National Research Survey Programme

Lakes 2016

Lickeen Lough

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Iascach Intíre Éireann
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Fish Stock Survey of Lickeen Lough, September 2016

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

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

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1.1 Introduction

Lickeen Lough is situated in the Inagh catchment, approximately 3km north-east of Ennistymon, Co. Clare (Plate 1.1 and Fig. 1.1). It has a surface area of 84ha, a mean depth >4m, a maximum depth of 20m and is characterised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l $CaCO_3$).

Historically, Lickeen Lough held a stock of Arctic char (O' Reilly, 2007). However the population is now extinct. A substantial fish kill (effecting brown trout, rainbow trout, perch and other species) occurred in the lake in June 1998, which may have contributed to their demise. Wild brown trout up to 2.3kg are taken from the lake by anglers and it is stocked annually with rainbow trout by the Lickeen Lough Trout Anglers Co-operative. The lake is subject to water abstraction, supplying drinking water to North County Clare (Lickeen Lough Trout Anglers Co-operative, 2010).

Lickeen Lough 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 rudd were found to be the dominant species present in the lake. Brown trout, three spined stickleback and eels were also captured during the survey.

During the 2010 survey, an extensive algal bloom was visible on the lake and another bloom was evident during the 2016 survey (Plate 1.2).

Plate 1.1 Lickeen Lough

Plate 1.2 Algal bloom on Lickeen Lough, September 2016

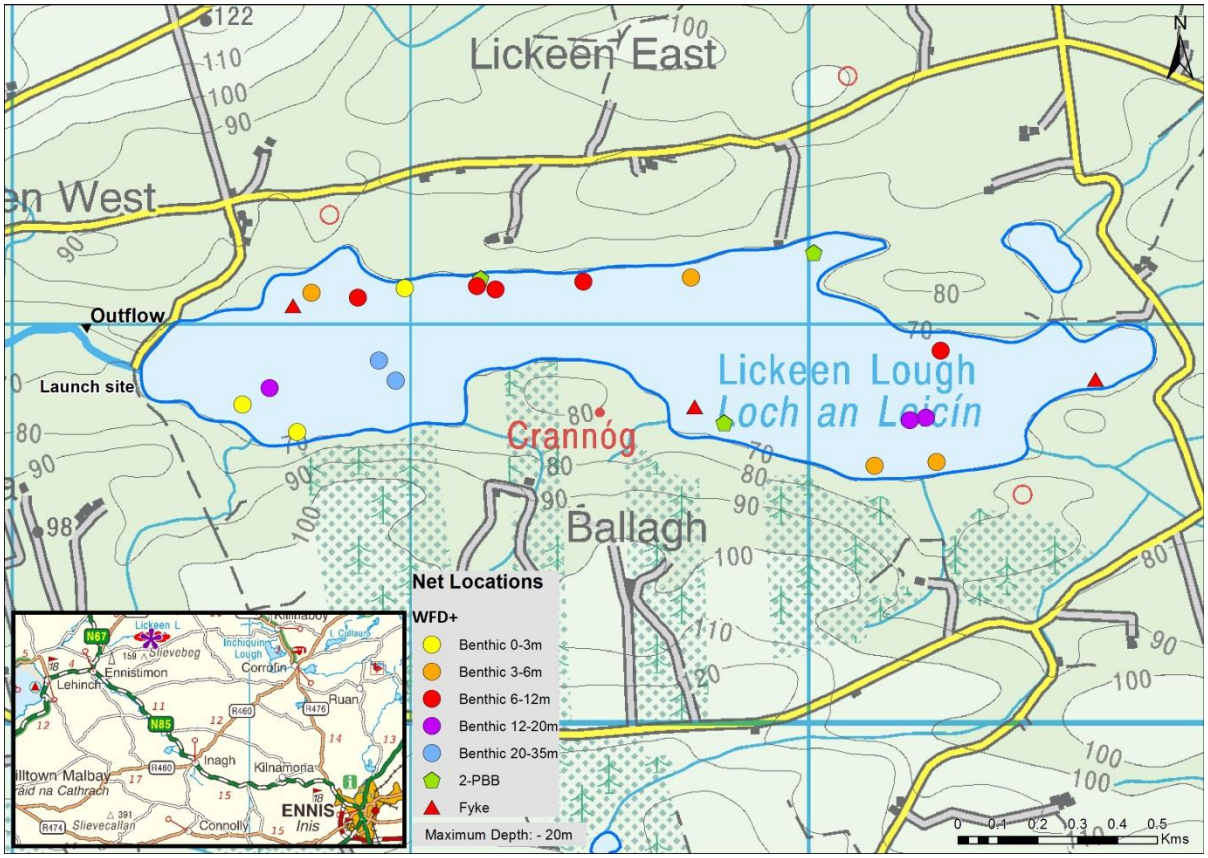

Fig. 1.1. Location map of Lickeen Lough showing net locations and depths of each net (outflow is indicated on map)

1.2 Methods

1.2.1 Netting methods

Lickeen Lough was surveyed over two nights from the 19th to the 21st of September 2016. A total of three sets of Dutch fyke nets and 17 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (3 @ 0-2.9m, 4 @ 3-5.9m, 5 @ 6-11.9m, 3 @ 12-19.9m and 2 @ 20-34.9m) were deployed in the lake (20 sites). The netting effort was supplemented using three two-panel benthic braided (63.5mm and 88.9mm mesh knot to knot) survey gill nets (2-PBB).

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 were measured and weighed on site and scales were removed from all brown trout and rudd. 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.

1.2.3 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.

1.2.2 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 on the IFI NRSP team when moving between water bodies.

1.3 Results

1.3.1 Species Richness

A total of three fish species were recorded on Lickeen Lough in September 2016, with 306 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Rudd was the most common fish species recorded, followed by brown trout and eels. During the previous surveys in 2013, 2010 and 2007 the same species composition was recorded with the exception of three spined stickleback which were not recorded in the 2016 survey (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 Lickeen Lough, September 2016

Scientific name	Common name	Number of fish captured			
		2-PBB	BM CEN	Fyke	Total
Scardinius erythrophthalmus	Rudd	0	250	6	256
Salmo trutta	Brown trout	0	44	2	46
Anguilla anguilla	Eel	0	0	4	4

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 2016 survey are summarised in Table 1.2.

Rudd was the dominant fish species in terms of both abundance (CPUE) and biomass (BPUE) captured during the 2016 survey (Table 1.2).

The mean CPUE and BPUE (excluding the larger 88.9mm mesh panel) for all species captured in the 2007, 2010, 2013 and 2016 surveys are illustrated in Figure 1.2 and 1.3.

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

Scientific name	Common name	Mean CPUE (± S.E) **
Scardinius erythrophthalmus	Rudd	0.397 (0.099)
Salmo trutta	Brown trout	0.065 (0.017)
*Anguilla Anguilla**	European eel*	0.022 (0.015)*
		Mean BPUE (± S.E) **
Scardinius erythrophthalmus	Rudd	18.825 (5.508)
Salmo trutta	Brown trout	10.012 (3.358)
*Anguilla anguilla**	European eel*	4.686 (2.856)*

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

**CPUE and BPUE data above for all fish species except eels are not comparable to earlier surveys as an extra panel was added to the 2-PBB to provide additional information on large coarse fish.

Brown trout

Brown trout CPUE and BPUE decreased after the 2007 survey, increased slightly from the 2010 to 2016 sampling occasions; however these differences were not statistically significant (Fig 1.2 and 1.3).

Rudd

The mean rudd CPUE and BPUE increased after the 2007 survey, decreased from 2010 to 2013 and increased in the 2016 survey; however these differences were also not statistically significant (Fig 1.2 and 1.3).

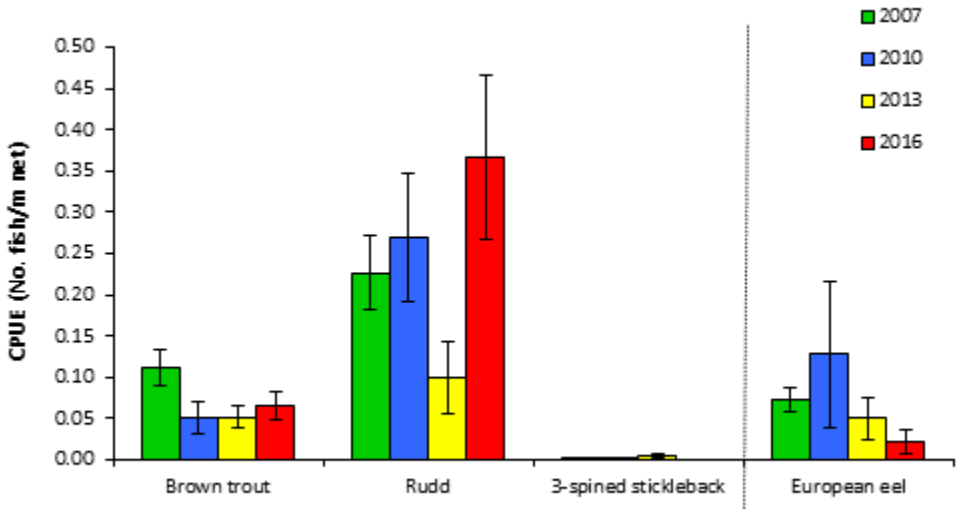

Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lickeen Lough (Eel CPUE based on fyke nets only), 2007, 2010, 2013 and 2016

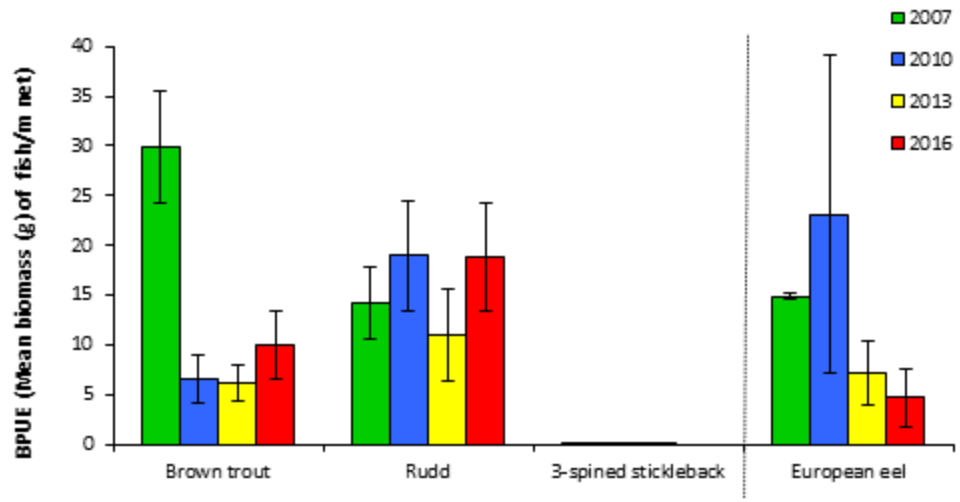

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lickeen Lough (Eel BPUE based on fyke nets only), 2007, 2010, 2013 and 2016

1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2016 survey ranged in length from 13.3cm to 32.8cm (mean = 22.5cm) (Fig.1.4). Four age classes were present, ranging from 1+ to 4+, with a mean L1 of 7.1cm (Table 1.3). The dominant age class was 1+ (Fig. 1.4). Mean brown trout L4 in 2016 was 28.1cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.3). Brown trout captured during the 2010 and 2013 surveys had similar length and age ranges, with the narrowest range exhibited in 2016 (Fig.1.4).

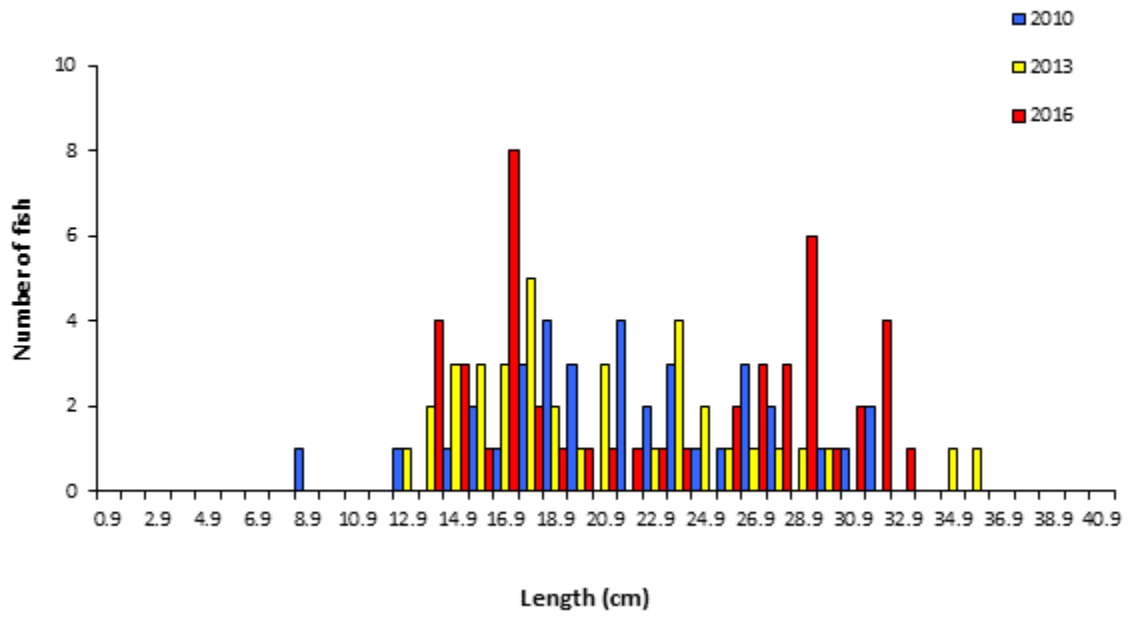

Fig. 1.4. Length frequency of brown trout captured on Lickeen Lough, 2010, 2013 and 2016

Table 1.3. Mean (±S.E.) brown trout length (cm) at age for Lickeen Lough, September 2016

	L_1	L_2	L_3	L_4	Growth Category
Mean (±S.E.)	7.1 (0.2)	16.8 (0.3)	24.3 (0.5)	28.1 (0.3)	Slow
N	34	21	9	2	
Range	5.7-10.2	14.6-19.0	22.5-26.9	27.8-28.4	

Rudd

Rudd captured during the 2016 survey ranged in length from 7.2cm to 24.0cm (mean = 13.8 cm) (Fig. 1.5). Nine age classes were present, ranging from 1+ to 10+, with a mean L1 of 3.0cm (Table 1.4). The dominant age class was 3+ (Fig. 1.5). Rudd captured during the 2010 survey had a similar length and age range (Fig.1.5); however the rudd recorded in 2013 had a much smaller length and age range (Fig 1.5).

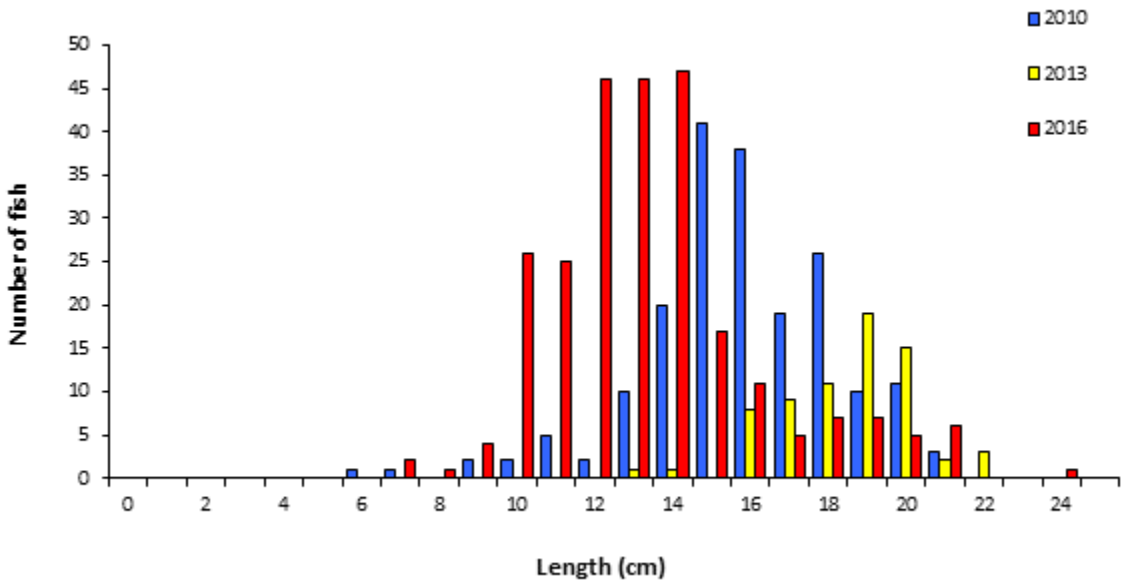

Fig. 1.5. Length frequency of rudd captured on Lickeen Lough, 2010, 2013 and 2016

Table 1.4. Mean (±S.E.) rudd length (cm) at age for Lickeen Lough, September 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}
Mean (±S.E.)	3.0 (0.1)	6.3 (0.2)	9.9 (0.2)	12.5 (0.3)	14.6 (0.4)	16.2 (0.4)	17. 7 (0.3)	18.9 (0.3)	19.9 (0.5)	19.1
N	42	40	34	21	18	14	11	11	4	1
Range	2.0-4.1	3.8-8.2	6.8-12.5	9.6-15.3	11.6-17.2	13.6-18.3	16.2-19.3	17.4-20.3	18.5-20.8	19.1-19.1

Other fish

Four eels captured during the 2016 survey ranged in length from 37.5m to 54.0cm.

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 brown trout captured during the survey were examined and are presented below.

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 22 stomachs were examined. Of these six were found to contain no prey items. Of the remaining 16 stomachs containing food, 44% contained zooplankton, 31% invertebrates, 13% unidentified digested material, 6% fish and 6% fish/zooplankton (Fig 1.6).

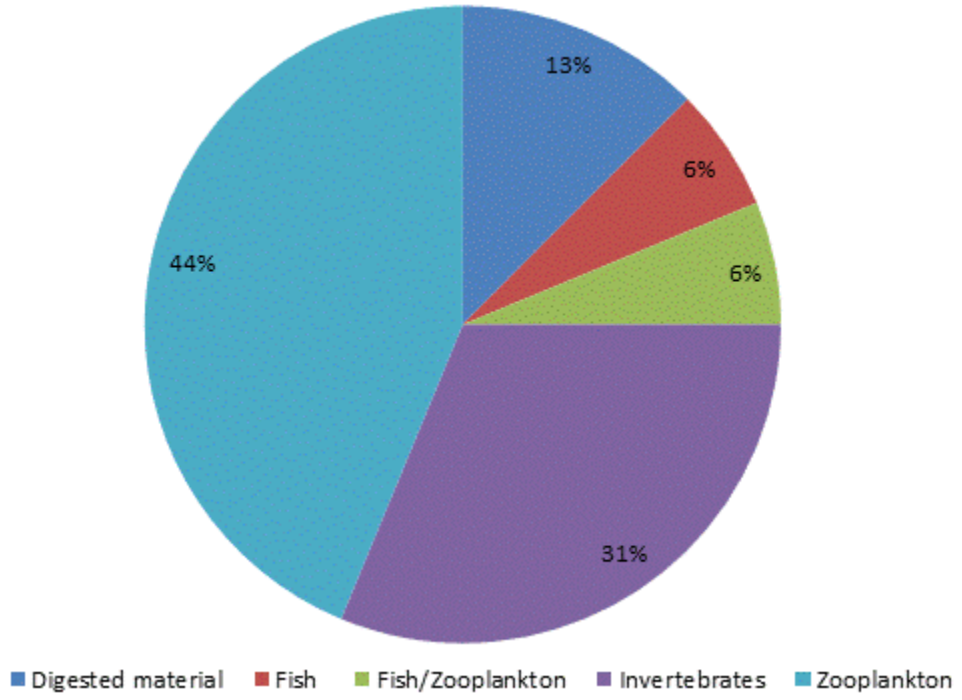

Fig. 1.6. Diet of brown trout (n=16) captured on Lickeen Lough, 2016 (% occurrence)

1.4 Summary and ecological status

A total of three fish species were recorded on Lickeen Lough in the September 2016 survey. Rudd was the dominant fish species in terms of both abundance (CPUE) and biomass (BPUE) captured in the survey gill nets.

Brown trout CPUE and BPUE decreased after 2007, increased slightly from the 2010 and 2013 sampling occasions; however, these differences were not statistically significant. Brown trout ranged in length from 13.3cm to 32.8cm with four age classes ranging from 1+ to 4+, indicating reproductive success in five of the previous six years. The dominant age class was 1+. Length at age analyses revealed that brown trout in the lake exhibit a slow rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971).

The mean rudd CPUE and BPUE fluctuated between 2007 and 2016; however, these differences were not statistically significant. Rudd ranged in length from 7.2cm to 24.0cm with nine age classes ranging from 1+ to 10+, indicating reproductive success in ten of the previous eleven years. The dominant age class was 3+.

There has been a substantial change in the fish populations in the lake since the 1990s; char and perch are absent from the lake, leading to the conclusion that the substantial fish kill in 1998 and the effects of continued eutrophication have contributed to their demise. The lake may also have been subject to the illegal stocking of rudd, a non-native fish species, over the last ten years as they have been captured in the current and previous WFD lake fish surveys but were not recorded in the lake in the 1990s. Lickeen Lough is stocked with rainbow trout (a non-native species). These hatchery reared fish have been released into the lake to create an angling amenity in the area, as the native brown trout stock have declined in recent years and cannot support large fishing pressures. No stocked rainbow trout were captured during the present survey.

A summary of the effects of stocking on the lake and recommendations for the future can be found in the 2010 survey report (Kelly *et al.,* 2011a).

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, Lickeen Lough has been assigned an ecological status of Bad for 2016 based on the fish populations present. The lake was assigned a fish status of Bad in 2010 and Poor for 2007 and 2013.

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

1.5 References

Amundsen P-A, Gabler H-M, Staldvik FJ. (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.

Kelly, F. and Connor, L. (2007). *WFD Surveillance Monitoring - Fish in Lakes (2007).* Central Fisheries Board Unpublished Report.

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, NSSHARE project.

Kelly, F.L., Harrison A., Connor, L., Morrissey, E., Wogerbauer, C., Matson, R., Feeney, R., O'Callaghan, R. and Rocks, K. (2011a) *Water Framework Directive Fish Stock Survey of Lickeen Lough, September 2010*. Inland Fisheries Ireland.

Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., Wogerbauer, C., Feeney, R., O'Callaghan, R. and Rocks, K. (2011b) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland.

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.

Kelly, F.L., Connor, L., Morrissey, E., Coyne, J., Matson, R., Feeney, R. and Rocks, K. (2014) *Water Framework Directive Fish Stock Survey of Lickeen Lough, September 2013*. Inland Fisheries Ireland.

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.

Lickeen Lough Trout Anglers Co-operative (2010) www.fishing-burren.com

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.

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

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