National Research Survey Programme

Lakes 2023

Lough Derravaragh

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Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Lough Derravaragh, July-August 2023

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National Research Survey Programme

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

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1. Introduction

Lough Derravaragh is situated in County Westmeath, north of Mullingar between Castlepollard, Crookedwood and Multyfarnham in the Inny River catchment (Figure 1.1). The lake has a surface area of 914ha and a maximum depth of approximately 30m. The estimated terrain elevation above sea level is 64m. The lake is categorised as typology class 12 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and high alkalinity (>100mg/l $CaCO_3$). The Inny River, which is a major tributary of the River Shannon, flows into and out of Lough Derravaragh on the north-western side of the lake (Figure 1.1). It is a popular lake for angling and other water sports.

The lake is protected as a Special Protection Area (SPA) under the EU Birds Directive (EC/79/409) (NPWS, 2014). The lake is also recognised as a 'wetland of international importance' under the terms of the Ramsar Convention (Ramsar Convention, 1971) to which Ireland is a signatory.

Three bird species (Greenland white-fronted goose (*Anser albifrons flavirostris*), whooper swan (*Cygnus cygnus*), and golden plover (*Pluvialis apricaria*)) are listed on Annex I of the EU Birds Directive, requiring special conservation measures are present on the lake (NPWS, 2002). A notable feature of Lough Derravaragh is the range of stoneworts (Charophytes) that occur within the lake. Eight species have been recorded here, several of which have a restricted range in Ireland; the rare Charophyte, *Chara denundata*, has been recorded in the area. Additionally, the Red List species, otter (*Lutra lutra*) and Irish hare (*Lepus timidus hibernicus*), have also been observed within the area. Raised bog and cutover bog are found adjacent to the lake (cutover bog is bog where some peat has been harvested, leaving remaining peat behind). There is only a small area of raised bog on the side of the lake, but formerly it comprised a very large bog complex. Most of this area has been reclaimed for agriculture. Conifers have been planted upon the high bog and a section of cutover (NPWS, 2002). A range of habitats have been created on the lake shore as a result of drainage of the River Inny. At the western side are extensive reed beds and swamps of downy birch and willows. The lake shore is a mineral-rich substrate and several plant species of poor fen habitats occur in abundance, such as black bog rush *Schoenus nigricans* and long-stalked yellow-sedge *Carlex lepidocarpa* (NPWS, 2002).

Historically the lake was managed as a brown trout fishery, and pike and perch were removed annually as predators and competitors of brown trout respectively (Fitzmaurice, 1983). Furthermore, the wild stocks of brown trout were augmented by stocking hatchery reared brown trout to try to improve the angling experience in the lake. However, fish stocks in the lake are no longer subject to management intervention in the form of pike and perch removal and stocking of hatchery reared brown trout

ceased in the early to mid-2000's. During the last 30 years the Lough Derravaragh Angling Association has worked closely with Inland Fisheries Ireland, and other stakeholders, to attempt to restore the lake. During the period of approximately 2004 to 2016 a substantial investment was made to enhance and rehabilitate the spawning and nursery habitat of the lake's tributary streams (IFI, 2018).

The lake is now managed as a mixed fishery with good stocks of brown trout, pike and coarse fish. Roach were first recorded in fish stock assessments of the lake in 1977 (O' Grady, 1986). The lake holds brown trout with an average size of approximately 1.5lb (1.1kg) but fish of up to 6lb (2.7kg) are caught annually. The northern end of the lake is wide and mostly shallow, and it is in this area that the majority of the brown trout fishing is practiced. The southern end of the lake is narrow and deep; however, this end of the lake tends to produce bigger fish. The lake provides a good angling experience for other species too, especially pike (IFI, 2018).

Inland Fisheries Ireland (previously the Central Fisheries Board) undertook a number of fish stock surveys of Lough Derravaragh from 1979 to 2005. The lake was surveyed in 2017 using IFIs lake monitoring protocol (Connor *et al*., 2018) and as part of a wider study investigating the diet of pike (McLoone *et al.*, 2018). At that time roach and perch dominated fish stocks in the lake. Roach x bream hybrids, tench, brown trout, pike, bream and European eel were also recorded.

This report summarises the results of the 2023 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 Derravaragh at Donore Shore, July 2023.

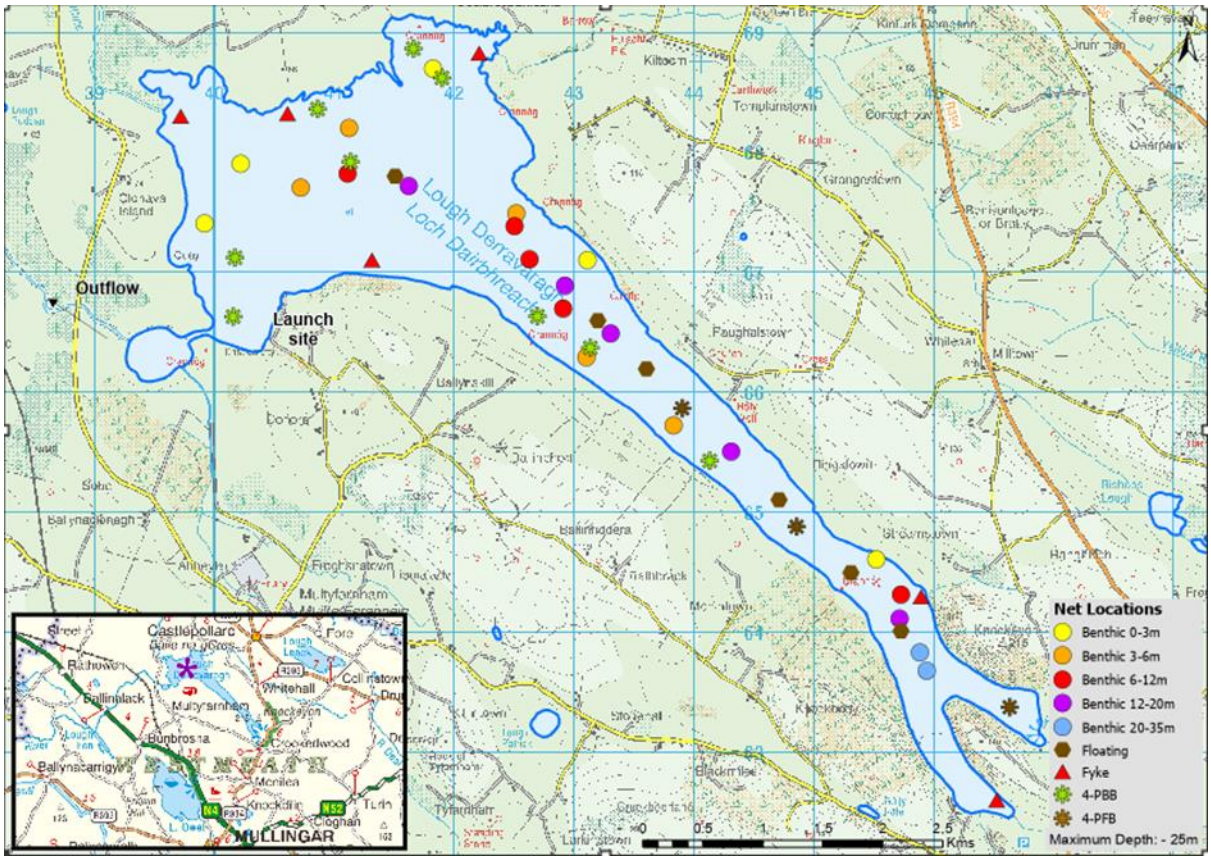

Figure 1.1. Location map of Lough Derravaragh showing net locations and depths of each net (outflow is indicated on map).

2. Methods

2.1. Netting methods

Lough Derravaragh was surveyed over three nights from the 31st of July to the 3rd of August 2023. A total of six sets of Dutch fyke nets, 22 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m, 5 @ 12-19.9m and 2 @ 20-34.9m) and six floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake. The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at nine additional sites and four-panel floating braided survey gill nets (4-PFB) at three locations. 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). Survey nets were deployed in the same locations as were randomly selected in the previous surveys (46 sites). 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. 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).

$$\mathbf{FO}_{\boldsymbol{i}} = \left(\frac{\boldsymbol{N_i}}{\boldsymbol{N}}\right) * \mathbf{100}$$

Where:
$\mathbf{FO}_{\boldsymbol{i}}$ is the percentage frequency of prey item i,
$\boldsymbol{N_i}$ is the number of fish with prey i in their stomach,
$\boldsymbol{N}$ 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

Seven fish species and one cyprinid hybrid type were recorded in Lough Derravaragh in July-August 2023. A total of 1624 fish were captured (Table 3.1). Perch was the most numerous fish species recorded, representing *c.* 74% of all fish captured in the survey. Roach, pike, tench, roach x bream hybrids, brown trout, bream and European eels were also captured. In 1979 to 2005 the same species composition was recorded. However, rudd have not been captured in either of the more recent surveys (Connor *et al.*, 2018).

Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Derravaragh, July-August 2023.

Scientific name	Common name	Number of fish captured					
		BM CEN	FM CEN	4-PBB	4-PFB	Fyke	Total
Perca fluviatilis	Perch	1176	19	11	1	1	1208
Rutilus rutilus	Roach	180	141	13	0	2	336
Esox lucius	Pike	16	0	3	0	5	24
Tinca tinca	Tench	1	0	23	0	0	24
Rutilus rutilus x Abramis brama	Roach x bream hybrid	6	0	9	1	3	19
Salmo trutta	Brown trout	0	0	5	0	0	5
Abramis brama	Bream	2	0	1	0	0	3
Anguilla anguilla	European eel	0	0	0	0	5	5

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 were the dominant species with respect to abundance (CPUE) while roach had the highest biomass (BPUE). Relatively high biomasses of perch and pike were also recorded (Table 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Derravaragh, July-August 2023.

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Perca fluviatilis	Perch	0.868 (0.213)	22.368 (6.323)
Rutilus rutilus	Roach	0.235 (0.075)	28.969 (6.996)
Esox lucius	Pike	0.014 (0.003)	20.769 (7.995)
Tinca tinca	Tench	0.005 (0.003)	8.452 (5.904)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.007 (0.002)	5.150 (1.791)
Salmo trutta	Brown trout	0.001 (0.000)	1.900 (1.472)
Abramis brama	Bream	0.001 (0.001)	1.512 (0.933)
*Anguilla anguilla**	European eel	0.013 (0.010)	6.123 (4.911)

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.

Plate 3.1 Tench from Lough Derravaragh

3.3 Species Profiles

Perch

Perch captured during the 2023 survey ranged in length from 4.0cm to 37.0cm (mean = 8.3cm) (Figure 3.1). While the overall length range of perch captured was similar on both occasions, in 2023, the population was characterised by a much higher proportion of small, juvenile (i.e. <10cm) fish. Perch were aged between 0+ and 7+ and all intervening age classes were represented in the sampled aged. Perch aged between 0+ (5cm – 7cm) and 2+ (12cm – 20cm) dominated the population, representing *c*. 63% of all the fish aged (Figure 3.1). Mean L1 (i.e. length at the end of the 1st year) was 6.1cm (Table 3.3).

While the abundance (CPUE) of perch has increased in 2023 compared to 2017, biomass (BPUE) has remained relatively constant (Figure 3.2).

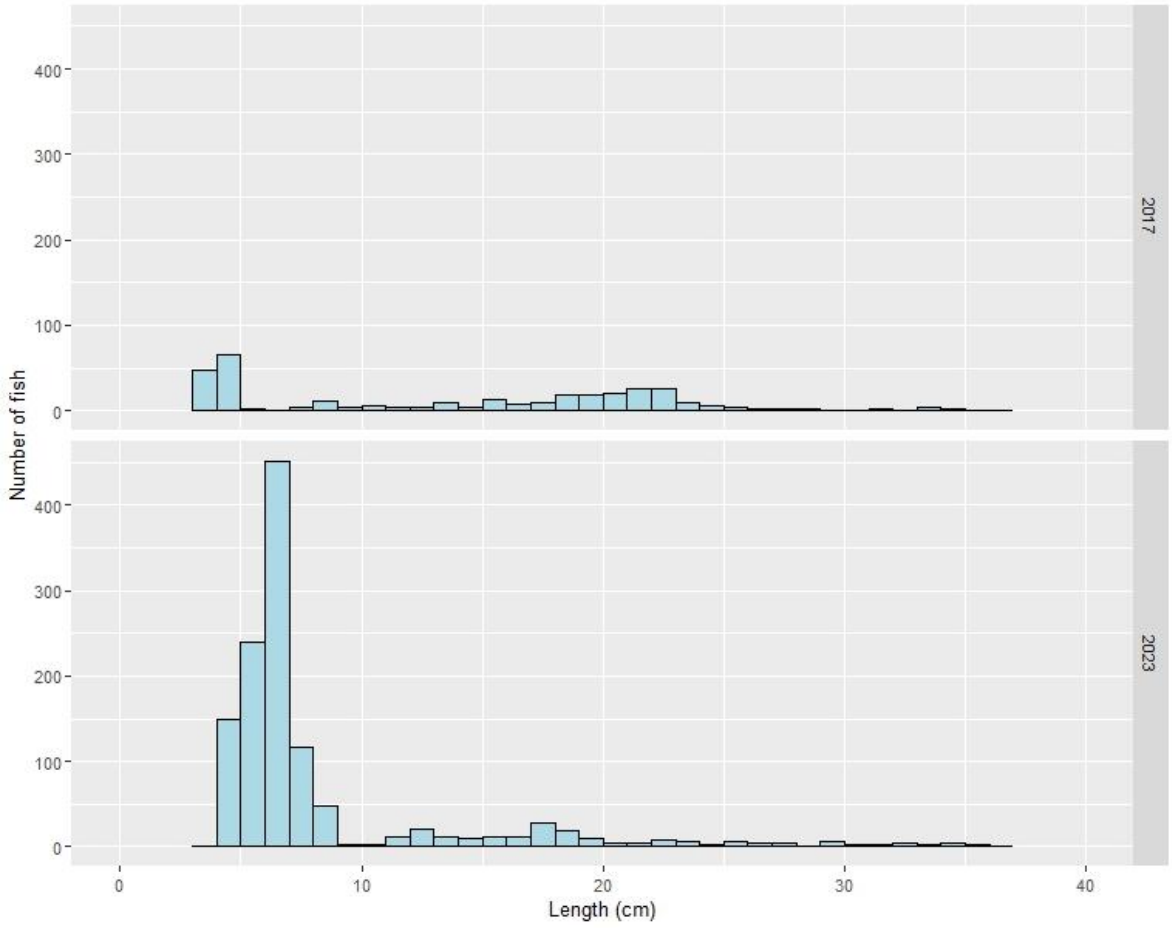

Figure 3.1. Length frequency of perch captured on Lough Derravaragh in 2017 and 2023.

Table 3.3. Mean (±S.E.) perch length (cm) at age for Lough Derravaragh, July-August 2023

	L_1	L_2	L_3	L_4	L_5	L_6	L_7
Mean (±S.E.)	6.1 (0.08)	11.7 (0.19)	17.3 (0.32)	21.1 (0.41)	24.9 (0.44)	28.2 (0.92)	-
N	93	69	39	28	21	6	1
Range	4.5-9.0	8.4-15.6	13.2-21.2	16.5-25.1	21.6-28.9	25.4-31.7	30.4

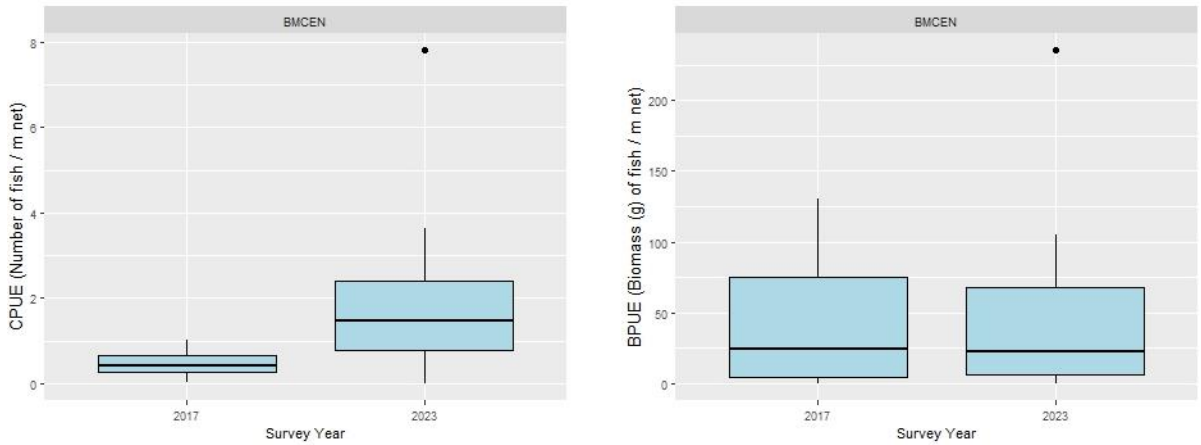

Figure 3.2. CPUE and BPUE of perch captured during surveys of Lough Derravaragh in 2017 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Roach

Roach captured during the 2023 survey ranged in length from 3.8cm to 34.9cm (mean = 15.9cm) (Figure 3.3). While the overall length range of roach captured was similar on both surveys, in 2023, the population was characterised by the presence of a high proportion of fish between 5cm and 20cm. In 2017, these size ranges were largely absent and the roach population at that time was dominated by a high proportion of much larger fish (< 25cm) (Figure 3.3).

Roach in the population were aged between 0+ (4cm) and 8+ (29cm to 34cm) (Figure 3.3 and Table 3.4). Modal peaks at 7cm - 9cm and 13cm - 14cm correspond to fish aged 1+ and 2+ respectively (Figure 3.3 and Table 3.4).

The shift in fish community structure was marked by a reduction in roach biomass (BPUE) in 2023 compared to 2017 (Figure 3.4)

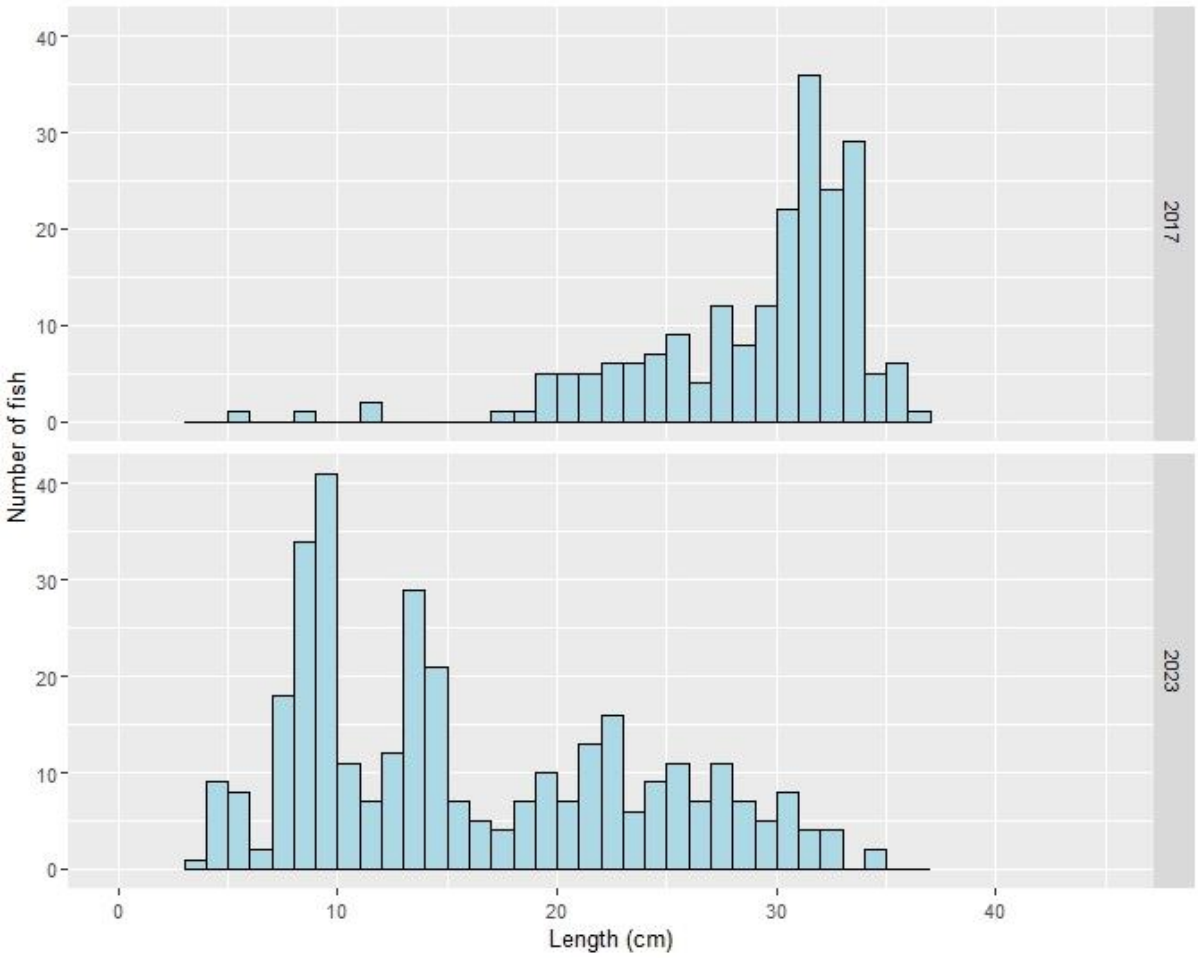

Figure 3.3. Length frequency of roach captured on Lough Derravaragh in 2017 and 2023.

Table 3.4. Summary age data from roach captured on Lough Derravaragh, July-August 2023. Number of fish 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	2	18	30	14	17	15	16	5	6
Mean	4.7	8.8	13.7	19.2	21.7	25.1	27.1	30.4	31.7
Min	4.4	7.2	10.7	15.7	18.6	16.7	23.8	28.1	29.1
Max	5	10.3	17.7	21.7	24.4	29.3	30.4	34.9	34.1

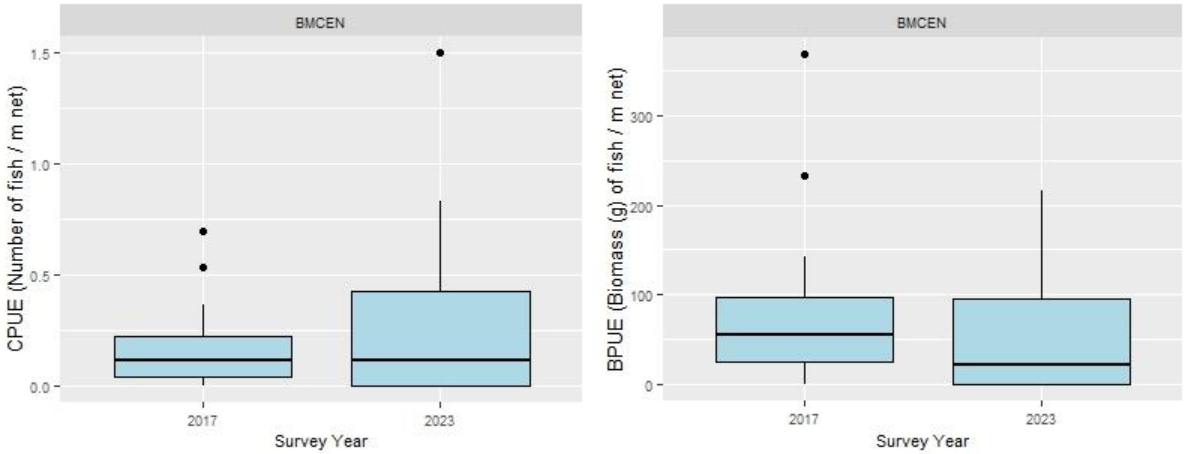

Figure 3.4. CPUE and BPUE of roach captured during surveys on Lough Derravaragh in 2017 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Pike

Pike captured during the 2023 survey ranged in length from 13.9cm to 101.0cm (mean 42.1cm) (Figure 3.5). Pike were aged between 0+ (13cm -17cm) and 10+(82cm – 84cm) (Table 3.5 and Figure 3.5). The largest pike (101cm) was aged at 10+ (Table 3.5).

Table 3.5. Summary age data from pike captured on Lough Derravaragh, July-August 2023. Number of fish 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+	9+	10+
N	10	1	-	1	-	2	1	1	-	4	2
Mean	17.6	27.1	-	42.3	-	51.5	66.5	58.2	-	83.6	83.4
Min	13.9	27.1	-	42.3	-	43.8	66.5	58.2	-	72.1	82.2
Max	22.5	27.1	-	42.3	-	59.2	66.5	58.2	-	101	84.6

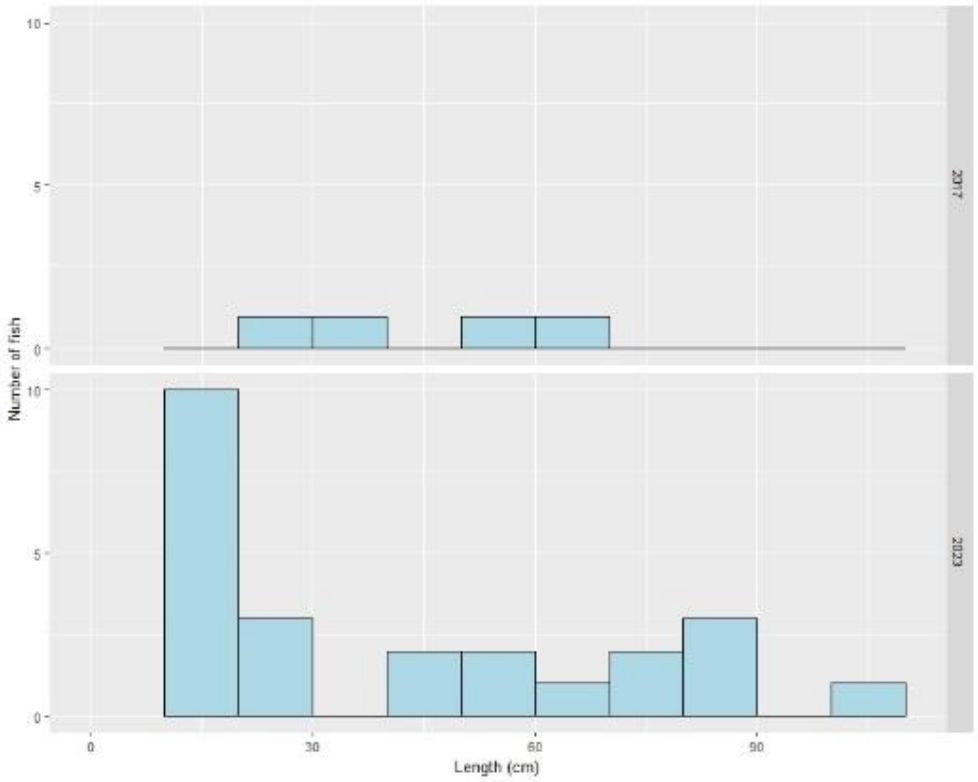

Figure 3.5. Length frequency of pike captured on Lough Derravaragh between 2017 and 2023.

Tench

Tench captured during the 2023 survey ranged in length from 35.7cm to 53.8cm (mean = 45.3cm) (Figure 3.6). The length range was similar to that recorded in 2017. Tench in the sample were aged between 4+ and 8+ (Table 3.6).

Table 3.6. Summary age data from tench captured on Lough Derravaragh, July-August 2023. Number of fish 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	-	-	-	-	6	4	3	-	1
Mean	-	-	-	-	40.9	44.2	47.1	-	53.6
Min	-	-	-	-	38.5	41.5	40	-	53.6
Max	-	-	-	-	44.8	46.9	52.4	-	53.6

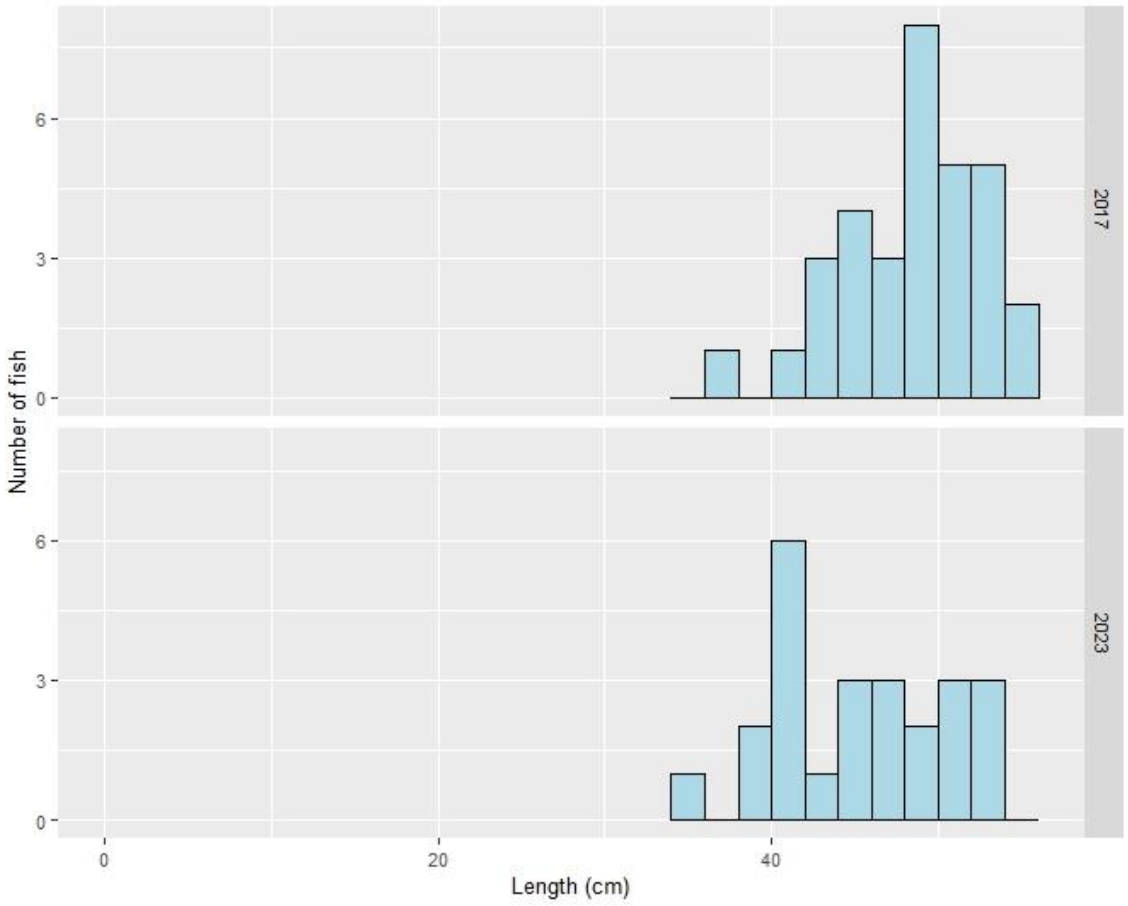

Figure 3.6. Length frequency of tench captured on Lough Derravaragh between 2017 and 2023

Roach x bream hybrids

Roach x bream hybrids captured during the 2023 survey ranged in length from 8.7cm to 45.3cm (mean = 32.2cm) (Figure 3.7). The prominent cohort of large roach x bream hybrids (i.e. > 40cm) captured in 2017 were absent from the sample in 2023.

Roach x bream hybrids were aged between 1+ and 12+. No one cohort dominated the population. Two year old to five year old fish were absent from the sample aged (Table 3.7).

Abundance (CPUE) and biomass (BPUE) of roach x bream hybrids has declined between 2017 and 2023. This is particularly evident for the larger cohorts targeted by the 4PBB nets (Figure 3.8).

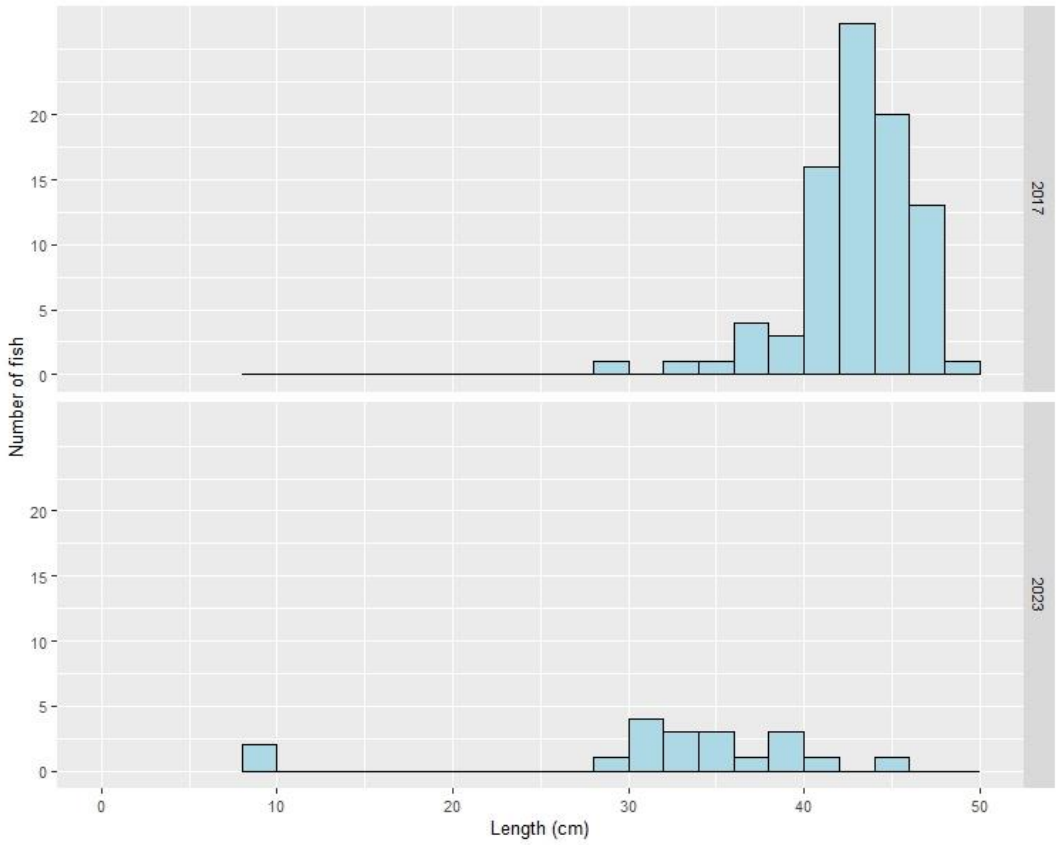

Figure 3.7. Length frequency of roach x bream hybrids captured on Lough Derravaragh in 2017 and 2023.

Table 3.7. Summary age data from tench captured on Lough Derravaragh, July-August 2023. Number of fish 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+	9+	10+	11+	12+
N	-	1	-	-	-	-	4	3	2	-	4	-	1
Mean	-	9.7	-	-	-	-	31.7	33.4	36.5	-	38.4	-	45.3
Min	-	9.7	-	-	-	-	30.5	31.0	34.2	-	36.0	-	45.3
Max	-	9.7	-	-	-	-	32.7	35.6	38.7	-	40.5	-	45.3

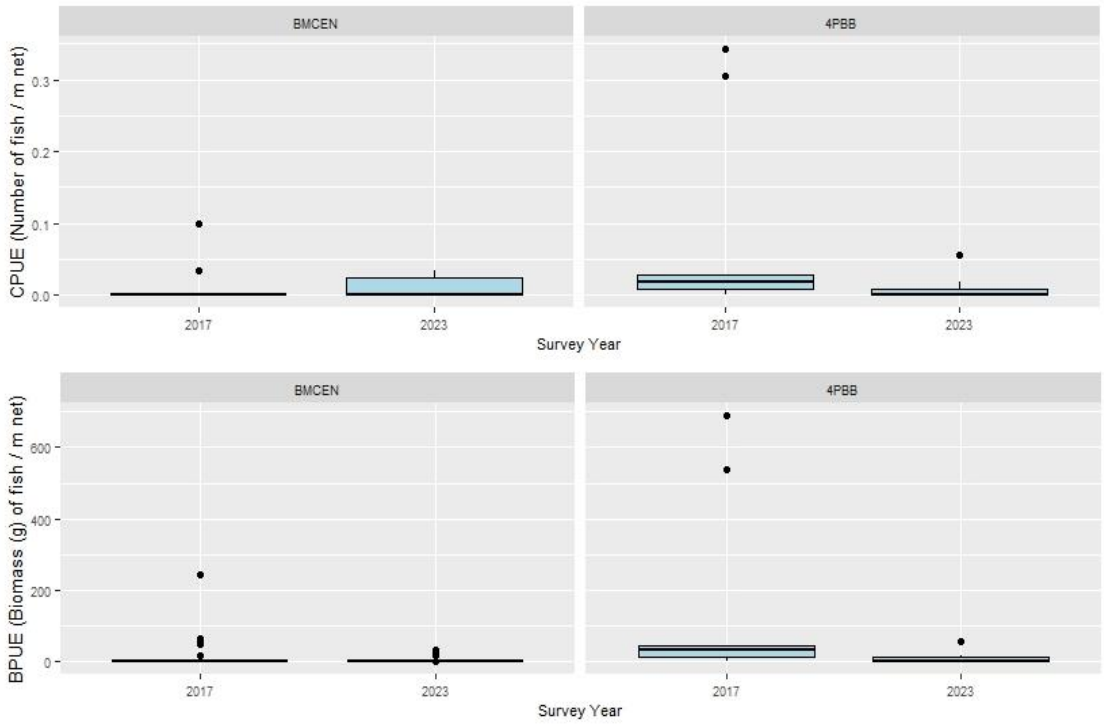

Figure 3.8. CPUE and BPUE of roach x bream hybrids captured during surveys of Lough Derravaragh in 2017 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Brown trout

Brown trout captured in the 2023 survey ranged in length from 42.5cm to 57.2cm (mean – 43.4cm). All fish were recorded in the 4PBB nets (which target larger fish) and no smaller fish were captured in the benthic (BMCEN) or floating (FMCEN) survey gill nets, in contrast to the 2017 survey when brown trout ranged in length from 25.7cm to 71.5cm (Connor *et al*., 2018). Several trout were captured in pelagic survey gill nets in the earlier survey and these nets were not deployed in 2023. Brown trout in 2023 were aged 6+ and 7+ and no younger trout were recorded. While a similar number of brown trout were captured in 2023 and 2017 in the comparable nets set, there appears to have been a shift towards older and larger trout, although sample size is small.

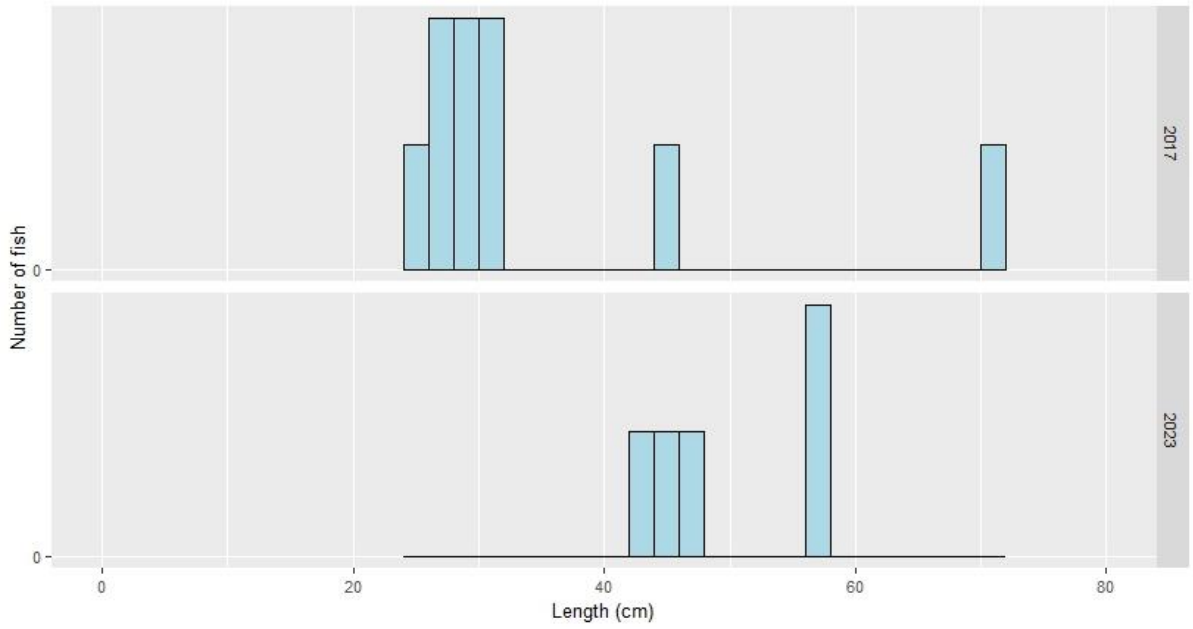

Figure 3.9. Length frequency of brown trout captured on Lough Derravaragh in 2017 and 2023.

Other Species

Bream captured in the survey ranged in length from 31.6cm to 41.3cm. These fish were aged 5+, 6+ and 11+.

European eel captured during the 2023 survey ranged in length from 52.0cm to 70.0cm (mean 62.6cm). Size range was similar in both surveys (Figure 3.10).

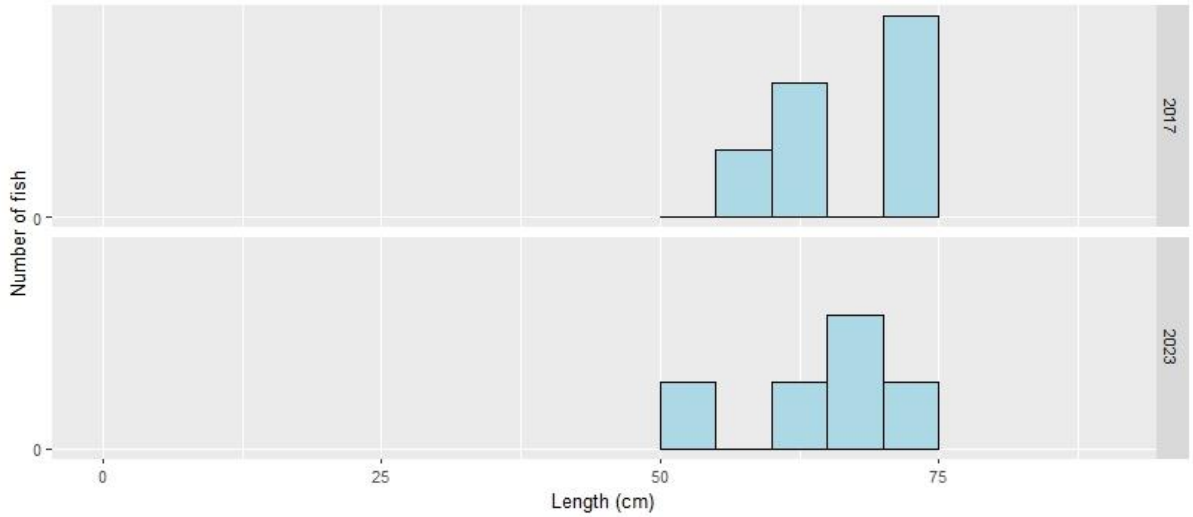

Figure 3.10. Length frequency of eel captured on Lough Derravaragh in 2017 and 2023.

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

Perch

A total of 96 perch stomachs were examined. Fifty (52%) were empty. Forty-six stomachs contained food. Invertebrates were the sole prey type recorded in 17 (40%) stomachs and were found together with fish in two stomachs (4%). Fish was the sole prey type recorded in fifteen (33%) stomachs. Zooplankton was the sole food item found in five (11%) stomachs and plant matter was found in one (2%) stomach. Unidentified digested material was recorded in six (13%) fish (Figure 3.11). Fish eating perch had consumed perch (4 stomachs), stickleback (1 stomach) and unidentified fish (9 stomachs).

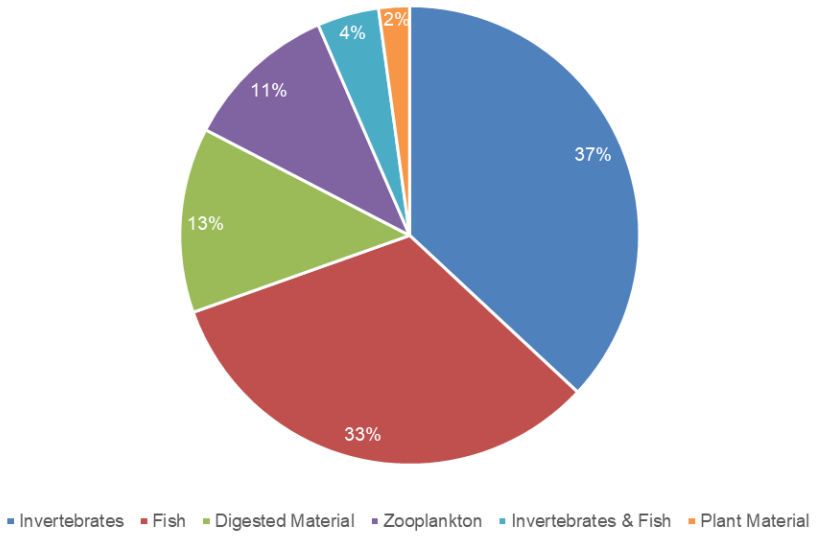

Figure 3.11. Diet of perch (N = 46) captured on Lough Derravaragh, 2023 (% FO).

Pike

Eleven stomachs were available for analysis. Five (45.5%) were empty. Of the remaining stomachs that contained food, two (33%) contained invertebrates, three (50%) contained fish .Plant matter was recorded in one (17%) stomach. Fish consumed were perch, stickleback and unidentified fish.

Brown trout

Three brown trout stomachs were examined, all of which contained food. Two (66%) stomachs contained fish, while unidentified digested material was recorded in the other stomach.

4. Summary and fish ecological status

A total of seven fish species and one cyprinid hybrid were recorded in Lough Derravaragh in July-August 2023. Perch was the dominant species in terms of abundance (CPUE) while roach had the highest biomass (BPUE) captured in the survey gill nets during the 2023 survey. Biomass of perch and pike was also relatively high.

Recruitment of the two most abundant species appears to be regular, and populations of both species were dominated by smaller and younger cohorts. These younger and smaller fish were much more prominent in both species in 2023 compared to the 2017. This was particularly true for roach where fish less than 20cm in length were largely absent in the earlier survey.

The population structure of roach x bream hybrids has also changed since the 2017 survey. At that time the population was dominated by large numbers of fish greater than 40cm in length, many of which were over specimen size (1.6kg/3.528lb) (Irish Specimen Fish Committee, 2024). Evidence of some limited recruitment (which requires successful spawning between both parent species (Hayden *et al.*, 2010)) in the addition to the capture of a small number of bream highlights that the latter species is still extant in the lake.

While captured in smaller numbers than other species (and which make interpretation more challenging) the brown trout population captured consisted solely of much larger fish in 2023 in contrast to 2017.

Classification and assigning lakes with an ecological status is a critical part of the WFD monitoring programme. It allows for the identification and prioritisation of 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, Lough Derravaragh has been assigned an ecological status of Moderate for 2023 based on the fish populations present. In 2017 the lake was assigned a status of Poor, although there is a large degree of uncertainty around these EQR values (Figure 4.1).

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

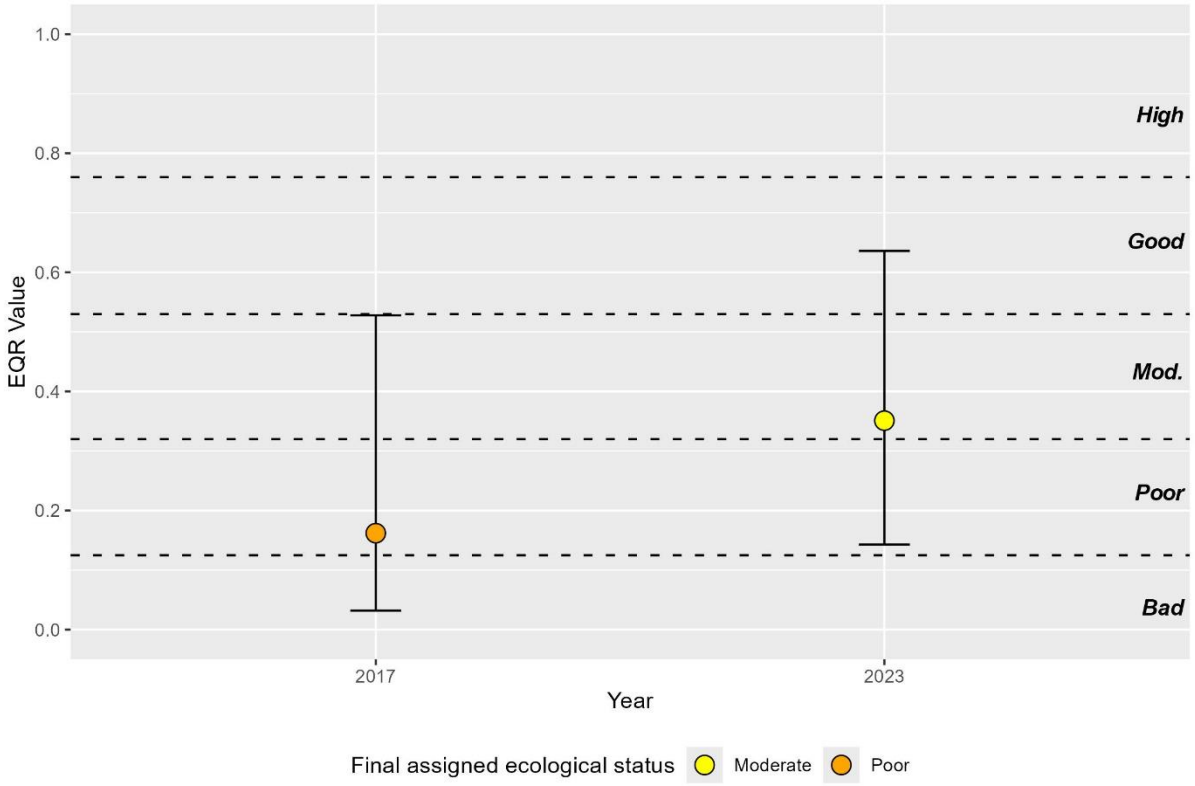

Figure 4.1. Fish ecological status, Lough Derravaragh, 2017 and 2023 (dashed line indicates EQR status boundaries).

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

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600