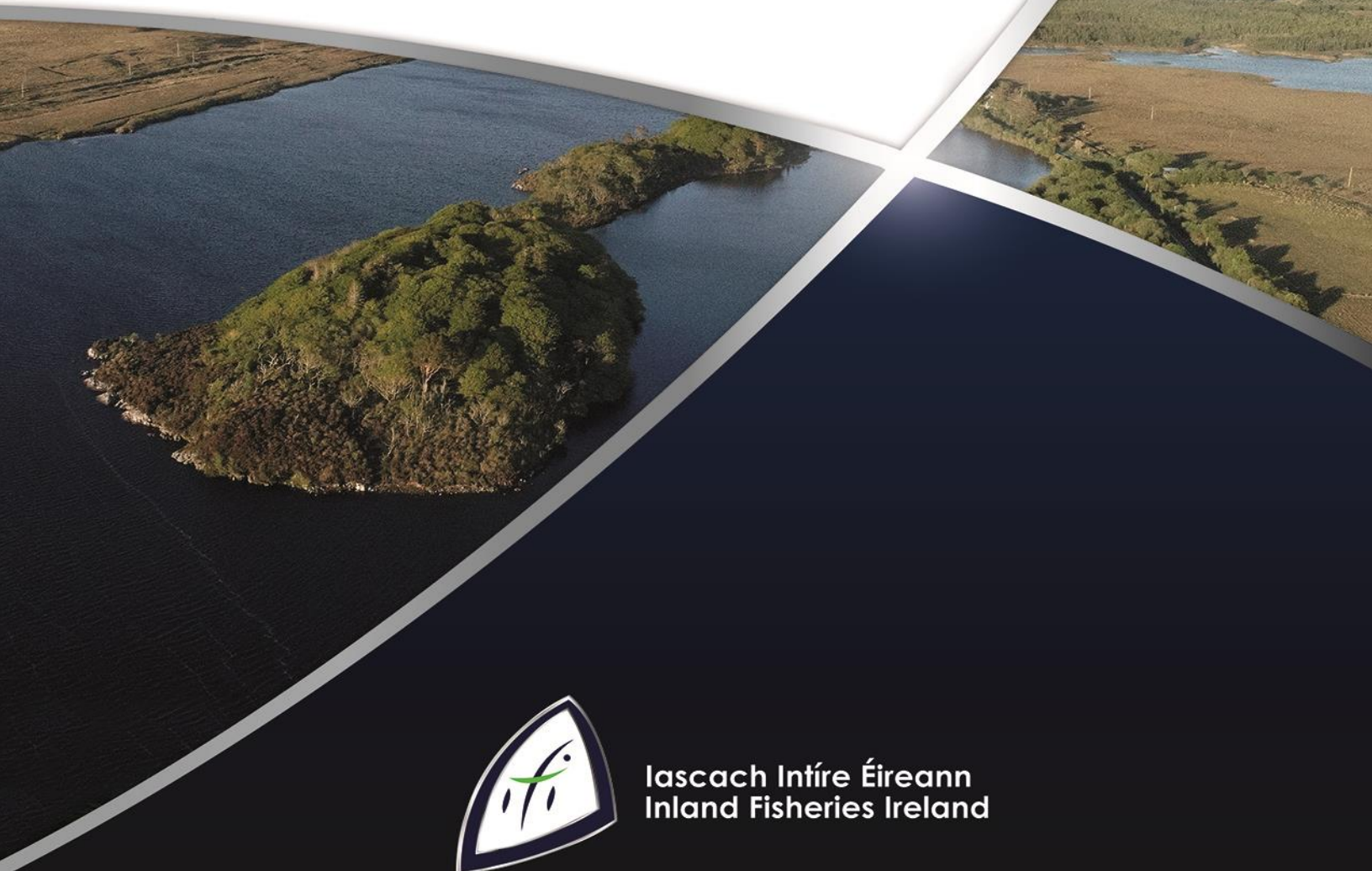# National Research Survey Programme
## Lakes 2019

## Kylemore Lough

IFI/2020/1-4497

Iascach Intíre Éireann
Inland Fisheries Ireland

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National Research Survey Programme

# Fish Stock Survey of Kylemore Lough, August 2019

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Cover photo: Aerial view of Lough Shindilla, Co. Galway © Inland Fisheries Ireland

**ACKNOWLEDGEMENTS**

## 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).  The lake is located adjacent to the N59 Clifden to Westport road, approximately five kilometers northeast of Letterfrack, Co. Galway.  It has a surface area of 134ha, a mean depth of >4m, a maximum depth of 30m and is categorised 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 $CaCO_3$).  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 SAC 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 SAC 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 a number of 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, 2013 and 2016 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007 and Kelly *et al*., 2011, 2014 and 2017).  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.

This report summarises the results of the 2019 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme.
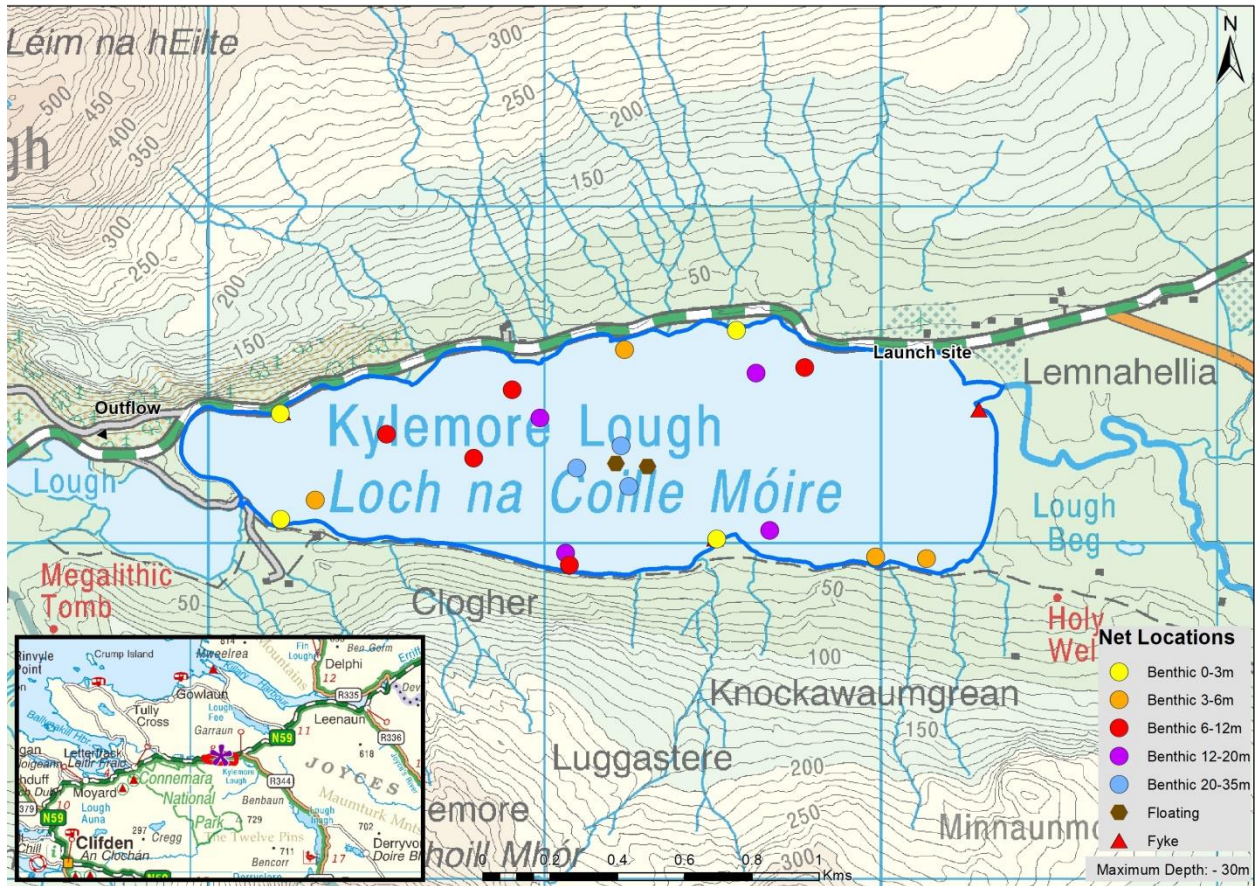
**Plate 1.1. Kylemore Lough**

**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 12th to the 14th of August 2019. 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 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 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. 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).

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

Where:

%FO$_i$ 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 varieties of trout (brown, ferox and sea trout) were recorded in Kylemore Lough in August 2019, with 144 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, 2013 and 2016, 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, 2014 and 2017).

**Table 1.1. Number of each fish species captured by each gear type during the survey on Kylemore Lough, August 2019**

| Scientific name | Common name | Number of fish captured | | | |
| --- | --- | --- | --- | --- | --- |
| | | BM CEN | FM CEN | Fyke | Total |
| *Salmo trutta* | Brown trout | 62 | 2 | 5 | 69 |
| | Sea trout | 2 | 2 | 0 | 4 |
| | Ferox trout | 2 | 0 | 0 | 2 |
| *Salvelinus alpinus* | Arctic char | 25 | 0 | 0 | 25 |
| *Phoxinus phoxinus* | Minnow | 22 | 0 | 0 | 22 |
| *Salmo salar* | Atlantic salmon | 12 | 0 | 5 | 17 |
| *Anguilla anguilla* | European eel | 0 | 0 | 5 | 5 |

*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, 2016 and 2019 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).  The mean CPUE fluctuated over the five surveys.  Between 2007 and 2010 the mean CPUE figure decreased.  The figure then increased in 2013 and again in 2016.  The mean CPUE in 2019 was lower than 2007, 2013

and 2016 (Table 1.2; Fig 1.2). The mean BPUE also fluctuated slightly across the five surveys. The mean BPUE recorded in 2019 was the highest figure recorded across all five surveys (Table 1.2; Fig 1.3).

### Arctic char

The mean Arctic char CPUE was similar to the 2016 value, but lower than 2007, 2010 and 2013. Mean BPUE was the lowest recorded to date (Table 1.2; Figs 1.2 and 1.3).
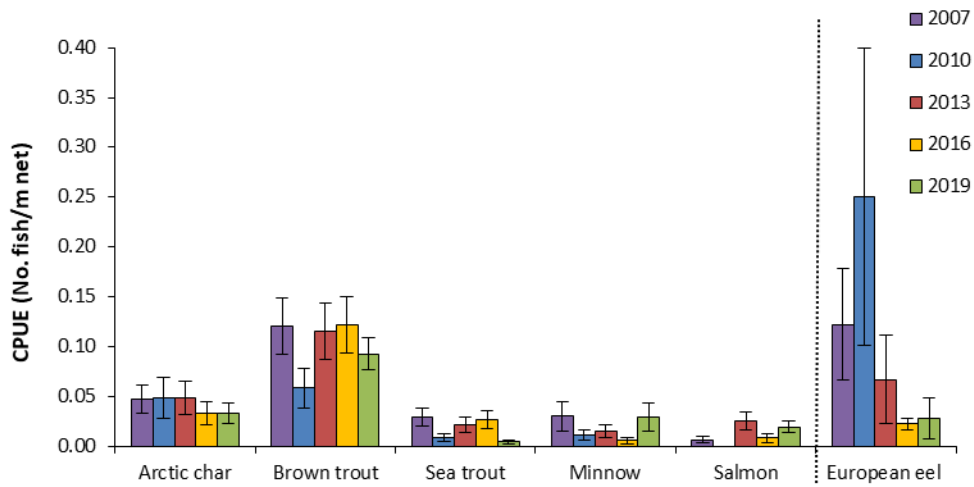
**Table 1.2.  Mean (S.E.) CPUE and BPUE for all fish species captured on Kylemore Lough, 2007, 2010, 2013, 2016 and 2019**

| Scientific name | Common name | 2007 | 2010 | 2013 | 2016 | 2019 |
|---|---|---|---|---|---|---|
| | | **Mean CPUE** | | | | |
| *Salmo trutta* | Brown trout* | 0.120 (0.028) | 0.058 (0.019) | 0.115 (0.028) | 0.122 (0.028) | 0.091 (0.016) |
| | Sea trout | 0.029 (0.009) | 0.008 (0.004) | 0.021 (0.007) | 0.027 (0.009) | 0.005 (0.002) |
| *Salvelinus alpinus* | Arctic char | 0.047 (0.014) | 0.048 (0.021) | 0.048 (0.017) | 0.033 (0.012) | 0.033 (0.010) |
| *Salmo salar* | Atlantic salmon | 0.006 (0.003) | - | 0.025 (0.009) | 0.008 (0.004) | 0.019 (0.006) |
| *Phoxinus phoxinus* | Minnow | 0.030 (0.015) | 0.011 (0.005) | 0.015 (0.006) | 0.005 (0.003) | 0.029 (0.014) |
| *Anguilla anguilla** | European eel** | 0.122 (0.056) | 0.250 (0.149) | 0.067 (0.044) | 0.022 (0.006) | 0.028 (0.020) |
| | | **Mean BPUE** | | | | |
| *Salmo trutta* | Brown trout* | 7.650 (1.857) | 10.231 (5.635) | 18.738 (6.809) | 15.584 (5.487) | 20.026 (7.618) |
| | Sea trout | 9.942 (3.691) | 3.575 (1.956) | 6.243 (2.118) | 7.781 (2.592) | 1.673 (0.993) |
| *Salvelinus alpinus* | Arctic char | 1.598 (0.640) | 3.129 (1.406) | 4.020 (1.664) | 1.297 (0.463) | 0.709 (0.222) |
| *Salmo salar* | Atlantic salmon | 0.105 (0.055) | - | 0.339 (0.126) | 0.157 (0.100) | 0.281 (0.095) |
| *Phoxinus phoxinus* | Minnow | 0.150 (0.075) | 0.017 (0.008) | 0.023 (0.010) | 0.014 (0.009) | 0.081 (0.040) |
| *Anguilla anguilla** | European eel** | 19.361 (10.121) | 60.606 (38.730) | 9.822 (5.971) | 4.401 (2.434) | 28.628 (26.329) |

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).

*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, 2016 and 2019**
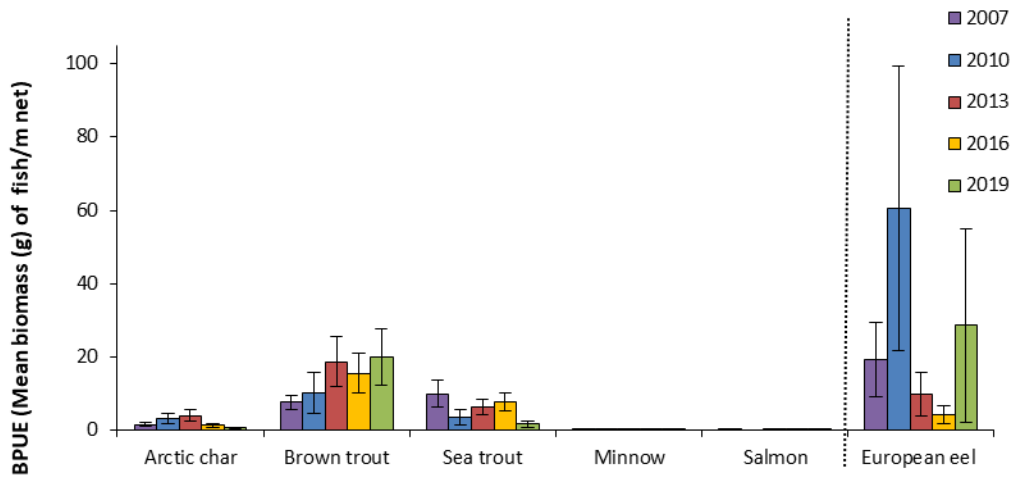


**Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Kylemore Lough (Eel CPUE based on fyke nets only), 2007, 2010, 2013, 2016 and 2019**

### 1.3.3 Length frequency distributions and growth

**Brown trout (including ferox trout)**

Brown trout captured during the 2019 survey ranged in length from 7.5cm to 62.0cm (mean = 24.4cm) (Fig. 1.4). Nine age classes were present, ranging from 0+ to 10+, with a mean L1 of 6.8cm (Table 1.3). The dominant age class was 2+ (Fig. 1.4). Mean brown trout L4 in 2019 was 24.8cm 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 2007, 2010, 2013 and 2016 surveys had similar length and age ranges, with some larger fish captured in the 2010, 2013 and 2016 surveys (Fig.1.4).
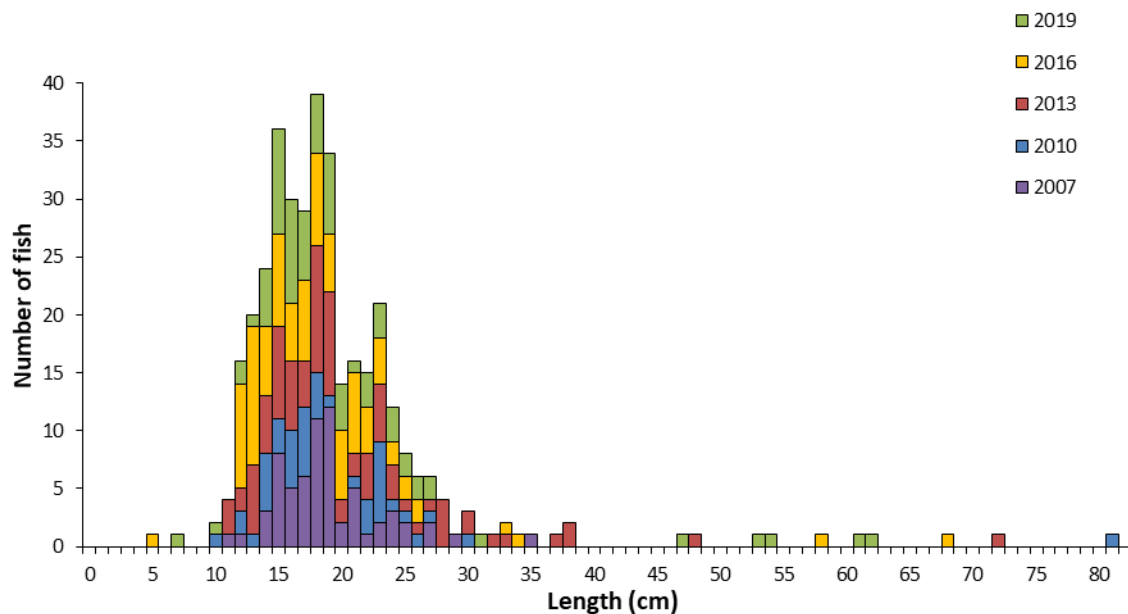


**Fig. 1.4. Length frequency of brown trout captured on Kylemore Lough, 2007, 2010, 2013, 2016 and 2019**

**Table 1.3. Mean (±S.E.) brown trout length (cm) at age for Kylemore Lough, August 2019**

|  | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ | $L_6$ | $L_7$ | $L_8$ | Growth Category |
|---|---|---|---|---|---|---|---|---|---|
| Mean (±S.E.) | 6.8 (0.1) | 14.4 (0.3) | 20.2 (0.5) | 24.8 (0.7) | 33.1 (0.1) | 38.5 (0.2) | 44.8 | 48.9 | Slow |
| N | 37 | 28 | 16 | 10 | 2 | 2 | 1 | 1 | |
| Range | 4.6-8.3 | 10.3-17.6 | 17.0-23.5 | 22.2-28.2 | 33.0-33.3 | 38.3-38.7 | - | - | |

## Arctic char

Arctic char captured during the 2019 survey ranged in length from 7.1cm to 16.0cm (mean = 11.8cm) (Fig.1.5) with four age classes present, ranging from 0+ to 3+.  The length and age range in 2019 was narrower than that observed in previous surveys (Fig. 1.5).
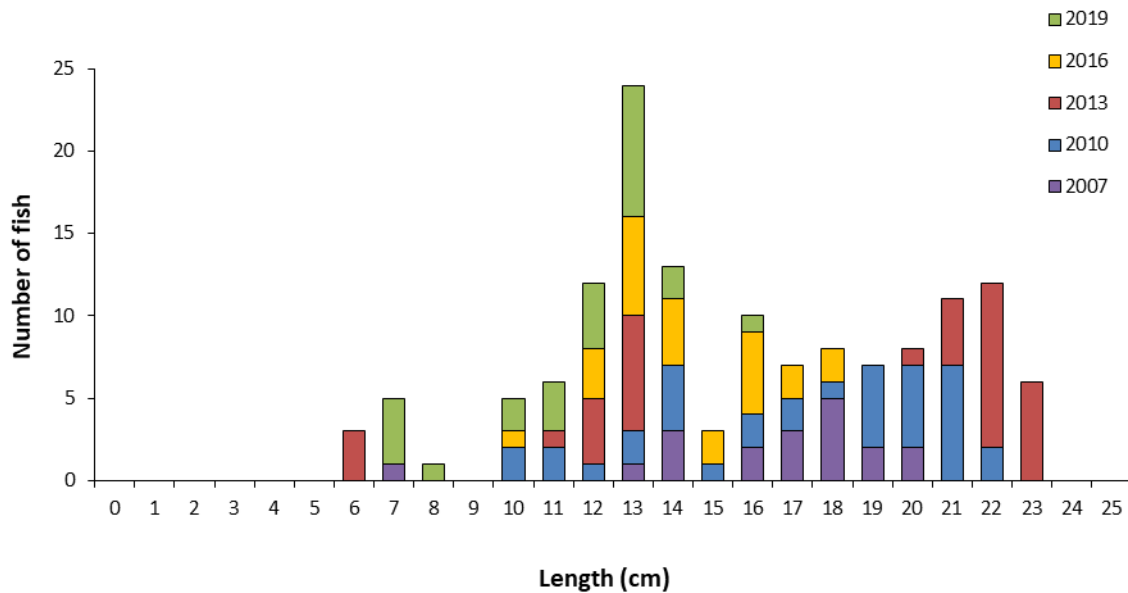


**Fig. 1.5. Length frequency of Arctic char captured on Kylemore Lough, 2007, 2010, 2013, 2016 and 2019**

## Other fish species

European eels were captured ranging in length from 40.2cm to 49.8cm.  Salmon ranged in length from 5.2cm to 14.0cm, a sub-sample were aged and were determined to be in the 1+ age class.  Four sea trout were captured during the 2019 survey, ranging in length from 23.4cm to 39.5cm and were aged at 2.0+ to 3.1sm+.  Minnow ranged in length from 3.0cm and 7.2cm.

### 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 sub-sample of brown trout and Arctic char captured during the survey were examined and are presented below.
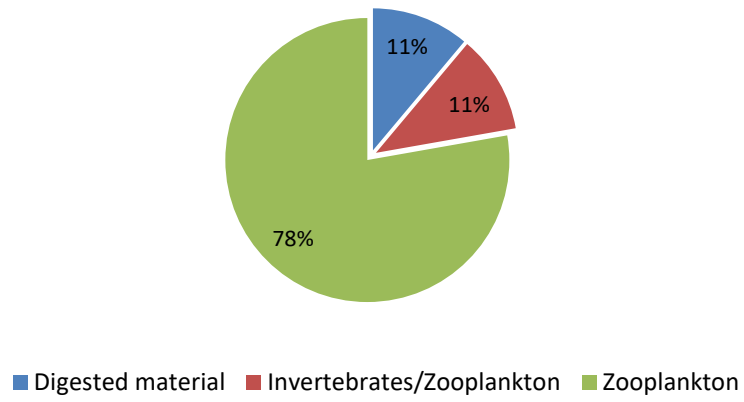
**Brown trout**

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 45 stomachs were examined. Of these four were found to contain no prey items. Of the remaining 41 stomachs containing food, 10% contained unidentified digested material, 19% zooplankton, 17% invertebrates/zooplankton and 54% invertebrates (Fig. 1.6).
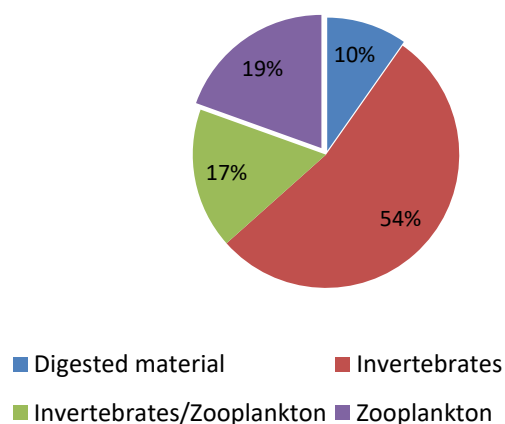


Fig 1.6. Diet of brown trout (n=41) captured on Kylemore Lough, 2019 (% FO)

**Arctic char**

A total of 20 Arctic char stomachs were examined. Of these, 11 were empty and the remaining nine contained 78% invertebrates, 11% invertebrates/zooplankton and 11% unidentified digested material (Fig. 1.7).

**Fig 1.7. Diet of Arctic char (n=9) captured on Kylemore Lough, 2019 (% FO)**

**1.4 Summary and ecological status**

A total of five fish species, including three varieties of trout (brown, ferox and sea trout) were recorded in Kylemore Lough in August 2019. Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2019 survey.

The mean brown trout CPUE decreased between the 2016 and 2019 surveys. Despite this the mean BPUE increased, indicating larger fish (including some ferox trout) were captured in 2019. Brown trout ranged in length from 7.5cm to 62.0cm and ranged in age from 0+ to 10+, no 5+ or 7+ trout were captured, indicating reproductive success in nine of the previous 11 years. 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 fluctuated slightly over the four sampling occasions; however, there was a slight decrease in 2019 in comparison to the other years. Arctic char ranged in length from 7.1cm to 16.0cm and ranged in age from 0+ to 3+, indicating recruitment success in each of the last four 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) in order 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, Kylemore Lough has been assigned an ecological status of High for 2019 based on the fish populations present. In previous years the lake was also assigned a fish status of High in 2007, 2013 and 2016 and Good in 2010 (Fig. 1.8)

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Kylemore an overall draft ecological status of Good, based on all monitored physico-chemical and biological elements, including fish.
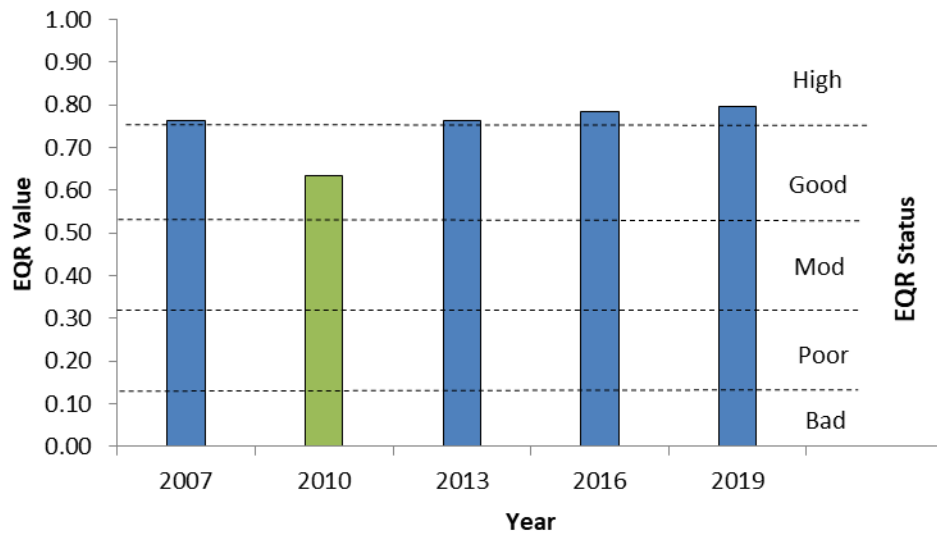
**Fig. 1.8. Fish ecological status, Kylemore Lough, 2007, 2010, 2013, 2016 and 2019 (dashed line indicates EQR status boundaries)**

**1.5 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.

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, NS Share 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.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.

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.

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: 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.

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