National Research Survey Programme

Lakes 2017

Lough Ennell

IFI/2018/1-4423

Iascach Intíre Éireann
Inland Fisheries Ireland

Inland Fisheries Ireland

National Research Survey Programme

Fish Stock Survey of Lough Ennell, September 2017

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

CITATION: Connor, L., Coyne, J., Corcoran, W., Cierpial, D., Ni Dhonnaibhain L., Delanty, K., McLoone, P., Morrissey, E., Gordon, P., O' Briain, R., Matson, R., Rocks, K., O' Reilly, S., Brett A., Garland D. and Kelly, F.L. (2018) Fish Stock Survey of Lough Ennell, September 2017. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

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

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland.

The authors would also like to acknowledge the funding provided for the project from the Department of Communications, Climate Action and Environment for 2017.

1.1 Introduction

Lough Ennell (Loch Ainninn) is a lake near the town of Mullingar, County Westmeath, Ireland. It is situated beside the N52 road, off the Mullingar/Kilbeggan road (Plate 1.1 and Fig. 1.1). It is approximately 7.2 km in length and 3.2 km wide, with a surface area of 1151ha and a maximum depth of approximately 30m. The lake is categorised as typology class 12 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and high alkalinity (>100mg/l $CaCO_3$). It has a large area of shallow water with nearly two-thirds of its area being less than 8m and almost half of it being less than 3m deep. The lake is dotted with islands, many of which have now become attached to the shoreline as the levels of the lake have changed. The main river flowing into Lough Ennell is the River Brosna, which enters on the Mullingar side of the lake and exits on the opposite side at Lilliput. The estimated terrain elevation above sea level is 81m.

The lake supports a diverse aquatic flora, with particularly well developed Charophyte beds. Reed beds and species-poor swamp vegetation occasionally fringe the lake, particularly around the points of inflow and outflow and on the eastern shore (NPWS, 2017). Much of the lake shore is dry, stony ground, which was formerly part of the lake bed but is now exposed by drainage, and colonised by calcareous grassland. Alkaline fen is also found on the lake shore (NPWS 2017). Lough Ennell is a Special Protection Area (SPA) under the EU Birds Directive and is of special conservation interest for a number of species (e.g. Pochard, Tufted Duck and Coot) and associated wetlands (NPWS, 2014).

Lough Ennell is a popular venue for brown trout fishing. In recent years the average size of brown trout has been nearly 0.9Kg, and fish of 1.3kg are taken frequently. The largest fish taken in recent years has exceeded 3.3 Kg. Lough Ennell produced Ireland's largest ever lake brown trout (11.8 kg) caught in 1894 and this record still stands today (IFI, 2017). The conformation and colour of Lough Ennell brown trout is unusual, they are shaped more like a summer salmon (grilse) than a trout, their colouration is similar to a sea trout and they are renowned for being a very hard fighting fish.

Inland Fisheries Ireland (previously the Central Fisheries Board) undertook a number of fish stock surveys of Lough Ennell from 1983 to 2007. Wild brown trout, stocked brown trout, perch, pike, roach, rudd, tench, bream and hybrids have been recorded in the lake (IFI unpublished data).

This report summarises the results of the 2017 fish stock survey (e.g. species composition, abundance and age structure) on the lake as part of IFI's brown trout research programme.

Plate 1.1. Lough Ennell looking north (Photo courtesy of IFI and No. 3 Operational Wing, Irish Air Corps [Aer Chór na hÉireann])

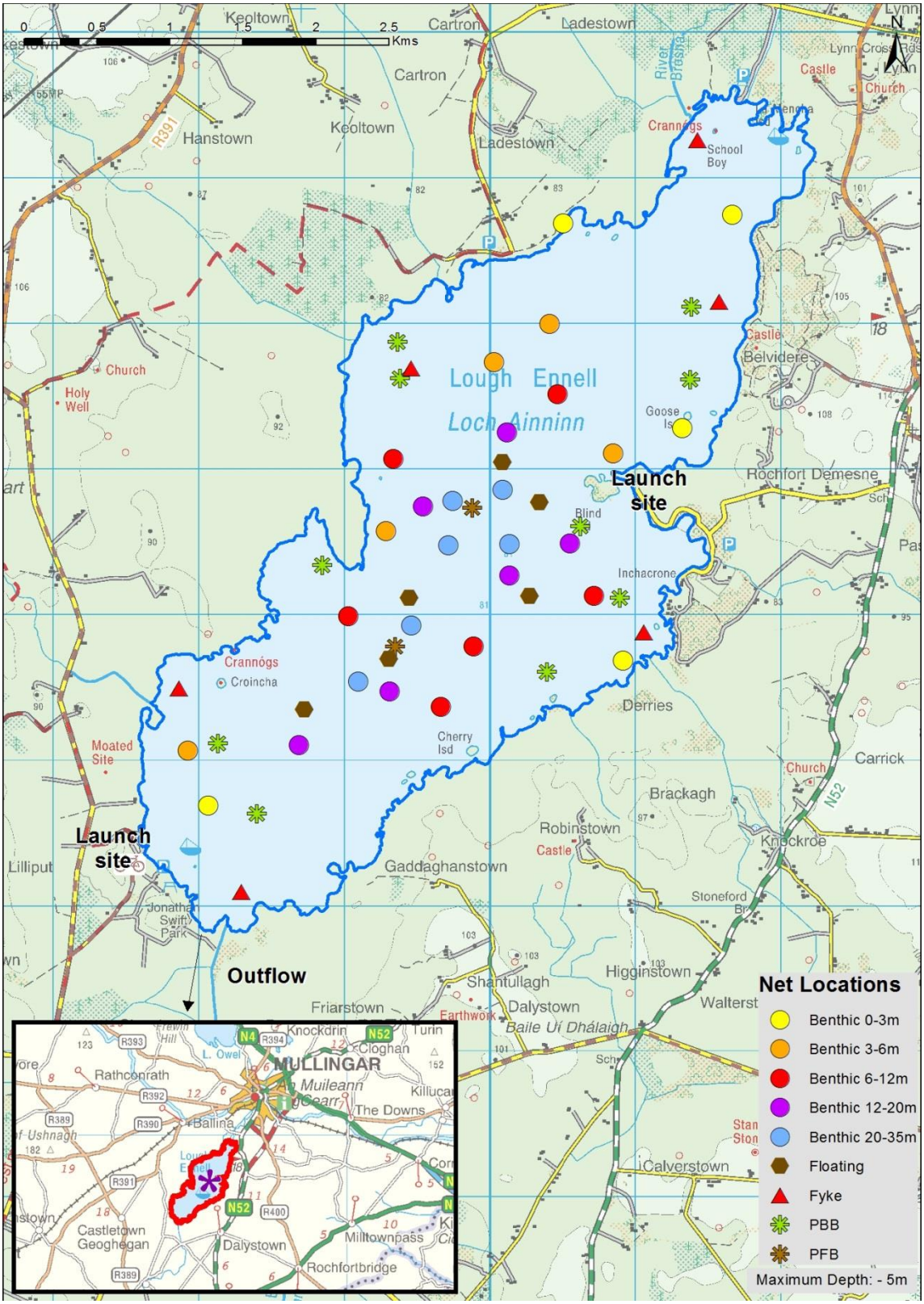

Fig. 1.1 Location map of Lough Ennell showing locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Lough Ennell was surveyed over three nights from the 19th to the 22nd of September 2017. A total of six sets of Dutch fyke nets (Fyke), 28 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 5 @ 3-5.9m, 6 @ 6-11.9m, 6 @ 12-19.9m and 6 @ 20-34.9m) and six floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (40 sites) (Fig. 1.1). In addition ten four-panel benthic braided survey gill nets (4-PBB) and two four-panel floating braided survey gill nets (4-PFB) were deployed in the lake to supplement the catches. The four-panel nets are composed of four 27.5m long panels each a standard mesh size (55mm, 60mm, 70mm and 90mm knot to knot) tied together randomly.

The site locations for the benthic monofilament multi-mesh gill nets (BM CEN) and the four-panel braided survey gill nets (4-PBB and 4-PFB) were chosen randomly within fixed depth zones (0-2.9m, 3-5.9m, 6-11.9m, 12-19.9m and 20-34.9m). 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 also randomised.

All fish were measured and weighed on site and scales were removed from all brown trout, rudd, hybrids, tench, roach and pike. Live fish were returned to the water whenever possible and practical (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 eight fish species and one type of hybrid were recorded on Lough Ennell in September 2017, with 842 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. Brown trout, roach, roach x bream hybrids, tench, pike, rudd, three-spined stickleback and eels were also recorded. During the previous surveys in 1983 to 2007 the same species composition was recorded with the exception of bream which were not recorded in the 2017 survey and eels and three-spined stickleback, which were only captured during the 2017 survey.

Table 1.1. Number of each fish species captured by each method during the survey on Lough Ennell, September 2017

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	Fyke	4-panel	Total
Perca fluviatilis	Perch	515	0	2	5	522
Rutilis rutilis	Roach	170	1	3	38	212
Rutilis rutilis x Abramis brama	Roach x bream hybrid	38	0	0	8	46
Salmo trutta	Brown trout	1	15	1	16	33
Scardinius erythrophthalmus	Rudd	10	0	0	3	13
Tinca tinca	Tench	3	0	0	7	10
Esox lucius	Pike	2	0	0	0	2
Gasterosteus aculeatus	Three-spined stickleback	1	0	0	0	1
Anguilla anguilla	European eel	1	0	2	0	3

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 2017 survey are summarised in Table 1.2 (Fig. 1.2 and 1.3).

Overall perch was the dominant species in terms of abundance (CPUE) and biomass (BPUE) (Fig. 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE (per metre of net) for all fish species captured on Lough Ennell, 2017

Scientific name	Common name	Mean CPUE (±S.E.)
Perca fluviatilis	Perch	0.332 (0.056)
Rutilis rutilis	Roach	0.117 (0.035)
Rutilis rutilis x Abramis brama	Roach x Bream	0.026 (0.009)
Salmo trutta	Brown trout	0.013 (0.005)
Scardinius erythrophthalmus	Rudd	0.007 (0.006)
Tinca tinca	Tench	0.003 (0.002)
Esox lucius	Pike	0.001 (0.001)
Gasterosteus aculeatus	Three-spined stickleback	0.001 (0.001)
*Anguilla anguilla**	European eel*	0.006 (0.004)
		Mean BPUE (±S.E.)
Perca fluviatilis	Perch	25.723 (6.018)
Rutilis rutilis	Roach	21.929 (5.484)
Rutilis rutilis x Abramis brama	Roach x Bream	7.889 (3.244)
Salmo trutta	Brown trout	4.440 (1.398)
Scardinius erythrophthalmus	Rudd	0.970 (0.680)
Tinca tinca	Tench	4.478 (2.416)
Esox lucius	Pike	3.295 (2.798)
Gasterosteus aculeatus	Three-spined stickleback	0.001 (0.001)
*Anguilla anguilla**	European eel*	1.348 (0.870)

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

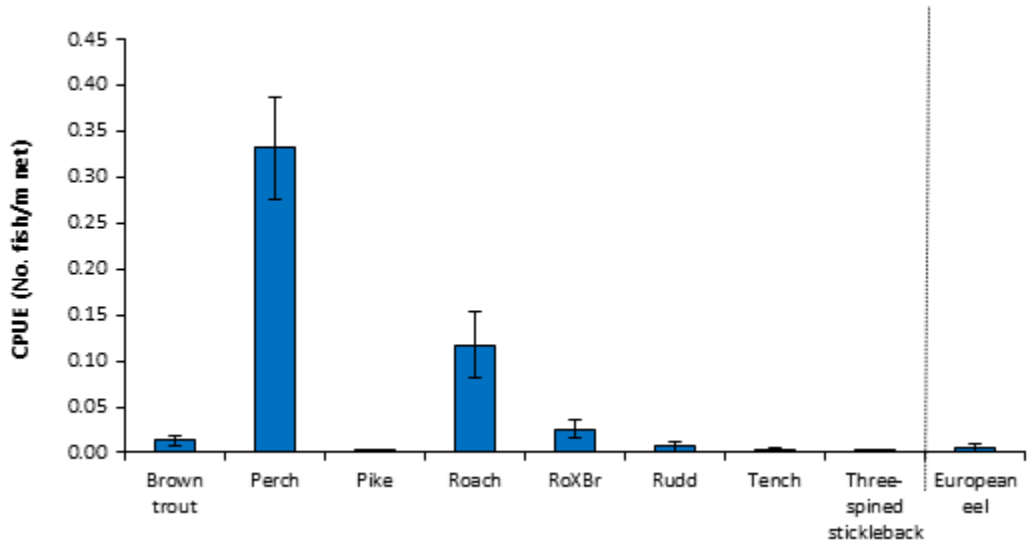

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Ennell (all nets) (Eel CPUE based on fyke nets only), 2017

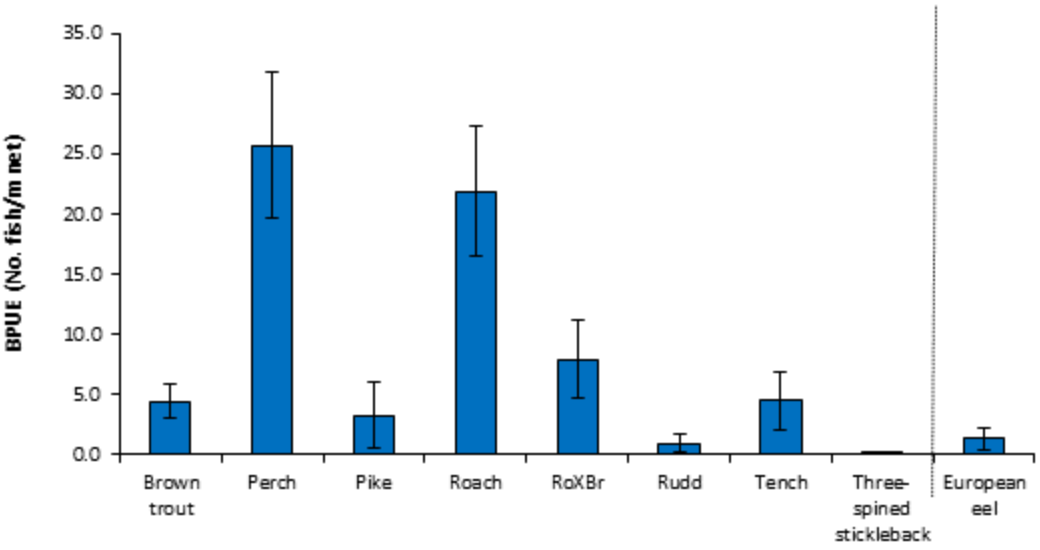

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Ennell (all nets) (Eel CPUE based on fyke nets only), 2017

1.3.3 Length frequency distributions and growth

Perch

Perch captured during the 2017 survey ranged in length from 4.8cm to 35.5cm (mean = 12.8cm) (Fig.1.4) with eleven age classes present, ranging from 0+ to 11+ with a mean L1 of 6.8cm (Table 1.3). The dominant age class was 0+ (Fig. 1.4).

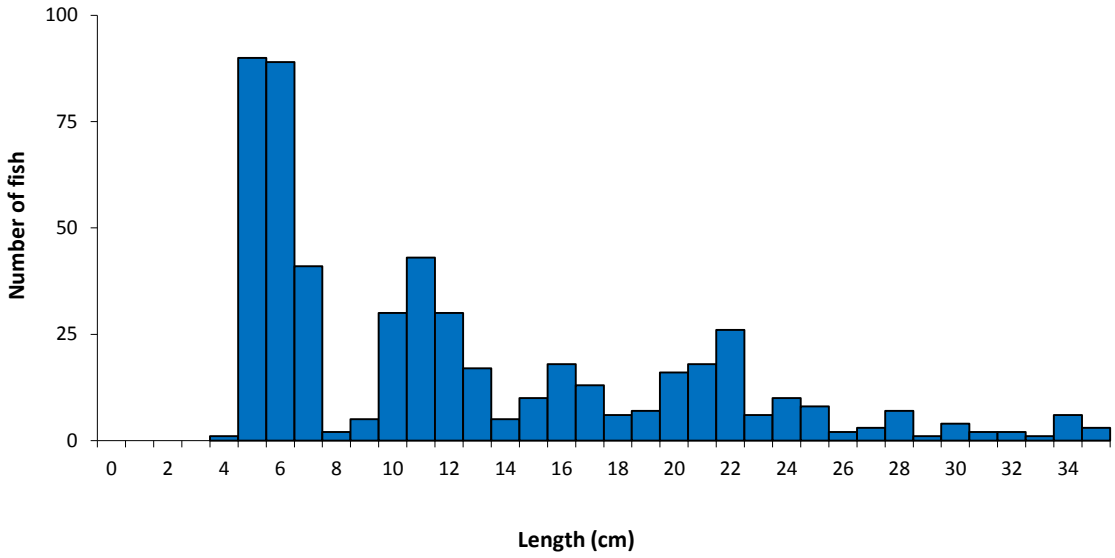

Fig. 1.4. Length frequency of perch captured on Lough Ennell, September 2017

Table 1.3. Mean (±S.E.) perch length (cm) at age for Lough Ennell, September 2017

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
Mean	6.9	12.2	17.6	21.5	24.7	26.7	28.0	29.7	31.9	31.2	32.8
(±S.E.)	(0.2)	(0.3)	(0.3)	(0.3)	(0.4)	(0.5)	(0.6)	(0.8)	(0.9)	(1.0)	(1.0)
N	66	53	45	34	24	19	13	9	6	2	2
Range	4.2-13.7	9.0-18.9	12.6-21.6	17.3-25.6	21.5-29.1	23.5-31.0	24.4-31.7	25.6-32.7	29.2-34.7	30.1-32.3	31.8-33.9

Roach

Roach captured during the 2017 survey ranged in length from 4.0cm to 38.0cm (mean = 19.6cm) (Fig.1.5) with ten age classes present, ranging from 0+ to 10+ with a mean L1 of 3.2cm (Table 1.4). The dominant age class was 2+ (Fig. 1.5).

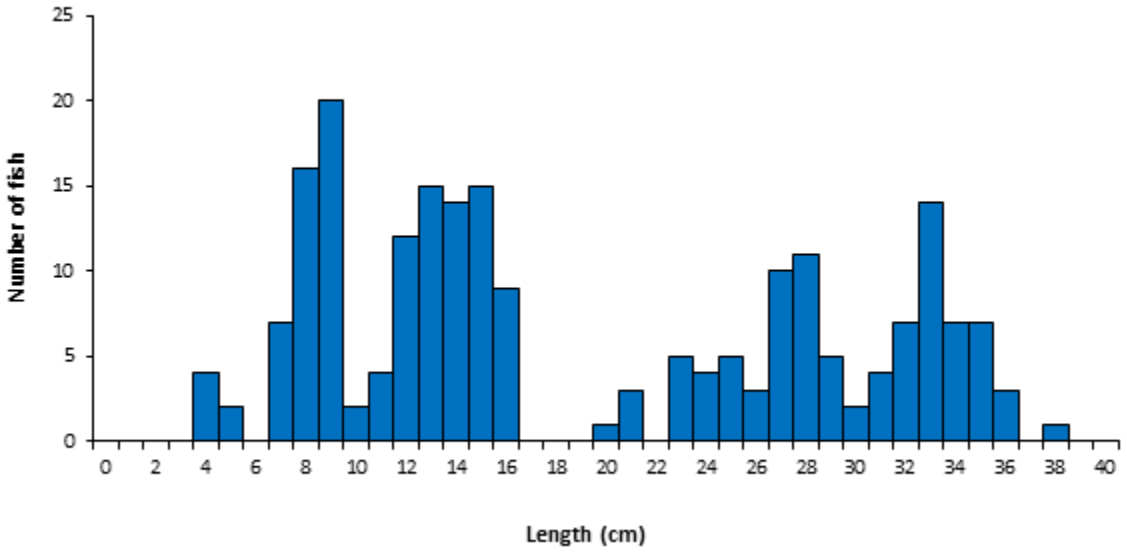

Fig. 1.5. Length frequency of roach captured on Lough Ennell, September 2017

Table 1.4. Mean (±S.E.) roach length (cm) at age for Lough Ennell, September 2017

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
Mean (±S.E.)	3.2 (0.1)	7.7 (0.2)	12.4 (0.4)	18.3 (0.5)	22.9 (0.5)	26.0 (0.5)	29.0 (0.5)	31.2 (0.5)	33.2 (0.5)	34.1
N	72	66	45	37	30	17	11	11	4	1
Range	2.0-4.5	5.0-10.3	7.4-19.6	12.1-25.7	18.8-31.8	21.5-29.0	25.4-30.7	27.1-33.1	32.4-34.4	34.1-34.1

Brown trout

Brown trout captured during the 2017 survey ranged in length from 14.8cm to 56.5cm (mean 32.1cm) (Fig. 1.6). Six age classes were present, ranging from 1+ to 6+, with a mean L1 of 6.1cm (Table 1.5). The dominant age class was 2+ (Fig. 1.6). Mean brown trout L4 in 2017 was 33.6cm indicating a fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.5).

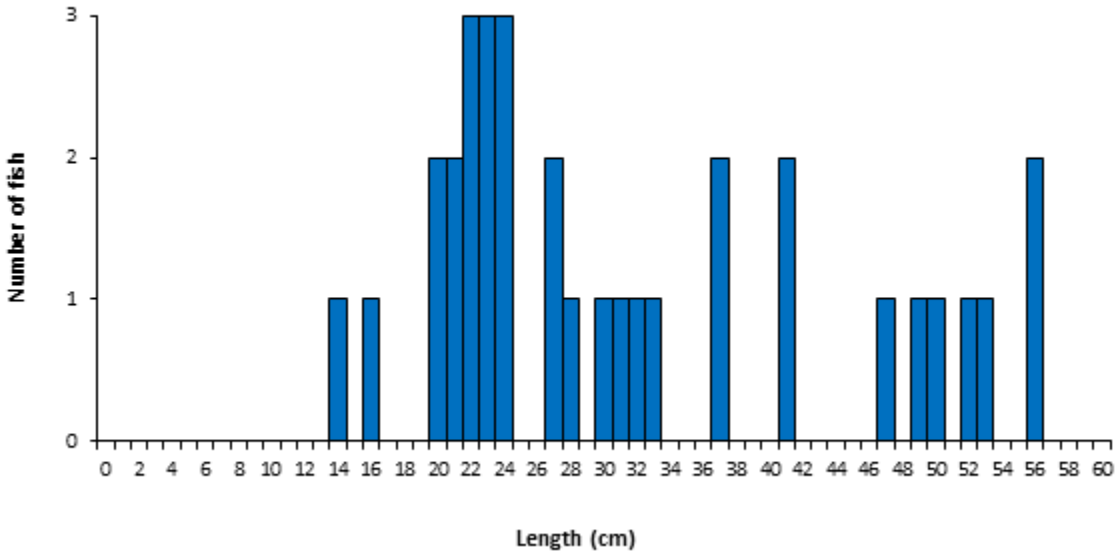

Fig. 1.6. Length frequency of brown trout captured on Lough Ennell, 2017

Table 1.5. Mean (±S.E.) brown trout length (cm) at age for Lough Ennell, September 2017

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	Growth Category
Mean (± S.E.)	6.1 (0.3)	13.0 (0.7)	21.4 (1.4)	33.6 (1.9)	41.3 (2.3)	45.3 (3.3)	54.5	Fast
N	30	27	20	10	8	3	1	
Range	3.5-8.8	6.8-25.8	11.2-33.1	23.8-43.1	30.6-49.2	38.5-48.9	54.5-54.5	

Other fish

Eels recorded during the 2017 survey ranged in length from 48.0cm to 54.0cm. Two pike were measured at 48.4cm and 78.8cm. Roach x bream hybrids ranged in length from 13.0cm to 48.0cm

(seven age classes recorded ranging from 2+ to 14+), rudd ranged from 6.3cm to 34.0cm (five age classes recorded ranging from 1+ to 12+) and tench ranged from 38.5cm to 48.0cm. One three-spined stickleback was measured at 1.6cm.

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 120 stomachs were examined. Of these 53 were found to contain no prey items. Of the remaining 67 stomachs containing food, 48% contained zooplankton, 36% unidentified digested material, 12% fish, 2% invertebrates, 1% zooplankton/fish and 1% zooplankton/unidentified digested material (Fig. 1.6).

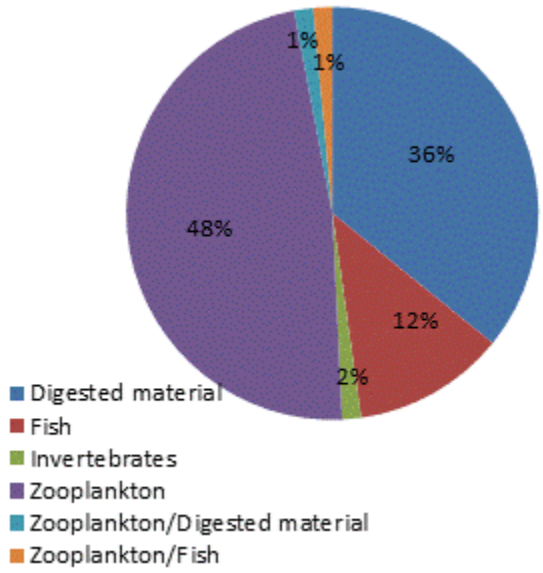

Fig 1.6. Diet of perch (n=67) captured on Lough Ennell, 2017 (% FO)

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 23 stomachs were examined. Of these seven were found to contain no prey items. Of the 16 stomachs containing food, 38% contained unidentified digested material, 25% invertebrates, 25% zooplankton, 6% unidentified digested material /invertebrates and 6% fish (Fig. 1.7).

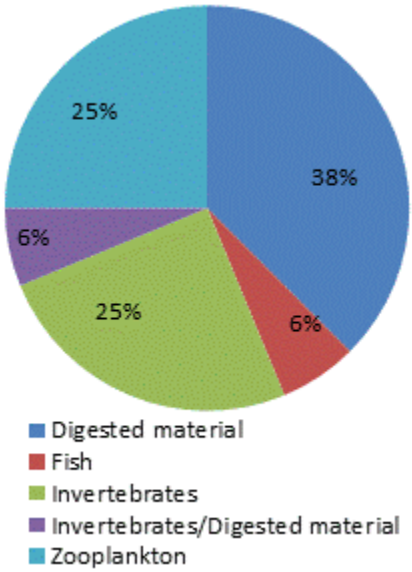

Fig 1.7. Diet of brown trout (n=16) captured on Lough Ennell, 2017 (% FO)

1.4 Summary and ecological status

A total of eight fish species and one type of hybrid were recorded on Lough Ennell in September 2017. Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2017 survey.

Perch captured during the 2017 survey ranged in length from 4.8cm to 35.5cm with eleven age classes present, ranging from 0+ to 11+, indicating reproductive success in eleven of the previous twelve years. The dominant age class was 0+.

Roach ranged in length from 4.0cm to 38.0cm (mean = 19.6cm) with ten age classes present, ranging from 0+ to 10+, indicating reproductive success in ten of the previous eleven years. The dominant age class was 2+.

Brown trout ranged in length from 14.8cm to 56.5cm with six age classes present, ranging from 1+ to 6+, indicating reproductive success in six of the previous seven years. The dominant age class was 2+. Length at age analyses revealed that brown trout in the lake exhibit a 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 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 Ennell has been assigned an ecological status of Moderate for 2017 based on the fish populations present.

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

1.5 References

Amundsen, P.A., Gabler H.M. and Staldvik F.J. (1996) A new approach to graphical analysis of feeding strategy from stomach contents data—modification of the Costello (1990) method. *Journal of Fish Biology,* **48,** 607–614.

Caffrey, J. (2010) *IFI Biosecurity Protocol for Field Survey Work*. Inland Fisheries Ireland.

Connor, L., Matson R. and Kelly F.L. (2017) Length-weight relationships for common freshwater fish species in Irish lakes and rivers. *Biology and Environment: Proceedings of the Royal Irish Academy,* **117 (**2), 65-75.

Hjelm, J., Persson, L., and Christensen, B. (2000). Growth, morphological variation and ontogenetic niche shifts in perch (*Perca fluviatilis*) in relation to resource availability. *Oecologia*, **122, (2),** 190-199.

IFI (2017) www.fishinginireland.info

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.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012b) 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.

NPWS (2017) Natura 2000 Data Form. National Parks and Wildlife Service, Dublin.

NPWS (2014) Site Synopsis, Lough Ennell SPA, Site Code 004044. National parks and Wildlife Service, Dublin.

O' Grady, M.F. (1981) *A Study of Brown Trout (Salmo trutta L.) Populations in Selected Irish Lakes*. Ph.D. Thesis, National University of Ireland.

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

www.fisheriesireland.ie
info@fisheriesireland.ie

+353 1 8842 600