

Lough Arrow



Sampling Fish for the Water Framework Directive - Lakes 2009



The Central and Regional
Fisheries Boards

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1.1 Introduction

Lough Arrow (Plate 1.1, Fig. 1.1) is a large limestone lake situated in Co. Sligo, approximately 24km south-east of Sligo town and 6.4km north-west of Boyle, Co. Roscommon. The lake is sheltered on three sides by hills and is the source of the Unshin River. It has a small catchment fed largely by springs on the lake bed and as such is hydrologically different from most lakes in Ireland (Roscommon County Council, 2009). Lough Arrow has a surface area of 1266ha, with a mean depth of 9m and a maximum depth of 33m. 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).

Lough Arrow is of major conservation significance as it conforms to a type (hard water lake) listed in Annex I of the EU Habitats Directive. It also supports a number of important bird species and a population of otter (a Red Data Book species which is legally protected under the 1976 Wildlife Act and is listed on Annex II of the EU Habitats Directive) (NPWS, 1999). The shores of the lake are, for the most part, stony, although the common club-rush (*Scirpus lacustris*) and common reed (*Phragmites australis*) occur abundantly in several bays (NPWS, 1999). Two comprehensive surveys of submerged vegetation in the lake were undertaken in 1984 and 2001, during which the open water aquatic flora was found to be dominated by species of *Chara*, *Potamogeton* and *Elodea canadensis*, whilst the shallow (<0.5m) areas commonly contained *Littorella* sp., *Potamogeton filiformis* and *Myriophyllum alterniflorum* (King, 2002).



Plate 1.1. Lough Arrow, looking west over the lake (Photo courtesy of CFB and No. 3 Operational Wing, Irish Air Corps [Aer Chór na hÉireann])

Lough Arrow is an important game fishery, managed by the North Western Regional Fisheries Board, with good stocks of brown trout and eels. The lake was once stocked with brown trout but this practice has now been discontinued (O'Reilly, 2007). Wild brown trout average 0.45kg in weight, with fish up to 2.7kg having been taken on the fly. The lake has previously been surveyed by the Central Fisheries Board (CFB) and the North Western Regional Fisheries Board (NWRFB) in 1979, 1980 (O'Grady, 1986), 1994, 2002 (O'Grady and Delanty, 2003) and 2007 (O'Grady and Delanty, 2007). In 1994, only perch, pike and brown trout were recorded, although three-spined stickleback were also recorded in the stomachs of pike. Rudd were encountered for the first time in 2002 and were captured again in the 2007 survey. Lough Arrow has been included in the CFB's long term water quality monitoring programme of lake ecosystems since 1975. A fisheries enhancement programme to increase spawning and nursery area for trout was initiated in the Lough Arrow catchment over the period 1998 to 2000 involving re-creation of pools and a natural meander pattern, fencing of streams from livestock and placing of additional spawning gravels in streams where appropriate (O'Grady, 2004).

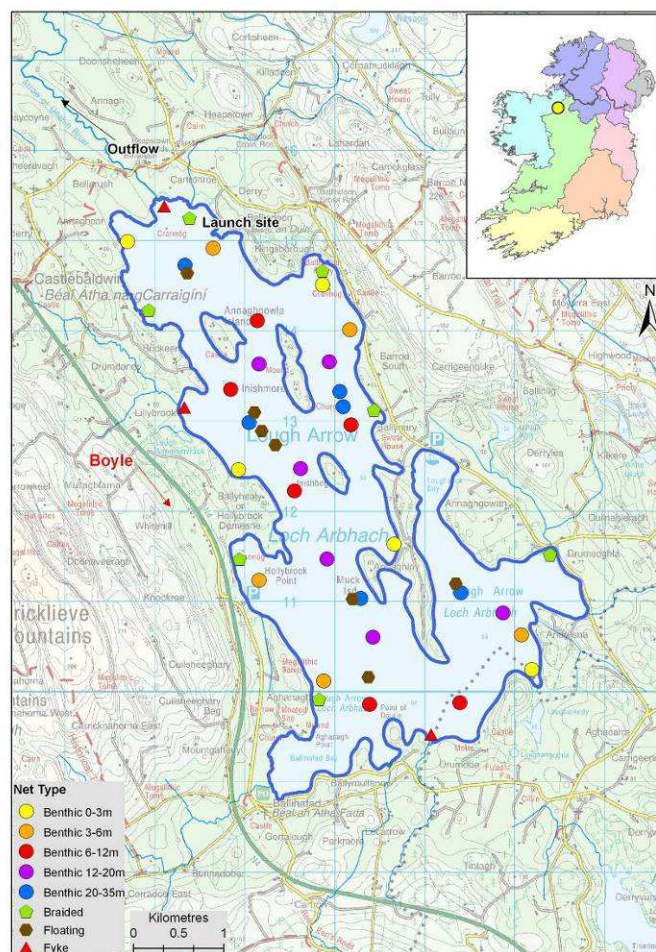


Fig. 1.1. Location map of Lough Arrow showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

Lough Arrow was surveyed over four nights from the 20th to the 24th of July 2009. 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 (5 @ 0-2.9m, 5 @ 3-5.9m, 6 @ 6-11.9m, 6 @ 12-19.9 and 6 @ 20-34.9m) and seven surface floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed randomly in the lake (38 sites). The netting effort was supplemented using seven benthic braided survey gill nets (62.5mm mesh knot to knot) at seven additional sites. Survey locations were randomly selected within each depth zone using a grid placed over a map of the lake. 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 trout, pike and roach. 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 eight fish species were recorded on Lough Arrow in July 2009, with 836 fish being captured (Table 1.1). Perch was by far the most abundant fish species recorded. Small numbers of brown trout were captured in the gill nets. Eels were captured in fyke nets only.

Table 1.1. List of fish species recorded (including numbers captured) during the survey on Lough Arrow, July 2009

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>Perca fluviatilis</i>	Perch	732	1	5	0	738
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	27	0	0	22	49
<i>Salmo trutta</i>	Brown trout	6	5	11	0	20
<i>Scardinius erythrophthalmus</i>	Rudd	18	2	0	0	20
<i>Abramis brama</i>	Bream	2	0	0	0	2
<i>Rutilus rutilus</i>	Roach	1	0	0	0	1
<i>Esox lucius</i>	Pike	0	1	0	0	1
<i>Anguilla anguilla</i>	European eel	0	0	0	5	5

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 are summarised in Table 1.2. The differences in mean brown trout CPUE and mean perch CPUE between Lough Arrow and four other similar lakes were assessed and no significant differences were found (Fig. 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE of all fish species captured on Lough Arrow, July 2009

Scientific name	Common name	
		Mean CPUE
<i>Perca fluviatilis</i>	Perch	0.547 (0.168)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.028 (0.018)
<i>Salmo trutta</i>	Brown trout	0.015 (0.005)
<i>Scardinius erythrophthalmus</i>	Rudd	0.015 (0.013)
<i>Abramis brama</i>	Bream	0.001 (0.001)
<i>Rutilus rutilus</i>	Roach	0.001 (0.001)
<i>Esox lucius</i>	Pike	0.001 (0.001)
<i>Anghuilla anguilla</i>	European eel	0.028 (0.020)
		Mean BPUE
<i>Perca fluviatilis</i>	Perch	16.090 (5.032)
<i>Salmo trutta</i>	Brown trout	11.616 (4.259)
<i>Scardinius erythrophthalmus</i>	Rudd	4.018 (3.090)
<i>Esox lucius</i>	Pike	2.008 (2.008)
<i>Abramis brama</i>	Bream	0.286 (0.286)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.026 (0.018)
<i>Rutilus rutilus</i>	Roach	0.024 (0.024)
<i>Anghuilla anguilla</i>	European eel	6.156 (3.813)

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

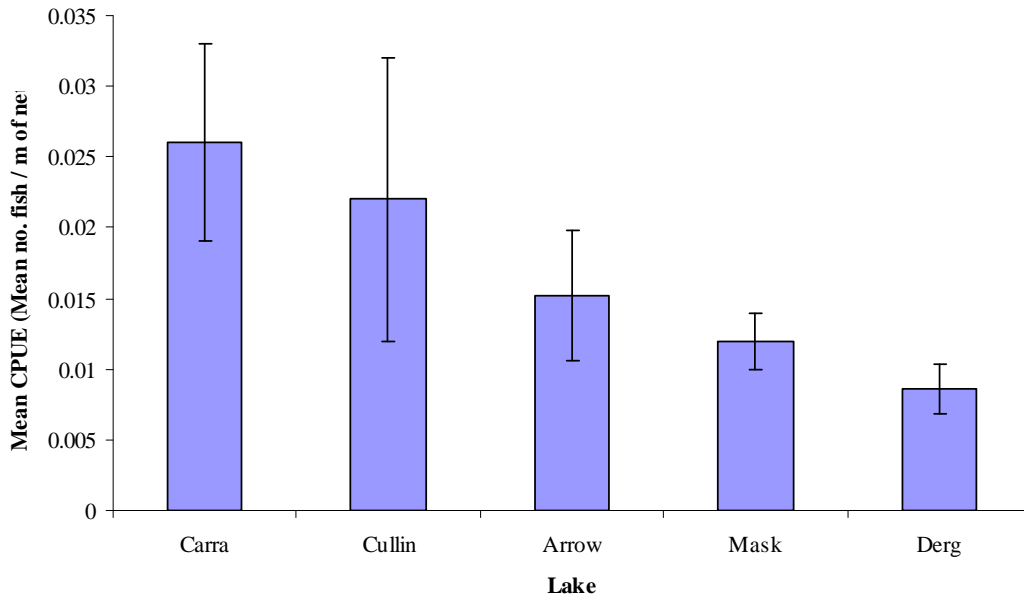


Fig. 1.2. Mean (\pm S.E.) brown trout CPUE in five lakes surveyed during 2009

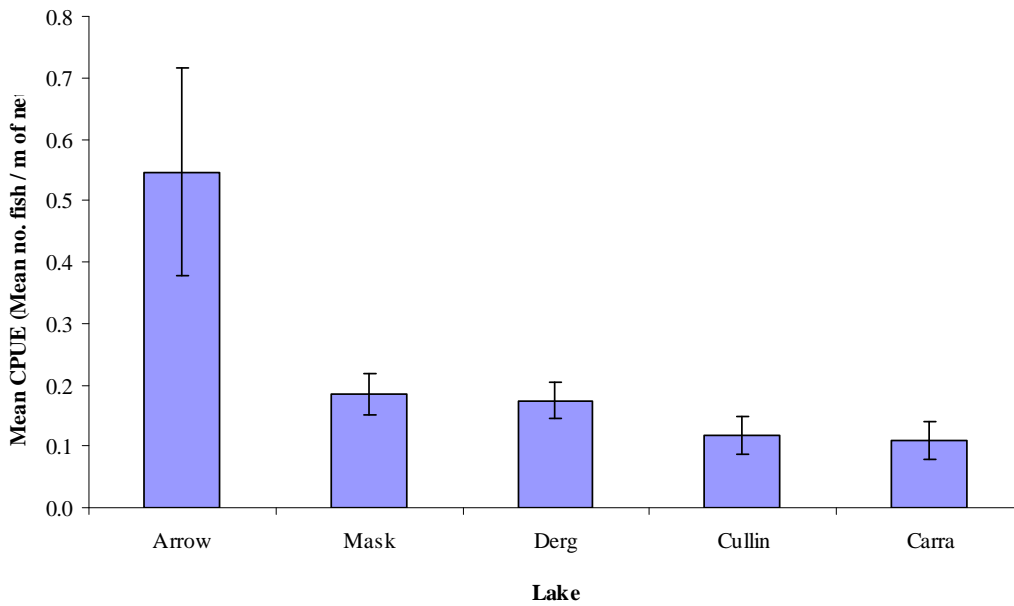


Fig. 1.3. Mean (\pm S.E.) perch CPUE in five lakes surveyed during 2009

1.3.3 Length frequency distributions

Perch ranged in length from 3.5cm to 30.9cm (mean = 7.8cm) (Fig.1.4). Brown trout ranged in length from 17.5cm to 59.0cm (mean = 33.0cm) (Fig. 1.5). Three-spined stickleback ranged in length from 2.1cm to 4.9cm. Rudd ranged in length from 13.4cm to 32.6cm. Eels ranged from 43.0cm to 56.0cm. Two bream were recorded, measuring 15.6cm and 26.0cm in length. One pike and one roach were also captured, measuring 57.0cm and 13.0cm in length respectively.

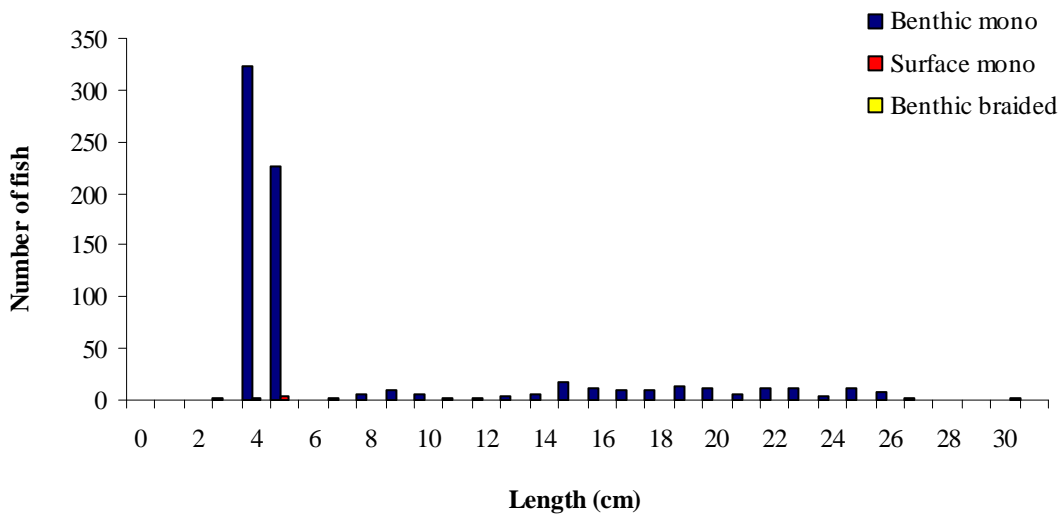


Fig. 1.4. Length frequency of perch (n=714) captured on Lough Arrow, July 2009

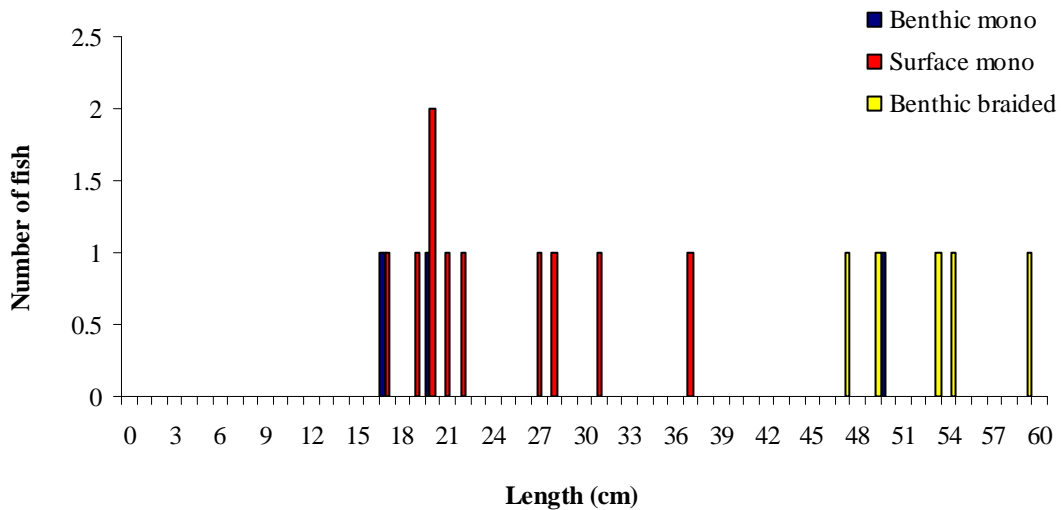


Fig. 1.5. Length frequency of brown trout (n=18) captured on Lough Arrow, July 2009

1.3.4 Fish age and growth

Ten age classes of perch were present, ranging from 0+ to 9+, with a mean L1 of 5.9cm (Table 1.2). The dominant age class was 0+ corresponding to the 2cm to 5cm length class (Fig. 1.4).

Five age classes of brown trout were present, ranging from 1+ to 5+, with a mean L1 of 8.0cm (Table 1.4). Mean brown trout L4 was 43.4cm indicating a very fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

Seven age classes of rudd were present, ranging from 2+ to 9+ and the two bream captured were aged 4+ and 7+.

Table 1.3. Mean (\pm SE) perch length (cm) at age for Lough Arrow, July 2009

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈	L ₉
Mean	5.9 (0.1)	11.0 (0.2)	15.5 (0.3)	19.3 (0.3)	22.2 (0.3)	23.9 (0.4)	24.4 (1.1)	26.8 (1.4)	27.8 (2.4)
N	114	91	61	41	32	19	4	3	2
Range	3.5-8.2	6.8-16.3	10.7- 19.7	14.1- 24.6	18.8- 24.8	21.0- 26.2	22.6- 26.9	24.6- 29.5	25.4- 30.2

Table 1.4. Mean (\pm SE) brown trout length (cm) at age for Lough Arrow, July 2009

	L ₁	L ₂	L ₃	L ₄	L ₅
Mean	8.0 (0.4)	15.9 (1.4)	28.5 (2.2)	43.4 (2.2)	52.1 (5.0)
N	14	6	5	3	2
Range	5.6-10.0	11.2-19.1	22.0-34.5	40.5-47.7	47.1-57.1

1.4 Summary

Perch was the dominant species in terms of both abundance (CPUE) and biomass (BPUE).

The mean perch CPUE in Lough Arrow was relatively high when compared to other similar lake types; however, these differences were not statistically significant. The dominant age class of perch was 0+ which corresponded to the 2cm to 5cm length class. Perch ages ranged from 0+ to 9+, indicating reproductive success in each of the previous number of years.

The mean brown trout CPUE in Lough Arrow was similar to other high alkalinity lakes surveyed. Although Lough Arrow exhibited a lower mean brown trout CPUE than Lough Carra and Lough Cullin and a higher mean CPUE than Lough Mask and Lough Derg these differences were not statistically significant. Brown trout ranged in age from 1+ to 5+ indicating reproductive success in the last number of 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).

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 WFD multimetric fish classification tool has been developed for the island of Ireland (Ecoregion 17) using CFB and Agri-Food and Biosciences Northern Ireland (AFBINI) data generated during the NSSHARE Fish in Lakes project (Kelly *et al.*, 2008). Using this tool, Lough Arrow has been assigned an ecological status classification of Good based on the fish populations present.

The EPA has assigned an overall status of Good to Lough Arrow in an interim draft classification. This is based on physico-chemical parameters and biotic elements such as macroinvertebrates, macrophytes and fish.

1.5 References

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