National Research Survey Programme
Lakes 2023

Lough Acoose

IFI/2024/1-4710

Iascach Intíre Éireann
Inland Fisheries Ireland

fisheriesireland.ie

Fish Stock Survey of Lough Acoose, August-September 2023

Iascach Intíre Éireann
Inland Fisheries Ireland

National Research Survey Programme

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

ACKNOWLEDGEMENTS

CYAL50346939 © National Mapping Division of Tailte Éireann.

1.   Introduction

Lough Acoose is situated in Co. Kerry in the upper Caragh catchment (Figure 1.1). The lake is located approximately seven kilometres south of Killorglin, between Glencar and Killorglin (Figure 1.1). The lake has a surface area of 66ha and a maximum depth of 19m. Lough Acoose is categorised as 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 $CaCO_3$).

Lough Acoose 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, 2013).

Lough Acoose is known to hold a stock of brown trout and gets a run of salmon grilse from July onwards. A review paper on the distribution and status of Arctic Char in Ireland (Igoe *et al.*, 2003), a rare and threatened species listed in the Irish Red Data Book for fish as vulnerable (King, 2011), reported that Arctic char were not present in the lake following a 1983 survey. In 2006 however, an EPA funded PhD studentship at University College Cork investigating the vulnerability of Arctic char eggs to environmental change found a population present in the lake (E. Morrissey, *pers. com.*). Recent IFI surveys also confirmed the presence of a population of Arctic char in the lake (Kelly *et al.*, 2009a, 2012a, 2015a, 2015b, Connor *et al.,* 2018 and Corcoran *et al.,* 2021).

Lough Acoose was previously surveyed in 2008, 2011, 2014, 2017 and 2020 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2009, 2012a, 2015, Connor *et al.,* 2018 and Corcoran *et al.,* 2021). During the 2020 survey, brown trout and Arctic char were found to be the dominant species present in the lake. Eels and salmon were also captured during the surveys.

This report summarises the results of the 2023 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme and IFI's Arctic char research programme.
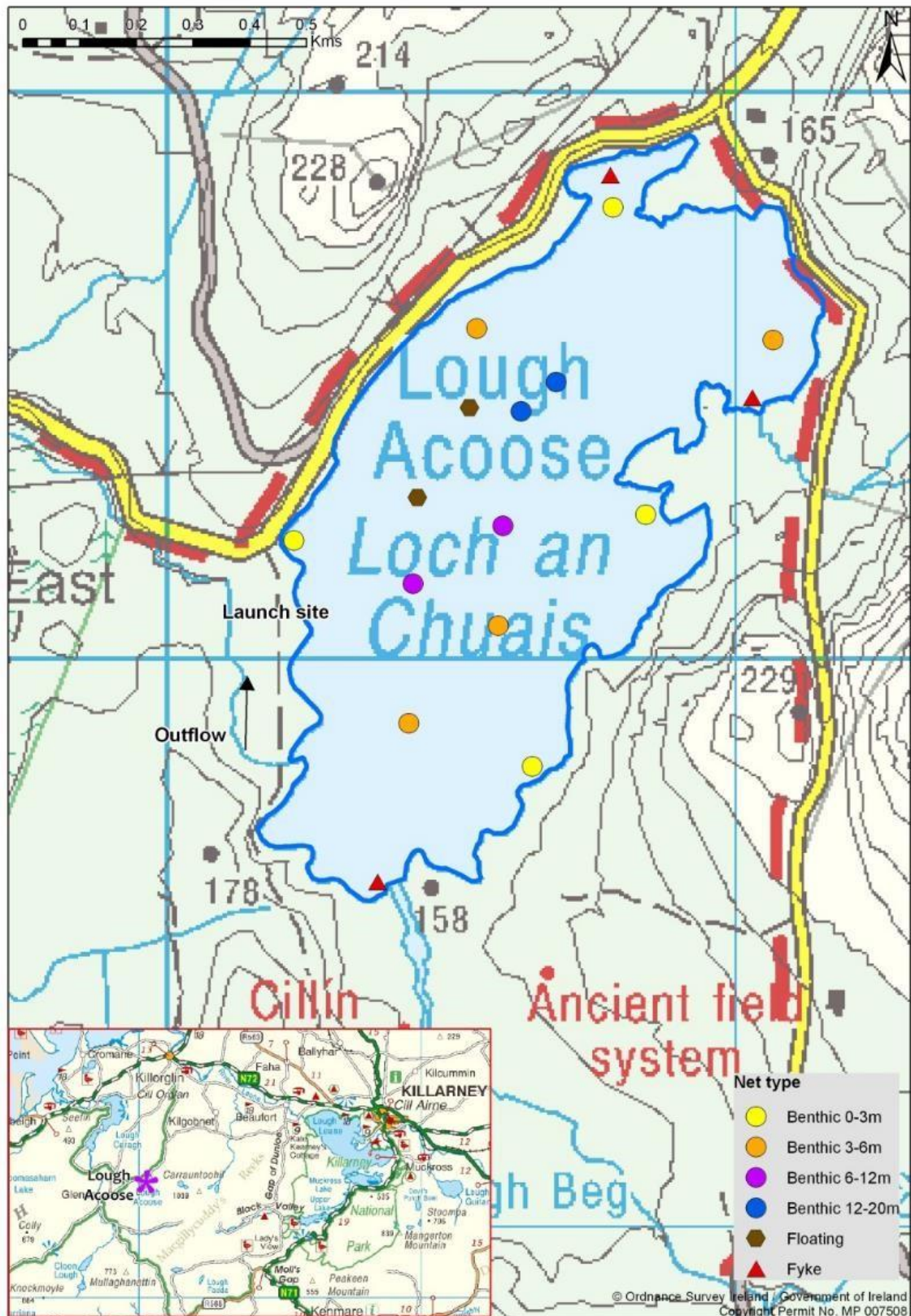
Figure 1.1. Location map of Lough Acoose showing net locations and depths of each net (outflow is indicated on map).

2.   Methods

2.1.   Netting methods

Lough Acoose was surveyed over two nights from the 30th of August 2023 to the 1st of September 2023. A total of three sets of Dutch fyke nets, 12 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (4 @ 0-2.9m, 4 @ 3-5.9m, 2 @ 6-11.9m and 2 @ 12-19.9m) and two floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (17 sites). 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 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).

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

Where:
$\mathbf{FO}_i$ 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

Four fish species were recorded in Lough Acoose in August / September 2023. A total of 386 fish were captured (Table 3.1). Brown trout was the most numerous fish species recorded, representing 87% of all fish captured in the survey. Arctic char, salmon and European eels were also captured. The same species composition was recorded on previous surveys of the lake with the exception of salmon which were not recorded in 2008 (Kelly *et al*., 2009, 2012a, 2015, Connor *et al.,* 2018 and Corcoran *et al.,* 2021).

Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Acoose, August / September 2023

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Salmo trutta	Brown trout	265	32	39	336
Salvelinus alpinus	Arctic char	35	2	4	41
Salmo salar	Salmon	7	0	0	7
Anguilla anguilla	European eel	0	0	2	2

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. Brown trout were the dominant species with respect to both abundance (CPUE) and biomass (BPUE) (Table 3.2).

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

| Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
Salmo trutta	Brown trout	0.620 (0.138)	52.949 (11.866)
Salvelinus alpinus	Arctic char	0.078 (0.022)	3.237 (1.058)
Salmo salar	Salmon	0.013 (0.007)	3.304 (3.081)
*Anguilla anguilla**	European eel	0.011 (0.011)	2.312 (2.312)

*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 2023 survey ranged in length from 7.0cm to 33.2cm (mean 18.7cm). Brown trout captured in previous surveys had similar length and age ranges. While generally dominated by smaller fish (i.e. <25cm), larger fish (i.e. 30cm - 45cm) have been captured in several surveys (Figure 3.2). Brown trout were aged between 1+ 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+, with just one representative in each of the two oldest age groups (i.e. 4+ and 5+) in the sample aged (Table 3.3).

Brown trout have remained relatively stable across all surveys of the lake, with no obvious trends in population abundance (CPUE) or biomass (BPUE) apparent (Figure 3.1).
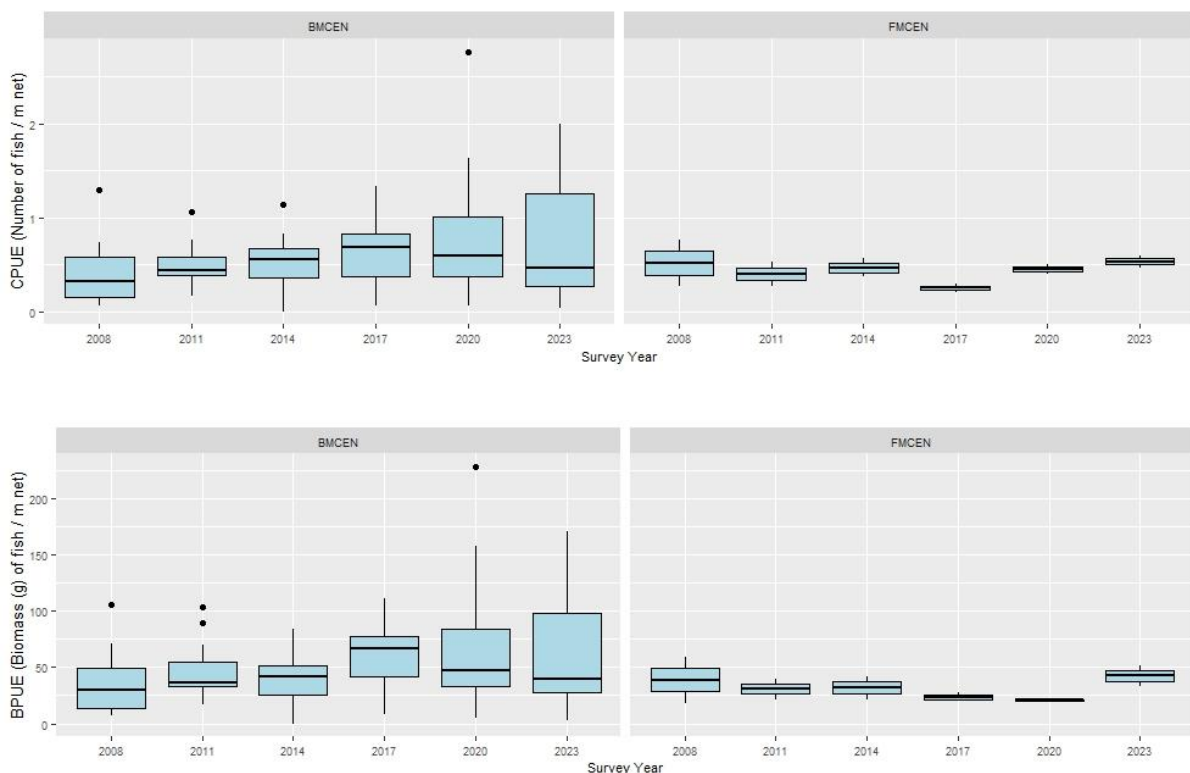
Figure 3.1. CPUE and BPUE of brown trout captured during surveys of Lough Acoose between 2008 and 2023. Figures are expressed as numbers of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.
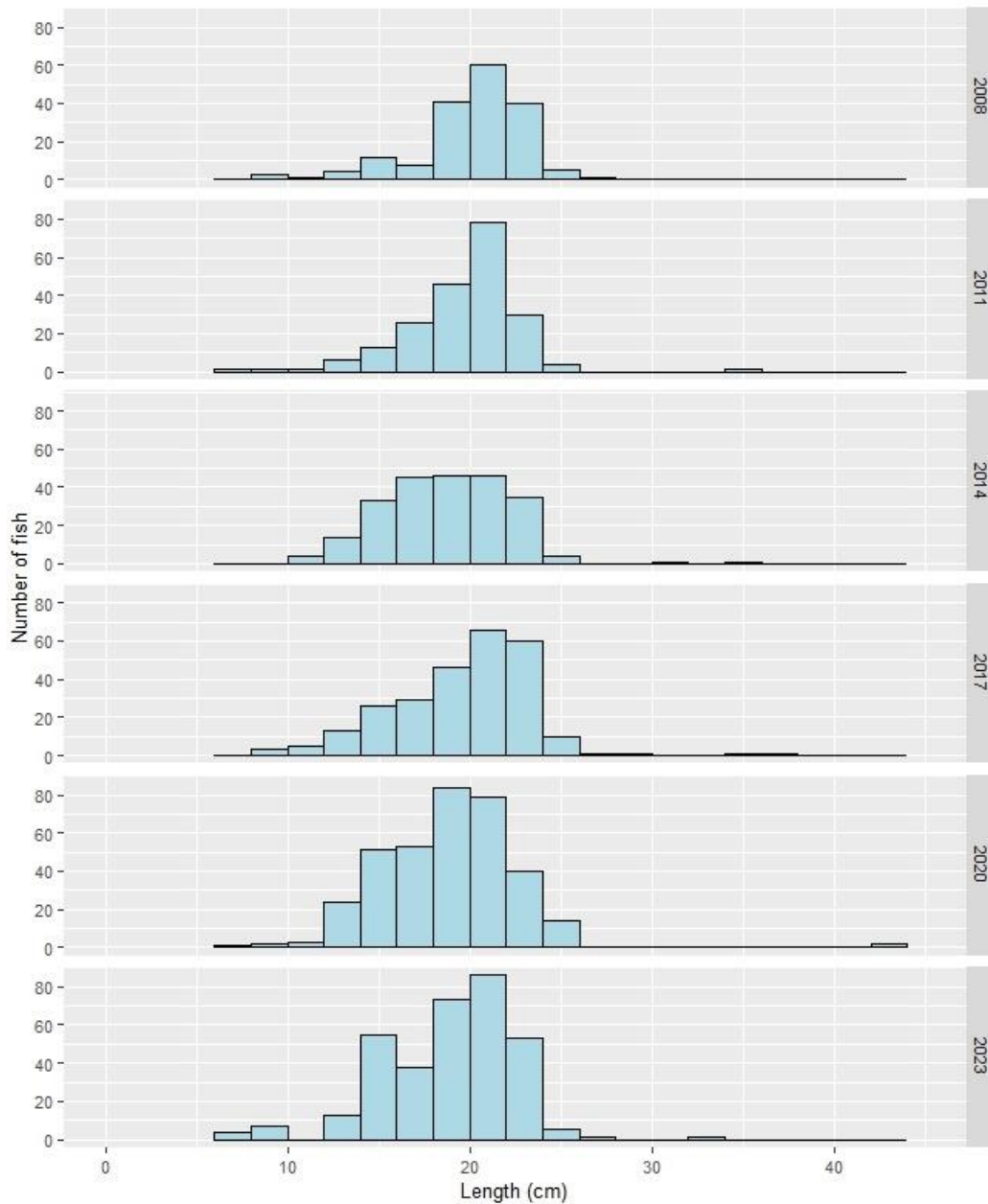
Figure 3.2. Length frequency of brown trout captured on Lough Acoose between 2008 and 2023

Table 3.3. Mean back-calculated (±S.E.) brown trout length (cm) at age for Lough Acoose, August-September 2023

Length (cm)	L_1	L_2	L_3	L_4	L_5
Mean (±S.E.)	6.5 (0.06)	13.2 (0.17)	18.3 (1.15)	23.7 (0.76)	-
N	73	44	17	2	1
Range	5.1-7.6	10.1-16.7	18.1-20.6	23.0-24.5	29.9

Arctic char

Arctic char captured during the 2023 survey ranged in length from 7.3cm to 18.0cm (mean 14.9cm) (Figure 3.3). There were fewer larger fish (i.e. > 15cm) recorded in 2023 compared to earlier surveys of the lake. However, the presence of two small (<10cm) individuals indicates that some recruitment is continuing (Figure 3.3). Otoliths from 34 Arctic char were examined for age analysis. Arctic char were aged between 0+ (7cm) and 3+ (18cm) (Figure3.3 and Table 3.4). Two and three year old Arctic char dominated the population.

Arctic char abundance (CPUE) and biomass (BPUE) have fluctuated across all surveys of the lake. While no obvious long-term trend in CPUE or BPUE was apparent, there was a slight decline in both metrics observed in 2023 compared to the two previous surveys of the lake (Figure 3.4).
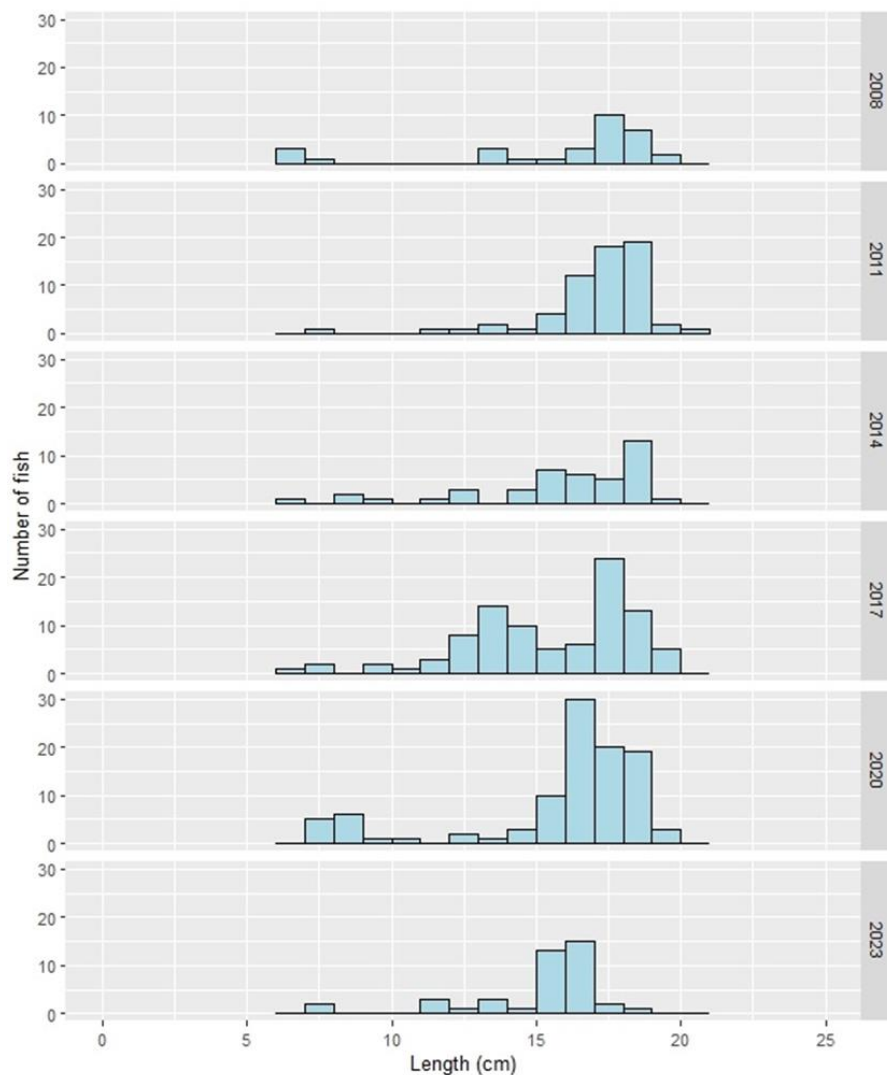
Figure 3.3. Length frequency of Arctic char captured on Lough Acoose between 2008 and 2023.

Table 3.4. Summary age data from Arctic char captured on Lough Acoose, August-September 2023. 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	2	20	10
Mean	7.4	12.8	15.6	16.6
Min	7.3	11.8	13.2	15.4
Max	7.5	13.8	16.7	18.0
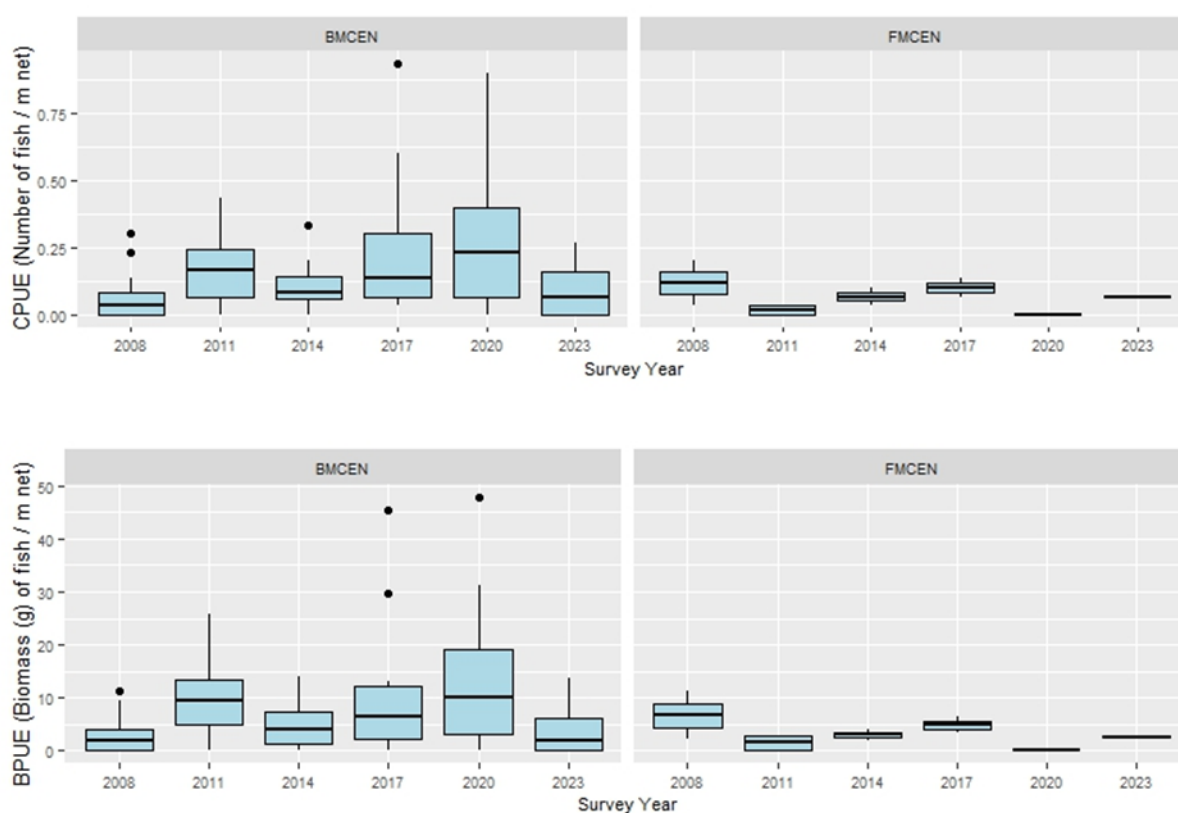
Figure 3.4. CPUE and BPUE of char captured during surveys of Lough Acoose between 2008 and 2023. Figures are expressed as numbers and biomass of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots.

<u>**European Eel**</u>

Two eels were captured in the 2023 survey measuring 32.3cm and 63cm in length (Figure 3.5). There was an overall decline in eel abundance (CPUE) and biomass (BPUE) observed since 2008 (Figure 3.6).
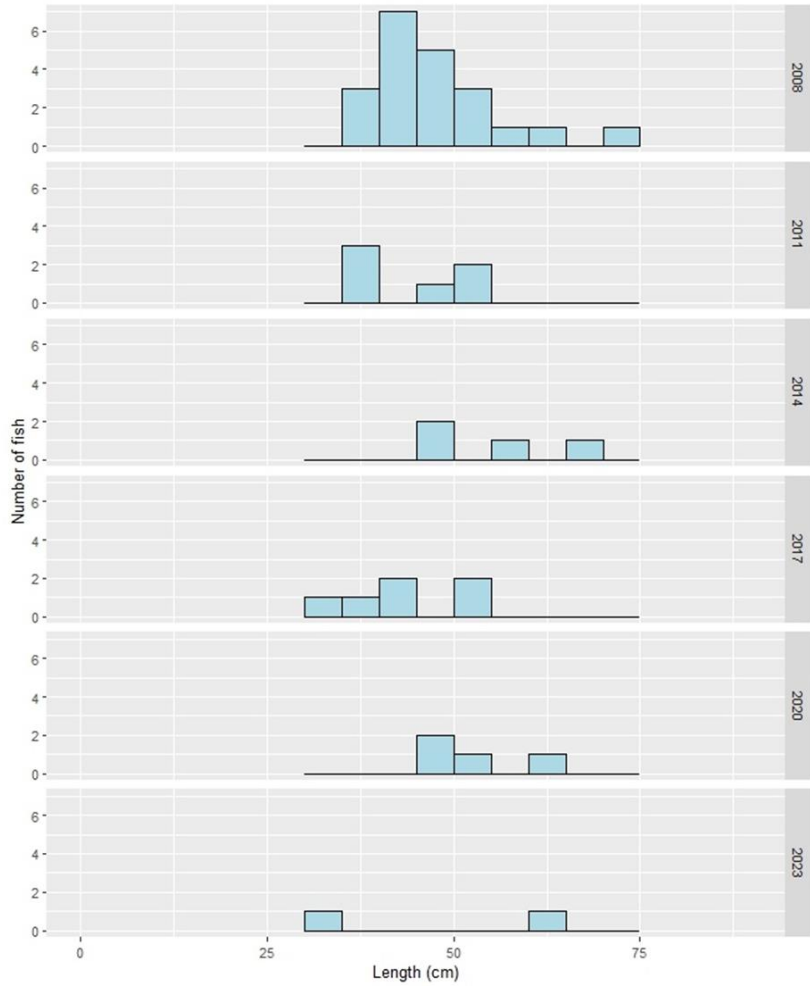
Figure 3.5. Length frequency of European eel captured on Lough Acoose between 2008 and 2023.
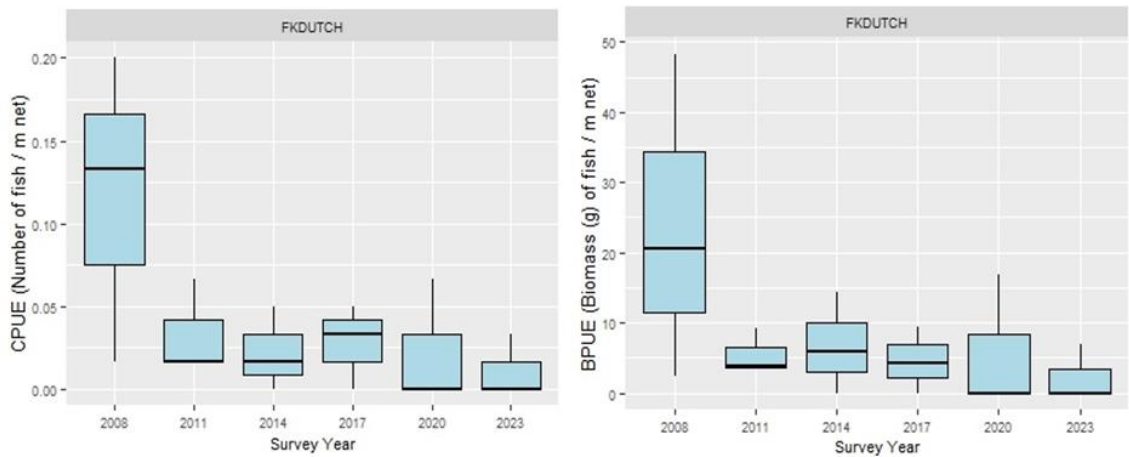

Figure 3.6. CPUE and BPUE of eel captured during surveys of Lough Acoose between 2008 and 2023. Figures are expressed as numbers and biomass of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range.

Other fish species

Seven salmon were captured ranging in length from 10.3cm to 53.2cm (mean 17.3cm). Five (10.3cm to 11.7cm) were aged as 1+ juvenile. One adult salmon (54.2cm) was aged as 2.1+. This fish migrated from the catchment as a two year old smolt and spent one year at sea before returning in 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 brown trout, salmon and Arctic char captured during the survey were examined and are presented below.

Brown trout

A total of 76 brown trout stomachs were examined. Forty one (53.9%) were empty. Thirty five stomachs contained food. Invertebrates were the sole prey type recorded in 20 (57%) stomachs and were found together with zooplankton in five stomachs (44%). Zooplankton was the sole prey type recorded in 10 (29%) stomachs. (Figure 3.7).
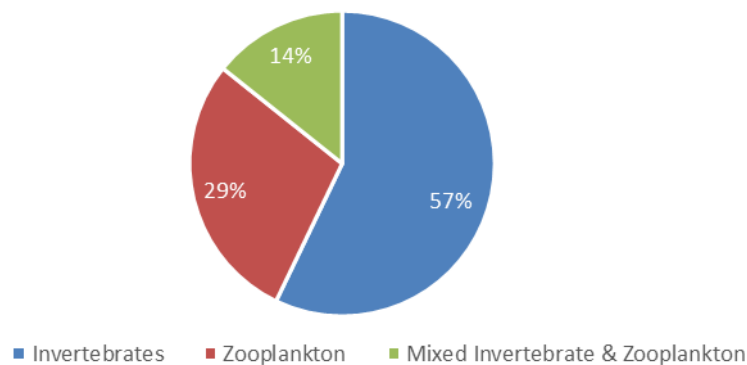
Figure 3.7. Diet of brown trout (N = 35) captured on Lough Acoose, 2023 (% FO).

Arctic char

A total of 35 Arctic char stomachs were examined. Of these, 13 (37%) were empty. Zooplankton was the sole prey type recorded in all 22 Arctic char stomachs which contained food.

Salmon

The stomach contents of five juvenile salmon were examined. One stomach was empty. Three salmon stomachs contained invertebrates. Zooplankton was recorded in one stomach.
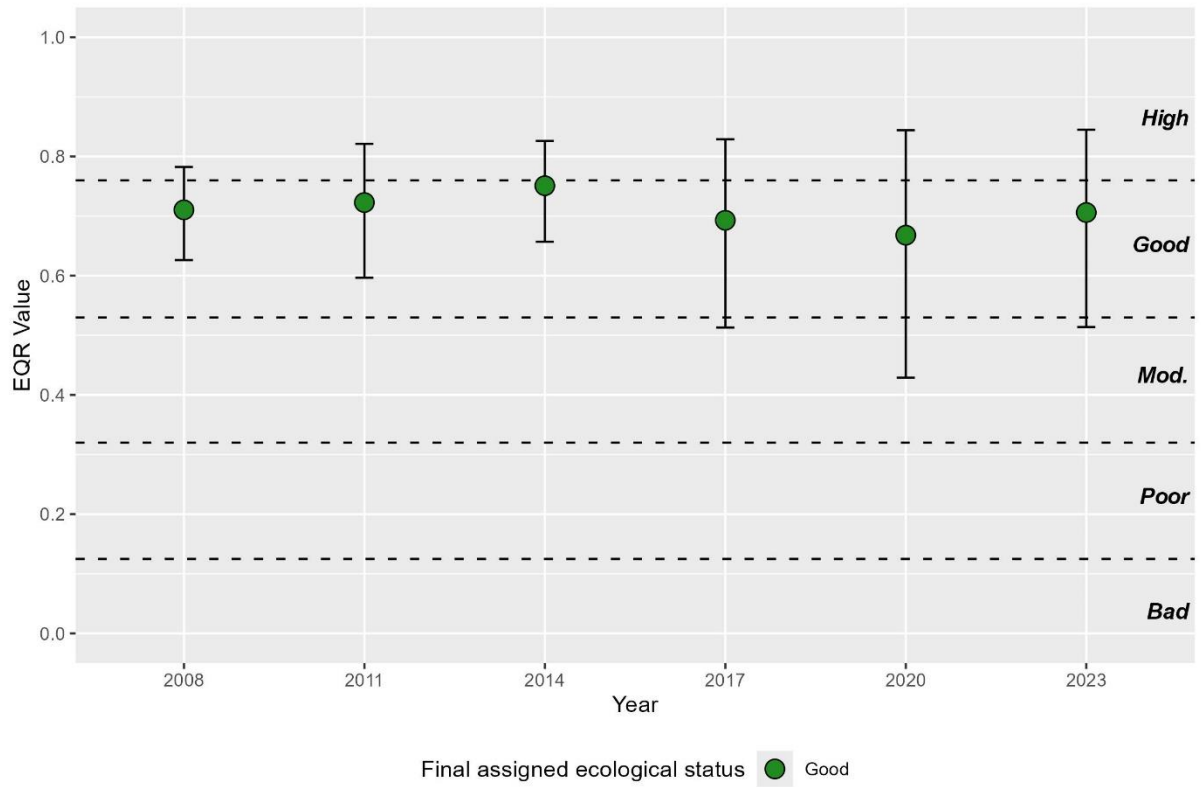
4.   Summary and fish ecological status

A total of four fish species were recorded in Lough Acoose in August-September 2023. Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2023 survey. Recruitment appears to be regular and the population, in common with previous surveys was dominated by younger and smaller individuals but with older and larger cohorts persisting in the population.

Arctic char is a rare species nationally and is endemic to the lake. CPUE and BPUE fluctuated between sampling occasions. No clear trend in either population metric was apparent. The length range of fish captured has remained relatively consistent across all sampling periods, and the capture of 0+and 1+ individuals (albeit in small numbers) in 2023 is evidence of some continued recruitment in the lake. In Ireland, Arctic char populations are threatened by the combined impact of several pressures including climate change and non-native species competition (Connor *et al.*, 2019).

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 (Ecological Quality Ratio) values for each lake and associated confidence in classification (Kelly *et al.*, 2012b).

Using the FIL2 classification tool, Lough Acoose has been assigned an ecological status of Good for 2023 based on the fish populations present. Lough Acoose has also consistently been assigned a status of Good for all previous Water Framework Directive monitoring surveys of the lake (Figure 4.1).

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

Figure 4.1. Fish ecological status, Lough Acoose, between 2008 to 2023 (dashed line indicates EQR status boundaries).

Plate 4.1. Lough Acoose, September 2023

5. References

Amundsen, P.A., Gabler, H.M. and Staldvik, F.J. (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.

Corcoran, W., Connor, L., McLoone, P., Bateman, A., Cierpial, D., Gavin, A., Gordon, P., McCarthy, E., Putthaaree, D., Twomey, C., Matson, R., Robson, S., Duffy, P., Rocks, K., Donovan, R., Crowley, D., and Kelly, F.L. (2021) *Fish Stock Survey of Lough Acoose, September 2020*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Connor, L., Coyne, J., Corcoran, W., Cierpial, D., Ni Dhonnaibhain L., Delanty, K., McLoone, P., Morrissey, E., Gordon, P., O' Briain, R., Matson, R., Rocks, K., O' Reilly, S., Brett A., Garland D. and Kelly, F.L. (2018) *Fish Stock Survey of Lough Acoose, August (2017).* National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Connor, L., Shephard, S., Rocks, K. and Kelly, F. L. (2019) Potential climate change impacts on Arctic char *Salvelinus alpinus* L. in Ireland. *Fisheries Management and Ecology*, **26**, 527-539.

EPA (2021) https://gis.epa.ie/EPAMaps/ Data - Catchments.ie - Catchments.ie. Accessed in May/June 2024.

Igoe F., O'Grady M.F., Tierney D. and Fitzmaurice P. (2003) Arctic Char *Salvelinus alpinus* (L.) in Ireland- A millennium review of its distribution and status with conservation recommendations. *Biology and Environment: Proceedings of the Royal Irish Academy*, **103B (1)**, 9-22.

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, NS Share project.

Kelly, F.L., Connor, L., Wightman, G., Matson, R. Morrissey, E., O'Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2009) *Water Framework Directive Fish Stock Survey of Lough Acoose*, 2008. Central and Regional Fisheries Boards report.

Kelly, F.L., Connor, L., Morrissey, E., Wogerbauer, C., Matson, R., Feeney, R. and Rocks, K. (2012a) *Water Framework Directive Fish Stock Survey of Lough Acoose, August 2011*. Inland Fisheries Ireland.

Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012b) 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., Feeney, R., Matson, R. and Rocks, K. (2015) *Water Framework Directive Fish Stock Survey of Lough Acoose, August 2014*. Inland Fisheries Ireland.

NPWS (2013) Site synopsis*: Killarney National Park, MacGillycuddy's Reeks and Caragh River Catchment. Site code: 000365*. Site Synopsis report, National Parks and Wildlife Service.

King, J.J., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.F., Kelly, F.L., O' Grady, M.F., Poole, R., Roche, W.K. and Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

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

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600