Sampling Fish for the Water Framework Directive

Lakes 2014

Lough Melvin

IASCACH INTÍRE ÉIREANN
INLAND FISHERIES IRELAND

Water Framework Directive Fish Stock Survey of Lough Melvin, July 2014

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1.1 Introduction

Lough Melvin is situated in the north-west of Ireland and is bordered by Co. Leitrim and Co. Fermanagh (Plate 1.1, Fig. 1.1). The lake is 12 kilometres in length, with a maximum width of less than three kilometres and a surface area of 2,125ha. The lake is greater than 10m in depth over 28% of its area, with a shallower area around the islands in the Fermanagh section and at the western end. Approximately 46% of the lake is less than 5m in depth. A deep trench runs east-west from Rossinver Bay towards the Drowes river outflow and has a maximum depth of 45m (Ferguson, 1986; Girvan and Foy, 2003). The geology of the catchment is dominated by Carboniferous rocks, predominantly sandstones and shales. The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderate alkalinity (20-100mg/l $CaCO_3$). It has also been classed as 1a (i.e. at risk of failing to meet good status by 2015) in the WFD characterisation report (EPA, 2005). Lough Melvin has been designated as a Special Area of Conservation (SAC) based on the fact that it is an oligo-mesotrophic lake, a lake category listed on Annex I of the EU Habitats Directive (NPWS, 2005). The lake is also designated as an SAC due to the presence of Atlantic salmon and otter, both species listed on Annex II of the same Directive.

Lough Melvin is one of the most important salmon and trout fisheries in the north-west of Ireland. It is an excellent example of a natural, post-glacial salmonid lake. The lake holds a relict population of Arctic char, Atlantic salmon (both of which are listed in the Irish Red Data Book (King *et al*., 2011) as vulnerable), perch and brown trout (NPWS, 2005). It is the brown trout that are of primary interest to most anglers. Three distinct varieties of brown trout (*Salmo trutta*) occur in this lake: sonaghan (*Salmo nigripinnis*), gillaroo (*Salmo stomachius*) and ferox (*Salmo ferox*). These have been found to be genetically distinct species and can be readily identified on the basis of their morphological and meristic features (Ferguson, 1986). The three types of trout exhibit distinct feeding patterns: sonaghan feed primarily on cladocerans, chironomid pupae and *Chaoborus;* gillaroo feed almost exclusively on benthic animals, including snails, trichopteran larvae and *Gammarus* spp. and ferox trout feed primarily on fish, including perch, Arctic char and brown trout (Ferguson, 1986).

The water quality of Lough Melvin has been surveyed intermittently since 1990 and the lake has consistently demonstrated mesotrophic characteristics (Champ, 1998; McGarrigle *et al*, 2002; Girvan and Foy, 2003). The water in Lough Melvin is heavily peat stained, which is thought to be the principal factor limiting primary production; the algal crop did not appear to change in diversity or abundance between 1990 and 2001/2002, but monitoring work on the lake has shown a substantial shift towards phosphorus enrichment with mean total phosphorus concentrations in the open water increasing from 19μg to 30μg P/l since 1990 (Girvan and Foy, 2003). There is evidence that blue green algal blooms are now more severe than previously. The health and status of the lake is particularly vulnerable to human activities, such as an increase in phosphorus loadings from housing,

forestry and agriculture within the surrounding catchment (Campbell and Foy, 2008). As part of the EU Intereg IIIA programme, a Catchment Management Plan was developed for Lough Melvin to promote the attainment of good ecological status and address the threat of nutrient enrichment, particularly from agriculture, forestry and domestic waste water (Campbell and Foy, 2008).

The lake has been surveyed for fish previously, primarily to evaluate brown trout stocks, by Inland Fisheries Ireland (previously the Central Fisheries Board and the Northern Regional Fisheries Board) in 1986 and 2001 using the standard IFI netting method for assessing brown trout stocks in lakes (O'Grady, 1981; Delanty and O'Grady, 2001). More recently it was surveyed in 2005 as part of the NS Share "Fish in Lakes Project (Kelly *et al*., 2007) and 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 was the most abundant fish species recorded. Arctic char, salmon, four types of brown trout (brown trout, sonaghan, gillaroo and ferox), rudd, roach x rudd hybrids, three-spined stickleback and eels were also recorded.

An additional experimental survey using hydroacoustic and pelagic gillnetting techniques was carried out on Lough Melvin over three nights between the 7th and 10th of July 2014. This survey was carried out as part of a Ph.D. research project which aims to incorporate hydroacoustic technology into the existing standard sampling protocols used to assign ecological and conservation status for the Water Framework and Habitats Directive for conservation and endangered fish species. The experimental survey concentrated on the deeper sections of the lake (depth >12m) and covered *circa* 23km of hydroacoustic transects. A separate report will be available in due course.

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.
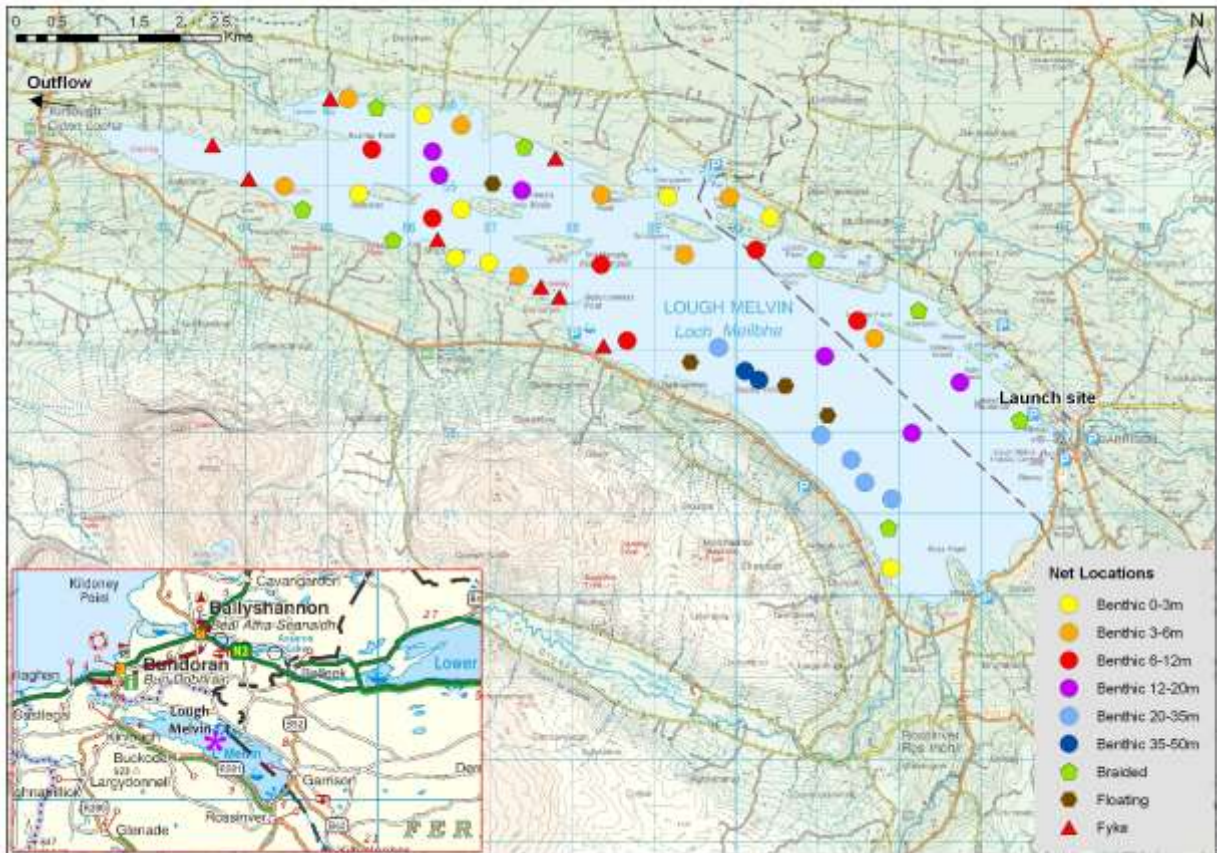
Plate 1.1. Lough Melvin

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

1.2 Methods

Lough Melvin was surveyed over four nights between the 7th and the 11th of July 2014. A total of eight sets of Dutch fyke nets, 35 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (8 @ 0-2.9m, 8 @ 3-5.9m, 6 @ 6-11.9m, 6 @ 12-19.9m, 5 @ 20-34.9m and 2 @ 35-49.9m) and four floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (47 sites). The netting effort was supplemented using eight benthic braided survey gill nets (62.5mm mesh knot to knot) at eight 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, salmon, rudd and 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 five fish species, four types of brown trout (brown trout, sonaghan, gillaroo and ferox) and one type of hybrid were recorded during the survey in 2014, with 805 fish being captured (Table 1.1). Perch was the most abundant fish species recorded, followed by rudd, eels, trout, Arctic char, roach x rudd hybrids and salmon. During the previous surveys in 2008 and 2011 the same species composition was recorded with the exception of three-spined stickleback, which were captured during the 2011 survey but were not recorded during the 2008 and 2014 survey.

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Melvin, July 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
Perca fluviatilis	Perch	554	0	0	43	597
Scardinius erythrophthalmus	Rudd	76	0	3	2	81
Salmo nigripinnis	Sonaghan	21	10	0	1	32
Salmo stomachius	Gillaroo	15	6	0	1	22
Salmo trutta	Brown trout	12	4	0	1	17
Salmo ferox	Ferox trout	9	0	1	0	10
Salvelinus alpinus	Arctic Char	5	0	0	0	5
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	1	0	0	0	1
Salmo salar	Salmon	0	0	1	0	1
Anguilla anguilla	Eel	2	0	0	37	39

Note: Results from the experimental hydroacoustic and pelagic gillnetting survey will be presented in a separate report.

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 brown trout CPUE and BPUE was significantly higher in 2014 than in 2011 (Kruskal-Wallis $H=17.7$, $P<0.001$ and $H=3.3$, $P<0.05$ respectively) (Table 1.2; Fig 1.2 and 1.3). The mean perch CPUE and BPUE fluctuated slightly over the three sampling years; however, these differences were not statistically significant (Table 1.2; Fig 1.2 and 1.3).
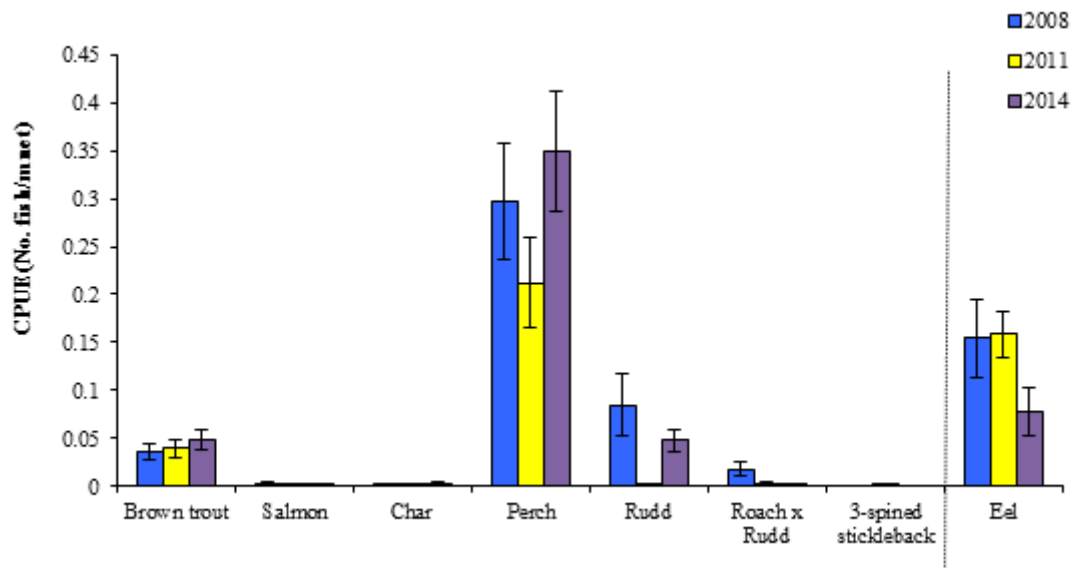
**Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Melvin, 2008, 2011 and 2014**

Scientific name	Common name	2008	2011	2014
		Mean CPUE		
Perca fluviatilis	Perch	0.296 (0.059)	0.212 (0.046)	0.348 (0.059)
Scardinius erythrophthalmus	Rudd	0.084 (0.032)	0.001 (0.001)	0.048 (0.011)
Salmo trutta	Brown trout	0.035 (0.008)	0.039 (0.009)	0.048 (0.011)
Salmo salar	Salmon	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)
Salvelinus alpinus	Arctic Char	0.001 (0.001)	0.001 (0.001)	0.003 (0.001)
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	0.018 (0.007)	0.002 (0.002)	0.001 (0.001)
Gasterosteus aculeatus	3-spined stickleback	-	0.001 (0.001)	-
Anguilla anguilla	European eel	0.154 (0.0407)	0.158 (0.024)	0.077 (0.025)
		Mean BPUE		
Perca fluviatilis	Perch	21.145 (4.723)	25.93 (6.114)	28.456 (5.557)
Scardinius erythrophthalmus	Rudd	12.782 (3.653)	0.001 (0.001)	10.144 (2.363)
Salmo trutta	Brown trout	7.7 (1.831)	11.037 (2.974)	11.081 (2.684)
Salmo salar	Salmon	6.861 (4.537)	0.023 (0.023)	1.185 (1.185)
Salvelinus alpinus	Arctic Char	0.012 (0.012)	0.001 (0.001)	0.377 (0.191)
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	4.485 (1.933)	2.187 (1.676)	0.616 (0.616)
Gasterosteus aculeatus	3-spined stickleback	-	0.002 (0.002)	-
Anguilla anguilla	European eel	17.413 (5.202)	22.352 (4.254)	9.597 (3.525)

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 Melvin (Eel CPUE based on fyke nets only), 2008, 2011 and 2014

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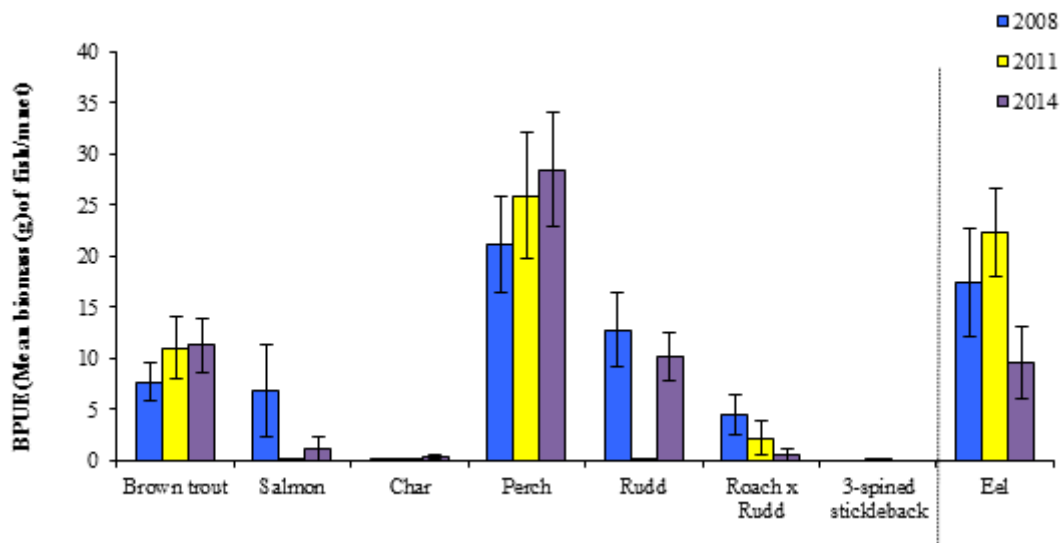
Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Melvin (Eel BPUE based on fyke nets only), 2008, 2011 and 2014

1.3.3 Length frequency distributions and growth

Brown trout (all types combined) captured during the 2014 survey ranged in length from 9.0cm to 55.0cm (mean = 23.8cm) (Fig. 1.4). Ten age classes were present, ranging from 1+ to 10+, with a mean L1 of 6.4cm (Table 1.3). The dominant age class was 2+ (Fig. 1.4). Mean brown trout L4 in 2014 was 26.1cm 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). Length-age ranges and growth rates were similar in 2011 and 2014; the narrowest age range was exhibited in the 2008 survey (Fig. 1.4).

Perch captured during the 2014 survey ranged in length from 7.1cm to 27.5cm (mean = 15.8cm) (Fig.1.5) with nine age classes present, ranging from 1+ to 10+, with a mean L1 of 5.9cm (Table 1.4). The dominant age class was 1+ (Fig. 1.4). Perch captured during the 2008 and 2011 surveys had similar length ranges with some larger fish recorded in 2008 and 2011 (Fig.1.5). Age ranges and growth rates were similar over the three sampling years however, there has been a shift in the dominant year class over the three sampling occasions (Fig.1.5).

Rudd captured during the 2014 survey ranged in length from 14.5cm to 35.5cm (mean = 21.3cm) (Fig.1.6). Rudd captured during the three surveys had similar lengths (Fig.1.6).

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Arctic char captured during the 2014 survey ranged in length from 5.5cm to 25.6cm (0+ to 3+) and eels ranged from 25.3cm to 59.8cm. One salmon measuring 61.0cm and aged 2.1+ and one roach x bream hybrid at 37.9cm were also recorded.
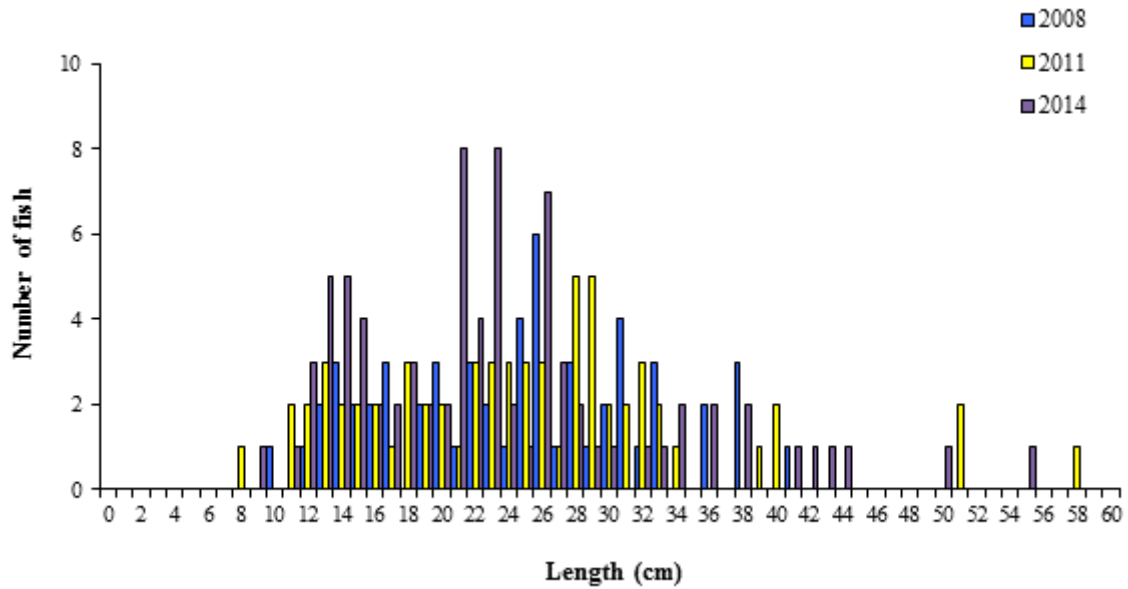

Fig. 1.4. Length frequency of brown trout captured on Lough Melvin, 2008, 2011 and 2014
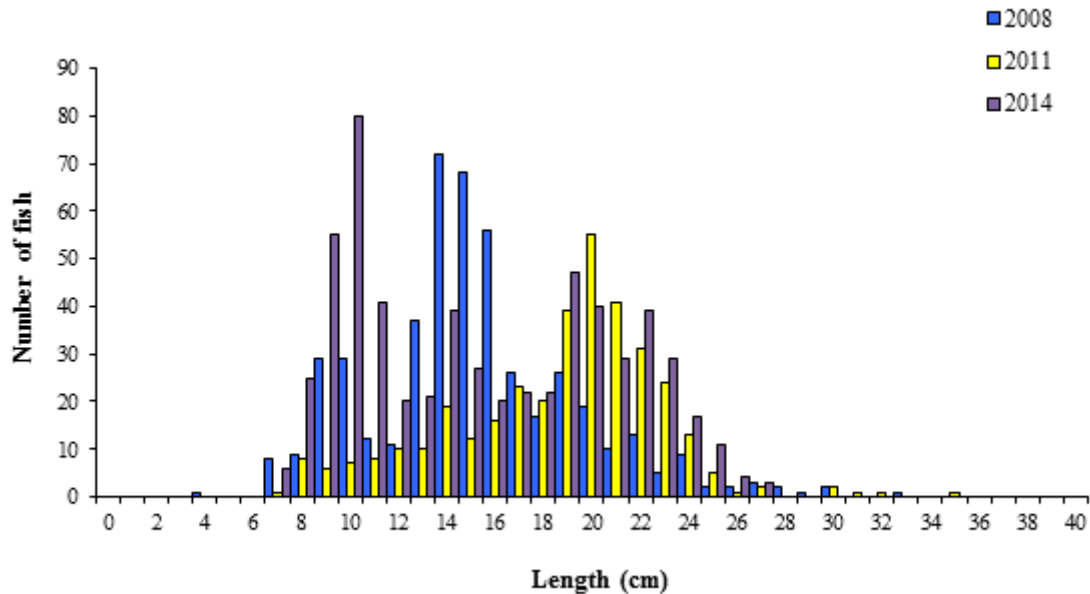

Fig. 1.5. Length frequency of perch captured on Lough Melvin, 2008, 2011 and 2014
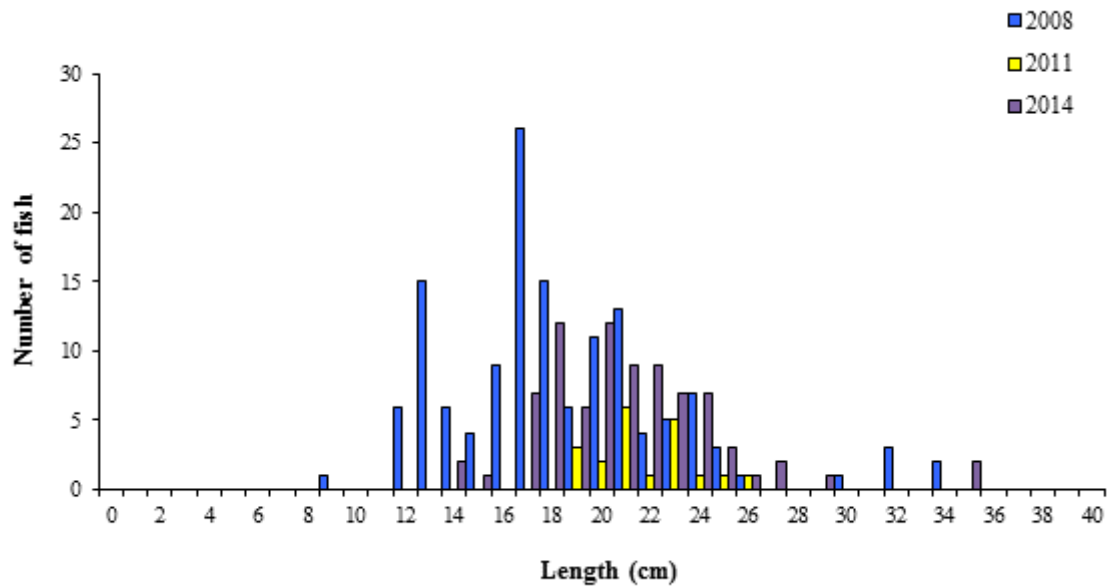
Fig. 1.6. Length frequency of rudd captured on Lough Melvin, 2008, 2011 and 2014

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

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	Growth Category
Mean	6.4 (0.2)	14.9 (0.4)	21.2 (0.5)	26.1 (0.5)	29.6 (0.7)	33.0 (0.8)	37.1 (1.1)	42.5 (1.5)	48.8 (2.6)	49.3	Slow
N	80	62	36	20	15	13	10	6	2	1	
Range	3.2-11.1	8.3-20.3	15.0-25.7	19.9-30.2	23.3-33.8	27.0-36.8	30.8-42.4	37.2-47.6	46.2-51.5	49.3-49.3	

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

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
Mean	5.9 (0.1)	11.8 (0.2)	16.5 (0.3)	19.4 (0.3)	21.6 (0.3)	22.8 (0.4)	23.4 (0.4)	24.5 (0.5)	26.6	27.3
N	68	48	34	27	20	15	14	12	1	1
Range	4.1-10.2	9.1-14.5	13.9-19.9	16.9-21.9	19.1-23.8	20.4-26.1	21.2-25.7	22.3-26.7	26.6-26.6	27.3-27.3

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 significantly higher in 2014 than in 2011. Brown trout ranged in age from 1+ to 10+, indicating reproductive success in each of the previous ten years. The dominant age class was 2+. 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 perch CPUE and BPUE fluctuated slightly over the three sampling years; however, these differences were not statistically significant. Perch ranged in age from 1+ to 10+, with no 0+ or 9+ fish being captured. The dominant age class was 1+.

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 Melvin was assigned an ecological status of Moderate for 2005 and 2008 and Good for both 2011 and 2014 based on the fish populations present.

In the 2010 to 2012 surveillance monitoring reporting period, the EPA assigned Lough Melvin 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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