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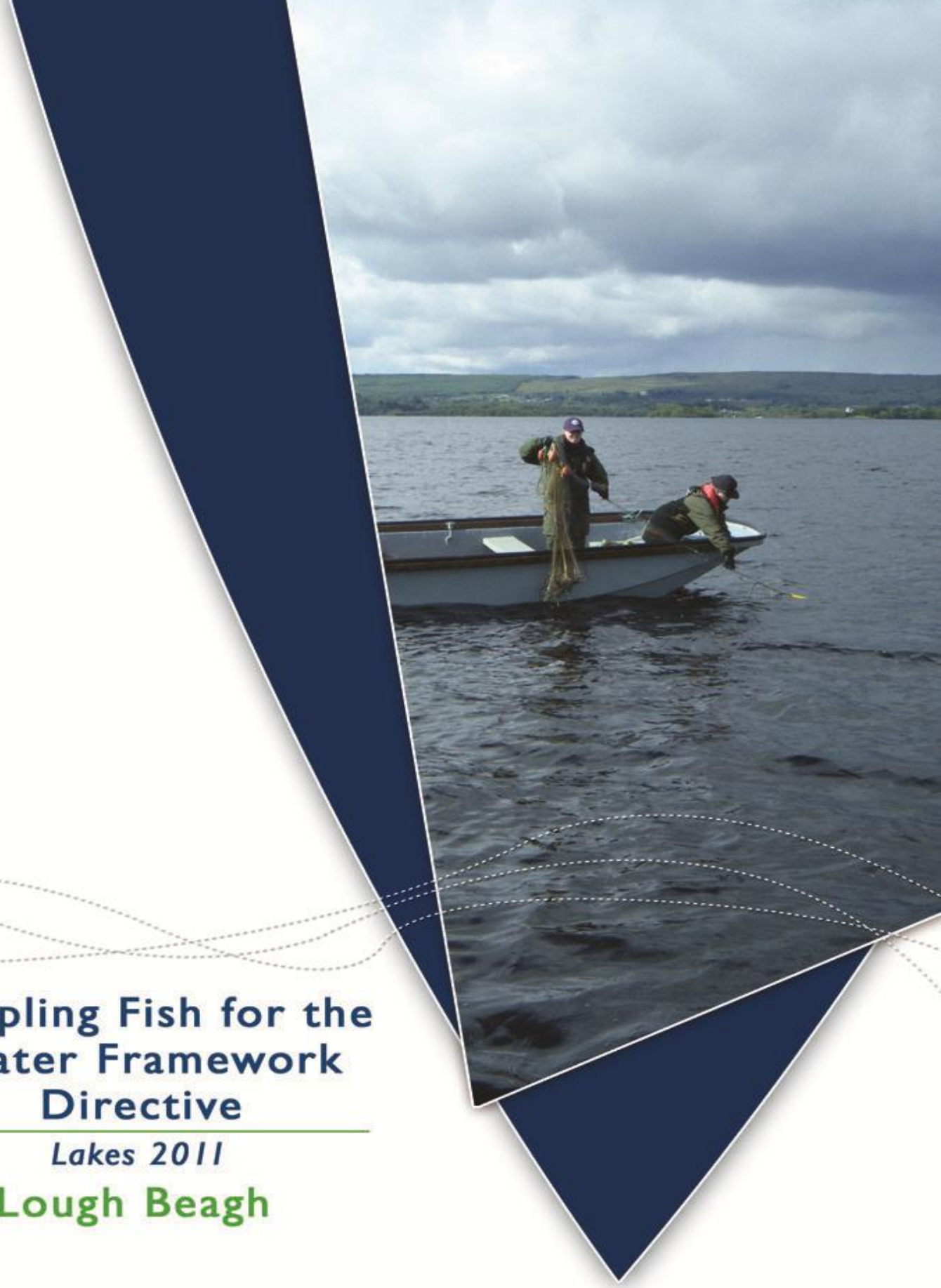

Sampling Fish for the Water Framework Directive

Lakes 2011

Lough Beagh

Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Beagh, August 2011

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Cover photo: Lynda and Fiona gill netting © Inland Fisheries Ireland

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1.1 Introduction

Lough Beagh is situated in a remote valley in the Lackagh catchment, within the Glenveagh National Park, 24 kilometres north-west of Letterkenny, Co. Donegal. A visitor's centre is located near the northern shore of the lake and a castle is located on the eastern shore (Fig. 1.1). Lough Beagh is volcanic in origin. It is a long, narrow lake, approximately 6.5 kilometres in length and 0.8 kilometres wide. The lake is surrounded by mountains on three sides (including the Derryveagh and Glendowan Mountains on the south, east and west side respectively) (Plate 1.1).

The lake has a surface area of 261ha, a mean depth of 9.2m and a maximum depth of 46.5m. The altitude of the lake is 45.3m above sea level. The lake is categorised as typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and low alkalinity (<20mg/l CaCO3). Lough Beagh has been classed as 2b (i.e. expected to meet good status by 2015) in the WFD Characterization report (EPA, 2005). The geology of the area is predominantly granite, felsite and other intrusive rocks rich in silica.

The lake holds brown trout, and occasional salmon and sea trout arrive into the lake during August (O' Reilly, 1987). Arctic char are also present in the lake. The lake was surveyed jointly by Inland Fisheries Ireland (previously the Central Fisheries Board and Northern Regional Fisheries Board) in 1989, 1994 and 1995. In 2005, the lake was again surveyed using the current WFD lake sampling methodology as part of the cross border NS Share "Fish in Lakes" project by Inland Fisheries Ireland and the Agri-Food and Biosciences Institute Northern Ireland (AFBINI) (Kelly *et al*., 2007). Subsequently Lough Beagh was surveyed in 2008 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2009). During this survey, brown trout were found to be the dominant species present in the lake. Arctic char, sea trout 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. Aerial view of Lough Beagh (Glenveagh) looking southwest (Photo courtesy of IFI and No. 3 Operational Wing, Irish Air Corps [Aer Chór na hÉireann])

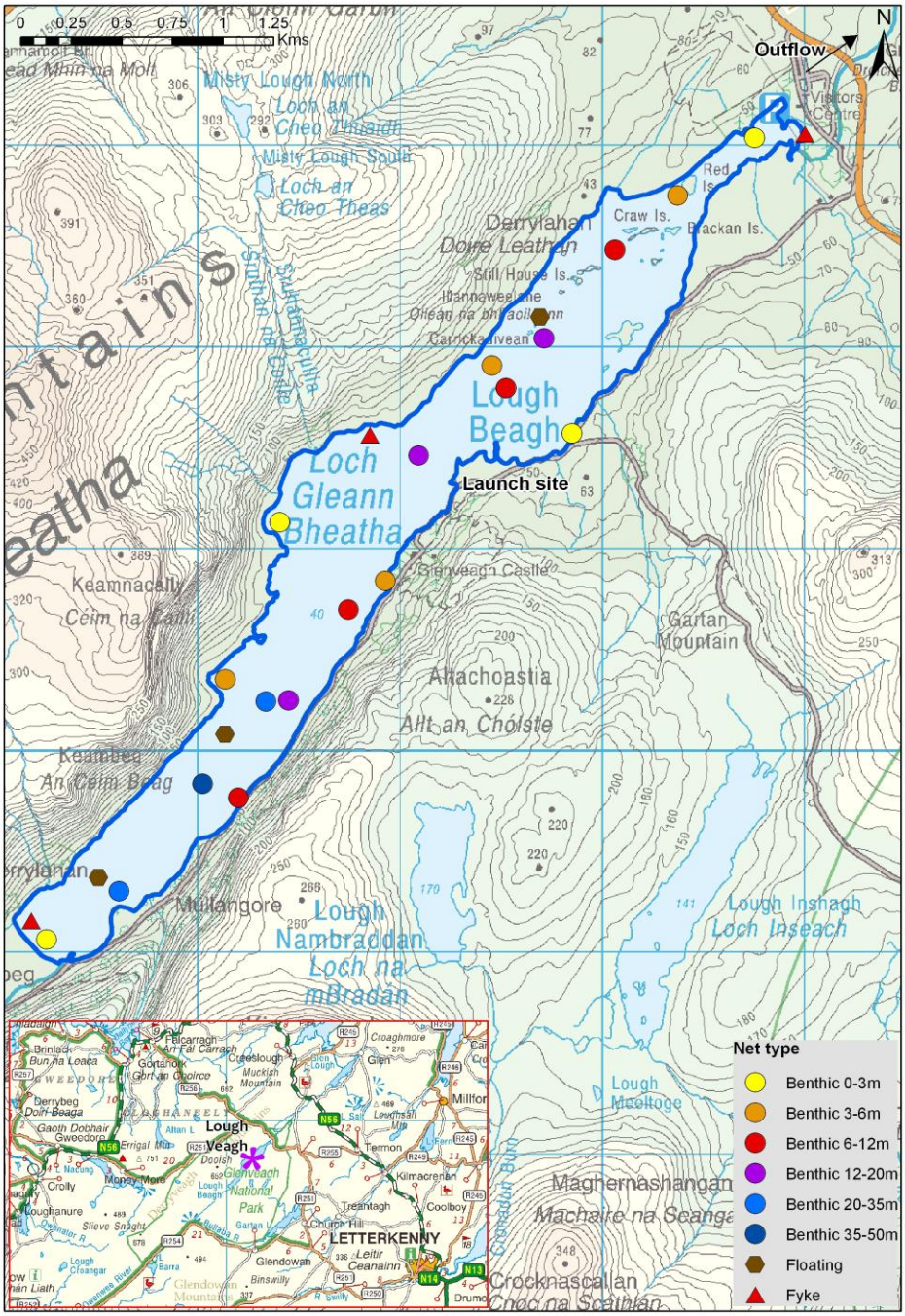

Fig. 1.1. Location map of Lough Beagh showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Beagh was surveyed over two nights between the 8th and the 10th of August 2011. A total of three sets of Dutch fyke nets, 18 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 4 @ 6-11.9m, 3 @ 12-19.9m, 2 @ 20-34.9m and 1 @ 35-49.9m) and three floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (24 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 were measured and weighed on site and scales were removed from all brown trout, salmon and sea trout. 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 (sea trout are included as a separate 'variety' of trout) were recorded in Lough Beagh in August 2011, with 218 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Brown trout was the most abundant fish species recorded, followed by Arctic char. Sea trout, salmon, minnow and eels were also recorded. During the previous survey in 2008 the same species composition was recorded with the exception of salmon and minnow, 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 Beagh, August 2011

Scientific name	Common name	Number of fish captured			
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	Total
Salmo trutta	Brown trout	138	14	1	153
	Sea trout	5	0	0	5
Salvelinus alpinus	Arctic char	35	12	1	48
Salmo salar	Salmon	1	0	0	1
Phoxinus phoxinus	Minnow	6	0	0	6
Anguilla anguilla	European eel	1	0	4	5

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 brown trout CPUE and BPUE was higher in 2011 than in 2008, these differences were not statistically significant (Figs. 1.2 and 1.3). However, in contrast the mean Arctic char CPUE and BPUE were significantly higher in 2011 than in 2008 ($z = -2.488$, $P<0.05$) ($z = -2.349$, $P<0.05$) (Figs. 1.2 and 1.3).

The differences in the mean brown trout CPUE between Lough Beagh and four 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 Beagh had a significantly higher mean brown trout CPUE than Lough Caragh and Lough Allua ($z = -2.112$ $P<0.05$ and $z = -4.177$ $P<0.05$).

The differences in the mean Arctic char CPUE between Lough Beagh 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 Beagh had a significantly higher mean Arctic char CPUE than Lough Talt, Lough Leane and Lough Melvin ($z = -3.140$ $P<0.05$, $z = -5.336$ $P<0.05$ and $z = -6.418$ $P<0.05$).

The differences in the mean brown trout BPUE between Lough Beagh and four 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 Beagh had a significantly higher mean brown trout BPUE than Upper Lake, Killarney and Lough Allua ($z = -2.260$ $P<0.05$ and $z = -4.377$ $P<0.05$).

The differences in the mean Arctic char BPUE between Lough Beagh 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 Beagh had a significantly higher mean Arctic char BPUE than Lough Leane and Lough Melvin ($z = -5.154$ $P<0.05$ and $z = -6.466$ $P<0.05$) and a significantly lower mean Arctic char BPUE than Lough Acoose and Lough Talt ($z = -2.084$ $P<0.05$ and $z = -2.647$ $P<0.05$).

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

Scientific name	Common name	2008	2011
		Mean CPUE	
Salmo trutta	Brown trout	0.126 (0.026)	0.211 (0.044)
Salvelinus alpinus	Arctic char	0.024 (0.008)	0.065 (0.017)
Salmo salar	Salmon	-	0.001 (0.001)
	Sea trout	0.002 (0.001)	0.007 (0.004)
Phoxinus phoxinus	Minnow	-	0.008 (0.005)
Anguilla anguilla	European eel	0.027 (0.011)	0.022 (0.014)
		Mean BPUE	
Salmo trutta	Brown trout	12.794 (3.112)	28.553 (7.421)
Salvelinus alpinus	Arctic char	0.669 (0.314)	1.958 (0.495)
Salmo salar	Salmon	-	4.967 (4.967)
	Sea trout	0.646 (0.589)	2.708 (1.926)
Phoxinus phoxinus	Minnow	-	0.022 (0.013)
Anguilla anguilla	European eel	7.033 (2.666)	2.572 (1.317)

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

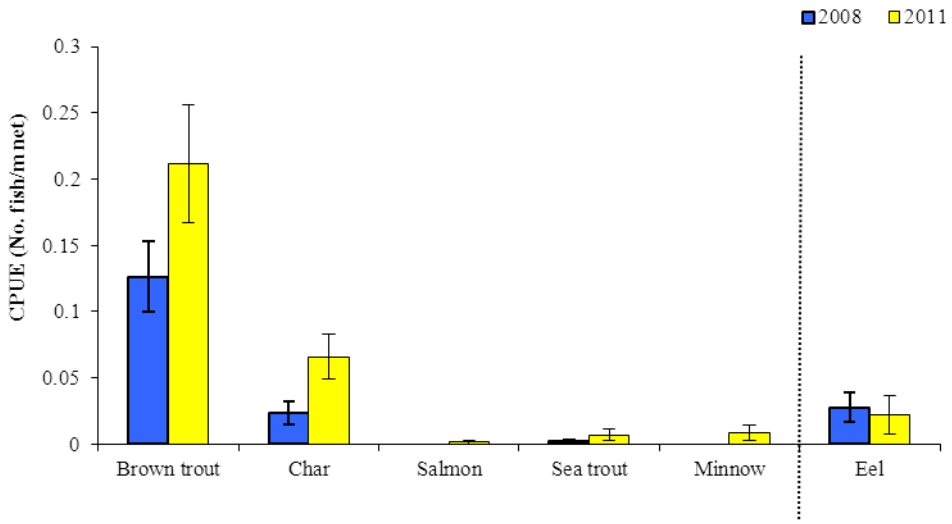

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Beagh (Eel CPUE based on fyke nets only), 2008 and 2011

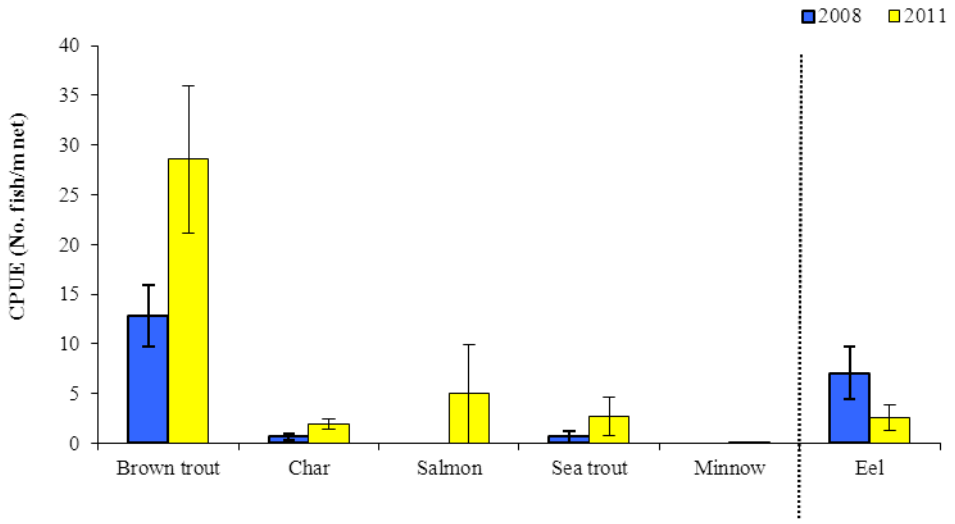

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Beagh (Eel CPUE based on fyke nets only), 2008 and 2011

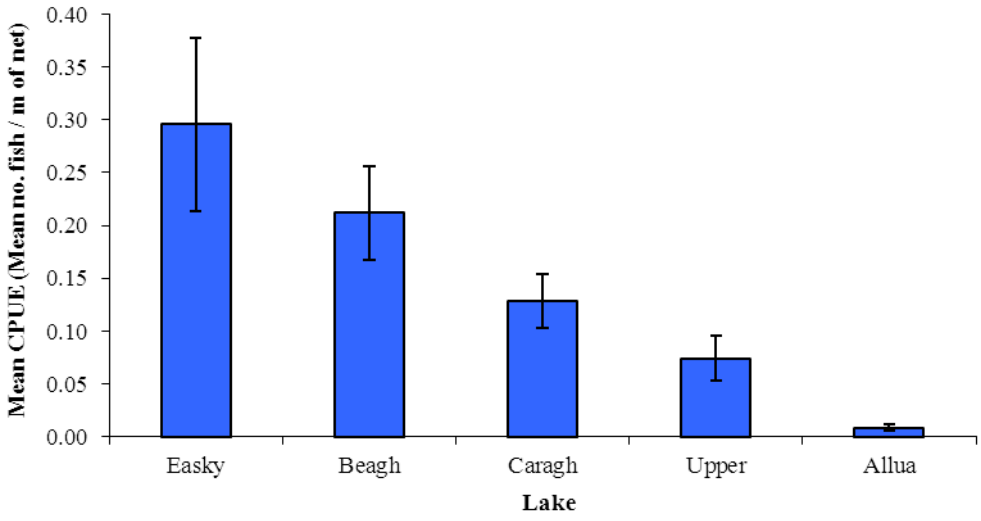

Fig. 1.4. Mean (±S.E.) brown trout CPUE in five lakes surveyed during 2011

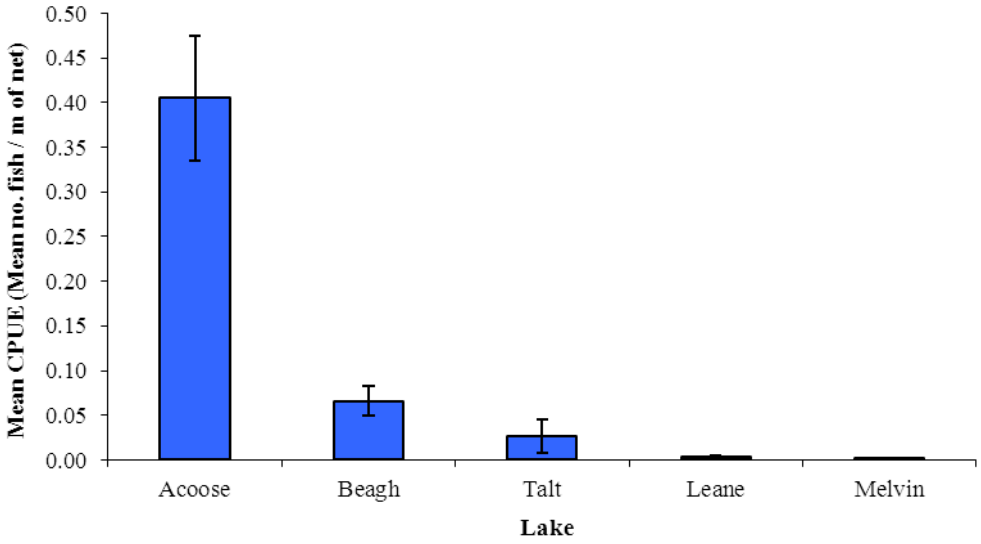

Fig. 1.5. Mean (±S.E.) Arctic char CPUE in five lakes surveyed during 2011

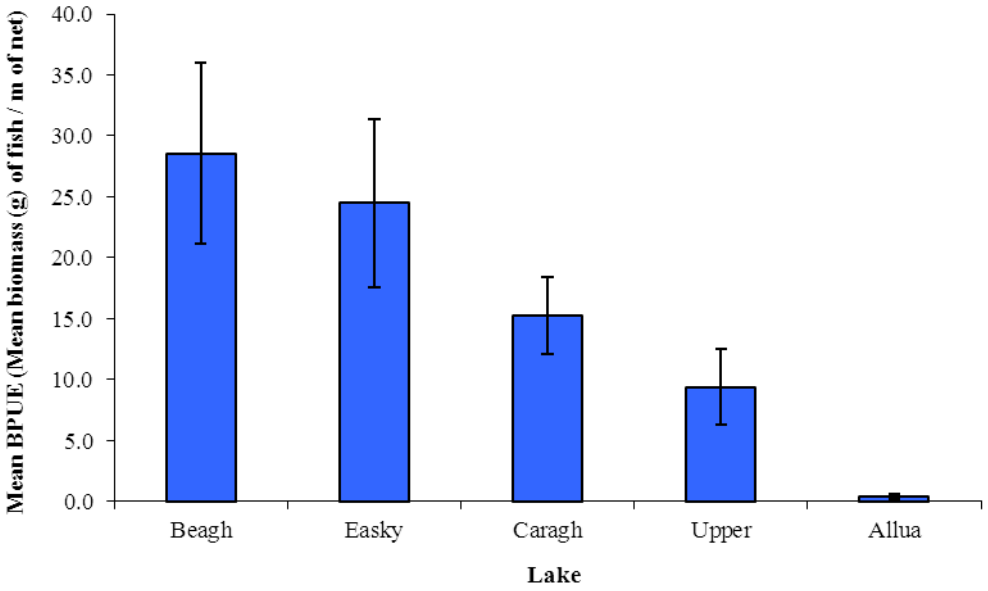

Fig. 1.6. Mean (±S.E.) brown trout BPUE in five lakes surveyed during 2011

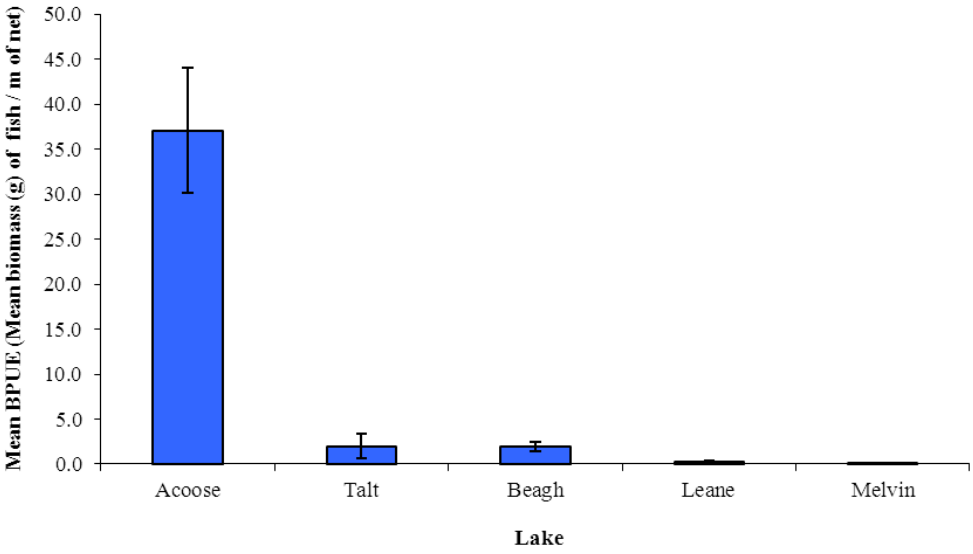

Fig. 1.7. Mean (±S.E.) Arctic char BPUE in five lakes surveyed during 2011

1.3.3 Length frequency distributions

Brown trout captured during the 2011 survey ranged in length from 6.4cm to 56.2cm (mean = 21.0cm) (Fig. 1.8). Brown trout captured during the 2008 survey ranged in length from 8.5cm to 36.0cm (Fig. 1.8).

Arctic char captured during the 2011 survey ranged in length from 5.6cm to 18.7cm (mean = 13.3cm) (Fig.1.9). Arctic char captured during the 2008 survey had lengths ranging from 6.0cm to 17.1cm (Fig.1.9).

Sea trout captured during the 2011 survey ranged in length from 23.1cm to 39.0cm and minnow ranged in length from 5.5cm to 6.8cm. One salmon was recorded at 71.5cm and eels ranged in length from 32.5cm to 49.2cm.

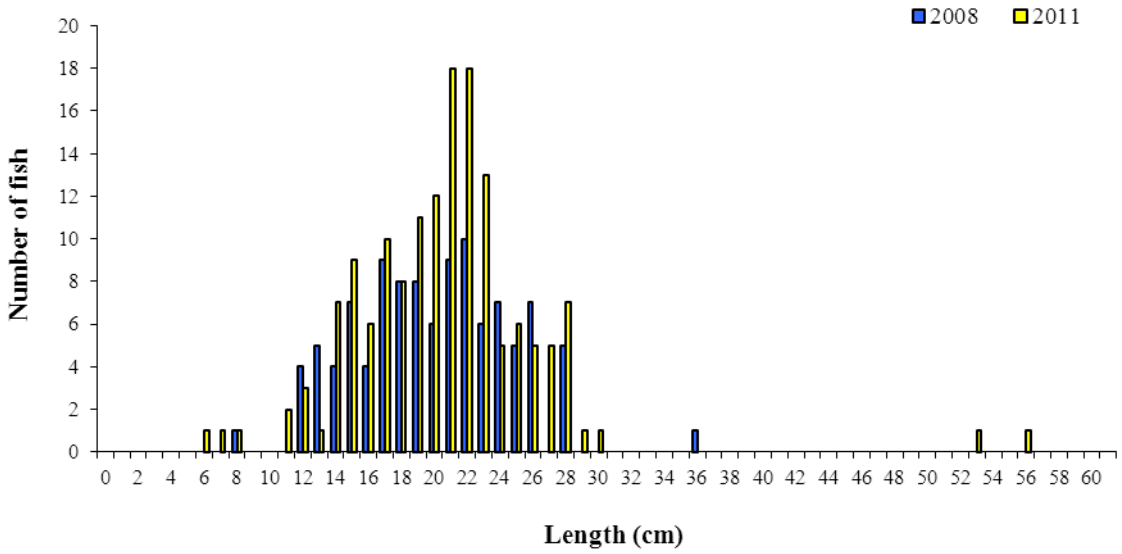

Fig. 1.8. Length frequency of brown trout captured on Lough Beagh, 2008 and 2011

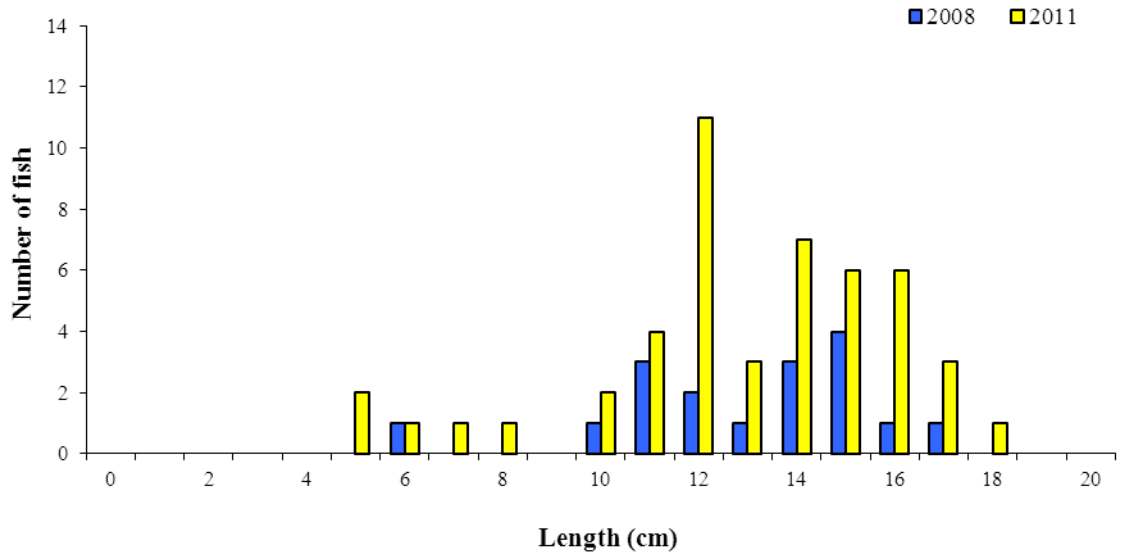

Fig. 1.9. Length frequency of Arctic char captured on Lough Beagh, 2008 and 2011

1.3.4 Fish age and growth

Six age classes of brown trout were present, ranging from 0+ to 5+, with a mean L1 of 7.4cm (Table 1.3). In the 2008 survey, brown trout also ranged from 0+ to 5+ with a mean L1 of 7.1cm. Mean brown trout L4 in 2011 was 24.8cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971). The dominant age class of brown trout was 2+, with ages ranging from 0+ to 5+ indicating reproductive success in each of the previous six years.

Five age classes of Arctic char were present, ranging from 0+ to 4+. Sea trout ranged in age from 2.0+ to 3.1+. A single salmon captured was aged 2.1+.

Table 1.3. Mean (±SE) brown trout length (cm) at age for Lough Beagh, August 2011

	L_1	L_2	L_3	L_4	L_5
Mean	7.4 (0.2)	15.2 (0.3)	21.1 (0.4)	25.9 (1.0)	34.5 (6.5)
N	76	63	32	11	3
Range	3.5-10.6	9.7-19.4	17.2-25.4	21.9-35.5	27.7-47.7

1.4 Summary

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

Although the mean brown trout CPUE and BPUE was higher in 2011 than in 2008, these differences were not statistically significant. The mean brown trout CPUE in Lough Beagh was significantly higher than Lough Caragh and Lough Allua. The mean brown trout BPUE in Lough Beagh was significantly higher than two other similar lakes surveyed during 2011; Upper Lake, Killarney, Co. Kerry and Lough Allua, Co. Cork. Brown trout ranged in age from 0+ to 5+, indicating reproductive success in each of the previous six 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).

The mean Arctic char CPUE and BPUE was significantly higher in 2011 than in 2008. The mean Arctic char CPUE in Lough Beagh was significantly higher than three other similar lakes surveyed during 2011; Lough Talt, Co. Sligo, Lough Leane, Co. Kerry and Lough Melvin, Co. Leitrim. The mean Arctic char BPUE in Lough Beagh was also significantly higher than Lough Leane and Lough Melvin, but had a lower BPUE than Lough Acoose, Co. Kerry and Lough Talt. Arctic char ranged in age from 0+ to 4+, with 0+ and 1+ fish being captured indicating reproductive success in recent years.

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 Beagh has been assigned an ecological status of Good based on the fish populations present in 2011. The ecological status assigned to the lake based on the 2008 survey data was High.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lough Beagh Upper an overall ecological status of High and Lough Beagh Lower 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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