National Research Survey Programme

Lakes 2023

Lough Caragh

IFI/2024/1-4716

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Inland Fisheries Ireland

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Fish Stock Survey of Lough Caragh, August 2023

National Research Survey Programme

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

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1. Introduction

Lough Caragh is situated in Co. Kerry at the mouth of the Glencar Valley, approximately two kilometres north-east of Glenbeigh (Plate 1.1, Figure 1.1). The lake has a surface area of 490ha, a mean depth of 11m and a maximum depth of 40m. The lake is categorised as typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and low alkalinity (<20mg/l $CaCO_3$).

Lough Caragh forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment Special Area of Conservation. This is a large area that encompasses a wide variety of habitats designated under Annex I of the EU Habitats Directive, including blanket bog, alluvial woodlands, alpine heath and both upland and lowland oligotrophic lakes. The site has also been selected for the following species, Killarney fern, slender naiad, freshwater pearl mussel, Kerry slug, marsh fritillary, Killarney shad, Atlantic salmon, brook lamprey, river lamprey, sea lamprey, lesser horseshoe bat and otter; all species listed on Annex II of the EU Habitats Directive (NPWS, 2013).

Lough Caragh is known for its spring salmon and grilse fishing, and to a lesser extent for brown trout and sea trout. The best salmon fishing is at the southern end of the lake along the west and east shores. Early in the season fish average 6.3kg (14lb) and the record for the lake is 12.7kg (28lb). The sea trout arrive in the lake in July. The brown trout are to be found on all the shores. They provide good angling for general small sized fish (0.1kg / 0.33lb) with larger fish to 0.45kg (1lb) (O' Reilly, 2007).

Lough Caragh has been surveyed on four occasions since 2018 (2008, 2011, 2014 and 2017) as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009, 2012a, 2015, Connor *et al*., 2018). In the more recent surveys of the lake, brown trout and perch have been the most abundant species recorded. Arctic char, sea trout, salmon and eels were also captured in these surveys.

This report summarises the results of the 2023 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. Aerial view of Lough Caragh.

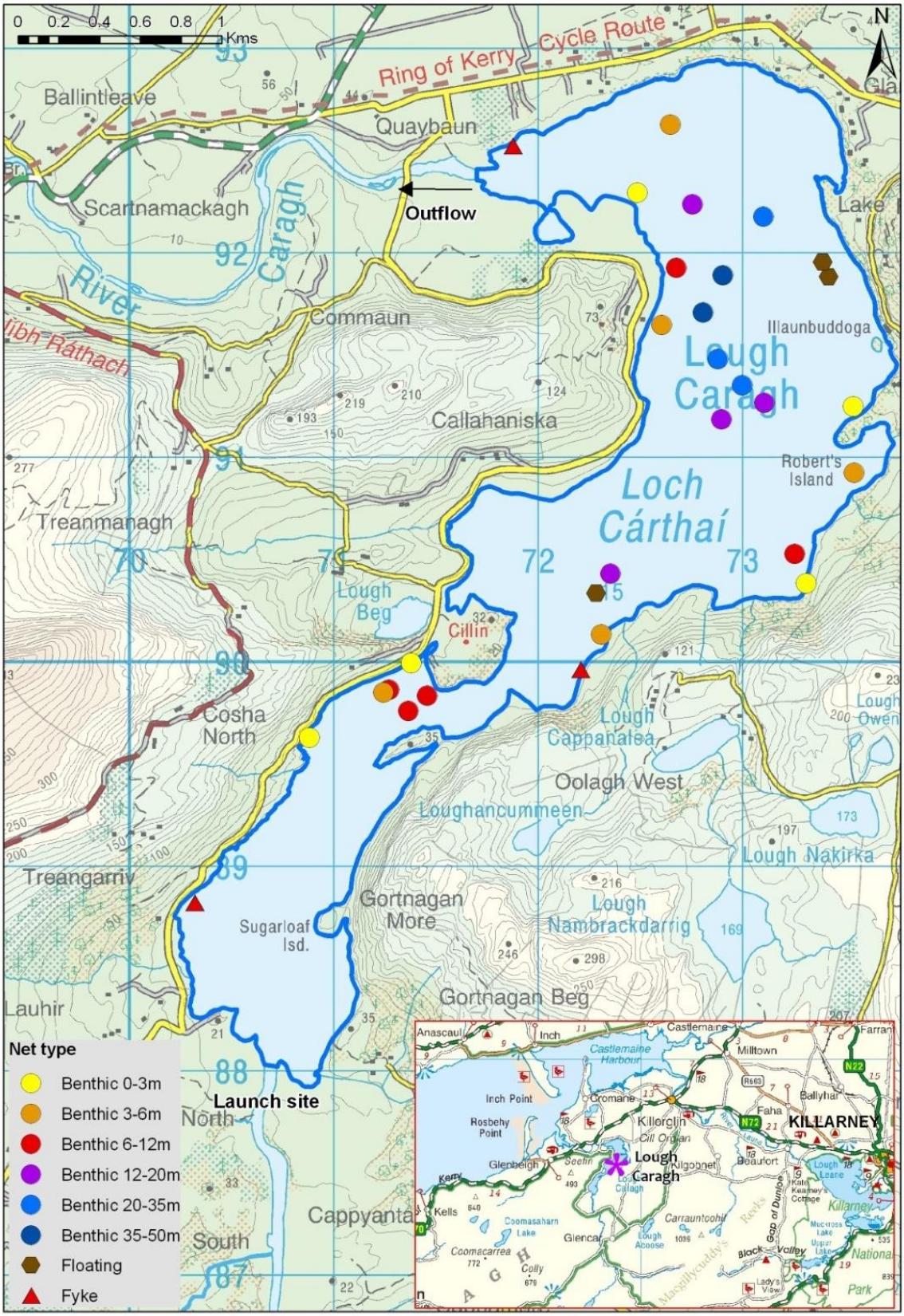

Figure 1.1. Location map of Lough Caragh showing net locations and depths of each net (outflow is indicated on map).

2. Methods

2.1. Netting methods

Lough Caragh was surveyed over two nights from the 28th to the 30th of August 2023. A total of three sets of Dutch fyke nets, 24 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, 5 @ 6-11.9m, 4 @ 12-19.9m, 3 @ 20-34.9m and 2 @ 35-50m) and three floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (30 sites). Survey nets were deployed in the same locations as were randomly selected in the previous surveys. 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. 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 Lough Caragh in August 2023. A total of 268 fish were captured (Table 3.1). Perch was the most numerous fish species recorded, representing *c.* 50% of all fish captured. Brown trout were also captured in relatively large numbers, accounting for 42% of all fish recorded. Rudd and European eel were also captured. Species composition has changed in the lake since WFD surveys began in 2008, with rudd recorded for the first time in 2023. Additionally, no salmon, sea trout or Arctic char were captured in 2023.

Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Caragh, August 2023.

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Perca fluviatilis	Perch	111	0	22	133
Salmo trutta	Brown trout	50	66	0	116
Scardinius erythrophthalmus	Rudd	15	0	2	17
Anguilla anguilla	European eel	0	0	2	2

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 was the dominant species with respect to abundance (CPUE) while brown trout had the highest biomass (BPUE) (Table 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Caragh, August 2023.

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	0.135 (0.028)	9.055 (1.930)
Salmo trutta	Brown trout	0.128 (0.042)	11.605 (3.484)
Scardinius erythrophthalmus	Rudd	0.017 (0.009)	2.673 (1.365)
*Anguilla anguilla**	European eel	0.011 (0.011)	1.291 (1.291)

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.

3.3. Species Profiles

Perch

Perch captured in the 2023 survey ranged in length from 6.0cm to 37.0cm (mean = 16.0cm) Comparatively few small (i.e. <10cm) perch have been captured on surveys of the lake, while the persistence of a small number of much larger individuals is common across all surveys (Figure 3.1).

Perch in the sample were aged between 1+ to 11+. All age groups from 0+ to 5+ (6cm to 23cm) were represented in the sample aged (Figure 3.1 and Table 3.3). 9+ and 11+ year groups were represented by one individual fish each in the sample. Mean L1 (i.e. age at the end of the 1st year) was 6.9cm (Table 3.3).

The increase in both abundance (CPUE) and biomass (BPUE) evident from 2008 to 2014 appears to have stabilised in the later surveys of the lake (Figure 3.2).

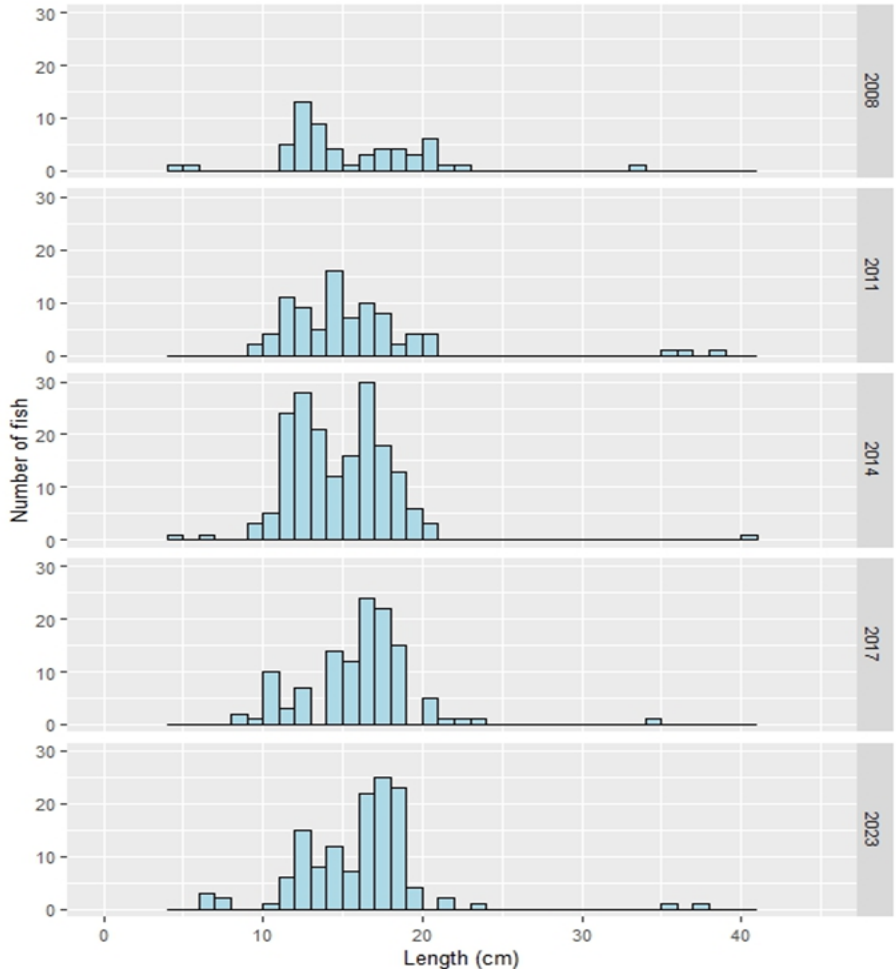

Figure 3.1. Length frequency of perch captured on Lough Caragh between 2008 and 2023.

Table 3.3. Mean (±S.E) perch length (cm) at age for Lough Caragh, August 2023

Length (cm)	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
Mean (±S.E)	6.4 (0.16)	12.3 (0.28)	15.0 (0.39)	16.7 (0.37)	18.7 (0.65)	24.0 (2.10)	28.2 (2.25)	30.7 (2.50)	33.3 (1.80)	-	-
N	49	33	21	15	10	2	2	2	2	1	1
Range	4.8-9.7	8.9-15.8	12.1-19.7	14.9-19.6	15.9-22.3	21.9-26.1	26.0-30.5	28.2-33.2	31.5-35.1	34.3	35.9

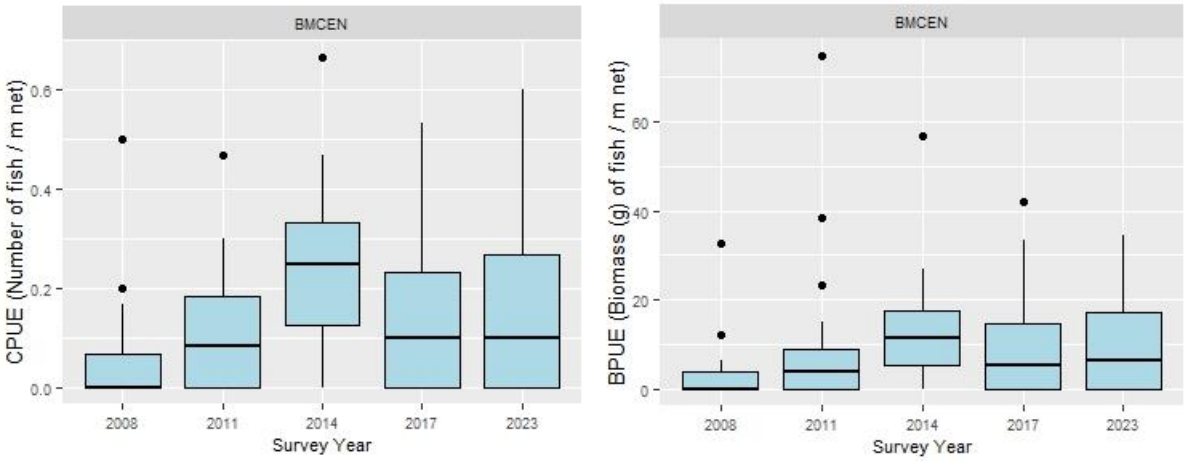

Figure 3.2. CPUE and BPUE of perch captured during surveys of Lough Caragh between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Brown trout

Brown trout captured during the 2023 survey ranged in length from 12.0cm to 26.7cm (mean 19.4cm) (Figure 3.3). Brown trout captured in previous surveys had broadly similar length ranges. Brown trout were aged between 1+ and 3+. Two-year-old fish were the most abundant cohort in the sample aged. Mean L1 (i.e. length at the end of the 1st year) was 7.1cm (Table 3.4).

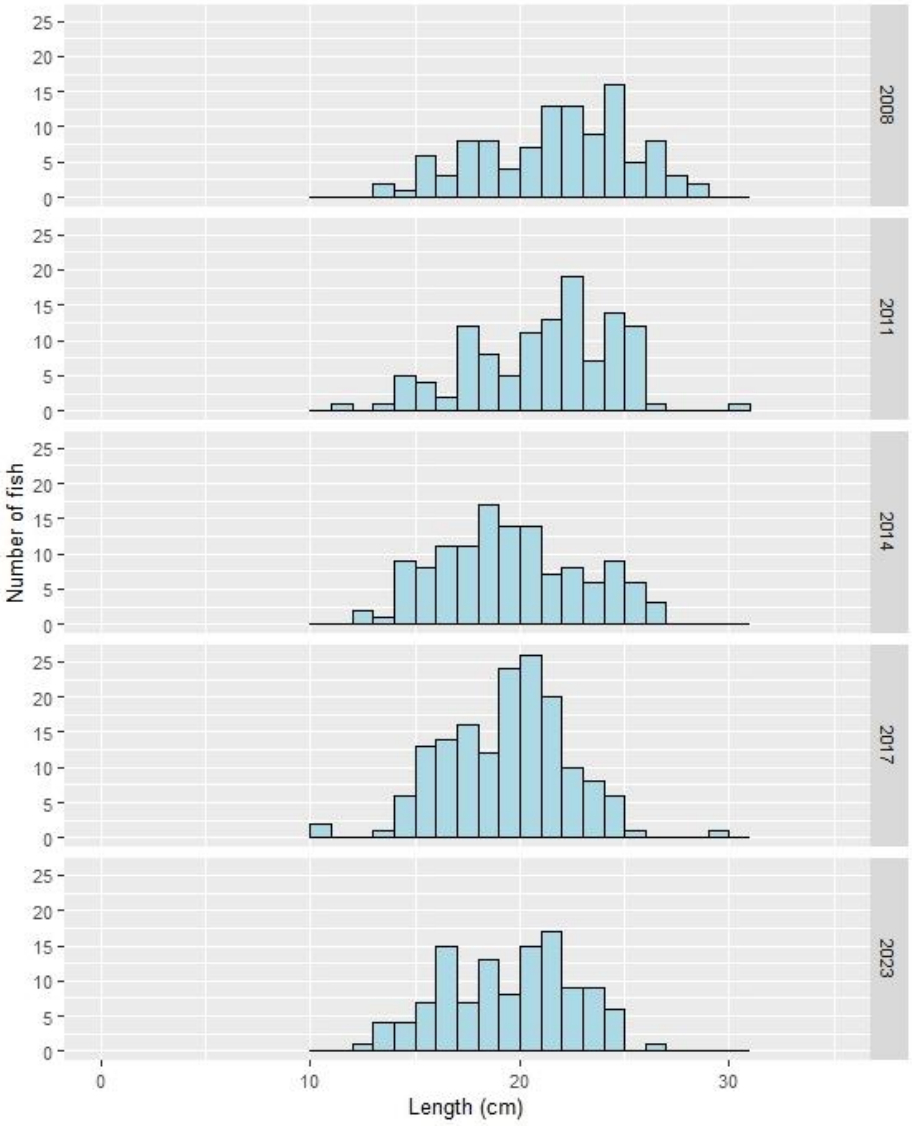

Figure 3.3. Length frequency of brown trout captured on Lough Caragh between 2008 and 2023.

Table 3.4. Mean (±S.E) brown trout length (cm) at age for Lough Caragh, August 2023

Length (cm)	L_1	L_2	L_3
Mean (±S.E)	7.1 (0.12)	14.4 (0.20)	20.2 (0.29)
N	54	48	15
Range	5.2-9.6	7.8-18.6	17.9-21.9

The abundance (CPUE) and biomass (BPUE) of brown trout captured in benthic survey gill nets was relatively stable across surveys (Figure 3.4). An apparent increase in abundance and biomass of trout captured in surface (FMCEN) survey gill nets evident between 2008 and 2017 may also have stabilised (Figure 3.4).

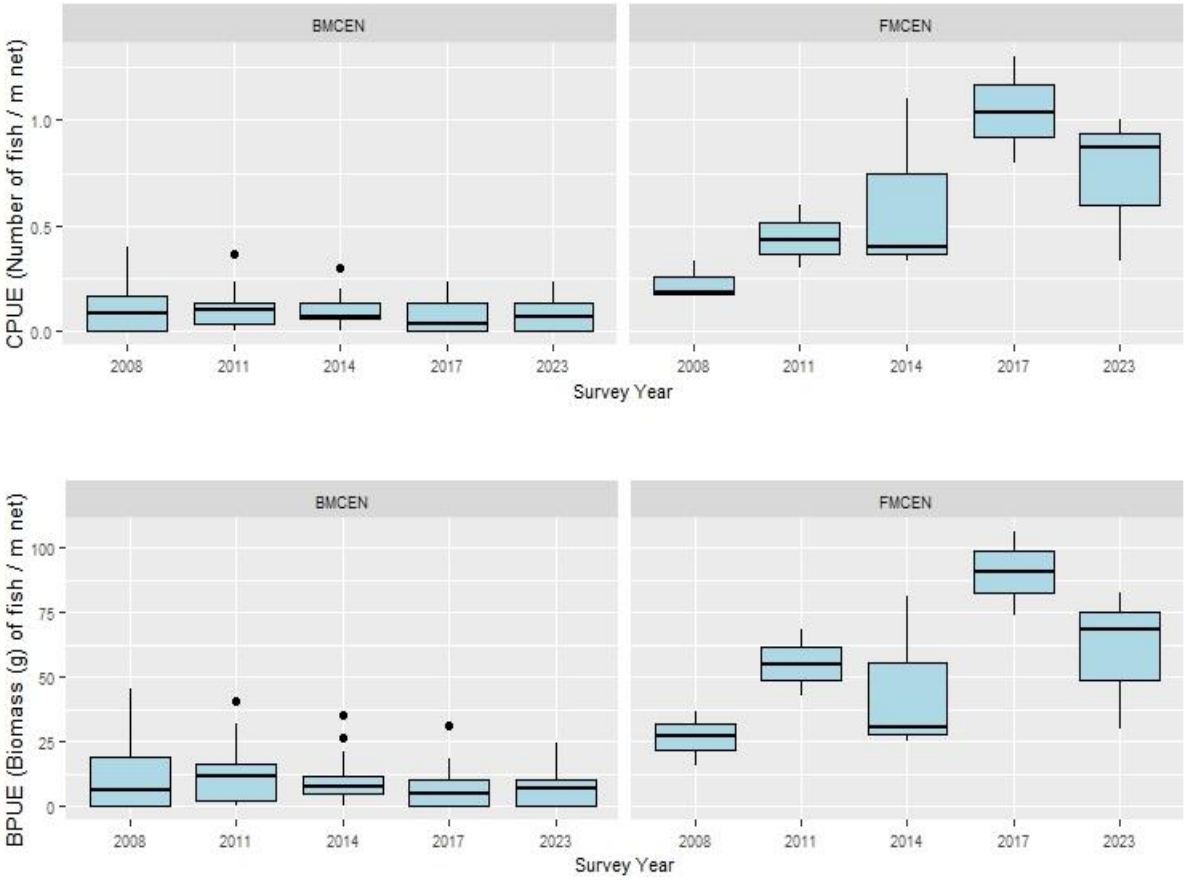

Figure 3.4. CPUE and BPUE of brown trout captured during surveys of Lough Caragh between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Arctic char

No arctic char were recorded in 2023. They were recorded on all previous surveys of the lake between 2008 and 2017.

Rudd

Rudd were captured for the first time in 2023. They ranged in length from 17cm to 23.4cm (mean = 20.3cm). Rudd were aged between 4+ and 8+.

Eel

Two eels were captured in the 2023 survey. They measured 37.4cm and 46.2cm. Abundance (CPUE) and biomass (BPUE) of eel declined in 2014, and has since remained low, compared to the earlier surveys of the lake (Figure 3.5).

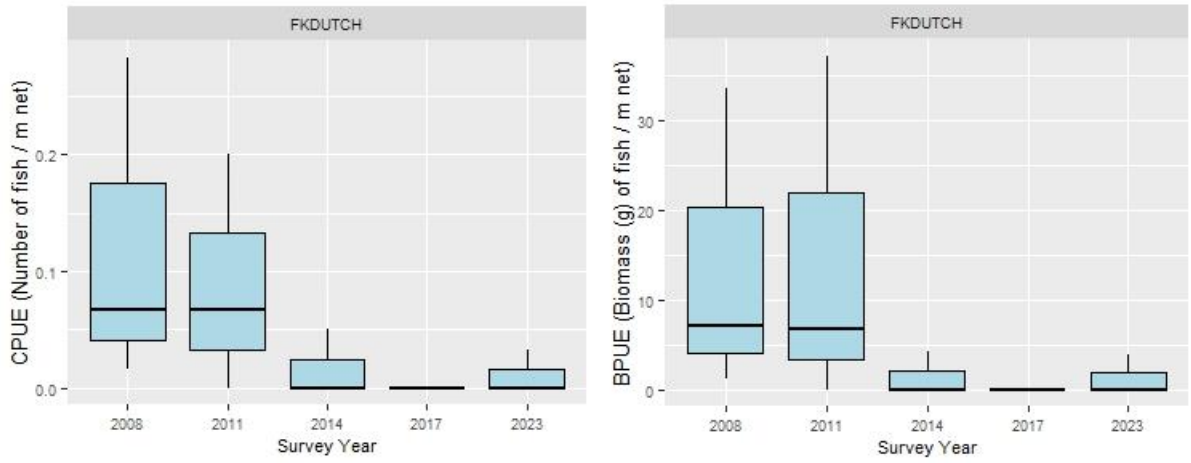

Figure 3.5. CPUE and BPUE of eel captured during surveys of Lough Caragh between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

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 brown trout and perch captured during the survey were examined and are presented below.

Brown trout

A total of 86 brown trout stomachs were examined. Thirty-four (40%) were empty. Fifty-two stomachs contained food. Invertebrates were the sole prey type recorded in 48 (92%) stomachs. The contents of three (6%) stomachs consisted of zooplankton, while unidentified digested material was recorded in one (2%) fish (Figure 3.6).

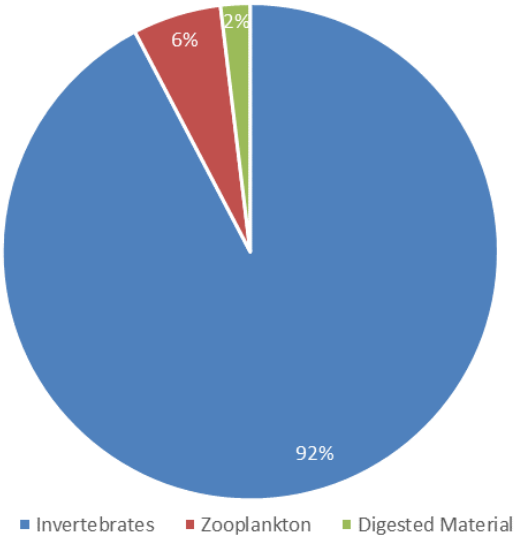

Figure 3.6. Diet of brown trout (N = 52) captured on Lough Caragh, 2023 (% FO).

Perch

A total of 47 stomachs were examined. Fifteen (32%) were empty. Thirty-two stomachs contained food. Invertebrates were the sole prey type recorded in 21 (66%) stomachs and were found together with zooplankton in seven (22%) stomachs. Four (12.5%) stomachs contained solely zooplankton (Figure 3.7).

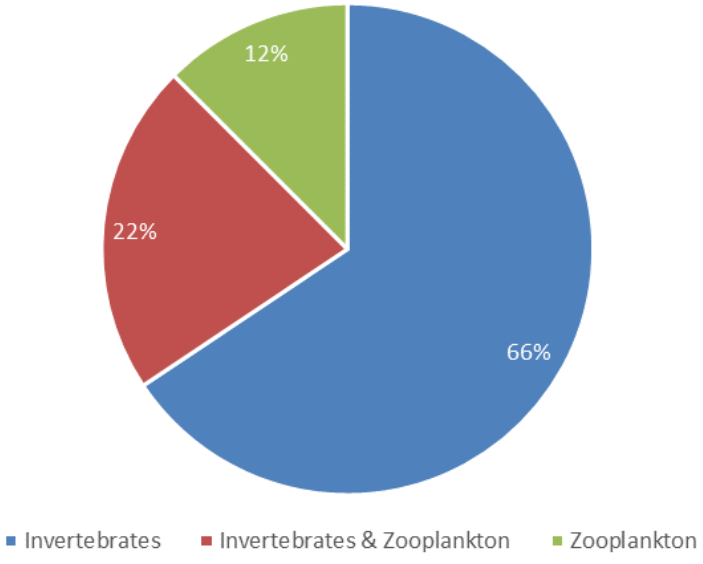

Figure 3.7. Diet of perch (N = 32) captured on Lough Caragh, 2023 (% FO).

4. Summary and fish ecological status

A total of four fish species were recorded in Lough Caragh in August 2023. Perch was the dominant species in terms of abundance (CPUE) while brown trout had the highest biomass (BPUE) captured in the survey gill nets during the 2023 survey. The perch are recruiting regularly to the lake. The population, which expanded from a comparatively low level between 2008 and 2014 appears to have stabilised in recent years.

The brown trout population appears to be relatively stable.

No Arctic char were captured in 2023. They were recorded in relatively small numbers in all previous surveys of the lake between 2008 and 2017 (e.g. Connor, 2018). Rudd were captured for the first time in 2023. Abundance (CPUE) and biomass (BPUE) of eel declined in 2014 and has since remained relatively low.

Classification and assigning lakes with an ecological status is a critical part of the WFD monitoring programme. It allows for the identification and prioritisation of 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 (Ecological Quality Ratio) values for each lake and associated confidence in classification (Kelly *et al*., 2012b).

Using the FIL2 classification tool, Lough Caragh has been assigned an ecological status of Good for 2023 based on the fish populations present. Lough Caragh was assigned a status of High following all previous surveys of the lake between 2008 and 2017 (Figure 4.1).

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

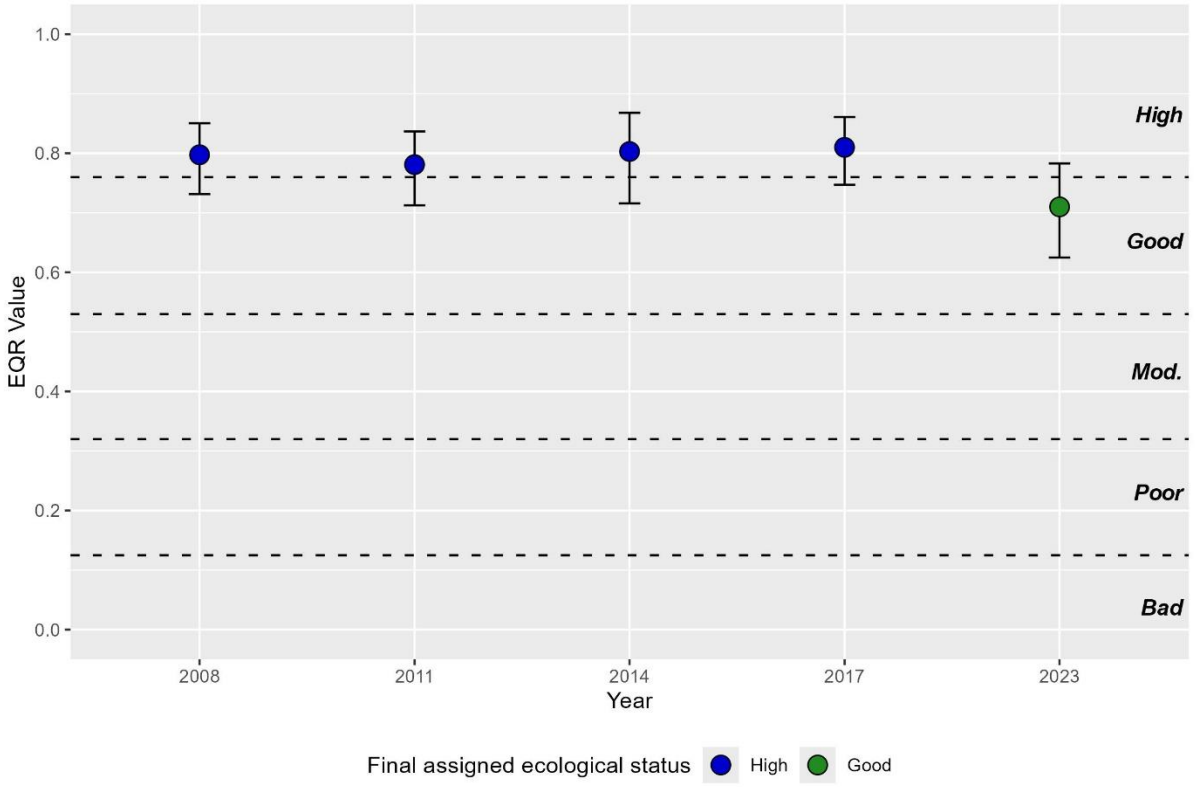

Figure 4.1. Fish ecological status of Lough Caragh between 2008 and 2023 (dashed line indicates EQR status boundaries).

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