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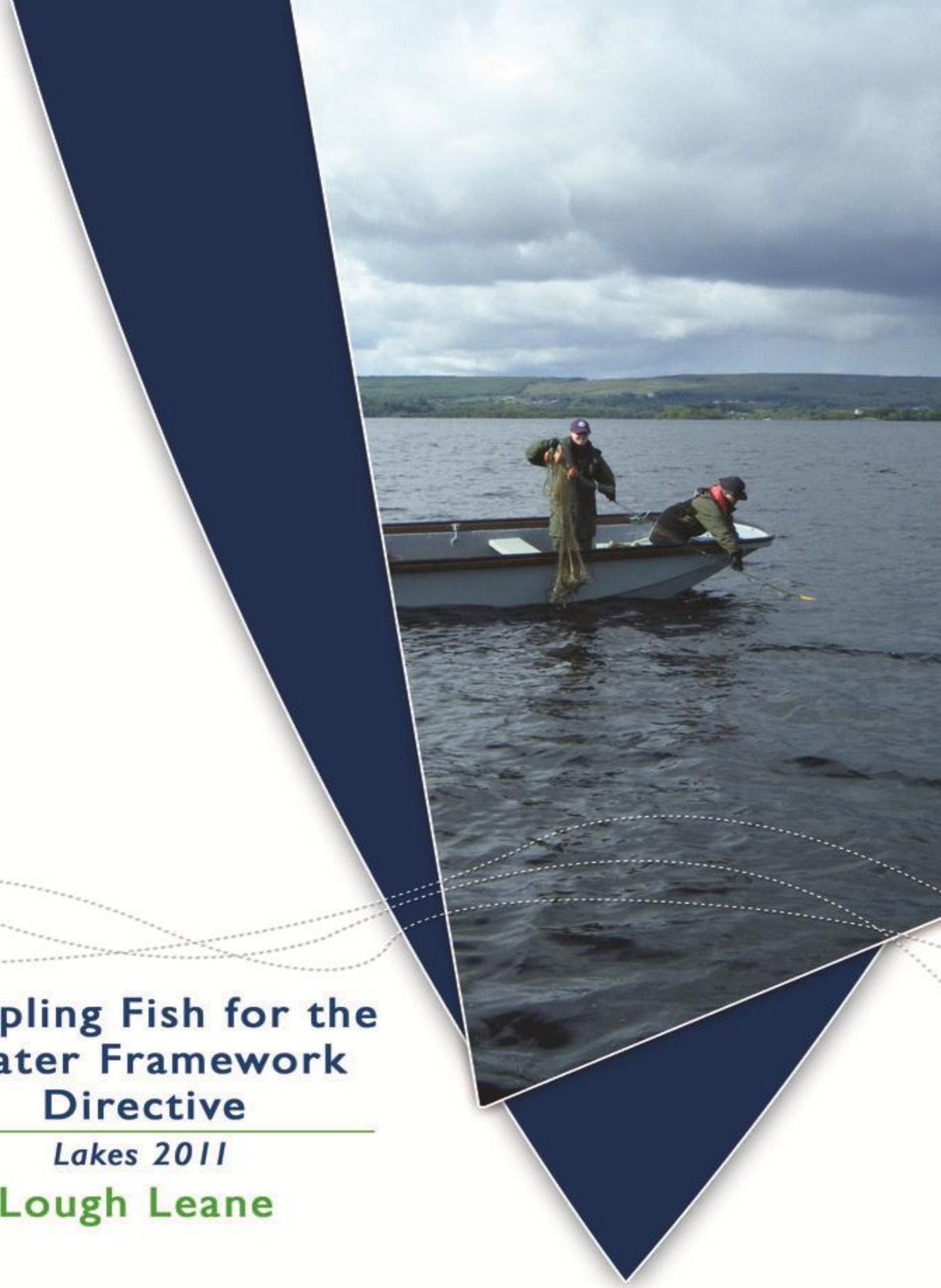

Sampling Fish for the Water Framework Directive

Lakes 2011

Lough Leane

Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Leane, September 2011

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1.1 Introduction

Lough Leane forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh river catchment candidate Special Area of Conservation (Plate 1.1, Fig. 1.1). This is a large area that encompasses a wide variety of habitats designated under Annex I of the EU Habitats Directive, including blanket bog, alluvial woodlands, alpine heath and both upland and lowland oligotrophic lakes. The site has also been selected for the following species, Killarney fern, slender naiad, freshwater pearl mussel, Kerry slug, marsh fritillary, Killarney shad, Atlantic salmon, brook lamprey, river lamprey, sea lamprey, lesser horseshoe bat and otter; all species listed on Annex II of the EU Habitats Directive (NPWS, 2005).

Lough Leane itself is the largest of the Killarney lakes, with a surface area of 1,978ha, a mean depth of 13m and a maximum depth of 60m. The lake falls into typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and moderate alkalinity (20-100mg/l $CaCO_3$).

A decline in water quality in the Lough Leane catchment has been evident throughout the past 40 years and in 1997 Lough Leane was classified as hypertrophic (Coillte 2010; Killarney National Park, 2010). This decline in water quality was principally attributed to increased levels of nutrients, most significantly phosphorus, being transported via the rivers to the lakes, which has led to eutrophication in recent years. (Coillte 2010; Killarney National Park, 2010). A number of algal blooms were noticed in Lough Leane during the summer of 1997 and this event resulted from excessive phosphorus levels within the lake and had the potential to cause significant damage to the ecology of the lake (Anon, 2009). In response to this, Kerry County Council set up the Lough Leane Working Group to co-ordinate efforts to monitor and manage water quality within the catchment between 1998 and 2001 (Coillte, 2010). This monitoring and management programme was a catchment wide initiative, aimed at stopping the eutrophication process and restoring the rivers and lakes to a satisfactory state by reducing phosphorus inputs from all sources. The project also aimed to identify and quantify all significant point and diffuse sources of pollution input, in particular those inputs from local authority activities, agriculture, forestry and septic tanks.

Lough Leane contains a variety of fish species, including brown trout, sea trout, ferox trout, salmon, perch, flounder, eel, tench and Arctic char. A landlocked subspecies of the twaite shad known as the Killarney shad (*Alosa fallax killarnensis*) is also present in Lough Leane and is unique to this lake. The Killarney shad are listed as one of the Annex II fish species in the EU Habitats Directive. Lough Leane is famous for its free rising trout and good salmon fishing (O'Reilly 2007), with hundreds of spring salmon and grilse being caught on the troll every year. Brown trout in the lake average 0.23kg; however, a specimen ferox trout was caught in 2005 weighing nearly 8kg (O' Reilly 2007).

Inland Fisheries Ireland (previously the Central Fisheries Board) has undertaken a number of fish stock surveys on Lough Leane. The two most recent (prior to 2008) were in 2001 and 2003 to assess the status of the Killarney shad population (Roche and Rosell, 2003). The Killarney shad population size at the time was estimated to be in excess of 20,000 individuals of 1+ and older fish (Roche and Rosell, 2003). A small number of char were also recorded during the 2003 survey. In 2002, the Irish Char Conservation Group carried out fish surveys on all three Killarney Lakes and brown trout were recorded in all. Muckross (Middle) lake was the only lake in which Arctic char were captured, with the population in Lough Leane believed to be extinct due to the eutrophication of the lake (Igoe, *pers. comm.*). Arctic char were not recorded in Upper Lake, however there are reports from anglers that char have been caught and released there.

Lough Leane was more recently 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. Salmon, brown trout, Killarney shad, flounder, rudd, tench and eels were also captured during the survey.

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

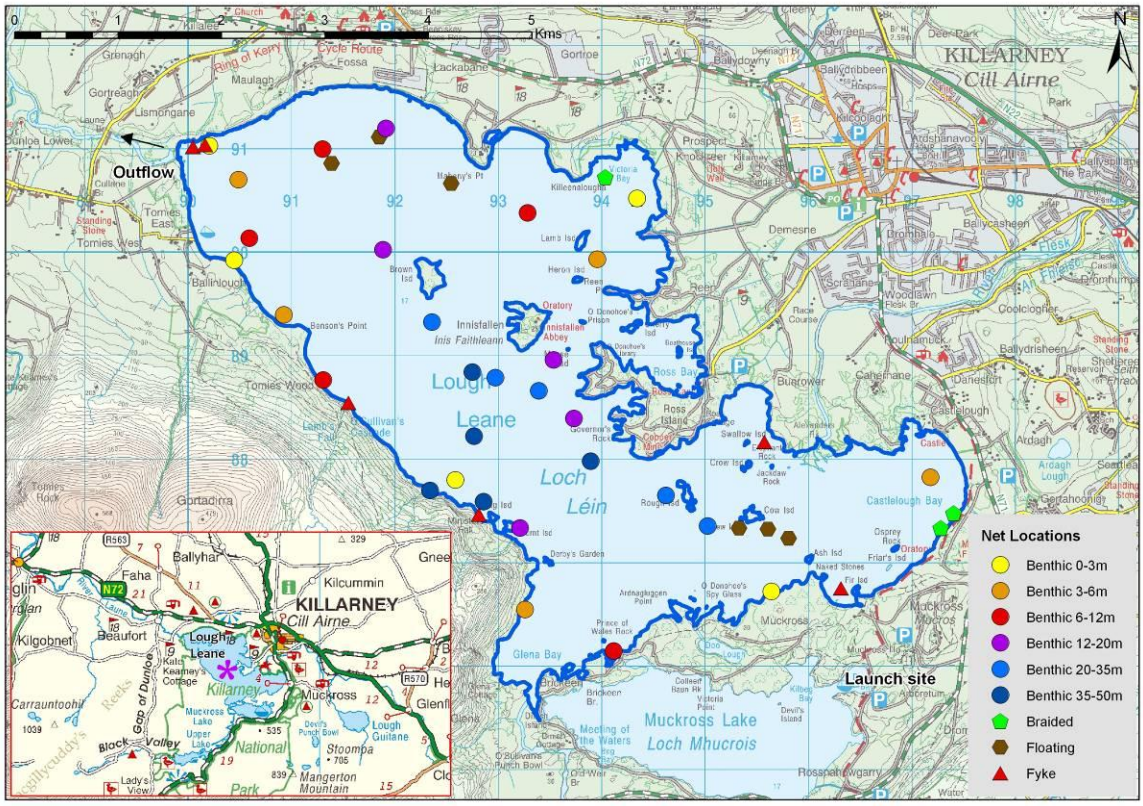

Fig. 1.1. Location map of Lough Leane showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Leane was surveyed over two nights between the 7th and the 9th of September 2011. A total of six sets of Dutch fyke nets, 29 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m, 5 @ 12-19.9m, 5 @ 20-34.9m and 5 @ 35-49.9m) and six floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed randomly in the lake (42 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, sea trout, shad, salmon, char, rudd and tench. 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 nine fish species (sea trout are included as a separate 'variety' of trout) were recorded on Lough Leane in September 2011, with 572 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 brown trout. Sea trout, salmon, Arctic char, Killarney shad (Plate 1.2), rudd, tench, flounder and eels were also recorded. During the previous survey in 2008 the same species composition was recorded with the exception of Arctic char and sea trout, 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 Leane, September 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	253	0	0	1	254
Salmo trutta	Brown trout	132	21	9	28	190
	Sea trout	1	0	0	0	1
Alosa fallax killarnensis	Killarney Shad	0	9	0	0	9
Salvelinus alpinus	Arctic char	4	0	0	0	4
Salmo salar	Salmon	2	0	1	0	3
Scardinius erythrophthalmus	Rudd	46	0	0	0	46
Platichthys flesus	Flounder	14	0	4	13	31
Tinca tinca	Tench	1	0	0	1	2
Anguilla anguilla	Eel	0	0	0	32	32

Plate 1.2. Killarney shad, Lough Leane

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 and BPUE was 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 Leane and four other similar lakes was assessed, with no overall significant differences being found (Fig. 1.4). However, Independent-Samples Mann-Whitney U tests between each lake showed that Lough Leane had a significantly lower mean perch CPUE than Lough Meelagh ($z = -2.388$, $P<0.05$).

The differences in the mean perch BPUE between Lough Leane and four other similar lakes was assessed, with no overall significant differences being found (Fig. 1.5). However, Independent-Samples Mann-Whitney U tests between each lake showed that Lough Leane had a significantly lower mean perch BPUE than Lough Owel ($z = -2.321$, $P<0.05$).

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

The differences in the mean brown trout CPUE between Lough Leane and four other similar lakes were also 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 Leane had a significantly higher mean brown trout CPUE than Lough Gill and Lough Owel ($z = -5.294$ $P<0.05$ and $z = -5.481$ $P<0.05$) and a significantly lower mean brown trout CPUE than Lough Fern and Carrowmore Lake ($z = -2.139$ $P<0.05$ and $z = -3.536$ $P<0.05$).

The differences in the mean brown trout BPUE between Lough Leane 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 Leane had a significantly higher mean brown trout BPUE than Lough Gill and Lough Owel ($z = -5.230$ $P<0.05$ and $z = -5.498$ $P<0.05$) and a significantly lower mean brown trout CPUE than Lough Fern and Carrowmore Lake ($z = -2.137$ $P<0.05$ and $z = -3.109$ $P<0.05$).

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

Scientific name	Common name	2008	2011
		Mean CPUE	
Salmo trutta	Brown trout	0.098 (0.025)	0.131 (0.033)
	Sea trout	-	0.003 (0.002)
Salmo salar	Salmon	0.005 (0.002)	0.002 (0.001)
Salvelinus alpinus	Arctic char	-	0.003 (0.001)
Alosa fallax killarnensis	Killarney Shad	0.007 (0.004)	0.006 (0.004)
Perca fluviatilis	Perch	0.121 (0.037)	0.187 (0.054)
Scardinius erythrophthalmus	Rudd	0.002 (0.001)	0.034 (0.015)
Tinca tinca	Tench	0.001 (0.001)	0.001 (0.001)
Platichthys flesus	Flounder	0.005 (0.002)	0.018 (0.005)
Anguilla anguilla	Eel	0.083 (0.021)	0.088 (0.055)
		Mean BPUE	
Salmo trutta	Brown trout	14.02 (4.494)	19.267 (5.264)
	Sea trout	-	0.611 (0.433)
Salmo salar	Salmon	12.662 (5.679)	4.7647 (2.941)
Salvelinus alpinus	Arctic char	-	0.234 (0.178)
Alosa fallax killarnensis	Killarney Shad	0.368 (0.257)	0.484 (0.34)
Perca fluviatilis	Perch	5.848 (1.629)	12.516 (3.503)
Scardinius erythrophthalmus	Rudd	0.379 (0.242)	5.014 (2.547)
Tinca tinca	Tench	0.655 (0.602)	1.241 (1.1931)
Platichthys flesus	Flounder	0.952 (0.400)	4.696 (1.638)
Anguilla anguilla	Eel	13.936 (3.861)	12.172 (5.916)

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

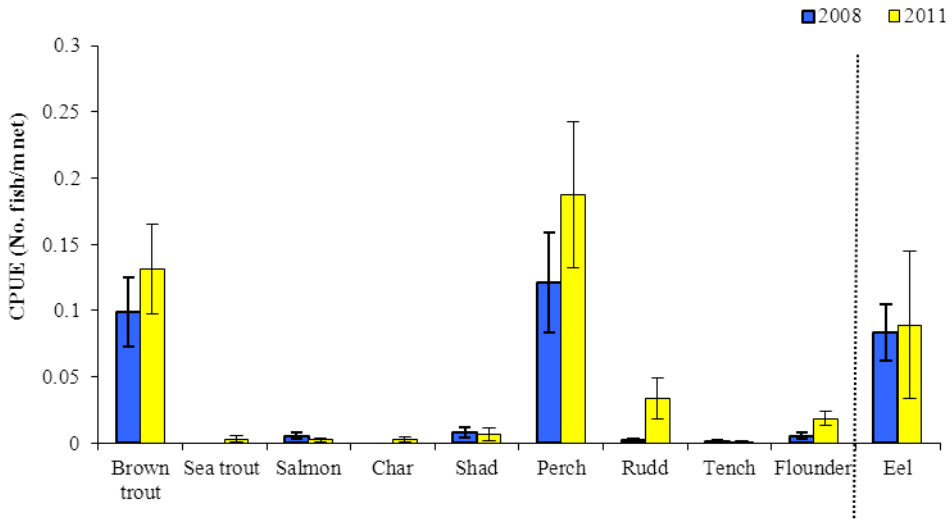

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Leane (Eel CPUE based on fyke nets only), 2008 and 2011

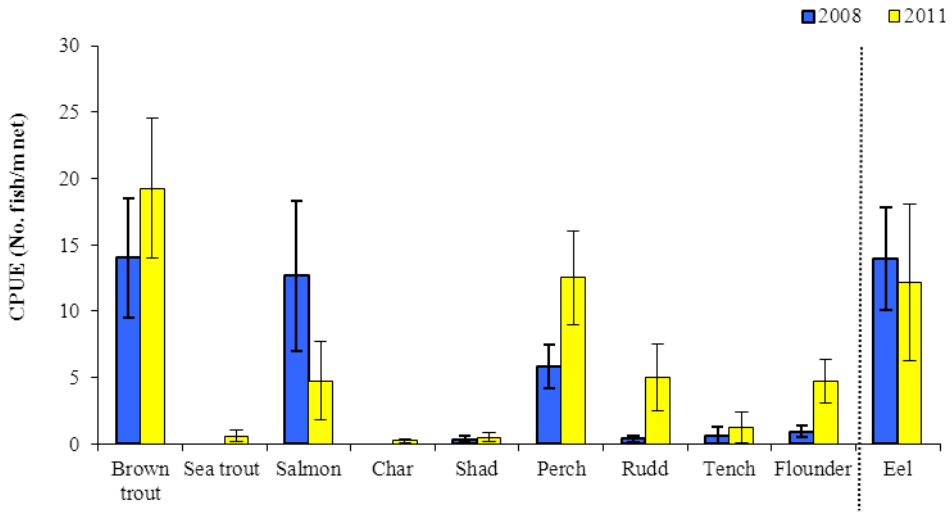

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Leane (Eel CPUE based on fyke nets only), 2008 and 2011

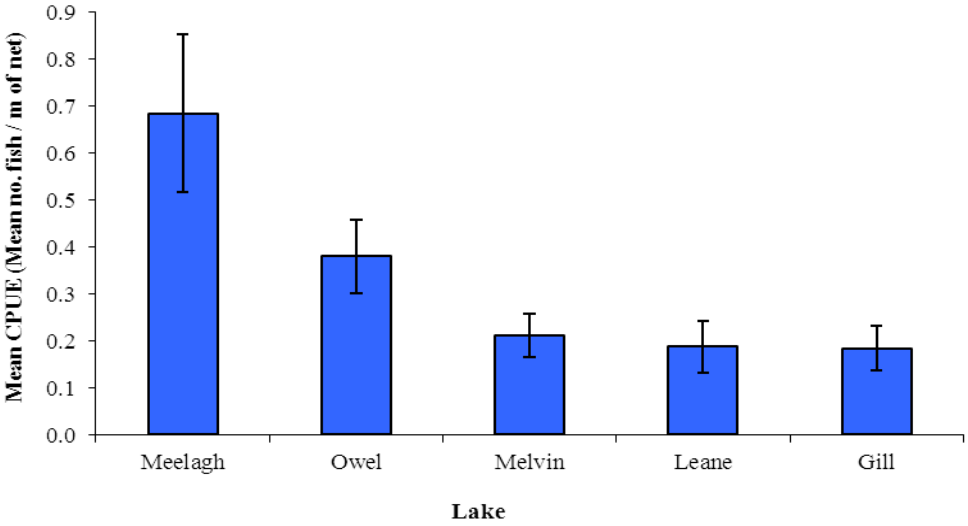

Fig. 1.4. Mean (±S.E.) perch CPUE in five lakes surveyed during 2011

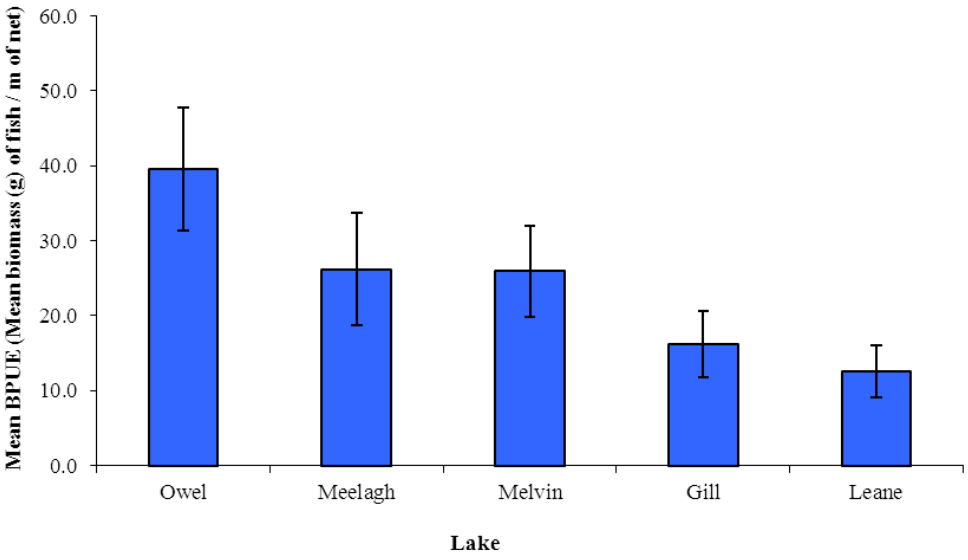

Fig. 1.5. Mean (±S.E.) perch BPUE in five lakes surveyed during 2011

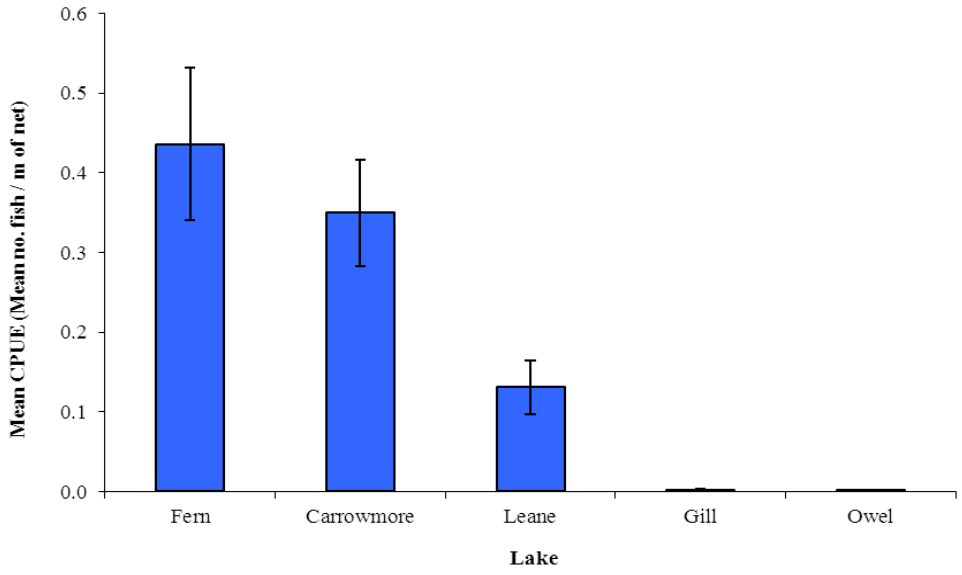

Fig. 1.6. Mean (±S.E.) brown trout CPUE in five lakes surveyed during 2011

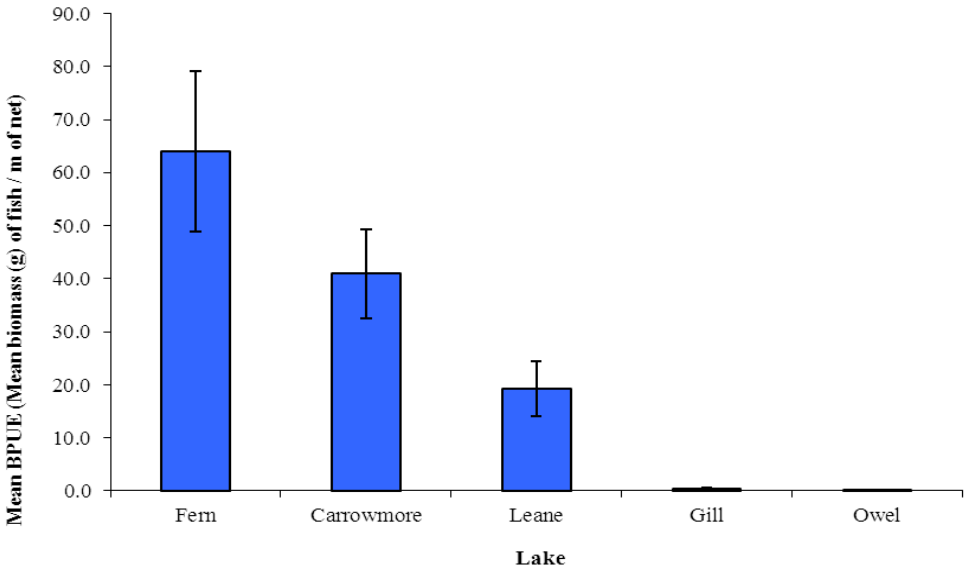

Fig. 1.7. Mean (±S.E.) brown trout BPUE in five lakes surveyed during 2011

1.3.3 Length frequency distributions

Perch captured during the 2011 survey ranged in length from 7.5cm to 22.6cm (mean = 16.1cm) (Fig.1.8). Perch captured during the 2008 survey had had a wider length range, from 4.6cm to 34.0cm (Fig.1.8).

Brown trout captured during the 2011 survey ranged in length from 13.2cm to 34.2cm (mean = 21.6cm) (Fig. 1.9). Brown trout captured during the 2008 survey ranged in length from 13.7cm to 31.2cm (Fig. 1.9).

Salmon captured during the 2011 survey ranged in length from 51.0cm to 68.0cm, Arctic char ranged in length from 12.8cm to 21.6cm, Killarney shad ranged in length from 15.0cm to 19.8cm, flounder ranged in length from 15.2cm to 34.0cm, rudd ranged from 13.5cm to 25.2cm and eels ranged in length from 27.2cm to 58.5cm. Two tench were recorded at 16.2cm and 48.5cm and one sea trout was recorded at 31.1cm.

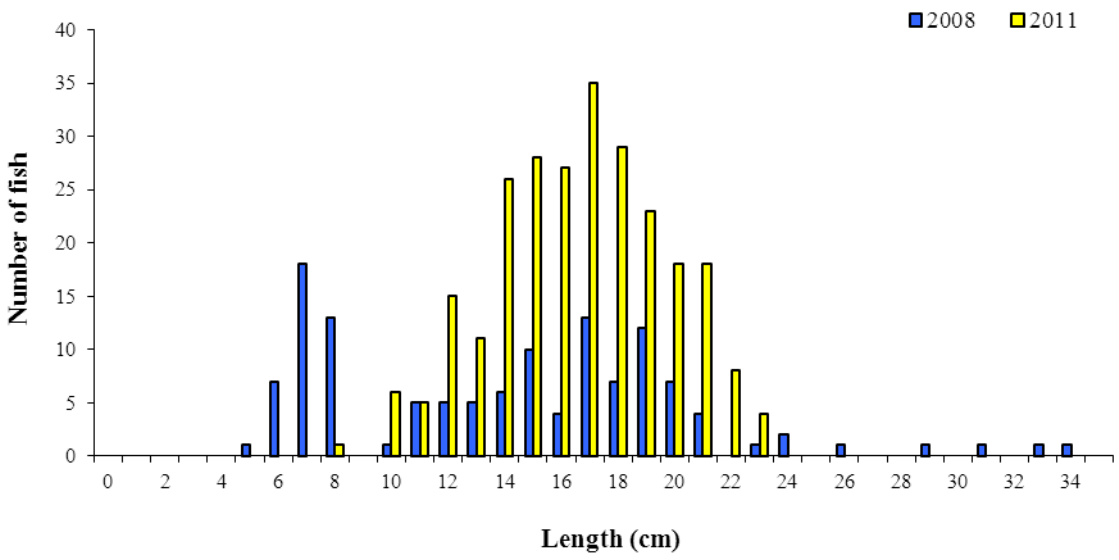

Fig. 1.8. Length frequency of perch captured on Lough Leane

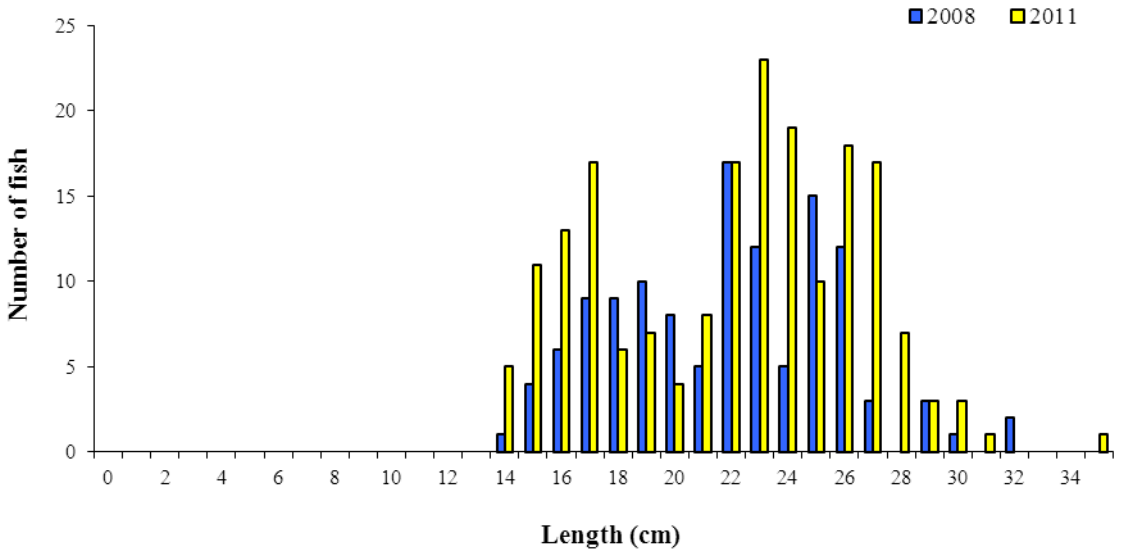

Fig. 1.9. Length frequency of brown trout captured on Lough Leane

1.3.4 Fish age and growth

Eight age classes of perch were present, ranging from 0+ to 7+, with a mean L1 of 6.4cm (Table 1.3). Similarly in the 2008 survey, perch ranged from 0+ to 7+ with a mean L1 of 6.8cm.

Five age classes of brown trout were present, ranging from 1+ to 6+, with a mean L1 of 6.6cm (Table 1.4). In the 2008 survey, brown trout ranged from 1+ to 4+ with a mean L1 of 6.8cm. Mean brown trout L4 in 2011 was 24.3cm indicating a very slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971). The dominant age classes of brown trout were 2+ and 3+, with ages ranging from 1+ to 6+ indicating reproductive success in six of the previous seven years.

Two age classes of Arctic char were present, ranging from 1+ to 3+, one salmon was present at 2.1+ and one sea trout was present at 3.0+.

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

	L_1	L_2	L_3	L_4	L_5	L_6	L_7
Mean	6.4 (0.1)	11.7 (0.2)	15.8 (0.4)	18.0 (0.3)	19.5 (0.3)	20.9 (0.3)	20.4
N	68	50	30	24	19	5	1
Range	4.5-8.7	8.8-16.0	11.7-18.9	15.2-20.2	16.0-21.4	19.6-21.4	20.4-20.4

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

	L_1	L_2	L_3	L_4	L_5	L_6
Mean	6.6 (0.2)	16.6 (0.4)	23.1 (0.4)	24.3 (1.1)	28.9	32.8
N	73	52	28	4	1	1
Range	3.6-10.1	7.2-22.0	17.8-26.5	21.7-26.2	28.9-28.9	32.8-32.8

1.4 Summary

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

The mean perch CPUE in Lough Leane was significantly lower than Lough Meelagh. Co. Roscommon and the mean perch BPUE was significantly lower than Lough Owel, Co. Westmeath. Perch ranged in age from 0+ to 7+, with 0+ and 1+ fish being captured indicating reproductive success in recent years. The dominant age class of perch was 2+.

The mean brown trout CPUE and BPUE in Lough Leane was significantly higher than Lough Gill, Co. Sligo and Lough Owel and significantly lower than Lough Fern, Co. Donegal and Carrowmore Lake, Co. Mayo. Brown trout ranged in age from 1+ to 6+, indicating reproductive success in six of the previous seven years. Length at age analyses revealed that brown trout in the lake exhibit a very 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, Lough Leane 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 also Good.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lough Leane an overall ecological status of Good, 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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