sprat	G (2019)	Good
Nore Estuary	SE 100 0400	SM	9	*Platichthys flesus*	Flounder	G (2019)	Moderate
Suir Estuary Upper	SE 100 0600	SM	8	*Platichthys flesus*	Flounder	G (2019)	Moderate
Suir Estuary Middle	SE 100 0550	SM	14	*Chelon labrosus*	Thick-lipped grey mullet	G (2019)	Moderate
Suir Estuary Lower	SE 100 0500	SM	10	*Chelon labrosus*	Thick-lipped grey mullet	G (2019)	Moderate
Barrow Nore Suir Complex	**NA**	**NA**	**29**	***Pomatoschistus minutus***	**Sand goby**	**G (2019)**	**Good**
ERBD							
Boyne Estuary	EA 010 0100	SM	15	*Sprattus sprattus*	Sprat	G (2018)	Moderate
Liffey Estuary Upper	EA 090 0400	AV	6	*Pomatoschistus minutus*	Sand goby	M (2010)*	Moderate
Liffey Estuary Lower	EA 090 0300	AV	10	*Ammodytes tobianus*	Lesser sandeel	M (2010)*	Moderate
Tolka Estuary	EA 090 0200	AV	10	*Pomatoschistus minutus*	Sand goby	G (2010)*	Moderate
Liffey Tolka Complex	**NA**	**NA**	**14**	***Pomatoschistus minutus***	**Sand goby**	**G (2010)***	**Good**

Note: *In 2010, The Transitional Fish Classification Index or TFCI, was used to calculate and report fish ecological status for transitional waters.

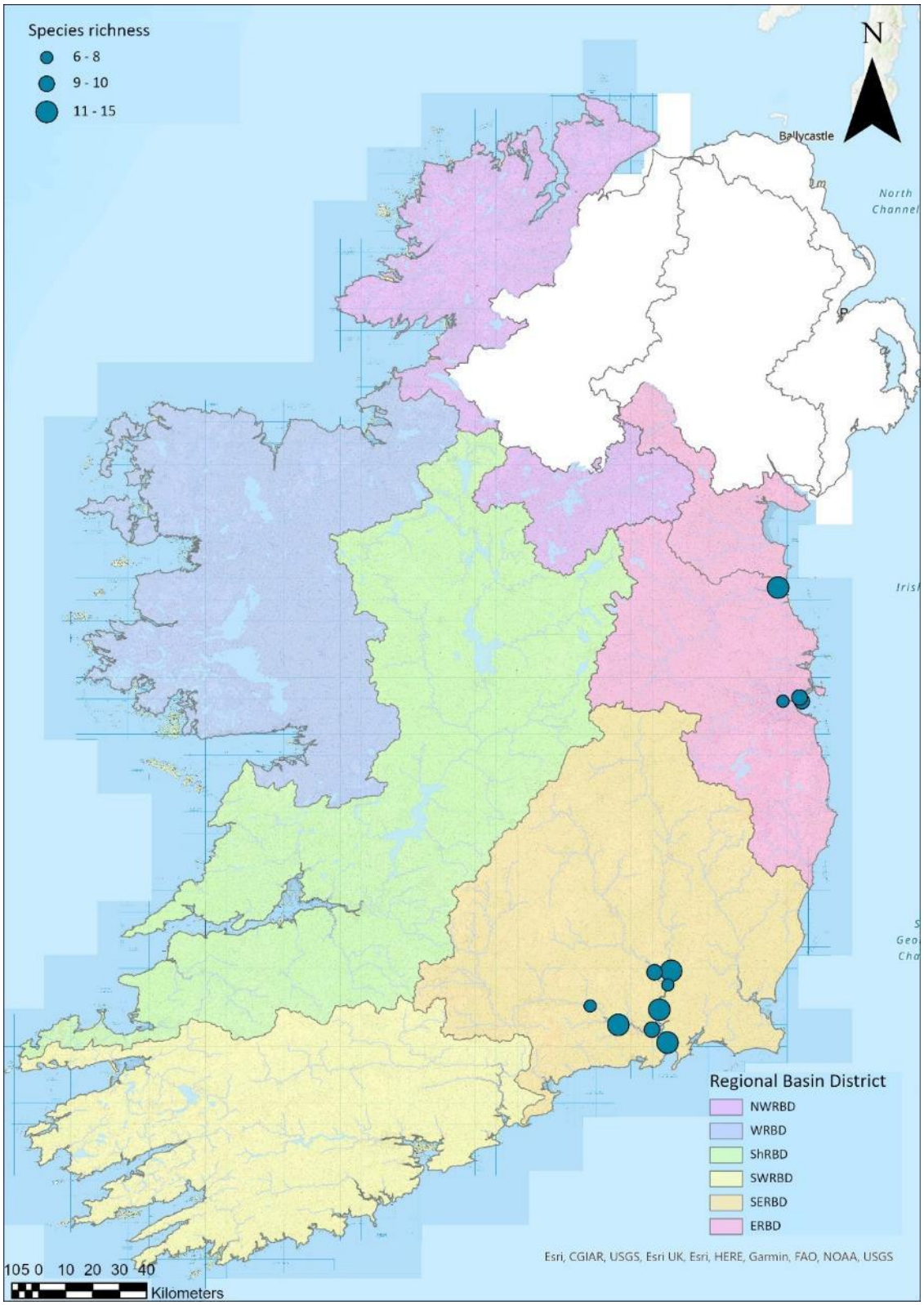

Figure 4.25. Species richness recorded at the 12 transitional waterbodies surveyed in 2022.

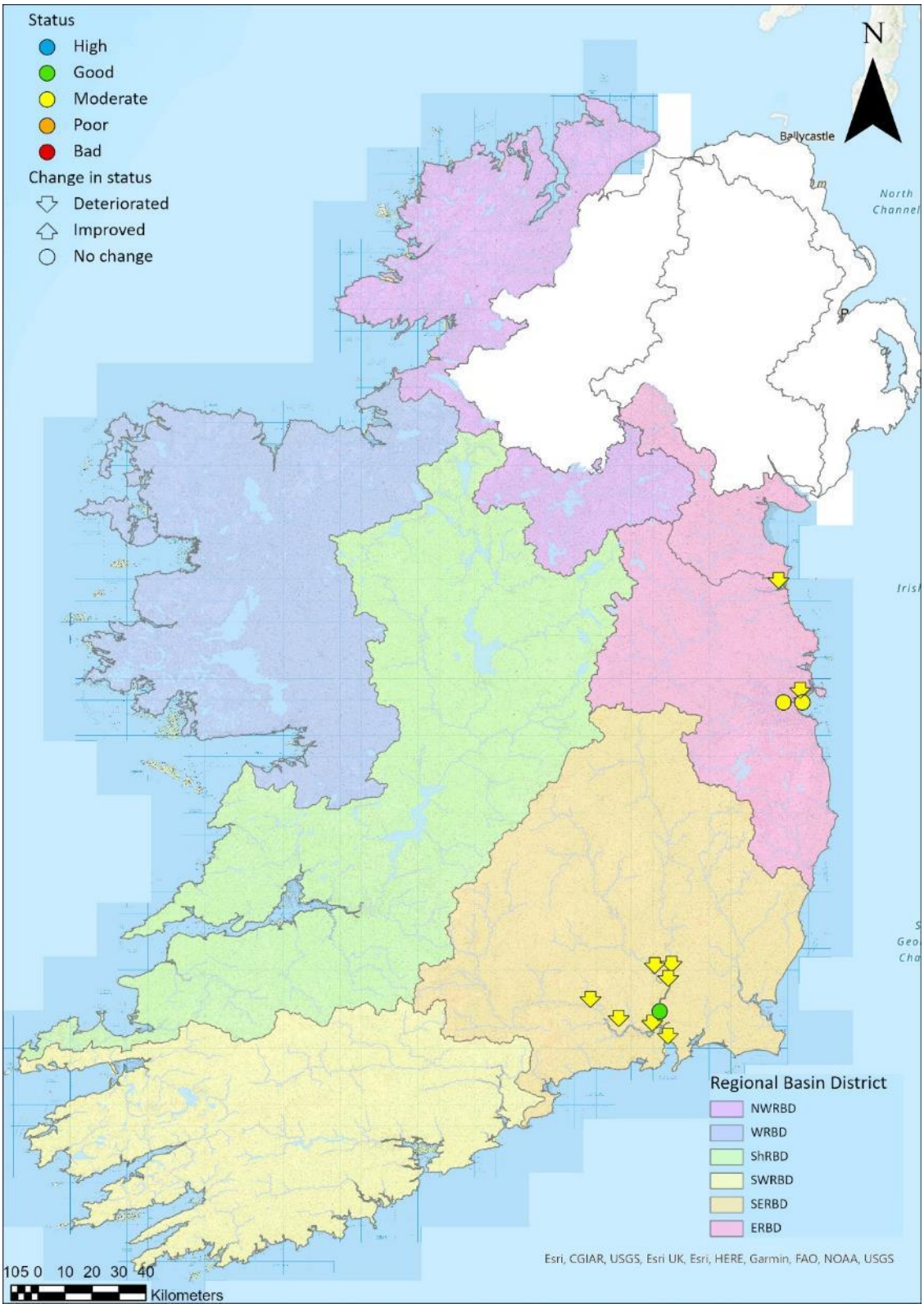

Figure 4.26. Ecological status of the 12 transitional waterbodies surveyed in 2022.

Plate 4.5 Sea bass captured in the Barrow-Nore-Suir Complex.

5. DISCUSSION

5.1 Lakes

A total of 16 fish species (sea trout are included as a separate "variety" of trout) and three cyprinid hybrids were recorded across the lakes surveyed during 2022. European eel was the most widely distributed species recorded, occurring in 19 lakes. Perch was the most abundant species, dominating catches in 14 of the 18 lakes where they were recorded.

Thirteen lakes (54.2%) were assigned a fish ecological status of High or Good in 2022. Eleven (45.8%) were assigned a status of Moderate or worse. Of the 11 lakes with a status of Moderate or worse, the most likely reason for this failure, was a large population and biomass of tolerant fish species (e.g. cyprinids). These species are more tolerant of low water quality than type specific indicator species such as brown trout and Arctic char and can proliferate when water quality declines. The EPA reported that during the 2016 to 2021 reporting period, five of the lakes assigned a failing fish ecological status (Moderate or worse), also failed at least one other ecological indicator. These were Glasshouse Lake and Lough Upper MacNean, both of which were assigned Poor macrophyte and Moderate phytoplankton status; Lough Lower Macnean was assigned Poor macrophyte and Moderate phytobenthos status; Lough Bridget and Ballyquirke Lake were both assigned Moderate macrophyte status (EPA 2021b).

When compared to previous surveys, the ecological status of 14 lakes showed no change, while four lakes, Lough Barra, Lough Eske, Lough Cullin and Lough Ree improved. For Loughs Barra, Eske and Cullin, this improvement was likely due to the increasing populations of type specific indicator species, particularly brown trout. The increase in fish ecological status in Lough Ree is likely due to a decrease in tolerant fish species (i.e. cyprinid biomass, particularly roach x bream hybrids). These changes in fish ecological status may be an indication that water quality is improving in these lakes.

Fish ecological status deteriorated in six lakes, Lough Macnean Upper, Lough Rea, Lough Bridget, Glenade Lough, Glasshouse Lake and Lough Lene when compared to previous surveys. Generally, the absence of key type-specific indicator species and the overabundance of tolerant fish species (e.g. cyprinid) were the key drivers in affecting change in fish ecological status.

5.2 Rivers

A total of 16 fish species (sea trout are included as a separate "variety" of brown trout) and two cyprinid hybrid varieties were recorded across the river sites surveyed during 2022. Brown trout was

the most widely distributed species, occurring at 71.0% of all sites surveyed. Salmon were less widely distributed, occurring at 24.9 % of sites.

Overall, 161 of the 169 river sites that were surveyed during 2022 were assigned a fish ecological status following a quality assurance/sense-checking exercise. Of the 161 sites classified, three sites (1.9%) were classified as having High fish ecological status, 31 (19.3%) as Good, 83 (51.5%) as Moderate, 41 (25.4%) as Poor and three (1.9) as Bad.

A total of 42 sites surveyed were surveillance monitoring sites. In total 37 were assigned a fish ecological status, five sites were left unassigned. Of the sites classified, two were assigned as High status (5.4%), 14 (37.9%) as Good, 16 (43.2%) as Moderate and five (13.5%) as Poor. No sites were classified as Bad.

A total of 53 sites had previously been surveyed and classified. Of these, the status of 41 (77.4%) sites remained consistent between surveys, while five (9.4%) sites deteriorated and seven (13.2%) showed an improved status.

Where a site was assigned a High or Good ecological status, or where a site showed an improvement in ecological status between surveys, the reason was generally due to the presence and/or increase in type specific fish species abundance (e.g., salmonids), or the presence/increase of an age cohort absent from previous surveys.

The most common reason for a site achieving a status of Moderate or worse, or for deteriorating between surveys was a decrease in type specific fish species abundance caused by various pressures such as water quality and presence of barriers to fish migration. In some cases, an age cohort previously recorded at the site was not captured during the most recent survey, indicating a failure in recruitment. This suggests either water quality issues, physical habit degradation (or a combination of both) and other pressures that affect fish species recruitment and persistence.

In 2022 127 sites were classified as Moderate or worse. In the majority of cases there were a combination of two factors affecting fish ecological status. At 71 sites, particularly in the Annalee (Erne) catchment in the NWRBD, a combination of water quality issues and artificial barriers affecting the movement of migratory species were the likely reasons for failing status. At 11 sites a combination of artificial barriers and degraded instream fish habitat were the reasons noted affecting fish ecological status. A total of 35 sites were affected by hydromorphology issues, mainly artificial barriers affecting fish movement. Many sites in the Shannon catchment for example, are affected by the dam at Ardnacrusha hydroelectric power station and associated infrastructure impeding upstream

movement of diadromous fish species (e.g. Atlantic salmon and European eel). Other pressures may also be affecting these sites.

Nine sites were affected by possible water quality issues. These sites showed a high abundance of tolerant fish species such as minnow, 3-spined stickleback and stone loach which can be an indicator of poor water quality and habitat (Kelly *et al*., 2007b), or simply proliferate in the absence of salmonids, which are more sensitive to deteriorations in water quality and habitat. The one remaining site, Tully Bridge on the Louisburgh River in the WRBD was assigned a Moderate status. This site reduced in status from Good due to a reduction in the numbers of type specific species (i.e. salmon) captured during the survey. While no obvious reason was determined for this reduction, it is likely linked to local water quality issues or pressures at sea.

5.3 Transitional waters

Three large estuaries were surveyed by IFI in 2022. They were the Barrow-Nore-Suir Complex in the SERBD, the Boyne Estuary and the Liffey-Tolka Complex in the ERBD.

The Barrow-Nore-Suir Complex, is made up of eight different waterbodies. In 2022, 29 fish species were captured across these eight waterbodies. Sand Goby was the most widespread and dominant species, occurring in high numbers across all waterbodies. Important angling species such as European seabass, brown trout, cod, pollack. Twaite shad (listed in Annex II of Directive 92/43/EEC of 1992 and classified as vulnerable on the Irish Red List (King *et al.,* 2011)) was also recorded. In 2022, 15 fish species were recorded in the Boyne Estuary and sprat was the most abundant species present. Fourteen fish species were recorded across the three waterbodies in the Liffey-Tolka Complex. Sand Goby was also the most abundant species recorded. A single European seabass was recorded in the Tolka Estuary, while cod were recorded in the Liffey Estuary Upper.

Of the 12 waterbodies surveyed in 2022, 11 were assigned a failing status of Moderate. The reasons for failure can be complex but species richness and species dominance are key indicators used. In many cases where a site achieves a status of Moderate or worse, the reason is either low species richness or an overabundance of one or two dominant species. This can be a natural occurrence, particularly in smaller estuaries or waterbodies where habitat variation is low or can be an indicator of a change in water quality. As many transitional waters are close to large urban centres, there can also be anthropogenic pressures in place. Urban run-off, development works, and hydromorphological issues such as dredging are among the reasons for declining ecological status in transitional waterbodies. Agricultural run-off, resulting in high influxes of nitrogen and phosphates can also negatively affect transitional waters.

Only one site on the Barrow-Nore-Suir Complex, New Ross Port, was assigned a status of Good in 2022. The remaining seven sites were assigned Moderate status. Evidence of nutrient enrichment was noted across the Barrow and Nore catchments during catchment wide river surveys carried out by IFI in 2020 and 2021, along with 26 deteriorations in fish ecological status (Gordon *et al*., 2021a, 2021b, 2021c and 2021d. EPA data from the 2016 to 2021 WFD survey period supports this finding and shows that in this period, several catchments on the rivers Barrow, Nore and Suir (e.g. the Gowran sub-catchment on the Barrow catchment EPA (2021f)) experienced issues with nitrogen and phosphorous conditions, particularly nitrates and ammonia. The EPA (2023) describe how coastal waters are sensitive to increased nitrogen levels and how human activities in upstream catchments can affect water quality. The report also describes how increased phosphate concentrations can affect the ecology and functioning of estuary ecosystems. The report shows that 20% of coastal waterbodies were in unsatisfactory condition for dissolved inorganic nitrogen. The Upper Barrow Estuary was 83% above the threshold value. The report shows that between 2012-2022 there has been a significant increase in winter median phosphate in 10 water bodies. The Barrow Nore Estuary Upper, The Nore Estuary, The Upper Barrow Estuary and New Ross Port are among the waterbodies showing this increase. Together this could indicate that nitrogen and phosphorous issues further up in the catchment, are having a detrimental effect on the coastal waterbodies downstream. It is likely that increased nitrogen and phosphorous concentrations in the upper catchments are driving the Moderate fish status assigned in the Barrow-Nore-Suir Complex.

Thick-lipped grey mullet were the dominant species in the Suir middle and Suir Lower Estuaries. The dominance of a particular species can lead to a waterbody being assigned a low ecological status. Generally captured in small numbers, there was a significant increase in mullet numbers between 2019 and 2022. This is an unusual occurrence and the reason for this increase in Thick-lipped grey mullet number may be linked to an increase in water temperature, rather than water quality issues. Mullet are species that are adapted to warmer temperatures, they are often observed in large shoals in the outflows of generation stations. IFI's Climate Change Mitigation Research Programme (CCMRP) team deployed water temperature loggers in the River Barrow and Nore transitional water in 2022. The data collated to date showed that there was more than 30 days where the mean daily water temperature exceeded 20^{o}C in the Nore TRAC during 2022 (Barry *et al*., 2023). The CCMRP team will be carrying out further research on these waterbodies to investigate the effect possible temperature increases will have on fish populations.

Despite the majority of waterbodies in the Barrow-Nore-Suir Complex being assigned an ecological status of Moderate, when the survey data from all eight waterbodies was combined and analysed over their entirety, the Barrow-Nore-Suir Complex was assigned a status of Good. This is likely because the

larger estuary offers a wider variety of habitats, which increases species richness. The Complex has a higher species richness value (29), than any of the associated waterbodies. The increased habitat available also means the complex as a whole, is less likely to be dominated by any particular species. The Barrow-Nore-Suir Complex was also assigned a Good fish ecological status in 2019.

The Boyne Estuary has declined in status since 2018, deteriorating from Good in 2018 to Moderate in 2022. In 2018 21 species were recorded in the Boyne Estuary but dropped to 15 in 2022. This reduction is likely due to a reduction in species richness caused by anthropogenic factors. The Boyne Estuary is close to the large urban centre of Drogheda and has a large catchment area encompassing many pressures (agriculture, hydromorphology, etc.). Pollution events such as agricultural and urban run-off, together with urban development, are likely to negatively impact the estuary. Similar, to the Barrow-Nore-Suir Complex, the Boyne Estuary has issues with nitrogen and phosphorous loading (EPA, 2023). Gordan *et al.,* (2023), describe how 88.5% of river sites surveyed in 2022 failed to reach Good fish ecological status. Data from the 2016-2021 WFD survey period, shows that several river catchments, such as the Blackwater (Kells), upstream from the Boyne Estuary have issues with nitrogen conditions (EPA, 2021b). The EPA (2023) described how the Boyne Estuary showed a significant increase in winter median phosphate concentrations between 2012-2022. These upstream pressures have the potential to reduce the presence of fish species across affected habitats.

The Liffey-Tolka Complex is made up of three small waterbodies. One waterbody, The Tolka Estuary was assigned a status of Good in 2022 and two waterbodies, the Liffey Estuary Upper and Liffey Estuary Lower were assigned a status of Moderate. All three waterbodies face pressures due to run-off both urban and agricultural in upstream catchments. All three estuaries also face heavy pressure from man-made structures and artificial modifications. The Liffey Estuary Upper runs through Dublin city, from Islandbridge to the Talbot Memorial Bridge. This area is heavily modified, with retaining walls, piers and dredging replacing natural habitats. This combination of man-made modifications limit species numbers and these pressures are the likely reason for the Moderate ecological fish status. The Liffey Estuary Lower runs from Talbot Memorial Bridge, through the Dublin Docklands and out to the Bull and Great South Walls, an area with very heavy development. Walled banks have replaced all the natural banks and the area has been heavily dredged to create shipping channels. The total catch in the Liffey Estuary Lower was dominated by lesser sand eel. A decline in fish habitats due to anthropogenic development and an overabundance of one species, are the likely reasons for the Moderate status. When analysed over its entirety, The Liffey-Tolka Complex achieved an ecological status of Good in 2022. Again. this larger estuary complex offered more habitat types to encourage a higher species richness. With a variety of habitats available, including more marine habitats, a single species is less likely to dominate, leading to a more balanced fish population structure. The Liffey-

Tolka Complex was previously surveyed in 2010, when it was also classified as having Good ecological status.

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