National Research Survey Programme

Lakes 2022

Ross Lake

IFI/2023/1-4672

Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Ross 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

1.   Introduction

Ross Lake is situated in the Corrib catchment, located approximately 1km south-east of Rosscahill and 3km north-west of Moycullen, Co. Galway in a chain of lakes entering Lough Corrib at Moycullen Bay (Plate 1.1, Figure 1.1). It has a surface area of 139ha, a mean depth of >4m, a maximum depth of 14m and is categorised as typology class 12 (as designated by the EPA for the purposes of the Water Framework Directive), i.e., deep (>4m), greater than 50ha and high alkalinity (>100mg/l CaCO3).

The presence of zebra mussels (*Dreissena polymorpha*) was confirmed in Ross Lake in May 2007 (IFI, pers. comm.). Ross Lake and the surrounding woodlands have been designated as a Special Area of Conservation (SAC) for containing a hard water lake, a habitat listed on Annex I of the EU Habitats Directive (Council Directive 92/43/EEC) (NPWS, 2013). The SAC also contains a breeding colony of the lesser horseshoe bat (*Rhinolophus hipposideros*), a species listed on Annex II of the same Directive. The woodlands and lakeside vegetation on the site provide foraging habitat within a small radius of the roost site (NPWS, 2013). The underlying geology of the area is limestone, with the main habitat in the SAC being Ross Lake, which has a limestone bed covered by deposits of precipitated marl and a shoreline of marl encrusted limestone boulders. The lake supports communities of *Chara pedunculata* and *Chara curta*, both of which are characteristic of marl lakes. The rocky limestone shore supports mostly fen-type vegetation characterised by Black Bog-rush (*Schoenus nigricans*).   The site also contains otter (*Lutra lutra*), a species listed on Annex II of the EU Habitats Directive, and a small colony of common gull (*Larus canus*). The main land uses within the site are angling, commercial forestry, and grazing of the woodland and wetland areas (NPWS, 2013).

Historically (i.e., prior to 1850's) Ross Lake supported a population of brown trout. Went (1957) reports that stocks in this relatively small lake were impacted by the pike originating from the resident population in Lough Corrib, which were able to colonise the lake *via* a newly open canal.

Along with other lakes in the Moycullen area, Ross Lake was developed as a coarse fishery with permanent stands located at several locations on the western shore of the lake. It was noted for stocks of roach (*Rutilus rutilus*), bream (*Abramis brama*), roach x bream hybrids (*Rutilus rutilus* x *Abramis brama*), perch (*Perca fluviatilis*) and pike (*Esox lucius*) (Gough, 1989).

Ross Lake has been surveyed on four occasions since 2007 (2007, 2020, 2013 and 2016 (Kelly and Connor, 2007 and Kelly *et al*., 2011, 2014 and 2017). During the previous surveys, perch and roach were the dominant species present in the lake. Roach x bream hybrids, bream, eels (*Anguilla anguilla*) and pike were also captured.

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

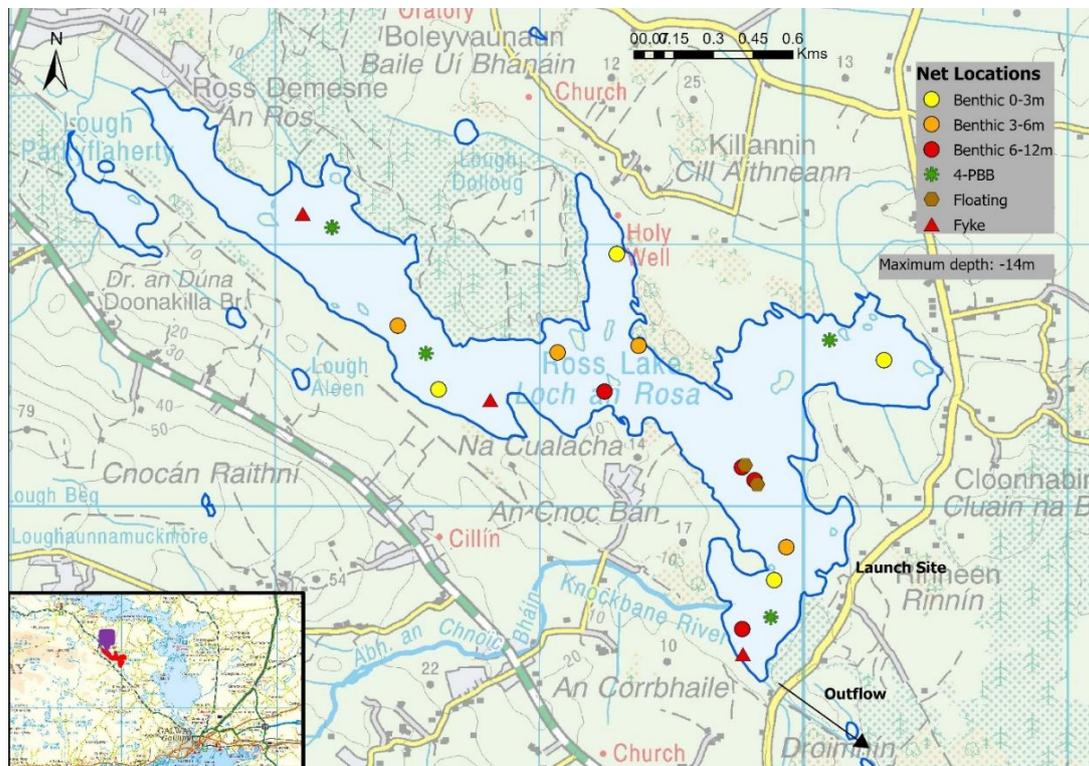**Plate 1.1. Ross Lake, September 2022.**

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

2. Methods

2.1. Netting methods

Ross Lake was surveyed over two nights from the 14th to the 16th of September 2022. A total of three sets of Dutch fyke nets, 12 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (4 @ 0-2.9m, 4 @ 3-5.9m and 4 @ 6-11.9m) and two floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (17 sites) at the same locations as previous surveys.

The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at four additional sites. The four-panel survey gill nets are composed of four 27.5m long panels each a different mesh size (55mm, 60mm, 70mm and 90mm mesh knot to knot). These survey 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 sub-sample of other species 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.

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).

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

Where:

$\mathbf{FO}_i$ is the percentage frequency of prey item i,

$\boldsymbol{N_i}$ 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 Inland Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff in IFI when moving between water bodies.

3.   Results

3.1.   Species Richness

A total of six fish species and one cyprinid hybrid were recorded on Ross Lake in September 2022, with 516 fish being captured (Table 3.1). Perch and roach were the two most common species captured. Roach x bream hybrids, bream, pike, tench and rudd were also recorded. During the previous surveys in 2007, 2010, 2013 and 2016, a similar species composition was recorded (Kelly and Connor, 2007 and Kelly *et al*., 2011, 2014 and 2017). Rudd (*Scardinius erythrophthalmus*) and tench (*Tinca tinca*) were both captured in survey nets for the first time in 2022. No eels were captured in 2022.

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

| Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
Perca fluviatilis	Perch	179	12	13	5	209
Rutilus rutilus	Roach	158	47	0	0	205
Rutilus rutilus x Abramis brama	Roach x bream hybrid	78	0	0	0	78
Abramis brama	Bream	11	0	2	0	13
Esox lucius	Pike	7	0	0	1	8
Tinca tinca	Tench	0	0	2	0	2
Scardinius erythrophthalmus	Rudd	1	0	0	0	1

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 were the dominant species captured in terms of abundance (mean CPUE). Roach x bream hybrids, which were also captured in relatively large numbers exhibited the highest biomass (mean BPUE) (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 and 3.2b respectively and illustrates fish community change over time. No trends in mean abundance and biomass of roach and perch were apparent, with populations of both species remaining relatively stable over time (Figures 3.1a and b). The apparent increasing trend in mean abundance of roach x bream hybrids, observed between 2007 and 2013 appears to have slowed in recent surveys (Figures 3.2a and b).

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

| Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	0.332 (0.095)	13.330 (4.159)
Rutilus rutilus	Roach	0.325 (0.095)	15.514 (4.081)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.124 (0.054)	18.419 (7.934)
Abramis brama	Bream	0.018 (0.009)	5.691 (2.855)
Esox lucius	Pike	0.012 (0.005)	12.404 (6.340)
Tinca tinca	Tench	0.001 (0.001)	1.408 (0.971)
Scardinius erythrophthalmus	Rudd	0.002 (0.002)	0.262 (0.262)

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).*
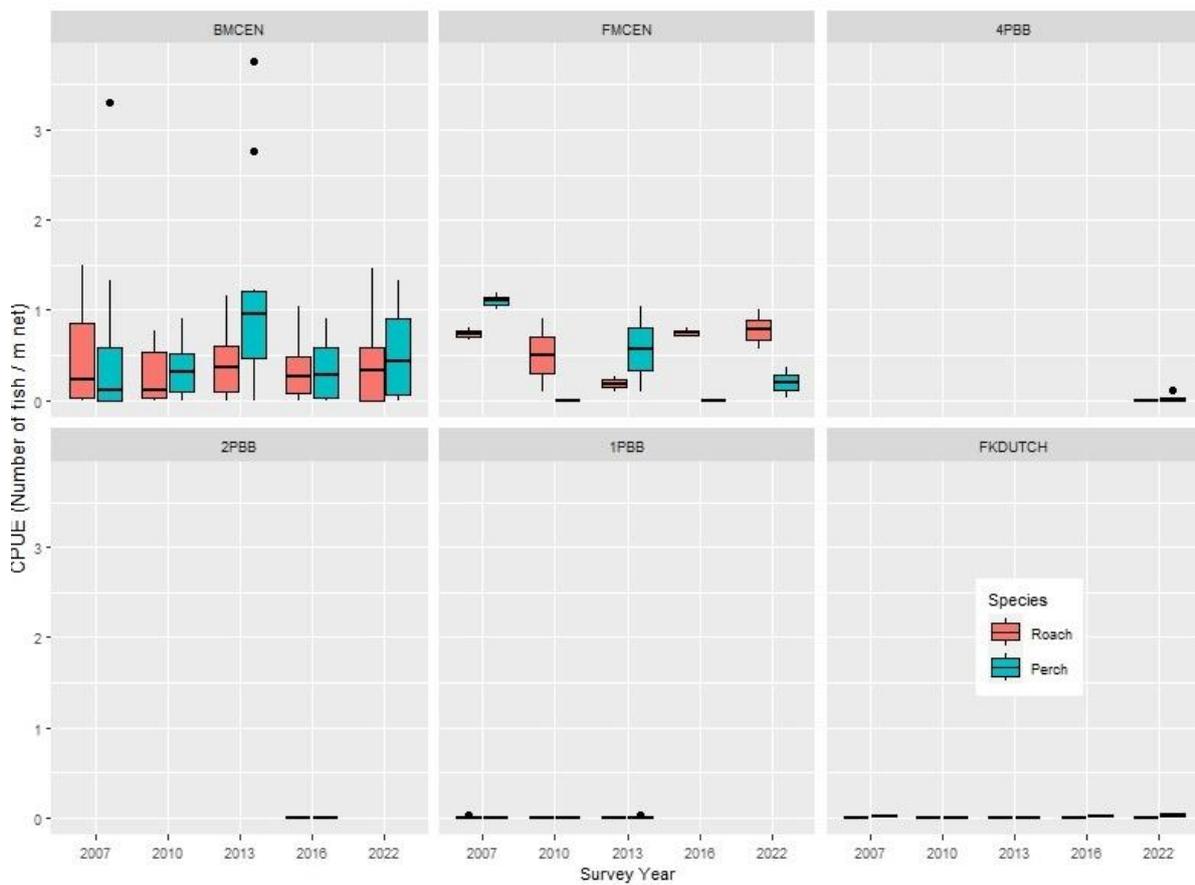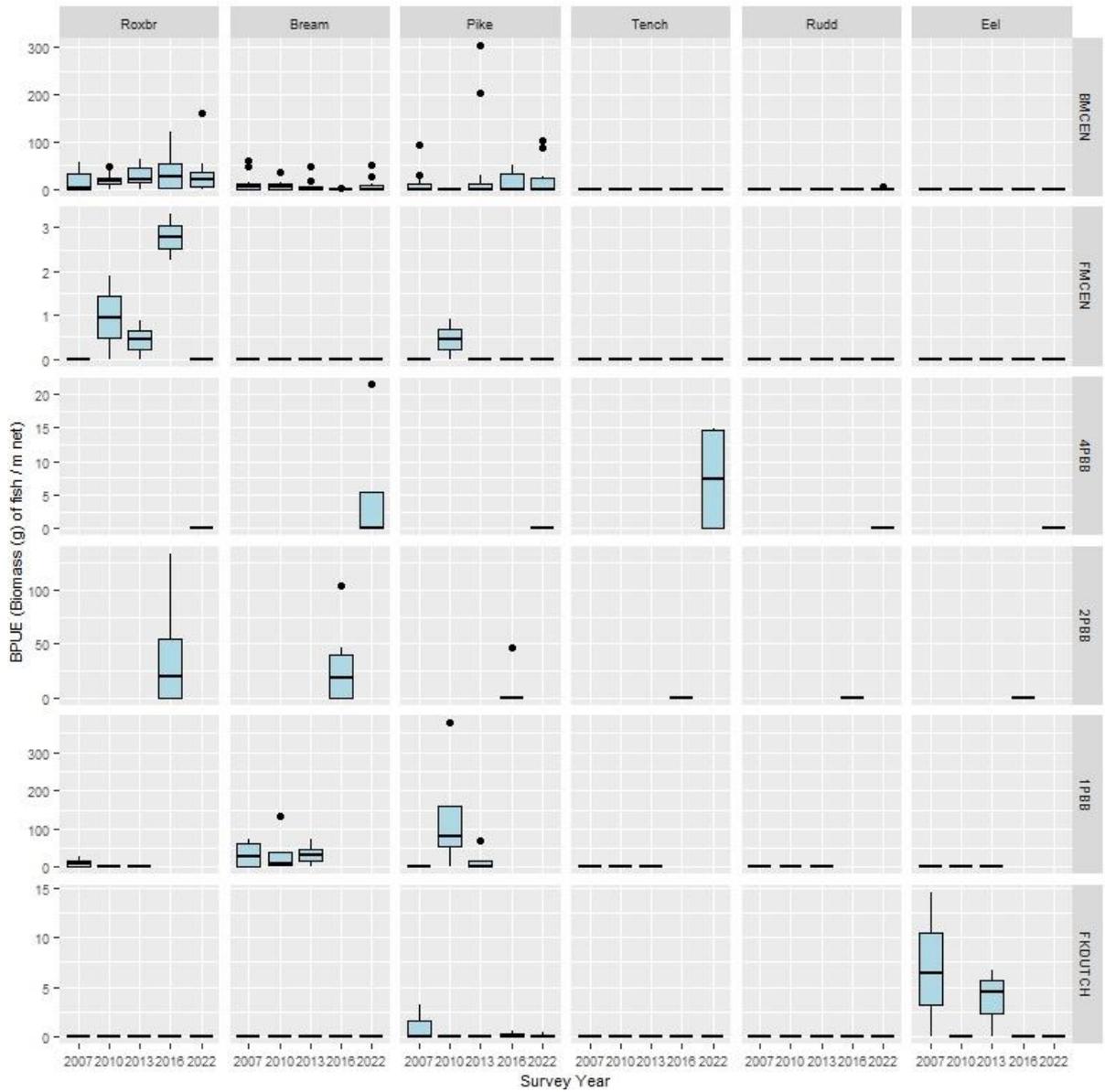

Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Ross Lake between 2007 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
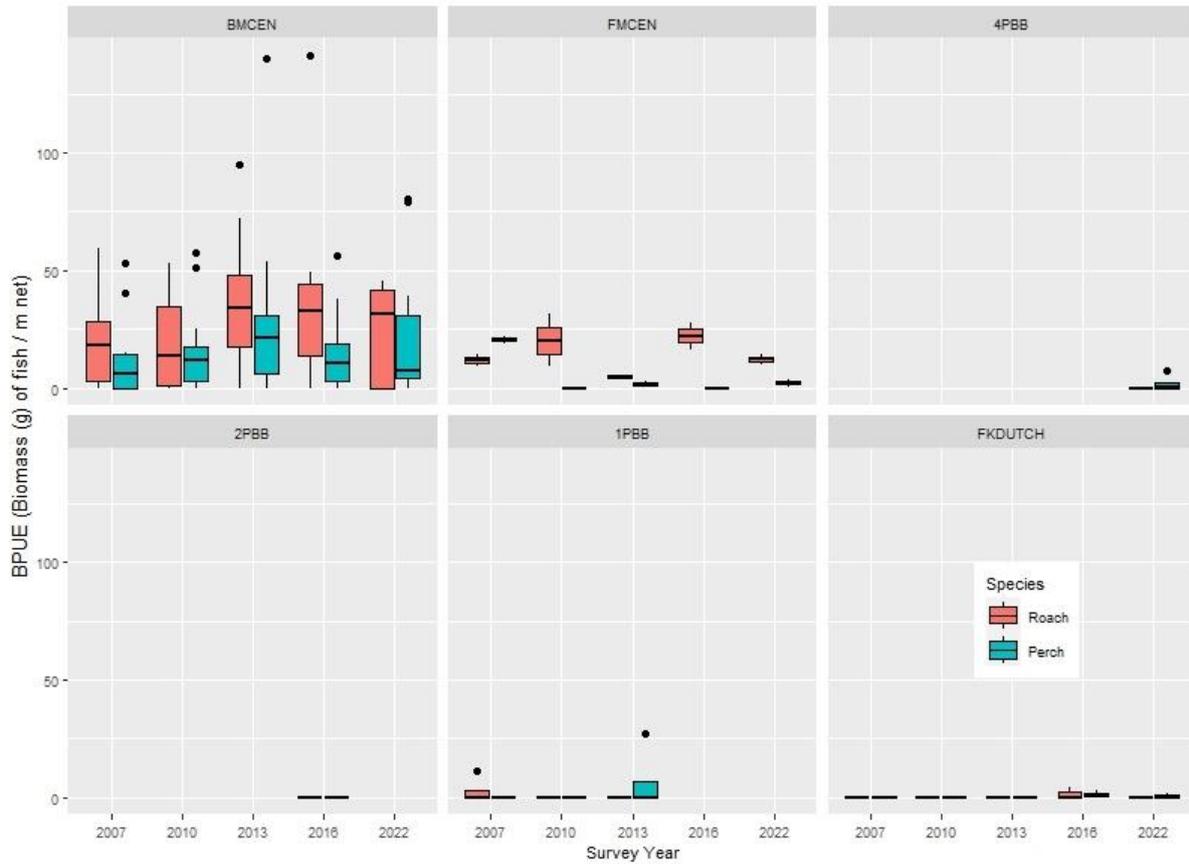
Figure 3.1b. BPUE of all roach and perch captured in each net type during surveys of Ross Lake from between 2007 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
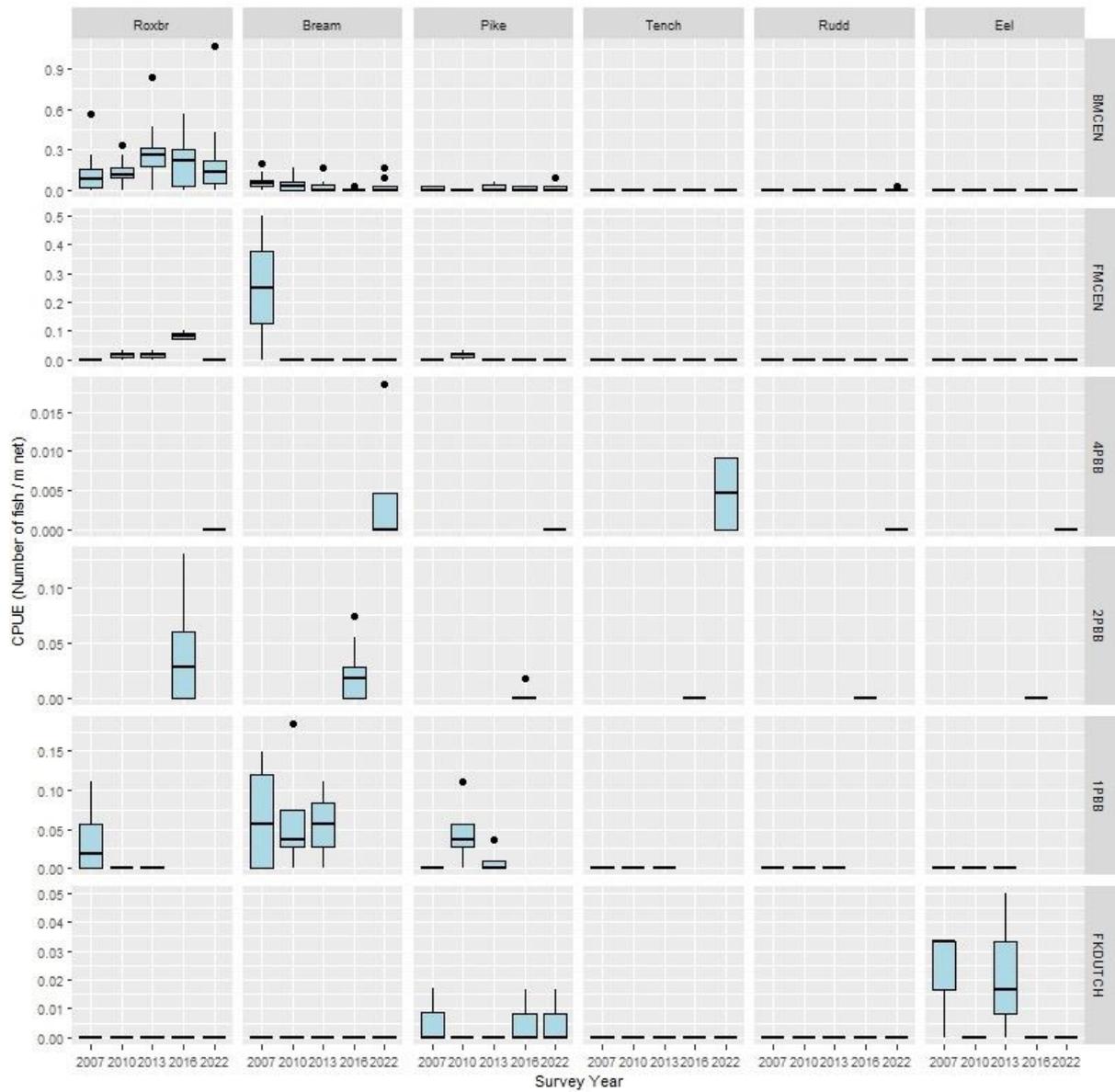
Figure 3.2a. CPUE (number of fish captured per linear meter of net) of other fish species captured in each net type during surveys Ross Lake in 2007 and 2022. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis is unique for each net type.

Figure 3.2b. BPUE (biomass of fish captured per linear meter of net) of other fish species captured in each net type during surveys of Ross Lake between 2007 and 2022. 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 is unique for each net type.

3.3. Length frequency distributions and growth

Roach

Roach captured during the 2022 survey ranged in length from 4.7cm to 30.5cm (mean 12.4cm). While roach captured had a similar length and age range across all surveys the population was characterised by a larger proportion of smaller fish (i.e., < 10.0cm) in 2022 (Figure 3.3). Roach were aged between 1+ and 7+ and all intervening age classes were present in the sample aged (Table 3.3). The most abundant age class was 1+ corresponding to the modal peak *c.* 7.0-10.0cm. While all year classes were well represented, comparatively few five-year-old fish were captured (18.0-20.0cm) (Table 3.3 and Figure 3.3).
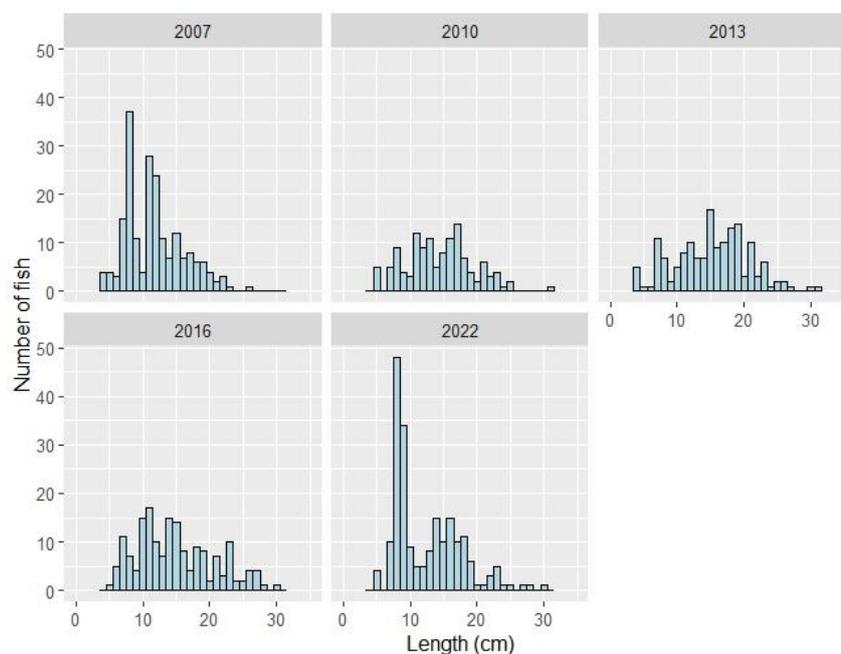

Figure 3.3. Length frequency of roach captured on Ross Lake, 2010, 2013, 2016 and 2022.

Table 3.3. Summary age data from roach captured Ross 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	17	15	11	15	2	10	6
Mean L (cm)	-	8.5	13.2	15.2	17.2	18.8	22.9	22.7
Min L (cm)	-	7.2	9.5	12.8	14.1	18.2	19.5	19.3
Max L (cm)	-	10.6	16.2	17.5	19.5	19.4	27.7	24.6

Perch

Perch captured during the 2022 survey ranged in length from 5.7cm to 35.5cm (mean 11.8cm). Perch captured across all surveys had a similar length range (Figure 3.4). Nine age classes were present in the sample aged (several larger fish were released and not available for age analysis). Perch were aged from 0+ to 10+. Mean L1 (i.e., age at the end of the first year) was 6.6cm (Table 3.4). While the population was dominated by younger age groups (1+ to 3+) there was evidence of the persistence of older and larger age groups in the population (Table 3.4 and Figure 3.4).
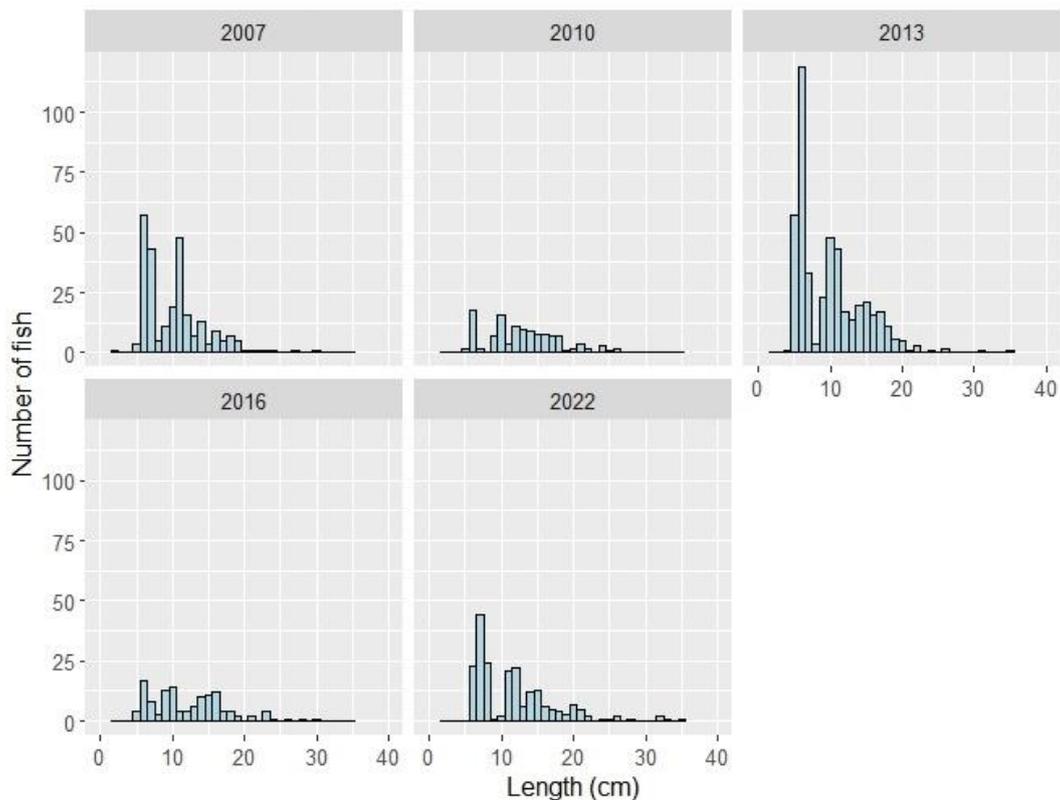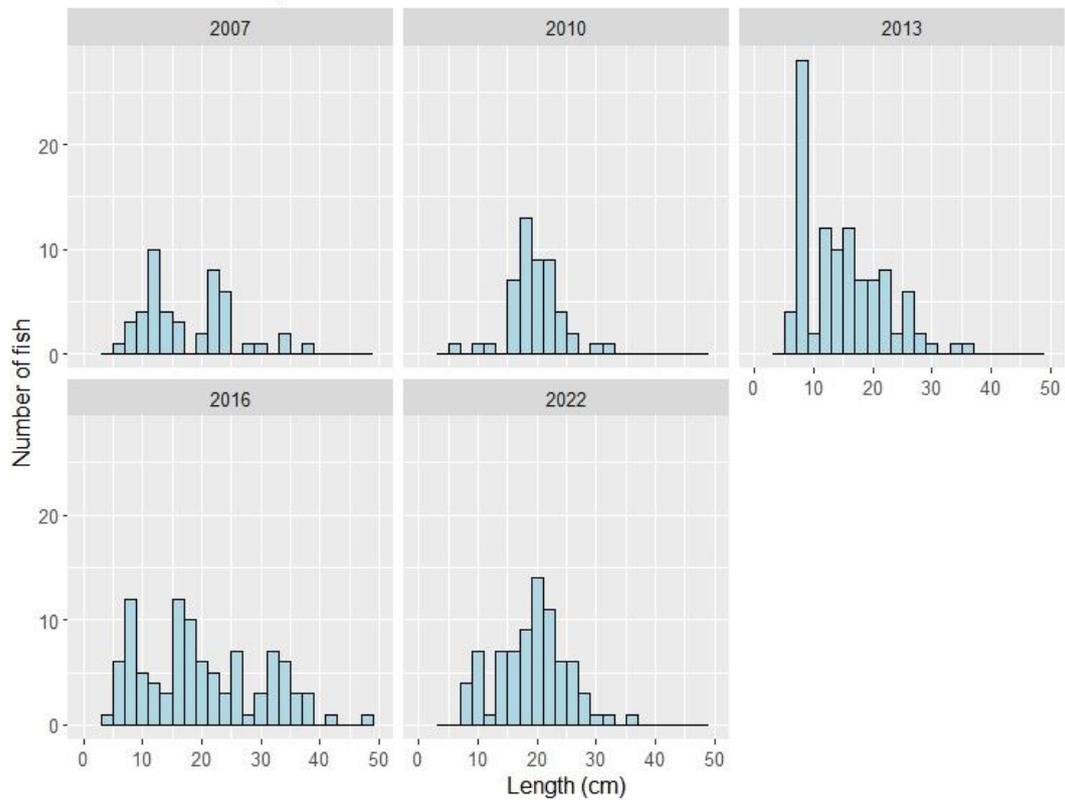

Figure 3.4. Length frequency of perch captured on Ross Lake, 2007, 2010, 2013, 2016 and 2022.

Table 3.4. Mean (±S.E.) perch length (cm) at age for Ross Lake, September 2022.

Length (cm)	Age class									
	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
Mean (±S.E.)	6.6 (0.1)	10.2 (0.2)	13.0 (0.3)	15.4 (0.4)	18.3 (1.3)	21.7 (2.6)	25.2 (2.6)	24.8 (2.3)	26.1 (2.3)	28.6 (3.4)
N	65	48	37	19	6	4	4	3	3	2
Range	4.3 - 8.5	6.6 - 12.1	8.9 - 15.8	12.0 - 18.3	14.3 - 21.9	17.3 - 28.5	20.6 - 31.3	22.1 - 29.1	23.4 - 30.7	25.2 - 31.9

Roach x bream hybrids

Roach x bream hybrids captured during the 2022 survey ranged in length from 7.7cm to 35.2cm (mean 19.1cm) (Figure 3.5 and Table 3.5). Roach x bream hybrids in the sample were aged between 1+ and 8+. All intervening age classes were represented, indicating regular recruitment in the lake. While the most abundant age class in the sample was 3+, other strong cohorts were also present (Table 3.5 and Figure 3.5).

Figure 3.5. Length frequency of roach x bream hybrids captured on Ross Lake, 2007, 2010, 2013, 2016 and 2022.

Table 3.5. Summary age data from roach x bream hybrids captured on Ross 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+
N	-	6	9	13	11	7	10	4	6
Mean L (cm)	-	9.3	12.9	17.2	18.9	21.3	23.7	26.5	28.8
Min L (cm)	-	7.7	9.2	13.3	14.3	20	20.1	24.6	22.4
Max L (cm)	-	10.8	15.7	19.7	21.2	23	25.6	27.8	35.2

Other fish

Bream ranged in length from 4.0cm to 45.0cm (mean 23.9cm). They were aged from 1+ to 9+. The presence of younger age groups is indicative of some recent recruitment of this species in the lake.

Pike ranged in length from 15.5cm to 74.0cm (mean 47.1cm) and were aged between 4+ and 6+. Two tench measuring 44.8cm and 44.5cm in length and both aged at 6+ were also captured. One rudd measuring 20.6cm and aged at 5+ was captured during the 2022 survey.

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.

Perch

A total of 34 stomachs were examined; of these 12 (35%) were found to contain no prey items. Of the remaining 22 stomachs containing food, 11 (50%) contained invertebrates, 7 (32%) zooplankton and 4 (18%) fish remains (Figure 3.5).
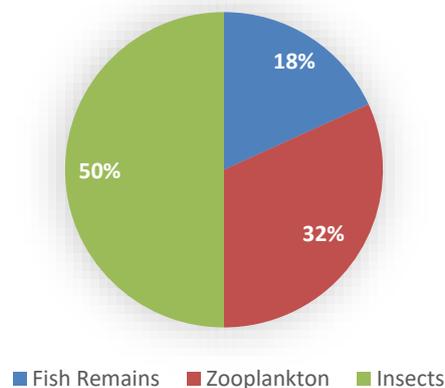
Figure 3.5. Diet of perch (N = 22) captured on Ross Lake, 2022 (% FO)

Pike

The contents of four pike stomachs were also examined, three contained no prey items and one contained fish.

4. Summary

A total of six fish species and one cyprinid hybrid were recorded on Ross Lake in September 2022.

Perch and roach were the most abundant species in terms of abundance (mean CPUE) captured during the 2022 survey. Roach x bream hybrids were also recorded in relatively large numbers, and this species had the highest biomass (mean biomass) of the species captured.

The two most abundant species captured (i.e. perch and roach) have each been recruiting regularly in the lake. Populations of both species were dominated by younger year groups. The roach x bream hybrid population, which requires both parent species to spawn (Hayden *et al.*, 2010), exhibited consistent recruitment patterns. While all age groups (i.e., between 1+ and 8+) were recorded in the sampled population, the proportion of younger and smaller cohorts was lower in 2022 compared to earlier surveys.

The presence of small bream indicates that this important coarse angling species continues to recruit in the lake.

Rudd and tench were captured for the first time in recent surveys of the lake in 2022. These species were also captured in a survey of neighbouring Ballyquirke Lough in 2022 (McLoone *et al*., 2023). Historically rudd were widespread though patchily distributed in Ireland and their colonisation history was uncertain (Kennedy and Fitzmaurice, 1974). Those authors reported rudd as being historically present in Lough Corrib so it is probable that these records may represent a recovery in that original population. Tench were historically less widespread in Ireland and the Corrib catchment sits outside their historical range (Kennedy and Fitzmaurice, 1970). It is likely that this record represents a more recent colonisation event.

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, Ross Lake has been assigned an ecological status of Poor for 2022 based on the fish populations present. Ross Lake was also assigned a status of Poor in 2016, 2013 and 2010. The lake was assigned Moderate status in 2007 (Figure 4.1).

In the 2016 to 2021 surveillance monitoring reporting period, the EPA assigned Ross Lake an overall ecological status of Moderate, based on all monitored physico-chemical and biological elements, including fish (EPA 2021).
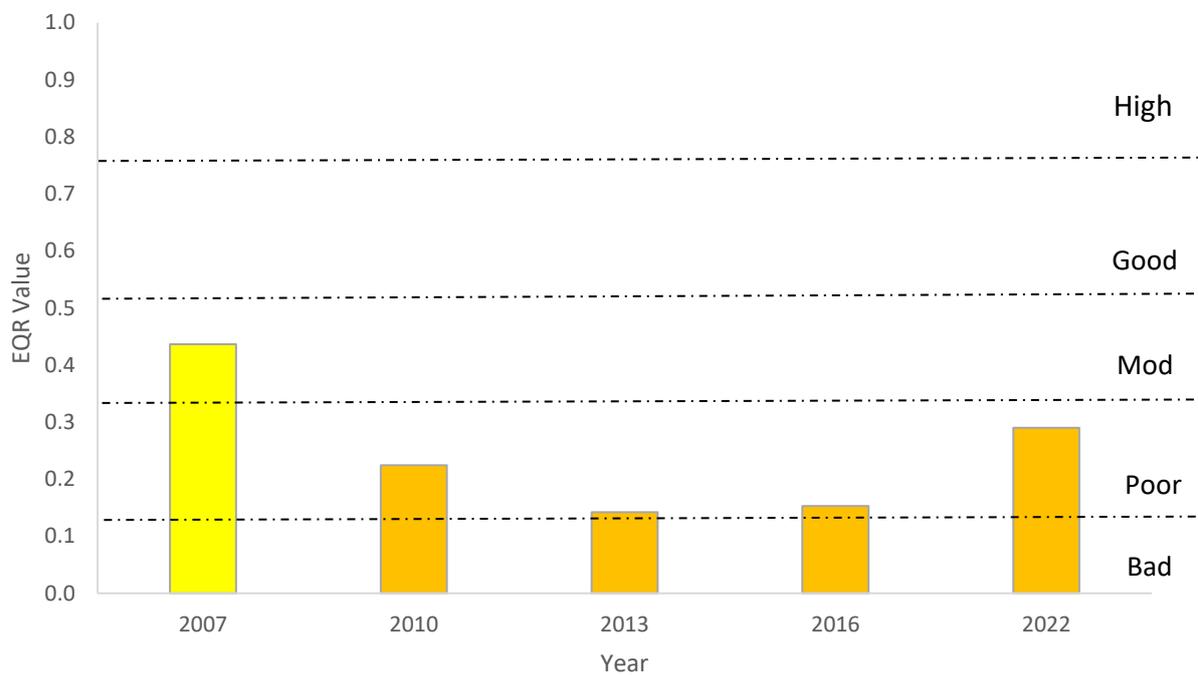
Figure 4.1. Fish ecological status, Ross Lake, 2007, 2010, 2013, 2016 and 2022 (dashed line indicates EQR status boundaries).

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.

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

Gough, H. (1989) *Coarse Fishing in Ireland*. Unwin Hyman Limited, London. 201pp

Hayden, B., Pulcini, D., Kelly-Quinn, M., O'Grady, M., Caffrey, J., McGrath, A. and Mariani, S. (2010) Hybridisation between two cyprinid fishes in a novel habitat: genetics, morphology and life-history traits. *BMC Evolutionary Biology*, **10 (1)**, 1-11.

Kelly, F. and Connor, L. (2007) *WFD Surveillance Monitoring - Fish in Lakes 2007*. Central Fisheries Board report.

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, NSSHARE project.

Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., Wogerbauer, C., Feeney, R., O'Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland.

Kelly, F.L., Harrison A., Connor, L., Morrissey, E., Wogerbauer, C., Matson, R., Feeney, R., O'Callaghan, R. and Rocks, K. (2011) *Water Framework Directive Fish Stock Survey of Ross Lake, September 2010*. Inland Fisheries Ireland.

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.

Kelly, F.L., Connor, L., Morrissey, E., Coyne, J., Matson, R., Feeney, R. and Rocks, K. (2014) *Water Framework Directive Fish Stock Survey of Ross Lake, August 2013*. Inland Fisheries Ireland.

Kelly, F.L., Connor, L., Coyne, J., Morrissey, E., Corcoran, W., Cierpial, D., Delanty, K., McLoone, P., Matson, R., Gordon, P., O' Briain, R., Rocks, K., O' Reilly, S., Kelly K., Puttharee, D., McWeeney, D., Robson S. and Buckley, S. (2017) *Fish Stock Survey of Ross Lake, September 2016*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Kennedy, M, and Fitzmaurice, P. (1970) The biology of the tench *Tinca tinca* (L.) in Irish waters. *Proceedings of the Royal Irish Academy. Section B: Biological, Geological, and Chemical Science*, pp. 31-82. Royal Irish Academy, 1970.

Kennedy, M, and Fitzmaurice, P. (1974) Biology of the rudd *Scardinius erythrophthalmus* (L) in Irish waters. *Proceedings of the Royal Irish Academy. Section B: biological, geological, and chemical science*, pp. 245-303. Royal Irish Academy, 1974.

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

NPWS (2013). Site *synopsis: Ross Lake and Woods. Site code: 001312*. Site Synopsis report, National Parks and Wildlife Service. https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY001312.pdf.

Went, A. E. (1957) The Pike in Ireland. *The Irish Naturalists' Journal*, **7**, 177-182.