Sampling Fish for the Water Framework Directive

Lakes 2014

Lough Sheelin

IASCACH INTÍRE ÉIREANN
INLAND FISHERIES IRELAND

Water Framework Directive Fish Stock Survey of Lough Sheelin,
June 2014

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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 recent years, with around 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 from 2011 (Mooney, *pers comm.*). 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). 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 (Kerins *et al*., in prep.).

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 and 2011 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009 and Kelly *et al*., 2012a). During the 2011 survey, perch were found to be the dominant species present in the lake. Brown trout, roach, pike, roach x bream hybrids, tench 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 2014 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])
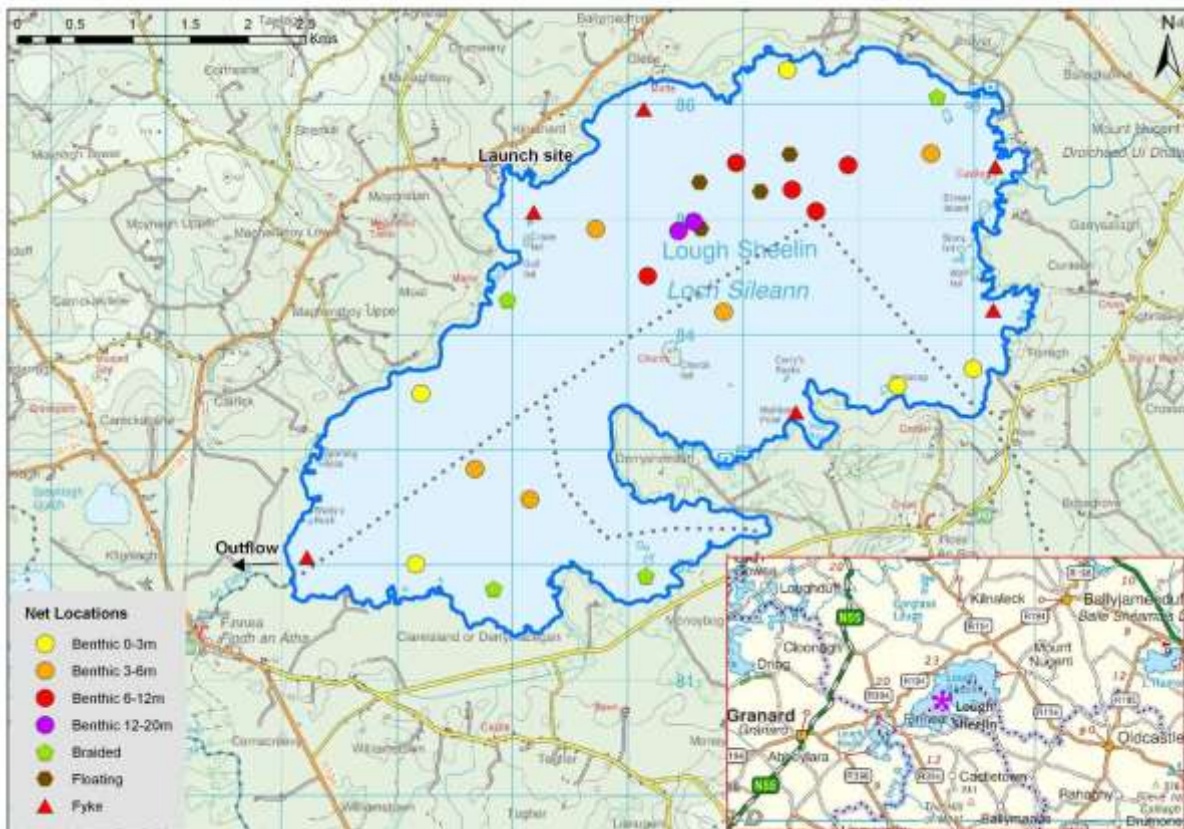
Fig. 1.1. Location map of Lough Sheelin showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Sheelin was surveyed over two nights between the 23rd and the 25th of June 2014. 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 surveys in 2008 and 2011. 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 and pike. 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 five fish species were recorded on Lough Sheelin in June 2014, with 597 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, followed by roach, brown trout, pike and eels. During the previous surveys in 2008 and 2011 the same species composition was recorded with the exception of tench, which were only captured during the 2011 survey and bream which were only recorded during the 2008 survey. Roach x bream hybrids were recorded in the 2008 and 2011 surveys but were not captured in 2014.

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Sheelin, June 2014

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
Salmo trutta	Brown trout	7	4	4	0	15
Perca fluviatilis	Perch	462	0	0	8	470
Rutilus rutilus	Roach	94	2	0	1	97
Esox lucius	Pike	10	0	0	1	11
Anguilla anguilla	Eel	0	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 2008, 2011 and 2014 surveys are summarised in Table 1.2. Mean CPUE and BPUE for all species is illustrated in Figure 1.2 and 1.3.

Perch was the dominant species in terms of abundance (CPUE) and biomass (BPUE). The mean wild brown trout CPUE and BPUE was significantly higher in 2014 than in 2008 and 2011 (Kruskal-Wallis $H=3.5$, $P<0.05$ and $H=3.5$, $P<0.05$ respectively) (Table 1.2; Fig 1.2 and 1.3). Although the mean perch and roach CPUE and BPUE fluctuated slightly over the three year sampling period, these differences were not statistically significant (Table 1.2; Fig 1.2 and 1.3).
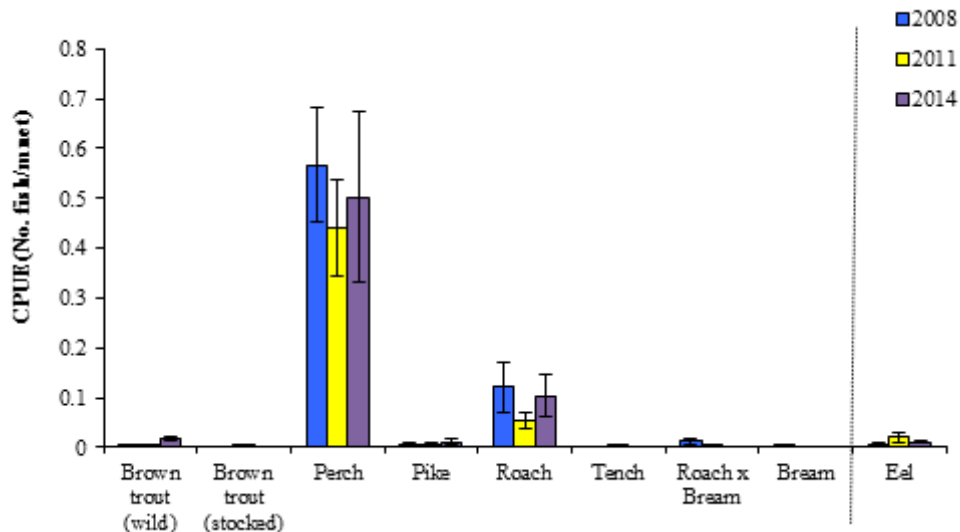
Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Sheelin, 2008, 2011 and 2014

| Scientific name	Common name	2008	2011	2014
		Mean CPUE		
Salmo trutta	Brown trout (wild)	0.003 (0.002)	0.003 (0.001)	0.016 (0.005)
Salmo trutta	Brown trout (stocked)	-	0.001 (0.001)	-
Perca fluviatilis	Perch	0.567 (0.114)	0.441 (0.097)	0.501 (0.171)
Rutilus rutilus	Roach	0.121 (0.049)	0.053 (0.016)	0.103 (0.042)
Esox lucius	Pike	0.005 (0.002)	0.005 (0.003)	0.011 (0.004)
Tinca tinca	Tench	-	0.004 (0.002)	-
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.013 (0.006)	0.002 (0.001)	-
Abramis brama	Bream	0.004 (0.002)	-	-
Anguilla anguilla	European eel	0.005 (0.005)	0.019 (0.009)	0.011 (0.003)
		Mean BPUE		
Salmo trutta	Brown trout (wild)	1.328 (0.912)	2.926 (2.76)	12.922 (4.904)
Salmo trutta	Brown trout (stocked)	-	0.677 (0.677)	-
Perca fluviatilis	Perch	42.965 (9.668)	54.969 (12.205)	51.694 (14.803)
Rutilus rutilus	Roach	10.313 (3.317)	10.43 (3.848)	11.108 (3.870)
Esox lucius	Pike	6.287 (3.319)	4.828 (3.576)	2.494 (1.409)
Tinca tinca	Tench	-	4.587 (3.112)	-
Rutilus rutilus x Abramis brama	Roach x bream hybrid	6.807 (3.03)	3.022 (2.293)	-
Abramis brama	Bream	1.808 (1.7)	-	-
Anguilla anguilla	European eel	1.395 (1.395)	10.502 (6.284)	5.255 (1.825)

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.

*Eel CPUE and BPUE based on fyke nets only

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Sheelin (Eel CPUE based on fyke nets only), 2008, 2011 and 2014
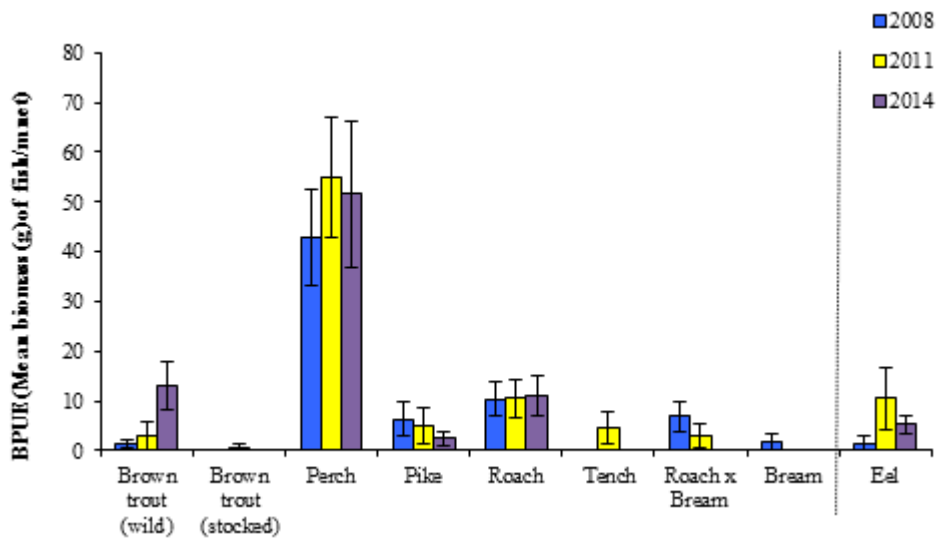
Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Sheelin (Eel BPUE based on fyke nets only), 2008, 2011 and 2014

1.3.3 Length frequency distributions and growth

Brown trout captured during the 2014 survey ranged in length from 16.3cm to 52.2cm (mean = 34.4cm) (Fig. 1.4) with five age classes present, ranging from 2+ to 6+, with a mean L1 of 6.6cm. The dominant age class was 2+ (Fig. 1.4) (Table 1.3). Mean brown trout L4 in 2014 was 40.9cm indicating a very 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 2014 surveys had similar length ranges, however, 2008 exhibited a narrower length range (Fig. 1.4). Age ranges and growth rates were similar over the three sampling years (Fig. 1.4).

Perch captured during the 2014 survey ranged in length from 5.4cm to 36.5cm (mean = 13.8cm) (Fig.1.5) with nine age classes present, ranging from 0+ to 9+, with a mean L1 of 6.4cm (Table 1.4). The dominant age class was 1+ (Fig. 1.5). Perch captured during the 2008 and 2011 surveys had a similar length range, age range and growth rate to the 2014 survey, with a wider age range recorded in 2014 (Fig.1.5). The dominant age class was different over the three sampling years.

Roach captured during the 2014 survey ranged in length from 4.9cm to 34.5cm (mean = 14.6cm) (Fig.1.6) with eight age classes present, ranging from 1+ to 8+, with a mean L1 of 2.5cm (Table 1.5). The dominant age class was 2+ (Fig. 1.6). Roach captured during the 2008 and 2011 surveys had a similar length range, age range and growth rate to the 2014 survey (Fig.1.6).

Pike captured during the 2014 survey ranged in length from 18.9cm to 47.5cm and eels ranged from 59.0cm to 72.0cm.
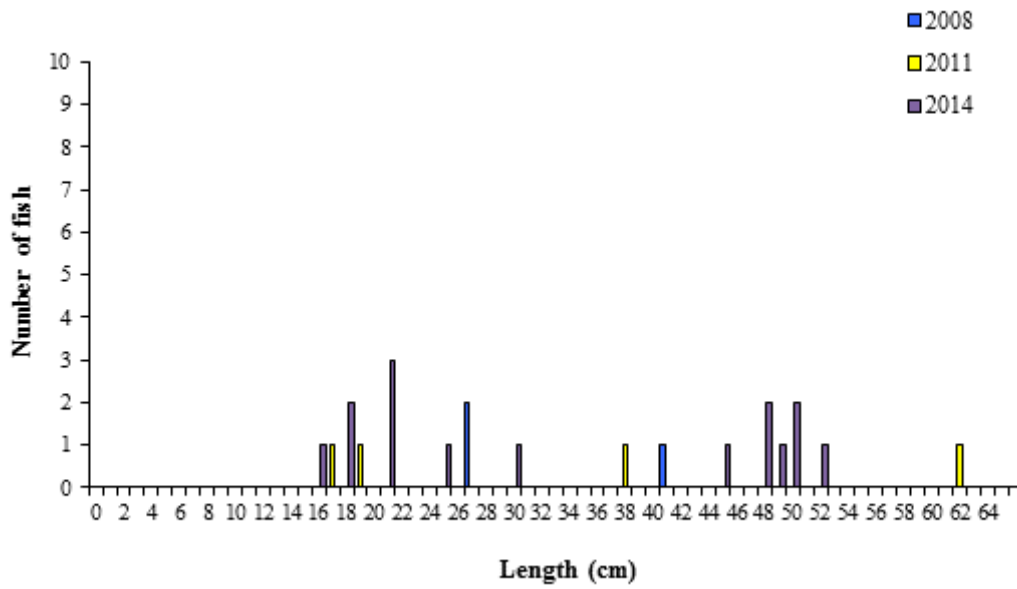
Fig. 1.4. Length frequency of brown trout captured on Lough Sheelin, 2008, 2011 and 2014
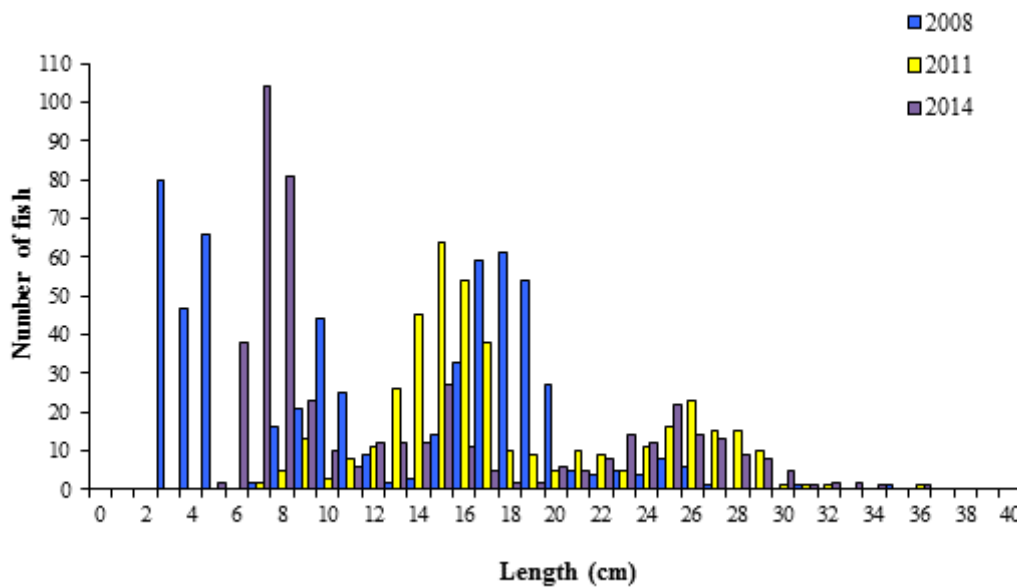

Fig. 1.5. Length frequency of perch captured on Lough Sheelin, 2008, 2011 and 2014
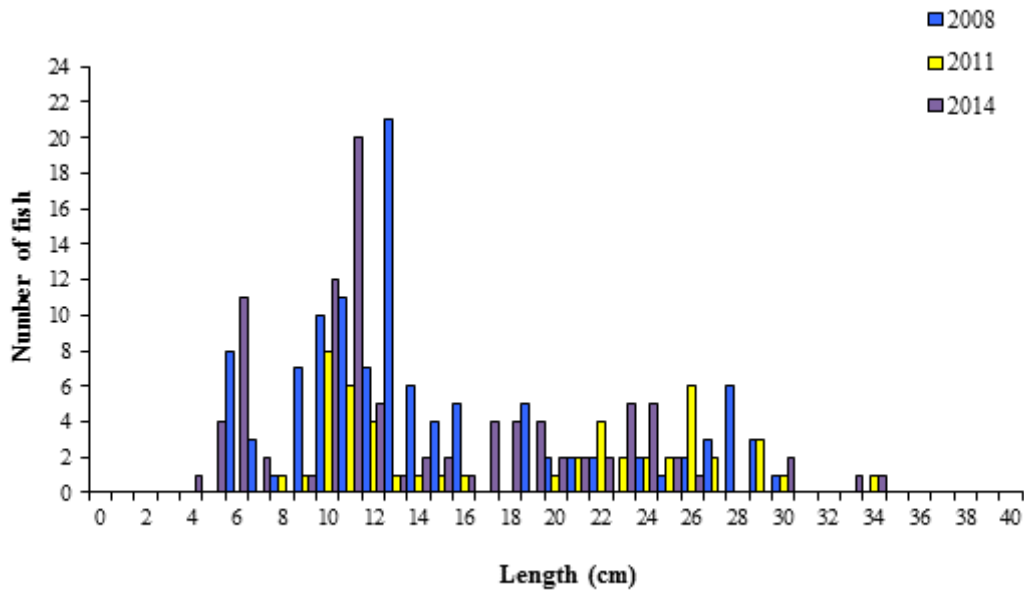
Fig. 1.6. Length frequency of roach captured on Lough Sheelin, 2008, 2011 and 2014

Table 1.3. Mean (±SE) brown trout length (cm) at age for Lough Sheelin, June 2014

	L₁	L₂	L₃	L₄	L₅	L₆	Growth Category
Mean	6.6 (0.4)	16.2 (1.2)	29.5 (2.9)	40.9 (2.1)	47.1 (2.0)	46.5	Very fast
N	15	15	8	7	4	1	
Range	4.6-9.3	10.8-26.9	18.8-39.8	32.9-47.4	42.3-51.3	46.5-46.5	

Table 1.4. Mean (±SE) perch length (cm) at age for Lough Sheelin, June 2014

	L₁	L₂	L₃	L₄	L₅	L₆	L₇	L₈	L₉
Mean	6.4 (0.2)	12.4 (0.3)	19.5 (0.3)	23.8 (0.3)	26.3 (0.4)	27.9 (0.4)	29.6 (0.5)	31.0 (0.6)	34.1 (1.1)
N	84	68	45	34	23	15	13	13	3
Range	4.5-14.5	8.4-19.8	13.7-23.8	18.7-27.7	22.0-30.4	25.8-30.3	27.1-32.0	28.0-35.0	32.9-36.3

Table 1.5. Mean (±SE) roach length (cm) at age for Lough Sheelin, June 2014

	L₁	L₂	L₃	L₄	L₅	L₆	L₇	L₈
Mean	2.5 (0.1)	6.1 (0.2)	11.1 (0.3)	16.3 (0.3)	20.2 (0.5)	24.3 (0.7)	29.2 (1.2)	29.1
N	43	42	35	29	18	11	4	1
Range	2.0-3.2	3.3-9.2	8.2-18.4	12.5-23.2	18.0-27.3	21.8-30.0	27.4-32.6	29.1-29.1

1.4 Summary

Perch was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2014 survey.

The mean brown trout CPUE and BPUE was higher in 2014 than in 2008 and 2011. Brown trout ranged in age from 2+ to 6+, with no 0+ or 1+ fish recorded. The dominant age class was 2+. 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).

The mean perch CPUE and BPUE fluctuated slightly over the three year sampling period; however, these differences were not statistically significant. Perch ranged in age from 0+ to 9+, indicating reproductive success in each of the previous ten years. The dominant age class was 1+.

The mean roach CPUE and BPUE fluctuated slightly over the three sampling occasions; however, these differences were not statistically significant. Roach ranged in age from 1+ to 8+, with no 0+ fish being captured. The dominant age class was 2+.

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., 2012b). Using the FIL2 classification tool, Lough Sheelin has been assigned an ecological status of Moderate for 2008, 2011 and 2014 based on the fish populations present.

In the 2010 to 2012 surveillance monitoring reporting period, the EPA assigned Lough Sheelin an overall draft ecological status of Moderate, based on all monitored physico-chemical and biological elements, including fish.

1.5. References

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