

National Research Survey Programme

Lakes 2024

Doo Lough

IFI/2025/1-4769



Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Doo Lough, October 2024



**Iascach Intíre Éireann
Inland Fisheries Ireland**

National Research Survey Programme

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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 Housing, Local Government and Heritage and Department of Communications, Climate Action and Environment / Department of Climate, Energy and the Environment for 2024.

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1. Introduction

Doo Lough is located approximately 6km north-west of Leenaun, Co. Mayo (Plate 1.1 and Figure 1.1). It is one of four lakes (i.e. Fin, Doo, Glencullin and Cunne) situated in the Delphi fishery. Glencullin Lough, located directly above Doo Lough, flows into the lake via a short stream. Doo Lough in turn drains into Fin Lough which is connected to Killary Harbour via the Bundorragha River.

The lake is approximately 3.5km in length and up to 750m wide. It has a surface area of 155ha, a maximum depth of 46m and an altitude of 30m a.s.l. The lake falls into typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and low alkalinity (<20mg/l CaCO₃).

Doo Lough forms part of the Mweelrea/Sheefry/Erriff candidate Special Area of Conservation (SAC) complex (NPWS, 2021). The site has been selected for containing active blanket bog, lagoons, machair, decalcified dunes and petrifying springs - all priority habitats on Annex I of the EU Habitats Directive. The SAC is also selected for containing the following species listed on Annex II of the same Directive - freshwater pearl mussel, Atlantic salmon, otter, the snails *Vertigo angustior* and *V. geyeri*, the plant slender naiad (*Najas flexilis*) and the liverwort petalwort (NPWS, 2021).

Doo Lough is an oligotrophic lake (NPWS, 2021) and was once famous for its sea trout fishery, which has been in decline since the late 1980s due to problems with sea lice (O' Reilly, 2007). Doo Lough holds brown trout, sea trout, Arctic char and gets both a spring and grilse salmon run (O' Reilly, 2007).

The lake has been previously surveyed on four occasions (2009, 2012, 2015, 2018) using IFI's fish in lakes monitoring protocol (Connor *et al.*, 2018; Kelly *et al.*, 2010, 2013 and 2016). In each of these surveys, brown trout were found to be the most abundant species present in the lake. Arctic char, sea trout, three-spined stickleback, salmon and eels were also captured in every survey.

This report summarises the results of the 2024 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 Doo, looking northwest across the lake.

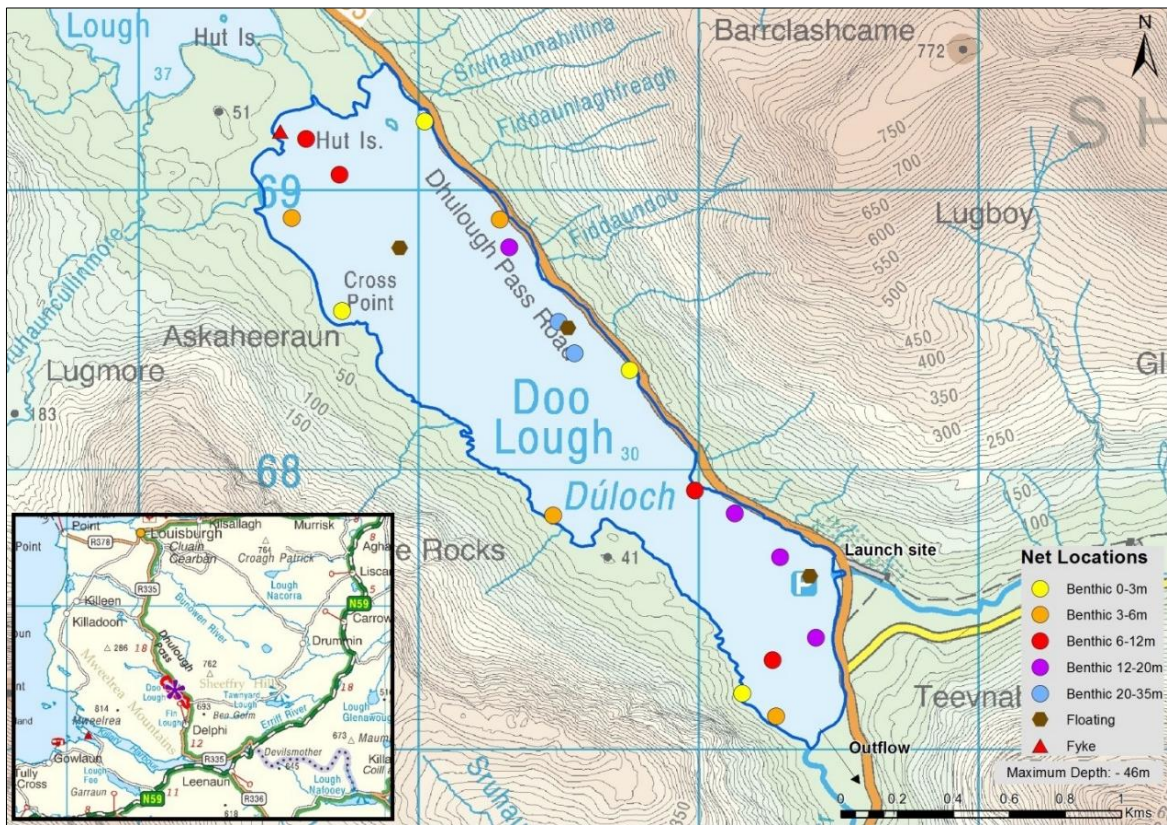


Figure 1.1. Location map of Doo Lough showing locations and depths of each net (outflow is indicated on map).

2. Methods

2.1. Netting methods

Doo Lough was surveyed over two nights from the 1st to the 3rd of October 2024. A total of two sets of Dutch fyke nets, 21 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 4 @ 6-11.9m, 4 @ 12-19.9m, 3 @ 20-34.9 and 2 @ 35-49.9m) and three floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (26 sites). Survey 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 were measured and weighed on site and scales were removed from a sub-sample of brown trout, sea trout, Arctic char and salmon. 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.

3. Results

3.1. Species Richness

Five fish species were recorded in Doo Lough in October 2024. A total of 327 fish were captured (Table 3.1). Three-spined stickleback was the most numerous fish species recorded, representing c. 50% of all fish captured. Brown trout and sea trout were also recorded in relatively high numbers and accounted for c. 30% of all fish recorded in the survey. Arctic char, Atlantic salmon and European eel were also captured. All five species were recorded on all previous surveys of the lake between 2009 and 2018 (Connor *et al.*, 2018; Kelly *et al.*, 2010, 2013 and 2016)

Table 3.1. Number of each fish species captured by each gear type during the survey on Doo Lough, October 2024.

Scientific name	Common name	Number of fish captured			
		BM CEN	FMCEN	Fyke	Total
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	157	7	1	165
<i>Salmo trutta</i>	Brown trout	84	3	7	94
	Sea trout	7	0	0	7
<i>Salvelinus alpinus</i>	Arctic char	37	1	1	39
<i>Salmo salar</i>	Atlantic salmon	5	0	0	5
<i>Anguilla anguilla</i>	European eel	0	0	17	17

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.

Three-spined stickleback was the dominant species with respect to abundance (CPUE). Brown trout had the highest relative biomass for fish captured in all net types (Table 3.2). European eel recorded in fyke nets only, also had a relatively high biomass (BPUE) (Table 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Doo Lough, October 2024.

Scientific name	Common name	Mean CPUE (\pm S.E)	Mean BPUE (\pm S.E)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.211 (0.059)	0.433 (0.134)
<i>Salmo trutta</i>	Brown trout	0.117 (0.023)	10.123 (2.526)
	Sea trout	0.008 (0.003)	2.730 (1.234)
<i>Salvelinus alpinus</i>	Arctic char	0.049 (0.027)	4.654 (2.842)
<i>Salmo salar</i>	Atlantic salmon	0.006 (0.003)	3.883 (3.788)
<i>Anguilla anguilla</i> *	European eel	0.142 (0.125)	26.606 (23.293)

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.

3.3. Species Profiles

Brown trout

Brown trout captured during the 2024 survey ranged in length from 5.6cm to 39.7cm (mean = 18.2cm). Brown trout captured in the 2024 survey had a broadly similar length range compared to those captured in the earlier surveys (Figure 3.1). In 2018, there was a slightly smaller range of individuals captured (7.7cm to 32.0cm), while fish of 45.4cm and 51.3cm were caught in 2012 and 2015 respectively.

Brown trout were aged between 0+ and 5+ and all intervening age classes were present in the sample aged. Mean L1 (i.e. length at the end of the 1st year) was 6.5cm (Table 3.3). Younger fish dominated the population. The most abundant age class was 2+ (14.6 - 21.6cm). This year class accounted for c. 49% of all the brown trout in the sample aged.

Table 3.3. Mean (\pm S.E.) brown trout length (cm) at age for Doo Lough, October 2024

Length (cm)	L ₁	L ₂	L ₃	L ₄	L ₅
Mean (\pm S.E.)	6.5 (0.05)	13.8 (0.14)	20.2 (0.45)	26.3 (1.35)	30.5 (2.67)
N	61	45	15	5	3
Range	5.4-7.8	11.0-16.2	16.9-22.7	21.2-28.9	25.2-33.5

Brown trout abundance (CPUE) and biomass (BPUE) have fluctuated across all surveys of the lake (Figure 3.2). The upward trend observed for both metrics in 2018 is no longer evident.

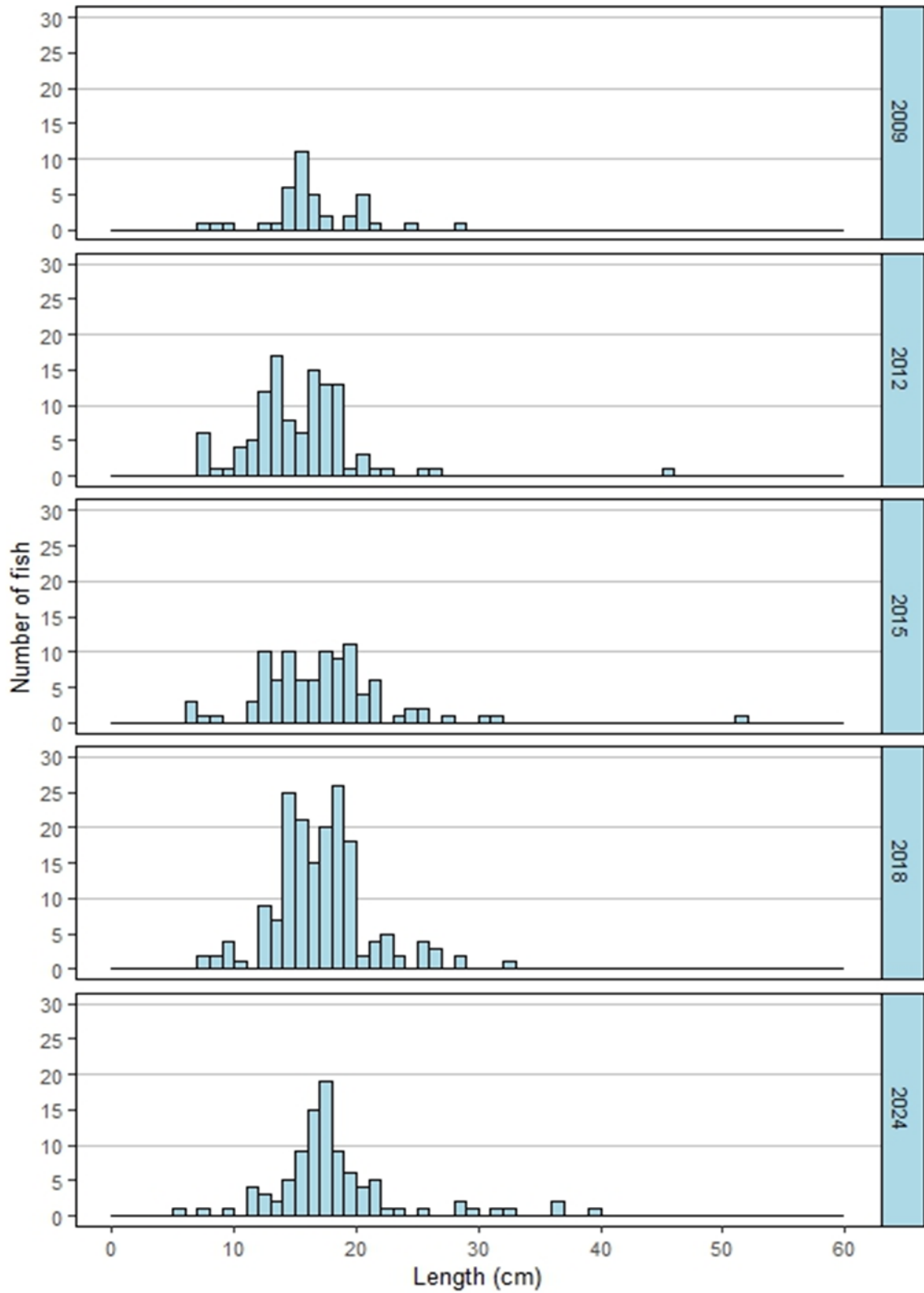


Figure 3.1. Length frequency of brown trout captured on Doo Lough between 2009 and 2024.

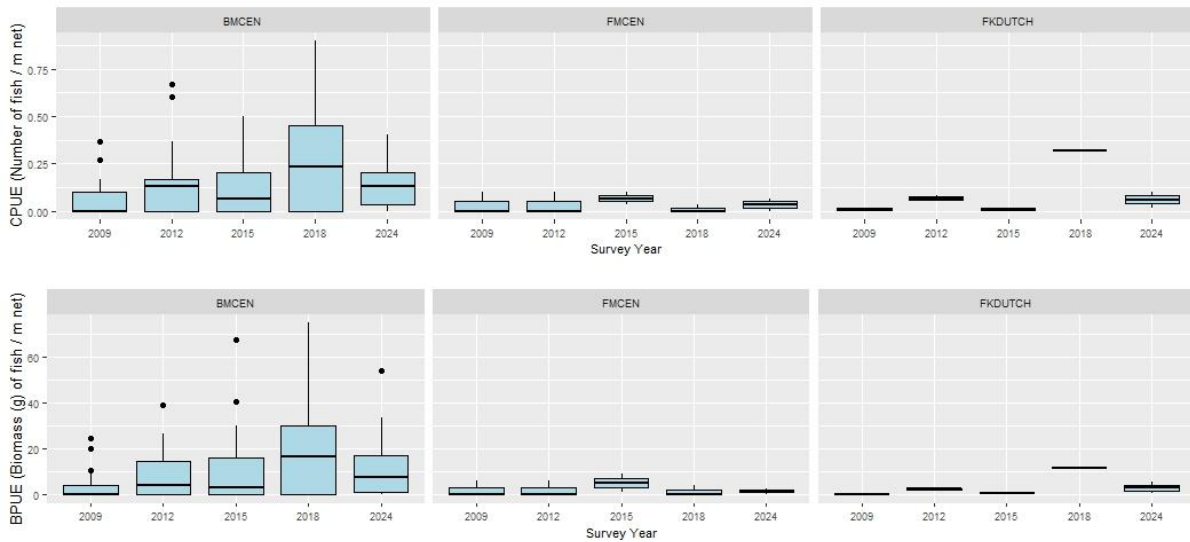


Figure 3.2. CPUE and BPUE of brown trout captured during surveys of Doonagh Lough between 2009 and 2024. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical ‘whiskers’ show the data range. Outliers are marked by dots.

Arctic char

Arctic char captured during the 2024 survey ranged in length from 7.5cm to 22.3cm (mean = 19.4m). Arctic char caught in this survey exhibited a similar length range compared with earlier surveys (Figure 3.3). In contrast to the 2015 survey, when the population contained a large proportion of smaller fish (10cm - 12cm). In the latter surveys, the Arctic char population has tended to be dominated by a greater proportion of larger individuals.

Arctic char were aged between 0+ and 3+ (Table 3.4). In 2024 the population was dominated by larger and older fish. The older cohorts (i.e.2+ and 3+, 16cm – 22cm, Figure 3.3) accounted for c. 83% of all fish in the sample aged. However, the presence of 0+ fish (7cm – 8cm, Figure 3.3) indicates that some recruitment is continuing in the lake.

Arctic char populations have remained relatively stable across all surveys of the lake, with no obvious trends in abundance (CPUE) or biomass (BPUE) apparent (Figure 3.4).

Table 3.4. Summary age data from Arctic char captured on Doo Lough, October 2024. Number of fish and length ranges of all fish aged in the sample is presented.

Length (cm)	Age class			
	0+	1+	2+	3+
N	2	3	11	13
Mean	8.1	13.3	20.5	20.7
Min	7.5	9.8	16.8	18.6
Max	8.7	17.8	22.1	21.6

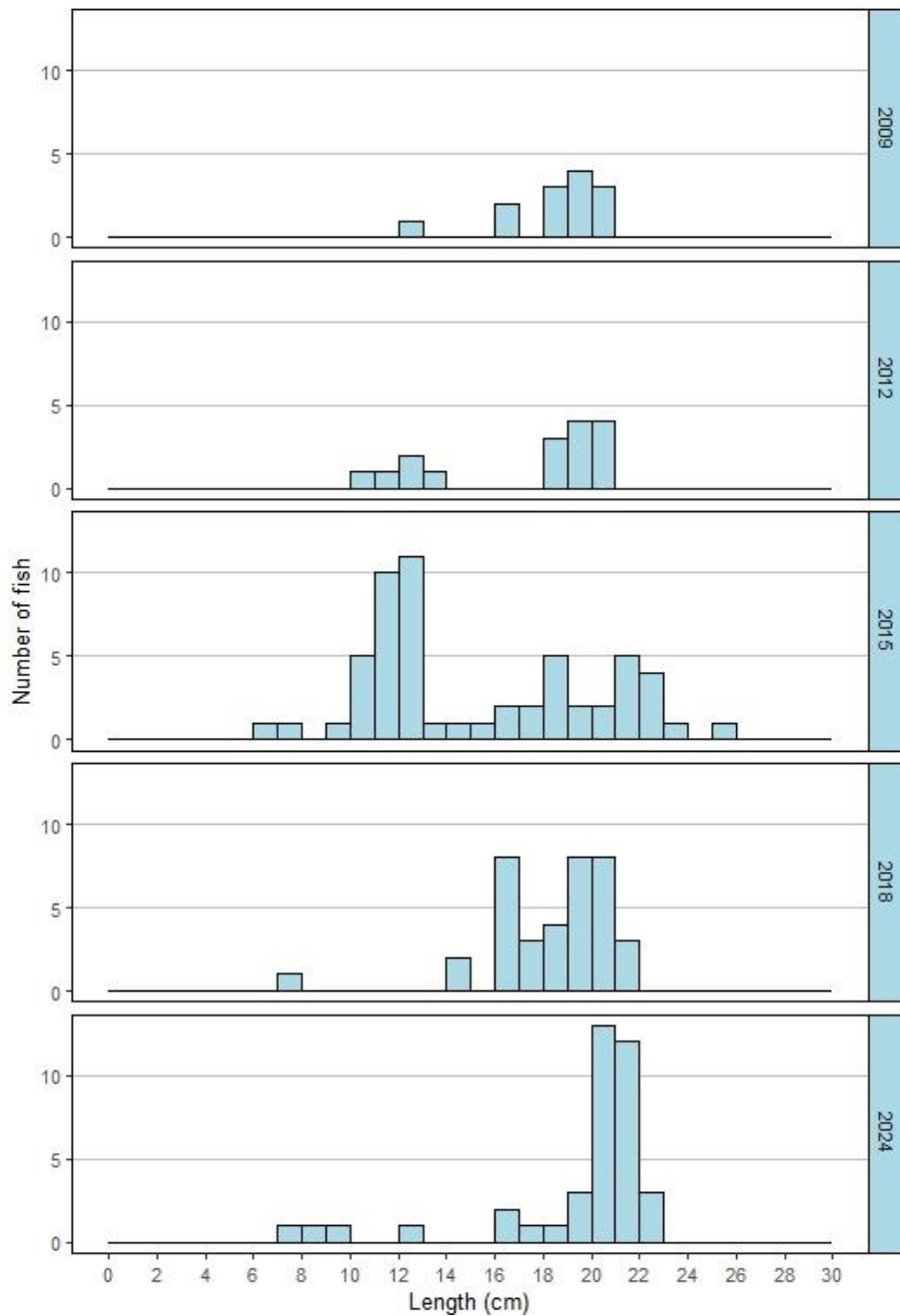


Figure 3.3. Length frequency of Arctic char captured on Doo Lough between 2009 and 2024.

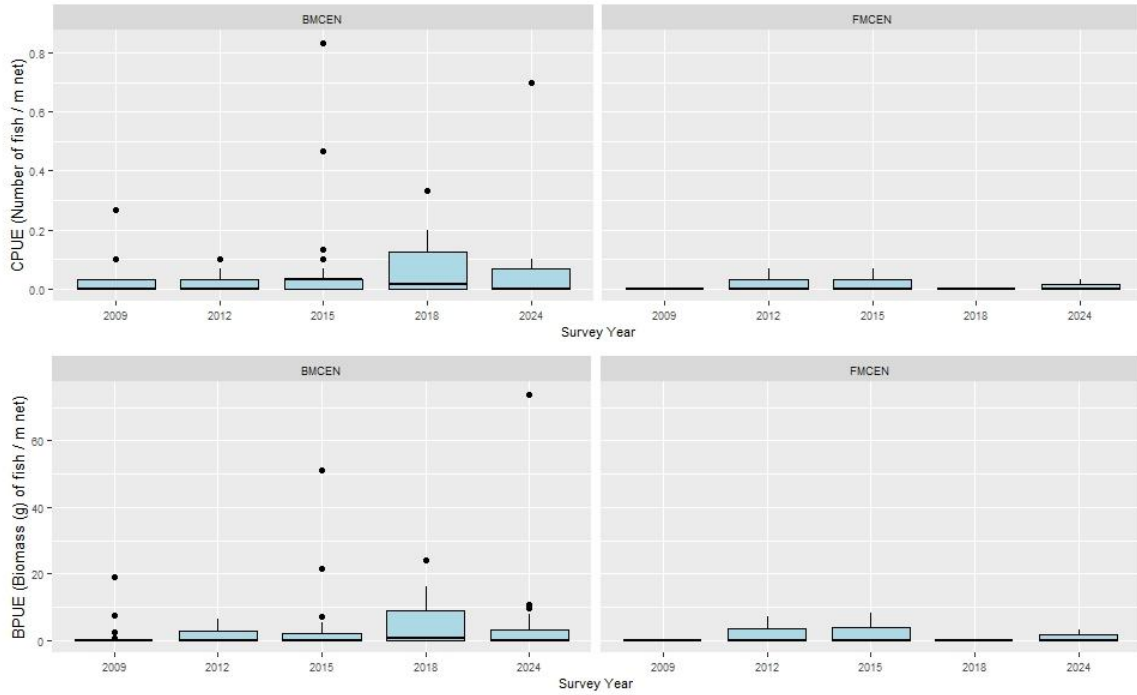


Figure 3.4. CPUE and BPUE of Arctic char captured during surveys of Doo Lough between 2009 and 2024. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.



Plate 3.1. Deploying a survey gill net on Doo Lough, October 2024.

European eel

European eel captured during the 2024 survey ranged in length from 41.6cm to 59.6cm (mean = 48.1) (Figure 3.5). European eel captured in the 2024 survey had a broadly similar length range compared to those captured in the earlier surveys (Figure 3.5).

European eel abundance (CPUE) and biomass (BPUE) were higher in 2024 when compared to all previous surveys of the lake (Figure 3.6).

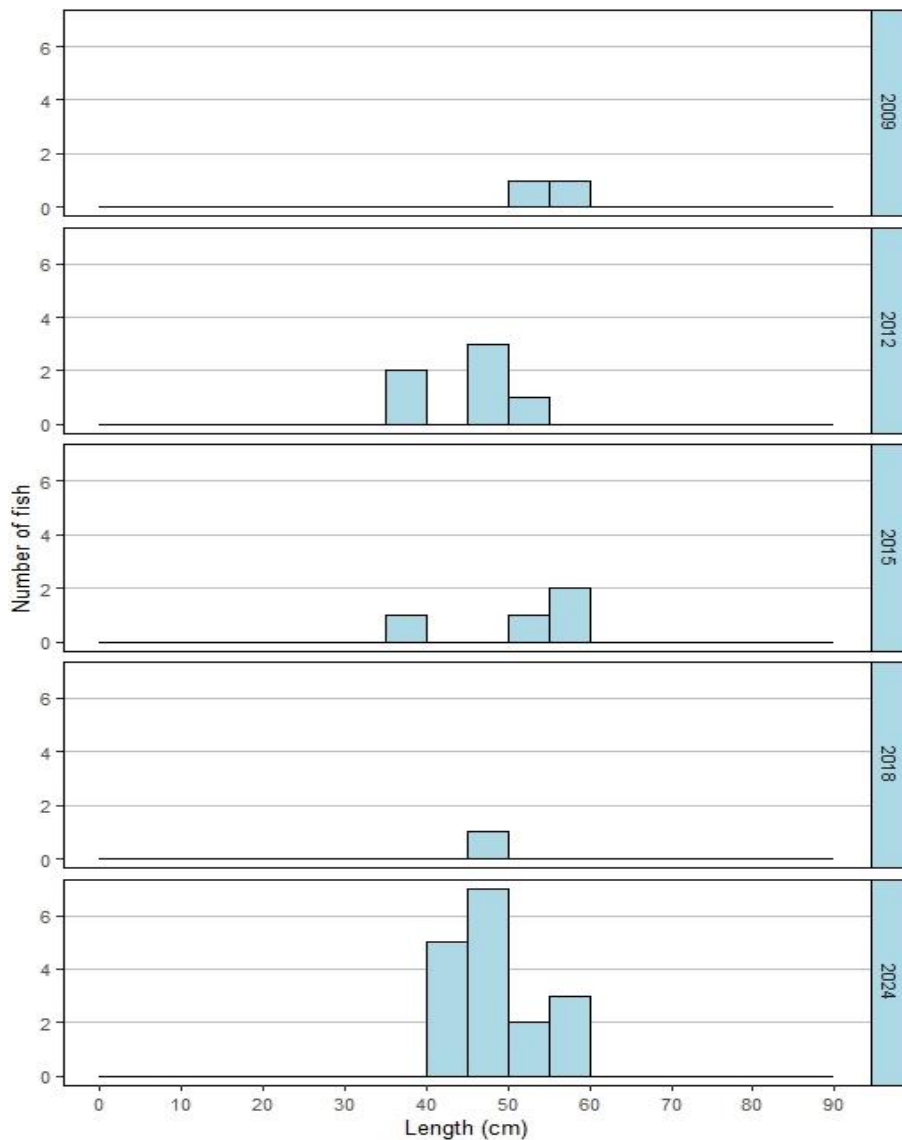


Figure 3.5. Length frequency of eel captured on Doo Lough between 2009 and 2024.

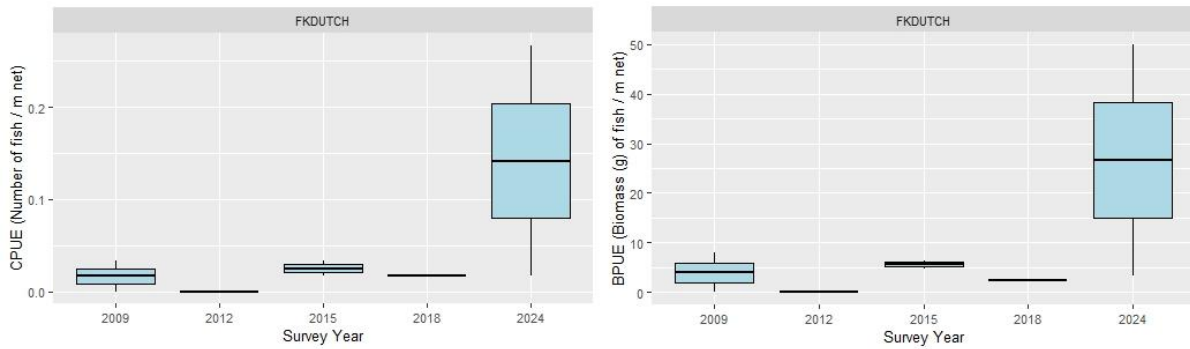


Figure 3.6. CPUE and BPUE of eel captured during surveys of Doo Lough between 2009 and 2024. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Sea trout

Six sea trout were captured during the survey. They ranged from 27.1cm to 38.6cm (mean = 31.5). Two of these fish were aged 2+ and four were aged 2.1+.

Abundance (CPUE) and biomass (BPUE) of sea trout captured in benthic survey gill nets was lower in 2024 than all previous years (Figure 3.7).

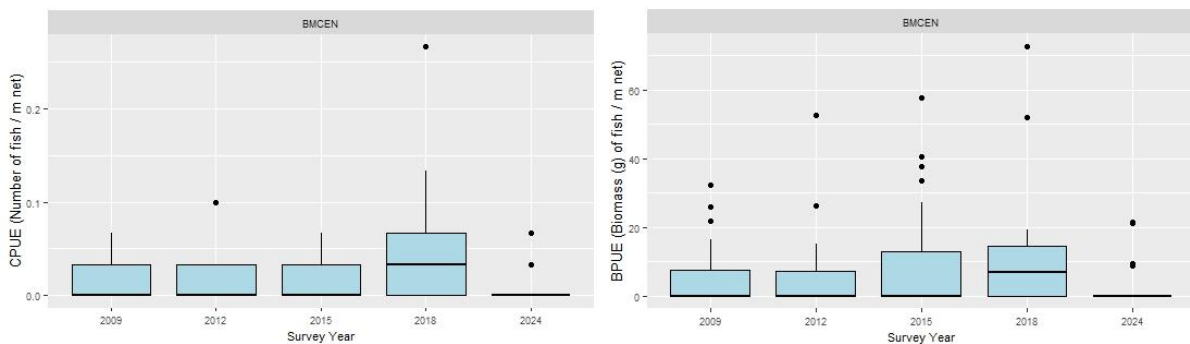


Figure 3.7. CPUE and BPUE of sea trout captured during surveys of Doo Lough between 2009 and 2024. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

Atlantic salmon

Five salmon ranging from 8.6cm to 66cm (mean = 22.5cm) were captured in the survey. Of these fish, one was an adult salmon, while the remaining four were juveniles ranging in length from 8.6cm to 12cm (mean = 11.6cm).

Three-spined stickleback

Three-spined stickleback caught during the survey ranged from 3.0cm to 6.7cm (mean = 5cm). Abundance (CPUE) and biomass (BPUE) of three-spined stickleback captured in benthic survey gill nets in 2024 was higher than previous surveys (Figure 3.8).

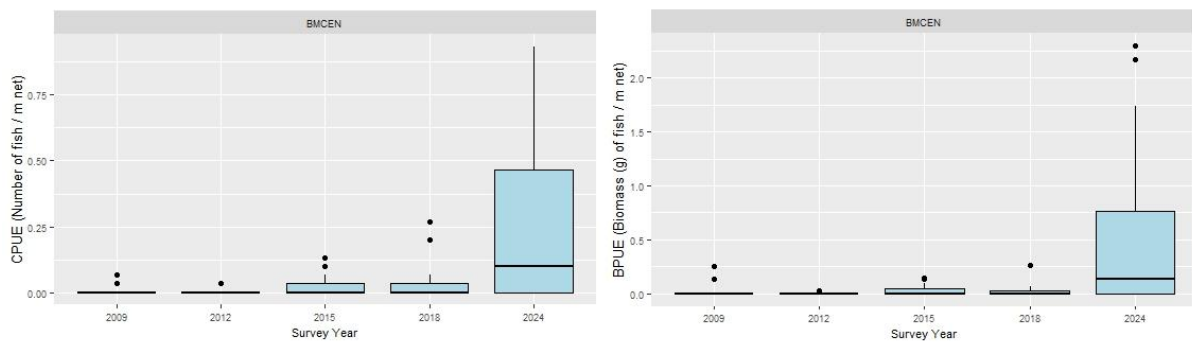


Figure 3.8. CPUE and BPUE of three-spined stickleback captured during surveys of Doo Lough between 2009 and 2024. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

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, sea trout, Arctic char and salmon captured during the survey were examined and are presented below.

Brown trout

A total of 43 brown trout stomachs were examined. Of these, 19 were found to be empty (44%). Of the stomachs that contained food, invertebrates were the sole prey item recorded in 16 stomachs (25%) and were present together with zooplankton in one stomach (4%). Zooplankton alone was found in six stomachs (24%) and unidentified fish remains were observed in one stomach (4%). These results are represented below (Figure 3.9).

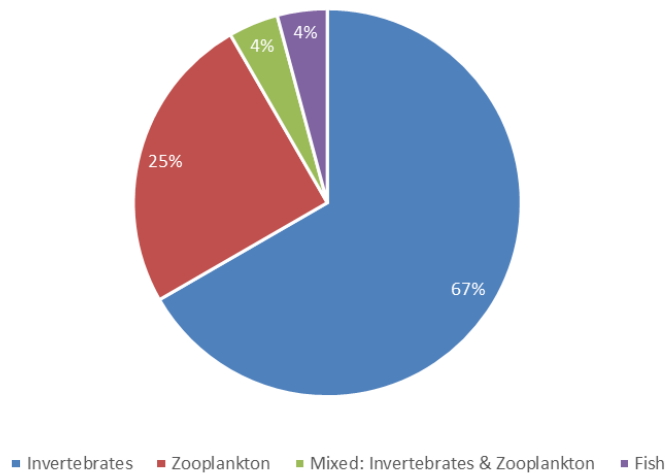


Figure 3.9. Diet of brown trout (N =24) captured on Doo Lough, 2024 (% FO).

Arctic char

A total of 31 Arctic char stomachs were examined. Eleven (35%) of these were empty. Zooplankton was the sole prey type recorded in all of the remaining Arctic char stomachs.

Atlantic salmon and sea trout

Four juvenile Atlantic salmon stomachs were available for analysis. One of these was empty. The remaining three all contained invertebrates as their sole prey item.

The one sea trout stomach which was examined was empty.

4. Summary and fish ecological status

Five fish species were recorded in Doo Lough in October 2024. Sea trout, a separate 'variety' of trout were also present. Three-spined stickleback was the dominant species in terms of abundance (CPUE) while brown trout was the dominant species in terms of biomass (BPUE) captured in survey gill nets during the 2024 survey. A relatively high biomass of European eel captured in fyke nets only was also noted.

Brown trout captured in the 2024 survey had a broadly similar length range compared to those captured in earlier surveys. Brown trout abundance (CPUE) and biomass (BPUE) have fluctuated across all surveys of the lake (Figure 3.2). The upward trend observed for both metrics in 2018 is no longer evident.

Abundance (CPUE) and biomass (BPUE) of sea trout captured in benthic survey gill nets was lower in 2024 than previous years

Arctic char ranged in length from 7.5cm to 22.3cm (mean = 19.4m). The length range of Arctic char was similar to earlier surveys. However, there was a shift to a higher proportion of larger individuals (20-22cm) from 2015 to 2024. Arctic char populations have remained relatively stable across all surveys of the lake, with no obvious trends in abundance (CPUE) or biomass (BPUE) apparent. Nationally, Arctic char populations have been shown to be threatened by deteriorating water quality, climate change and a combination of climate change and colonization of non-native fish populations (Connor *et al.*, 2019; Morrissey-McCaffrey *et al.*, 2019). Other more localised issues can also impact upon isolated lake populations.

A positive trend in European eel abundance (CPUE) and biomass (BPUE) was observed in 2024 when compared to all previous surveys undertaken

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 Doo Lough has been assigned an ecological status of Good for 2024 based on the fish populations present. In previous years the lake was assigned a fish ecological status of High (Figure 4.1).

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

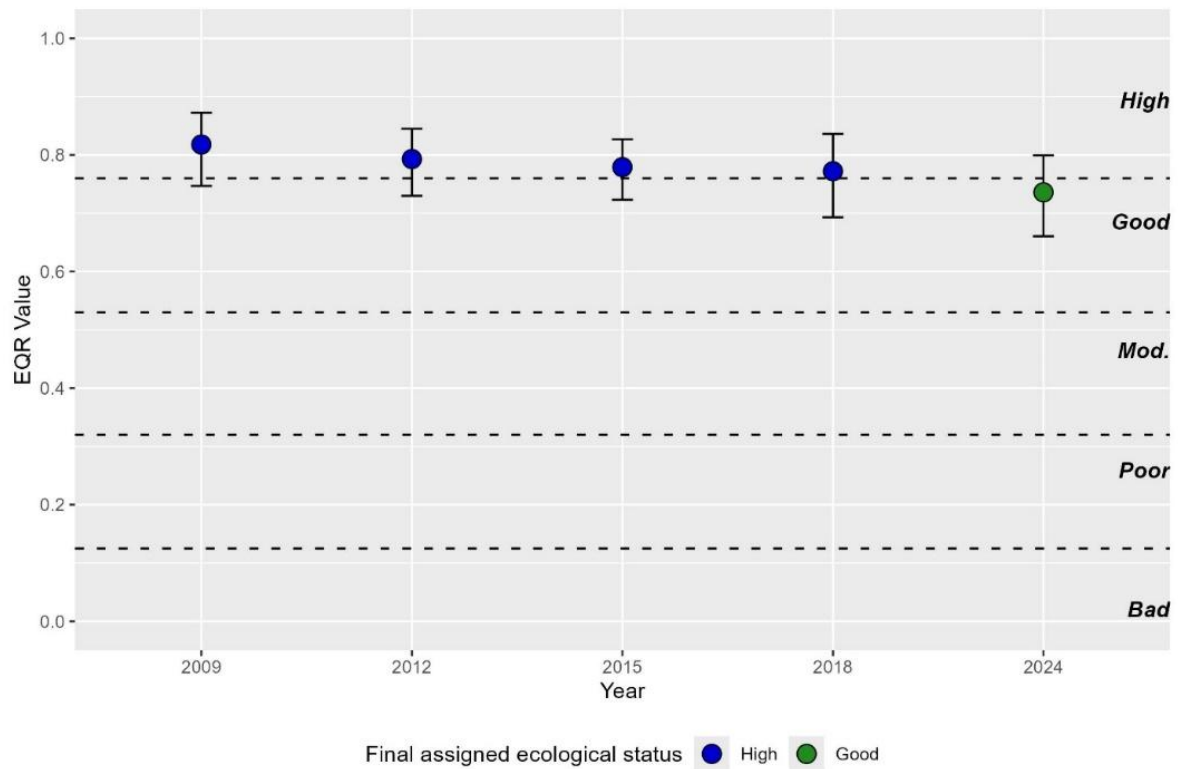


Figure 4.1. Fish ecological status Doo Lough, between 2009 and 2024 (dashed line indicates EQR status boundaries).

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