

National Research Survey Programme

Lakes 2016

Inchiquin Lough

IFI/2017/1-4353



Iascach Iníre Éireann
Inland Fisheries Ireland



Inland Fisheries Ireland

National Research Survey Programme

**Fish Stock Survey of Inchiquin Lough,
August/September 2016**

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

CITATION: Kelly, F.L., Connor, L., Coyne, J., Morrissey, E., Corcoran, W., Cierpial, D., Delanty, K., McLoone, P., Matson, R., Gordon, P., O' Briain, R., Rocks, K., O' Reilly, S., Puttharee, D., McWeeney, D., Robson S. and Buckley, S. (2017) Fish Stock Survey of Inchiquin Lough, August/September 2016. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

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

© Inland Fisheries Ireland 2017



ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge the help and co-operation of all their colleagues in Inland Fisheries Ireland.

The authors would also like to acknowledge the funding provided for the project from the Department of Communications, Climate Action and Environment for 2016.

The report includes Ordnance Survey Ireland data reproduced under OSi Copyright Permit No. MP 007508.

*Unauthorised reproduction infringes Ordnance Survey Ireland and Government of Ireland copyright.
© Ordnance Survey Ireland, 2016.*



1.1 Introduction

Inchiquin Lough is located in the upper reaches of the Fergus catchment approximately one kilometre outside Corrofin village, Co. Clare and ten kilometres north-west of Ennis (Plate 1.1, Fig. 1.1). The lake is part of the River Fergus catchment. It is quite a deep lake with limited shallows (Champ, 1979). The lake has a surface area of 107ha and a maximum depth of 27m. The lake is categorised as typology class 12 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and high alkalinity (>100 mg/l CaCO₃).

The lake is part of the East Burren Complex Special Area of Conservation (SAC). The River Fergus is the only major over-ground river within the site. Well-developed bryophyte and lichen communities are found in association with petrifying springs. Stonewort (*Chara* spp.) beds are common in Inchiquin Lough. The East Burren Complex is of international scientific interest owing to the presence of fine examples of typical Burren habitats, together with an oligotrophic wetland complex of lakes, turloughs, fen, cut-over bog and calcareous marsh. Some of the only remaining woodland habitats to be found in the Burren occur within the complex. The occurrence of many rare plants and animals within the SAC adds considerably to its scientific and conservation value. The site is of high ornithological interest also, for the internationally and nationally important numbers of waterfowl that use it (NPWS, 2016).

Inchiquin Lough is primarily an early season lake and fishes best from March to May (IFI, 2016) and in high water in September (O' Reilly, 1998). As this is a deep lake, the most productive fishing areas are along the shore-line or adjacent to the islands. However, over recent years excessive weed growth has limited fishing during high summer in some areas of the lake (IFI, 2016). The lake was showing signs of eutrophication in the 1970s (Flanagan and Toner, 1975). O' Reilly (1998) also noted that the lake suffered from algal blooms in summer and more recently algal blooms have been observed on the lake in 2014 (Clare People, 2014).

The lake was surveyed in 2002, as part of a fish stock assessment by IFI's research section using seven-panel benthic braided survey gill nets (O'Grady and Delanty, 2003). During this survey, brown trout, pike and perch were recorded. Prior to this the lake was surveyed during the period 1976 – 1978 (O'Grady, 1981). Rudd and tench are also known to be present in the lake (O'Grady, 1981).



The 2016 fish stock survey on Inchiquin Lough had two objectives:

1. Determine the current status of the fish stocks in the lake
2. Undertake an inter-calibration exercise between the WFD multi method approach (BM CEN, FM CEN, Fyke and 2-PBB) and the “modified” method established by IFI in the late 1970s to assess the status of brown trout in lakes (8PBB).

This report summarises the results of the 2016 fish stock survey (e.g. species composition, abundance and age structure) on the lake using both methods above, while the data from the method inter-calibration exercise is presented in a separate report.



Plate 1.1. Inchiquin Lough

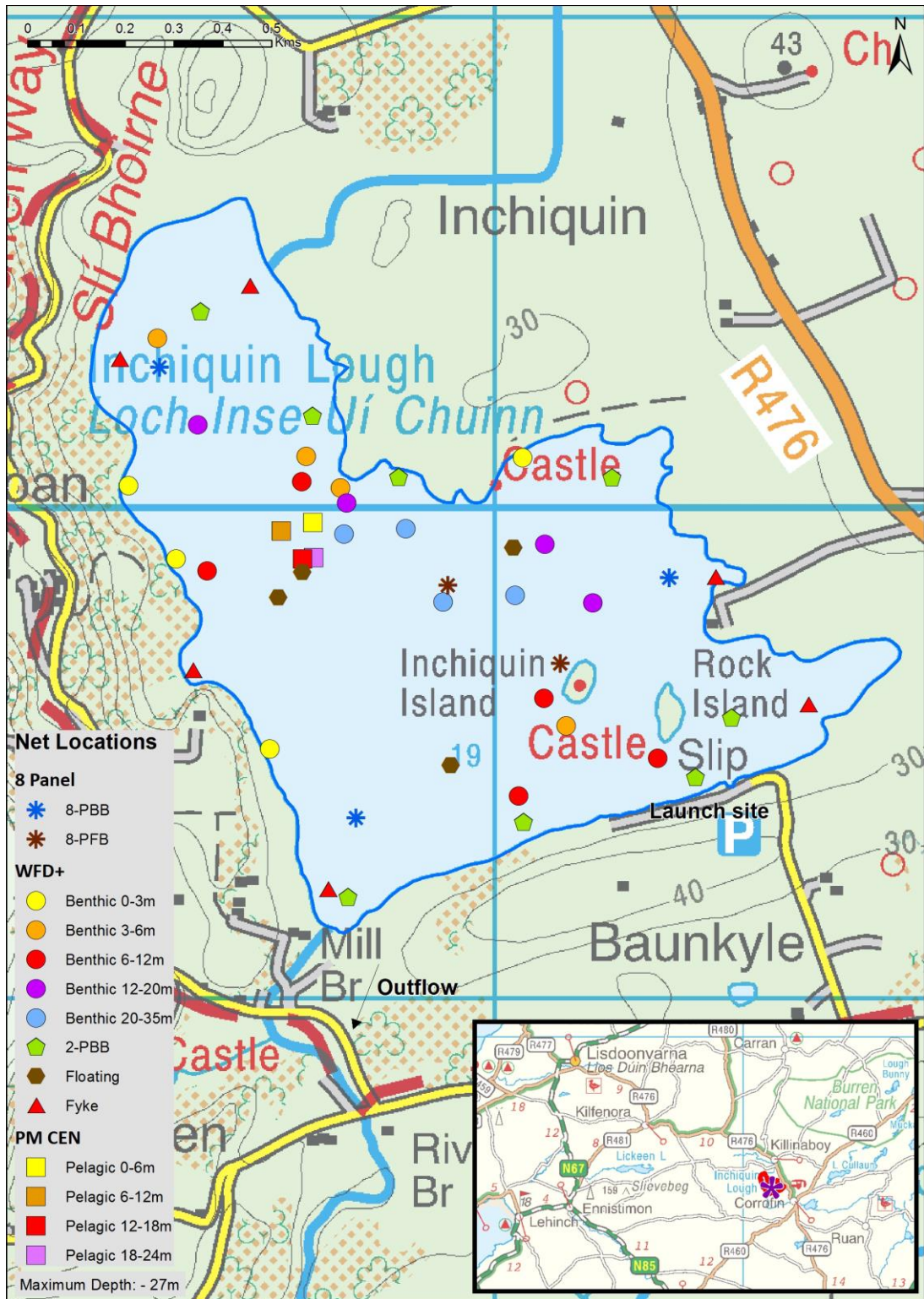


Fig. 1.1. Location map of Inchiquin Lough showing locations and depths of each net (outflow is indicated on map)



1.2 Methods

1.2.2 Netting methods

A multi-method fish stock survey (various survey net types) was undertaken on Lough Inchiquin over three nights from the 29th of August to the 1st of September 2016.

a. WFD+

A total of six Dutch fyke nets (Fyke), 21 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh knot to knot) CEN standard survey gill nets and four surface floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh knot to knot) CEN standard survey gill nets were deployed in the lake. The netting effort was supplemented using eight two-panel benthic braided (63.5mm and 88.9mm mesh knot to knot) survey gill nets (2-PBB).

b. 8-panel

In addition three eight-panel benthic braided survey gill nets (8-PBB) and two eight-panel floating braided survey gill nets (8-PFB) were deployed on the lake. These survey gill nets are composed of eight 27.5m long panels each a different mesh size, tied together randomly. The panels ranged from 2" (50.8mm stretched mesh, 25.4mm mesh knot to knot) to 5" (127mm stretched mesh, 63.5mm mesh knot to knot) in half inch (12.7mm) increments (O'Grady, 1981) with the addition of a 7" (177.8mm stretched mesh, 88.9mm mesh knot to knot) panel.

c. Pelagic

A further four pelagic multi-mesh (12 panel, 6.25-55mm mesh size) 30m x 6m CEN standard survey gill nets were set (PM CEN).

The site locations for the benthic and surface monofilament multi-mesh gill net (BM CEN and FM CEN) were chosen randomly within fixed depth zones (0-2.9m, 3-5.9m, 6-11.9m, 12-19.9m and 20-34.9m). The pelagic gill nets were set over the deepest part of the lake, at 6m intervals from the surface to the lake bed. 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 also randomised.



All fish apart from perch were measured and weighed on site and scales were removed from all brown trout, pike 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 returned to the laboratory for further analysis.

1.2.2 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.

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



1.3 Results

1.3.1 Species Richness

A total of five fish species were recorded on Inchiquin Lough in August/September 2016, with 2048 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. Brown trout, pike, rudd and eels were also recorded. During the previous surveys in 1978/1979 and 2002 the same species composition was recorded with the exception of eels and rudd, which were only captured during the 2016 survey.

Table 1.1. Number of each fish species captured by each method during the survey on Inchiquin Lough, August/September 2016

Scientific name	Common name	Number of fish captured			
		WFD+	Pelagic	8-panel	Total
<i>Perca fluviatilis</i>	Perch	743	1176	19	1938
<i>Salmo trutta</i>	Brown trout	13	23	26	62
<i>Esox lucius</i>	Pike	11	1	7	19
<i>Scardinius erythrophthalmus</i>	Rudd	1	0	0	1
<i>Anguilla anguilla</i>	European eel	28	0	0	28

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 (Fig. 1.2a and b and 1.3).

Overall perch was the dominant species in terms of CPUE and pike was the dominant species in terms of biomass (BPUE) (Fig. 1.2a/b and 1.3). Juvenile perch were the dominant species in the pelagic zone in terms of CPUE and brown trout was dominant in terms of BPUE (Fig. 1.2a/b and 1.3).



Table 1.2. Mean (S.E.) CPUE and BPUE (per metre of net) for all fish species captured on Inchiquin Lough, 2016

Scientific name	Common name	WFD+	Pelagic (PM CEN)	8-panel
Mean CPUE (±S.E.)				
<i>Perca fluviatilis</i>	Perch	0.619 (0.176)	2.450 (1.081)	0.017 (0.015)
<i>Salmo trutta</i>	Brown trout	0.010 (0.004)	0.048 (0.012)	0.024 (0.007)
<i>Esox lucius</i>	Pike	0.009 (0.004)	0.002 (0.002)	0.006 (0.003)
<i>Scardinius erythrophthalmus</i>	Rudd	0.0009 (0.0009)	-	-
<i>Anguilla Anguilla</i> *	European eel*	0.078(0.029) *	-	-
Mean BPUE (±S.E.)				
<i>Salmo trutta</i>	Brown trout	5.371 (2.569)	11.788 (4.960)	10.338 (4.013)
<i>Perca fluviatilis</i>	Perch	11.712 (3.314)	5.881 (2.336)	1.274 (1.125)
<i>Esox lucius</i>	Pike	9.336 (5.201)	3.904 (3.904)	18.945 (11.530)
<i>Scardinius erythrophthalmus</i>	Rudd	0.042 (0.042)	-	-
<i>Anguilla Anguilla</i> *	European eel*	14.886 (5.327) *	-	-

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

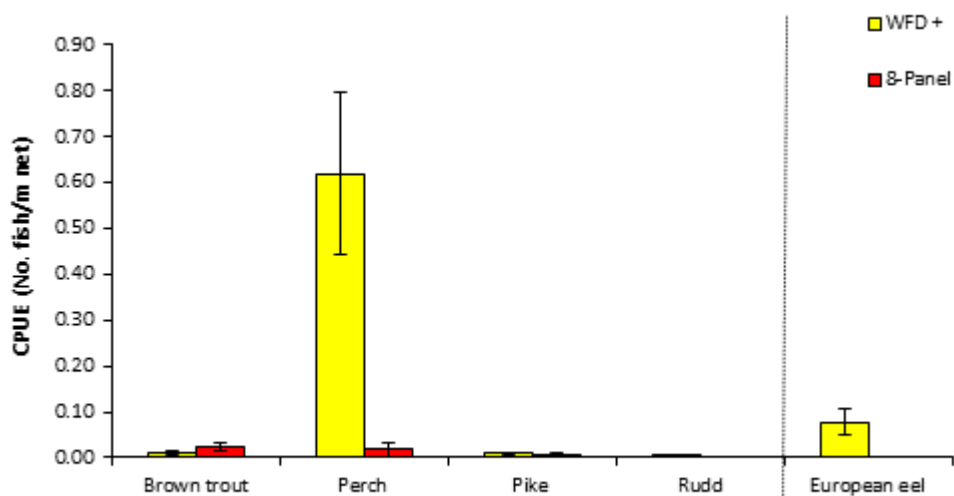


Fig. 1.2a. Mean (±S.E.) CPUE for all fish species captured in Inchiquin Lough (WFD+ and 8-panel nets only) (Eel CPUE based on fyke nets only), 2016

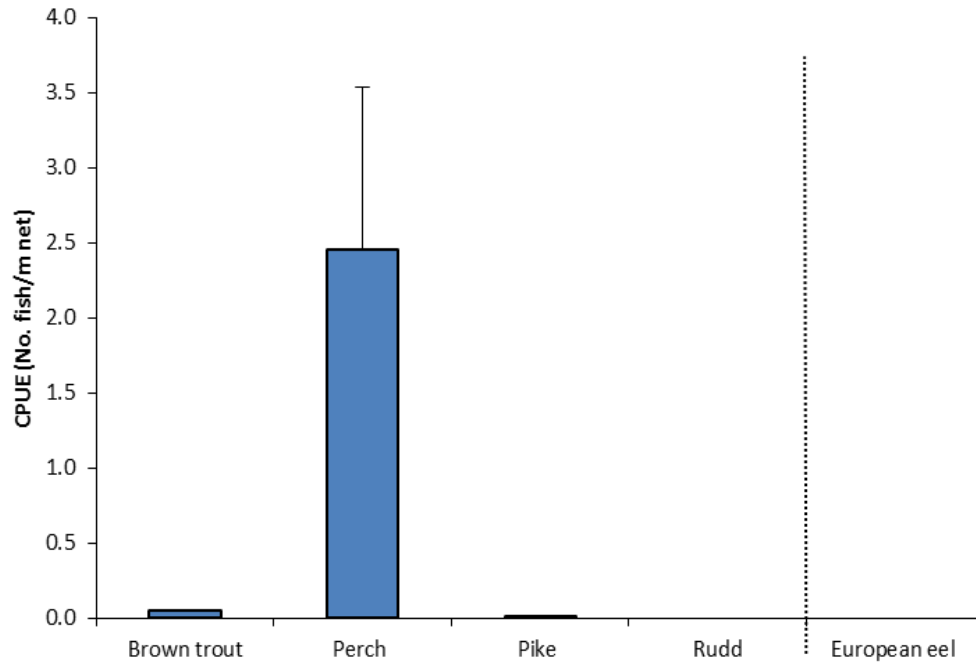


Fig. 1.2b. Mean (\pm S.E.) CPUE for all fish species captured in Inchiquin Lough (PM CEN nets only), 2016

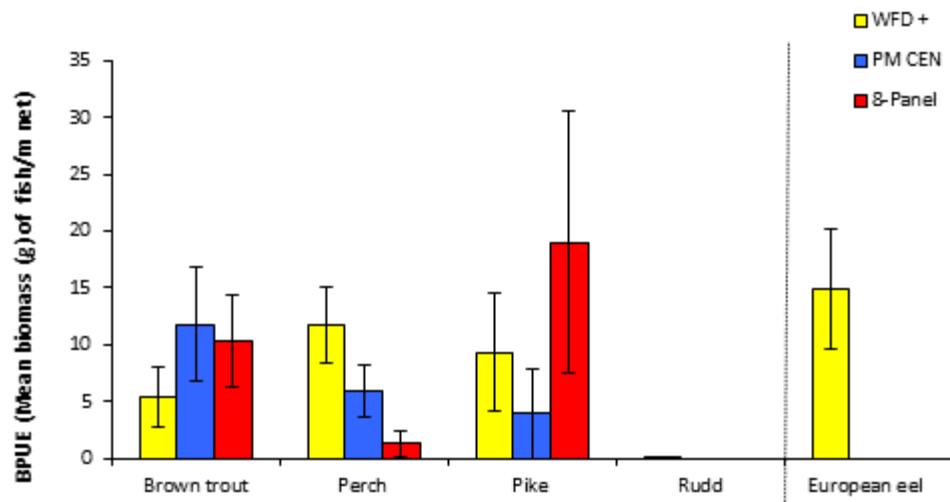


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Inchiquin Lough (Eel BPUE based on fyke nets only), 2016



1.3.3 Length frequency distributions and growth

Perch

Perch captured during the 2016 survey ranged in length from 2.2cm to 36.0cm (mean = 7.4cm) (Fig.1.4) with six age classes present, ranging from 0+ to 7+ with a mean L1 of 6.9cm (Table 1.4). The dominant age class was 1+ (Fig. 1.4).

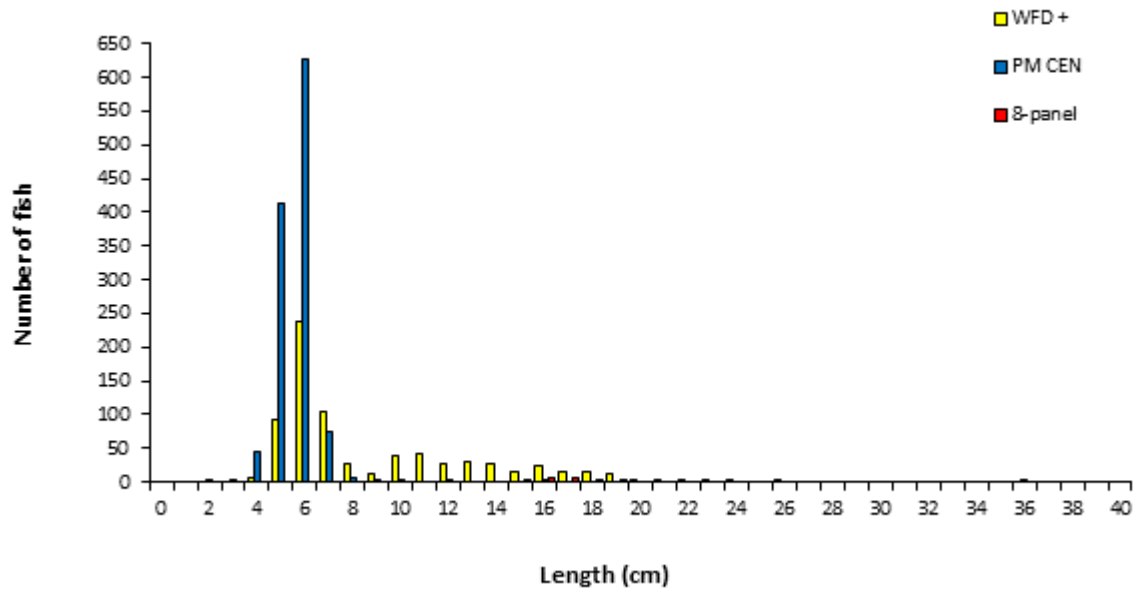


Fig. 1.4. Length frequency of perch captured on Inchiquin Lough, 2016

Table 1.3. Mean (\pm S.E.) perch length (cm) at age for Inchiquin Lough, August/September 2016

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇
Mean (\pm S.E.)	6.9 (0.1)	13.0 (0.3)	17.2 (0.3)	19.7 (0.8)	20.4	23.9	25.0
N	53	34	21	4	1	1	1
Range	4.5-8.9	8.9-15.8	15.0-19.4	17.9-21.0	20.4-20.4	23.9-23.9	25.0-25.0



Brown trout

Brown trout captured during the 2016 survey ranged in length from 13.7cm to 58.7cm (mean 28.8cm) (Fig. 1.5). Six age classes were present, ranging from 1+ to 6+, with a mean L1 of 8.6cm (Table 1.4). The dominant age class was 1+ (Fig. 1.5). Mean brown trout L4 in 2016 was 36.7cm indicating a very fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.4).

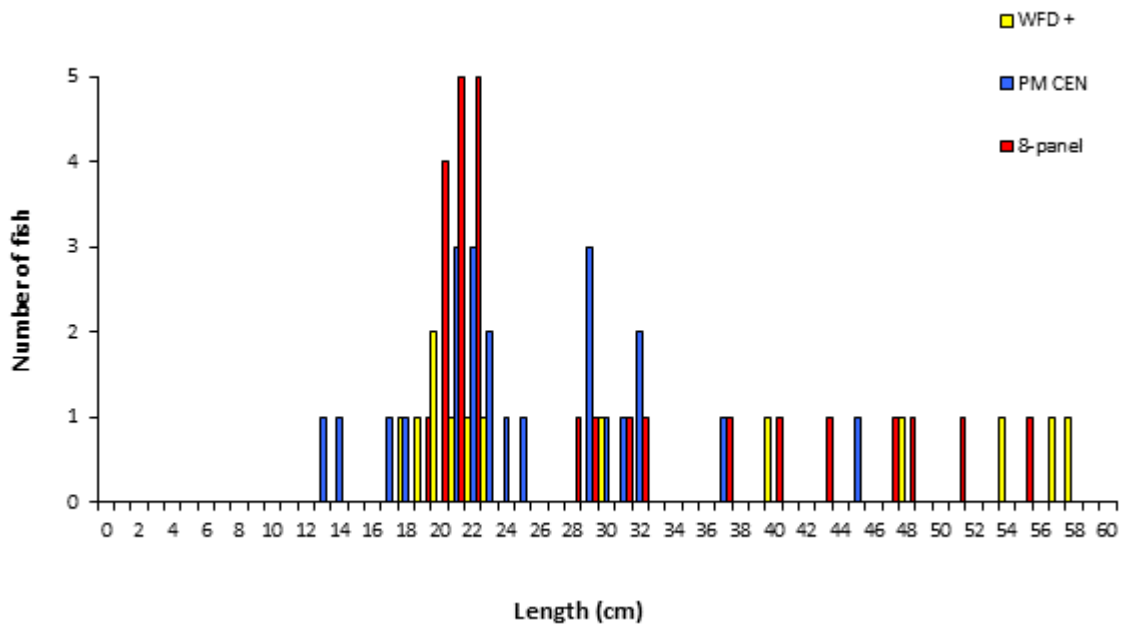


Fig. 1.5. Length frequency of brown trout captured on Inchiquin Lough, 2016

Table 1.4. Mean (\pm S.E.) brown trout length (cm) at age for Inchiquin Lough, August/September 2016

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	Growth Category
Mean (\pm S.E.)	8.6 (0.2)	18.8 (1.1)	28.9 (1.4)	36.7 (1.3)	44.1 (1.3)	54.7	Very fast
N	46	25	9	6	3	1	
Range	5.5-10.9	11.1-28.0	24.6-35.4	31.2-40.0	42.2-46.5	54.7-54.7	

Other fish

Eels recorded during the 2016 survey ranged in length from 31.5cm to 58.6cm. One rudd was measured at 14.5cm. Pike ranged in length from 13.7cm to 106.9cm.



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 104 stomachs were examined. Of these 28 were found to contain no prey items. Of the remaining 76 stomachs containing food, 37% contained zooplankton, 33% invertebrates, 16% fish, 10% unidentified digested material and 4% zooplankton/invertebrates (Fig. 1.6).

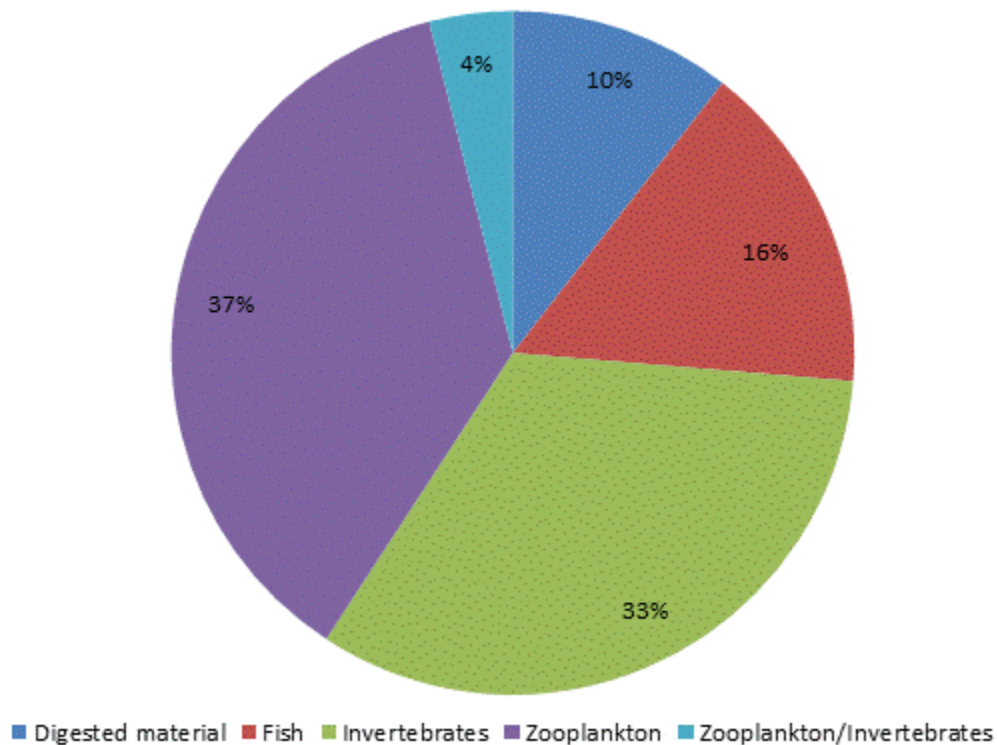


Fig 1.6. Diet of perch (n=76) captured on Inchiquin Lough, 2016 (% occurrence)

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 26 stomachs were examined. Of these seven were found to contain no prey items. Of the 19 stomachs containing food, 58% contained invertebrates, 26% zooplankton, 11% zooplankton/invertebrates and 5% unidentified digested material (Fig. 1.7).

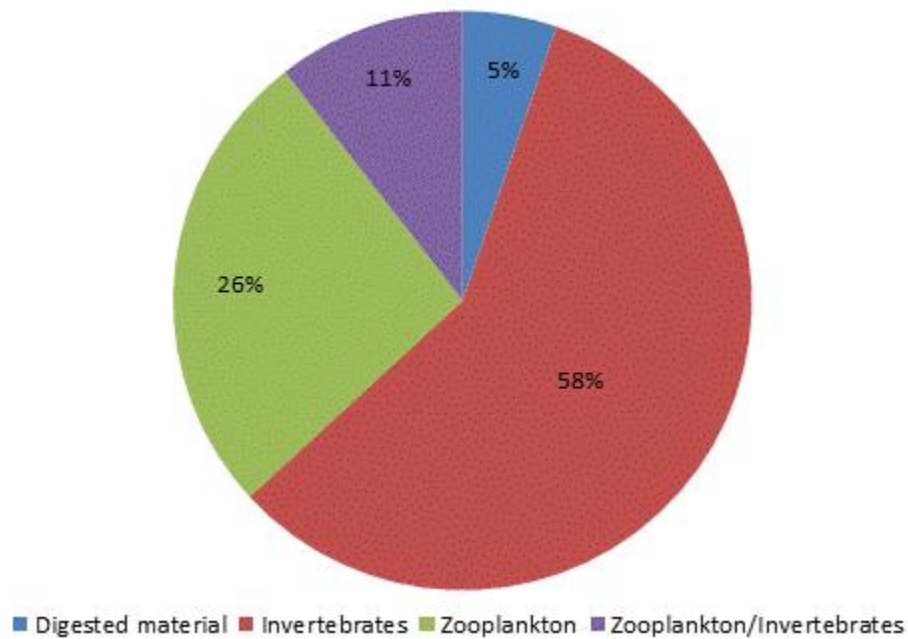


Fig 1.7. Diet of brown trout (n=19) captured on Inchiquin Lough, 2016 (% occurrence)



1.4 Summary and ecological status

A total of five fish species were recorded on Inchiquin Lough in the August/September 2016 survey. Perch was the dominant fish species in terms of abundance (CPUE) and pike was the dominant fish species in terms of biomass (BPUE) captured in the survey gill nets during the 2016 survey.

Perch ranged in length from 2.2cm to 36.0cm and ranged in age from 0+ to 7+, indicating reproductive success in six of the previous eight years. The dominant age class was 1+.

Brown trout ranged in length from 13.7cm to 58.7cm with six age classes present, ranging from 1+ to 6+, indicating reproductive success in six of the previous seven years. The dominant age class was 1+. Length at age analyses revealed that brown trout in the lake exhibit a very fast rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971).

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, Inchiquin Lough has been assigned an ecological status of High for 2016 based on the fish populations present.

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



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.
- Clare People (2014) clarepeople.com
- Hjelm, J., Persson, L., and Christensen, B. (2000) Growth, morphological variation and ontogenetic niche shifts in perch (*Perca fluviatilis*) in relation to resource availability. *Oecologia*, **122**, (2), 190-199.
- Champ, T. (1979). Water monitoring and eutrophication studies carried out by the Inland Fisheries Trust in the Clare area, 1972 – 1979.
- Flanagan, P.J. and Toner, P.F. (1975) *A Preliminary Survey of Irish Lakes*. An Foras Forbartha, Water Resources Division.
- IFI (2016) www.fisheriesireland.ie
- 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, NS Share project.
- Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012b) Development and application of an ecological classification tool for fish in lakes in Ireland. *Ecological Indicators*, **18**, 608-619.
- Kelly, F., Connor, L., Matson, R., Feeney, R., Morrissey, E., Coyne, J. and Rocks, K. (2015) *Sampling Fish for the Water Framework Directive – Summary Report 2014*. 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*, **71B** (18), 269-352.
- NPWS (2016) *Site Synopsis. East Burren Complex SAC. Site Code 001926*. Site Synopsis report, National Parks and Wildlife Service.
- O' Grady, M. and Delanty, K. (2003) *A Fish Stock Assessment of Lough Inchiquin Co. Clare*. Central Fisheries Board Report.
- O' Grady, M.F. (1981) *Trout Populations Studies on Lake Inchiquin*. Central Fisheries Board Internal Report.



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. (1998) *Loughs of Ireland. A Flyfisher's Guide*. 3rd Edition. Merlin Unwin Books.

**Inland Fisheries Ireland
3044 Lake Drive,
Citywest Business Campus,
Dublin 24,
Ireland.
D24 Y265**

**www.fisheriesireland.ie
info@fisheriesireland.ie**

+353 1 8842 600

