National Research Survey Programme
Lakes 2019

Lough Shindilla

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Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Lough Shindilla, August 2019

Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Cover photo: Aerial view of Lough Shindilla, Co. Galway © 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 of the SAC is composed 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 rock and Rhynchosporion, all habitats listed on Annex I of the E.U. Habitats Directive (NPWS, 2006). The SAC was 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, was 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, 2013 and 2016 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007 and Kelly *et al.,* 2011, 2014 and 2017). During the 2016 survey perch were found to be the most dominant species in the lake, followed by brown trout. Arctic char and European eel were also captured. Salmon were captured during the 2007 and 2013 surveys.

This report summarises the results of the 2019 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme.
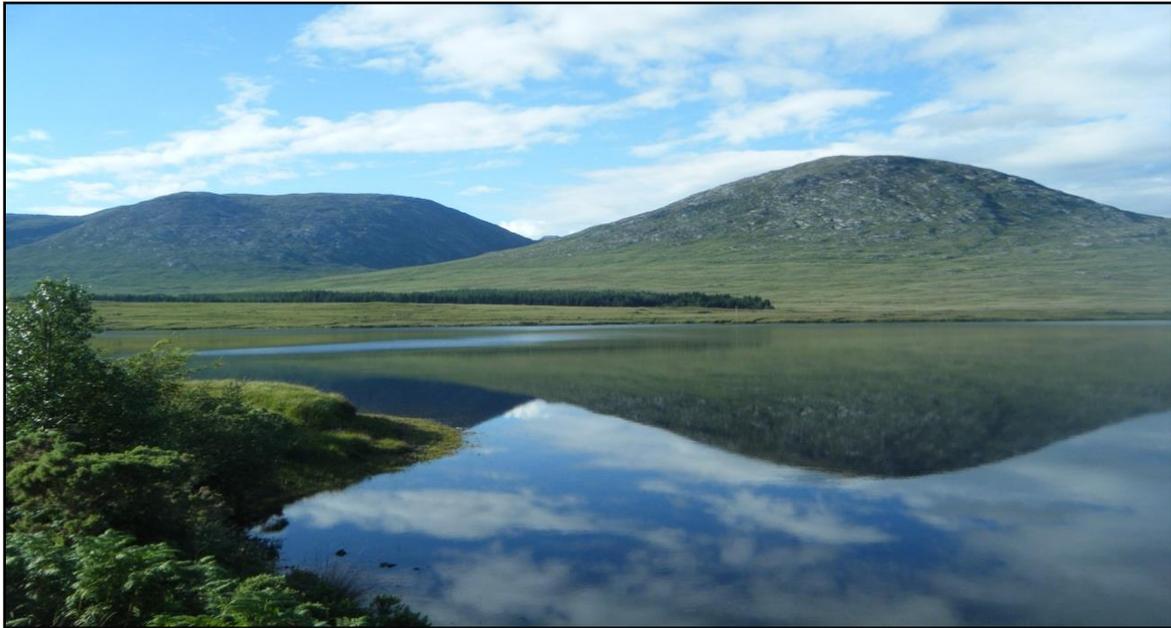
Plate 1.1. Lough Shindilla

Plate 1.2: Aerial view of Lough Shindilla (looking across the lake from northeast to southwest). Lough Ardderry is shown on the left side of the image.
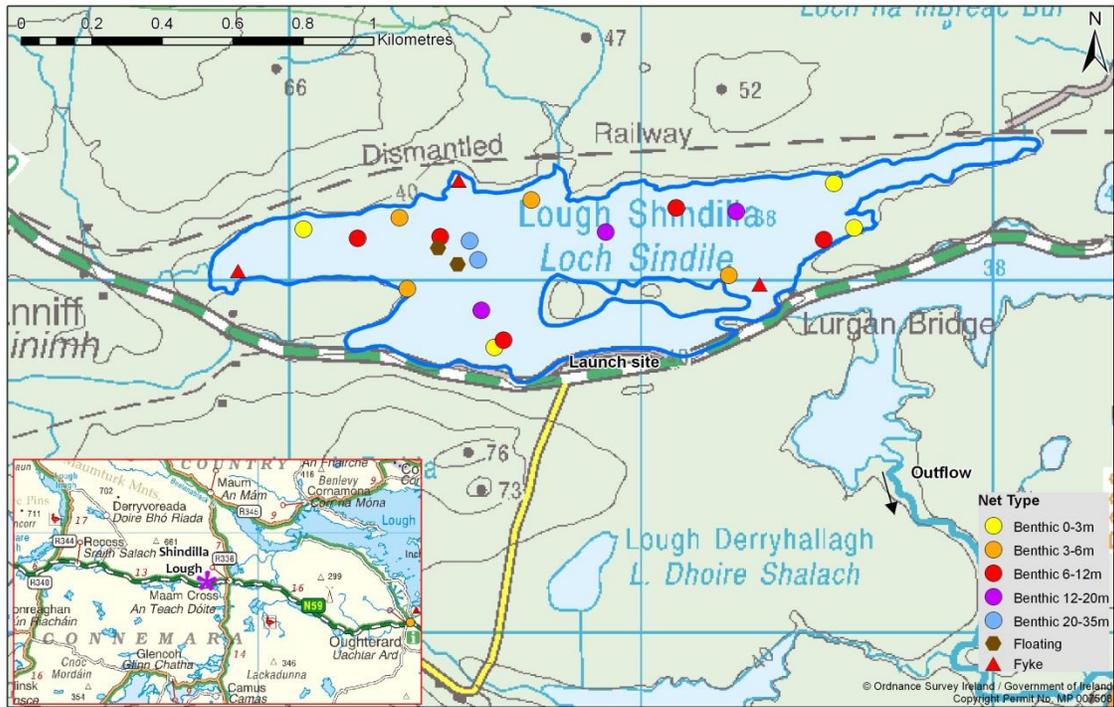
Fig. 1.1. Location map of Lough Shindilla showing net locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Lough Shindilla was surveyed over two nights from the 19th to the 21st of August 2019. 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 previous surveys. 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 brown trout and salmon. 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. Fish were frozen immediately after the survey and transported back to the IFI laboratory for later dissection.

1.2.2 Fish diet

Total stomach contents were inspected and individual items were counted and identified to the lowest taxonomic level possible. The percentage frequency occurrence (%FO) of prey items were then calculated to identify key prey items (Amundsen *et al.*, 1996).

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

Where:

$\%FO_i$ 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 August 2019, with 192 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 salmon. During the previous surveys in 2007, 2010, 2013 and 2016, the same species composition was recorded with the exception of Arctic char which had been recorded in all years except 2019 and perch which were not recorded prior to 2010. Small number of three-spined stickleback were only captured in 2010, minnow were only present in 2007, salmon were not recorded in 2010 or 2016 (Kelly and Connor, 2007 and Kelly *et al*., 2011, 2014 and 2017).

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Shindilla, August 2019

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Perca fluviatilis	Perch	163	0	6	169
Salmo trutta	Brown trout	11	2	1	14
Salmo salar	Salmon	1	0	0	1
Anguilla anguilla	European eel	0	0	8	8

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 2010, 2013 and 2016 and 2019 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 abundance (CPUE) and biomass (BPUE). Perch were not recorded in the 2007 survey. Mean perch CPUE has increased steadily since the species were first recorded in 2010. A similar trend was also observed for the mean BPUE, although there was a slight decrease from 2013 to 2016 (Table 1.2; Figs. 1.2 and 1.3).

Brown trout

The mean brown trout CPUE for 2019 was lower than for previous surveys. The mean BPUE for 2019 was also lower than previous surveys, with the exception of the 2010 survey, which recorded a lower BPUE than the 2019 survey (Table 1.2; Figs. 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Shindilla, 2007, 2010, 2013, 2016 and 2019

Scientific name	Common name	2007	2010	2013	2016	2019
		Mean CPUE				
Perca fluviatilis	Perch	-	0.032 (0.013)	0.070 (0.021)	0.133 (0.041)	0.241 (0.062)
Salmo trutta	Brown trout	0.046 (0.012)	0.033 (0.015)	0.072 (0.018)	0.033 (0.013)	0.020 (0.006)
Salmo salar	Salmon	0.001 (0.001)	-	0.001 (0.001)	-	0.001 (0.001)
Salvelinus alpinus	Arctic char	0.091 (0.028)	0.077 (0.030)	0.022 (0.008)	0.004 (0.002)	-
Gasterosteus aculeatus	Three-spined stickleback	-	0.001 (0.001)	-	-	-
Phoxinus phoxinus	Minnow	0.010 (0.006)	-	-	-	-
*Anguilla anguilla**	European eel*	0.067 (0.059)	0.122 (0.047)	0.039 (0.011)	0.050 (0.010)	0.044 (0.036)
		Mean BPUE				
Perca fluviatilis	Perch	-	6.907 (3.435)	9.950 (3.431)	9.556 (2.058)	18.707 (4.807)
Salmo trutta	Brown trout	3.812 (1.035)	1.539 (0.698)	5.467 (1.486)	4.005 (1.859)	1.838 (0.710)
Salmo salar	Salmon	5.797 (5.597)	-	0.043 (0.043)	-	0.037 (0.037)
Salvelinus alpinus	Arctic char	7.717 (2.482)	5.104 (2.132)	3.301 (1.298)	0.587 (0.328)	-
Gasterosteus aculeatus	Three-spined stickleback	-	0.0001 (0.001)	-	-	-
Phoxinus phoxinus	Minnow	0.043 (0.030)	-	-	-	-
*Anguilla Anguilla**	European eel*	9.028 (8.746)	16.183 (5.837)	4.194 (0.682)	5.336 (2.178)	4.959 (3.426)

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 (Connor *et al.,* 2017).
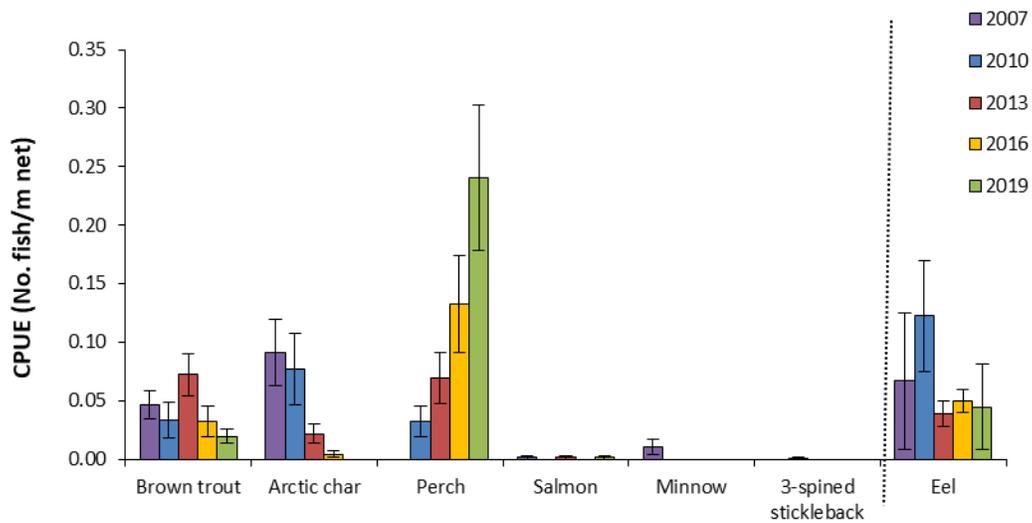
*Eel CPUE and BPUE based on fyke nets only

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, 2016 and 2019
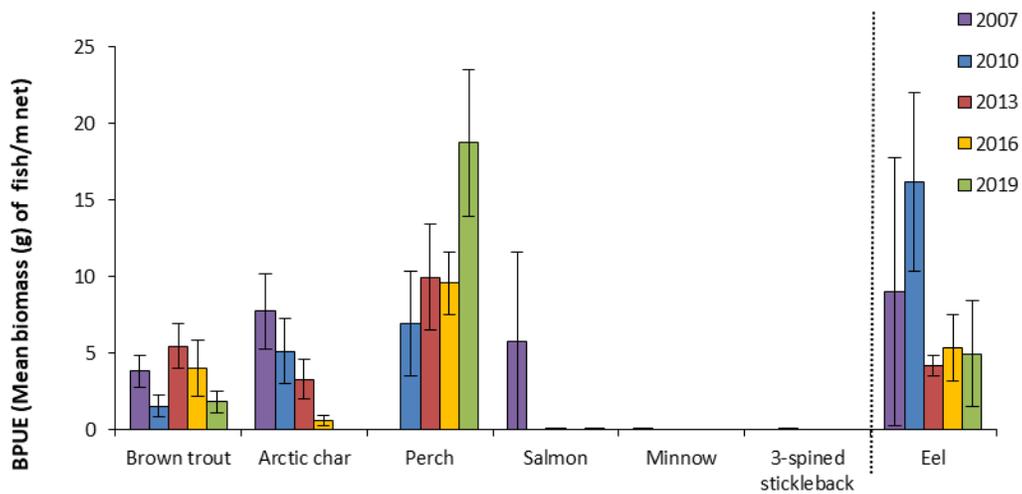

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Shindilla (Eel BPUE based on fyke nets only), 2007, 2010, 2013, 2016 and 2019

1.3.3 Length frequency distributions and growth

Perch

Perch captured during the 2019 survey ranged in length from 11.1cm to 22.7cm (mean = 17.2cm) (Fig. 1.4. Perch captured during the 2019 survey had a narrower length and age range than previous surveys. There was an absence of perch greater than 23.0cm and fewer juveniles captured when compared to previous surveys (Fig.1.4). Eight age classes were present, ranging from 1+ to 9+, with a mean L1 of 6.7cm (Table 1.3). The dominant age class was 3+ (Table 1.3).
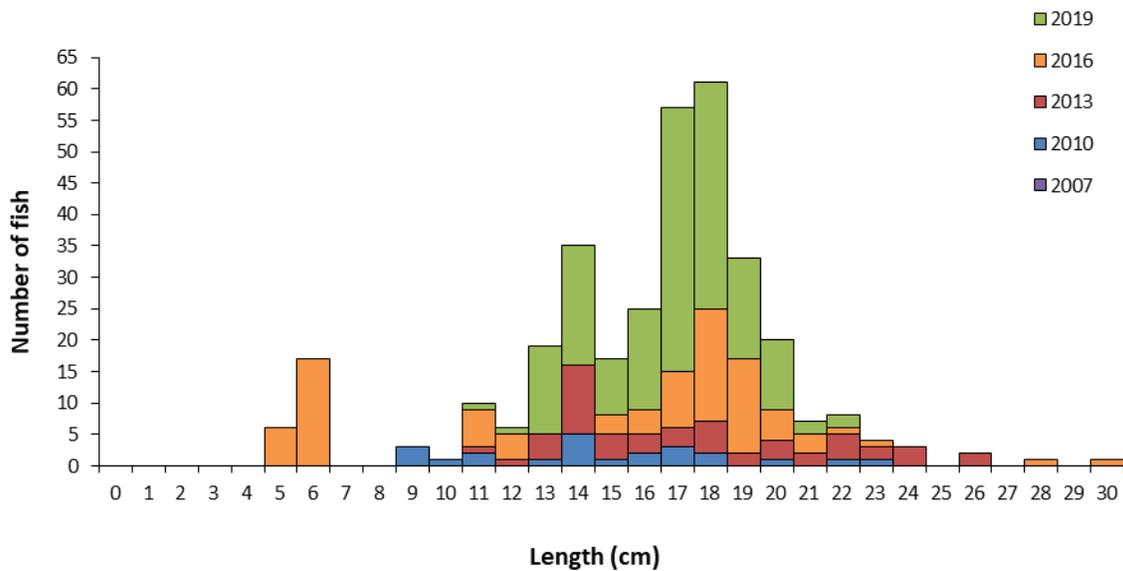

Fig. 1.4. Length frequency of perch captured on Lough Shindilla, 2007, 2010, 2013, 2016 and 2019

Table 1.3. Mean (±S.E.) perch length (cm) at age for Lough Shindilla, August 2019

	L1	L2	L3	L4	L5	L6	L7	L8	L9
Mean (±S.E.)	6.7 (0.1)	13.1 (0.2)	16.4 (0.2)	18.3 (0.2)	19.4 (0.2)	20.6 (0.4)	21.2 (0.7)	21.9	22.2
N	52	41	33	12	11	6	2	1	1
Range	4.7-9.1	11.4-17.1	14.1-18.6	17.5-19.5	18.6-21.1	19.4-22.0	20.5-21.8	-	-

Brown trout

Brown trout captured during the 2019 survey ranged in length from 13.0cm to 27.7cm (mean = 19.1cm) (Fig. 1.5). Brown trout captured in the 2019 had a narrower length range compared to previous surveys (Fig.1.5). Three age classes were present, ranging from 1+ to 3+, with a mean L1 of 7.7cm (Table 1.4). The dominant age class was 2+ (Table. 1.4).
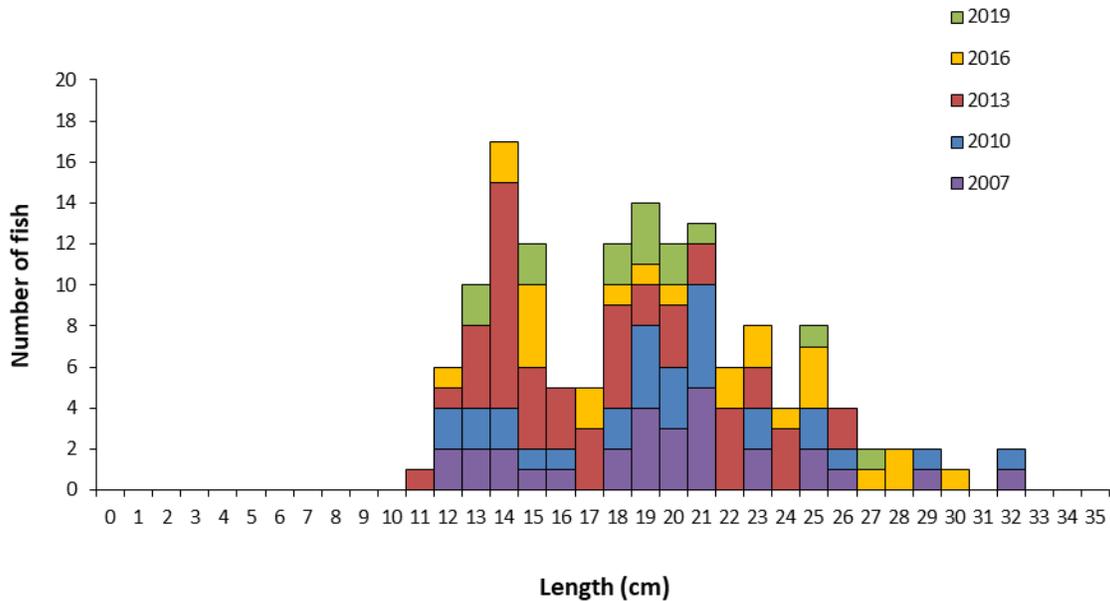

Fig. 1.5. Length frequency of brown trout captured on Lough Shindilla, 2007, 2010, 2013, 2016 and 2019

Table 1.4. Mean (±S.E.) brown trout length (cm) at age for Lough Shindilla, August 2019

	L_1	L_2	L_3
Mean (±S.E.)	7.7 (0.3)	15.4 (1.0)	21.3
N	12	9	1
Range	6.1-9.8	12.6-22.5	-

Other fish species

Eight eels ranging from 34.5cm to 48.3cm were recorded. One salmon was captured measuring 13.0cm and aged at 1+.

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 40 stomachs were examined, of these 19 were found to contain no prey items. Of the 21 remaining stomachs, 81% contained zooplankton and 19% contain invertebrates (Fig. 1.6).
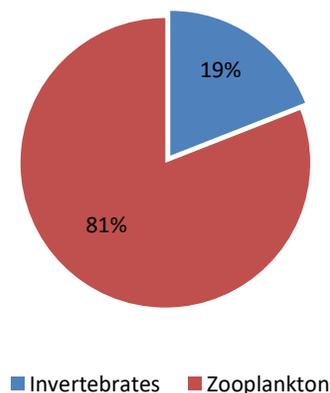

■ Invertebrates ■ Zooplankton

Fig 1.6. Diet of perch (n=21) captured on Lough Shindilla, 2019 (% FO)

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 10 stomachs were examined. Of these four were found to contain no prey items. Of the remaining six stomachs containing food, 83% contained invertebrates and 17% zooplankton (Fig. 1.7).
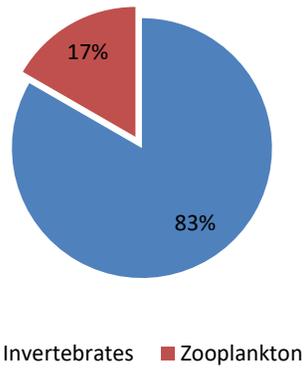
Invertebrates ■ **Zooplankton**

Fig 1.7. Diet of brown trout (n=18) captured on Lough Shindilla, 2019 (% FO)

1.4 Summary and ecological status

A total of four fish species were recorded on Lough Shindilla in August 2019. Perch was the dominant species in terms of both abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2019 survey. Perch were first recorded in 2010, since then the mean CPUE has steadily increased in each survey.

The mean brown trout CPUE was lower in 2019 than in previous surveys. The mean BPUE from 2019 decreased from 2013 and 2016, but was slightly higher than the 2010 figure.   Brown trout ranged in age from 1+ to 3+, indicating reproductive success in three of the previous four years.

Arctic char were not captured in the 2019 survey. Arctic char were recorded in previous surveys.

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 2019 based on the fish populations present. The lake was also assigned High fish status in 2007, 2010, 2013 and 2016 (Fig. 1.8).

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Shindilla an overall draft ecological status of High, based on all monitored physico-chemical and biological elements, including fish.
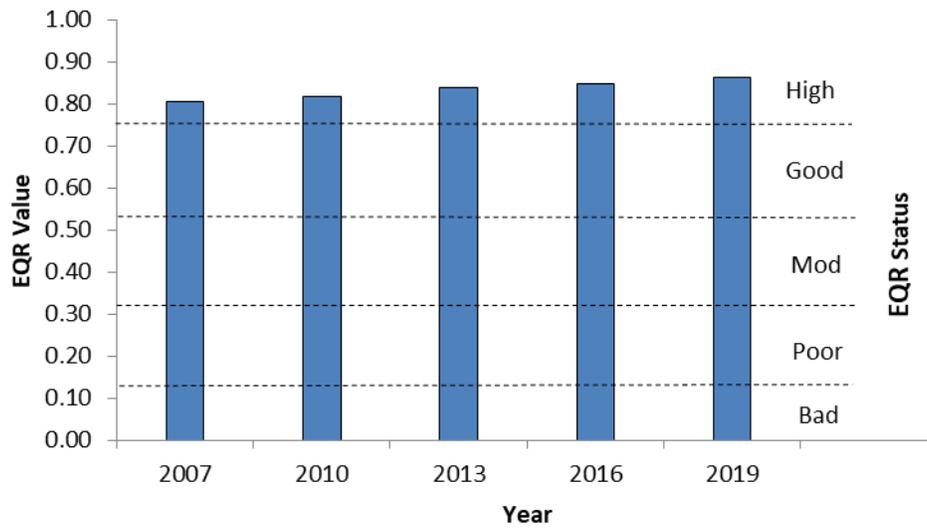
Fig. 1.8. Fish ecological status, Lough Shindilla, 2007, 2010, 2013, 2016 and 2019

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Inland Fisheries Ireland
3044 Lake Drive,
Citywest Business Campus,
Dublin 24,
Ireland.
D24 Y265

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600