National Research Survey Programme
Lakes 2022

Glenade Lough

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Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Glenade Lough, September 2022

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1. Introduction

Glenade Lough is situated at the top of the Bonet catchment in county Leitrim, in a valley between the Arroo and Benbulben Mountain ranges, approximately 9km north-west of Manorhamilton (Plate 1.1, Figure 1.1). The lake has a surface area of 73.3ha, a mean depth <4m and a maximum depth of 11.5m. It is categorised as typology class 6 (as designated by the EPA for the Water Framework Directive), i.e., shallow (<4m), greater than 50ha and moderately alkaline (20-100mg/l CaCO3).

Glenade Lough has been designated as a Special Area of Conservation (NPWS, 2013). The underlying geology of the lake is composed of carboniferous limestone and shales. The lake is naturally eutrophic, a habitat listed on Annex I of the E.U. Habitats Directive. The water is clear, well aerated and relatively nutrient poor, and the shoreline is generally stony or sandy (NPWS, 2013). There is a diverse range of pondweeds present in the lake, which include *Potamogeton praelongus, P. pusillus, P. lucens* and *P. natans* (NPWS, 2013). Glenade Lough is home to a large population of the native, white-clawed crayfish (*Austropotamobius pallipes*), a species listed on Annex II of the E.U. Habitats Directive. The lake is also home to the plant species quillwort (*Isoetes lacustris*) and slender naiad (*Najas flexilis*), a species also listed on Annex II of the E.U. Habitats Directive (NPWS, 2013). Surrounding the lake are areas of deciduous woodland which includes species such as hazel (*Corylus avellana*), ash (*Fraxinus excelsior*), alder (*Alnus glutinosa*), oak (*Quercus petraea*), beech (*Fagus sylvatica*), rhododendron (*Rhododendron ponticum*) and sycamore (*Acer pseudoplatanus)* (NPWS, 2013).

Glenade Lough has been surveyed on four occasions since 2007 (2007, 2010, 2013 and 2016) for the national Water Framework Directive fish monitoring programme (Kelly and Connor, 2007 and Kelly *et al.*, 2011, 2014 and 2017). During the 2016 survey, perch was found to be the dominant species present in the lake followed by roach. Relatively small numbers of pike and eels were also captured during the survey.

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.
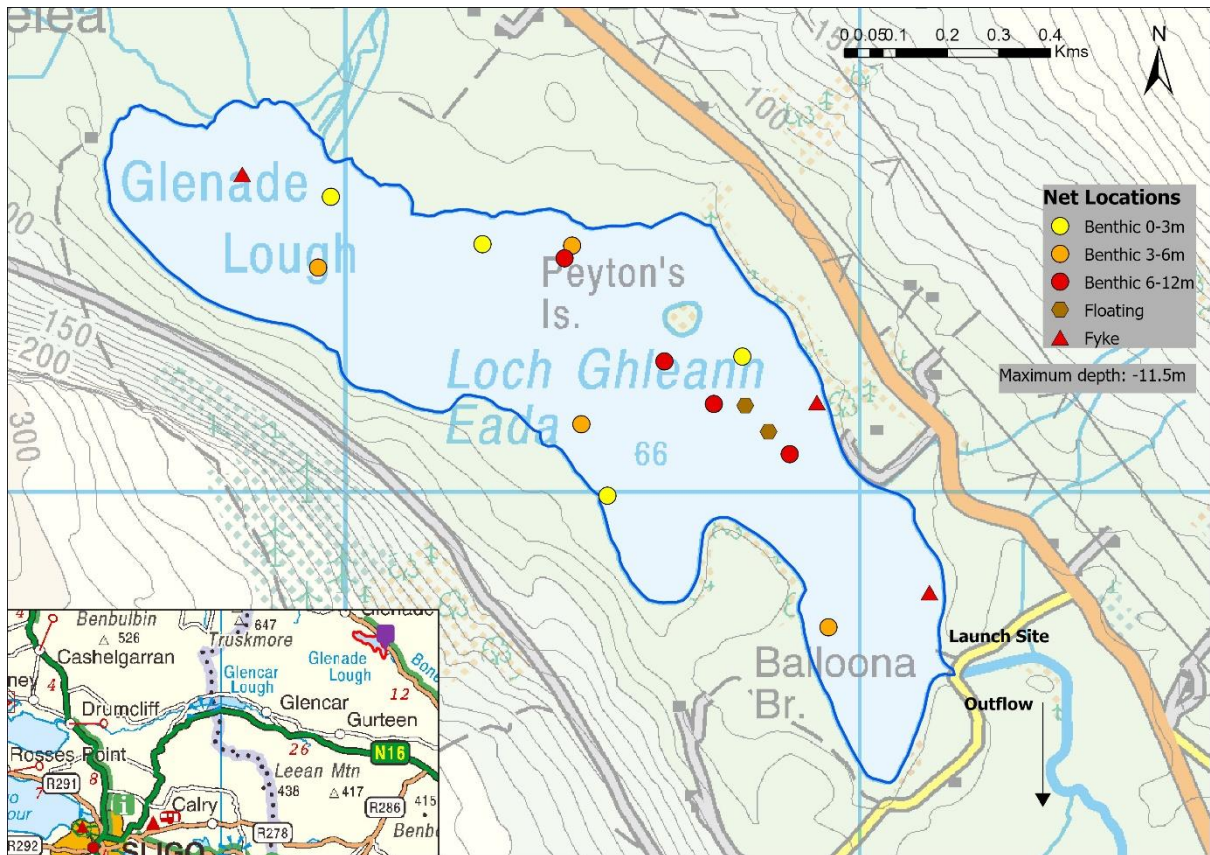
Plate 1.1. Glenade Lough

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

2. Methods

2.1. Netting methods

Glenade Lough was surveyed over one night, from the 26th to the 27th 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 (BM CEN) (4 @ 0-2.9m, 4 @ 3-5.9m and 4 @ 6-11.9m) and two floating benthic monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gills net were deployed in the lake (17 sites). The 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 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

Four fish species were recorded in Glenade Lough in September 2022. A total of 459 fish were captured (Table 3.1). Perch and roach were the most common fish species recorded, representing c. 58% and 41 % of all fish captured respectively. Relatively small numbers of eels and pike were also recorded. During the previous surveys on the lake the same species composition was recorded (Kelly and Connor, 2007 and Kelly *et al*., 2011, 2014 and 2017).

Table 3.1. Number of each fish species captured by each gear type during the survey on Glenade Lough, September 2022.

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Perca fluviatilis	Perch	262	0	6	268
Rutilus rutilus	Roach	188	0	0	188
Esox lucius	Pike	2	0	0	2
Anguilla anguilla	European eel	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. Roach and perch dominated fish stocks with respect to both abundance and biomass (Table 3.2).

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

Scientific name	Common name	Mean CPUE (± S.E.)	Mean BPUE (± S.E.)
Perca fluviatilis	Perch	0.520 (0.123)	28.127 (9.133)
Rutilus rutilus	Roach	0.369 (0.100)	23.765 (5.153)
Esox lucius	Pike	0.004 (0.003)	5.636 (3.890)
Anguilla anguilla	European eel	0.006 (0.006)*	1.040 (1.040)*

*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 box plots of CPUE and BPUE for each species captured in all surveys per net type between 2007 and 2022 are presented in Figures 3.1 and 3.2 respectively and illustrates fish community change over time. Fish populations in the lake have remained relatively stable. Abundance and biomass of all the main species in the lake have fluctuated across all sampling occasions. No clear trends were apparent, although the biomass (BPUE) of roach recorded in the latter surveys (2016 and 2022) was lower than that recorded between 2007 and 2013.
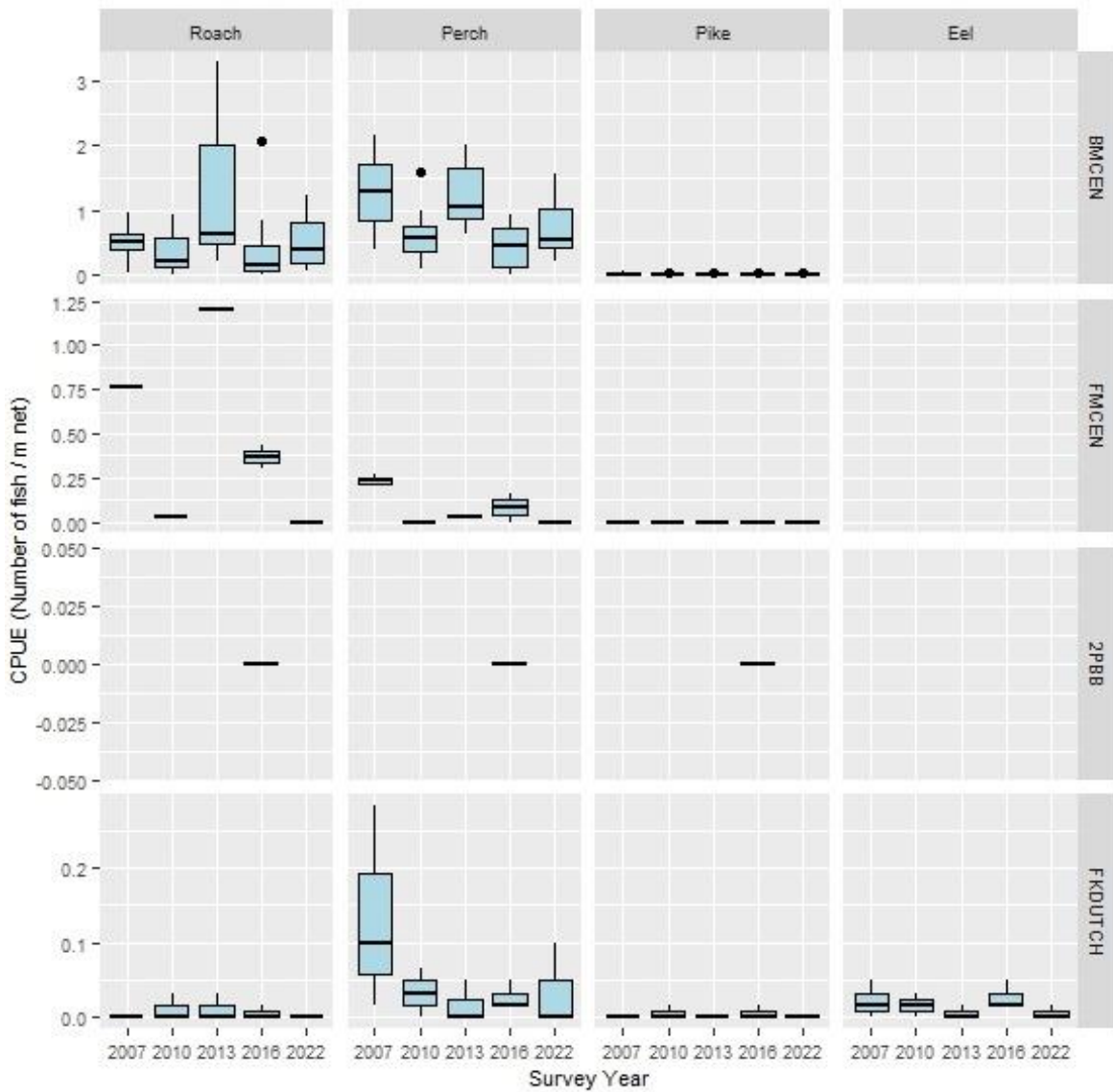
Figure 3.1. CPUE of all fish species captured in each net type during surveys of Glenade Lough between 2007 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis (CPUE) is unique for each net type.
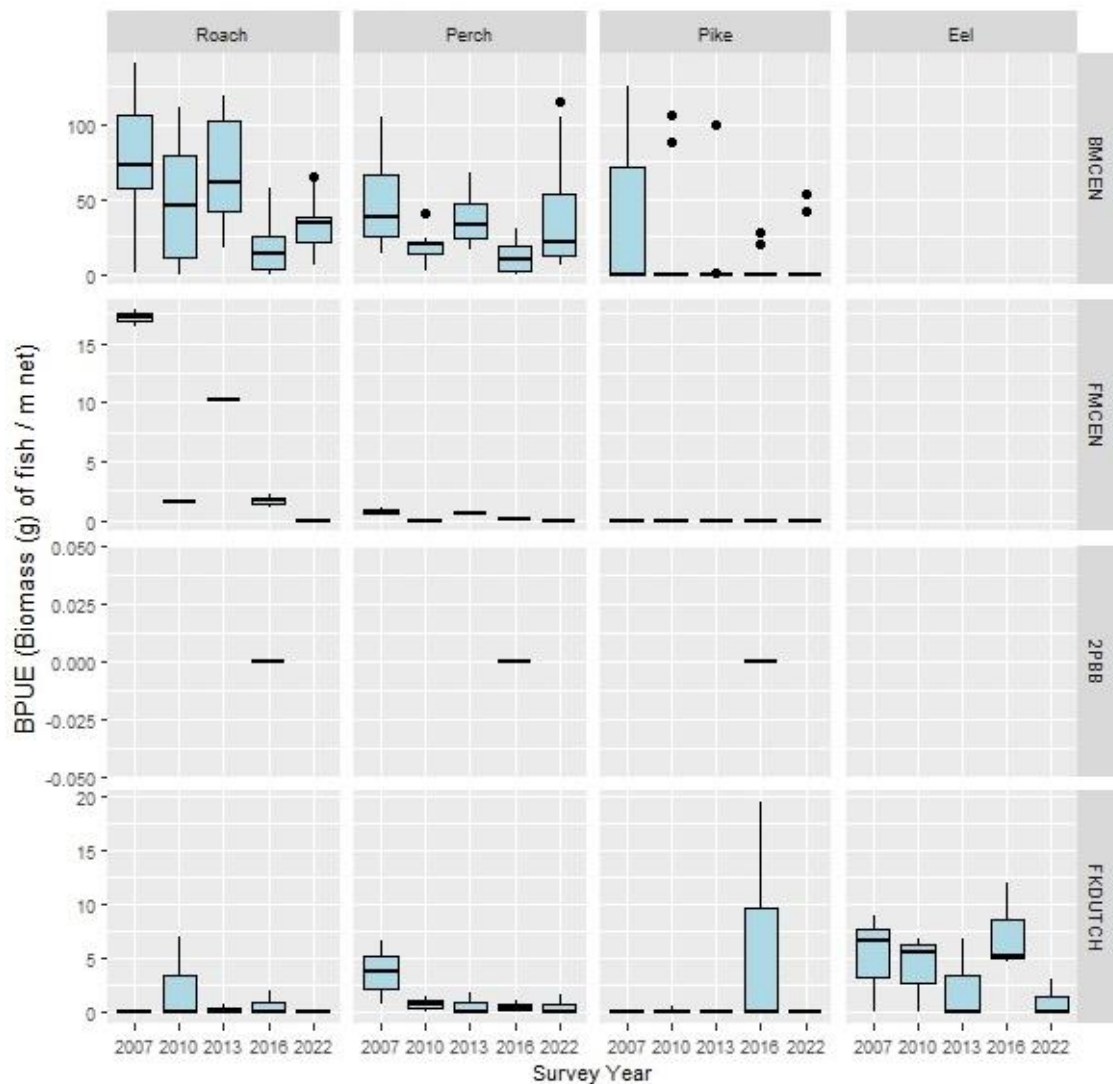
Figure 3.2. BPUE of all fish species captured in each net type during surveys of Glenade Lough between 2007 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. 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 5.0cm to 40.0cm (mean 13.1cm). There was a greater persistence of larger fish (i.e. >20cm) in 2022 compared to earlier surveys of the lake (Figure 3.3). Perch were aged between 0+ and 10+ and all age classes were present in the sample aged (several larger and possibly older fish were released and not available for aging). Mean L1 (i.e. age at the end of the 1st year) was 6.9cm (Table 3.3). The most abundant year classes were 1+ and 4+ (*c*. 5cm - 11cm and 12cm – 20cm) (Figure 3.3)
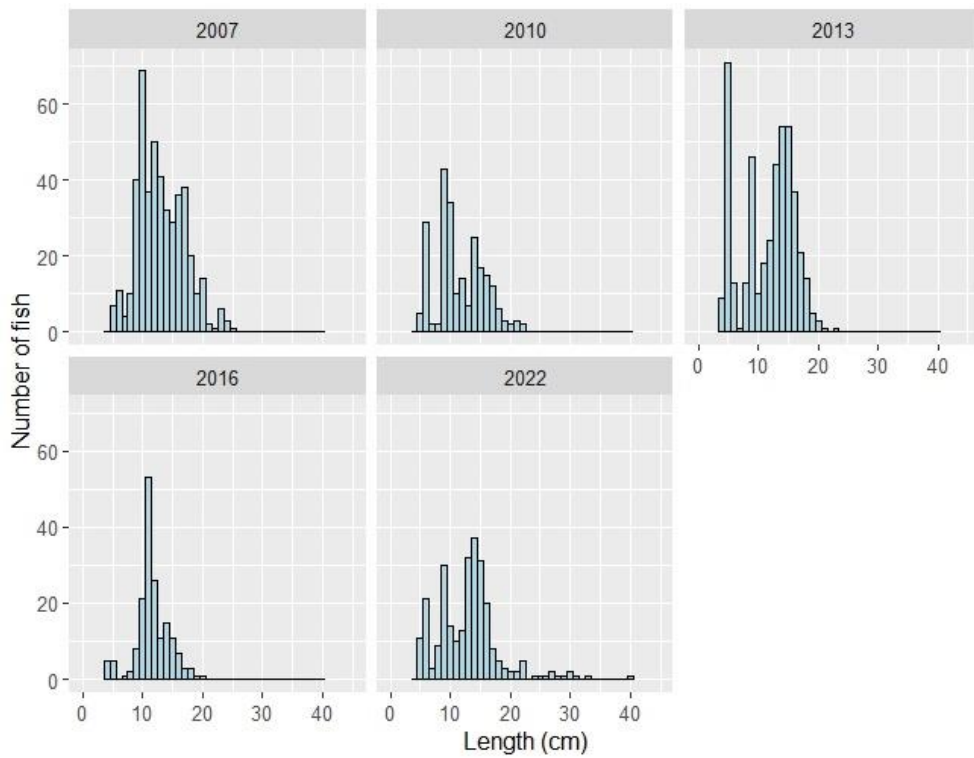
Figure 3.3. Length frequency of perch captured on Glenade Lough in 2007 and 2022

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

Length (cm)	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
Mean	6.9	10.3	13.1	15.7	18.3	20.3	22.3	21.33	26.2	-
(±S.E.)	0.2	0.2	0.3	0.5	0.8	1.2	2.3	2.5	0.3	-
N	75	58	51	41	22	11	5	3	2	1
Min	4.1	7.2	9.8	11.2	14.2	14.2	15.3	16.7	25.9	30
Max	9.5	13.9	18.7	23.8	25.8	25.8	29.3	25.1	26.4	30

Roach

Roach captured during the 2022 survey ranged in length from 7.5cm to 27.3cm (mean 14.4cm). Smaller (i.e. < 10cm) fish were less prominent compared to earlier surveys of the lake (Figure 3.4). Roach were aged between 1+ and 8+ and all intervening age classes were present. The dominant age class was 4+ (*c.*15cm - 20cm) (Figure 3.4 and Table 3.4).
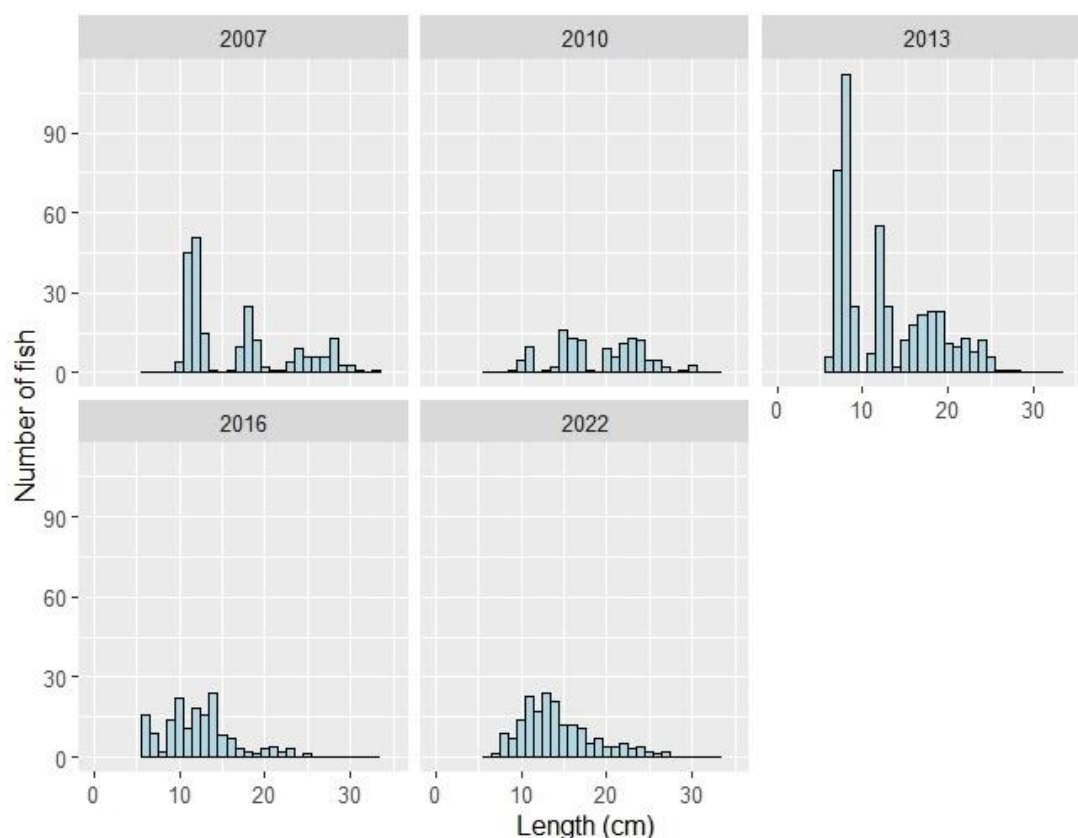

Figure 3.4. Length frequency of roach captured on Glenade Lough in 2007 and 2022.

Table 3.4. Summary age data from roach captured on Glenade Lough, September 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+
N	0	4	13	3	32	14	8	1	2
Mean L (cm)	-	8.3	10.4	12.4	15.6	20.7	22.6	-	25.6
Min L (cm)	-	7.5	8.7	11.7	12.8	18.2	18.2	27.3	24
Max L (cm)	-	8.7	11.7	12.8	20.7	24.5	25.6	27.3	27.1

Other Species

During the 2022 survey, one eel measuring 49.6cm in length was recorded. Two pike measuring 55.3cm and 59.8cm in length were also captured. Both fish were aged 3+.

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. Both pike captured were released and not available for diet analysis

Perch

A total of 67 perch stomachs were examined; of these 56 (84%) were empty. Of the eleven stomachs that contained food, six (55%) contained invertebrates. Two of these fish had consumed crayfish and four (36%) had unidentified digested material in their stomachs. Unidentified fish remains were recorded in one perch stomach (9%). (Figure 3.5).
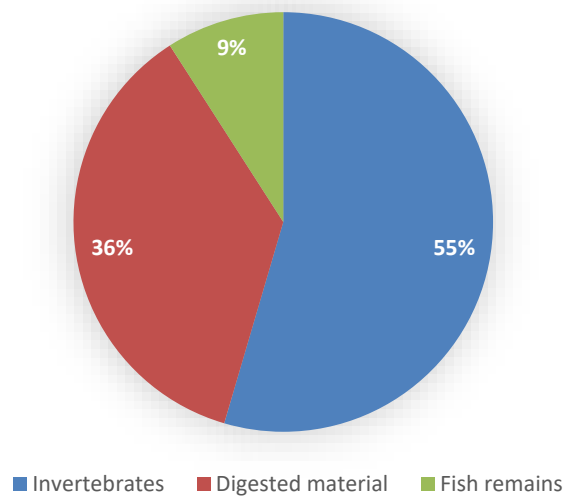

Figure 3.5. Diet of perch (N = 11) captured on Glenade Lough in 2022 (% FO)

4. Summary and fish ecological status

A total of four fish species were recorded in Glenade Lough in September 2022.

Perch and roach were the dominant fish species both in terms of abundance (CPUE) and biomass (BPUE) captured during the 2022 survey. Overall populations of both species have remained relatively stable across all surveys of the lake, although there were some differences in size structure apparent in both species across sampling years. While recruitment was regular for both species, the roach population in particular was dominated by relatively older fish, and comparatively few fish smaller than 10cm (i.e 1+) were captured in 2022.

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, Glenade Lough has been assigned an ecological status of Moderate for 2022 based on the fish populations present. In the previous survey Glenade was assigned a status of Good. Previously Glenade Lough was assigned Poor fish ecological status in 2013, Moderate status in 2010 and Bad status in 2007 (Figure 4.1). These changes are likely due to fluctuations in biomass of tolerant species (Corcoran *et al*., 2023).

In the 2016 to 2021 surveillance monitoring reporting period, the EPA assigned Glenade Lough an overall ecological status of Good, based on all monitored physico-chemical and biological elements, including fish.
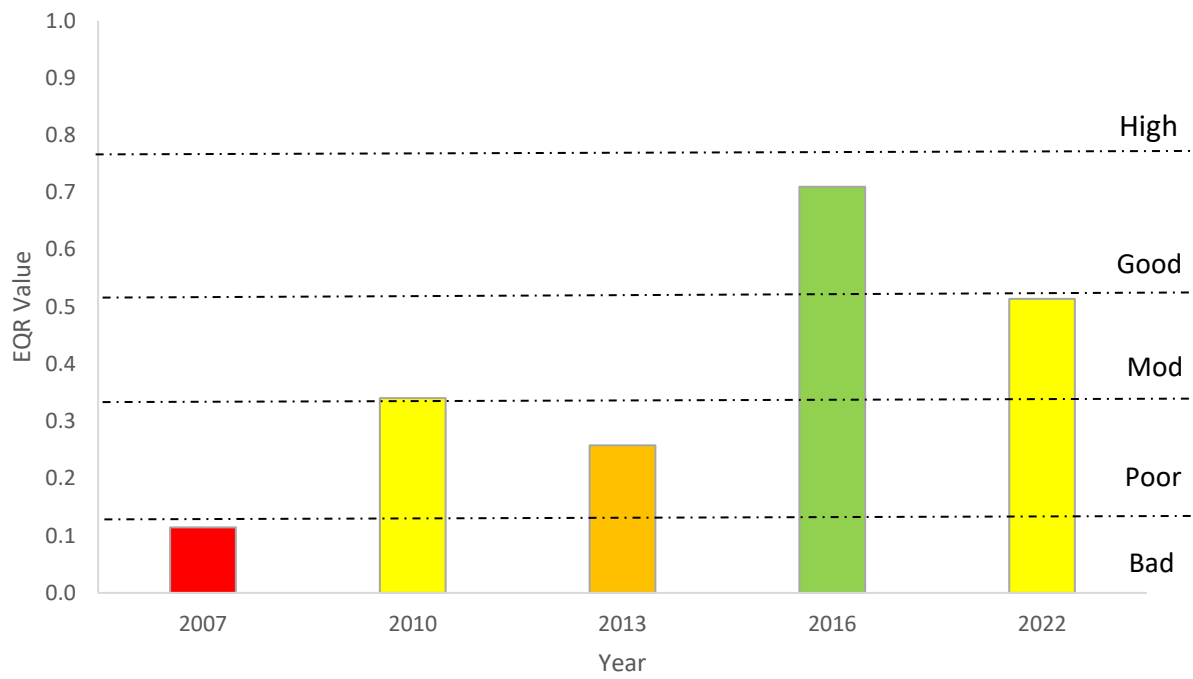
Figure 4.1. Fish ecological status, Glenade Lough in 2007, 2010, 2013, 2016 and 2022 (dashed line indicates EQR status boundaries).

Plate 4.1. Glenade Lough, looking north along the lake in September 2022

5.   References

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