

National Research Survey Programme

Lakes 2021

Lough Melvin

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Iascach Intíre Éireann
Inland Fisheries Ireland

Fish Stock Survey of Lough Melvin, July 2021



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Inland Fisheries Ireland**

National Research Survey Programme

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

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1. Introduction

Lough Melvin is situated in the north-west of Ireland and is bordered by Co. Leitrim and Co. Fermanagh (Plate 1.1, Figure 1.1). The lake is 12 kilometres in length, with a maximum width of less than three kilometres and a surface area of 2,125ha. The lake is greater than 10m in depth over 28% of its area, with a shallower area around the islands in the Co. Fermanagh section and at the western end in Co. Leitrim. Approximately 46% of the lake is less than 5m in depth. A deep trench runs east-west from Rossinver Bay towards the Drowes river outflow and has a maximum depth of 45m (Ferguson, 1986; Girvan and Foy, 2003). The geology of the catchment is dominated by Carboniferous rocks, predominantly sandstones and shales. The lake is categorised as typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderate alkalinity (20-100mg/l CaCO₃). It has also been classed as at risk of failing to meet good status by 2027. Lough Melvin has been designated as a Special Area of Conservation (SAC) based on the fact that it is an oligo-mesotrophic lake, a lake category listed on Annex I of the EU Habitats Directive (NPWS, 2021). The lake is also designated as an SAC due to the presence of Atlantic salmon and otter, both species listed on Annex II of the same Directive.

Lough Melvin is one of the most important salmon and trout fisheries in the north-west of Ireland. It is an excellent example of a natural, post-glacial salmonid lake. The lake holds a population of Arctic char, Atlantic salmon (both of which are listed in the Irish Red Data Book as vulnerable (King *et al.*, 2011)), perch and brown trout (NPWS, 2021). It is the brown trout that are of primary interest to most anglers. Three distinct varieties of brown trout (*Salmo trutta*) occur in this lake: sonaghen (*Salmo nigripinnis*), gillaroo (*Salmo stomachicus*) and ferox (*Salmo ferox*). These have been found to be genetically distinct ecotypes and can be readily identified on the basis of their morphological and meristic features (Ferguson and Prodöhl, 2022). The three types of trout exhibit distinct feeding patterns: sonaghen feed primarily on cladocerans (water fleas), chironomid pupae (non-biting midges) and *Chaoborus* (phantom midge larvae); gillaroo feed almost exclusively on benthic animals, including snails, trichopteran (caddis fly) larvae and *Gammarus* spp. (freshwater shrimp) and ferox trout feed primarily on fish, including perch, Arctic char and brown trout (Ferguson, 1986).

The water quality of Lough Melvin has been surveyed intermittently since 1990 and the lake has consistently demonstrated mesotrophic characteristics (Champ, 1998; McGarrigle *et al.*, 2002; Girvan and Foy, 2003). The water in Lough Melvin is heavily peat stained, which is thought to be the principal factor limiting primary production; the algal crop did not appear to change in diversity or abundance between 1990 and 2001/2002, but monitoring work on the lake has shown a substantial shift towards phosphorus enrichment with mean total phosphorus concentrations in the open water increasing

from 19µg to 30µg P/l from 1990 to 2003 (Girvan and Foy, 2003). There is evidence that blue green algal blooms are now more severe than previously. The health and status of the lake is particularly vulnerable to human activities, such as an increase in phosphorus loadings from housing, forestry and agriculture within the surrounding catchment (Campbell and Foy, 2008). As part of the EU Interreg IIIA programme, a Catchment Management Plan was developed for Lough Melvin to promote the attainment of good ecological status and address the threat of nutrient enrichment, particularly from agriculture, forestry and domestic waste-water (Campbell and Foy, 2008).

The lake has been surveyed for fish previously, primarily to evaluate brown trout stocks, by Inland Fisheries Ireland (previously the Central Fisheries Board and the Northern Regional Fisheries Board) in 1986 and 2001 using the standard IFI netting method for assessing brown trout stocks in lakes (O' Grady, 1981; Delanty and O' Grady, 2001). Since then Lough Melvin has been surveyed on five occasions (2008, 2011, 2014, 2017 and 2021) since 2008 (Kelly *et al.*, 2009, 2012a, 2015a and 2015b and Connor *et al.* 2018). During the earlier surveys, perch was the most abundant fish species recorded. Arctic char, salmon, three ecotypes of trout (sonaghen, gillaroo and ferox), rudd, roach x rudd hybrids and eels were also recorded.

This report summarises the results of the 2021 fish stock survey carried out on the lake using Inland Fisheries Ireland's fish in lakes monitoring protocol. The protocol is WFD compliant and also provides insight into fish stock status in the lake.



Plate 1.1. Lough Melvin



Plate 1.2. Lough Melvin, July 2021

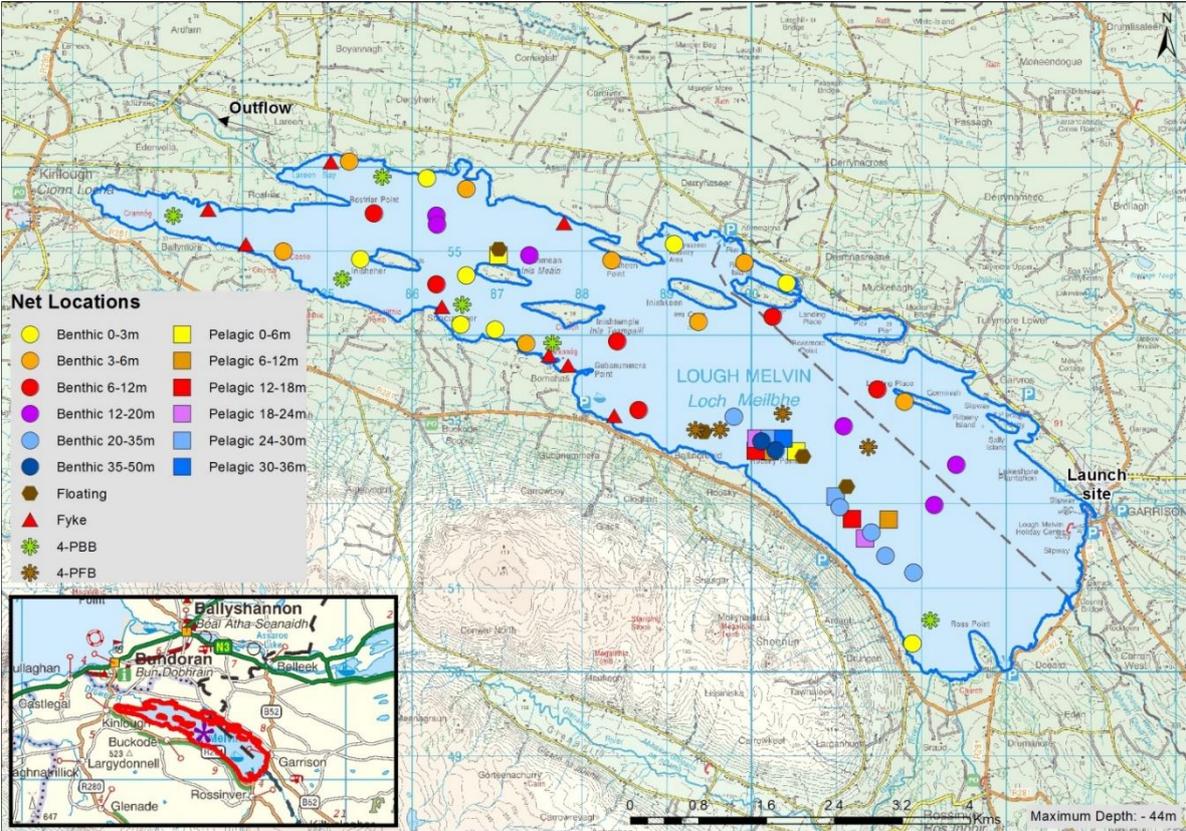


Figure 1.1. Location map of Lough Melvin showing locations and depths of each net (outflow is indicated on map)

2. Methods

2.1. Netting methods

Lough Melvin was surveyed over three nights between the 19th and the 22nd of July 2021. A total of eight sets of Dutch fyke nets (Fyke), 35 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets (8 @ 0-2.9m, 8 @ 3-5.9m, 6 @ 6-11.9m, 6 @ 12-19.9m, 5 @ 20-34.9m and 2 @ 35-49.9m) and four floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (47 sites) (Figure 1.1).

The netting effort was supplemented using seven four-panel benthic braided survey gill nets (4-PBB) and five four-panel floating braided survey gill nets (4-PFB). The four-panel survey gill 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 locate the precise location of each net. The angle of each gill net in relation to the shoreline was randomised.

All fish apart from perch were measured and weighed on site and scales were removed from a sub-sample of other species except eels. Live fish were returned to the water whenever possible (i.e. when the likelihood of their survival was considered to be good). Samples of fish were retained for further analysis. Fish were frozen immediately after the survey and transported back to the IFI laboratory for later dissection.

2.2. Fish diet

Total stomach contents were inspected, and individual items were counted and identified to the lowest taxonomic level possible. The percentage frequency occurrence (%FO) of prey items were then calculated to identify key prey items E.

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

Where:

FO_i is the percentage frequency of prey item i ,

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

N is total number of fish with stomach contents.

2.3. Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment 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.

3. Results

3.1. Species Richness

Seven fish species and two types of cyprinid hybrid were recorded on Lough Melvin in July 2021. A total of 1,010 fish were captured. The number of each species captured by each gear type is shown in Table 3.1. Perch was the most common fish species recorded, representing 76% of all fish captured in the survey nets.

Roach were recorded for the first time on the lake with two individuals captured in 2021. One large roach x bream hybrid was also captured.

Other species captured included brown trout, eels, roach x rudd hybrid, rudd, Arctic char and Atlantic salmon. Some examples of the brown trout ecotypes, i.e. Sonaghen, Gillaroo and Ferox were subsequently identified in the laboratory. However, in the absence of genetic analysis, all species have been classified as brown trout in this report. Similar species compositions have been recorded during recent surveys of the lake (Kelly *et al.*, 2009, 2012a, 2015a and 2015b and Connor *et al.* 2018).

Table 3.1. Number of each fish species captured by each gear type during the survey on Lough Melvin, July 2021

Scientific name	Common name	Number of fish captured					Total
		BM CEN	FM CEN	4- PBB	4- PFB	Fyke	
<i>Perca fluviatilis</i>	Perch	683	0	3	1	79	766
<i>Salmo trutta</i> *	Brown trout (all ecotypes)	72	14	19	19	8	132
<i>Salmo salar</i>	Salmon	1	1	4	8	0	14
<i>Scardinius erythrophthalmus</i>	Rudd	1	0	0	0	6	7
<i>Salvelinus alpinus</i>	Arctic char	1	0	0	0	0	1
<i>Rutilus rutilus</i>	Roach	2	0	0	0	0	2
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	1	0	0	0	0	1
<i>Rutilus rutilus x S. erythrophthalmus</i>	Roach x rudd hybrid	2	0	0	0	0	2
<i>Anguilla anguilla</i> *	European eel	4	0	0	0	81	85

*It was not possible to assign all trout to an ecotype in the field, so all trout have been assigned to one species group.

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. Perch was the dominant fish species in terms of abundance (CPUE) and biomass (BPUE) captured during the 2021 survey (Table 3.2). The brown trout species group also accounted for a large proportion of the fish biomass captured. Eels which are typically captured in fyke nets only were also captured in large numbers (Table 3.2).

Table 3.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Melvin, 2021

Scientific name	Common name	Mean CPUE (± S.E)	Mean BPUE (± S.E)
<i>Perca fluviatilis</i>	Perch	0.409 (0.082)	38.882 (7.880)
<i>Salmo trutta</i>	Brown trout (all ecotypes)	0.057 (0.009)	21.632 (4.129)
<i>Salmo salar</i>	Salmon	0.003 (0.001)	5.547 (2.594)
<i>Scardinius erythrophthalmus</i>	Rudd	0.002 (0.002)	0.401 (0.326)
<i>Salvelinus alpinus</i>	Arctic char	0.001 (0.001)	0.169 (0.169)
<i>Rutilus rutilus</i>	Roach	0.001 (0.001)	0.208 (0.149)
<i>Rutilus rutilus x Abramis brama</i>	Roach x bream hybrid	0.001 (0.001)	0.669 (0.669)
<i>R. rutilus x S. erythrophthalmus</i>	Roach x rudd hybrid	0.001 (0.001)	0.323 (0.227)
<i>Anguilla anguilla</i> *	European eel*	0.169 (0.063)	35.961 (12.976)

Note: Where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species (Connor *et al.*, 2017). *Eel CPUE and BPUE based on fyke nets only.

For comparison purposes CPUE and BPUE for each species captured in all surveys, per net type, between 2005 and 2021 are presented in Figures 3.1a to 3.2b respectively and illustrates fish community change over time. Numbers and biomass of the combined brown trout species group have remained relatively stable over all survey occasions, and no clear trends were apparent. A large proportion of trout were captured in floating CEN nets across all surveys, and is consistent with the pelagic habitat preference of sonaghen trout. Arctic char continue to be captured in small numbers, while the apparent reduction in eel catch in 2014 and 2017 was reversed in 2021 when large numbers of eel were recorded (Figure 3.1a and 3.1b). Perch was the most abundant species captured across all surveys. Roach and its hybrid with bream were recorded for the first time in 2021 and rudd numbers continued to decline (Figures 3.2a and 3.2b).

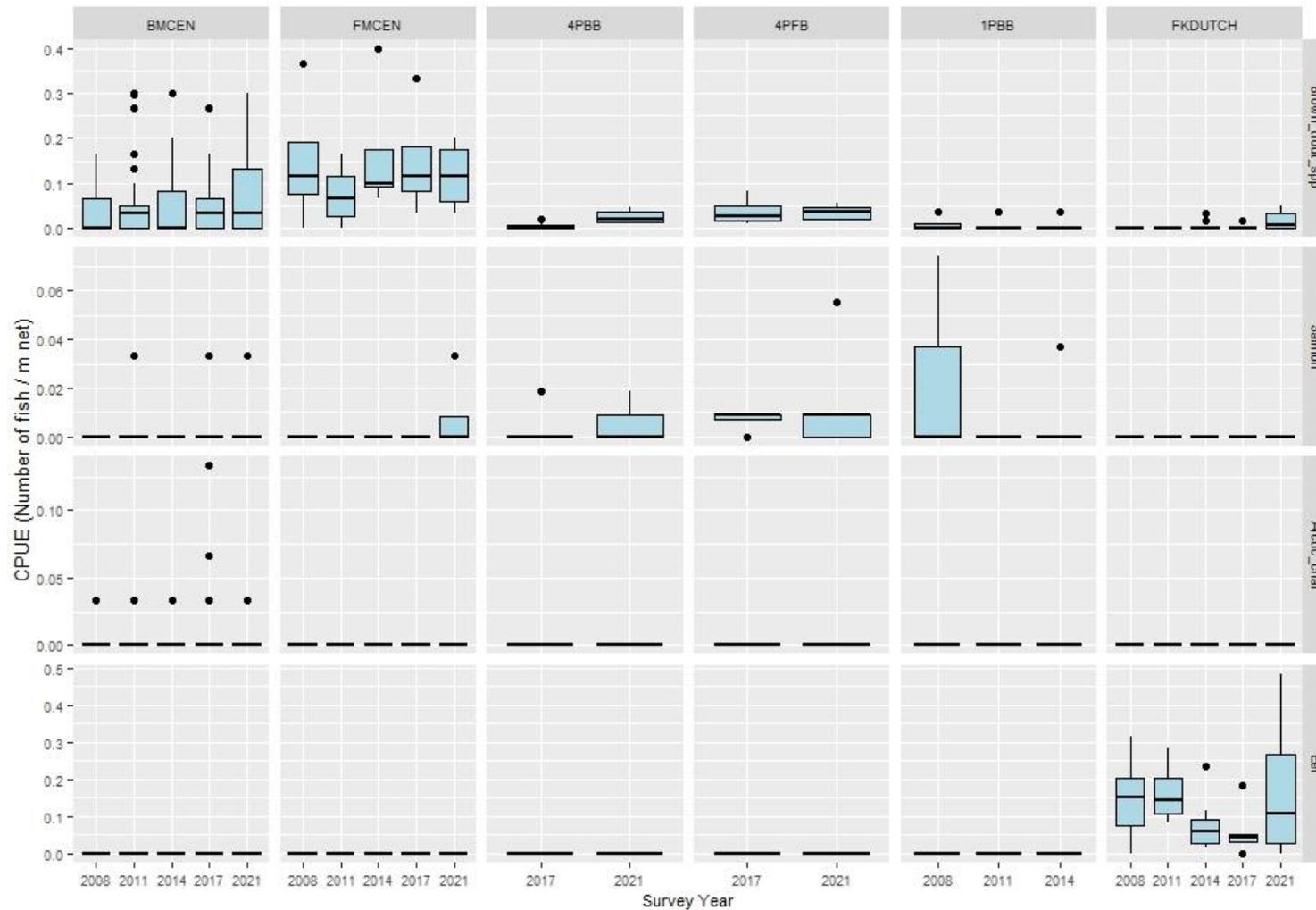


Figure 3.1a. CPUE (number of fish captured per linear meter of net deployed) of brown trout and other native fish species captured in each net type during surveys of Lough Melvin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis is unique for each species

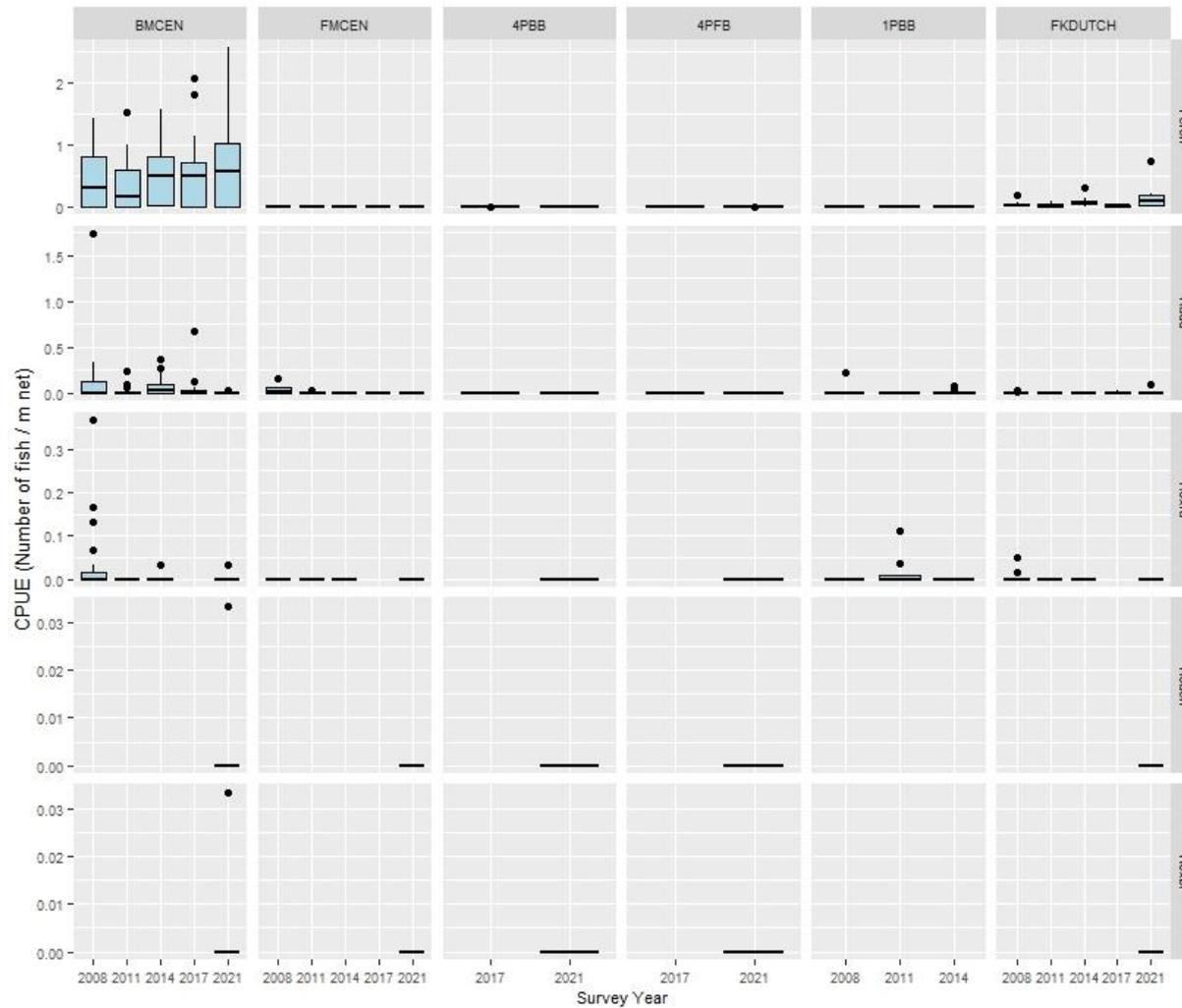


Figure 3.2a CPUE (number of fish captured per linear meter of net deployed) of perch and cyprinid species captured in each net type during surveys of Lough Melvin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75th and 25th percentiles are marked by the upper and lower boundary of each box. The vertical ‘whiskers’ show the data range. Outliers are marked by dots. The y axis is unique for each species

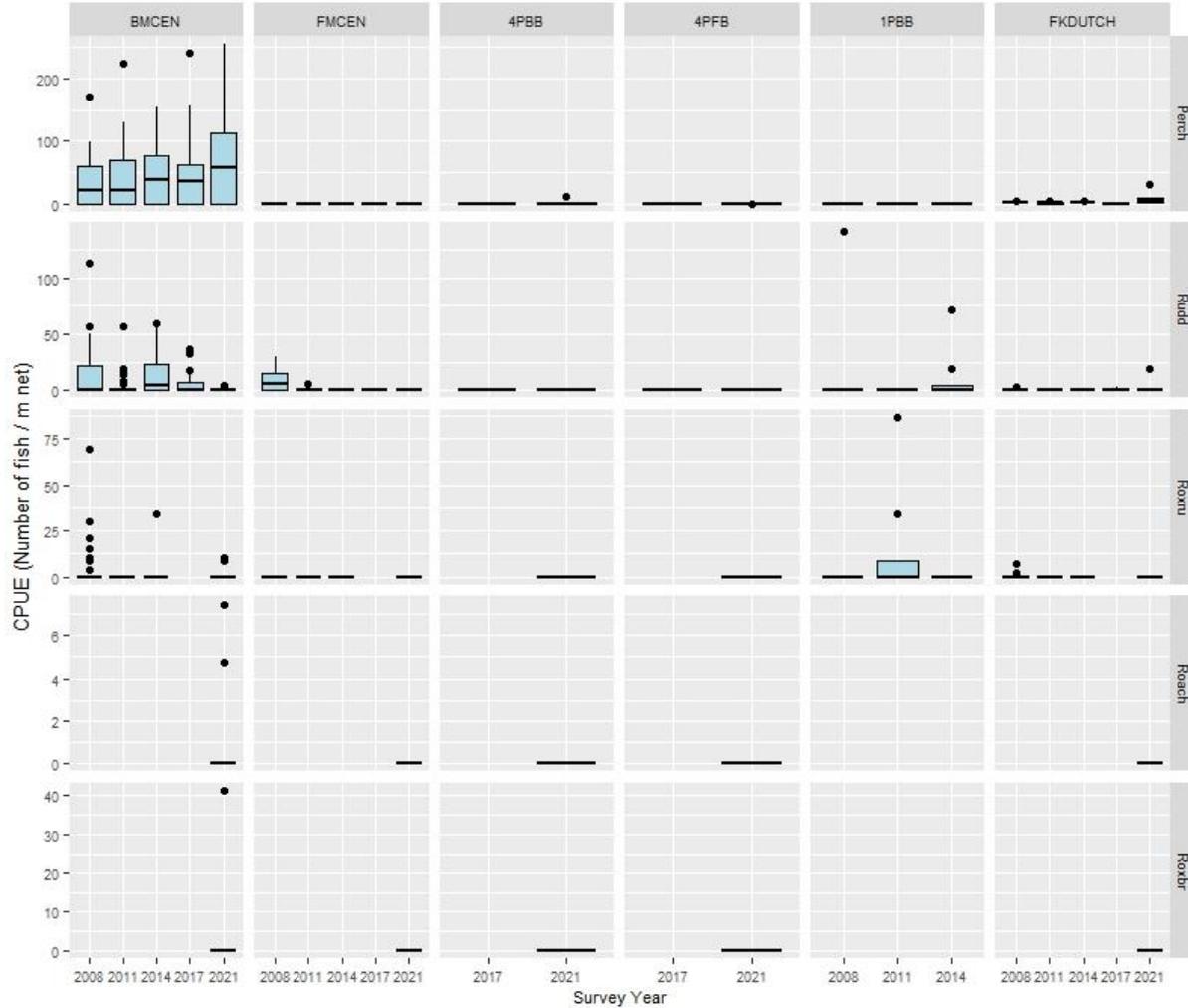


Figure 3.2b. BPUE (mean biomass (g) of fish captured per linear meter of net deployed) of perch and cyprinid species captured in each net type during surveys of Lough Melvin between 2008 and 2021. The horizontal bars represent the median value of the sample, while the 75% and 25% percentiles are marked by the upper and lower boundary of each box. The vertical 'whiskers' show the data range. Outliers are marked by dots. The y axis is unique for each species

3.3. Length frequency distributions and growth

Brown trout (all ecotypes)

Brown trout captured during the 2021 survey ranged in length from 10.0cm to 65.5cm (mean = 29.1cm) (Figure 3.3). While the length range was similar across surveys, larger numbers of fish measuring less than 20cm were captured in 2021 when compared to previous years. There was also evidence of the persistence of larger and older individuals, likely to be piscivorous ferox trout, in the population (Figure 3.3). Ten age classes were recorded in the sample aged. Brown trout were aged from 0+ to 9+ and all intervening age classes were represented. The dominant age class was 1+ (c. 12-19cm Figure 3.3). Mean L1 (i.e. length at the end of the first year) was 7.8cm (Table 3.3). Mean brown trout L4 in 2021 was 28.5cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 3.3).

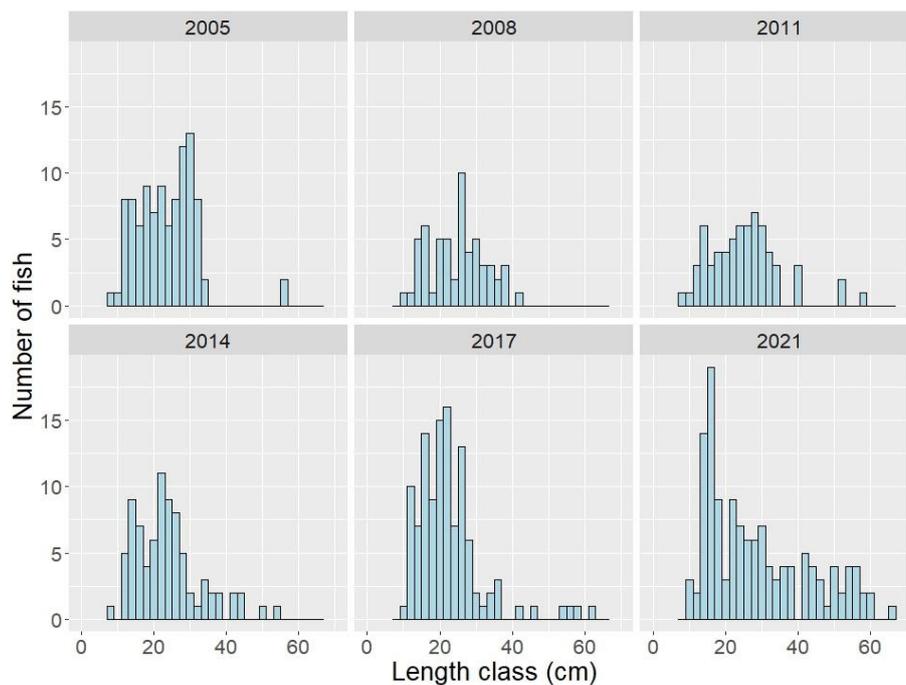


Figure 3.3. Length frequency of brown trout (all varieties) captured on Lough Melvin, 2005, 2008, 2011, 2014, 2017 and 2021

Table 3.3. Mean (\pm S.E.) brown trout (all varieties) length (cm) at age for Lough Melvin, July 2021

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈
Mean	7.8	14.8	22.1	28.5	35.3	41.0	46.9	51.0
(\pmS.E.)	(0.2)	(0.2)	(0.4)	(0.7)	(1.1)	(0.7)	(1.0)	(1.1)
N	108	45	39	25	22	15	9	8
Range	4.2- 17.7	12.2- 19.3	18.8- 32.0	24.3- 44.0	31.4- 56.8	36.3- 46.1	42.0- 51.0	47.1- 56.0

Perch

Perch captured during the 2021 survey ranged in length from 5.0cm to 39.8cm (mean = 17.5cm). While length range was similar across surveys, differences in the proportions of various size classes were apparent (Figure 3.4). Perch were aged between 1+ and 11+, and all intervening age classes were present with the exception of 10+. The most abundant age class was 3+ (c 12-20cm Figure 3.4). Mean L1 (i.e. length at the end of the first year) was 6.6cm (Table 3.4).

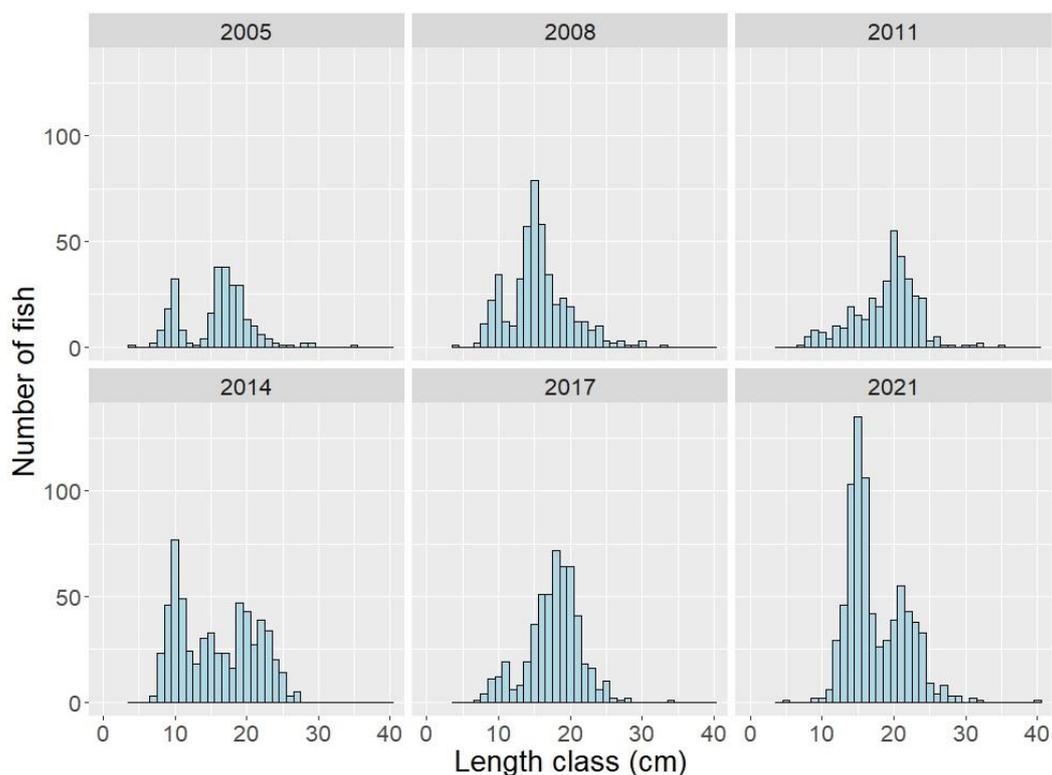


Figure 3.4. Length frequency of perch captured on Lough Melvin, 2005, 2008, 2011, 2014, 2017 and 2021

Table 3.4. Mean (\pm S.E.) perch length (cm) at age for Lough Melvin, July 2021

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆	L ₇	L ₈	L ₉	L ₁₀	L ₁₁
Mean	6.6	12.1	16.1	19.3	21.4	22.8	25.2	28.4	29.3	30.4	31.2
(\pmS.E.)	(0.2)	(0.2)	(0.2)	(0.3)	(0.3)	(0.5)	(0.6)	(0.5)	(0.3)	(0.0)	(0.0)
N	84	83	72	39	32	17	10	4	2	1	1
Range	3.9- 11.8	8.0- 17.3	12.0- 19.9	15.5- 22.1	17.0- 24.3	19.1- 25.8	21.7- 27.2	27.2- 29.7	29.0- 29.6	-	-

Rudd

Rudd (n = 7) captured during the 2021 survey ranged in length from 19.5cm to 23.8cm (mean = 21.2cm). Fewer rudd, with a consequently reduced length range, were captured in 2021 compared to earlier surveys (Figure 3.5). All rudd captured were aged between 6+ and 8+.

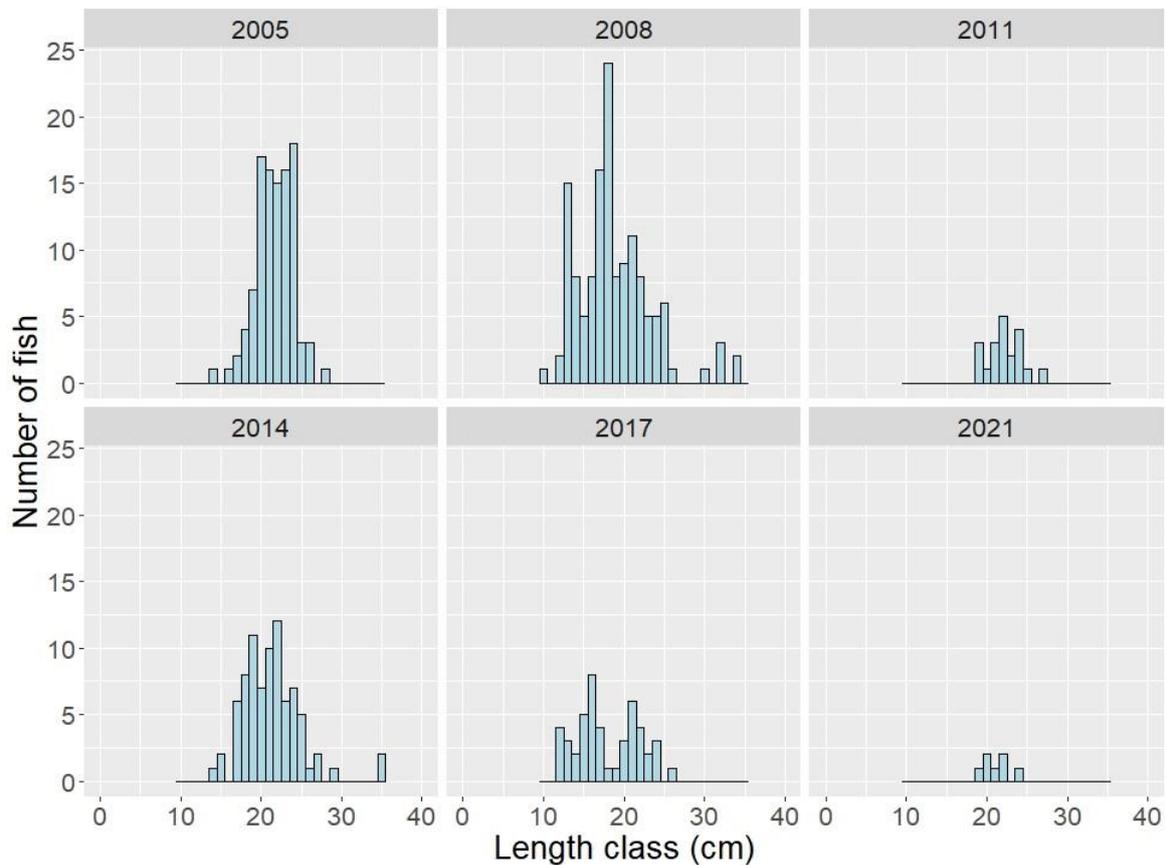


Figure 3.5. Length frequency of rudd captured on Lough Melvin, 2005, 2008, 2011, 2014, 2017 and 2021

Other fish species

Eels captured during the 2021 survey ranged in length from 33.0cm to 70.0cm (mean = 48.5cm) (Figure 3.6). A total of 14 Atlantic salmon (one juvenile and 13 adult (upstream migrant)) were captured. One juvenile (1+) measured 13.0cm. Adult salmon ranged in length from 52.0cm to 73.4cm (mean = 58.9cm).

Two roach were captured in the survey. They measured 20.2cm (5+) and 22.0cm respectively. One roach x bream hybrid measured 25.5cm. This fish was aged at 7+. Two roach x rudd hybrids measuring 23.5cm (8+) and 24.5cm (10+) were also captured.

One Arctic char, measuring 26.5cm was also captured in the survey.

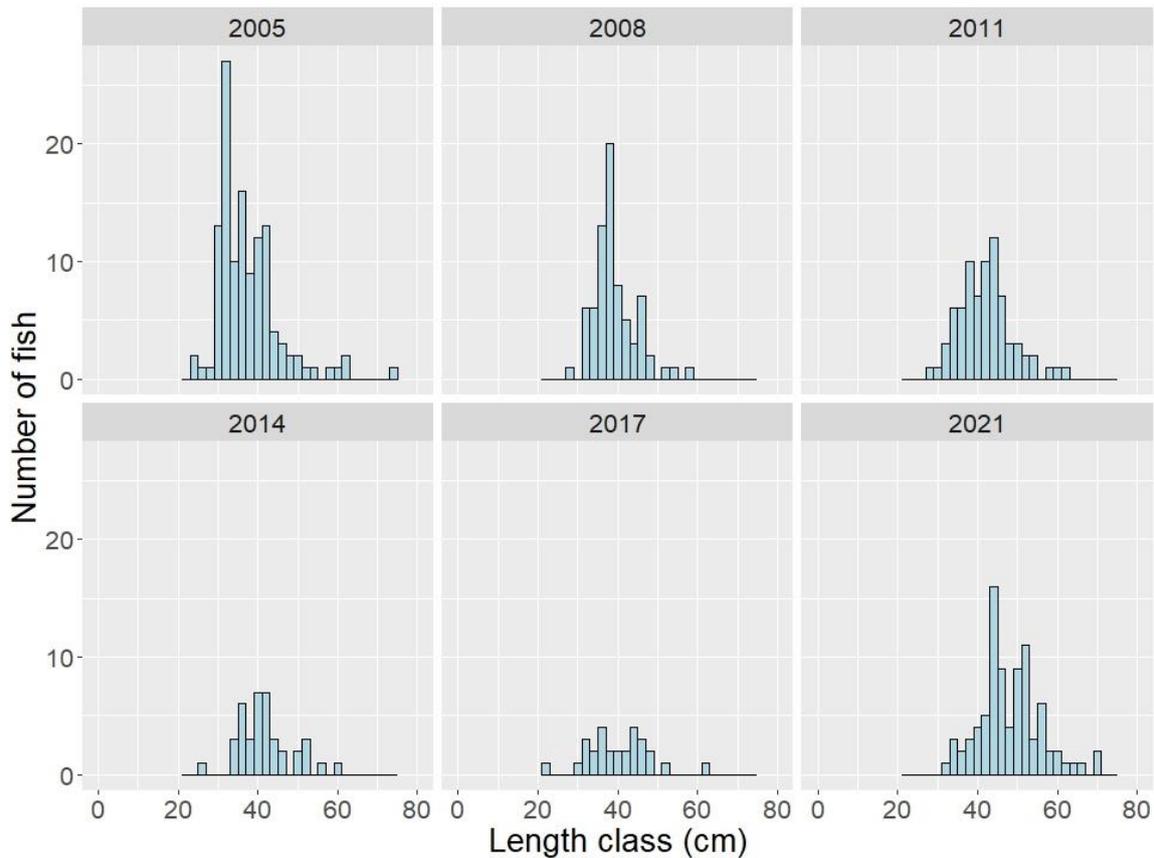


Figure 3.6. Length frequency of European eel captured on Lough Melvin, 2005, 2008, 2011, 2014, 2017 and 2021

3.4. Stomach and diet analysis

The dietary analysis conducted provides insight to the prey of examined fish immediately prior to capture. Longer term and seasonal studies provide a more robust assessment of fish diet.

The stomach contents of a subsample of brown trout and perch captured during the survey were examined and are presented below.

Brown trout

A total of 47 stomachs were examined. Of these 31 were found to contain no prey items. Of the 16 stomachs containing food, 11 stomachs (69%) contained invertebrates, with snails occurring in stomachs of those fish morphologically consistent with gillaroo trout. Fish were recorded in three (19%) brown trout stomachs (Figure 3.7). Piscivorous (ferox) trout ranged in length from 44cm to 60cm. Zooplankton and unidentified digested material were each recorded in one (6%) brown trout stomach.

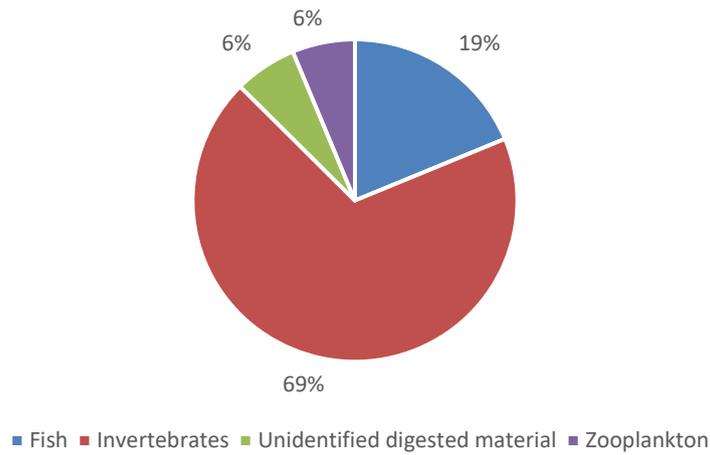


Figure 3.7. Diet of brown trout (all varieties) (n = 16) captured on Lough Melvin, 2021 (% FO)

Perch

A total of 90 perch stomachs were examined. Of these 43 were found to contain no prey items. Of the remaining 47 stomachs containing food, 36 (77%) contained zooplankton. Invertebrates were recorded in 10 stomachs (21%). Unidentified digested material was noted in one (2%) stomach (Figure 3.8).

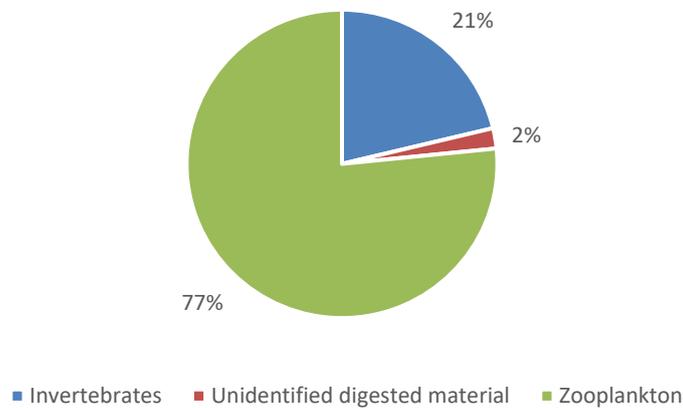


Figure 3.8. Diet of perch (n = 47) captured on Lough Melvin, 2021 (% FO)

4. Summary and ecological status

A total of seven fish species and two types of cyprinid hybrids were recorded in Lough Melvin in 2021.

Abundance (CPUE) and biomass (BPUE) of the combined brown trout species complex have remained relatively stable over all survey occasions, and no clear trends were apparent. Brown trout (all varieties) ranged in length from 10.0cm to 65.5cm. Brown trout were aged between 0+ and 9+. All intervening age groups were represented in the sample indicating that the Melvin population(s) are long lived population with regular and stable recruitment. The most abundant age class was 1+ and smaller fish were more prominent in the population sampled in 2021 than in earlier surveys. Length at age analyses revealed that brown trout in the lake exhibit a slow rate of growth according to the classification scheme of Kennedy and Fitzmaurice (1971).

Perch, in common with previous surveys of the lake was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2021 survey. Perch ranged in length from 5.0cm to 39.8cm. Perch ranged in age from 1+ to 11+, with all intervening age groups (with the exception of 10+) represented. This indicates that recruitment to the adult population is regular and stable. The dominant age class was 3+. The absence of 0+ group perch may be attributed to the timing of the survey (i.e. July) when perch fry are often too small to be captured in the survey nets used.

Seven rudd were captured in the 2021 survey, and numbers have consistently declined across all surveys of the lake. Rudd ranged in length from 19.5cm to 23.8cm and all were aged between 6+ and 8+. Therefore, while novel cyprinid species have been recorded in the lake for the first time in 2021, it would appear that the rudd population has contracted in recent years, with limited evidence of recent recruitment.

Roach, and its hybrid with bream were recorded for the first time in the survey. Two roach captured were both aged 5+. While roach x rudd hybrids have been recorded previously, roach were not known from the lake and it is possible that these fish have originated from the wider Lough Melvin catchment or from elsewhere. Cyprinids were also recorded in Lough Lattone in 2021 (McLoone *et al.*, 2022). The roach x bream hybrid captured was estimated as 7+. This age, together with the fact that hybridisation requires the presence of both parent species indicates that it is unlikely that either of these species were spawned naturally within the lake. Colonisation from upstream via Lough Lattone is possible, and deliberate introduction cannot be ruled out.

While the brown trout species complex remains in an overall healthy state, and all three species (i.e. gillaroo, sonaghen and ferox) were captured in 2021, the impact of the colonisation and potential proliferation of cyprinid species is of concern. Species such as gillaroo (which is believed to be unique to Lough Melvin) which has specialised food and habitat requirements may be particularly vulnerable.

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 Melvin has been assigned an ecological status of Good for 2021 based on the fish populations present. In previous years the lake was assigned a fish status of Moderate in 2005 and 2008, Good in 2014 and 2017 and High in 2011 (Figure 4.1).

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Lough Melvin an overall ecological status of Moderate.

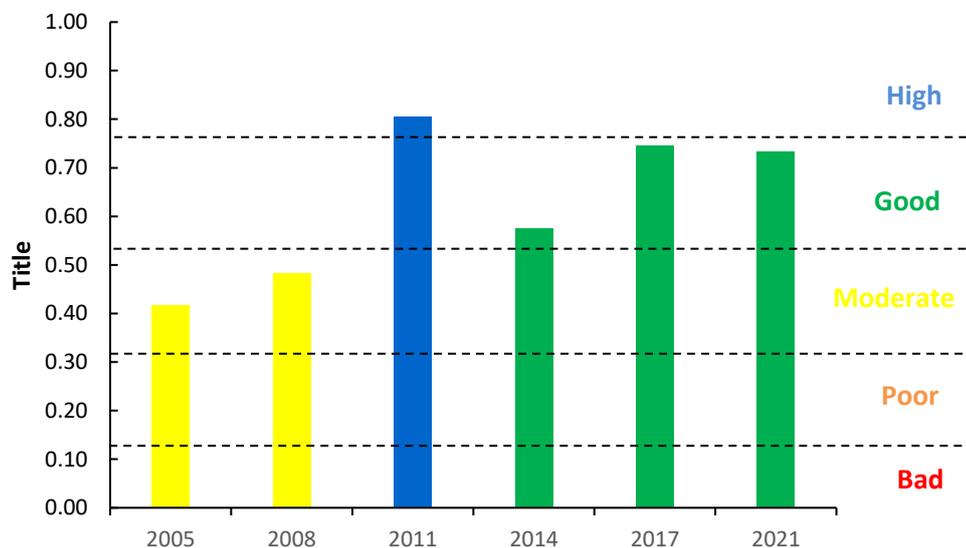


Figure 4.1. Fish ecological status of Lough Melvin, 2005, 2008, 2011, 2014, 2017 and 2021

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**Inland Fisheries Ireland
3044 Lake Drive,
Citywest Business Campus,
Dublin 24,
Ireland.
D24 CK66**

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

+353 1 8842 600

