



Sampling Fish for the Water Framework Directive

Lakes 2012

Lough Carra



Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Carra, July 2012

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1.1 Introduction

Lough Carra is situated in County Mayo and forms the most northerly part of the Great Western Lakes system of Lough Corrib, Lough Mask and Lough Carra (Plate 1.1, Fig. 1.1). The lake is located approximately 5km north of Ballinrobe, Co. Mayo.

Lough Carra is the largest marl lake in Ireland, with a surface area of approximately 1600ha (NPWS, 2004; Irvine *et al.*, 2003). It is a hard water lake which acquires most of its water via the feeder streams that flow in at various points around its perimeter (Huxley and Huxley, 2009). The majority of the lake is shallow with a mean depth of approximately 1.8m; however, there are sections of the lake where depths reach over 19m (Huxley and Huxley, 2009). Lough Carra is well known for its green/blue colour which is due to the formation of calcareous encrustations (NPWS, 2004). The lake contains well developed stonewort communities with *Chara curta*, *C. desmacantha*, *C. rudis* and *C. contraria* also recorded (NPWS, 2004).

There are approximately 73 islands scattered throughout the lake, varying in size from less than 50m² to just over 10,000m² (Fig. 1.1). The lake is categorised as typology class 10 (as designated by the EPA for the purposes of the Water Framework Directive), i.e. shallow (<4m), greater than 50ha and highly alkaline (>100mg/l CaCO₃).

Results from an Inland Fisheries Ireland (IFI) survey in March 2009 on Lough Carra suggest that the lake supports an excellent and healthy stock of brown trout, possibly one of the best in the country (IFI, 2009). The average size of the brown trout taken from Lough Carra is greater than any of the other western lakes and the lake has previously produced a specimen of 8.2kg (O' Reilly, 2007). Lough Carra is believed to be one of the few remaining wild brown trout calcareous lakes within the EU (Irvine *et al.* 2003). During the 1990s fishery rehabilitation and enhancement works were undertaken in Lough Carra's spawning streams by IFI (previously the Regional Fisheries Boards) and this has led to greatly increased recruitment of juvenile brown trout to the lake. These works have resulted in a doubling of the adult stock in the lake, compared to the stock levels of the 1970's (O' Grady, 2009). Other fish species present in Lough Carra include pike, perch and eel. This species composition has not changed since the early 1960's (Inland Fisheries Trust unpublished data).

The lake was also previously surveyed in June 2009 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2010). During this survey, perch were found to be the dominant species present in the lake. Brown trout, three-spined stickleback, pike and eels were also captured during the survey.



Plate 1.1. Lough Carra

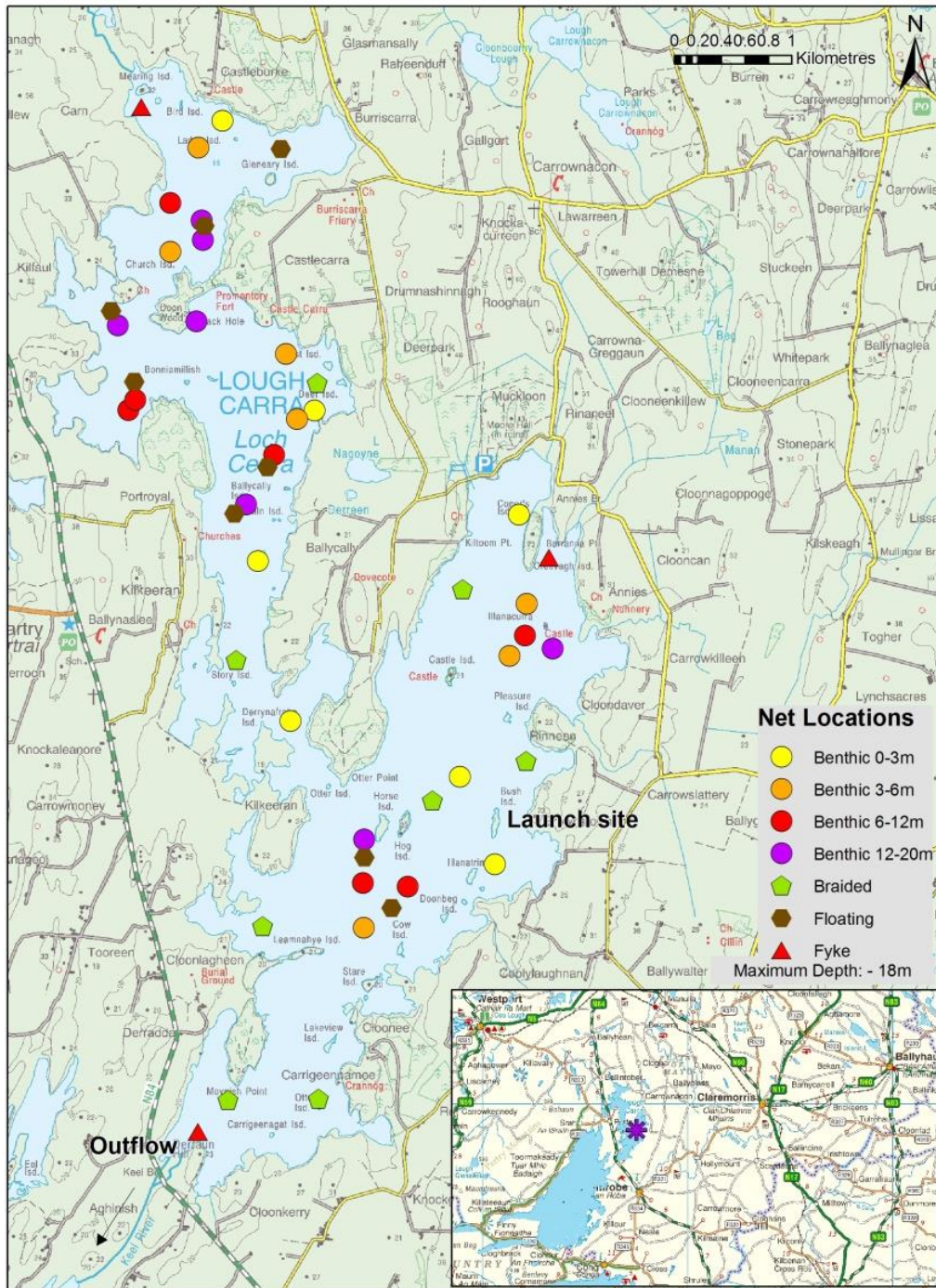


Fig. 1.1. Location map of Lough Carra showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Carra was surveyed over three nights between the 2nd and the 5th of July 2012. A total of three sets of Dutch fyke nets, 28 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (7 @ 0-2.9m, 7 @ 3-5.9m, 7 @ 6-11.9m and 7 @ 12-19.9m) and eight surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed randomly in the lake (39 sites). The netting effort was supplemented using eight benthic braided (62.5mm mesh knot to knot) survey gill nets (8 additional sites). Nets were deployed in the same locations as were randomly selected in the previous survey in 2009. 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 trout and pike. 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 returned to the laboratory for further analysis.

1.3 Results

1.3.1 Species Richness

A total of five fish species were recorded on Lough Carra in July 2012, with 322 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 three-spined stickleback, brown trout, pike and eels. A similar species composition was recorded during the previous survey in 2009 (Kelly *et al.*, 2010).

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Carra, July 2012

Scientific name	Common name	Number of fish captured				Total
		Benthic mono multimesh gill nets	Benthic braided gill nets	Surface mono multimesh gill nets	Fyke nets	
<i>Salmo trutta</i>	Brown trout	26	1	5	0	32
<i>Perca fluviatilis</i>	Perch	227	7	4	0	238
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	38	0	0	0	38
<i>Esox lucius</i>	Pike	4	0	0	0	4
<i>Anguilla anguilla</i>	Eel	0	0	0	10	10

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 2009 and 2012 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 appeared slightly lower in 2012 than in 2009, these differences were not statistically significant (Fig. 1.2 and Fig. 1.3).

The differences in the mean brown trout CPUE between Lough Carra and six similar lakes was assessed, with an overall significant difference being found (Kruskal-Wallis, $P < 0.05$) (Fig. 1.4). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Carra had a significantly higher mean brown trout CPUE than Lough Cullaun ($z = 2.205$, $P < 0.05$), Lough Derg ($z = 2.05$, $P < 0.05$), Lough Mask ($z = 1.825$, $P < 0.05$) and Muckanagh Lough ($z = 1.665$, $P < 0.05$).

The differences in the mean brown trout BPUE between Lough Carra and six similar lakes was assessed, with an overall significant difference being found (Kruskal-Wallis, $P < 0.05$) (Fig. 1.5). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Carra had a significantly higher mean brown trout BPUE than Lough Cullaun ($z = 2.06$, $P < 0.05$), Lough Derg ($z = 2.218$, $P < 0.05$) and Lough Mask ($z = 2.375$, $P < 0.05$).

The mean perch CPUE also appeared higher in 2012 than in 2009, however this difference was not statistically significant (Fig. 1.2).

The differences in the mean perch CPUE and BPUE between Lough Carra and six similar lakes was assessed, with an overall significant difference being found (Kruskal-Wallis, $P < 0.05$) (Fig. 1.6 and Fig. 1.7). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Carra had a significantly higher mean perch CPUE and BPUE than Lough Mask ($z = 2.903$, $P < 0.05$ and $z = 2.991$, $P < 0.05$).

Although the mean perch BPUE appeared lower in 2012 than in 2009, this difference was not statistically significant (Fig. 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Carra, 2009 and 2012

Scientific name	Common name	2009	2012
Mean CPUE			
<i>Salmo trutta</i>	Brown trout	0.026 (0.109)	0.023 (0.006)
<i>Perca fluviatilis</i>	Perch	0.109 (0.030)	0.169 (0.042)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.013 (0.008)	0.027 (0.012)
<i>Esox lucius</i>	Pike	0.002 (0.001)	0.003 (0.001)
<i>Anguilla anguilla</i>	Eel	0.067 (0.029)	0.056 (0.047)
Mean BPUE			
<i>Salmo trutta</i>	Brown trout	17.105 (6.153)	10.316 (3.005)
<i>Perca fluviatilis</i>	Perch	18.160 (6.131)	15.012 (3.662)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.013 (0.008)	0.023 (0.010)
<i>Esox lucius</i>	Pike	0.495 (0.294)	0.797 (0.395)
<i>Anguilla anguilla</i>	Eel	19.207 (6.079)	20.778 (17.249)

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

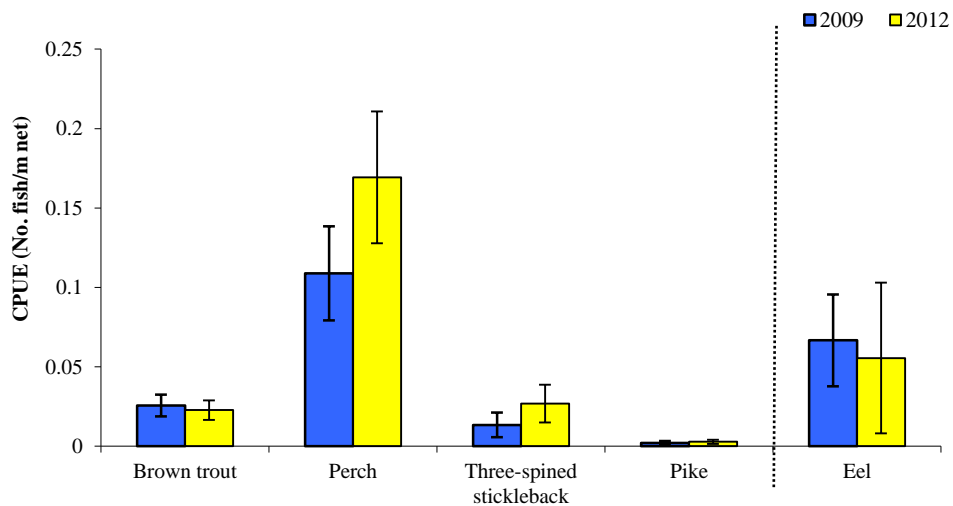


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Lough Carra (Eel CPUE based on fyke nets only), 2009 and 2012

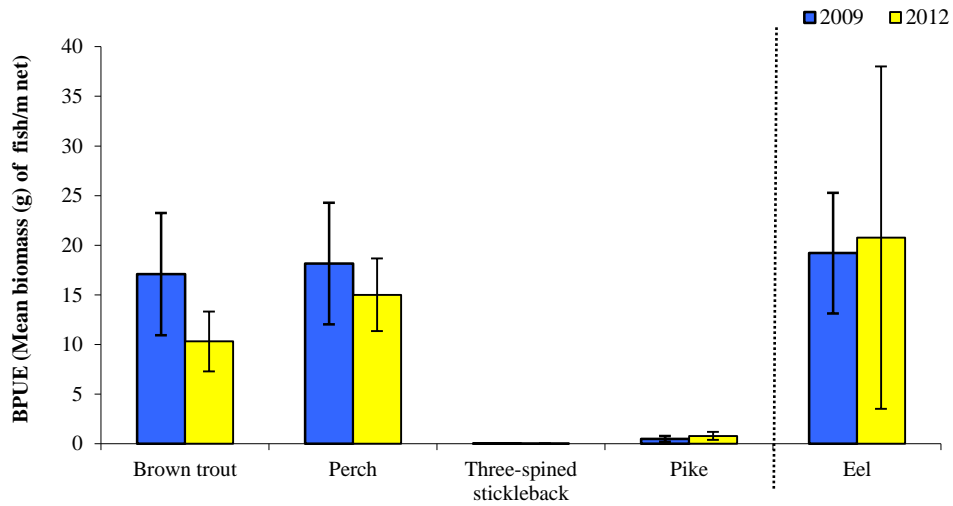


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Lough Carra (Eel BPUE based on fyke nets only), 2009 and 2012

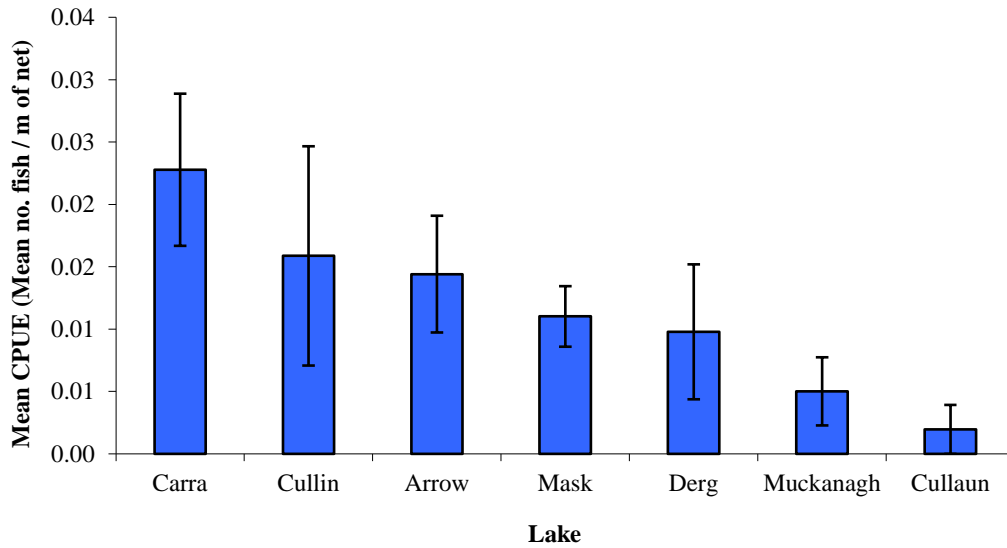


Fig. 1.4. Mean (\pm S.E.) brown trout CPUE in seven lakes surveyed during 2012

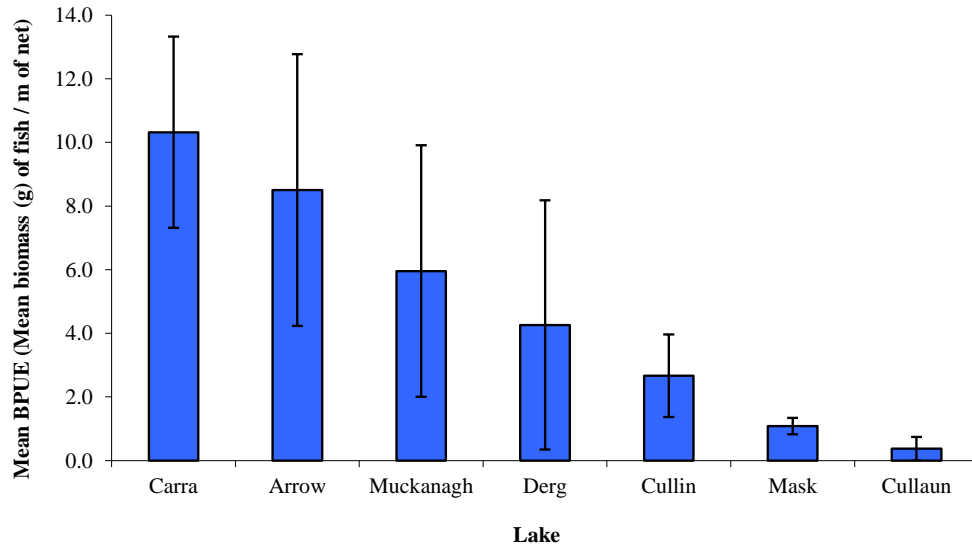


Fig. 1.5. Mean (\pm S.E.) brown trout BPUE in seven lakes surveyed during 2012

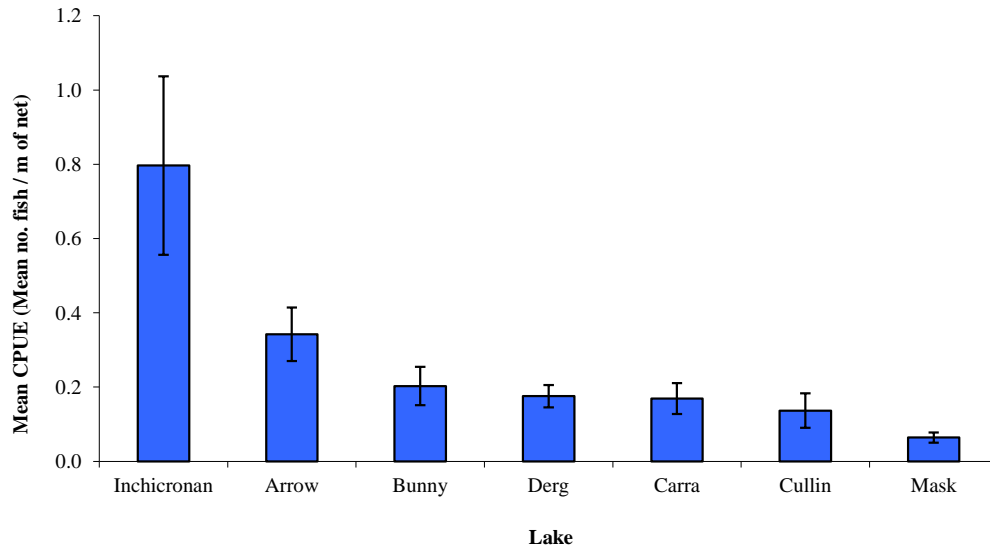


Fig. 1.6. Mean (\pm S.E.) perch CPUE in seven lakes surveyed during 2012

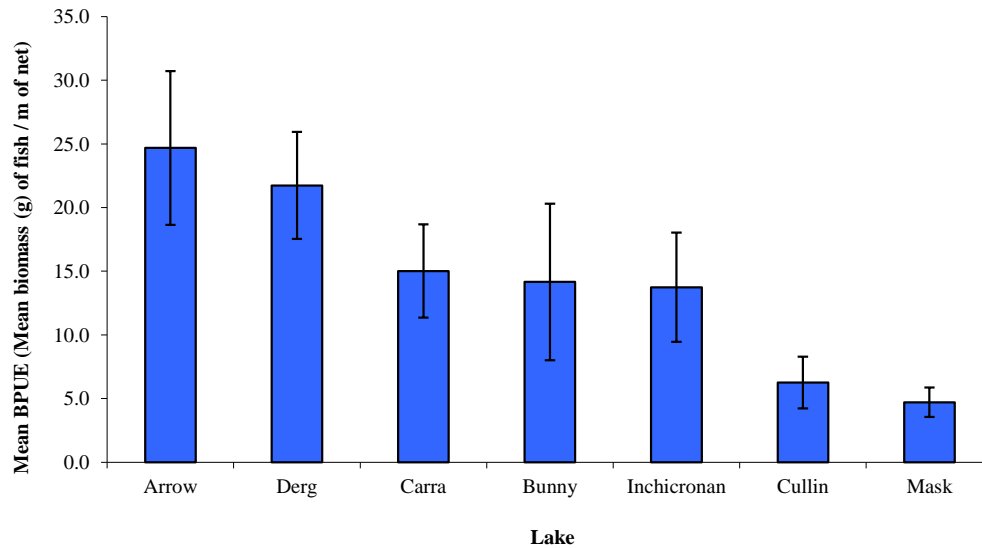


Fig. 1.7. Mean (\pm S.E.) perch BPUE in seven lakes surveyed during 2012

1.3.3 Length frequency distributions

Brown trout captured during the 2012 survey ranged in length from 15.2cm to 55.5cm (mean = 27.6cm) (Fig. 1.6). Brown trout captured during the 2009 survey ranged in length from 13.5cm to 53.0cm (Fig. 1.6).

Perch captured during the 2012 survey ranged in length from 3.3cm to 37.3cm (mean = 12.6cm) (Fig. 1.7). Perch captured during the 2009 survey ranged in length from 5.6cm to 34.5cm (Fig. 1.7).

Eels captured during the 2012 survey ranged in length from 45.2cm to 73.4cm, three-spined stickleback ranged in length from 3.5cm to 5.3cm and three pike ranged in length from 30.1cm to 35.5cm.

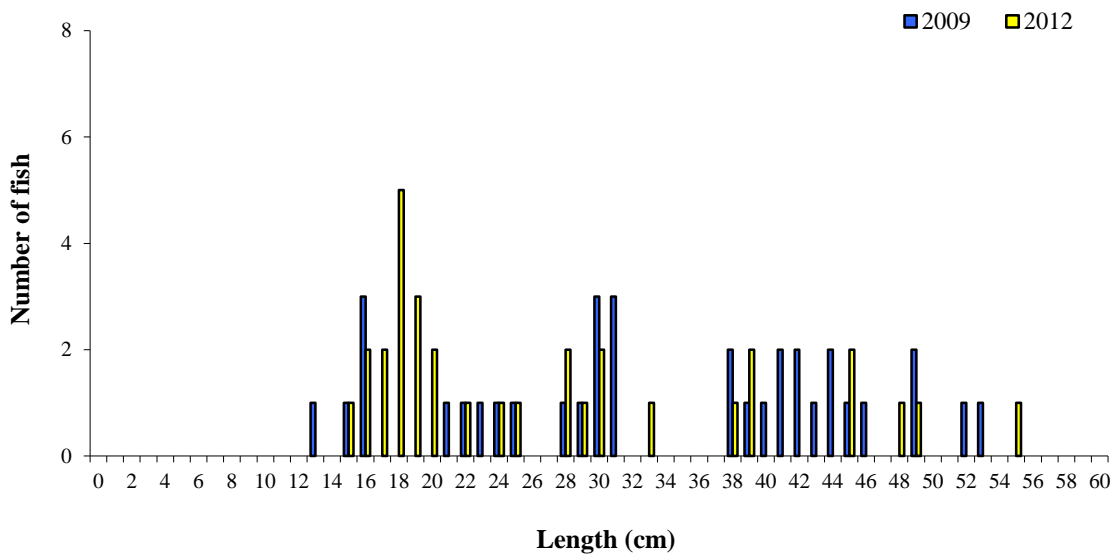


Fig. 1.6. Length frequency of brown trout captured on Lough Carra, 2009 and 2012

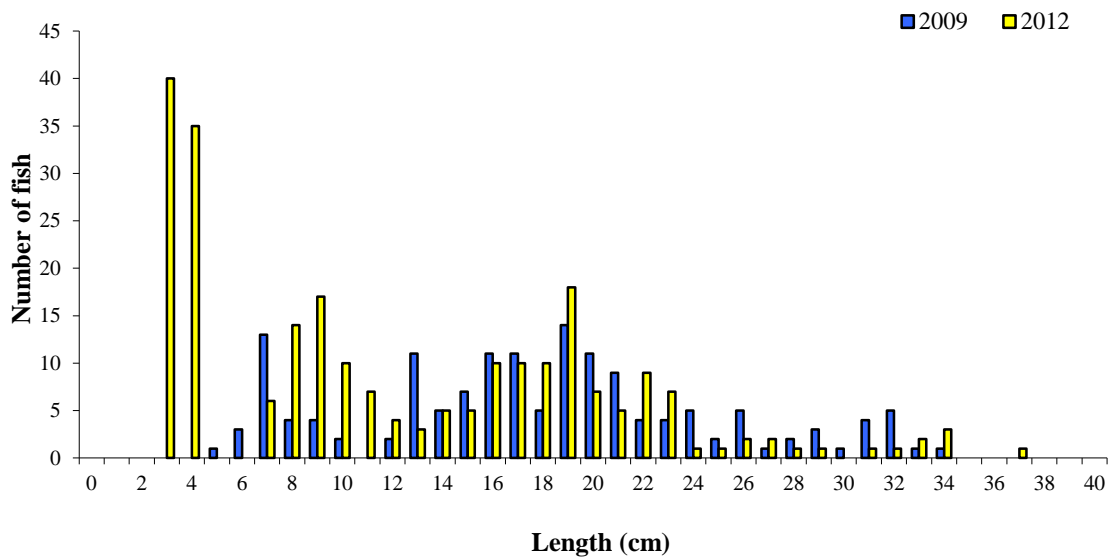


Fig. 1.7. Length frequency of perch captured on Lough Carra, 2009 and 2012

1.3.4 Fish age and growth

Four age classes of brown trout were present, ranging from 1+ to 4+, with a mean L1 of 6.9cm (Table 1.3). The dominant age class was 2+ (Fig. 1.6). In the 2009 survey, brown trout ranged from 1+ to 5+ with a mean L1 of 6.9cm. Brown trout exhibited a very fast rate of growth in this lake.

Eight age classes of perch were present, ranging from 0+ to 7+, with a mean L1 of 6.8cm (Table 1.4). The dominant age class was 0+ (Fig. 1.7). In the 2009 survey, perch ranged from 1+ to 7+ with a mean L1 of 6.3cm.

Table 1.3. Mean (\pm SE) brown trout length (cm) at age for Lough Carra, July 2012

	L ₁	L ₂	L ₃	L ₄
Mean	6.9 (0.3)	16.7 (1.2)	33.4 (3.0)	44.6 (3.1)
N	28	20	5	3
Range	2.9-8.4	7.1-17.6	13.1-19.6	13.1-19.6

Table 1.4. Mean (\pm SE) perch length (cm) at age for Lough Carra, July 2012

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇
Mean	6.8 (0.1)	12.4 (0.2)	18.2 (0.4)	22.5 (0.7)	26.5 (1.1)	30.0 (1.7)	32.0 (2.7)
N	46	36	13	13	13	13	13
Range	4.3-11.1	9.7-16.6	13.5-23.3	15.5-29.1	18.1-33.3	20.2-34.0	27.1-36.3

1.4 Summary

Perch 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 appeared slightly lower in 2012 than in 2009, these differences were not statistically significant. The mean brown trout CPUE in Lough Carra was significantly higher than that calculated for Lough Cullaun, Lough Derg, Lough Mask and Muckanagh Lough. The mean brown trout BPUE in Lough Carra was also significantly higher than for Lough Cullaun, Lough Derg and Lough Mask. Brown trout ranged in age from 1+ to 4+, indicating reproductive success in four of the previous five years. The dominant age class of perch was 2+. Length at age analyses revealed that brown trout in the lake exhibit a very fast rate of growth.

Although the mean perch CPUE and BPUE appeared slightly different in 2012 than in 2009, these differences were not statistically significant. The mean perch CPUE and BPUE in Lough Carra was

significantly higher than Lough Mask, another similar lake surveyed. Perch ranged in age from 0+ to 7+, indicating reproductive success in the previous eight years. The dominant age class of perch was 0+.

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 Carra has been assigned an ecological status of High based on the fish populations present in 2012. The ecological status assigned to the lake based on the 2009 survey data was Good.

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