

National Research Survey Programme

Lakes 2019

Lough Mask

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Iascach Intíre Éireann
Inland Fisheries Ireland



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National Research Survey Programme

**Fish Stock Survey of Lough Mask,
July 2019**

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

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1.1 Introduction

Lough Mask is situated north of Lough Corrib, adjacent to the town of Ballinrobe, Co. Mayo (Plate 1.1, Fig. 1.1). It is the sixth largest lake in Ireland with a surface area of approximately 8,218ha. The length of the lake from north to south is approximately 16km and the width is approximately 6.4km at its widest point (O' Reilly, 2007). The main rivers flowing into Lough Mask are the Cloon, Robe, Owenbrin, Finny, Glensaul, Glentraig and the Keel River, which is the out flowing river from Lough Carra. Lough Mask is linked to Lough Corrib by the Cong Canal.

Lough Mask is generally a shallow lake with a mean depth of 5m; however it attains a maximum depth of 57m along a long narrow trench on the western shore of the lake (NPWS, 2004). The lake is categorised as typology class 12 (as designated by the EPA for the purposes of the WFD), i.e. deep (>4m), greater than 50ha and high alkalinity (>100mg/l CaCO₃). The underlying geology of Lough Mask is Carboniferous limestone, with areas of shale and sandstone, and it is an excellent example of a lowland oligotrophic lake (NPWS, 2004).

Lough Mask, Carra and Cloon make up the Lough Carra/Lough Mask Special Area of Conservation (SAC) complex. Six habitats listed on Annex I of the EU Habitats Directive are found in this site, including two priority habitats - limestone pavement and Cladium fen (NPWS, 2004). This is also an important SAC for otter, a species that is listed on Annex II of the E.U. Habitats Directive (NPWS, 2004).

The zebra mussel, an invasive species in Ireland, was confirmed to be present in Lough Mask in 2008. Roach, an invasive fish species was first recorded in a fish stock assessment survey in 1996, since then the population has spread throughout the lake.

Lough Mask is noted for its populations of brown trout and ferox trout, with the average size of brown trout ranging from 0.6kg to 1.4kg. The largest ferox trout can reach up to 9kg in weight (O' Reilly, 2007).

The lake was previously surveyed in 1996 as part of Inland Fisheries Ireland's (IFI) brown trout stock assessment programme using seven-panel benthic braided survey gill nets. Five fish species were recorded at that time; brown trout, Arctic char, pike, perch and a single roach (O' Grady *et al.*, 1996). More recently the lake was surveyed by IFI for the WFD fish monitoring programme in 2009, 2012 and 2015 (Kelly *et al.*, 2010, 2013 and 2016). During these surveys, perch, roach, brown trout, bream, Arctic char, eels, pike, stone loach and roach x bream hybrids were recorded.

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



Plate 1.1. Lough Mask (aerial view southwest across the lake from Cushlough Bay)

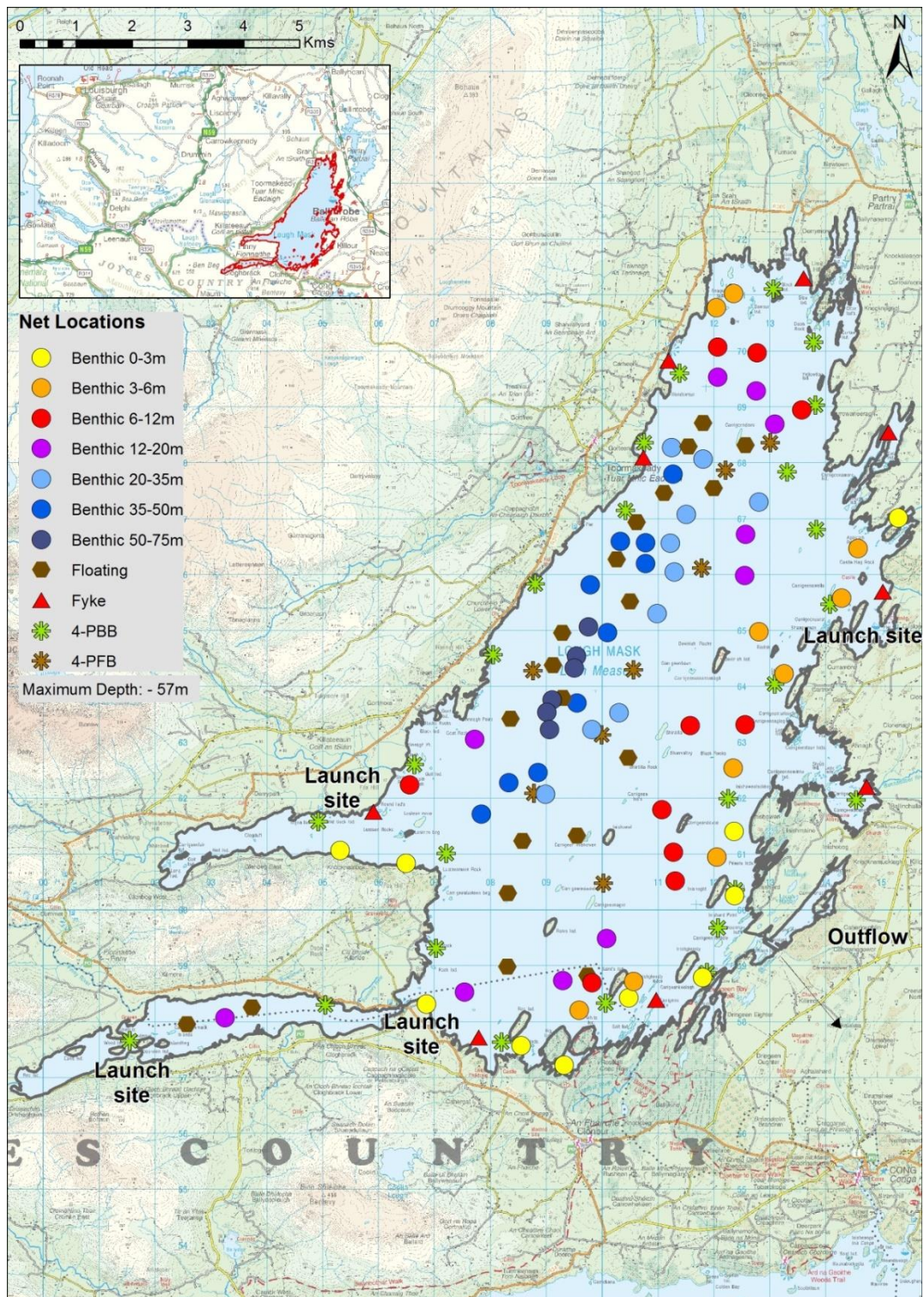


Fig. 1.1. Location map of Lough Mask showing net locations and depths of each net (outflow is indicated on map)



1.2 Methods

1.2.1 Netting methods

Lough Mask was surveyed over nine nights from the 1st to the 17th of July 2019. A total of nine sets of Dutch fyke nets, 66 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (BM CEN) (10 @ 0-2.9m, 10 @ 3-5.9m, 10 @ 6-11.9m, 10 @ 12-19.9m, 10 @ 20-34.9m, 10 @ 35-49.9m and 6 @ 50-74.9m) and 20 floating monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (FM CEN) were deployed in the lake (95 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) and four-panel floating braided survey gill nets (4-PFB) at 33 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 all brown trout and from a sub-sample of roach, bream and roach x bream hybrids. 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 Hydroacoustic survey

A parallel hydroacoustic and pelagic gillnetting survey was also carried out on Lough Mask in July 2019. The survey concentrated on the deeper sections of the lake (depth >12m) and covered *circa* 125km of hydroacoustic transects. A separate report will be available in due course.

1.2.3 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 hybrid variety were recorded in Lough Mask in July 2019, with 988 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 roach, bream, roach x bream hybrids, brown trout, Arctic char, European eels, pike and, three-spined stickleback. During the previous surveys in 2009, 2013 and 2015 the same species composition was recorded with the exception of stone loach which was recorded in the 2015 survey and three-spined stickleback which was not recorded in the 2009, 2015 and 2015 surveys (Kelly *et al.*, 2010, 2013 and 2016).

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

Scientific name	Common name	Number of fish captured				
		BM CEN	FM CEN	4-PBB	Fyke	Total
<i>Perca fluviatilis</i>	Perch	517	2	3	26	548
<i>Rutilus rutilus</i>	Roach	189	0	3	1	193
<i>Abramis brama</i>	Bream	1	0	98	0	99
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	11	0	70	0	81
<i>Salmo trutta</i>	Brown trout	22	10	21	0	53
<i>Salvelinus alpinus</i>	Arctic char	6	0	0	0	6
<i>Esox lucius</i>	Pike	2	0	0	0	2
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	1	0	0	1	1
<i>Anguilla anguilla</i>	European eel	0	0	0	3	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 (only the 60mm mesh panel of 4-PBB was used for comparison purposes), whereas eel CPUE/BPUE is based on fyke nets only. Trends in mean CPUE and BPUE for all species captured in the fish stock surveys on the lake from 2009 to 2019 are summarised in Table 1.2 and illustrated in Figures 1.2 and 1.3.

Brown trout

Brown trout CPUE was relatively similar across the four survey occasions (Table 1.2 and Fig. 1.2). Brown trout BPUE fluctuated slightly across the four sampling occasions and was lower in 2019 than 2015 (Table 1.2; Fig. 1.3).



Perch

Perch was the dominant species in terms of abundance (CPUE) in 2019. The mean perch CPUE increased from 2012 to 2019. The mean perch BPUE was also higher in 2019 than 2012 and 2015 (Table 1.2; Fig. 1.2).

Roach

Roach was the dominant species in terms of biomass (BPUE). Mean roach abundance (CPUE) was higher in 2019 than 2012 and 2015; however, 2009 recorded the highest roach CPUE (Table 1.2; Fig. 1.3). The mean roach BPUE was higher in 2009 compared to subsequent surveys, BPUE figures remained relatively stable between 2012, 2015 and 2019 (Table 1.2; Fig. 1.3).

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Mask, 2009, 2012, 2015 and 2019

Scientific name	Common name	2009	2012	2015	2019**
Mean CPUE					
<i>Perca fluviatilis</i>	Perch	0.184 (0.033)	0.064 (0.013)	0.069 (0.013)	0.139 (0.050)
<i>Rutilus rutilus</i>	Roach	0.071 (0.012)	0.035 (0.007)	0.037 (0.010)	0.049 (0.015)
<i>Salmo trutta</i>	Brown trout	0.012 (0.002)	0.011 (0.002)	0.012 (0.002)	0.009 (0.002)
<i>Salvelinus alpinus</i>	Arctic char	0.009 (0.003)	0.001 (0.001)	0.003 (0.001)	0.002 (0.001)
<i>Abramis brama</i>	Bream	0.005 (0.004)	0.013 (0.008)	0.003 (0.002)	0.008 (0.004)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	-	0.003 (0.0003)	-	0.010 (0.004)
<i>Esox lucius</i>	Pike	0.002 (0.001)	0.0004 (0.0003)	0.001 (0.000)	0.001 (0.000)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	-	-	-	0.0003 (0.000)
<i>Anguilla anguilla</i> *	European eel*	0.015 (0.009)*	0.026 (0.015)*	0.013 (0.013)*	0.006 (0.003)*
Mean BPUE					
<i>Perca fluviatilis</i>	Perch	13.860 (2.519)	4.707 (1.158)	3.643 (0.713)	8.135 (1.666)
<i>Rutilus rutilus</i>	Roach	24.334 (4.628)	11.541 (2.412)	8.694 (2.347)	10.717 (2.785)
<i>Salmo trutta</i>	Brown trout	7.449 (2.390)	1.081 (0.260)	5.316 (1.197)	4.031 (1.182)
<i>Salvelinus alpinus</i>	Arctic char	0.973 (0.491)	0.118 (0.059)	0.192 (0.087)	0.104 (0.059)
<i>Abramis brama</i>	Bream	2.841 (2.717)	14.998 (9.527)	3.674 (2.801)	4.968 (2.216)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	-	0.134 (0.134)	-	8.505 (4.4049)
<i>Esox lucius</i>	Pike	8.075 (3.940)	1.561 (1.551)	0.414 (0.348)	0.248 (0.175)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	-	8.854 (5.611)	-	0.001 (0.001)
<i>Anguilla anguilla</i> *	European eel*	3.552 (1.744)*	8.854 (5.611)*	5.007 (3.046)*	1.743 (0.955)*

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

**For comparison purposes CPUE and BPUE data above for all fish species except eels, is calculated using all survey nets apart from the 55mm, 70mm and 90mm panels from the 4-PBB and 4-PFB survey nets.

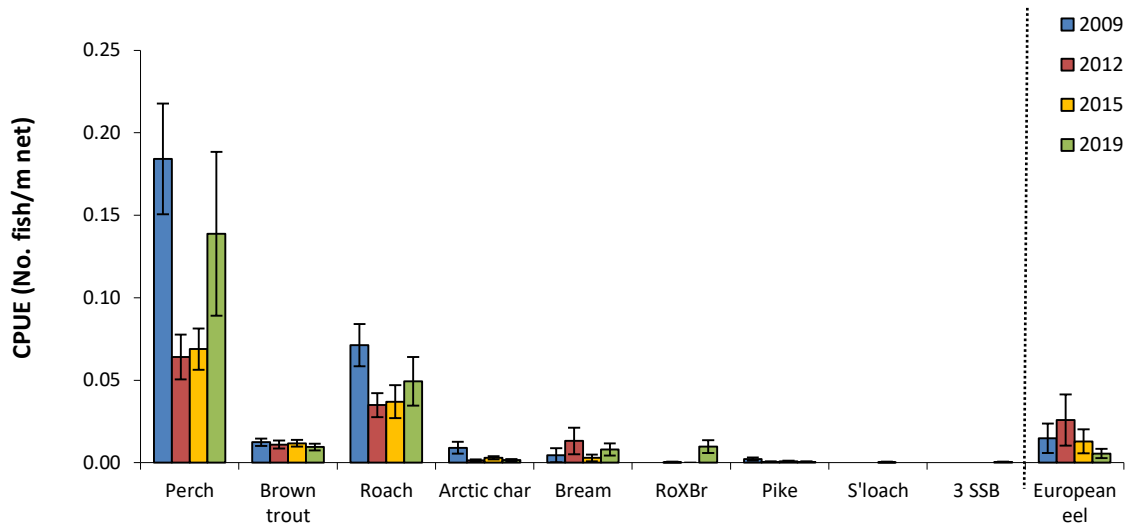


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Lough Mask 2009, 2012, 2015 and 2019 (Note: For comparison purposes CPUE data for all fish species except eels, was calculated using all survey nets apart from the 55mm, 70mm and 90mm panels from the 4-PBB and 4PFB survey nets; Eel CPUE is based on fyke nets only).

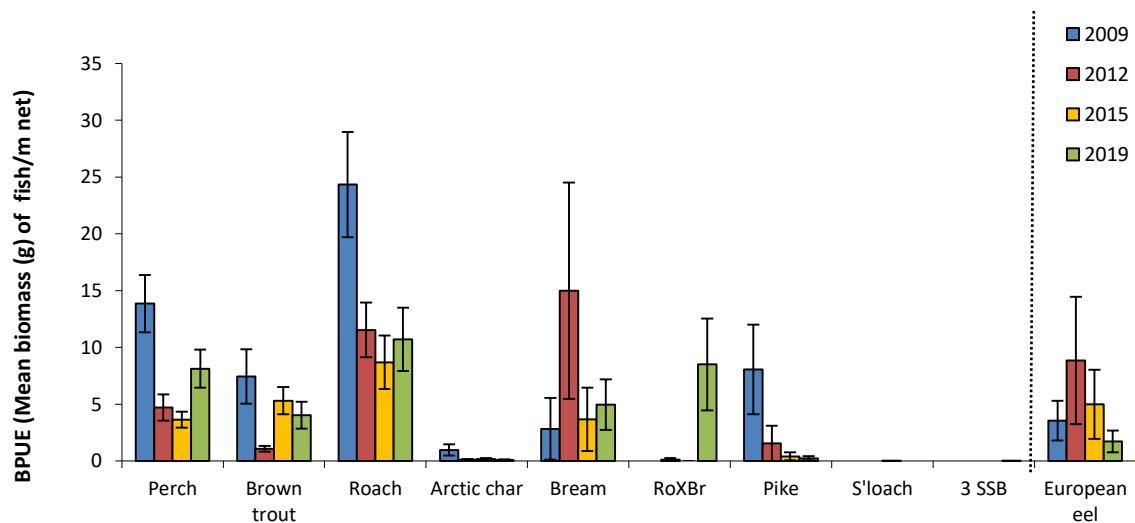


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Lough Mask (Eel BPUE based on fyke nets only), 2009, 2012, 2015 and 2019 (Note: for comparison purposes BPUE data for all fish species except eels, was calculated using all survey nets apart from the 55mm, 70mm and 90mm panels from the 4-PBB and 4PFB survey nets; Eel BPUE is based on fyke nets only).



1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2019 survey ranged in length from 6.2 to 78.5cm (mean = 32.7cm) (Fig. 1.4). Nine age classes were present, ranging from 0+ to 10+, with a mean L1 of 7.3cm (Table 1.3). The dominant age class was 3+ (Fig. 1.4). Mean brown trout L4 in 2019 was 33cm indicating a fast 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 previous surveys had broadly similar length and age ranges compared to the 2019 survey (Fig. 1.4).

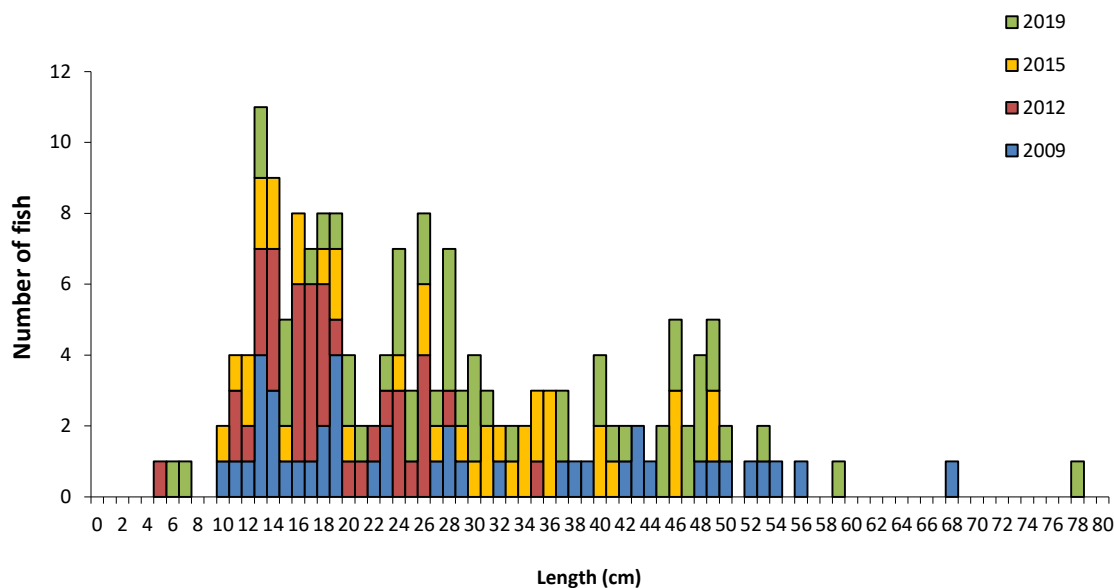


Fig. 1.4. Length frequency of brown trout captured on Lough Mask, 2009, 2012, 2015 and 2019

Table 1.3. Mean (\pm S.E.) brown trout length (cm) at age for Lough Mask, July 2019

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈	L ₉	L ₁₀	Growth
Mean (\pm S.E.)	7.3 (0.1)	15.5 (0.3)	24.3 (0.4)	33.0 (0.5)	40.6 (0.6)	47.0 (0.7)	55.6 (0.2)	62.4	67.5	74.2	Fast
N	41	35	27	14	12	7	2	1	1	1	
Range	5.9- 8.7	12.9- 18.9	18.6- 28.2	29.5- 35.9	38.0- 44.7	45.1- 50.8	55.4- 55.7	-	-	-	

Perch

Perch captured during the 2019 survey ranged in length from 5.0cm to 37.9cm (mean = 13.3cm) (Fig. 1.5). Perch had a similar length and age range to previous surveys (Fig. 1.5). Eight age classes were present in 2019, ranging from 1+ to 8+, with a mean L1 of 6.4cm (Table 1.4). The dominant age class was 1+ (Table 1.4).

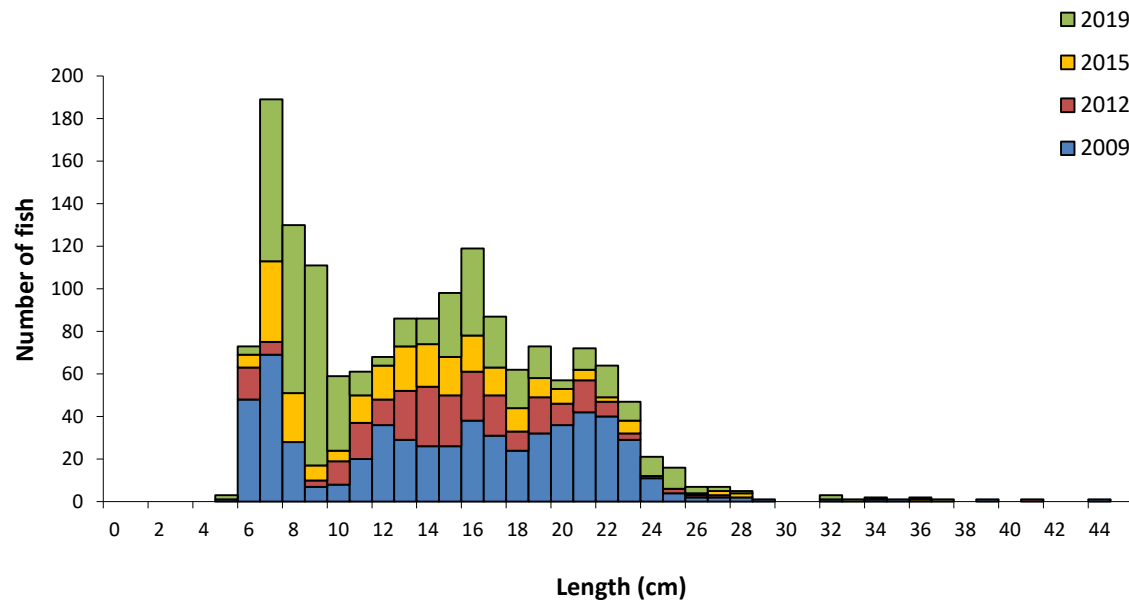


Fig. 1.5. Length frequency of perch captured on Lough Mask, 2009, 2012, 2015 and 2019

Table 1.4. Mean (\pm S.E.) perch length (cm) at age for Lough Mask, July 2019

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈
Mean (\pm S.E.)	6.4 (0.1)	11.2 (0.2)	15.9 (0.3)	19.4 (0.4)	21.7 (0.5)	24.1 (0.6)	25.3 (1.2)	25.4 (1.2)
N	98	74	64	37	28	17	7	3
Range	3.6-9.6	6.7-15.9	12.3-22.9	14.8-25.4	17.0-30.8	21.1-30.6	22.6-31.9	23.4-27.5

Roach

Roach captured during the 2019 survey ranged in length from 6.0cm to 33.6cm (mean = 21.3cm) (Fig. 1.6). Roach captured in the 2019 survey had a broadly similar length range compared to previous surveys although a greater proportion of larger roach were recorded in 2009 (Fig.1.6). Nine age classes were present, ranging from 3+ to 11+ with all intervening age classes present in the sample aged, with 6+ the dominant age class (Fig 1.6).

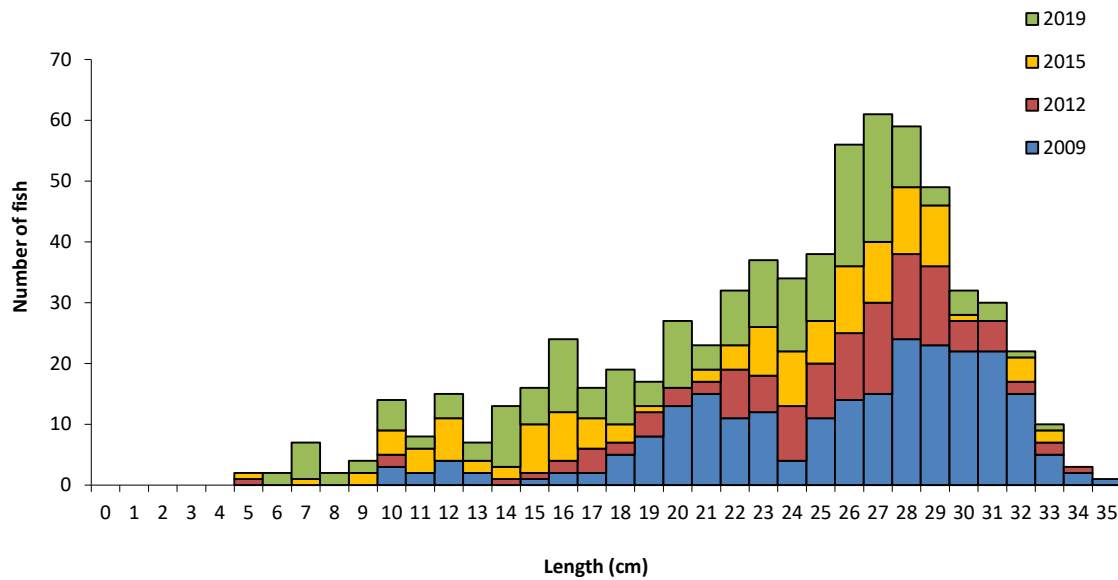


Fig. 1.6. Length frequency of roach captured on Lough Mask, 2009, 2012, 2015 and 2019

Other fish species

Arctic char captured in the 2019 survey ranged in length from 10.1 cm to 23.7cm, with a mean length of 15.4cm.

Bream captured in the 2019 ranged in length from 24.7cm to 48.5cm, with a mean length of 32.8cm. Bream ranged in age from 5+ to 15+ and were dominated by the 6+ year class.

Roach x bream hybrids ranged from 8.5cm to 45.3cm, with a mean length of 35.4cm. Roach x bream hybrids ranged from 2+ to 16+, with 8+ the dominant age class.

European eels ranged from 46.0cm to 61.0cm. Two pike were captured measuring 38.4cm and 41.3cm. Two three-spined stickleback measuring 3.0cm and 5.8cm were 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, brown trout and pike 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 36 brown trout stomachs were examined. Of these 15 were found to contain no prey items. Of the remaining 21 stomachs containing food, 38% contained invertebrates, 29% contained zooplankton, 14% contained fish, 10% contained invertebrates/zooplankton and 9% contained unidentified digested material (Fig. 1.7).

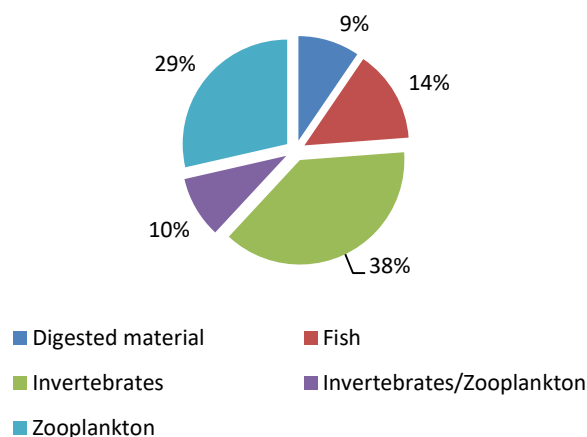


Fig 1.7. Diet of brown trout (n=21) captured on Lough Mask, July 2019 (% FO)

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 100 stomachs were examined, of these 28 were found to contain no prey items. Of the 72 remaining stomachs, 49% contained invertebrates, 24% zooplankton, 12% unidentified digested material, 8% fish, 4% crayfish and 3% invertebrates/zooplankton and (Fig. 1.8).

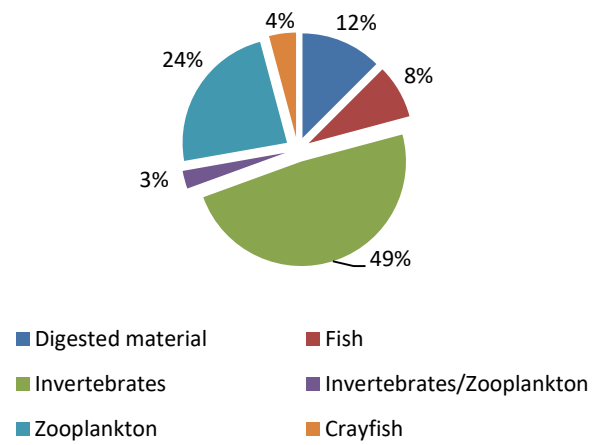


Fig 1.8. Diet of perch (n=72) captured on Lough Mask, July 2019 (% FO)

Pike

Two pike were available for stomach analysis and both stomachs were empty.



1.4 Summary and ecological status

A total of eight fish species and one type of hybrid were recorded in Lough Mask in July 2019. Perch was the dominant species in terms of abundance (CPUE) and roach was the most dominant species in terms of biomass (BPUE) captured in the survey gill nets during the 2019 survey.

The mean brown trout CPUE was relatively similar to the CPUE recorded in previous surveys. The mean BPUE fluctuated across the four sampling occasions, but was lower in 2019 than that recorded in 2009 and 2015. Brown trout captured during the 2019 survey ranged in length from 6.2 to 78.5cm. Nine age classes ranging from 0+ to 10+ were recorded, indicating reproductive success throughout the previous 11 years. Growth rate analysis indicates brown trout in Lough Mask, display a fast growth rate according to the classification scheme of Kennedy and Fitzmaurice (1971).

Perch CPUE and BPUE were higher than the figures recorded in the 2012 and 2015 surveys; however both values were less than those recorded in the 2009 survey. Perch ranged in length from 5.0cm to 37.9cm in the 2019 survey. Eight age classes were present, ranging from 1+ to 8, indicating reproductive success in eight of the last nine years. The absence of 0+ perch is most likely due to the timing of the survey. In early summer 0+ perch are unlikely to be of sufficient size to be captured in the survey gill nets. The dominant age class was 1+.

Mean roach abundance (CPUE) was higher in 2019 than 2012 and 2015; however it was lower than the figure calculated for 2009. The mean BPUE for roach between 2012 and 2019 was relatively similar, but was also lower than the figure for 2009. All year classes from 3+ to 11+ were recorded in the sample aged, which was dominated by older, larger cohorts.

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



Mask has been assigned an ecological status of Good for 2019 based on the fish populations present. The lake was also assigned Good fish status in 2009, 2012 and 2015.

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Mask an overall draft ecological status of Good, based on all monitored physico-chemical and biological elements, including fish.



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