



Sampling Fish for the Water Framework Directive

Lakes 2011

Lough Sheelin



Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Sheelin, June 2011

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Cover photo: Lynda and Fiona gill netting © 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 falls into 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 CaCO₃).

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 recent years, with around 16,000 2+ fish introduced in 2004, followed by between 3,000 and 6,000 per year thereafter. The water quality in the lake and the catchment has been monitored on a continuous basis by Inland Fisheries Ireland (previously the Shannon Regional Fisheries Board and the Central Fisheries Board) since the 1970s (Champ, 1979, 1991, 1993, 1998; Duggan and Champ, 1992; Kerins *et al.*, 2007). A recently published study has shown 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 (Kerins *et al.*, 2007).

The fish population in Lough Sheelin has also 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 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, tench, 3-spined stickleback, 9-spined stickleback and eels.

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

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).

This report summarises the results of the 2011 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme.



Plate 1.1. Lough Sheelin (Photo courtesy of IFI and No. 3 Operational Wing, Irish Air Corps [Aer Chór na hÉireann])

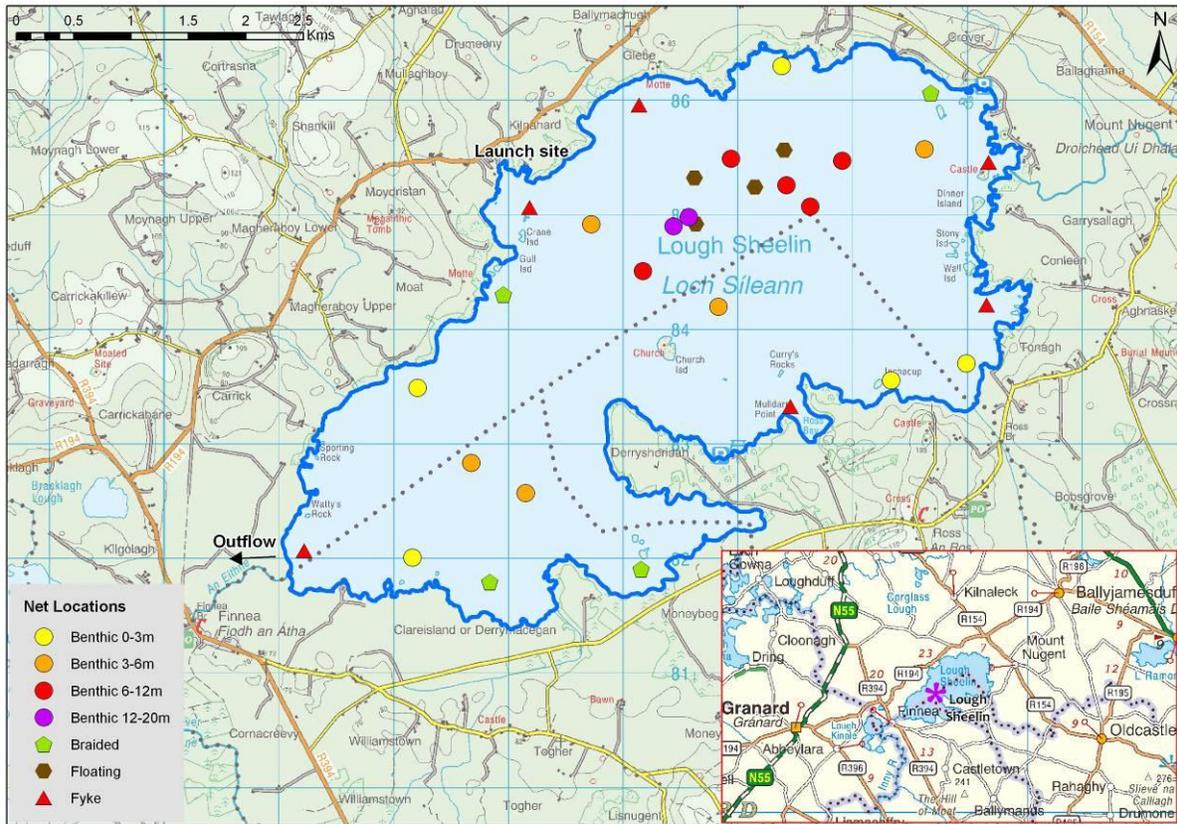


Fig. 1.1. Location map of Lough Sheelin showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Sheelin was surveyed over two nights between the 27th and the 29th of June 2011. A total of six sets of Dutch fyke nets, 17 benthic monofilament multi-mesh (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 (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (27 sites). The netting effort was supplemented using four benthic braided survey gill nets (62.5mm mesh knot to knot) at four additional sites. Nets were deployed in the same locations as were randomly selected in the previous survey in 2008. 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 apart from perch were measured and weighed on site and scales were removed from all brown trout, roach, pike, tench and roach x bream hybrids. 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.

1.3 Results

1.3.1 Species Richness

A total of six fish species and one type of hybrid were recorded on Lough Sheelin in June 2011, with 485 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, pike, tench, brown trout, roach x bream hybrids and eels were also recorded. During the previous survey in 2008 the same species composition was recorded with the exception of bream, which were present during the 2008 survey but were not captured in the current survey and also tench were present during the current survey but were not captured in the 2008 survey.

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Sheelin, June 2011

Scientific name	Common name	Number of fish captured				
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Benthic braided gill nets	Fyke nets	Total
<i>Perca fluviatilis</i>	Perch	406	2	1	2	411
<i>Rutilus rutilus</i>	Roach	47	2	0	1	50
<i>Esox lucius</i>	Pike	4	0	0	3	7
<i>Anguilla anguilla</i>	Eel	0	0	0	7	7
<i>Salmo trutta</i>	Brown trout (wild)	2	1	0	0	3
<i>Salmo trutta</i>	Brown trout (stocked)	1	0	0	0	1
<i>Tinca tinca</i>	Tench	1	0	2	1	4
<i>Rutilus rutilus x Abramis brama</i>	Roach x Bream	1	0	1	0	2

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 2008 and 2011 are summarised in Table 1.2. Mean CPUE and BPUE for all fish species is illustrated in Figures 1.2 and 1.3.

Although the mean perch and roach CPUE was lower in 2011 than in 2008, these differences were not statistically significant (Fig. 1.2). The differences in the mean perch CPUE between Lough Sheelin and five other similar lakes was assessed, and found to be statistically significant (Kruskal-Wallis, $P < 0.05$) (Fig. 1.4). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Sheelin had a significantly higher mean perch CPUE than Upper Lough Corrib and Lower Lough Corrib ($z = -3.487$ $P < 0.05$ and $z = -3.041$ $P < 0.05$).

Although the mean perch BPUE was higher in 2011 than in 2008, these differences were not statistically significant (Fig. 1.3). The differences in the mean perch BPUE between Lough Sheelin and five other similar lakes was assessed, and found to be statistically significant (Kruskal-Wallis, $P < 0.05$) (Fig. 1.5). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Sheelin had a significantly higher mean perch BPUE than Upper Lough Corrib and Lower Lough Corrib ($z = -3.492$ $P < 0.05$ and $z = -3.091$ $P < 0.05$).

The differences in the mean roach CPUE between Lough Sheelin and five other similar lakes was assessed, and found to be statistically significant (Kruskal-Wallis, $P < 0.05$) (Fig. 1.6). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Sheelin had a significantly higher mean roach CPUE than Lough O’Flynn ($z = -1.988$, $P < 0.05$) and significantly lower than Templehouse Lake and Lough Egish ($z = -4.371$ $P < 0.05$ and $z = -2.213$ $P < 0.05$).

The differences in the mean roach BPUE between Lough Sheelin and five other similar lakes was assessed, and found to be statistically significant (Kruskal-Wallis, $P < 0.05$) (Fig. 1.7). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Sheelin had a significantly higher mean roach BPUE than Lough O’Flynn ($z = -2.072$, $P < 0.05$) and significantly lower than Templehouse Lake and Lough Egish ($z = -4.109$ $P < 0.05$ and $z = -2.457$ $P < 0.05$).

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

Scientific name	Common name	2008	2011
Mean CPUE			
<i>Salmo trutta</i>	Brown trout (wild)	0.003 (0.002)	0.003 (0.001)
<i>Salmo trutta</i>	Brown trout (stocked)	-	0.001 (0.001)
<i>Perca fluviatilis</i>	Perch	0.567 (0.114)	0.441 (0.097)
<i>Esox lucius</i>	Pike	0.005 (0.002)	0.005 (0.003)
<i>Rutilus rutilus</i>	Roach	0.121 (0.049)	0.053 (0.016)
<i>Tinca tinca</i>	Tench	-	0.004 (0.002)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.013 (0.006)	0.002 (0.001)
<i>Abramis brama</i>	Bream	0.004 (0.002)	-
<i>Anguilla anguilla</i>	European eel	0.005 (0.005)	0.019 (0.009)
Mean BPUE			
<i>Salmo trutta</i>	Brown trout (wild)	1.328 (0.912)	2.926 (2.76)
<i>Salmo trutta</i>	Brown trout (stocked)	-	0.677 (0.677)
<i>Perca fluviatilis</i>	Perch	42.965 (9.668)	54.969 (12.205)
<i>Esox lucius</i>	Pike	6.287 (3.319)	4.828 (3.576)
<i>Rutilus rutilus</i>	Roach	10.313 (3.317)	10.43 (3.848)
<i>Tinca tinca</i>	Tench	-	4.587 (3.112)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	6.807 (3.03)	3.022 (2.293)
<i>Abramis brama</i>	Bream	1.808 (1.7)	-
<i>Anguilla anguilla</i>	European eel	1.395 (1.395)	10.502 (6.284)

* On the rare occasion where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species.

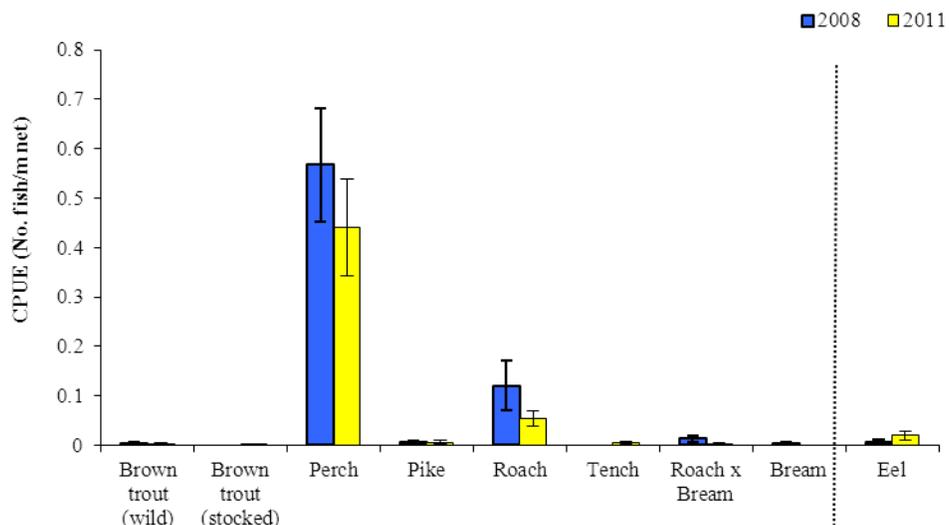


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Lough Sheelin (Eel CPUE based on fyke nets only), 2008 and 2011

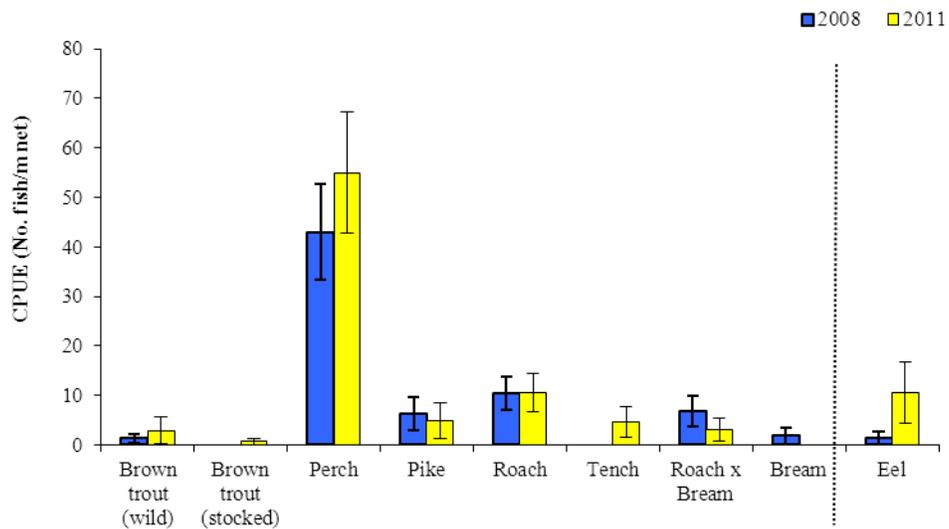


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Lough Sheelin (Eel CPUE based on fyke nets only), 2008 and 2011

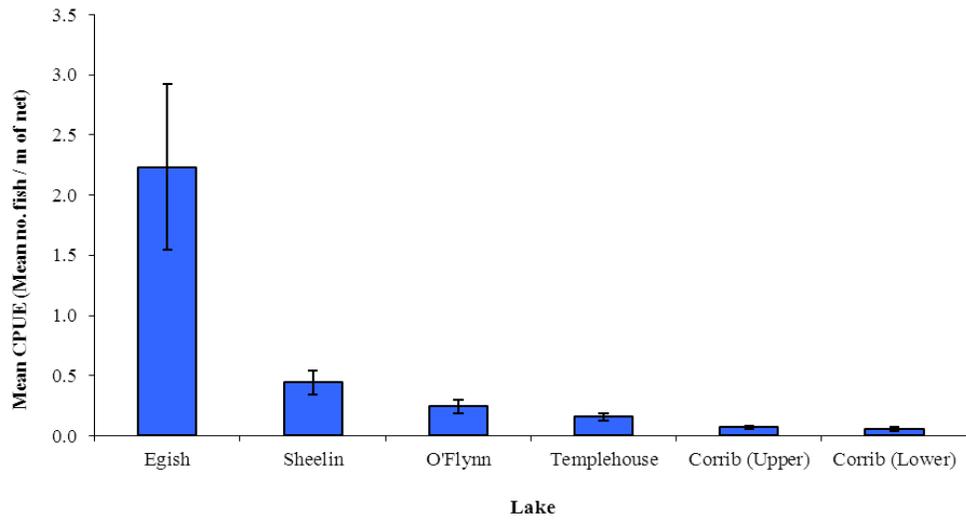


Fig. 1.4. Mean (\pm S.E.) perch CPUE in six lakes surveyed during 2011

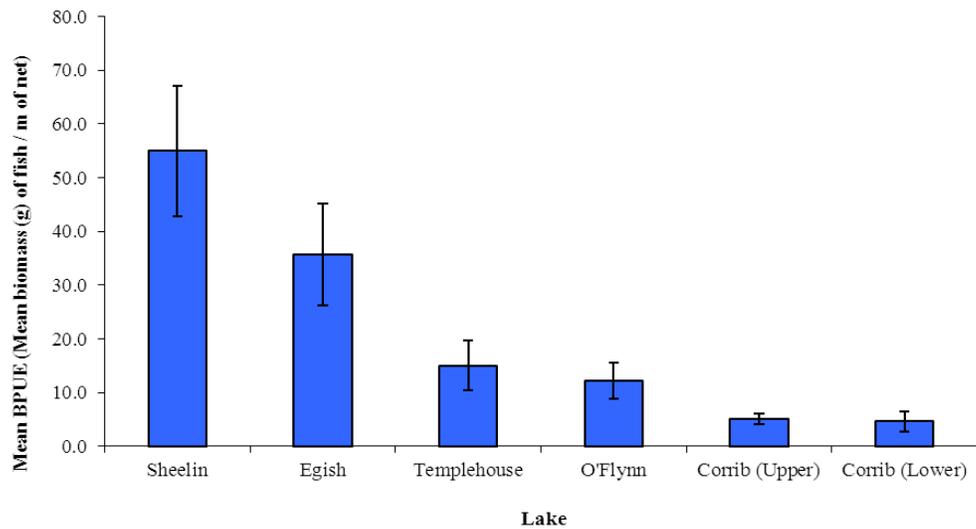


Fig. 1.5. Mean (\pm S.E.) perch BPUE in six lakes surveyed during 2011

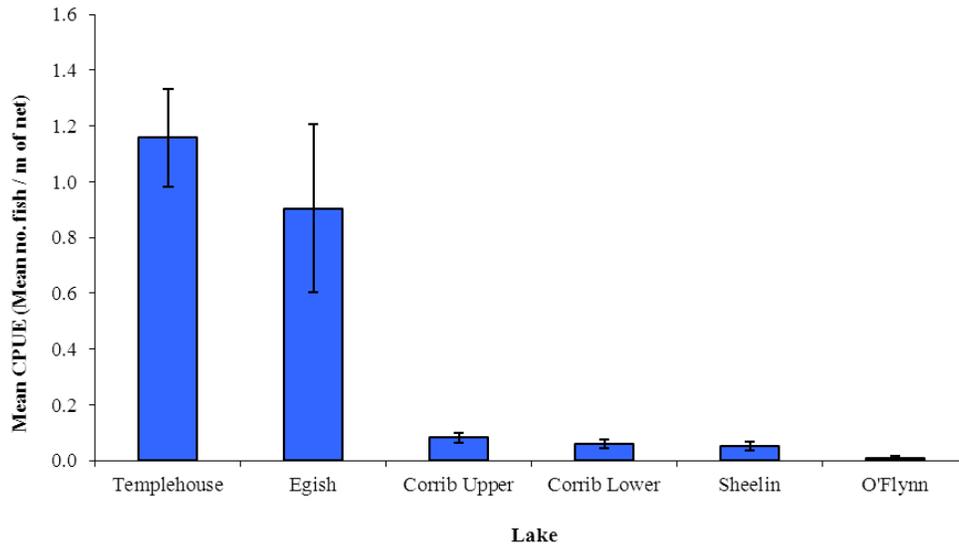


Fig. 1.6. Mean (\pm S.E.) roach CPUE in six lakes surveyed during 2011

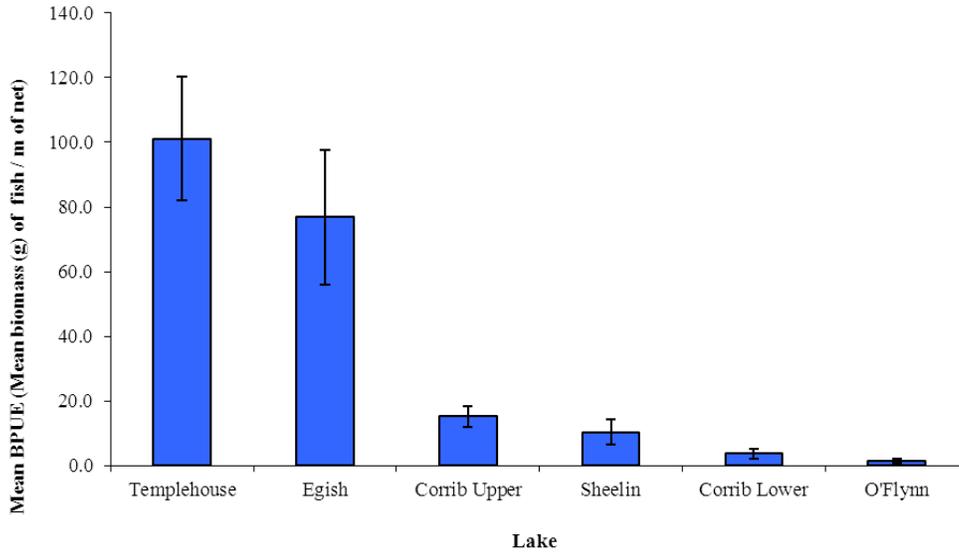


Fig. 1.7. Mean (\pm S.E.) roach BPUE in six lakes surveyed during 2011

1.3.3 Length frequency distributions

Perch captured during the 2011 survey ranged in length from 6.1cm to 36.0cm (mean = 17.3cm) (Fig.1.8).

Perch captured during the 2008 survey had lengths ranging from 3.0cm to 35.6cm (Fig.1.8).

Roach captured during the 2011 survey ranged in length from 8.0cm to 34.0cm (mean = 18.8cm) (Fig. 1.9). Roach captured during the 2008 survey ranged in length from 6.0cm to 30.0cm (Fig. 1.9).

Roach x bream hybrids captured during the 2011 survey ranged in length from 34.0cm to 43.5cm, tench ranged in length from 34.2cm to 44.9cm, pike ranged from 22.1cm to 69.5cm and eels ranged in length from 45.0cm to 79.0cm. Brown trout ranged in length from 17.3cm to 62.0cm.

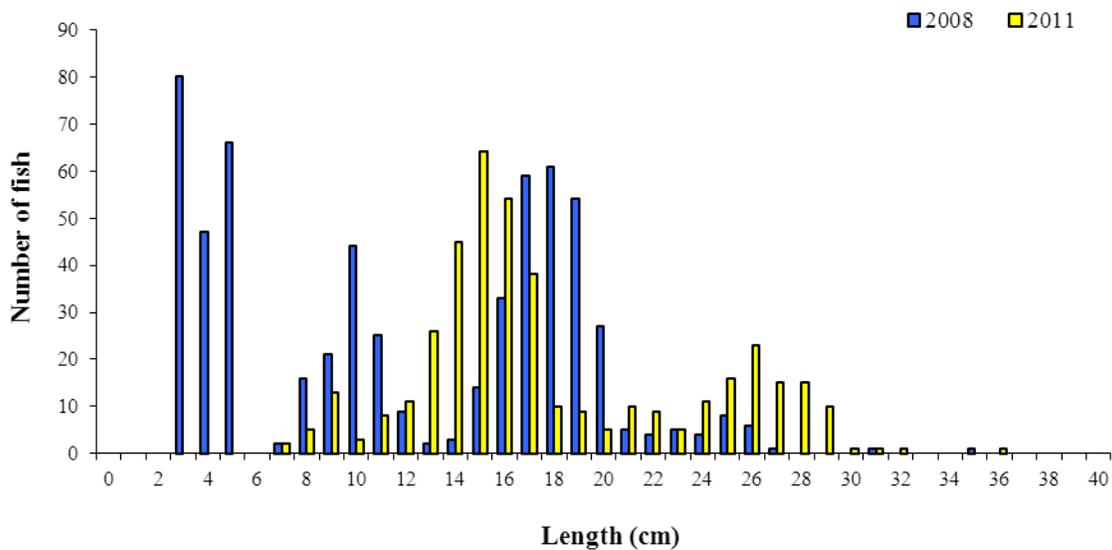


Fig. 1.8. Length frequency of perch captured on Lough Sheelin, 2008 and 2011

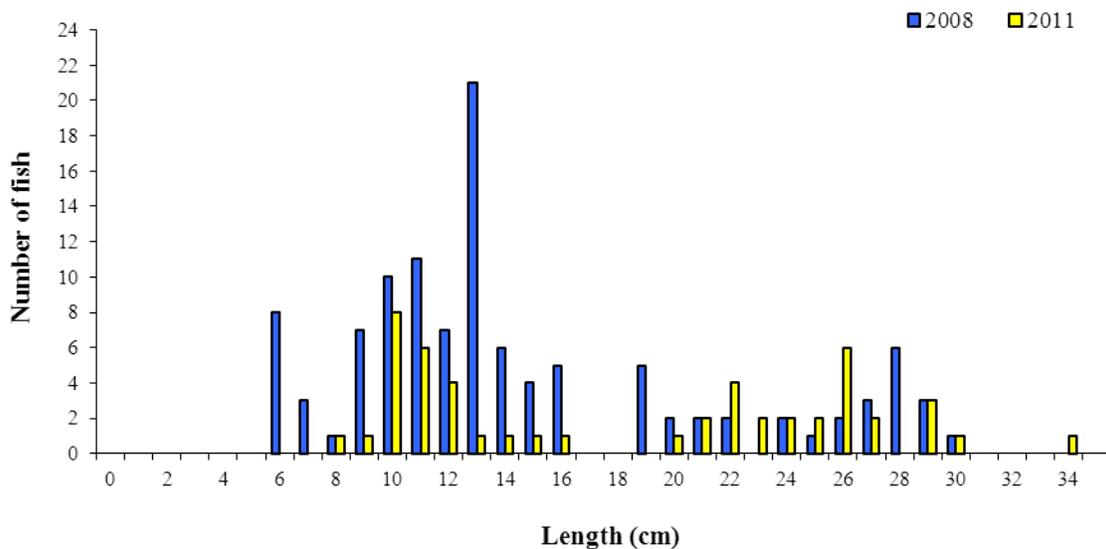


Fig. 1.9. Length frequency of roach captured on Lough Sheelin, 2008 and 2011

1.3.4 Fish age and growth

Six age classes of perch were present, ranging from 0+ to 5+ indicating reproductive success in each of the previous six years. The mean L1 was 6.1cm (Table 1.3). In the 2008 survey, perch ranged from 0+ to 5+ with a mean L1 of 7.0cm. The dominant age class of perch was 2+ in 2011.

Six age classes of roach were present, ranging from 2+ to 8+, with a mean L1 of 2.7cm and dominant age classes of 2+ (Table 1.4). In the 2008 survey, roach ranged from 1+ to 7+ with a mean L1 of 4.0cm.

Brown trout ranged in age from 1+ to 6+, with a mean L1 of 7.3cm. The mean brown trout L4 in 2011 was 44.7cm indicating a very fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

Table 1.3. Mean (\pm SE) perch length (cm) at age for Lough Sheelin, June 2011

	L ₁	L ₂	L ₃	L ₄	L ₅
Mean	6.1 (0.1)	12.3 (0.3)	19.0 (0.3)	22.9 (0.4)	25.3 (0.4)
N	110	93	60	42	40
Range	4.3-8.6	7.3-18.6	11.2-24.7	14.2-28.1	20.1-31.5

Table 1.4. Mean (\pm SE) roach length (cm) at age for Lough Sheelin, June 2011

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆
Mean	2.7 (0.1)	7.2 (0.3)	11.9 (0.5)	18.4 (0.5)	23.2 (0.6)	25.6 (1.0)
N	41	41	27	25	21	8
Range	1.5-4.2	4.1-10.8	6.7-15.9	12.9-22.0	17.3-26.6	21.4-28.5

1.4 Summary

Perch was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets.

There were no significant differences between the mean perch CPUE and BPUE between 2008 and 2011. The mean perch CPUE and BPUE in Lough Sheelin was significantly higher than Upper Lough Corrib and Lower Lough Corrib, Co. Galway. Perch ranged in age from 0+ to 5+, with 0+ and 1+ fish being captured indicating reproductive success in recent years. The dominant age class of perch was 2+.

There were no significant differences between the mean roach CPUE and BPUE between 2008 and 2011. The mean roach CPUE and BPUE in Lough Sheelin was significantly higher than Lough O’Flynn and significantly lower than Templehouse Lake and Lough Egish, other similar lakes surveyed. Roach ranged in age from 2+ to 8+, with no 0+ or 1+ fish being captured.

Four brown trout ranged in age from 1+ to 6+. Length at age analyses revealed that brown trout in the lake exhibit a very fast rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971).

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 by 2015 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, Lough Sheelin has been assigned an ecological status of Moderate based on the fish populations present. The ecological status assigned to the lake based on the 2008 survey data was also Moderate.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lough Sheelin an overall ecological status of Moderate, based on all monitored physico-chemical and biological elements, including fish. This status classification will be revised at the end of 2012.

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