



# Sampling Fish for the Water Framework Directive

*Lakes 2011*

**Lough Caragh**



Iascach Intíre Éireann  
Inland Fisheries Ireland

## Water Framework Directive Fish Stock Survey of Lough Caragh, August 2011

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

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## 1.1 Introduction

Lough Caragh (Plate 1.1, Fig. 1.1) is situated in Co. Kerry at the mouth of the Glencar Valley, approximately two kilometres north-east of Glenbeigh. The lake has a surface area of 490ha, a mean depth of 11m and a maximum depth of 40m. The lake falls into typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and low alkalinity (<20mg/l CaCO<sub>3</sub>).

Lough Caragh forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River catchment candidate Special Area of Conservation. 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 Caragh is known for its spring salmon and grilse fishing, and to a lesser extent for brown trout and sea trout. The best salmon fishing is at the southern end of the lake along the west and east shores. Early in the season fish average 6.3kg and the record for the lake is 12.7kg. The sea trout arrive in the lake in July. The brown trout are to be found on all the shores and generally average 0.2-0.4kg (O' Reilly, 2007).

Lough Caragh was previously surveyed in 2008 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2009). During this survey, brown trout and Arctic char were found to be the dominant species present in the lake. Perch and eels were also captured during the survey.

At the time of the 2011 survey, felling of conifers had been conducted in the forestry plantation in the upstream catchment of Lough Caragh (Plate 1.2).



**Plate 1.1. Lough Caragh looking north-east over the lake**



**Plate 1.2. Forestry felling in the upper Lough Caragh catchment**



## 1.2 Methods

Lough Caragh was surveyed over two nights between the 24<sup>th</sup> and the 26<sup>th</sup> of August 2011. A total of three sets of Dutch fyke nets, 24 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, 4 @ 12-19.9m, 3 @ 20-34.9m and 2 @ 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 (30 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 and salmon. 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 Caragh in August 2011, with 228 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 perch, eels, sea trout, Arctic char and salmon. During the previous survey in 2008 the same species composition was recorded with the exception of sea trout and salmon, 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 Caragh, August 2011**

Scientific name	Common name	Number of fish captured			Total
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	75	40	1	116
	Sea trout	1	2	0	3
<i>Salvelinus alpinus</i>	Arctic char	3	0	0	3
<i>Salmo salar</i>	Salmon	2	0	0	2
<i>Perca fluviatilis</i>	Perch	85	0	0	85
<i>Anguilla anguilla</i>	European eel	2	0	17	19

### ***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 and perch CPUE was higher in 2011 than in 2008, this difference was not statistically significant. The differences in the mean brown trout CPUE between Lough Caragh and four other similar lakes were 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 Caragh had a significantly higher mean brown trout CPUE than Upper Lake and Lough Allua ( $z = -2.090$   $P < 0.05$  and  $z = -4.783$   $P < 0.05$ ) and had a significantly lower mean brown trout CPUE than Lough Beagh ( $z = -2.112$ ,  $P < 0.05$ ).

The differences in the mean perch CPUE between Lough Caragh and two similar lakes was assessed, with no overall significant differences being found (Fig. 1.5).

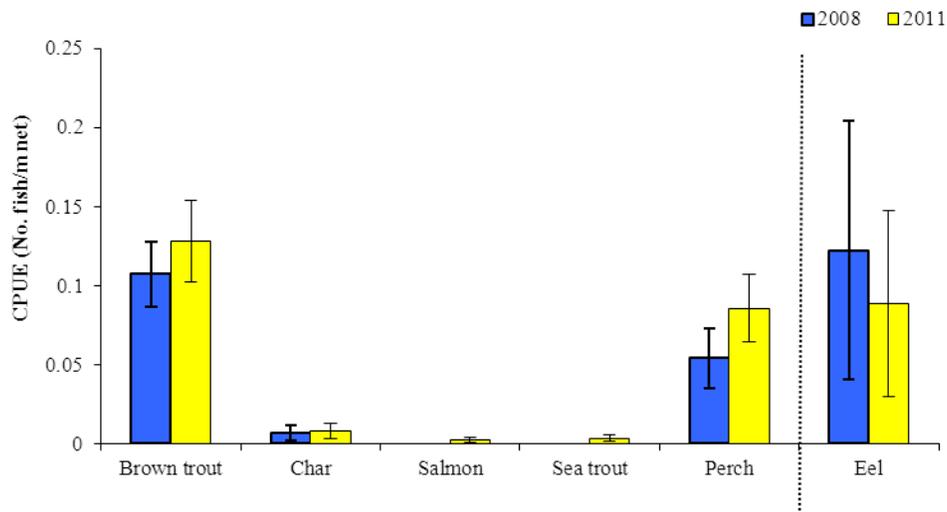
Although the mean brown trout BPUE was higher in 2011 than in 2008, this difference was also not statistically significant. The differences in the mean brown trout BPUE between Lough Caragh and four other similar lakes were assessed and found to be statistically significant (Kruskal-Wallis,  $P < 0.05$ ) (Fig. 1.6). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Caragh had a significantly higher mean brown trout BPUE than Upper Lake and Lough Allua ( $z = -2.000$   $P < 0.05$  and  $z = -4.901$   $P < 0.05$ ).

The mean perch BPUE was higher in 2011 than in 2008, however this difference was not statistically significant. The differences in the mean perch BPUE between Lough Caragh and two similar lakes was assessed, with no overall significant differences being found (Fig. 1.7).

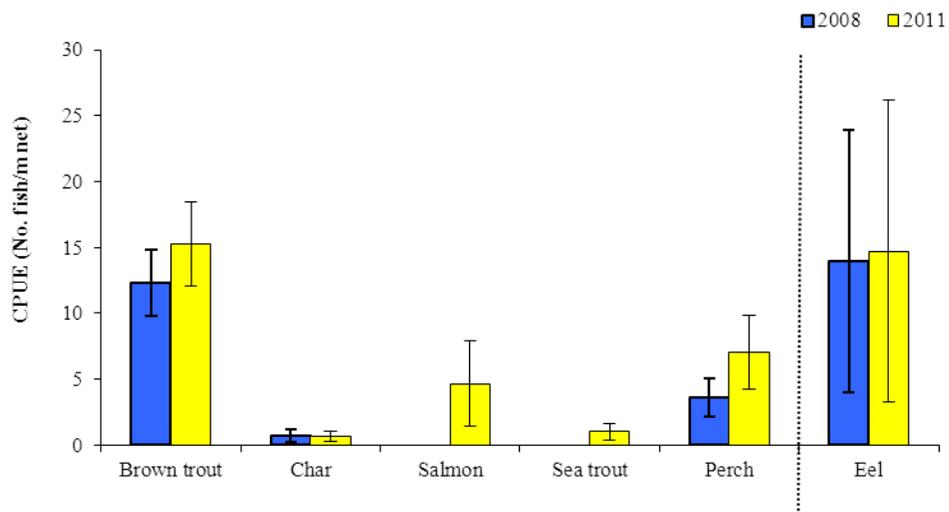
**Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Caragh, 2008 and 2011**

Scientific name	Common name	2008	2011
<b>Mean CPUE</b>			
<i>Salmo trutta</i>	Brown trout	0.107 (0.021)	0.128 (0.025)
<i>Salvelinus alpinus</i>	Arctic char	0.006 (0.004)	0.007 (0.004)
<i>Salmo salar</i>	Salmon	-	0.002 (0.001)
	Sea trout	-	0.003 (0.001)
<i>Perca fluviatilis</i>	Perch	0.053 (0.018)	0.085 (0.021)
<i>Anguilla anguilla</i>	European eel	0.122 (0.081)	0.088 (0.058)
<b>Mean BPUE</b>			
<i>Salmo trutta</i>	Brown trout	12.287 (2.503)	15.261 (3.198)
<i>Salvelinus alpinus</i>	Arctic char	0.725 (0.504)	0.65 (0.416)
<i>Salmo salar</i>	Salmon	-	4.655 (3.240)
	Sea trout	-	1.012 (0.634)
<i>Perca fluviatilis</i>	Perch	3.636 (1.472)	7.032 (2.784)
<i>Anguilla anguilla</i>	European eel	13.944 (9.959)	14.705 (11.467)

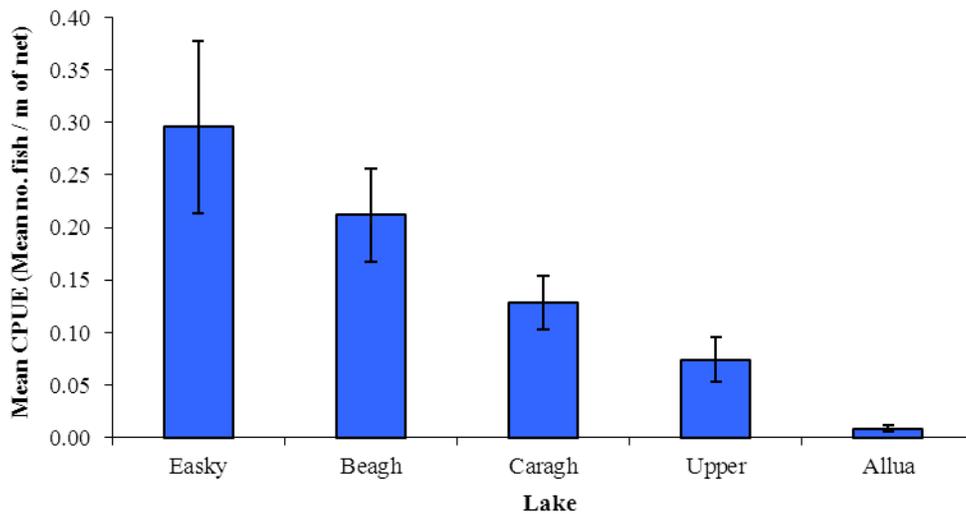
\* On the rare occasion where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species.



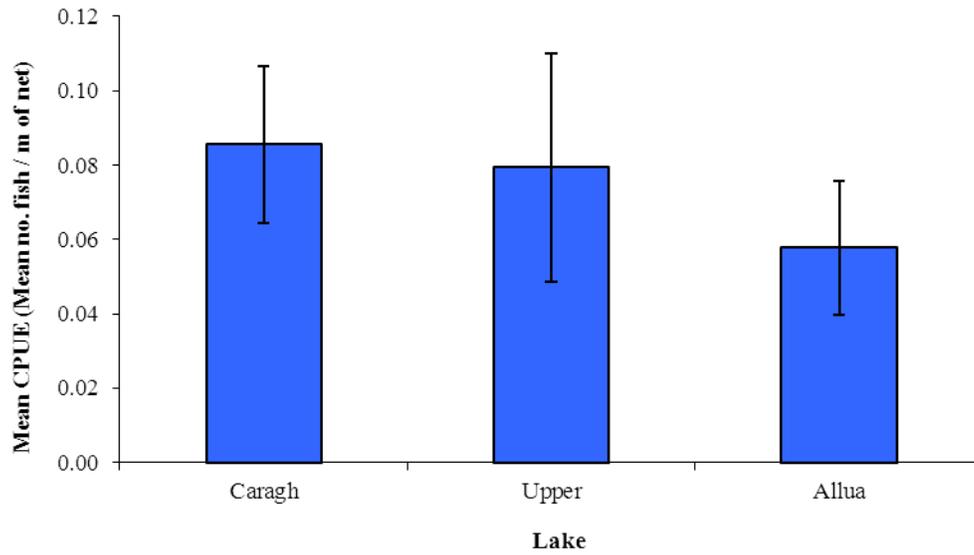
**Fig. 1.2. Mean ( $\pm$ S.E.) CPUE for all fish species captured in Lough Caragh (Eel CPUE based on fyke nets only), 2008 and 2011**



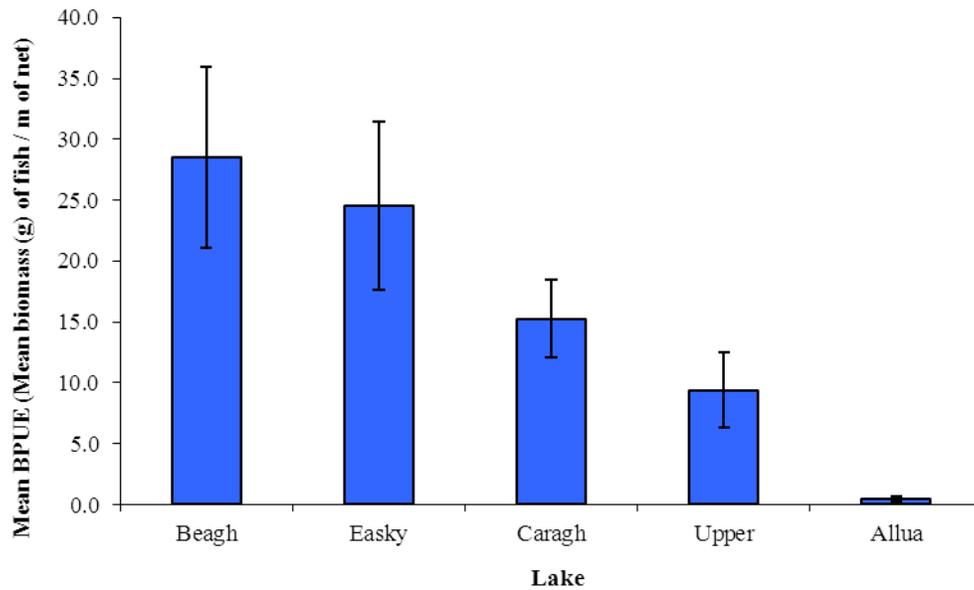
**Fig. 1.3. Mean ( $\pm$ S.E.) BPUE for all fish species captured in Lough Caragh (Eel CPUE based on fyke nets only), 2008 and 2011**



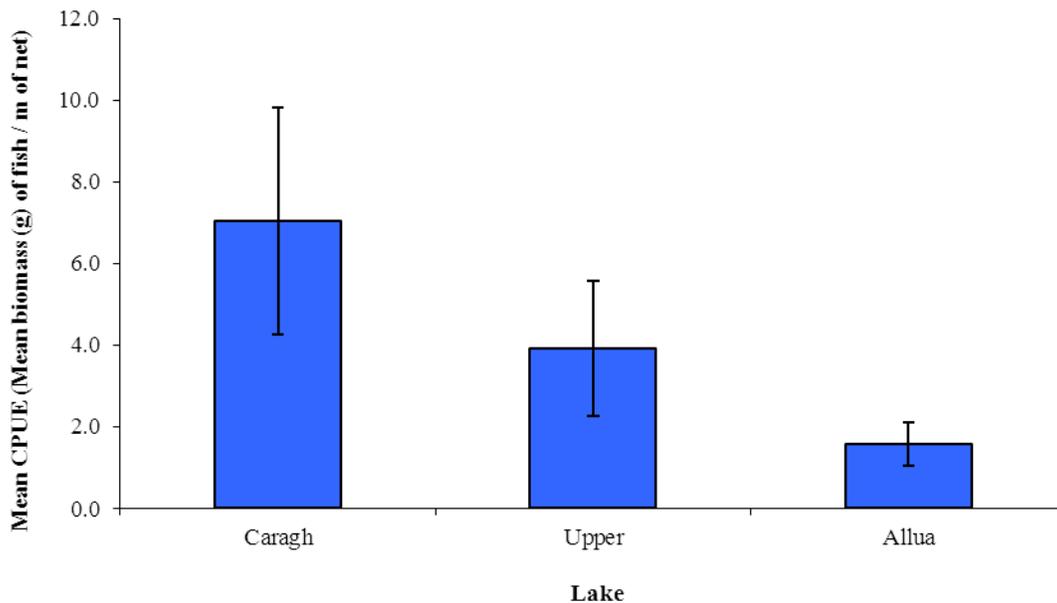
**Fig. 1.4. Mean ( $\pm$ S.E.) brown trout CPUE in five lakes surveyed during 2011**



**Fig. 1.5. Mean ( $\pm$ S.E.) perch CPUE in three lakes surveyed during 2011**



**Fig. 1.6. Mean ( $\pm$ S.E.) brown trout BPUE in five lakes surveyed during 2011**



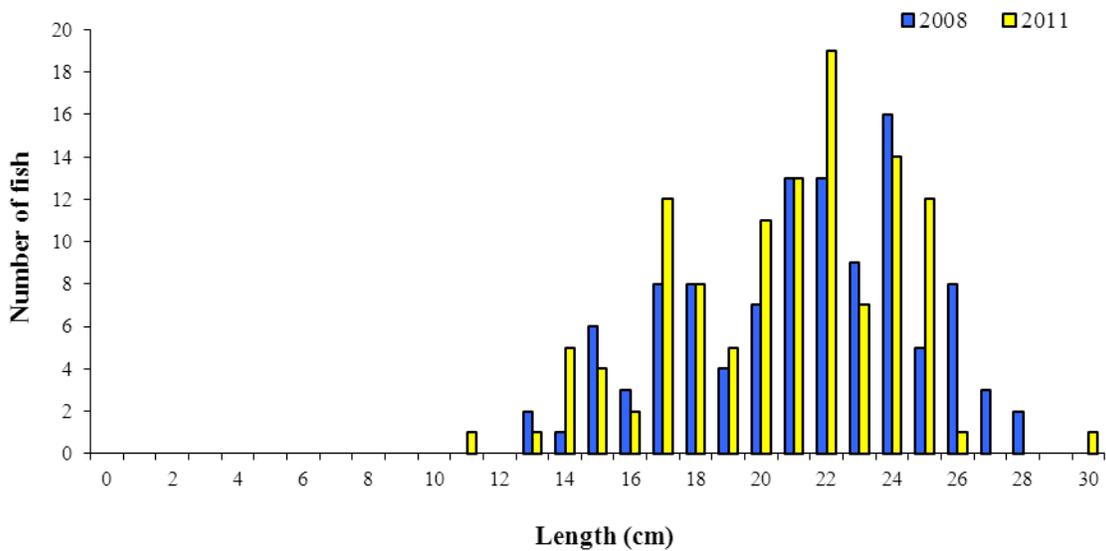
**Fig. 1.7. Mean ( $\pm$ S.E.) perch BPUE in three lakes surveyed during 2011**

### *1.3.3 Length frequency distributions*

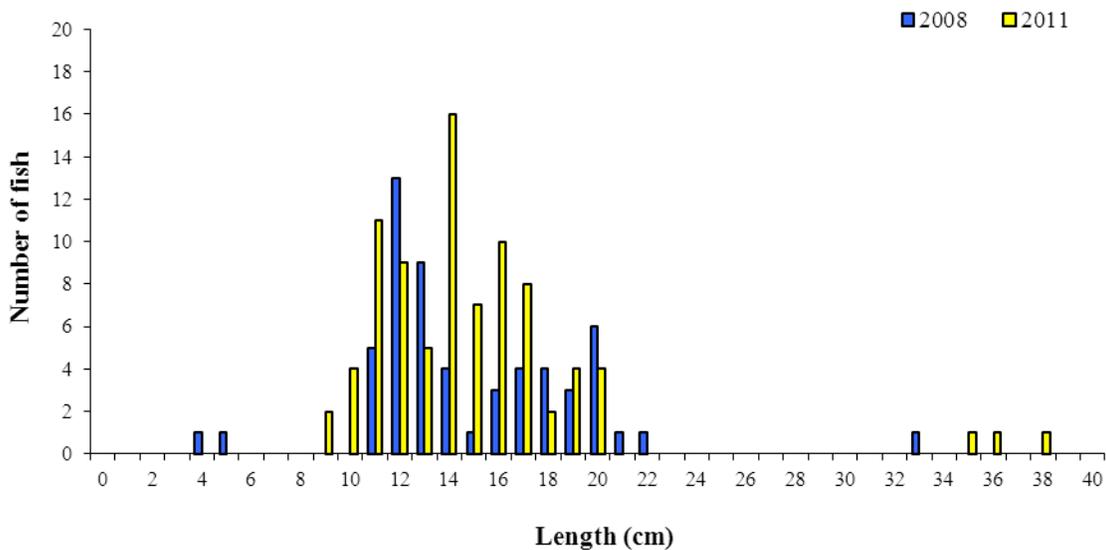
Brown trout captured during the 2011 survey ranged in length from 11.2cm to 30.5cm (mean = 21.0cm) (Fig. 1.8). Brown trout captured during the 2008 survey ranged in length from 13.5cm to 28.3cm (Fig. 1.8).

Perch captured during the 2011 survey ranged in length from 9.0cm to 38.5cm (mean = 15.3cm) (Fig.1.9). Perch captured during the 2008 survey had lengths ranging from 4.3cm to 33.2cm (Fig.1.9).

Arctic char captured during the 2011 survey ranged in length from 16.2cm to 22.0cm, sea trout ranged in length from 19.8cm to 33.6cm and eels ranged in length from 30.3cm to 56.0cm. Two adult salmon were recorded at 54.7cm and 58.3cm.



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



**Fig. 1.9. Length frequency of perch captured on Lough Caragh, 2008 and 2011**

### 1.3.4 Fish age and growth

Five age classes of brown trout were present, ranging from 1+ to 5+, with a mean L1 of 5.4cm (Table 1.3). In the 2008 survey, brown trout ranged from 1+ to 4+ with a mean L1 of 6.1cm. Mean brown trout L4 in 2011 was 21.8cm 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 in 2011 were 2+ and 3+.

Eight age classes of perch were present, ranging from 1+ to 9+, with a mean L1 of 5.9cm (Table 1.4). In the 2008 survey, perch ranged from 0+ to 5+ with a mean L1 of 7.8cm. The dominant age class of perch was 2+, with ages ranging from 1+ to 9+ indicating reproductive success in nine of the previous ten years.

Three Arctic char were present, ranging from 1+ to 4+ and the two salmon were aged 2.1+ and 2.1+2sm.

**Table 1.3. Mean ( $\pm$ SE) brown trout length (cm) at age for Lough Caragh, August 2011**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
Mean	5.4 (0.2)	12.4 (0.5)	18.2 (0.5)	21.9 (0.8)	24.1 (0.3)
N	56	51	31	11	2
Range	3.4-9.9	6.7-22.1	12.1-24.9	18.0-27.9	23.6-24.4

**Table 1.4. Mean ( $\pm$ SE) perch length (cm) at age for Lough Caragh, August 2011**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>	L <sub>6</sub>	L <sub>7</sub>	L <sub>8</sub>	L <sub>9</sub>
Mean	5.9 (0.1)	12.4 (0.2)	17.0 (0.4)	19.9 (0.8)	26.4 (2.5)	27.6 (3.8)	34.2 (1.0)	35.5	37.7
N	52	42	20	12	4	3	2	1	1
Range	4.2-8.4	8.5-14.7	14.0- 20.9	15.5- 25.7	19.2- 31.2	20.0- 32.3	33.1- 35.2	35.5- 35.5	37.7- 37.7

## 1.4 Summary

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

The mean brown trout CPUE and BPUE in Lough Caragh was slightly higher in 2011 than in the 2008 survey, however this difference was not statistically significant. The mean brown trout CPUE in the lake was significantly higher than the mean CPUR from other low alkalinity lakes surveyed in 2011 such as Upper Lake, Co. Kerry and Lough Allua, Co. Cork, and was significantly lower than Lough Beagh, Co.

Donegal. The mean brown trout BPUE in Lough Caragh was also significantly higher than Upper Lake and Lough Allua.

Brown trout ranged in age from 1+ to 5+, indicating reproductive success in five of the previous six 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).

The mean perch CPUE and BPUE in Lough Caragh was similar to the other lakes assessed, with no statistically significant differences being found between lakes. Perch ranged in age from 1+ to 9+, indicating reproductive success in nine of the previous ten 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 Caragh has been assigned an ecological status of High based on the fish populations present in 2011. The ecological status assigned to the lake based on the 2008 survey data was also High.

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

## 1.5 References

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