

# National Research Survey Programme

## Lakes 2022

### Lough Macnean Upper

IFI/2023/1-4667



Iascach Intíre Éireann  
Inland Fisheries Ireland

## **Fish Stock Survey of Lough Macnean Upper, August 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., 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

© Inland Fisheries Ireland 2023

## **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.

*The report includes Ordnance Survey Ireland data reproduced under OSi Copyright Permit No. MP 007508.*

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.*

*© Ordnance Survey Ireland, 2022.*

## 1. Introduction

Lough Macnean Upper is the larger of the two Macnean lakes, situated on the border of counties Fermanagh, Leitrim and Cavan at an altitude of 47m a.s.l. (Plate 1.1, Figure 1.1). It is a mesotrophic lake with a surface area of 644ha, mean depth of 5.2m and maximum depth of 22.7m. The lake falls into 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<sub>3</sub>).

Lough Macnean Upper is fed by several rivers (Lurgan, Esky and Black Rivers) and flows into Lough Macnean Lower via the Belcoo River. 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 shores of the lake have good examples of wet woodland and extensive fen and reed bed communities (NIEA, 2009b). The islands on the lake are important breeding sites for lapwing (*Vanellus vanellus*), snipe (*Gallinago gallinago*) and curlew (*Numenius arquata*) (NIEA, 2009b). The white-clawed crayfish (*Austropotamobius pallipes*), a species listed on Annex II of the EU Habitats Directive, has been recorded in the lake (NIEA, 2009b).

Lough Macnean Upper is a mixed coarse fishery and is particularly noted for its pike angling. The shoreline is broken up by areas of woodland and sheltered bays fringed with reed swamps and fen (NIEA, 2009a). Agricultural usage along the shoreline of the lake is not very developed when compared to the lower lake. Surrounding fields tend to be rush-infested with overgrown hedges (NIEA, 2009a).

A survey carried out in 1969 revealed perch (*Perca fluviatilis*), pike (*Esox lucius*), roach (*Rutilus rutilus*), roach x bream hybrids (*Rutilus rutilus* x *Abramis brama*) and brown trout (*Salmo trutta*) were present in Lough Macnean Upper (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. Roach, pike, bream (*Abramis brama*), roach x bream hybrids, eels (*Anguilla anguilla*) and brown trout 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.



Plate 1.1. Lough Macnean Upper, July 2022.

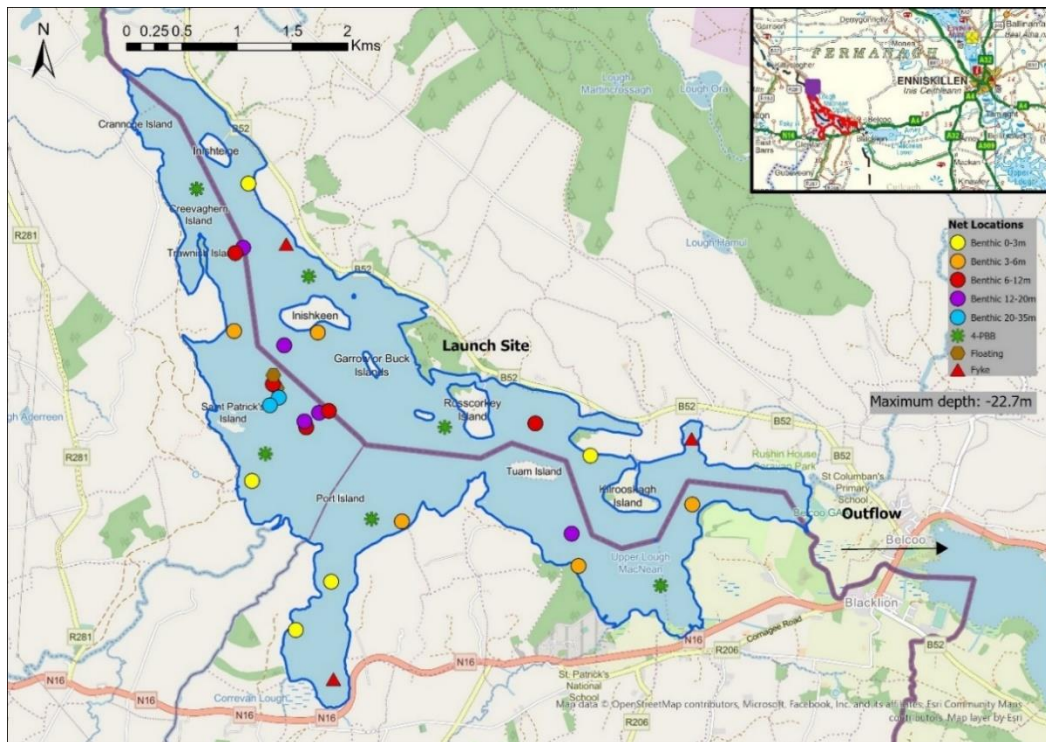


Figure 1.1. Location map of Lough Macnean Upper showing net locations and depths of each net (outflow is indicated on map).

## 2. Methods

### 2.1. Netting methods

Lough Macnean Upper was surveyed over two nights from the 25<sup>th</sup> to the 27<sup>th</sup> of July 2022. A total of three sets of Dutch fyke nets, 22 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m, 5 @ 12-19.9m and 2 @ 20-34.9m) and two floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake. The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at six 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 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

Six fish species and one cyprinid hybrid were recorded on Lough Macnean Upper in July 2022. A total of 878 fish were captured (Table 3.1). Perch and roach were the most common fish species recorded, together representing c. 84% of all fish captured. Roach x bream hybrids, bream, pike, brown trout, and eels were also captured. The same species composition was captured in the 2016 survey (Kelly *et al.*, 2007, 2011, 2014 and 2017).

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

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
<i>Perca fluviatilis</i>	Perch	447	26	0	13	486
<i>Rutilus rutilus</i>	Roach	206	47	0	0	253
<i>R. rutilus x Abramis brama</i>	Roach x bream hybrid	77	0	1	0	78
<i>Abramis brama</i>	Bream	12	0	17	0	29
<i>Esox lucius</i>	Pike	4	1	2	0	7
<i>Salmo trutta</i>	Brown trout	0	0	1	0	1
<i>Anguilla anguilla</i>	European eel	0	0	0	24	24

#### 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 were the dominant species with respect to abundance (CPUE) and biomass (BPUE) across all net types (Table 3.2).

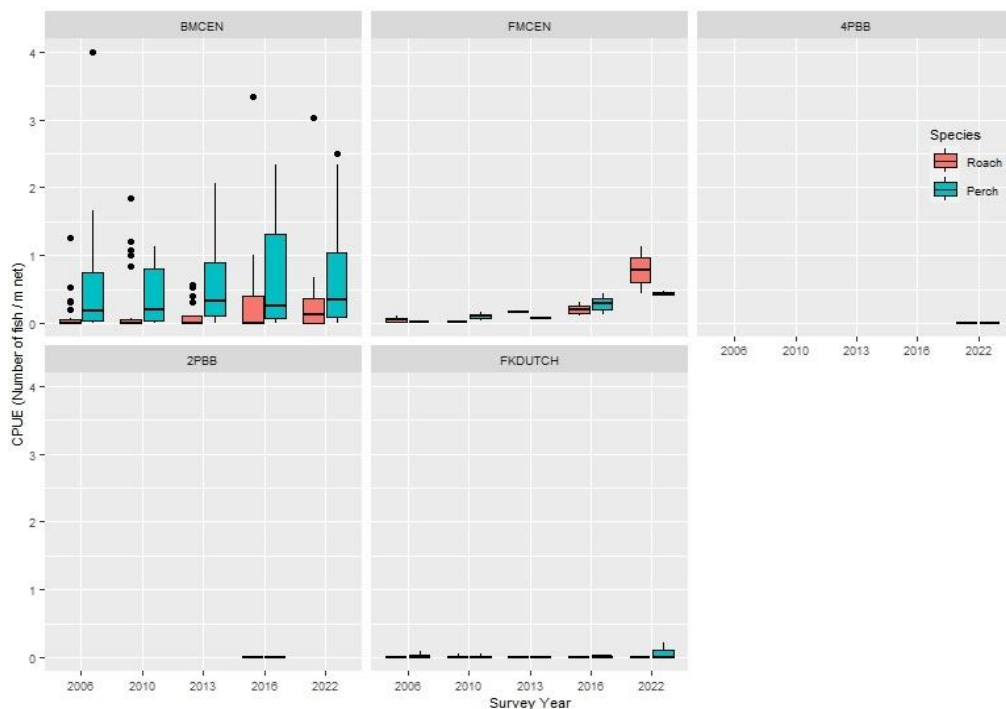
For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type between 2006 and 2022 are presented in Figures 3.1a to 3.2b and illustrates fish community change over time. Perch and roach have dominated fish stocks across all surveys of the lake. While

numbers and biomass have fluctuated, perch CPUE and BPUE have remained relatively stable with no upward or downward trends apparent. There was a slight upward trend in abundance and biomass of roach (Figure 3.1a and b). Eel CPUE and BPUE were lowest during the first survey in 2007 and have fluctuated since that time. No trends in CPUE or BPUE of other species was evident.

**Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Macnean Upper, July 2022.**

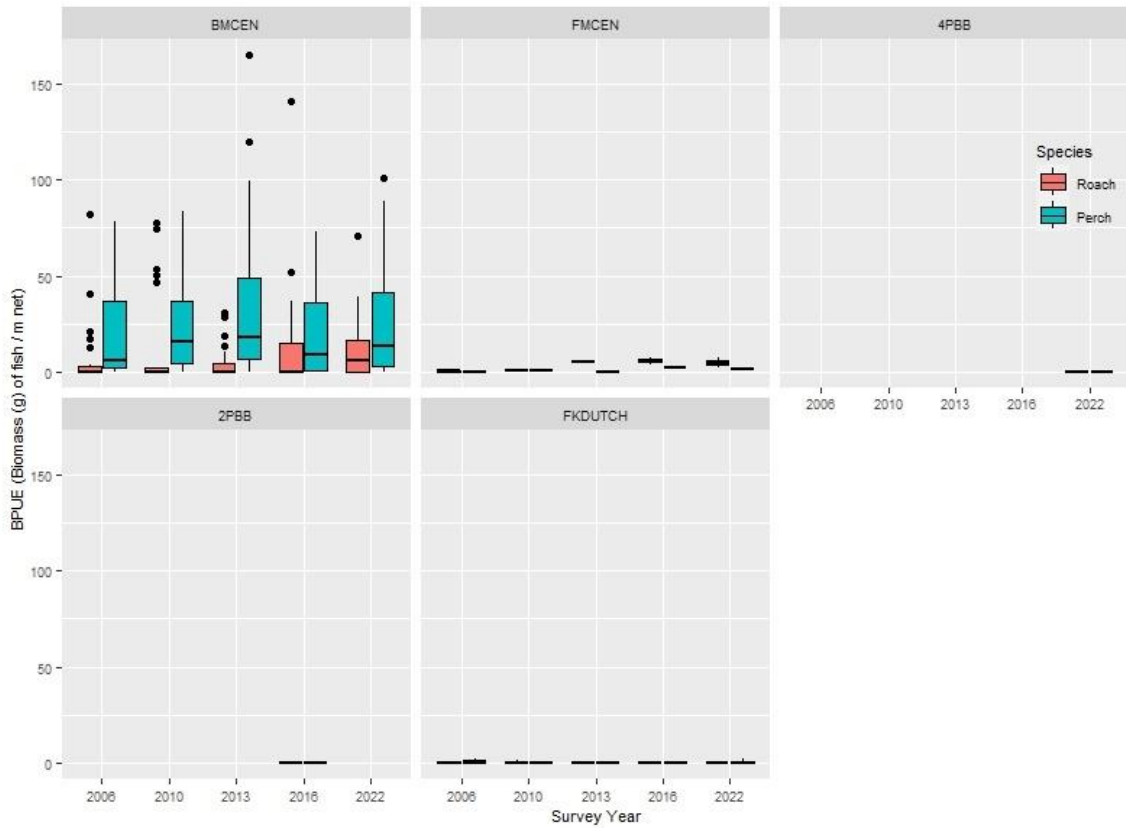
Scientific name	Common name	Mean CPUE ( $\pm$ S.E)	Mean BPUE ( $\pm$ S.E)
<i>Perca fluviatilis</i>	Perch	0.484 (0.119)	18.687 (5.150)
<i>Rutilus rutilus</i>	Roach	0.256 (0.098)	7.852 (2.531)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.078 (0.034)	8.700 (3.018)
<i>Abramis brama</i>	Bream	0.017 (0.005)	9.731 (3.413)
<i>Esox lucius</i>	Pike	0.006 (0.002)	11.371 (5.560)
<i>Salmo trutta</i>	Brown trout	0.000 (0.000)	0.044 (0.044)
<i>Anguilla anguilla</i>	European eel	0.133 (0.067)	30.505 (16.430)

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.

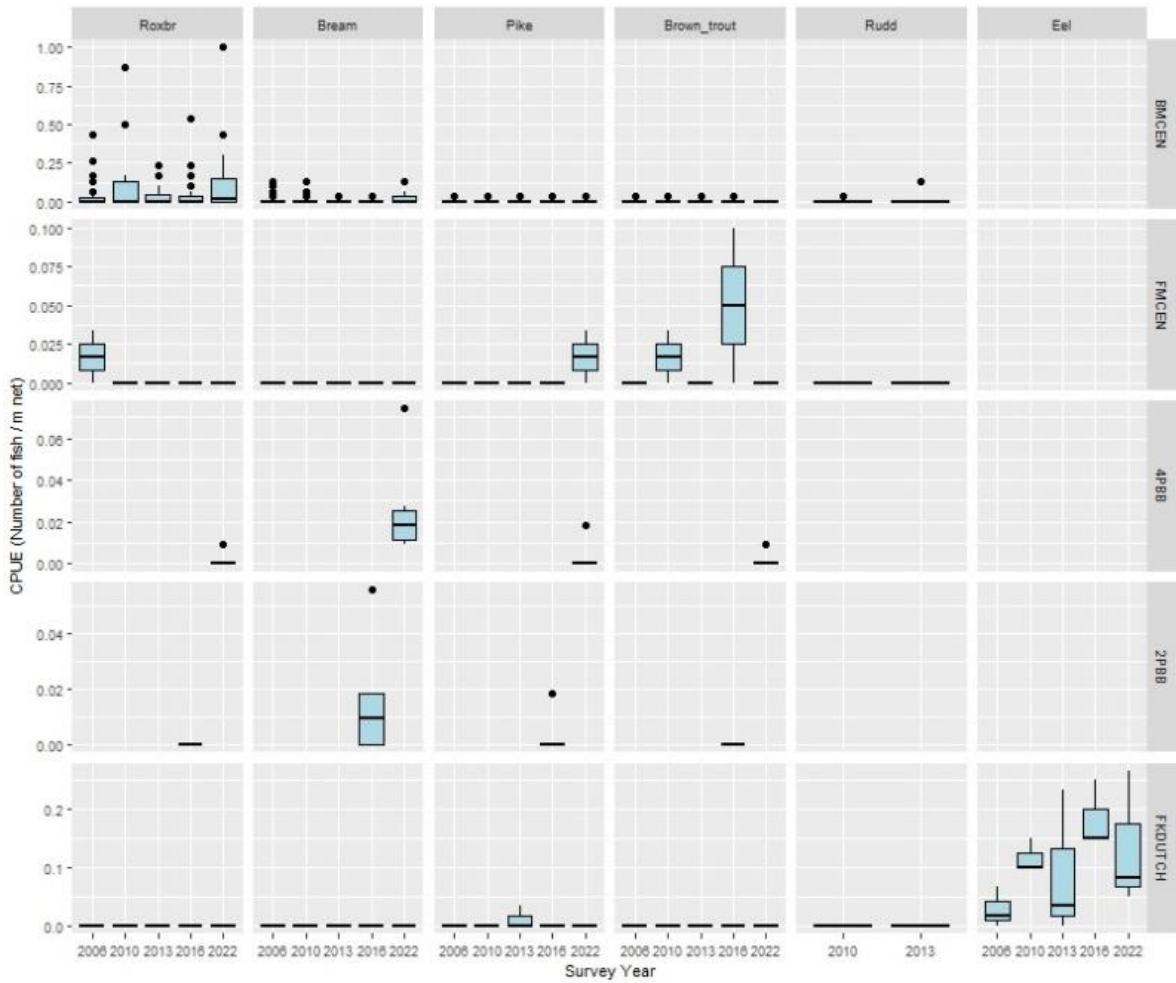


**Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Lough Macnean Upper between 2006 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 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.**

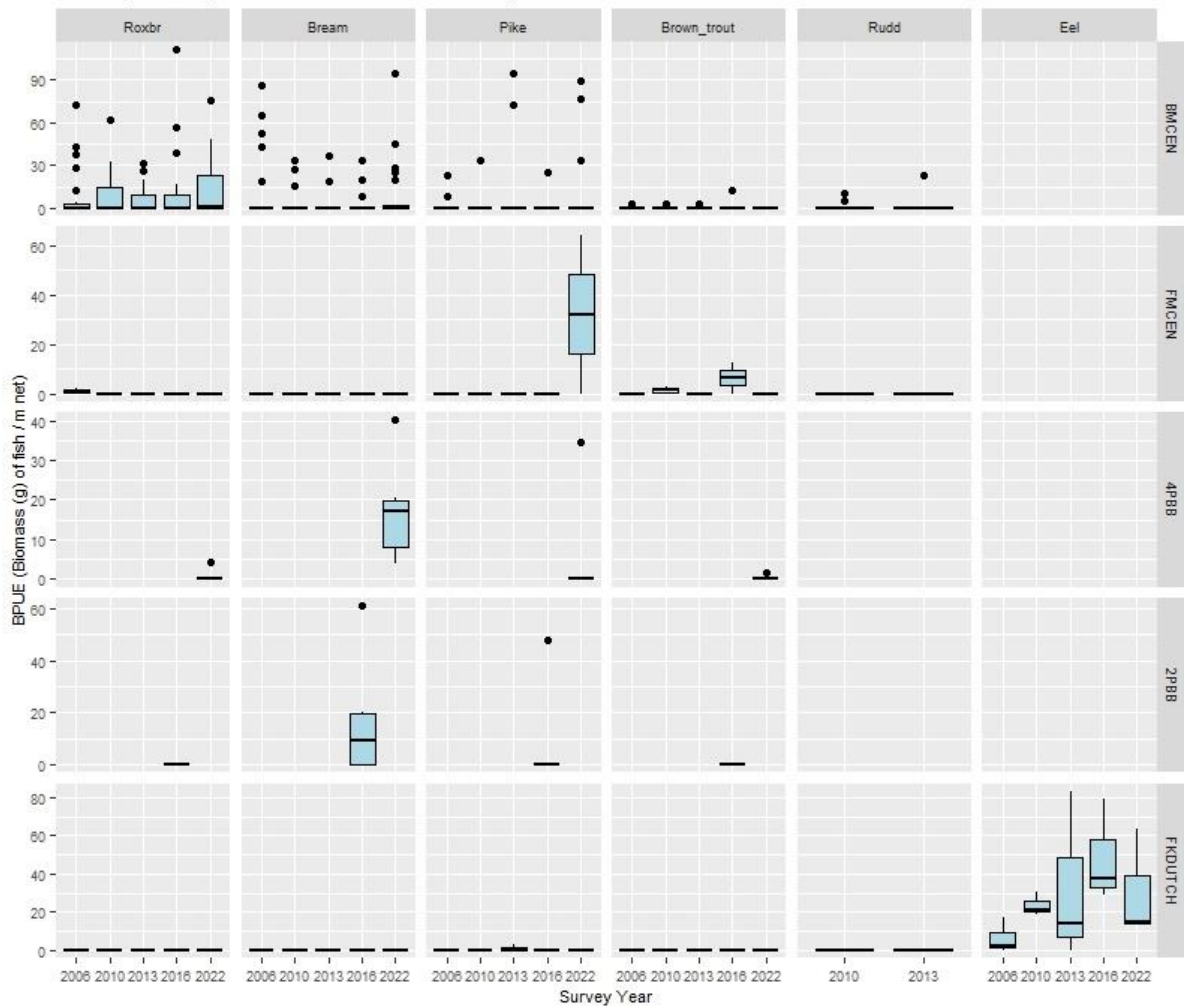




**Figure 3.1b. BPU.E of roach and perch captured in each net type during surveys of Lough Macnean Lower from between 2006 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</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 Upper 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.**

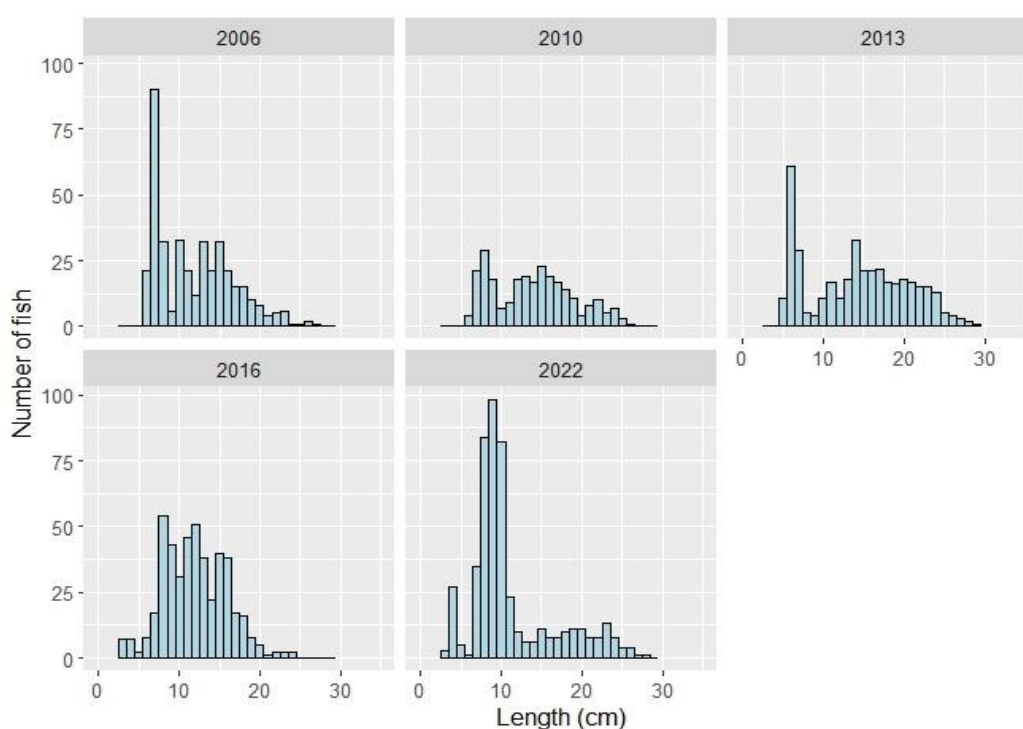


**Figure 3.2b. BPUE of other fish species captured in each net type during surveys of Lough Macnean Upper from between 2006 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</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 3.5cm to 28.0cm (mean 11.2cm) (Figure 3.3). Perch captured during previous surveys had similar length ranges overall, although the relative proportions of length (and age classes) has varied between surveys (Figure 3.3). Perch were aged between 1+ and 8+ and all intervening age classes were present in the sample. Mean L1 (i.e. length at the end of the 1<sup>st</sup> year) was 6.0cm (Table 3.3). The most abundant age class was 1+ (c.6cm-12cm, Figure 3.3).



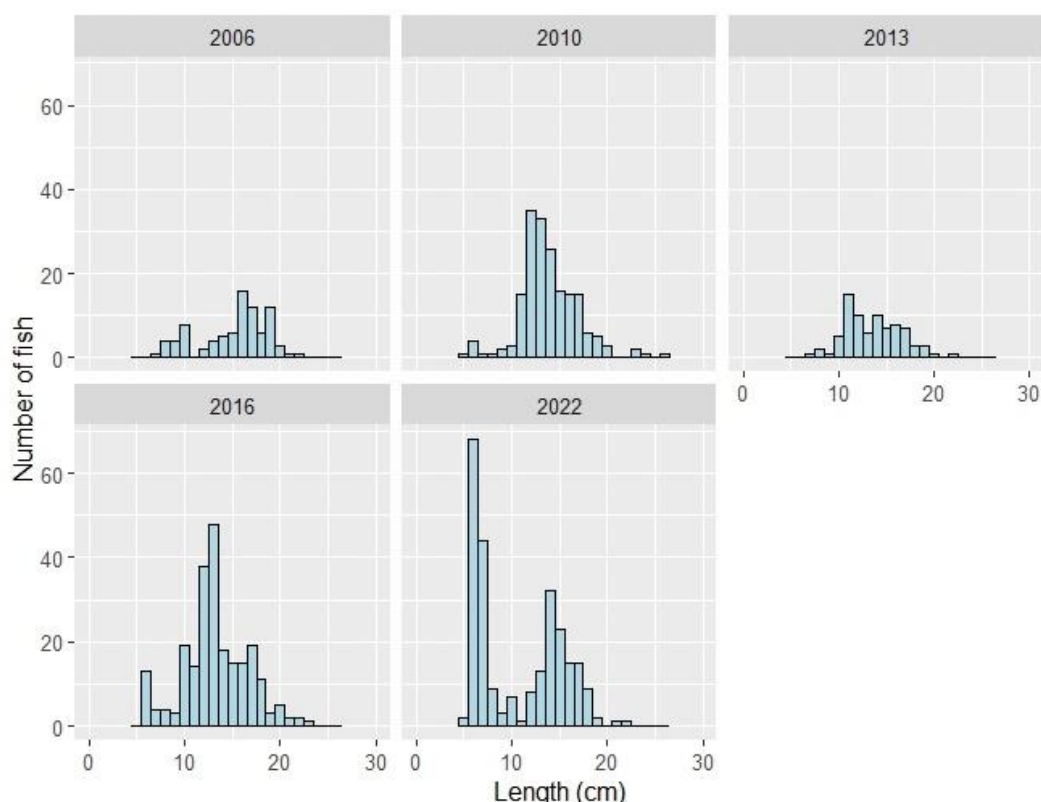
**Figure 3.3. Length frequency of perch captured on Lough Macnean Upper, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.3. Mean ( $\pm$ S.E.) perch length (cm) at age for Lough Macnean Upper, 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>	L <sub>7</sub>	L <sub>8</sub>	L <sub>9</sub>
Mean	6.0)	9.7	13.8	16.9	19.2	22.1	23.2	25	25.5
$\pm$ S.E.	0.1	0.2	0.2	0.3	0.3	0.4	0.6	1	1.2
N	100	80	68	59	43	24	12	3	2
Min	4.2	6.8	9.7	12.3	15.1	17.9	18.7	23.1	24.3
Max	8.7	13.8	19.1	21.9	22.5	25.2	25.6	26.4	26.47

## Roach

Roach captured during the 2022 survey ranged in length from 5.0cm to 22.0cm (mean 10.8cm). Few large fish (>20cm) were recorded in any survey of the lake and in 2022 the roach population was characterised by a large proportion of smaller (and younger) individuals (Figure 3.4). Roach were aged between 1+ and 8+ and all intervening age classes were represented in the sample aged (Table 3.4). The population was dominated by younger age classes and the most abundant age class was 2+ (6-8cm; Figure 3.4; Table 3.4). Other strong cohorts were also evident (Figure 3.4).



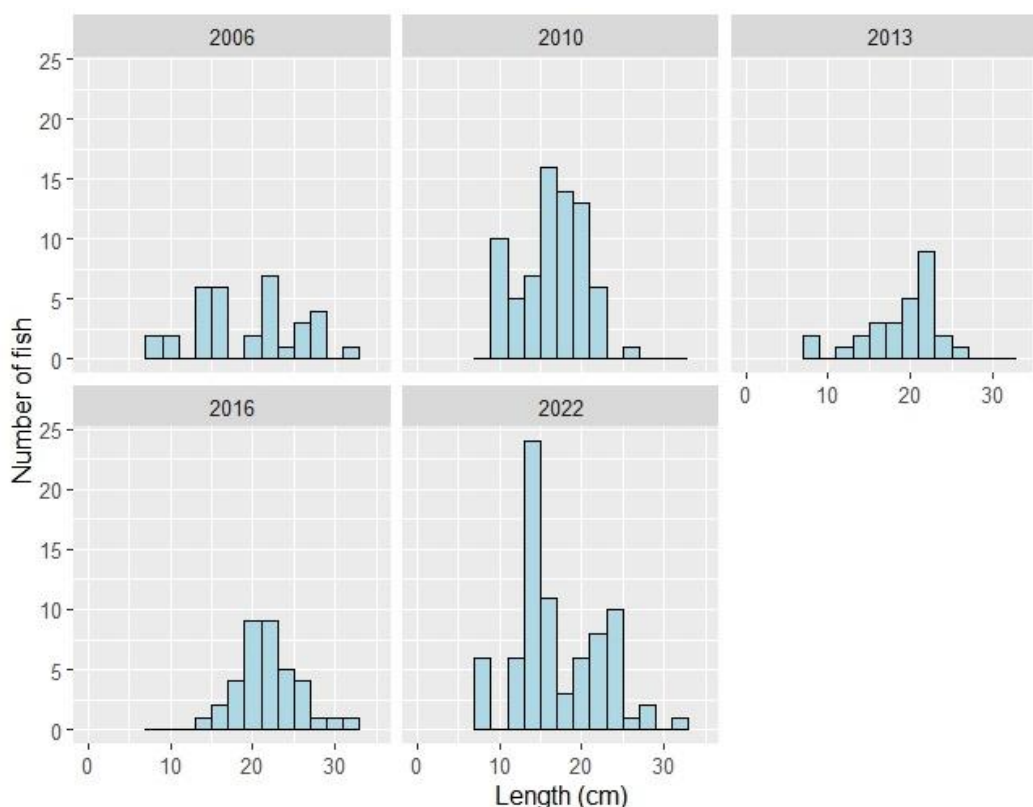
**Figure 3.4. Length frequency of roach captured on Lough Macnean Upper, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.4. Summary age data from roach captured on Lough Macnean Upper, July 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.**

Length (cm)	Age class							
	1+	2+	3+	4+	5+	6+	7+	8+
<b>N</b>	2	10	5	7	8	5	1	1
<b>Mean</b>	6	8.2	11.5	13.3	15.9	17.9	-	-
<b>Min</b>	5.9	6.7	10.1	12.6	14.5	17.5	21.1	-
<b>Max</b>	6.1	10	12.3	14.3	17.3	18.1	21.1	-

### Roach x bream hybrids

Roach x bream hybrids captured during the 2022 survey ranged in length from 7.0cm to 32.0cm (mean 17.2cm) (Figure 3.5). Fish were aged between 3+ to 10+. All intervening age classes were represented in the sample aged, with several strong age cohorts (between 4+ and 8+) evident (Table 3.5). Few small (<10cm) fish were recorded and the absence of younger age groups suggest that recruitment may have been limited in recent years.



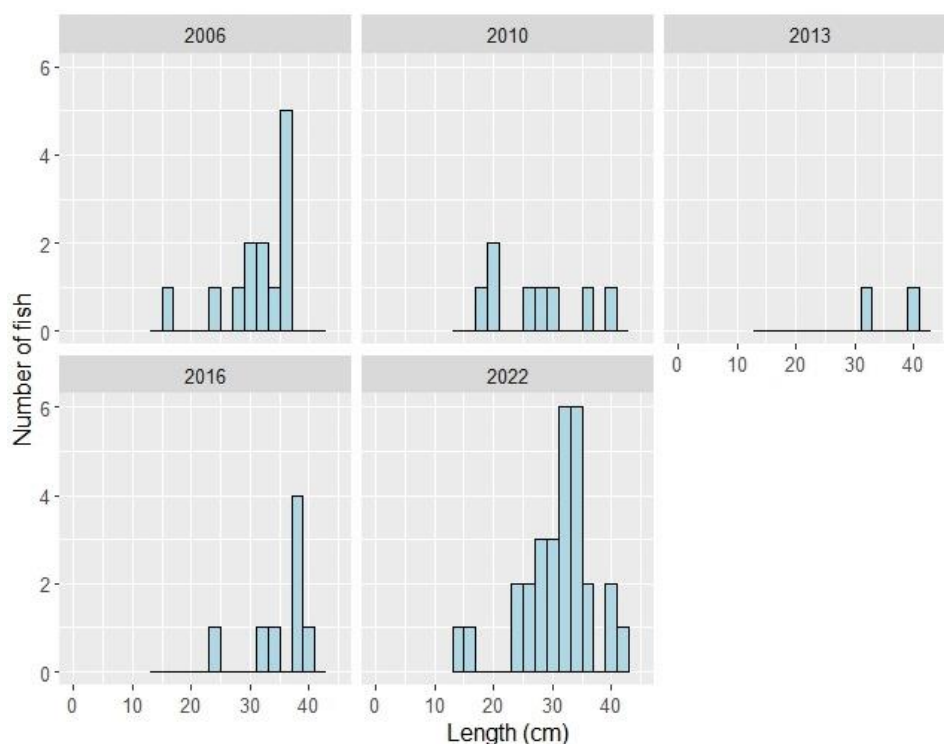
**Figure 3.5. Length frequency of roach x bream hybrids captured on Lough Macnean Upper, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.5. Summary age data from roach x bream hybrids captured on Lough Macnean Upper, July 2022. Number of fish (N) and length ranges of all fish aged in the sample is presented.**

Length (cm)	Age class									
	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
<b>N</b>	0	0	1	7	5	4	6	7	2	1
<b>Mean</b>	-	-	11.8	14.8	18	20.3	22	24.2	27.2	-
<b>Min</b>	-	-	-	13.5	16.7	19.2	21.3	23.5	26.9	32
<b>Max</b>	-	-	-	15.9	19.1	20.9	22.6	25	27.5	32

## **Bream**

Bream ranged in length from 14.6cm to 42.0cm (mean 30.8cm) (Figure 3.6). While a greater number of larger bream were captured in 2022 compared to earlier surveys, this may partially be attributed to the deployment of the supplementary 4-PBB nets in 2022. Nevertheless, the population was dominated by bream aged between 6+ and 9+ (Table 3.5; c. 28cm -35cm; Figure3.6). There was a marked absence of younger and smaller individuals suggesting that recruitment may have been limited in recent years.



**Figure 3.6. Length frequency of bream captured on Lough Macnean Upper, 2006, 2010, 2013, 2016 and 2022.**

**Table 3.6. Summary age data from bream captured on Lough Macnean Upper, 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+	13+
<b>N</b>	-	-	-	2	-	1	5	5	5	7	2	-	1	1
<b>Mean</b>	-	-	-	15	-	-	23.2	28.7	31.7	32.3	36.1	-	-	-
<b>Min</b>	-	-	-	14.6	-	23.4	26.3	30	33.4	34	37.6	-	40.3	42
<b>Max</b>	-	-	-	15.4	-	23.4	28.7	31.1	33.1	35.2	39.1	-	40.3	42

### Other fish

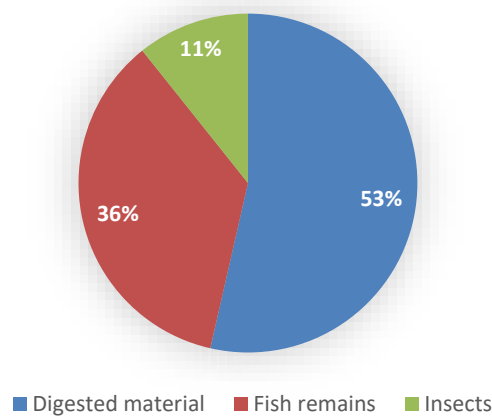
European eels captured during the 2022 survey ranged in length from 25.0cm to 67.0cm (mean 8.4cm). Pike ranged in length from 31.5cm to 70.7cm (mean 59.5cm) and in age from 2+ to 5+. One brown trout measuring 22.3cm and aged at 4+ was also captured.

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

### Perch

A total of 96 perch stomachs were examined. Of these 68 (70.8%) were empty. Of the remaining 28 stomachs containing food, 15 (53%) contained unidentified digested material. Fish were recorded in 10 (36%) stomachs. Invertebrates were recorded in three (11%) stomachs (Figure 3.7).



**Figure 3.7. Diet of perch (N = 28) captured on Lough Macnean Upper, 2022 (% FO).**

### Other species

The stomach contents of three pike captured during the 2022 were examined. Two stomachs were empty. The remaining sample contained fish. The stomach of the one brown trout captured was found to be empty.



## 4. Summary

Six fish species and one cyprinid hybrid were recorded on Lough Macnean Upper in July 2022.

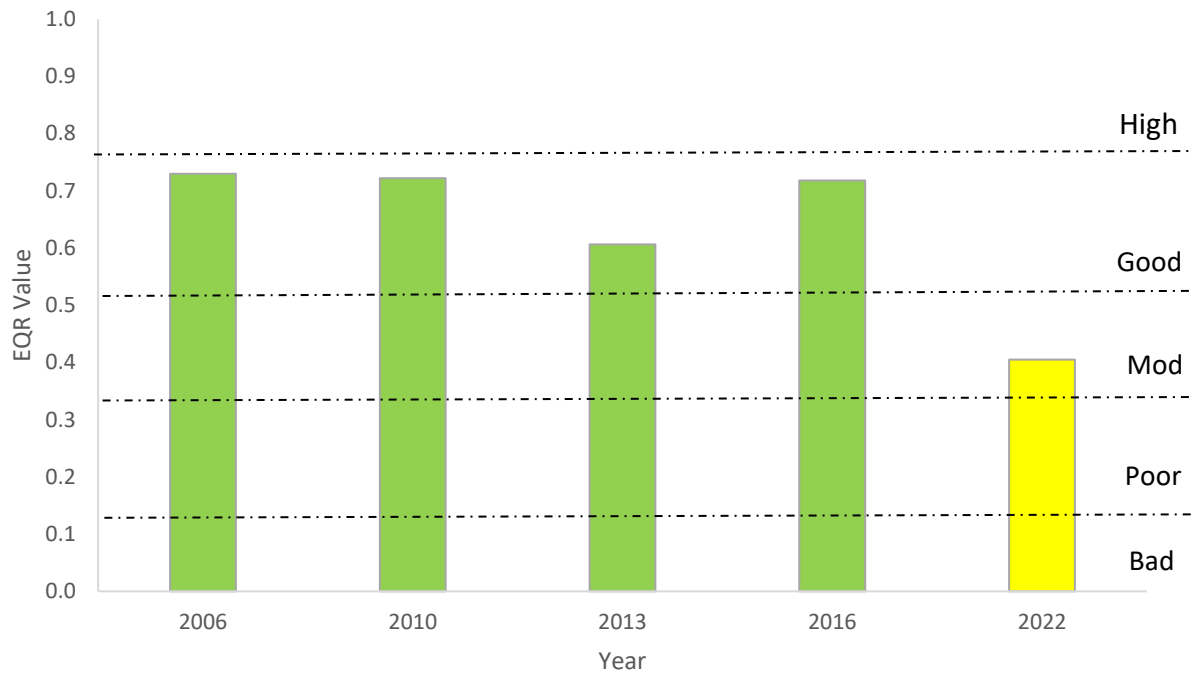
Perch were the most abundant species in terms of abundance (CPUE) and biomass (BPUE). The perch population has remained relatively stable in Macnean Upper Lough, with no noticeable trend in CPUE and BPUE observed. The population was dominated by younger and smaller individuals and recruitment patterns were consistent. Roach were also captured in relatively large numbers in 2022, and there was some evidence of increasing trends in both abundance and biomass since the lake was surveyed in 2006. Roach also exhibited regular recruitment and the population was characterised by a preponderance of smaller younger individuals.

A single brown trout was captured in 2022. One trout was also recorded in 2016, showing a small persistent population exists 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, Macnean Upper Lough has been assigned an ecological status of Moderate for 2022 based on the fish populations present. In all previous surveys Macnean Upper Lough had been assigned a status of Good (Figure 4.1). The likely driver of this fall is an increase of tolerant fish species (e.g. roach) (Corcoran *et al.*, 2023).

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



**Figure 4.1. Fish ecological status, Macnean Upper Lough, 2006, 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.
- 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](https://gis.epa.ie/EPAMaps/Data-Catchments.ie-Catchments.ie). Accessed in May/June 2023.
- Kelly, F.L. Connor, L. and Champ, W.S.T. (2007) *A Survey of the fish populations in 46 lakes in the Northern Regional Fisheries Board, June to September 2005 and 2006*. North South Share Aquatic Resource (NS Share) Lakes Project.
- 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.L., 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 Lough MacNea Upper, July 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 Lough Macnean Upper, June 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 Lough Macnean Upper, July 2016*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

NIEA (2009a) [http://www.ni-environment.gov.uk/print/landscape/country\\_landscape/5/5-land.htm](http://www.ni-environment.gov.uk/print/landscape/country_landscape/5/5-land.htm)

NIEA (2009b) Wetlands and Lakes [http://www.ni-environment.gov.uk/print/land-home/landscape\\_home/country\\_landscape/5/5-bio.htm](http://www.ni-environment.gov.uk/print/land-home/landscape_home/country_landscape/5/5-bio.htm)

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

**[www.fisheriesireland.ie](http://www.fisheriesireland.ie)  
[info@fisheriesireland.ie](mailto:info@fisheriesireland.ie)**

**+353 1 8842 600**

