National Research Survey Programme
Lakes 2017

Lough Sheelin

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Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Lough Sheelin, July 2017

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

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1.1 Introduction

Lough Sheelin is situated in counties Cavan, Meath and Westmeath in the Inny catchment (Plate 1.1, Fig. 1.1). The lake is located north-east of Finnea, Co. Westmeath. It is seven kilometres long and has a surface area of 1,900 hectares. The River Inny flows through the lake. Lough Sheelin is a relatively shallow lake with a mean depth of 4.4m, a maximum depth of 15m, and 51% of the lake is less than 5m in depth (Champ *pers. comm*.). The geology of the catchment is predominantly Carboniferous limestone, but Silurian/Ordovician formations underlie the western and northern drainage basin. The lake is eutrophic, and is categorised as typology class 12 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and high alkalinity (>100 mg/l $CaCO_3$).

In the 1960s and 1970s Lough Sheelin was one of Ireland's top trout angling lakes, managed and developed by the Inland Fisheries Trust (now Inland Fisheries Ireland). Phosphorus originating from intensive agricultural developments has caused progressive enrichment of Lough Sheelin since the early 1970s (Champ, 1998 and 2003). This has resulted in the trout population diminishing and the fish stock becoming dominated by cyprinids (O'Grady, *pers comm*.). The lake has been stocked with brown trout in the past, with approximately 16,000 2+ fish introduced in 2004, followed by between 3,000 and 6,000 per year thereafter. Stocking of brown trout into the lake ceased in 2011 (Mooney, *pers comm*.). The water quality in the lake and the catchment was monitored on a continuous basis by Inland Fisheries Ireland (previously the Shannon Regional Fisheries Board and the Central Fisheries Board) from the 1970s to 2015 (Champ, 1979, 1991, 1993, 1998; Duggan and Champ, 1992; Kerins *et al*., 2007). Kerins *et al*., 2007 showed a modest decrease in the total phosphorus loadings to the lake between 1988 and 2005, suggesting that the phosphorus losses from the catchment are slowly declining; however, more recent data (2006 to 2014) indicates that there has been no improvement in the nutrient loadings to the lake (IFI unpublished data).

Zebra mussels (*Dreissena polymorpha*), an invasive species in Ireland, were first noted in Lough Sheelin during 2003 and it is thought they were introduced to the lake in 2000 and 2001. Large populations of the mussel have been evident in the lake since 2004 (O' Grady *et al*., 2008).

The fish population in Lough Sheelin has been surveyed regularly since 1978 by Inland Fisheries Ireland using a gill netting technique that was developed in the late 1970s (O'Grady, 1981) to assess trout stocks (trout > 19.8cm in length) on selected lake fisheries. Other fish species are also captured as a by-catch

during these surveys. This work has proved to be an effective management tool in illustrating the fluctuations in fish stocks over time (Delanty and O'Grady, 2001). An extensive database has been developed based on this method. The standing crop of trout (>19.8cm) in Lough Sheelin varied between 100,000 and 120,000 fish in the early 1980s and has since decreased substantially (O'Grady *et al.*, 2008). Unfortunately roach, a non-native invasive species, were introduced into the lake during the 1970s and their population has fluctuated dramatically since that time. Lough Sheelin currently holds stocks of brown trout, pike, perch, roach, roach hybrids, tench, 3-spined stickleback, 9-spined stickleback and eels.

More recently Lough Sheelin was surveyed in 2008, 2011 and 2014 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2009, Kelly *et al.*, 2012a and Kelly *et al.*, 2015a and 2015b). During the 2014 survey, perch were found to be the dominant species present in the lake. Brown trout, roach, pike and eels were also captured during the survey.

This report summarises the results of the 2017 fish stock survey carried out on the lake.

Plate 1.1. Lough Sheelin (Photo courtesy of IFI and No. 3 Operational Wing, Irish Air Corps [Aer Chór na hÉireann])
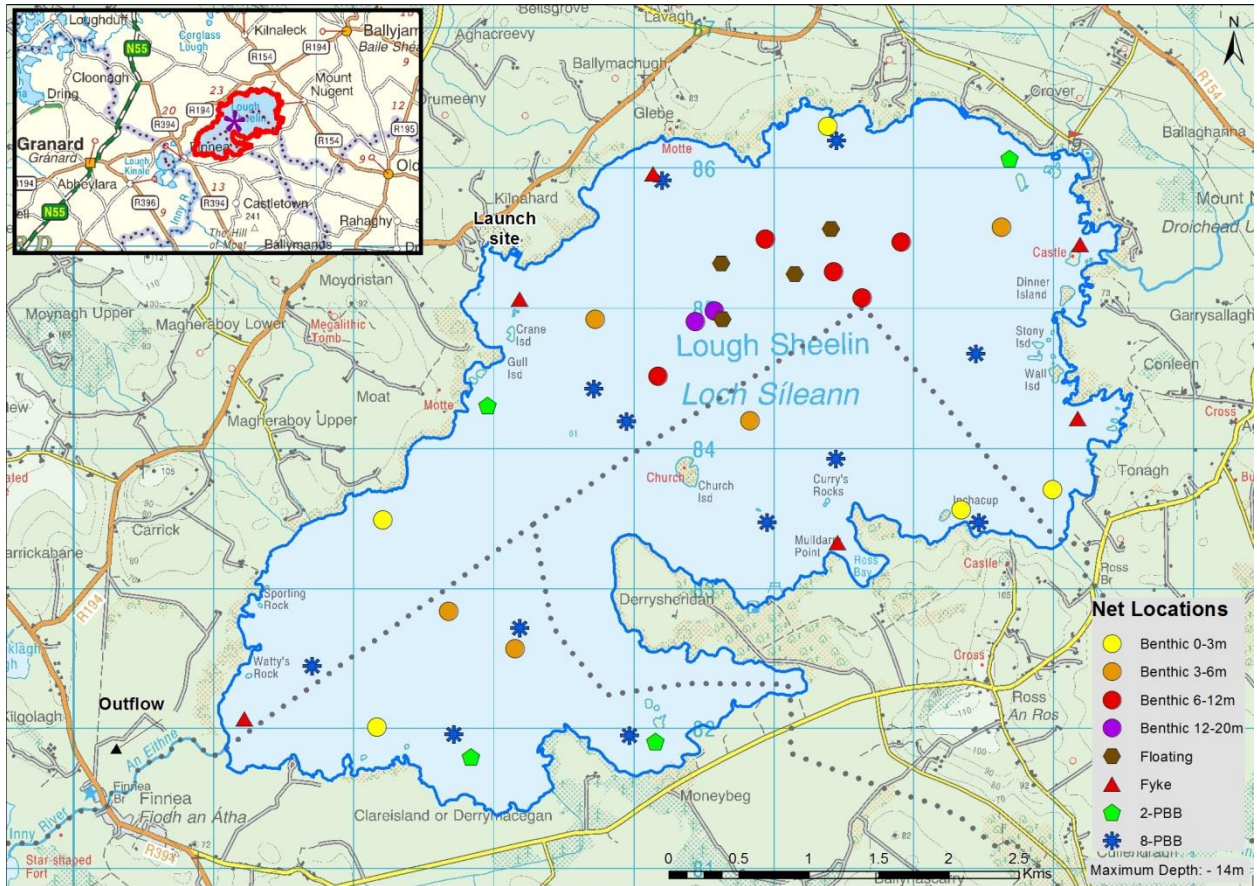
Fig. 1.1. Location map of Lough Sheelin showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Lough Sheelin was surveyed over three nights between the 10th and the 13th of July 2017. A total of six sets of Dutch fyke nets (Fyke), 17 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m and 2 @ 12-19.9m) and four floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (27 sites) (Fig. 1.1). The netting effort was supplemented using four two-panel benthic braided (63.5mm and 88.9mm mesh knot to knot) survey gill nets (2-PBB) (Fig. 1.1).

The site locations for the benthic and surface monofilament multi-mesh gill net (BM CEN and FM CEN) were chosen randomly within fixed depth zones (0-2.9m, 3-5.9m, 6-11.9m and 12-19.9m). 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 also randomised.

All fish apart from perch were measured and weighed on site and scales were removed from all brown trout, roach, hybrids, tench and pike. Live fish were returned to the water whenever possible and practical (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

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 six fish species and one type of hybrid were recorded on Lough Sheelin in July 2017, with 868 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Perch was the most abundant fish species recorded. Roach, brown trout, pike, three-spined stickleback tench and roach x bream hybrids were also recorded. During the previous surveys in 2008, 2011 and 2014 the same species composition was recorded, with the exception of tench which were not recorded in 2008 and 2014, roach x bream hybrids which were not recorded in 2014, bream which were not recorded in 2011 and 2014 and three-spined stickleback which were only recorded in 2017 (Kelly *et al*., 2009, Kelly *et al*., 2012a and Kelly *et al*., 2015a and 2015b). Wild brown trout were recorded in each of the four sampling years and stocked brown trout were only recorded in the 2011 survey.

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Sheelin, July 2017

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	2-Panel	Fyke	Total
Perca fluviatilis	Perch	716	3	0	3	722
Rutilus rutilus	Roach	119	1	0	1	121
Salmo trutta	Brown trout (wild)	8	1	3	0	12
Esox lucius	Pike	6	0	0	1	7
Gasterosteus aculeatus	Three-spined stickleback	4	0	0	0	4
Tinca tinca	Tench	0	0	1	0	1
Rutilus rutilus x Abramis brama	Roach x bream hybrid	1	0	0	0	1

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 2017 survey are summarised in Table 1.2.

Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured during the 2017 survey (Table 1.2).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Sheelin, 2017

Scientific name	Common name	Mean CPUE (± S.E) *
Perca fluviatilis	Perch	0.775 (0.229)
Rutilus rutilus	Roach	0.130 (0.072)
Salmo trutta	Brown trout (wild)	0.011 (0.004)
Esox lucius	Pike	0.007 (0.003)
Gasterosteus aculeatus	Three-spined stickleback	0.004 (0.003)
Tinca tinca	Tench	0.001 (0.001)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.001 (0.001)
		Mean BPUE (± S.E) *
Perca fluviatilis	Perch	18.501 (6.364)
Rutilus rutilus	Roach	7.052 (3.141)
Salmo trutta	Brown trout (wild)	10.644 (4.030)
Esox lucius	Pike	1.188 (0.572)
Gasterosteus aculeatus	Three-spined stickleback	0.006 (0.004)
Tinca tinca	Tench	0.759 (0.759)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	2.241 (2.241)

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).

*CPUE and BPUE data above for all fish species except eels are not comparable to earlier surveys as extra panels were added to the 1-PBB to provide additional information on large fish.

The mean CPUE and BPUE (excluding the 88.9mm mesh panel of 2-PBB) for all species captured in the 2008, 2011, 2014 and 2017 surveys are illustrated in Figures 1.2 and 1.3.

Although the mean perch and roach CPUE and BPUE fluctuated slightly over the four sampling occasions, these differences were not statistically significant (Table 1.2; Fig 1.2 and 1.3). The mean

brown trout CPUE and BPUE was significantly lower in 2008 compared to 2014 and 2017 (Kruskal-Wallis H=4.417, P<0.05 and H=4.526, P<0.05) (Table 1.2; Fig 1.2 and 1.3).
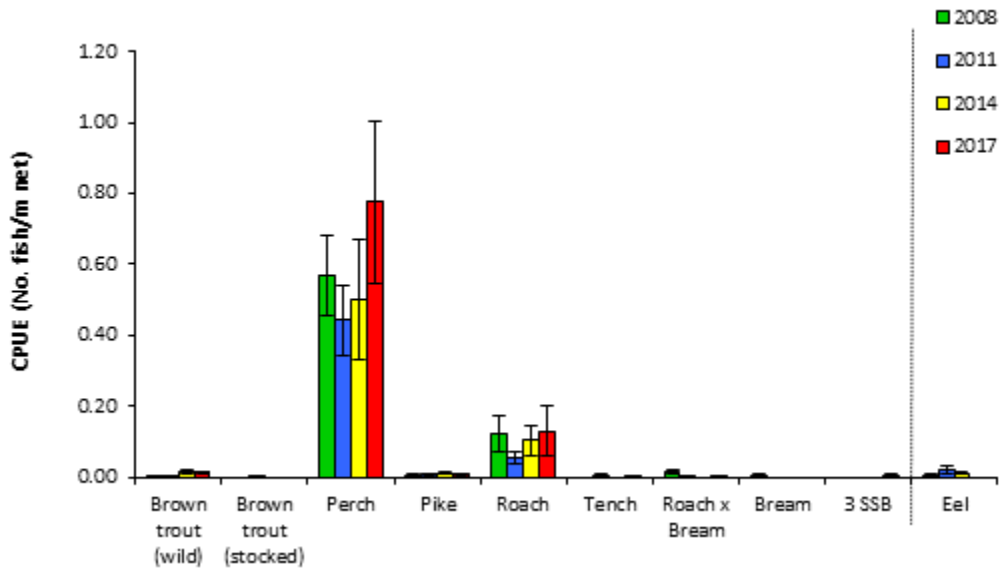

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Sheelin (Eel CPUE based on fyke nets only), 2008, 2011, 2014 and 2017
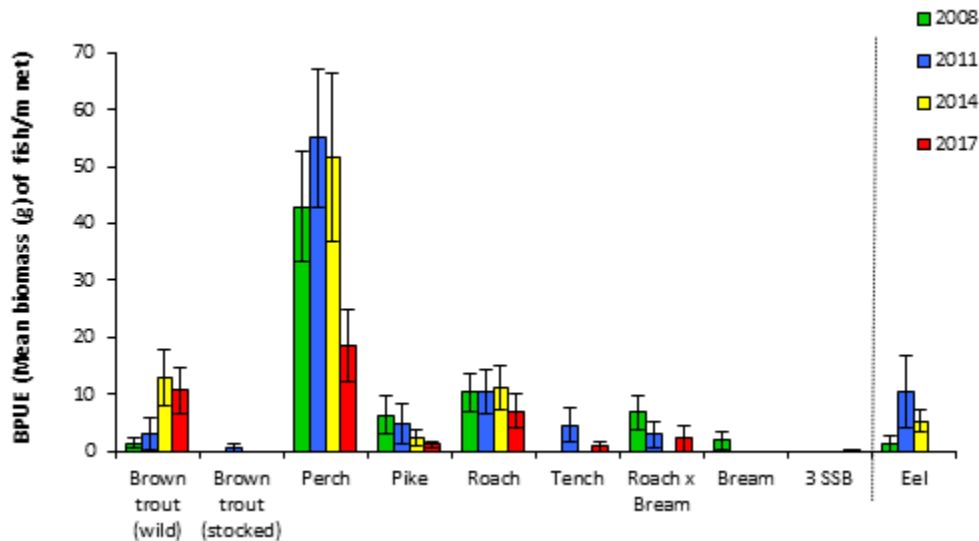

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Sheelin (Eel BPUE based on fyke nets only), 2008, 2011, 2014 and 2017

1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2017 survey ranged in length from 14.3cm to 59.0cm (mean = 38.2cm) (Fig. 1.4). Four age classes were present, ranging from 1+ to 6+, with a mean L1 of 6.3cm (Table 1.3). Mean brown trout L4 in 2017 was 33.2cm indicating a fast 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 2011 and 2017 surveys had the largest length and age ranges compared to the 2008 and 2014 surveys (Fig.1.4).
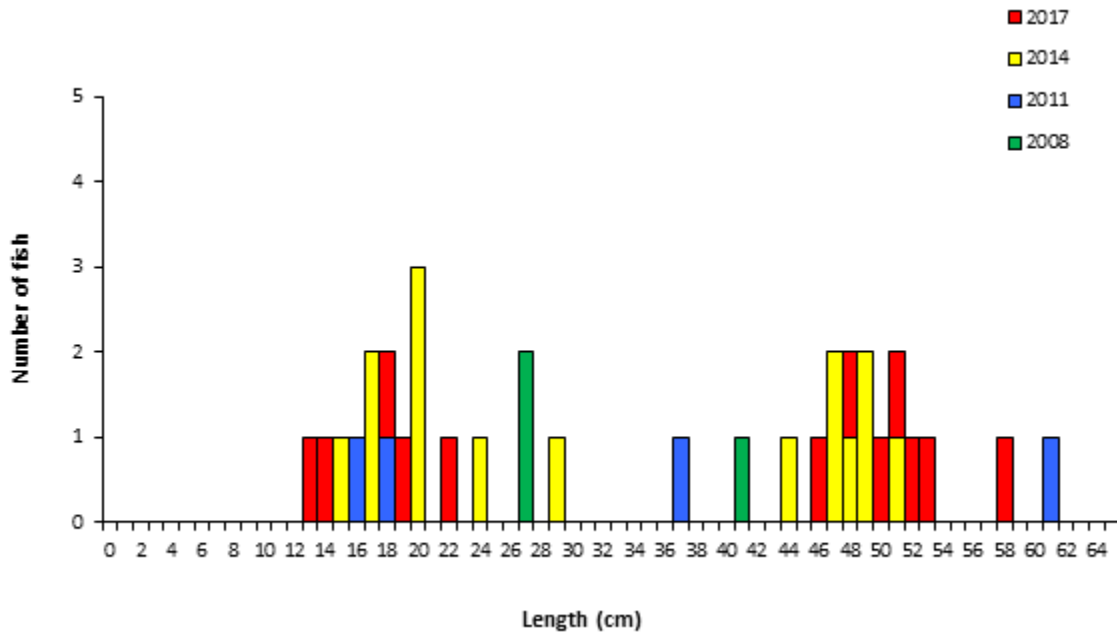

Fig. 1.4. Length frequency of brown trout captured on Lough Sheelin, 2008, 2011, 2014 and 2017

Table 1.3. Mean (±S.E.) brown trout length (cm) at age for Lough Sheelin, July 2017

	L_1	L_2	L_3	L_4	L_5	L_6	Growth Category
Mean (±S.E.)	6.3 (0.3)	13.7 (0.8)	23.8 (2.2)	33.2 (1.0)	42.8 (1.6)	47.8 (1.3)	Fast
N	11	9	6	6	6	6	
Range	5.1-8.5	10.2-16.9	16.4-28.6	30.7-36.5	37.6-47.3	42.8-52.1	

Perch

Perch captured during the 2017 survey ranged in length from 3.5cm to 30.0cm (mean = 7.7cm) (Fig.1.5) with four age classes present, ranging from 0+ to 3+, with a mean L1 of 6.0cm (Table 1.4). The dominant age class was 0+ (Fig. 1.5). Perch captured during the 2008, 2011 and 2014 surveys had a similar length and age range (Fig.1.5).
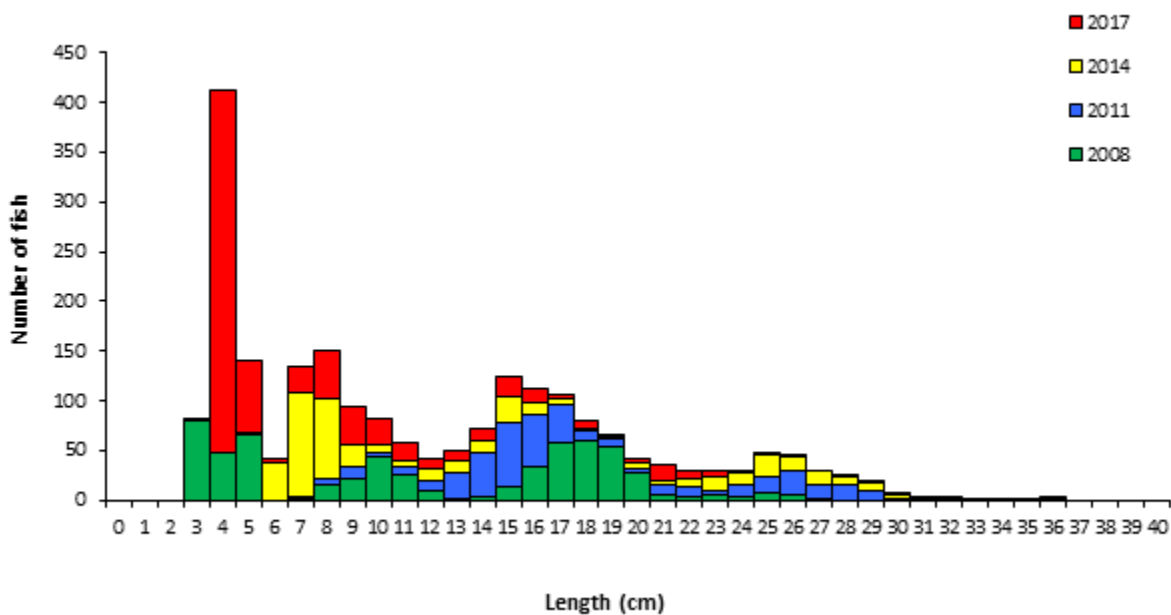

Fig. 1.5. Length frequency of perch captured on Lough Sheelin, 2008, 2011, 2014 and 2017

Table 1.4. Mean (±S.E.) perch length (cm) at age for Lough Sheelin, July 2017

	L_1	L_2	L_3
Mean (±S.E.)	6.0 (0.1)	10.8 (0.2)	16.3 (0.8)
N	44	25	10
Range	3.9-8.6	7.9-12.8	13.3-20.6

Roach

Roach captured during the 2017 survey ranged in length from 5.0cm to 28.0cm (mean = 10.9cm) (Fig.1.6) with four age classes present, ranging from 1+ to 4+, with a mean L1 of 3.4cm (Table 1.5). The dominant age class was 1+ (Fig. 1.6). Roach captured during the 2008, 2011 and 2014 surveys had a larger length and age range (Fig.1.6).
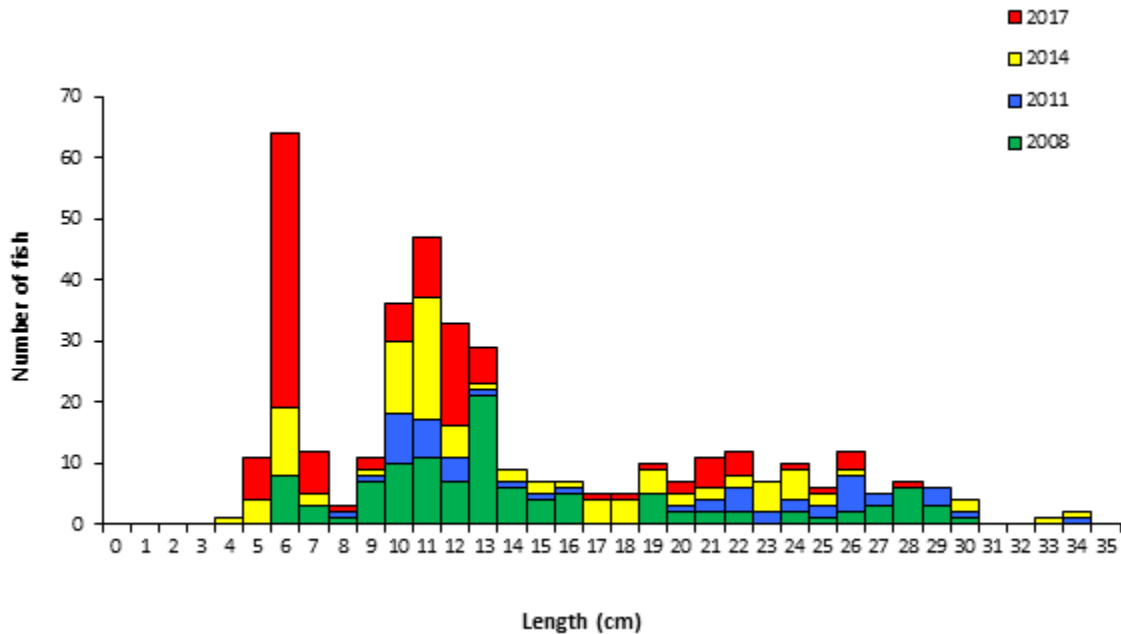

Fig. 1.6. Length frequency of roach captured on Lough Sheelin, 2008, 2011, 2014 and 2017

Table 1.5. Mean (±S.E.) roach length (cm) at age for Lough Sheelin, July 2017

	L_1	L_2	L_3	L_4
Mean (±S.E.)	3.4 (0.1)	7.2 (0.4)	9.4 (0.5)	14.6
N	23	15	8	1
Range	2.4-4.8	4.6-10.3	7.0-11.9	14.6-14.6

Other fish species

Pike captured during the 2017 survey ranged in length from 17.5cm to 38.0cm, aged 0+ to 2+. One roach x bream hybrid was measured at 45.5cm (aged 13+) and one tench at 42.0cm. Three-spined stickleback ranged in length from 3.8cm to 4.5cm.

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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 perch 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 six stomachs were examined and all contained prey items, 67% contained invertebrates, 17% fish and 16% unidentified digested material (Fig. 1.7).
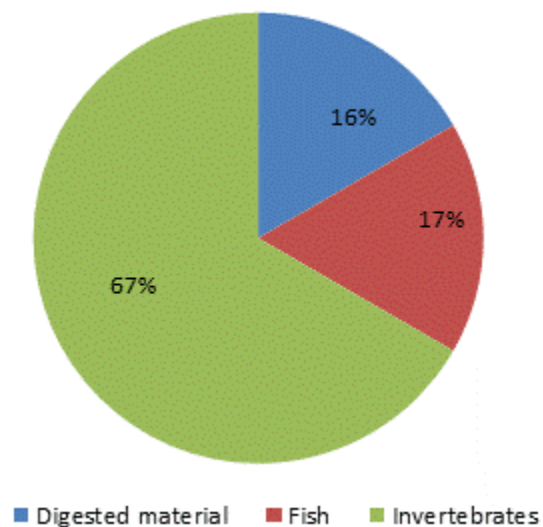

Fig 1.7. Diet of brown trout (n=6) captured on Lough Sheelin, 2017 (% occurrence)

Perch

Perch initially start to feed on pelagic zooplankton. Once they reach an intermediate size they start feeding on benthic resources eventually moving on to feed on fish once they are large enough (Hjelm *et al*., 2000). A total of 91 stomachs were examined. Of these 33 were found to contain no prey items. Of

the remaining 58 stomachs containing food, 38% contained zooplankton, 36% unidentified digested material, 14% fish and 12% invertebrates (Fig. 1.8).
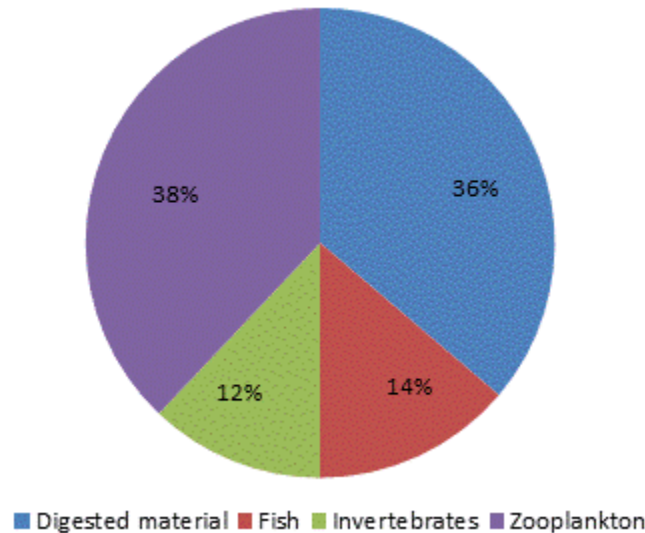

Fig 1.8. Diet of perch (n=58) captured on Lough Sheelin, 2017 (% occurrence)

1.4 Summary and ecological status

A total of six fish species and one type of hybrid were recorded in Lough Sheelin in July 2017. Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured during the 2017 survey.

Brown trout captured during the 2017 survey ranged in length from 14.3cm to 59.0cm (mean = 38.2cm). Four age classes were present, ranging from 1+ to 6+, indicating reproductive success in six of the previous seven years. Mean brown trout L4 in 2017 was 33.2cm indicating a fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971). Brown trout captured during the 2011 and 2017 surveys had the largest length and age ranges compared to the 2014 survey.

Perch captured during the 2017 survey ranged in length from 3.5cm to 30.0cm (mean = 7.7cm) with four age classes present, ranging from 0+ to 3+, indicating reproductive success in each of the previous four

years. The dominant age class was 0+. Perch captured during the 2011 and 2014 surveys had a similar length and age range.

Roach captured during the 2017 survey ranged in length from 5.0cm to 28.0cm (mean = 10.8cm) with four age classes present, ranging from 1+ to 4+, indicating reproductive success in four of the previous five years. The dominant age class was 1+. Roach captured during the 2011 and 2014 surveys had a larger length and age range.

Although the mean perch and roach CPUE and BPUE fluctuated slightly over the four sampling occasions, these differences were not statistically significant. The mean brown trout CPUE and BPUE was significantly lower in 2008 compared to 2014 and 2017.

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 Sheelin has been assigned an ecological status of Good for 2017 based on the fish populations present. In previous years the lake was assigned a fish status of Moderate in 2008, 2011 and 2014.

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

1.5 References

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