National Research Survey Programme

Lakes 2023

Lough Gill

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Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Lough Gill, July 2023

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Inland Fisheries Ireland

National Research Survey Programme

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1.   Introduction

Lough Gill is mainly situated in Co. Sligo, with part of the north-eastern end of the lake extending into Co. Leitrim (Plate 2.1 and Figure 1.1). It is located within the Garavogue catchment, between Dromahair in Co. Leitrim and Sligo town, and drains into the River Garavogue. Lough Gill is a large lake, with a surface area of 1,401ha and a maximum depth of 31m. It is approximately ten kilometres in length and four kilometres wide at its widest point. It is surrounded by wooded hills and contains around 20 small islands (Plate 1.1). The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and moderate alkalinity (20-100mg/l $CaCO_3$). The lake is naturally eutrophic and lies within the Lough Gill SAC (001976). Fish species listed include sea, river and brook lamprey and Atlantic salmon. White clawed crayfish and otter are also present (NPWS, 2016). The lake is the main domestic water supply for Sligo town.

Many environmental and ecological studies have been carried out on Lough Gill over the past sixty years (e.g. Cotton, 1994). In 1953 samples of planktonic algae were taken from 26 Irish lakes in order to assess their trophic status. A sample analysed from Lough Gill indicated that the lake was eutrophic (Round and Brook, 1959). The first water quality survey of Irish lakes in 1973 and 1974 included Lough Gill and the authors considered that the lake was naturally eutrophic at that time. They determined this from slightly raised orthophosphate levels, from the composition of the phytoplankton community and from reports that algal blooms had occurred in the lake for the two years prior to their study (Flanagan and Toner, 1975). Blooms of blue-green bacteria were a noticeable feature of the lake in the autumn months of the 1980s. Water quality in the lake deteriorated during the 1990's due to a number of reasons, one of these was the dumping of chicken slurry in the upstream Bonet catchment (Cotton, 1994).

Lough Gill is generally considered to be an important game fishery but is also utilized as a coarse fishery. It holds a mixture of fish species including lamprey, eel, salmon, sea trout, brown trout, pike, bream, gudgeon, stone loach, perch, rudd, roach and flounder. The lake receives a large run of spring salmon and it is one of the few lakes in the country to have a reputation for being a predominantly salmon fishery (O' Reilly, 2007). Some stocking of brown trout fingerlings was carried out between 1968 and 1977 in an attempt to enhance the native fish population in the lake. The lake was previously surveyed to assess its fish stocks as part of a fish stock management programme in 1974, 1989 and in the early 1990s by Inland Fisheries Ireland (IFI) (previously the North Western Regional Fisheries Board and the Central Fisheries Board) (Collins, P., *pers*. *comm*.; O'Grady, 1990). The 1974 survey revealed

that there was a large stock of small perch and a good stock of pike present in the lake. Brown trout and bream were also recorded during the survey (O'Grady, *pers*. *comm*.). The 1989 survey indicated the presence of five fish species (i.e. salmon, trout, bream, perch and pike) and revealed that there were substantial populations of perch and pike, localized bream stocks and a relatively small trout population (O' Grady, 1990). Rudd were encountered in the lake in the early 1990s by IFI (Collins, P., *pers. comm*.).

The lake has been surveyed on four occasions since 2008 (2008, 2011, 2014 and 2017) as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009, 2012a, 2015, Connor *et al.,* 2018). During the 2017 survey, perch were found to be the dominant species present in the lake. Brown trout, roach, bream, pike, roach x bream hybrids and European eel were also captured.

This report summarises the results of the 2023 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.
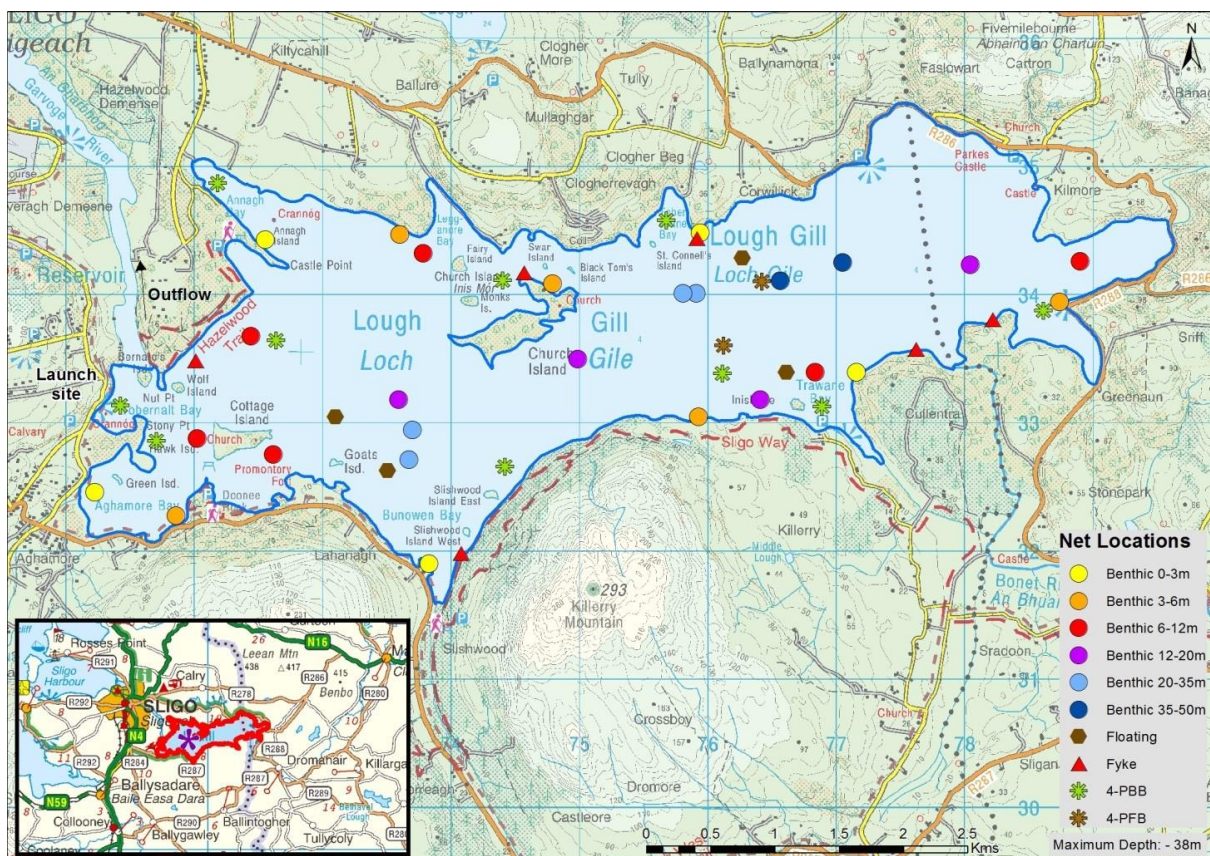

Figure 1.1. Location map of Lough Gill showing net locations and depths of each net (outflow is indicated on map).

2. Methods

2.1. Netting methods

Lough Gill was surveyed over three nights between the 17th and the 20th of July 2023. A total of six sets of Dutch fyke nets (Fyke), 26 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (5 @ 0-2.9m, 5 @ 3-5.9m, 6 @ 6-11.9m, 4 @ 12-19.9m, 4 @ 20-34.9m and 2 @ 35-49.9m) and four floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (36 sites). In addition, 10 four-panel benthic braided survey gill nets (4-PBB) and two four-panel floating braided survey gill nets (4-PFB) were deployed in the lake (Figure 1.1). The 4-PBB nets are composed of four 27.5m long panels each a different mesh size (55mm, 60mm, 70mm and 90mm). Nets were deployed in the same locations as were randomly selected in the previous survey. A handheld GPS was used to mark the precise location of each net. The angle of each gill net in relation to the shoreline was randomised.

All fish apart from perch were measured and weighed on site and scales were removed from a sub-sample of other species. 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 and transported back to the IFI laboratory for later dissection.

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).

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

Where:
$\mathbf{FO}_i$ is the percentage frequency of prey item i,
N_i is the number of fish with prey i in their stomach,
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.

Plate 2.1. Lough Gill, looking west over Cottage Island, July 2023.

Plate 2.2 Lough Gill, looking east across the lake, July 2023

3.   Results

3.1. Species Richness

Six fish species and one type of cyprinid hybrid were recorded on Lough Gill in July 2023. A total of 730 fish were captured (Table 1.1). Perch and roach were the most numerous fish species recorded. Together they represented *c*. 78% of all fish captured in the survey. Roach x bream hybrids, bream, brown trout, pike and European eels were also captured. The same species composition was recorded in the previous surveys with the exception of salmon and flounder that were recorded in 2011, and stone loach which were recorded in 2008 (Kelly *et al*., 2009, 2012a, 2015, Connor *et al.,* 2018).

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

Scientific name	Common name	Number of fish captured					
		BM CEN	FM CEN	4-PBB	4-PFB	Fyke	Total
Perca fluviatilis	Perch	342	6	9	0	5	362
Rutilus rutilus	Roach	184	26	0	0	0	210
Rutilus rutilus x Abramis brama	Roach x bream hybrid	25	0	63	0	1	89
Abramis brama	Bream	2	0	24	0	0	26
Salmo trutta	Brown trout	3	1	0	1	0	5
Esox lucius	Pike	2	0	0	0	0	2
Anguilla anguilla	European eel	0	0	0	0	36	36

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. Perch was the dominant species with respect to abundance (CPUE), while roach x bream hybrids recorded the highest biomass (BPUE) (Table 3.2).

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

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	0.245 (0.056)	15.553 (3.686)
Rutilus rutilus	Roach	0.146 (0.051)	13.332 (3.982)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.030 (0.007)	19.203 (4.586)
Abramis brama	Bream	0.006 (0.003)	5.811 (3.694)
Salmo trutta	Brown trout	0.003 (0.001)	1.393 (0.885)
Esox lucius	Pike	0.001 (0.001)	1.252 (0.895)
*Anguilla anguilla**	European eel	0.100 (0.052)	13.947 (7.371)

*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.*

3 Species Profiles

Perch

Perch captured during the 2023 survey ranged in length from 4.1cm to 41.5cm (mean = 14.0cm) (Figure 3.1). Length range of perch was broadly similar across all surveys of the lake, with evidence of persistence of larger individuals frequently evident. This was particularly the case in the latter surveys. In 2023 perch were aged between 0+ and 11+. No one year class dominated the population, and all age classes between 0+ (4-8cm) and 6+ (21cm – 27cm) were well represented (Figure 3.1). Stronger year classes included 1+, 2+ and 5+ cohorts. Mean L1 (i.e. length at the end of the 1st year) was 5.9cm (Table 3.3).

Perch populations have remained relatively stable across all surveys and no obvious trends in abundance (CPUE) and biomass (BPUE) were apparent (Figure 3.2).
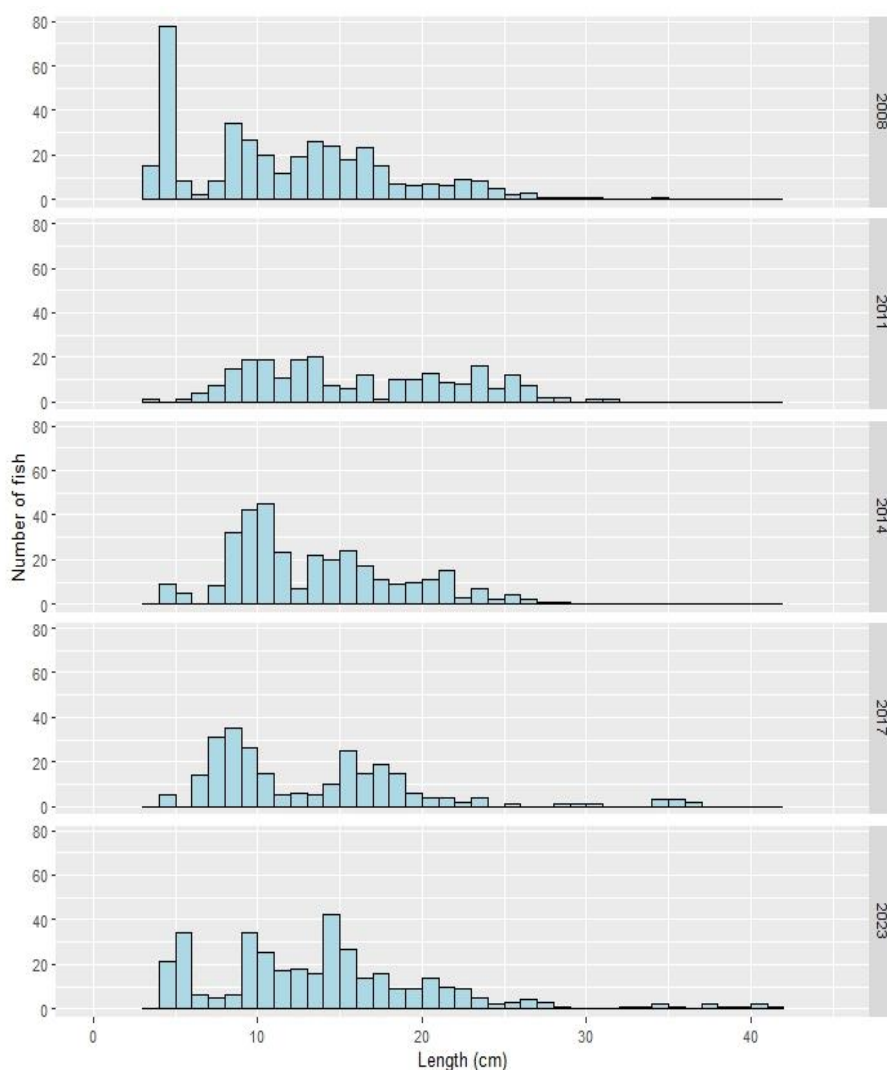

Figure 3.1. Length frequency of perch captured on Lough Gill between 2008 and 2023.

Table 3.3. Mean (±S.E.) perch length (cm) at age for Lough Gill, July 2023.

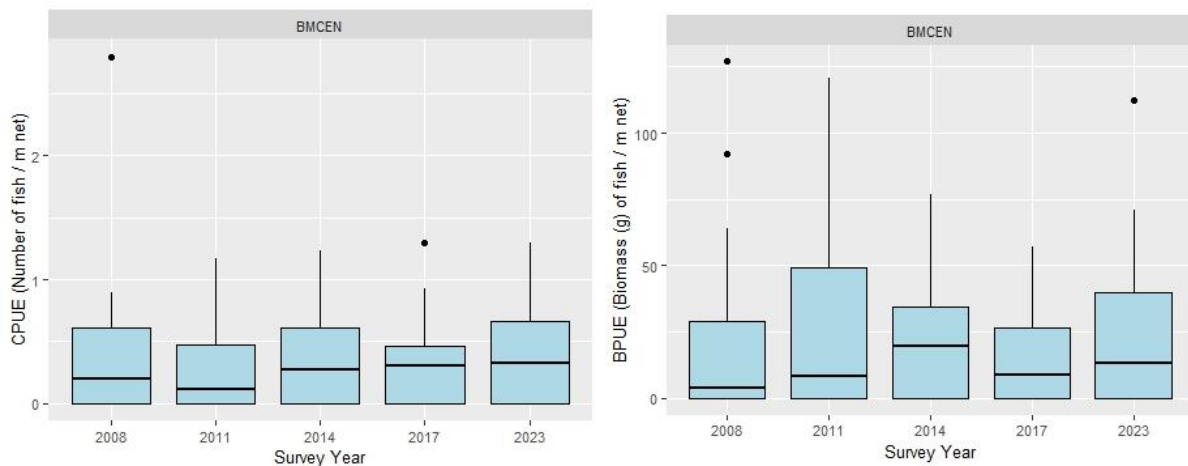|	L$_1$	L$_2$	L$_3$	L$_4$	L$_5$	L$_6$	L$_7$	L$_8$	L$_9$	L$_{10}$	L$_{11}$
Mean (±S.E.)	5.9 (0.12)	11.5 (0.20)	15.5 (0.26)	18.6 (0.30)	20.6 (0.32)	24.1 (0.59)	26.9 (1.03)	30.1 (1.56)	35.8 (1.04)	38.3 (0.84)	40.0 (0.90)
N	99	80	62	52	42	23	13	8	5	3	2
Range	4.0-9.5	8.5-16.3	12.4-21.6	15.2-25.0	16.9-26.1	20.8-30.5	22.2-33.5	23.5-35.5	33.4-38.6	36.7-39.5	39.1-40.9

Figure 3.2. CPUE and BPUE of perch captured during surveys of Lough Gill between 2008 and 2023. 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.

<u>**Roach**</u>

Roach captured during the 2023 survey ranged in length from 6.7cm to 27.5cm (mean = 16.0cm) (Figure 3.3). Length range of roach was broadly similar across all surveys of the lake, but with some evidence of limited recruitment. In 2023 roach were aged between 0+ and 9+ and all intervening age classes were present (Table 3.4). The largest year class was 2+ (10cm – 13cm). While 4 and 5 year old fish were also well represented, 1+ (i.e. < 10cm) and 3+ roach (13cm – 18cm) were less abundant compared to other cohorts (Figure 3.3).

Roach populations have remained relatively stable across all surveys and no obvious trends in abundance (CPUE) and biomass (BPUE) were apparent (Figure 3.4).
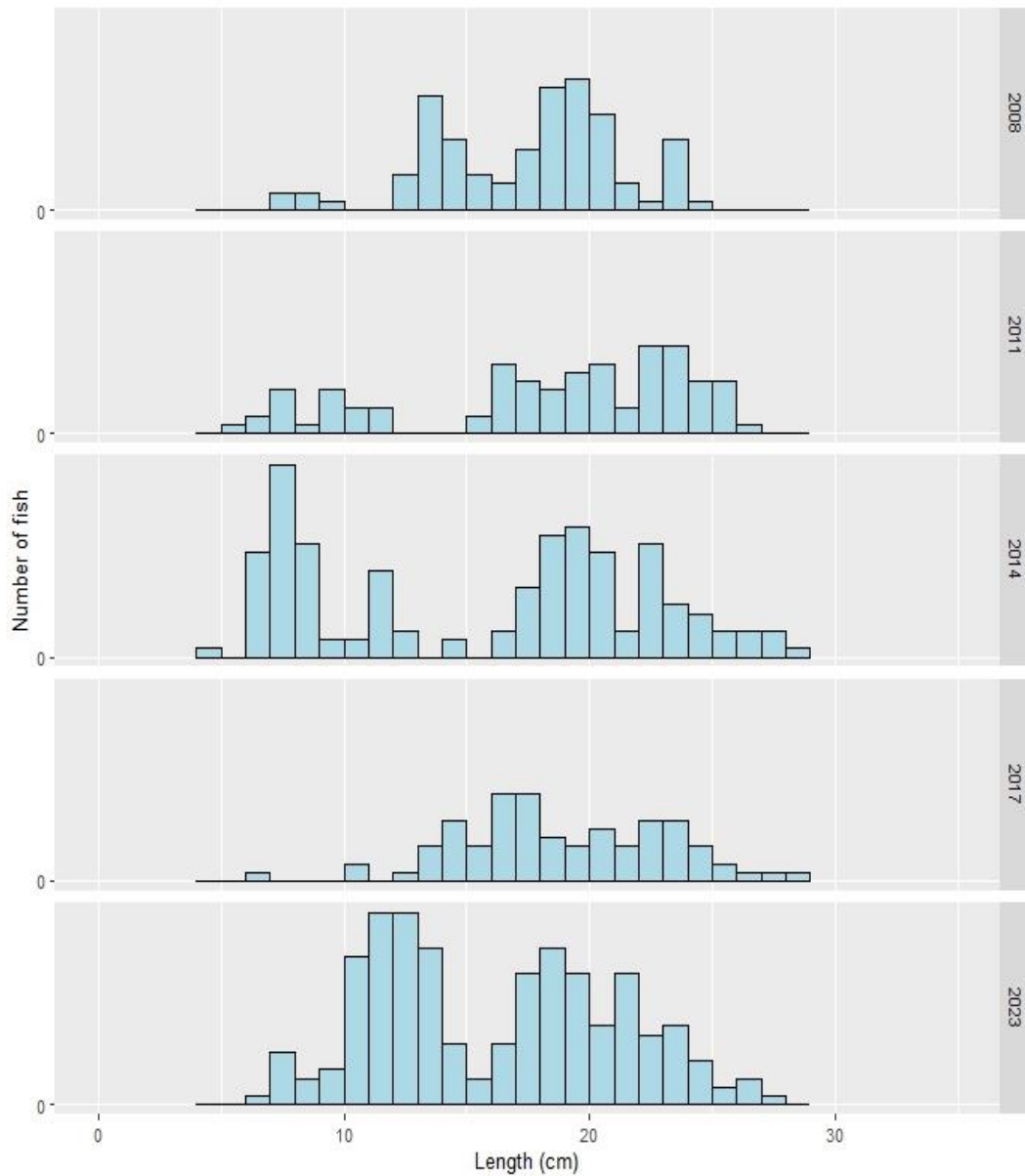
Figure 3.3. Length frequency of roach captured on Lough Gill between 2008 and 2023.

Table 3.4. Summary age data from roach captured on Lough Gill, July 2023. Number of fish and length ranges of all fish aged in the sample is presented.

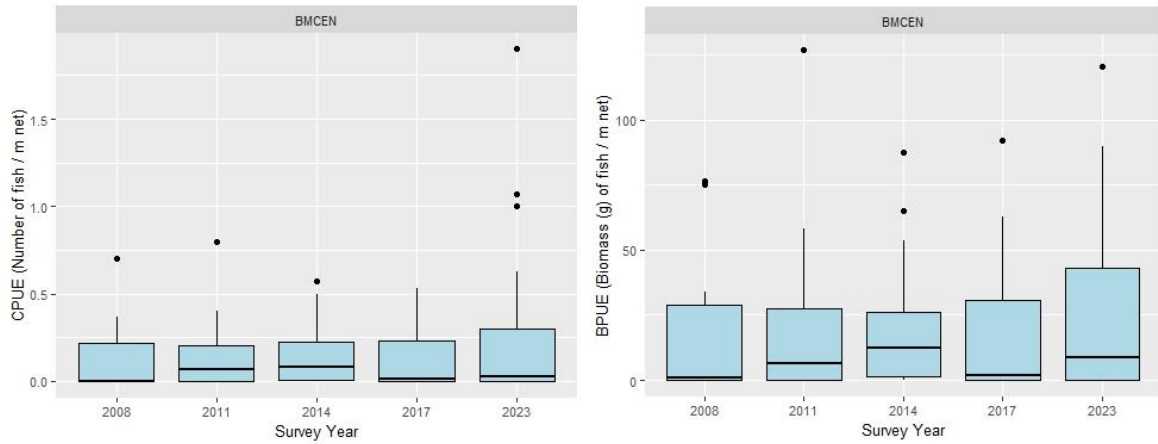| Length (cm)	Age class									
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
N	-	2	19	5	15	14	8	4	6	1
Mean	-	7.7	12.0	16.1	18.2	21.0	22.9	24.1	26.0	24.5
Min	-	7.7	10.1	13.7	16.2	16.5	21.2	21.5	24.9	24.5
Max	-	7.7	13.7	18.3	20.5	24.1	24.3	26.3	27.5	24.5

Figure 3.4. CPUE and BPUE of roach captured during surveys of Lough Gill between 2008 and 2023. 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.

Roach x bream hybrids

Roach x bream hybrids captured during the 2023 survey ranged in length from 25.5cm to 41.2cm (mean = 32.7cm) (Figure 3.5). In 2023 roach x bream hybrids were strongly dominated by larger fish (i.e. > 30cm). In 2023 roach x bream were aged from 6+ to 15+ (Table 3.5). While no one age class dominated, 9+ fish (28cm – 34cm) were the largest cohort in the sample aged (Figure 3.4; Table3.5).

There was no apparent trend in abundance (CPUE) and biomass (BPUE) of roach x bream hybrids captured in benthic survey nets. However there was a relatively large increase in both CPUE and BPUE in four panel benthic braided nets (4PBB) from 2017 to 2023 survey nets . These survey nets target larger fish compared to the BMCEN nets which capture fish of all size ranges (Figure 3.6).

Table 3.5. Summary age data from roach x bream hybrids captured on Lough Gill, September 2023. Number of fish 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+
N	-	-	-	-	-	-	4	8	9	12	8
Mean	-	-	-	-	-	-	26.1	28.1	32.3	32.2	34.2
Min	-	-	-	-	-	-	25.5	25.8	29.3	28.7	30.3
Max	-	-	-	-	-	-	26.8	29.7	36.8	34.8	38.3

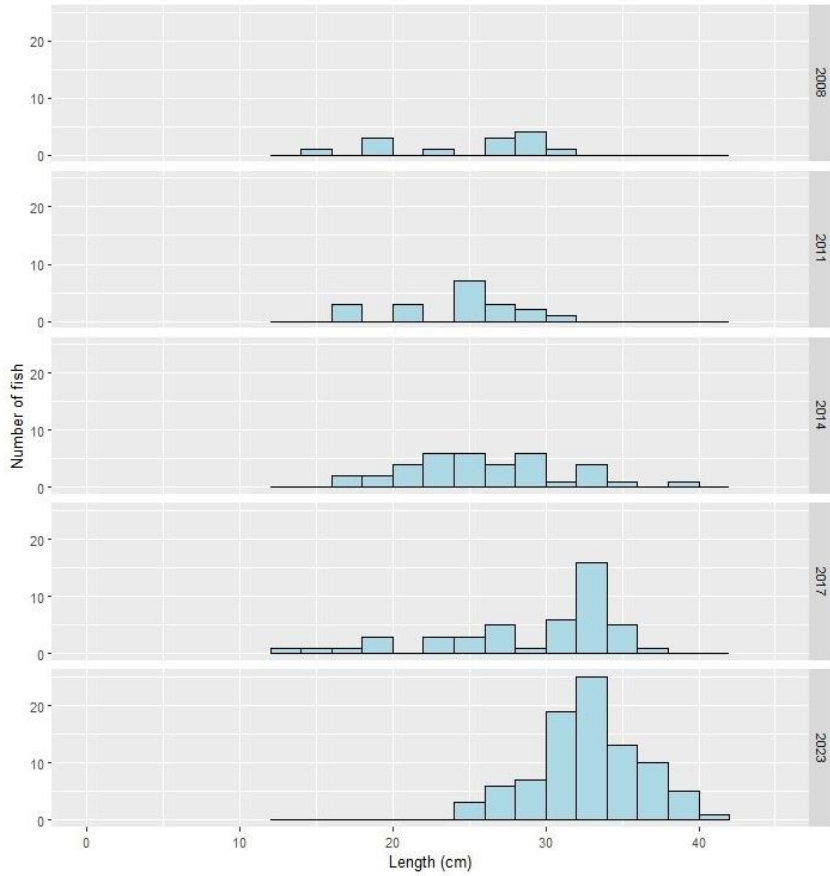| Length (cm)	Age class				
	11+	12+	13+	14+	15+
N	6	1	9	4	2
Mean	33.2	31.1	35.7	36.6	37.5
Min	30.4	31.1	32.1	34.8	35.2
Max	36.1	31.1	41.2	38	39.7

Figure 3.5. Length frequency of roach x bream hybrids captured on Lough Gill between 2008 and 2023.
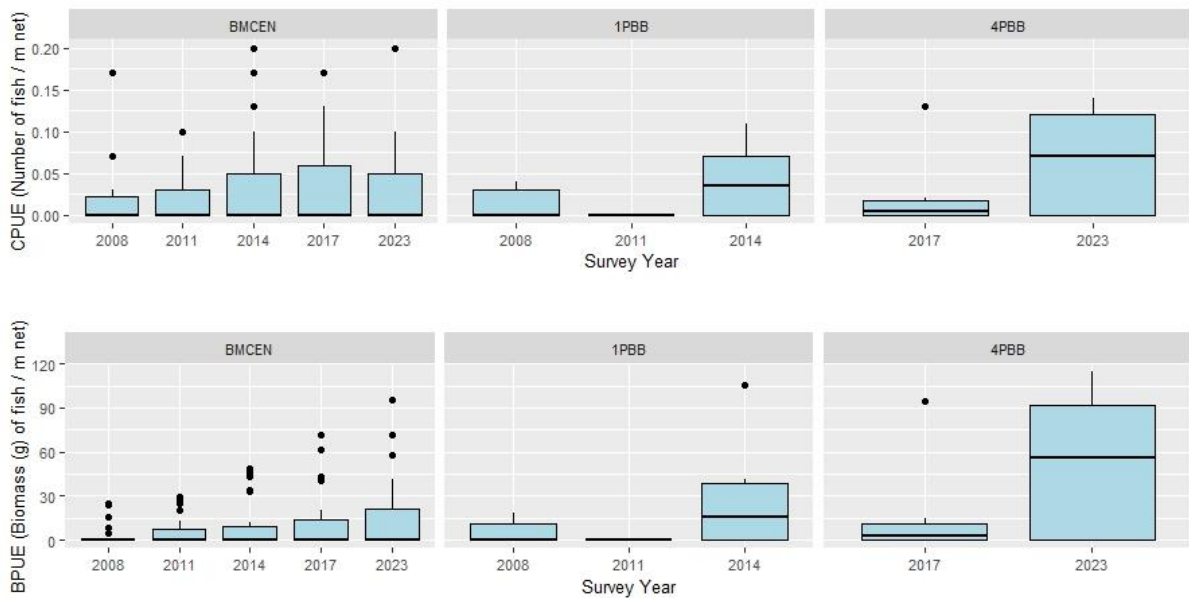

Figure 3.6. CPUE and BPUE of roach x bream hybrids captured during surveys of Lough Gill between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Bream

Bream captured during the 2023 survey ranged in length from 27.0cm to 44.0cm (mean = 36.7cm) (Figure 3.7). In 2023, bream were strongly dominated by larger fish (i.e. > 30cm). This represents a shift from earlier surveys when a broader range, of generally smaller bream, was captured. No bream measuring <20cm were captured in 2023. In 2023 bream were aged from 7+ to 14+ (Table 3.6). While no one age class dominated. 10+ fish (32cm – 39cm) were the largest age cohort in the sample (Figure 3.6 and Table 3.6).

There was an apparent decline in the abundance (CPUE) and biomass (BPUE) of bream captured in BM CEN nets (which capture fish of all sizes). This was not evident in the 4PBB survey nets which target larger fish (Figure 3.8).
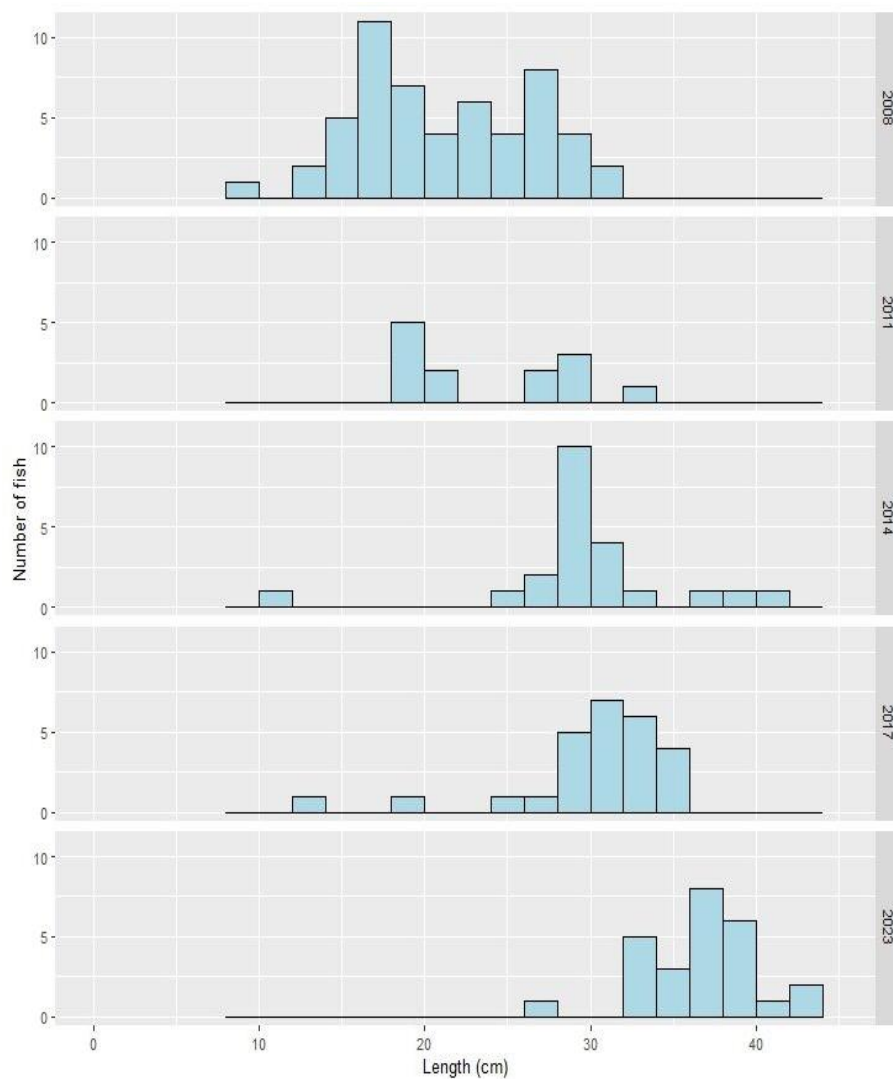

Figure 3.7. Length frequency of bream captured on Lough Gill between 2008 and 2023.

Table 3.6. Summary age data from bream captured on Lough Gill, September 2023. Number of fish 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+
N	-	-	-	-	-	-	-	2	3	3	6
Mean	-	-	-	-	-	-	-	35.0	37.3	33.5	36.1
Min	-	-	-	-	-	-	-	33.7	36.6	32.1	32.4
Max	-	-	-	-	-	-	-	36.2	38.4	35.2	39.5

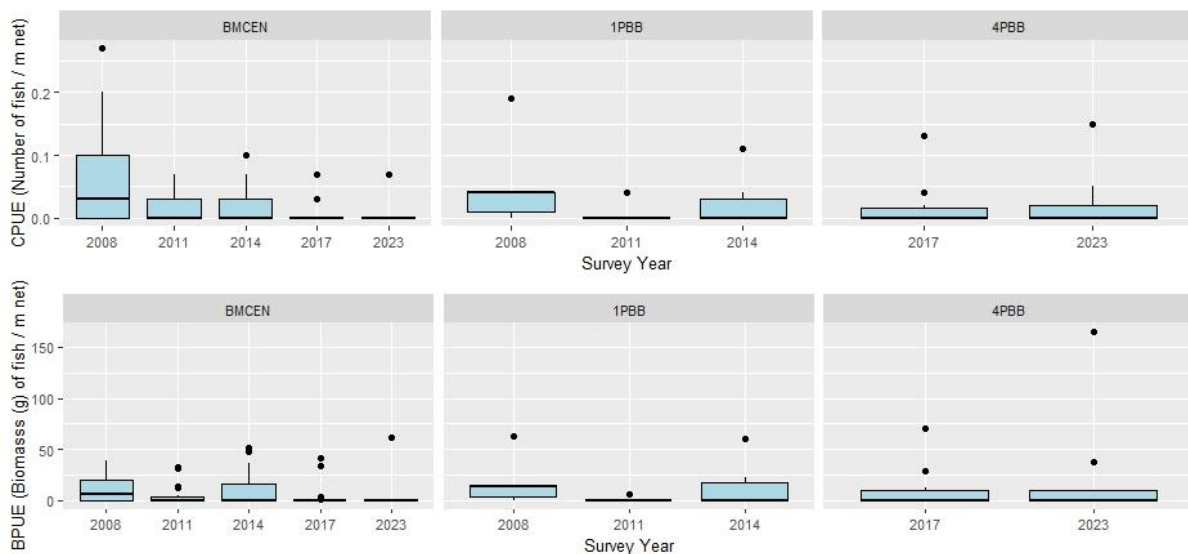| Length (cm)	Age class			
	11+	12+	13+	14+
N	3	3	4	1
Mean	39.9	38.3	37.4	42.9
Min	35.4	37.5	36	42.9
Max	44	39.8	39.2	42.9

Figure 3.8. CPUE and BPUE of bream captured during surveys of Lough Gill between 2008 and 2023. 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.

Brown trout

Brown trout captured during the 2023 survey ranged in length from 20.2cm to 47.7cm (mean = 30.1cm) (Figure 3.9). Brown trout were aged between 2+ and 5+.

Generally captured in relatively small numbers compared to other species in the lake, there was no obvious trend apparent in brown trout abundance (CPUE) or biomass (BPUE). However, there was a clear bias towards the capture of trout in all types of floating net deployed in the surveys (Figure 3.10).
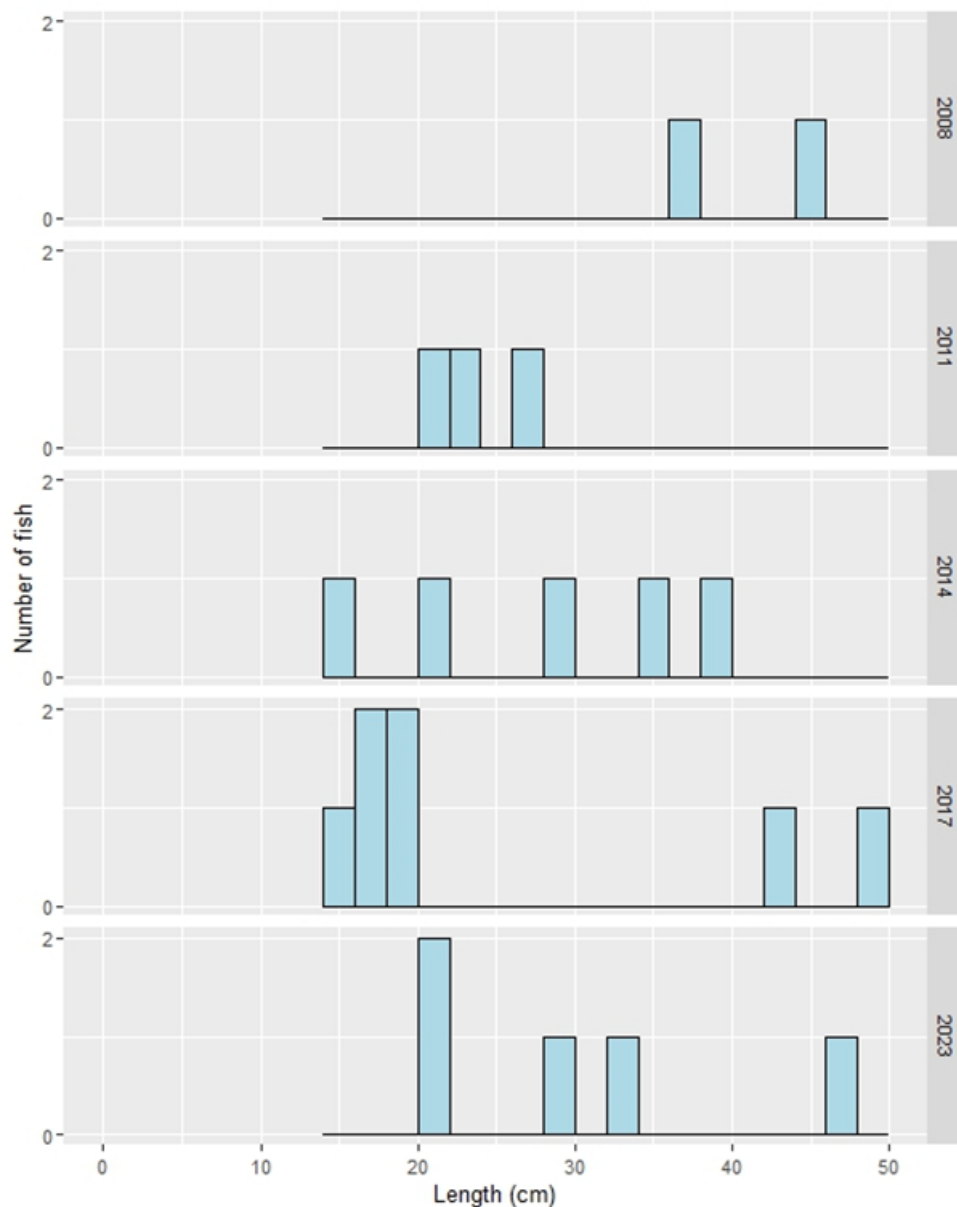

Figure 3.9. Length frequency of brown trout captured on Lough Gill between 2008 and 2023
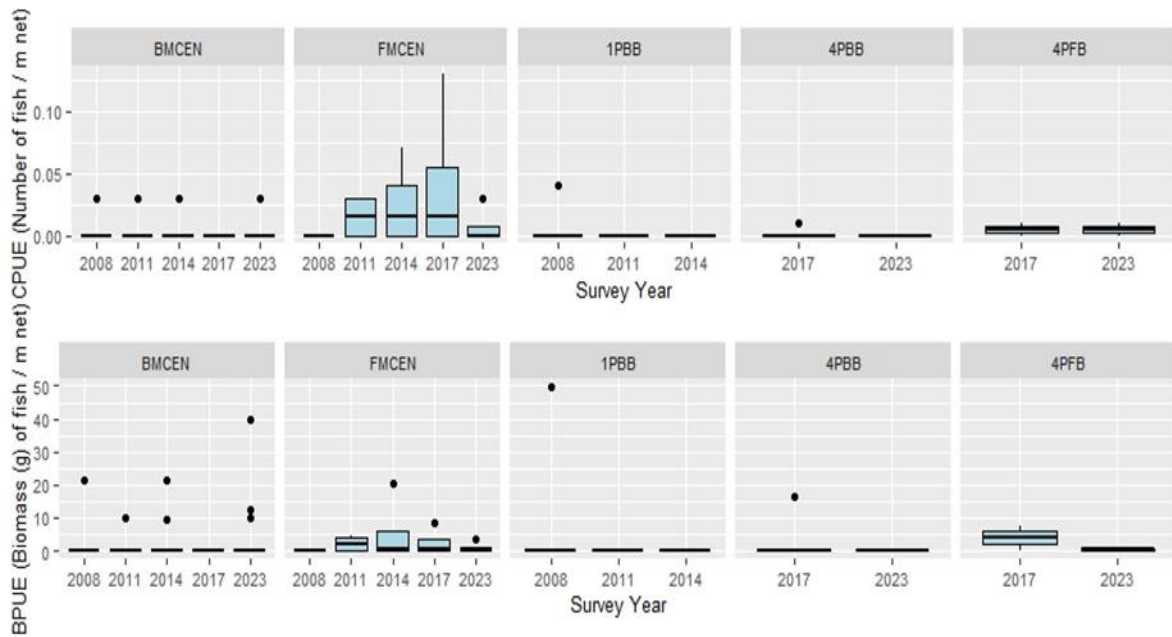
Figure 3.10. CPUE and BPUE of brown trout captured during surveys of Lough Gill between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value to the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical whiskers show the data range. Outliers are marked by dots.

European eel

European eel captured during the 2023 survey ranged in length from 33.0cm to 55.2cm (mean = 42.7cm) (Figure 3.12). There has been an apparent decline in both abundance and biomass of eel captured between 2008 and 2023 (Figure 3.11).
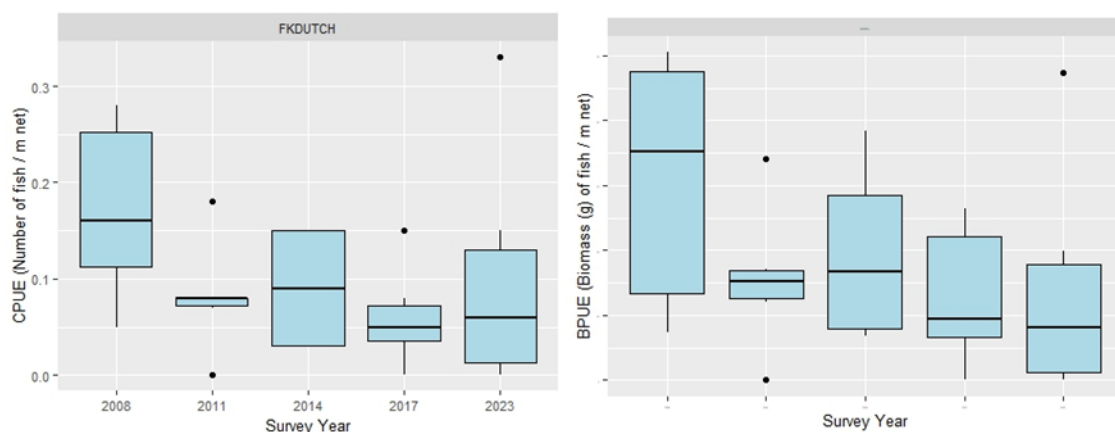

Figure 3.11. CPUE and BPUE of European eel captured during surveys of Lough Gill between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
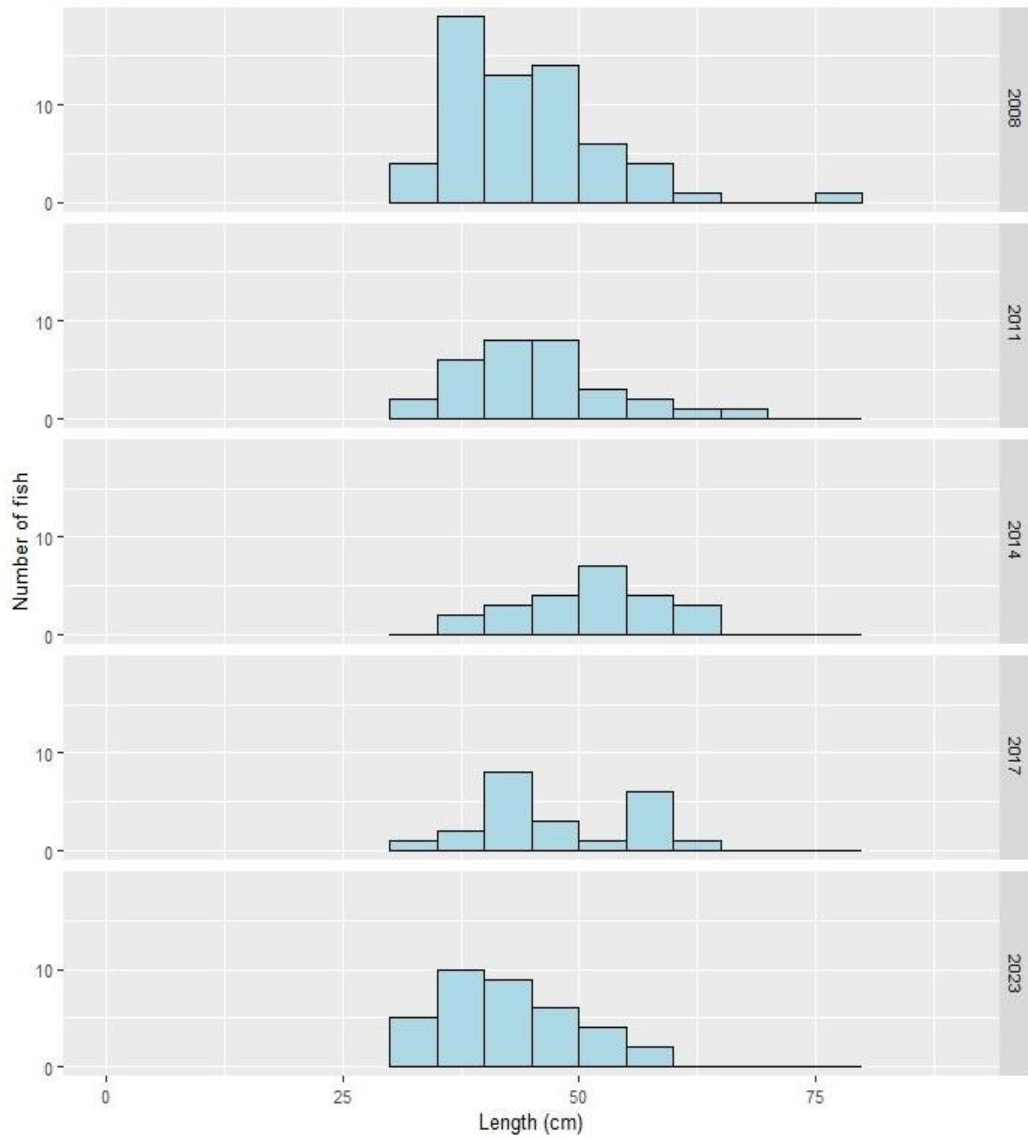
Figure 3.12. Length frequency of European eel captured on Lough Gill between 2008 and 2023

Other fish species

Two pike captured measured 46.4cm and 52.6cm.

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, brown trout and pike captured during the survey were examined and are presented below.

Perch

A total of 97 perch stomachs were examined. Forty-two (43%) were empty. Fifty-five stomachs contained food. Invertebrates were the sole prey type recorded in 23 (42%) stomachs and were found together with zooplankton in three (5%) stomachs. Zooplankton was the sole prey type recorded in 14 (25%) stomachs. Fish was the sole prey type recorded in twelve (22%) stomachs and was found together with invertebrates in a further two (4%) perch stomachs. Unidentified digested material was recorded in one fish (1.8%) (Figure 3.12).
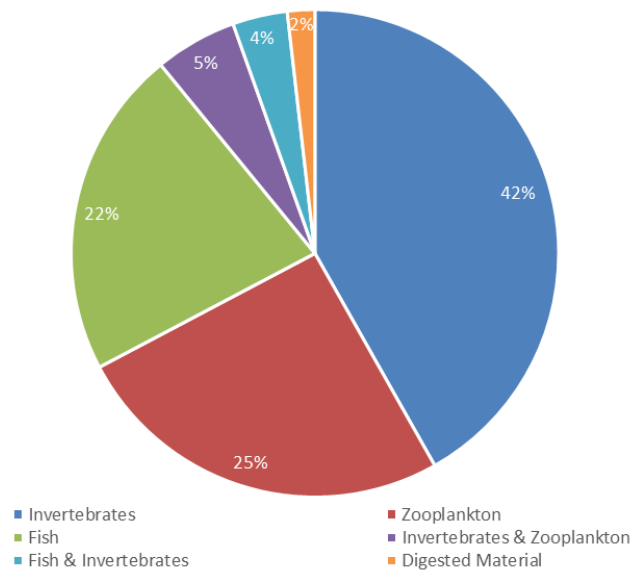

Figure 3.13. Diet of perch (N = 55) captured on Lough Gill, 2023 (% FO).

Brown trout

A total of three brown trout stomachs were examined, one of which was empty. The contents of the remaining two stomachs consisted solely of invertebrates.

Pike

Two pike stomachs were available for analysis. Of these, one was empty, while the other contained unidentified fish remains.

4.   Summary and fish ecological status

A total of six fish species and one cyprinid hybrid type were recorded in Lough Gill in July 2023. Perch was the dominant species in terms of abundance (CPUE) while roach x bream hybrids had the highest biomass (BPUE) captured in the survey gill nets during the 2023 survey.

Both the two most abundant species (i.e. perch and roach) are recruiting regularly in the lake. Both populations are stable and neither population was dominated by any particular age cohort.

The roach x bream hybrid population was characterised by a dominance of large and old fish. There was limited evidence of successful recruitment (which requires spawning populations of both parent species (Hayden *et al*., 2010) in this variety in recent years.

The youngest bream sampled was assigned an age of 7+. While bream populations remain relatively stable, the absence of smaller and younger bream suggests that recruitment has been limited in recent years.

Brown trout continue to be recorded in relatively small numbers. Abundance and biomass was typically higher in floating nets for this species.

Classification and assigning lakes with an ecological status is a critical part of the WFD monitoring programme. It allows for the identification and prioritisation of 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) in order to make it fully WFD compliant, including producing EQR (Ecological Quality Ratio) values for each lake and associated confidence in classification (Kelly *et al.*, 2012b).

Using the FIL2 classification tool, Lough Gill has been assigned an ecological status of Moderate for 2023 based on the fish populations present. Lough Gill was assigned a status of Good for all previous surveys of the lake since 2008 (Figure 4.1).

In the 2016 to 2021 surveillance monitoring reporting period, the EPA assigned Lough Gill an overall ecological status of Poor, based on all monitored physico-chemical and biological elements, including fish (EPA 2021).
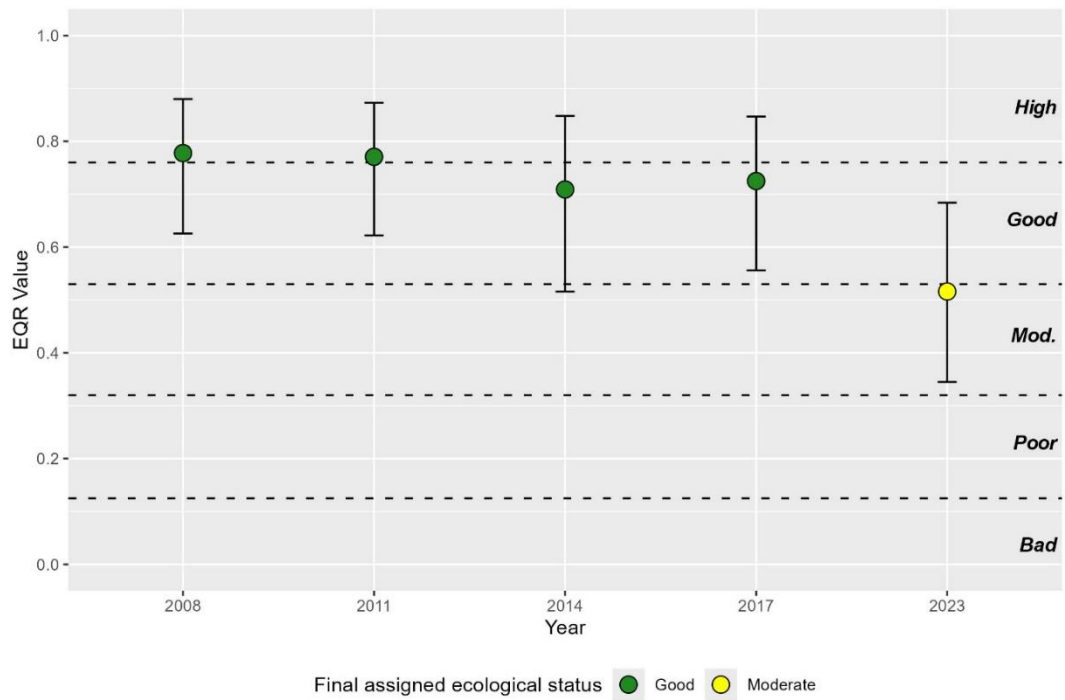
Figure 4.1. Fish ecological status, Lough Gill, between 2008 and 2023 (dashed line indicates EQR status boundaries).

Plate 3.1. Servicing a survey gill net on Lough Gill, July 2023.

5. References

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