National Research Survey Programme

Lakes 2016

Kylemore Lough

IFI/2017/1-4361

Iascach Intíre Éireann
Inland Fisheries Ireland

Inland Fisheries Ireland

National Research Survey Programme

Fish Stock Survey of Kylemore Lough, August 2016

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

CITATION: 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 Kylemore Lough, August 2016. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

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

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 thank the fishery owners for granting access during the survey.

The authors would also like to acknowledge the funding provided for the project from the Department of Communications, Climate Action and Environment for 2016.

1.1 Introduction

Kylemore Lough is the largest of the three lakes, situated in the Dawros catchment in Co. Galway, approximately 5km north-east of Letterfrack, Co. Galway (Plate 1.1, Fig. 1.1). It has a surface area of 134ha, a mean depth of > 4m, a maximum depth of 30m and 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 $CaCO_3$). The lake has a stock of brown trout, Arctic char and gets a run of salmon and sea trout from June to the end of the angling season (O' Reilly, 2007).

Kylemore Lough is situated within the Twelve Bens/Garraun Complex Special Area of Conservation (SAC). This is an extensive site located in the north-west of Connemara and is dominated by mountainous terrain. Geologically, the site can be divided into two distinct sections; the Twelve Bens which are composed of quartzite and schists in the valleys and the mountains to the north of Kylemore which are composed of gneiss, sandstones and mudstones (NPWS, 2005). The main soil type within the site is peat. Eight of the habitat types listed in the SAC are found in Annex I of the EU Habitats Directive. The SAC also contains the following species listed on Annex II of the Habitats Directive - freshwater pearl mussel, Atlantic salmon, otter and the plant, slender naiad (NPWS, 2005).

Kylemore Lough was previously surveyed in 2007, 2010 and 2013 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007 and Kelly *et al*., 2011 and 2014). Brown trout were found to be the dominant species present on the lake in all survey years. Sea trout, Arctic char, salmon, minnow and eels were also captured during the surveys. No salmon were recorded during the 2010 survey.

Plate 1.1. Kylemore Lough

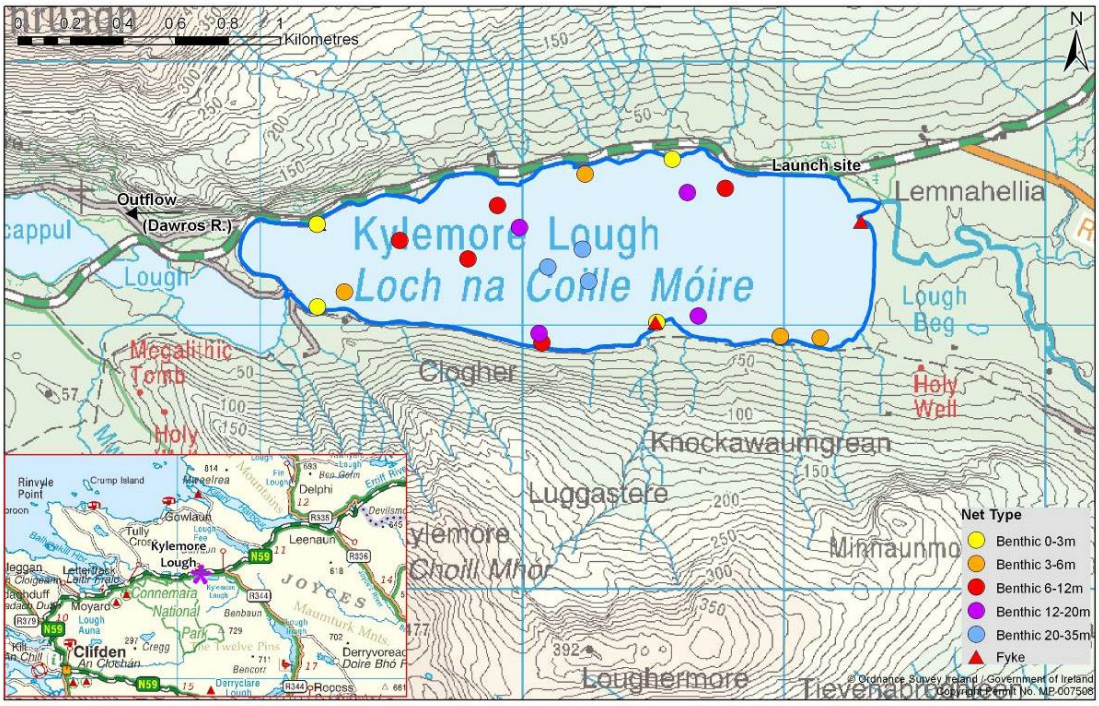

Fig. 1.1. Location map of Kylemore Lough showing net locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Kylemore Lough was surveyed over two nights from the 15th to the 17th of August 2016. A total of three sets of Dutch fyke nets, 20 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, 5 @ 6-11.9m, 4 @ 12-19.9m and 3 @ 20-34.9m) and two floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (25 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, salmon and Arctic char. 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.

1.2.2 Fish diet

Fish were frozen before being dissected for stomach content analysis in the IFI laboratory. 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).

$$\%O_i = (N_i / N) \times 100$$

Where:

$\%O_i$ is the percentage frequency of prey item i,
N_i is the number of a particular species with prey i in their stomach,
N is total number of a particular species 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 five fish species, including three types of trout (brown trout, ferox trout and sea trout) were recorded in Kylemore Lough in August 2016, with 151 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, followed by Arctic char and sea trout. During the previous surveys in 2007, 2010 and 2013 the same species composition was recorded with the exception of salmon which were not recorded in 2010 (Kelly and Connor, 2007 and Kelly *et al*., 2011 and 2014).

Table 1.1. Number of each fish species captured by each gear type during the survey on Kylemore Lough, August 2016

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Salmo trutta	Brown trout	87	1	1	89
	Sea trout	19	1	0	20
	Ferox trout	2	0	0	2
Salvelinus alpinus	Arctic char	25	0	0	25
Salmo salar	Atlantic salmon	6	0	1	7
Phoxinus phoxinus	Minnow	4	0	0	4
Anguilla anguilla	European eel	0	0	4	4

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 2007, 2010, 2013 and 2016 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). Although the mean brown trout CPUE fluctuated slightly over the four sampling occasions, these differences were not statistically significant (Table 1.2; Fig 1.2 and 1.3). There were also no significant differences in mean BPUE across the four sampling years, although the BPUE fluctuated slightly.

Arctic char

The mean Arctic char CPUE and BPUE also fluctuated slightly over the four sampling occasions; however, these differences were not statistically significant (Table 1.2; Fig 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Kylemore Lough, 2007 to 2016

Scientific name	Common name	2007	2010	2013	2016
			Mean CPUE		
Salmo trutta	Brown trout*	0.120 (0.028)	0.058 (0.019)	0.115 (0.028)	0.122 (0.028)
	Sea trout	0.029 (0.009)	0.008 (0.004)	0.021 (0.007)	0.027 (0.009)
Salvelinus alpinus	Arctic char	0.047 (0.014)	0.048 (0.021)	0.048 (0.017)	0.033 (0.012)
Salmo salar	Atlantic salmon	0.006 (0.003)	-	0.025 (0.009)	0.008 (0.004)
Phoxinus phoxinus	Minnow	0.030 (0.015)	0.011 (0.005)	0.015 (0.006)	0.005 (0.003)
Anguilla anguilla	European eel**	0.122 (0.056)	0.250 (0.149)	0.067 (0.044)	0.022 (0.006)
			Mean BPUE		
Salmo trutta	Brown trout*	7.650 (1.857)	10.231 (5.635)	18.738 (6.809)	15.584 (5.487)
	Sea trout	9.942 (3.691)	3.575 (1.956)	6.243 (2.118)	7.781 (2.592)
Salvelinus alpinus	Arctic char	1.598 (0.640)	3.129 (1.406)	4.020 (1.664)	1.297 (0.463)
Salmo salar	Atlantic salmon	0.105 (0.055)	-	0.339 (0.126)	0.157 (0.100)
Phoxinus phoxinus	Minnow	0.150 (0.075)	0.017 (0.008)	0.023 (0.010)	0.014 (0.009)
*Anguilla Anguilla**	European eel**	19.361 (10.121)	60.606 (38.730)	9.822 (5.971)	4.401 (2.434)

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.

*Includes ferox trout

**Eel CPUE and BPUE based on fyke nets only

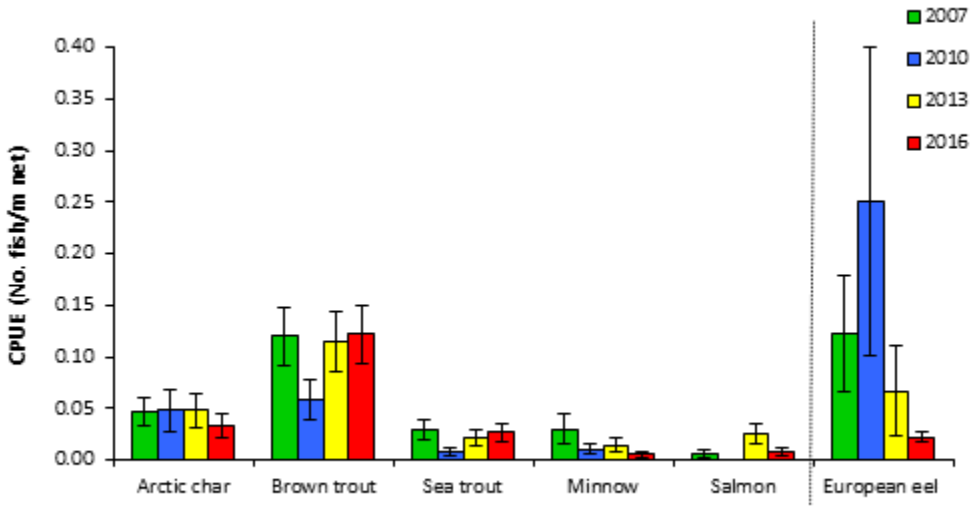

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Kylemore Lough (Eel CPUE based on fyke nets only), 2007, 2010, 2013 and 2016

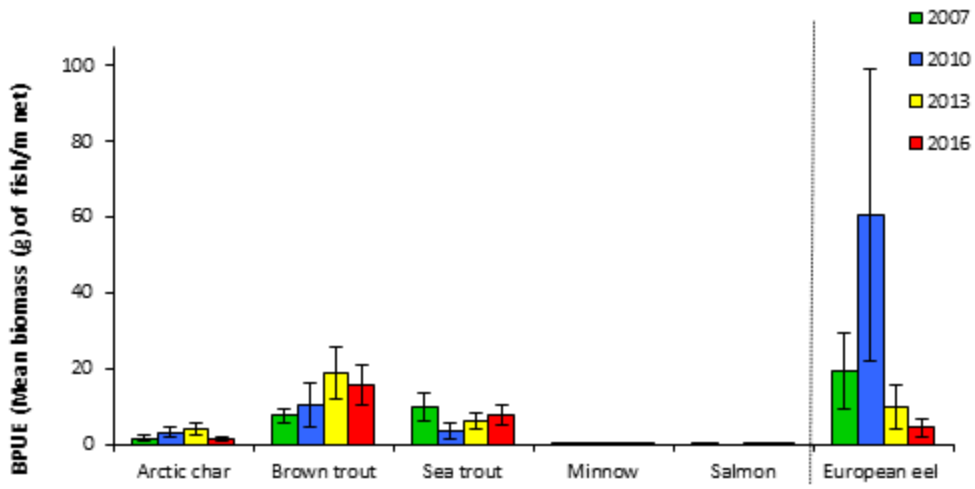

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Kylemore Lough (Eel BPUE based on fyke nets only), 2007, 2010, 2013 and 2016

1.3.3 Length frequency distributions and growth

Brown trout (including ferox trout)

Brown trout captured during the 2016 survey ranged in length from 5.9cm to 68.0cm (mean = 18.9cm) (Fig. 1.4). Seven age classes were present, ranging from 1+ to 8+, with a mean L1 of 6.4cm (Table 1.3). The dominant age class was 1+ (Fig. 1.4). Mean brown trout L4 in 2016 was 27.3cm 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 2010 and 2013 surveys had similar length and age ranges, with some larger and older fish recorded in the 2010 and 2013 surveys (Fig.1.4).

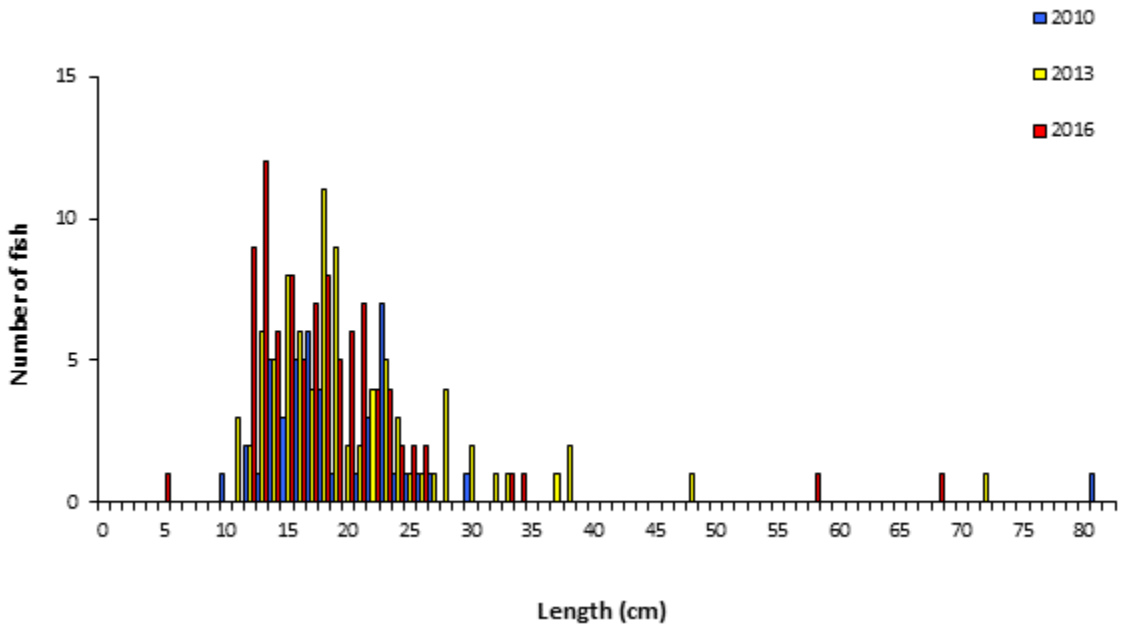

Fig. 1.4. Length frequency of brown trout captured on Kylemore Lough, 2010, 2013 and 2016

Table 1.3. Mean (±S.E.) brown trout length (cm) at age for Kylemore Lough, August 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	Growth Category
Mean (±S.E.)	6.4	13.9	20.3	27.3	38.3	50.9	56.0	63.2	Slow
N	48	36	19	8	3	2	1	1	
Range	4.1-9.5	7.2-20.7	11.3-26.6	21.1-37.5	32.4-45.5	46.5-55.3	56.0-56.0	63.2-63.2	

Arctic char

Arctic char captured during the 2016 survey ranged in length from 10.5cm to 18.5cm (mean = 14.7cm) (Fig.1.5) with three age classes present, ranging from 2+ to 4+. Arctic char captured during the 2010 and 2013 surveys had a larger length and age range (Fig.1.5).

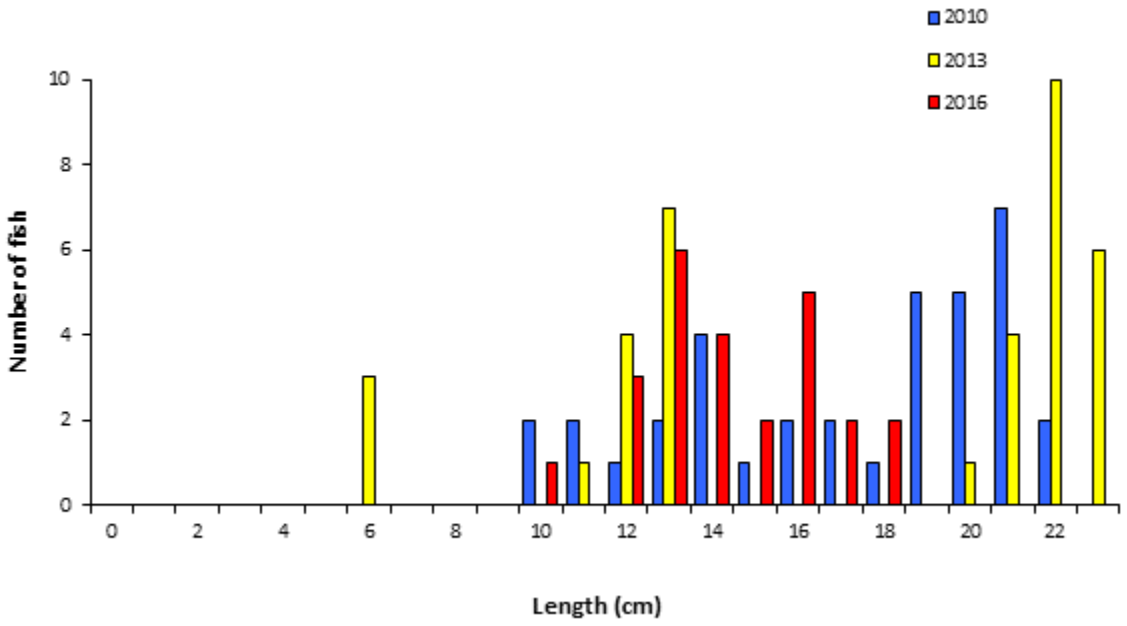

Fig. 1.5. Length frequency of Arctic char captured on Kylemore Lough, 2010, 2013 and 2016

Other fish species

Eels captured during the 2016 survey ranged in length from 35.0cm to 60.8cm. Juvenile salmon captured measured 8.0cm to 12.6cm. Sea trout ranged in length from 24.0cm to 38.9cm and ages ranged from 2.0+ to 4.0+. Minnow ranged in length from 6.0cm to 6.9cm.

1.3.4 Stomach and diet analysis

Dietary analysis studies provide a good indication of the availability of food items and the angling methods that are likely to be successful. However, the value of stomach content analysis is limited unless undertaken over a long period as diet may change on a daily basis depending on the availability of food items. 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 34 stomachs were examined. Of these 13 were found to contain no prey items. Of the remaining 21 stomachs containing food, 71% contained invertebrates, 10% zooplankton, 9% unidentified digested material, 5% zooplankton/invertebrates and 5% fish/invertebrates (Fig. 1.6).

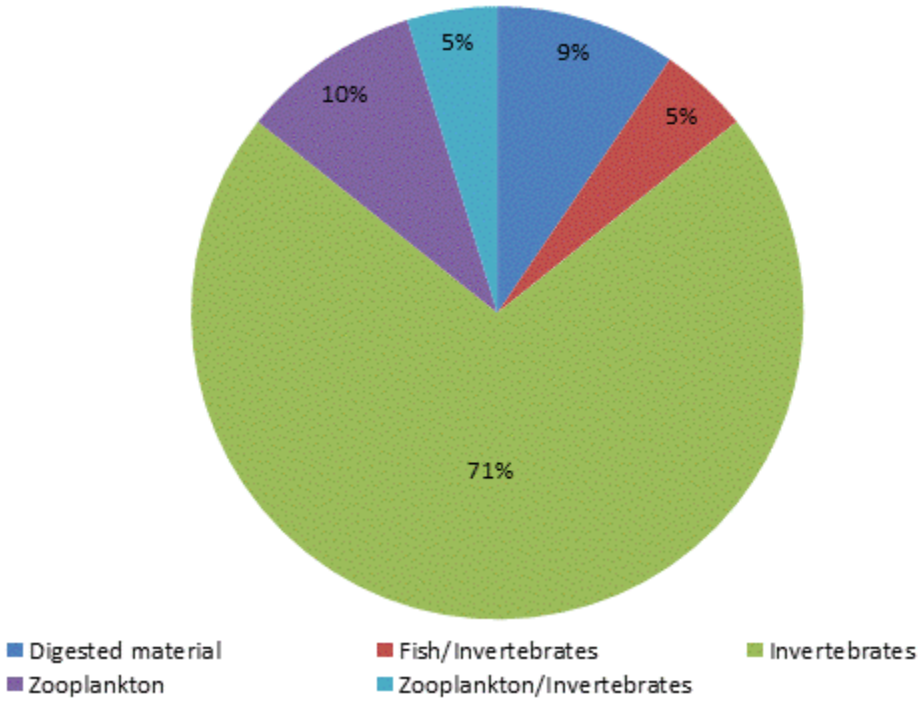

Fig 1.6. Diet of brown trout (n=21) captured on Kylemore Lough, 2016 (% occurrence)

Arctic char

A total of seven Arctic char stomachs were examined. Of these, two were empty and the remaining five contained 80% zooplankton and 20% invertebrates (Fig. 1.7).

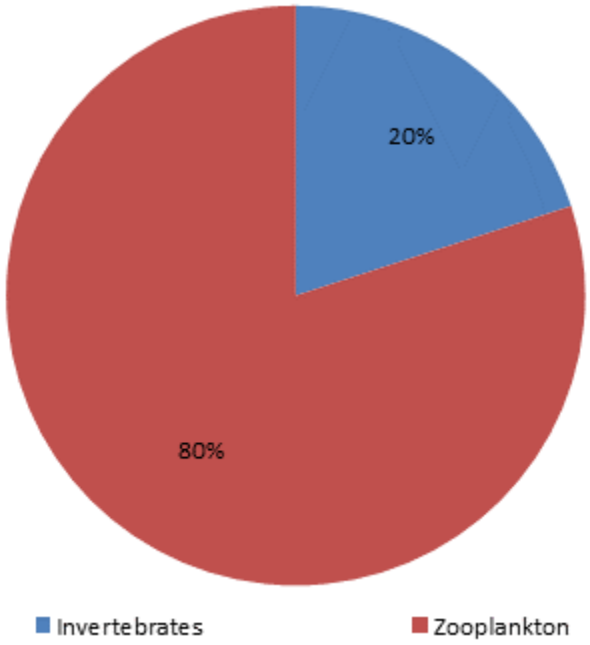

Fig 1.7. Diet of Arctic char (n=5) captured on Kylemore Lough, 2016 (% occurrence)

1.4 Summary and ecological status

A total of five fish species, including three types of trout (brown trout, ferox trout and sea trout) were recorded in Kylemore Lough in August 2016. Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2016 survey.

Although the mean brown trout CPUE increased slightly over the four sampling occasions, these differences were not statistically significant. There were also no significant differences in mean BPUE across the four sampling years, although the BPUE fluctuated slightly. Brown trout ranged in age from 1+ to 8+, indicating reproductive success in the previous eight out of nine years. The dominant age class was 1+. 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 decreased slightly over the four sampling occasions; however, these differences were not statistically significant. Arctic char ranged in age from 0+ to 5+, with five age classes present.

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, Kylemore Lough has been assigned an ecological status of High for 2016 based on the fish populations present. In previous years the lake was assigned a fish status of Good in 2010 and High in 2007 and 2013.

In the 2010 to 2015 surveillance monitoring reporting period, the EPA assigned Kylemore Lough an overall ecological status of Good.

1.5 References

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

Kelly, F. and Connor, L. (2007) *WFD Surveillance Monitoring - Fish in Lakes 2007*. Central Fisheries Board 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, 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 Kylemore 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 Kylemore Lough, August 2013*. 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.

King, J.J., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.G., 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.

NPWS (2005) Site *synopsis: The Twelve Bens, Garraun Complex. Site code: 002031*. 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