Lough Corrib

Sampling Fish for the Water Framework Directive - Lakes 2008

The Central and Regional Fisheries Boards

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1.1 Introduction

Lough Corrib (Plates 1.1 and 1.2), the second largest lake in Ireland (after Lough Neagh), is situated in Co. Galway in the River Corrib catchment. The lake stretches from outside Galway city to within three kilometers of Maam Cross, a distance of over 50 kilometers (Figs. 1.1 and 1.2). The main rivers draining into Lough Corrib include the Black, Clare, Dooghta, Cregg, Owenriff Rivers and the Cong canal which joins Lough Corrib to Lough Mask. The lake can be divided into two parts; Lower Lough Corrib - a relatively shallow basin underlain by carboniferous limestone in the south, and Upper Lough Corrib - a larger, deeper basin underlain by more acidic granite, schists, shales and sandstones to the north (NPWS, 2004). The lake has a surface area of 16,562Ha (5,042ha Lower Lough and 11,520ha Upper Lough), and has a maximum depth of 42m. The lower lake falls into typology class 10 (as designated by the EPA for the Water Framework Directive), i.e. shallow (mean depth <4m), greater than 50ha and high alkalinity (>100mg/l $CaCO_3$) and the upper lake fits into typology class 12, i.e. deep (mean depth >4m), greater than 50Ha and high alkalinity (>100mg/l $CaCO_3$). The lake supports 14 habitats and six species, including salmon that are listed on Annex I and Annex II respectively of the EU Habitats Directive (NPWS, 2004).

Lough Corrib is one of the best game fisheries in the world and is internationally renowned for its brown trout fishing. The lake is known to hold brown trout, salmon, perch, roach, bream, roach x bream hybrids, eels, 3-spined stickleback and pike. Unfortunately roach, a non-native invasive fish species, was introduced to the lake in the early 1980s (O' Grady, 1986).

The lake was previously surveyed to assess its fish stocks by the Central Fisheries Board (CFB) and the Western Regional Fisheries Board (CFB) in 1986 and 1996 (O' Grady, 1986; O' Grady *et al*, 1996). Lough Corrib has also been included in the CFB and WRFBs long term water quality monitoring programme of lake ecosystems since 1975.

Roach a non-native invasive fish species was first identified in Lower Lough Corrib in the early 1980s and subsequently spread to all corners of the lake. High numbers of roach were observed in routine netting operations on the lake from the late 1980s until 1992 when a decline in the stock was observed (O' Grady, 1996). In early 2007, large numbers of the protozoan parasite *Cryptosporidium* were detected in water from the lake, leading to contamination of the public water supply and an outbreak of cryptosporidiosis in Galway city. Another unwelcome visitor to the lake is the highly invasive plant species *Lagarosiphon major* (also known as "Curly Waterweed") which was first identified in the lake in 2005. This rapidly colonizing plant has already excluded native plant species from bays in which it has become established. The Zebra mussel (*Dreissena polymorpha*), another invasive species in Ireland was first recorded in Lough Corrib during 2007 and it is thought they were introduced to the lake in 2000 and 2001.

Plate 1.1. Upper Lough Corrib looking south east near Cornamona (Photo courtesy of CFB and No. 3 Operational Wing, Irish Air Corps (Aer Chór na hÉireann))

Plate 1.2. Lower Lough Corrib west shore (near L. Kip river) (Photo courtesy of CFB and No. 3 Operational Wing, Irish Air Corps (Aer Chór na hÉireann))

1.2 Methods

The lower lake was surveyed over four nights from the 16th to the 20th of June 2008. A total of six sets of Dutch fyke nets, 24 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) survey gill nets (14 @ 0-2.9m and 10 @ 3-5.9m) (30 sites) were deployed. The netting effort was supplemented using six benthic braided (62.5mm mesh knot to knot) survey gill nets (6 additional sites) (Fig. 1.1).

The upper lake was surveyed over five nights from the 19th to the 27th of June 2008. A total of nine sets of Dutch fyke nets, 52 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) survey gillnets (12 @ 0-2.9m, 12 @ 3-5.9m, 12 @ 6-11.9m, 6 @ 12-19.9m, 7 @ 20-34.9m and 3 @ 35-49.9m) and eight surface monofilament multi-mesh (12 panel, 5-55mm mesh size) survey gillnets were deployed. The netting effort was supplemented using 11 benthic braided (62.5mm mesh knot to knot) survey gill nets and two surface braided (62.5mm mesh knot to knot) survey gill nets (13 additional sites) (Fig. 1.2).

Survey locations were randomly selected using a grid placed over a map of the lake. The angle of each gill net in relation to the shoreline was randomised.

All fish captured apart from perch were measured and weighed on site and scales were removed from brown trout, pike, roach, roach x bream hybrids and bream. 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.

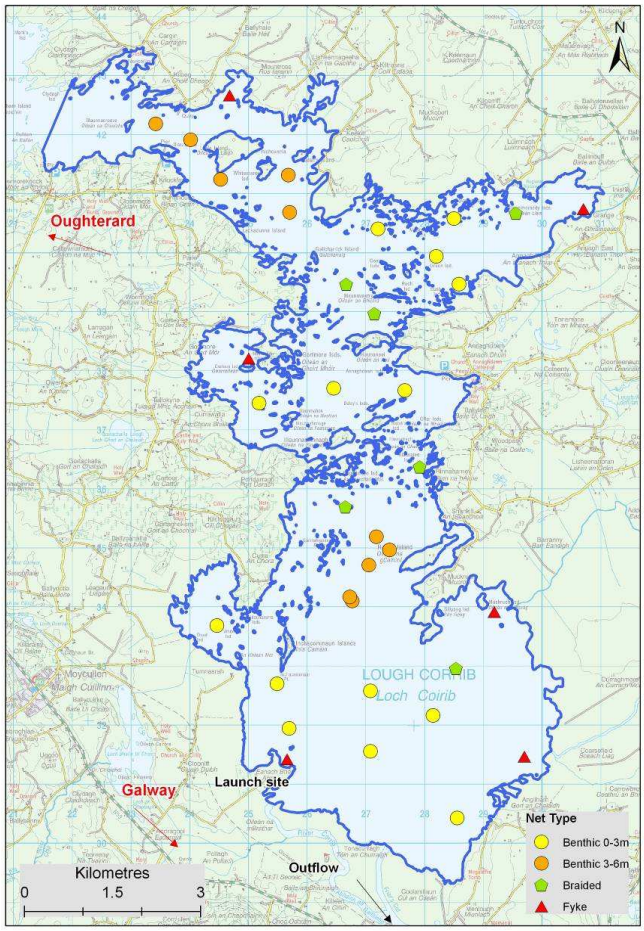

Fig. 1.1. Location map of Lower Lough Corrib showing locations and depths of each net (outflow is indicated on map)

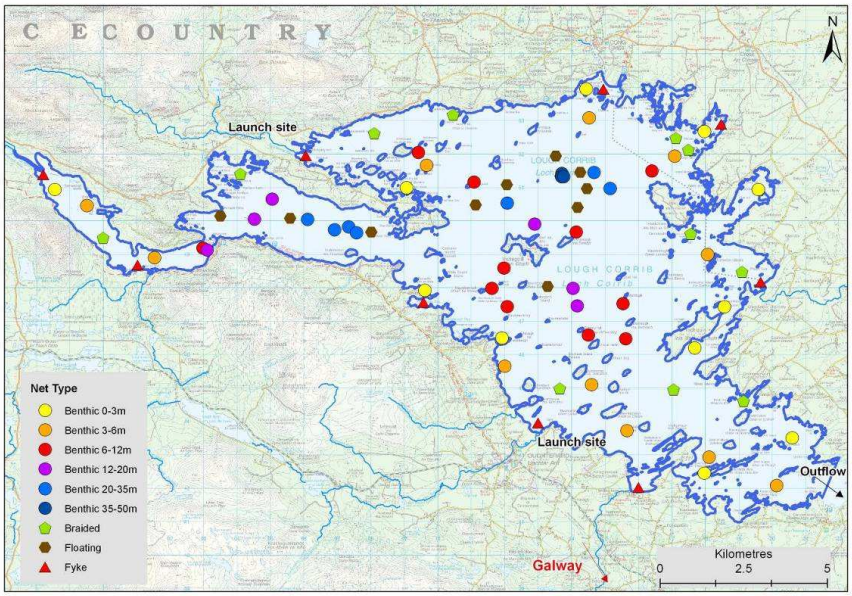

Fig. 1.2. Location map of Upper Lough Corrib showing locations and depths of each net (outflow is indicated on map)

1.3 Results

1.3.1 *Species Richness*

A total of seven fish species and one hybrid were recorded on Lower and Upper Lough Corrib between the 16th and 27th of June 2008. The species encountered and numbers captured by each gear type are shown in Tables 1.1 and 1.2. A total of 1716 fish were captured during the survey in Lower and Upper Lough Corrib combined. Perch, followed by roach were the most common fish species encountered in the benthic gill nets. A small number (40) of brown trout were recorded. In total, 36 eels were captured (Table 1.1 and 1.2).

Table 1.1. List of fish species recorded (including numbers captured) during the WFD surveillance monitoring survey on Lower Lough Corrib, June 2008

Scientific name	Common name	Number of fish captured			
		Benthic mono multimesh gill nets	Benthic braided gill nets	Dutch fykes	Total
Salmo trutta	Brown trout	13	6	0	19
Perca fluviatilis	Perch	283	1	1	285
Rutilus rutilus	Roach	271	2	2	275
Esox lucius	Pike	9	7	1	17
	Roach x Bream	8	0	0	8
Abramis brama	Bream	0	1	0	1
Gasterosteus aculeatus	3-spined stickleback	1	0	3	4
Anguilla anguilla	Eel	2	0	6	8

Table 1.2. List of fish species recorded (including numbers captured) during the WFD surveillance monitoring survey on Upper Lough Corrib, June 2008

Scientific name	Common name	Number of fish captured					
		Benthic mono multimesh gill nets	Benthic braided gill nets	Surface mono multimesh gill nets	Surface braided gill nets	Dutch fykes	Total
Salmo trutta	Brown trout	12	0	3	6	0	21
Perca fluviatilis	Perch	686	0	0	0	15	701
Rutilus rutilus	Roach	277	6	0	0	2	285
	Roach x Bream	23	11	0	0	0	34
Abramis brama	Bream	16	3	0	0	0	19
Esox lucius	Pike	3	3	0	0	3	9
Gasterosteus aculeatus	3-spined stickleback	2	0	0	0	0	2
Anguilla anguilla	Eel	0	0	0	0	28	28

1.3.2 *Fish abundance*

Fish abundance was calculated as the mean number of fish caught per metre of net, i.e. mean CPUE. Fish biomass was calculated as the mean weight of fish caught per metre of net, i.e. mean BPUE. A summary of CPUE and BPUE data for each species and gear type is shown in Table 1.3.

Table 1.3. Mean CPUE (mean number of fish per m of net) and mean BPUE (mean weight of fish per m of net) for all fish species recorded on Lower and Upper Lough Corrib, June 2008

Gear type	3-spine	Roach	Perch	Roachxbream	Brown trout	Pike	Eels	Bream
Lower Corrib			**Mean CPUE (mean number of fish/m of net)**					
Gill nets (all)	0.001	0.304	0.316	0.009	0.022	0.019	-	0.001
Fykes	0.008	0.006	0.003	0	0	0.003	0.017	0
			Mean BPUE (mean weight (g) of fish/m of net)					
Gill nets (all)	0.004	26.273	22.233	3.096	15.405	37.330	-	2.605
Fykes	0.033	0.178	0.006	0	0	0.203	4.901	0
Upper Corrib			**Mean CPUE (mean number of fish/m of net)**					
Gill nets (all)	0.001	0.135	0.327	0.017	0.010	0.003	-	0.009
Fykes	0	0.004	0.028	0	0	0.006	0.052	0
			Mean BPUE (mean weight (g) of fish/m of net)					
Gill nets (all)	0.004	21.144	25.276	9.644	10.019	8.856	-	5.790
Fykes	0	0.040	1.799	0	0	1.025	11.953	0

Comparison of CPUEs - 1996 v^{s} 2008

For comparative purposes, CPUEs for the dominant fish species from the 1996 survey (braided multi-mesh nets, 62.5-125mm mesh size, 96250m^2 total area) and the 2008 survey (monofilament multi-mesh nets, 5-55mm mesh size, 3735m^2 total area) were recalculated as the total number of each species captured/total area of net deployed (Fig 1.3). Brown trout CPUE was approximately twice as high in 2008 compared to 1996. Roach CPUE in 2008 was over 10 times that in 1996, whilst perch CPUE was over 1200 times than that recorded in 1996. Pike CPUE was similar in 2008 than 1996 and roach x bream hybrid CPUE was almost 20 times greater in 2008 than in 1996 (Fig. 1.3).

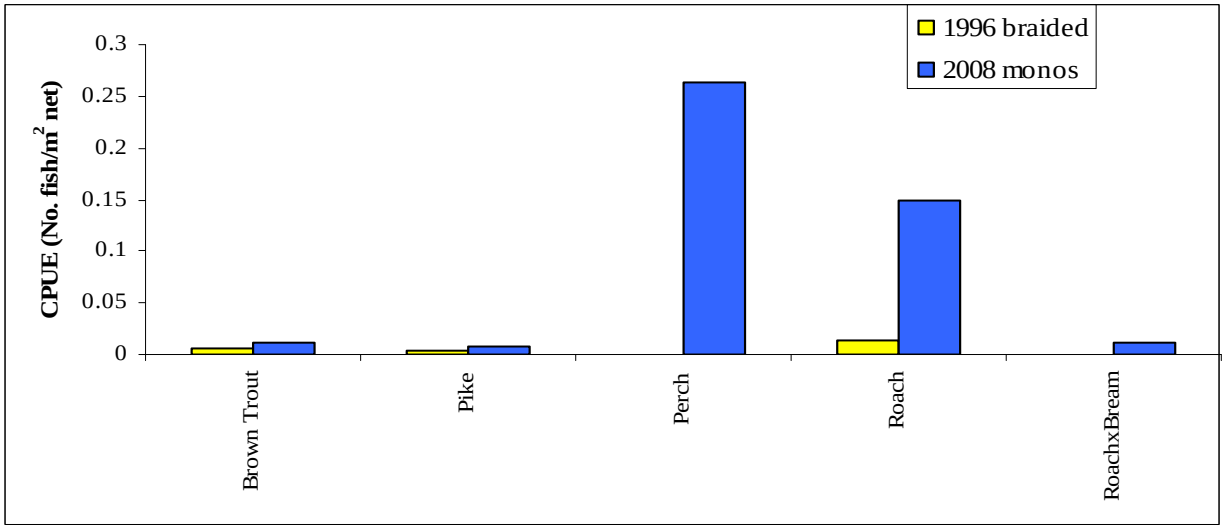

Fig. 1.3. CPUE of selected fish species (total number of fish/total area of net) captured in 1996 and 2008 on Lower and Upper Lough Corrib

1.3.3 *Length frequency distributions*

Length frequency data for perch and roach from Lower Lough Corrib are shown in Figures 1.4 and 1.5. Perch ranged in length from 3.0cm to 37.5cm (mean = 14.6 cm) (Fig. 1.4). Roach ranged in length from 5.8cm to 31.3cm (mean = 15.4cm) (Fig. 1.5). Eels ranged from 40.0cm to 61.1cm. Pike ranged in length from 20.0cm to 95.0cm. Roach x bream hybrids ranged from 9.8cm to 41.5cm and one bream measuring 47.5cm was also recorded.

Length frequency data for perch and roach from Upper Lough Corrib are shown in Figures 1.6 and 1.7. Perch ranged in length from 6.4cm to 30.6cm (mean = 16.0cm) (Fig. 1.6). Roach ranged in length from 5.5cm to 35.0cm (mean = 19.8cm) (Fig. 1.7). Eels ranged from 38.5cm to 69.0cm. Pike ranged in length from 5.8cm to 80.0cm. Roach x bream hybrids had lengths from 13.0cm to 42.5cm and bream lengths ranged from 18.0cm to 43.9cm.

Brown trout recorded in Lower Lough Corrib ranged in length from 13.3cm to 53.3cm and ranged from 6.6cm to 65.5cm in Upper Lough Corrib (Fig. 1.8).

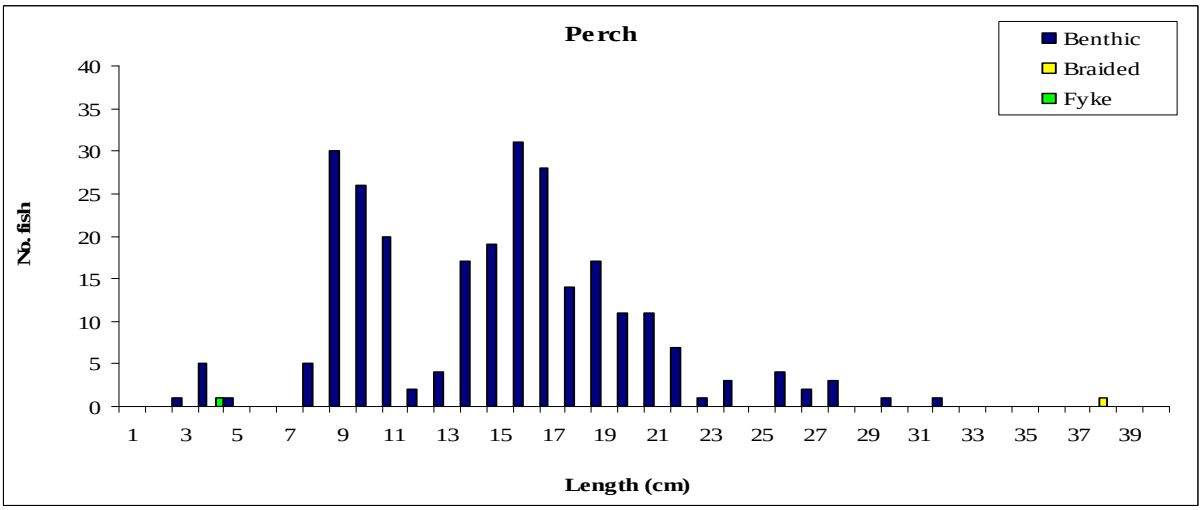

Fig. 1.4. Length frequency of perch captured on Lower Lough Corrib, June 2008

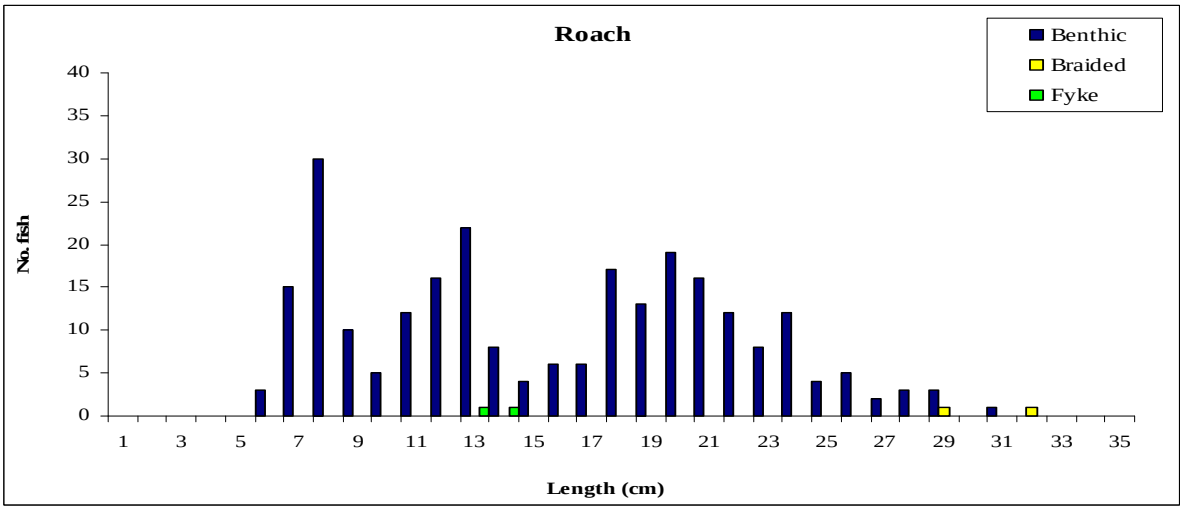

Fig. 1.5. Length frequency of roach captured on Lower Lough Corrib, June 2008

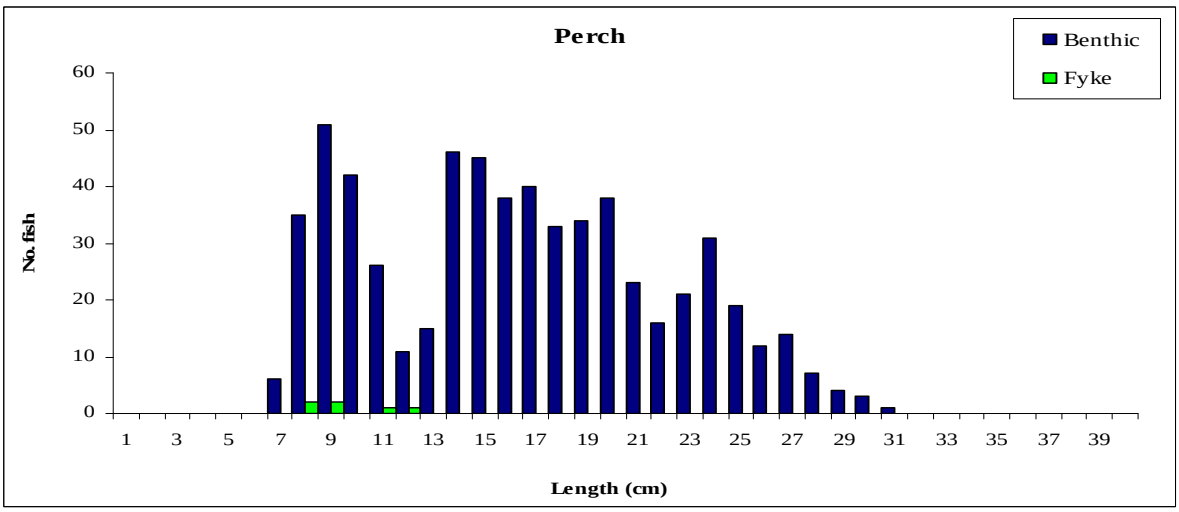

Fig. 1.6. Length frequency of perch captured on Upper Lough Corrib, June 2008

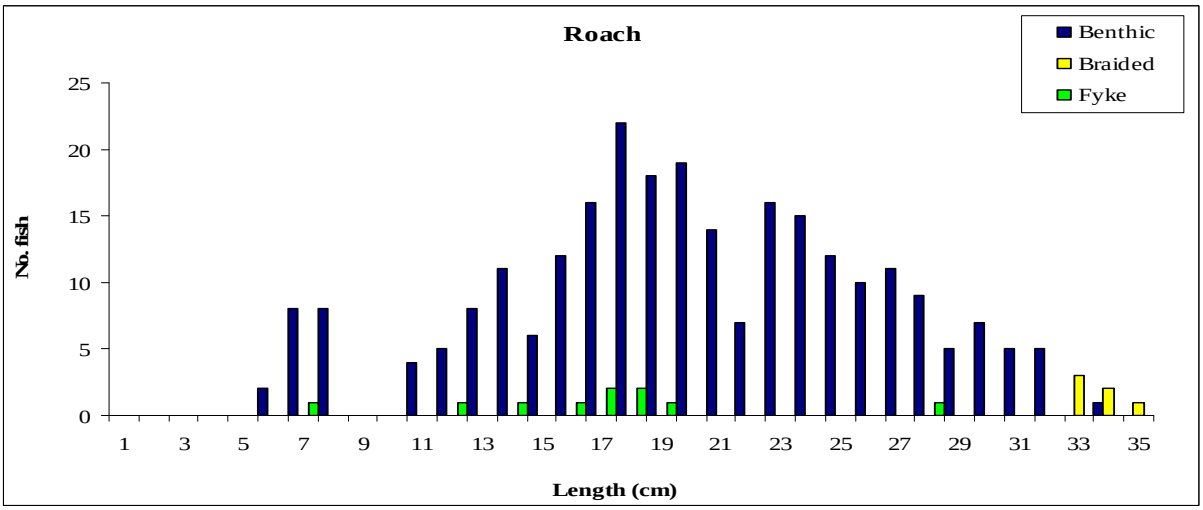

Fig. 1.7. Length frequency of roach captured on Upper Lough Corrib, June 2008

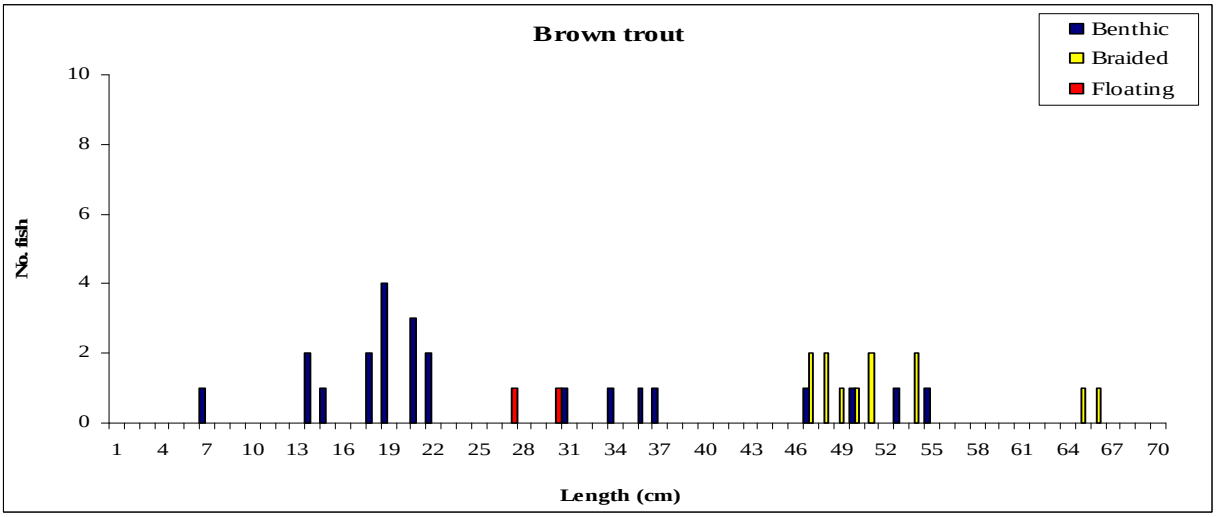

Fig. 1.8. Length frequency of brown trout captured on Upper and Lower Lough Corrib, June 2008

1.3.4 *Fish age and growth*

Perch ranged in age from 0+ to 5+ in Lower Lough Corrib. Mean perch L1 was 6.1cm (Table 1.4). Roach ranged in age from 1+ to 7+. Mean roach L1 was 3.4cm (Table 1.5). Pike ranged from 1+ to 6+. Roach x bream hybrids ranged from 2+ to 6+, while the single bream captured was 12+.

Table 1.4. Mean (and standard deviation) perch length (cm) at age for Lower Lough Corrib, June 2008 (L1=back calculated length at the end of the first winter etc.)

	L_1	L_2	L_3	L_4	L_5
Mean	6.1 (1.06)	11.8 (1.51)	17.4 (1.79)	21.4 (2.93)	26.0 (4.75)
N	83	60	35	21	4
Range	4.5-9.7	9.7-16	14.4-22.6	16.6-26.4	19.6-30.7

Table 1.5. Mean (and standard deviation) roach length (cm) at age for Lower Lough Corrib, June 2008 (L1=back calculated length at the end of the first winter etc.)

	L_1	L_2	L_3	L_4	L_5	L_6	L_7
Mean	3.4 (0.68)	8.1 (1.70)	13.7 (2.77)	18.4 (2.59)	21.1 (2.08)	24.7 (0.60)	28.4
N	114	99	75	45	20	10	1
Range	2-5.8	4.6-11.3	9.1-19.1	13.6-22.8	17.2-25.5	23.8-25.6	-

Perch ranged in age from 0+ to 9+ in Upper Lough Corrib. Mean perch L1 was 5.9cm (Table 1.6). Roach ranged in age from 1+ to 11+. Mean roach L1 was 3.6cm (Table 1.7). Pike ranged in age from 0+ to 5+. The roach x bream hybrids had ages ranging from 2+ to 13+, while the bream ranged from 3+ to 11+.

Table 1.6. Mean (and standard deviation) perch length (cm) at age for Upper Lough Corrib, June 2008 (L1=back calculated length at the end of the first winter etc.)

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9
Mean	5.9 (0.88)	11.3 (1.54)	16.4 (1.78)	19.2 (1.72)	21.1 (1.88)	22.7 (1.74)	24.4 (2.07)	26.1 (2.13)	25.8 (1.47)
N	107	87	61	43	35	29	27	24	6
Range	4-8	8.2-15.6	13.1-20.5	16.2-23.7	17.7-26.6	19.1-26.8	20.5-28.7	21.8-30.2	23.2-27.4

Table 1.7. Mean (and standard deviation) roach length at age for Upper Lough Corrib, June 2008 (L1=back calculated length at the end of the first winter etc.)

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
Mean	3.6 (0.63)	8.1 (1.47)	13.7 (2.12)	18.2 (2.17)	22.1 (2.00)	24.6 (2.12)	27.3 (2.15)	28.6 (2.27)	29.6 (2.70)	30.8	32.4
N	121	110	102	72	47	25	20	13	7	1	1
Range	2.3-5.8	5.2-11.7	9.8-18.3	14.6-22.7	17.3-25.7	19.3-28.1	23.4-30.0	25.1-31.9	26.9-33.8	-	-

Brown trout ranged in age from 1+ to 5+ in Lower Lough Corrib and from 0+ to 5+ in Upper Lough Corrib. Length frequency and age analysis revealed that 2+ and 4+ were the most common age groups, accounting for approximately 29% and 37% of the brown trout recorded respectively. One year old fish accounted for 13% of the brown trout recorded, whilst 11% of the fish were aged at 5+. Mean L4 for brown trout in Lower and Upper Lough Corrib was 41.8cm (Table 1.8), indicating that the growth of trout in the lake is very fast based on the classification of brown trout growth developed by Kennedy and Fitzmaurice (1971).

Table 1.8. Mean (SD) brown trout length (cm) at age for Upper and Lower Lough Corrib, June 2008 (L1=back calculated length at the end of the first winter etc.)

	L_1	L_2	L_3	L_4	L_5
Mean	7.9 (1.3)	16.6 (4.3)	29.7 (6.5)	41.8 (6.2)	52.3 (9.9)
N	33	28	17	15	3
Range	6.1-10.7	11.1-26.3	21.2-39.1	31.2-51.2	43.4-63.0

1.4 Summary

Perch was the dominant fish species in Upper and Lower Lough Corrib, followed by roach. The mean CPUE for perch in Upper and Lower Lough Corrib were similar, with both being lower than the mean perch CPUE when compared to other high alkalinity lakes surveyed in 2008 (Kelly *et al*., 2009). The mean CPUE for roach in Lower Lough Corrib was twice that of Upper Lough Corrib. Both Lower Lough Corrib and Upper Lough Corrib had a low eel CPUE when compared to other high alkalinity lakes surveyed (Kelly *et al*., 2009).

High alkalinity lakes had the lowest brown trout CPUE values among the three alkalinity lake categories surveyed during 2008 (Kelly *et al*., 2009). Among the high alkalinity lakes alone, however, Lower Lough Corrib had the highest brown trout mean CPUE and mean BPUE, followed by Upper Lough Corrib.

Comparisons between the 1996 and 2008 surveys are difficult as the CPUE values are not directly comparable. The net types used were different and there was also a seasonal difference between surveys. The monofilament, multi-mesh survey gill nets (5-55mm mesh) supplemented by single panel braided survey gill nets (62.5mm mesh) and fyke nets used in the recent 2008 survey are designed to capture a range of fish species and sizes and are much more effective at catching small and juvenile fish than the multi-panel braided nets used in 1996. The multi-panel (62.5 to 125mm mesh knot to knot) braided survey gill nets used in 1996 were designed to specifically assess the status of brown trout greater than 19.8cm in length, with few smaller fish being captured. The 1996 survey was conducted in spring, when few juvenile perch would have been captured, compared with the 2008 survey which was conducted during the summer.

However, for comparative purposes, CPUEs for the dominant fish species from the 1996 survey (braided multi-mesh nets, 62.5-125mm mesh size, 96250m^2 total area) and the 2008 survey (monofilament multi-mesh nets, 5-55mm mesh size, 3735m^2 total area) were recalculated as the total number of each species captured/total area of net deployed. These results show large increases in the CPUEs of roach and particularly perch between 1996 and 2008. Although it is likely that the composition of these two species has indeed increased between the two surveys, it must be recognised that a large proportion of the increases seen are likely due to the capture of a much greater proportion of small juveniles of both perch and roach in the 2008 survey compared with the 1996 survey. This is

supported by the length frequency graphs (Figs. 1.4 to 1.7), which show a significant proportion of fish captured in 2008 were <16cm in length. Very few fish of this size were captured in the large mesh sizes used in the 1996 survey. Although the brown trout CPUE approximately doubled between 1996 and 2008, much of this increase may be due to the difference in nets used. This is supported by the length frequency graphs (Figs. 1.4 to 1.7), which show a significant proportion (approx. 25%) of fish captured in 2008 were <20cm in length.

Growth of perch in Upper Lough Corrib was lower than the mean perch growth rate when compared to other high alkalinity lakes surveyed in 2008, e.g. Lough Sheelin and Lough O'Flynn, whilst the perch growth rate in Lower Lough Corrib was higher than the mean growth rate among other high alkalinity lakes surveyed (Kelly *et al*., 2009). The roach had similar growth to other high alkalinity lakes surveyed in 2008, e.g. Annaghmore Lake and Lough Sheelin (Kelly *et al*., 2009). The growth of brown trout was very fast when compared to all other lakes sampled, with the exception of Lough O'Flynn where a high proportion of the brown trout caught were stocked fish (Kelly *et al*., 2009). The oldest brown trout captured on Lough Corrib in the 2008 survey was 5+. The oldest brown trout captured in the 1996 survey was 8+.

In 1996, six fish species and three types of hybrids were recorded (roach, brown trout, pike, perch, rudd, salmon, roach x bream, roach x rudd and rudd x bream). Salmon were not recorded in the 2008 survey; however, this is not entirely unexpected due to the transient nature of the salmon life cycle. Three-spined stickleback were recorded in 2008, along with bream, both of which were not recorded in 1996. The main notable change in species presence/absence, however, is the loss of rudd and rudd hybrids. It is likely that with the increase in abundance of roach, rudd have been displaced through hybridization and competition for resources.

Arctic char have historically existed in Lough Corrib; however none were recorded in the 2008 survey or in the previous 1996 survey. The last reports of char in the lake came from anglers in the 1980's (O' Grady, 1996). It is most likely that char became extinct between the late 1980's and early 1990's due to a moderate increase in trophic status observed in the lake (O' Grady, 1996) as it is known that char are sensitive to changes in water quality (Baroudy, 1995).

Future WFD monitoring surveys will provide further information on the stability of the fish species in the lake. It is recommended that brown trout populations should be closely monitored on both the Upper and Lower Loughs in order to continue providing information to aid in the effective management of this valuable resource.

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 new WFD multimetric fish classification tool has been developed for the island of Ireland

(Ecoregion 1) using Agri-Food and Biosciences Institute Northern Ireland (AFBINI) and CFB data (Kelly *et al*., 2008). Using this tool and expert opinion Lough Corrib has been assigned a draft classification of moderate status for fish. The EPA has assigned an overall classification of good status to Lough Corrib in an interim draft classification. This is based on physico-chemical parameters and biotic elements such as macroinvertebrates and macrophytes.

1.5 References

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The Central Fisheries Board
Swords Business Campus,
Swords,
Co. Dublin,
Ireland.

Web: www.wfdfish.ie
www.cfb.ie
Email: info@cfb.ie
Tel: +353 1 8842600
Fax: +353 1 8360060

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