

# National Research Survey Programme

## Lakes 2022

### Lough Cullin

IFI/2023/1-4658



Iascach Intíre Éireann  
Inland Fisheries Ireland

## **Fish Stock Survey of Lough Cullin, September 2022**



**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 Cullin is a large, shallow lake situated to the west of Foxford, which is connected to Lough Conn by a narrow inlet at Pontoon, Co. Mayo (Plate 1.1, Figure 1.1). The outflow from the lake discharges directly into the River Moy south-west of Foxford (NPWS, 2014). Lough Cullin has a surface area of 1019.3ha with a maximum depth of approximately 3m (O'Reilly, 2007). The underlying geology of the lake is mainly granite with some areas of limestone present in the southern region of the catchment (NPWS, 2014). The lake is categorised as typology class 10 (as designated by the EPA for the purposes of the Water Framework Directive), i.e., shallow (<4m), greater than 50ha and high alkalinity (>100mg/l CaCO<sub>3</sub>).

Lough Cullin is located within the River Moy Special Area of Conservation (NPWS, 2020). The underlying geology of much of the site is Carboniferous limestone, with areas of Carboniferous sandstone, Dalradian quartzites and schists also present. Some of the tributaries at the east and south of Lough Conn, and all in Lough Cullin are underlain by granite. The site has been selected as a candidate SAC for containing alluvial wet woodlands, raised bog, old oak woodlands (present on the shores of Lough Cullin), degraded raised bog and Rhynchosporion depressions (*Rhynchospora alba*), all priority habitats on Annex I of the E.U. Habitats Directive. This SAC has also been selected due to the presence of the following species, listed on Annex II of the same Directive – Atlantic salmon (*Salmo salar*), otter (*Lutra lutra*), sea and brook lamprey (*Lampetra planeri*) and white-clawed crayfish (*Austropotamobius pallipes*) (NPWS, 2020). Lough Cullin is a moderately hard water lake with relatively low colour and good water clarity. The phytoplankton in the lake is dominated by diatoms and blue-green algae (NPWS, 2020). Lough Cullin also supports important concentrations of wintering waterfowl and is designated as a Special Protection Area, as one of the few breeding sites for Common Scoter in Ireland (NPWS, 2020).

Lough Cullin was once regarded as one of Ireland's premier brown trout fisheries, but was often considered to be the 'poor relation' of Lough Conn. Historically, in angling terms, Lough Cullin was noted for supporting a large population of relatively small (<0.5kg) brown trout (*Salmo trutta*) (O'Grady and Delanty, 2001). The lake was also regarded as a very important salmon fishery and receives a run of salmon during the spring and summer months (NPWS, 2014). In fact, all the salmon, of which there can be many, destined for Lough Conn and its inflowing rivers must pass through Lough Cullin.

The early IFI surveys conducted in 1994, 1998 and 2001 captured salmon, sea trout, rudd and roach x rudd hybrids (O'Grady and Delanty, 2001). The lake was previously surveyed on four occasions (2009,

2012, 2015 and 2018) as part of the WFD surveillance monitoring programme (Kelly *et al.*, 2010, Kelly *et al.* 2013, Kelly *et al.* 2016 and Connor *et al.*, 2019).

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. Lough Cullin, August 2022.**

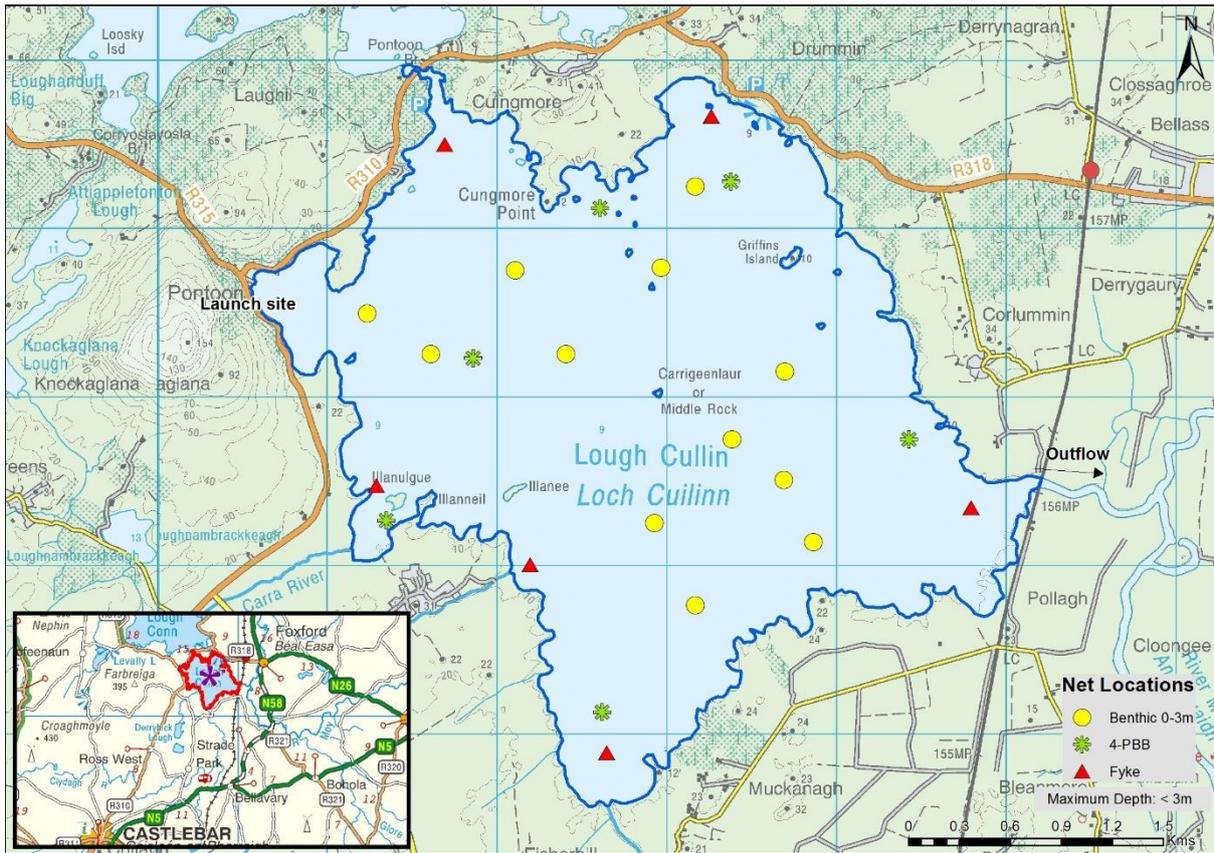


Figure 1.1. Location map of Lough Cullin showing locations and depths of each net (outflow is indicated on map).

## 2. Methods

### 2.1. Netting methods

Lough Cullin was surveyed over three nights from the 29<sup>th</sup> August to the 1<sup>st</sup> of September 2022. A total of six sets of Dutch fyke nets (Fyke), twelve benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (12 @ 0-2.9m) were deployed in the lake (18 sites)

The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at six additional sites (Figure 1.1). 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).

All survey nets were deployed in the same locations as were randomly selected in 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 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).

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

Where:

$FO_i$  is the percentage frequency of prey item  $i$ ,

$N_i$  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 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. Calm conditions on Lough Cullin, August 2022**

### 3. Results

#### 3.1. Species Richness

Seven fish species and one type of hybrid were recorded on Lough Cullin in August/September 2022. A total of 558 fish were captured (Table 3.1). Roach were the most common fish species recorded, representing almost 60% of all fish captured. Perch were also captured in relatively high numbers. Brown trout, tench, rudd, salmon, roach x rudd hybrids and eels were also captured. A similar species composition was recorded in previous surveys. Three-spined stickleback (2012 and 2018) and pike (2009, 2015 and 2018) were recorded during previous surveys, but were not captured in 2022.

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

Scientific name	Common name	Number of fish captured			
		BM CEN	4-PBB	Fyke	Total
<i>Rutilus rutilus</i>	Roach	316	2	8	326
<i>Perca fluviatilis</i>	Perch	138	0	0	138
<i>Salmo trutta</i>	Brown trout	24	5	0	29
<i>Scardinius erythrophthalmus</i>	Rudd	20	1	0	21
<i>Tinca tinca</i>	Tench	2	16	1	19
<i>Salmo salar</i>	Salmon	0	1	0	12
<i>R. rutilus x S. erythrophthalmus</i>	Roach x rudd hybrid	1	0	0	1
<i>Anguilla anguilla</i>	European eel	0	0	12	12

#### 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. The CPUE and BPUE for each species captured in the 2022 survey is summarised in Table 3.2. In 2022 roach dominated fish stocks with respect to both biomass (mean BPUE) and abundance (mean CPUE).

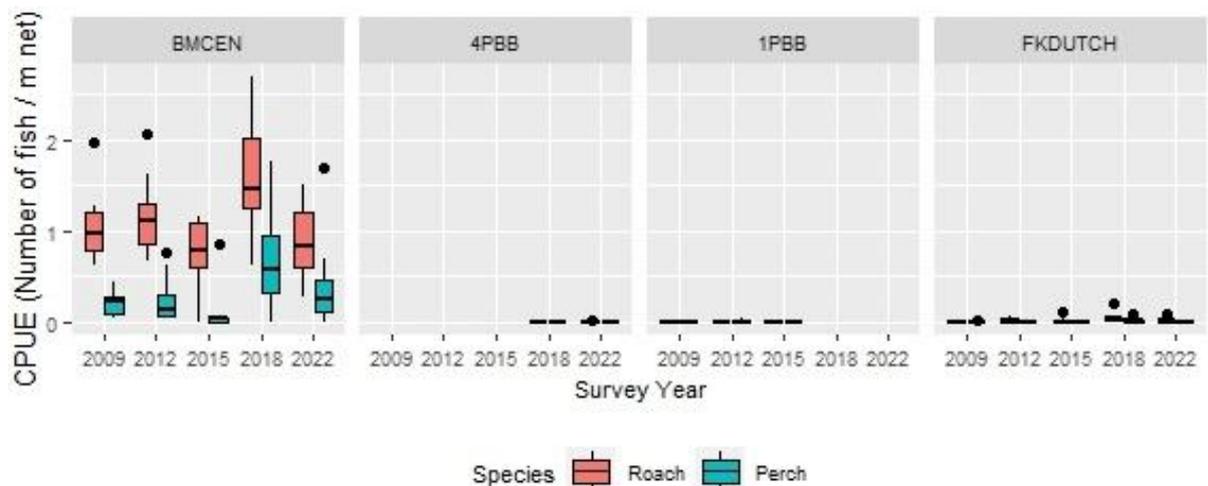
For comparison purposes box plots of CPUE and BPUE for each species captured in all surveys per net type between 2009 and 2021 are presented in Figures 3.1a to 3.2b and illustrates fish community change over time. While the abundance of roach has remained relatively similar across all sampling occasions (except 2018), biomass recorded was lower in 2018 and 2022 compared to the earlier surveys. There is evidence of an increasing trend in abundance and biomass of both brown trout and

perch. Abundance and biomass of eel were lower in both 2018 and 2022 compared to the surveys conducted in 2009 and 2012. No clear trends in the populations of other species were apparent.

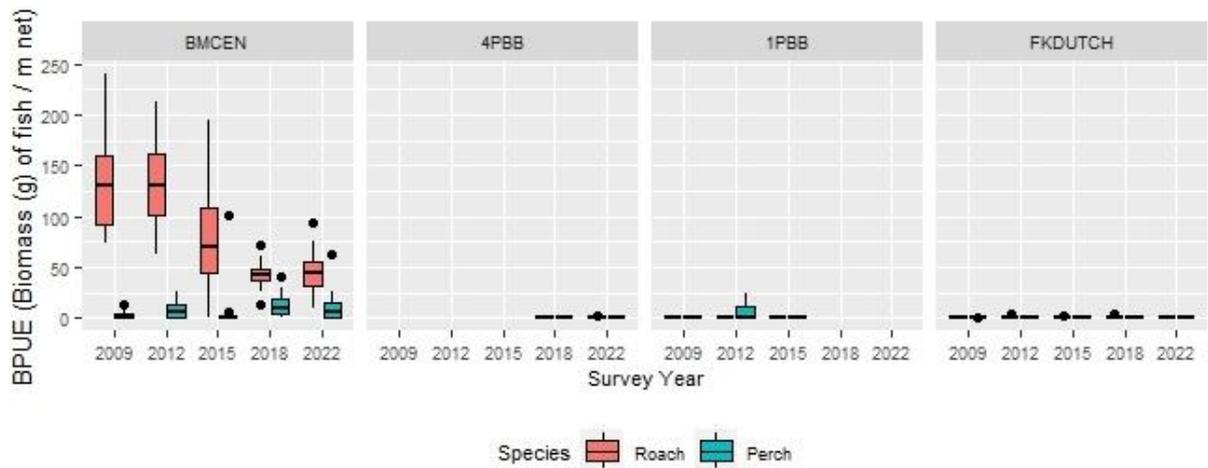
**Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Cullin, 2022.**

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
<i>Rutilus rutilus</i>	Roach	0.445 (0.106)	23.261 (5.775)
<i>Perca fluviatilis</i>	Perch	0.192 (0.077)	6.453 (2.844)
<i>Salmo trutta</i>	Brown trout	0.035 (0.014)	4.086 (1.482)
<i>Scardinius erythrophthalmus</i>	Rudd	0.028 (0.012)	2.569 (1.204)
<i>Tinca tinca</i>	Tench	0.010 (0.006)	1.386 (0.704)
<i>Salmo salar</i>	Salmon	0.000 (0.000)	1.892 (1.892)
<i>R. rutilus x S. erythrophthalmus</i>	Roach x rudd hybrid	0.001 (0.001)	0.167 (0.167)
<i>Anguilla anguilla</i>	European eel	0.033 (0.013)*	3.711 (1.590)*

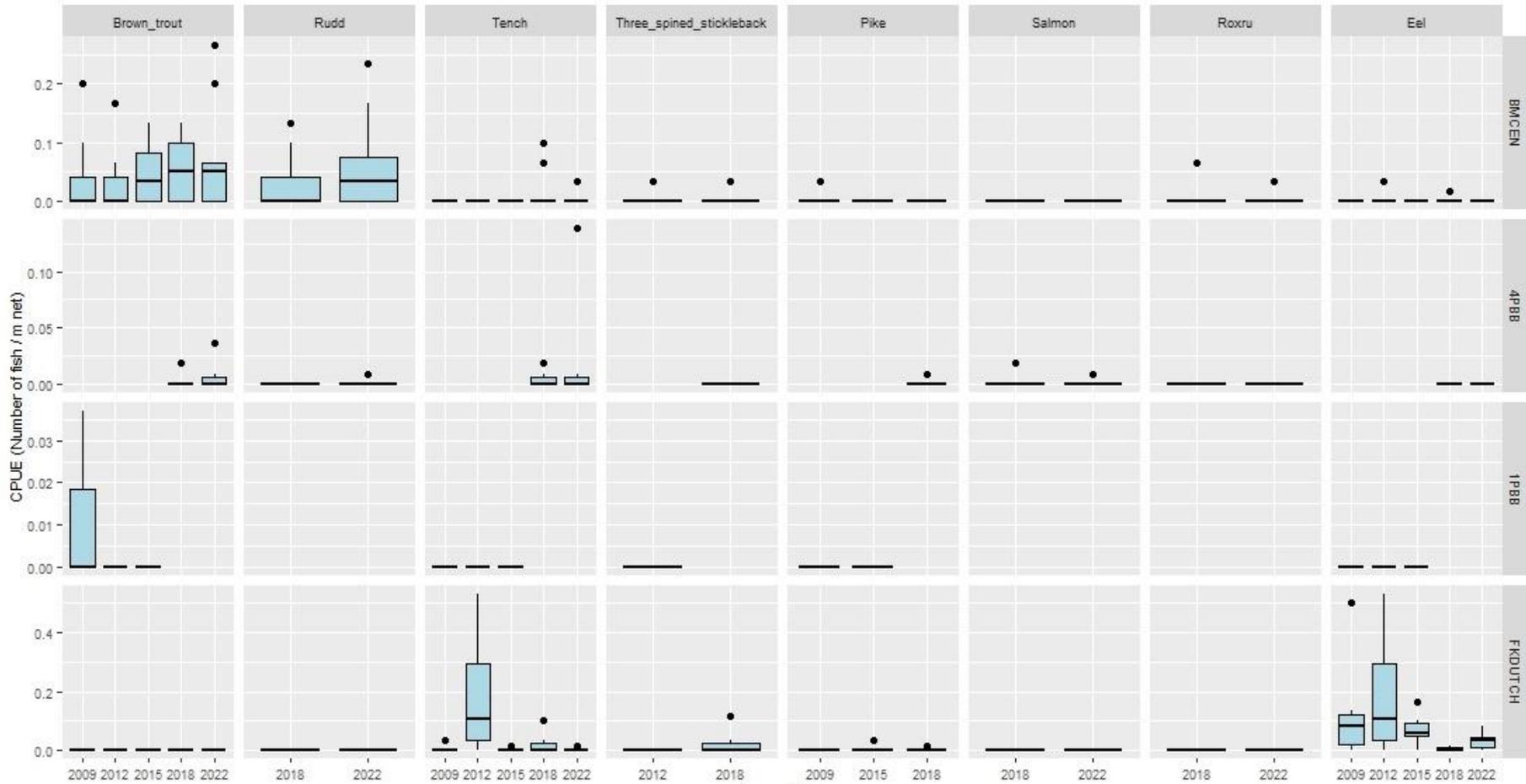
Note: Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor et al., 2017). \*Eel CPUE and BPUE based on fyke nets only.



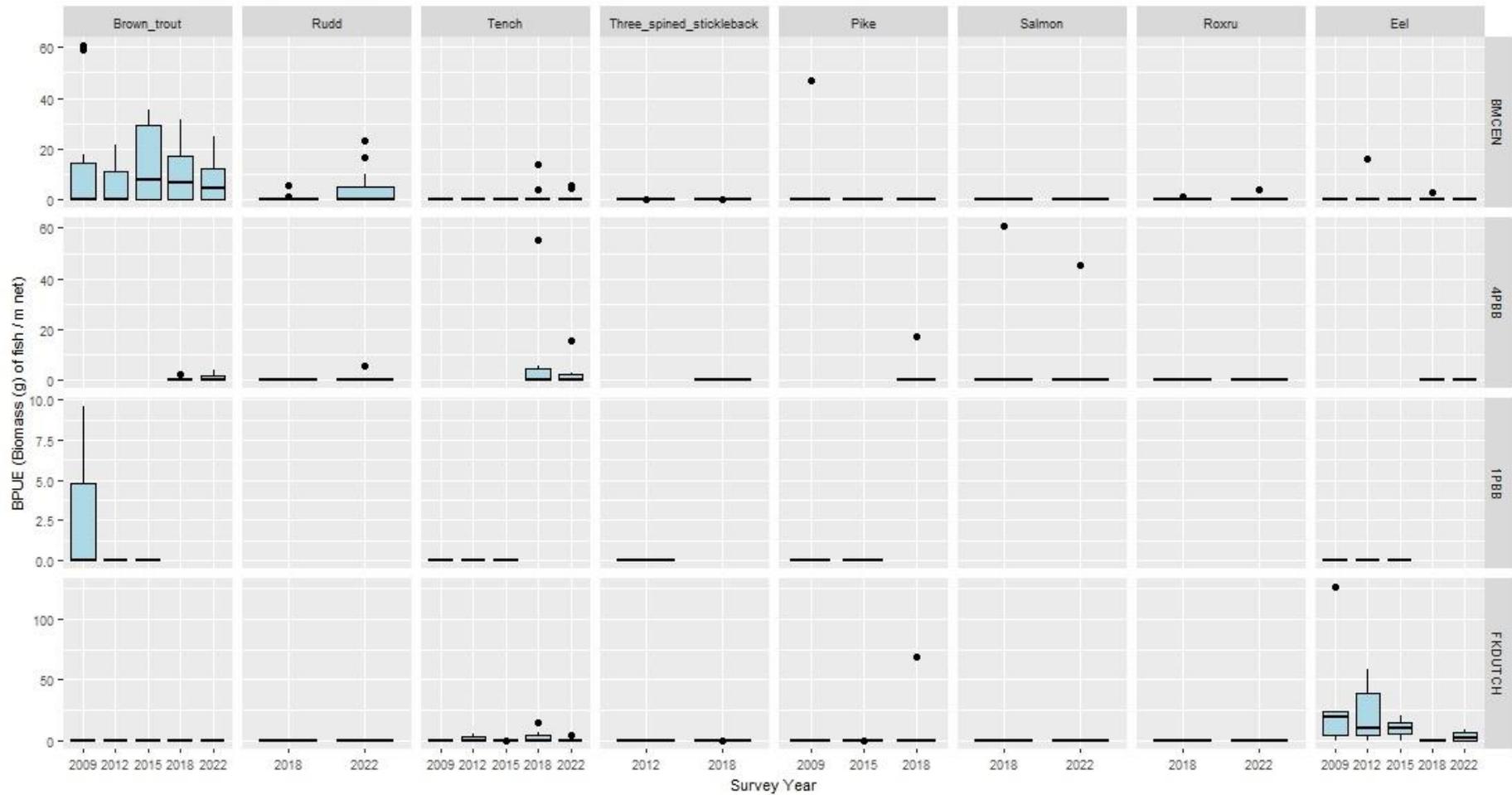
**Figure 3.1a. CPUE of roach and perch captured in each net type during surveys of Lough Cullin between 2009 and 2022. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</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.**



**Figure 3.1b. BPUE of roach and perch captured in each net type during surveys of Lough Cullin between 2009 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<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.**



**Figure 3.2a. CPUE of brown trout and other fish species captured in each net type during surveys of Lough Cullin between 2009 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<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 (CPUE) is unique for each net type.**



**Figure 3.2b. BPUE of brown trout and other fish species captured in each net type during surveys of Lough Cullin between 2009 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<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 (BPUE) is unique for each net type.**

### 3.3. Length frequency distributions and growth

#### Roach

Roach captured during the 2022 survey ranged in length from 3.8cm to 28.3cm (mean 12.8cm). Proportionately fewer larger and older roach were recorded in 2022 and 2018 when compared to earlier surveys. (Figure 3.4). Roach were aged between 1 + and 8+. The 2+ to 6+ age groups were all well represented in the population aged. Older (i.e. >=7+) and younger individuals ((i.e. >=1+) were less prominent (Table 3.3).

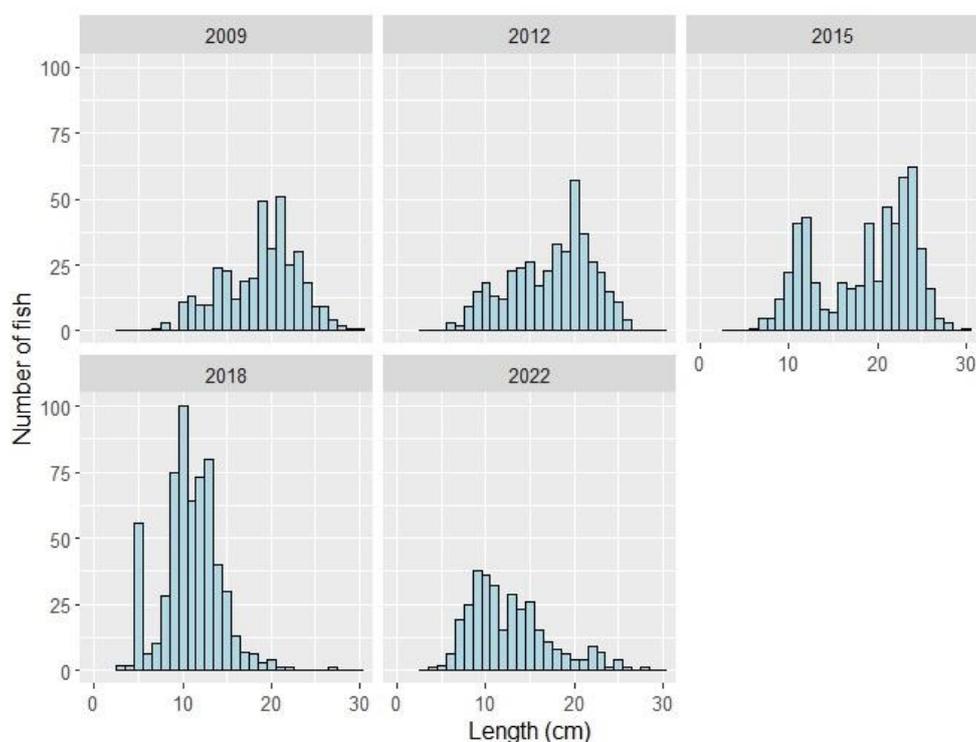


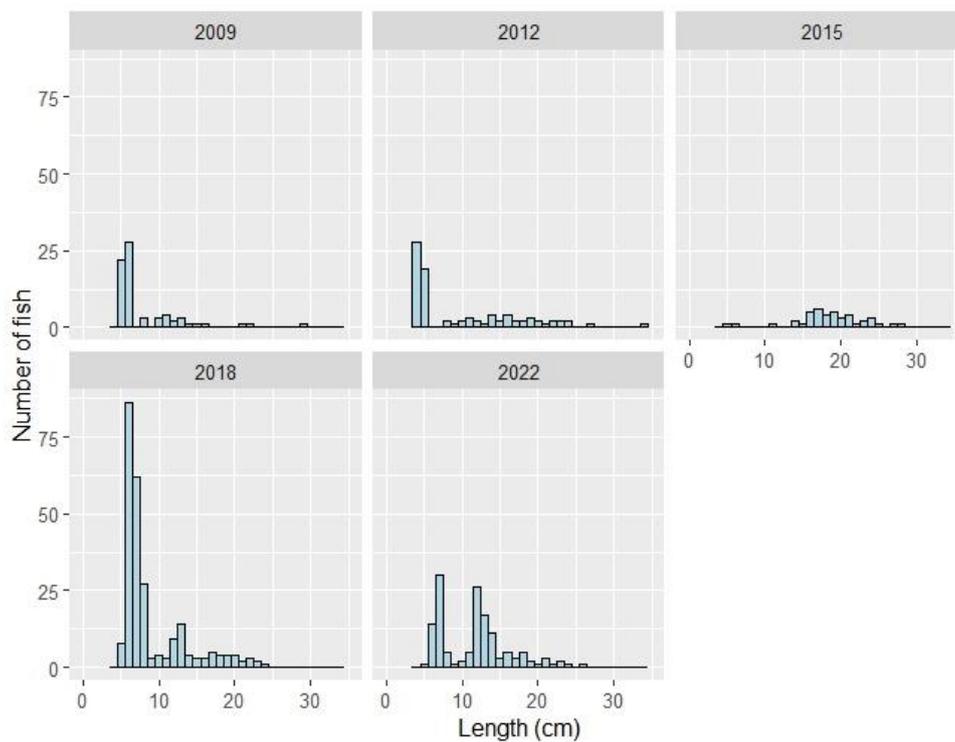
Figure 3.3. Length frequency of roach captured on Lough Cullin, 2009, 2012, 2015, 2018 and 2022.

Table 3.3. Summary age data for roach captured on Lough Cullin, August/September 2022. Number of fish (N) and length range (cm) of all fish aged in the sample is presented.

Length (cm)	Age class							
	1+	2+	3+	4+	5+	6+	7+	8+
N	1	12	10	13	6	8	1	1
Mean L (cm)	-	9.9	13.4	17.9	21.1	24.1	-	-
Min L (cm)	7.3	8.3	12.3	16.3	19.3	22.3	26.1	28.3
Max L (cm)	7.3	11.8	14.9	19.6	22.3	25.5	26.1	28.3

## Perch

Perch captured during the 2022 survey ranged in length from 5.5cm to 26.5cm (mean 11.8cm) with fewer perch captured in 2022 compared to 2018 (Figure 3.4). Five age classes were present, ranging from 1+ to 5+ and all intervening age classes were present in the sample. The dominant age classes were 1+ and 2+ (Figure 3.4). This contrasts with surveys conducted between 2009 and 2015 when comparatively few younger and smaller fish were captured (Figure 3.4). Mean L1 (i.e. age at the end of the 1<sup>st</sup> year) was 6.5cm (Table 3.4).



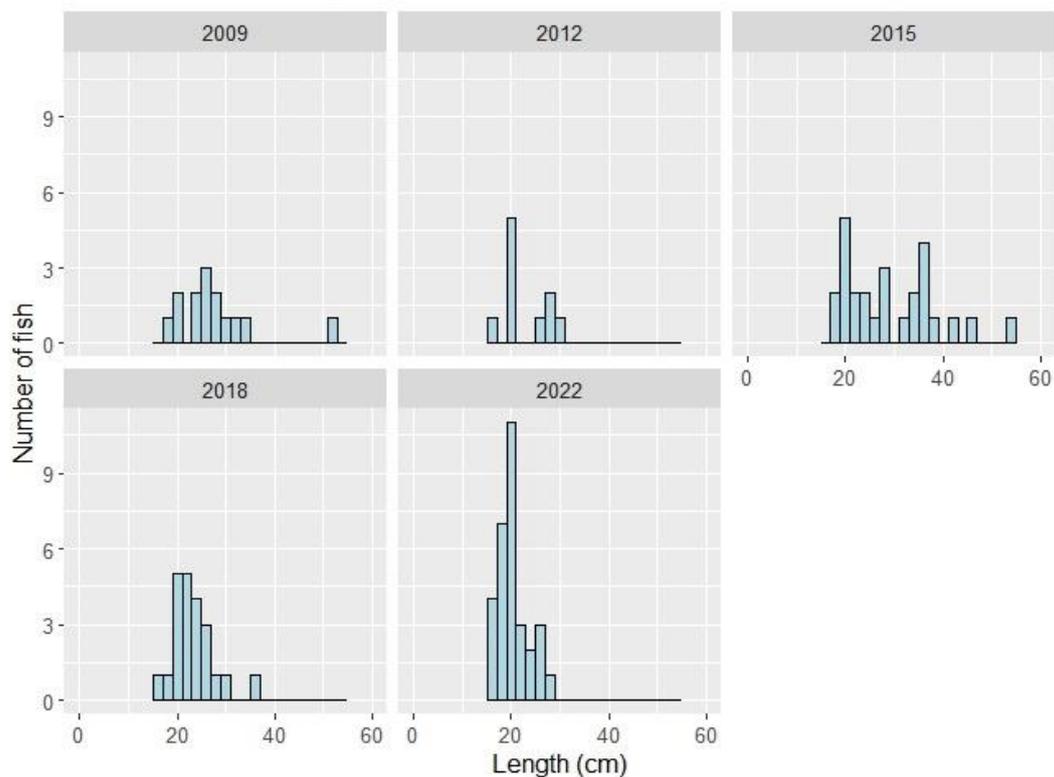
**Figure 3.4. Length frequency of perch captured on Lough Cullin, 2009, 2012, 2015, 2018 and 2022.**

**Table 3.4. Mean ( $\pm$ S.E.) perch length (cm) at age captured, Lough Cullin, August 2022.**

Length (cm)	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
Mean ( $\pm$ S.E.)	6.5 (0.1)	12.2 (0.2)	16.8 (0.3)	20.4 (0.6)	22.4 (1.0)
N	14	15	15	4	3
Range	5.0 - 8.4	9.2 - 14.9	14.3 - 20.5	18.0 - 22.8	20.4 - 23.5

## **Brown trout**

Brown trout captured during the 2022 survey ranged in length from 15.5cm to 36.9cm (mean 23.1cm) (Figure 3.5). Brown trout were aged from 1+ and 3+ (Table 3.5). In contrast to some of the earlier surveys there was limited evidence of persistence of larger and older individuals. However, greater numbers of fish less than 20cm were captured in 2022 (Figure 3.5). Mean L1 (i.e. age at the end of the 1<sup>st</sup> year) was 7.5cm (Table 3.5).



**Figure 3.5. Length frequency of brown trout captured on Lough Cullin, 2009, 2012, 2015, 2018 and 2022.**

**Table 3.5. Mean ( $\pm$ S.E.) brown trout length (cm) at age captured, Lough Cullin, August 2022.**

Length (cm)	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>
Mean ( $\pm$ S.E.)	7.5 (0.2)	15.5 (0.3)	22.5 (0.9)
N	7	10	4
Range	5.6 - 8.7	13.2 - 16.9	20.6 - 24.7

### Other fish species

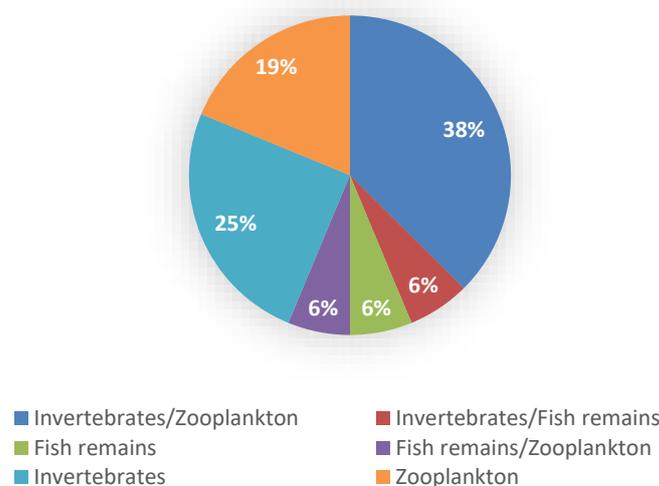
Rudd ranged in length from 7.0cm to 30.5cm (mean 16.1cm). Rudd were aged between 1+ and 10+ with seven age groups present. Tench ranged in length from 13.5cm to 26.3cm (mean 19.0cm). One salmon at 78.5cm was recorded. One roach x rudd hybrid measuring 18.5cm in length, aged 6+ was captured. Eels ranged in length from 25.0cm and 50.0cm (mean 37.9cm).

### **3.4. Stomach and diet analysis**

Dietary analysis studies provide a good indication of the availability of food items and the angling methods that are likely to be successful. However, the value of stomach content analysis is limited unless undertaken over a long period as diet may change on a daily basis depending on the availability of food items. The stomach contents of a subsample of perch and brown trout captured during the survey were examined and are presented below.

#### Perch

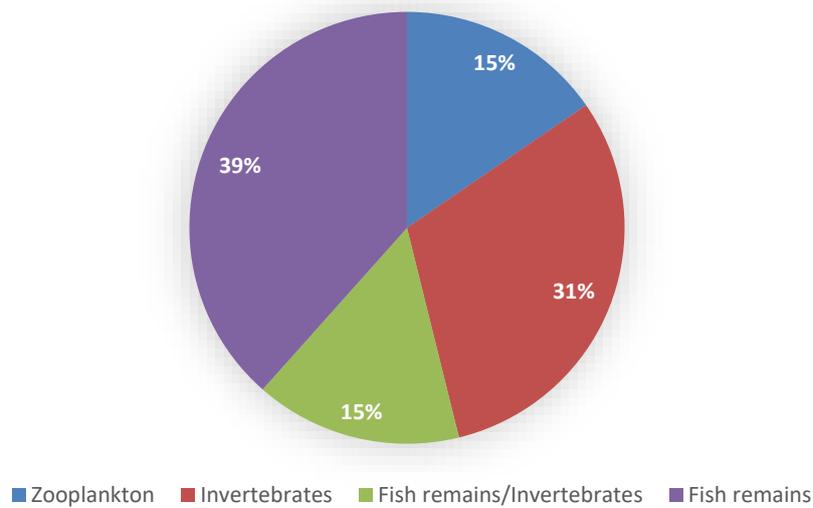
A total of 28 perch stomachs were examined and 12 were empty. Of the 16 stomachs containing food, invertebrates and zooplankton were found together in six (37.5%) stomachs. Invertebrates were the sole prey item recorded in four (25%) stomachs and occurred with fish in one (6%) stomach. Fish were also recorded with invertebrates and with zooplankton in one stomach respectively. Fish was the sole prey item in one perch stomach. Zooplankton was the sole prey recorded in three (19%) stomachs. (Figure 3.6).



**Figure 3.6. Diet of perch (N = 16) captured on Lough Cullin, August 2022 (% FO)**

### **Brown trout**

A total of 40 brown trout stomachs were examined from Lough Cullin and 27 of these contained no prey items. Of the remaining 13 stomachs containing food, fish was the sole prey type recorded in five (38.5%) stomachs and was recorded with invertebrates in two (15%) stomachs. Invertebrates were the sole prey type found in 4 (31%) stomachs. Two (15.5%) trout stomachs contained zooplankton (Figure 3.7).



**Figure 3.7. Diet of brown trout (N = 13) captured on Lough Cullin, August 2022 (% FO).**

#### 4. Summary and fish ecological status

A total of seven fish species and one type of hybrid were recorded on Lough Cullin in August/September 2022.

Roach was the dominant species in terms of both abundance (CPUE) and biomass (BPUE) captured in during the 2022 survey. The abundance of roach has remained relatively stable across since 2009 (with the exception of 2018). While perch recruitment seems to be regular and stable, proportionately fewer larger fish were recorded in 2022 compared to earlier surveys and biomass was lower in 2018 and 2022 compared to earlier surveys. Only small numbers of 1+ roach were captured in 2022. This cohort was prominent in only the 2018 survey suggesting that these individuals were either unavailable to capture during surveys (i.e. they are too small or inhabit inaccessible habitats) , or that they recruit from elsewhere in the catchment.

The abundance and biomass of perch was also relatively high in 2022 and there is evidence of an increasing trend in both abundance and biomass. This species is also recruiting regularly to the lake. However in contrast to roach, a greater proportion of younger and smaller fish were recorded in in 2022 (and 2018) compared to earlier surveys.

There is also evidence of an increasing trend in abundance of brown trout since the 2009 and 2012 surveys. Brown trout ranged in length from 15.5cm to 36.9cm and while few larger fish were captured, there was an apparent increase in the number of smaller (i.e. <20cm) fish captured in 2022 compared to earlier surveys suggesting that recruitment has improved. While no 0+ brown trout were captured as part of this survey, this cohort is likely present in connected streams and rivers. Similar trends in brown trout population structure were apparent on Lough Conn, a lake connected to Lough Cullin at Pontoon bridge, also reported a slight increase in brown trout numbers compared to the most recent survey. (McLoone *et al.*, 2023).

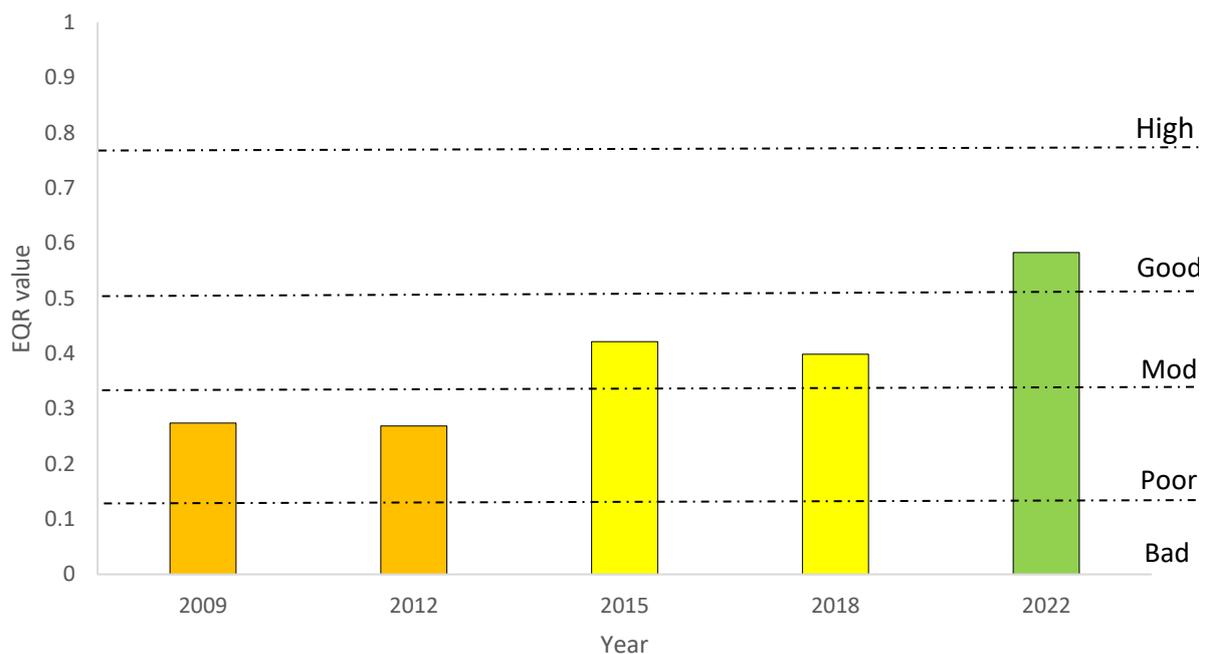
Abundance and biomass of eel were lower in both 2018 and 2022 compared to the surveys conducted in 2009 and 2012.

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, Lough Cullin has been assigned an ecological status of Good for 2022 based on the fish populations present (Figure 4.1). This is an improvement in the fish ecological status of the lake from Moderate in 2018. This increase in fish status is likely due to the increase in brown trout BPUE between surveys and a decrease in pollution tolerant species (Corcoran *et al.*, 2023). In earlier surveys the lake was assigned an ecological fish status of Moderate in 2015 and Poor in 2009 and 2012 (Figure 4.1).

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



**Figure 4.1. Fish ecological status, Lough Cullin, 2009, 2012, 2015, 2018 and 2022 (dashed line indicates EQR status boundaries).**

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