

# National Research Survey Programme

## Lakes 2022

### Lough Macnean Lower

IFI/2023/1-4666



Iascach Intíre Éireann  
Inland Fisheries Ireland

## **Fish Stock Survey of Lough Macnean Lower, August 2022**



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Inland Fisheries Ireland**

National Research Survey Programme

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## 1. Introduction

Lough Macnean Lower is a large freshwater lake located in County Fermanagh, at an altitude of 51m a.s.l. (Plate 1.1, Figure 1.1). It is a mesotrophic lake, with a surface area of 456ha, mean depth of 1.5m and maximum depth of 12.7m. The lake is categorised as typology class 6 (as designated by the EPA for the purposes of the Water Framework Directive), *i.e.*, shallow (<4m), greater than 50ha and moderately alkaline (20-100mg/l CaCO<sub>3</sub>).

Lough Macnean Lower is fed by the Belcoo River which flows from Lough Macnean Upper into the lake near the village of Belcoo (Figure 1.1). Lough Macnean Lower contains two islands, Cushrush Island which is the larger of the two and Inishee or Jinny's Island, which is smaller and is completely forested. A causeway was built onto Cushrush Island in the 1960's to allow animals to be moved on to the island. The shores of both the lower and upper loughs have good examples of wet woodland and of extensive fen and reed bed communities (NIEA, 2009b). The islands in both loughs are important breeding sites for lapwing (*Vanellus vanellus*), snipe (*Gallinago gallinago*) and curlew (*Numenius arquata*) (NIEA, 2009b).

Both Lough Macnean Upper and Lough Macnean Lower were formed by a process of glaciation. Glaciers excavated deep basins in the carboniferous rocks, creating steep valley sides and rocky cliffs (NIEA, 2009a). The lower lough is enclosed by a steep limestone escarpment. Agricultural usage along the shorelines of Lough Macnean Lower is more developed when compared to the upper lough. The underlying limestone soils produce good quality grassland, and the southern shores and lower slopes are farmed intensively (NIEA, 2009a).

The shape of Lough Macnean Lower was changed dramatically during the 1960's when a major dredging operation took place. The level of the lake was dropped by approximately 1m resulting in wide areas of shallows as well as exposure of a lot of soft and barren shoreline (IFT, unpublished data).

In a survey carried out in 1969, perch (*Perca fluviatilis*), pike (*Esox lucius*), rudd (*Scardinius erythrophthalmus*), roach (*Rutilus rutilus*), bream (*Abramis brama*), rudd x bream (*Scardinius erythrophthalmus* x *Abramis brama*) and roach x bream (*Rutilus rutilus* x *Abramis brama*) hybrids were all recorded in Lough Macnean Lower (IFT, unpublished data). The lake was again surveyed in 2006, 2010, 2013 and 2016 (Kelly *et al.*, 2007, 2011, 2014 and 2017). During the 2016 survey perch were found to be the dominant species present in the lake, followed by roach. Roach x bream hybrids, rudd, pike, eels (*Anguilla anguilla*) and bream were also recorded.

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.

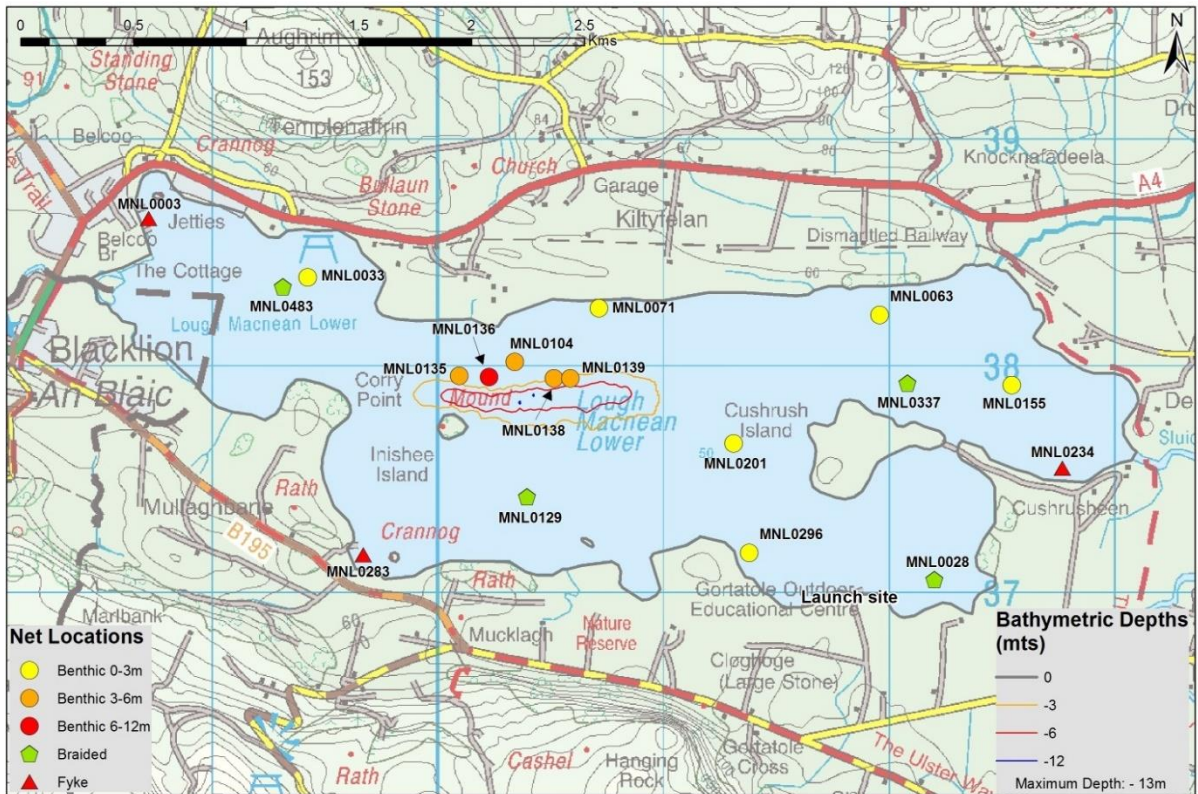


Figure 1.1. Location map of Lough Macnean Lower showing net locations and depths of each net (outflow is indicated on map).

## 2. Methods

### 2.1. Netting methods

Lough Macnean Lower was surveyed over two nights from the 27<sup>th</sup> to the 29<sup>th</sup> of July 2022. A total of three sets of Dutch fyke nets and eleven benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (6 @ 0-2.9m, 4 @ 3-5.9m and 1 @ 6-11.9m) were deployed in the lake (14 sites). 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 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 sub-sample of other species except eels. 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 counted and 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).

$$FO_i = \left( \frac{N_i}{N} \right) * 100$$

Where:

$FO_i$  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.

### 3. Results

#### 3.1. Species Richness

Eight fish species and one type of hybrid were recorded on Lough Macnean Lower in July 2022. A total of 831 fish were captured (Table 3.1). Perch and roach were the most common fish species recorded, together representing c. 77% of all fish captured. Roach and roach x bream hybrids were also recorded in relatively large numbers (Table 3.1). Brown trout, bream, pike, tench, gudgeon and eels were recorded in smaller numbers. Generally similar species mixes were recorded on previous sampling occasions. Tench were recorded for the first time in 2016 (Kelly *et al.*, 2017), and brown trout were recorded for the first time (in recent surveys) in 2022.

**Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Macnean Lower, July 2022.**

Scientific name	Common name	Number of fish captured			
		BM CEN	4-PBB	Fyke	Total
<i>Perca fluviatilis</i>	Perch	403	2	0	405
<i>Rutilus rutilus</i>	Roach	237	2	0	239
<i>R. rutilus x Abramis brama</i>	Roach x bream hybrid	129	38	0	167
<i>Abramis brama</i>	Bream	5	3	0	8
<i>Esox lucius</i>	Pike	3	2	1	6
<i>Salmo trutta</i>	Brown trout	1	0	0	1
<i>Tinca tinca</i>	Tench	0	0	1	1
<i>Gobio gobio</i>	Gudgeon	1	0	0	1
<i>Anguilla anguilla</i>	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. Perch and roach were the dominant species with respect to abundance (mean CPUE) in 2022. Roach x bream hybrids recorded the highest biomass (mean BPUE) of all species captured Table 3.2.

For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type between 2006 and 2022 are presented in Figures 3.1a to 3.2b and illustrates fish community change over time. Populations (abundance and biomass) of the two most abundant species (perch

and roach) have fluctuated across the surveys; however there was no obvious trend apparent. However, both abundance and biomass of roach x bream hybrids have increased across all surveys since 2006 (Figure 3.2 and b).

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

Scientific name	Common name	Mean CPUE ( $\pm$ S.E)	Mean BPUE ( $\pm$ S.E)
<i>Perca fluviatilis</i>	Perch	0.747 (0.235)	18.006 (3.910)
<i>Rutilus rutilus</i>	Roach	0.440 (0.126)	35.879 (9.260)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.258 (0.048)	74.873 (18.122)
<i>Abramis brama</i>	Bream	0.011 (0.004)	5.589 (2.227)
<i>Esox lucius</i>	Pike	0.008 (0.003)	15.672 (9.307)
<i>Salmo trutta</i>	Brown trout	0.002 (0.002)	0.299 (0.299)
<i>Tinca tinca</i>	Tench	0.001 (0.001)	0.058 (0.058)
<i>Gobio gobio</i>	Gudgeon	0.002 (0.002)	0.019 (0.019)
<i>Anguilla anguilla</i>	European eel	0.017 (0.010)	7.099 (3.897)

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



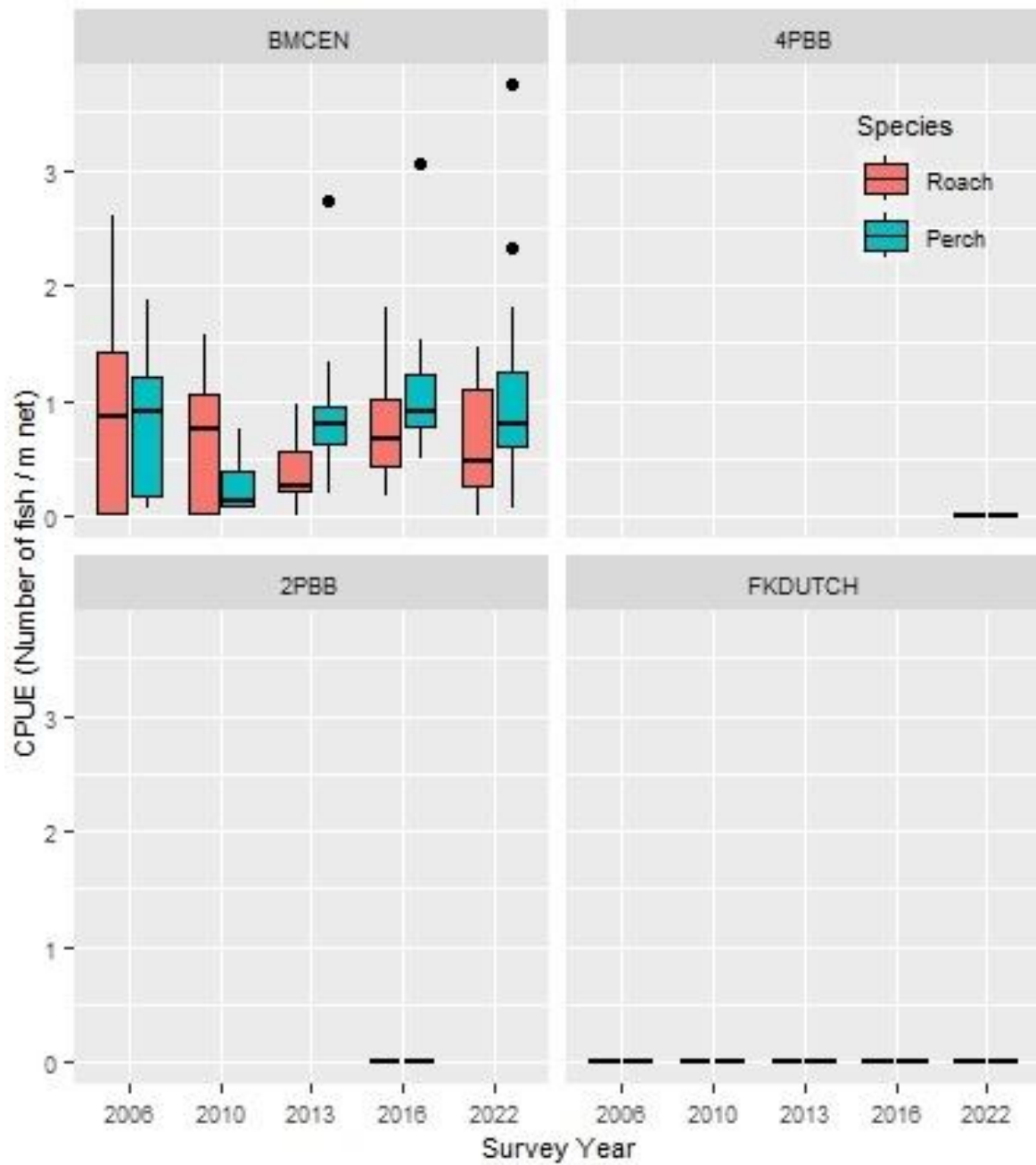


Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Lough Macnean Lower between 2006 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

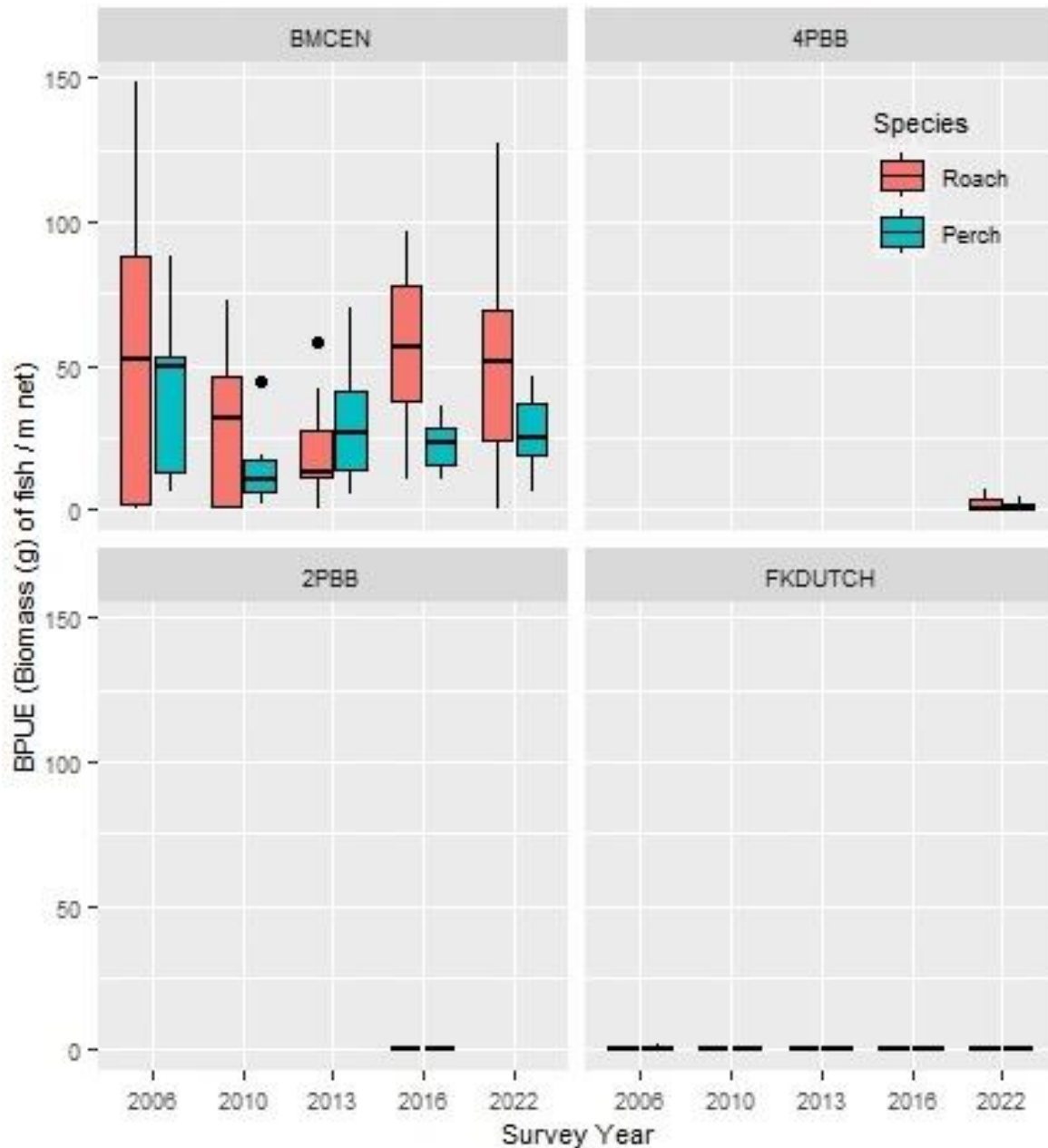


Figure 3.1b. BPUE of roach and perch captured in each net type during surveys of Lough Macnean Lower from between 2006 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

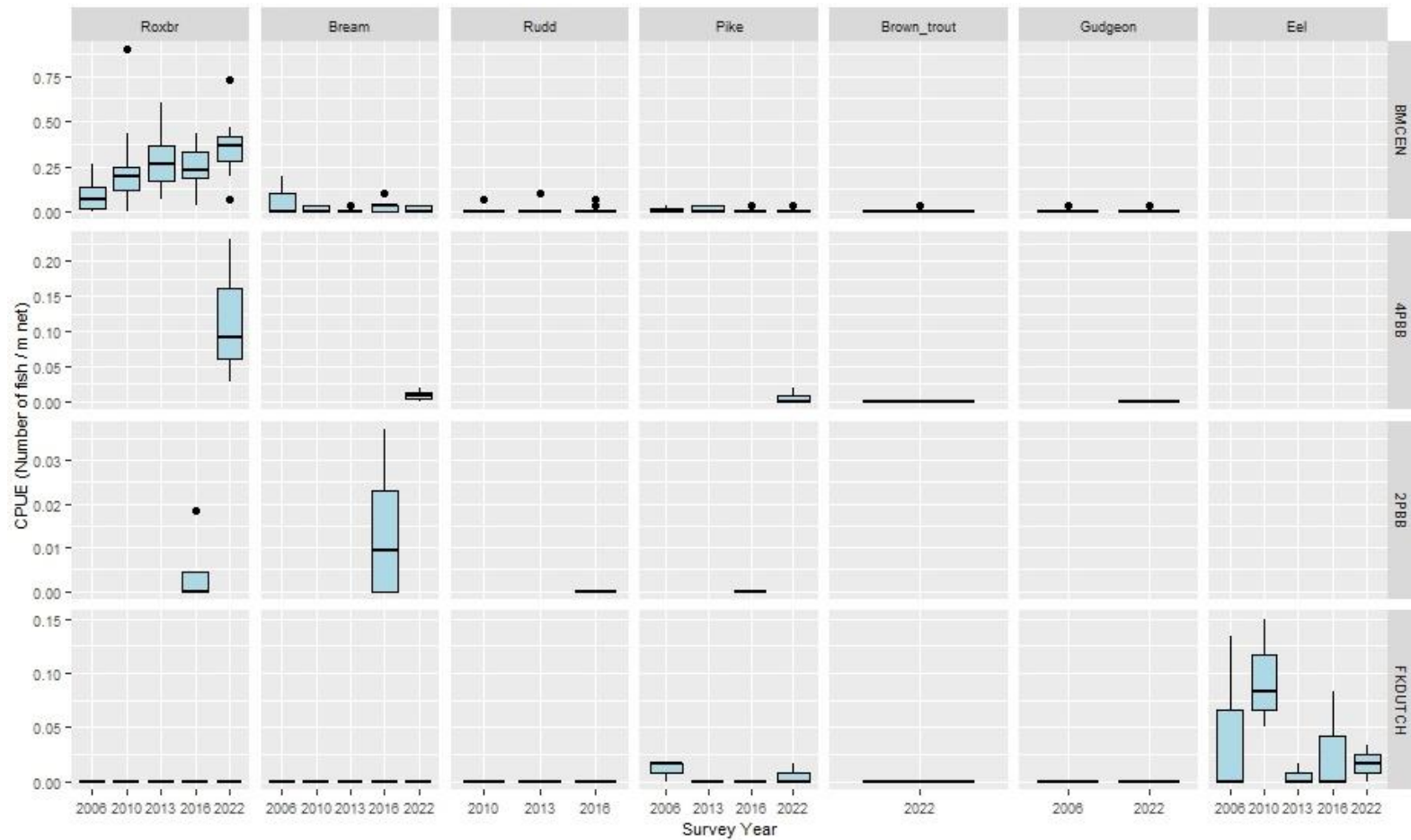
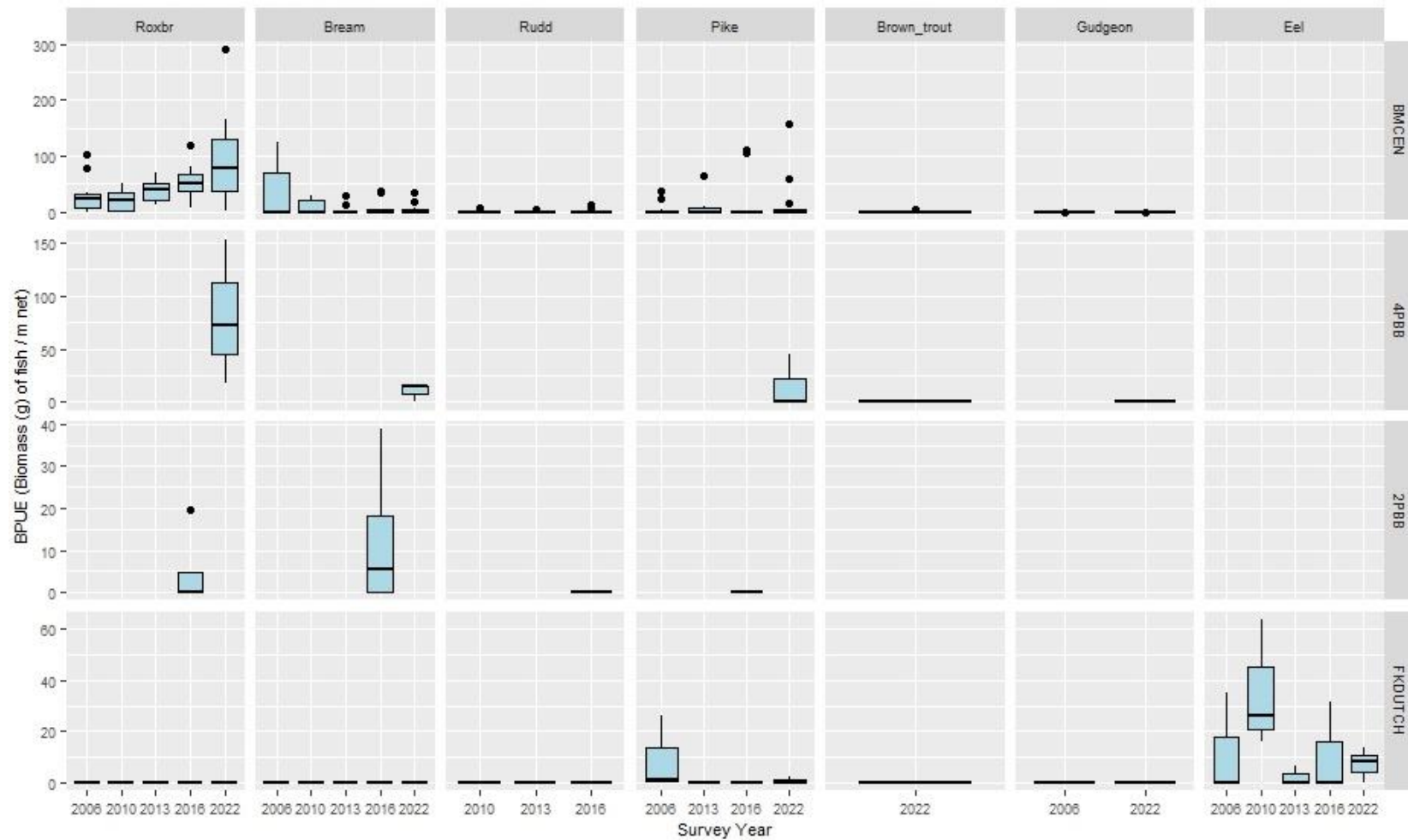


Figure 3.2a. CPUE of other fish species captured in each net type during surveys of Lough Macnean Lower between 2006 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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.

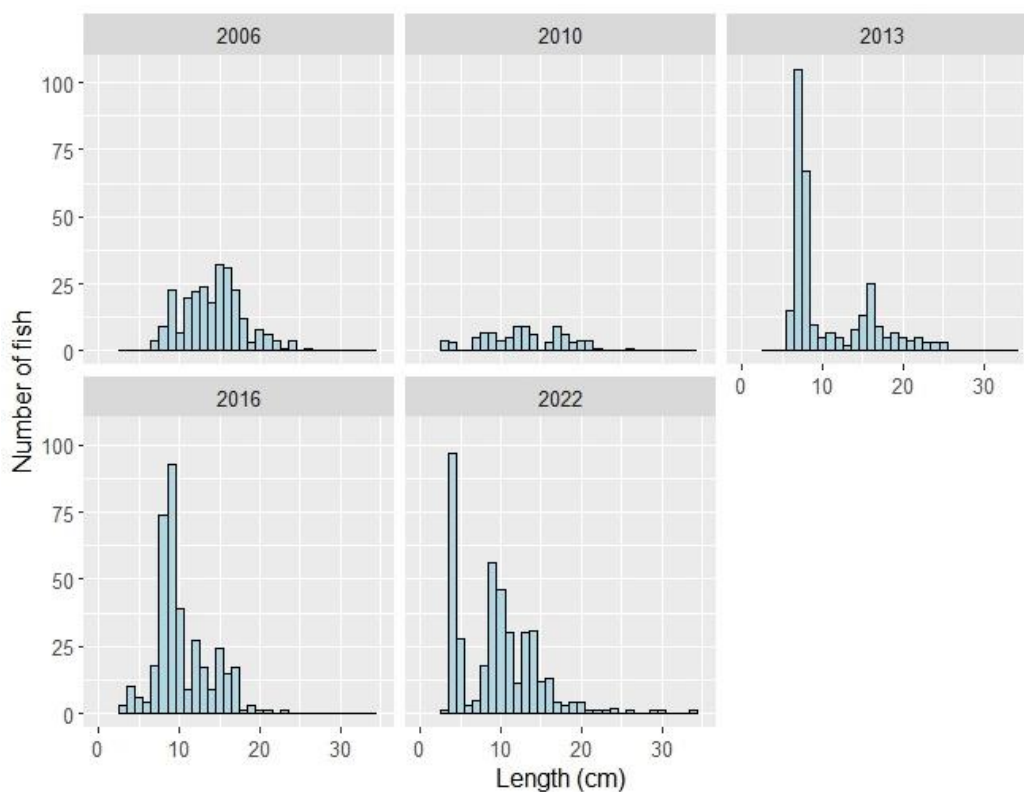


**Figure 3.2b. BPUE of other fish species captured in each net type during surveys of Lough Macnean Lower from between 2006 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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 3.0cm to 33.9cm (mean 9.6cm). Perch captured during previous surveys had a similar length and age range with some larger and older fish recorded in the 2022 survey (Figure 3.3). Perch were aged between 1+ and 6+, and all intervening age classes were present (very small fish were not aged). Mean L1 (i.e. age at the end of the 1<sup>st</sup> year) was 7.4cm (Table 3.3). This suggests that the modal peak at 5cm represent 0+ juveniles in their first year of life. Other strong size and age groups were apparent (Figure 3.3).



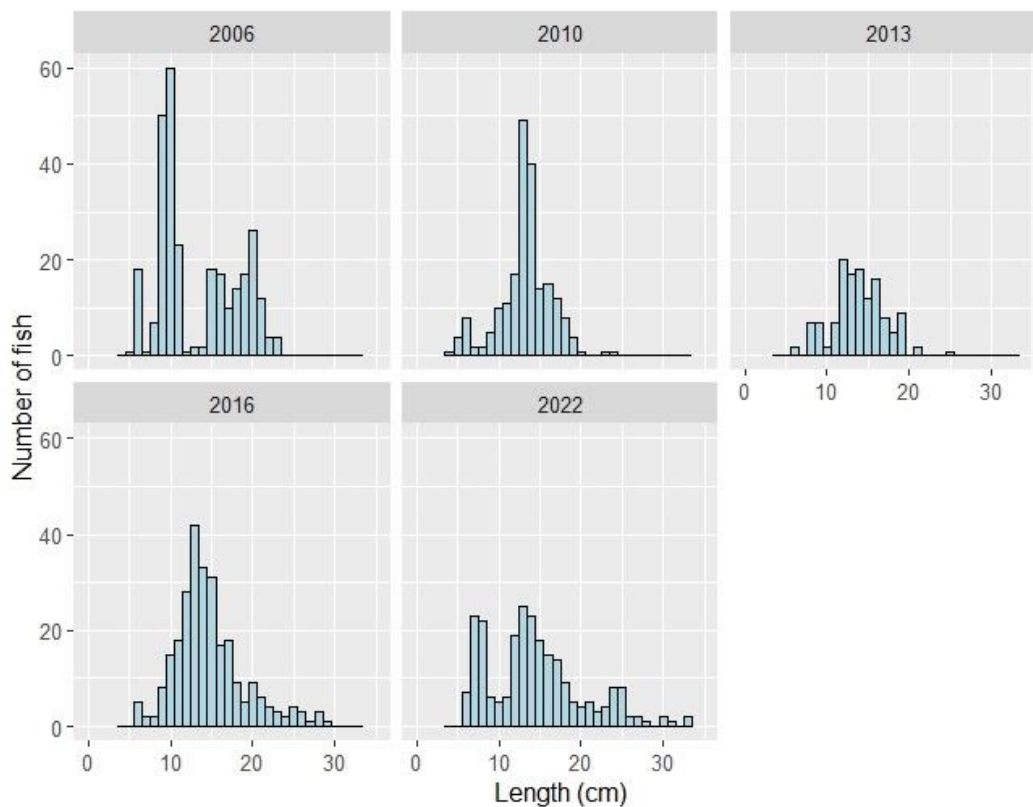
**Figure 3.3. Length frequency of perch captured on Lough Macnean Lower, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.3. Mean ( $\pm$ S.E.) perch length (cm) at age for Lough Macnean Lower, July 2022**

Length (cm)	Age class					
	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>
Mean ( $\pm$ S.E.)	7.4 (0.2)	12.0 (0.3)	15.9 (0.6)	18.9 (0.6)	22.6 (0.2)	-
N	59	36	16	9	3	1
Range	5.1 - 11.0	8.4 - 14.8	11.7 - 20.2	15.2 - 21.5	22.4 - 23.0	24.9

## Roach

Roach captured during the 2022 survey ranged in length from 6.0cm to 33.5cm (mean 14.6cm). Larger fish (i.e. > 15-20cm) were more prominent in the sample in 2022 compared to earlier surveys (Figure 3.4). Roach were aged between 1+ and 11+ and all intervening age groups (with the exception of 10+ fish) were represented in the sample aged (Table 3.4). Three year old fish were the most abundant age class in the sample. However, other age groups were also strongly represented with evidence of persistence of older individuals in the population (Table 3.4).



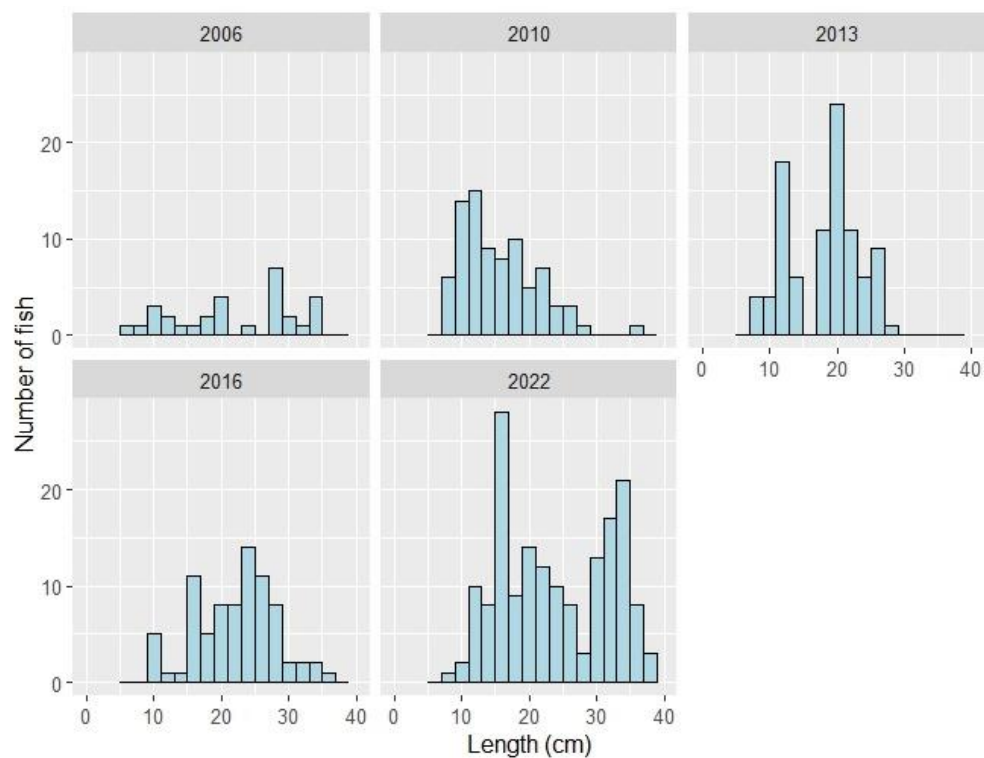
**Figure 3.4. Length frequency of roach captured on Lough Macnean Lower, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.4. Summary age data from roach captured on Lough Macnean Lower, July 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+
N	0	5	10	11	10	7	5	9	4	3	0	1
Mean L (cm)	-	10	12.3	14.2	16.2	18.9	20.6	24.1	23.9	27.4	-	-
Min L (cm)	-	7.8	10	12.2	14	15.5	17.2	21.5	22	24.5	-	33.5
Max L (cm)	-	12.2	13.5	15.5	17.1	22.5	23.5	26.9	24.8	29.7	-	33.5

### Roach x bream hybrid

Roach x bream hybrids captured during the 2022 survey ranged in length from 7.4cm to 38.6cm (mean 24.0cm) (Figure 3.5). Roach x bream hybrids were aged between 1+ and 12+ and all intervening age classes were present (Table 3.5). Several strong year classes were present in the sample aged (Table 3.5). The persistence of older cohorts, particular 10+ fish is evident in the larger numbers of fish measuring between 29cm and 37cm. Larger and older fish were more prominent in the population in 2022 compared to earlier surveys (Figure 3.5).



**Figure 3.5. Length frequency of roach x bream hybrid captured on Lough Macnean Lower, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.5. Summary age data from roach x bream hybrids captured on Lough Macnean Lower, July 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+
<b>N</b>	0	2	9	13	6	13	17	3	3	0	14	4	6
<b>Mean L (cm)</b>	-	9.7	12.4	16.3	16.9	20.1	22	27.2	29.3	32.5	33.4	34.8	36.4
<b>Min L (cm)</b>	-	7.4	11	11.5	13.3	14.1	15.5	22.9	23	29.6	29.6	33.2	33.5
<b>Max L (cm)</b>	-	11.9	15.3	22.8	19.3	24.1	27	29.5	35.8	34.7	37	37.2	38.6

### Other fish

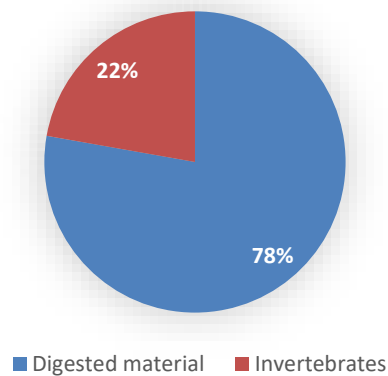
Pike ranged in length from 25.6cm to 85.2cm (mean 58.9cm) and in age from 2+ to 7+. Bream ranged from 25.6cm to 85.2cm (mean 30.9cm) and were aged from 5+ to 14+. Three eels captured during the 2022 survey ranged in length from 61.0cm to 65.0cm (mean 62.7cm). Tench (15.1cm, 2+), brown trout (24.0cm, 2+) and gudgeon (9.3cm) were also captured.

### **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 captured during the survey were examined and are presented below.

### Perch

A total of 56 perch stomachs were examined. Of these 47 (84%) were empty. Of the nine stomachs containing food, seven (78%) contained unidentified digested material. Invertebrates were found in two (22%) perch stomachs (Figure 3.6).



**Figure 3.6. Diet of perch (N = 9) captured on Lough Macnean Lower, 2022 (% FO).**

### Pike

The stomach contents of six pike were available for dietary analysis. Two stomachs were empty. Three pike (25.6cm to 68.8cm) had fed on fish. The stomach of one (43.3cm) pike contained invertebrates.

### Brown trout

One brown trout captured during the 2022 survey was found to be empty.



## 4. Summary

Eight fish species and one type of hybrid were recorded on Lough Macnean Lower in July 2022. A similar species mix was recorded on previous sampling occasions.

Roach and perch were the dominant fish species in terms of abundance (mean CPUE). Both species have each been recruiting regularly in the lake and populations have remained relatively stable across all surveys of the lake. Populations of both species were dominated by younger age classes, but with some persistence of older individuals. This is particularly marked in the roach population where several strong older year classes were present.

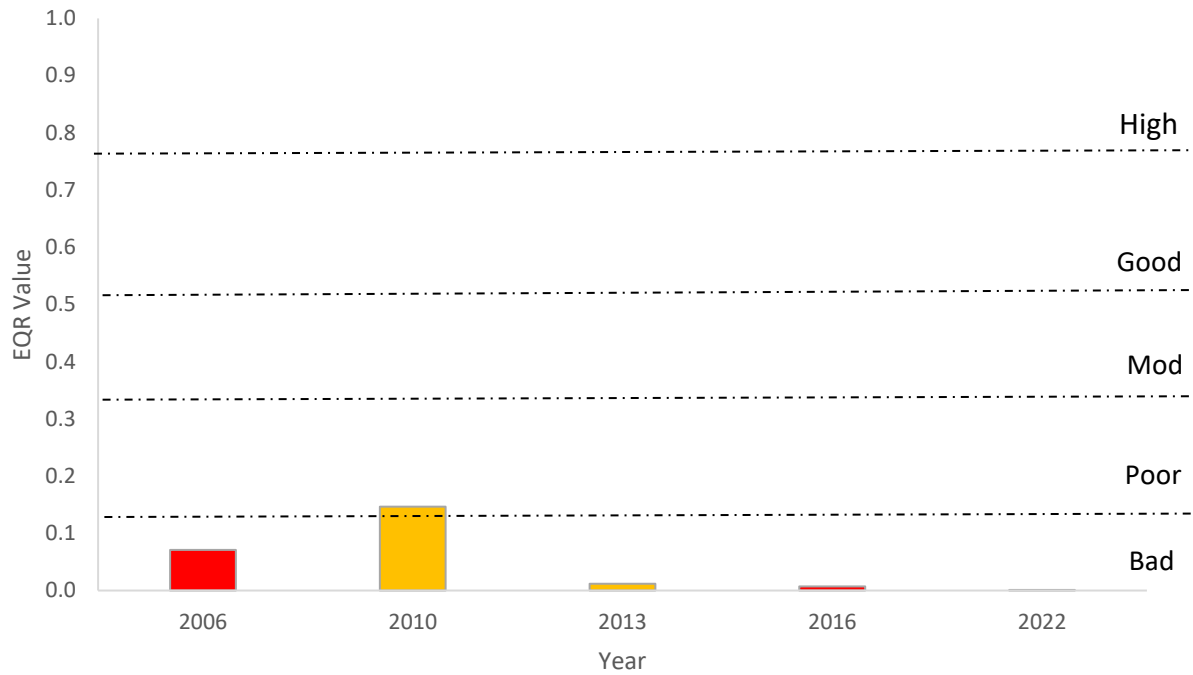
Roach x bream hybrids were also captured in relatively large numbers and had the highest biomass (mean BPUE) of all fish captured in the survey. The roach x bream hybrid population, which requires both parent species to spawn (Hayden *et al.*, 2010), also exhibited consistent recruitment patterns. All the younger year groups were present, and there were several relatively strong older (i.e. > 10+) year classes apparent.

A single brown trout was captured in 2022. This is the first time a brown trout has been recorded in an IFI survey on 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, Macnean Lower Lough has been assigned an ecological status of Bad for 2022 based on the fish populations present. The lake was previously assigned Bad status in 2006 and 2016. In 2013 the FIL2 tool assigned Bad status to the lake; however on expert opinion review upgraded the lake to Poor. In 2010 the Lough was also assigned Poor status (Figure 4.1).

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



**Figure 4.1. Fish ecological status, Macnean Lower Lough, 2006, 2010, 2013, 2016 and 2022 (dashed line indicates EQR status boundaries).**

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