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Spelga Dam: Fish stock assessment and targeted Pike Assessment 2023

February 2024

Contents

1 Introduction

Spelga Reservoir is situated in the Mourne Mountains of County Down, at an elevation of 370 meters above mean sea level (Figure 1). It covers a catchment area of approximately 5.5 km². The reservoir is owned by Northern Ireland Water (NIW) and its recreational fishing is managed by the Department of Agriculture, Environment and Rural Affairs (DAERA) as part of its public angling estate. The construction of the reservoir and dam occurred between 1953 and 1957 with the purpose of supplying potable water to parts of Belfast and County Down. During drought periods, including the time of this survey, the water level significantly drops, reducing the lake's wetted area and revealing the original Belfast to Kilkeel road, along with various civil engineering structures such as bridges. These structures likely serve as important habitats for fish. Spelga Reservoir is recognized by DAERA as an important game angling fishery, primarily for wild brown trout (Salmo trutta). A fish stock assessment was previously undertaken within the Reservoir in 1981 (Cragg-Hine, 1981).

Following reports from local anglers of pike presence in the reservoir, AFBI undertook a preliminary netting exercise in October 2021 to investigate fish species present. A single pike specimen was captured during this preliminary survey (Gallagher and Rosell, 2021). In response to this discovery, and considering the potential impact of Spelga's wild Brown Trout stock, DAERA commissioned AFBI to conduct a fish stock assessment survey in compliance with CEN (2005) standards within the reservoir and an electrofishing survey at two feeder streams to assess the status of all species. This effort was followed by a targeted survey of pike during their spawning season in March 2023.

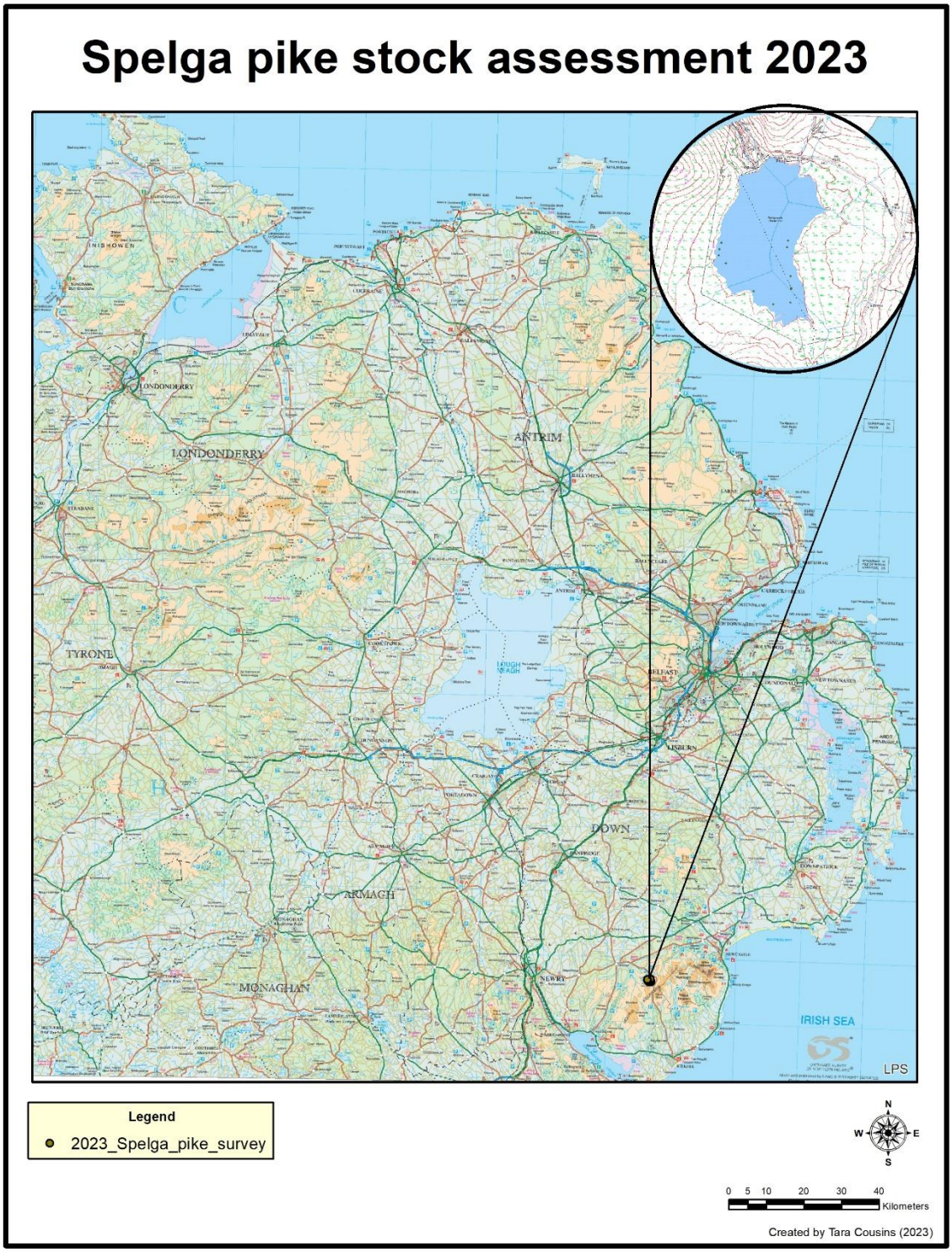


Figure 1: Map depicting the location of Spelga Dam in Northern Ireland.

2 Materials and Methods

2.1 CEN stock assessment and electrofishing survey

The reservoir was sampled over two nights, from August 23rd to August 25th, 2022. Given the size and maximum depth of Spelga Reservoir (see Figure 2), a total of four sets of double trap Dutch fyke nets, 18 EU standard monofilament multimesh gill nets (12 panel, 5 - 55mm) as per CEN (2005), and four braided nylon gill nets (mesh = 50mm) were deployed. These nets were placed at 22 different sites across various depth strata (refer to Table 1 & Figure 3). Nets were set in the afternoon and their positions recorded on a handheld GPS. Nets were then retrieved the following morning, allowing a soak time of approximately 20 hours.

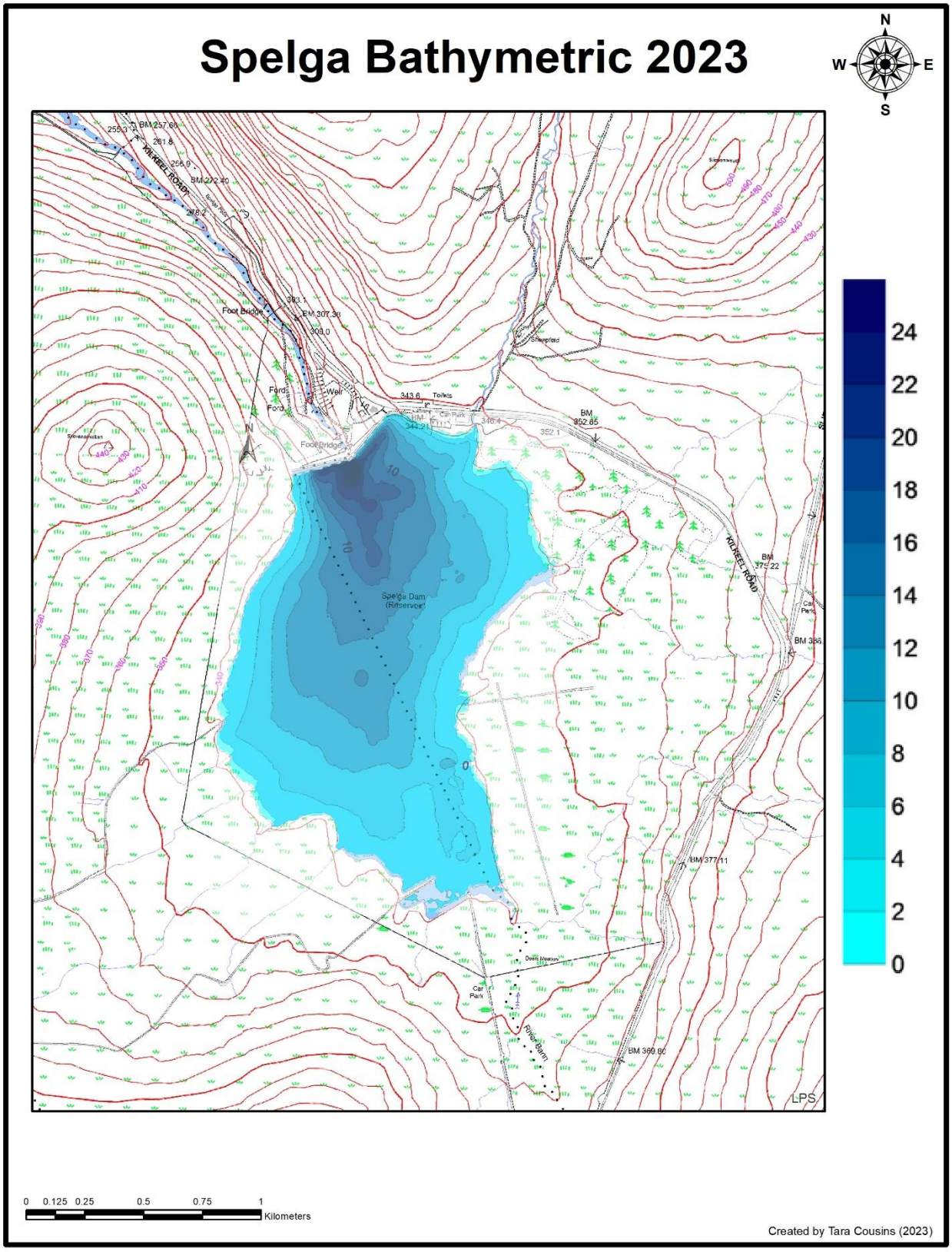


Figure 2: Bathymetric profile (provided by NIEA) of Spelga Dam.

Table 1: Net type and depth zone of ach net deployed in the current study.

Net	Net Type	Depth Zone
F1	Fyke	0-3m
F2	Fyke	0-3m
F3	Fyke	0-3m
F4	Fyke	0-3m
G1	CEN	0-3m
G2	CEN	0-3m
G3	CEN	3-6m
G4	Fixed Mesh 50mm	6m
G5	CEN	6-12m
G6	CEN	12-20m
G7	Floating CEN	>20m
G8	CEN	3-6m
G9	Fixed Mesh 50mm	4m
G10	Fixed Mesh 50mm	4m
G11	CEN	3-6m
G12	CEN	3-6m
G13	CEN	0-3
G14	CEN	0-3
G15	CEN	6-12m
G16	Floating CEN	>20m
G17	Fixed Mesh 50mm	3m
G18	CEN	6-12m

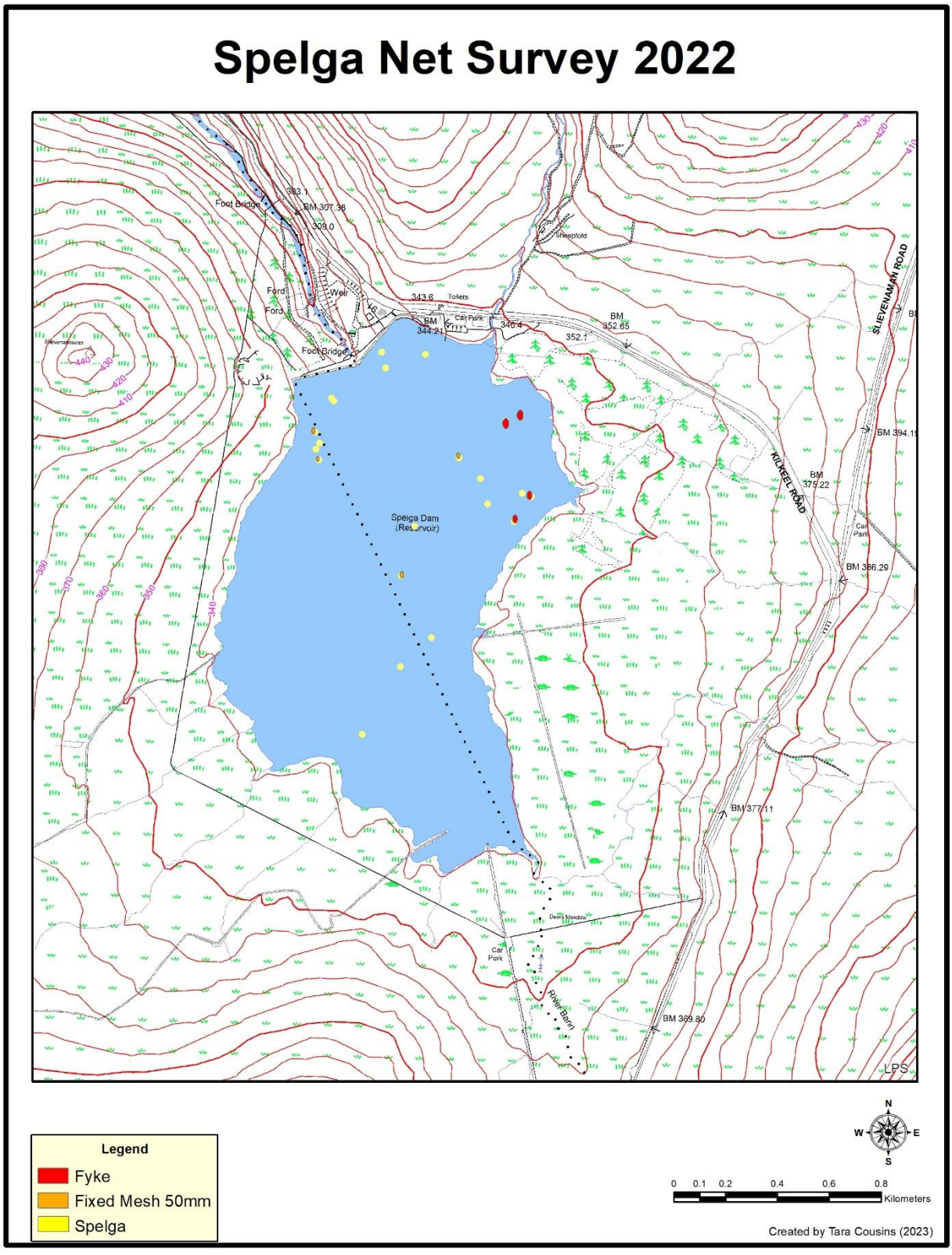


Figure 3: Location of survey nets. Yellow = Fyke Net, Orange = Fixed Mesh 50mm, and Yellow = CEN monofilament gill net.

Two feeder streams, one in the northern area of the reservoir near the main car park, and one in the southern areas of the reservoir at Deer's Meadow were sampled by electrofishing (Figure 4). The electrofishing process involved a 10-minute upstream sweep using an electrofishing backpack to provide semi-quantitative data. Due to low water conductivity in the area, the voltage on the electrofishing gear was set to 275V at 70Hz. All captured specimens were measured and returned to the stream alive. A Mann-Whitney U test was used to statistically compare the mean length of brown trout captured from the reservoir against those captured in the feeder streams.

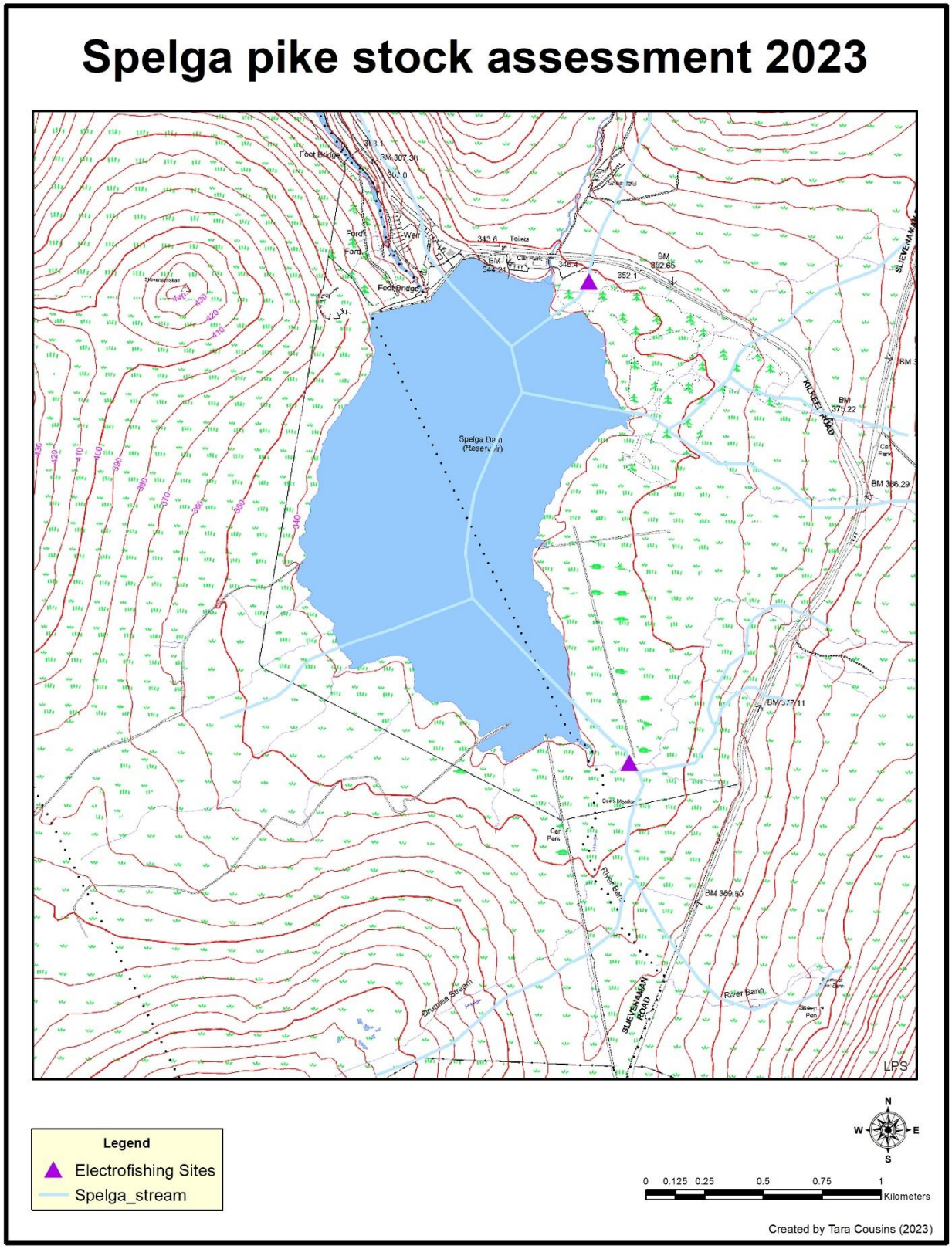


Figure 4: Location of the northern and southern stream which were electrofished in August 2022.

2.2 Targeted Pike Survey

A targeted survey of the reservoir was conducted over two nights, from March 1st to March 3rd, 2023. Nets were deployed in three zones that exhibited typical lake morphology for pike spawning. Three types of net were used; CEN multifilament, braided 40mm and braided 50mm. Nets were set individually (n = 8) or in a 50mm – CEN gang (n = 4) where the 2 types of net were combined at a site. No CEN nets were set individually. All nets were soaked for approximately 23 hours at a mean depth of 1.9m. Nets were set randomly in three zones; on the east, south and west shore (*Table 2* and Figure 5).

Table 2 - Net type, zone, depth and time of setting for nets deployed during the targeted pike survey.

Net	Net Type	Zone	Time set	Time lifted	Min Depth	Max depth
SPG_1	Gang (CEN + 50mm)	1	10:55	09:50	0.5m	1.7m
SPG_2	Gang (CEN + 50mm)	2	10:58	09:54	2.4m	1.4m
SPG_3	50mm	2	11:03	09:57	1.4m	1.6m
SPG_4	40mm	1	11:09	09:47	2m	3m
SPG_5	40mm	1	11:15	09:43	2.1m	2.8m
SPG_6	40mm	1	11:17	09:38	1.8m	2.8m
SPG_7	Gang (CEN + 50mm)	1	11:32	09:55	2.2m	2.9m
SPG_8	50mm	1	11:37	09:50	2m	2.5m
SPG_9	Gang (CEN + 50mm)	3	11:46	10:50	1.6m	2m
SPG_10	40mm	3	11:50	10:48	1m	1.3m
SPG_11	40mm	3	11:53	10:43	1.4m	1.9m
SPG_12	40mm	3	11:56	10:40	1.5m	2m

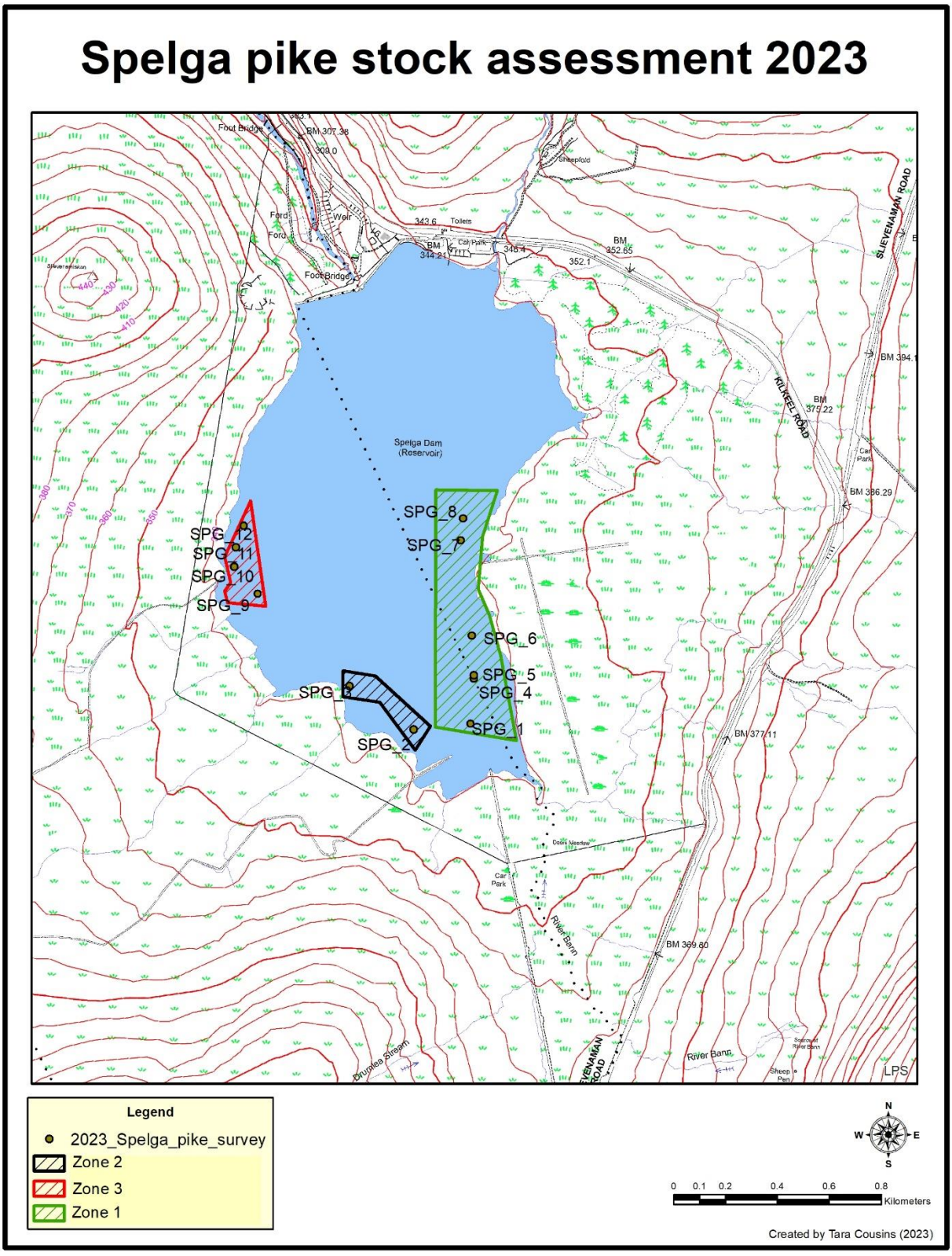


Figure 5 - Location of sampling zones and net positions at Spelga reservoir. Hashed Green = Zone 1, Black = Zone 2, Red = Zone 3.

2.3 Sample analysis

All fish were removed from the nets, placed in labelled sample bags and frozen for later analysis. In the laboratory, thawed fish were identified to species level, measured to the nearest millimetre (from tip of nose to fork in tail) and weighed (to the nearest 0.1g). Ageing structures were removed from each fish: scales were taken from brown trout and opercular bones from pike. In all fish, a longitudinal ventral incision from the vent to a line level with the pectoral fin was made. The sex of each individual fish was recorded following visual assessment of gonads following Nikolsky (1963). Presence or absence of endo (internal) and ecto (external) parasites was also recorded. Stomach contents were removed, and prey items were identified (where possible) and counted.

3 Results

3.1 CEN Fish stock assessment Survey

In the CEN fish stock assessment survey 25 fish were captured representing two species; Brown Trout (*Salmot trutta*) (18 individuals), and 3 Spined Stickleback (*Gasterosteus aculeatus*) (seven individuals) (Table *3*). No pike were captured at this time.

Table 3: Number of each species captured per net. *Denotes three – spined stickleback

Net	Net Type	Depth Zone	Brown Trout	Stickleback*
F1	Fyke	0-3m	0	0
F2	Fyke	0-3m	0	3
F3	Fyke	0-3m	0	0
F4	Fyke	0-3m	0	0
G1	CEN	0-3m	0	3
G2	CEN	0-3m	1	0
G3	CEN	3-6m	5	0
G4	Fixed Mesh 50mm	6m	1	0
G5	CEN	6-12m	3	1
G6	CEN	12-20m	2	0
G7	Floating CEN	>20m	0	0
G8	CEN	3-6m	1	0
G9	Fixed Mesh 50mm	4m	0	0
G10	Fixed Mesh 50mm	4m	0	0
G11	CEN	3-6m	0	0
G12	CEN	3-6m	0	0
G13	CEN	0-3	2	0
G14	CEN	0-3	0	0
G15	CEN	6-12m	0	0
G16	Floating CEN	>20m	0	0
G17	Fixed Mesh 50mm	3m	0	0
G18	CEN	6-12m	3	0
		Total	18	7

Calculations of catch per unit effort (no. of fish m^{-1} of net) are presented in (Table 4). Brown trout ranged in length from 15.3 to 36.7 cm, in mass from 49 to 662 g, and age ranged from 3+ to 8+ (Figure 7).

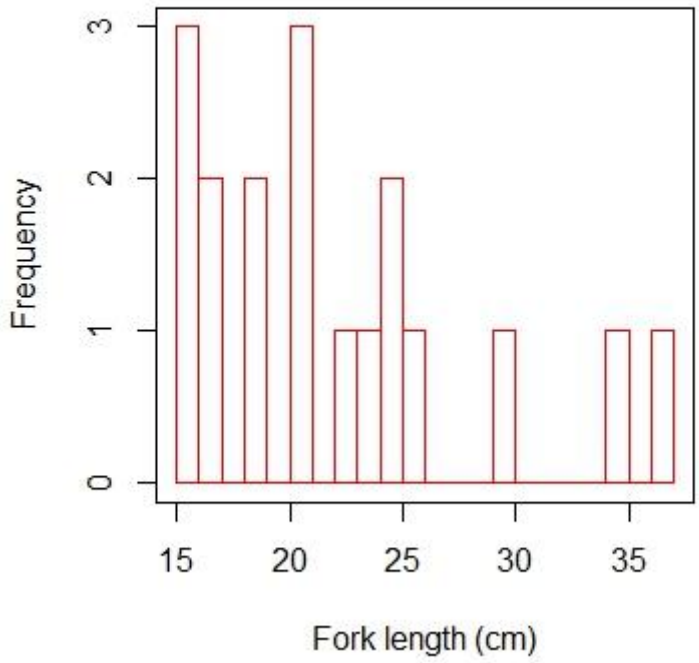


Figure 6 - Length frequency histogram of Brown Trout captured from Spelga reservoir during the 2022 CEN survey.

Brown trout exhibited a male to female sex ratio of 2:5. Analysis of stomach contents indicated a diet dominated by three-spined sticklebacks. Brown Trout ranged in age from 0+ to 8+ years and in length from 15.3 to 36.7cm (Figure *7*). Three individuals were found to be infected with cestode endoparasites. Length - Weight relationship (Fulton's condition factor) is a useful metric to assess the overall condition of fish. Parasite load was not found to impact condition factor in parasitised fish.

Table 4: Catch per Unit Effort (mean CPUE (± Standard Deviation)) of net caught fish from Spelga Reservoir. *Denotes three – spined stickleback

Net Type	Brown Trout	Stickleback*
CEN	0.041 (±0.05)	0.095 (±0.03)
Fixed Mesh 50mm	0.009 (±0.02)	0
Fyke	0	0.025 (±0.05)

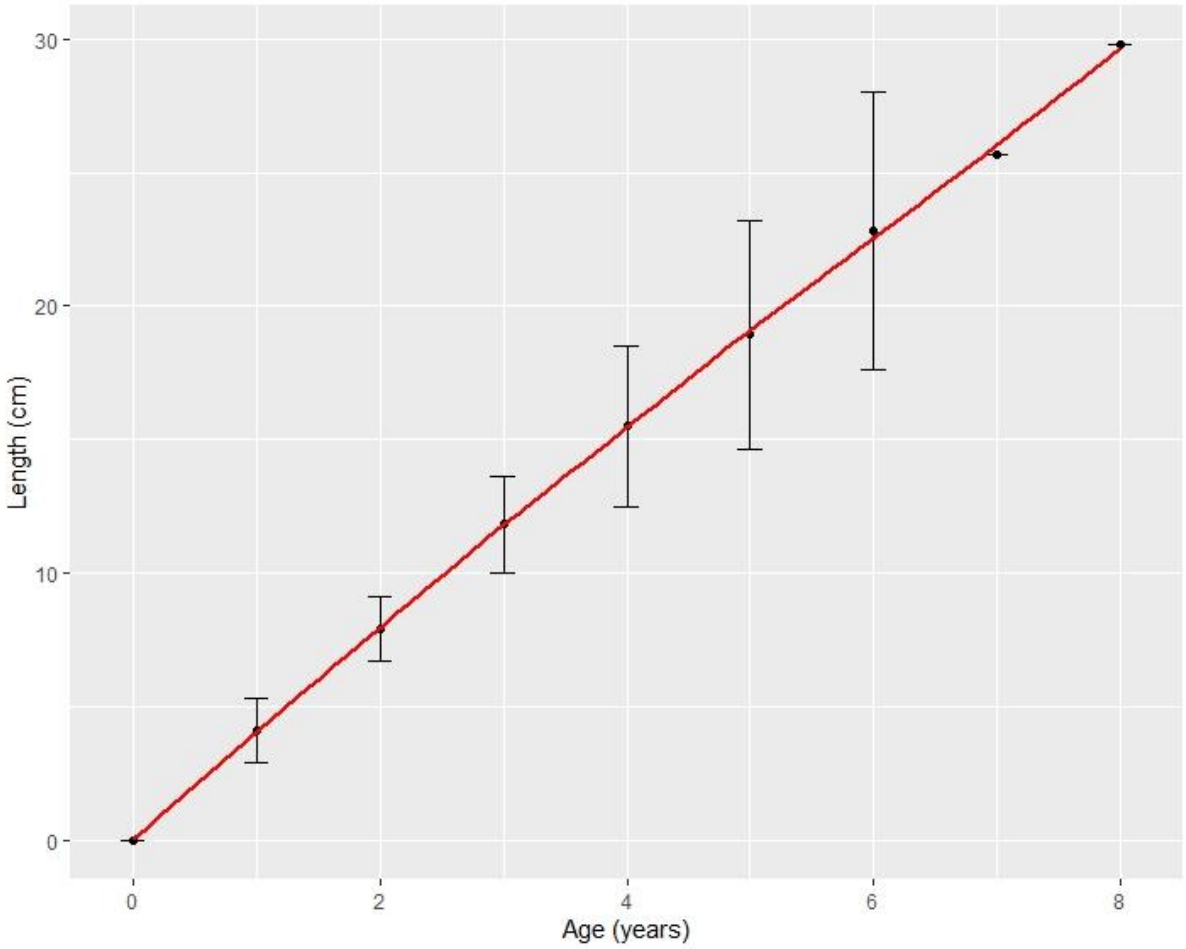


Figure 7: Back-calculated growth rate of Brown Trout sampled from Spelga Reservoir in 2022.

3.2 Electrofishing surveys

Only one species of fish (Brown trout) was captured during the electrofishing surveys undertaken within the two feeder streams shown in Figure 4. Twenty-seven fish were captured within the northern stream and twelve within the southern stream. These fish were all juvenile and ranged in size from 5.3cm to 13.9 cm (*Figure 8*).

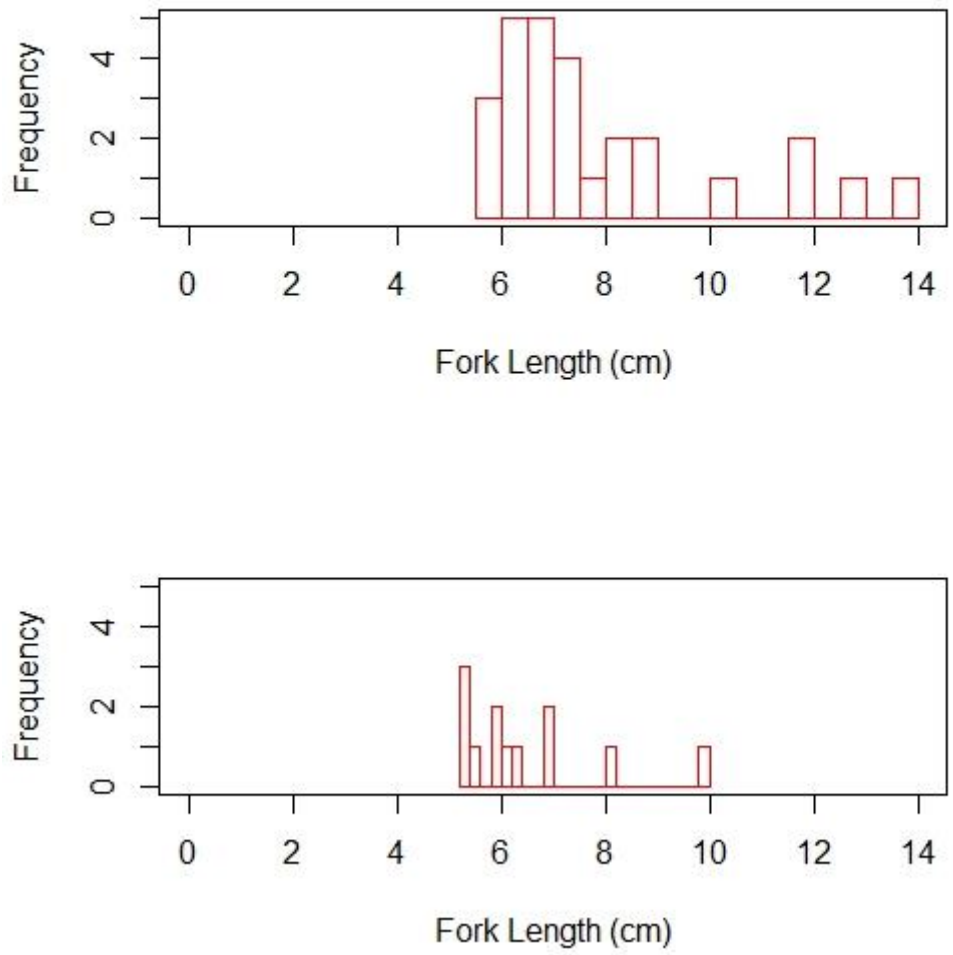


Figure 8 - Length frequency histograms of brown trout captured by electrofishing from the northern feeder stream (top) and the southern feeder stream (bottom).

Brown trout caught in the feeder streams were significantly smaller than those caught from the reservoir (Mann- Whitney U test: W = 702, p <0.001) (*Figure 9*).

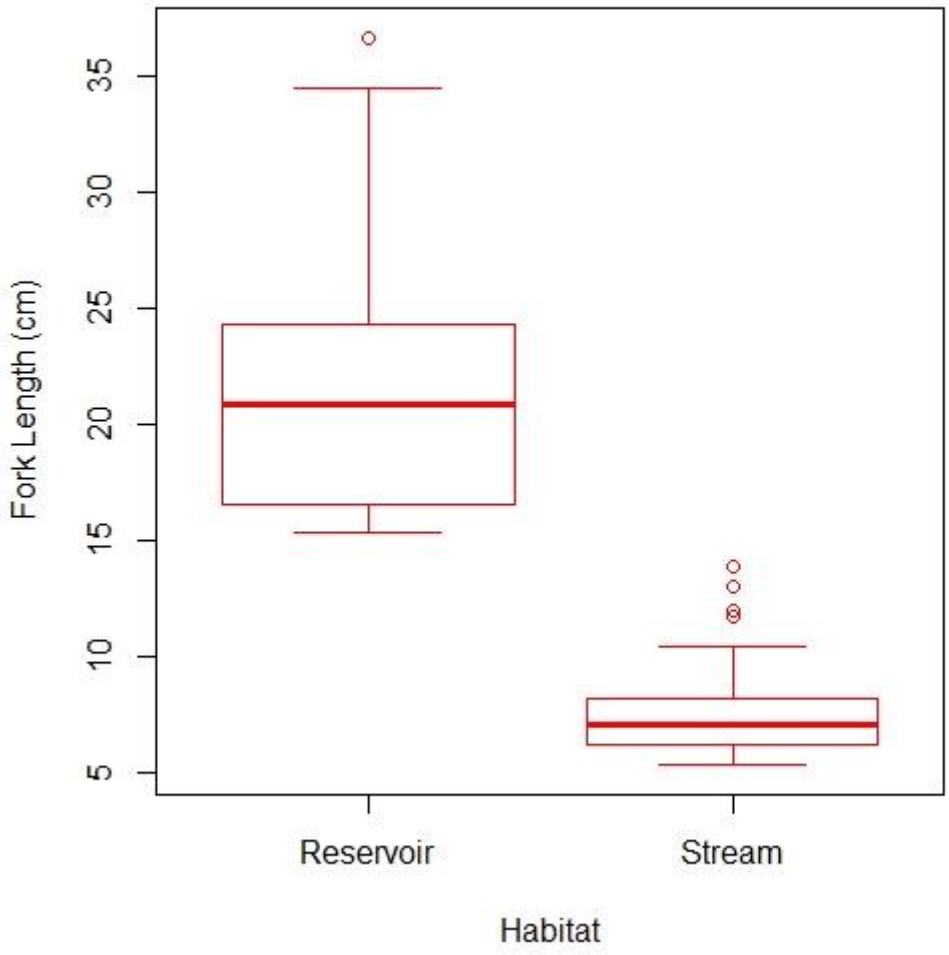


Figure 9- Boxplot displaying fork length of brown trout caught from the reservoir and the feeder streams (northern and southern combined) (W = 702, p <0.001).

3.3 Targeted Pike Survey

In the targeted survey, 21 fish of two species were captured; 13 pike and eight brown trout (for CPUE see *Table 5*).

Table 5 - Catch per Unit Effort (CPUE) of fish caught from Spelga reservoir during the targeted pike survey.

Net	Brown Trout	Pike
CEN	0.027 (±0.039)	0
40mm braided	0.01 (±0.016)	0.04 (± 0.034)
50mm braided	0	0.025 (±0.031)

Pike ranged in fork length from 56 to 75cm (average = 65.27cm) and biomass ranged from 1.7 to 5.2kg (average = 3.2 kg). Specimens ranged in age from 4+ to 8+ (Figure 10).

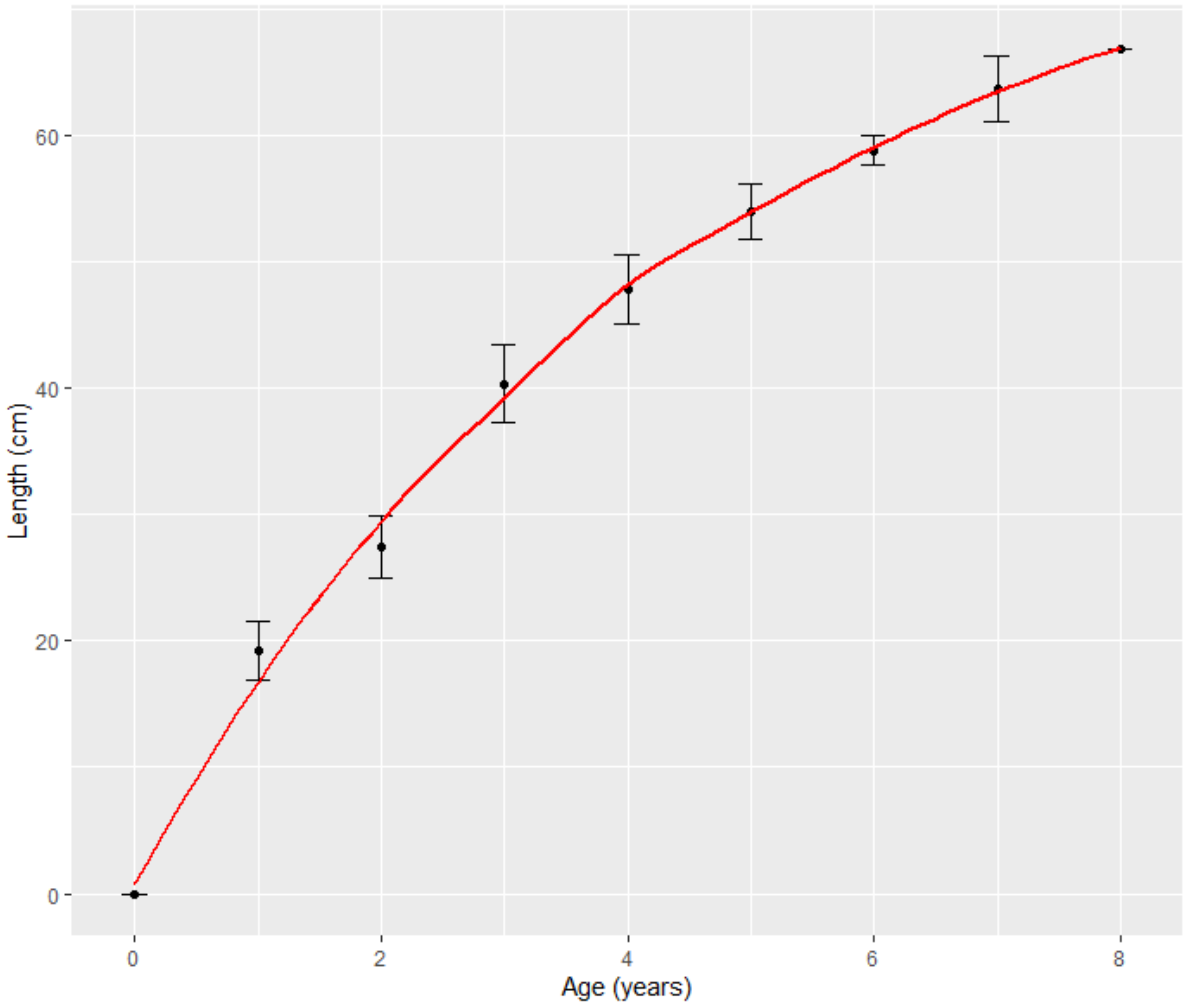
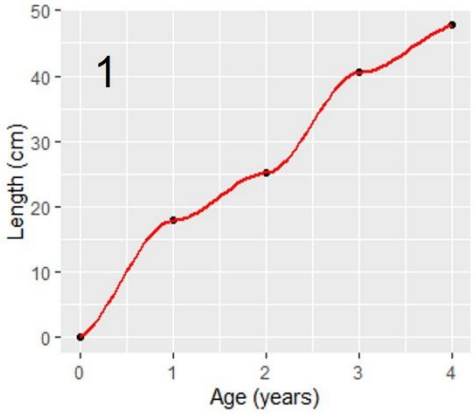
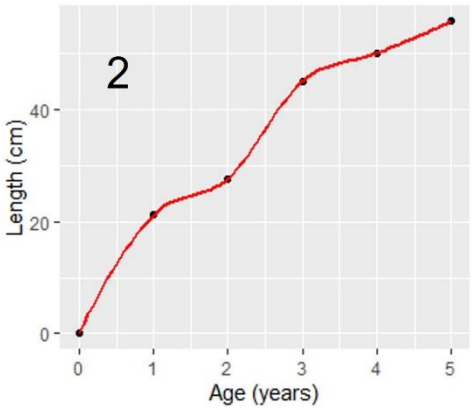


Figure 10: Growth rate (estimated length at age) of pike captured from Spelga in March 2023 estimated from back-calculated data fitted with a Loess line. Male and female combined.

Detailed examination of individual growth rates revealed a negative inflection point or a temporary slowing of growth at age 2+ in all but 2 individuals (pike no.'s 5 and 11) (

Figure 11).


1
Length (cm)
Age (years)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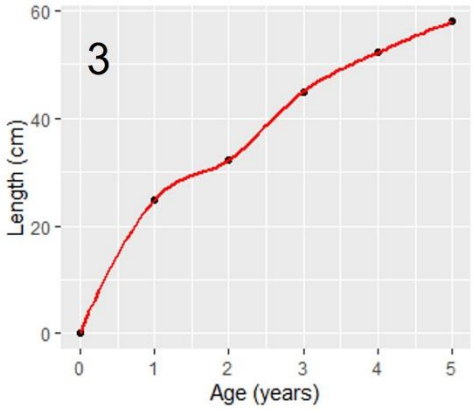
Length (cm)
Age (years)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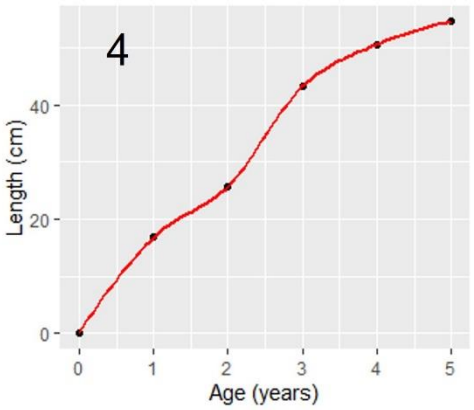
Length (cm)
Age (years)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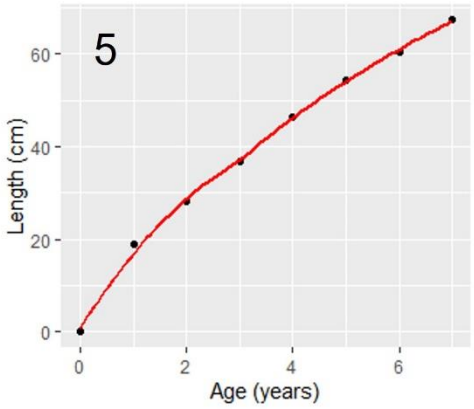
Length (cm)
Age (years)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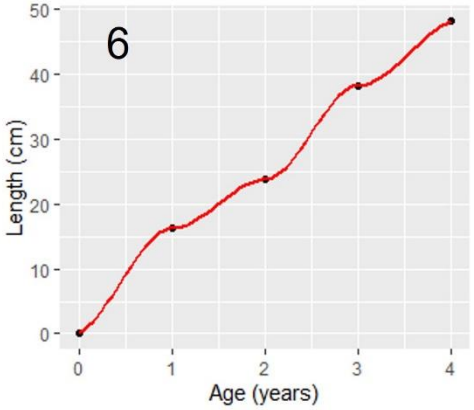
Length (cm)
Age (years)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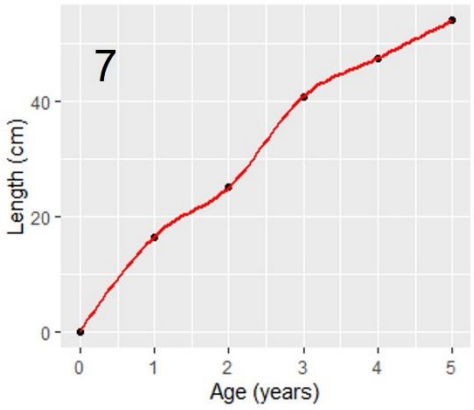
Length (cm)
Age (years)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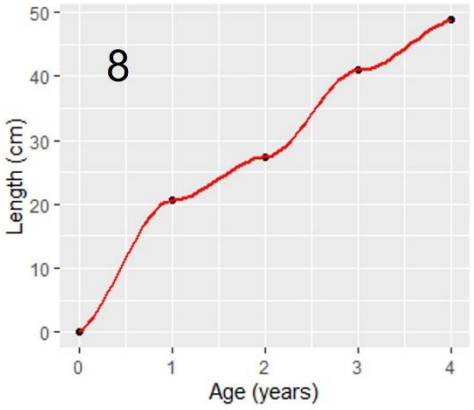
Length (cm)
Age (years)


8
Length (cm)
Age (years)

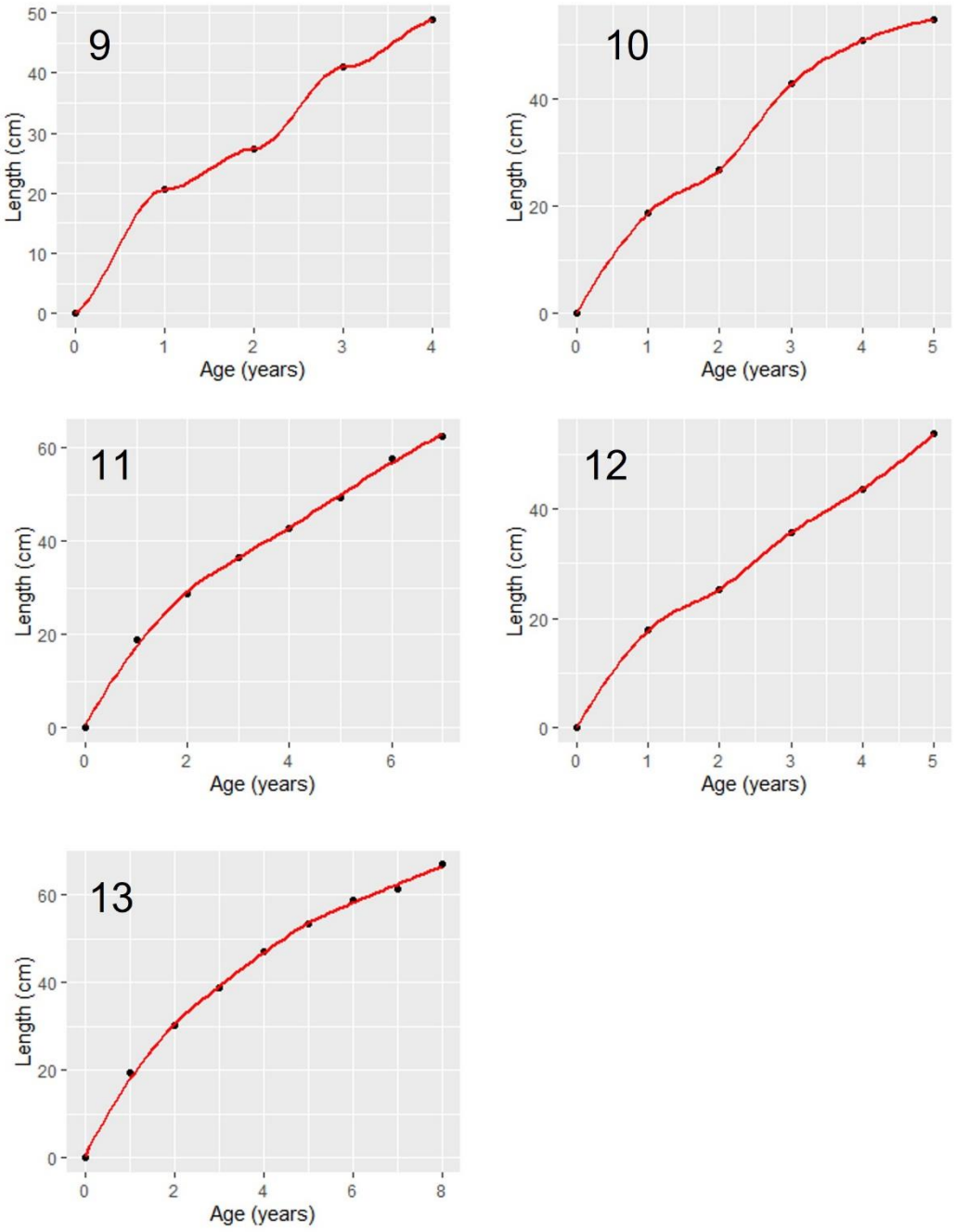


Figure 11: Somatic growth rates of individual pike specimens retained during March 2023 study.

Pike exhibited a male to female sex ratio of 1:12. Gonad examination of the individuals indicated that 10 fish including an individual male and nine females were spent, the remaining three females were gravid and had a gonadosomatic index (a metric which represents the relative weight of the gonad divided by the overall weight of the fish) ranging from 16.08 to 22.9 indicating that they had not yet spawned. Gut content analysis (GCA) indicated that 10 pike had empty stomachs, an individual pike

had remnants of a single brown trout in its stomach and 2 individuals had fed on amphibians and frogspawn.

Eight brown trout were captured during the survey, four live specimens were released, and the remainder retained. Brown trout ranged in length from 23 to 39 cm and in biomass from 146 to 884 g. The retained specimens exhibited a male to female ratio of 0.5 to 2. GCA revealed a varied diet. A single male individual exhibited piscivory (diet of fish) and remnants of 10 sticklebacks (*Gasterosteus aculeatus*) were found in its stomach. Of the remaining individuals; one had an empty stomach and 3 exhibited invertivory (insect based diet) typical of both surface (adult mayfly, caddisfly and water boatmen) and bottom (caddisfly and non-biting midge larvae) feeding.

4 Discussion

As stated in Gallagher and Rosell (2021), pike status in Ireland is controversial with conflicting theories about their origins (see Pedreschi et al. (2014), Ensing (2015) and Pedreschi and Mariani (2015)). McLoone et al. (2018) states that pike are present in 522 Irish lakes and they coexist with trout in 97 of these. McLoone et al. (2018) states that "only the largest and deepest lakes with strong connectivity can be confidently assumed to have a high probability of coexistence" of pike and brown trout. Spelga has a small surface area (55ha) and is generally shallow except for a small deep depression close to the dam wall. For these reasons the introduction of pike likely creates a vulnerable situation for the trout stock.

These surveys confirmed that the Spelga fish community was limited to three species; brown trout, three spined stickleback (from GCA) and pike as per Gallagher and Rosell (2021). No pike were captured in the EU water framework directive (2000) compliant CEN survey, which perhaps indicates some limitations of that survey technique. The capture of 13 pike individuals in the targeted survey is indicative of a resident population, however due to its targeted nature this survey method has limitations in providing robust stock assessment data. Given that the youngest pike encountered was 4+ this may not be indicative of successful annual recruitment. In an established pike population, it would be expected that individuals attain 9+ years of age (Rosell pers comm) but the eldest from this survey was 8+, this may be indicative of a relatively recent introduction (<10 years) rather than an established population. Growth rates of pike from Spelga were comparable to that of Lough Erne (Gallagher and Rosell, 2019) and Poulaphouca Reservoir (Roche et al., 1999) - another waterbody artificially flooded for the provision of potable water.

To investigate two key aspects in the context of the pike population, namely, a) whether these pike were introduced into the lake directly, and b) the potential timeframe of such introductions, an analysis of growth rates was conducted for each individual pike, as illustrated in

Figure 11. Notably, there was no discernible evidence of a shared stocking event; however, a negative inflection point emerged at age 2+ for 11 out of the 13 individuals. This phenomenon is likely attributable to the onset of sexual maturity and, conceivably, a dietary change from feeding on invertebrates to fish known as an ontogenetic shift which can affect growth.

During the survey period, electrofishing revealed substantial numbers of juvenile trout inhabiting the Spelga feeder streams. However, in accordance with the findings of Gallagher and Rosell (2021), netting surveys within the reservoir failed to capture any brown trout aged less than three years. This observation may suggest a considerable predation pressure on juvenile brown trout as they migrate from the nursery streams into the reservoir. Notably, one individual pike (length – 75 cm) was discovered with a small brown trout in its gastrointestinal tract. Additionally, during the CEN survey, three out of 18 brown trout were found to be infected by a cestode endoparasite, a common occurrence in wild brown trout populations.

4.1 Pike Control Strategies

In line with the recommendations made by Gallagher and Rosell (2021), achieving eradication of the pike population without causing further ecological harm poses significant challenges. However, feasible management approaches could be considered. For example, it may be advisable for DAERA to initiate discussions with Northern Ireland Water concerning the regulation of water levels within the reservoir. One potential strategy involves maintaining high water levels during the pike spawning season to create optimal marginal spawning habitat for egg deposition. Subsequently, prior to the emergence of larvae, lowering the reservoir's water level would expose pike eggs above the waterline, facilitating desiccation and thereby mitigating recruitment. If this approach is not feasible, targeted netting operations in the spring, just before spawning, using 40 mm and 50 mm gill nets in the three designated areas marked in Figure 5, could effectively reduce the spawning stock and help curtail the pike population size.

5 References

CEN 2005. Water Quality - Sampling of Fish with Multi-Mesh Gillnets. European Committee for Standardization. Brussels & Belgium.

CRAGG-HINE, D. 1981. *RE: Letter re: Spelga reservoir Brown Trout Stock.* Type to CRAWFORD, M.

ENSING, D. 2015. Pike (*Esox lucius*) could have been an exclusive human introduction to Ireland after all: a comment on Pedreschi et al. (2014). *Journal of Biogeography,* 42**,** 604-607.

EU 2000. *Directive 2000/60/EC of the European Parliament and of the Council of 23.10.2000 establishing a framework for Community action in the field of water policy,* Brussels, European Union.

GALLAGHER, K. & ROSELL, R. 2019. Assessment of fish stocks in Lower Lough Erne: 1992 - 2016. Belfast: Agri-Food and Biosciences Institute.

GALLAGHER, K. & ROSELL, R. 2021. Fish stock assessment of Spelga Dam and determination of pike (*Esox lucius*) status. Belfast, UK: Agri - Food and Biosciences Institute.

MCLOONE, P., SHEPHARD, S., DELANTY, K., ROCKS, K., FEENEY, R. & KELLY, F. 2018. Coexistence of pike Esox lucius and brown trout Salmo trutta in Irish lakes. *Journal of Fish Biology,* 93**,** 1005-1011.

NIKOLSKY, G. V. 1963. *The Ecology of Fishes,* London, Academic Press Inc.

PEDRESCHI, D., KELLY-QUINN, M., CAFFREY, J., O'GRADY, M. & MARIANI, S. 2014. Genetic structure of pike (*Esox lucius*) reveals a complex and previously unrecognized colonization history of Ireland. *Journal of Biogeography,* 41**,** 548-560.

PEDRESCHI, D. & MARIANI, S. 2015. Towards a balanced view of pike in Ireland: a reply to Ensing. *Journal of Biogeography,* 42**,** 607-609.

ROCHE, W., O'GRADY, M. & BRACKEN, J. J. 1999. Some characteristics of a pike *Esox lucius* L-population in an Irish reservoir. *Hydrobiologia,* 392**,** 217-223.