National Research Survey Programme

Lakes 2021

Lough Muckno

IFI/2022/1-4609

Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Lough Muckno,

September 2021

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., Twomey, C., Burke, E., Matson, R., Robson, S., Duffy, P., Donovan, R. and Kelly, F.L. (2022) Fish Stock Survey of Lough Melvin, July 2021. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

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ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland. The assistance and cooperation of the Irish Angling Development Alliance is gratefully acknowledged.

The authors would also like to acknowledge the funding provided for the programme from the Department of Housing, Local Government and Heritage and Department of Communications, Climate Action and Environment for 2022.

1. Introduction

Muckno Lough is located within the Muckno Leisure Park on the eastern side of the town of Castleblaney, Co. Monaghan (Plate 1.1, Figure 1.1). The lake has a surface area of 316ha, a mean depth of >4m and a maximum depth of 20m. The lake is categorised as typology class 8 (as designated by the EPA for the purposes of the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l CaCo3).

Muckno Lough has been assigned an ecological status of Bad for the period 2013-2018 (O' Boyle and Craig, 2020). The lake is designated as a Natural Heritage Area and was classed as highly eutrophic in 2006 (Monaghan County Council, 2007). Flanagan and Toner (1975) reported algal blooms on the lake during 1972, 1973 and 1974, and these continue to be a feature on the lake, where bathing water quality is impacted (EPA 2020).

Lough Muckno contains large stocks of bream, roach, roach x bream hybrids, tench, perch and pike (IFI, 2010). The lake supports an extremely active coarse angling community, and it hosts a number of prestigious coarse angling competitions throughout the year. The lake has also historically contained a stock of brown trout (Flanagan and Toner, 1975; Paddy Green IFI, *pers. comm*.). A fish stock survey carried out in September 1968 revealed that bream, rudd, perch, tench, pike and brown trout were present in the lake, with brown trout up to 1800g being captured (Inland Fisheries Trust, unpublished data).

The lake has been surveyed on four occasions since 2006 (2006, 2009, 2012 and 2015) as part of the NSSHARE Fish in Lakes Project (Kelly *et al*., 2007) and as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2010, 2013 and 2016). A similar species composition has been recorded in the lake on each of the latter survey occasions, with perch and roach being the dominant species recorded. Other species captured include, bream, roach x bream hybrids, pike, gudgeon and eels. Brown trout were captured during the 2009 and 2015 surveys.

This report summarises the results of the 2021 fish stock survey carried out on the lake using Inland Fisheries Ireland's fish in lakes monitoring protocol. The methodology is WFD compliant and enables determination of ecological status based upon fish communities. It also provides insight into current fish stock status in assessed lakes, facilitating comparison within and between lakes.

Plate 1.1. Lough Muckno, from the southern shore in September 2021

Plate 1.2. Setting a braided survey net on Lough Muckno, September 2021

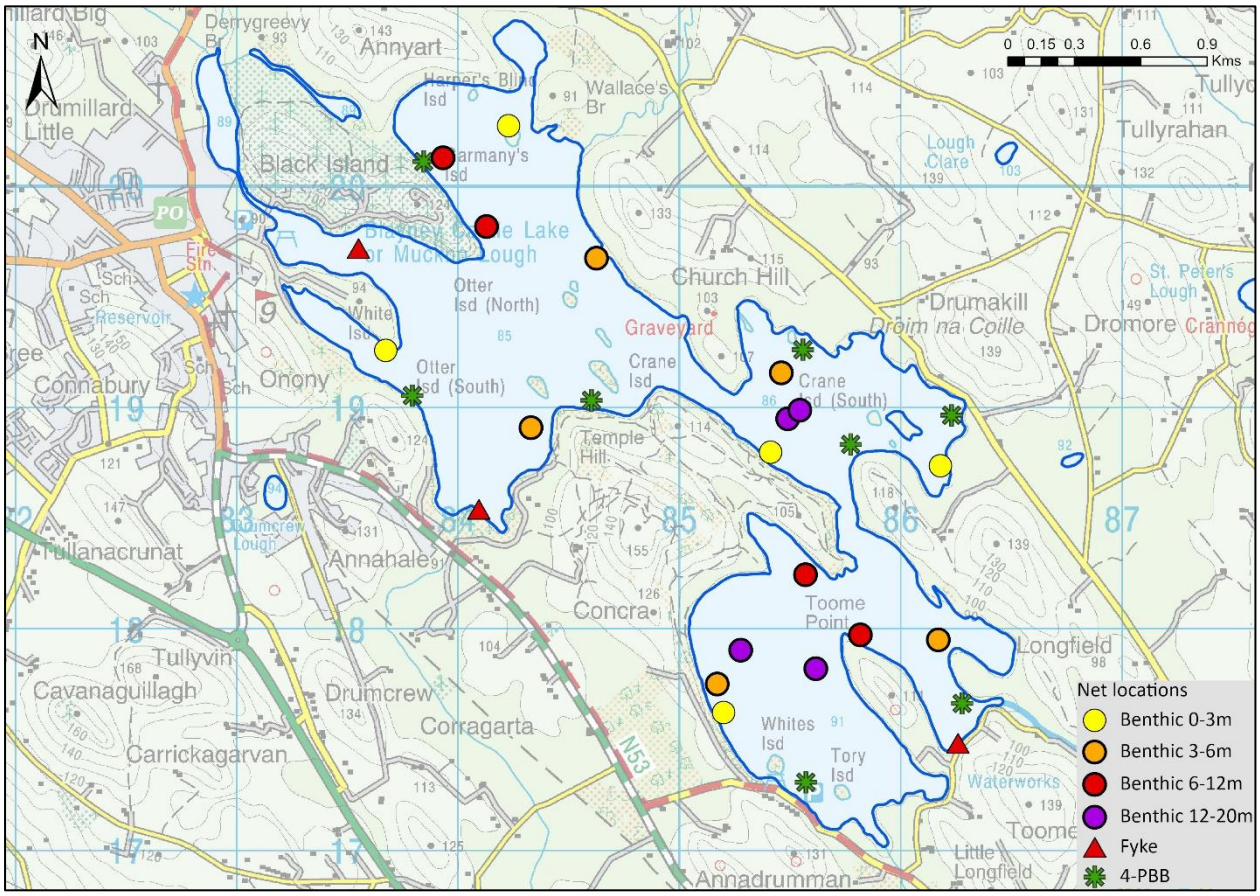

Figure 1.1. Location map of Lough Muckno showing locations and depths of each net.

2. Methods

2.1. Netting methods

Lough Muckno was surveyed over three nights between the 8th and the 10th of September 2021. A total of three sets of Dutch fyke nets and 18 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, 4 @ 6-11.9m and 4 @ 12-19.9m) were deployed in the lake (21 sites). The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at eight additional sites (Figure 1.1). The four-panel survey gill nets are composed of four 27.5m long panels each a different mesh size (55mm, 60mm, 70mm and 90mm knot to knot). These nets were deployed in random locations throughout the lake. A handheld GPS was used to locate the precise location of each net. The angle of each gill net in relation to the shoreline was randomised.

All fish apart from perch were measured and weighed on site and scales were removed from a 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).

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

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.

1.3 Results

3.1. Species Richness

Five fish species and one type of hybrid were recorded on Lough Muckno in September 2021. A total of 2255 fish were captured. The number of each species captured by each gear type is shown in Table 3.1. Perch and roach were the most abundant fish species recorded, accounting for *c*. 69% and 24% of all fish captured during the survey respectively. Other species captured included bream, roach x bream hybrids, eels and pike. A similar species composition was recorded in the four previous surveys between 2006 and 2015 (Connor *et al*. 2015).

Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Muckno, September 2021

Scientific name	Common name	Number of fish captured			
		BM CEN	4-PBB	Fyke	Total
Perca fluviatilis	Perch	1561	0	2	1563
Rutilus rutilus	Roach	535	0	0	535
Rutilus rutilus x Abramis brama	Roach x bream hybrid	58	10	0	68
Abramis brama	Bream	44	25	0	69
Esox lucius	Pike	1	5	1	7
Anguilla anguilla	European eel	0	0	13	13

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 (WFD and WFD+). For all fish species except eel, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only. Mean CPUE and BPUE for all fish species captured during the survey are summarised in Table 3.2. In 2021 perch and roach were the two most abundant species captured with respect to both abundance and and biomass (Table 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Muckno, 2021

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	1.795 (0.513)	23.756 (6.645)
Rutilus rutilus	Roach	0.615 (0.188)	27.434 (7.958)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.070 (0.019)	10.014 (2.303)
Abramis brama	Bream	0.059 (0.012)	14.985 (3.461)
Esox lucius	Pike	0.003 (0.002)	7.669 (4.617)
**Anguilla anguilla*	European eel	0.072 (0.024)	14.747 (3.740)

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

For comparison purposes CPUE and BPUE for each species captured in all surveys, per survey net type, between 2006 and 2021 are presented in Figures 3.1 (and b) and 3.2 (and b) respectively. Perch and roach have dominated fish stocks on all previous sampling occasions since 2006 (Figures 3.1a and 3.1b). While numbers of the former species have risen in recent surveys, this is not matched with a concomitant increase in BPUE, and is driven by the capture of large numbers of perch fry in 2015 and 2021. Biomass of roach and perch has remained relatively stable across all survey years (Figure 3.1b).

With the exception of eels, no clear trends are apparent in populations of other species captured. Numbers and biomass of eel were highest in the 2006 survey (Figures 3.2a and 3.2b).

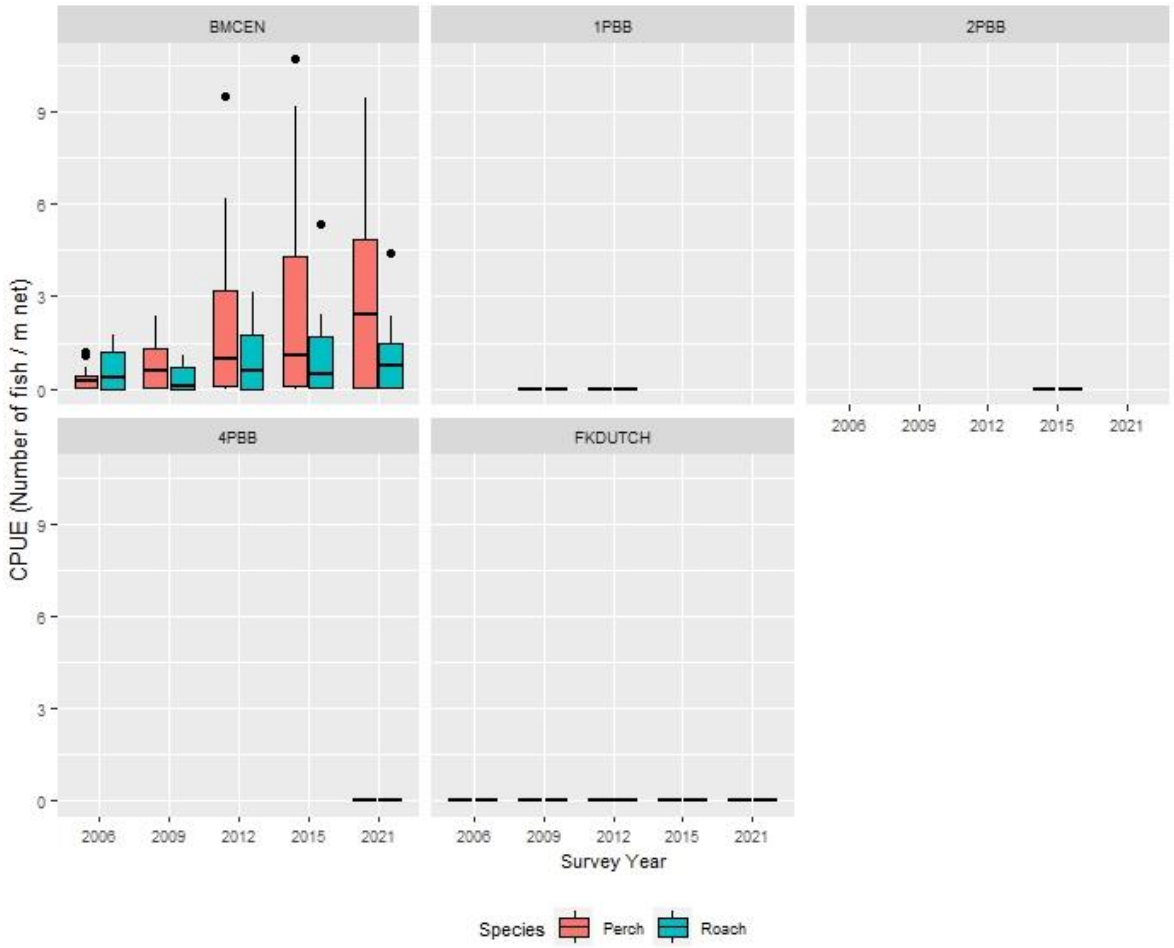

Figure 3.1a. CPUE of perch and roach captured in each net type during surveys of Lough Muckno between 2006 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

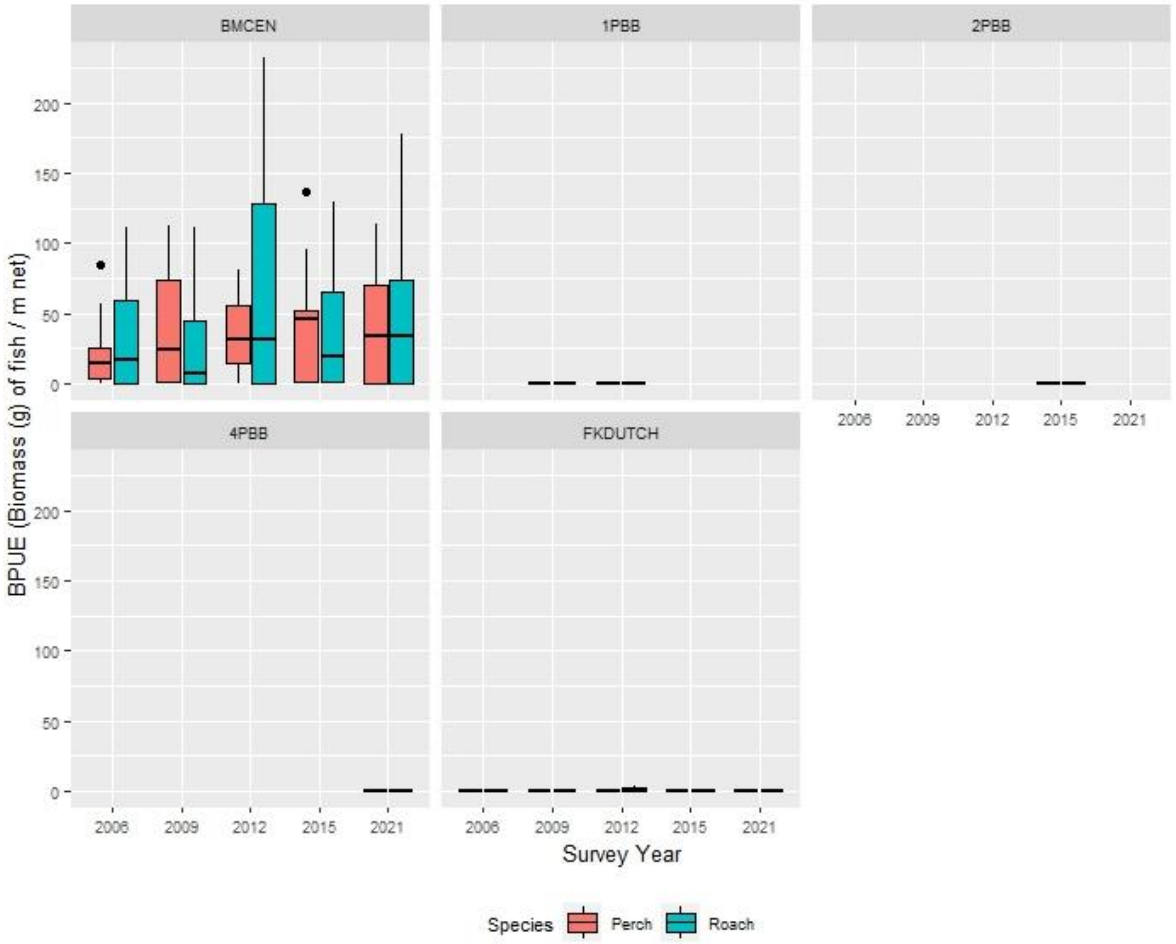

Figure 3.1b. BPUE of perch and roach captured in each net type during surveys of Lough Muckno between 2009 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

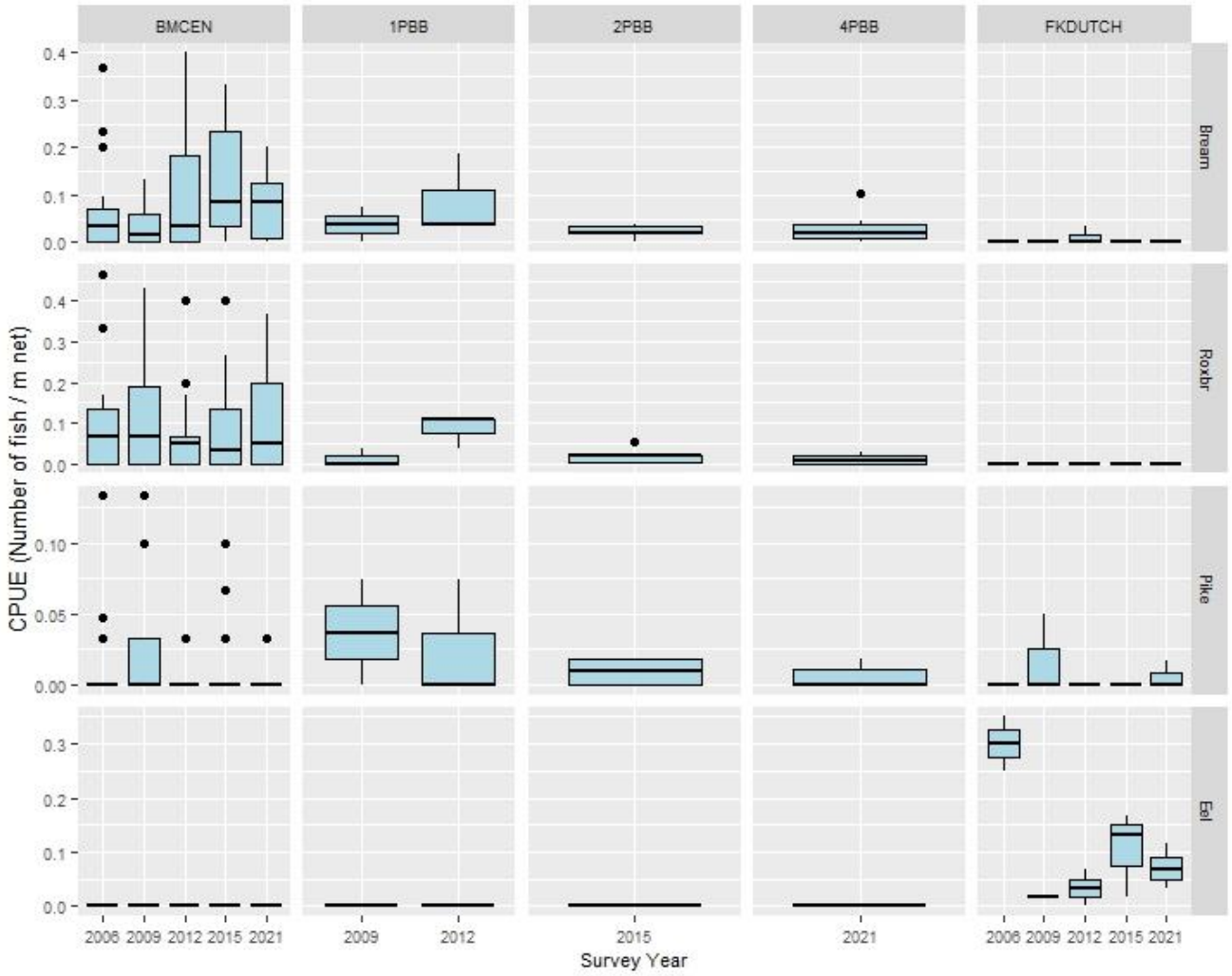

Figure 3.2a. CPUE of other regularly occurring species captured in each net type during surveys of Lough Muckno between 2006 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis (CPUE) is unique for each species.

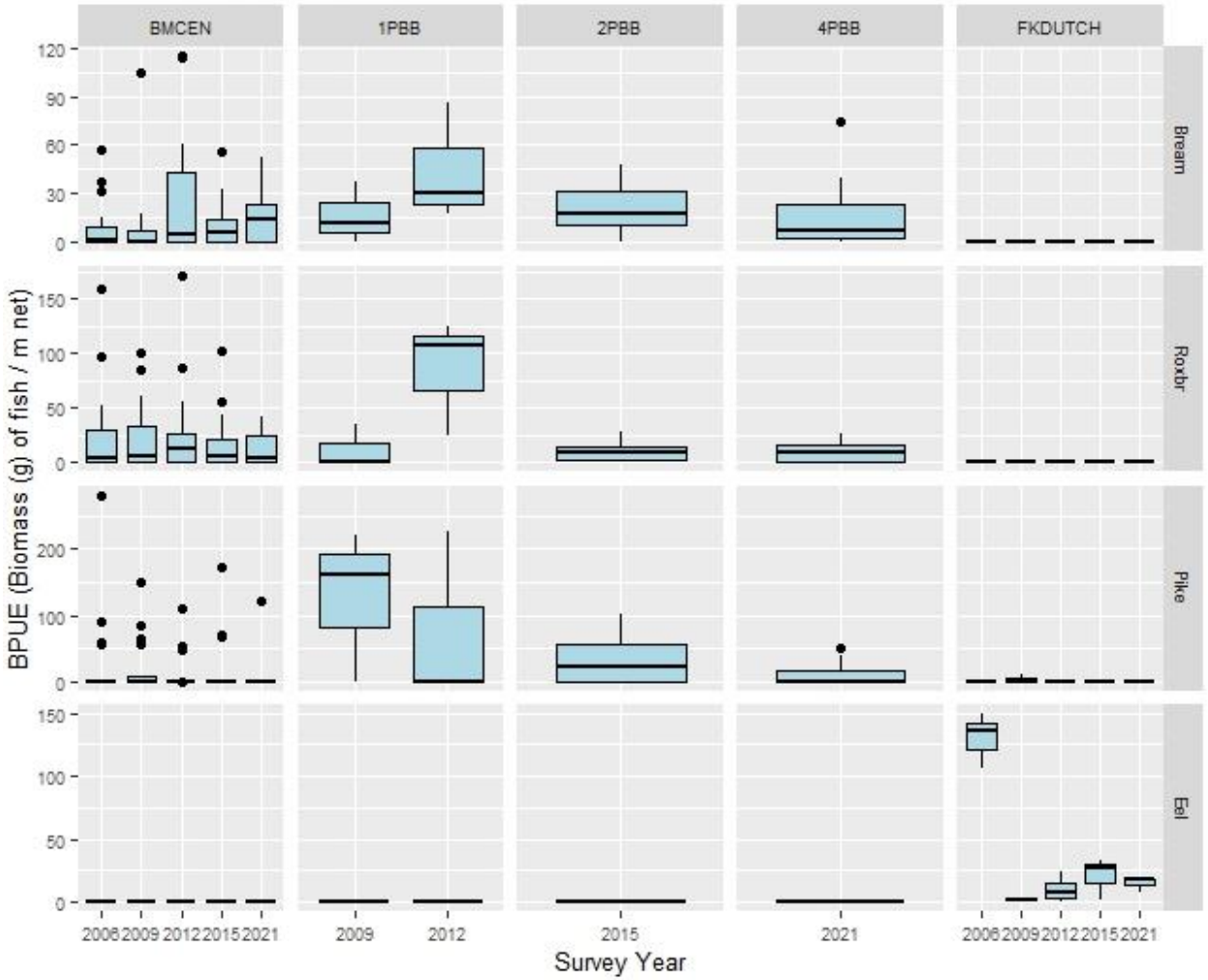

Figure 3.2b. BPUE of other regularly occurring species captured in each net type during surveys of Lough Muckno between 2006 and 2021. Figures are expressed as biomass of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis (BPUE) is unique for each species.

3.3. Length frequency distributions and growth

Perch

Perch captured during the 2021 survey ranged in length from 4.5cm to 37.3cm (mean = 7.5cm) (Figure 3.3). Perch in the sample were aged between 0+ and 7+ and all intervening age groups were present. Mean L1 (length at 1 year) was 5.8cm (Table 3.3). The dominant age group was 0+ (i.e young of year (YOY)) corresponding with fish in the 5.0cm to 6.0cm length range with very strong 0+ cohorts recorded in all surveys since 2012 (Figure 3.3).

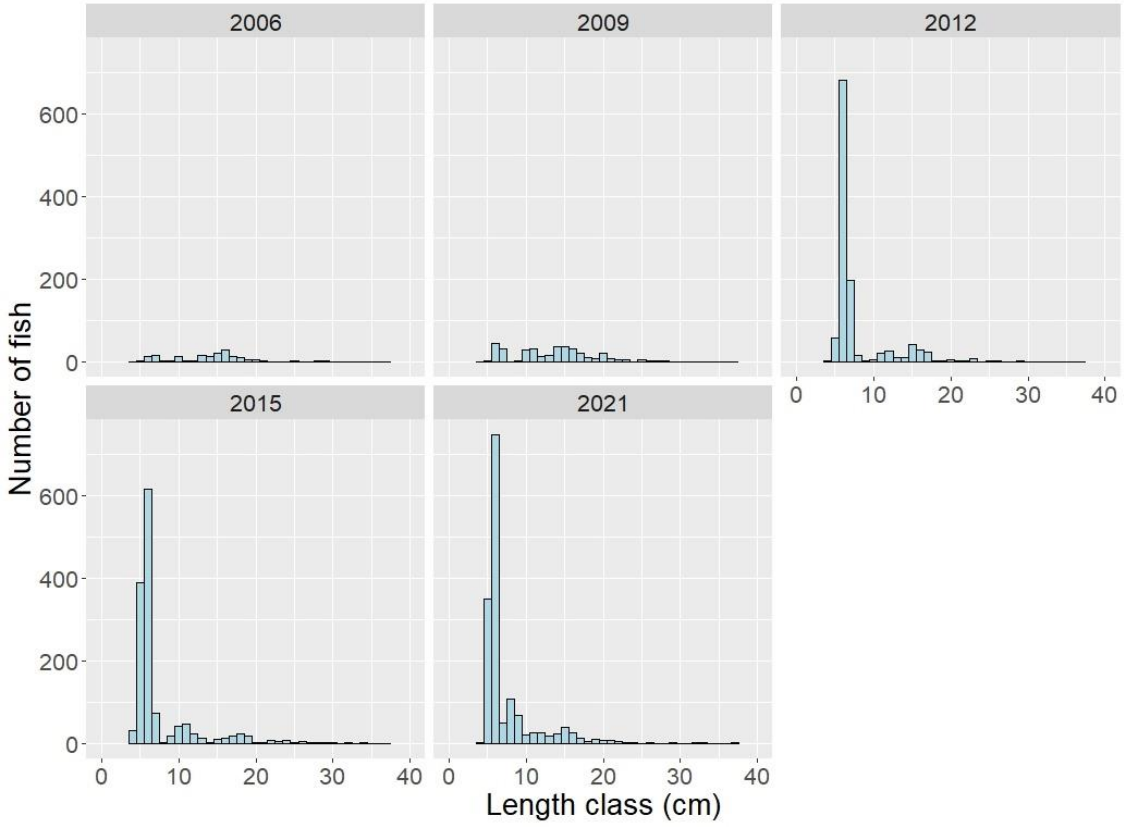

Figure 3.3. Length frequency of perch captured on Lough Muckno, 2006, 2009, 2012, 2015 and 2021

Table 3.3. Mean (±S.E.) perch length (cm) at age for Lough Muckno, September 2021

	L_1	L_2	L_3	L_4	L_5	L_6	L_7
Mean (±S.E.)	5.8 (0.1)	10.4 (0.1)	15.8 (0.3)	20.1 (0.4)	24.1 (0.9)	27.4 (1.7)	34.0 (1.6)
N	105	75	46	29	15	6	2
Range	4.0-9.0	7.2-13.2	10.7-19.3	15.9-25.3	20.5-30.0	22.9-32.7	32.4-35.6

Roach

Roach captured during the 2021 survey ranged in length from 3.7cm to 26.3cm (mean = 13.5cm) (Figure 3.4). Roach were aged between 2+ to 9+ (Table 3.4). All cohorts from 2+ to 6+ were well represented in the sample aged, indicating regular and strong recruitment over those years. However, few older or larger fish (i.e. > 7+ and 20cm) were recorded. No 1+ roach were recorded in the sample aged, and few fish <10cm were also captured (Figure 3.4).

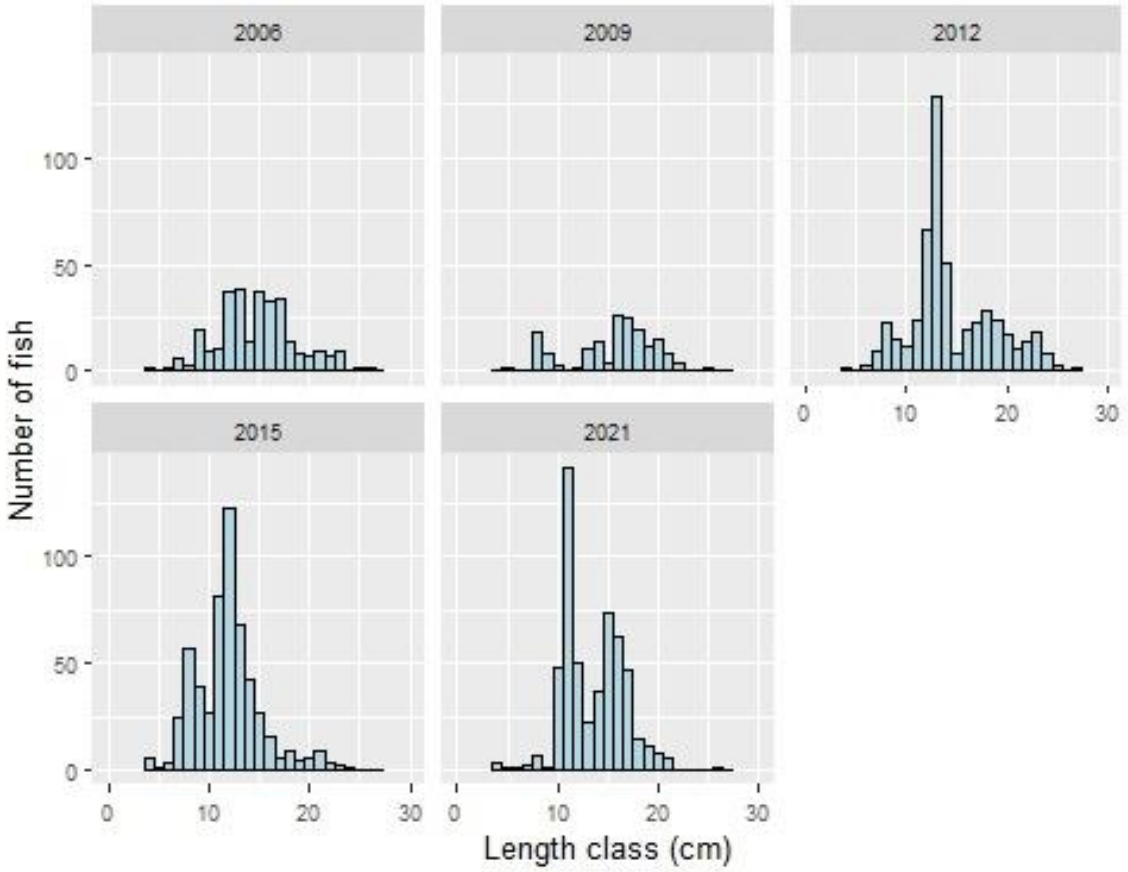

Figure 3.4. Length frequency of roach captured on Lough Muckno, 2006, 2009, 2012, 2015 and 2021

Table 3.4. Summary age data from roach captured on Lough Muckno, September 2021. Number of fish and length ranges of all fish aged in the sample is presented.

	Age Class								
	0+	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9+**
N	-	13	11	8	11	9	4	0	1
Mean L (cm)	-	11.3	13.8	16.2	17.9	19.8	21.1	-	-
Min L (cm)	-	10.2	11.8	15.2	16.6	19.1	20.9	-	26.3
Max L (cm)	-	12.4	15.0	18.8	21.5	20.6	21.5	-	26.3

Bream

Bream captured during the 2021 survey ranged in length from 3.0cm to 47.0cm (mean = 24.7cm) (Figure 3.5). Bream in the sample were aged between 2+ and 14+. Three age cohorts (11+ to 13+) were not present in the sample aged, while 8+ bream was the largest year class in the sample (Table 3.5). This cohort comprised approximately *c.* 26% of all bream aged, corresponding to those fish measuring between *c.* 27cm - 32cm (Figure 3.5 and Table 3.4). While recruitment of this species has been relatively regular, few younger or smaller bream were recorded in 2021 compared to previous surveys.

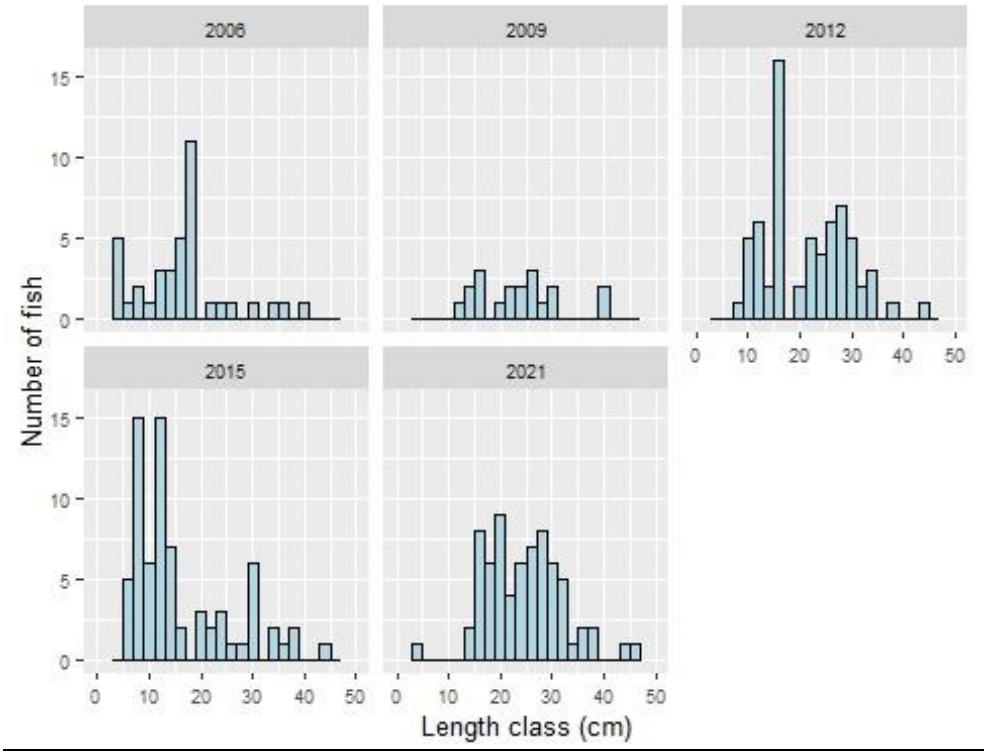

Figure 3.5. Length frequency of bream captured on Lough Muckno, 2006, 2009, 2012, 2015 and 2021

Table 3.5. Summary age data from bream captured on Lough Muckno, September 2021. Number of fish and length ranges of all fish aged in the sample is presented.

	Age Class														
	0+	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9+**	**10+**	**11+**	**12+**	**13+**	**14+**
N	-	0	3	7	4	7	9	6	15	3	3	0	0	0	1.0
Mean L (cm)	-	-	14.0	16.7	18.7	21.1	24.1	26.5	29.9	34.1	37.2	-	-	-	-
Min L (cm)	-	-	13.2	16.3	17.4	20.2	22.5	24.3	27.3	31.5	36.0	-	-	-	44.2
Max L (cm)	-	-	15.2	17.7	19.3	22.9	26.5	28.1	32.7	36.0	37.8	-	-	-	44.2

Roach x bream hybrids

Roach x bream hybrids captured during the 2021 survey ranged in length from 7.5cm to 38.5cm (mean = 20.4cm) (Figure 3.6). Roach x bream hybrids in the sample were aged between 1+ and 14+. All age classes with the exception of 9+ and 10+ fish were represented. However, relatively few fish older than 7+ were recorded, and 3+ and 4+ fish were the largest age class in the sample. While recruitment has been occurring regularly, relatively few younger or smaller roach x bream hybrids were captured (Table 3.6).

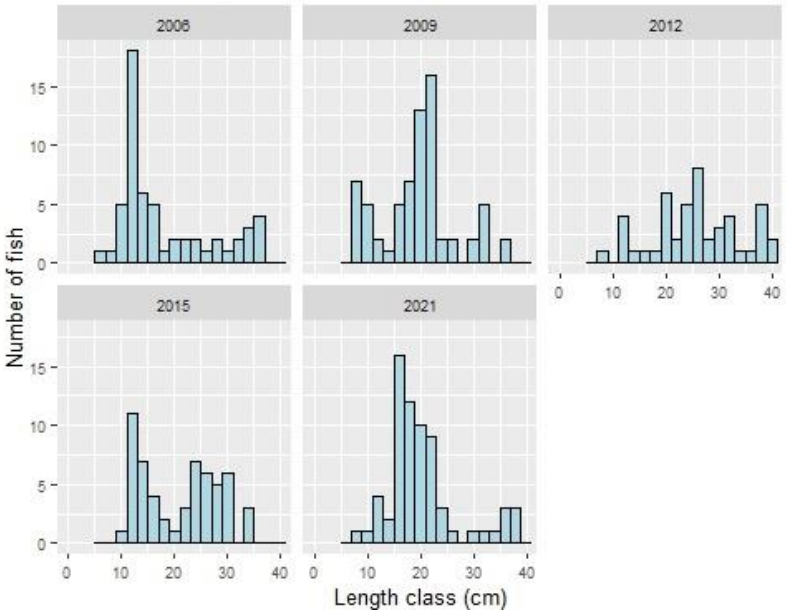

Figure 3.6. Length frequency of roach x bream hybrids captured on Lough Muckno, 2006, 2009, 2012, 2015 and 2021

Table 3.6. Summary age data from roach x bream hybrids captured on Lough Muckno, September 2021. Number of fish and length ranges of all fish aged in the sample is presented.

	Age Class														
	0+	**1+**	**2+**	**3+**	**4+**	**5+**	**6+**	**7+**	**8+**	**9+**	**10+**	**11+**	**12+**	**13+**	**14+**
N	-	1	4	10	9	5	8	5	1	0	0	1	1	2	1
Mean L (cm)	-	-	12.7	15.9	18.4	19.9	22	22.9	-	-	-	-	32.7	34.2	-
Min L (cm)	-	11.2	11.6	14.7	14.7	19.2	20.7	22.2	24.7	-	-	30.5	-	34.3	36.4
Max L (cm)	-	11.2	13.8	16.7	19.7	20.6	26.4	23.7	24.7	-	-	30.5	-	35.4	36.4

Other fish

Seven pike were captured during the survey. Pike ranged in length from 19.5cm to 83.1cm (mean = 59.5cm. Thirteen eels were also recorded during the 2021 survey and ranged in length from 34.0cm to 61.0cm (mean = 47.0cm).

3.4. Stomach and diet analysis

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

Perch

A total of 93 stomachs were examined. Of these 65 (70%) were found to contain no prey items. Of the remaining 28 stomachs, 23 (82%) contained unidentified digested material. Fish were recorded in five (18%) stomachs (Figure 3.7).

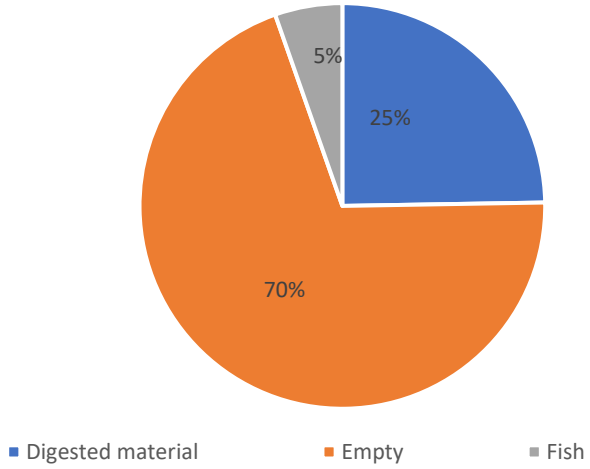

Figure 3.7. Diet of perch (n = 28) captured on Lough Muckno 2021

Pike

One pike stomach was available for analysis. This fish, which measured 83.0cm had been feeding on perch fry.

4. Summary and ecological status

A total of six fish species and one type of hybrid (roach x bream) were recorded on Lough Muckno in September 2021. A similar species mix was recorded when the lake was last surveyed in 2015, with the exception of gudgeon and brown trout which were not captured in 2021.

Perch and roach were the two most abundant species in respect of both biomass and abundance (BPUE and CPUE). Both species have each been recruiting regularly in the lake and are dominated by juvenile age groups. The perch population in particular was dominated by juvenile fish, which is a regular feature of surveys in Irish lakes conducted at that time of the year when perch fry are recorded in high abundance. The roach population was also dominated by younger age cohorts, and few fish greater than 20cm (7 years) were captured. The scarcity of roach less than 10cm in length, and the absence of 1+ fish from the sample aged, suggests that recruitment in 2020 may have been limited.

The bream population in Lough Muckno appears to be relatively stable, with regular recruitment to the adult population. While there is some evidence that bream are relatively long lived with fish in the sample aged ranging from 2+ to 14+, the population was dominated by younger fish, with few bream older than 8+ recorded.

The roach x bream hybrid population, which requires both parent species to spawn (Hayden *et al.*, 2010), has also exhibited relatively consistent recruitment patterns. The roach x bream hybrid population (in common with both parent species) was dominated by fish younger year classes.

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) in order 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, Lough Muckno has been assigned an ecological status of Moderate based on the fish populations present. In previous years the lake was assigned Poor status in 2012 and 2015 and Bad status in 2006 and 2009 (Fig. 4.1).

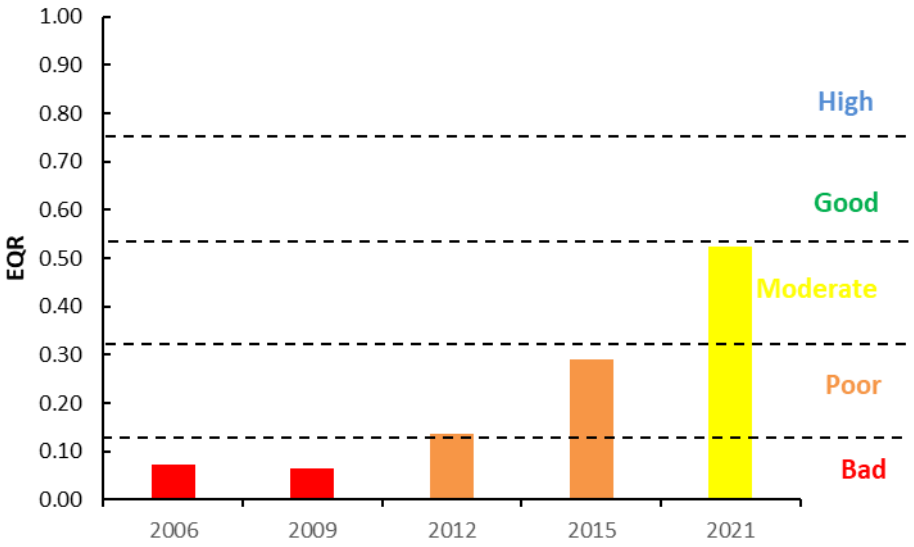

Figure 4.1. Fish ecological status, Lough Muckno 2006 to 2021.

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Muckno an overall draft ecological status of Bad, based on all monitored physico-chemical and biological elements, including fish. This status classification will be revised during 2022.

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