National Research Survey Programme

Lakes 2020

Lough Beagh

IFI/2021/1-4548

Iascach Intíre Éireann
Inland Fisheries Ireland

Inland Fisheries Ireland

National Research Survey Programme

Fish Stock Survey of Lough Beagh, August/September 2020

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 Lough Beagh, 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 authors would also like to thank National Parks and Wildlife service (NPWS) and their staff in Glenveagh National Park for facilitating access and providing assistance during the survey.

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

Lough Beagh is situated in a remote valley in the Lackagh catchment, within the Glenveagh National Park, 24 kilometres north-west of Letterkenny, Co. Donegal (Fig. 1.1). A visitor's centre is located near the northern shore of the lake and a castle is located on the eastern shore. Lough Beagh is volcanic in origin. It is a long, narrow lake, approximately 6.5 kilometres in length and 0.8 kilometres wide. The lake is surrounded by mountains on three sides (including the Derryveagh and Glendowan Mountains on the south, east and west side respectively) (Plate 1.1 and Fig. 1.1).

The lake has a surface area of 261ha, a mean depth of 9.2m and a maximum depth of 46.5m. The altitude of the lake is 45.3m above sea level. The lake is classed as 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). Lough Beagh was characterised as 2b (i.e. expected to meet good status by 2015) in the WFD Characterization report (EPA, 2005). The geology of the area is predominantly granite, felsite and other intrusive rocks rich in silica.

The lake holds brown trout, and occasional salmon. Sea trout arrive into the lake during August (O' Reilly, 1987). Arctic char are also present in the lake. The lake was surveyed by Inland Fisheries Ireland (previously the Central Fisheries Board and Northern Regional Fisheries Board) in 1989, 1994 and 1995. In 2005, the lake was again surveyed using the current WFD lake sampling methodology as part of the cross border Interreg IIIA funded NS Share "Fish in Lakes" project by Inland Fisheries Ireland and the Agri-Food and Biosciences Institute Northern Ireland (AFBINI) (Kelly *et al*., 2007). Subsequently Lough Beagh was surveyed in 2008, 2011, 2014 and 2017 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009, 2012a, 2015a, 2015b and Connor *et al* 2018). During the 2017 survey, brown trout were found to be the dominant species present in the lake. Arctic char, sea trout, salmon, minnow and eels were also captured during the survey.

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 and IFI's Arctic char and brown trout research programmes.

Plate 1.1. View of Lough Beagh (Glenveagh)

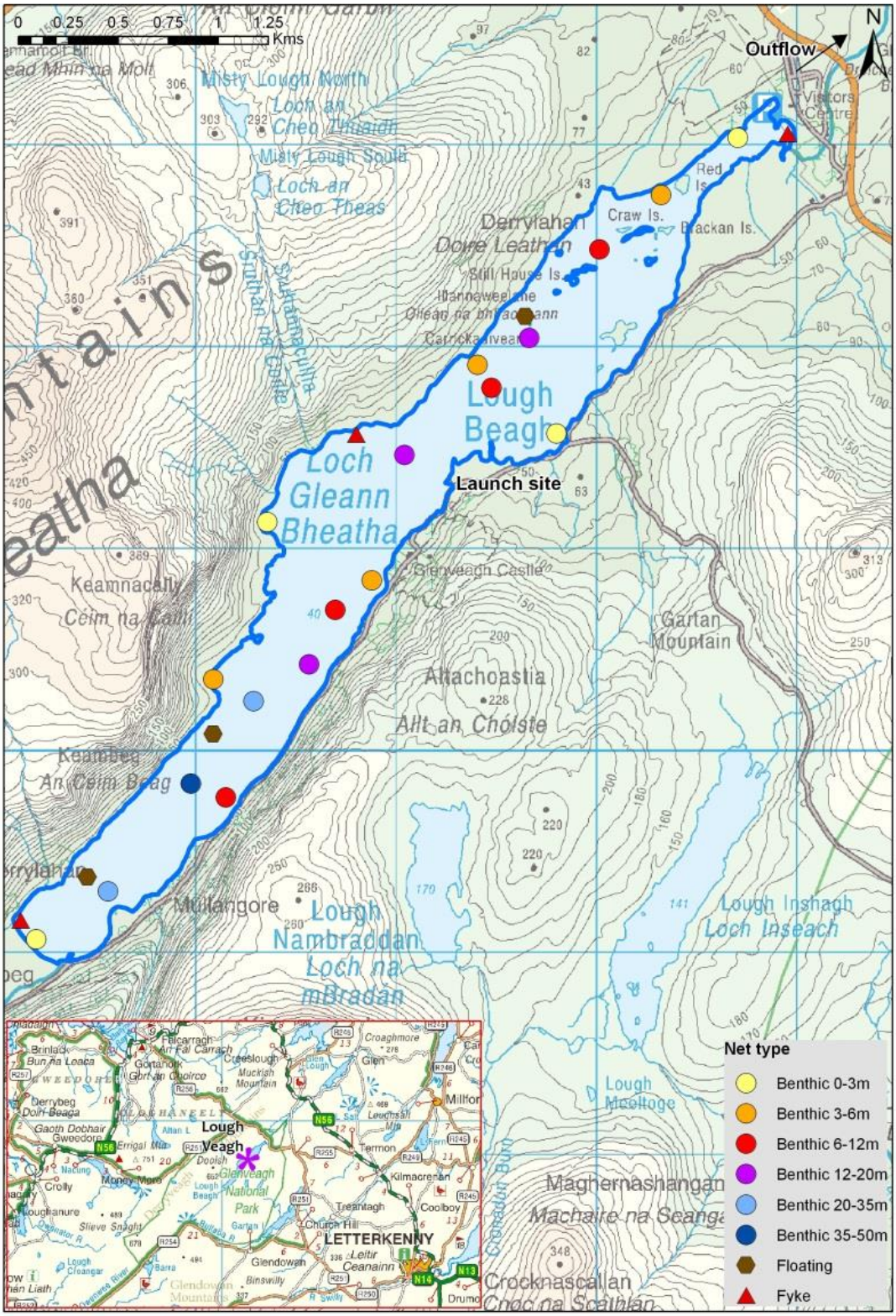

Fig. 1.1 Location map of Lough Beagh showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Lough Beagh was surveyed over three nights, from the 17th to the 19th of August and from the 31st of August to the 1st of September. A total of three sets of Dutch fyke nets, 18 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, 3 @ 12-19.9m, 2 @ 20-34.9m and 1 @ 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 (24 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, Arctic char, salmon and sea trout. 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 (%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.

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 fish species (sea trout are included as a separate 'variety' of trout) were recorded on Lough Beagh in August 2020. A total of 235 fish were captured. The number of each species captured by each gear type is shown in Table 1.1. Brown trout was the most abundant fish species recorded, followed by Arctic char, minnow, eels and sea trout. During the previous surveys the same species composition was recorded except for salmon which were captured in 2011, 2014 and 2017 (Kelly *et al*., 2009, 2012a, 2015a, 2015b and Connor *et al* 2018).

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

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Salmo trutta	Brown trout	150	3	11	164
	Sea trout	3	0	0	3
Salvelinus alpinus	Arctic char	28	2	0	30
Phoxinus phoxinus	Minnow	29	1	0	30
Anguilla anguilla	Eel	0	0	8	8

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 2020 and previous surveys are summarised in Table 1.2 and illustrated in Figures 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 has been relatively stable over the five sampling occasions (Table 1.2; Fig 1.2 and 1.3). Mean CPUE increased between 2008 and 2014 before decreasing in 2017, mean CPUE then increased in 2020.

Mean brown trout BPUE increased between 2017 and 2020. Mean BPUE had decreased between 2014 and 2017 having previously increased steadily between 2008 and 2014 (Table 1.2; Fig 1.2 and 1.3).

Arctic char

The mean Arctic char CPUE and BPUE also fluctuated slightly over the five sampling occasions. The highest CPUE and BPUE recorded was in 2014. Both CPUE and BPUE increased between 2008 and 2014 but decreased slightly between 2017 and 2020 (Table 1.2; Fig 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Beagh, 2008, 2011, 2014, 2017 and 2020.

Scientific name	Common name	2008	2011	2014	2017	2020
				Mean CPUE (±S.E.)		
Salmo trutta	Brown trout	0.126 (0.026)	0.211 (0.044)	0.318 (0.680)	0.164 (0.039)	0.220 (0.059)
	Sea trout	0.002 (0.001)	0.007 (0.004)	0.0139 (0.007)	0.007 (0.004)	0.004 (0.003)
Salvelinus alpinus	Arctic char	0.024 (0.008)	0.065 (0.017)	0.065 (0.017)	0.044 (0.013)	0.042 (0.011)
Phoxinus phoxinus	Minnow	-	0.008 (0.005)	0.074 (0.023)	0.017 (0.011)	0.042 (0.019)
Salmo salar	Salmon	-	0.001 (0.001)	0.003 (0.002)	0.002 (0.002)	-
*Anguilla anguilla**	Eel*	0.027 (0.011)*	0.022 (0.014)*	0.061 (0.039)*	0.061 (0.006)*	0.044 (0.014)
				Mean BPUE (±S.E.)		
Salmo trutta	Brown trout	12.794 (3.112)	28.553 (7.421)	34.651 (6.753)	19.960 (4.984)	26.579 (7.861)
	Sea trout	0.646 (0.589)	2.708 (1.926)	6.138 (4.037)	2.999 (2.105)	2.262 (1.912)
Salvelinus alpinus	Arctic char	0.669 (0.314)	1.958 (0.495)	2.891 (0.804)	2.141 (0.654)	1.731 (0.458)
Phoxinus phoxinus	Minnow	-	0.022 (0.013)	0.173 (0.052)	0.038 (0.024)	0.096 (0.045)
Salmo salar	Salmon	-	4.967 (4.967)	0.038 (0.027)	0.042 (0.035)	-
*Anguilla Anguilla**	Eel*	7.033 (2.666)*	2.572 (1.317)*	6.961 (4.968)*	7.658 (1.175)*	5.107 (1.476)

Note: On the rare occasion 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

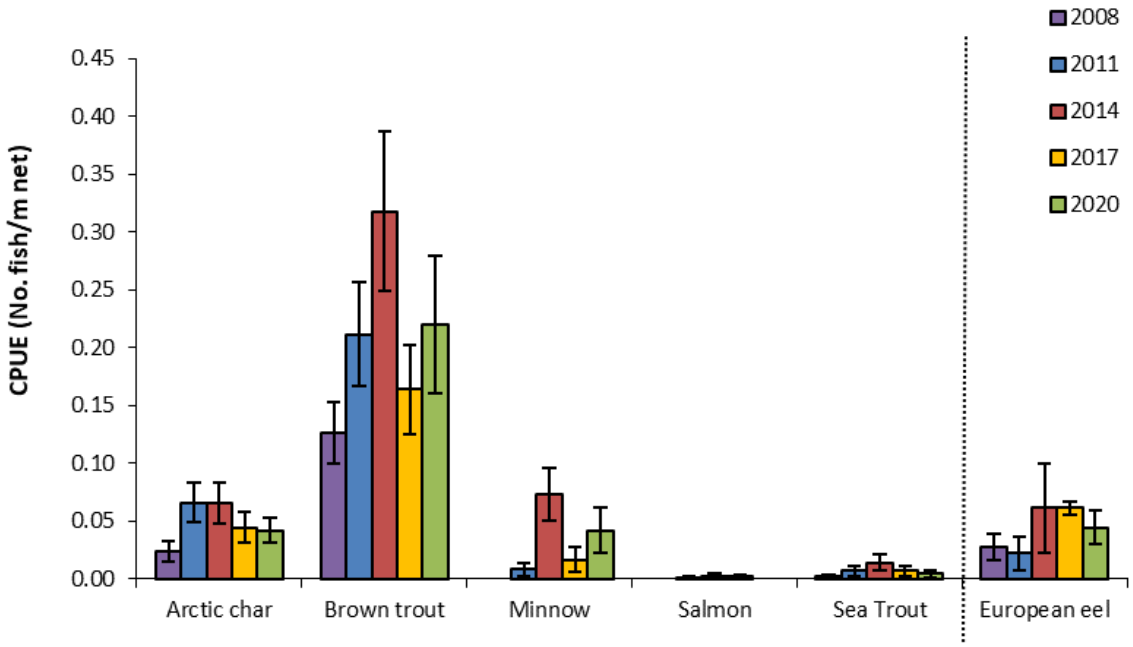

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Beagh (Eel CPUE based on fyke nets only), 2008, 2011, 2014, 2017 and 2020.

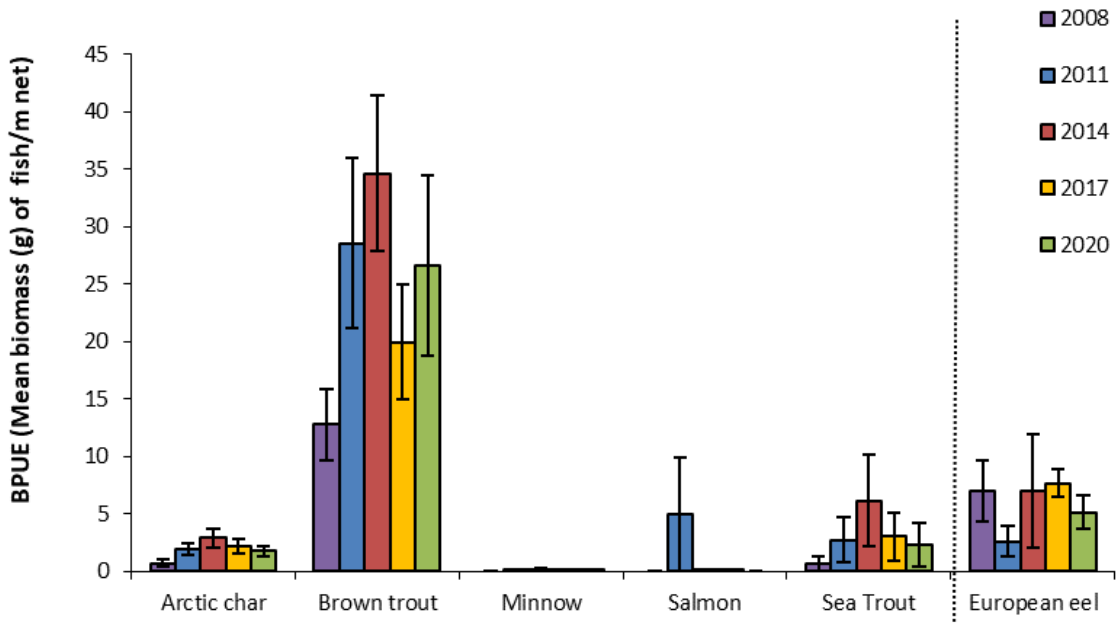

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Beagh (Eel BPUE based on fyke nets only), 2008, 2011, 2014, 2017 and 2020.

1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2017 survey ranged in length from 7.0cm to 50.2cm (mean = 20.6) (Fig. 1.4). Five age classes were present, ranging from 0+ to 4+. The dominant age class was 2+ (Fig. 1.4). Mean length of one year old brown trout (L1) was estimated at 8.0cm (Table 1.3). Mean brown trout L4 in 2020 was 24.7cm, 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 the 2008, 2011, 2014 and 2017 surveys had similar length and age ranges compared to the 2020 results (Fig.1.4). A 50.2 cm trout captured in 2020 was the largest specimen observed across all surveys.

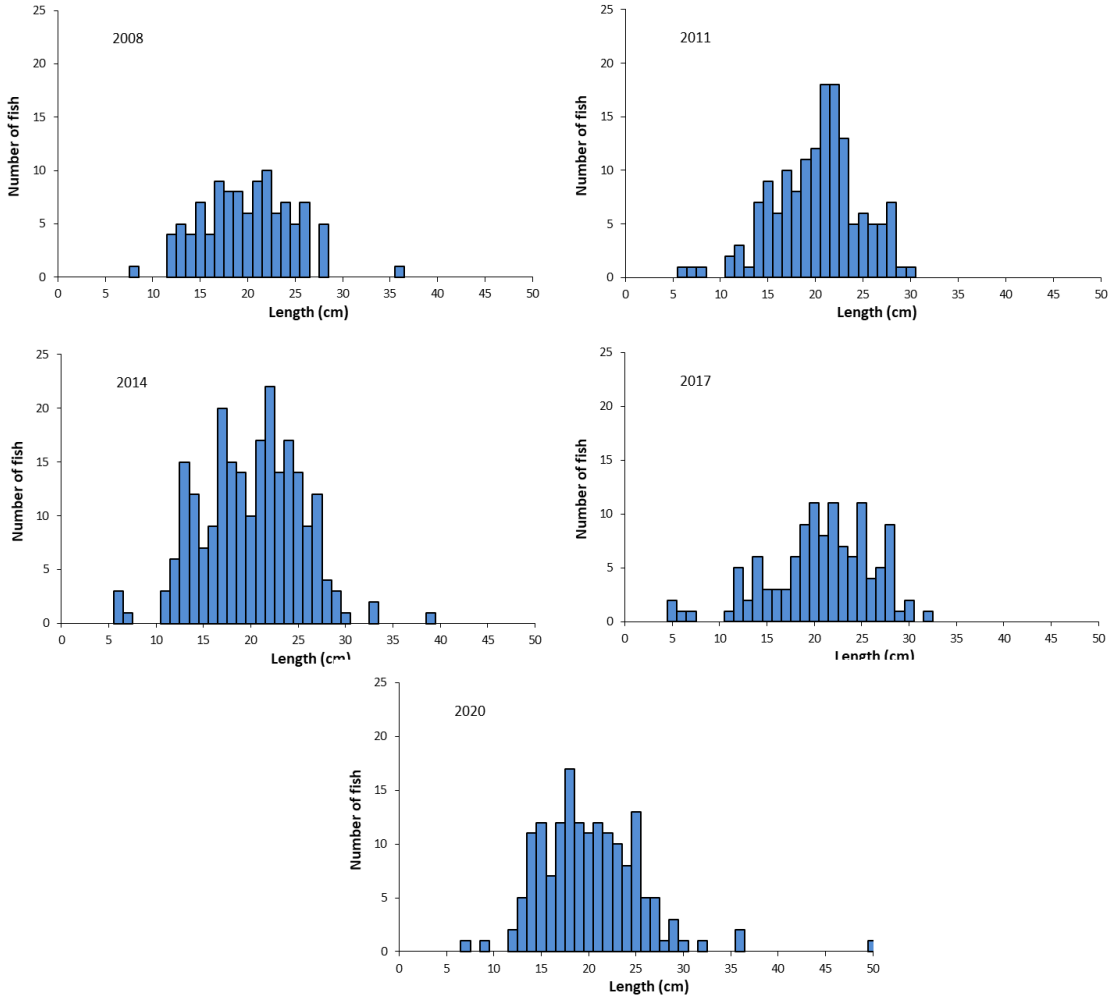

Fig. 1.4. Length frequency of brown trout captured on Lough Beagh, 2008, 2011, 2014, 2017 and 2020

Table 1.3. Mean (±S.E.) brown trout length (cm) at age for Lough Beagh, July/August 2020

	L_1	L_2	L_3	L_4	Growth Category
Mean (±S.E.)	8.0 (0.2)	15.8 (0.3)	21.5 (0.4)	24.7 (0.5)	Slow
N	77	51	20	3	
Range	4.3-13.3	10.5-21.1	17.5-26.6	23.4-25.4	

Plate 1.2.Lough Beagh, September 2020

Arctic char

Arctic char captured during the 2020 survey ranged in length from 5.8cm to 19.2cm (mean = 14.6cm) with six age classes present, ranging from 0+ to 5+ (Fig.1.5). Arctic char captured during the 2020 survey had a broadly similar length range compared to previous surveys, but the 2011 and 2020 surveys captured more juvenile fish compared to those in 2008, 2014 and 2017 (Fig 1.5).

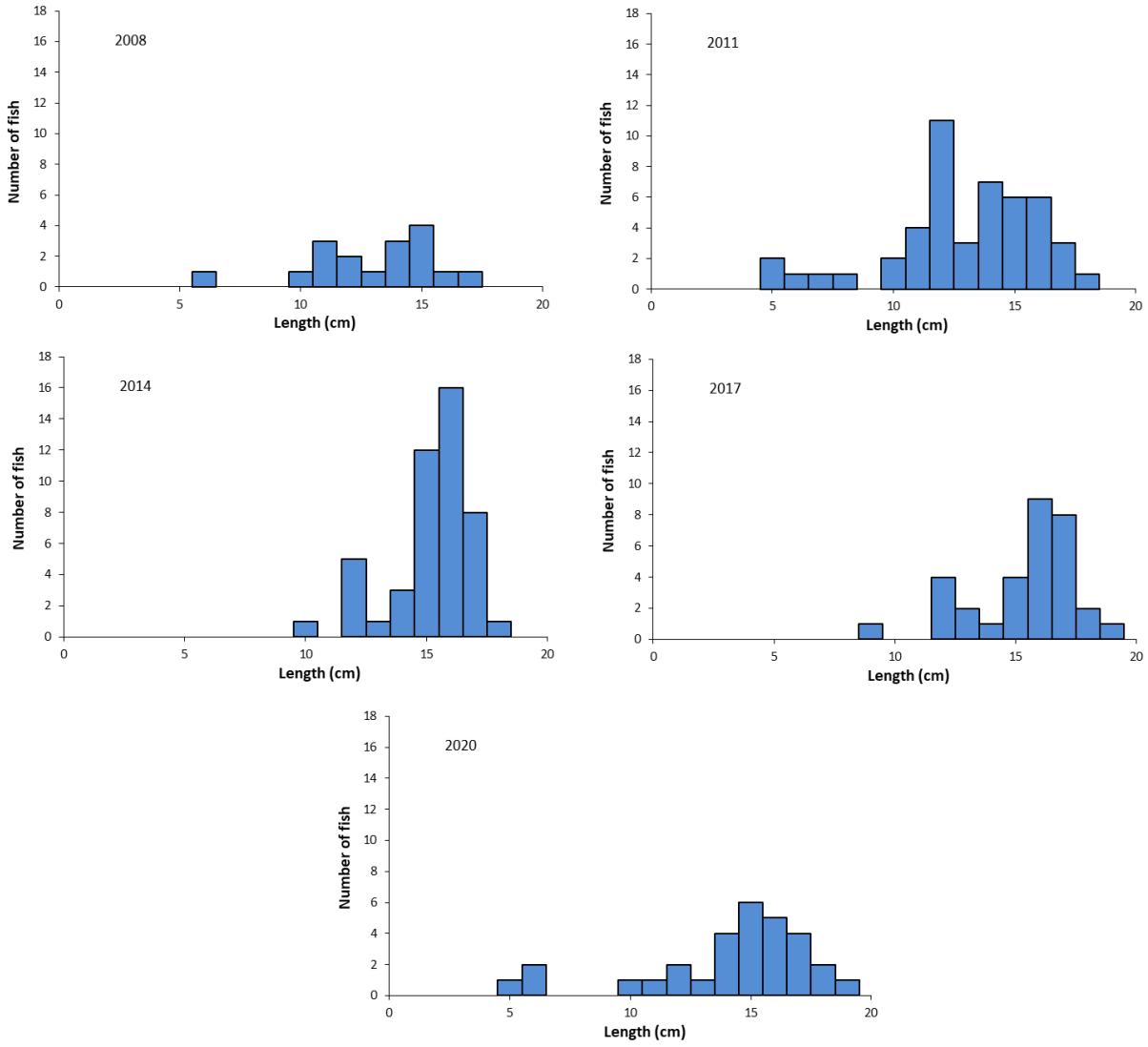

Fig. 1.5. Length frequency of Arctic char captured on Lough Beagh, 2008, 2011, 2014, 2017 and 2020

Other fish species

Sea trout ranged in length from 29.1cm to 38.2cm and ages ranged from 2.1+ (migrated to the sea at 2 years, before returning one year later) to 3.1+(migrated to the sea at 3 years, before returning one year later). Eels captured during the 2020 survey ranged in length from 38.0cm to 44.6cm. Minnow ranged in length from 5.4cm to 7.3cm.

1.3.4 Stomach and diet analysis

The stomach contents of a subsample of brown trout and Arctic char 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 78 stomachs were examined. Of these 54 were found to contain no prey items. Of the remaining 24 stomachs containing food, 13 brown trout stomachs (c. 55%) contained fish. Eight (33%) contained only fish, while five (21%) contained both fish and invertebrates. Six stomachs (25%) contained invertebrates, while both invertebrates and zooplankton were recorded in three (13%) stomachs. Zooplankton was the only prey item recorded in three (8%) brown trout stomachs (Fig. 1.6).

Arctic char

A total of 21 Arctic char stomachs were examined. Of these, 11 were empty. Of the ten stomachs which contained food, four (40%) contained invertebrates exclusively, while one (10%) contained both invertebrates and zooplankton. Zooplankton was the only prey item recorded in ten (44%) Artic char stomachs (Fig. 1.7).

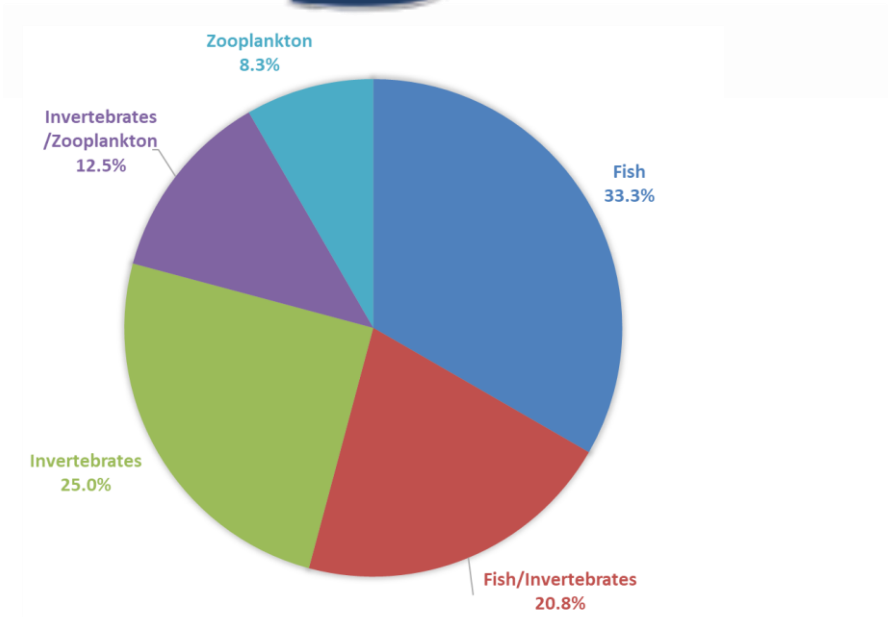

Fig 1.6. Diet of brown trout (n=24) captured on Lough Beagh, 2020 (% FO)

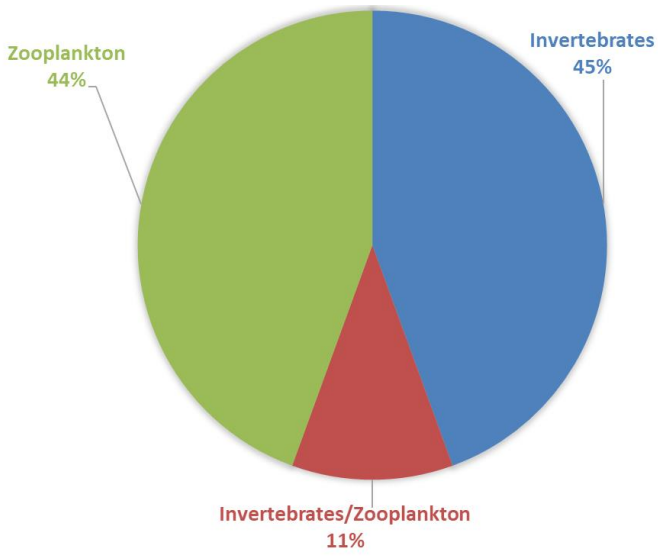

Fig 1.7. Diet of Arctic char (n=10) captured on Lough Beagh, 2020 (% FO)

1.4 Summary and ecological status

A total of four fish species (sea trout are included as a separate 'variety' of trout) were recorded on Lough Beagh in August/September 2020. Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE). Mean brown trout CPUE and BPUE fluctuated across the five surveys completed between 2008 and 2020. Brown trout ranged in age from 0+ to 4+, indicating reproductive success in the previous five years. The dominant age class was 2+. 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).

The mean Arctic char CPUE and BPUE has remained relatively stable in Lough Beagh across the five sampling seasons. Arctic char ranged in age from 0+ to 5+, indicating reproductive success in the previous six years. The dominant age class of Arctic char was 3+.

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*., 2012b).

Using the FIL2 classification tool, Lough Beagh has been assigned an ecological status of High for 2020 based on the fish populations present. Lough Beagh was also assigned a High status in 2017 and 2008, while in 2008 and 2011 it was assigned Good status (Fig 1.8).

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

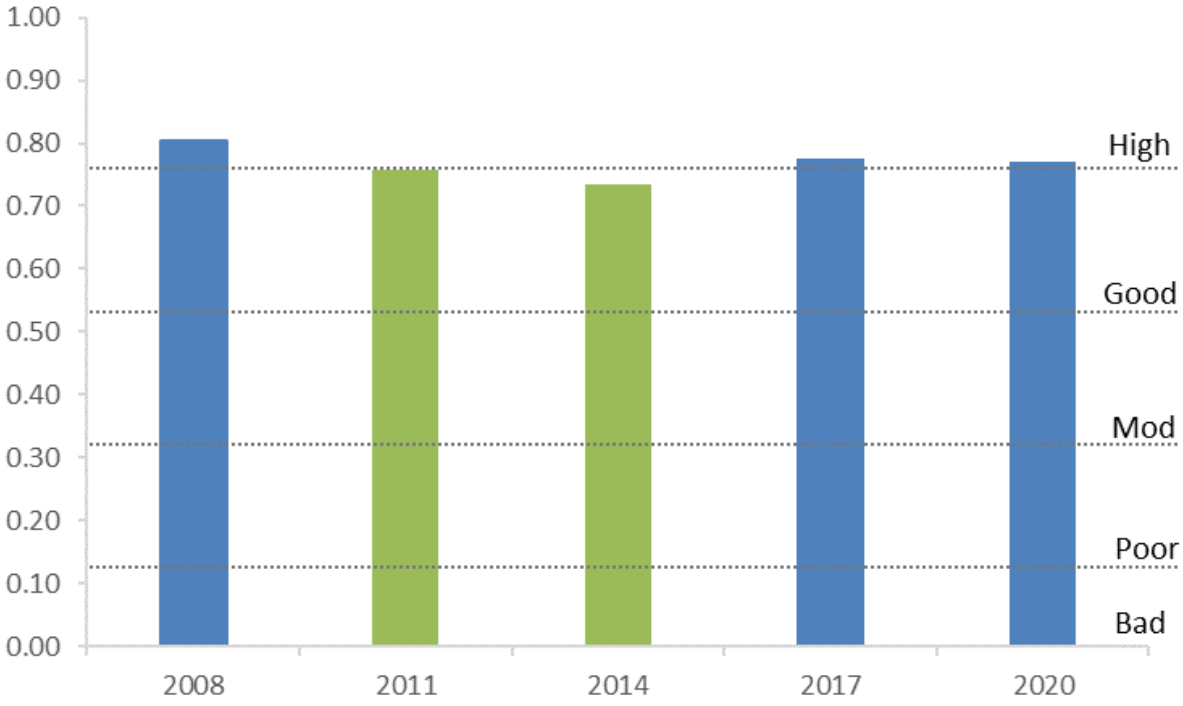

Fig. 1.8. Fish ecological status of Lough Beagh, 2008, 2011, 2014, 2017 and 2020

1.5 References

Amundsen, P.A., Gabler H.M., 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.

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 Beagh, July/August 2017*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

EPA (2005) *The Characterisation and Analysis of Ireland's River Basin Districts in accordance with section 7 (2&3) of the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).* National Summary Report (Ireland). 166pp.

Kelly, F., Connor, L. and Champ T. (2007) *A Survey of the Fish Populations in 46 lakes in the Northern Regional Fisheries Board, June to September 2005 and 2006*. (Central Fisheries Board, unpublished report).

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) *Sampling fish for the Water Framework Directive – Summary report 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 Beagh, 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. and Rocks, K. (2015a) *Sampling Fish for the Water Framework Directive – Summary Report 2014*. Inland Fisheries Ireland.

Kelly, F.L., Connor, L., Morrissey, E., Coyne, J., Feeney, R., Matson, R. and Rocks, K. (2015b) *Water Framework Directive Fish Stock Survey of Lough Beagh, July 2014*. Inland Fisheries Ireland.

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.

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. (1987) *Trout and Salmon Loughs of Ireland, A Fisherman's Guide*. UK. Unwin Hyman.

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

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600