National Research Survey Programme
Lakes 2016

Lough Shindilla

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Iascach Intíre Éireann
Inland Fisheries Ireland

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**Fish Stock Survey of Lough Shindilla,
September 2016**

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

ACKNOWLEDGEMENTS

1.1 Introduction

Lough Shindilla is the uppermost lake on the Screebe system in Co. Galway, located approximately 0.75km west of Maam Cross (Plate 1.1, Fig. 1.1). The lake has a surface area of 65.3ha, a mean depth >4m, a maximum depth of 22m and has been characterised as typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and low alkalinity (<20mg/l $CaCO_3$).

Lough Shindilla is located in the Maumturk Mountains Special Area of Conservation (SAC). Most of the mountains in the SAC exceed 600m in height and the majority of the land within the site lies above an altitude of 250m. The main bedrock in the south is made up of quartzite and in the north of the SAC the bedrock is generally comprised of shales and slates (NPWS, 2006).

The site is a SAC for containing blanket bog, lowland oligotrophic lakes, alpine heath, siliceous rocky and Rhynchosporion, all habitats listed on Annex I of the E.U. Habitats Directive (NPWS, 2006). The SAC is also selected for containing slender naiad and Atlantic salmon, both species listed on Annex II of the same Directive. Species listed in the Red Data Book which are located in the SAC include the Irish hare and the common frog. Peregrine, a species listed on Annex I of the EU Birds Directive also occur within the SAC (NPWS, 2006).

Damaging activities and threats to the Maumturk Mountains SAC include overgrazing, peat-cutting and afforestation. Grazing, in particular by sheep, is quite severe within the site and has resulted in the erosion of both lowland and mountain blanket bog (NPWS, 2006).

The lake holds a stock of brown trout and gets the occasional run of sea trout and salmon (O' Reilly, 2007). Lough Shindilla was previously surveyed in 2007, 2010 and 2013 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007 and Kelly *et al.,* 2011 and 2014). During the 2013 survey brown trout were found to be the dominant species present in the lake, followed closely by perch. Arctic char, eels and salmon were also captured.
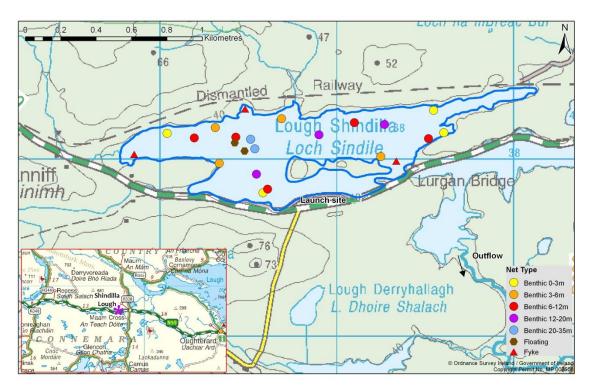
Plate 1.1. Lough Shindilla

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

1.2 Methods

1.2.1 Netting methods

Lough Shindilla was surveyed over two nights from the 5th to the 7th of September 2016. A total of three sets of Dutch fyke nets, 18 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (4 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 3 @ 12-19.9m and 2 @ 20-34.9m) and two floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (23 sites). Nets were deployed in the same locations as were randomly selected in the previous survey. 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 Arctic char and brown trout. 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.

1.2.2 Fish diet

Fish were frozen before being dissected for stomach content analysis in the IFI laboratory. Total stomach contents were inspected and individual items were counted and identified to the lowest taxonomic level possible. The percentage frequency occurrence (%O) of prey items were then calculated to identify key prey items (Amundsen *et al.*, 1996).

$$\%O_i = (N_i / N) \times 100$$

Where:

   $\%O_i$ is the percentage frequency of prey item i,
   N_i is the number of a particular species with prey i in their stomach,
   N is total number of a particular species with stomach contents.

1.2.3 Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment in order to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by Inland Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff in IFI when moving between water bodies.

1.3 Results

1.3.1 Species Richness

A total of four fish species were recorded in Lough Shindilla in September 2016, with 130 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Perch was the most common fish species recorded, followed by brown trout, eels and Arctic char. During the previous surveys in 2013, 2010 and 2007 the same species composition was recorded with the exception of salmon which were not recorded in 2010 or 2013, three-spined stickleback which were only captured in 2010, minnow which were only present in 2007 and perch were not recorded in 2007 (Kelly and Connor, 2007 and Kelly *et al*., 2011 and 2014).

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Shindilla, September 2016

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Perca fluviatilis	Perch	89	0	5	94
Salmo trutta	Brown trout	20	1	3	24
Salvelinus alpinus	Arctic char	1	2	0	3
Anguilla anguilla	European eel	0	0	9	9

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 the 2007, 2010, 2013 and 2016 surveys are summarised in Table 1.2 and illustrated in Figures 1.2 and 1.3.

Perch

Perch was the dominant species in terms of both abundance (CPUE) and biomass (BPUE) in 2016. The mean perch CPUE increased over the four sampling occasions. The mean perch CPUE in 2016 was significantly higher than 2010 (Kruskal-Wallis H=5.67, P<0.05) (Table 1.2; Fig 1.2 and 1.3). No perch

were recorded in 2007. There were no significant differences in the mean perch BPUE across the three sampling years.

Brown trout

The mean brown trout CPUE was lower in 2016 than in 2007 and 2013 but was similar to 2010, with mean BPUE fluctuating over the four sampling occasions. The 2013 mean brown trout CPUE and BPUE was significantly higher than in 2010 (Kruskal-Wallis H=5.79, P<0.05 and H=6.80, P<0.05) (Table 1.2; Fig 1.2 and 1.3).

Arctic char

The mean Arctic char CPUE and BPUE was significantly lower in 2016 than in 2007 and 2010 (Kruskal-Wallis H=5.14, P<0.05 and H=5.67, P<0.05) (Table 1.2; Fig 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Shindilla, 2007 to 2016

Scientific name	Common name	2007	2010	2013	2016
			Mean CPUE		
Salmo trutta	Brown trout	0.046 (0.012)	0.033 (0.015)	0.072 (0.018)	0.033 (0.013)
Perca fluviatilis	Perch	-	0.032 (0.013)	0.070 (0.021)	0.133 (0.041)
Salvelinus alpinus	Arctic char	0.091 (0.028)	0.077 (0.305)	0.022 (0.008)	0.004 (0.002)
Salmo salar	Salmon	0.001 (0.001)	-	0.001 (0.001)	-
Phoxinus phoxinus	Minnow	0.010 (0.006)	-	-	-
Gasterosteus aculeatus	Three-spined stickleback	-	0.001 (0.001)	-	-
Anguilla anguilla	European eel	0.067 (0.059)	0.122 (0.475)	0.039 (0.011)	0.050 (0.010)
			Mean BPUE		
Salmo trutta	Brown trout	3.812 (1.035)	1.539 (0.697)	5.467 (1.486)	4.005 (1.859)
Perca fluviatilis	Perch	-	6.907 (3.434)	9.950 (3.431)	9.556 (2.058)
Salvelinus alpinus	Arctic char	7.717 (2.482)	5.104 (2.131)	3.301 (1.298)	0.587 (0.328)
Salmo salar	Salmon	5.797 (5.597)	-	0.043 (0.043)	-
Phoxinus phoxinus	Minnow	0.043 (0.030)	-	-	-
Gasterosteus aculeatus	Three-spined stickleback	-	0.0004 (0.0004)	-	-
Anguilla anguilla	European eel	9.028 (8.746)	16.183 (5.836)	4.194 (0.682)	5.336 (2.178)

Note: On the rare occasion where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species.
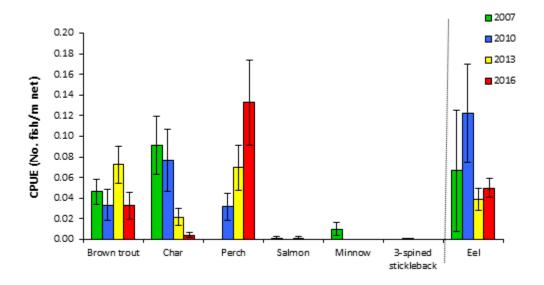
*Eel CPUE and BPUE based on fyke nets only

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Shindilla (Eel CPUE based on fyke nets only), 2007, 2010, 2013 and 2016
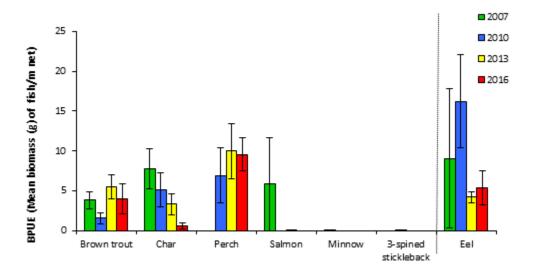

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Shindilla (Eel BPUE based on fyke nets only), 2007, 2010, 2013 and 2016

1.3.3 Length frequency distributions and growth

Perch

Perch captured during the 2016 survey ranged in length from 5.5cm to 30.9cm (mean = 15.2cm) (Fig. 1.4). Eight age classes were present, ranging from 0+ to 8+, with a mean L1 of 6.8cm (Table 1.3). The dominant age class was 3+ (Fig. 1.4). Perch captured during the 2010 and 2013 surveys had a similar length and age range with more juveniles recorded in the 2016 survey (Fig.1.4).
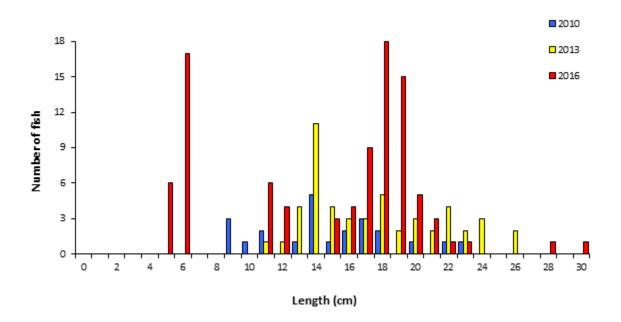

Fig. 1.4. Length frequency of perch captured on Lough Shindilla, 2007 to 2016

Table 1.3. Mean (±S.E.) perch length (cm) at age for Lough Shindilla, September 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
Mean (±S.E.)	6.8 (0.2)	14.0 (0.3)	17.5 (0.4)	19.5 (0.7)	20.6 (0.9)	23.5 (1.7)	28.8	30.1
N	33	27	19	13	10	5	1	1
Range	4.5-9.0	11.9-17.5	15.1-22.7	16.7-25.5	17.5-26.5	19.2-27.5	28.8-28.8	30.1-30.1

Brown trout

Brown trout captured during the 2016 survey ranged in length from 12.9cm to 30.6cm (mean = 20.9m) (Fig. 1.5). Four age classes were present, ranging from 1+ to 4+, with a mean L1 of 7.0cm (Table 1.4). The dominant age class was 1+ (Fig. 1.5). Mean brown trout L4 in 2016 was 24.7cm indicating a very slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.4). Brown trout captured during the 2010 and 2013 surveys had similar length and age ranges, with some larger fish recorded in the 2013 and 2016 surveys (Fig.1.5).
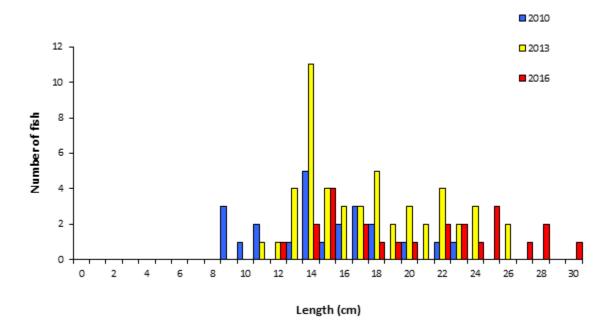

Fig. 1.5. Length frequency of brown trout captured on Lough Shindilla, 2010, 2013 and 2016

Table 1.4. Mean (±S.E.) brown trout length (cm) at age for Lough Shindilla, September 2016

	L_1	L_2	L_3	L_4	Growth Category
Mean (±S.E.)	7.0 (0.2)	16.2 (0.6)	20.6 (0.7)	24.7 (0.7)	Very slow
N	18	13	7	5	
Range	5.7-7.9	12.4-19.0	18.4-23.1	23.5-27.0	

Arctic char

Three Arctic char captured during the 2016 survey ranged in length from 21.0cm to 25.3cm (mean = 22.8cm) (Fig.1.6) with two age classes present, 2+ and 4+. Arctic char captured during the 2010 and 2013 surveys had a larger length and age range (Fig.1.6).
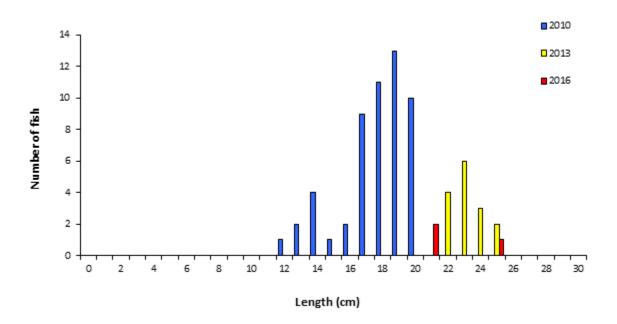

Fig. 1.6. Length frequency of Arctic char captured on Lough Shindilla, 2010, 2013 and 2016

Other fish species

Eels captured during the 2016 survey ranged in length from 32.0cm to 53.1cm.

1.3.4 Stomach and diet analysis

Dietary analysis studies provide a good indication of the availability of food items and the angling methods that are likely to be successful. However, the value of stomach content analysis is limited unless undertaken over a long period as diet may change on a daily basis depending on the availability of food items. The stomach contents of a subsample of perch and brown trout captured during the survey were examined and are presented below.

Perch

Perch initially start to feed on pelagic zooplankton. Once they reach an intermediate size they start feeding on benthic resources eventually moving on to feed on fish once they are large enough (Hjelm *et al.*, 2000). A total of 3 stomachs were examined and these contained 100% invertebrates (Fig. 1.7).
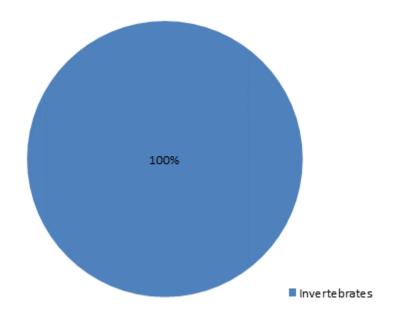

Fig 1.7. Diet of perch (n=3) captured on Lough Shindilla, 2016 (% occurrence)

Brown trout

Adult trout usually feed principally on crustaceans (*Asellus* sp*.* and *Gammarus* sp.), insects (principally chironomid larvae and pupae) and molluscs (snails) (Kennedy and Fitzmaurice, 1971, O'Grady, 1981). A total of 18 stomachs were examined and they all contained prey items; 89% contained invertebrates, 6% invertebrates/zooplankton and 5% invertebrates/digested material (Fig. 1.8).
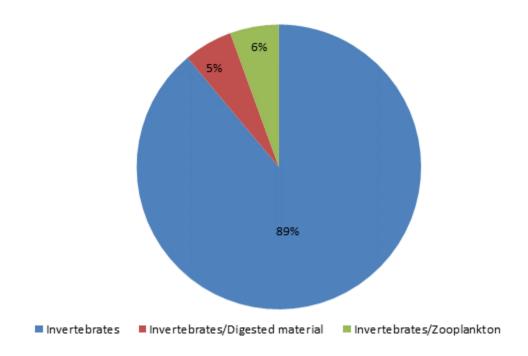

Fig 1.8. Diet of brown trout (n=18) captured on Lough Shindilla, 2016 (% occurrence)

1.4 Summary and ecological status

A total of four fish species were recorded on Lough Shindilla in September 2016. Perch was the dominant species in terms of both abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2016 survey. The mean perch CPUE increased over the four sampling occasions, and the mean perch CPUE from 2016 was significantly higher than the 2010 figure. There were no significant differences in the mean perch BPUE across the four sampling occasions.

The mean brown trout CPUE was lower in 2016 than in 2013 and was similar to 2010, with mean BPUE fluctuating over the four sampling occasions. The 2013 mean brown trout CPUE and BPUE was significantly higher than in 2010. Brown trout ranged in age from 1+ to 4+, indicating reproductive success in four of the previous five years. The dominant age class was 1+. 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).

The mean Arctic char CPUE and BPUE was significantly lower in 2016 than in 2010. Arctic char ranged in age from 2+ to 4+, with two age classes present.

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 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.*, 2012b). Using the FIL2 classification tool, Lough Shindilla has been assigned an ecological status of High for 2016 based on the fish populations present. The lake was also assigned High fish status in 2007, 2010 and 2013.

In the 2010 to 2015 surveillance monitoring reporting period, the EPA assigned Lough Shindilla an overall ecological status of High.

1.5 References

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