Sampling Fish for the Water Framework Directive

Lakes 2012

Lough Derg

Iascach Intíre Éireann
Inland Fisheries Ireland

Water Framework Directive Fish Stock Survey of Lough Derg, June 2012

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Cover photo: Netting survey on Dromore Lough © Inland Fisheries Ireland

ACKNOWLEDGEMENTS

1.1 Introduction

Lough Derg is the third largest lake in Ireland and the largest and most southerly lake on the Shannon system, stretching for 40km from Portumna, Co. Galway in the north to Killaloe, Co. Clare and Ballina, Co. Tipperary in the south (Plate 1.1, Fig. 1.1). It is a long, relatively narrow lake, bordered by counties Tipperary, Galway and Clare.

Lough Derg is a mixed fishery, with salmon, trout, pollan, coarse fish and pike present (O'Reilly, 2007). It is a very popular fishing destination, especially during mayfly season, when average trout weights are close to 1kg and fish up to 5kg can be taken (O'Reilly, 2007).

The lake is categorised as typology class 12 (as designated by the EPA for the purposes of the Water Framework Directive), i.e. deep (>4m), greater than 50ha and high alkalinity (>100mg/l CaCO3). The surface area of the lake is approximately 13,000ha. It is relatively shallow towards the northern end with depths averaging 6m (NPWS, 2004); however it narrows towards the southern end with depths reaching up to 36m. Water levels are regulated by the Electricity Supply Board due to the presence of Ireland's largest hydroelectric power station, Ardnacrusha, which is located at the end of a purpose built channel (the head-race canal) connected to the River Shannon, approximately 8km below the southern end of the lake. The northern end of the lake is bordered by relatively flat, agricultural land, while the lower reaches of the lake are bordered by the Slieve Aughty Mountains in the west and the Arra Mountains in the east.

In the early 1990's Lough Derg was classified as highly eutrophic and in 1997 the presence of zebra mussel was confirmed in the lower lough (Minchin *et al.,* 2002). This confirmation of the plankton feeding zebra mussel coincided with a significant increase in water clarity (NPWS, 2004).

The north-eastern shore of Lough Derg has been designated as a Special Area of Conservation, with six habitats listed on Annex I of the E.U. Habitats Directive. Four of these habitats are regarded as priority habitats - *Cladium* fen, alluvial woodland, limestone pavement and yew woodland (NPWS 2003). The lake itself is a Special Protection Area that supports important numbers of wintering wildfowl (NPWS, 2003). Lough Derg is also of conservation interest for the fish and freshwater invertebrate species present. The lake contains a landlocked population of sea lamprey (*Petromyzon marinus*) and all three species of lamprey are present in the Lower River Shannon catchment. The fish species, pollan (*Coregonus autumnalis*), which is listed on Annex V of the EU Habitats Directive is present in Lough Derg; one of only five sites in Ireland (RoI and NI) where it is known to occur (Lough Neagh, Lower Lough Erne, Lough Ree and Lough Derg and Lough Allen) (NPWS, 2004; Harrison *et al*., 2010).

The lake was previously surveyed in June/July 2009 by Inland Fisheries Ireland 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. Roach, roach x bream hybrids, bream, brown trout, tench, pike and eels were also captured during the survey.

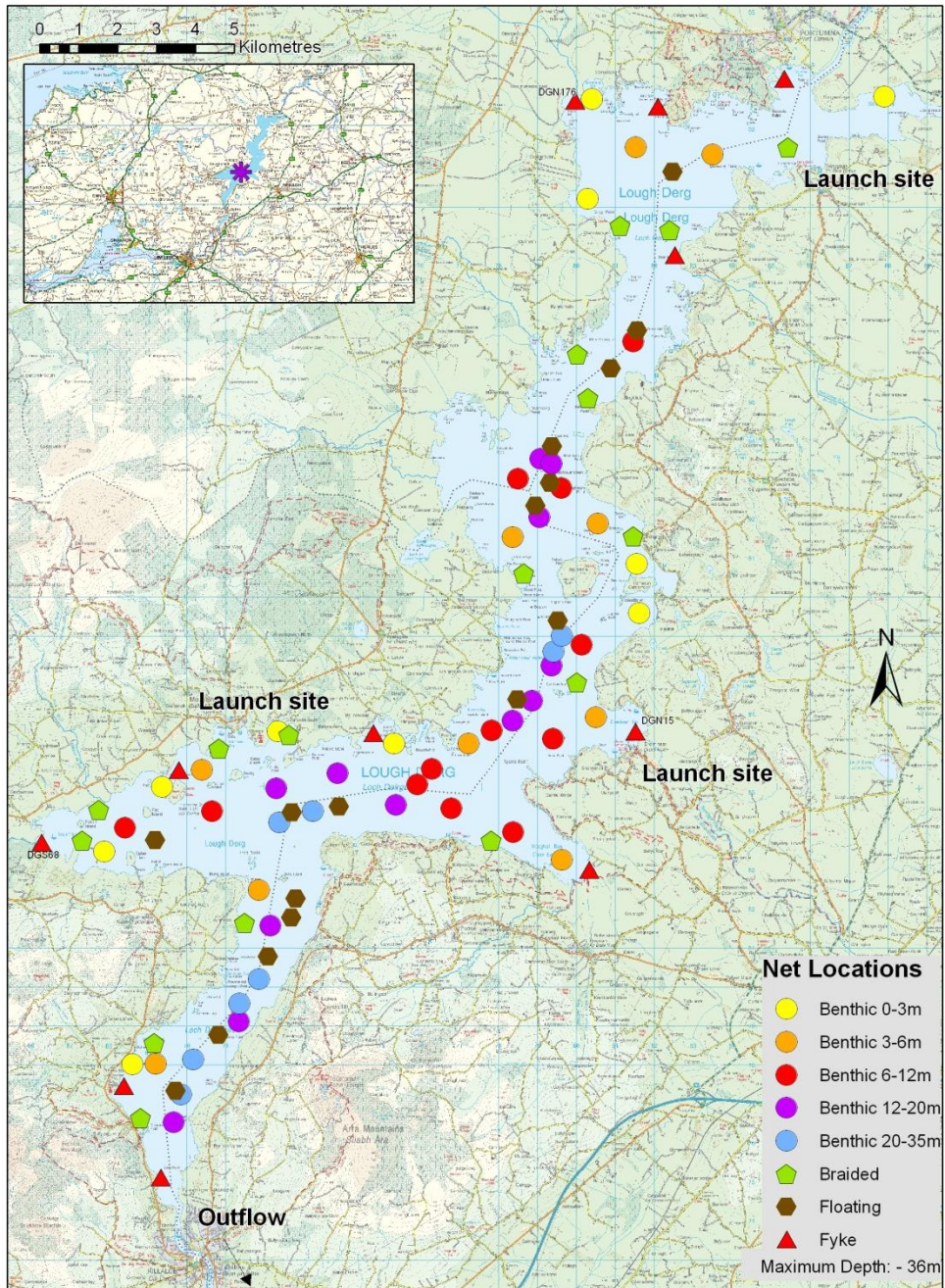**Plate 1.1. Lough Derg between Tuamgraney and Twomilegate (Co. Clare)**

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

1.2 Methods

Lough Derg was surveyed over six nights between the 18th to the 28th of June 2012. A total of 12 sets of Dutch fyke nets, 52 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (10 @ 0-2.9m, 10 @ 3-5.9m, 12 @ 6-11.9m, 12 @ 12-19.9m and 8 @ 20-34.9m) and 16 surface monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed randomly in the lake (80 sites). The netting effort was supplemented using 16 benthic braided survey gill nets (62.5mm mesh knot to knot) at 16 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. A further four pelagic multi-mesh (12 panel, 6.25-55mm mesh size) CEN standard survey gill nets were set in areas where it was thought pollan were most likely to occur from hydroacoustic evidence.

All fish apart from perch were measured and weighed on site and scales were removed from all pollan, trout, roach, bream, hybrids 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 seven fish species and one type of hybrid were recorded on Lough Derg in June 2012, with 985 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 roach, roach x bream hybrids, brown trout, pike, bream, eels and pollan. During the previous survey in 2009 the same species composition was recorded with the exception of pollan, which were present during the 2012 survey but were not captured in 2009 and tench, which were present during the 2009 survey but were not captured in 2012 (Kelly *et al.*, 2010).

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

Scientific name	Common name	Number of fish captured					
		Benthic mono multimesh gill nets	Surface mono multimesh gill nets	Pelagic mono multimesh gill nets	Benthic braided gill nets	Fyke nets	Total
Salmo trutta	Brown trout	9	17	0	3	0	29
Coregonus autumnalis	Pollan	0	0	2	0	0	2
Perca fluviatilis	Perch	519	1	2	2	8	532
Rutilus rutilus	Roach	173	9	0	16	4	202
Rutilus rutilus x Abramis brama	Roach x bream hybrid	52	0	0	75	1	128
Esox lucius	Pike	4	0	0	9	0	13
Abramis brama	Bream	0	0	0	1	0	1
Anguilla anguilla	European eel	3	0	0	0	75	78

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 higher 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 and BPUE between Lough Derg and six similar lakes was assessed, with overall significant differences being found (Kruskal-Wallis, $P<0.05$) (Fig. 1.4 and Fig. 1.5). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Derg had a significantly lower mean brown trout CPUE and BPUE than Lough Carra ($z = 2.05$, $P<0.05$ and $z = 2.218$, $P<0.05$).

Although the mean perch CPUE and BPUE also appeared slightly higher in 2012 than in 2009, these differences were not statistically significant (Fig. 1.2 and Fig. 1.3).

The differences in the mean perch CPUE and BPUE between Lough Derg and six similar lakes was assessed, with overall significant differences 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 Derg had a

significantly higher mean perch CPUE and BPUE than Lough Mask Lough (z = 2.351, P<0.05 and z = 2.679, P<0.05) and a significantly lower mean perch CPUE than Inchicronan Lough (z = 1.78, P<0.05).

The mean roach CPUE and BPUE appeared lower in 2012 than in 2009, however these differences were not statistically significant (Fig. 1.2 and Fig. 1.3).

The differences in the mean roach CPUE and BPUE between Lough Derg and three similar lakes was assessed, with overall significant differences being found (Kruskal-Wallis, P<0.05) (Fig. 1.8 and Fig. 1.9). Independent-Samples Mann-Whitney U tests between each lake showed that Lough Derg had a significantly lower mean roach CPUE than Lough Cullin (z = 3.306, P<0.05) and Lough Arrow (z = 3.505, P<0.05) and significantly higher mean roach CPUE than Lough Mask (z = 2.118, P<0.05).

Independent-Samples Mann-Whitney U tests between each lake showed that Lough Derg had a significantly lower mean roach BPUE than Lough Cullin (z = 2.845, P<0.05) and significantly higher mean roach BPUE than Lough Mask (z = 2.022, P<0.05) and Lough Arrow (z = 3.562, P<0.05).

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

Scientific name	Common name	2009	2012
		Mean CPUE	
Salmo trutta	Brown trout	0.009 (0.002)	0.010 (0.002)
Coregonus autumnalis	Pollan	-	0.0002 (0.0001)
Perca fluviatilis	Perch	0.174 (0.030)	0.176 (0.029)
Rutilus rutilus	Roach	0.081 (0.017)	0.067 (0.014)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.092 (0.020)	0.045 (0.009)
Esox lucius	Pike	0.002 (0.001)	0.005 (0.002)
Abramis brama	Bream	0.013 (0.006)	0.0004 (0.0004)
Tinca tinca	Tench	0.0004 (0.0004)	-
Anguilla anguilla	European eel	0.171 (0.024)	0.104 (0.027)
		Mean BPUE	
Salmo trutta	Brown trout	2.559 (0.793)	4.262 (1.608)
Coregonus autumnalis	Pollan	-	0.007 (0.007)
Perca fluviatilis	Perch	11.954 (2.524)	21.731 (4.055)
Rutilus rutilus	Roach	24.194 (4.369)	20.243 (3.704)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	75.903 (18.114)	43.633 (9.062)
Esox lucius	Pike	1.175 (0.865)	14.222 (5.998)
Abramis brama	Bream	6.626 (2.934)	0.356 (0.356)
Tinca tinca	Tench	0.183 (0.183)	-
Anguilla anguilla	European eel	31.860 (5.613)	24.111 (7.810)

* On the rare occasion where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species.
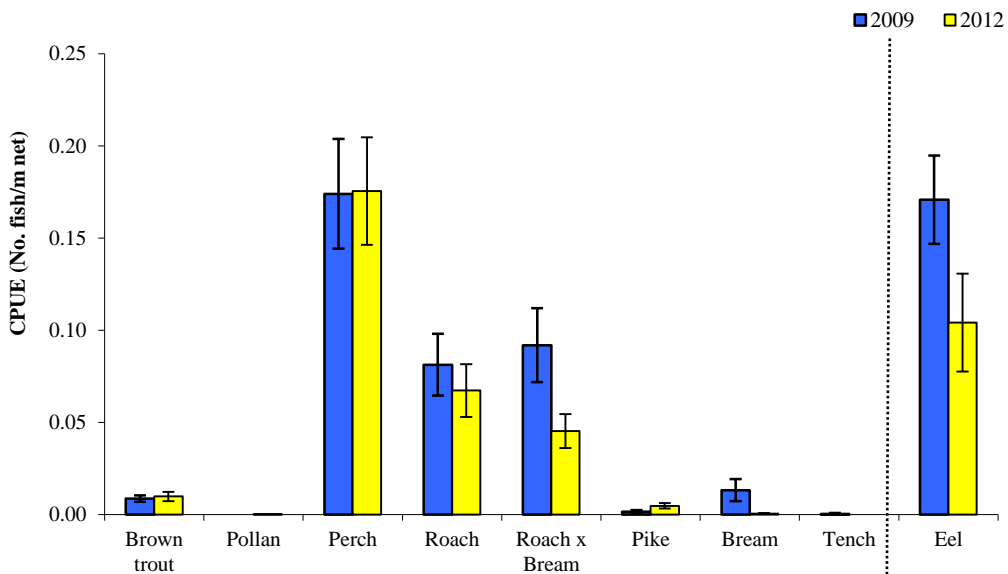
Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Derg (Eel CPUE based on fyke nets only), 2009 and 2012
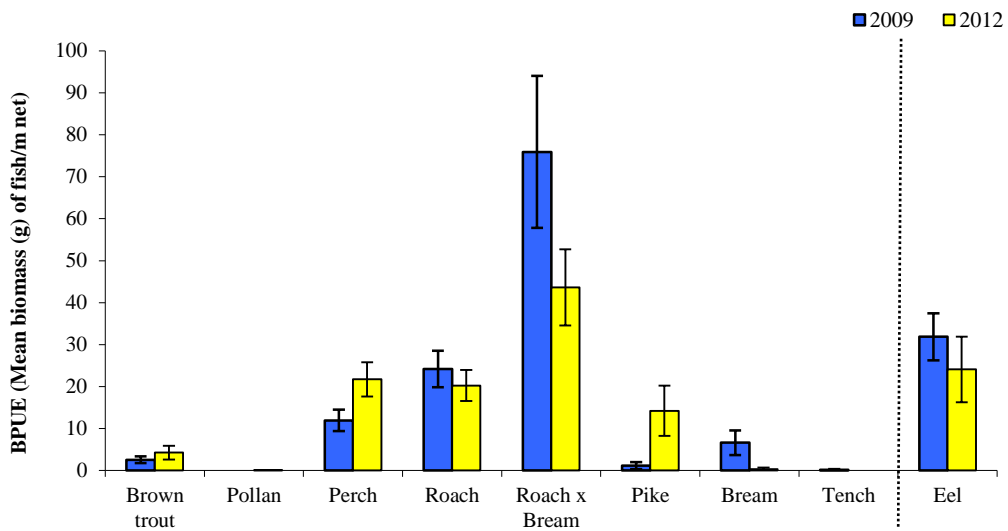

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Derg (Eel BPUE based on fyke nets only), 2009 and 2012
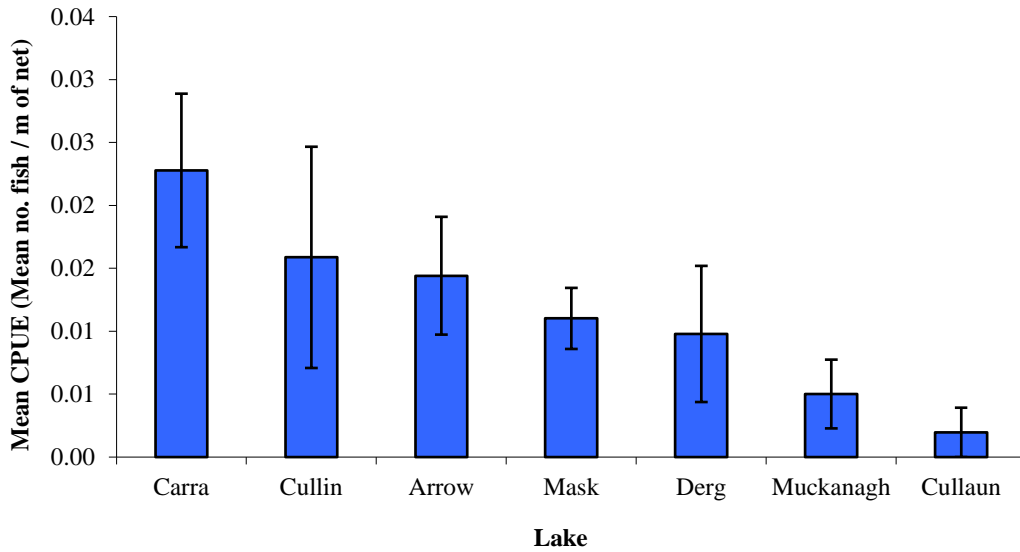
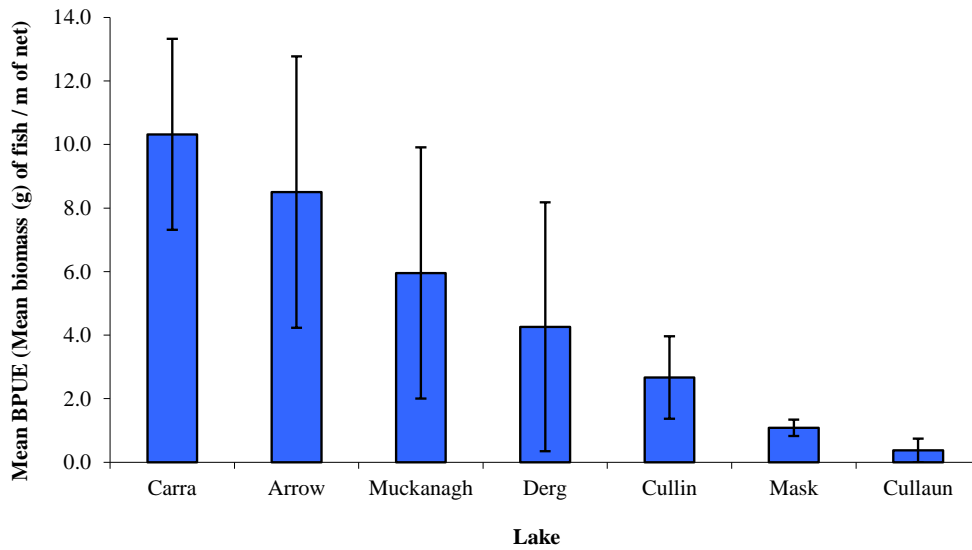**Fig. 1.4. Mean (±S.E.) brown trout CPUE in seven lakes surveyed during 2012**

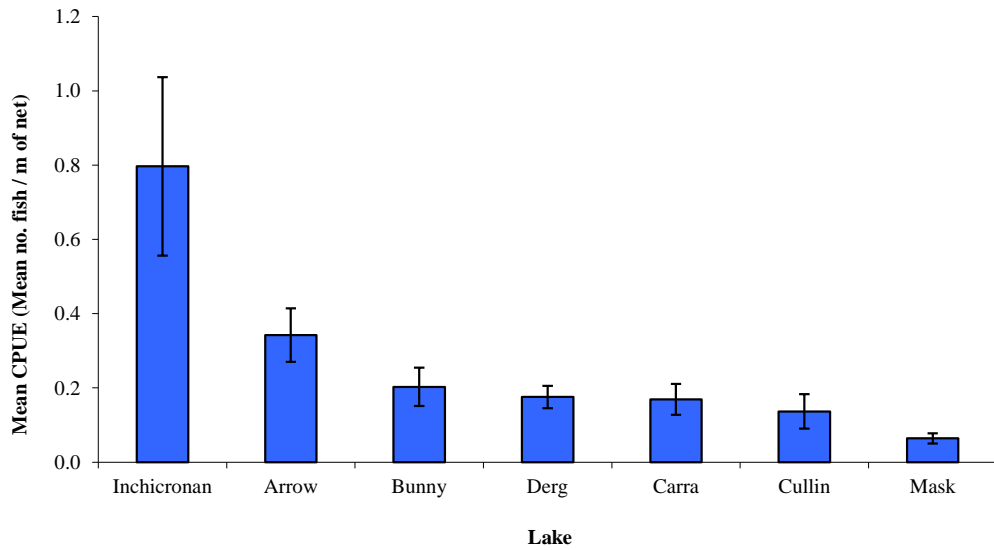**Fig. 1.5. Mean (±S.E.) brown trout BPUE in seven lakes surveyed during 2012**

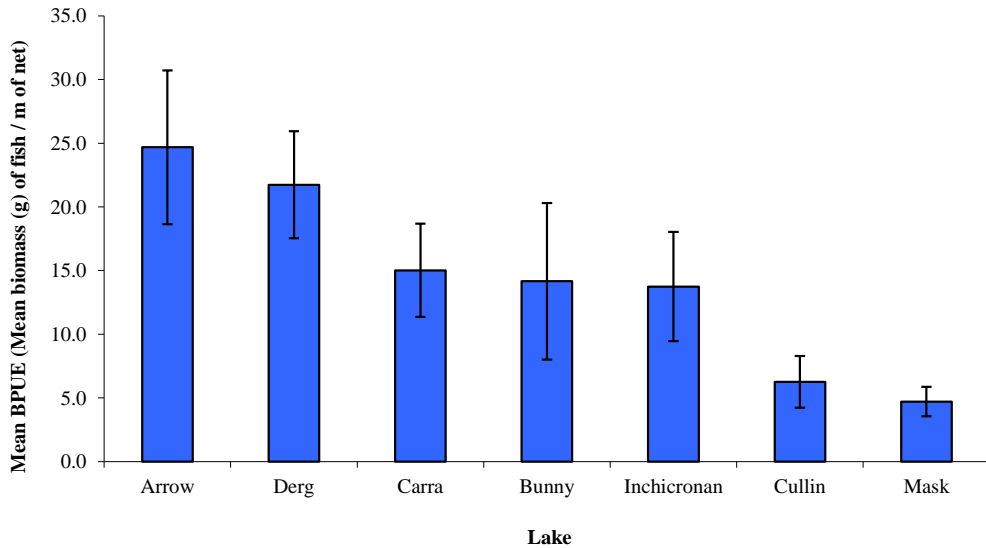**Fig. 1.6. Mean (±S.E.) perch CPUE in seven lakes surveyed during 2012**

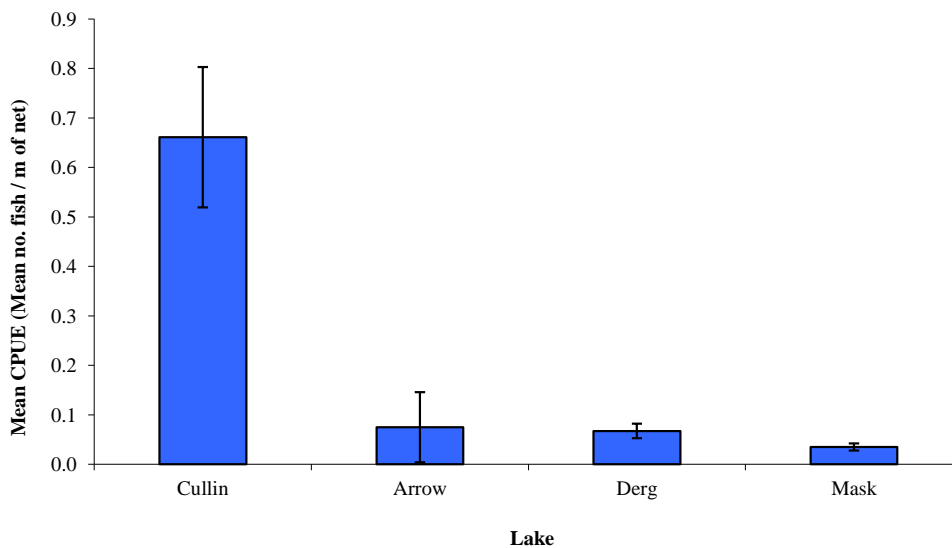**Fig. 1.7. Mean (±S.E.) perch BPUE in seven lakes surveyed during 2012**

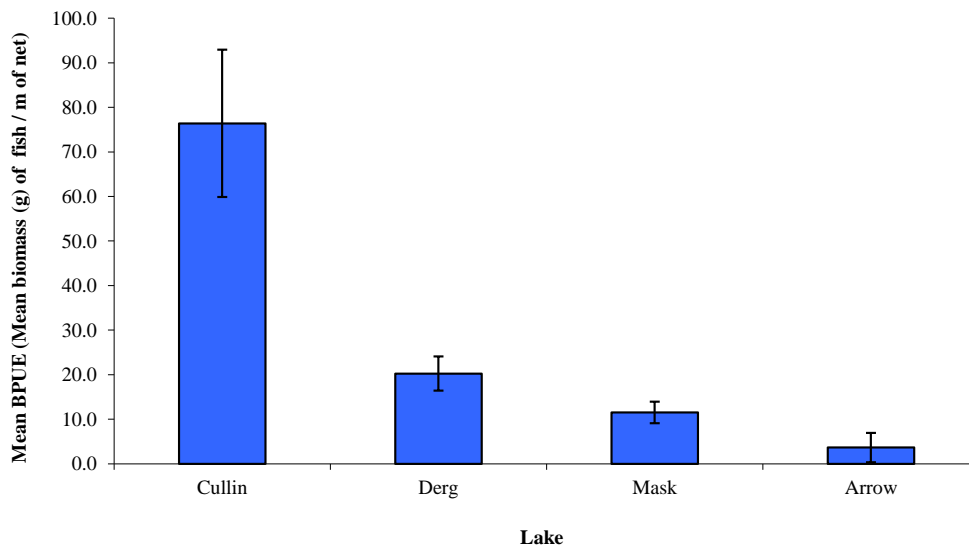**Fig. 1.8. Mean (±S.E.) roach CPUE in four lakes surveyed during 2012**

Fig. 1.9. Mean (±S.E.) roach BPUE in four lakes surveyed during 2012

1.3.3 Length frequency distributions

Brown trout captured during the 2012 survey ranged in length from 15.0cm to 58.3cm (mean = 28.1cm) (Fig. 1.6). Brown trout captured during the 2009 survey ranged in length from 17.1cm to 49.2cm (Fig. 1.6).

Perch captured during the 2012 survey ranged in length from 3.5cm to 33.8cm (mean = 18.9cm) (Fig. 1.7). Perch captured during the 2009 survey ranged in length from 3.2cm to 31.0cm (Fig. 1.7).

Roach captured during the 2012 survey ranged in length from 6.5cm to 35.0cm (mean = 22.6cm) (Fig. 1.8). Roach captured during the 2009 survey had lengths ranging from 6.0cm to 36.1cm (Fig. 1.8).

Eels captured during the 2012 survey ranged in length from 32.3cm to 100.3cm, pike ranged in length from 38.5cm to 83.0cm and roach x bream hybrids ranged in length from 12.5cm to 41.6cm. One bream was recorded at 37.6cm and two pollan were measured at 6.9cm and 19.0cm.
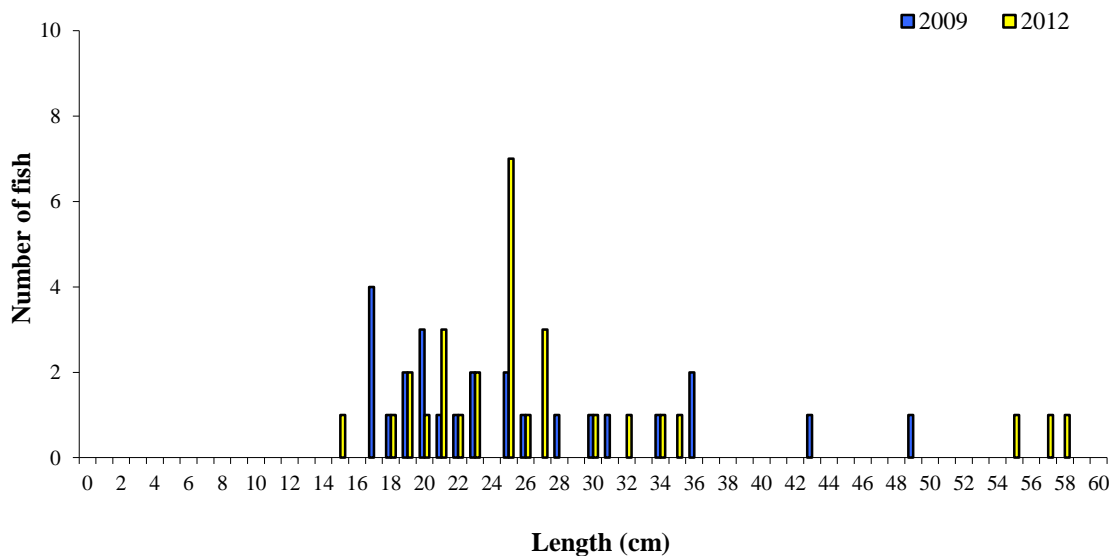

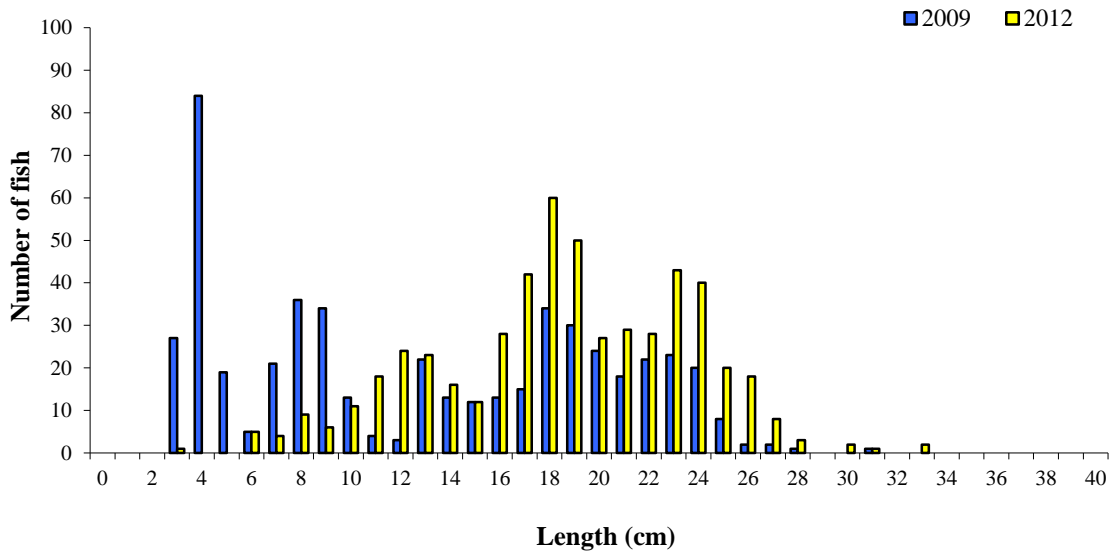**Fig. 1.6. Length frequency of brown trout captured on Lough Derg, 2009 and 2012**

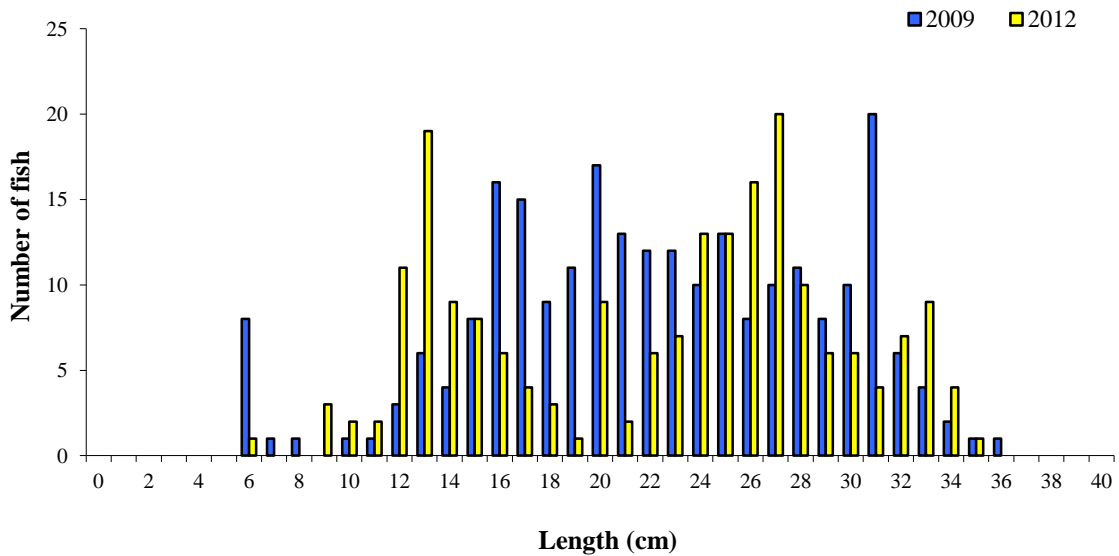**Fig. 1.7. Length frequency of perch captured on Lough Derg, 2009 and 2012**

Fig. 1.8. Length frequency of roach captured on Lough Derg, 2009 and 2012

1.3.4 Fish age and growth

Five age classes of brown trout were present, ranging from 2+ to 7+, with a mean L1 of 7.2cm (Table 1.3). In the 2009 survey, brown trout ranged from 1+ to 5+ with a mean L1 of 7.4cm. Mean brown trout L4 in 2012 was 40.1cm indicating a very fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

Nine age classes of perch were present, ranging from 1+ to 13+, with a mean L1 of 6.6cm (Table 1.4). The dominant age class was 3+ (Fig. 1.7). In the 2009 survey, perch ranged from 0+ to 11+ with a mean L1 of 6.0cm.

Eleven age classes of roach were present, ranging from 1+ to 11+, with a mean L1 of 2.4cm (Table 1.5). In the 2009 survey, roach ranged from 1+ to 14+ with a mean L1 of 3.5cm.

Two age classes of pollan were present, ranging from 0+ to 1+.

Table 1.3. Mean (±SE) brown trout length (cm) at age for Lough Derg, June 2012

	L_1	L_2	L_3	L_4	L_5	L_6	L_7
Mean	7.2 (0.4)	16.7 (0.9)	24.8 (2.1)	40.1 (3.9)	48.1 (5.2)	52.2 (3.6)	54.5
N	26	26	11	4	2	2	1
Range	4.1-10.6	9.4-30.2	17.6-42.4	31.6-48.4	42.9-53.3	48.9-56.1	54.5-54.5

Table 1.4. Mean (±SE) perch length (cm) at age for Lough Derg, June 2012

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}	L_{13}
Mean	6.6 (0.1)	12.2 (0.2)	17.6 (0.2)	21.1 (0.3)	23.7 (0.3)	25.3 (0.4)	26.7 (1.1)	29.5 (1.7)	26.9	27.9	29.0	30.0	30.2
N	112	94	67	43	35	29	7	3	1	1	1	1	1
Range	4.1-9.2	8.5-15.8	12.5-21.5	17.6-25.5	20.0-27.2	21.7-28.5	23.0-30.0	26.1-31.7	26.9-26.9	27.9-27.9	29.0-29.0	30.0-30.0	30.2-30.2

Table 1.5. Mean (±SE) roach length (cm) at age for Lough Derg, June 2012

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
Mean	2.4 (0.1)	6.7 (0.2)	12.1 (0.3)	16.7 (0.3)	20.8 (0.3)	23.9 (0.3)	26.8 (0.3)	28.8 (0.4)	30.1 (0.5)	30.9 (0.2)	32.6 (0.3)
N	106	105	101	73	67	60	38	22	16	10	6
Range	1.6-4.3	3.2-10.6	6.8-17.8	11.7-22.9	14.7-26.9	17.4-27.9	22.1-29.7	25.3-31.5	27.2-33.0	29.7-31.9	31.6-33.5

1.4 Summary

Perch was the dominant species in terms of abundance (CPUE) and roach x bream hybrids were the dominant species in terms of biomass (BPUE) captured in the survey gill nets.

Although the mean brown trout CPUE and BPUE in Lough Derg was slightly higher in 2012 than in the 2009 survey, these differences were not statistically significant. The mean brown trout CPUE and BPUE in Lough Derg was significantly lower than Lough Carra, another similar lake surveyed. Brown trout ranged in age from 2+ to 7+, indicating reproductive success in five of the previous eight years. Length at age analyses revealed that brown trout in the lake exhibit a very fast rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971).

The mean perch CPUE and BPUE in Lough Derg was slightly higher in 2012 than in the 2009 survey, however these differences were not statistically significant. The mean perch CPUE and BPUE in Lough Derg was significantly higher than Lough Mask, another similar lake surveyed. Also the mean perch CPUE in Lough Derg was significantly lower than Inchicronan Lough, another similar lake surveyed. Perch ranged in age from 1+ to 13+, indicating reproductive success in nine of the previous fourteen years. The dominant age class was 3+.

Although the mean roach CPUE and BPUE in Lough Derg was slightly lower in 2012 than in the 2009 survey, these differences were not statistically significant. The mean roach CPUE in Lough Derg was significantly lower than Lough Cullin and Lough Arrow and significantly higher than Lough Mask, other similar lakes surveyed. The mean roach BPUE in Lough Derg was significantly lower than Lough Cullin and significantly higher than Lough Mask and Lough Arrow. Roach ranged in age from 1+ to 11+, indicating reproductive success in eleven of the previous twelve 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 Derg has been assigned an ecological status of Poor based on the fish

populations present in 2012. The ecological status assigned to the lake based on the 2009 survey data was also Poor.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lough Derg an overall ecological status of Poor, 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

Harrison, A.J., Kelly, F.L., Rosell, R.S., Champ, T.W.S., Connor, L. and Girvan, J.R. (2010) First record and initial hydroacoustic stock assessment of pollan *Coregonus autumnalis* Pallas in Lough Allen, Ireland. *Biology and Environment: Proceedings of the Royal Irish Academy*, **110**B, 69-74.

Kelly, F.L., Harrison, A., Connor, L., Allen, M., Rosell, R. and Champ, T. (2008) *FISH IN LAKES Task 6.9: Classification tool for Fish in Lakes. FINAL REPORT*. Central Fisheries Board, NS Share project.

Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., O'Callaghan, R., Wogerbauer, C., Feeney, R., Hanna, G. and Rocks, K. (2010) *Sampling Fish for the Water Framework Directive – Summary Report 2009*. The Central and Regional Fisheries Boards.

Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012) Development and application of an ecological classification tool for fish in lakes in Ireland. *Ecological Indicators*, **18**, 608-619.

Kennedy, M. and Fitzmaurice, P. (1971) Growth and Food of Brown Trout *Salmo Trutta* (L.) in Irish Waters. *Proceedings of the Royal Irish Academy,* **71 (B) (18),** 269-352.

Minchin D., Lucy F., and Sullivan M. (2002) *Monitoring of zebra mussels in the Shannon-Boyle navigation, other navigable regions and principal Irish lakes, 2000 & 2001*. Marine Institute, Abbotstown, Dublin 15. ISSN: 1649-0053

NPWS (2003) *Site Synopsis: Lough Derg, North East Shore. Site Code: 002241*. Site Synopsis report, National Parks and Wildlife Service.

NPWS (2004) *Site Synopsis: Lough Derg (Shannon) SPA. Site Code: 004058*. Site Synopsis report, National Parks and Wildlife Service.

O' Reilly P (2007) *Loughs of Ireland. A Flyfisher's Guide. 4th edition*. Merlin Unwin Books.

ShIRBD (2009) http://www.shannon-fishery-board.ie/catchment/native-fish.htm