

National Research Survey Programme

Lakes 2019

Inniscarra Reservoir

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Iascach Iníre Éireann
Inland Fisheries Ireland



Inland Fisheries Ireland

National Research Survey Programme

**Fish Stock Survey of Inniscarra Reservoir,
September 2019**

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

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1.1 Introduction

Inniscarra Reservoir is located 11 kilometres to the west of Cork City on the River Lee system (Plate 1.1, Fig. 1.1). The reservoir encompasses an area of 489 hectares and was created by the Electricity Supply Board (ESB) in 1956, with the construction of two dams on the River Lee at Carrigadrohid (21m high) and Inniscarra (44m high) (Fitzpatrick and Bree, 2001). It is one of the largest waterbodies in the south-west region of Ireland, with its linear shape providing *circa* 40km of shoreline. Inniscarra Reservoir has a surface area of 488ha and a maximum depth of 34.7M. The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and moderate alkalinity (20-100mg/l CaCO₃).

The reservoir is situated in a primarily agricultural area, with some industrial activity in the form of quarrying on its southern and northern shores. The reservoir supports a number of water-based activities including boating and sailing. A designated site for water-skiing is located at the mouth of the Dripsey Arm on the north eastern shore where the Dripsey River joins the reservoir (Fig.1.1). The reservoir is also the site of the National Rowing Centre. Swimming is also very popular on the north western shoreline.

With its diverse fish stocks and its close proximity to Cork City, Inniscarra Reservoir is a popular coarse angling destination with both domestic and international anglers. The shore line has been developed to enhance access for anglers at several locations. Several prestigious national and international angling competitions are held on the lake on an annual basis. The fish stocks present in the reservoir have altered significantly since it was created. The River Lee (a predominantly salmonid river) provided some of the initial stocks of brown trout, which were enhanced with fingerling stocking by the Inland Fisheries Trust (IFT) in the 1960s. A pike control program which was operated by the Inland Fisheries Trust during the 1960's, ceased in the 1970's when the reservoir was designated as a mixed coarse fishery. A population of adult bream was introduced into Carrigadrohid Reservoir in 1974. In the 1980's this stock of bream had spread downstream and was discovered at Inniscarra Reservoir by the angling community.

The reservoir has been surveyed on three occasions since 2005 (i.e. 2005, 2008 and 2015) by Inland Fisheries Ireland using a variety of survey netting techniques. In 2005 a survey using eight-panel benthic braided survey gill nets (8-PBB), supplemented with a number of 60m monofilament survey gill nets found that stocks were dominated by a large population of small to medium sized bream, with healthy stocks of perch, rudd and pike also present. Roach x bream hybrids were also captured, despite no

roach being recorded (CFB, 2005). In 2008, the reservoir was surveyed using the netting protocol developed for IFIs Water Framework Directive (WFD) fish surveillance monitoring programme in lakes. While perch was the most abundant fish species, more bream were captured than both roach x bream hybrids and roach. The latter species was recorded for the first time during that survey (CFB, 2008). In 2015, Inniscarra Reservoir was surveyed as part of IFI's national coarse fish and pike research programme and as part of a method intercalibration exercise using both the WFD and the 8-PBB methods (Kelly *et al.*, 2016).

Fish species captured during previous surveys include, brown trout, salmon, roach, bream, roach x bream hybrids, rudd, perch, pike, gudgeon and eel.

This report summarises the results of the 2019 fish stock survey carried out on the lake.



Plate 1.1. Inniscarra Reservoir, near Coachford, Co. Cork, September 2019

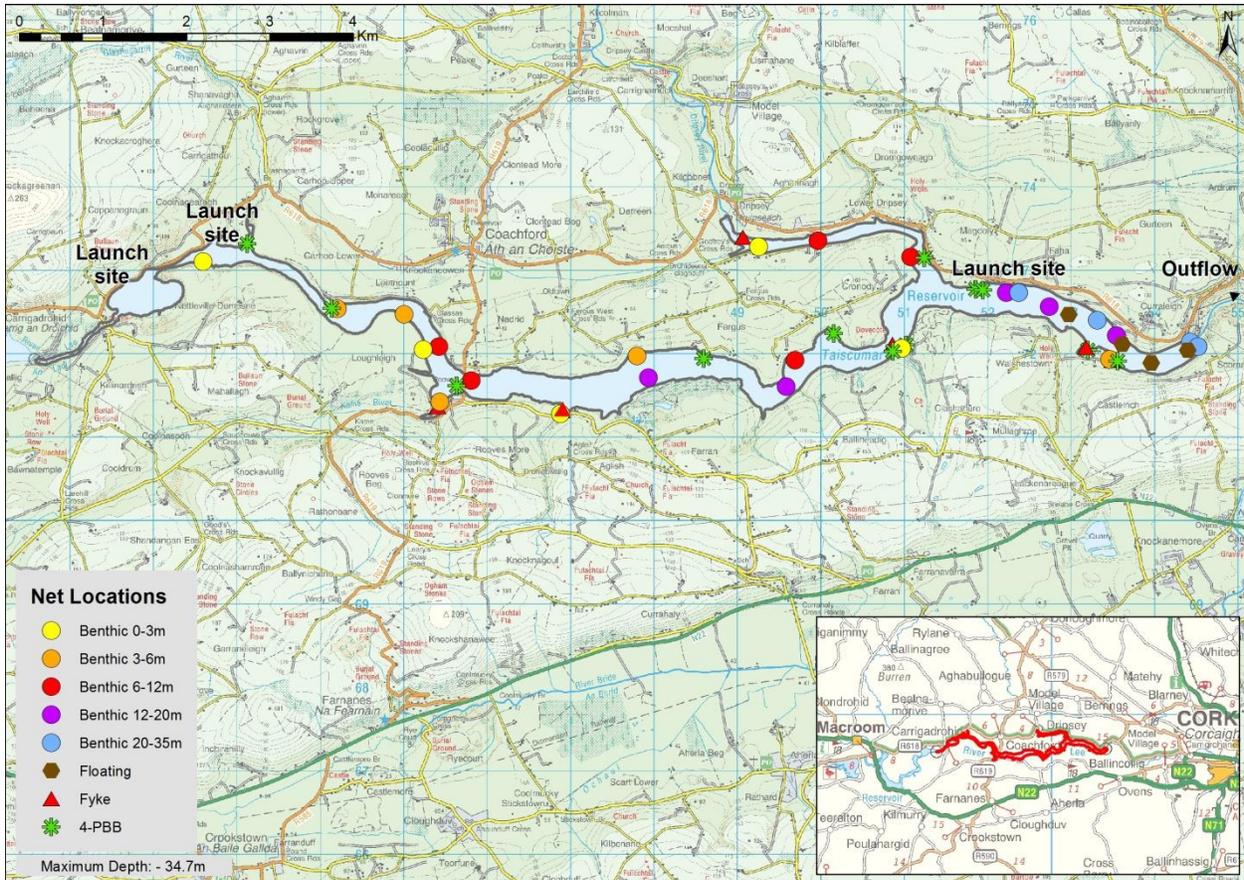


Fig. 1.1. Location map of Inniscarra Reservoir showing net locations and depths of each net (outflow is indicated on map)



Plate 1.2 Bream captured and released on Inniscarra Reservoir, September 2019



1.2 Methods

1.2.1 Netting methods

Inniscarra Reservoir was surveyed over four nights from the 16th to the 20th of September 2019. A total of six sets of Dutch fyke nets, 24 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, 5 @ 12-19.9m and 4 @ 20-34.9m) and four floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (34 sites). These nets were deployed in the same locations as were randomly selected in previous surveys. The netting effort was supplemented using four-panel benthic braided survey gill nets (4-PBB) at 12 additional sites. The 4-panel nets are composed of four 27.5m long panels each a different mesh size (55mm, 60mm, 70mm and 90mm knot to knot). These nets were deployed in random locations throughout the lake.

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 a sub-sample of other species except eels. 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).

$$FO_i = \left(\frac{N_i}{N} \right) * 100$$

Where:

FO_i is the percentage frequency of prey item i ,

N_i is the number of pike with prey i in their stomach,

N is total number of pike 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 hybrid variety were recorded in Inniscarra Reservoir in September 2019. A total of 786 fish were 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 roach, roach x bream hybrid, bream, gudgeon, brown trout, pike, rudd and carp. The latter species, while known to be present in the lake, has not been recorded in earlier fish stock assessments.

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

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
<i>Perca fluviatilis</i>	Perch	310	0	6	8	324
<i>Rutilus rutilus</i>	Roach	179	55	0	2	236
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	101	4	9	0	114
<i>Abramis brama</i>	Bream	18	0	61	0	79
<i>Gobio gobio</i>	Gudgeon	12	0	0	0	12
<i>Salmo trutta</i>	Brown trout	2	7	2	0	11
<i>Esox lucius</i>	Pike	5	0	2	1	8
<i>Scardinius erythrophthalmus</i>	Rudd	1	0	0	0	1
<i>Cyprinus carpio</i>	Carp	0	0	1	0	1



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 and roach were the dominant species in terms of abundance (CPUE). Roach were more abundant than both bream and their hybrid. Perch was also dominant with respect to biomass (BPUE) followed by bream, roach x bream hybrids, brown trout and roach (Table 1.2; Figs. 1.2 and 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Inniscarra Reservoir, 2019

Scientific name	Common name	Mean CPUE (\pm S.E) **	Mean BPUE (\pm S.E) **
<i>Perca fluviatilis</i>	Perch	0.227 (0.071)	17.664 (5.794)
<i>Rutilus rutilus</i>	Roach	0.170 (0.041)	9.180 (2.130)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.076 (0.015)	9.685 (1.930)
<i>Abramis brama</i>	Bream	0.025 (0.006)	13.302 (3.561)
<i>Gobio gobio</i>	Gudgeon	0.009 (0.006)	0.164 (0.100)
<i>Salmo trutta</i>	Brown trout	0.019 (0.006)	9.447 (3.465)
<i>Esox lucius</i>	Pike	0.005 (0.002)	2.403 (0.903)
<i>Scardinius erythrophthalmus</i>	Rudd	0.003 (0.001)	1.231 (0.771)
<i>Cyprinus carpio</i>	Carp	0.0004 (0.004)	0.479 (0.479)

Note: Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor *et al.*, 2017).

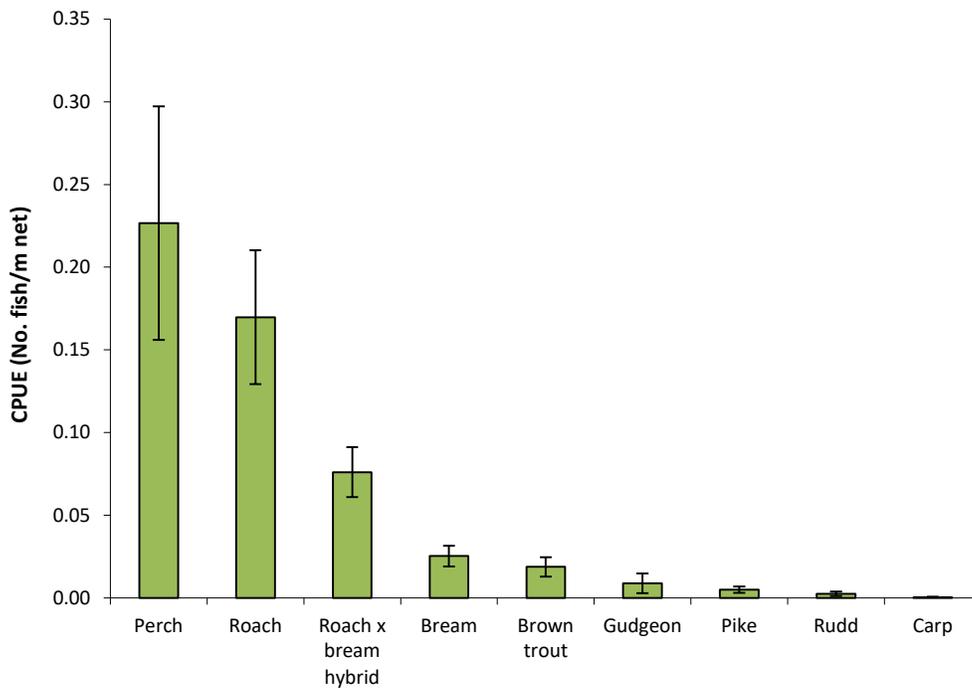


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Inniscarra Reservoir, September 2019

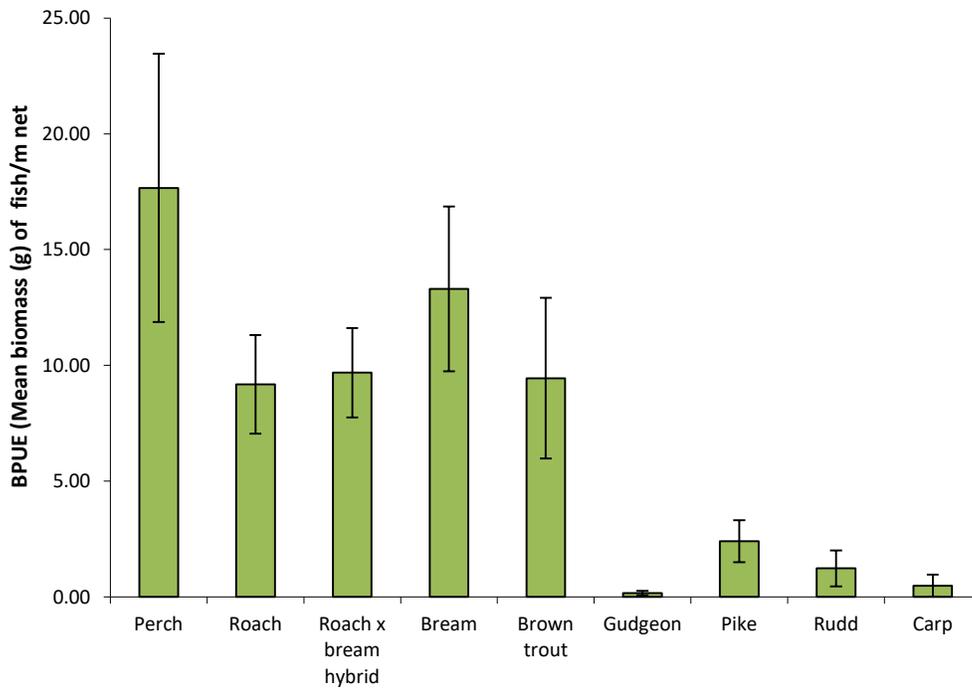


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Inniscarra Reservoir, September 2019

1.3.3 Change in cyprinid abundance and biomass

To ensure comparison between surveys, only fish caught in those nets deployed on each of the three survey occasions are presented; i.e. all of the survey nets with the exception of 55mm, 70mm and 90mm meshes of the 4-PBB gill nets. Roach were first recorded during a fish stock assessment conducted in 2008, when 19 individuals were captured. At that time, bream was the most abundant cyprinid captured and had a higher biomass than both roach and roach x bream hybrids. In the two most recent surveys fewer bream than roach or their hybrid were recorded.

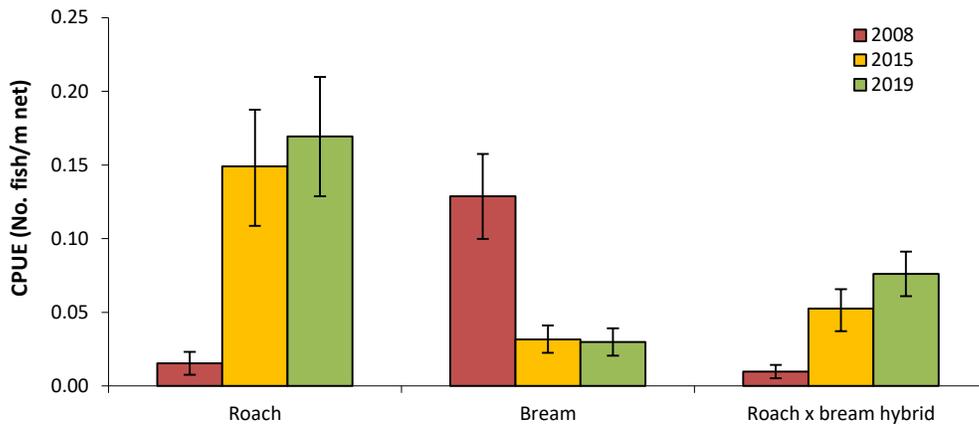


Figure 1.9. Mean (\pm S.E.) CPUE for roach, bream and their hybrid captured in Inniscarra Reservoir, 2008, 2015 and 2019. Figures include all fish except those captured in the 55mm, 70mm and 90mm meshes of the 4-PBB gill nets

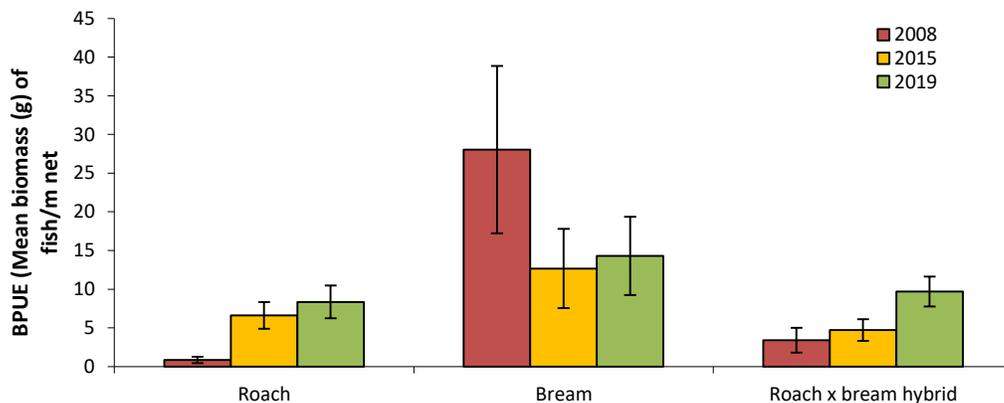


Figure 1.9. Mean (\pm S.E.) BPUE for roach, bream and their hybrid captured in Inniscarra Reservoir, 2008, 2015 and 2019. Figures include all fish except those captured in the 55mm, 70mm and 90mm meshes of the 4-PBB gill nets



1.3.4 Length frequency distributions and growth

Because of the various netting methods employed during the surveys conducted, information presented in the graphs is confined to fish captured using the WFD methodology in 2015 and in all nets deployed in 2019 (i.e. WFD methods and 55mm, 70mm and 90mm panels of the 4-PBB gill nets).

Perch

Perch captured during the 2019 survey ranged in length from 4.1cm to 38.1cm (mean = 14.5cm). Nine age classes were present, ranging from 0+ to 8+. Mean L1 (age at 1 year) was 6.5cm (Table 1.3). This corresponds to the large modal peak at 6-7cm, indicating that the majority of the perch captured during the 2019 survey were young of year (YOY) fish at the end of their first growing season (Fig. 1.4). While size range was similar compared to the 2015 survey, a greater proportion of larger fish were captured on that occasion, when few juveniles were captured. Few four year old perch were captured in 2019, (despite many older fish being recorded in the sample) suggesting that recruitment of the 2015 cohort may have been limited.

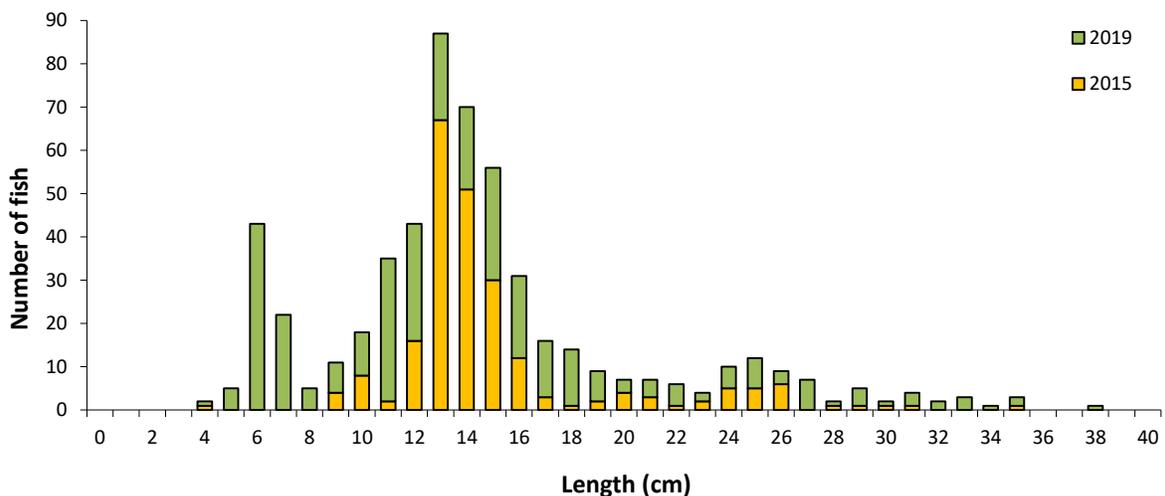


Fig. 1.4. Length frequency of perch captured on Inniscarra Reservoir, 2015 and 2019

Table 1.3. Mean (\pm S.E.) perch length (cm) at age for Inniscarra Reservoir, September 2019

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈
Mean (\pm S.E.)	6.5 (0.1)	11.8 (0.1)	15.0 (0.3)	17.1 (0.4)	19.7 (0.5)	23.0 (0.7)	26.4 (1.0)	33.6 (1.5)
N	106	75	63	52	47	38	13	2
Range	4.0-9.1	9.3-15.4	12.2-22.3	13.6-24.8	15.2-28.1	16.2-32.4	21.2-33.5	32.1-35.0



Roach

Roach captured during the 2019 survey ranged in length from 4.5cm to 23.1cm (mean = 13.5cm) (Fig. 1.5). Roach were aged between 0+ and 7+. All age classes were represented, indicating regular recruitment of roach in the reservoir. In contrast, few very small roach (i.e. <8cm) were recorded in the 2015 survey (Fig.1.5). The sample aged in 2019 was dominated by 2+ and 3+ fish (Table 1.4).

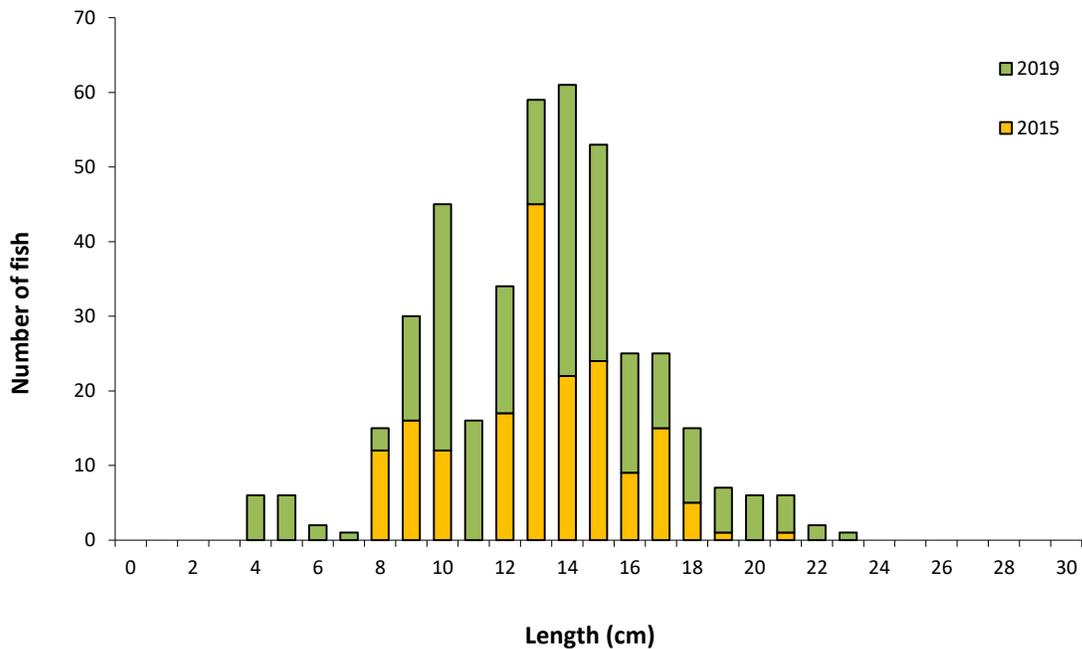


Fig. 1.5. Length frequency of roach captured on Inniscarra Reservoir, 2015 and 2019

Table 1.4. Summary age data from roach captured on Inniscarra Reservoir, September 2019. Number of fish and length ranges of all fish aged in the sample is presented

	Age class							
	0+	1+	2+	3+	4+	5+	6+	7+
n	3	3	23	21	6	10	6	4
Mean L (cm)	4.8	9.9	12.1	15.2	17.5	20.0	20.7	21.8
Min L (cm)	4.8	9.8	9.3	11.6	16.2	17.9	19.8	20.8
Max L (cm)	5.0	10.3	17.7	18.5	19.6	21.9	22.7	23.1



Roach x bream hybrids

Roach x bream hybrids captured during the 2019 survey ranged in length from 4.8cm to 41.0cm (mean = 19.7cm). A greater number of larger (>30cm) roach x bream were captured in 2019 compared to the 2015 survey (Fig.1.6). Furthermore, no large roach x bream hybrids were captured in equivalent panels of the 8-PBB nets in 2015 (data not presented). Roach x bream hybrids were aged between 2+ and 14+. The population was dominated by 3+ to 5+ fish with several missing year classes indicating regular, but varied recruitment of roach x bream hybrids in the population (Table 1.5)

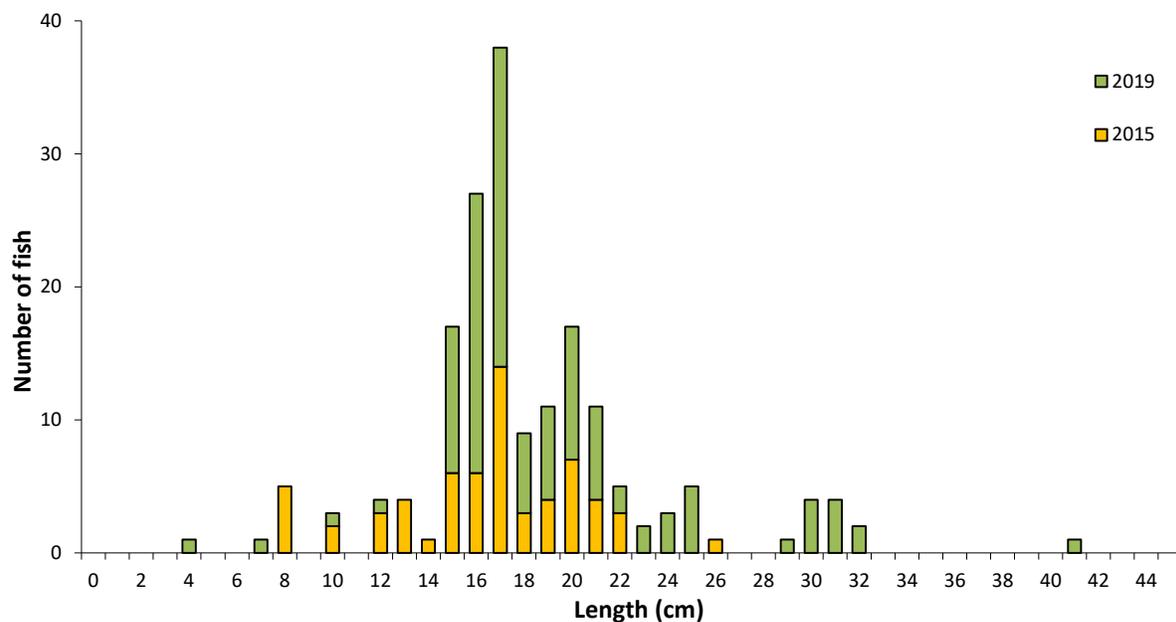


Fig. 1.6. Length frequency of roach x bream hybrids captured on Inniscarra Reservoir, 2015 and 2019

Table 1.5. Summary age data from roach x bream hybrids captured on Inniscarra Reservoir, September 2019. Number of fish and length ranges of all fish aged in the sample is presented.

Age Class	Age Class														
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+
n	-	-	1	13	13	10	4	5	-	3	6	1	-	-	1
Mean L (cm)	-	-	10.1	16.3	18.4	20.6	23.4	25	-	30.1	31.3	32.9	-	-	41
Min L (cm)	-	-	10.1	15.3	15.8	19.2	22.5	24.5	-	29.2	30.3	32.9	-	-	41
Max L (cm)	-	-	10.1	17.7	20.4	21.7	25.6	25.6	-	31.2	32.6	32.9	-	-	41



Bream

Bream captured during the 2019 survey ranged in length from 5.1cm to 43.3cm (mean = 31.1cm). The 2019 survey recorded larger fish (>40.0cm) compared to the 2015 survey, and no bream were captured in equivalent panels of the 8-PBB nets in 2015 (data not presented). Smaller bream (i.e. <20.0cm) were also more prominent in the 2015 survey (Fig.1.7). Bream were aged between 1+ and 12+. The population was dominated by 5+ to 8+ fish. While all age classes with the exception of 0+ and 2+ were present in the sample aged, comparatively few fish younger than 5+ were recorded (Table 1.6).

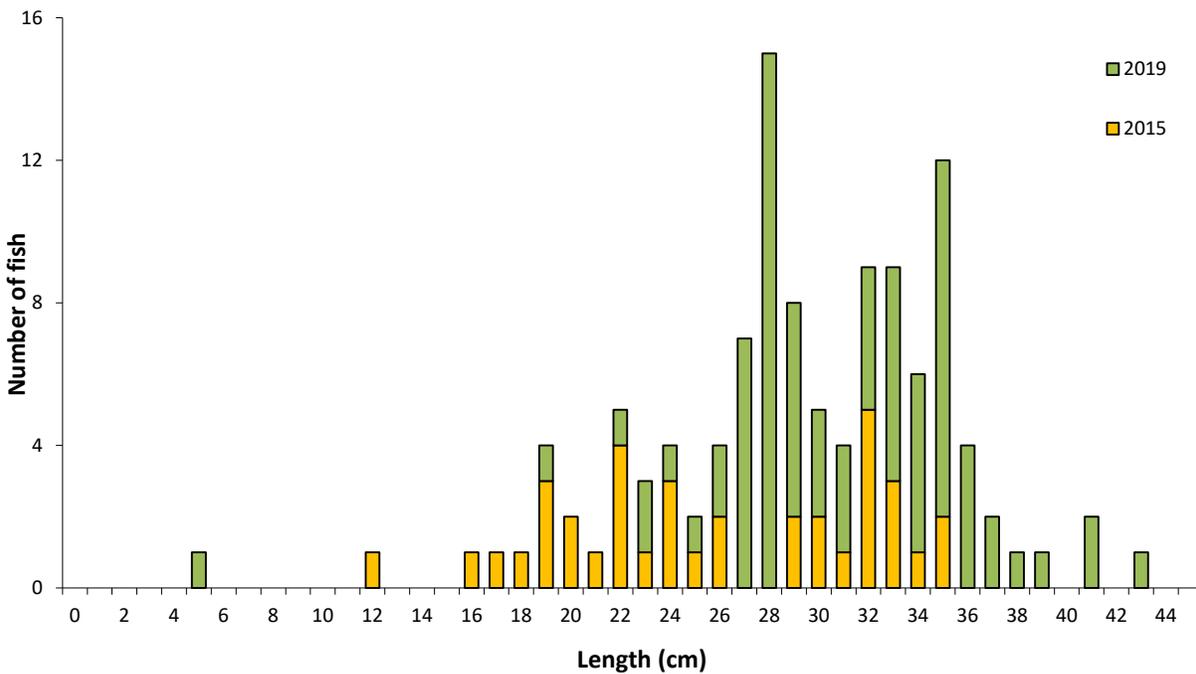


Fig. 1.7. Length frequency of bream captured on Inniscarra Reservoir, 2015 and 2019

Table 1.7. Summary age data from bream captured on Inniscarra Reservoir, September 2019. Number of fish and length ranges of all fish aged in the sample is presented.

	Age class												
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+
n	-	1	-	1	3	18	8	14	11	3	1	1	1
Mean L (cm)	-	5.1	-	19.7	24.3	28.0	29.8	33.3	35.3	37.8	39.6	41.6	43.3
Min L (cm)	-	5.1	-	19.7	22	23.3	28	30.4	34	37.2	39.6	41.6	43.3
Max L (cm)	-	5.1	-	19.7	27.4	33.2	31.4	36	36.5	38.4	39.6	41.6	43.3



Other fish species

Eleven brown trout measuring from 18.4cm to 46.7cm (mean 26.8cm) were captured during the survey. Four age classes (2+ to 6+) were recorded and two year old fish were the most abundant cohort in the sample aged. Many of the brown trout were captured in floating monofilament survey gill nets set over the deepest areas of the reservoir.

Gudgeon (n = 12) ranging from 7.3cm to 10.0cm were recorded in the survey. Eight pike were recorded, and ranged in length from 17.7cm to 70.7cm. One rudd (14.0cm & 3+) was also captured. One carp, measuring 29.2 cm and aged 3+ was also recorded during the survey.

1.3.5 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 sub-sample of perch, brown trout and pike 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 109 stomachs were examined, of these 57 were found to contain no prey items. Of the 52 remaining stomachs 20 (39%) contained fish, 12 (23%) unidentified digested material, 11 (21%) invertebrates and nine (17%) zooplankton (Fig. 1.8).

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 eight stomachs were examined. Of these four were found to contain no prey items. Of the remaining four stomachs containing food, three stomachs contained invertebrates and one contained fish remains.

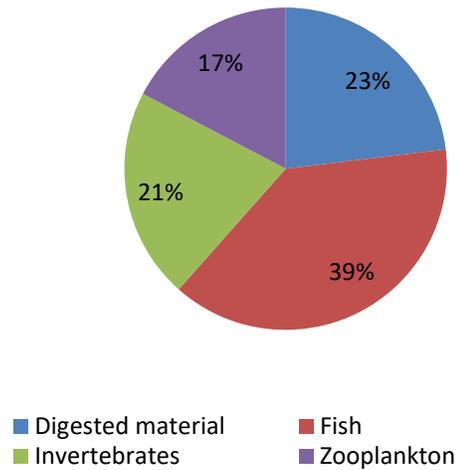


Fig. 1.8. Diet of perch (n=52) captured on Inniscarra Reservoir, 2019 (% FO)

Pike

A total of four pike were available for dietary analysis. One fish contained roach, and an unidentified cyprinid scale was recorded in the stomach of a second pike. Two stomachs were empty.



1.5 Summary and ecological status

A total of eight fish species and one hybrid variety were recorded in Inniscarra Reservoir in September 2019. Perch and roach were the dominant species in terms of abundance (CPUE). While perch recorded the highest overall biomass, other “species” such as roach x bream hybrids, bream, brown trout, roach, and also recorded high biomasses.

A broadly similar species composition was recorded when the lake was last surveyed in 2015 (Kelly *et al.*, 2016). One carp was recorded in 2019, and while this is the first capture of this species in a fish stock assessment, they are caught occasionally by anglers.

The two most abundant species captured (i.e. perch and roach) have each been recruiting regularly in the reservoir. Both species were dominated by younger individuals and no poor or weakly represented year classes were apparent in recent years. Numbers of bream captured were lower compared to 2008, but broadly similar to 2015. Eleven age classes were present, ranging from 1+ to 12+, indicating successful recruitment in 11 of the previous 13 years. However, relatively few smaller or younger bream were captured on the most recent occasion. The roach x bream hybrid population, which requires both parent species to spawn (Hayden *et al.*, 2010), also exhibited regular, but variable recruitment patterns. Ten age classes were present, ranging from 1+ to 14+. The population was dominated by 3+ - 5+ age groups. Bream and roach x bream hybrids both appear to be much longer lived than roach in the reservoir. While fish stocks have remained relatively stable since the last survey was conducted in 2015, a marked increase in roach and roach x bream hybrid stocks, and a concomitant reduction in bream stocks is apparent between 2008 and 2019.

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). The tool utilises catch data from all WFD survey nets deployed in each lake, with the exception of those fish captured in the 55mm, 70mm and 90mm meshes of the benthic braided gill nets to ensure comparability of effort between surveys. Using



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