

# National Research Survey Programme

## Lakes 2021

### Lough Sheelin

IFI/2022/1-4612



Iascach Intíre Éireann  
Inland Fisheries Ireland

**Fish Stock Survey of Lough Sheelin,  
July 2021**



**Iascach Intíre Éireann  
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 Sheelin is situated in counties Cavan, Meath and Westmeath in the Inny catchment (Plate 1.1, Fig. 1.1). The lake is located north-east of Finnea, Co. Westmeath. It is seven kilometres long and has a surface area of 1,900 hectares. The River Inny flows through the lake. Lough Sheelin is a relatively shallow lake with a mean depth of 4.4m, a maximum depth of 15m, and 51% of the lake is less than 5m in depth (Champ *pers. comm.*). The geology of the catchment is predominantly Carboniferous limestone, but Silurian/Ordovician formations underlie the western and northern drainage basin. The lake is categorised as typology class 12 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and high alkalinity (>100 mg/l CaCO<sub>3</sub>).

In the 1960s and 1970s Lough Sheelin was one of Ireland's top trout angling lakes, managed and developed by the Inland Fisheries Trust (now Inland Fisheries Ireland). Phosphorus originating from intensive agricultural developments has caused progressive enrichment of Lough Sheelin since the early 1970s (Champ, 1998 and 2003). This has resulted in the trout population diminishing and the fish stock becoming dominated by cyprinids (O'Grady, *pers comm.*). The lake has been stocked with brown trout in the past, with approximately 16,000 2+ fish introduced in 2004, followed by between 3,000 and 6,000 per year thereafter. Stocking of brown trout into the lake ceased in 2011 (Mooney, *pers comm.*). The water quality in the lake and the catchment was monitored on a continuous basis by Inland Fisheries Ireland (previously the Shannon Regional Fisheries Board and the Central Fisheries Board) from the 1970s to 2015 (Champ, 1979, 1991, 1993, 1998; Duggan and Champ, 1992; Kerins *et al.*, 2007). Kerins *et al.* (2007) showed a modest decrease in the total phosphorus loadings to the lake between 1988 and 2005, suggesting that the phosphorus losses from the catchment are slowly declining; however, more recent data (2006 to 2014) indicates that there has been no improvement in the nutrient loadings to the lake (IFI unpublished data).

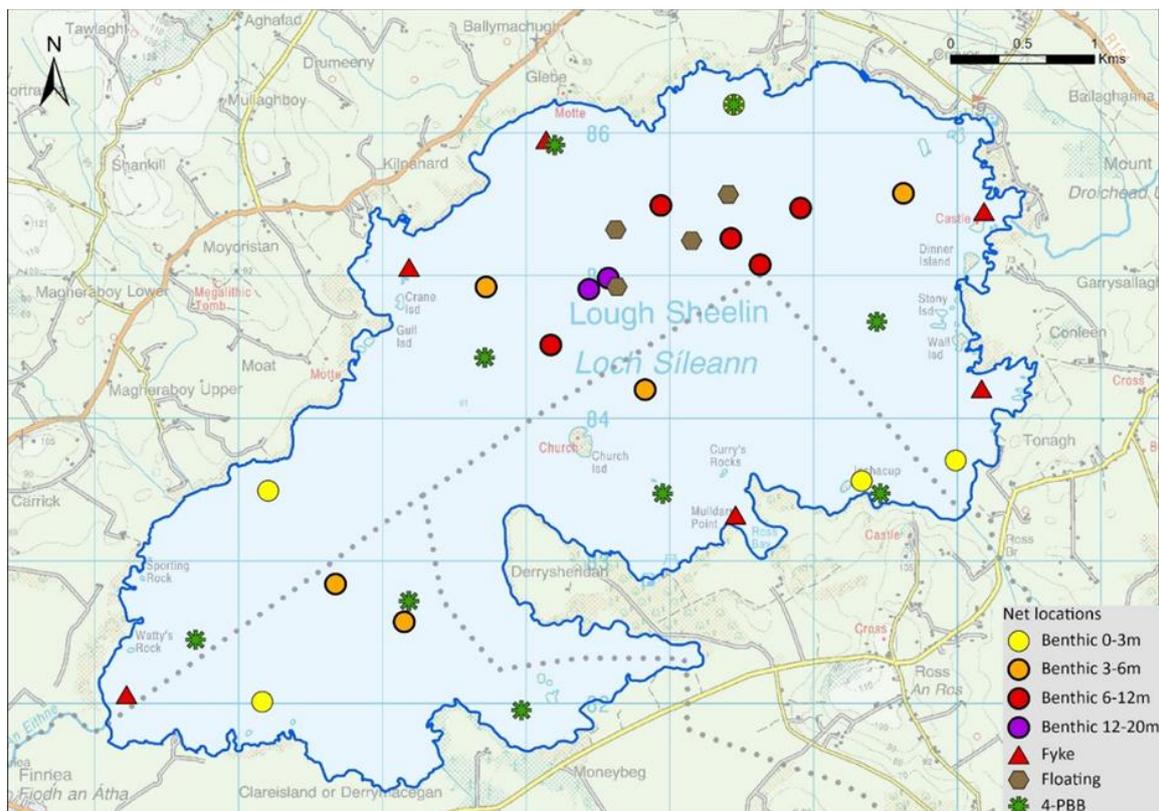
Zebra mussels (*Dreissena polymorpha*), an invasive species in Ireland, were first noted in Lough Sheelin during 2003 and it is thought they were introduced to the lake in 2000 and 2001. Large populations of the mussel have been evident in the lake since 2004 (O'Grady *et al.*, 2008).

The fish population in Lough Sheelin has been surveyed regularly since 1978 by Inland Fisheries Ireland using a gill netting technique that was developed in the late 1970s (O'Grady, 1981) to assess trout stocks (trout > 19.8cm in length) on selected lake fisheries. Other fish species are also captured as a by-catch during these surveys. This work has proved to be an effective tool in illustrating the fluctuations in fish stocks over time (Delanty and O'Grady, 2001) and providing insight into impact of management interventions (Shephard *et al.*, 2018). It was estimated that the standing crop of brown

trout (>19.8cm) in Lough Sheelin varied between 100,000 and 120,000 fish in the early 1980s and has since decreased substantially (O’Grady *et al.*, 2008). Roach, a non-native invasive species subject to restrictions under Regulations 49 and 50 of the [European Communities \(Birds and Natural Habitats\) Regulations 2011 \[SI. 477\]](#) was introduced into the lake during the 1970s and their population has fluctuated dramatically since that time.

More recently the lake has been surveyed on four occasions since 2008 (Kelly *et al.*, 2009, 2012a and 2015b and Connor *et al.*, 2018). During the 2017 survey, perch were found to be the dominant species present in the lake. Brown trout, roach, pike and eels were also captured during the survey. Lough Sheelin currently holds stocks of brown trout, pike, perch, roach, bream, roach hybrids, tench, 3-spined stickleback, 9-spined stickleback and eels. The pike population is subject to ongoing management intervention aimed at controlling its population within the lake.

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 protocol is WFD compliant and also provides insight into fish stock status in the lake.



**Fig. 1.1. Location map of Lough Sheelin showing locations and depths of each net**

## 2. Methods

### 2.1 Netting methods

Lough Sheelin was surveyed over two nights between the 12<sup>th</sup> and the 13<sup>th</sup> of July 2017. A total of six sets of Dutch fyke nets (Fyke), 17 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m and 2 @ 12-19.9m) and four floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (27 sites) (Fig. 1.1). The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at nine 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 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).

$$FO_i = \left( \frac{N_i}{N} \right) * 100$$

Where:

**FO<sub>i</sub>** is the percentage frequency of prey item *i*,

**N<sub>i</sub>** is the number of fish with prey *i* in their stomach,

**N** is total number of fish with stomach contents.

### 2.3 Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment in order 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

Six fish species and one type of hybrid were recorded on Lough Sheelin in July 2021. A total of 790 fish were captured. The number of each species captured by each gear type is shown in Table 3.1. Perch was the most abundant fish species recorded and accounted for c. 88% of all fish captured in the survey. Roach, brown trout, pike, three-spined stickleback, tench and roach x bream hybrids were also recorded. A similar species mix (with some inter annual variation in species composition) has been recorded on previous summer surveys of the lake (Kelly *et al.*, 2009, Kelly *et al.*, 2012a and Kelly *et al.*, 2015b and Connor *et al.*, 2018). No eels were captured in 2021.

**Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Sheelin, July 2021**

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
<i>Perca fluviatilis</i>	Perch	695	0	1	0	696
<i>Rutilus rutilus</i>	Roach	34	1	1	11	47
<i>Salmo trutta</i>	Brown trout	8	0	13	0	21
<i>Esox lucius</i>	Pike	6	0	0	4	10
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	4	0	1	0	5
<i>Tinca tinca</i>	Tench	0	0	10	0	10
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	1	0	0	0	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. Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured during the 2021 survey (Table 3.2).

For comparison purposes mean CPUE and BPUE for each species, per survey net type, captured in all surveys between 2009 and 2021 are presented in Figures 3.1 (a and b) and 3.2 (a and b) respectively and illustrates fish community change over time. Populations of the two most abundant species (i.e. perch and roach) have remained relatively stable across surveys conducted since 2008, with perch consistently recording the highest numbers and biomass (Figures 3.1a and 3.1b). Numbers of brown trout have increased from a low initial base, while no eel have been recorded in either of the last two surveys conducted in 2017 and 2021 (Figure 3.2a & 3.2b).

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

Scientific name	Common name	Mean CPUE ( $\pm$ S.E)	Mean BPUE ( $\pm$ S.E)
<i>Perca fluviatilis</i>	Perch	0.644 (0.168)	25.894 (9.563)
<i>Rutilus rutilus</i>	Roach	0.038 (0.012)	5.026 (1.658)
<i>Salmo trutta</i>	Brown trout	0.011 (0.004)	11.578 (4.079)
<i>Esox lucius</i>	Pike	0.007 (0.004)	2.115 (1.592)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.004 (0.002)	1.580 (1.023)
<i>Tinca tinca</i>	Tench	0.003 (0.003)	2.663 (2.663)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.001 (0.001)	0.002 (0.002)

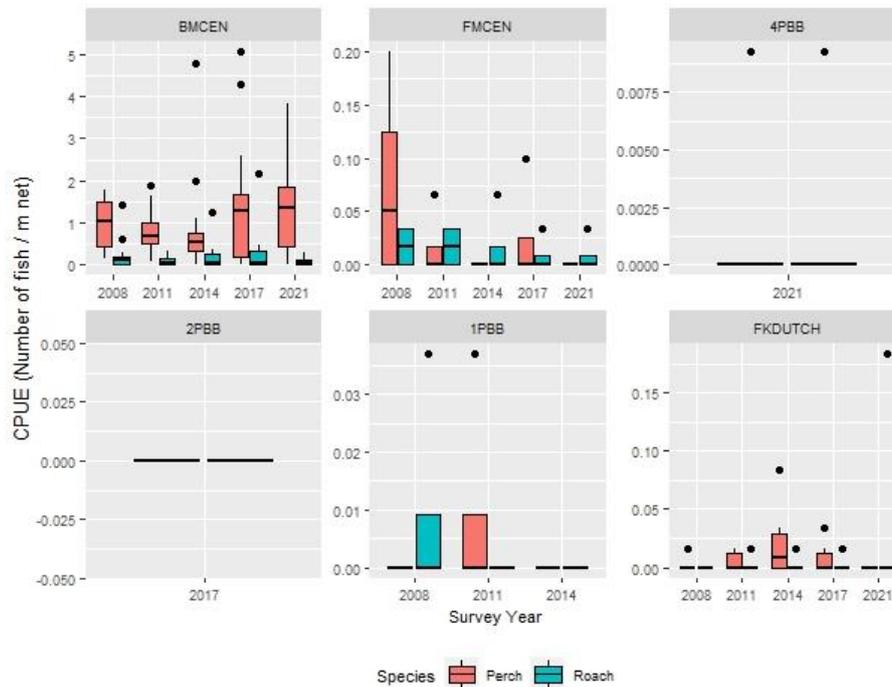
Note: Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor *et al.*, 2017).



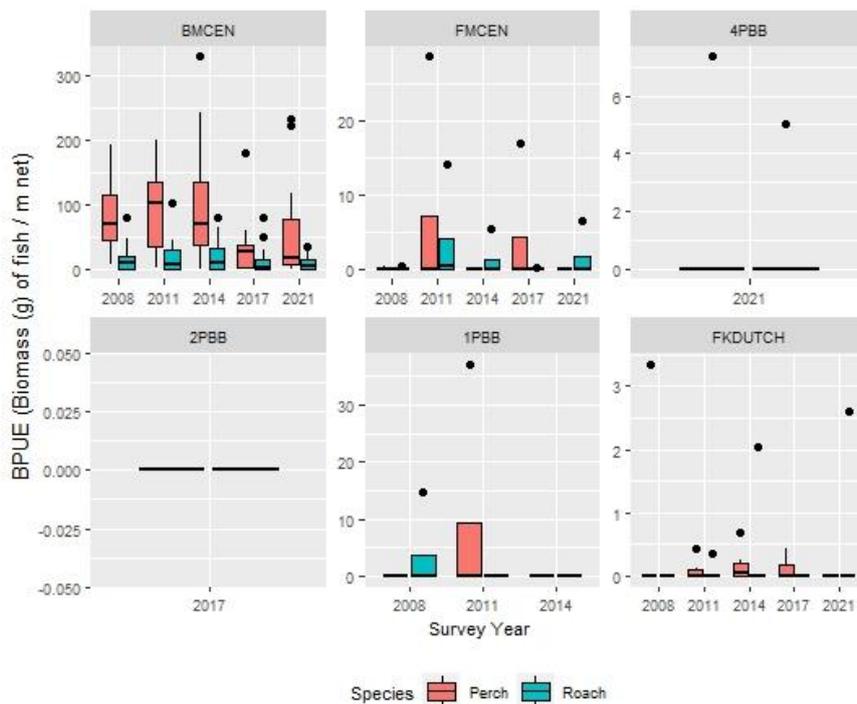
**Plate 1.1. Lough Sheelin, July 2021**



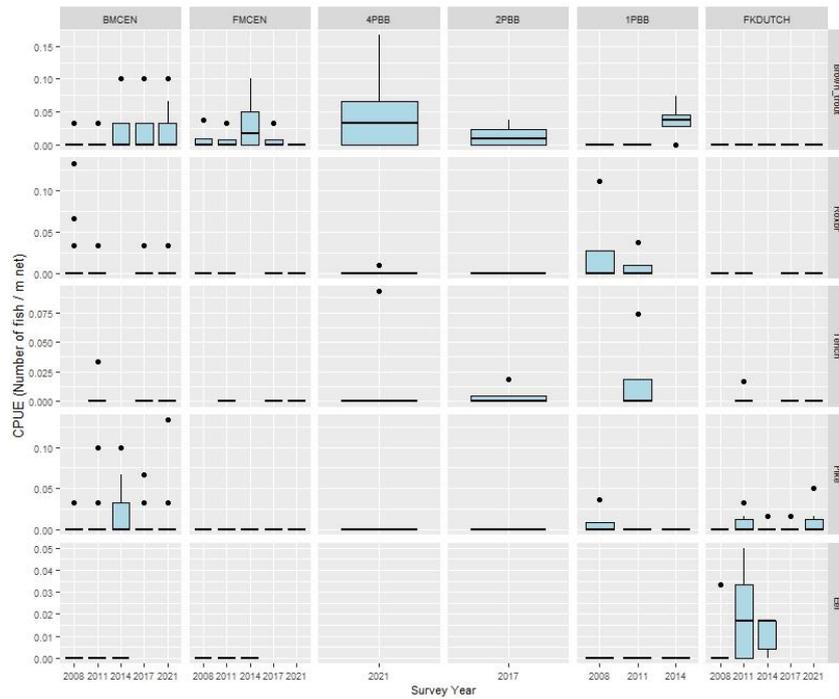
**Plate 1.2. Kilnahard, Lough Sheelin, July 2021**



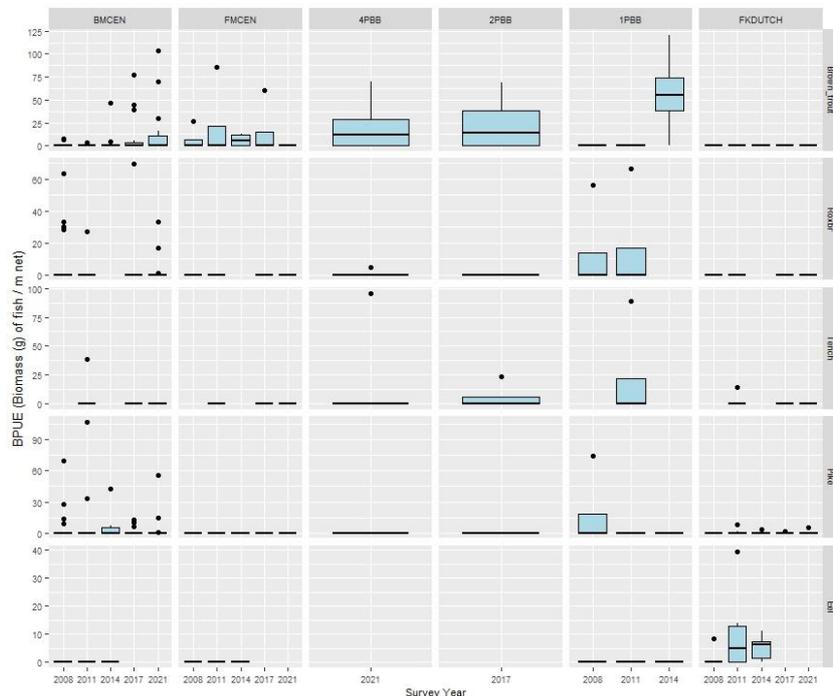
**Figure 3.1a.** CPUE (number of fish captured per linear meter of net) of perch and roach in each net type during surveys of Lough Sheelin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> percentiles are marked by the 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 3.1b.** BPUE (biomass of fish captured per linear meter of net) of perch and roach in each net type during surveys of Lough Sheelin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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 3.2a. CPUE (number of fish captured per linear meter of net) of brown trout and other fish species captured in each net type during surveys of Lough Sheelin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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 species.**

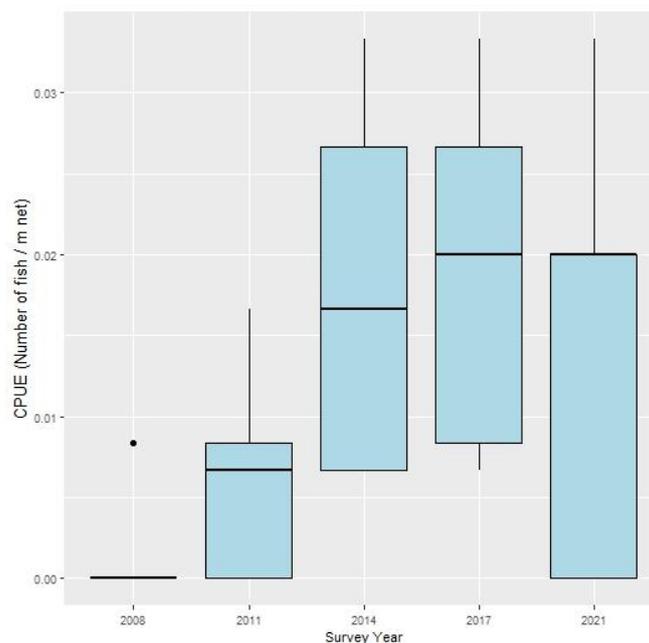


**Figure 3.2b. BPUE (biomass of fish captured per linear meter of net) of roach and other fish species captured in each net type during surveys of Lough Sheelin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> percentiles are marked by the upper and lower boundary of each box. The vertical ‘whiskers’ show the data range. The y axis is unique for each species.**

## Brown trout CPUE in Lough Sheelin

Survey catch data is inherently subject to considerable variation. Larger bodied species (e.g. brown trout), which may be naturally less abundant than smaller species such as perch and roach are often captured in relatively low numbers and in a small proportion of the survey nets deployed. Changes in netting methodologies have also occurred since 2008 where the number and mesh size of supplementary braided nets has varied. This is apparent in the graphs above (Figures 3.1a to 3.2b) which can make visual interpretation of fish catches difficult.

For brown trout, fish catches and CPUEs from floating and benthic CEN nets have been pooled to reduce some of this variation. This has been achieved by aggregating catches within each depth zone for BMCEN nets on each sampling occasion. In this way all of the nets deployed within each depth zone are treated as one sampling unit for that survey occasion. Sampling effort, and netting locations across surveys were essentially identical. Braided nets which were set in varying quantities and with varying mesh sizes, and fyke nets (which captured no brown trout in any survey) have been excluded. Aggregate CPUEs for surveys since 2008 are presented in Figure 3.3. Stocks of brown trout have improved from a low base recorded in 2008 and have remained relatively stable since 2014. No trout were recorded in FMCENs in 2021 which accounts for some of the variation evident in that years data.

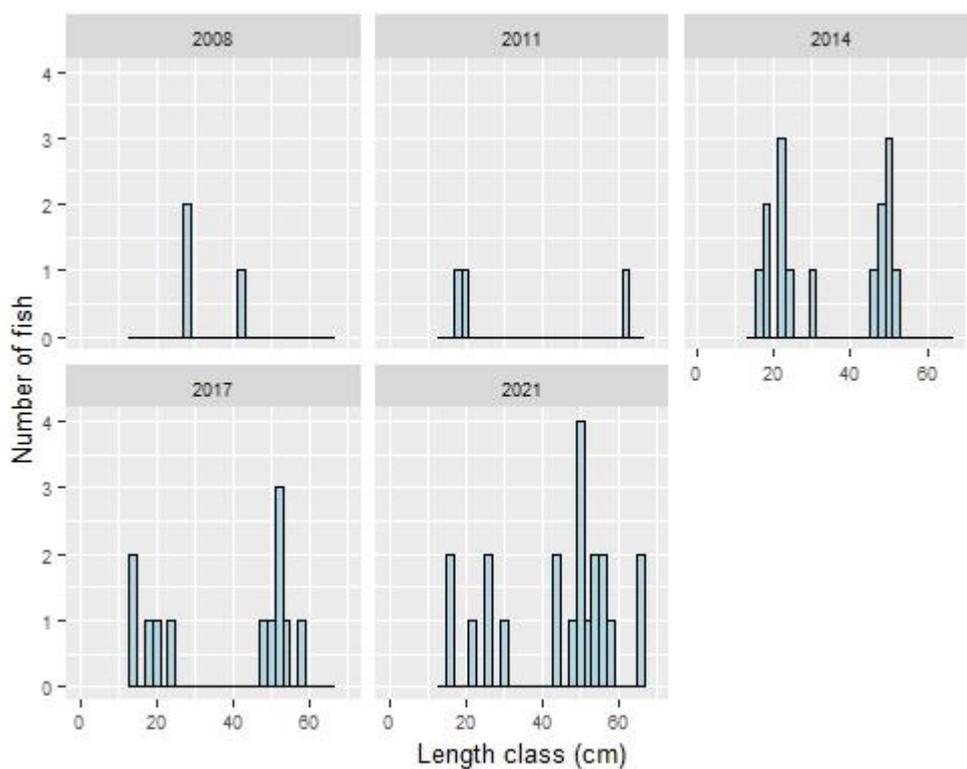


**Figure 3.3. CPUE (number of fish captured per linear meter of net deployed) of brown trout captured in benthic and floating CEN nets during surveys of Lough Sheelin between 2008 and 2021. Data has been pooled within each depth zone. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.**

### 3.3 Length frequency distributions and growth

#### Brown trout

Brown trout captured during the 2021 survey ranged in length from 16.1cm to 66.0cm (mean =44.3cm) (Fig. 3.4). Brown trout were aged from 1+ to 7+ and all intervening age classes (excluding 4+) were present. The dominant age class in the sample was 5+. Mean L1 (i.e. length at the end of the first year) was 8.7cm (Table 3.3). Mean brown trout L4 in 2021 was 37.5cm indicating a fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 3.3).



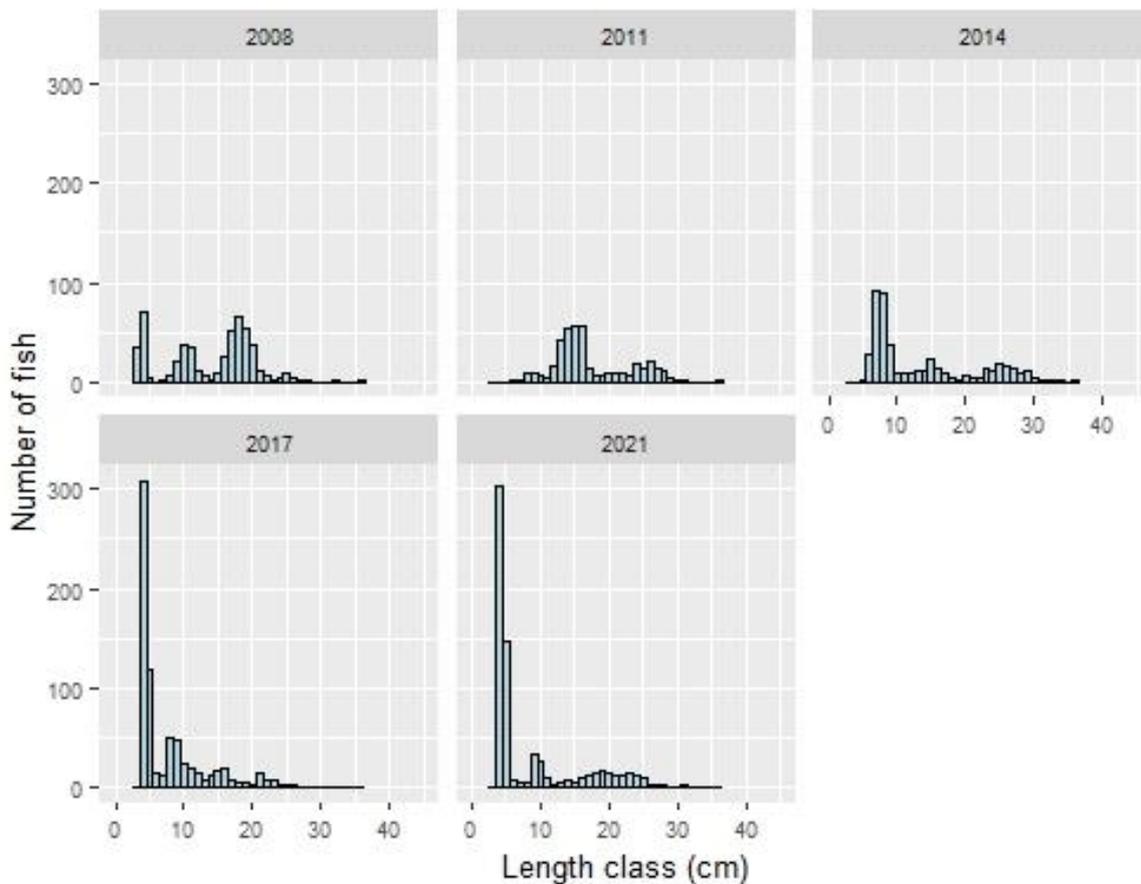
**Fig. 3.4. Length frequency of brown trout captured on Lough Sheelin, 2008, 2011, 2014, 2017 and 2021**

**Table 3.3. Mean ( $\pm$ S.E.) brown trout length (cm) at age for Lough Sheelin, July 2021**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>	L <sub>7</sub>
Mean ( $\pm$ S.E.)	8.7 (0.4)	17.4 (0.9)	26.7 (1.4)	37.5 (1.7)	45.3 (1.7)	51.7 (1.5)	-
N	20	18	16	14	14	6	1
Range	6.2-12.7	12.5-27.4	18.9-38.2	28.9-49.8	35.8-59.1	48.1-58.6	64.5 (0.0)

## Perch

Perch captured during the 2021 survey ranged in length from 3.2cm to 36.1cm (mean = 8.7cm) (Fig.3.5). Perch were aged from 0+ to 6+ and all intervening age classes were present. The population was heavily dominated by 0+ (i.e. young of the year) perch (c. 5cm) and few fish older than 4+ (c. 23cm-27cm) were captured (Fig. 3.5). Mean L1 (i.e. length at the end of the first year) was 6.1cm (Table 3.4).



**Fig. 3.5. Length frequency of perch captured on Lough Sheelin, 2008, 2011, 2014, 2017 and 2021**

**Table 3.4. Mean ( $\pm$ S.E.) perch length (cm) at age for Lough Sheelin, July 2021**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>
Mean ( $\pm$ S.E.)	6.1 (0.1)	12.3 (0.2)	19.0 (0.4)	23.4 (0.6)	25.6 (1.5)	-
N	89	67	46	13	2	1
Range	3.0-8.8	8.7-16.1	13.7-24.5	19.9-26.7	24.1-27.0	29.8 (0.0)

## Roach

Roach captured during the 2021 survey ranged in length from 6.3cm to 30.5cm (mean =15.5cm) (Fig.3.6). Roach were aged from 1+ to 6+ and all intervening age groups were present (Table 3.5). No one year class dominated the population. Very few larger (i.e. >30cm) and older ( $\geq 7$ ) fish were recorded (Fig. 3.6).

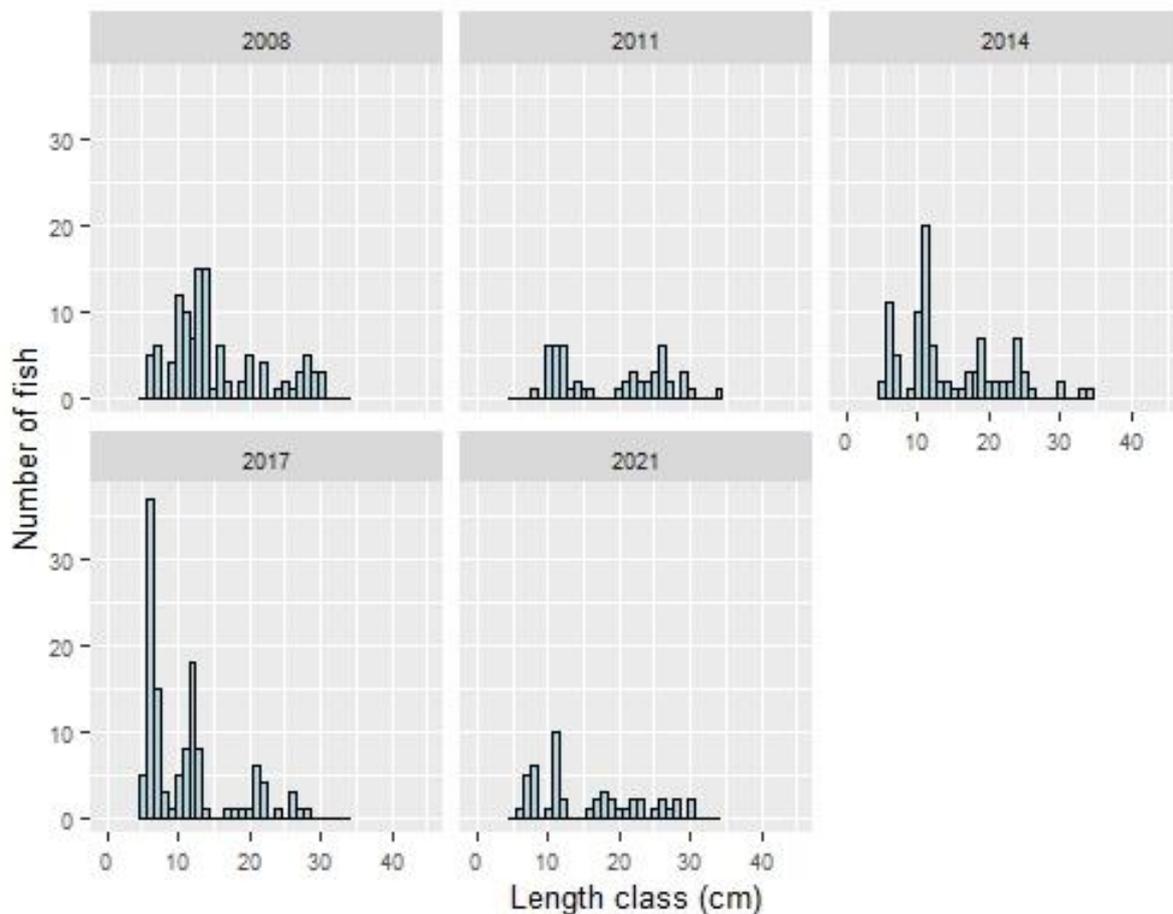


Fig. 3.6. Length frequency of roach captured on Lough Sheelin, 2008, 2011, 2014, 2017 and 2021

Table 3.5. Summary age data from roach captured on Lough Sheelin, August 2021. Number (N) of fish and length ranges of all fish aged in the sample is presented.

	Age Class						
	0+	1+	2+	3+	4+	5+	6+
<b>N</b>	0	4	6	7	3	6	3
<b>Mean L (cm)</b>	-	7.6	11.2	18.5	21.5	26.1	29.2
<b>Min L (cm)</b>	-	7.4	10.0	15.6	21.1	23.5	27.0
<b>Max L (cm)</b>	-	8.2	12.1	22.8	21.8	28.0	30.5

### **Other fish species**

Pike captured during the 2021 survey ranged in length from 10.0cm to 41.2cm (mean = 28.3cm). Roach x bream hybrids ranged in length from 12.5cm to 36.5cm (mean = 24.2cm). Tench ranged in length from 32.0cm to 45.5cm (mean = 358.1cm). One three-spined stickleback was measured at 4.3cm.

### ***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, brown trout and pike captured during the survey were examined and are presented below.

#### **Brown trout**

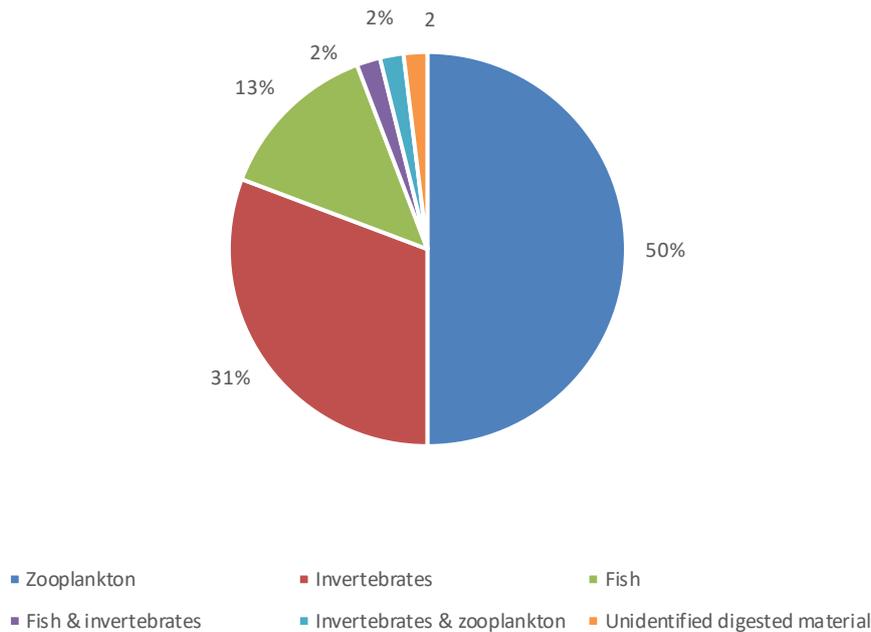
Ten brown trout stomachs were available for dietary analysis. Three stomachs contained food. Invertebrates were found in two stomachs, while the third brown trout stomach contained zooplankton.

#### **Perch**

A total of 74 perch stomachs were examined. Of these 22 were found to contain no prey items. Of the remaining 52 stomachs containing food, zooplankton were recorded in 26 (50%). Invertebrates were the sole prey item in 16 (31%), while zooplankton and invertebrates were present in one (2%) stomach. Fish were the sole prey type recorded in seven (13%) stomachs and occurred with invertebrates in one (2%). Zooplankton were the sole prey item in one perch stomach (2%) (Fig. 3.6).

#### **Pike**

One pike stomach was available for analysis. This stomach was empty.



**Fig 3.7. Diet of perch (n=74) captured on Lough Sheelin, July 2021 (% occurrence)**

#### 4. Summary and ecological status

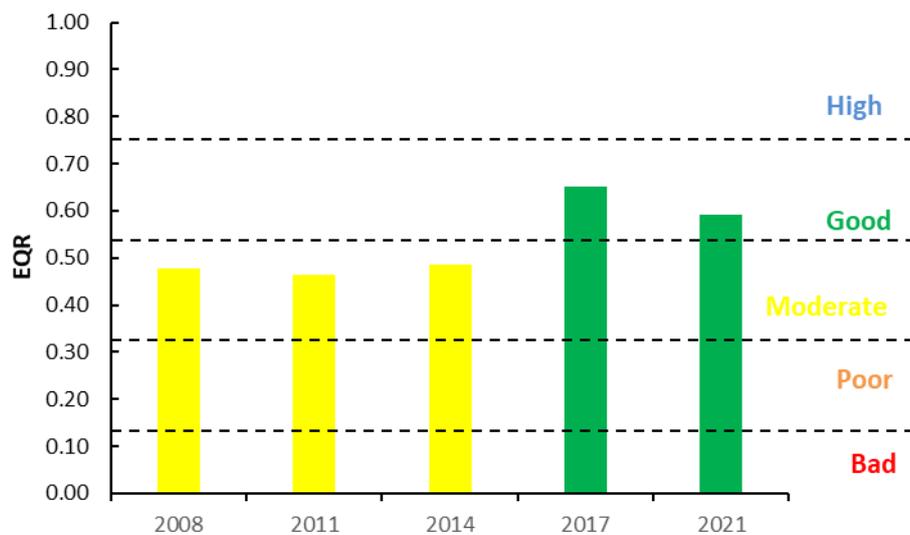
A total of six fish species and one type of hybrid were recorded in Lough Sheelin in July 2021. Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured during the 2021 survey.

Brown trout were aged from 1+ to 7+ and all intervening age classes (excluding 4+) were present. The dominant age class in the sample was 5+. No one age class dominated the population. Smaller and younger fish were, however captured, indicating that recruitment of this species is likely to be regular and stable. The number of brown trout captured remains higher compared to the initial survey in 2008.

The two most abundant species (i.e. roach and perch) appear to be recruiting regularly in the lake. Both populations are generally characterised by younger and smaller individuals, with little evidence of longer lived individuals persisting in the population. The perch population in 2021, as it was in 2017 was heavily dominated by 0+ fry.

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.*, 2012b). Using the FIL2 classification tool, Lough Sheelin has been assigned an ecological status of Good for 2021 based on the fish populations present. In previous years the lake was assigned a fish status of Moderate in 2008, 2011 and 2014 and Good in 2017 (Figure 4.1).



**Figure 4.1. Fish ecological status, Lough Sheelin, 2008 to 2021.**

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Sheelin an overall ecological status of Good based on all monitored physico-chemical and biological elements, including fish.

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