National Research Survey Programme
Lakes 2022

Ballyquirke Lough

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Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Ballyquirke Lough,

September 2022

National Research Survey Programme

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

Cover photo: Lough Lene, Co. Westmeath © Inland Fisheries Ireland

ACKNOWLEDGEMENTS

1.   Introduction

Ballyquirke Lough (Loch Bhaile Ui Choirc) is located approximately 1km south of Moycullen, Co. Galway. The lake is connected to Lough Corrib via the Ballyquirke Canal which exits from the north-east corner of the lake (Figure 1.1). The lake is situated at an altitude of 5 m.a.s.l., has a surface area of 73.6ha, mean depth of 2.9 m and maximum depth of 12.2m. The dominant geology of the lake is limestone and calcareous shale. Adjacent land use is predominantly agricultural with a large proportion of pasture. The lake is categorised as typology class 6 for the purposes of Water Framework Directive (WFD), i.e., shallow (<4m), greater than 50ha and moderately alkaline (> 20mg/l CaCO3).

The lake falls within the Lough Corrib Special Area of Conservation (SAC) (00297). The SAC supports a number of protected habitats and species including the sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*) and Atlantic salmon (*Salmo salar*) (NPWS, 2017).

The lake was previously surveyed in 1996 and 2016 when roach, bream, roach x bream hybrid, perch, rudd, rudd x bream hybrid, eel and pike were recorded (CFB, 1997; McLoone *et al*. 2017). The lake supports an important coarse fish and pike fishery.

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.
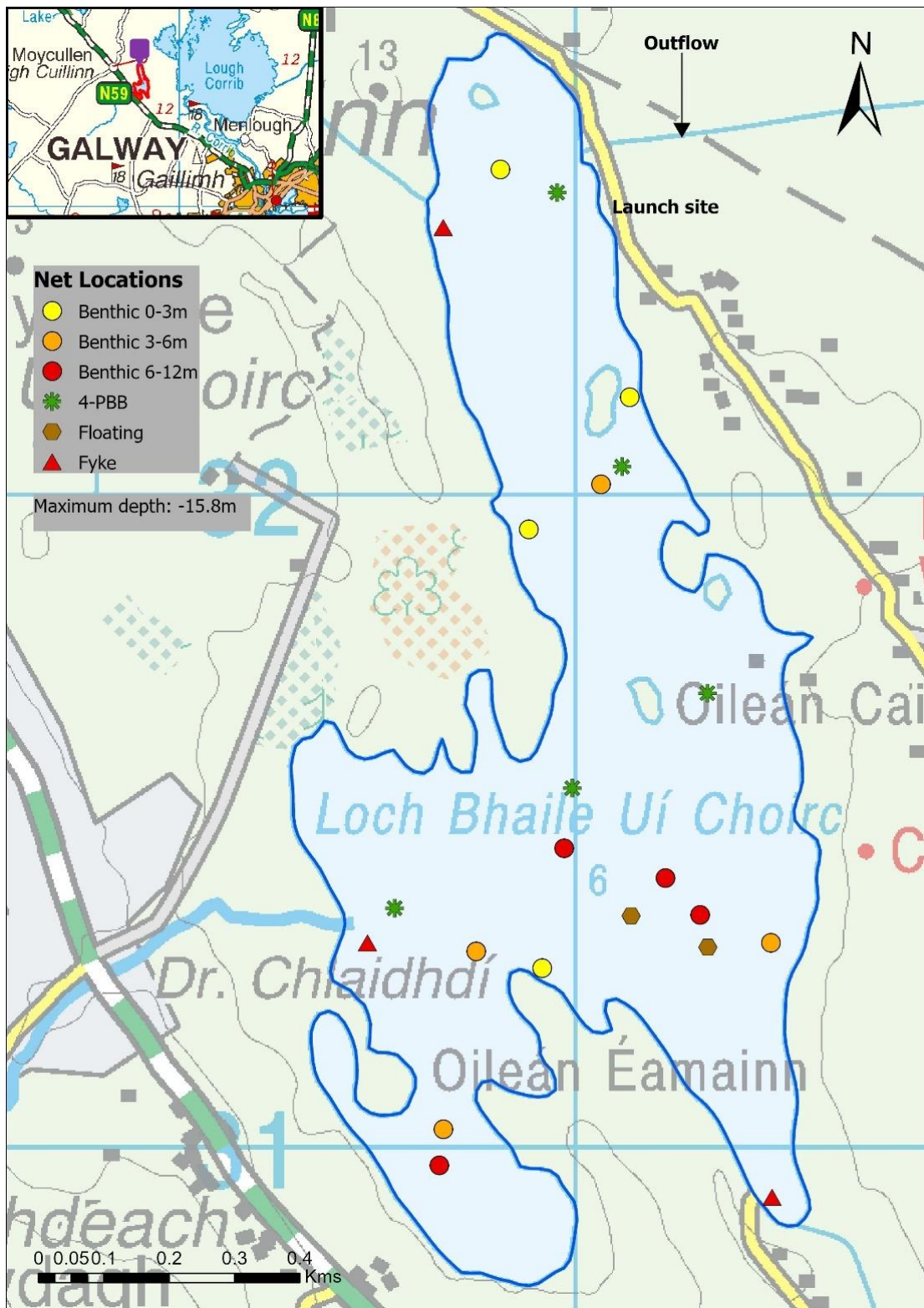

Plate 1.1. Ballyquirke Lough, September 2022

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

2. Methods

2.1. Netting methods

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

The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at five 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 survey nets were deployed in random locations throughout the lake.

A handheld GPS was used to locate the precise location of each survey 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 identified to the lowest taxonomic level possible. The percentage frequency occurrence (%FO) of prey items were then calculated to identify key prey items (Amundsen *et al.*, 1996).

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

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

2.3. Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by Inland Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff in IFI when moving between water bodies.

3. Results

3.1. Species Richness

Seven fish species and one cyprinid hybrid variety were recorded in Ballyquirke Lough in September 2022. A total of 788 fish were captured (Table 3.1). Perch was the most common fish species recorded, followed by roach and roach x bream hybrids respectively. A similar species composition was recorded in the surveys conducted in 1996 and 2016 (CFB, 1997; McLoone *et al.*, 2017). One tench was captured during the current survey.

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

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
Perca fluviatilis	Perch	416	3	0	8	427
Rutilus rutilus	Roach	181	24	3	3	211
R. rutilus x A. brama	Roach x bream hybrid	36	0	84	0	120
Abramis brama	Bream	5	1	17	0	23
Esox lucius	Pike	2	0	1	1	4
Scardinius erythrophthalmus	Rudd	0	1	0	0	1
Tinca tinca	Tench	0	0	1	0	1
Anguilla anguilla	European eel	0	0	0	1	1

3.2. Fish abundance

Fish abundance (mean CPUE) and biomass (mean BPUE) were calculated as the mean number/weight of fish caught per metre of net. For all fish species except eel, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only.

In 2022 perch and roach were the dominant fish species in terms of abundance. Roach x bream hybrids, which were also captured in large numbers, were dominant in terms of biomass. A relatively high biomass of bream and pike was also recorded (Table 3.2).

For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type in 2016 and 2022 are presented in Figures 3.1a to 3.2b respectively and illustrates fish community

change over time. The median CPUE and BPUE of both perch and roach was higher than those reported from the previous survey.

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

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	0.613 (0.205)	13.341 (3.856)
Rutilus rutilus	Roach	0.300 (0.089)	26.588 (7.809)
R. rutilus x A. brama	Roach x bream hybrid	0.086 (0.018)	67.517 (19.494)
Abramis brama	Bream	0.016 (0.005)	9.928 (3.264)
Esox lucius	Pike	0.004 (0.002)	7.689 (5.489)
Anguilla anguilla	European eel	0.006 (0.006)	0.697 (0.697)
Scardinius erythrophthalmus	Rudd	0.001 (0.001)	0.009 (0.009)
Tinca tinca	Tench	0.000 (0.000)	0.671 (0.671)

Note: *Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor et al., 2017).*
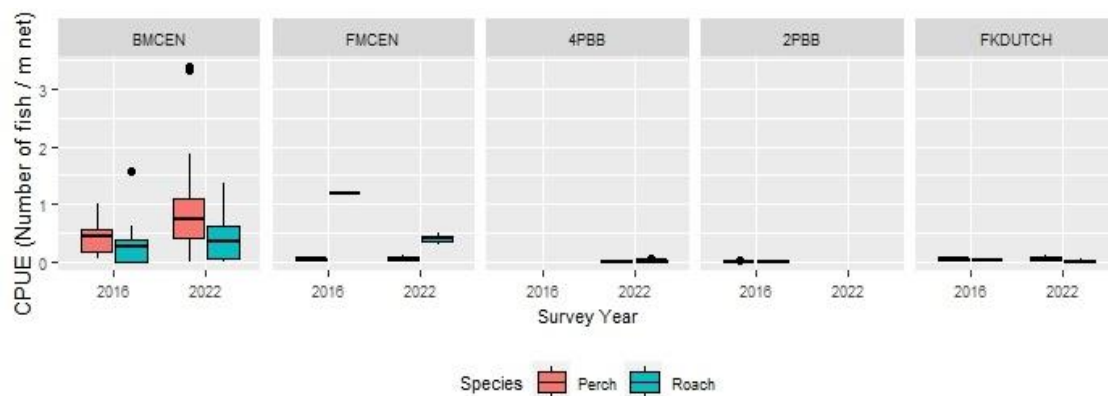

Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Ballyquirke Lough in 2016 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
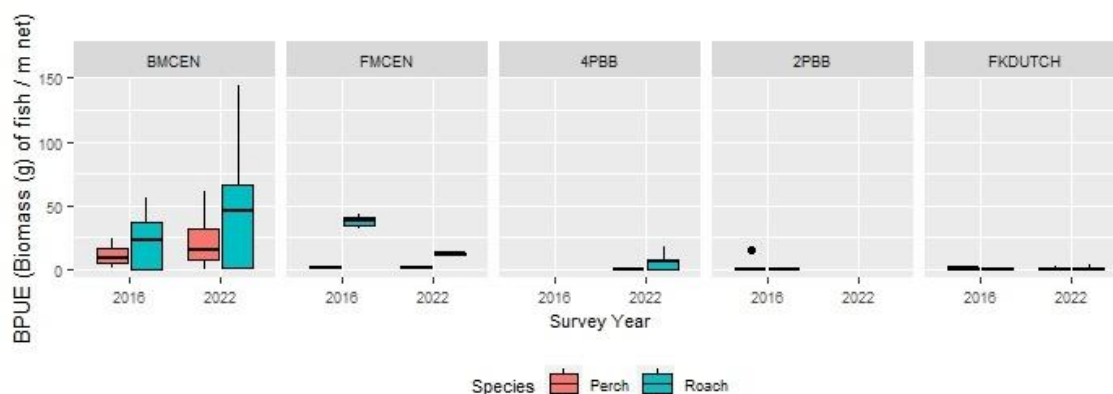

Figure 3.1b. BPUE of roach and perch captured in each net type during surveys of Ballyquirke Lough in 2016 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
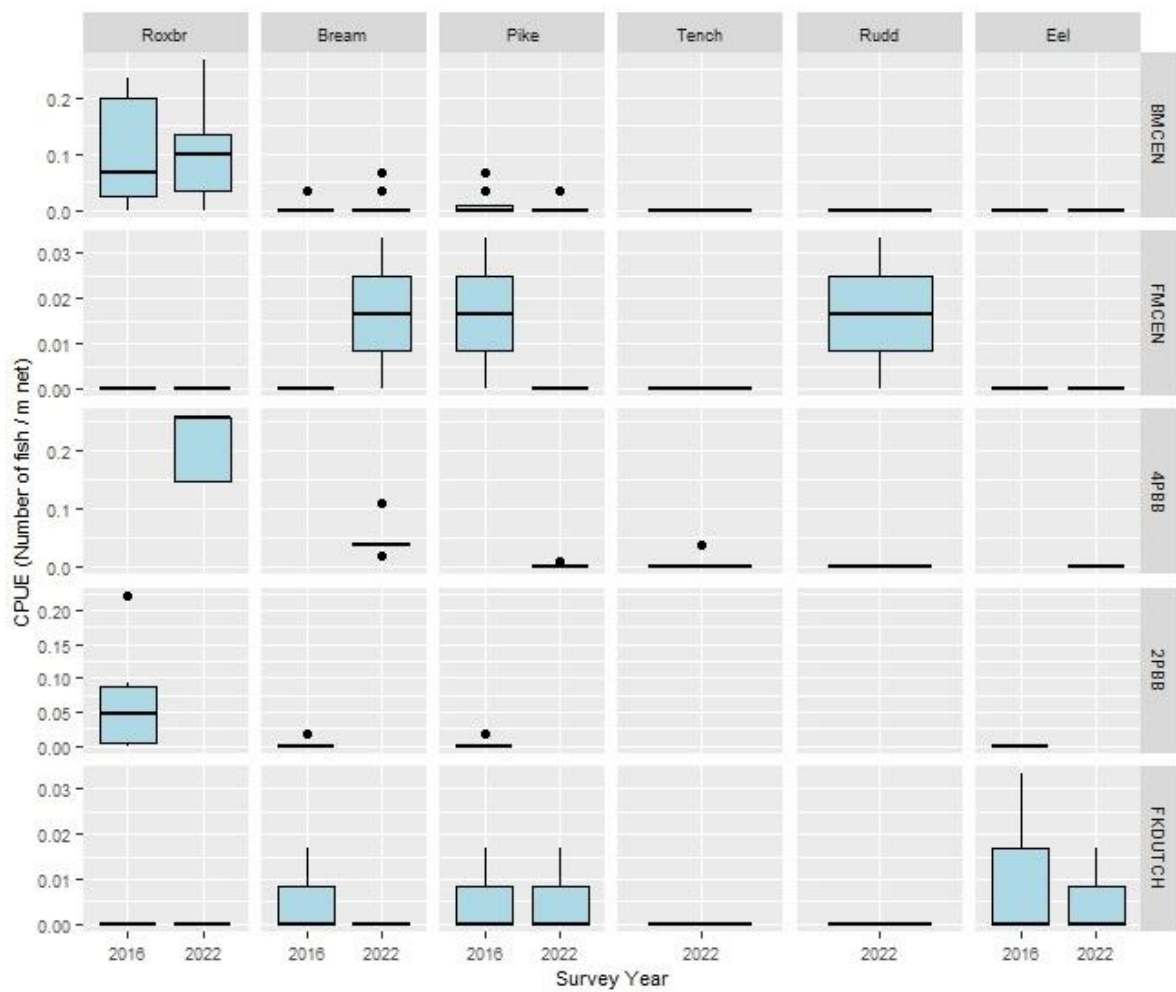
Figure 3.2a. CPUE (number of fish captured per linear meter of net) of other fish species captured in each net type during surveys of Ballyquirke Lough in 2016 and 2022. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis is unique for each net type.

Figure 3.2b. BPUE (biomass of fish captured per linear meter of net) of other fish species captured in each net type during surveys of Ballyquirke Lough in 2016 and 2022. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis is unique for each net type.
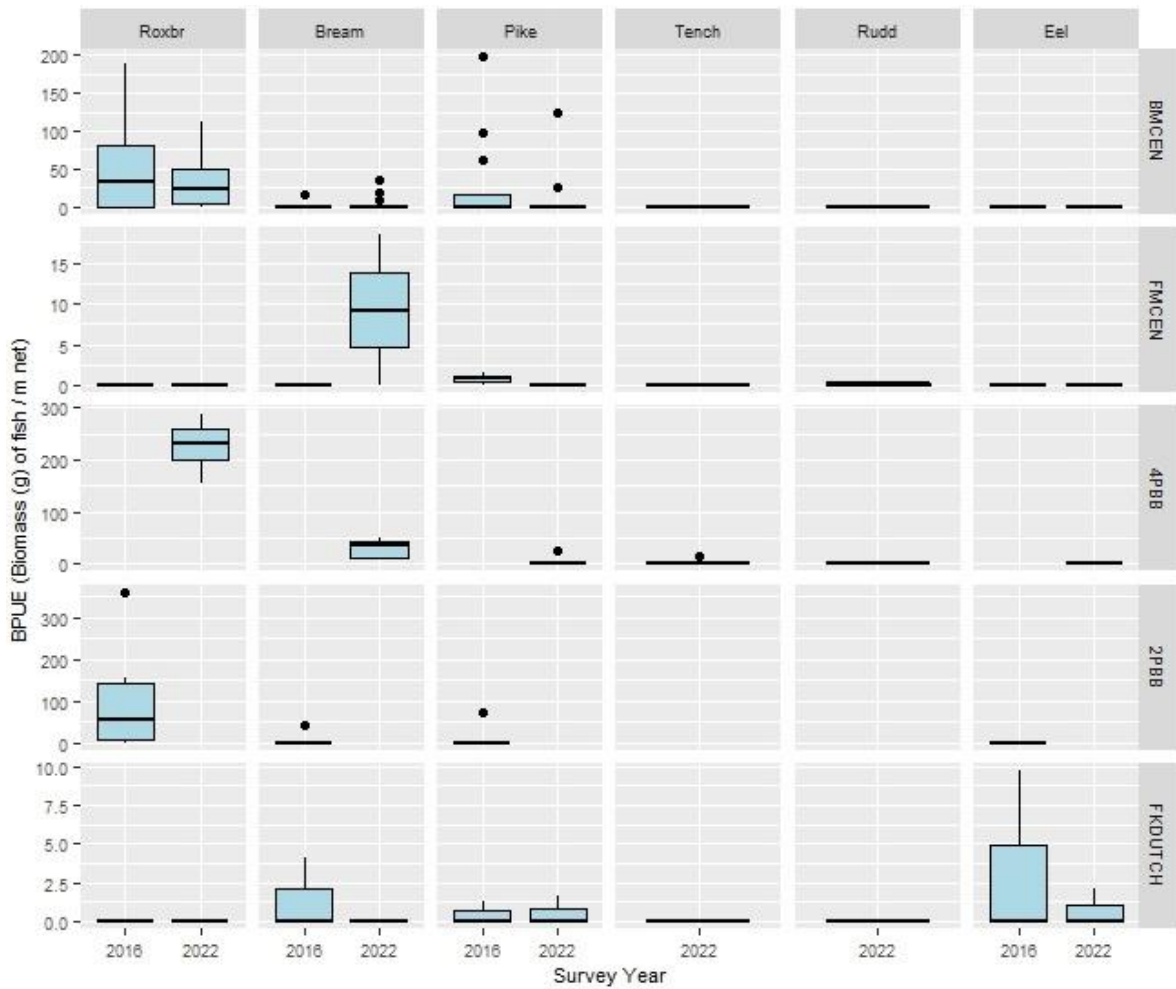
3.3. Length frequency distributions and growth

Perch

Perch captured during the 2022 survey ranged in length from 4.5cm to 31.8cm (mean 9.5cm). While there was evidence of larger fish persisting in the population, the population was dominated by small (<7.0cm) perch. The modal peak of 5-6cm in length corresponds to 0+ juveniles (Figure 3.3). Mean L1 (i.e. age at the end of the 1st year) was 8cm. Perch were aged between 0+ and 6+, and all intervening age classes were present in the sample (Table 3.3).
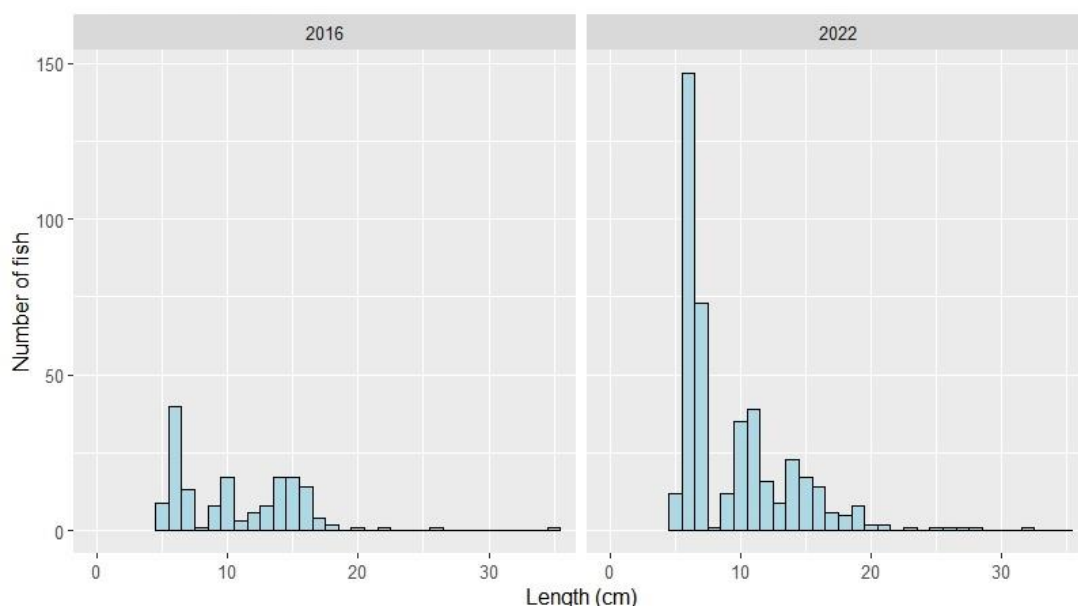
Figure. 3.3. Length frequency of perch captured on Ballyquirke Lough in 2016 and 2022.

Table 3.3. Mean (±S.E.) perch length (cm) at age for Ballyquirke Lough, September 2022

Length (cm)	Age class					
	L$_1$	L$_2$	L$_3$	L$_4$	L$_5$	L$_6$
Mean (±S.E.)	8 (0.2)	12.2 (0.3)	15.6 (0.4)	19.5 (1.0)	25.2 (0.1)	-
N	63	42	26	9	6	1
Range	5.4 - 10.9	9.4 - 17.2	11.7 - 21.5	14.5 - 23.6	25.0 - 25.4	27.4

Roach

Roach captured during the 2022 survey ranged in length from 4.7cm to 33.7cm (mean 14.8cm) (Figure 3.4). The length frequency of roach was broadly similar to that captured in 2016, although the strong modal peak (i.e., at 10.0cm) recorded in 2016 was not evident in 2022, where length was more equally distributed. Roach were aged between 1+ and 13+ with all age groups between 0+ and 10 + recorded. Roach were relatively long lived, with strong 7 and 8 year old cohorts present in the sample aged (Table 3.4).
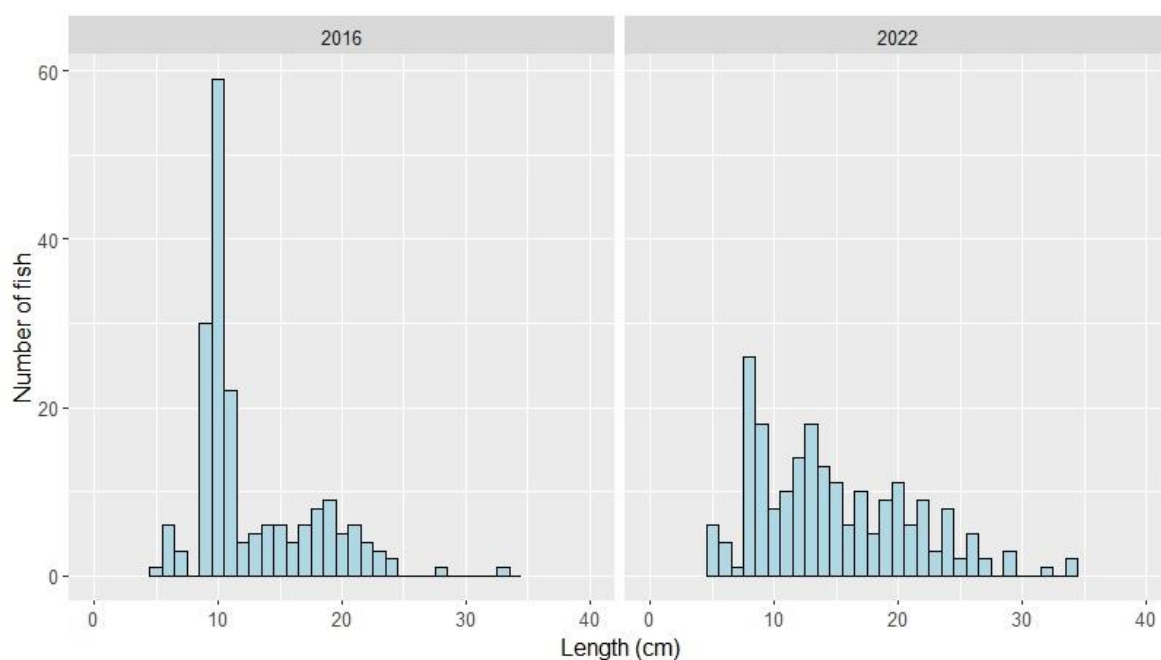

Figure. 3.4. Length frequency of roach captured on Ballyquirke Lough in 2016 and 2022.

Table. 3.4. Summary age data from roach captured on Ballyquirke Lough, August 2022. Number (N) of fish 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+	13+
N	3	7	6	9	4	4	8	10	3	1	1
Mean	5.4	8.4	10.7	14.6	17.9	19.9	22.4	25	27.7	-	-
Min	5.0	7.6	9.6	12.5	17.5	18.5	20.1	22.3	25.3	27.3	33.7
Max	6.1	10.7	11.7	16.9	18.3	22.5	25.7	28.9	29	27.3	33.7

Roach x bream hybrids

Roach x bream hybrids captured during the survey ranged from 8.8cm to 49.9cm (mean 34.7cm) (Figure 3.5). Roach x bream hybrids were aged from 2+ to 19+, with all age groups between 2+ and 13+ present in the sample aged (Table 3.5). Larger and older fish dominated this population, with a majority of the population greater than 30.0cm in length. (Table 3.5).
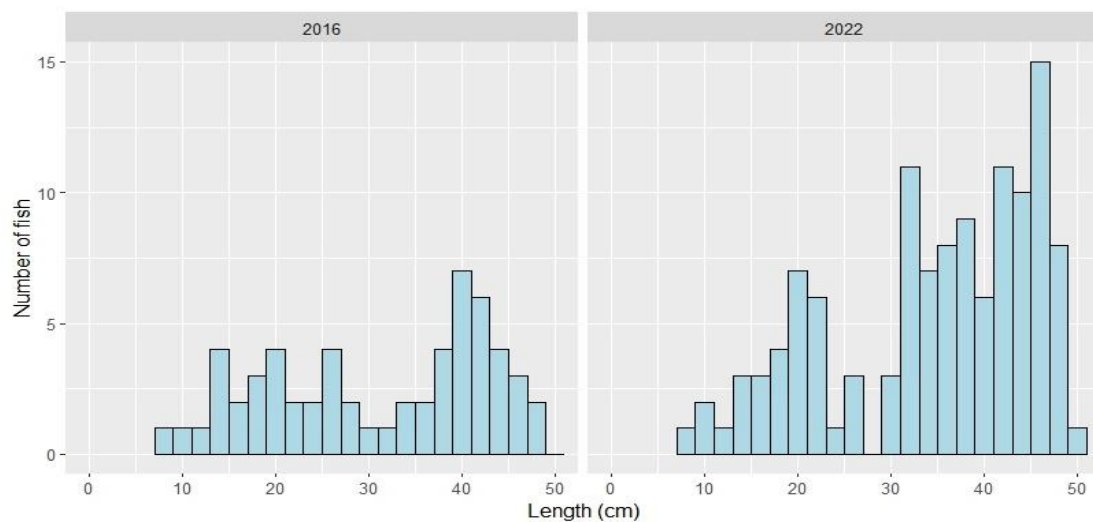

Figure. 3.5. Length frequency of roach x bream hybrids captured on Ballyquirke Lough, 2016 and 2022.

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

Length (cm)	Age class							
	2+	3+	4+	5+	6+	7+	8+	9+
N	2	3	3	4	8	4	2	5
Mean	9.4	12.2	15.9	19.1	20.6	23.2	25.8	33.5
Min	8.8	10	15.0	18.5	19.2	22.7	25.6	30.1
Max	10	13.4	16.8	20.5	21.3	24.4	25.9	41.6

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

Length (cm)	Age class						
	10+	11+	12+	13+	17+	18+	19+
N	7	1	2	2	1	1	1
Mean	35.6	-	42.4	44.2	-	-	-
Min	32.8	35.4	42	42.3	46.0	47.2	49.9
Max	41.2	35.4	42.8	46.1	46.0	47.2	49.9

Bream

Twenty-three bream were captured during the 2022 survey. These ranged in length from 4.6cm to 46.2cm (mean 33.0cm) (Figure 3.6). The population was dominated by relatively larger and older individuals, with just one juvenile fish (4.6cm - not aged) recorded. Bream were aged between 4+ and 12+ (Table 3.6).
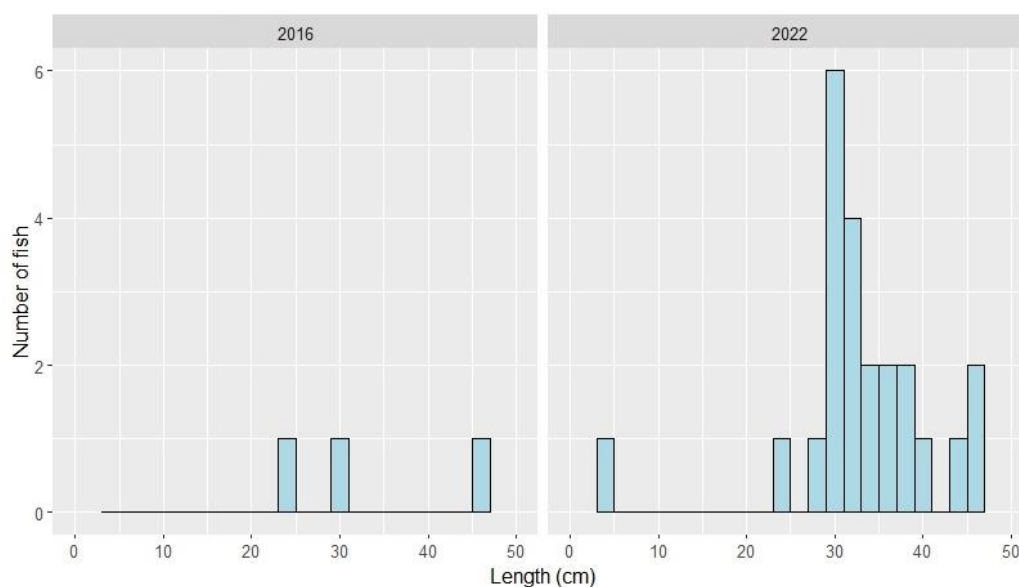

Figure. 3.6. Length frequency of bream captured on Ballyquirke Lough, 2016 and 2022.

Table. 3.6. Summary age data from roach x bream hybrids captured on Ballyquirke Lough, August 2022. Number (N) of fish and length ranges of all fish aged in the sample is presented.

Length (cm)	Age class						
	4+	6+	7+	8+	9+	10+	12+
N	1	2	7	4	3	1	1
Mean	-	30.0	30.7	35.9	38.1	-	-
Min	23.8	28.0	29.4	34.8	35.8	43.2	46.2
Max	23.8	32.0	32.7	37.5	39.9	43.2	46.2

Other fish species

Pike ranged in length from 24.0cm to 78.6cm (mean 55.3cm) and were aged from 1+ to 6+. One European eel, measuring 42.5cm, was recorded. Individual rudd (7.2cm and 2+) and tench (45.3cm) 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 78 perch stomachs were examined. Of these 65 (83%) were found to contain no prey items. Of the remaining 13 stomachs containing food, unidentified digested food material was present in ten fish (77%) and fish remains were recorded in three stomachs (23%) (Figure 3.7).
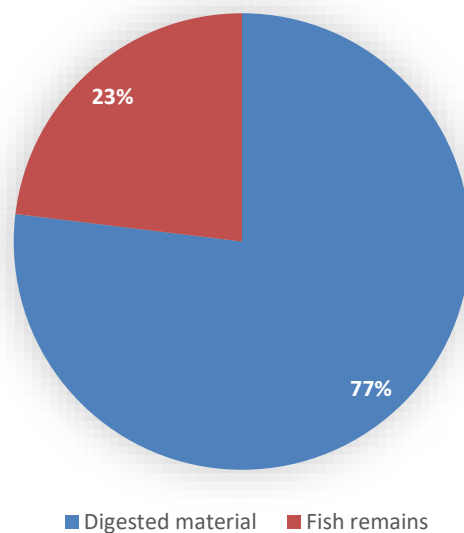

Figure 3.7. Diet of perch (N=13) captured on Ballyquirke Lough, 2022 (% FO).

4.   Summary and fish ecological status

Seven fish species and one cyprinid hybrid variety were recorded in Ballyquirke Lough in September 2022. A similar species mix was recorded when the lake was previously surveyed in 2016, with the addition of rudd and tench in 2022.

Perch and roach were the dominant fish species in terms of abundance (CPUE). Both species have been recruiting regularly in the lake. The perch population was dominated by younger and juvenile fish. While younger year groups dominated both populations, there was evidence of older year classes persisting in both species.

Roach x bream hybrids were the dominant species in terms of biomass (BPUE). The sample included a large proportion of large (i.e., >30.0cm) and older fish. The roach x bream hybrid population requires both parent species to be present to spawn (Hayden *et al.*, 2010). While the bream population was also dominated by larger and older fish, the capture of one juvenile (4.6cm) bream was evidence of some continued spawning and recruitment.

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

Classification and assigning lakes with an ecological status is a critical part of the WFD monitoring programme. It allows River Basin District managers to identify and prioritise lakes that currently fall short of the minimum "Good Ecological Status" that is required if Ireland is not to incur penalties. A multimetric fish ecological classification tool (Fish in Lakes – 'FIL') was developed for the island of Ireland (Ecoregion 17) using IFI and Agri-Food and Biosciences Institute Northern Ireland (AFBINI) data generated during the NSSHARE Fish in Lakes project (Kelly *et al.*, 2008). This tool was further developed during 2010 (FIL2) to make it fully WFD compliant, including producing EQR values for each lake and associated confidence in classification (Kelly *et al*., 2012).

Using the FIL2 classification tool, Ballyquirke Lake has been assigned an ecological status of Bad for 2022 based on the fish populations present. The lake was also assigned a status of Bad in 2016.

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

5.   References

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