National Research Survey Programme
Lakes 2019

Lough Inagh

IFI/2020/1-4507

Iascach Intíre Éireann
Inland Fisheries Ireland

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Fish Stock Survey of Lough Inagh, September 2019

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ACKNOWLEDGEMENTS

1.1 Introduction

Lough Inagh is situated in the Ballynahinch system approximately 7.5km north of Recess, Co. Galway. The lake is located in the Inagh valley with the Twelve Pins Mountains rising to the west and the Maumturk mountain range to the east. Lough Inagh is fed primarily from the Tooreenacoona River, which then flows out of the lake into Derryclare Lough (Plate 1.1, Fig. 1.1).

The lake has a surface area of 309ha and 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 Inagh is situated within the Twelve Bens/Garraun Complex Special Area of Conservation (SAC). This is an extensive SAC located in the north-west of Connemara and is dominated by mountainous terrain. Geologically, the SAC can be divided into two distinct sections; the Twelve Bens which are composed of quartzite and schists in the valleys and the mountains to the north of Kylemore which are composed of gneiss, sandstones and mudstones (NPWS, 2005). The main soil type within the site is peat. Eight of the habitat types listed in the SAC are found in Annex I of the EU Habitats Directive. The SAC also contains many species listed on Annex II of the Habitats Directive: freshwater pearl mussel, Atlantic salmon, otter and the plant, slender naiad (NPWS, 2005).

Lough Inagh is part of the Lough Inagh and Derryclare Fishery. The lake holds a stock of brown trout and has a spring and grilse salmon fishery and a run of sea trout (O' Reilly, 2007). The lake was previously surveyed in 2002 and 1997 (Gargan and Rogers, 2002). At that time the lake held a stock of Arctic char, brown trout, sea trout, minnow and eel (Gargan and Rogers, 2002).

Perch were discovered in the lake in 2016, since then stock management efforts (using perch traps) have been on-going to remove them from the lake.

This report summarises the results of the 2019 fish stock survey. This survey was a joint survey, carried out by IFIs, National Research Survey Program and Habitats Directive and Red Data Book teams. The aim of the survey was to assess the current status of fish stocks in Lough Inagh after the introduction of perch, and determine the current status of Arctic char in the lake.
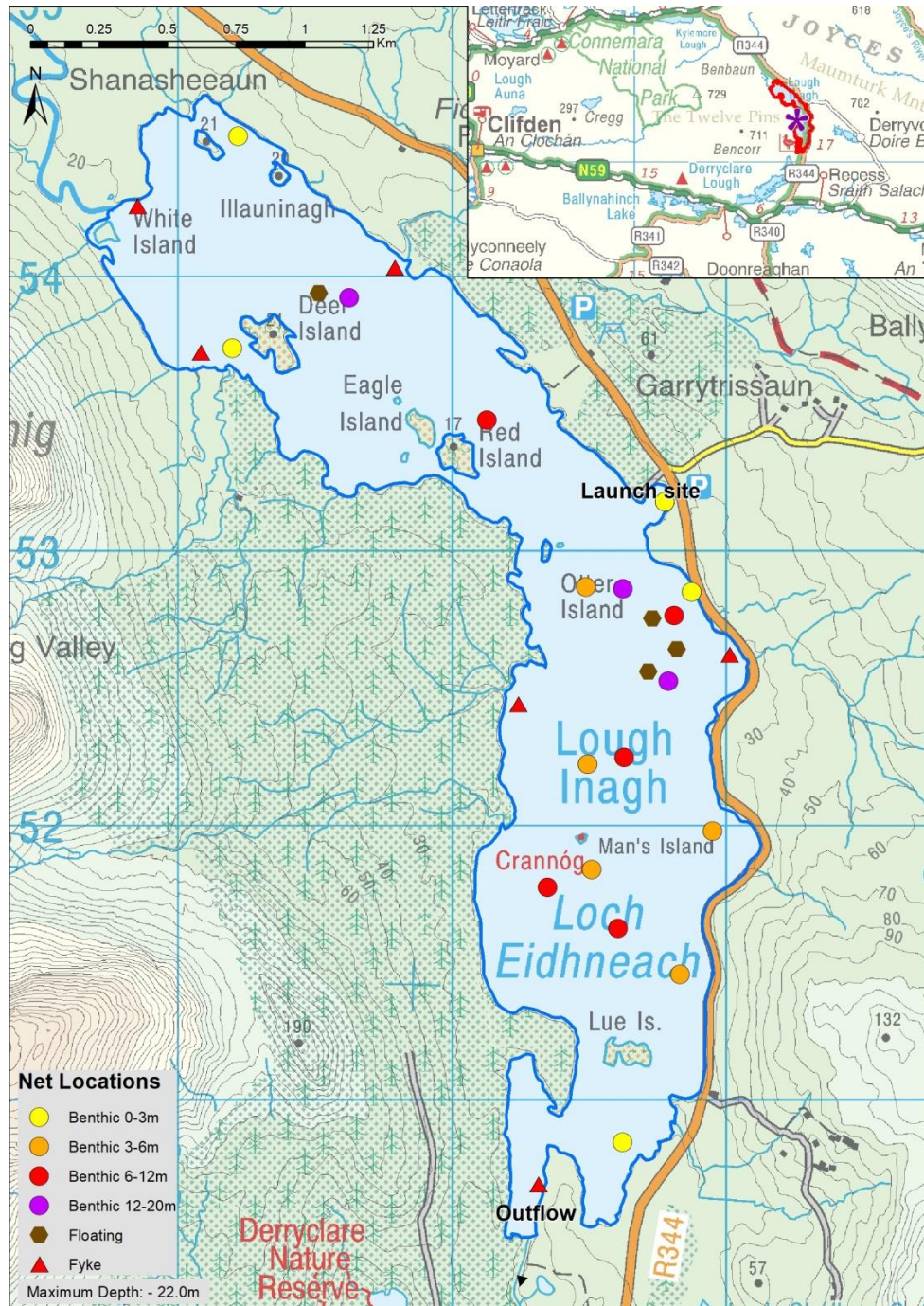
Plate 1.1. Lough Inagh

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

1.2 Methods

1.2.1 Netting methods

Lough Inagh was surveyed over two nights from the 23rd to the 25th of September 2019. A total of six sets of Dutch fyke nets, 18 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m and 3 @ 12-19.9m) and four floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (28 sites). 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, sea 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).

$$\%FO_i = (N_i/\ N)\times100$$

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 (sea trout are included as a separate 'variety' of trout) were recorded in Lough Inagh in September 2019, with 244 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, sea trout and salmon.

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

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
Perca fluviatilis	Perch	195	0	15	210
Salmo trutta	Brown trout	11	7	1	19
	Sea trout	1	0	0	1
Salmo salar	Atlantic salmon	1	0	0	1
Anguilla anguilla	European eel	0	0	13	13

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 2019 survey are summarised in Table 1.2 and illustrated in Figures 1.2 and 1.3.

Perch were the dominant species in terms of CPUE and BPUE followed by brown trout, sea trout and salmon (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 Inagh, 2019

Scientific name	Common name	Mean CPUE (± S.E)
Perca fluviatilis	Perch	0.241 (0.057)
Salmo trutta	Brown trout	0.022 (0.007)
	Sea trout	0.001 (0.001)
Salmo salar	Atlantic salmon	0.001 (0.001)
*Anguilla anguilla**	European eel*	0.036 (0.012)*
		Mean BPUE (± S.E)
Perca fluviatilis	Perch	20.409 (4.983)
Salmo trutta	Brown trout	12.651 (5.218)
	Sea trout	0.952 (0.952)
Salmo salar	Atlantic salmon	0.003 (0.003)
*Anguilla anguilla**	European eel*	4.170 (1.552)*

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
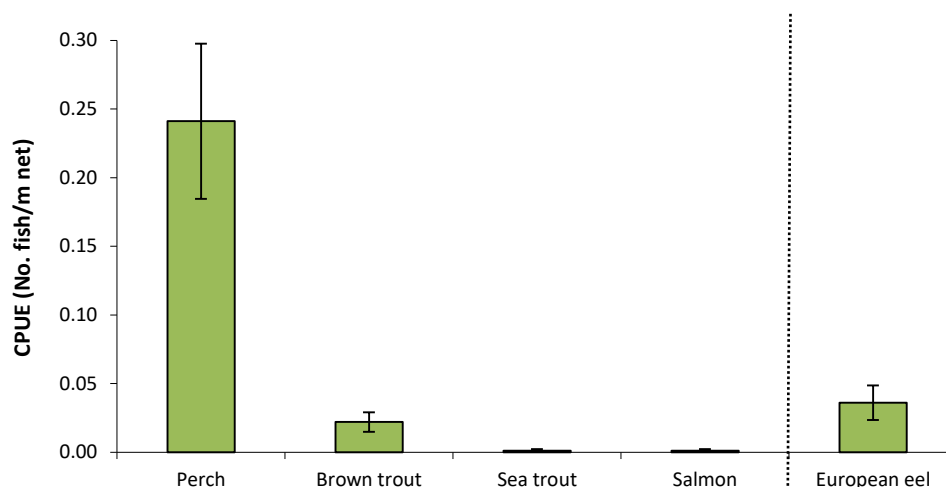

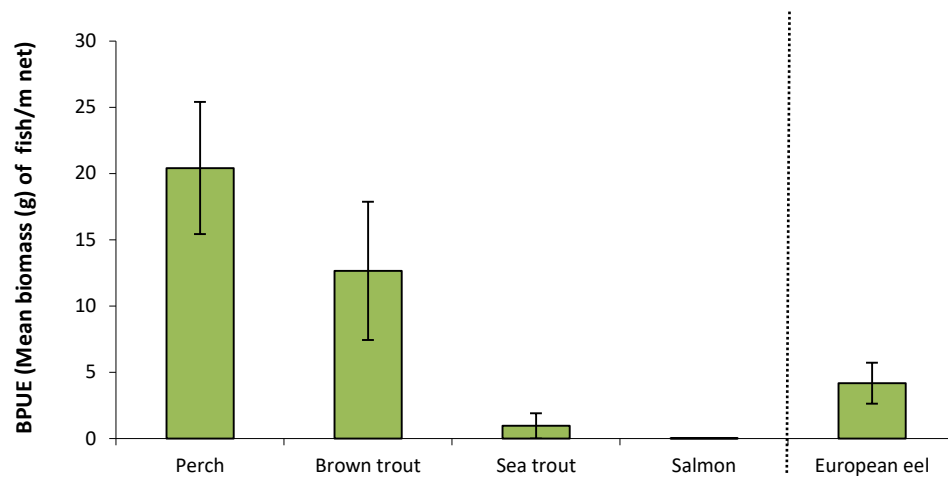**Fig. 1.2. Mean (±S.E.) CPUE for all fish species captured in Lough Inagh (Eel CPUE based on fyke nets only), 2019**

Fig. 1.3. Mean (±S.E.) BPUE for all fish species captured in Lough Inagh (Eel BPUE based on fyke nets only), 2019

1.3.3 Length frequency distributions and growth

Perch

Perch captured during the 2019 survey ranged in length from 10.8cm to 39.3cm (mean = 17.1cm). Six age classes were present, ranging from 1+ to 6+, with a mean L1 of 7.5cm. The dominant age class was 1+ (Table 1.3, Fig 1.4.).
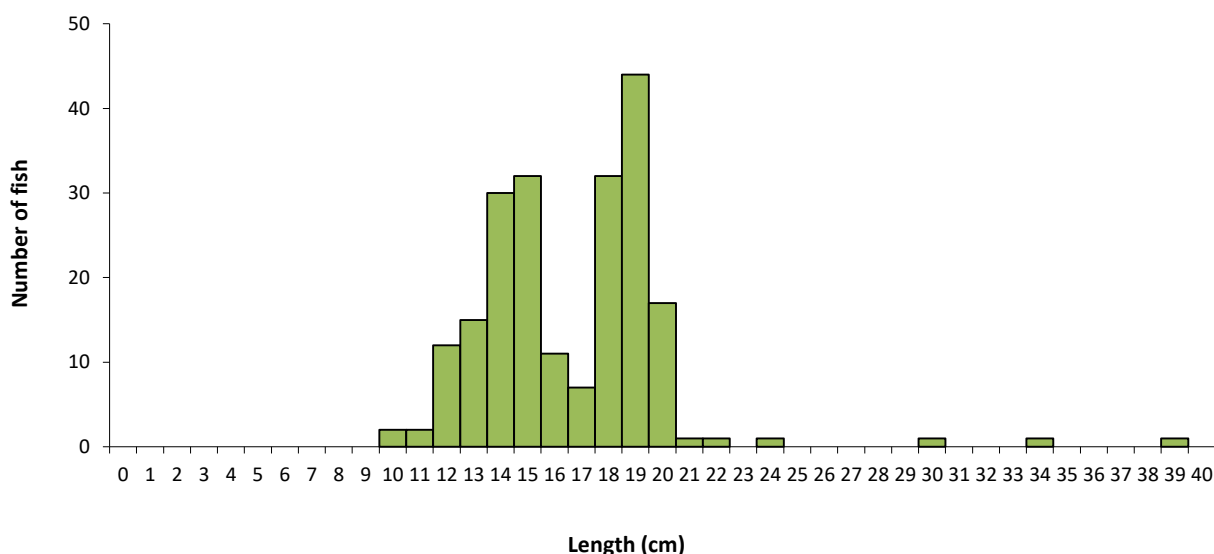

Fig. 1.4. Length frequency of perch captured on Lough Inagh, 2019

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

	L_1	L_2	L_3	L_4	L_5	L_6
Mean (±S.E.)	7.5 (0.2)	15.1 (0.5)	19.5 (0.8)	27.1 (1.2)	30.2 (1.5)	34.2 (2.8)
N	51	26	18	4	3	2
Range	5.1-11.8	10.5-23.0	13.4-26.9	24.2-29.4	27.9-32.9	31.4-36.9

Brown trout

Brown trout captured during the 2019 survey ranged in length from 14.3cm to 64.5cm (mean = 28.9cm) (Fig. 1.5). Six age classes were present, ranging from 1+ to 9+, with a mean L1 of 7.1cm. The dominant age class was 2+ (Table 1.4, Fig 1.5.). Mean brown trout L4 in 2019 was 26.7cm indicating a 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 in 2002 ranged in length from 6.1cm to 56.2cm.
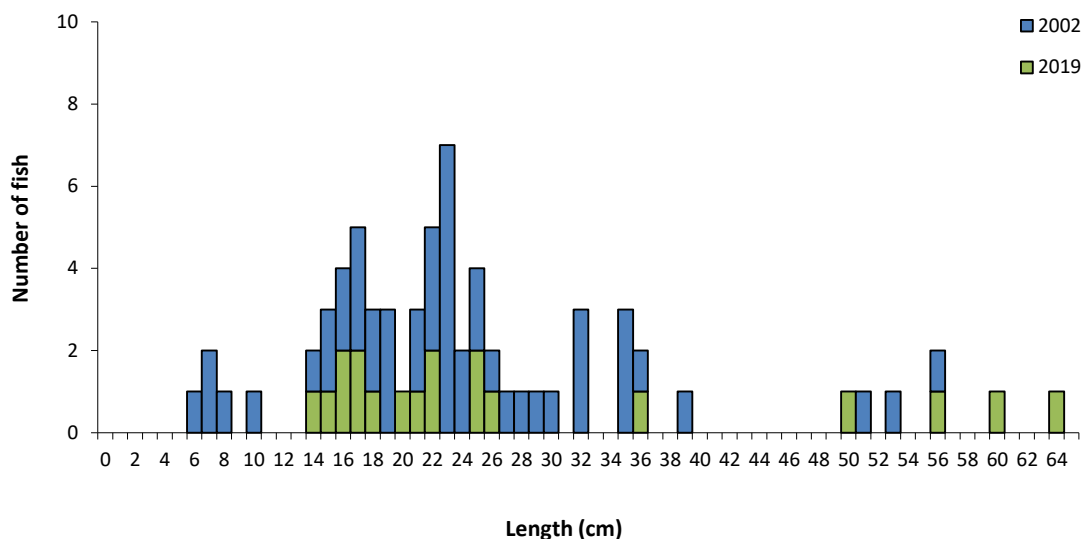

Fig. 1.5. Length frequency of brown trout captured on Lough Inagh, 2002 and 2019.

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

	L_1	L_2	L_3	L_4	L_5	L_6	L7	L_8	L_9	Growth rate
Mean (±S.E.)	7.1 (0.2)	14.9 (0.3)	20.5 (0.4)	26.7 (1.4)	33.6 (3.0)	41.6 (5.0)	50.0 (6.6)	43.3	46.5	Slow
N	17	13	6	4	4	4	3	1	1	
Range	5.2-8.8	13.5-16.7	18.6-21.6	24.0-30.7	29.2-42.2	33.3-53.6	38.1-60.9	-	-	

Other fish species

European eel ranging in length from 30.0cm to 48.5cm were recorded. One 0+ salmon measuring 6.1cm was recorded. One sea trout measuring 42.5cm and aged as 3.1.1+ was also recorded.

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 51 stomachs were examined, of these 14 were found to contain no prey items. Of the 37 remaining stomachs, 59% contained invertebrates, 32% contained zooplankton, 3% contained fish, 3% unidentified digested material and 3% contain invertebrates/zooplankton (Fig. 1.6).
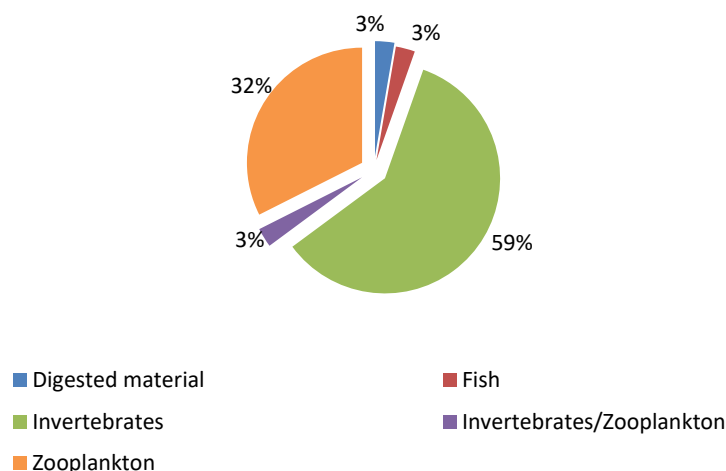

■ Digested material　　　　■ Fish
■ Invertebrates　　　　■ Invertebrates/Zooplankton
■ Zooplankton

Fig 1.6. Diet of perch (n=37) captured on Lough Inagh, September 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 ten stomachs were examined. Of these three were found to contain no prey items. Of the remaining seven stomachs containing food, 100% contained invertebrates.

1.4 Summary and ecological status

A total of four fish species (sea trout are included as a separate 'variety' of trout) were recorded in Lough Inagh in September 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. This contrasts with the previous survey in 2002 when brown trout and Arctic char were the dominant fish species in the lake (Gargan and Rogers, 2002).

Perch ranged in length from 10.8cm to 39.3cm. Six age classes were present, ranging from 1+ to 6+, this indicates successful recruitment in six if the previous seven years.

Brown trout ranged in length from 14.3cm to 64.5cm. Six age classes were present, ranging from 1+ to 9+, indicating consistent recruitment over the previous 10 years. There were no 0+ or 4+ fish recorded in 2019.   Growth rate analysis indicates a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971).

Arctic char were not captured during the 2019 survey. The Arctic char population may now be so small that it is difficult to capture using conventional sampling methods and could be on the verge of extinction.   Introductions of perch and other non-indigenous species cause declines in Arctic char populations and can also lead to extinctions in some lakes (Kelly *et al.*, 2014, Kelly *et al.*, 2017, Connor *et al.*, 2019 and Morrissey-McCaffrey *et al.*, 2018). Arctic char populations are generally sensitive to the presence of other fish species and have a tendency to be less dominant where they co-exist in Ireland (Igoe & Hammer, 2004). Arctic char conservation in Ireland should focus on protecting the remaining populations and preventing the dispersal of non-indigenous fish species to lakes where Arctic char are present because, unlike other stressors (e.g. pollution), species introductions are almost impossible to reverse (Connor et al., 2019 and Morrissey-McCaffrey et al., 2018). In Ireland, lake morphology (e.g. size and depth) may also influence the coexistence potential of brown trout and species such as pike, with implications for brown trout conservation following introduction of novel species (McLoone *et al.*, 2018).

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.*, 2012). Using the FIL2 classification tool, Lough Inagh has been assigned an ecological status of High for 2019 based on the fish populations present.

1.5 References

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