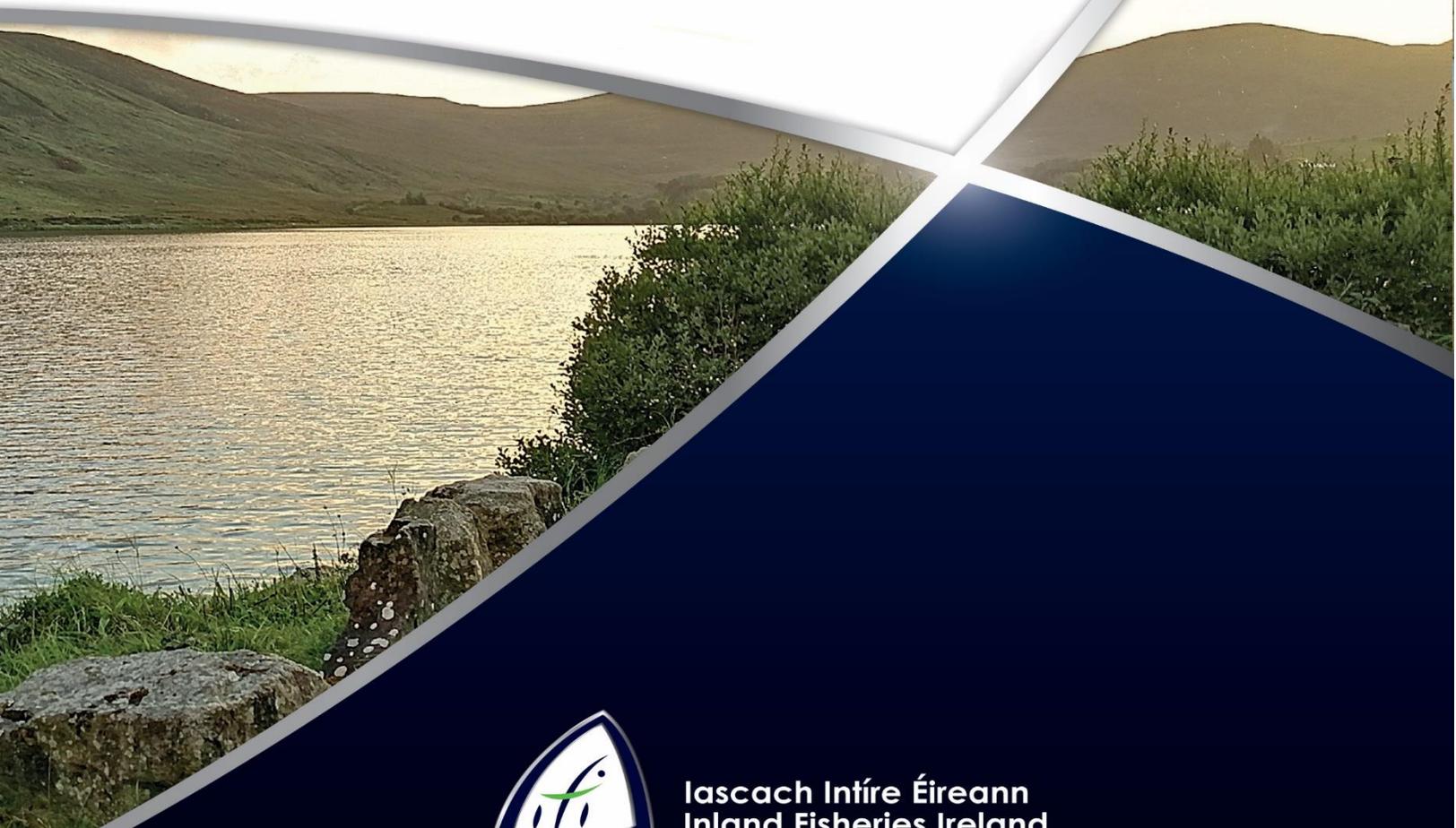


National Research Survey Programme

Lakes 2020

Glen Lough

IFI/2021/1-4551



Iascach Intíre Éireann
Inland Fisheries Ireland



Inland Fisheries Ireland

National Research Survey Programme

**Fish Stock Survey of Glen Lough,
August 2020**

William Corcoran, Lynda Connor, Paul McLoone, Anne Bateman, Daniel Cierpial, Áine Gavin, Paul Gordon, Elliot McCarthy, Dylan Putthaaree, Ciaran Twomey, Ronan Matson, Stephen Robson, Paul Duffy, Kieron Rocks, Róisín Donovan, Danielle Crowley and Fiona L. Kelly.

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

CITATION: 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 Glen Lough, August 2020. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Cover photo: Netting survey on Lough Talt © Inland Fisheries Ireland

© Inland Fisheries Ireland 2020



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 Communications, Climate Action and Environment for 2020.

The report includes Ordnance Survey Ireland data reproduced under OSi Copyright Permit No. MP 007508.

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.
© Ordnance Survey Ireland, 2020.*



1.1 Introduction

Glen Lough is located in the Lackagh catchment, approximately 5km east of Creeslough, Co. Donegal, with Glen village at the northern end of the lake (Plate 1.1, Fig. 1.1). The lake is located approximately 1.5km upstream of the tidal limit of the Lackagh River and approximately 7km downstream of Lough Beagh (Glenveagh) on the Owencarrow River. The lake is situated at an altitude of 27m a.s.l., has a surface area of 168ha, a mean depth of 4.9m and a maximum depth of 21m. Glen Lough falls into typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and low alkalinity (<20mg/l CaCO₃) (EPA, 2005). The geology of the area is predominantly granite, felsite and other intrusive rocks rich in silica.

Glen Lough is encompassed within the Cloghernagore Bog and Glenveagh National Park Special Area of Conservation (SAC). The site supports populations of Atlantic salmon and freshwater pearl-mussel (*Margaritifera margaritifera*); species that are both afforded protected status in Ireland and listed on Annex II of the EU Habitats Directive (NPWS, 2005). Several bird species listed on the Red Data Book and on Annex I of the EU Birds Directive breed within the SAC. Turf cutting and afforestation are the main threats to the SAC, with erosion, over-grazing by sheep and deer and burning also having an impact (NPWS, 2005).

Glen Lough used to be one of the great spring salmon lakes; however, it never really recovered from the effects of the salmon disease Ulcerative Dermal Necrosis (UDN) in the 1960s (O' Reilly, 2007). In 1970 an Inland Fisheries Trust survey revealed the presence of brown trout only in the lake (IFT, unpublished data). A conclusion of the survey was that there was limited spawning in the upper reaches of the tributaries and impassable waterfalls restricting spawning to the lower reaches of the system. The lake is now best known as a sea trout fishery, even though numbers have declined (O' Reilly, 2007).

Glen Lough was previously surveyed in 2006 as part of the NSSHARE Fish in Lakes Project (Kelly *et al.*, 2007). In 2010, 2013 and 2016 Glen Lough was surveyed as part of the WFD monitoring programme (Kelly *et al.*, 2011 and 2014 and 2017). During the 2016 survey brown trout were found to be the dominant species present in the lake. Arctic char, sea trout, eels, minnow and salmon were also captured.

This report summarises the results of the 2020 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme.



Plate 1.1. Glen Lough

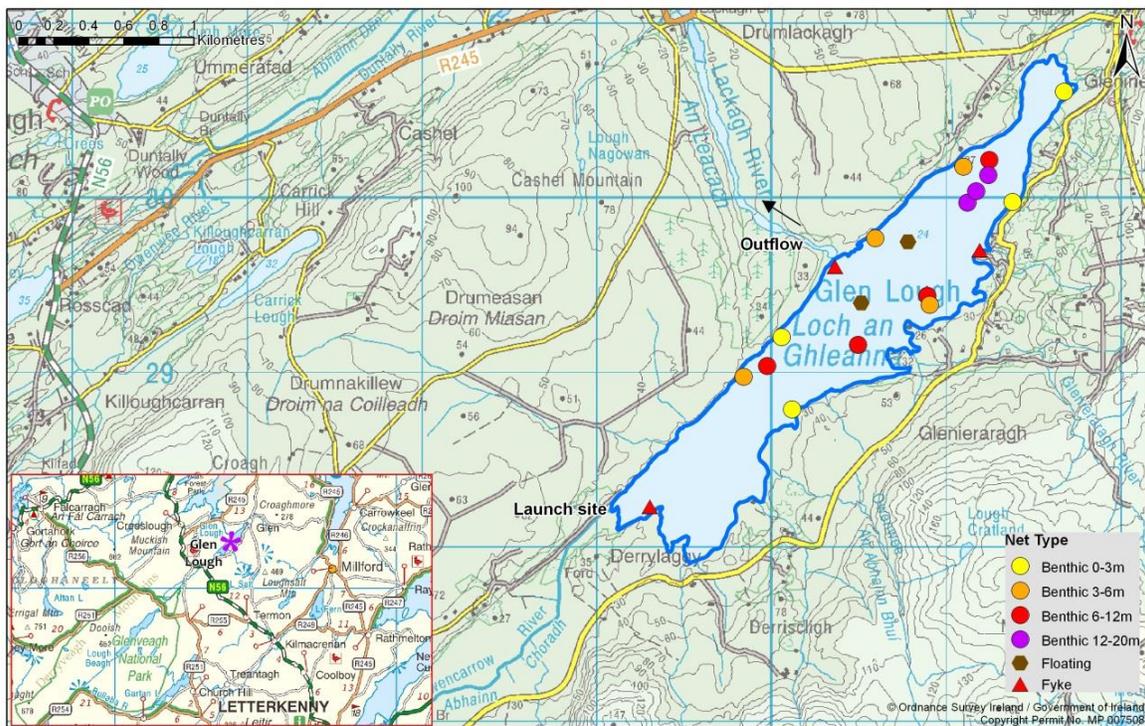


Fig. 1.1. Location map of Glen Lough showing net locations and depths of each net (outflow is indicated on map)



1.2 Methods

1.2.1 Netting methods

Glen Lough was surveyed over two nights from the 26th to the 28th of August 2020. A total of three sets of Dutch fyke nets, 15 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, 4 @ 6-11.9m and 3 @ 12-19.9m) and two floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (20 sites). Nets were deployed in the same locations as were randomly selected in the previous survey. 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 all 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.

1.2.2 Fish diet

Total stomach contents were inspected and individual items were counted and identified to the lowest taxonomic level possible. The percentage frequency occurrence (%O) 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.

1.2.3 Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment in order 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.



1.3 Results

1.3.1 Species Richness

A total of four species were recorded on Glen Lough in August 2020, with 160 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Brown trout was the most common fish species recorded. Arctic char, minnow and eels and were also recorded. During the previous surveys in 2006, 2010, 2013 and 2016 the same species composition was recorded except for sea trout which were recorded in 2006, 2013 and 2106 and salmon which were recorded in 2006, 2010, 2013 and 2016 (Kelly and Connor, 2007 and Kelly *et al.*, 2011, 2014 and 2017).

Table 1.1. Number of each fish species captured by each gear type during the survey on Glen Lough, August 2020

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
<i>Salmo trutta</i>	Brown trout	68	3	4	75
<i>Salvelinus alpinus</i>	Arctic char	33	9	0	42
<i>Phoxinus phoxinus</i>	Minnow	34	0	0	34
<i>Anguilla anguilla</i>	European eel	0	0	9	9

1.3.2 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 2006, 2010, 2013 and 2016 surveys are summarised in Table 1.2. Mean CPUE and BPUE for all species is illustrated in Figure 1.2 and 1.3.

Brown trout

Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE). Mean brown trout CPUE and BPUE remained relatively stable over the five sampling occasions, with a peak in 2013. (Table 1.2; Fig 1.2 and 1.3).



Arctic char

The mean Arctic char CPUE and BPUE has been relatively stable over the most recent surveys (2010-2020). Highest abundance and biomass figures for this species were recorded in the 2006 survey (Table 1.2; Fig 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Glen Lough, 2006 to 2020

Scientific name	Common name	2006	2010	2013	2016	2020
Mean CPUE						
<i>Salmo trutta</i>	Brown trout	0.165 (0.288)	0.137 (0.033)	0.216 (0.053)	0.164 (0.042)	0.122 (0.033)
	Sea trout	0.017 (0.006)	-	0.002 (0.002)	0.003 (0.002)	-
<i>Salvelinus alpinus</i>	Arctic char	0.173 (0.078)	0.081 (0.027)	0.073 (0.023)	0.067 (0.015)	0.070 (0.015)
<i>Phoxinus phoxinus</i>	Minnow	0.010 (0.006)	0.007 (0.004)	0.043 (0.023)	0.022 (0.011)	0.057 (0.023)
<i>Salmo salar</i>	Salmon	0.016 (0.006)	0.002 (0.002)	0.022 (0.011)	0.005 (0.003)	-
<i>Anguilla anguilla</i>	European eel	0.189 (0.049)	0.108 (0.058)	0.083 (0.019)	0.056 (0.015)	0.050 (0.042)
Mean BPUE						
<i>Salmo trutta</i>	Brown trout	19.519 (4.372)	19.451 (6.020)	24.819 (6.069)	21.861 (5.754)	13.835 (3.976)
	Sea trout	3.122 (1.322)	-	0.307 (0.307)	1.041 (0.717)	-
<i>Salvelinus alpinus</i>	Arctic char	8.221 (4.248)	3.802 (1.334)	3.453(1.057)	2.491 (0.545)	4.217 (1.080)
<i>Phoxinus phoxinus</i>	Minnow	0.017 (0.017)	0.019 (0.011)	0.113 (0.055)	0.069 (0.044)	1.260 (1.095)
<i>Salmo salar</i>	Salmon	10.053 (9.997)	0.013 (0.013)	0.321 (0.168)	0.384 (0.323)	-
<i>Anguilla anguilla</i>	European eel	35.887 (10.953)	30.383 (16.950)	14.317 (5.464)	8.418 (1.292)	0.362 (0.362)

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

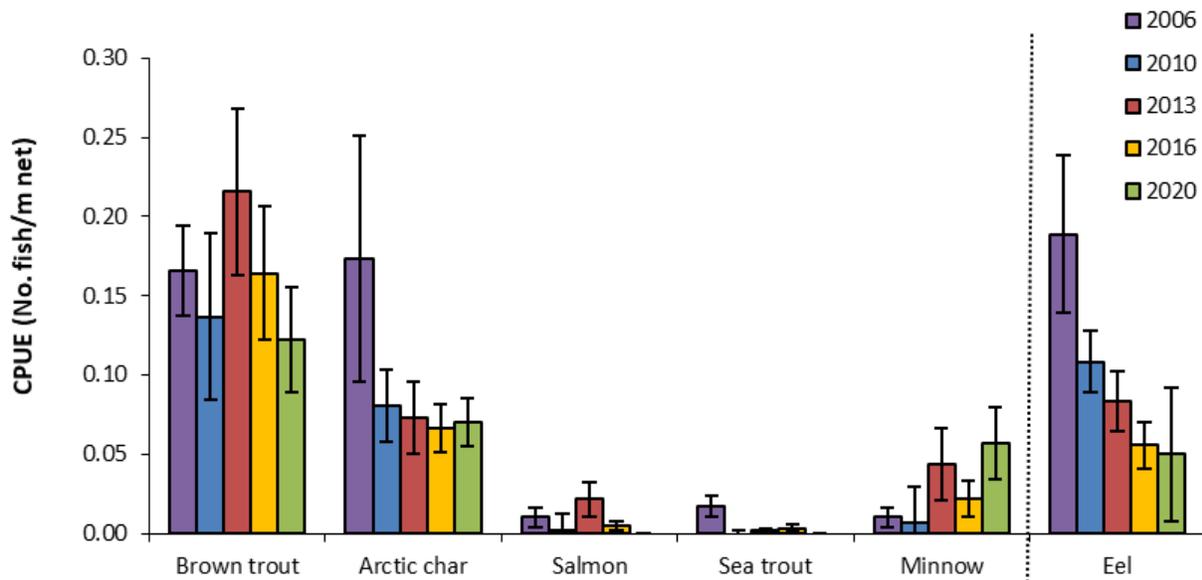


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Glen Lough (Eel CPUE based on fyke nets only), 2006, 2010, 2013, 2016 and 2020

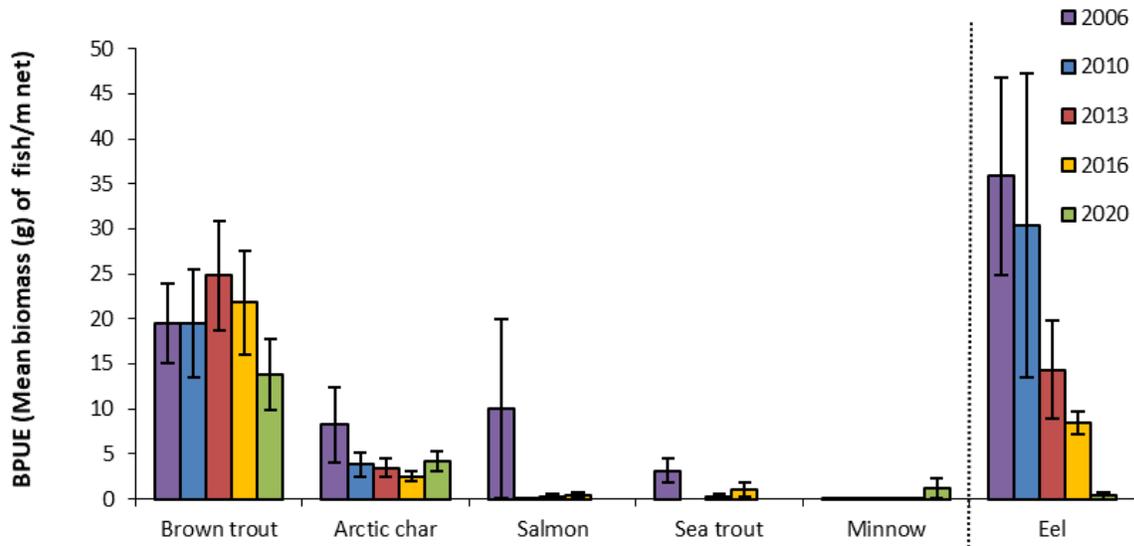


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Glen Lough (Eel BPUE based on fyke nets only), 2006, 2010, 2013, 2016 and 2020

1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2020 survey ranged in length from 10.0cm to 40cm (mean = 20.5cm) (Fig. 1.4). Six age classes were present, ranging from 0+ to 5+. The dominant age class was 3+ (Fig. 1.4). Mean length of trout after their first year (L1) was estimated at 6.6cm. Mean brown trout L4 in 2020 was 23.6cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.3). Brown trout captured during all surveys had broadly similar length and age ranges. Occasional larger and older fish have been recorded (Fig.1.4).

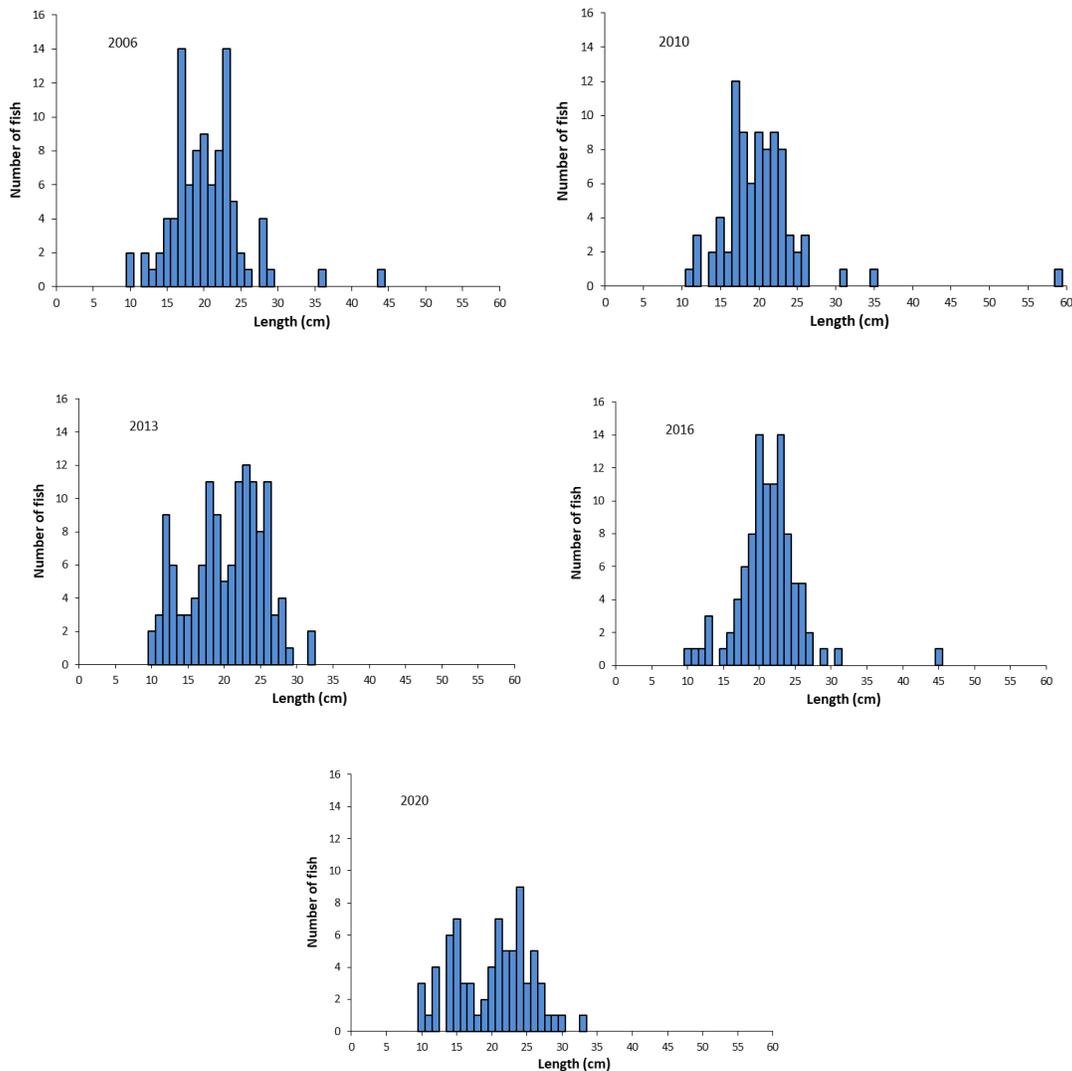


Fig. 1.4. Length frequency of brown trout captured on Glen Lough, 2006, 2010, 2013, 2016 and 2020



Table 1.3. Mean (\pm S.E.) brown trout length (cm) at age for Glen Lough, August 2020

	L ₁	L ₂	L ₃	L ₄	L ₅	Growth Category
Mean (\pm S.E.)	6.6 (0.2)	13.1 (0.4)	18.6 (0.3)	23.67 (0.4)	26.8 (0.8)	Slow
N	52	39	27	8	4	
Range	3.9-10.3	8.2-17.7	15.2-22.0	21.8-25.4	25.4-28.7	

Arctic char

Arctic char captured during the 2020 survey ranged in length from 6.9cm to 23.2cm (mean = 15.7cm) (Fig.1.5). Six age classes were present, ranging from 0+ to 6+. No 1+ fish were recorded in the survey. The dominant age class in Glen Lough was 3+. Arctic char captured during the previous surveys had a similar length and age range. However, no fish between 9 and 13cm were captured during 2020. This size corresponds to the 1 year old cohort which were not captured in 2020. (Fig.1.5).

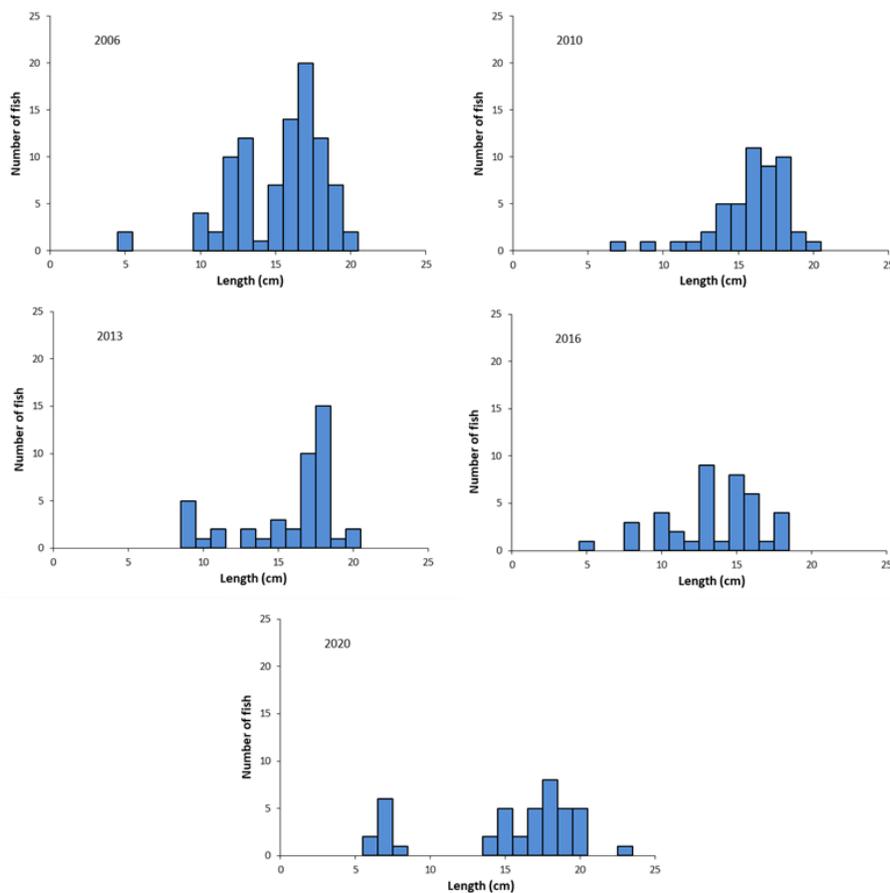


Fig. 1.5. Length frequency of Arctic char captured on Glen Lough, 2006, 2010, 2013, 2016 and 2020

Other fish species

Eels captured during the 2020 survey ranged in length from 32.5cm to 58.0cm. Minnow ranged in length from 5.2cm to 9.0cm.

1.3.4 Stomach and diet analysis

Dietary analysis studies provide an indication of the availability of food items and the angling methods that are likely to be successful. The stomach contents of a subsample of brown trout captured during the survey were examined and are presented below.

Brown trout

Adult trout usually feed principally on crustaceans (*Asellus* sp. and *Gammarus* sp.), insects (principally chironomid larvae and pupae) and molluscs (snails) (Kennedy and Fitzmaurice, 1971, O'Grady, 1981). A total of 41 stomachs were examined. Of these 14 were empty. Invertebrates were the sole dietary item consumed by 15 fish (55.6%). Invertebrates were recorded with unidentified digested material (DM), plant matter and fish in 4 (15%), 3 (11%) and 1 (4%) brown trout stomachs respectively. Fish were recorded in two (8%) brown trout stomachs, and were the sole dietary item found in one (4%) stomach (Fig. 1.6).

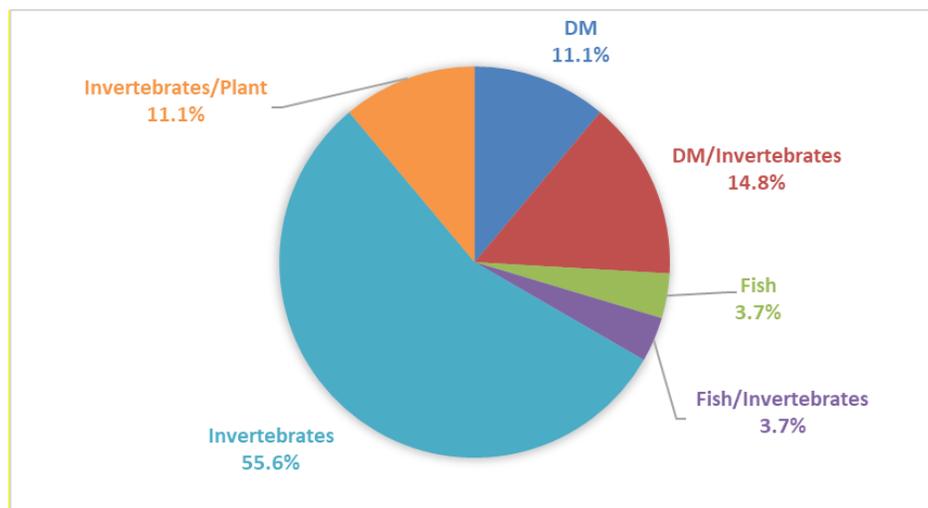


Fig 1.6. Diet of brown trout (n=27) captured on Glen Lough, 2020 (% FO)

Arctic Char

A total of 28 Arctic char stomachs were examined. 20 of these stomachs were found to be empty. Of the eight stomachs found to contain food, 87.5% contained invertebrates and 12.5% contained unidentified digested material (Fig. 1.7).

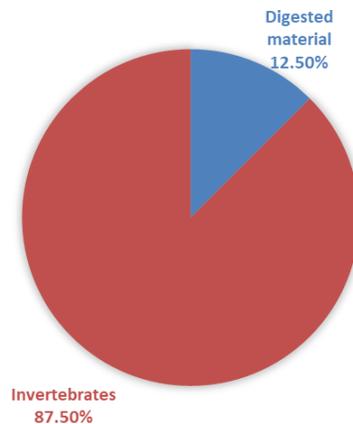


Fig 1.7. Diet of Arctic char (n=8) captured on Glen Lough, 2020 (% occurrence)

1.4 Summary and ecological status

A total of four fish species were recorded on Glen Lough in the August 2020 survey.

Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets. Both CPUE and BPUE have remained relatively stable across all surveys from 2006 to 2020. Six age classes were present, ranging from 0+ to 5+, indicating reproductive success in each of the previous six years. The dominant age class was 3+. Length at age analyses revealed that brown trout in the lake exhibit a slow rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971). Invertebrates were the main food item in stomachs of brown trout captured during the survey.

The mean Arctic char CPUE and BPUE has remained relatively stable in recent surveys, following an apparent (but statistically insignificant) decline compared to the 2006 survey. Arctic char ranged in age from 0+ to 6+. However, no 1+ fish (i.e. from the 2018/9 winter spawning) were recorded. This indicates Arctic char successfully spawned in five of the last six years.

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.*, 2012b).

Using the FIL2 classification tool, Glen Lough has been assigned an ecological status of High for 2020 based on the fish populations present. The lake was also assigned High status in 2006, 2010, 2013 and 2016 (Fig. 1.8).

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Glen Lough an overall ecological status of Good.

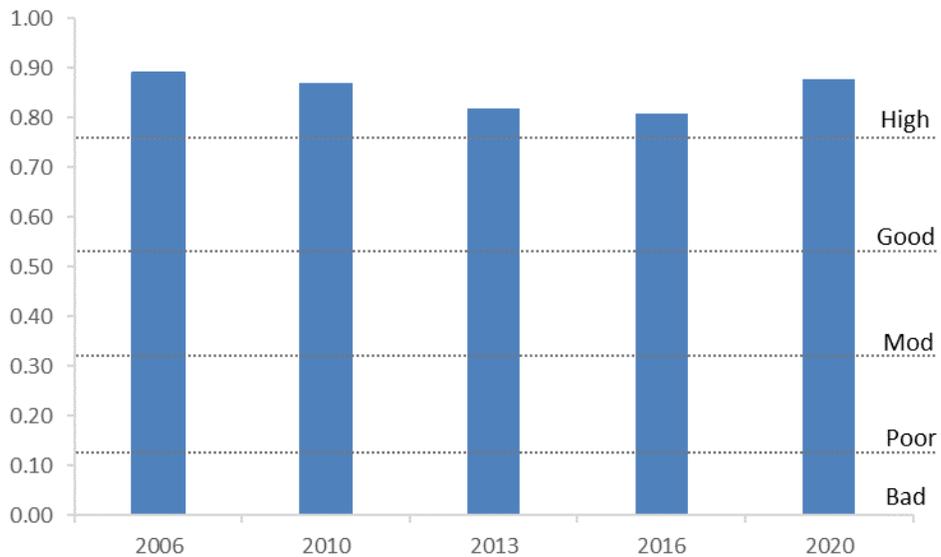


Fig. 1.8. Fish ecological status of Glen Lough, 2006, 2010, 2013, 2016 and 2020



1.5 References

- Amundsen P-A, Gabler H-M, Staldivik FJ. (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.
- EPA (2005) Submission in accordance with Article 5 of Directive 2000/60/EC of the European Parliament and of the Council of 23rd October 2000 establishing a framework for community action in the field of water policy, and in accordance with EC-DE Environment D.2 document “Reporting Sheets for 2005 Reporting” dated 19 November 2004. Version 2. May 2005. Prepared by the Office of the Environment Assessment EPA, Johnstown Castle, Wexford.
- Kelly, F.L. Connor, L. and Champ, W.S.T. (2007) *A Survey of the Fish Populations in 46 lakes in the Northern Regional Fisheries Board, June to September 2005 and 2006*. North South Shared Aquatic Resource (NS Share) Lakes Project.
- 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, NSSHARE project.
- Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., Wogerbauer, C., Feeney, R., O’Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland.
- Kelly, F.L., Harrison A., Connor, L., Morrissey, E., Wogerbauer, C., Matson, R., Feeney, R., O’Callaghan, R. and Rocks, K. (2011) *Water Framework Directive Fish Stock Survey of Glen Lough, August 2010*. Inland Fisheries Ireland.
- Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012) 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., Matson, R., Feeney, R. and Rocks, K. (2014) *Water Framework Directive Fish Stock Survey of Glen Lough, August 2013*. Inland Fisheries Ireland.
- Kelly, F.L., Connor, L., Coyne, J., Morrissey, E., Corcoran, W., Cierpial, D., Delanty, K., McLoone, P., Matson, R., Gordon, P., O’ Briain, R., Rocks, K., O’ Reilly, S., Kelly K., Puttharee, D., McWeeney, D., Robson S.



and Buckley, S. (2017) *Fish Stock Survey of Glen Lough, August 2016*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Kennedy, M. and Fitzmaurice, P. (1971) Growth and food of brown trout *Salmo Trutta* (L.) in Irish waters. *Proceedings of the Royal Irish Academy*, **71(B) (18)**, 269-352.

NPWS (2005) *Site synopsis: Cloghernagore Bog and Glenveagh National Park. Site code: 002047*. Site Synopsis report, National Parks and Wildlife Service.

O' Grady, M.F. (1981). *A study of brown trout (Salmo trutta L.) populations in selected Irish lakes*. Ph.D. Thesis, National University of Ireland.

O' Reilly P. (2007) *Loughs of Ireland. A Flyfisher's Guide*. 4th Edition. Merlin Unwin Books.

**Inland Fisheries Ireland
3044 Lake Drive,
Citywest Business Campus,
Dublin 24,
Ireland.
D24 Y265**

**www.fisheriesireland.ie
info@fisheriesireland.ie**

+353 1 8842 600

