

# National Research Survey Programme

## Lakes 2021

### Lough Leane

IFI/2022/1-4607



Iascach Intíre Éireann  
Inland Fisheries Ireland

**Fish Stock Survey of Lough Leane,  
August/September 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 Leane forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River catchment candidate Special Area of Conservation (Plate 1.1a, Plate 1.1b and Figure 1.1). 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, 2018).

Lough Leane itself is the largest of the Killarney lakes, with a surface area of 1,978ha, a mean depth of 13m and a maximum depth of 66m. The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and moderate alkalinity (20-100mg/l CaCO<sub>3</sub>).

A decline in water quality in the Lough Leane catchment was evident throughout the latter part of the twentieth century and in 1997 Lough Leane was classified as hypertrophic (Anon, 2003). This decline in water quality was principally attributed to increased levels of nutrients, most significantly phosphorus, being transported via the rivers to the lakes, which has led to eutrophication in the past (Anon, 2003). A number of algal blooms were noticed in Lough Leane during the summer of 1997 and this event resulted from excessive phosphorus levels within the lake and had the potential to cause significant damage to the ecology of the lake (Anon, 2009). In response to this, Kerry County Council set up the Lough Leane Working Group to co-ordinate efforts to monitor and manage water quality within the catchment between 1998 and 2001 (Anon, 2003). This monitoring and management programme was a catchment wide initiative, aimed at stopping the eutrophication process and restoring the rivers and lakes to a satisfactory state by reducing phosphorus inputs from all sources. The project also aimed to identify and quantify all significant point and diffuse sources of pollution input, in particular those inputs from local authority activities, agriculture, forestry and septic tanks.

Lough Leane contains a variety of fish species, including brown trout, sea trout, ferox trout, salmon, perch, flounder, eel, rudd, tench and Arctic char. A landlocked sub-species of the twaite shad known as the Killarney shad (*Alosa fallax killarnensis*) is also present and is unique to this lake (Plate 1.2). The Killarney shad is listed in Annex II of the EU Habitats Directive.

Lough Leane is famous for its free rising trout and good salmon fishing (O’ Reilly, 2007), with hundreds of spring salmon and grilse being caught on the troll every year. Brown trout in the lake average 0.23kg; however, a specimen ferox trout was caught in 2005 weighing nearly 8kg (O’ Reilly, 2007).

Inland Fisheries Ireland (previously the Central Fisheries Board) has undertaken several fish stock surveys on Lough Leane. Two surveys were undertaken in 2001 and 2003 to assess the status of the Killarney shad population (Roche and Rosell, 2003). The Killarney shad population size at the time was estimated to be in excess of 20,000 individuals of 1+ and older fish (Roche and Rosell, 2003). A small number of Arctic char were also recorded during the 2003 survey. In 2002, the Irish Char Conservation Group carried out fish surveys on all three Killarney Lakes and brown trout were recorded in all. Muckcross (Middle) lake was the only lake in which Arctic char were captured, with the population in Lough Leane believed to be extinct due to the eutrophication of the lake (Igoe, *pers. comm.*). Lough Leane has been surveyed on four occasions (2008, 2011, 2014 and 2017) since 2008 (Kelly *et al.*, 2009, 2012a 2015a and 2015b, Connor *et al.* 2018a).

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.



**Plate 1.1a. Lough Leane, September 2021**



Plate 1.1b. Lough Leane, September 2021

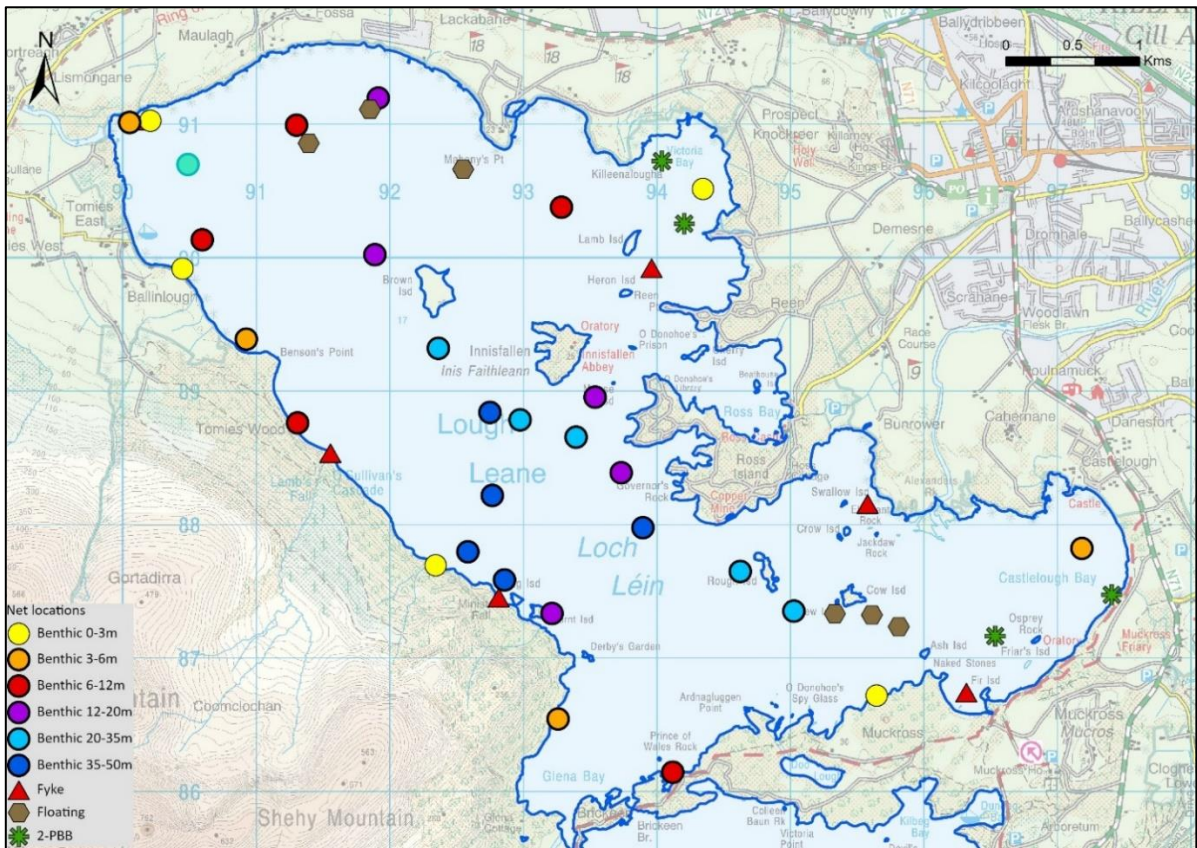


Figure 1.1. Location map of Lough Leane showing locations and depths of each net

## 2. Methods

### 2.1. Netting methods

Lough Leane was surveyed over three nights from the 31<sup>st</sup> of August to the 3<sup>rd</sup> of September 2021. A total of six sets of Dutch fyke nets (Fyke), 30 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (6 @ 0-2.9m, 4 @ 3-5.9m, 4 @ 6-11.9m, 4 @ 12-19.9m, 3 @ 20-34.9m and 3 @ 35-49.9m) and six floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed randomly in the lake (42 sites) (Figure 1.1). The netting effort was supplemented using two-panel benthic braided survey gill nets (2-PBB) at four additional sites. The two-panel survey gill are composed of two 27.5m long panels each a different mesh size (60mm and 90mm) tied together randomly. 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:

$FO_i$  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

Ten fish species were recorded on Lough Leane in August/September 2021. A total of 566 fish were captured. The number of each species captured by each gear type is shown in Table 3.1. Brown trout was the most common fish species recorded. Perch, rudd, Killarney shad, salmon, tench, flounder, Arctic char, minnow and eels were also recorded. The same species were recorded in the four previous surveys of the lake conducted between 2008 and 2017 (Kelly *et al.*, 2009, 2012a, 2015a, 2015b and Connor *et al.* 2018a). Sea trout were recorded in the 2011 survey, and minnow were recorded for the first time in 2021.

**Table 3.1. Number of each fish species captured by each method during the survey on Lough Leane, August/September 2021**

Scientific name	Common name	Number of fish captured				Total
		BM CEN	FM CEN	2-PBB	Fyke	
<i>Salmo trutta</i>	Brown trout	131	8	10	16	165
<i>Perca fluviatilis</i>	Perch	151	0	0	3	154
<i>Scardinius erythrophthalmus</i>	Rudd	114	12	0	19	145
<i>Alosa fallax killarneyensis</i>	Killarney shad	37	16	0	0	53
<i>Salmo salar</i>	Salmon	10	0	3	1	14
<i>Tinca tinca</i>	Tench	2	0	15	3	20
<i>Platichthys flesus</i>	Flounder	3	0	0	2	5
<i>Phoxinus phoxinus</i>	Minnow	1	0	0	0	1
<i>Salvelinus alpinus</i>	Arctic char	2	0	0	0	2
<i>Anguilla anguilla</i> *	European eel	1	0	0	6	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, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only. In 2021 brown trout and perch were the dominant fish species in terms of abundance (CPUE) with large numbers of rudd also recorded. Salmon was the dominant fish species in terms of biomass (BPUE) captured. Twelve of the 14 salmon captured were adult upstream migrants. Of those species normally resident in the lake, brown trout, tench, rudd and perch recorded high biomasses (Table 3.2).

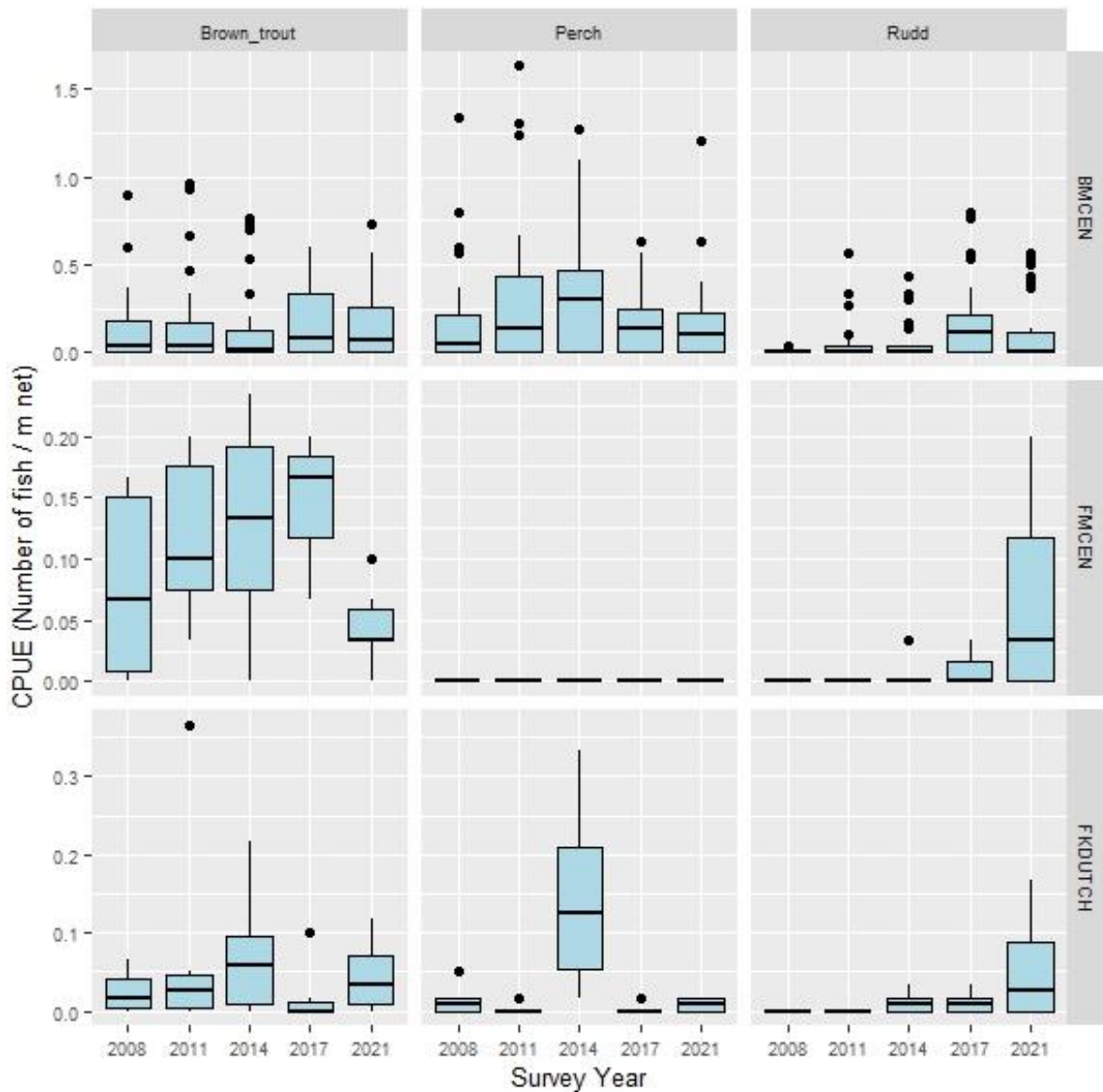


**Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Leane, 2021**

Scientific name	Common name	Mean CPUE ( $\pm$ S.E) **	Mean BPUE ( $\pm$ S.E) **
<i>Salmo trutta</i>	Brown trout	0.111 (0.024)	13.980 (3.225)
<i>Perca fluviatilis</i>	Perch	0.111 (0.032)	9.079 (2.601)
<i>Scardinius erythrophthalmus</i>	Rudd	0.098 (0.026)	10.990 (2.548)
<i>Alosa fallax killarnensis</i>	Killarney shad	0.038 (0.011)	3.573 (1.011)
<i>Salmo salar</i>	Salmon	0.009 (0.003)	20.885 (9.085)
<i>Tinca tinca</i>	Tench	0.009 (0.006)	13.939 (9.426)
<i>Platichthys flesus</i>	Flounder	0.003 (0.001)	0.573 (0.310)
<i>Phoxinus phoxinus</i>	Minnow	0.001 (0.001)	0.003 (0.003)
<i>Salvelinus alpinus</i>	Arctic char	0.001 (0.001)	0.168 (0.117)
<i>Anguilla anguilla</i> *	European eel	0.017 (0.006)	1.942 (0.748)

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

CPUE and BPUE for each species captured in all surveys between 2005 and 2021, per net type, are presented in Figures 3.1 (and b) to 3.2 (and b) respectively and illustrates fish community change over time. For clarity, only data from those survey nets set on each survey occasion, and which typically capture the majority of fish (i.e. benthic and floating monofilament and dutch fyke nets) are presented. Numbers and biomass of the three most abundant species (i.e. brown trout, perch and rudd) have exhibited minor fluctuations over all sampling occasions. No clear trends are apparent, although rudd numbers appear to have increased from an initially low level in 2008. (Figure 3.1a and 3.1b). Populations of Killarney shad, which are endemic to Lough Leane also appear to be relatively stable, while Arctic char continue to be captured in relatively small numbers. There was an apparent decline in numbers and biomass of eel across the surveys conducted since 2007 (Figure 3.2a and 3.2b).



**Figure 3.1a.** CPUE of brown trout, perch and rudd in each net type during surveys of Lough Leane between 2008 and 2021. 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

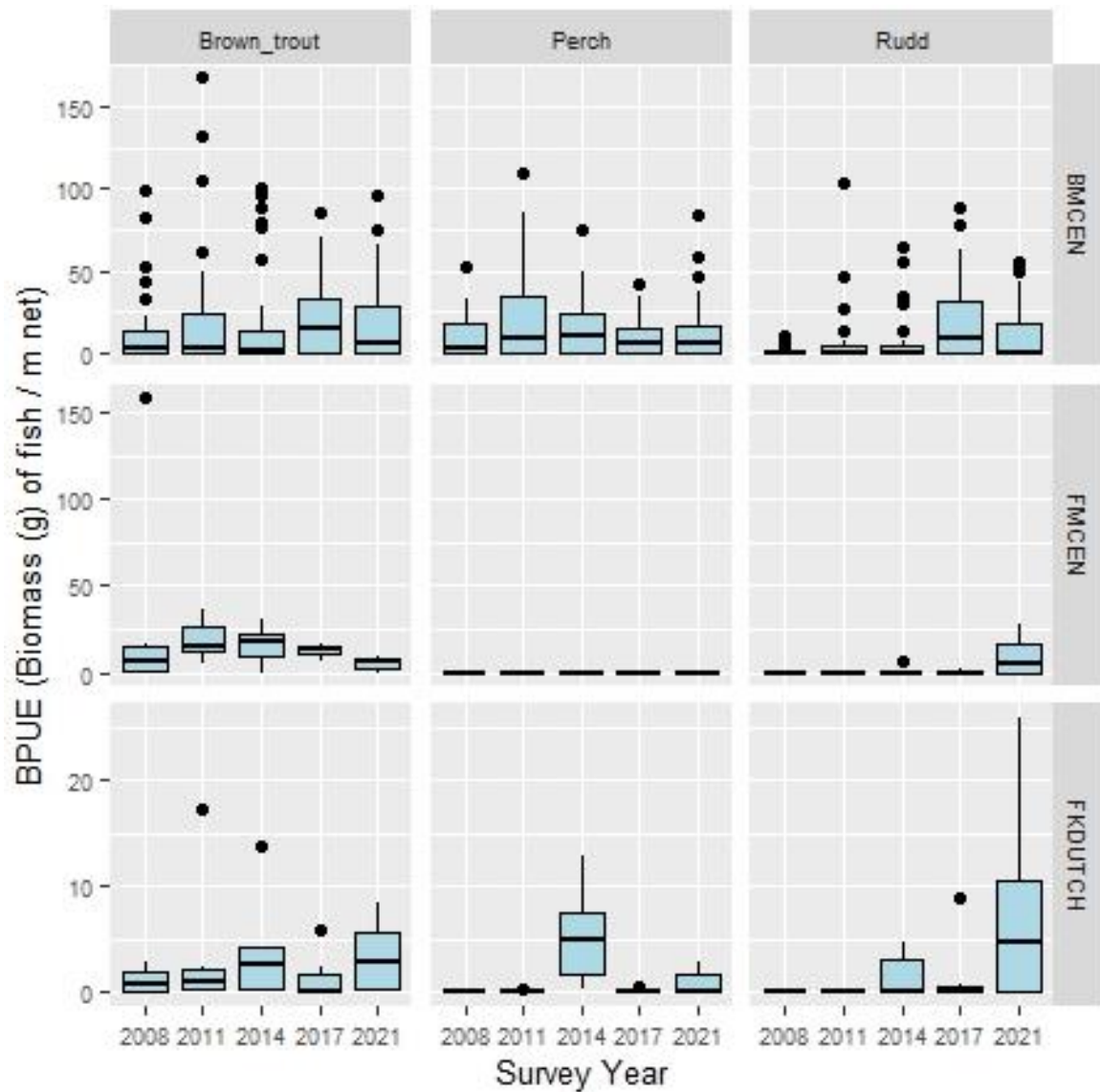


Figure 3.1b. BPUE of brown trout, perch and rudd in each net type during surveys of Lower Lough Leane between 2008 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> 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

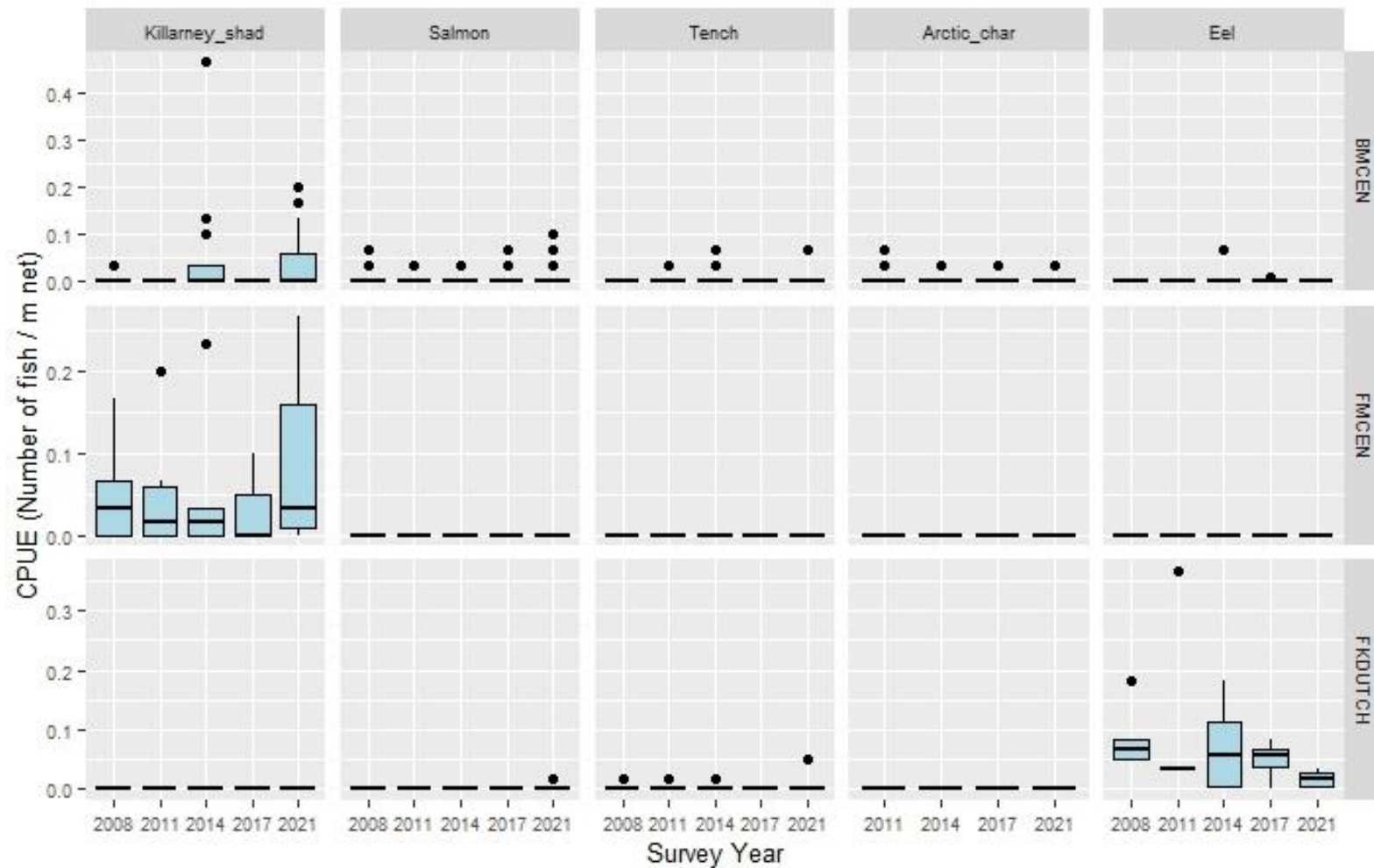


Figure 3.2a. CPUE of Killarney shad and other regularly captured species in each net type during surveys of Lough Leane between 2008 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<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

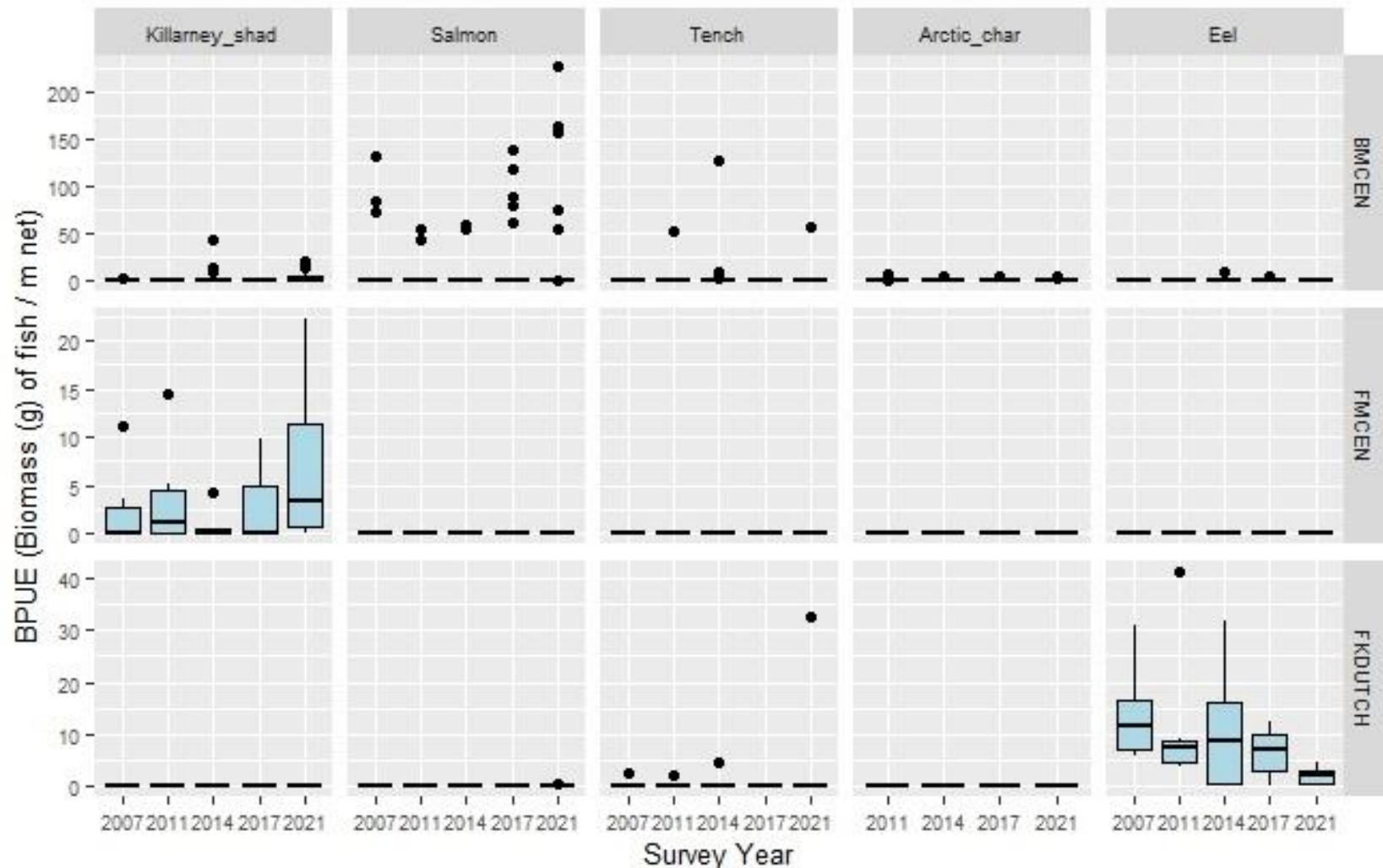
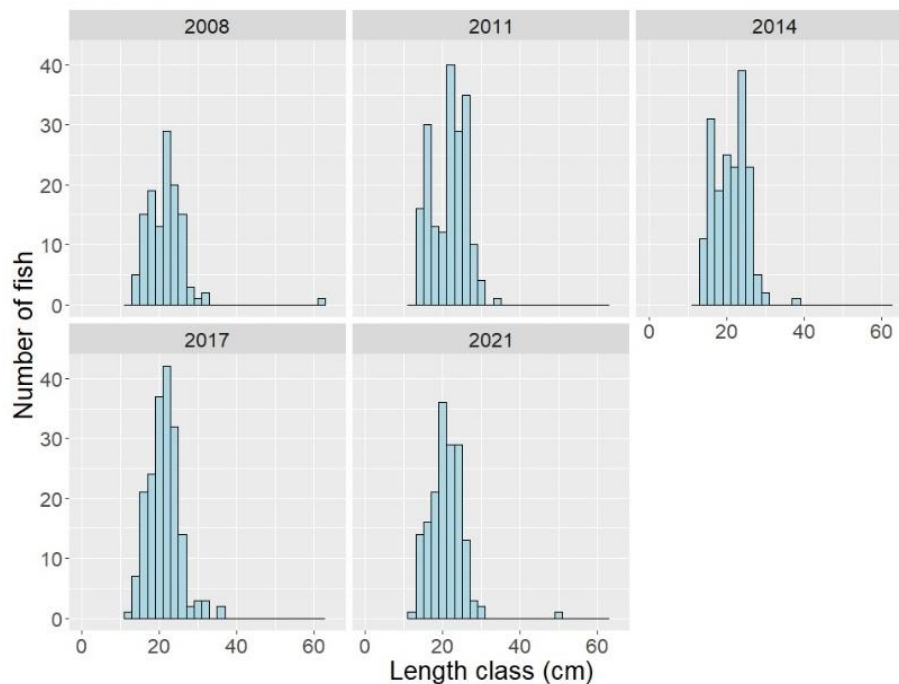


Figure 3.2b. BPUE of Killarney shad and other regularly captured species in each net type during surveys of Lower Lough Leane between 2008 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75% and 25% 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

### 3.5. Length frequency distributions and growth

#### Brown trout

Brown trout captured during the 2021 survey ranged in length from 12.0cm to 49.9cm (mean = 20.8cm). Length range was similar when compared to previous surveys of the lake (Figure 3.3). Brown trout in the sample were aged between 1+ and 7+. Younger fish dominated the population with 1+ to 3+ trout comprising greater than 90% of the sample. Few older brown trout were captured with five 4+ trout and one 7+ brown trout recorded in the sample aged. In the small number of older trout captured, L4 (i.e. length at the end of the 4<sup>th</sup> year) in 2021 was 25.7cm indicating a very slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 3.3).



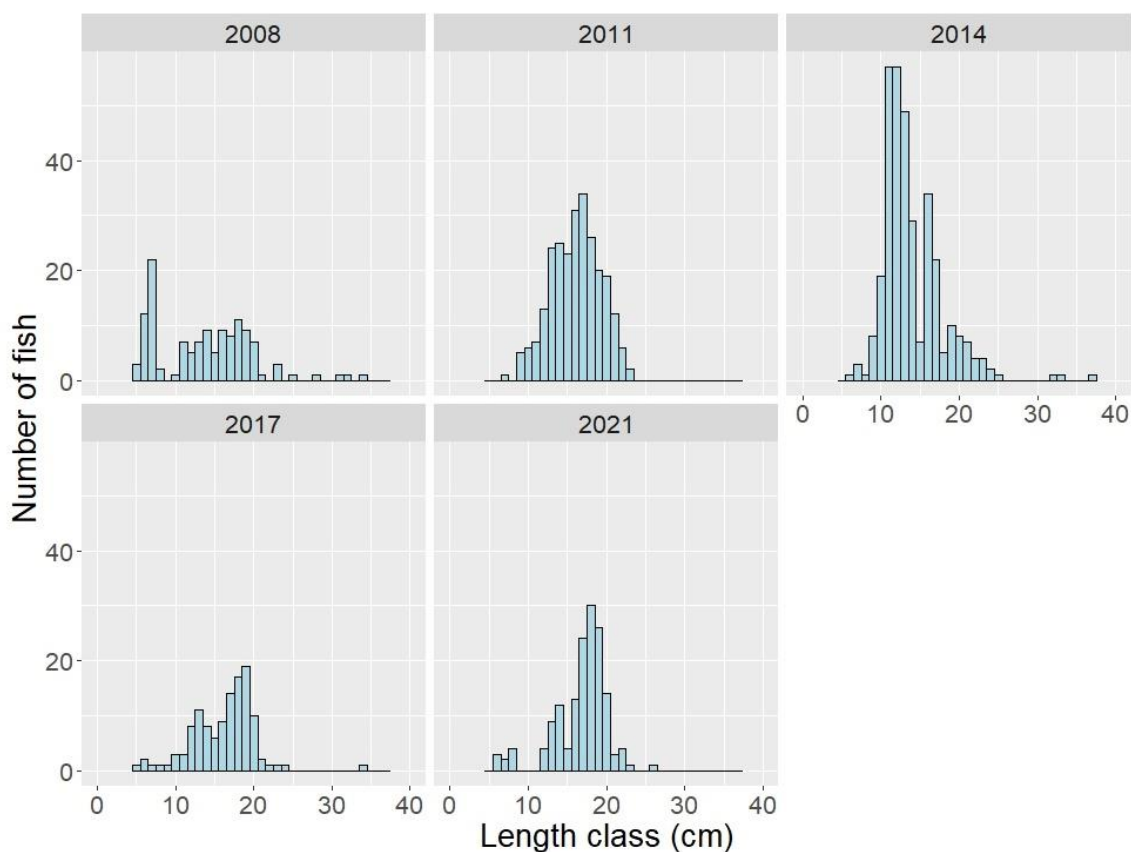
**Figure 3.3. Length frequency of brown trout captured on Lough Leane, 2008, 2011, 2014, 2017 and 2021**

**Table 3.3. Mean ( $\pm$ S.E.) brown trout length (cm) at age for Lough Leane, September 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.)	7.4 (0.2)	14.7 (0.4)	20.5 (0.3)	25.7 (1.3)	-	-	-
N	72	52	31	6	1	1	1
Range	3.8-12.4	10.3-22.1	16.3-25.4	22.4-30.5	35.9	44.5	48.1

## Perch

Perch captured during the 2021 survey ranged in length from 6.1cm to 25.7cm (mean = 16.9cm) (Figure 3.4). Perch in the sample ranged in age from 0+ to 6+ with all intervening age classes represented in the sample aged. Mean length at the end of the 1st year (L1) was 5.9cm (Table 3.6). The most abundant age class was 3+ (c 14-21cm, Figure 3.4). Young of the year perch (0+ and < 7cm) were poorly represented in the sample (Figure 3.4).



**Figure 3.4. Length frequency of perch captured on Lough Leane, 2008, 2011, 2014, 2017 and 2021**

**Table 3.4. Mean ( $\pm$ S.E.) perch length (cm) at age for Lough Leane, August/September 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>
<b>Mean (<math>\pm</math>S.E.)</b>	7.0 (0.2)	12.6 (0.3)	16.5 (0.3)	18.3 (0.3)	20.0 (0.3)	-
<b>N</b>	48	37	35	17	11	1
<b>Range</b>	4.9-9.5	9.5-16.0	13.2-20.5	15.2-20.8	19.0-21.7	21.0

## Rudd

Rudd captured during the 2021 survey ranged in length from 4.4cm to 26.2cm (mean = 18.2cm) (Figure 3.5). Rudd were aged between 2+ and 8+ with all intervening year classes present (Table 3.5). The majority of fish in the sample were aged between 3+ and 8+ with 6 year old fish the largest cohort in the sample (Table 3.5). In common with previous surveys conducted since 2008, relatively few younger and smaller rudd were captured in 2021 (Figure 3.5).

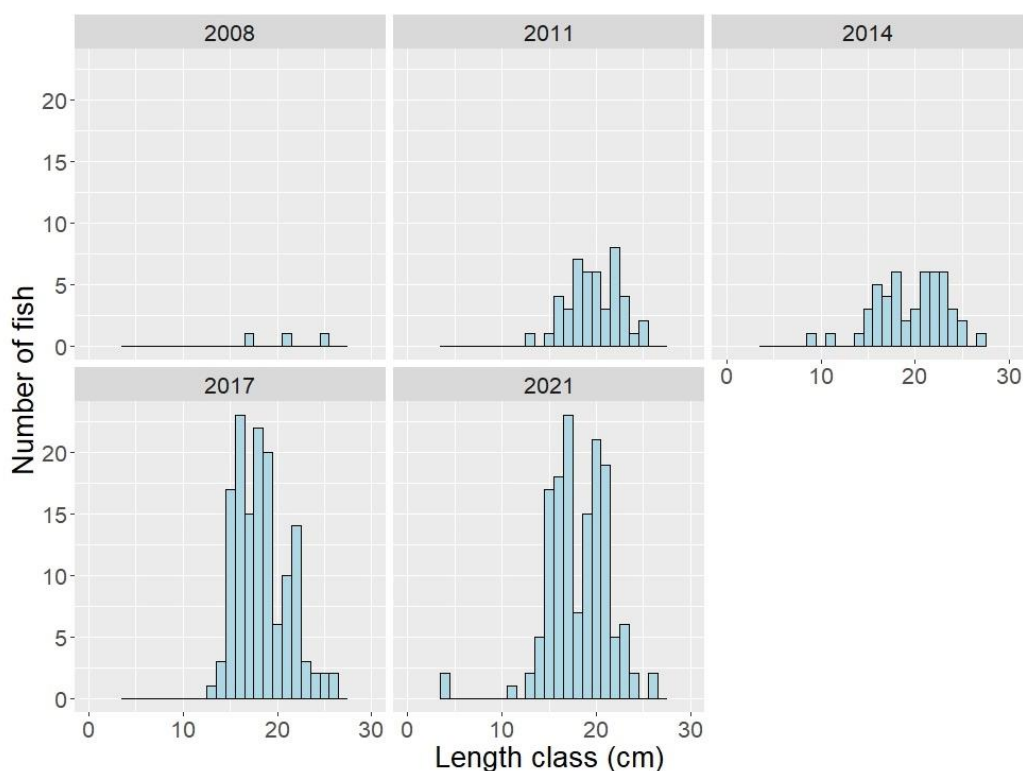


Figure 3.5. Length frequency of rudd captured on Lough Leane, 2008, 2011, 2014, 2017 and 2021

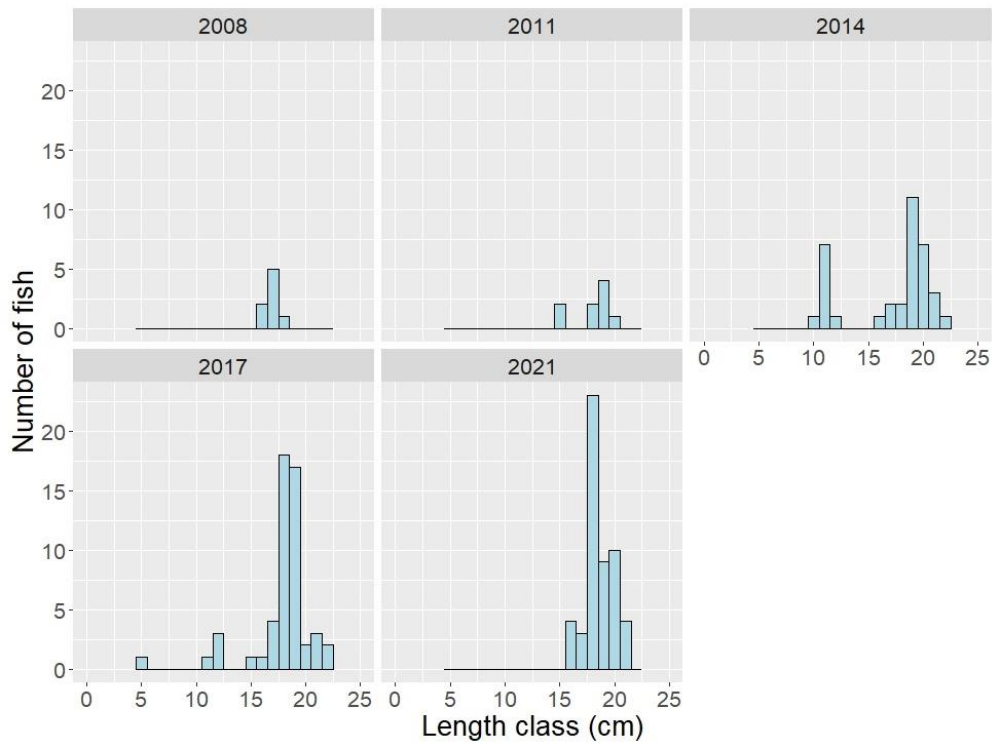
Table 3.5. Summary age data from rudd captured on Lough Leane, August/September 2021. Number (N) of fish and length ranges of all fish aged in the sample is presented

	Age Class								
	0+	1+	2+	3+	4+	5+	6+	7+	8+
<b>N</b>	-	-	1.0	10.0	7.0	8.0	15.0	1.0	1.0
<b>Mean L (cm)</b>	-	-	-	14.8	16.8	19.2	20.8	-	-
<b>Min L (cm)</b>	-	-	11.2	13.1	15.1	17.2	18.6	22.5	23.3
<b>Max L (cm)</b>	-	-	11.2	16.7	21.6	22.8	23.0	22.5	23.3



### Killarney shad

Killarney shad captured during the 2021 survey ranged in length from 15.9cm to 21.4cm (mean =18.6cm) (Figure 3.6). While numbers of fish captured in 2021 compared favourably with previous surveys, no smaller or younger fish were captured in 2021 (Figure 3.6)



**Figure 3.6. Length frequency of Killarney shad captured on Lough Leane, 2008, 2011, 2014, 2017 and 2021.**

### Other fish species

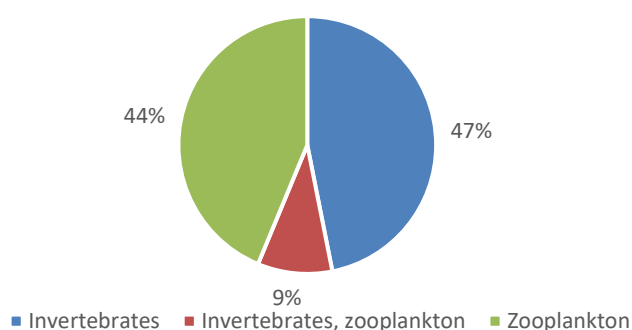
Seven eels recorded during the 2021 survey ranged in length from 29.0cm to 46.0cm (mean = 41.0cm). Two Arctic char were captured and measured at 21.7cm and 21.8cm. Tench recorded during the 2021 survey ranged in length from 24.5cm to 47.9 (mean 41.2cm). Fourteen salmon were captured. These included two 1+ juveniles (11.7cm and 13.9cm) and 12 migratory adults which ranged in length from 54.0cm to 63.5cm. Flounder ranged from 17.6cm to 30.0cm.

### 3.6. 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.

#### Brown trout

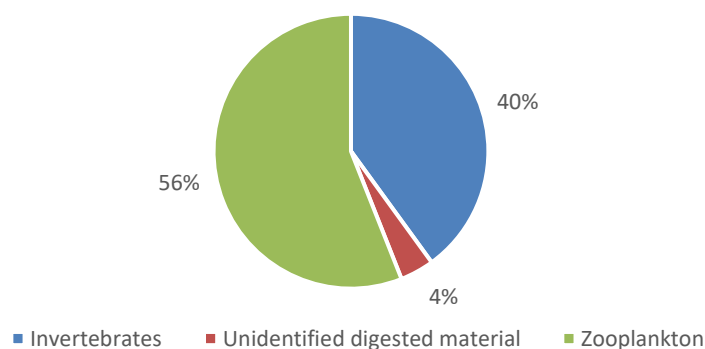
A total of 89 trout stomachs were examined. Of these, 57 were found to contain no prey items. Of the 32 stomachs containing food, 15 fish (47%) contained invertebrates only. Zooplankton were the sole prey type found in 14 (44%) stomachs. Three (9%) of the brown trout stomachs examined contained both invertebrates and zooplankton (Figure 3.7).



**Figure 3.7. Diet of brown trout (n = 32) captured on Lough Leane, August/September 2021 (% FO)**

#### Perch

A total of 47 stomachs were examined. Of these 22 were found to contain no prey items. Of the remaining 25 stomachs containing food, Zooplankton was the sole prey type found in 14 (56%) stomachs. Invertebrates were recorded in ten (40%) stomachs and unidentified digested material was recorded in one perch stomach (Figure 3.8).



**Figure 3.8. Diet of perch (n = 25) captured on Lough Leane, 2021 (% FO)**

## 4. Summary and ecological status

A total of ten fish species were recorded on Lough Leane in the August/September 2021 fish stock survey. Three species (brown trout, perch and rudd) dominated fish stocks in the lake in terms of abundance (CPUE). Atlantic salmon was the dominant fish species in terms of biomass (BPUE) captured, although this was composed predominantly of large, adult upstream migrants.

Brown trout ranged in length from 12.0cm to 49.9cm and were aged from 1+ to 7+. Stocks appear relatively stable across recent surveys, and the population in 2021 was strongly dominated by fish between 1 and 3+. Length at age analyses revealed that brown trout in the lake exhibit a very slow rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971). However, this figure is based upon a relatively small sample of fish in that older age cohort.

Perch ranged in length from 6.1cm to 25.7cm. Recruitment is regular, with all age groups between 0+ and 6+ recorded. However, the dominant age class was 3+ and relatively few 0+ and 1+ fish were captured. This appears to be a common feature of the perch population in Lough Leane.

Rudd have been captured in relatively large numbers in all recent surveys of the lake conducted since 2010. In 2021, rudd ranged in length from 4.4cm to 26.2cm. Rudd were aged between 2+ and 8+. The dominant age class was 6+ and the majority of the fish in the sample aged were greater than 3+ indicating relatively limited recruitment in recent years. However, in all surveys of the lake, relatively few younger and smaller rudd have been captured.

Abundance of Killarney shad captured in 2021 compare favourably with results from previous surveys. However, no small or juvenile shad were captured in 2021.

In common with previous surveys of the lake, Arctic char numbers remain low.

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 together with expert opinion, Lough Leane has been assigned an ecological status of Good for 2021 based on the fish populations present. In previous years the lake was also assigned a fish status of Good in 2008, 2011, 2014 and 2017. In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Leane an overall ecological status of Good

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