National Research Survey Programme

Lakes 2016

Lough Derg

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Iascach Intíre Éireann
Inland Fisheries Ireland

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National Research Survey Programme

Fish Stock Survey of Lough Derg,

June/July 2016

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Table of Contents

Acknowledgements

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1. Introduction

Lough Derg is the third largest lake in Ireland and the largest and most southerly lake on the Shannon system. A long and relatively narrow lake its character changes significantly as you travel from Portumna, Co. Galway in the north to Killaloe, Co. Clare and Ballina, Co. Tipperary in the south (Plates 1.1, 1.2 and 1.3, Fig. 2.1). The lake is categorised as typology class 12 (as designated by the EPA for the purposes of the Water Framework Directive (WFD)), i.e. deep (>4m), greater than 50ha and high alkalinity (>100mg/l CaCO3). The surface area of the lake is approximately 13,000ha. It is relatively shallow towards the northern end with depths averaging 6m; however it narrows and deepens towards the southern end with depths reaching up to 36m (Flanagan and Toner, 1975). Water levels are regulated by the Electricity Supply Board due to the presence of Ireland's largest hydroelectric power station, Ardnacrusha, which is located at the end of a purpose built channel (the head-race canal) connected to the River Shannon, approximately 8km below the southern end of the lake. The northern end of the lake is bordered by relatively flat, agricultural land, while the lower reaches of the lake are bordered by the Slieve Aughty Mountains in the west and the Arra Mountains in the east (Flanagan and Toner, 1975).

Lough Derg is a mixed fishery, with salmon, trout, pollan, perch, roach, bream, tench, hybrids and pike present (O' Reilly, 2007). Historically it was one of the great brown trout fisheries, though angling was mainly concentrated on the mayfly season. In the 1980s the fishing for brown trout dropped off considerably particularly in the northern half of the lake, due to a deterioration in water clarity and increasing eutrophication (O' Reilly, 1987). Nevertheless it is still a popular brown trout angling destination, especially during mayfly season, when average trout weights are close to 1kg and fish up to 5kg can be taken (O' Reilly, 2007). The lake is also a popular coarse fish and pike angling destination. Pike up to 13.6kg have been reported regularly.

During the mid-1970's the lake was showing signs (e.g. algal blooms) of eutrophication and in the early 1990's Lough Derg was classified as highly eutrophic. More recently Lough Derg has been assigned an ecological status of Poor in the 2010 to 2015 ecological classification of Irish lakes for the WFD (EPA, 2017).

The presence of zebra mussel was confirmed in the lower lake in 1997 (Minchin *et al.,* 2002). This confirmation of the plankton feeding zebra mussel coincided with a significant increase in water clarity (NPWS, 2004). More recently the invasive Asian clam (*Corbicula fluminea*) was recorded in Lough Derg in 2011 (Invasive Species Ireland, 2011).

The north-eastern shore of Lough Derg has been designated as a Special Area of Conservation, with six habitats listed on Annex I of the E.U. Habitats Directive. Four of these habitats are regarded as priority habitats - *Cladium* fen, alluvial woodland, limestone pavement and yew woodland (NPWS, 2003). The lake itself is a Special Protection Area that supports important numbers of wintering wildfowl (NPWS, 2003). Lough Derg is also of conservation interest for the fish and freshwater invertebrate species present. The lake contains a landlocked population of sea lamprey (*Petromyzon marinus*) and all three species of lamprey are present in the Lower River Shannon catchment. The fish species, pollan (*Coregonus autumnalis*), which is listed on Annex V of the EU Habitats Directive is present in Lough Derg; one of only five lakes in Ireland (RoI and NI) (Lough Neagh, Lower Lough Erne, Lough Ree and Lough Derg and Lough Allen) where it is currently known to reside (NPWS, 2004; Harrison *et al*., 2010). This limited distribution in tandem with their sensitivity to anthropogenic changes makes them vulnerable to extinction (Harrod *et al.*, 2001). They are considered a pelagic species and are an important part of Ireland's native biodiversity. They are completely unique to Ireland and represent the only known lacustrine Arctic cisco (*Coregonus autumnalis* Pallas) population in the world; therefore they are of high conservation value (Maitland, 2004).

The lake was previously surveyed to assess the status of its fish stocks in June/July 2009 and June 2012 by Inland Fisheries Ireland as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al*., 2010 and 2013). During both of these surveys, perch were determined to be the dominant species present in the lake. Roach, roach x bream hybrids, bream, brown trout, tench, pike and eels were also captured during the surveys.

The objectives of the 2016 fish stock survey were:

1. Determine the current status of the fish stocks in the lake
2. Carry out a hydroacoustic survey of the lake to assess the status of the pollan population.
3. 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 and hydroacoustic survey on Lough Derg, while the inter-calibration results are presented in a separate report.

Plate 1.1. Lough Derg, photo taken from Terryglass pier

Plate 1.2. Lough Derg, looking across to the western shore between Tuamgraney and Twomilegate (Co. Clare)

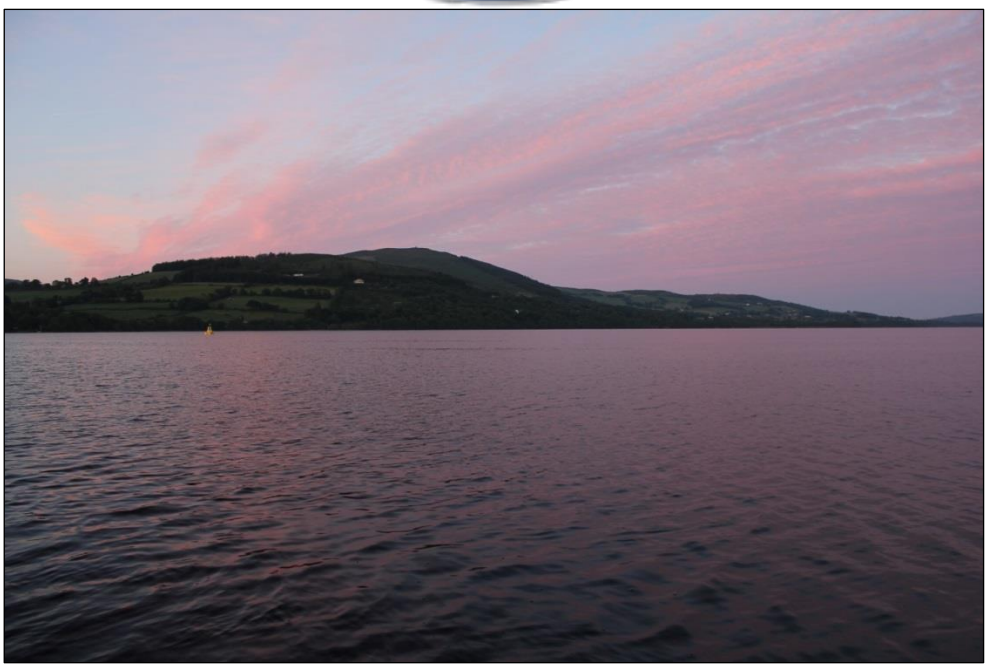

Plate 1.3. Dawn breaking at Lough Derg South, near Castletown, Co. Tipperary

2. Methods

A multi-method fish stock survey was undertaken on Lough Derg over 11 nights between the 13th of June and the 5th of July 2016. Three netting protocols (WFD+, eight panel braided and pelagic CEN) described below were used alongside an extensive hydroacoustic survey of the pelagic zone (open water area of the lake – >12m contour line for the purposes of this survey) to provide a comprehensive picture of the fish community in Lough Derg.

2.1 Netting

2.1.1 WFD+

The WFD+ survey comprised a total of 12 Dutch fyke nets (Fyke), 52 benthic monofilament multi-mesh (12 panel, 5-55mm mesh knot to knot) European standard survey gillnets (BM CEN) and 15 surface floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh knot to knot) European standard survey gillnets were deployed in the lake (CEN, 2015). The netting effort was supplemented using 19 two-panel benthic braided (63.5mm and 88.9mm mesh knot to knot) survey gillnets (2-PBB) (3 additional to the 2012 survey). These latter survey gillnets were modified to include the 88.9mm mesh panel (WFD+). WFD survey nets were deployed in the same locations as randomly chosen in the previous surveys. Site locations for additional nets (WFD+) were chosen randomly within fixed depth zones. 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.

2.1.2 Eight panel braided survey gillnets (8-PBB and 8-PFB)

A total of 54 eight-panel benthic braided survey gillnets (8-PBB) and seven eight panel floating braided survey gillnets (8-PFB) were also deployed on the lake. These are composed of eight 27.5m long panels each a different mesh size, tied together in a random order that was standard for each net. The panels ranged from 2" (25.4mm mesh knot to knot) to 5" (63.5mm mesh knot to knot) in 0.5” (12.5mm) increments (O’Grady, 1981) with the addition of a 7" (88.9mm mesh knot to knot) panel. Site locations were chosen randomly and 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.

2.1.3 Pelagic survey gillnetting

The pelagic zone (area of lake with depth >12m) of Lough Derg was sampled over four nights between the 16th of June and the 1st of July using European standard 12 panel (5-55mm) multi-mesh

pelagic survey gillnets (PM CEN) (30m x 6m) set at 6m intervals from lake surface to lake bed (CEN, 2015). Additional pelagic nets were set to ensure net locations covered the areas surveyed by hydroacoustics. The additional netting effort followed two designs (1) non-random; pelagic gillnets set at 6m intervals at additional deep sites and (2) random locations for each of the available depth zones (0-6, 6-12, 12-18, 18-24, etc.) (Fig. 2.2) (CEN, 2015). Pelagic survey gillnets were set before sunset and lifted after dawn. A handheld GPS was used to mark the precise location of each net.

2.2.4 Fish handling

All fish captured by the WFD+ and eight panel protocols apart from perch were measured and weighed on site and scales were removed from all pollan, while a subset were taken from trout, roach, bream, hybrids and pike (five fish from each length range was sampled). The pelagic catch was sorted by net, mesh size and vertical distribution (per 1.5m panel from float-line to lead-line). Each fish was numbered, identified, measured, weighed and scales were then taken from each fish, where possible, for ageing. 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.

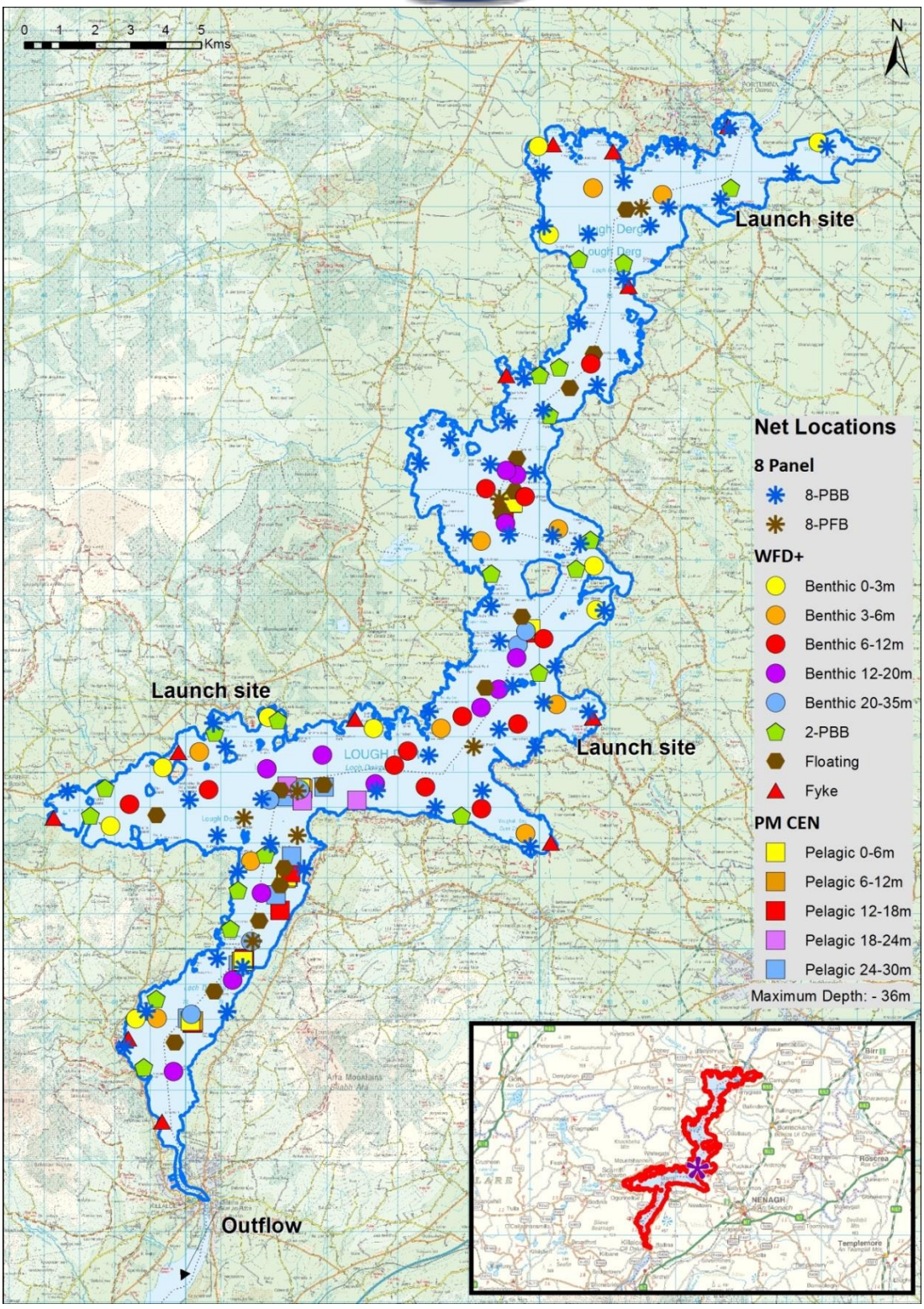

Fig. 2.1. Location map of Lough Derg showing locations and depths of each net type (outflow is indicated on map)

2.2 Hydroacoustic survey of the pelagic zone

Pollan are of high conservation importance; therefore it is desirable to monitor them using minimum impact techniques such as hydroacoustic technology. Hydroacoustics (echo-sounding) technology sends a beam of sound into the water column and fish in the beam send back an echo. The location of the fish is determined by the time it takes for the echo to return and the size of the fish by how loud the returning echo is. Hydroacoustic data usually requires an element of ground truthing; this is normally undertaken using pelagic survey gillnets.

The lake was divided into two sectors for the hydroacoustics survey; Lough Derg North and Lough Derg South (Fig. 2.2) as pollan are a cold-water fish species their abundance was expected to be impacted by the differences in available habitat in Derg North and South.

A hydroacoustic survey was conducted in calm conditions on Lough Derg South between the hours of 21:55 and 05:55 on the nights of the 15th and 16th of June 2016. The survey in accordance with the European standard (CEN, 2015) followed a systematic parallel transect design, had a total track length of 53.1km and the degree of coverage had a co-efficient of variation (CV) of 0.08.

Although inclement weather hampered the hydroacoustic survey on Lough Derg North between the hours of 01:30 and 03:10 on the nights of the 21st and the 22nd of June 2016, a successful survey was conducted; however the data collected in the <12m layer was encroached by air entrained from the waves which impacted the estimates in this layer. However, survey gillnets show that no pollan were captured in this layer and therefore this did not impact the pollan acoustic estimate. The Derg North survey followed a zig-zag transect design; total track length was 6.1km and the degree of coverage had a co-efficient of variation (CV) of 0.12 (Fig. 2.2).

A SIMRAD EY60 scientific echosounder was used; two vertical split-beam circular transducers (120kHz and 200kHz) were deployed off the side of the boat at a depth of 0.5m. Both transducers were calibrated using the appropriate standard copper sphere and the nominal 3dB beam angle of the transducers was 7°. Ping rate was set at 5 pings s^{-1}, pulse duration was 0.256ms. A differential GPS connected to the echosounder recorded the location and reported an average sailing speed of 7km h^{-1} or 1.9 m s^{-1}. Lake conditions in Lough Derg South were generally ideal with no wave action; however five transects (14% recorded distance Derg South) recorded on the 15th and six recorded on the 22nd experienced noticeable wave action but no heave correction was required to analyse the data. Range sampled was 60m; transmitted power was 100 W for 120kHz and 90 W for 200kHz.

Water temperature ranged from 17.3°C at the surface to 12.9°C at 31m with a mean temperature of 15.9°C. Mean water conductivity was 416.8µS/cm.

Sonar5 Pro post-processing software (Balk and Lindem, 2014) was later used to analyse the hydroacoustic recordings, track counting with fish baskets *in situ* was the method applied. Base threshold for data conversion was -120dB. Amplitude echograms were converted to TVG 40logR. Single Echo Detection (SED) criteria were defined as follows; minimum echo length: 0.7, maximum echo length: 1.4, maximum phase deviation: 0.15, maximum gain compensation: 3dB (one-way), multi peak suppression: medium. Dynamic sound profile was applied and minimum target strength (TS) for SED acceptance was set at -50dB which corresponded to a 5.3cm fish (Love, 1971). The simple automatic function was used to track fish; min track length was 2 pings, max ping gap was 1 and gating range was set at 0.15m. Fish were tracked in two layers (3.0 to 12.0m and >12m) as pelagic net catches showed a shift in the species composition above and below 12m. Transects ranged in length from 280m to with a mean length of 1,317m, transects >775m were divided into smaller elementary sampling units (ESU); mean length of ESU was 487m. Analysis detected fish in both layers and all echoes detected were divided into four acoustic size categories. The acoustic echoes were subsequently apportioned to individual fish species and size categories based on their percentage occurrence in the pelagic survey gillnets for Derg North and South (Fig. 2.2).

The arithmetic mean of fish density and biomass were calculated from hydroacoustic data recorded using the 120kHz transducer. Only pelagic gillnets set between the 16th and 22nd of June (Derg South) and the 21st June (Derg North) were used to estimate the relative abundance of pollan in the <12m and >12m layers for four acoustic size categories; small (5 to 10cm), medium (10 to 20cm), large (20 to 33cm) and very large (33 to 123cm). This subset of netting data was considered appropriate as it was collected within seven days of the hydroacoustic data being recorded.

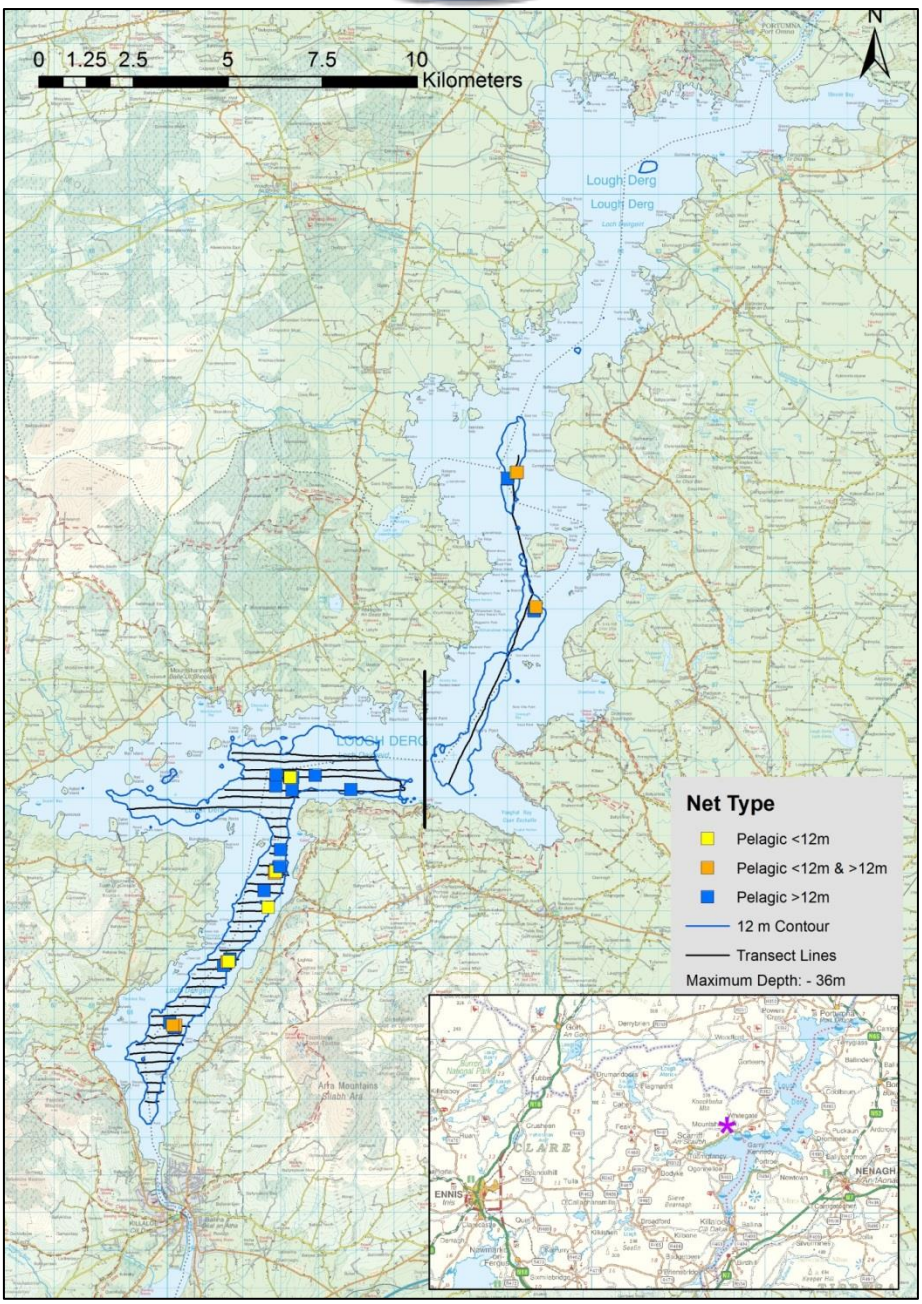

Fig. 2.2. Location map of Lough Derg showing the 12m contour line, all hydroacoustic tracks and pelagic survey gillnet locations.

2.3 Fish length frequency, age and growth

In addition to determining fish stock abundance and the collection of basic biometric data, stock assessments provide insight into the age profile and growth rates of the species captured. Determining age is an important tool in fisheries biology and stock management (Gursoy *et al*., 2005) and is analogous with the aging of trees through growth rings (Campana, 2001). In fish, growth

patterns (fine ridges, known as circuli) visible on the scales, are used to infer age and growth rate. In temperate climates, rapid growth during the summer is evidenced by widely spaced circuli. In the winter, growth slows and circuli are more tightly banded. The outer edge of the tightly banded circuli, termed the annulus, marks the end of that season's growth (Ericksen, 1999). By counting these annuli the age of the fish can be estimated, while the growth rate of each fish can be inferred by back calculating length at age (Bagenal and Tesch, 1978). Generation of growth rate models also provides an insight into population life history such as life span and the average maximum attainable size of long lived individuals.

Three commonly utilised growth models (Von-Bertalanffy, Gompertz and Logistic) were fitted to the data in the FSA package (Ogle, 2016) in R (R Core Team, 2015). In this instance, Observed Length at Age (OLA) was used. The most appropriate model was chosen based on the Aikake Information Criterion (AIC) (the AIC is a measure of how each model fits a specific data set) and with regard to the observed length and age data derived from each survey, so that the most convincing model was chosen if AIC values were similar. Asymptotic length ($L\infty$) (defined as the average length of the very oldest fish in any population) can be viewed as the maximum predicted length for each species. It thus provides insights into the fishery potential of that particular species.

Length frequency (1cm intervals), age and growth analysis was carried out on four fish species and on roach x bream hybrids

2.4 Fish diet

Fish were frozen before being dissected for stomach content analysis in the IFI laboratory. Total stomach contents were inspected and individual items 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).

$$\%O_{ij} = (N_{ij}/ N_j)\times 100$$

Where:

$\%O_i$ is the percentage frequency occurrence of prey item i, in fish species j stomach,

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

N_j is total number of species j with stomach contents.

2.5 Water chemistry:

Dissolved oxygen (mg L^{-1}), temperature (C°), pH and conductivity (µS cm^{-1}) were recorded at 1m intervals from the surface to 31m. A calibrated Hydrolab MS5 multi-parameter water quality sonde was used.

2.6 Pollan conservation status

Currently there are no formal conservation criteria for pollan in Ireland; therefore in this study the UK favourable condition table (Joint Nature Conservation Committee, 2005) for *Coregonus lavaretus* and *Coregonus albula* was used to assign a provisional conservation status for the Lough Derg pollan population.

2.7 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 IFI's National Research Survey Programme (NRSP) team when moving between water bodies.

3. Results

3.1 Species richness

A total of eight fish species and one type of hybrid were recorded on Lough Derg in June 2016, with 7,251 fish being captured. The number of each species captured by each gear type is shown in Table 3.1. Roach was the most common fish species recorded, followed by perch, roach x bream hybrids, brown trout, pike, eels, bream, pollan, and tench. During the previous surveys in 2009 and 2012 the same species composition was recorded, with the exception of pollan, which were not captured in the 2009 survey and tench, which were not captured in 2012 (Kelly *et al.*, 2010 and 2013).

Species richness was lower in the pelagic survey nets than in the benthic and surface survey nets with only five species and one hybrid recorded by the pelagic survey nets. In the pelagic zone perch was the most common fish species recorded, followed by roach, brown trout, pollan, roach x bream hybrids and pike.

Table 3.1. Number of each fish species captured by each gear type during the fish stock survey on Lough Derg, June/July 2016

Scientific name	Common name	Number of fish captured			
		WFD+	Pelagic	8-panel	Total
Rutilus rutilus	Roach	412	46	2858	3316
Perca fluviatilis	Perch	1072	254	864	2190
Rutilus rutilus x Abramis brama	Roach x bream hybrid	130	4	1161	1295
Salmo trutta	Brown trout	30	36	175	241
Esox lucius	Pike	2	1	67	69
Abramis brama	Bream	8	0	41	49
Coregonus autumnalis	Pollan	0	24	2	26
Tinca tinca	Tench	3	0	5	8
Anguilla anguilla	European eel	57	0	0	57

3.2 Fish abundance and biomass

Fish abundance (mean CPUE) and biomass (mean BPUE) were calculated as the mean number/weight (g) of fish caught per metre of net for WFD+ and eight panel braided nets. The pelagic net effort was standardised per metre of benthic CEN net to facilitate the direct comparison of CPUE and BPUE data from all CEN survey gillnets. For all fish species except eel, CPUE/BPUE is based on all nets, whereas eel CPUE/BPUE is based on fyke nets only.

Overall in the benthic zone roach, perch, roach x bream hybrids and brown trout were the most abundant fish species in terms of abundance (CPUE) and roach x bream hybrids, roach and perch were dominant in terms of biomass (BPUE) (Table 3.2, Figs. 3.1 and 3.2). In the pelagic zone (PM CEN) perch was the dominant fish species followed by roach, trout and pollan in terms of abundance (CPUE), while brown trout followed by roach were dominant in terms of biomass (BPUE) (Table 3.2, Figs. 3.1 and 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE (per metre of net) for all fish species captured on Lough Derg, WFD+, PM CEN and 8-panel

Scientific name	Common name	Method		
		WFD+	PM CEN	8-panel
			Mean CPUE (±S.E.) **	
Perca fluviatilis	Perch	0.368 (0.0900)	0.059 (0.0270)	0.0640 (0.0100)
Rutilus rutilus	Roach	0.140 (0.0520)	0.011 (0.0030)	0.2130 (0.0220)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	0.029 (0.0060)	0.001 (0.0001)	0.0870 (0.0100)
Salmo trutta	Brown trout	0.010 (0.0020)	0.008 (0.0020)	0.0130 (0.0020)
Abramis brama	Bream	0.002 (0.0030)	-	0.0030 (0.0010)
Esox lucius	Pike	0.0001 (0.0001)	0.0002 (0.0002)	0.0050 (0.0010)
Tinca tinca	Tench	0.001 (0.0001)	-	0.0004 (0.0002)
Coregonus autumnalis	Pollan	-	0.006 (0.0020)	0.0001 (0.0001)
*Anguilla Anguilla**	European eel	0.079 (0.021)	-	-
			Mean BPUE (±S.E.) **	
Abramis brama	Bream	3.368 (1.770)	-	5.312 (1.487)
Salmo trutta	Brown trout	1.580 (0.423)	2.337 (0.764)	7.672 (1.242)
Perca fluviatilis	Perch	13.260 (2.449)	0.610 (0.398)	9.758 1.604)
Esox lucius	Pike	0.027 (0.021)	0.466 (0.466)	12.480 (2.383)
Rutilus rutilus	Roach	19.644 (3.623)	1.228 (0.377)	56.767 (5.959)
Rutilus rutilus x Abramis brama	Roach x bream hybrid	33.598 (7.349)	0.594 (0.333)	97.091 (11.152)
Tinca tinca	Tench	0.663 (0.456)	-	0.643 (0.372)
Coregonus autumnalis	Pollan	-	0.609 (0.255)	0.441 (0.395)
*Anguilla Anguilla**	European eel	16.732 (5.493)	-	-

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

**CPUE and BPUE data above for all fish species except eels are not comparable to earlier WFD surveys as an extra panel was added to the supplementary nets (now 2-PBB) to provide additional information on large coarse fish (but can be converted if comparisons required)

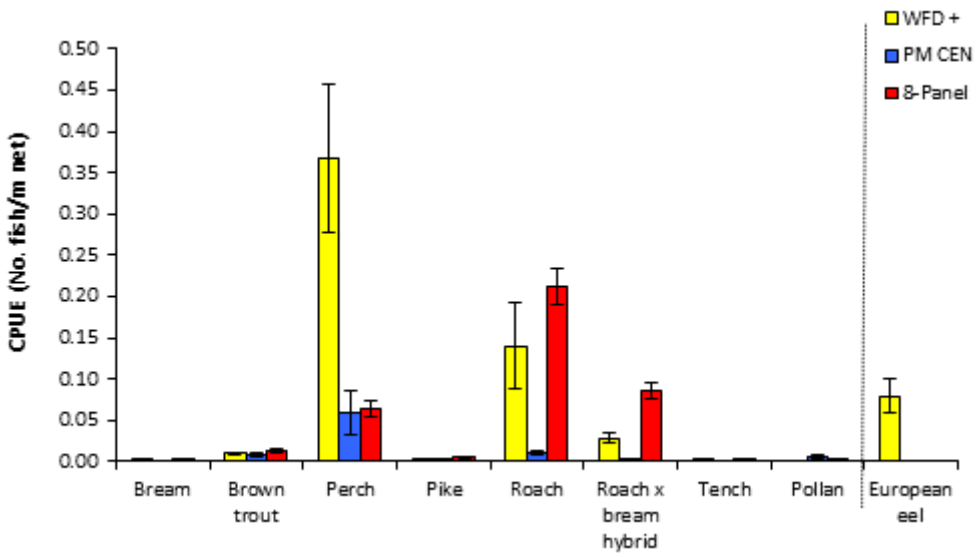

Fig. 3.1. Mean (±S.E.) CPUE for all fish species captured in Lough Derg (Eel CPUE based on fyke nets only), 2016

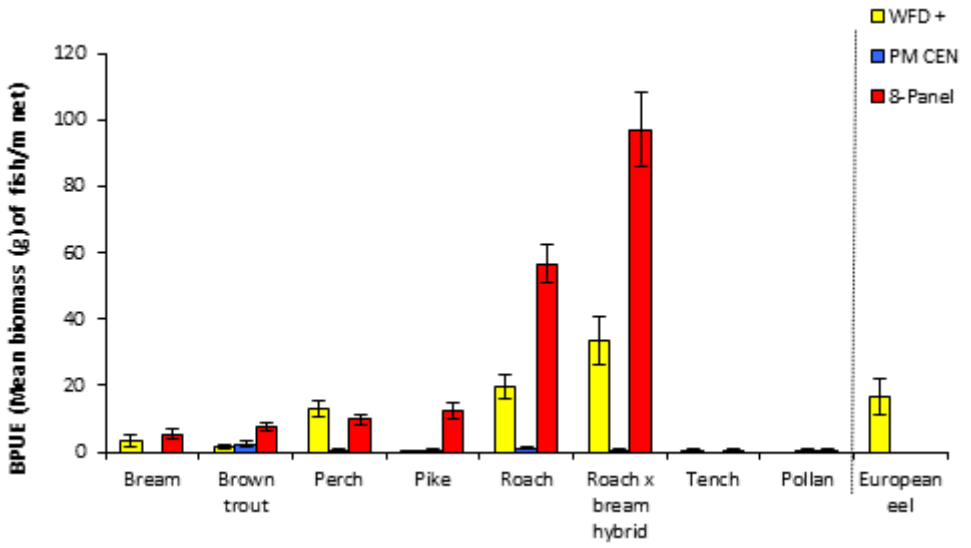

Fig. 3.2. Mean (±S.E.) BPUE for all fish species captured in Lough Derg (Eel BPUE based on fyke nets only), 2016

3.2.1 Percentage occurrence of pollan in the pelagic ground-truth netting

The percentage occurrence of pollan in Lough Derg North was calculated to be 0%, for all size classes in the <12m layer. While in the >12m layer the percentage occurrence of pollan for the small, medium, large and very large size classes respectively was calculated to be 0%, 3.7%, 16.7% and 0% respectively (Fig. 3.3).

The percentage occurrence of pollan in Lough Derg South was calculated to be 0%, 7.7%, 11.1% and 0% for the small, medium, large and very large size classes respectively in the <12m layer. While in the >12m layer for the percentage occurrence of pollan for the four size classes was calculated to be 16.7%, 35%, 83.3% and 0% respectively (Fig. 3.3).

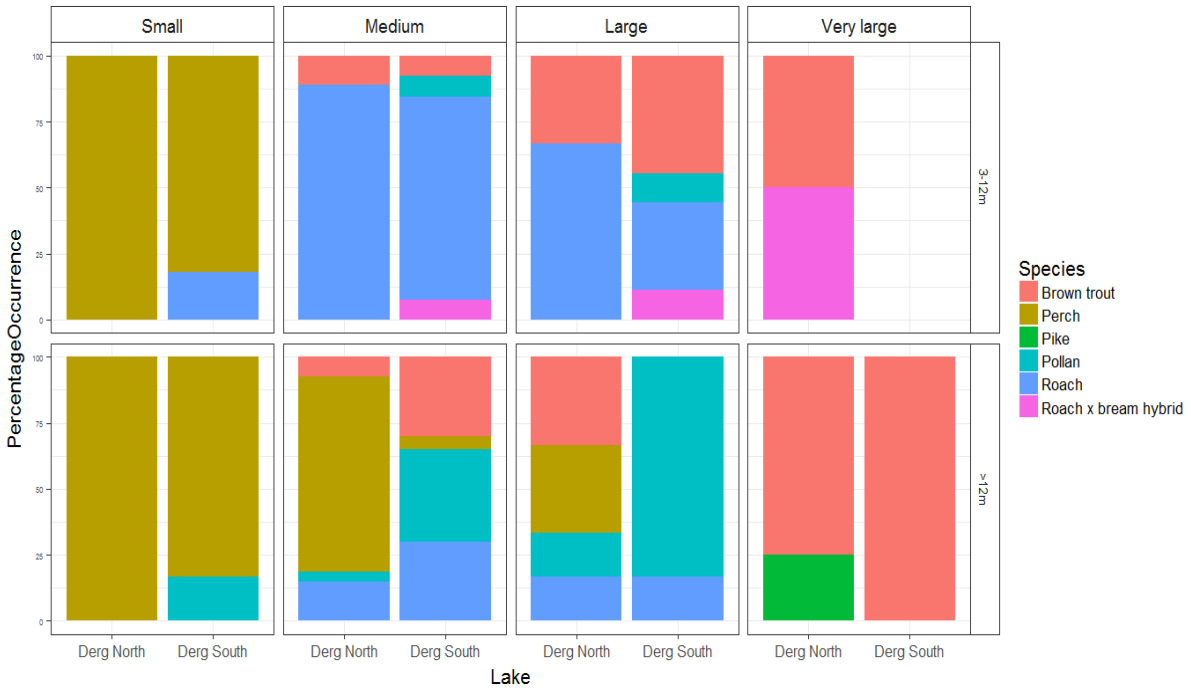

Fig. 3.3. The percentage occurrence of all fish species captured in acoustic pelagic gillnets (above and below 12m) used to ground-truth Lough Derg North and South acoustic estimates

3.2.2 Acoustic abundance of pollan in the pelagic zone

Lough Derg North

The total abundance of fish in the <12m layer of Lough Derg North was estimated as 134.07 fish ha^{-1} (Table 3.3). However, no pollan were recorded in the <12m layer of the pelagic zone of Lough Derg

North; therefore the abundance of pollan in the <12m layer of Lough Derg North was estimated to be 0 pollan ha^{-1} (Table 3.4). The total abundance of fish in the >12m layer of Lough Derg North was estimated as 32.09 fish ha^{-1} (Table 3.3), while the total abundance of pollan was 0.64 pollan ha^{-1} (Table 3.4). There were no small or very large pollan detected in the >12m layer of Lough Derg North, but the medium and large size categories had abundances of 0.25 pollan ha^{-1} and 0.39 pollan ha^{-1} respectively (Table 3.4).

Lough Derg South

The total abundance of fish in the <12m layer of Lough Derg South was estimated as 7.5 fish ha^{-1} (Table 3.3), while the total abundance of pollan was estimated as 0.27 pollan ha^{-1} (Table 3.4). There were no small or very large pollan detected in the <12m layer, but the medium and large size categories had similar abundances of 0.13 pollan ha^{-1} and 0.14 pollan ha^{-1} respectively (Table 3.4). The total abundance of fish in the >12m layer of Lough Derg South was estimated as 6.4 fish ha^{-1} (Table 3.), while the total abundance of pollan was 1.82 pollan ha^{-1}(Table 3.4). There were no very large pollan detected in the >12m layer of Lough Derg South, but the small, medium and large size categories had abundances of 0.58 pollan ha^{-1}, 0.78 pollan ha^{-1} and 0.47 pollan ha^{-1} respectively (Table 3.4).

Table 3.3. Arithmetic mean acoustic total fish abundance (fish/ha) and biomass (g/ha) for four fish sizes and total in the pelagic zone of Lough Derg North and South, June 2016

Size category	Layer	Small	Medium	Large	Very Large	Total
dB Range		-50 to -45dB	-44 to -39 dB	-39 to -35dB	-34 to -23dB	-50 to -23dB
Size class (cm)		5.3 to 10.0	10.0 to 20.0	20.0 to 33.0	33.0 to 123	4.5 to 123
			Abundance (fish ha^{-1}) <12m			
Derg North	<12m	124.02	10.05	0	0	134.07
Derg North	>12m	23.07	6.66	2.36	0	32.09
Derg North	**Total**	**147.09**	**16.71**	**2.36**	**0**	**166.16**
Derg South	<12m	3.74	1.66	1.26	0.84	7.50
Derg South	>12m	3.49	2.22	0.57	0.12	6.40
Derg South	**Total**	**7.23**	**3.88**	**1.83**	**0.96**	**13.9**
			Biomass (g ha^{-1}) <12m			
Derg North	<12m	258.42	323.41	0	0	581.83
Derg North	>12m	122.06	356.76	534.22	0	1013.04
Derg North	**Total**	**380.48**	**680.17**	**534.22**	**0**	**1594.87**
Derg South	<12m	15.54	131.35	125.09	101.45	373.43
Derg South	>12m	12.69	85.07	582.46	476.91	1157.13
Derg South	**Total**	28.23	216.42	707.55	578.36	1530.59

Table 3.4. Arithmetic mean acoustic pollan abundance (fish/ha) and biomass (g/ha) for four fish sizes and total in the pelagic zone of Lough Derg, June/July 2016

Lake	Layer	Small	Medium	Large	Very large	Total
dB Range		**-50 to -45dB**	**-44 to -39 dB**	**-39 to -35dB**	**-34 to -23dB**	**-50 to -23dB**
Size class (cm)		**5.3 to 10.0**	**10.0 to 20.0**	**20.0 to 33.0**	**33.0 to 123**	**4.5 to 123**
			Pollan Abundance (individuals ha^{-1})			
Derg North	<12m	0	0	0	0	0
Derg North	>12m	0	0.25	0.39	0	0.64
Derg North	**Total**	**0**	**0.25**	**0.39**	**0**	**0.64**
Derg South	<12m	0	0.13	0.14	0	0.27
Derg South	>12m	0.58	0.78	0.47	0	1.83
Derg South	**Total**	**0.58**	**0.90**	**0.61**	**0**	**2.09**
			Pollan Biomass (g ha^{-1})			
Derg North	<12m	0	0	0	0	0
Derg North	>12m	0	13.20	89.05	0	102.25
Derg North	**Total**	**0**	**13.20**	**89.05**	**0**	**102.25**
Derg South	<12m	0	6.54	64.65	0	71.19
Derg South	>12m	2.59	45.97	104.20	0	152.76
Derg South	**Total**	**2.59**	**52.52**	**168.85**	**0**	**223.96**

Total pollan acoustic abundance

The arithmetic mean acoustic abundance estimates were multiplied by area of the lake greater than 12m (1,956ha >12m; 462ha in the north and 1,494ha in the south) to calculate population estimates for pollan in Lough Derg North and South (Table 3.5). An estimated 166 pollan, none of which were juveniles (0+ and 1+) occurred in the >12m layer of the pelagic zone of Lough Derg North and no pollan were recorded in the <12m layer (Table 3.5). An estimated 403 pollan, none of which were juveniles (0+ and 1+) occurred in the <12m layer of the pelagic zone of Lough Derg South. In addition it is estimated that 2,719 individuals, 867 of which were juveniles occur in the >12m layer of the pelagic zone of Lough Derg South. Therefore the total pollan population of Lough Derg was estimated to be 3,288, (26.4% juveniles) in June 2016.

Table 3.5: Population estimates for pollan in the pelagic zone of Lough Derg, June/July 2016

	Layer	Total pollan estimate	Juvenile pollan (0+ and 1+) estimate
Derg North	>12m	166	0
Derg North	<12m	0	0
Derg South	>12m	2719	867
Derg South	<12m	403	0
Total		**3288**	**867**

3.3 Fish length frequency, age and growth

3.3.1 Brown trout

Brown trout captured during the 2016 survey ranged in length from 12.1cm to 80.4cm (mean 29.8cm) (Fig. 3.4). Eight age classes were present, ranging from 1+ to 8+, with a mean L1 of 7.2cm (Table 3.6). The dominant age class was 2+ (Fig. 3.4). Brown trout in the pelagic zone ranged in length from 16.0cm to 54.0cm. Mean brown trout L4 in 2016 was 34.2cm indicating a fast rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 3.6).

It was not possible to fit a growth model for brown trout in Lough Derg (Fig. 3.5). This may reflect the inherent variation within the length at age for the fish aged, due to differing life history strategies (e.g. age at migration from natal streams) adopted for individuals within the whole lake.

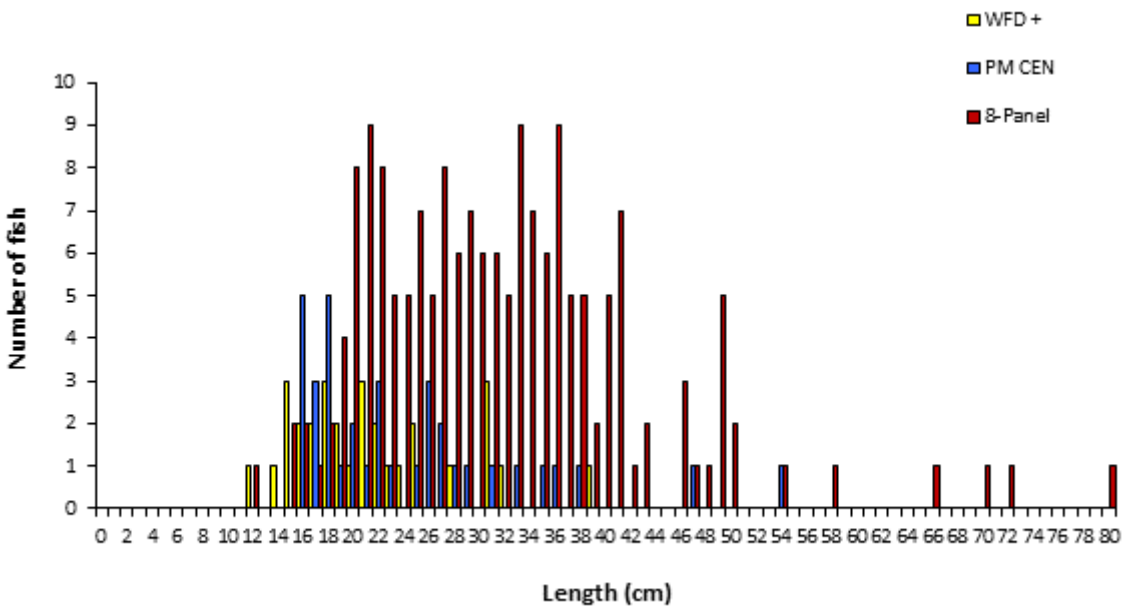

Fig. 3.4. Length frequency of brown trout captured on Lough Derg, June/July 2016

Table 3.6. Mean back calculated (±S.E.) brown trout length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	Growth Category
Mean (± S.E.)	7.2 (0.1)	15.4 (0.3)	25.6 (0.5)	34.2 (0.7)	44.4 (1.5)	53.9 (3.1)	62.3	67.2	Fast
N	167	151	90	40	12	5	1	1	
Range	3.0-11.8	9.4-25.3	15.8-35.6	25.2-42.5	37.9-54.3	45.7-63.1	-	-	

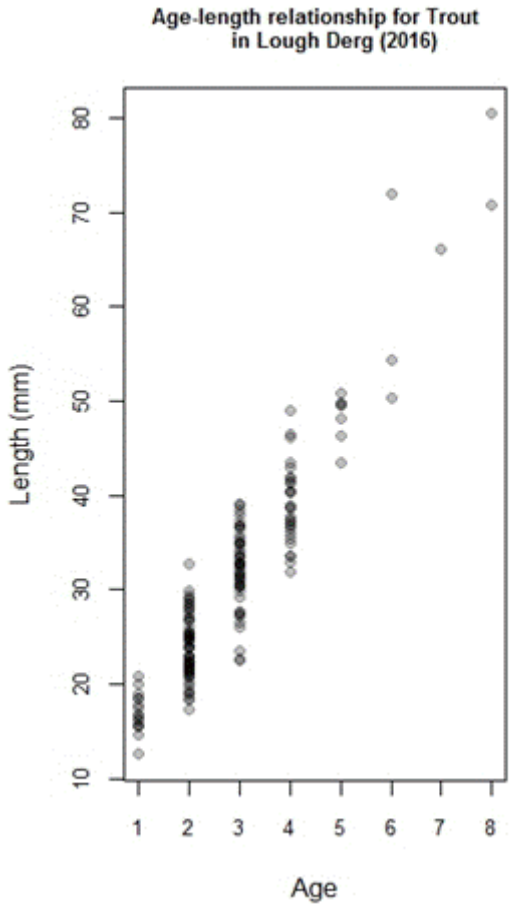

Fig. 3.5. Age-length relationship of brown trout captured on Lough Derg, June/July 2016

3.3.2 Perch

Perch captured during the 2016 survey ranged in length from 2.1cm to 33.2cm (mean = 14.2cm) (Fig. 3.6) and ranged in age from 0+ to 11+ with a mean L1 of 6.2 cm (Table 3.7). Perch in the pelagic zone ranged in length from 1.1cm to 27.2cm. The dominant age class captured using the WFD+ methodology was 1+, with young of year perch (YOY+) prominent in pelagic survey nets. (Fig. 3.6). All age classes with the exception of 10 year old fish were recorded in the sample indicating regular and relatively stable recruitment in the lake (Fig.3.7). Asymptotic length (L∞) was estimated as 32.2cm (29.9-35.2) (Fig. 3.7).

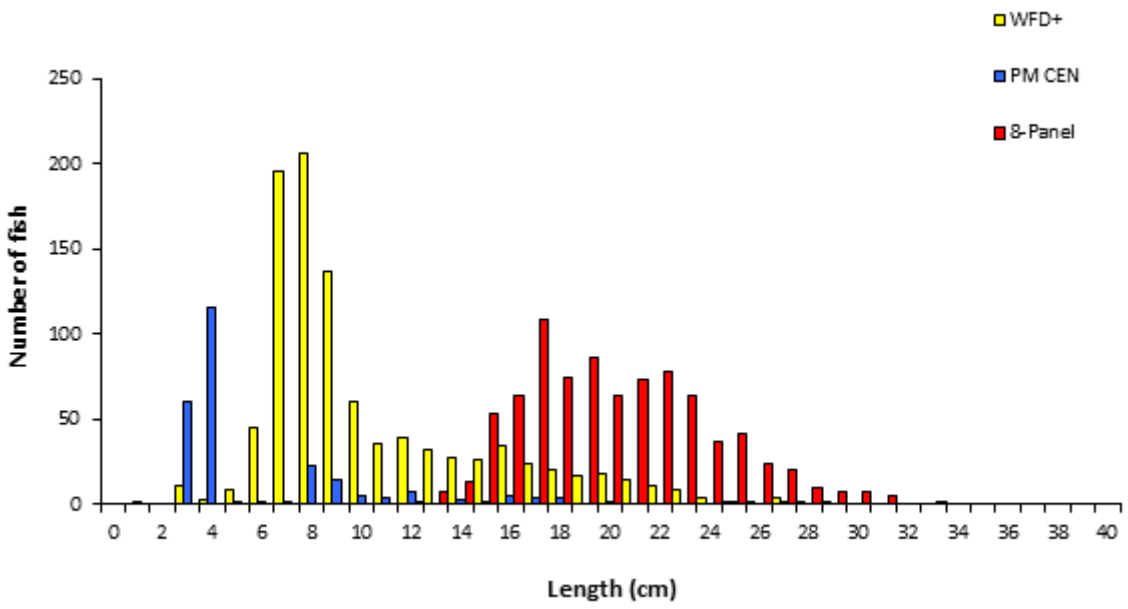

Fig. 3.6. Length frequency of perch captured on Lough Derg, June/July 2016

Table 3.7. Mean back calculated (±S.E.) perch length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}
Mean (±S.E.)	6.2 (0.1)	11.9 (0.2)	16.9 (0.3)	20.9 (0.4)	22.9 (0.5)	25.1 (0.5)	26.7 (0.5)	28.5 (0.8)	28.9 (1.1)	26.6	27.7
N	88	73	54	26	16	14	12	7	4	1	1
Range	4.1-8.9	7.2-16.3	12.3-22.6	16.9-25.1	18.5-25.6	21.1-28.0	23.2-28.4	24.4-30.8	25.7-30.5	-	-

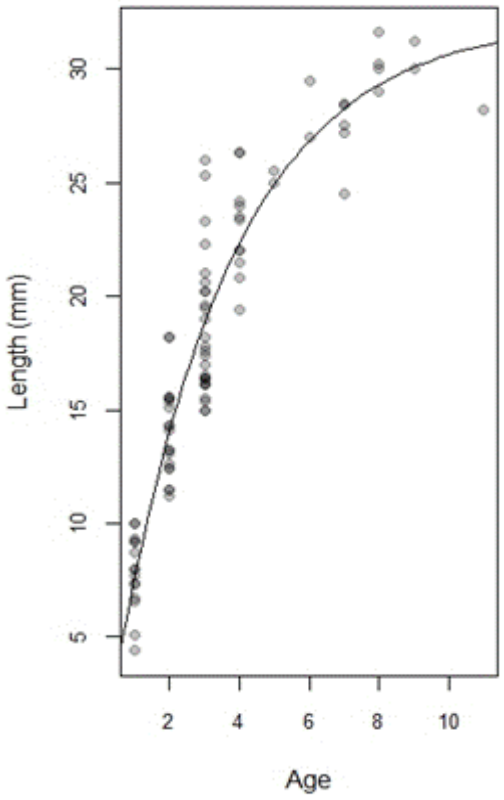

Fig. 3.7. Age-length relationship of perch captured on Lough Derg, June/July 2016

3.3.3 Roach

Roach captured during the 2016 survey ranged in length from 3.2cm to 42.6cm (mean = 22.3cm) (Fig. 3.8). Age of roach ranged from 1+ to 15+; all age classes, with the exception of 13 and 14 year old fish were recorded. Roach in the pelagic zone ranged in length from 6.1cm to 29.5cm. Mean L1 was 3.6cm (Table 3.8). The dominant age class was 4+ (Fig. 3.8).

There were several modal peaks present at approximately 6, 16, and 25 cm length classes indicating that while recruitment is regular, several year classes were more prominent (Fig. 3.9). Asymptotic length was estimated as 50.5cm (42.6-64.2cm). The large variation in this estimate may be due to the small number of large fish in the sample.

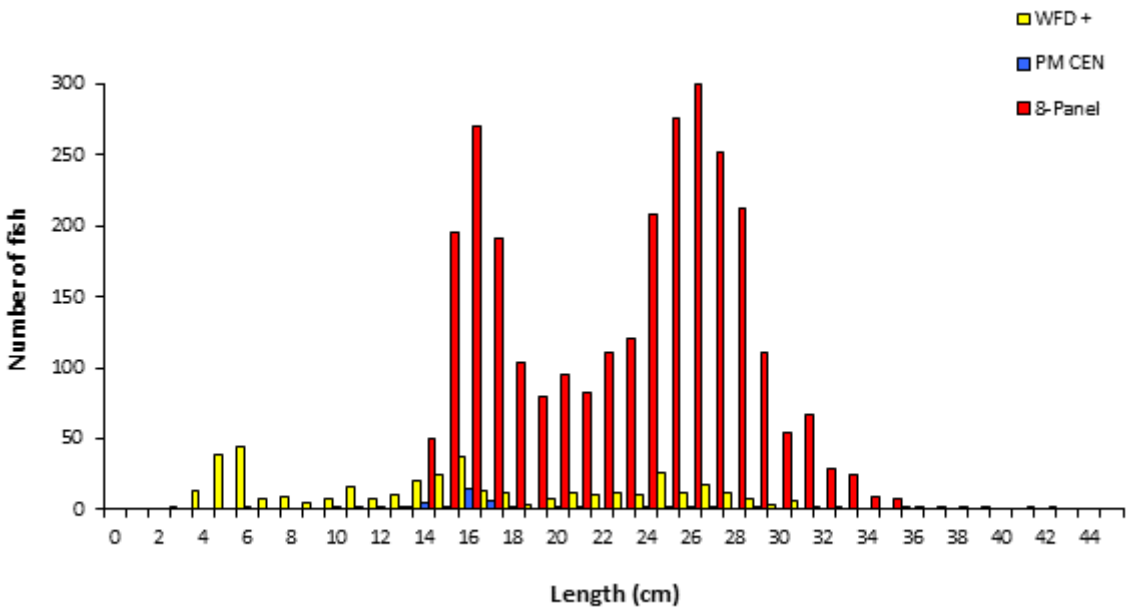

Fig. 3.8. Length frequency of roach captured on Lough Derg, June/July 2016

Table 3.8. Mean back calculated (±S.E.) roach length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
Mean (± S.E.)	3.6 (0.1)	7.7 (0.1)	12.0 (0.2)	16.0 (0.3)	19.3 (0.4)	22.8 (0.4)	25.3 (0.4)	27.5 (0.5)
N	88	85	75	64	47	40	36	21
Range	2.5-4.7	5.4-10.8	8.5-16.6	11.8-20.6	14.2-24.2	16.4-28.6	19.5-29.4	23.2-31.1
	L_9	L_{10}	L_{11}	L_{12}	L_{13}	L_{14}	L_{15}	
Mean (± S.E.)	29.5 (0.5)	30.7 (0.7)	32.1 (0.8)	34.0 (0.8)	34.3	35.7	37.1	
N	17	12	7	4	1	1	1	
Range	25.1-32.3	26.6-34.0	30.1-35.0	32.5-36.1	-	-	-	

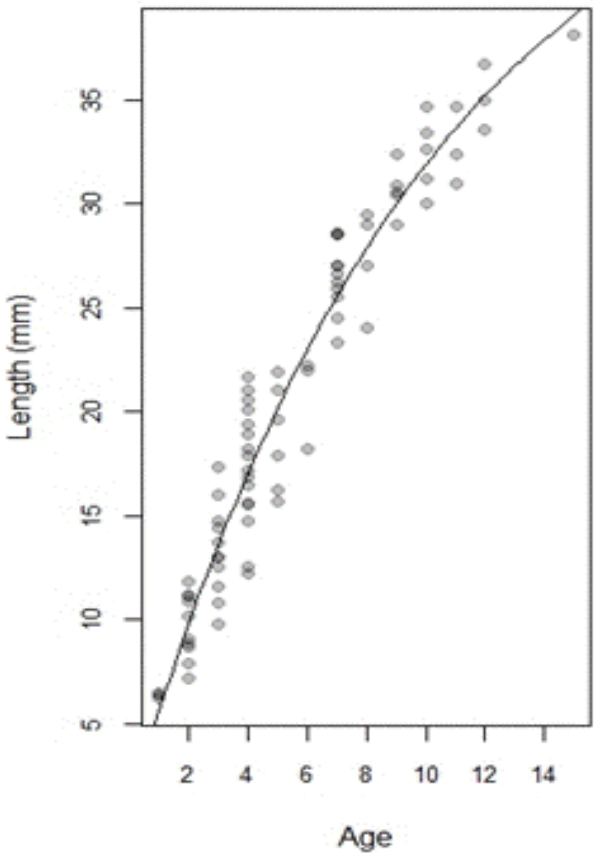

Fig. 3.9. Age-length relationship of roach captured on Lough Derg, June/July 2016

3.3.4 Bream

Bream captured during the 2016 survey ranged in length from 30.5cm to 55.0cm (mean = 44.1cm) (Fig. 3.10). Bream were aged from 6 + to 16+, with eight age classes present (Table 3.9).

The sample was dominated by large (>38cm) and old (≥ 10+) individuals (Fig. 3.10 and 3.11). The smallest fish recorded in the sample was 30.5cm in length. This individual was aged 6+ and was the only bream of less than 10 years of age recorded. The small sample and the inherent variation in length and age data of the older individuals prevented fitting of accurate growth models for bream. Length at age data is, however, presented (Fig. 3.11).

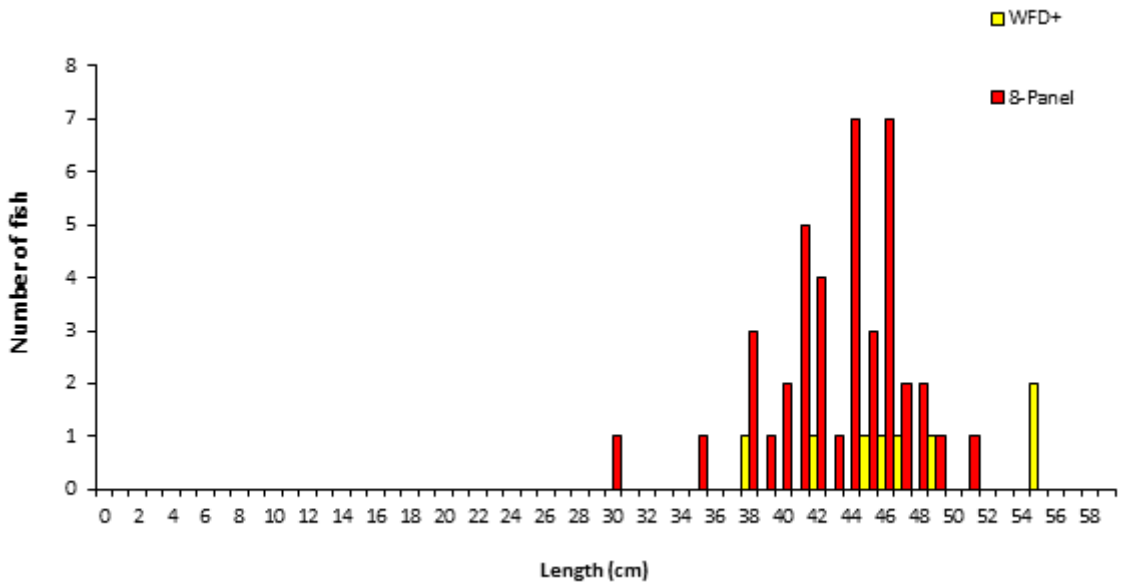

Fig. 3.10. Length frequency of bream captured on Lough Derg, June/July 2016

Table 3.9. Mean back calculated (±S.E.) bream length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8
Mean (± S.E.)	3.3 (0.1)	7.3 (0.2)	12.1 (0.4)	16.2 (0.4)	20.5(0.5)	24.2 (0.5)	27.6 (0.4)	31.2 (0.5)
N	25	25	25	25	25	25	24	24
Range	2.6-4.3	5.4-9.9	8.9-18.9	13.0-21.3	16.5-25.6	20.2-29.6	24.2-31.8	27.0-36.2
	L_9	L_{10}	L_{11}	L_{12}	L_{13}	L_{14}	L_{15}	L_{16}
Mean (± S.E.)	34.7 (0.6)	37.2 (0.6)	39.8 (0.6)	41.8 (0.7)	44.0 (0.8)	44.5 (1.1)	46.1 (1.5)	47.7
N	24	24	23	19	17	9	5	1
Range	29.0-39.8	31.7-43.1	34.2-46.2	35.8-47.9	38.3-49.0	40.2-49.7	42.0-50.8	47.7-47.7

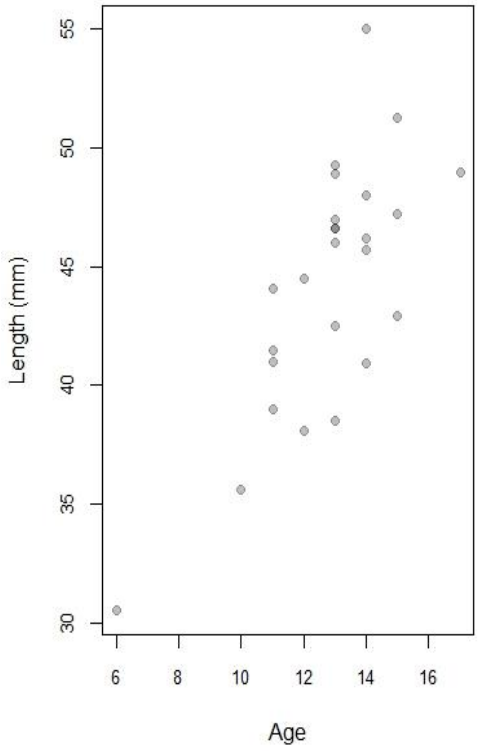

Fig. 3.11. Age-length relationship of bream captured on Lough Derg, June/July 2016

3.3.5 Roach x bream hybrids

Roach x bream hybrids captured during the 2016 survey ranged in length from 14.9cm to 48.0cm (mean = 37.2cm) (Fig. 3.12) and were aged from 3+ to 18+ (Table 3.10). All intervening year classes, with the exception of 17 year old fish were recorded in the sample. Roach x bream hybrids in the pelagic zone ranged in length from 14.2cm to 37.0cm (Fig. 3.12).

The smallest fish recorded in the sample was 14.2cm in length and was aged 3+. The population was heavily dominated by large individuals (>30 cm), indeed, more than 80% of the roach x bream hybrids recorded in both 8-PBB and WFD+ net types exceeded this length. This indicates that recruitment of roach x bream hybrids has been limited in recent years. Asymptotic length was estimated as 48.1cm (43.3-58.8) (Fig. 3.13).

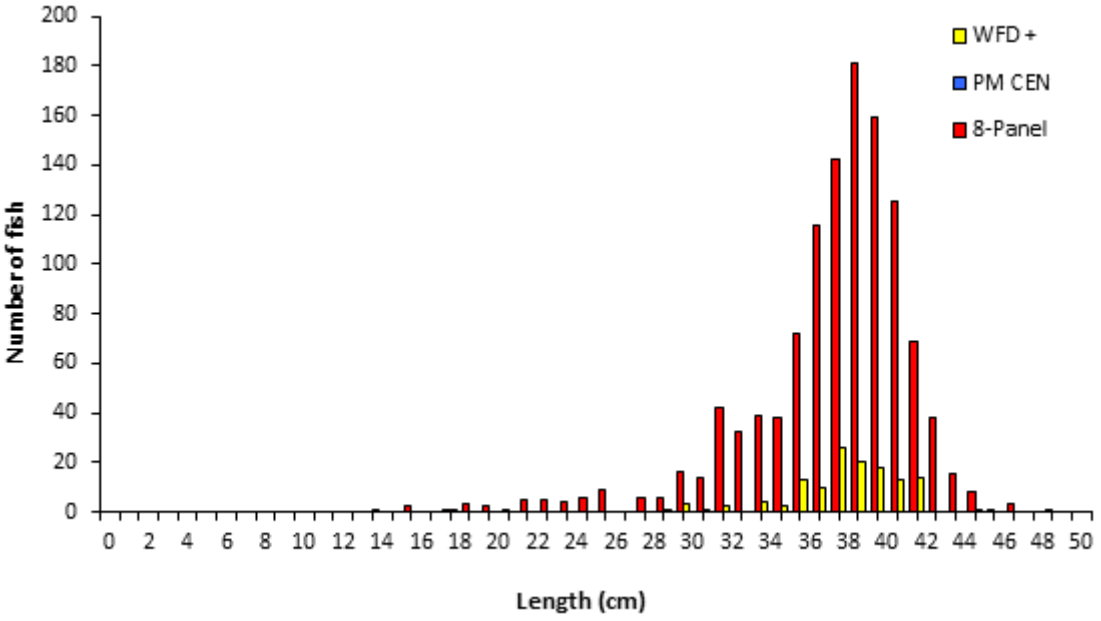

Fig. 3.12. Length frequency of roach x bream hybrids captured on Lough Derg, June/July 2016

Table 3.10. Mean back calculated (±S.E.) roach x bream hybrid length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	L_9
Mean (± S.E.)	3.4 (0.1)	7.2 (0.2)	11.9 (0.3)	16.4 (0.4)	19.9 (0.4)	23.2 (0.5)	26.1 (0.5)	28.4 (0.5)	30.8 (0.5)
N	62	62	62	60	53	49	48	42	39
Range	2.4-4.7	4.1-11.7	7.7-17.7	11.5-22.9	14.5-26.9	17.2-36.1	19.8-35.2	22.7-36.6	25.0-38.7
	L_{10}	L_{11}	L_{12}	L_{13}	L_{14}	L_{15}	L_{16}	L_{17}	L_{18}
Mean (± S.E.)	32.8 (0.5)	35.0 (0.5)	36.7 (0.6)	38.2 (0.7)	39.4 (1.1)	39.6 (1.0)	40.6 (2.2)	37.7	39.5
N	33	30	25	19	12	6	3	1	1
Range	26.2-39.1	27.6-41.6	29.9-43.9	32.0-46.7	34.1-47.5	35.4-42.8	36.5-44.1	37.7-37.7	39.5-39.5

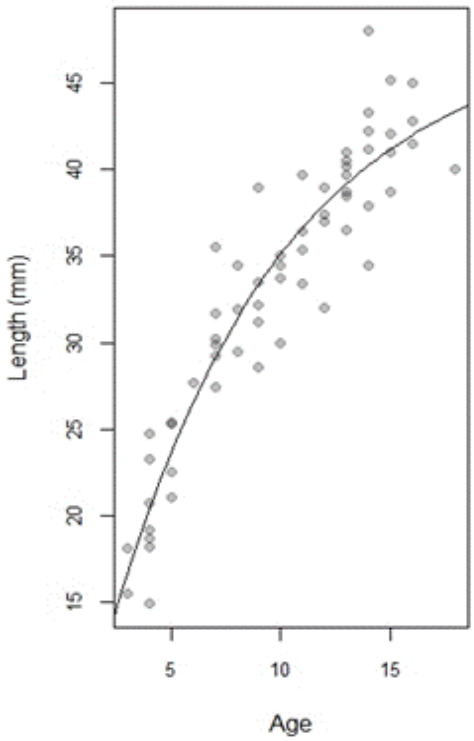

Fig. 3.13. Age-length relationship of roach xbream hybrids captured on Lough Derg, June/July 2016

3.3.6 Pollan

Pollan ranged in length from 6.4cm to 35.7cm (Fig. 3.15). Five age classes were present in the pelagic gillnets ranging from 1+ to 6+, with a mean L1 of 12.2cm (Table 3.11). The dominant age class was 1+ (Fig. 3.15). All age classes with the exception of the 5+ year class were recorded in the sample.

The pollan in Lough Derg had a Von Bertalanffy growth coefficient (k) of 0.257. The Von Bertalanffy growth curve illustrates that pollan growth did not level off i.e. the largest fish in the sample was still growing (Fig. 3.14). The theoretical maximum length ($L\infty$) for pollan in Lough Derg was calculated to be 42.01cm and the theoretical length as age zero t_0 was calculated to be 0.3264 (Fig. 3.14).

Table 3.11. Mean back calculated (±S.D.) pollan length (cm) at age for Lough Derg, June/July 2016

	L_1	L_2	L_3	L_4	L_5	L_6
Mean (± S.E.)	12.2 (2.2)	19.0 (2.7)	24.0 (1.0)	26.8 (1.0)	32.3	34.8
N	23	9	6	4	1	1
Range	27.6-41.6	29.9-43.9	32.0-46.7	34.1-47.5	35.4-42.8	36.5-44.1

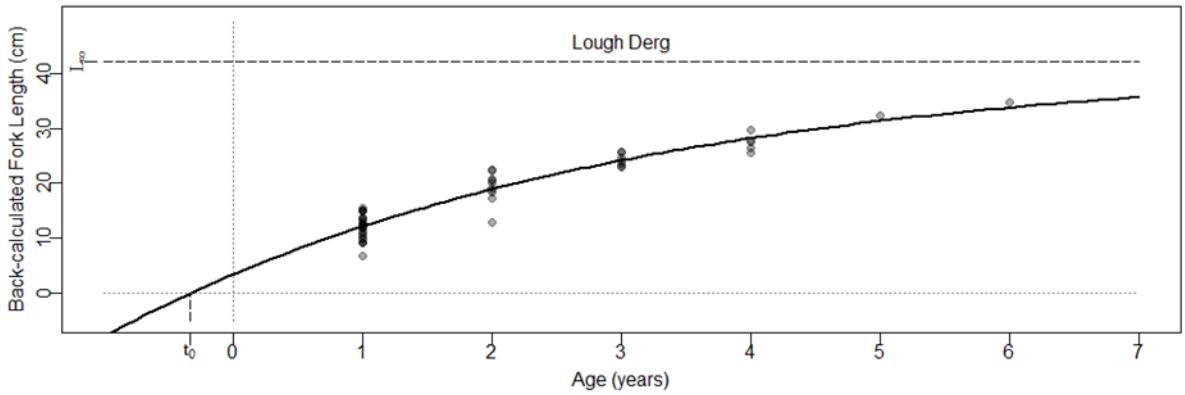

Fig. 3.14. Von Bertalanffy growth curve calculated from back-calculated length at age for pollan illustrating parameters L_∞ and t_0.

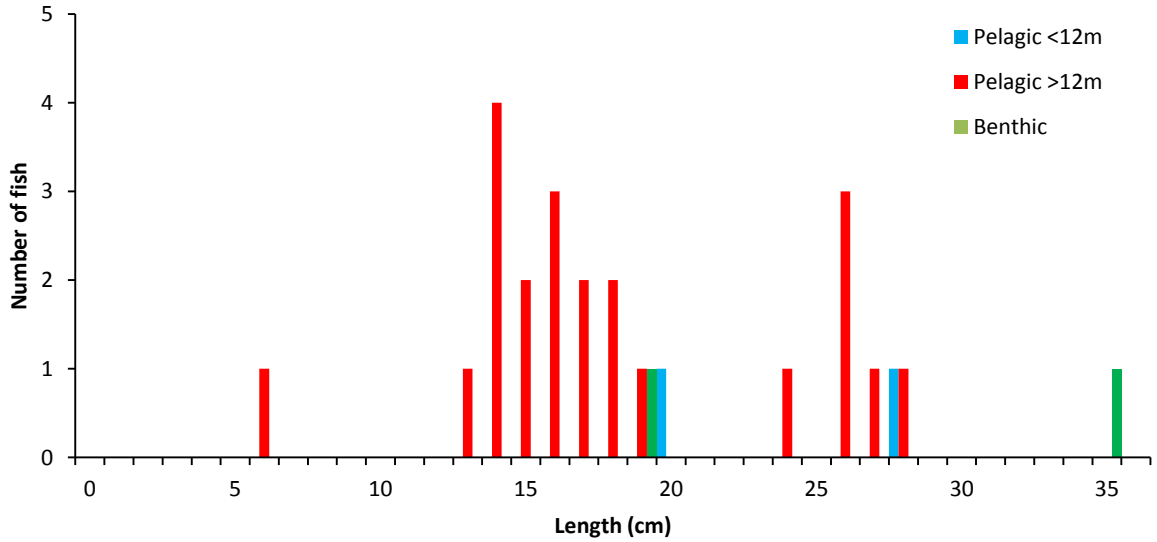

Fig. 3.15. Length frequency distribution of all pollan captured in Lough Derg, June/July 2016.

3.3.7 Pike

Pike captured during the 2016 survey ranged in length from 18.5cm to 107.2cm (mean = 62.5cm) (Fig 3.16).

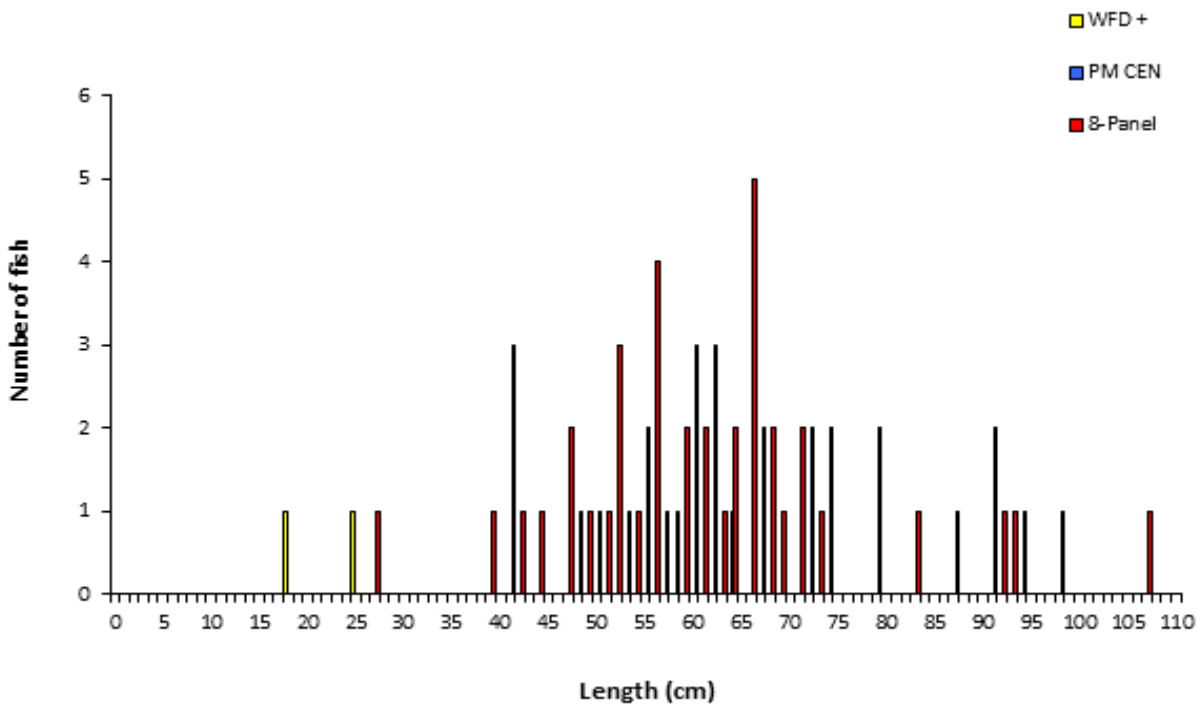

Fig. 3.16. Length frequency of pike captured on Lough Derg, June/July 2016

3.3.8 Other fish

Eels recorded during the 2016 survey ranged in length from 35.4cm to 71.2cm and tench ranged in length from 16.7cm to 49.8cm.

3.4 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 brown trout, perch and pike captured during the survey were examined and are presented below.

3.4.1 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 64 stomachs were examined. Of these 15 were found to contain no prey items. Of the 49 stomachs containing food, 33% contained unidentified digested material, 27% zooplankton, 16% invertebrates and 12% fish (Fig. 3.17).

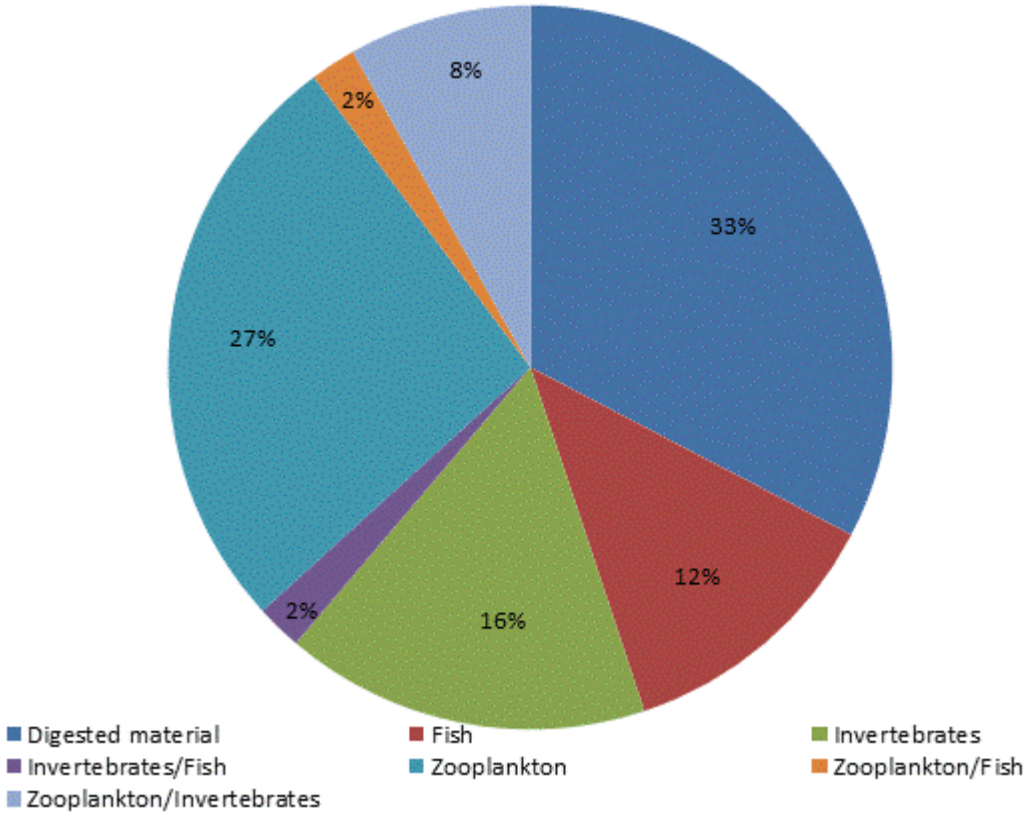

Fig. 3.17. Diet of brown trout (n=49) captured on Lough Derg, June/July 2016 (% occurrence)

3.4.2 Perch

Perch initially start to feed on pelagic zooplankton. Once they reach an intermediate size (approximately 14-16cm) they start feeding on benthic resources eventually moving on to feed on fish when they are large enough (Hjelm *et al*., 2000). A total of 118 stomachs were examined. Of these 29 were found to contain no prey items. Of the 89 stomachs containing food, 31% contained zooplankton, 27% unidentified digested material, 17% invertebrates and 16% fish (Fig. 3.18).

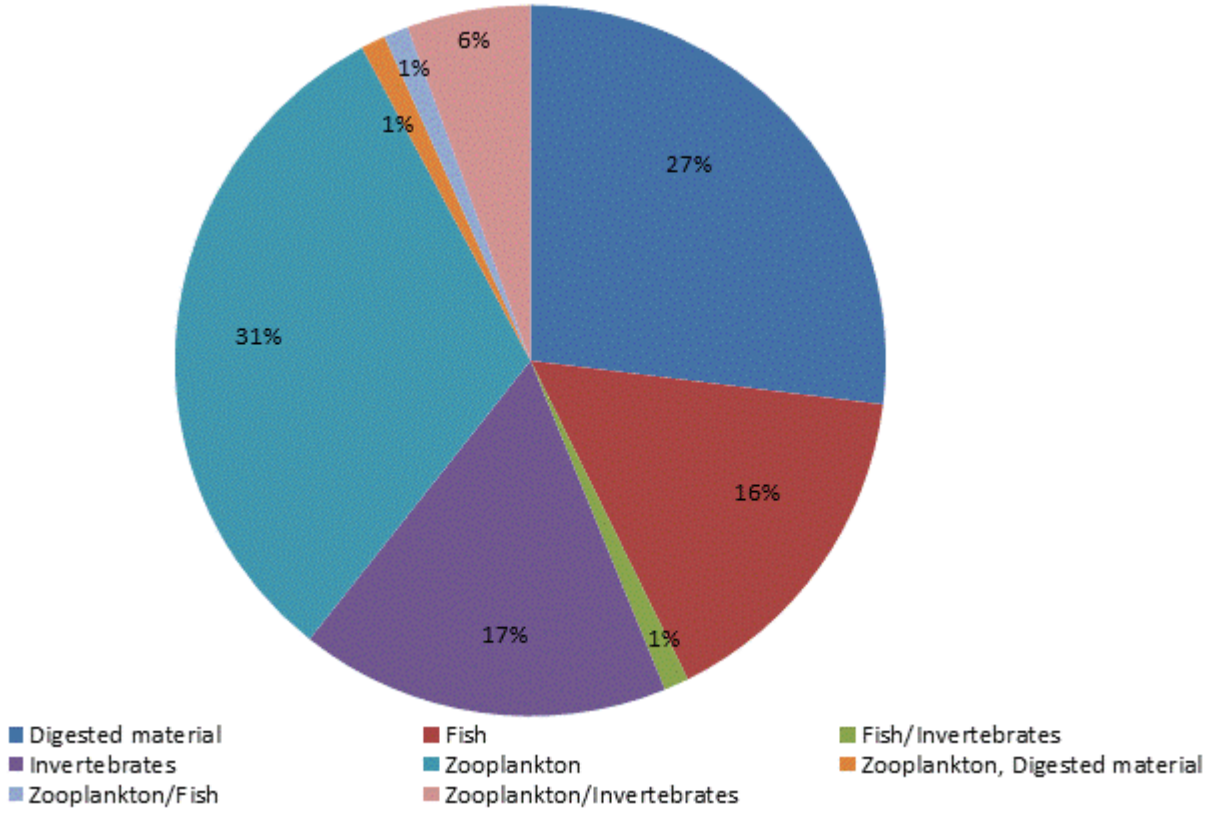

Fig. 3.18. Diet of perch (n=89) captured on Lough Derg 2016 (% occurrence)

3.4.3 Pike

A total of 61 pike stomachs were examined. Of these 27 were found to contain no prey items. Of the 34 stomachs containing food, 79% contained fish, 15% fish/invertebrates and 6% invertebrates (Fig. 3.19). Identifiable fish diet consisted of roach, perch, roach x bream hybrids, trout and stickleback.

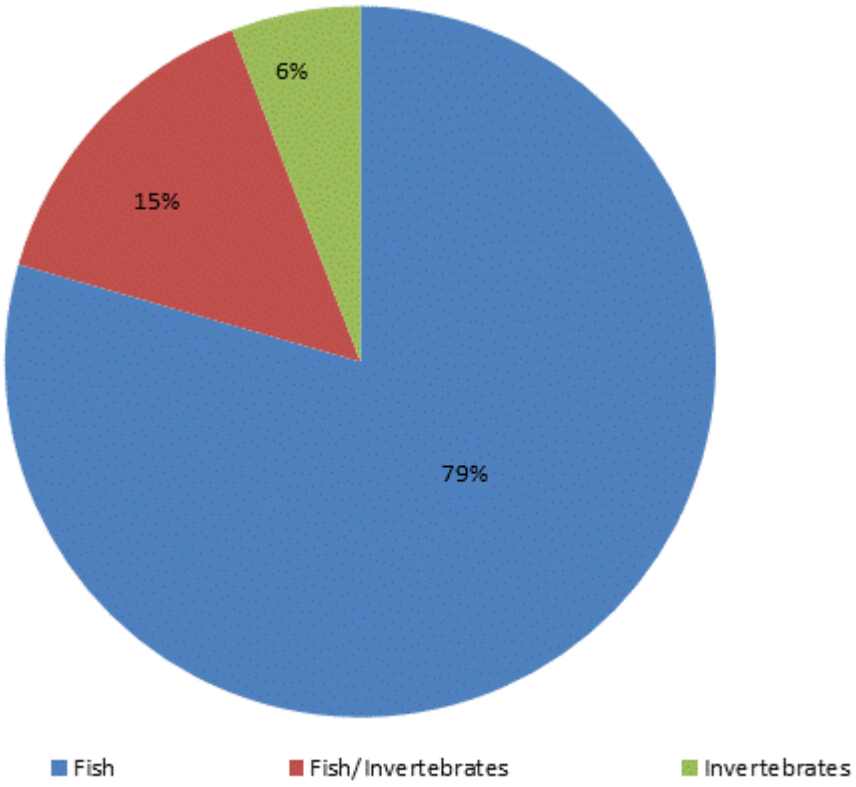

Fig. 3.19. Diet of pike (n=34) captured on Lough Derg 2016 (% occurrence)

3.5 Water Chemistry:

There was evidence of seasonal stratification of temperature and dissolved oxygen in the water column during the survey (Fig. 3.20). There was a 4°C difference between the surface and bottom temperature, with the transition occurring at approximately 15m (Fig. 3.20). The mean pH was 8.37 and the mean conductivity was 416.8 µS cm^{-1}.

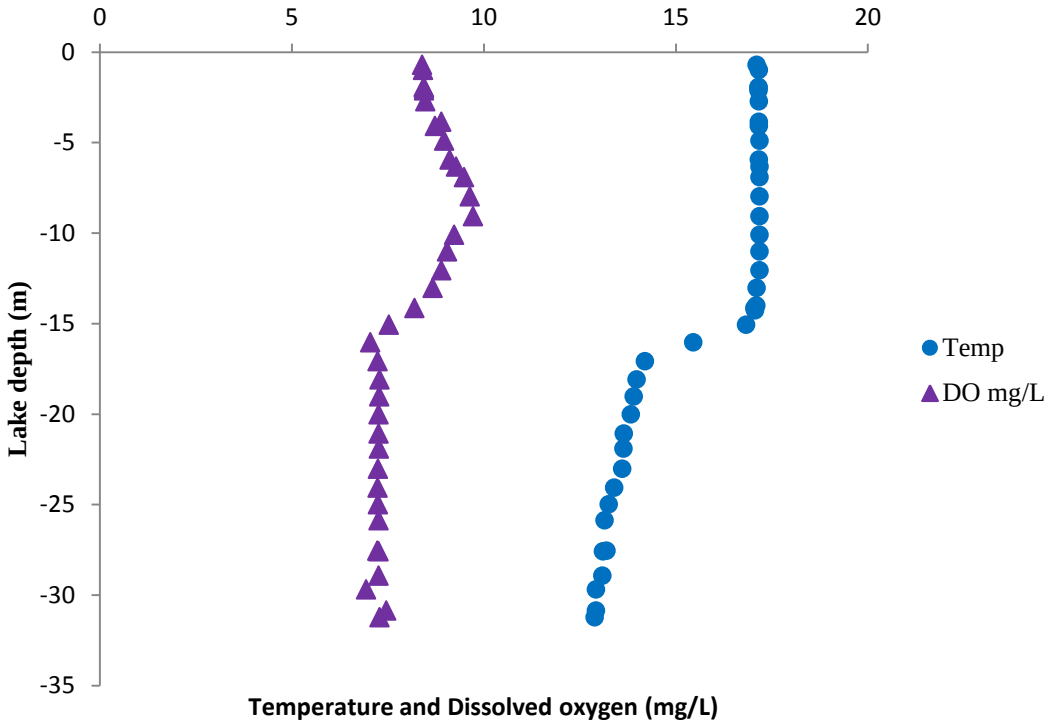

Fig. 3.20. Relationship between dissolved oxygen (mg L^{-1}), temperature (C°) and depth on Lough Derg, 21st June 2016

3.6 Conservation status of pollan in Lough Derg

Currently there are no formal conservation criteria for pollan in Ireland; therefore the UK favourable condition table (Joint Nature Conservation Committee, 2005) for *Coregonus lavaretus* and *Coregonus albula* was used to assign a provisional conservation status for the Lough Derg pollan population (Table 3.12). According to this table healthy coregonid populations must be present and spawning, there must be no loss of age classes and 70% of the population should be juveniles (0+/1+), etc. (Table 3.12).

Pollan in Lough Derg do not comply with all the required attributes, (1) Less than 70% of the population were juveniles and (2) the natural hydrology of the lake is modified and (3) many modifications are present and (4) there have been numerous introductions of invasive species such as roach, zebra mussel and Asian clam.

Therefore the pollan population has been assigned a provisional conservation status of **Unfavourable – Bad.**

Plate 3.1 Pollan captured in Lough Derg

Table 3.12. Comparison of Lough Derg results to minimum criteria for assignment of favourable conservation status (JNCC)

Minimum JNCC Criterion	Lough Derg
Present and spawning successfully	Yes, (Kelly *et al*., 2013 and this survey)
70% of population juveniles (0+/1+)	No, 28% of the pelagic population are juveniles
pH > 5.5	Yes, 8.37
Total Phosphorus (TP) (annual mean) <= 20µg L^{-1}	Yes, 5µg L^{-1} (N=23, 2013)*
**DO >4mg L^{-1}	Yes, 8.1 mg L^{-1}
**Natural hydrology (no barriers, etc.) Levels stable during winter spawning period	No
**Habitat composition (littoral & pelagic zones)	Many modifications throughout the lake
**No introductions or translocations	Numerous introductions (Roach, Asian clam and zebra mussel and other species)

Note: *Data from Environmental Protection Agency (once per month – 4 sites); **Discretionary

4. Summary and fish ecological status

Eight fish species and one type of hybrid were recorded in the fish stock survey on Lough Derg between the 13th of June and 5th of July 2016. Overall perch, roach, roach x bream hybrids and brown trout were the most abundance fish species in terms of abundance (CPUE) and roach x bream hybrids followed by roach and perch were the most abundant fish species in terms of biomass (BPUE) captured in the survey gillnets.

Five fish species and one type of hybrid were recorded in the pelagic zone (open water area of the lake >12m) of the lake; perch, roach, brown trout, pollan, roach x bream hybrids and pike. Perch, roach and brown trout were the most abundant (CPUE) fish species in this zone, and the sample was dominated by juvenile perch.

Brown trout ranged in length from 12.1cm to 80.4cm with eight age classes present, ranging from 1+ to 8+, indicating reproductive success in eight of the previous nine years. The dominant age class was 2+. Brown trout in the pelagic zone ranged in length from 16.0cm to 54.0cm. Length at age analyses revealed that brown trout in the lake exhibit a fast rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971). Of the 49 brown trout stomachs examined containing food, 33% contained unidentified digested material, 27% zooplankton, 16% invertebrates and 12% fish.

Perch ranged in length from 2.1cm to 33.2cm and ranged in age from 0+ to 11+, indicating reproductive success in eleven of the previous twelve years. The dominant age class was 1+. Young of year perch (0+) were prominent in pelagic survey nets. All age classes with the exception of 10 year old fish were recorded in the sample indicating regular and relatively stable recruitment in the lake. Asymptotic length (or theoretical maximum length) was estimated as 32.2cm (29.9-35.2). Of the 89 stomachs examined containing food, 31% contained zooplankton, 27% unidentified digested material, 17% invertebrates and 16% fish.

Roach ranged in length from 3.2cm to 42.6cm. Roach in Lough Derg are relatively long lived and fish up to 15+ were recorded during the survey. Mean L1 was 3.6cm. Thirteen age classes were present indicating reproductive success in thirteen of the previous sixteen years. The dominant age class was 4+. Roach in the pelagic zone ranged in length from 6.1cm to 29.5cm. There were several modal peaks present at approximately 6, 16, and 25 cm length classes indicating that while recruitment was regular, several year classes were more prominent). Asymptotic length was estimated as 50.5cm (42.6-64.2cm).

Bream ranged in length from 30.5cm to 55.0cm and ranged in age from 6 + to 16+, with eight age classes present. The sample was dominated by large (>38cm) and old (≥ 10+) individuals. The absence of smaller juvenile bream suggests that recent recruitment in the lake has been limited.

Roach x bream hybrids were the third most abundant species recorded in the survey and the dominant species with respect to biomass. Roach x bream hybrids ranged in length from 14.9cm to 48.0cm (mean = 37.2cm) and were aged from 3+ to 18+. Roach x bream hybrids in the pelagic zone ranged in length from 14.2cm to 37.0cm. The population was dominated by larger (>37cm) and older (>10 years old) individuals. Roach x bream hybrid recruitment requires spawning between both parent species (Hayden *et al.,* 2010) and this hybrid occurs in large numbers in many Irish lakes (Hayden *et al*., 2014). The paucity of smaller specimens in the survey may indicate that only a small population of mature bream exist in the lake and that recruitment is limited. Asymptotic length was estimated as 48.1cm (43.3-58.8). While roach x bream hybrids are a long lived variety, many of these fish were approaching their 'maximum' predicted size. The paucity of smaller individuals (<30cm) also suggests that the abundance of roach x bream hybrids in the lake may decline as the older cohorts naturally die off.

Pike captured during the 2016 survey ranged in length from 18.5cm to 107.2cm (mean = 62.5cm). The sampled fish were found to be predominantly piscivorous at the time of the survey. Identifiable fish species present in the stomachs were roach, perch, roach x bream hybrids, trout and stickleback. One interesting finding was the presence of roach x bream hybrids in the stomach contents of several fish. Previous studies in Ireland had suggested that this species was largely unavailable to pike, a gape limited predator, due to its deep body shape (Pedreschi *et al*.**,** 2015).

Pollan ranged in length from 6.4cm to 35.7cm and were aged from 1+ to 6+ with the exception of the 5+ year class. The dominant age class was 1+. The asymptotic length was calculated to be 42cm. It was estimated that there were a total of 3,288 pollan, of which 867 (26.4%) were juveniles, present in the pelagic zone in Lough Derg, June 2016. Their distribution was mainly restricted to the deeper and southern section of the lake.

Current threats to pollan include introduced/invasive species, habitat degradation and climate change (Harrod *et al.*, 2001). Water abstraction has also been identified as a threat to other pelagic species such as Arctic char (Maitland *et al.*, 2007). The addition of new stressors could cause the extinction of the Lough Derg population. The above estimate of pollan in Lough Derg suggests that this population is highly vulnerable to extinction and careful management of the population and the lake is required to ensure the continued viability of this protected species in Lough Derg. Pollan in

Lough Derg have been assigned a provisional conservation status of **Unfavourable – Bad** and are considered impacted due to their small population size, low percentage abundance of juveniles and the presence of various pressures such as habitat modifications and species translocations.

Pollan spawning has never been described for the Shannon lakes but it is assumed to be similar to that of the Lough Neagh pollan. Lough Neagh pollan are reported to spawn in December over shallow (1-3m) rocky areas in December/January and hatch towards the end of February (Dabrowski, 1981; Harrod and Griffiths, 2004). To optimise management of the pollan population spawning areas and times need to be identified on Lough Derg.

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 by 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 Derg has been assigned an ecological status of Poor in 2009 and 2012 and **Moderate** for **2016** based on the fish populations present.

In the 2010 to 2015 surveillance monitoring reporting period, the EPA assigned Lough Derg an overall ecological status of **Poor**.

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