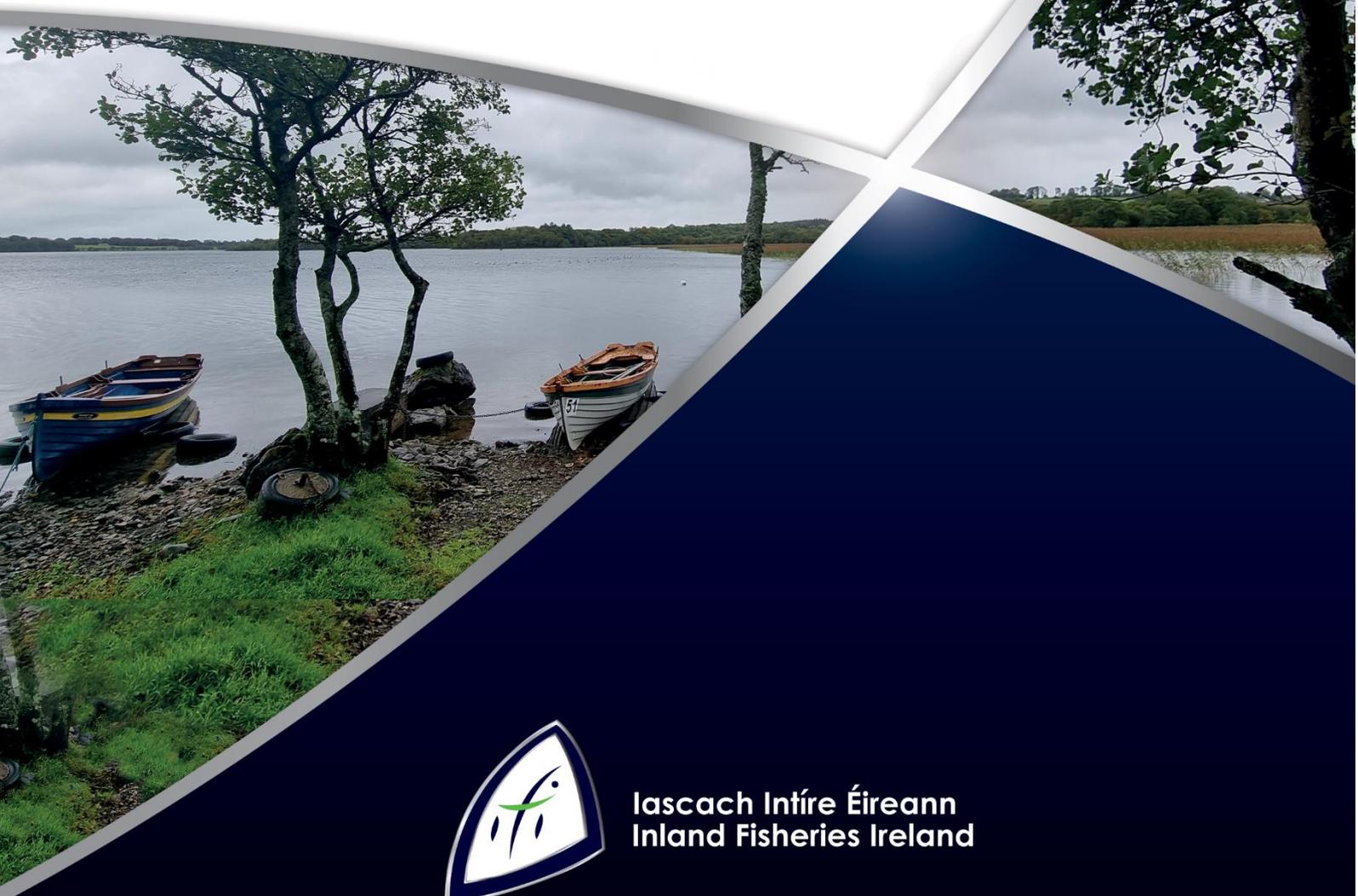


# National Research Survey Programme

## Lakes 2022

### Lickeen Lough

IFI/2023/1-4665



Iascach Intíre Éireann  
Inland Fisheries Ireland

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



**Iascach Intíre Éireann  
Inland Fisheries Ireland**

National Research Survey Programme

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

CITATION: McLoone, P., Corcoran, W., Bateman, A., Cierpial, D., Gavin, A., Gordon, P., McCarthy, E., Heagney, B., Hyland, J., Robson, S., Kelly, K and Kelly, F.L. (2023). Fish Stock Survey of Lickeen Lough, September 2022. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Cover photo: Lough Lene, Co. Westmeath © Inland Fisheries Ireland

© Inland Fisheries Ireland 2023

## **ACKNOWLEDGEMENTS**

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland.

The authors would also like to acknowledge the funding provided for the project from the Department of Communications, Climate Action and Environment for 2022.

*The report includes Ordnance Survey Ireland data reproduced under OSi Copyright Permit No. MP 007508.*

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.*

*© Ordnance Survey Ireland, 2022.*

## 1. Introduction

Lickeen Lough is situated in the Inagh catchment, approximately 3km north-east of Ennistymon, Co. Clare (Plate 1.1 and Figure 1.1). It has a surface area of 84ha, a mean depth of >4m, a maximum depth of 20m and is characterised as typology class 8 (as designated by the EPA for the Water Framework Directive), *i.e.*, deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l CaCO<sub>3</sub>).

Historically, Lickeen Lough held a stock of Arctic char (*Salvelinus alpinus*) (O' Reilly, 2007); however, the population is now extinct. A substantial fish kill (effecting brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), perch (*Perca fluviatilis*) and other species) occurred in the lake in June 1998, which may have contributed to their demise. Wild brown trout up to 2.3kg (5lbs) have been taken from the lake by anglers. Until recently the lake was stocked with rainbow trout by a local angling cooperative. The lake is subject to water abstraction, supplying drinking water to Ennistymon (EPA, 2023).

Lickeen Lough was previously surveyed in 2007, 2010, 2013 and 2016 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007 and Kelly *et al.*, 2011, 2014 and 2017). During the 2016 survey rudd (*Scardinius erythrophthalmus*) were found to be the dominant species present in the lake. Brown trout and eels (*Anguilla anguilla*) were also captured during the survey.

Extensive algal blooms were visible on the lake during previous surveys in 2010 and 2016 (Kelly *et al.*, 2011 and 2017).

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 Lickeen Lough, September 2022

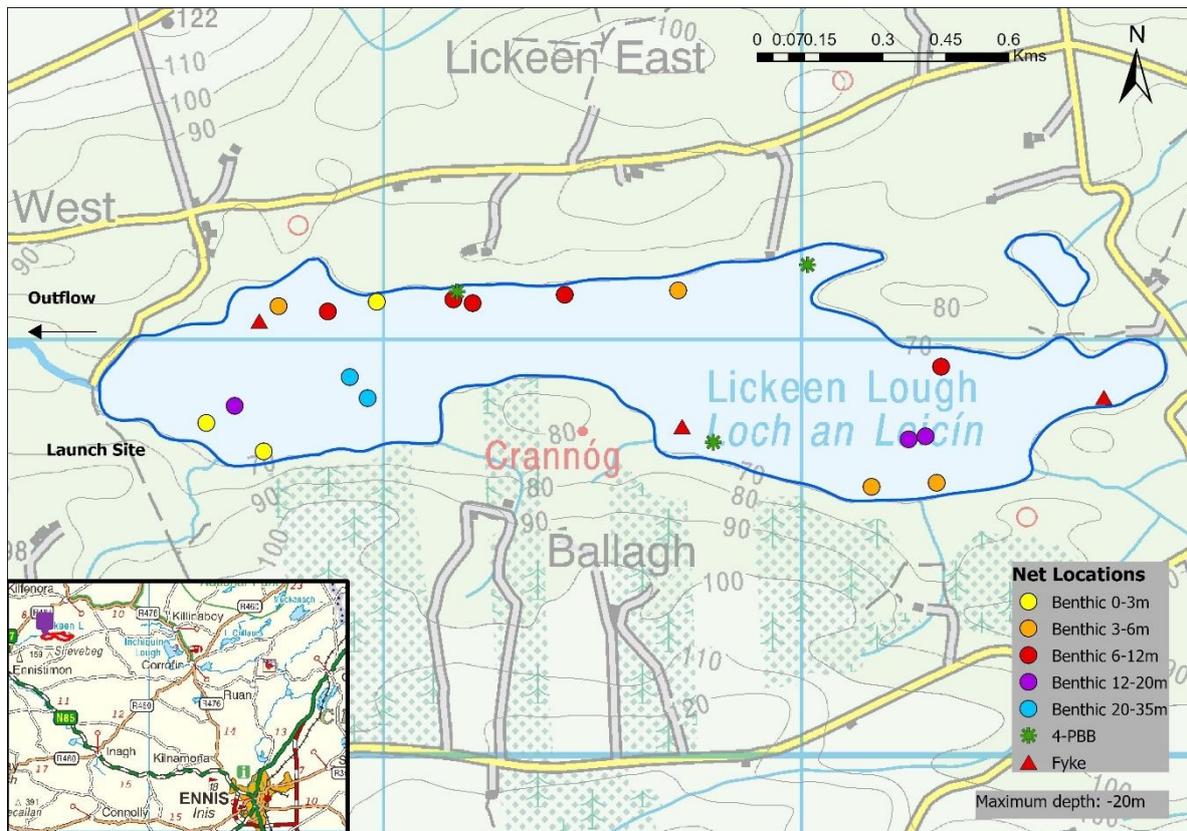


Figure 1.1. Location map of Lickeen Lough showing net locations and depths of each net (outflow is indicated on map).

## 2. Methods

### 2.1. Netting methods

Lickeen Lough was surveyed over two nights from the 6<sup>th</sup> to the 8<sup>th</sup> of September 2022. A total of three sets of Dutch fyke nets and 17 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (3 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 3 @ 12-19.9m and 2 @ 20-34.9m) were deployed in the lake (20 sites). 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 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:

$FO_i$  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.

### 3. Results

#### 3.1. Species Richness

Four fish species were recorded on Lickeen Lough in September 2022. A total of 326 fish were captured (Table 1.1). Rudd was the most common fish species recorded, representing 85% of all fish captured. Brown trout, three-spined stickleback and European eel were also recorded. The same species composition has been recorded on previous surveys (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 Lickeen Lough, September 2022.**

Scientific name	Common name	Number of fish captured			
		BM CEN	4-PBB	Fyke	Total
<i>Scardinius erythrophthalmus</i>	Rudd	263	0	14	277
<i>Salmo trutta</i>	Brown trout	36	1	0	37
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	2	0	0	2
<i>Anguilla anguilla</i>	Eel	0	0	10	10

#### 3.2. Fish abundance

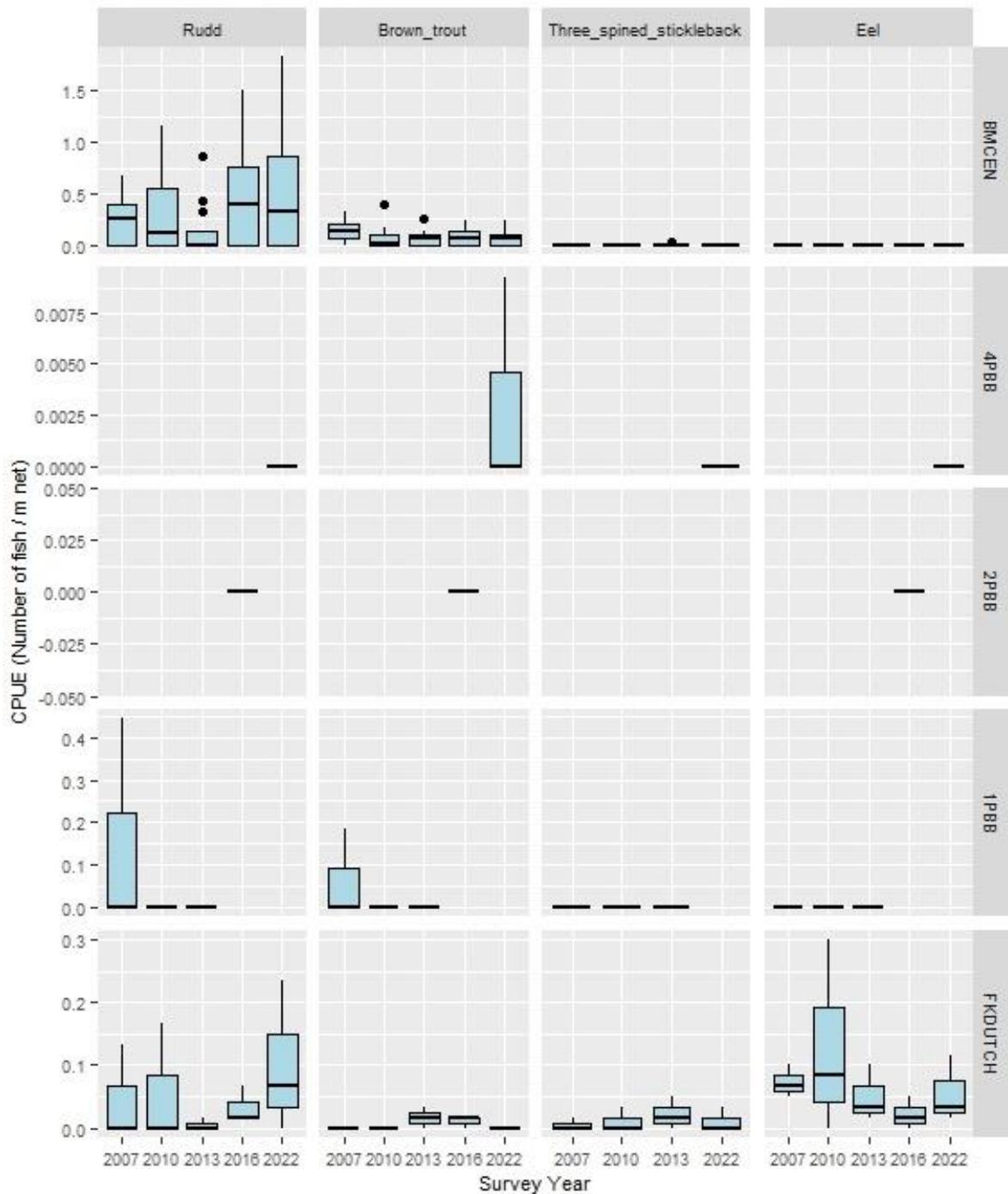
Fish abundance (mean CPUE) and biomass (mean BPUE) were calculated as the mean number/weight of fish caught per metre of net. For all fish species except eel, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only. In 2022, rudd was the dominant species with respect to both abundance (mean CPUE) and biomass (mean BPUE) (Table 3.2).

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 (Figures 3.1 and 3.2). No clear trends in rudd populations were apparent, while brown trout abundance and biomass was higher in the initial survey than was recorded in subsequent years.

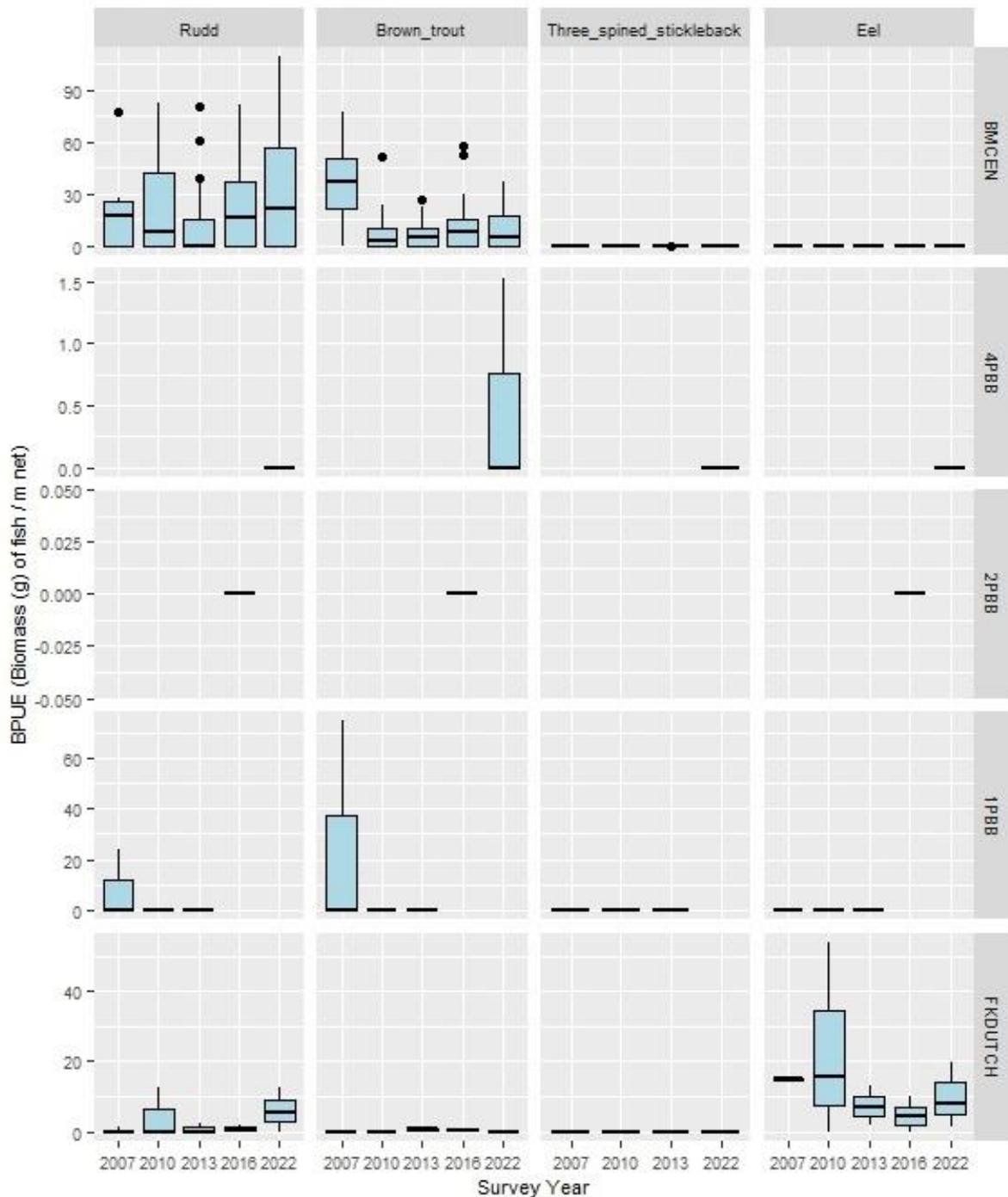
**Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lickeen Lough.**

Scientific name	Common name	Mean CPUE ( $\pm$ S.E)	Mean BPUE ( $\pm$ S.E)
<i>Scardinius erythrophthalmus</i>	Rudd	0.388 (0.114)	23.694 (6.968)
<i>Salmo trutta</i>	Brown trout	0.053 (0.015)	7.418 (2.278)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.001 (0.001)	0.001 (0.001)
<i>Anguilla anguilla</i>	Eel	0.056 (0.031)*	9.826 (5.430)*

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 3.1. CPUE of all fish species captured in each net type during surveys of Lickeen 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 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 3.2.** BPUE of all fish species captured in each net type during surveys of Lickeen Lough from 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 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

#### Rudd

Rudd captured during the 2022 survey ranged in length from 6.2cm to 21.4cm (mean 15.0cm) (Figure 3.3). Rudd were aged between 1+ and 8+, and all age classes (with the exception of seven year old fish) were represented. The population was dominated by 2+ and 3+ fish, with relatively few younger fish captured (Table 3.3).

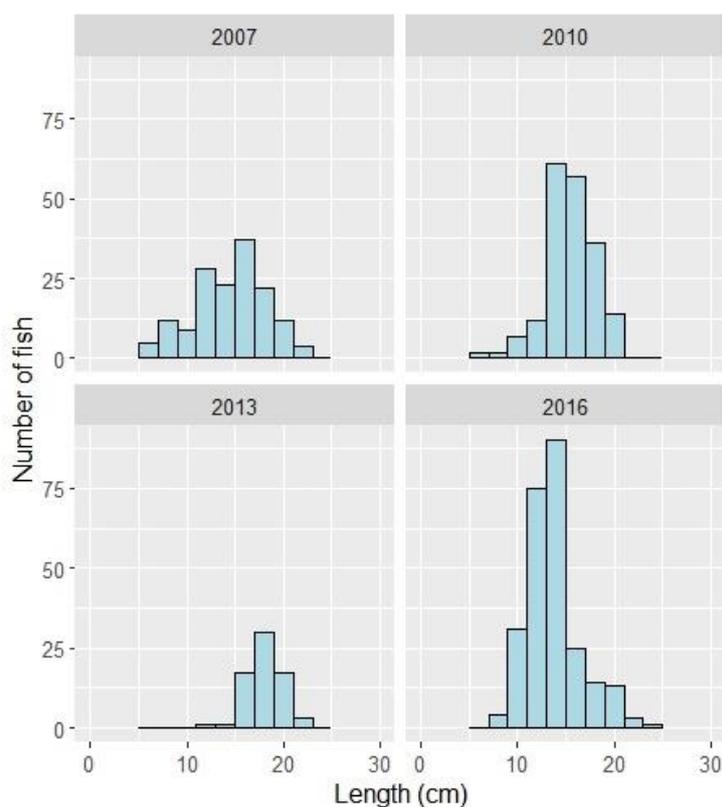


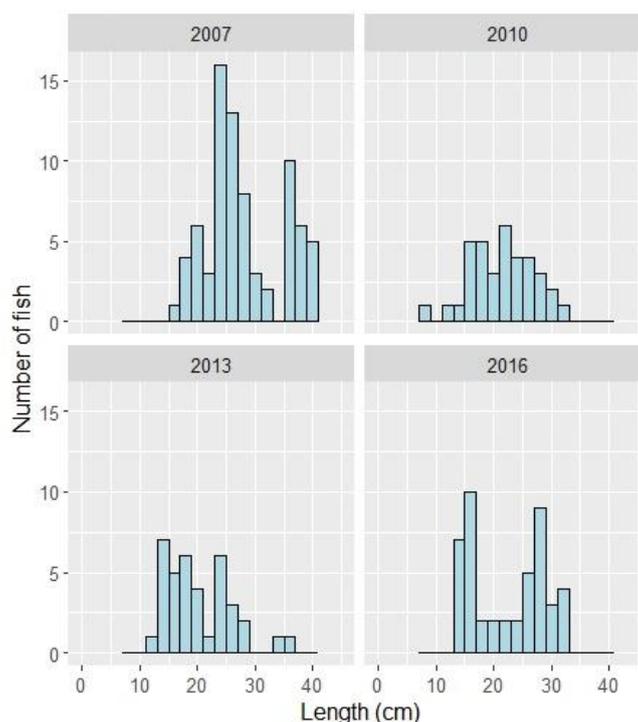
Figure 3.3. Length frequency of rudd captured on Lickeen Lough, 2007, 2010, 2013, 2016 and 2022.

Table 3.3. Summary age data from rudd captured on Lickeen 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	6	12	16	5	7	5	0	2
Mean L (cm)	-	8	11.2	14.4	16.6	18.9	20	-	19.2
Min L (cm)	-	6.3	8.6	12.5	15.2	17.6	18.2	-	18.3
Max L (cm)	-	9.5	13.3	16.8	17.8	19.8	21.4	0	20.1

## **Brown trout**

Brown trout captured during the 2022 survey ranged in length from 12.3cm to 32.4cm (mean 22.2cm) (Figure 3.4). Four age classes were present, ranging from 1+ to 4+. The dominant age class was 3+ (Figure 3.4). Mean L1 (i.e. length at the end of the 1<sup>st</sup> year) was 6.1cm (Table 3.4). Brown trout captured during the 2010, 2013 and 2016 surveys had similar length and age ranges, with the narrowest length range exhibited in 2022 (Figure 3.4).



**Figure 3.4. Length frequency of brown trout captured on Lickeen Lough, 2007, 2010, 2013, 2016 and 2022.**

**Table 3.4. Mean ( $\pm$ S.E.) brown trout length (cm) at age for Lickeen Lough, September 2022.**

Length (cm)	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>
Mean ( $\pm$ S.E.)	6.1 (0.3)	12.3 (0.6)	21.0 (0.9)	-
N	17	14	10	1
Range	4.2 - 9.3	9.4 - 16.2	16.9 - 25.9	29.4

## **Other fish species**

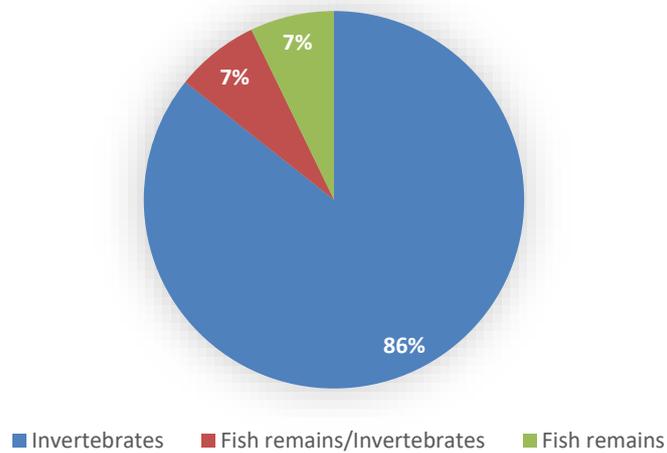
European eel captured during the 2022 survey ranged in length from 36.5cm to 58.0cm (mean 47.7cm). Two three-spined stickleback were also captured measuring 2.3cm and 3.0cm.

### 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 captured during the survey were examined and are presented below.

#### **Brown trout**

A total of 22 stomachs were examined. Eight (36%) were empty. Of the remaining 14 stomachs containing food, 12 (86%) contained invertebrates. Fish were the sole prey type recorded in one (7%) stomach and was found together with invertebrates in one other stomach (Figure 3.5).



**Figure 3.5. Diet of brown trout (N = 14) captured on Lickeen Lough, 2022 (% FO)**

## 4. Summary and fish ecological status

Four fish species were captured on Lickeen Lough in 2022.

Rudd were the dominant species in terms of both abundance (mean CPUE) and biomass (mean BPUE) captured in the survey gill nets during the 2022 survey. The population has remained relatively stable across all sampling occasions.

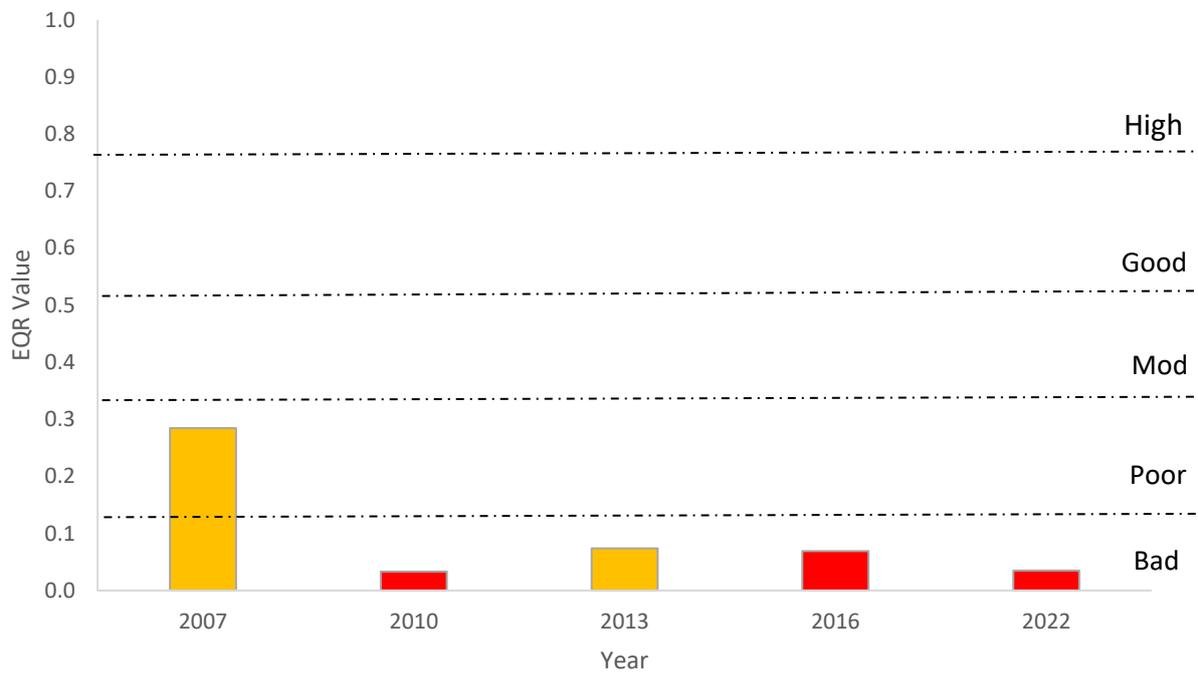
Brown trout were the second most common species recorded in Lickeen Lough. After an initial decrease in CPUE after 2007, the population appears to have stabilised, with no obvious trend between 2010 and 2022.

There was evidence (in the form of dead and decaying algae in the water) of a recent algal bloom at the time that the survey was conducted.

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, Lickeen Lough has been assigned an ecological status of Bad for 2022 based on the fish populations present. Lickeen Lough was also assigned Bad status in the 2016 survey. Previously the Lough was assigned Poor status in 2007 and 2013 and Bad status in 2010 and 2016, (Figure 4.1).

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



**Figure 4.1. Fish ecological status, Lickeen Lough, 2007, 2010, 2013, 2016 and 2022 (dashed line indicates EQR status boundaries).**

## 5. References

- Amundsen P-A, Gabler H-M, Staldvik FJ. (1996) A new approach to graphical analysis of feeding strategy from stomach contents data—modification of the Costello (1990) method. *Journal of Fish Biology*, **48**, 607–614.
- Caffrey, J. (2010) *IFI Biosecurity Protocol for Field Survey Work*. Inland Fisheries Ireland.
- Connor, L., Matson R. and Kelly F.L. (2017) Length-weight relationships for common freshwater fish species in Irish lakes and rivers. *Biology and Environment: Proceedings of the Royal Irish Academy*, **117** (2), 65-75.
- EPA (2021) [https://gis.epa.ie/EPAMaps/Data - Catchments.ie - Catchments.ie](https://gis.epa.ie/EPAMaps/Data-Catchments.ie-Catchments.ie). Accessed in May/June 2023.
- Kelly, F. and Connor, L. (2007) *WFD Surveillance Monitoring - Fish in Lakes (2007)*. Central Fisheries Board Unpublished Report.
- Kelly, F.L., Harrison, A., Connor, L., Allen, M., Rosell, R. and Champ, T. (2008) *FISH IN LAKES Task 6.9: Classification tool for Fish in Lakes. FINAL REPORT*. Central Fisheries Board, NSSHARE project.
- Kelly, F.L., Harrison A., Connor, L., Morrissey, E., Wogerbauer, C., Matson, R., Feeney, R., O’Callaghan, R. and Rocks, K. (2011a) *Water Framework Directive Fish Stock Survey of Lickeen Lough, September 2010*. Inland Fisheries Ireland.
- Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., Wogerbauer, C., Feeney, R., O’Callaghan, R. and Rocks, K. (2011b) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland.
- Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012) Development and application of an ecological classification tool for fish in lakes in Ireland. *Ecological Indicators*, **18**, 608-619.
- Kelly, F.L., Connor, L., Morrissey, E., Coyne, J., Matson, R., Feeney, R. and Rocks, K. (2014) *Water Framework Directive Fish Stock Survey of Lickeen Lough, September 2013*. Inland Fisheries Ireland.
- Kelly, F.L., Connor, L., Coyne, J., Morrissey, E., Corcoran, W., Cierpial, D., Delanty, K., McLoone, P., Matson, R., Gordon, P., O’ Briain, R., Rocks, K., O’ Reilly, S., Kelly K., Puttharee, D., McWeeney, D., Robson S. and Buckley, S. (2017) *Fish Stock Survey of Lickeen Lough, September 2016*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

EPA (2023) <https://www.epa.ie/publications/compliance--enforcement/drinking-water/audit-reports/clare/Ennistymon-Audit-10052023.pdf>

O' Reilly, P. (2007) *Loughs of Ireland. A Flyfisher's Guide*. 4<sup>th</sup> Edition. Merlin Unwin Books.

**Inland Fisheries Ireland  
3044 Lake Drive,  
Citywest Business Campus,  
Dublin 24,  
Ireland.  
D24 CK66**

**[www.fisheriesireland.ie](http://www.fisheriesireland.ie)  
[info@fisheriesireland.ie](mailto:info@fisheriesireland.ie)**

**+353 1 8842 600**

