



Sampling Fish for the Water Framework Directive

Lakes 2011

Upper Lake Killarney



Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Upper Lake, September 2011

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

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1.1 Introduction

Upper Lake, Killarney is situated at the bottom of Killarney's Black Valley in Killarney National Park, Co. Kerry (Plate 1.1, Fig. 1.1). Upper Lake has a surface area of 169ha, a mean depth of 14.5m and a maximum depth of 36m. The lake falls into typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), larger than 50ha and low alkalinity (<20mg/l CaCO₃).

Upper Lake forms part of the Killarney National Park, Macgillicuddy'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). Upper Lake itself is a long and rocky lake holding both salmon (spring salmon and grilse) and brown trout. Brown trout in the lake average around 0.2kg (O' Reilly, 2007).

Upper Lake was previously 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, rudd, minnow, 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. Upper Lake, Killarney

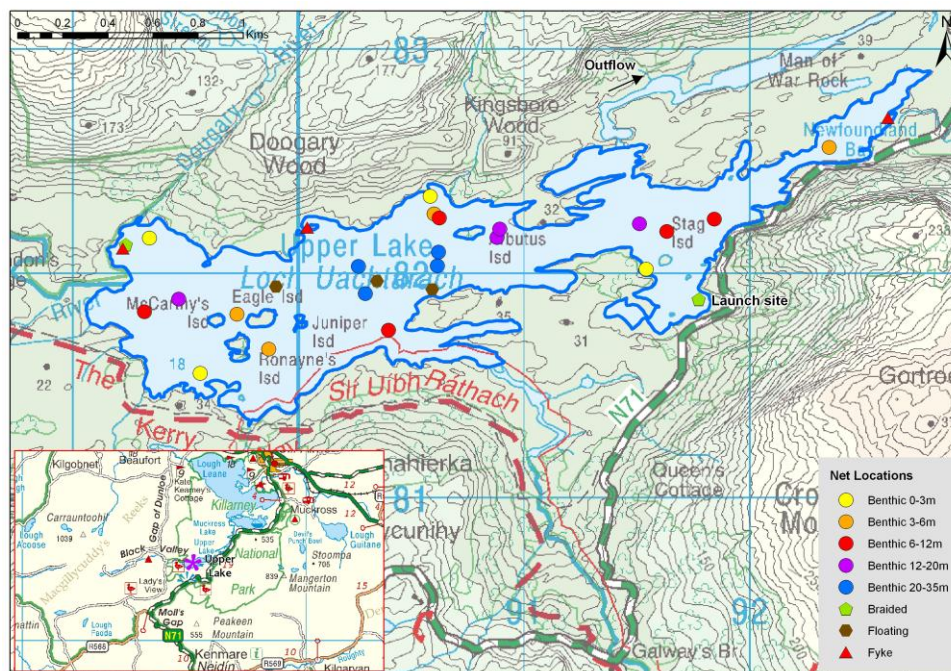


Fig. 1.1. Location map of Upper Lake showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Upper Lake was surveyed over one night from the 6th to the 7th of September 2011. A total of three sets of Dutch fyke nets, 21 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 4 @ 12-19.9m, 4 @ 20-34.9m and 3 @ 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 (27 sites). The netting effort was supplemented using two benthic braided survey gill nets (62.5mm mesh knot to knot) at two 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 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 seven fish species were recorded on Upper Lake in September 2011, with 174 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. Salmon, rudd, tench, minnow and eels were also recorded. During the previous survey in 2008 the same species composition was recorded.

Table 1.1. Number of each fish species captured by each gear type during the survey on Upper Lake, 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
<i>Salmo trutta</i>	Brown trout	59	3	1	2	65
<i>Salmo salar</i>	Salmon	5	0	0	0	5
<i>Perca fluviatilis</i>	Perch	68	0	0	2	70
<i>Scardinius erythrophthalmus</i>	Rudd	6	0	0	0	6
<i>Tinca tinca</i>	Tench	0	0	0	3	3
<i>Phoxinus phoxinus</i>	Minnnow	1	0	0	0	1
<i>Anguilla anguilla</i>	European eel	3	0	0	1	24

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 were 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 Upper Lake and four other similar lakes were also 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 Upper Lake had a significantly higher mean brown trout CPUE than Lough Allua ($z = -3.072$, $P < 0.05$).

The differences in the mean brown trout BPUE between Upper Lake 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 Upper Lake had a significantly higher mean brown trout BPUE than Lough Allua ($z = -3.405$, $P < 0.05$) and had a significantly lower mean brown trout BPUE than Lough Beagh and Lough Caragh ($z = -2.260$ $P < 0.05$ and $z = -2.000$ $P < 0.05$).

Although the mean perch CPUE and BPUE were slightly 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 and BPUE between Upper Lake and two similar lakes were assessed, with no overall significant differences being found (Figs. 1.6 and 1.7).

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

Scientific name	Common name	2008	2011
Mean CPUE			
<i>Salmo trutta</i>	Brown trout	0.034 (0.011)	0.073 (0.021)
<i>Salmo salar</i>	Salmon	0.002 (0.001)	0.005 (0.002)
<i>Perca fluviatilis</i>	Perch	0.07 (0.022)	0.079 (0.031)
<i>Scardinius erythrophthalmus</i>	Rudd	0.018 (0.01)	0.006 (0.003)
<i>Tinca tinca</i>	Tench	0.001 (0.001)	0.001 (0.001)
<i>Phoxinus phoxinus</i>	Minnow	0.001 (0.001)	0.001 (0.001)
<i>Anguilla anguilla</i>	European eel	0.033 (0.033)	0.116 (0.048)
Mean BPUE			
<i>Salmo trutta</i>	Brown trout	3.892 (1.219)	9.393 (3.089)
<i>Salmo salar</i>	Salmon	6.082 (4.845)	21.917 (12.108)
<i>Perca fluviatilis</i>	Perch	3.78 (1.568)	3.928 (1.654)
<i>Scardinius erythrophthalmus</i>	Rudd	2.861 (1.617)	0.625 (0.311)
<i>Tinca tinca</i>	Tench	0.944 (0.944)	1.354 (1.354)
<i>Phoxinus phoxinus</i>	Minnow	0.005 (0.005)	0.002 (0.002)
<i>Anguilla anguilla</i>	European eel	2.361 (2.361)	35.366 (26.541)

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

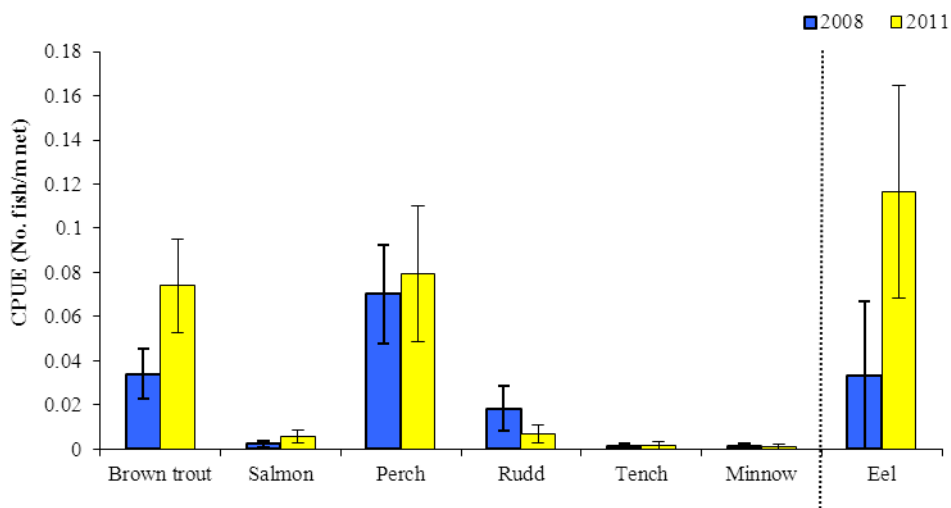


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Upper Lake (Eel CPUE based on fyke nets only), 2008 and 2011

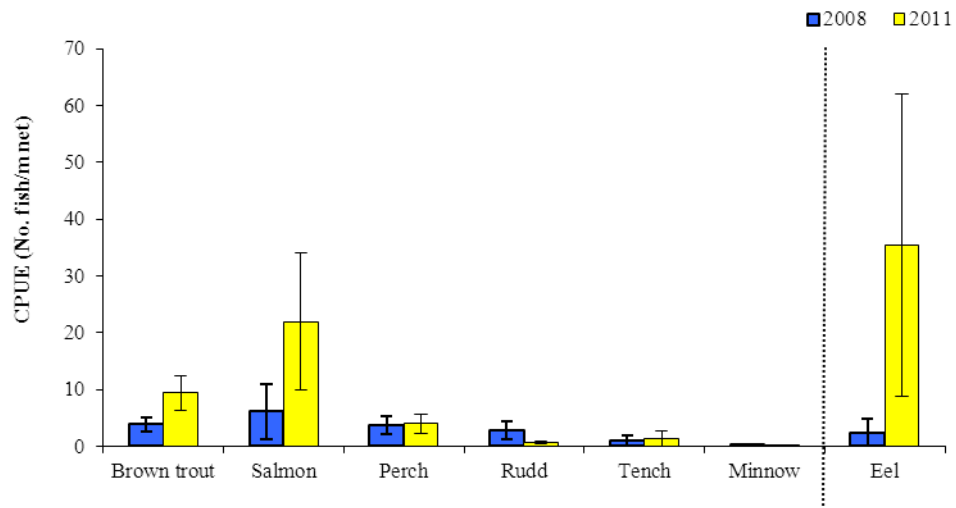


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Upper Lake (Eel CPUE based on fyke nets only), 2008 and 2011

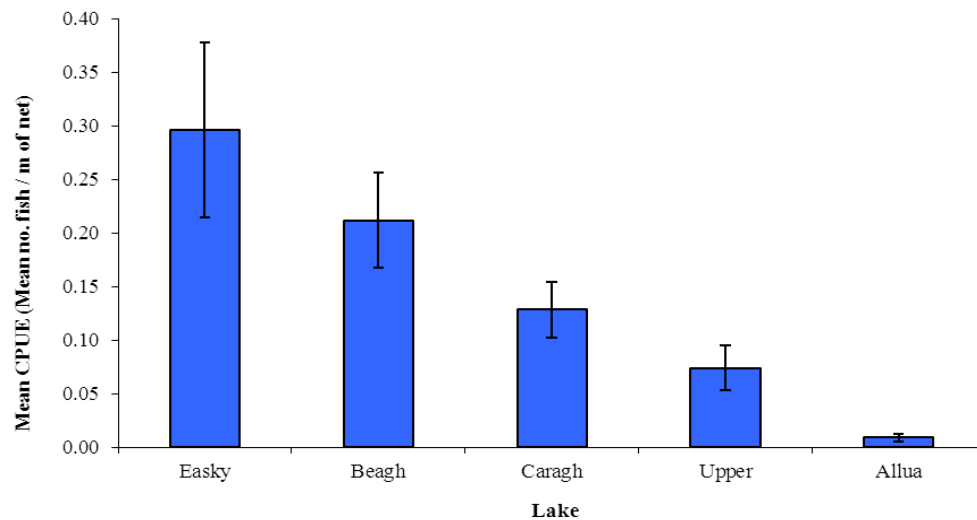


Fig. 1.4. Mean (\pm S.E.) brown trout CPUE in five lakes surveyed during 2011

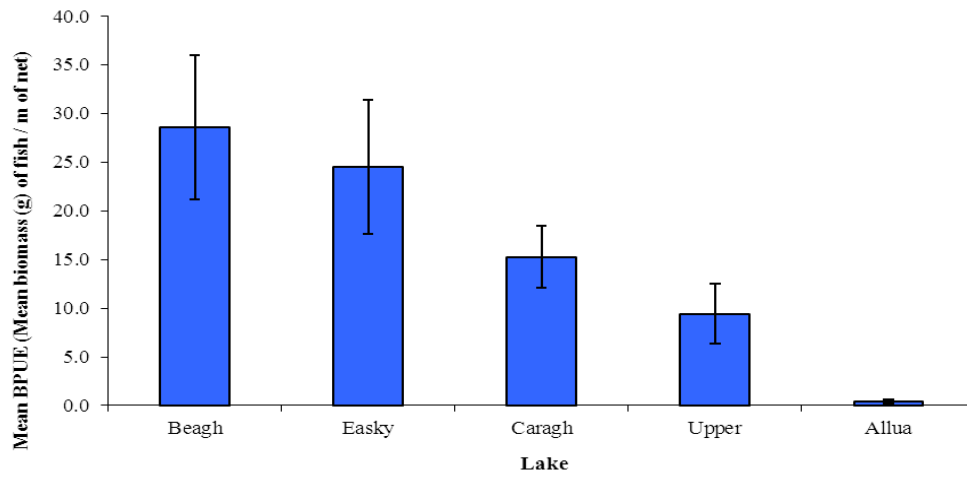


Fig. 1.5. Mean (\pm S.E.) brown trout BPUE in five lakes surveyed during 2011

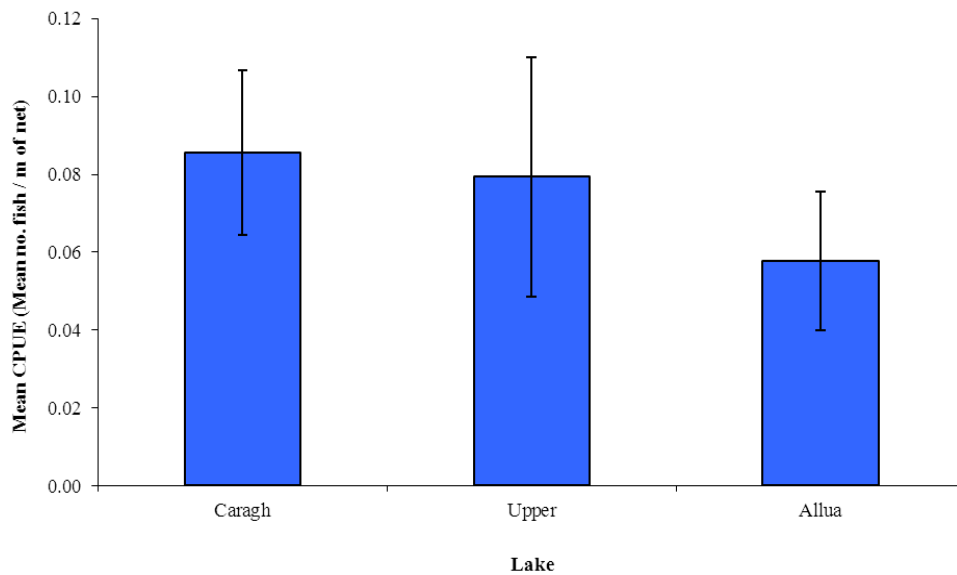


Fig. 1.6. Mean (\pm S.E.) perch CPUE in three lakes surveyed during 2011

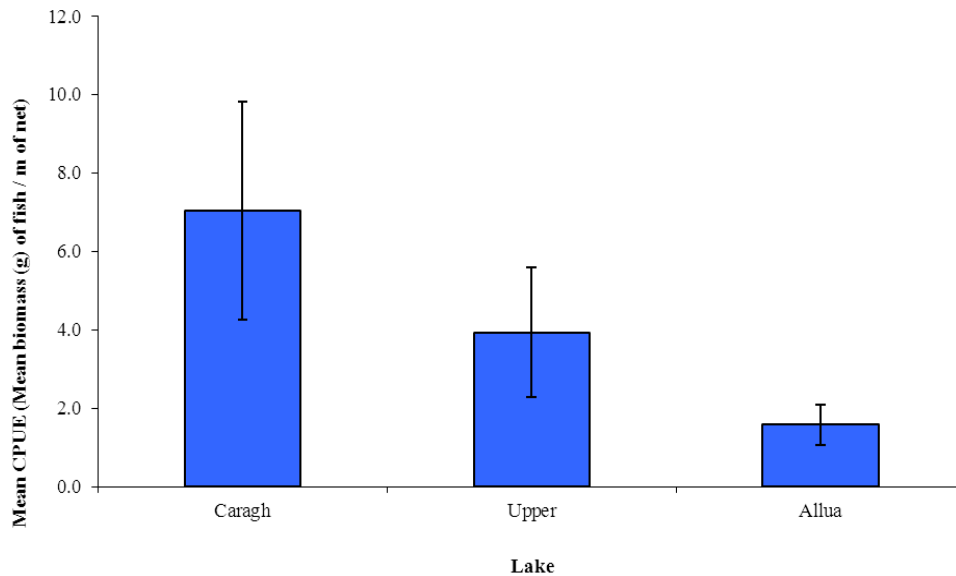


Fig. 1.7. Mean (\pm S.E.) perch BPUE in three lakes surveyed during 2011

1.3.3 Length frequency distributions

Perch captured during the 2011 survey ranged in length from 10.0cm to 21.9cm (mean = 15.0cm) (Fig.1.8). Perch captured during the 2008 survey had lengths ranging from 4.2cm to 25.5cm (Fig.1.8).

Brown trout captured during the 2011 survey ranged in length from 13.2cm to 32.2cm (mean = 21.3cm) (Fig. 1.9). Brown trout captured during the 2008 survey ranged in length from 15.3cm to 27.0cm (Fig. 1.9).

Salmon captured during the 2011 survey ranged in length from 53.0cm to 77.0cm, tench ranged in length from 34.0cm to 37.0cm, rudd ranged from 15.0cm to 21.3cm and eels ranged in length from 28.5cm to 86.0cm. One minnow was recorded at 5.0cm.

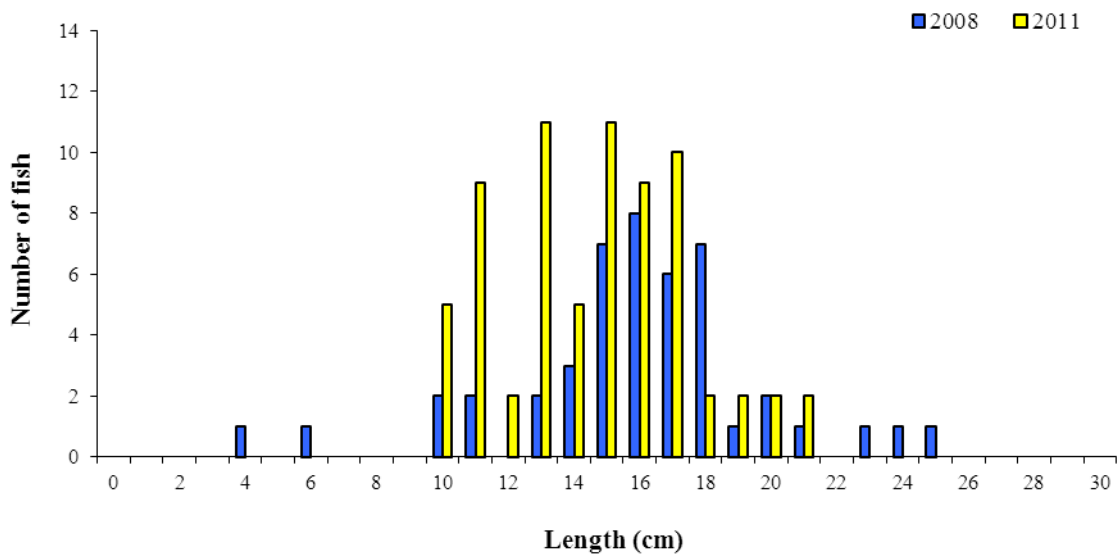


Fig. 1.8. Length frequency of perch captured on Upper Lake, September 2008 and 2011

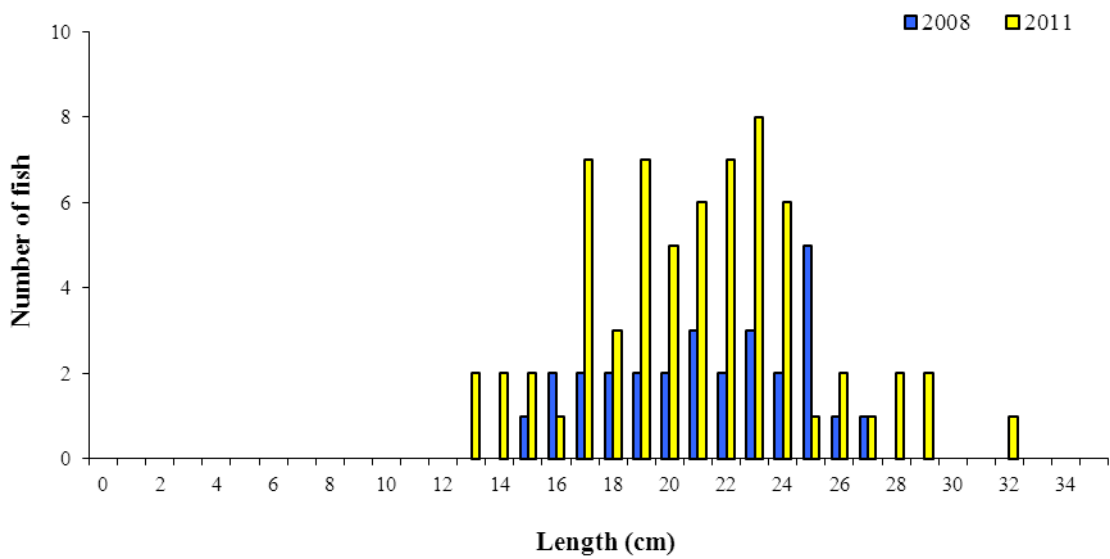


Fig. 1.9. Length frequency of brown trout captured on Upper Lake, September 2008 and 2011

1.3.4 Fish age and growth

Six age classes of perch were present, ranging from 1+ to 6+, with a mean L1 of 6.0cm (Table 1.3). In the 2008 survey, perch ranged from 0+ to 5+ with a mean L1 of 6.6cm.

Six age classes of brown trout were also present, ranging from 1+ to 6+ indicating reproductive success in recent years. The mean L1 was 6.3cm and the dominant age class was 2+ (Table 1.4). In the 2008 survey, brown trout ranged from 1+ to 3+ with a mean L1 of 7.0cm. Mean brown trout L4 in 2011 was 23.7cm indicating a very slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

Salmon ranged in age from 2.1+ to 2.2+ and one rudd was aged at 7+.

Table 1.3. Mean (\pm SE) perch length (cm) at age for Upper Lake, September 2011

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆
Mean	6.0 (0.1)	12.3 (0.2)	15.2 (0.4)	17.0 (0.6)	18.4 (1.0)	20.8 (0.8)
N	43	32	13	11	6	2
Range	3.8-8.6	9.3-14.4	12.2-17.6	13.1-19.5	14.5-21.1	20.0-21.6

Table 1.4. Mean (\pm SE) brown trout length (cm) at age for Upper Lake, September 2011

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆
Mean	6.3 (0.2)	14.1 (0.5)	19.6 (0.5)	23.7 (0.7)	27.3 (0.8)	30.2 (1.3)
N	45	39	25	7	3	2
Range	3.1-9.1	7.9-20.1	15.1-25.3	21.6-26.2	25.8-28.8	28.8-31.5

1.4 Summary

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

Although the mean perch CPUE and BPUE were slightly higher in 2011 than in 2008 these differences were not statistically significant. The mean perch CPUE and BPUE in Upper Lake was compared to four other similar lakes assessed in 2011, with no statistically significant differences being found between lakes. Perch ranged in age from 1+ to 6+, indicating reproductive success in recent years. The dominant age class of perch was 2+.

Although the mean brown trout CPUE and BPUE were higher in 2011 than in 2008, these differences were not statistically significant. The mean brown trout CPUE in Upper Lake was significantly higher

than Lough Allua, Co. Kerry another similar lake surveyed. The mean brown trout BPUE in Upper Lake was significantly also higher than Lough Allua and significantly lower than Lough Beagh, Co. Donegal and Lough Caragh, Co. Kerry. Brown trout ranged in age from 1+ to 6+, indicating reproductive success recent 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, Upper Lake has been assigned an ecological status of Moderate based on the fish populations present. The ecological status assigned to the lake based on the 2008 survey data was also Moderate.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Upper Lake an overall ecological status of High, 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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