National Research Survey Programme

Lakes 2022

Glasshouse Lake

IFI/2023/1-4660

Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Glasshouse Lake, September 2022

Iascach Intíre Éireann
Inland Fisheries Ireland

National Research Survey Programme

Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

CITATION: McLoone, P., Corcoran, W., Bateman, A., Cierpial, D., Gavin, A., Gordon, P., McCarthy, E., Heagney, B., Hyland, J., Robson, S., Duffy, P., Donovan, R., and Kelly, F.L. (2023). Fish Stock Survey of Glasshouse Lake, September 2022. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Cover photo: Lough Lene, Co. Westmeath © Inland Fisheries Ireland

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland.

The authors would also like to acknowledge the funding provided for the project from the Department of Communications, Climate Action and Environment for 2022.

1. Introduction

Glasshouse Lake is located approximately 7km northeast of Carrigallen in Co. Cavan (Figure 1.1). The area of the lake is 54 hectares, mean depth is <4m and maximum depth is 13m. It is located within the Erne Catchment, proximal to, but separate from the Lough Oughter lake complex to which it is linked *via* the Cullies River which enters and exits the lake at the western portion of the lake. The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l $CaCO_3$). The lake is largely reed fringed with the exception of the roadside shoreline and small sections of the eastern and western shores. The roadside shoreline is generally shallow, but areas of deeper water occur off the eastern and western shores. The lake is reported to contain reasonable stocks of small to medium sized pike, but larger fish are known to be present. There is shore fishing for bream (*Abramis brama*), roach (*Rutilus rutilus*), roach x bream hybrids (*Abramis brama* x *Rutilus rutilus*), perch (*Perca fluviatilis*), pike (*Esox lucius*) and some tench (*Tinca tinca*) and there is good access *via* a lakeside road to shore fishing from a "Coillte" forest (IFI, 2017).

The lake was previously surveyed in 1969 (Inland Fisheries Trust, unpublished). At that time, bream, perch, pike, rudd (*Scardinius erythrophthalmus*) and rainbow trout (*Oncorhynchus mykiss*) were recorded. Several roach and roach x bream hybrids were also captured at that time, which represent early records for roach and their hybrids in Irish lakes. Glasshouse lake was last surveyed by Inland Fisheries Ireland in 2017. Perch and roach were the most abundant species recorded in the lake (McLoone *et al*., 2017).

This report summarises the results of the 2022 fish stock survey carried out on the lake using Inland Fisheries Ireland's (IFI) fish in lakes monitoring protocol. The protocol is WFD compliant and provides insight into fish stock status in the lake.

Plate 1.1. Glasshouse Lake, August 2022.

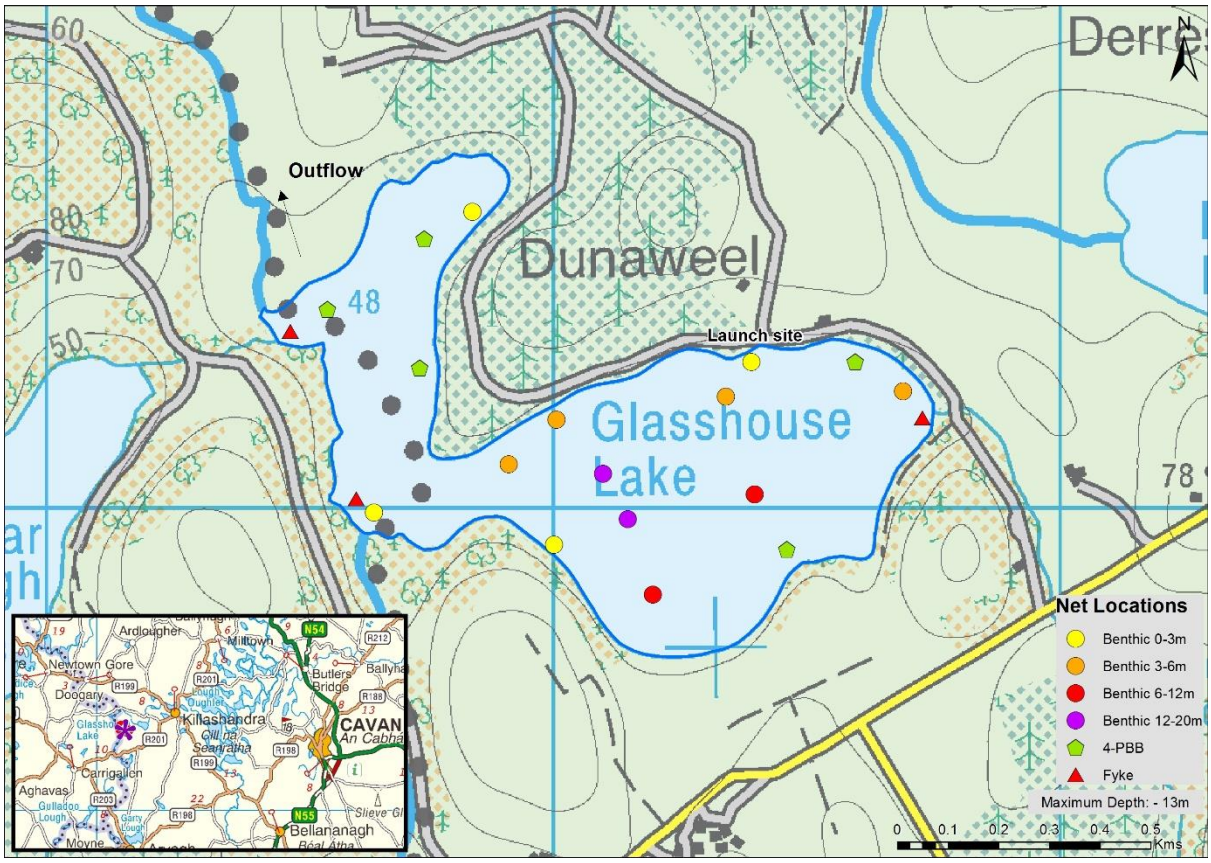

Figure 1.1. Location map of Glasshouse Lake showing net locations and depths of each net (outflow is indicated on map).

2. Methods

2.1. Netting methods

Glasshouse Lake was surveyed over two nights from the 22nd to the 24th of August 2022. A total of three sets of Dutch fyke nets (Fyke) and 12 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 2 @ 6-11.9m and 2 @ 12-19.9m) were deployed in the lake (15 sites). The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at five additional sites (Figure 1.1). The four-panel survey gill nets are composed of four 27.5m long panels each a different mesh size (55mm, 60mm, 70mm and 90mm knot to knot). These nets were deployed in random locations throughout the lake. A handheld GPS was used to locate the precise location of each net. The angle of each gill net in relation to the shoreline was randomised.

All fish apart from perch were measured and weighed on site and scales were removed from a representative sample of all other fish species (excluding eels and gudgeon) captured. Live fish were returned to the water whenever possible (*i.e.*, when the likelihood of their survival was considered to be good). Samples of fish were retained for further analysis. Fish were frozen immediately after the survey for later dissection in the IFI laboratory.

2.2. Fish diet

Total stomach contents were inspected, and individual items were identified to the lowest taxonomic level possible. The percentage frequency occurrence (%FO) of prey items were then calculated to identify key prey items (Amundsen *et al.*, 1996).

$$\mathbf{FO}_{\boldsymbol{i}} = \left(\frac{\boldsymbol{N}_{\boldsymbol{i}}}{\boldsymbol{N}}\right) * \mathbf{100}$$

Where:
$\mathbf{FO}_{\boldsymbol{i}}$ is the percentage frequency of prey item i,
$\boldsymbol{N}_{\boldsymbol{i}}$ is the number of fish with prey i in their stomach,
$\boldsymbol{N}$ is total number of fish with stomach contents.

2.3. Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by IFI for this purpose (Caffrey, 2010) and is followed by staff in IFI when moving between water bodies.

3. Results

3.1. Species Richness

Eight fish species and three cyprinid hybrid types were recorded on Glasshouse Lake in September 2022. In total, 1864 fish were captured (Table 3.1). Perch and roach were the most common fish species captured, together representing *c*. 89% of all fish captured in the survey. Gudgeon, bream, rudd, roach x bream hybrids, tench, rudd x bream hybrids, pike, rudd x roach hybrids and European eel were also recorded. The same species composition was recorded in 2017, with the exception of rudd x bream hybrids which were not recorded in 2017 (McLoone *et al*., 2017).

Table 3.1. Number of each fish species captured by each gear type during the survey on Glasshouse Lake.

Scientific name	Common name	Number of fish captured			
		BM CEN	4-PBB	Fyke	Total
Perca fluviatilis	Perch	1003	1	1	1005
Rutilus rutilus	Roach	648	0	0	648
Gobio gobio	Gudgeon	67	0	0	67
Abramis brama	Bream	11	40	0	51
Scardinius erythrophthalmus	Rudd	40	1	0	41
Rutilus rutilus x Abramis brama	Roach x bream hybrid	26	2	0	28
Tinca tinca	Tench	1	8	0	9
S. erythrophthalmus x A.brama	Rudd x bream hybrid	8	0	0	8
Esox lucius	Pike	2	0	1	3
S. erythrophthalmus x R. rutilus	Roach x rudd hybrid	1	0	0	1
Anguilla anguilla	European eel	0	0	3	3

3.2. Fish abundance

Fish abundance (mean CPUE) and biomass (mean BPUE) were calculated as the mean number/weight of fish caught per metre of net. For all fish species except eel, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only. In 2022 perch and roach dominated fish populations in terms of abundance (CPUE) and biomass (BPUE) respectively. (Table 3.2).

For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type between 2009 and 2021 are presented in Figures 3.1a to 3.2b respectively and illustrates fish community change between the two recent surveys of the lake. Populations of all species appeared relatively stable between surveys.

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Glasshouse Lake

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	1.680 (0.527)	27.103 (9.126)
Rutilus rutilus	Roach	1.080 (0.312)	47.343 (13.343)
Gobio gobio	Gudgeon	0.112 (0.049)	0.781 (0.348)
Scardinius erythrophthalmus	Rudd	0.067 (0.040)	6.926 (3.643)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.044 (0.018)	8.443 (3.209)
Abramis brama	Bream	0.037 (0.010)	18.191 (5.454)
S. erythrophthalmus x Abramis brama	Rudd x bream hybrid	0.013 (0.013)	1.263 (1.263)
Tinca tinca	Tench	0.005 (0.003)	6.881 (3.514)
Esox lucius	Pike	0.004 (0.002)	5.511 (4.646)
S. erythrophthalmus x Rutilus rutilus	Rudd x roach hybrid	0.002 (0.002)	0.128 (0.128)
Anguilla anguilla	European eel	0.017 (0.010)*	6.039 (4.527)*

*Note: Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor et al., 2017). *Eel CPUE and BPUE based on fyke nets only.*

Large bream, caught and released on Glasshouse Lake, August 2022.

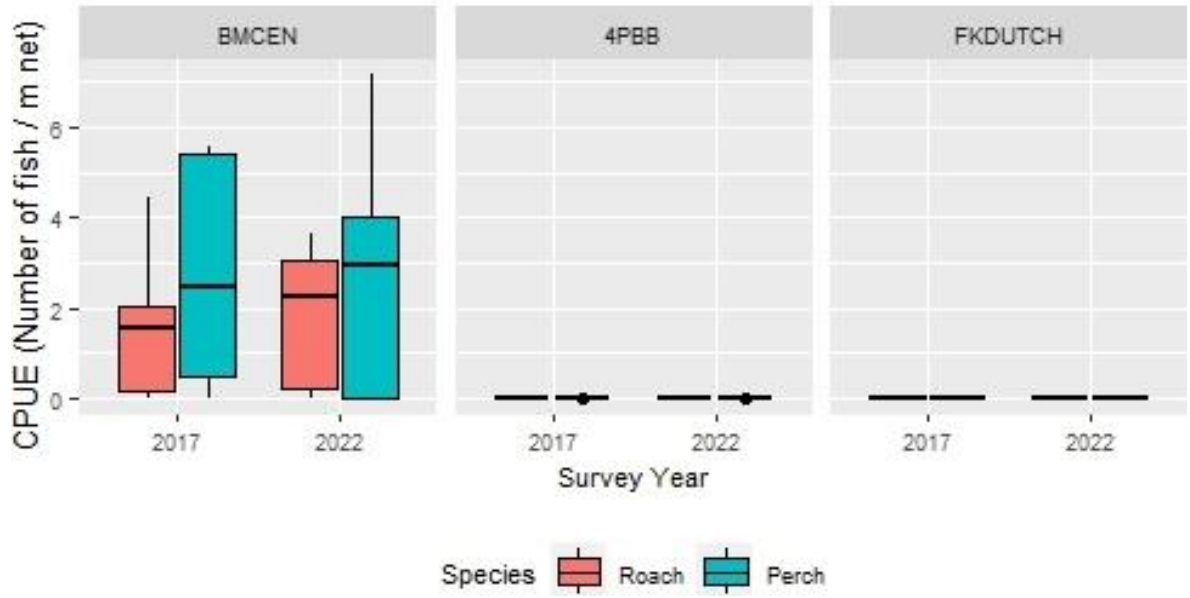

Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Glasshouse Lake in 2017 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

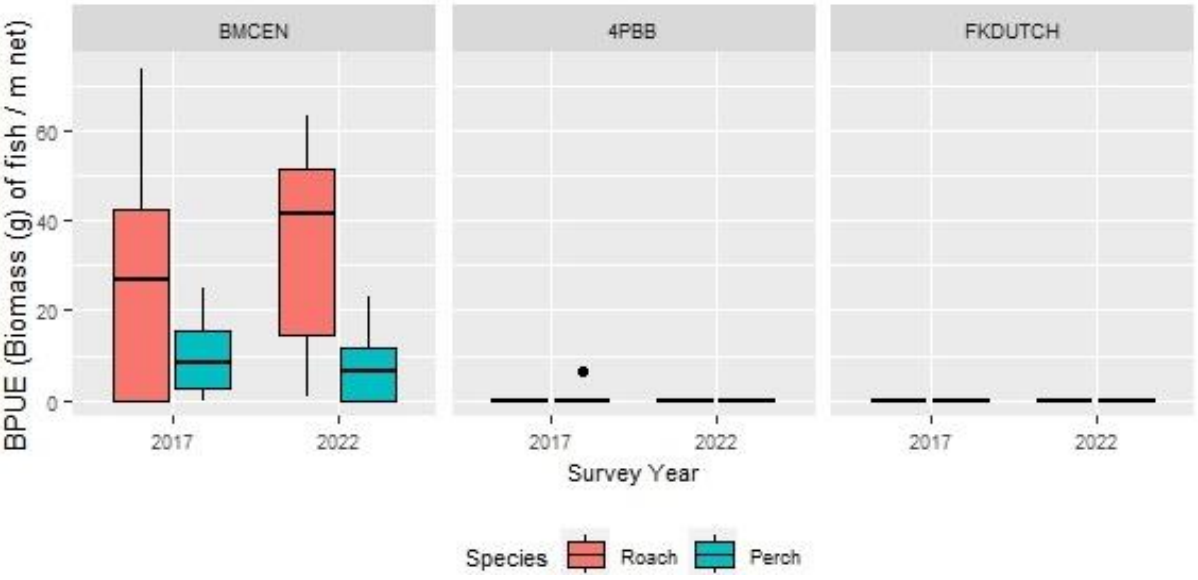

Figure 3.1b. BPUE of roach and perch captured in each net type during surveys of Glasshouse Lake in 2017 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots..

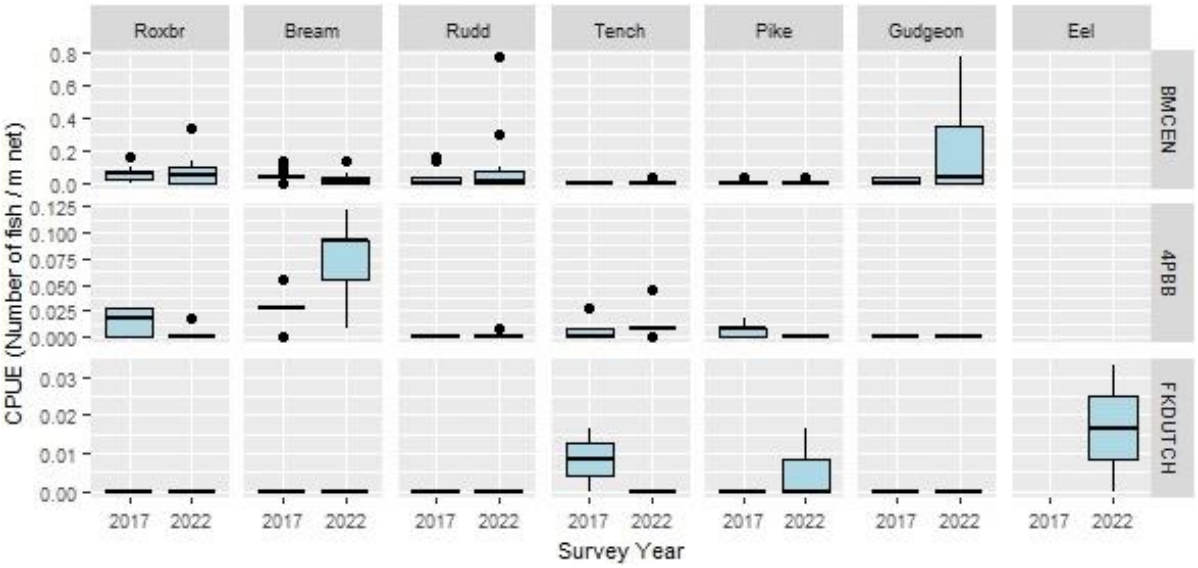

Figure 3.2a. CPUE of other fish species captured in each net type during surveys of Glasshouse Lake in 2017 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis (CPUE) is unique for each net type.

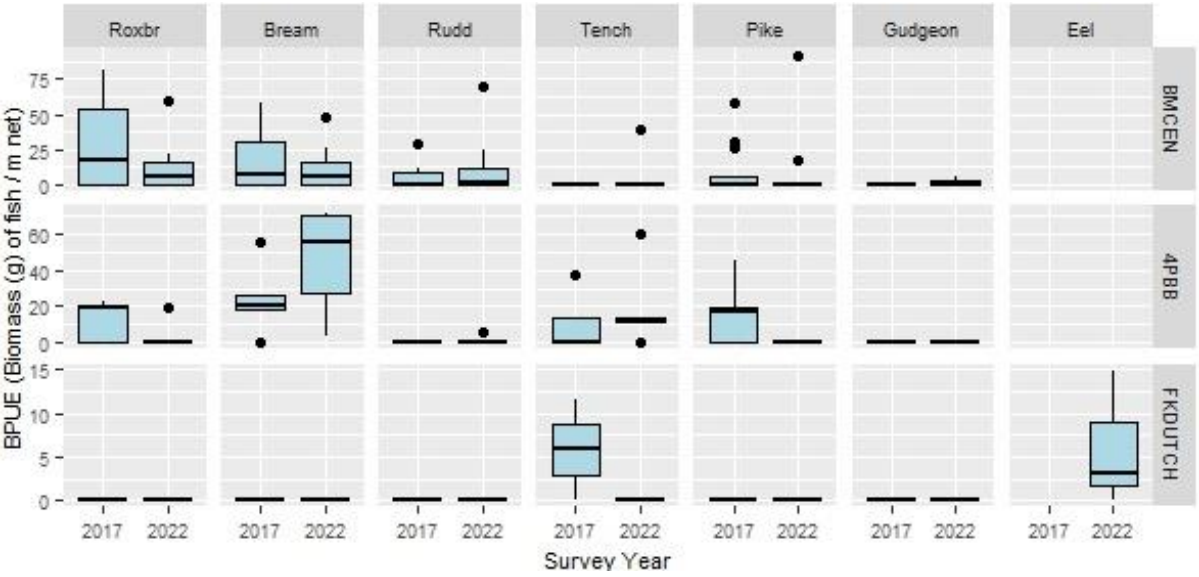

Figure 3.2b. BPUE of other fish species captured in each net type during surveys of Glasshouse Lake in 2017 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis (BPUE) is unique for each net type.

3.3. Length frequency distributions and growth

Perch

Perch captured during the 2022 survey ranged in length from 3.2cm to 28.0cm (mean 8.7cm). A similar length range of fish between 2017 and 2022 was observed, although there was a greater proportion and number of fish greater than 10cm captured in 2022 (Figure 3.3). All age classes from 0+ to 6+ were represented in the sample indicating regular recruitment in recent years. Mean length at L1 (i.e. length at the end of the 1st year) was 5.9cm (Table 3.3).

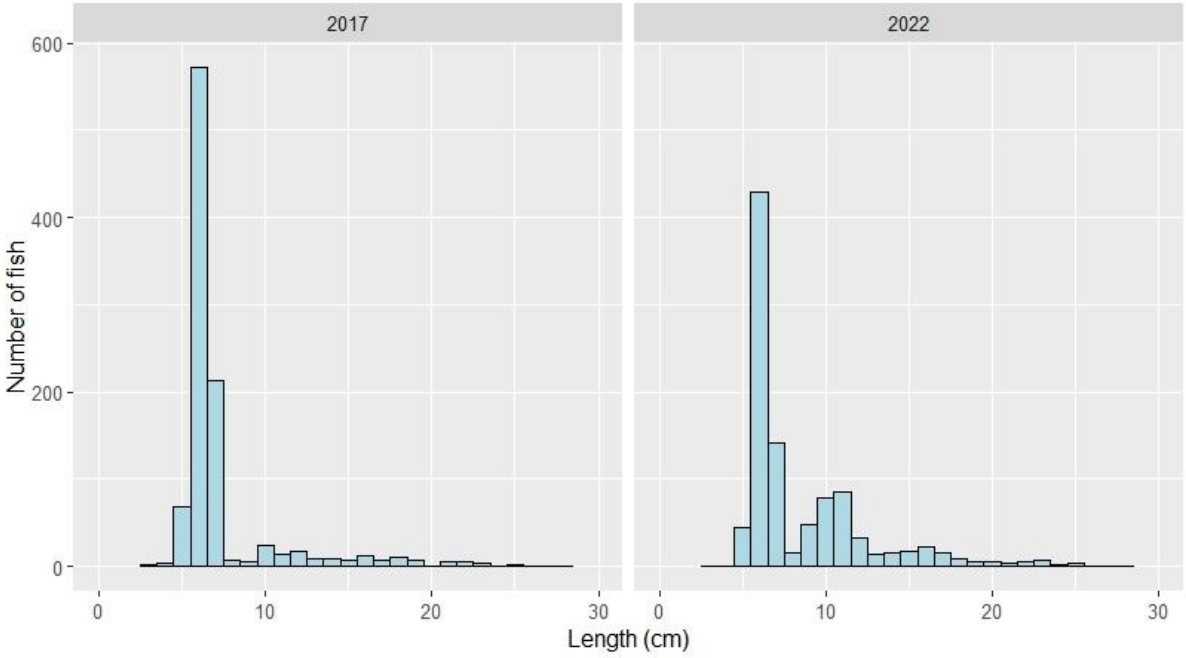

Figure 3.3. Length frequency of perch captured on Glasshouse Lake in 2017 and 2022.

Table 3.3. Mean (±S.E.) perch length (cm) at age for at age for Glasshouse Lake, September 2022.

	L_1	L_2	L_3	L_4	L_5	L_6
Mean	5.9	9.7	13.9	17.1	20.3	22.6
±S.E.	0.1	0.2	0.2	0.2	0.4	1.3
N	98	72	51	36	20	5
Min	3.6	6.7	10.6	14.5	17.1	18.8
Max	8.9	12.9	17.5	20.1	23.8	26.3

Roach

Roach captured during the 2022 survey ranged in length from 4.0cm to 25.8cm (mean 12.6cm). There were a greater proportion of roach > 15cm captured in 2022 compared to earlier surveys (Figure 3.4). Roach were aged between 2+ and 8+and all intervening age classes were represented in the sample aged. Relatively few younger and smaller fish were captured and the population was dominated by fish greater than 3 + (Table 3.4).

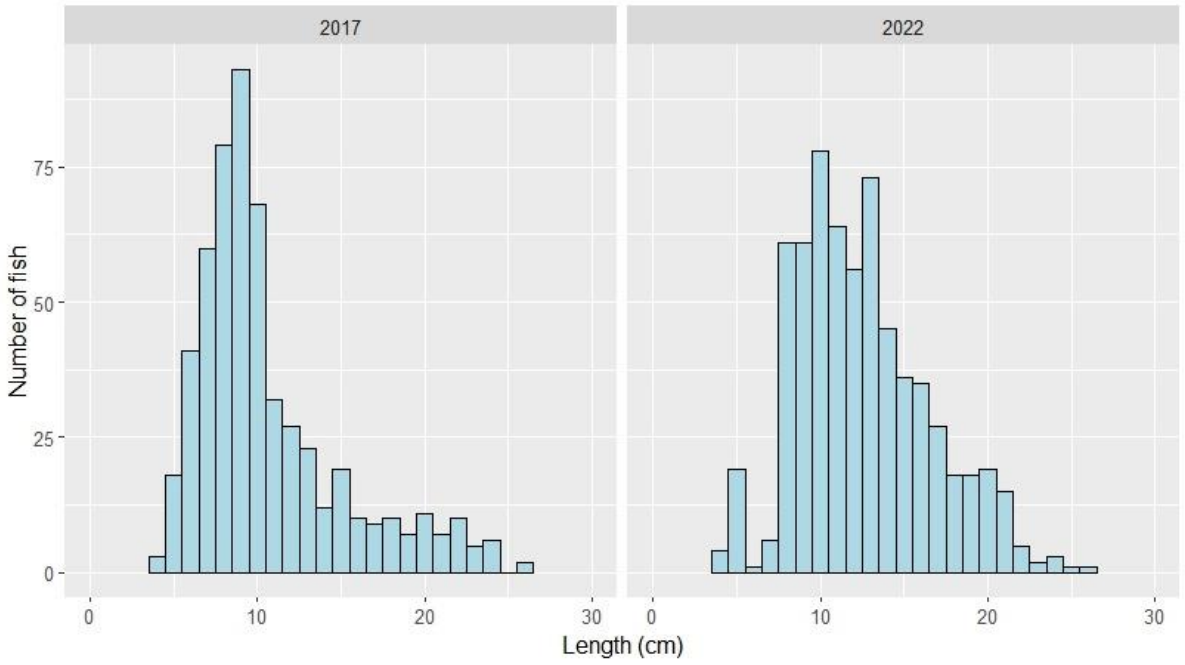

Figure 3.4. Length frequency of roach captured on Glasshouse Lake in 2017 and 2022

Table 3.4. Summary age data from roach captured Glasshouse Lake, September 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.

Length (cm)	Age class							
	0+	1+	2+	3+	4+	5+	6+	7+
N	0	5	9	12	10	6	7	2
Mean	-	7.9	11	13.6	17.6	20.3	22.6	25.3
Min	-	7.7	9.2	11.3	16.1	19.1	21.2	24.8
Max	-	8	13.7	15.8	19.3	21	23.9	25.8

Bream

Bream captured ranged in length from 19.0cm to 46.1cm (mean 30.4cm) in 2022 (Figure 3.5). Bream in the sample were aged between 4+ and 13+. There were several missing age classes indicating intermittent recruitment. Five and six year old fish (c. 25-31cm. Figure 3.5) dominated the population (Table 3.5).

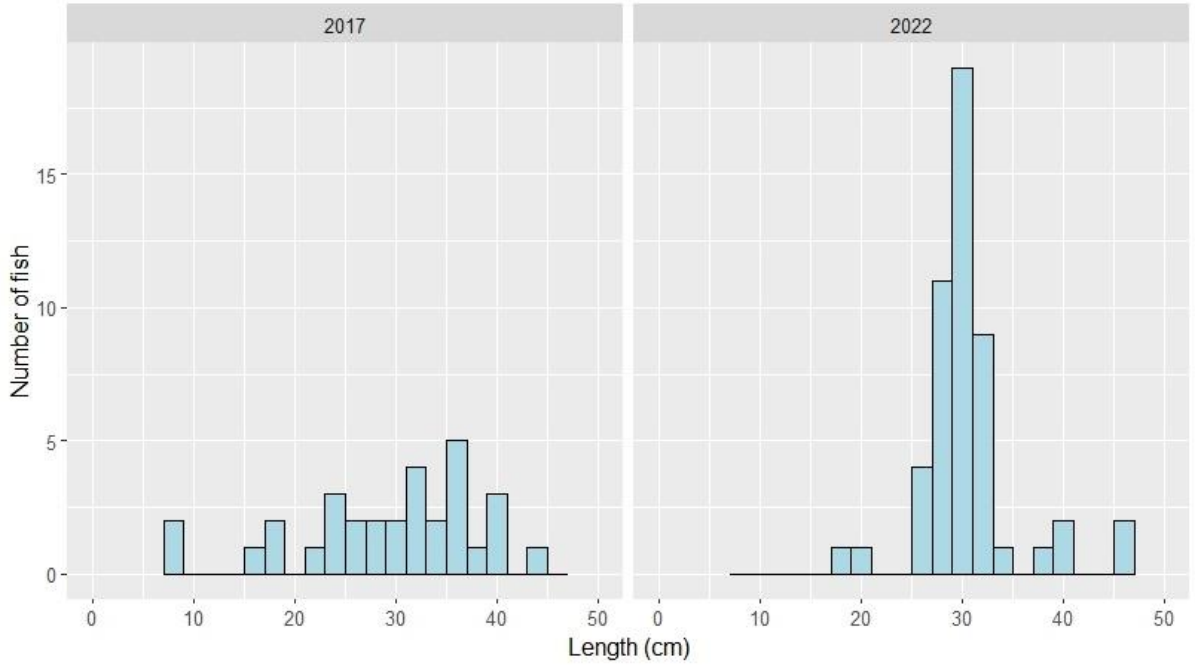

Figure 3.5. Length frequency of bream captured on Glasshouse Lake in 2017 and 2022

Table 3.5. Summary age data from bream captured Glasshouse Lake, September 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.

Length (cm)	Age class													
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+
N	0	0	0	1	0	8	10	3	0	1	2	0	0	1
Mean L (cm)	-	-	-	-	-	27.2	30.2	32.7	-	-	39.8	-	-	-
Min L (cm)	-	-	-	20.3	-	25.5	28.7	32	-	375	39.8	-	-	46.1
Max L (cm)	-	-	-	20.3	-	28.6	31.6	33.3	-	37.5	39.8	-	-	46.1

Roach x bream hybrids

Roach x bream hybrids captured ranged in length from 12.0cm to 39.0cm (mean 20.5cm) in 2022 (Figure 3.6). Roach bream hybrids in the sample were aged between 3+ and 14+. There were several missing age classes indicating intermittent recruitment, and no single year class dominated the population (Table 3.6).

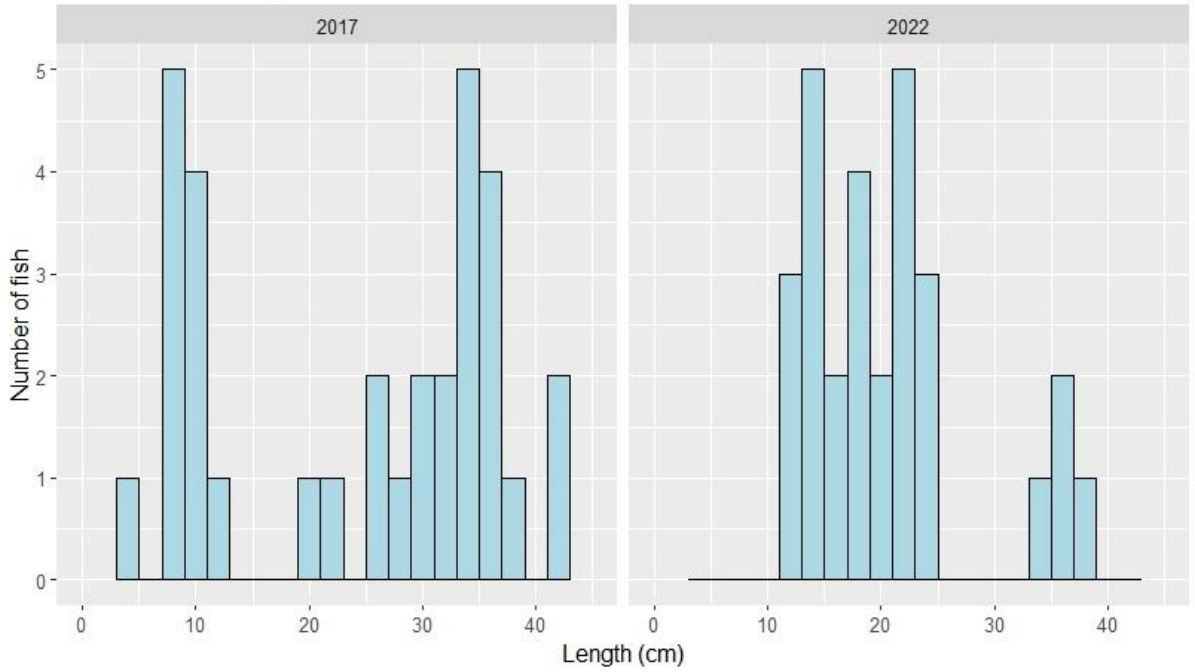

Figure 3.6. Length frequency of roach x bream hybrids captured on Glasshouse Lake in 2017 and 2022.

Table 3.6. Summary age data from roach x bream hybrids captured Glasshouse Lake, September 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.

Length (cm)	Age class														
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+
N	0	0	0	2	3	4	4	5	1	0	1	1	1	0	1
Mean L (cm)	-	-	-	12.3	13.5	16.0	18.8	21.9	-	-	-	-	-	-	-
Min L (cm)	-	-	-	12.0	12.5	14.1	18.3	20.0	23.3	-	34.5	35.2	36.0	-	39.0
Max L (cm)	-	-	-	12.6	14.1	17.1	19.3	23.2	23.3		34.5	35.2	36.0	-	39.0

Rudd

Rudd captured in the 2022 survey ranged in length from 6.4cm to 30.2cm (mean 16.8cm) (Figure 3.7). Rudd in the sample were aged between 1+ and 9+. All intervening year classes (with the exception of 8+) were recorded, indicating regular recruitment. However, the majority of the fish aged were greater than 3+(Table 3.7).

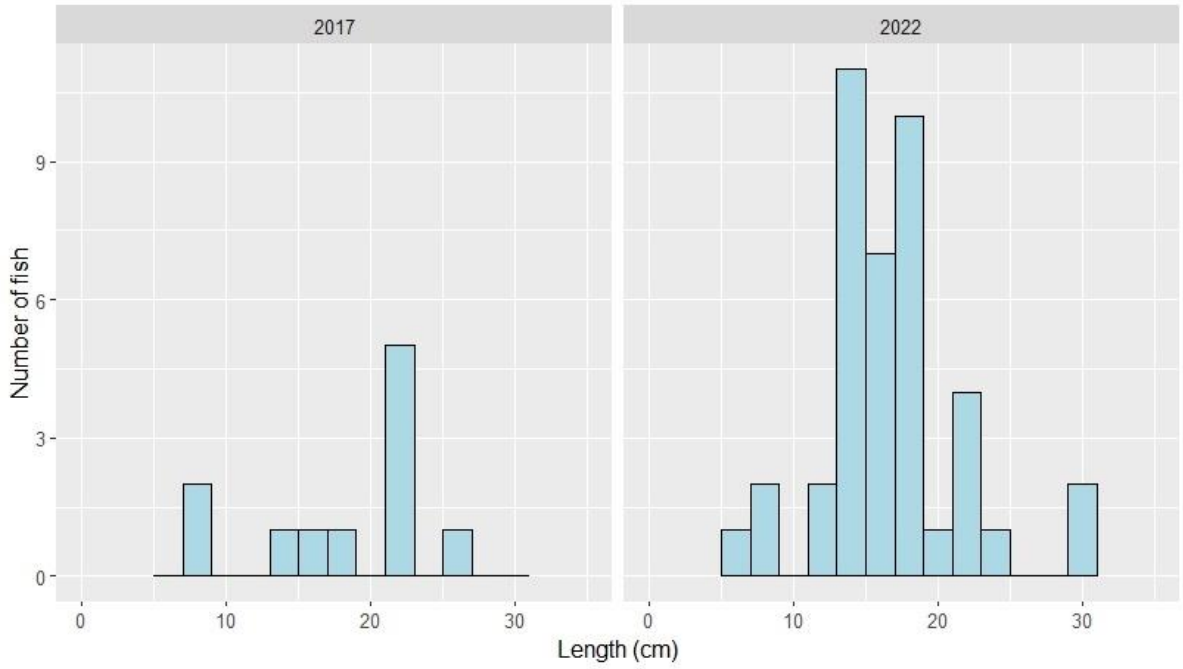

Figure 3.7. Length frequency of rudd captured on Glasshouse Lake in 2017 and 2022

Table 3.7. Summary age data from rudd captured Glasshouse Lake, September 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.

Length (cm)	Age Class									
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
N	-	1	2	6	5	4	3	3	0	1
Mean L (cm)	-	-	7.8	13.4	15.0	17.4	19.4	22.0	-	-
Min L (cm)	-	6.4	7.7	12.0	14.0	17.0	19.0	21.0	-	30.0
Max L (cm)	-	6.4	7.9	14.0	16.0	18.0	21.0	23.0	-	30.0

Other fish species

Nine tench captured ranged in length from 33.6cm to 45.5cm (mean 41.5cm). Eight rudd x bream hybrids were captured. They ranged in length from 13.4cm to 22.0cm (mean 17.1cm) and were aged between 4+ and 7+. One roach x rudd hybrid measuring 16.5cm and aged at 5+ was also captured during the survey. Three pike measuring between 11.7cm and 71.4cm in length were recorded. Gudgeon ranged in length from 4.2cm to 10.0cm (mean 7.7cm). Three eels were captured and released during the survey. They ranged in length from 52.0cm to 71.5cm in length.

3.4. Stomach and diet analysis

The dietary analysis conducted provides insight to the prey of examined fish immediately prior to capture. Longer term and seasonal studies provide a more robust assessment of fish diet. The stomach contents of a subsample of perch and pike captured during the survey were examined and are presented below.

Perch

A total of 97 perch stomachs were examined; of these 38 (39%) were empty. Of the 59 stomachs that contained food, 31 (53%) contained zooplankton. Invertebrates were recorded in 16 (27%) contained invertebrates only. Fish were recorded as the sole prey type in 11 stomachs (19%) and were recorded with invertebrates in one (2%) stomach (Figure 3.8).

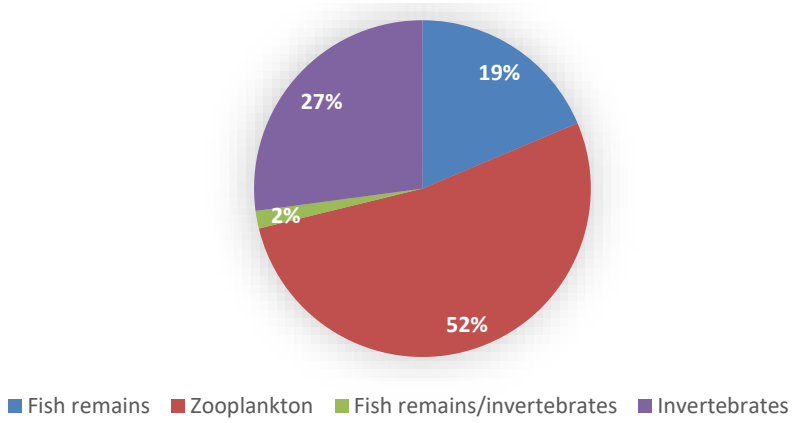

Figure 3.8. Diet of perch (N = 59) captured on Glasshouse Lake in 2022 (% FO)

Pike

Two pike stomach contents were available for analysis; one stomach was empty. One pike (41.0cm) contained invertebrates.

4. Summary

Eight fish species and three types of cyprinid hybrid were recorded on Glasshouse Lake in September 2022. A similar species mix was recorded in 2017 with the addition of rudd x bream hybrids which were not recorded on the previous occasion.

Perch and roach were the most abundant species in terms of catch per unit effort (CPUE). The CPUE for both species has remained relatively stable between the two sampling occasions. Both species exhibit regular recruitment, although there is some evidence to suggest that roach recruitment has been limited in more recent years. The previous survey highlighted the persistence of rudd in the lake some 50 years following the colonisation of roach (McLoone *et al*, 2017). Rudd continue to persist and the capture of rudd x bream hybrids is further evidence of the relative health of the rudd population in the lake.

Bream and roach x bream hybrids which are both important angling species were also captured in relatively large numbers. However, there is evidence that recruitment for both bream and its hybrid with roach is intermittent in the lake.

Classification and assigning lakes with an ecological status is a critical part of the WFD monitoring programme. It allows River Basin District managers to identify and prioritise lakes that currently fall short of the minimum "Good Ecological Status" that is required if Ireland is not to incur penalties. A multimetric fish ecological classification tool (Fish in Lakes – 'FIL') was developed for the island of Ireland (Ecoregion 17) using IFI and Agri-Food and Biosciences Institute Northern Ireland (AFBINI) data generated during the NSSHARE Fish in Lakes project (Kelly *et al.*, 2008). This tool was further developed during 2010 (FIL2) to make it fully WFD compliant, including producing EQR values for each lake and associated confidence in classification (Kelly *et al*., 2012).

Using the FIL2 classification tool, Glasshouse Lake has been assigned an ecological status of Bad for 2022 based on the fish populations present (Figure 4.1). Previously Glasshouse Lake had been assigned a status of Poor. This deterioration is likely due to an increase in the total biomass of pollution tolerant fish species (*i.e.* cyprinids) (Corcoran *et al*., 2023).

In the 2016 to 2021 surveillance monitoring reporting period, the EPA assigned Glasshouse Lake an overall ecological status of Bad, based on all monitored physico-chemical and biological elements, excluding fish (EPA 2021).

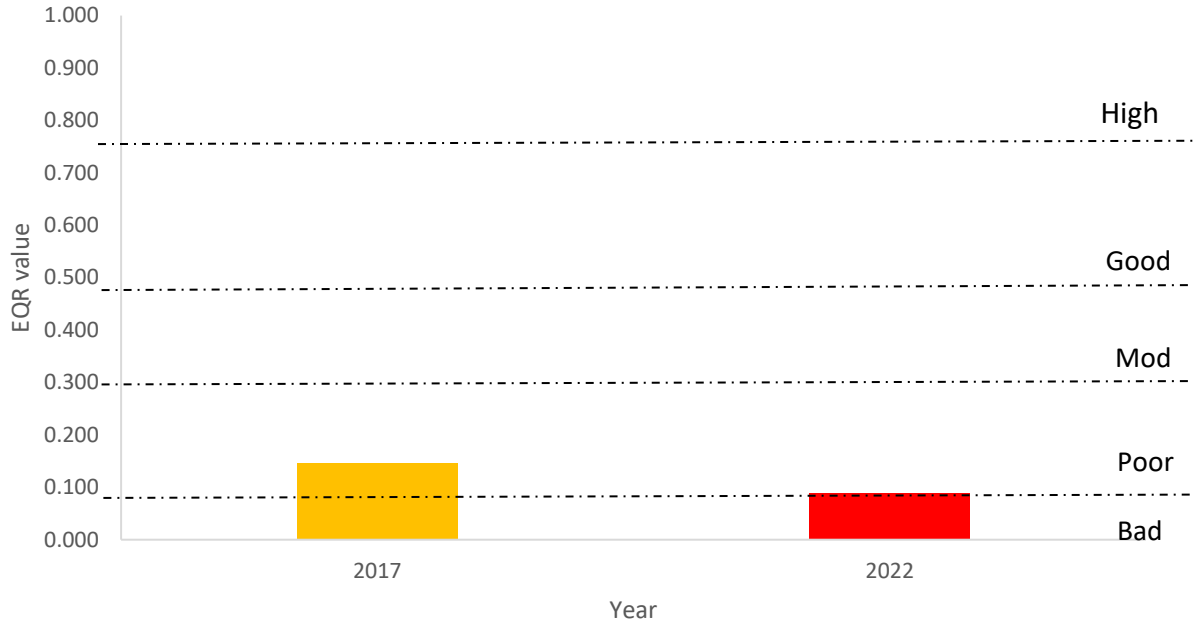

Figure 4.1. Fish ecological status of Glasshouse Lake, 2017 and 2022.

5. References

Amundsen P-A, Gabler H-M, Staldvik FJ. (1996) A new approach to graphical analysis of feeding strategy from stomach contents data—modification of the Costello (1990) method. *Journal of Fish Biology,* **48,** 607–614.

Caffrey, J. (2010) *IFI Biosecurity Protocol for Field Survey Work*. Inland Fisheries Ireland.

Connor, L., Matson, R. and Kelly, F.L. (2017) Length-weight relationships for common freshwater fish species in Irish lakes and rivers. *Biology and Environment: Proceedings of the Royal Irish Academy,* **117 (2)**, 65-75.

Corcoran, W., Matson, R., McLoone, P., Bateman, A., Cierpial, D., Gavin, A., Gordon, P., McCarthy, E., Kelly, K., Robson, S., Wightman, G., Roche, W. and Kelly, F.L (2023) *Sampling Fish for the Water Framework Directive - Summary Report 2021*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

EPA (2021) https://gis.epa.ie/EPAMaps/ Data - Catchments.ie - Catchments.ie. Accessed in May/June 2023.

IFI (2017) http://www.fishinginireland.info/pike/north/glasshouse.htm

Kelly, F.L., Harrison, A., Connor, L., Allen, M., Rosell, R. and Champ, T. (2008) *FISH IN LAKES Task 6.9: Classification tool for Fish in Lakes*. FINAL REPORT. Central Fisheries Board, NS Share project.

Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012) Development and application of an ecological classification tool for fish in lakes in Ireland. *Ecological Indicators*, **18**, 608-619.

McLoone, P., Connor, L., Coyne, J., Corcoran, W., Cierpial, D., Ni Dhonnaibhain, L., Delanty, K., Morrissey, E., Gordon, P., O' Briain, R., Matson, R., Rocks, K., O' Reilly, S., Brett A., Garland D. and Kelly, F.L. (2017) *Fish Stock Survey of Glasshouse Lake, August 2017*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Inland Fisheries Ireland
3044 Lake Drive,
Citywest Business Campus,
Dublin 24,
Ireland.
D24 CK66

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600