# National Research Survey Programme

## Lakes 2022

## Lough Rea

IFI/2023/1-4670

Iascach Intíre Éireann
Inland Fisheries Ireland

# Fish Stock Survey of Lough Rea, August 2022

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Inland Fisheries Ireland

National Research Survey Programme

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

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# 1. Introduction

Lough Rea is situated in the Kilcolgan catchment in Co. Galway (Plate 1.1, Figure 1.1). It is an abstraction lake, providing water to the nearby town of Loughrea (County Galway Guide, 2010). The lake is situated at an altitude of 85m a.s.l., has a surface area of 301ha, a mean depth of 3.9m, a maximum depth of 23m and is categorised as typology class 10 (as designated by the EPA for the Water Framework Directive), i.e., shallow (<4m), greater than 50ha and high alkalinity (>100mg/l $CaCO_3$).

Lough Rea has been designated as both a Special Area of Conservation (SAC) and a Special Protected Area (SPA) (NPWS, 2013 and 2010). It is a hard water lake, a habitat listed on Annex I of the EU Habitats Directive. The underlying geology of the area is of carboniferous limestone. Plant species characteristic of calcareous waters and common to the lake include stonewort species, *Chara curta* and *C. contraria*. Internationally important numbers of over wintering shoveler birds have been recorded at the site, along with nationally important numbers of tufted duck (*Aythya fuligul*) and coot (*Fulica atra*). The presence of these birds has led to the site being designated as a Special Protection Area (SPA) (NPWS, 2010).

Lough Rea is surrounded by intensively farmed pastureland and consequently the main threat to the lake comes from agricultural run-off and possible nutrient input from the town of Loughrea.

Fishing on Lough Rea is managed by the Loughrea Anglers' Association. There are good numbers of rudd (*Scardinius erythrophthalmus*) and perch (*Perca fluviatilis*), along with a stock of pike (*Esox lucius*) present in the lake. Brown trout (*Salmo trutta*) with an average weight of 1.5lbs (0.6kg) are also found in the lake (O' Reilly, 2010).

Lough Rea is fed by springs and small streams on the south-eastern shore and has poor spawning areas for trout (NPWS, 2013). Brown trout spawning is limited to a single narrow inflowing stream and to the outflowing stream and there has been a history of coarse fish and pike management and brown trout stocking in the lake. In the early 1920's brown trout from nearby Lough Atorick in Co. Clare were stocked into the lake which had previously been populated with coarse fish and pike (Healy, 1953). Further stocks of brown trout were introduced from Lough Atorick in 1936 and 1939 and this practice continued until at least the 1950's. These stocks were supplemented by fry hatched out locally from ova supplied from Lough Owel in Co. Westmeath and elsewhere (Healy, 1953). Lough Rea Anglers Association operate a small hatchery on the lake and female brown trout have been stripped almost annually since 1939. Fish are stocked into the lake at the unfed fry stage.

The lake has been surveyed on three occasions since 2010 (2010, 2016 and 2016) (Kelly *et al*., 2011, 2014 and 2017). Species captured include, brown trout, perch, rudd, perch, pike, eel (*Anguilla anguila*) three-spined stickleback (*Gasterosteus aculeatus*) and nine-spined stickleback (*Pungitius pungitius*). While the species mix has remained similar across all sampling occasions, the relative size of the individual species populations has fluctuated between surveys.

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.

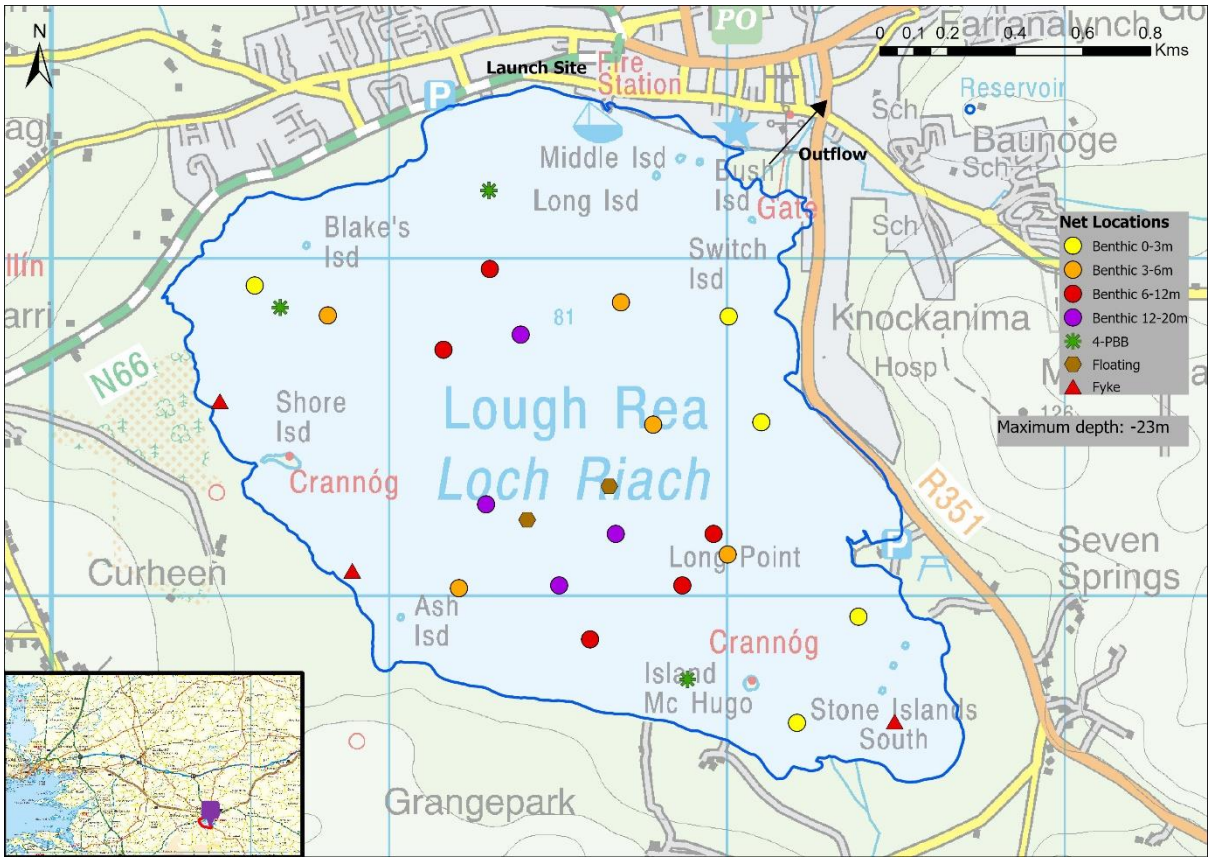


**Figure 1.1. Location map of Lough Rea showing net locations and depths of each net (outflow is indicated on map).**

# 2. Methods

## 2.1. Netting methods

Lough Rea was surveyed over two nights from the 15th to the 17th of August 2022. A total of three sets of Dutch fyke nets, 19 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 and 4 @ 12-19.9m) and two floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (24 sites) at the same locations as previous surveys.

The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at three 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 rudd, brown trout and pike. 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).

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

Where:

$\mathbf{FO}_{\boldsymbol{i}}$ 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.

**Plate 2.1. Setting nets on Lough Rea, August 2022**

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# 3. Results

## 3.1. Species Richness

Seven fish species were recorded on Lough Rea in August 2022. A total of 1618 fish were captured (Table 3.1). Perch and rudd were the most abundant fish species recorded, together representing *c.* 89% of all fish captured. Three-spined stickleback were also recorded in relatively large numbers. Smaller numbers of eel, nine-spined stickleback, brown trout (stocked) and pike were also recorded.

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

| Scientific name | Common name | Number of fish captured | | | |
|---|---|---|---|---|---|
| | | BM CEN | 4-PBB | Fyke | Total |
| *Perca fluviatilis* | Perch | 943 | 0 | 0 | 943 |
| *Scardinius erythrophthalmus* | Rudd | 482 | 14 | 0 | 496 |
| *Gasterosteus aculeatus* | Three-spined stickleback | 162 | 1 | 0 | 163 |
| *Salmo trutta* | Brown trout | 4 | 0 | 0 | 4 |
| *Pungitius pungitius* | Nine-spined stickleback | 3 | 0 | 0 | 3 |
| *Esox lucius* | Pike | 2 | 0 | 0 | 2 |
| *Anguilla anguilla* | European eel | 0 | 0 | 7 | 7 |

## 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, mean CPUE/BPUE is based on all nets, whereas eel mean CPUE/BPUE is based on fyke nets only. In 2022, perch and rudd dominated fish stocks with respect to both abundance and biomass (Table 3.2).

For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type between 2009 and 2021 are presented in Figures 3.1 and 3.2 respectively and illustrates fish community change over time.

Abundance and biomass of both perch and rudd were higher in 2022 than more recent surveys of the lake. Abundance and biomass of eel have declined slightly over all surveys. No clear trends in the populations of other, less abundant species are apparent (Figures 3.1 and 3.2).

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

| Scientific name | Common name | Mean CPUE (± S.E) | Mean BPUE (± S.E) |
|---|---|---|---|
| *Perca fluviatilis* | Perch | 1.124 (0.313) | 42.178 (14.290) |
| *Scardinius erythrophthalmus* | Rudd | 0.590 (0.239) | 26.594 (7.564) |
| *Gasterosteus aculeatus* | Three-spined stickleback | 0.194 (0.081) | 0.390 (0.164) |
| *Salmo trutta* | Brown trout | 0.005 (0.002) | 5.361 (2.606) |
| *Pungitius pungitius* | Nine-spined stickleback | 0.004 (0.003) | 0.008 (0.006) |
| *Esox lucius* | Pike | 0.001 (0.001) | 0.054 (0.054) |
| *Anguilla anguilla* | European eel | 0.039 (0.024)* | 11.786 (8.666)* |

***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.*

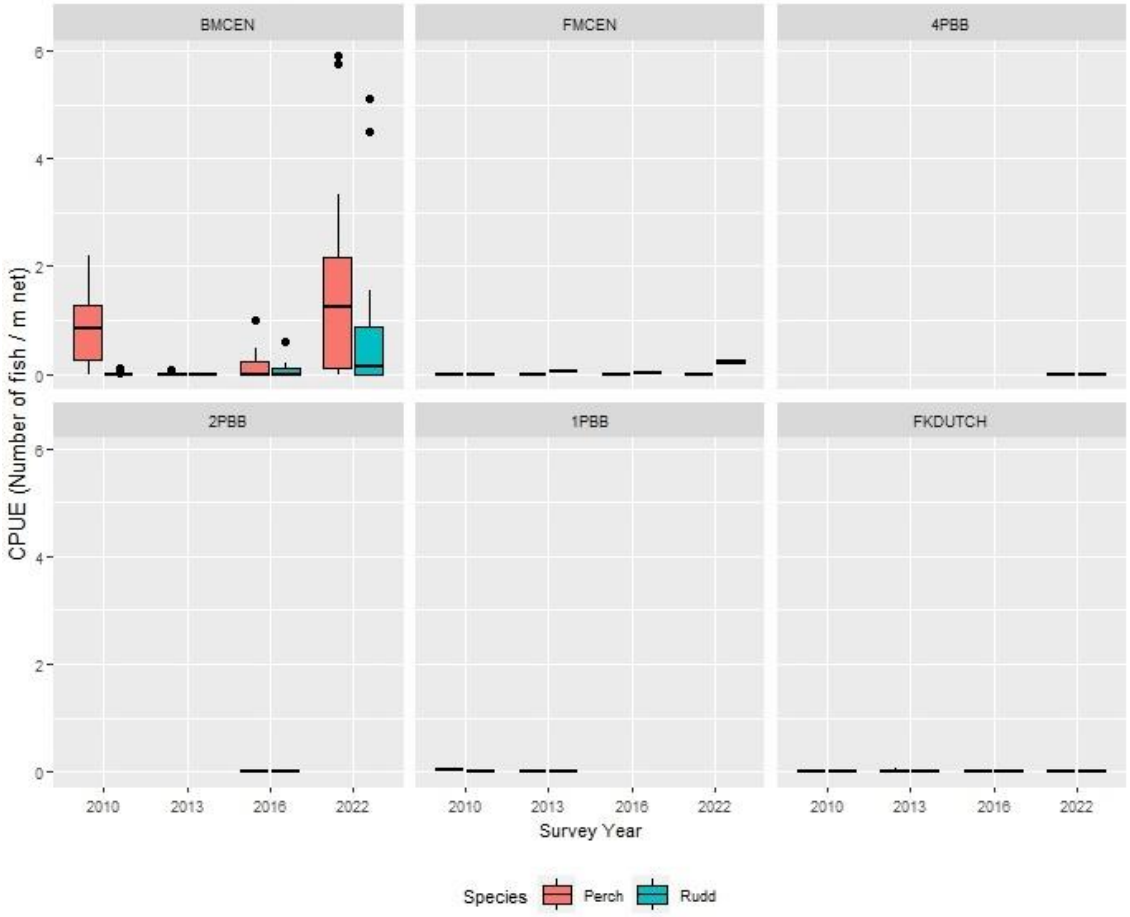


**Figure 3.1a. CPUE of perch and rudd captured in each net type during surveys of Lough Rea between 2010 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75$^{th}$ and 25$^{th}$ percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.**

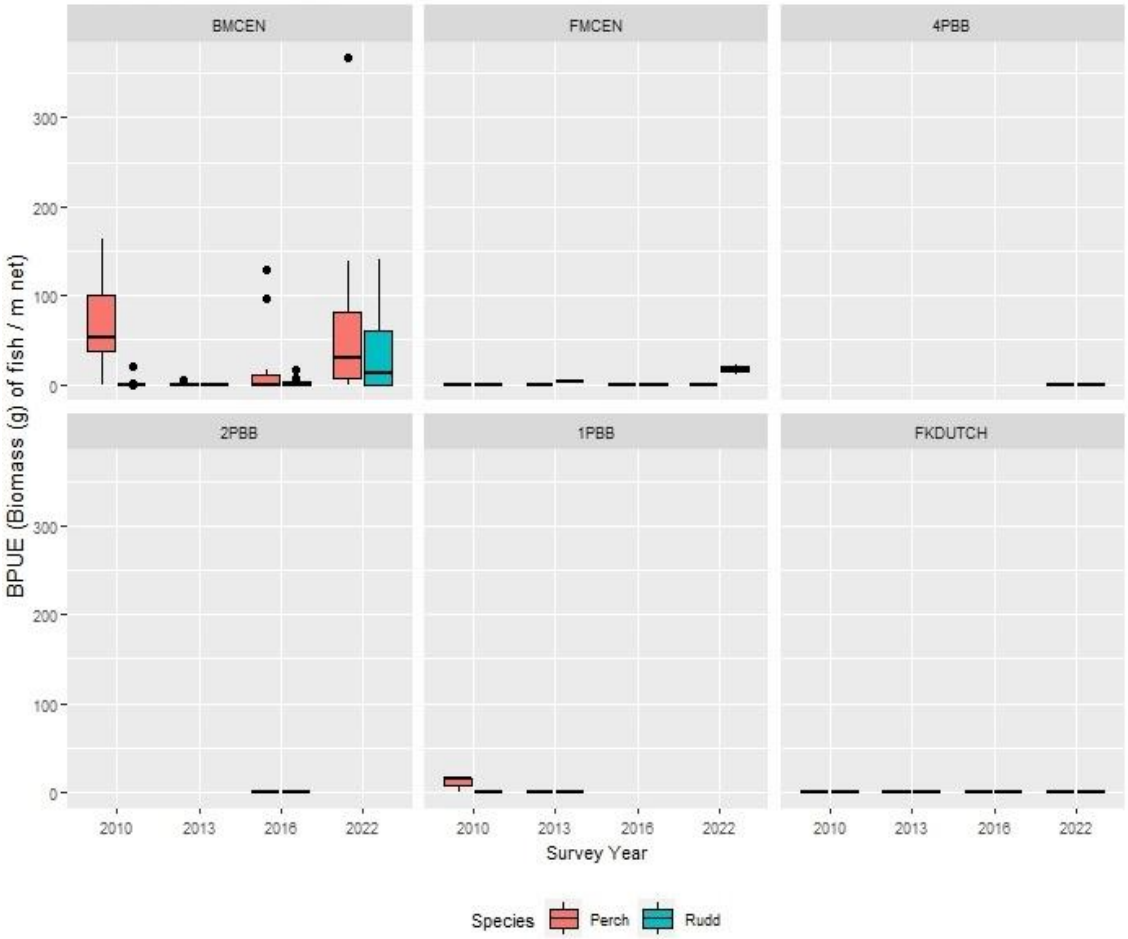


**Figure 3.1b. BPUE of perch and rudd captured in each net type during surveys of Lough Rea from between 2010 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75$^{th}$ and 25$^{th}$ percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.**

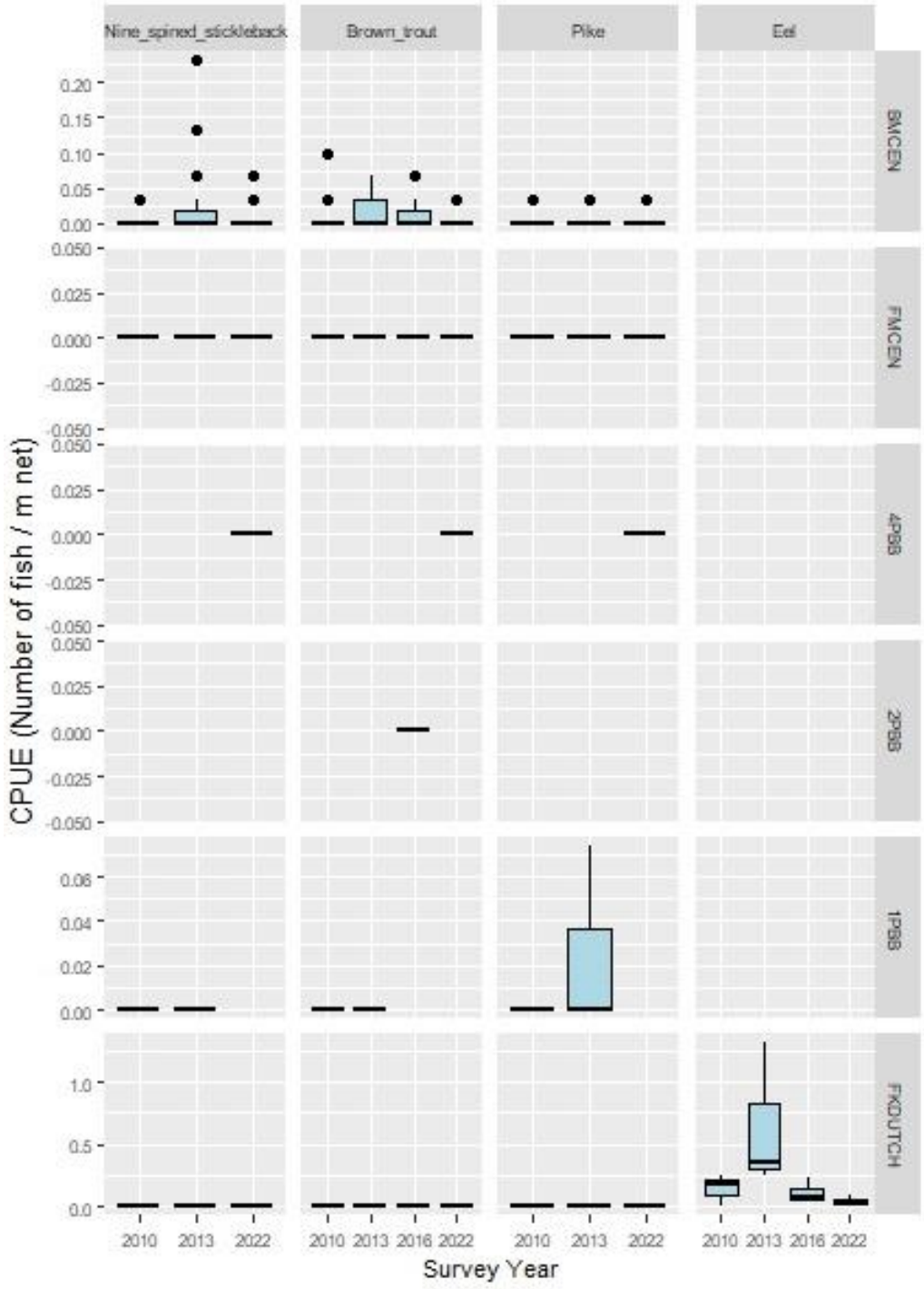


**Figure 3.2a. CPUE of other species captured in each net type during surveys of Lough Rea between 2010 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75$^{th}$ and 25$^{th}$ percentiles 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.**

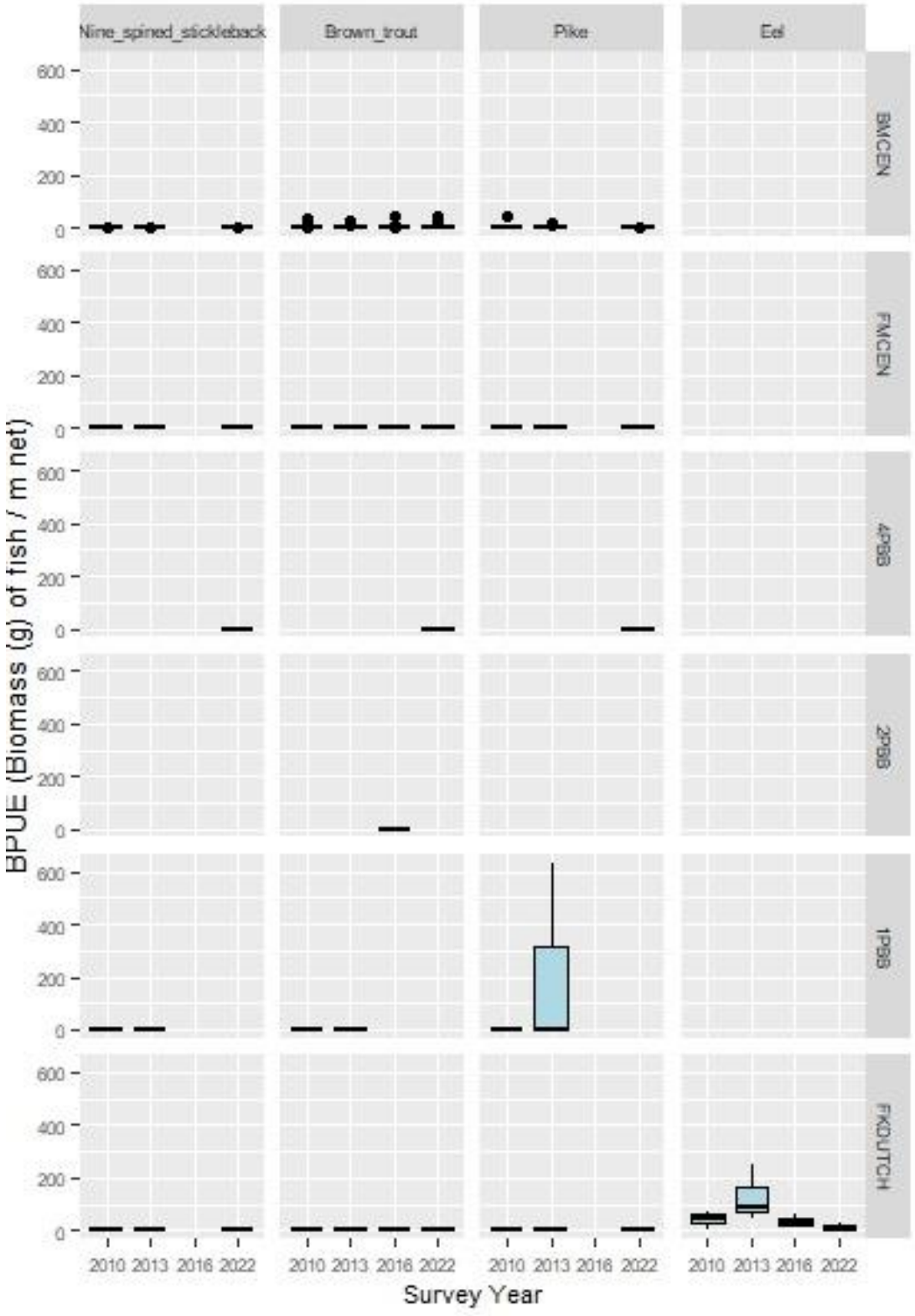


**Figure 3.2b. BPUE of other species captured in each net type during surveys of Lough Rea from between 2010 and 2022. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75$^{th}$ and 25$^{th}$ 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 3.0cm to 40.5cm (mean 9.6cm) with a much greater proportion of small (< 8.0cm) perch captured in 2022 compared to earlier surveys (Figure 3.3). Thirteen age classes were present in the sample aged, with all age classes from 1+ to 13+ represented. Mean L1 (i.e., age at the end of the first year) was 7.4cm (Table 3. 4). The population was dominated by small (predominantly 0+) fish. However, there was substantial persistence of older and larger fish in the population in 2022 (Table 3.4 and Figure 3.4).

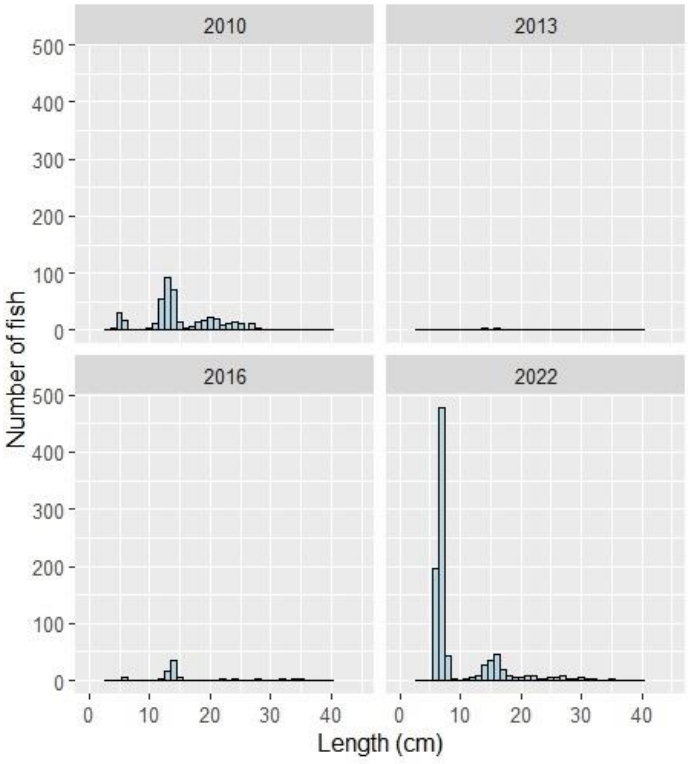


**Figure 3.3. Length frequency of perch captured on Lough Rea, 2010, 2013, 2016 and 2022.**

**Table 3.3. Mean (±S.E.) perch length (cm) at age for Lough Rea, August 2022.**

| Length (cm) | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ | $L_6$ | $L_7$ | $L_8$ | $L_9$ | $L_{10}$ | $L_{11}$ | $L_{12}$ | $L_{13}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean (±S.E.) | 7.4 (0.1) | 11.9 (0.2) | 15.3 (0.3) | 18.2 (0.4) | 21.1 (0.4) | 23.6 (0.7) | 25.1 (0.7) | 26.1 (1.2) | 28.2 (1.5) | 29.8 (0.3) | 34.9 (0.3) | - | - |
| N | 97 | 88 | 77 | 52 | 39 | 24 | 16 | 8 | 6 | 5 | 2 | 1 | 1 |
| Range | 4.0-9.2 | 7.8-16.4 | 10.6-21.8 | 11.1-23.6 | 14.8-25.6 | 14.8-29.6 | 19.0-29.8 | 19.0-29.6 | 21.6-31.5 | 21.6-32.9 | 34.6-35.2 | 37.5 | 39.6 |

**Rudd**

Rudd captured during the 2022 survey ranged in length from 4.4cm to 25.4cm (mean 11.4cm) (Figure 3.4). Seven age classes were present in the sample aged. All age groups between 1+ and 7+ were represented. While no one cohort dominated, there were comparatively fewer three-year old fish in the sample (Table 3.4). Similarly, there were fewer fish between 10cm - 15cm compared to other sizes in 2022 (Figure 3.4).

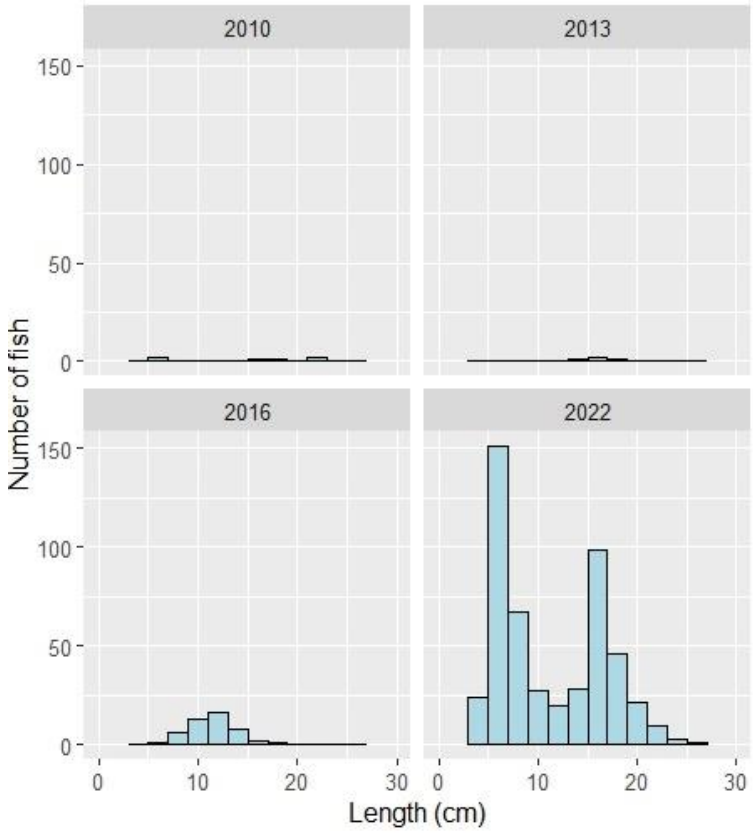


**Figure 3.4. Length frequency of rudd captured on Lough Rea, 2010, 2013, 2016 and 2022.**

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

| | Age class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Length (cm) | 0+ | 1+ | 2+ | 3+ | 4+ | 5+ | 6+ | 7+ |
| N | 0 | 8 | 9 | 3 | 9 | 9 | 9 | 3 |
| Mean L (cm) | - | 7.15 | 10.01 | 13.53 | 15.43 | 18.22 | 20.99 | 24.93 |
| Min L (cm) | - | 5.00 | 8.00 | 13.30 | 14.50 | 16.50 | 17.00 | 24.70 |
| Max L (cm) | - | 9.90 | 12.00 | 13.90 | 16.60 | 20.10 | 23.30 | 25.40 |

**Brown trout**

Brown trout captured during the 2022 survey ranged in length from 41.8cm to 48.3cm (mean 46.0cm) (Figure 3.5). Two age classes were present, with fish aged and 5+ and 6+. In previous surveys the population of brown trout in Lough Rea was characterised by a larger proportion of fish in the 20.0cm to 30.0cm range. In 2022, all trout were larger than 40.0cm (Figure 3.4).

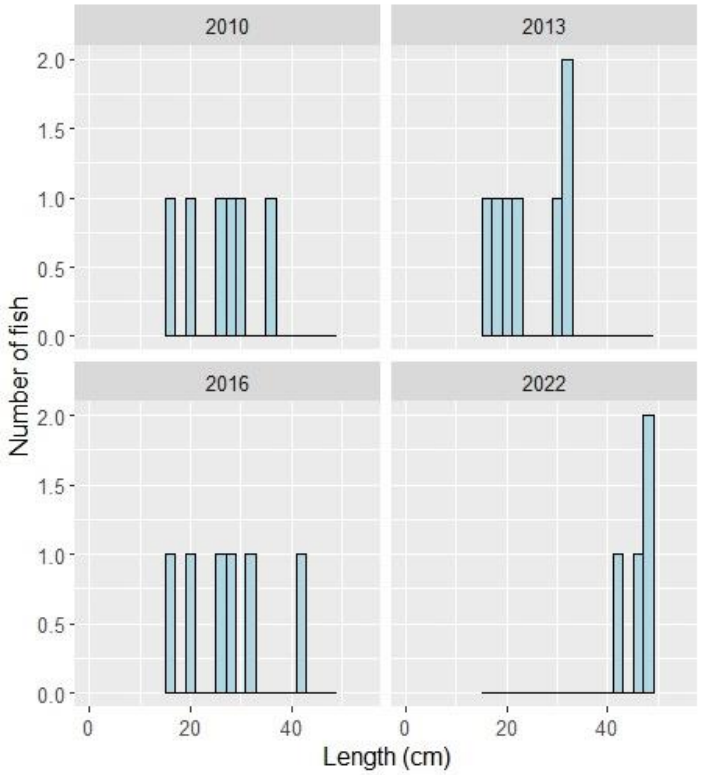


**Figure 3.5. Length frequency of brown trout captured on Lough Rea, 2010, 2013, 2016 and 2022.**

**Other fish**

Three-spined stickleback ranged in length from 2.3cm to 6.1cm (mean 4.0cm). European eel captured during the 2022 survey ranged in length from 45.5cm to 63.0cm (mean 55.1cm). Nine-spined stickleback ranged in length from 4.0cm to 4.5cm (mean 4.3cm). Pike measured 14.2cm and 20.7cm in length.

## 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 90 perch stomachs were examined; of these 47 (52%) contained no prey items. Of the remaining 43 stomachs containing food, it was not possible to identify the prey in 27 (63%) stomachs. Fish was the sole prey type recorded in nine (30%) perch stomachs, and one had fish and invertebrates (2%). Invertebrates were the sole prey found in two stomachs (5%) (Figure 3.6).

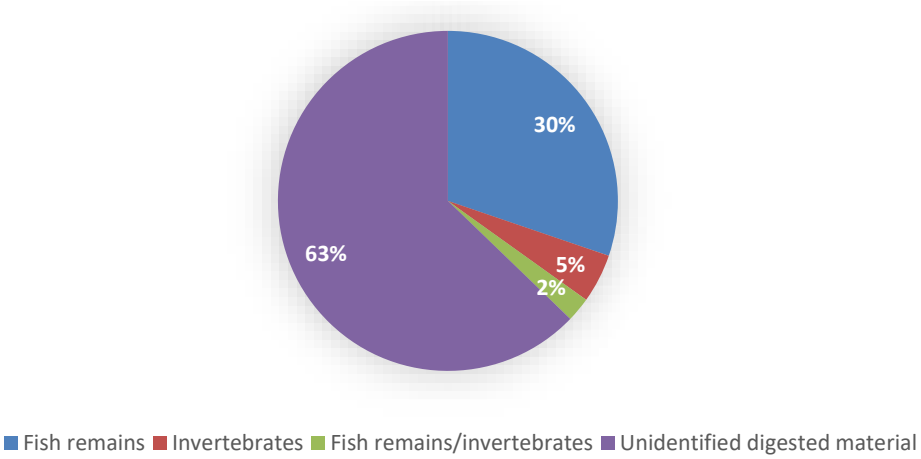


**Figure 3.6. Diet of perch (N = 9) captured on Lough Rea, August 2022 (%FO)**

**Other species**

Two brown trout stomachs were examined, one of which was empty. The other stomach contained fish. One pike stomach was also examined and contained unidentified fish.

# 4. Summary and fish ecological status

Seven fish species were recorded on Lough Rea in August 2022.

Perch was the dominant species in terms of abundance (mean CPUE) and biomass (mean BPUE) captured in the survey gill nets during the 2022 survey. Population abundance and biomass has fluctuated widely across all surveys of the lake since 2010 and are now at a high level compared to earlier surveys. Recruitment has been regular and consistent in recent years. Currently, the population, while largely dominated by large numbers of smaller fish is also characterised by the persistence of large numbers of older fish. Perch captured in 2022 were aged up to 13 years old.

Rudd were also captured in large numbers during the survey. The abundance and biomass of rudd recorded in 2022 was higher than that recorded in previous surveys since 2010.

The lake supports a vibrant and active fishery for brown trout. No trend in CPUE or BPUE was apparent although there were no smaller or younger fish captured in 2022 compared to previous surveys of 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) 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 Rea has been assigned an ecological status of Moderate for 2022 based on the fish populations present. This was a deterioration from the High status which was assigned in 2016. This change in status was largely driven by an increase in tolerant fish species, i.e. perch and rudd abundance and biomass (Corcoran *et al*., 2023). Previously Lough Rea was assigned Moderate status in 2013 and Good status in 2010 (Figure 4.1).

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

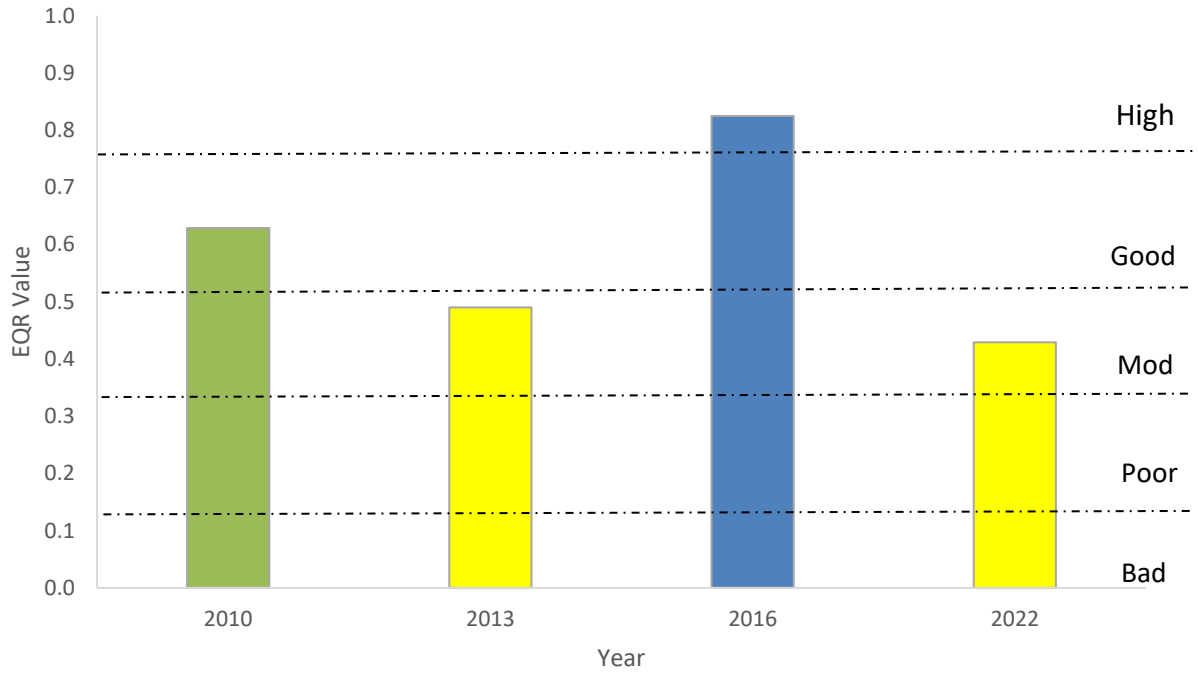


**Figure 4.1. Fish ecological status, Lough Rea, 2010, 2013, 2016 and 2022 (dashed line indicates EQR status boundaries).**

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