

National Research Survey Programme

Lakes 2021

Upper Lake Killarney

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Iascach Intíre Éireann
Inland Fisheries Ireland

**Fish Stock Survey of Upper Lake, Killarney,
August 2021**



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National Research Survey Programme

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1. Introduction

Upper Lake, Killarney is situated at the bottom of Killarney's Black Valley in Killarney National Park, Co. Kerry (Plate 1.1, Figure 1.1). Upper Lake has a surface area of 169ha, a mean depth of 14.5m and a maximum depth of 36m. The lake is categorised as typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), larger than 50ha and low alkalinity (<20mg/l CaCO₃).

Upper Lake forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River catchment candidate Special Area of Conservation. 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). Upper Lake itself is a long and rocky lake holding both salmon (spring salmon and grilse) and brown trout. Brown trout in the lake average around 0.2kg (O' Reilly, 2007).

Upper Lake has been surveyed on three occasions (2008, 2011 and 2014) since 2008 (Kelly *et al.*, 2009, 2012a and 2015). Perch and brown trout have dominated fish stocks on these sampling occasions.

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 1.1. Upper Lake, Killarney, August 2022

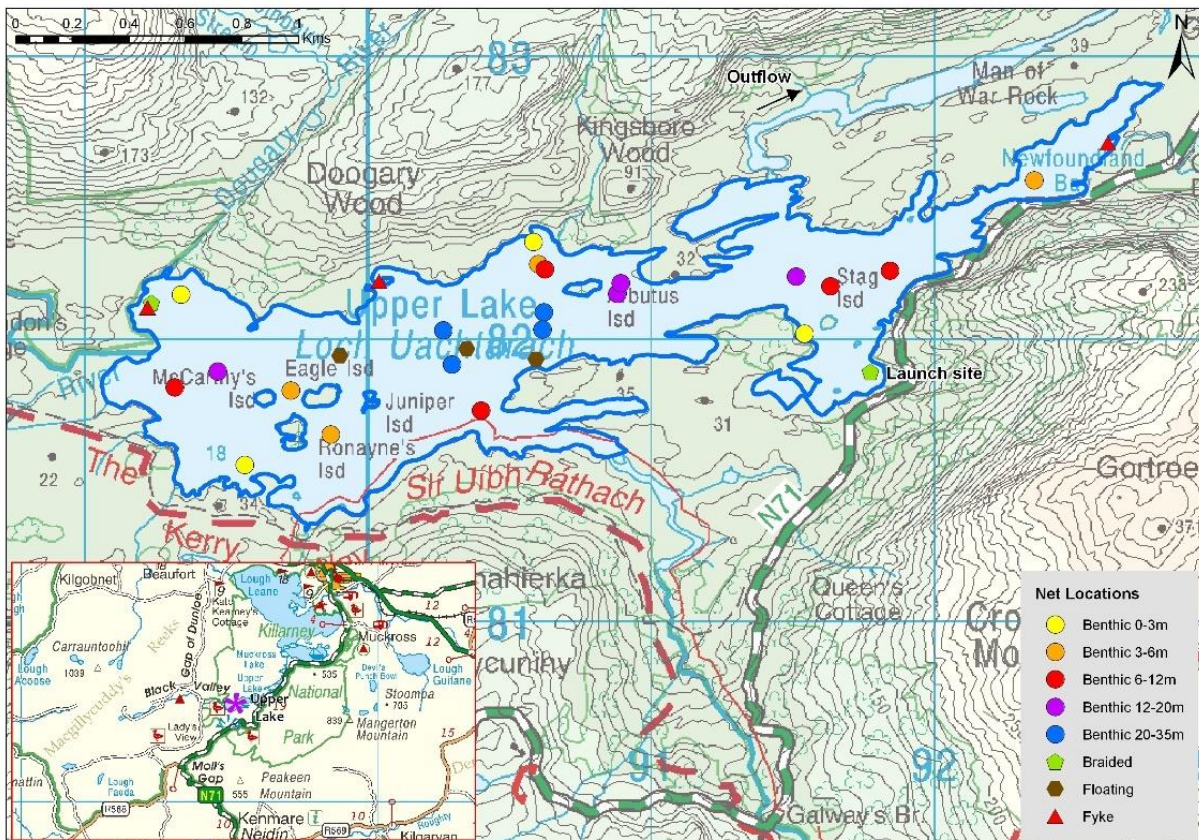


Figure. 1.1 Location map of Upper Lake showing locations and depths of each net (outflow is indicated on map)

2. Methods

2.1. Netting methods

Upper Lake was surveyed over one night on the 31st of August 2021. A total of three sets of Dutch fyke nets, 21 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 4 @ 12-19.9m, 4 @ 20-34.9m and 3 @ 35-49.9m) and three floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (27 sites). The netting effort was supplemented using two sets of two-panel benthic braided survey gill nets (2-PBB). The two-panel nets are composed of two 27.5m long panels, each a different mesh size (60mm and 90mm) tied together. Nets were deployed in the same locations as were randomly selected in the 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. 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

Six fish species were recorded on Upper Lake in August 2021. A total of 240 fish were captured. The number of each species captured by each gear type is shown in Table 3.1. Perch and brown trout were the two most common fish species recorded, together accounting for c. 64% of all fish captured. Rudd, eels, tench and salmon were also recorded in the survey. A similar species mix was recorded on previous sampling occasions.

Table 3.1. Number of each fish species captured by each gear type during the survey on Upper Lake, August 2021

Scientific name	Common name	Number of fish captured				Total
		BM CEN	FM CEN	2-PBB	Fyke	
<i>Perca fluviatilis</i>	Perch	105	0	0	0	105
<i>Salmo trutta</i>	Brown trout	80	9	4	4	97
<i>Scardinius erythrophthalmus</i>	Rudd	19	2	0	0	21
<i>Tinca tinca</i>	Tench	0	0	2	0	2
<i>Salmo salar</i>	Salmon	1	0	0	0	1
<i>Anguilla anguilla</i>	European eel	3	0	0	11	14

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. Mean CPUE and BPUE for all fish species captured in the 2021 survey are summarised in Table 3.2. In 2021, perch and brown trout were the dominant species with respect to both abundance and biomass. Eels, which were captured in fyke nets, also recorded a high biomass.

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Upper Lake, 2021

Scientific name	Common name	Mean CPUE (\pm S.E.)	Mean BPUE (\pm S.E.)
<i>Perca fluviatilis</i>	Perch	0.121 (0.046)	8.056 (2.931)
<i>Salmo trutta</i>	Brown trout	0.110 (0.022)	14.461 (3.660)
<i>Scardinius erythrophthalmus</i>	Rudd	0.024 (0.015)	3.293 (2.210)
<i>Tinca tinca</i>	Tench	0.003 (0.003)	1.867 (1.867)
<i>Salmo salar</i>	Salmon	0.001 (0.001)	3.108 (3.108)
<i>Anguilla anguilla</i> *	European eel	0.061 (0.039)	10.189 (6.755)

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

For comparison purposes the abundance (CPUE) and biomass (BPUE) for each species, per net type, captured in all surveys between 2008 and 2021 are presented in Figures 3.1 to 3.2 respectively and illustrates fish community change over time. Perch and brown trout have dominated fish communities during all previous surveys, and their populations have remained relatively stable across all surveys on the lake. There is some indication of an upward trend in brown trout numbers and biomass (Figures 3.1a and 3.1b). While eel numbers and biomass have fluctuated, no clear trends are apparent ((Figures 3.2a and 3.2b).

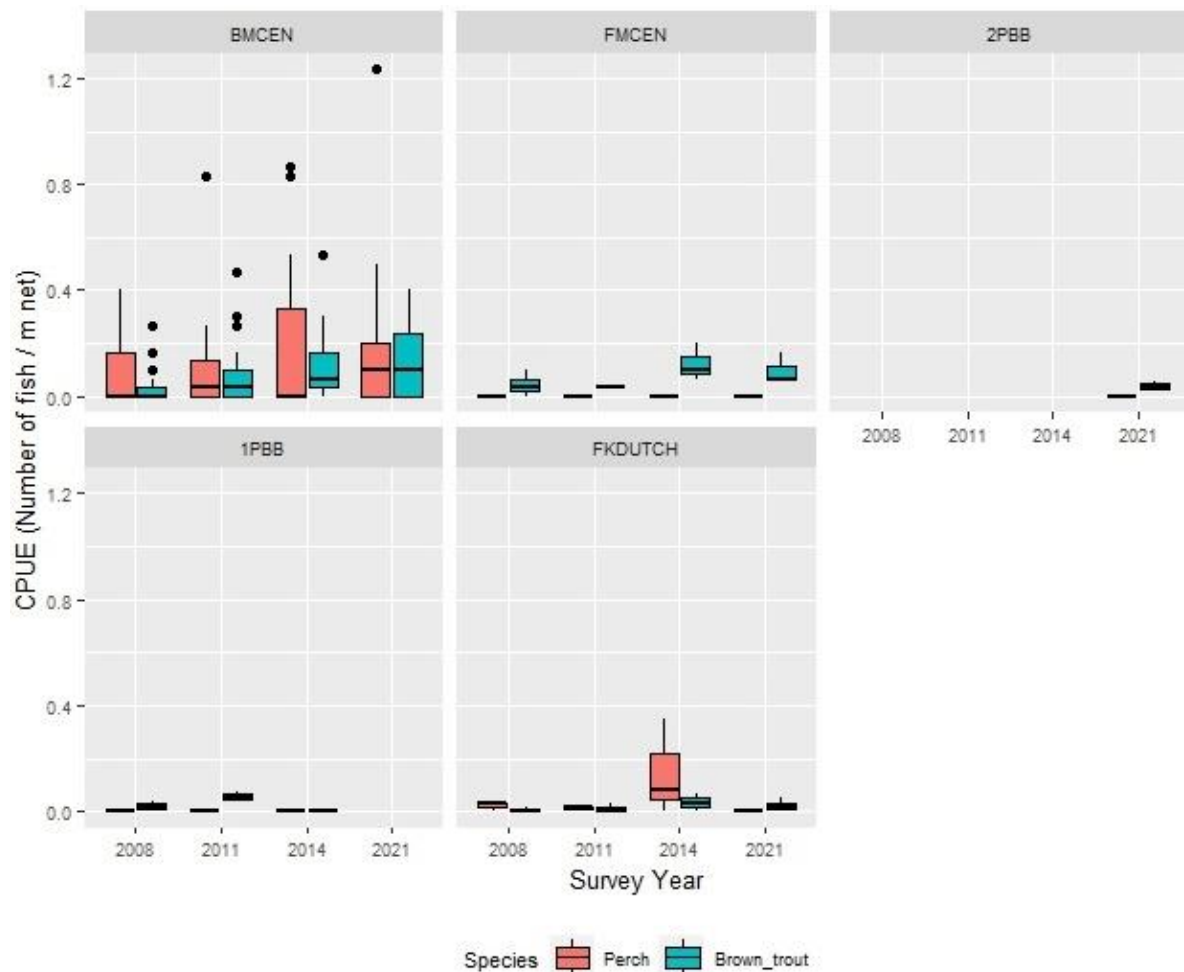


Figure 3.1a. CPUE of brown trout and perch captured in each net type during surveys of Upper Lake between 2008 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical ‘whiskers’ show the data range. Outliers are marked by dots.

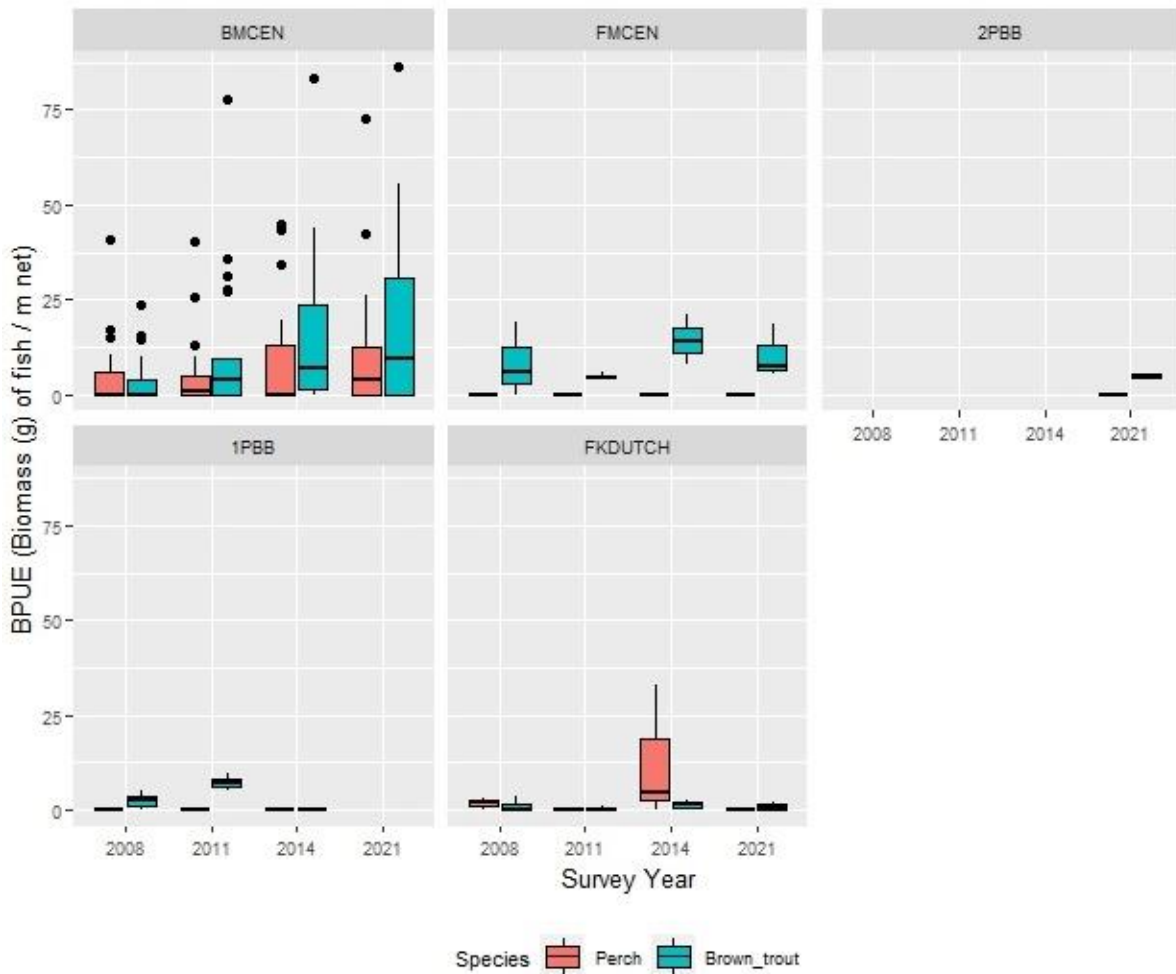


Figure 3.1b BPUE of brown trout and perch captured in each net type during surveys of Upper Lake between 2008 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

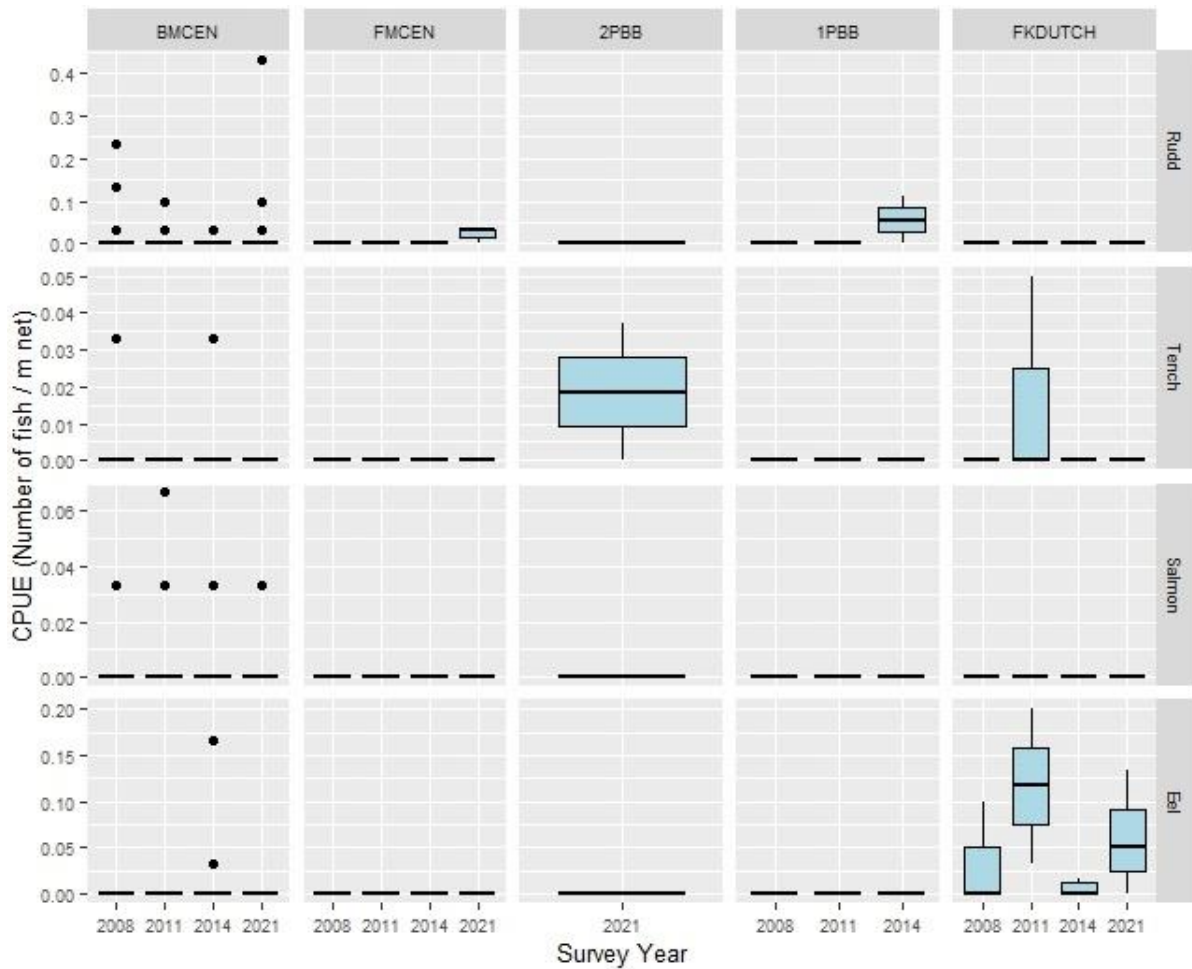


Figure 3.2a. CPUE of other regularly captured species in each net type during surveys of Upper Lough between 2008 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles 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 species.

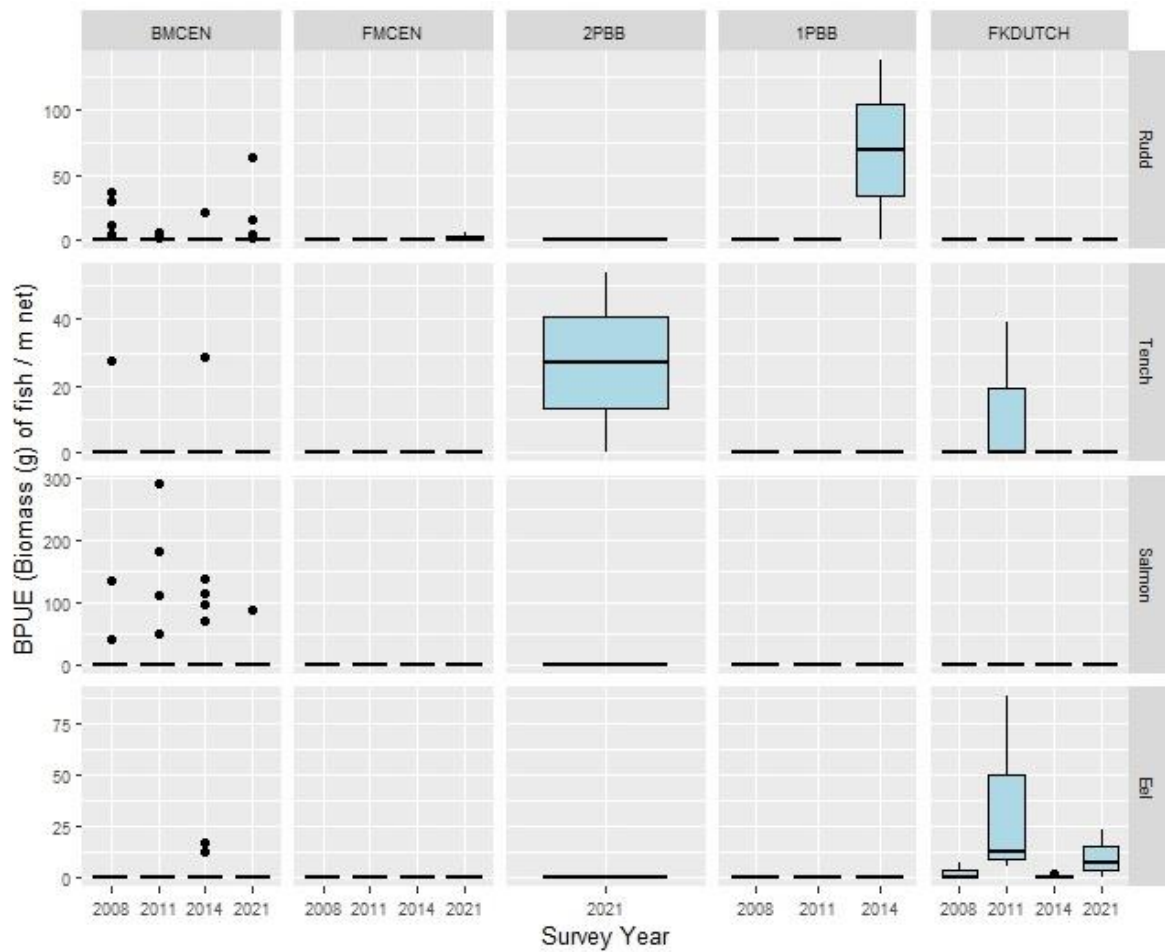


Figure 3.2b BPUE of other regularly captured species captured in each net type during surveys of Upper Lake between 2008 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th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

3.3. Length frequency distributions and growth

Brown trout

Brown trout captured during the 2021 survey ranged in length from 10.0cm to 51.2cm (mean = 20.9cm). Length range of the majority of fish sampled was similar across surveys, with the persistence of larger fish evident in 2014 and 2021 (Figure 3.3.) Seven age classes were recorded in the sampled aged and brown trout were aged from 1+ to 9+. 2+ brown trout (c. 17-23cm, Figure 3.3) were the largest age class in the sample aged. The population was dominated by younger fish, with the 1+ to 3+ age classes (c. 14-27cm - Figure 3.3) together represented c. 87% of all fish aged. Mean L1 (i.e. length at the end of the first year) was 7.6cm (Table 3.3). Mean L4 was 23.8cm 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).

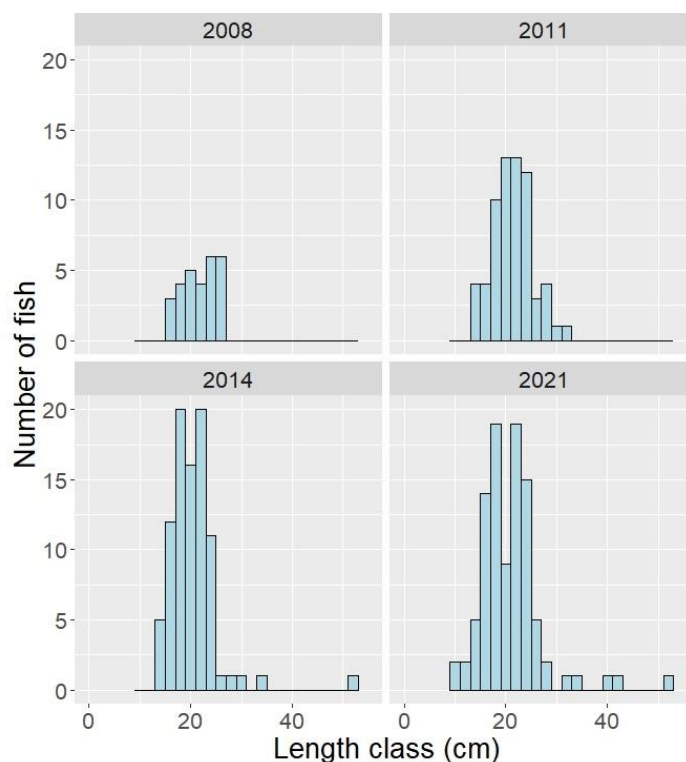


Figure 3.3. Length frequency of brown trout captured on Upper Lake, 2008, 2011, 2014 and 2021

Table 3.3. Mean (\pm S.E.) brown trout length (cm) at age for Upper Lake, September 2021

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈	L ₉
Mean	7.6	15.2	20.3	23.8	28.9	33.2	-	-	-
(\pmS.E.)	(0.2)	(0.4)	(0.4)	(0.5)	(0.9)	(1.2)	-	-	-
N	67	50	25	9	6	4	1	1	1
Range	3.2- 12.4	10.0- 21.7	16.6- 24.8	21.9- 27.1	26.9- 32.9	31.8- 36.7	36.4	41.3	47.6

Perch

Perch captured during the 2021 survey ranged in length from 9.0cm to 24.4cm (mean =16.4cm) (Figure 3.4). Perch were aged from 1+ to 8+. While all intervening ages classes were recorded in the sample, relatively few younger or smaller perch were recorded and 3+ and 4+ perch dominated the population. These groups together (c. 13cm to 20cm) represented c. 68% of all perch aged. Mean L1 (i.e. length at the end of the first year) was 6.5cm (Table 3.4).

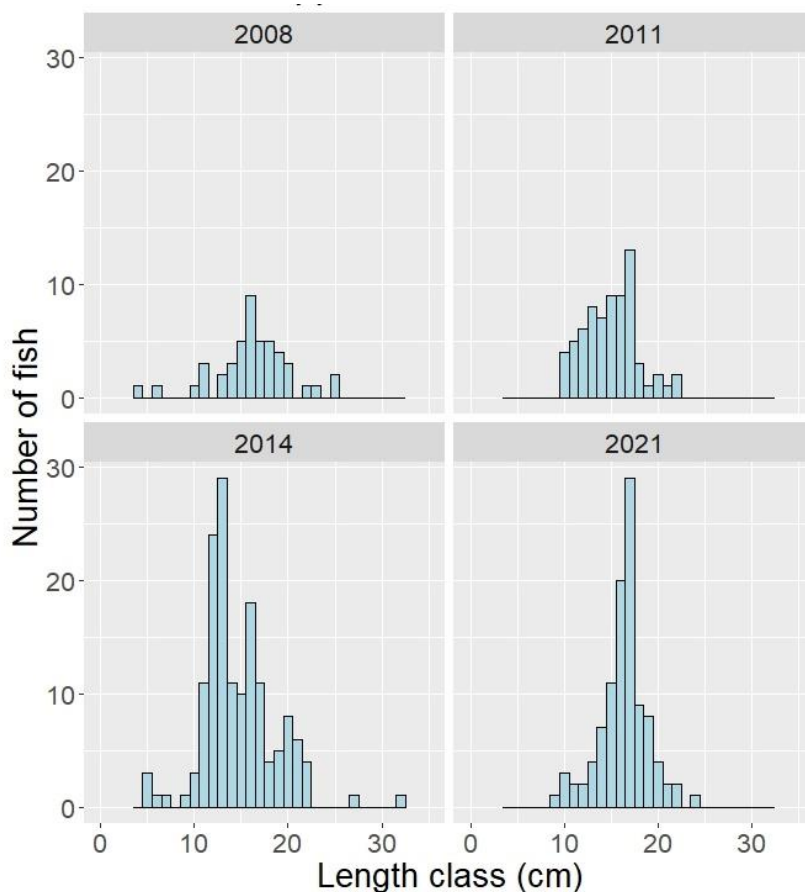


Figure 3.4. Length frequency of perch captured on Upper Lake, 2008, 2011, 2014 and 2021

Table 3.4. Mean (\pm SE) perch length (cm) at age for Upper Lake, September 2021

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈
Mean (\pmS.E.)	6.5 (0.2)	11.9 (0.2)	15.1 (0.2)	16.8 (0.3)	18.6 (0.4)	20.2 (0.4)	21.6 (0.9)	-
N	40	39	37	21	10	7	2	1
Range	4.8-9.1	9.7-14.8	12.5-18.0	14.8-19.6	16.7-21.2	19.0-22.5	20.7-23.3	23.8

Other species

Twenty one rudd were captured during the 2021 survey. They ranged in length from 14.0cm to 25.0cm (mean = 19.5cm) (Figure 3.5). The rudd population was dominated by older fish (Table 3.5).

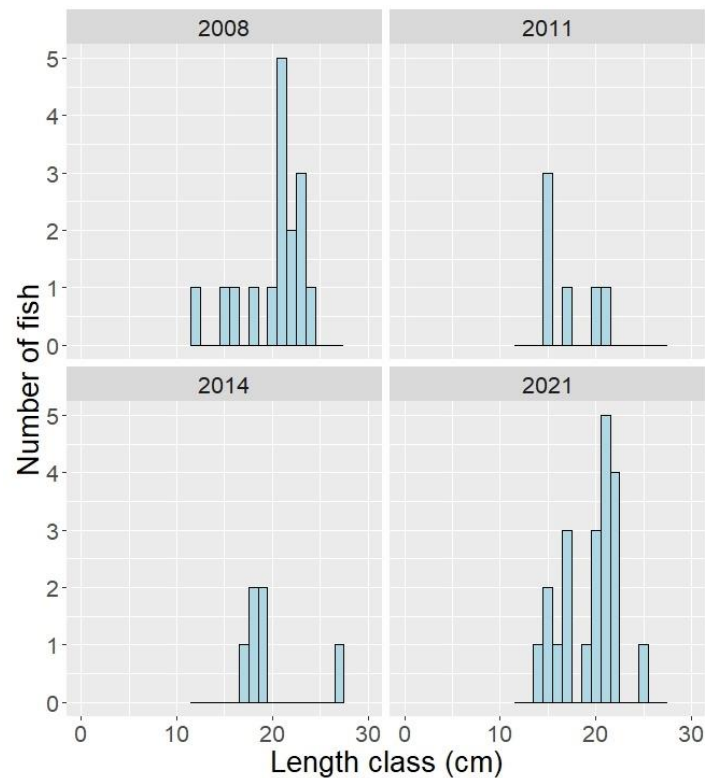


Figure 3.5. Length frequency of rudd captured on Upper Lake, 2008, 2011, 2014 and 2021.

Table 3.5. Summary age data from rudd captured on Upper Lake, August 2021. Number of fish and length ranges of all fish aged in the sample is presented.

	Age class							
	0+	1+	2+	3+	4+	5+	6+	7+
N	0	0	0	1	0	2	9	6
Mean L (cm)	-	-	-	-	-	17.3	20.2	22.2
Min L (cm)	-	-	-	16.2	-	17.2	17.2	20.7
Max L (cm)	-	-	-	16.2	-	17.4	21.6	25

Two tench captured measured 43.2cm and 43.5cm respectively. Fourteen eels were captured. They ranged in length from 39.5cm to 62.5cm (mean = 62.5cm). One adult salmon captured was measured at 64.0cm.

4. Summary and ecological status

Perch and brown trout were the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2021 survey. Eels captured in fyke nets also recorded a relatively high biomass.

Brown trout and perch have consistently recorded highest numbers and biomass across all sampling occasions. There is some evidence of a slight increase in numbers and biomass of brown trout compared to the earlier surveys in 2008 and 2011.

While brown trout were long lived (up to 9+) the population was dominated by younger individuals aged 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).

Perch were aged between 1+ and 8+. While all intervening age classes were recorded in the sample (indicating regular successful recruitment in the lake), relatively few younger perch were recorded. Similar results were recorded in the earlier surveys of this 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, Upper Lake has been assigned an ecological status of Moderate for 2021 based on the fish populations present. In previous years the lake was also assigned a moderate fish ecological status (Figure 3.6).

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

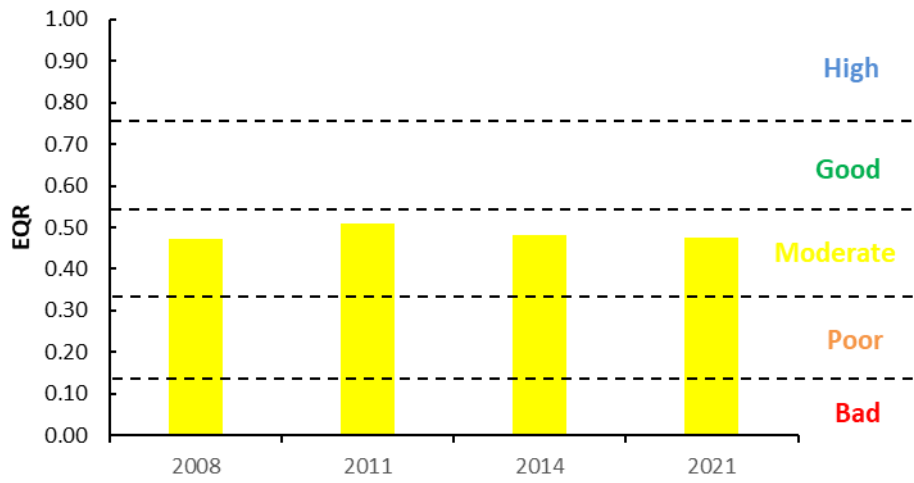


Figure 3.6. Fish ecological status, Upper Lake, Killarney, 2008 to 2021.

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