Sampling Fish for the Water Framework Directive

Lakes 2011

Lough Melvin

Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Melvin, July 2011

Fiona L. Kelly, Lynda Connor, Emma Morrissey, Ciara Wogerbauer, Ronan Matson, Rory Feeney and Kieran Rocks

Inland Fisheries Ireland, Swords Business Campus, Swords, Co. Dublin

ACKNOWLEDGEMENTS

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 characterization 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). It was also surveyed in 2005 using a similar method to that deployed during the 2011 survey, i.e. a method based on the European standard method for multimesh gill netting that was tested and developed during the NS Share "Fish in Lakes Project (Kelly *et al*., 2007).

More recently Lough Melvin was surveyed in 2008 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009). During this 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 and eels were also recorded.

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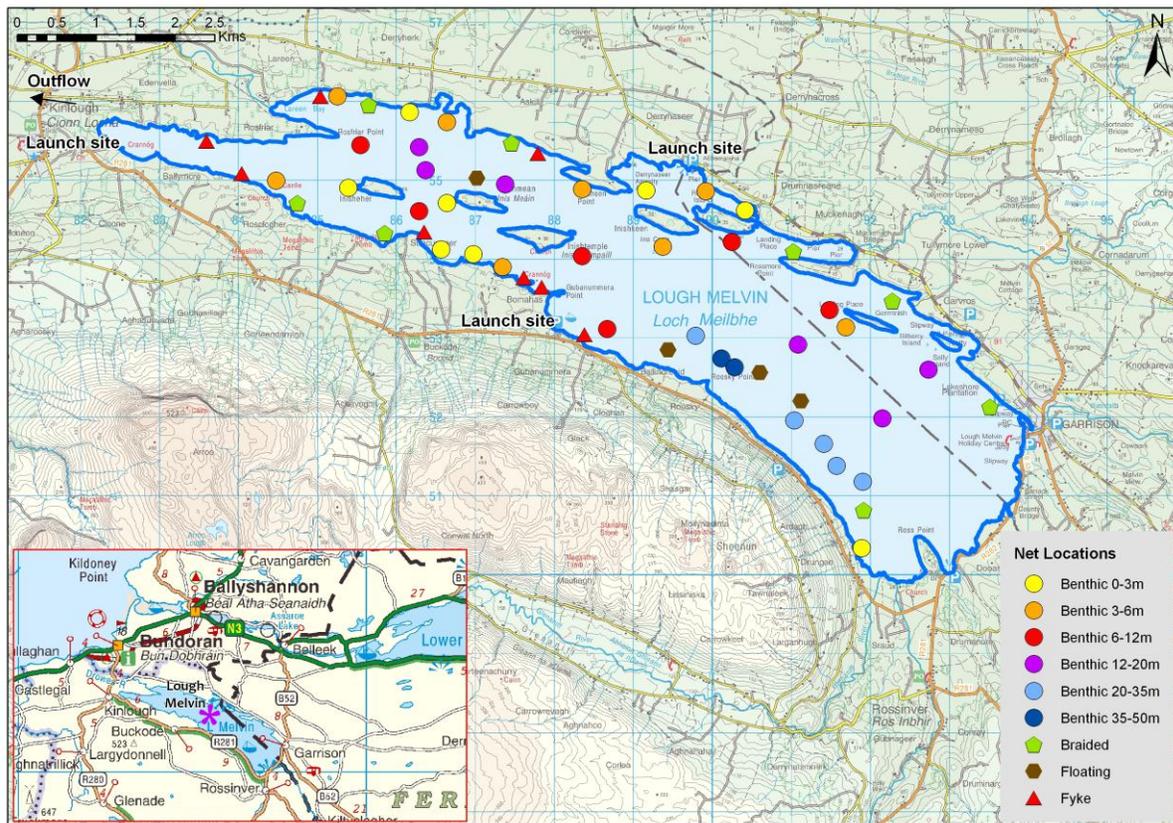
Fig. 1.1. Location map of Lough Melvin showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Melvin was surveyed over four nights between the 11th and the 15th of July 2011. 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 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, 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 six fish species, four types of brown trout (brown trout, sonaghan, gillaroo and ferox) and one type of hybrid were recorded in Lough Melvin in July 2011, with 525 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. Arctic char, salmon, four types of brown trout (brown trout, sonaghan, gillaroo and ferox), rudd, three-spined stickleback, roach x rudd hybrids and eels were also recorded. During the previous survey in 2008 the same species composition was recorded with the exception of three-spined stickleback, which were present during the 2011 survey but were not captured in 2008.

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Melvin, July 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
Perca fluviatilis	Perch	340	0	0	16	356
Salvelinus alpinus	Char	1	0	0	0	1
Salmo trutta	Brown trout	5	0	0	0	5
Salmo nigripinnis	Sonaghan	21	9	0	0	30
Salmo stomachius	Gillaroo	20	0	0	0	20
Salmo ferox	Ferox	9	0	1	0	10
Salmo salar	Salmon	1	0	0	0	1
Scardinius erythrophthalmus	Rudd	20	0	0	0	20
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	0	0	4	0	4
Gasterosteus aculeatus	3-spined stickleback	2	0	0	0	2
Anguilla anguilla	Eel	0	0	0	76	76

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 CPUE was lower in 2011 than in 2008 and the mean brown trout CPUE appeared higher in 2011 than in 2008, these differences were not statistically significant (Figs. 1.2 and 1.3).

The differences in the mean perch CPUE between Lough Melvin and four other similar lakes were assessed, with no overall significant differences being found (Fig. 1.4). However, Independent-Samples Mann-Whitney U tests between each lake showed that Lough Melvin had a significantly lower mean perch CPUE than Lough Meelagh ($z = -2.2.165$, $P<0.05$).

The differences in the mean brown trout (all types combined) CPUE between Lough Melvin and four other similar lakes were also 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 Melvin had a significantly higher mean brown trout CPUE than Lough Gill ($z = -4.026$, $P<0.05$) and a significantly lower mean brown trout CPUE than Lough Fern, Carrowmore Lake and Lough Leane ($z = -3.164$ $P<0.05$, $z = -5.271$ $P<0.05$ and $z = -2.507$ $P<0.05$).

Although the mean perch and brown trout BPUE was higher in 2011 than in 2008, these differences were not statistically significant.

The differences in the mean perch BPUE between Lough Melvin and four other similar lakes were assessed, with no overall significant differences being found (Fig. 1.6).

The differences in the mean brown trout (all types combined) BPUE between Lough Melvin and four other similar lakes were also 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 Melvin had a significantly higher mean brown trout BPUE than Lough Gill ($z = -3.764$, $P<0.05$) and a significantly lower mean brown trout BPUE than Lough Fern, Carrowmore Lake and Lough Leane ($z = -2.976$ $P<0.05$, $z = -4.232$ $P<0.05$ and $z = -1.871$ $P<0.05$).

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

Scientific name	Common name	2008	2011
		Mean CPUE	
Salmo trutta	Brown trout	0.035 (0.008)	0.039 (0.009)
Salmo salar	Salmon	0.002 (0.001)	0.001 (0.001)
Salvelinus alpinus	Arctic char	0.001 (0.001)	0.001 (0.001)
Perca fluviatilis	Perch	0.296 (0.059)	0.212 (0.046)
Scardinius erythrophthalmus	Rudd	0.084 (0.032)	0.001 (0.001)
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	0.018 (0.007)	0.002 (0.002)
Gasterosteus aculeatus	3-spined stickleback	-	0.001 (0.001)
Anguilla anguilla	European eel	0.154 (0.0407)	0.158 (0.024)
		Mean BPUE	
Salmo trutta	Brown trout	7.7 (1.831)	11.037 (2.974)
Salmo salar	Salmon	6.861 (4.537)	0.023 (0.023)
Salvelinus alpinus	Arctic char	0.012 (0.012)	0.001 (0.001)
Perca fluviatilis	Perch	21.145 (4.723)	25.93 (6.114)
Scardinius erythrophthalmus	Rudd	12.782 (3.653)	0.001 (0.001)
Rutilus rutilus x Scardinius erythrophthalmus	Roach x rudd hybrid	4.485 (1.933)	2.187 (1.676)
Gasterosteus aculeatus	3-spined stickleback	-	0.002 (0.002)
Anguilla anguilla	European eel	17.413 (5.202)	22.352 (4.254)

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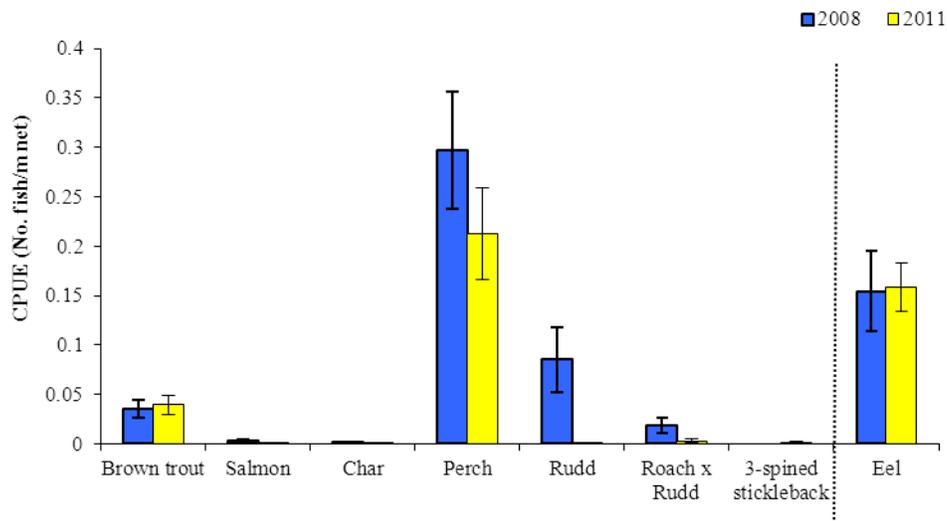

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Melvin (Eel CPUE based on fyke nets only), 2008 and 2011
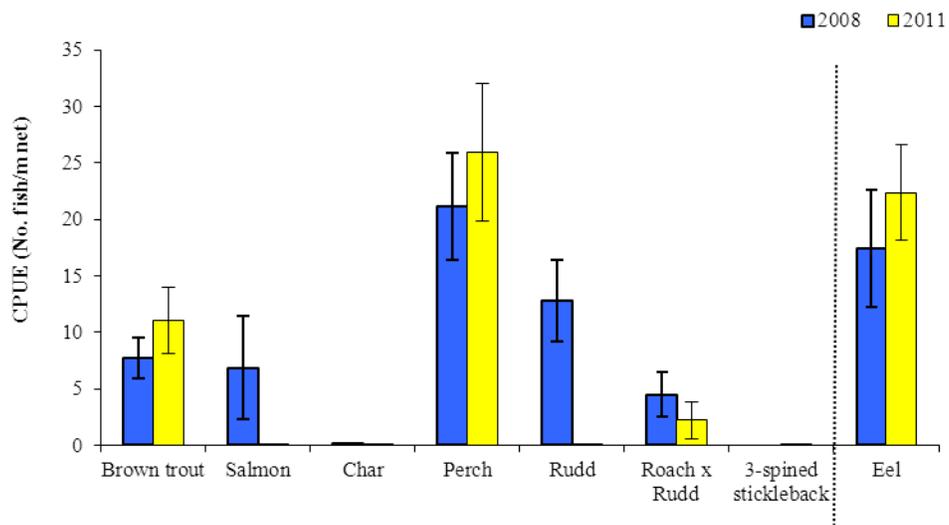
Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Melvin (Eel CPUE based on fyke nets only), 2008 and 2011
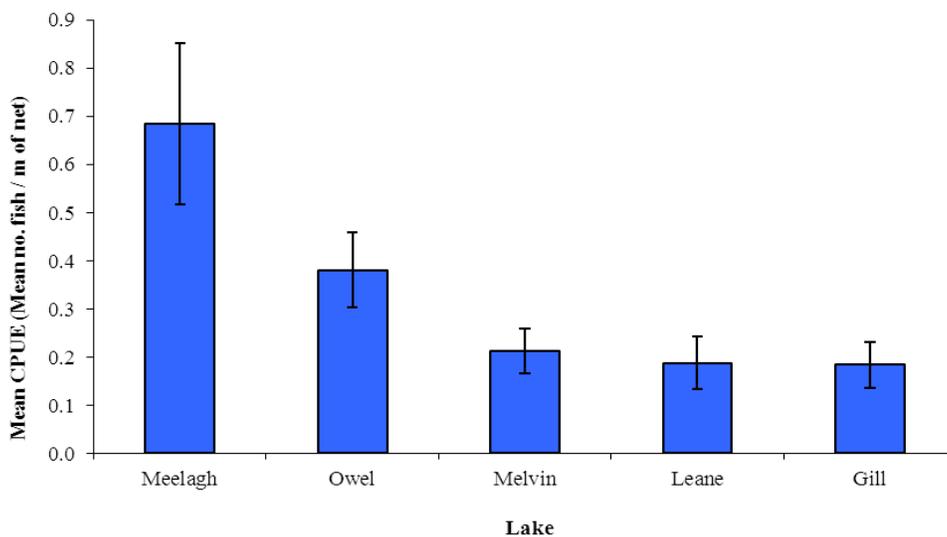

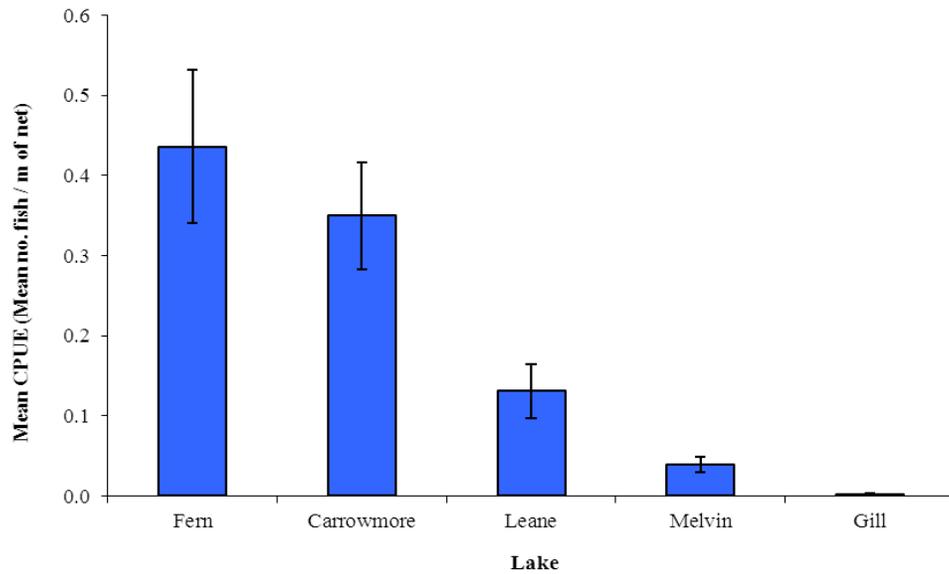**Fig. 1.4. Mean (±S.E.) perch CPUE in five lakes surveyed during 2011**

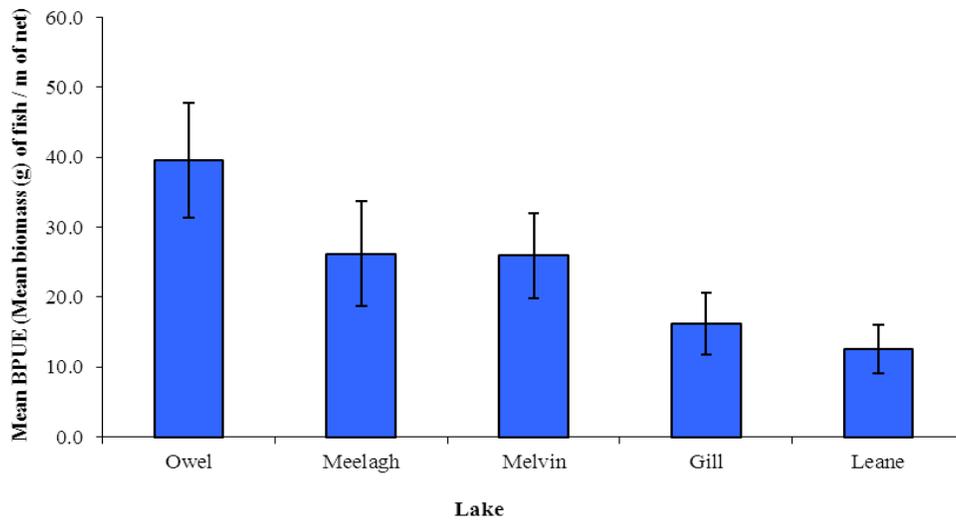**Fig. 1.5. Mean (±S.E.) brown trout CPUE in five lakes surveyed during 2011**

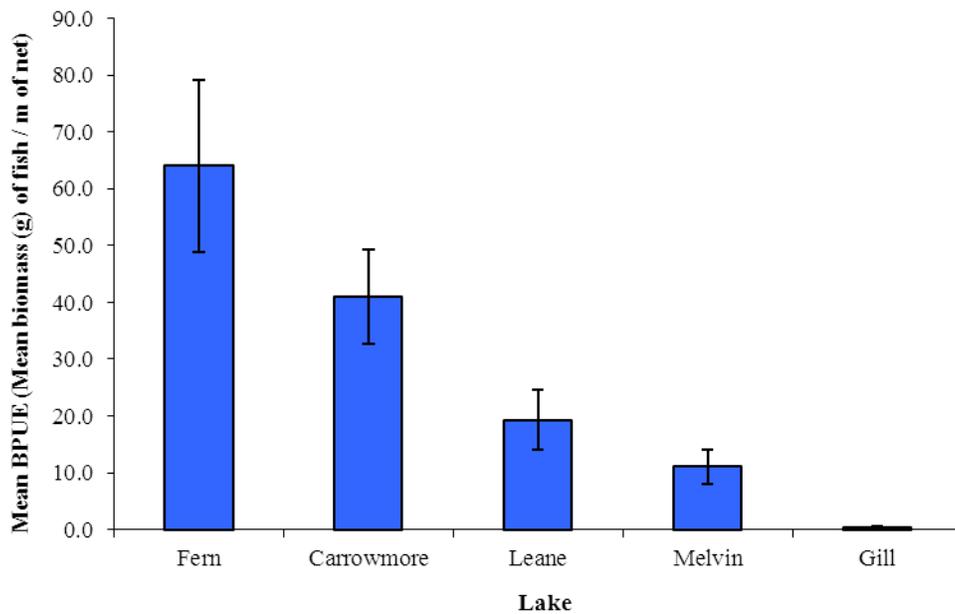**Fig. 1.6. Mean (±S.E.) perch BPUE in five lakes surveyed during 2011**

Fig. 1.7. Mean (±S.E.) brown trout BPUE in five lakes surveyed during 2011

1.3.3 Length frequency distributions

Perch captured during the 2011 survey ranged in length from 7.2cm to 35.0cm (mean = 18.9cm) (Fig. 1.8). Perch captured during the 2008 survey ranged in length from 4.0cm to 33.4cm (Fig. 1.8).

Brown trout (all types combined) captured during the 2011 survey ranged in length from 8.7cm to 58.5cm (mean = 25.3cm) (Fig.1.9). Brown trout captured during the 2008 survey had lengths ranging from 10.3cm to 41.5cm (Fig.1.9).

Rudd captured during the 2011 survey ranged in length from 19.3cm to 26.6cm, three-spined stickleback ranged in length from 4.5cm to 5.0cm and roach x rudd hybrids ranged in length from 31.0cm to 34.7cm. One juvenile salmon was recorded at 14.7cm, one Arctic char was recorded at 5.7cm and eels ranged in length from 29.0cm to 62.0cm.
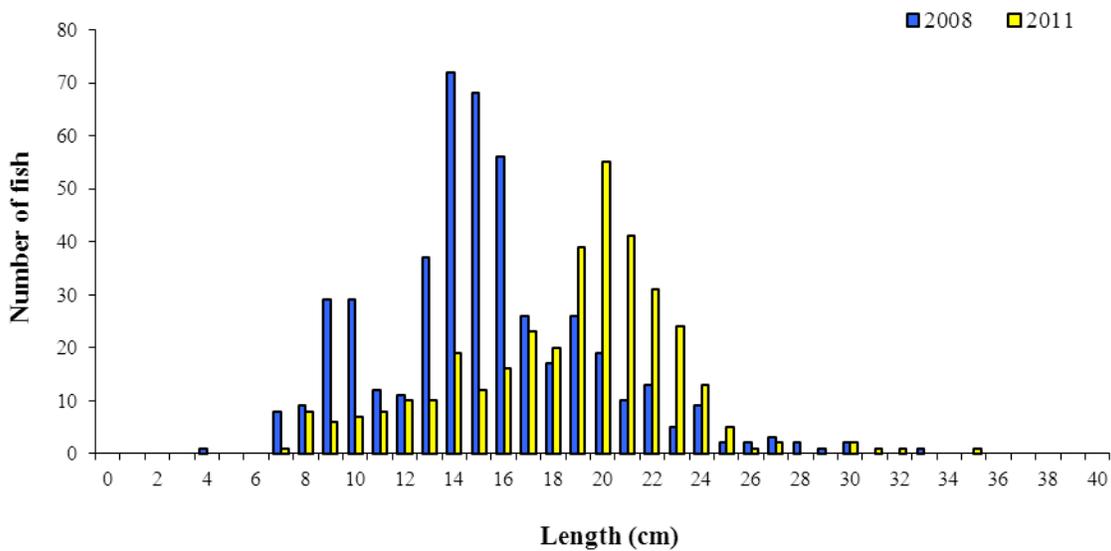
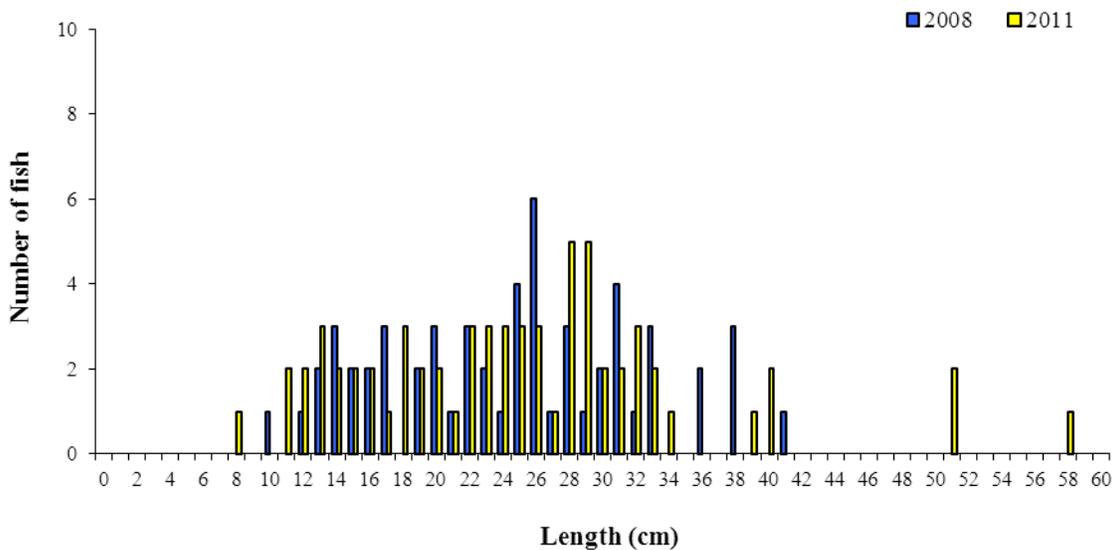**Fig. 1.8. Length frequency of perch captured on Lough Melvin**

Fig. 1.9. Length frequency of brown trout captured on Lough Melvin

1.3.4 Fish age and growth

Eight age classes of perch were present, ranging from 1+ to 8+, indicating reproductive success in eight of the previous nine years, with a mean L1 of 5.6cm (Table 1.4). The dominant age class of perch was 2+,. In the 2008 survey, perch ranged from 1+ to 6+ with a mean L1 of 5.9cm.

Nine age classes of brown trout (all types combined) were present, ranging from 1+ to 9+ indicating reproductive success in previous years. The mean L1 6.3cm (Table 1.4) and the dominant age class was 2+. In the 2008 survey, brown trout ranged from 1+ to 7+ with a mean L1 of 6.6cm. Mean brown trout L4 in 2011 was 27.8cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

A single salmon and a single Arctic char captured were aged at 1+ and 0+ respectively.

Table 1.3. Mean (±SE) perch length (cm) at age for Lough Melvin, July 2011

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
Mean	5.6 (0.1)	11.8 (0.2)	16.7 (0.3)	19.9 (0.4)	22.8 (0.4)	26.3 (0.9)	28.9 (1.3)	34.6
N	98	81	57	46	32	12	6	1
Range	4.17.7	8.4-14.8	12.3-20.9	15.0-24.7	18.1-27.6	22.5-31.2	23.7-32.8	34.-6-34.6

Table 1.4. Mean (±SE) brown trout length (cm) at age for Lough Melvin, July 2011

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9
Mean	6.3 (0.2)	15.1 (0.4)	22.4 (0.4)	27.8 (0.5)	32.7 (0.9)	39.0 (1.9)	43.2 (2.0)	49.6 (1.4)	56.0
N	61	52	37	23	10	6	5	3	1
Range	3.1-9.9	9.1-21.3	18.1-26.7	23.4-31.5	29.4-38.4	35.1-46.7	38.5-48.8	47.2-52.2	55.9-55.9

1.4 Summary

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

There was no significant difference in mean perch CPUE and BPUE between 2011 and 2008. The mean perch CPUE in Lough Melvin 2011 was significantly lower than that recorded in Lough Meelagh, Co. Roscommon. The mean perch BPUE in Lough Melvin was similar to the other lakes assessed, with no statistically significant differences being found between lakes. Perch ranged in age from 1+ to 8+, indicating reproductive success in eight of the previous nine years.

Although the mean brown trout CPUE and BPUE appeared higher in 2011 than in 2008, these differences were not statistically significant. The mean brown trout CPUE and BPUE in Lough Melvin was significantly higher than Lough Gill and lower than Lough Fern, Carrowmore Lake and Lough Leane, other similar lakes surveyed. Brown trout ranged in age from 1+ to 9+, indicating reproductive success in nine of the previous ten 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).

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, combined with expert opinion on non-native/alien species, Lough Melvin has been assigned an ecological status of Good based on the fish populations present. The ecological status assigned to the lake based on the 2008 survey data was Moderate.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lough Melvin 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.

1.5 References

Campbell, E. and Foy, B. (Eds.) (2008) *Executive Summary of Lough Melvin Catchment management Plan*. Northern Regional Fisheries Board.

Champ, W.S.T. (1998) Phosphorus/Chlorophyll relationships in Irish lakes: ecological consequences and suggested criteria for ecosystem management. In: Wilson, J. (Ed.) *Eutrophication in Irish Water*, 91-105. Royal Irish Academy, Dublin.

Delanty, K. and O' Grady, M. (2001) *Lough Melvin Fish Stock Report*. Central Fisheries Board. Internal report.

EPA (2005) *The Characterisation and Analysis of Ireland's River Basin Districts in accordance with section 7 (2&3) of the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).* National Summary Report (Ireland). 166pp.

Ferguson, A. (1986) Lough Melvin – A unique fish community. *Occasional papers in Irish Science and Technology*, No. 1, 17pp.

Girvan, J. and Foy, R. (2003) *Water Quality and Limnology of Lough Melvin (cSAC) – 1990 and 2001/02 (EHS CON 4/4/42).* Report prepared for Environment and Heritage Service by Queens University Belfast and Department of Agriculture and Rural Development Northern Ireland.

Kelly, F., Connor, L. and Champ, T. (2007) *A Survey of the Fish Populations in 46 lakes in the Northern Regional Fisheries Board, June to September 2005 and 2006*. Central Fisheries Board. Internal report.

Kelly, F.L, Champ, W.S.T., Connor, L., Rosell, R., Harrison, A. and Girvan, J. (2007) Sampling procedures for fish in lakes (PART B). *Testing of various fish sampling gear types (fyke nets, monofilament multi-mesh gillnets, braided gill nets, seine nets and electrofishing) on selected lakes in the NS Share area*. Central Fisheries Board. NS Share project 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 report.

Kelly, F.L., Connor, L., Wightman, G., Matson, R. Morrissey, E., O'Callaghan, R., Feeney, R., Hanna, G. and Rocks, K. (2009) *Sampling fish for the Water Framework Directive – Summary report 2008*. Central and Regional Fisheries *Boards*. Internal report.

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.

King, J., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J., Fitzpatrick, U., Gargan, P., Kelly, F., O' Grady, M., Poole, R., Roche, W. and Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

McGarrigle, M.C., Bowman, J.J., Clabby, K.J., Lucey, J., Cunningham, M., MacCárthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan, C. and Toner, P.F. (2002) Water Quality in Ireland 1998-2000, 128pp. Environmental Protection Agency, Wexford.

Inland Fisheries Ireland
Swords Business Campus,
Swords,
Co. Dublin,
Ireland.

Web: www.fisheriesireland.ie
Email: info@fisheriesireland.ie
Tel: +353 1 8842 600
Fax: +353 1 8360 060