

National Research Survey Programme

Lakes 2017

Lough Caragh

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National Research Survey Programme

**Fish Stock Survey of Lough Caragh,
August 2017**

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

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

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1.1 Introduction

Lough Caragh is situated in Co. Kerry at the mouth of the Glencar Valley, approximately two kilometres north-east of Glenbeigh (Plate 1.1, Fig. 1.1). The lake has a surface area of 490ha, a mean depth of 11m and a maximum depth of 40m. The lake is categorised as typology class 4 (as designated by the EPA for the Water Framework Directive), i.e. deep (mean depth >4m), greater than 50ha and low alkalinity (<20mg/l CaCO₃).

Lough Caragh forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River catchment candidate Special Area of Conservation. This is a large area that encompasses a wide variety of habitats designated under Annex I of the EU Habitats Directive, including blanket bog, alluvial woodlands, alpine heath and both upland and lowland oligotrophic lakes. The site has also been selected for the following species, Killarney fern, slender naiad, freshwater pearl mussel, Kerry slug, marsh fritillary, Killarney shad, Atlantic salmon, brook lamprey, river lamprey, sea lamprey, lesser horseshoe bat and otter; all species listed on Annex II of the EU Habitats Directive (NPWS, 2005).

Lough Caragh is known for its spring salmon and grilse fishing, and to a lesser extent for brown trout and sea trout. The best salmon fishing is at the southern end of the lake along the west and east shores. Early in the season fish average 6.3kg and the record for the lake is 12.7kg. The sea trout arrive in the lake in July. The brown trout are to be found on all the shores and generally average 0.2-0.4kg (O' Reilly, 2007).

Lough Caragh was previously surveyed in 2008, 2011 and 2014 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2009, 2012a, 2015a and 2015b). During the 2014 survey, perch followed by brown trout were found to be the dominant species present in the lake. Arctic char, sea trout, salmon and eels were also captured during the survey.

This report summarises the results of the 2017 fish stock survey carried out on the lake, as part of the Water Framework Directive surveillance monitoring programme and IFI's Arctic char research programme.



Plate 1.1. Lough Caragh



1.2 Methods

1.2.1 Netting methods

Lough Caragh was surveyed over two nights between the 21st and the 23rd of August 2017. A total of three sets of Dutch fyke nets, 24 benthic monofilament multi-mesh ((BM CEN) 12 panel, 5-55mm mesh size) CEN standard survey gill nets (5 @ 0-2.9m, 5 @ 3-5.9m, 5 @ 6-11.9m, 4 @ 12-19.9m, 3 @ 20-34.9m and 2 @ 35-49.9m) and three floating monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh size) CEN standard survey gill nets were deployed in the lake (30 sites) (Fig. 1.1). Nets were deployed in the same locations as were randomly selected in the previous survey. A handheld GPS was used to mark the precise location of each net. The angle of each gill net in relation to the shoreline was randomised.

All fish apart from perch were measured and weighed on site and scales were removed from all brown trout, sea trout and salmon. Live fish were returned to the water whenever possible (i.e. when the likelihood of their survival was considered to be good). Samples of fish were retained for further analysis. Fish were frozen immediately after the survey and transported back to the IFI laboratory for later dissection

1.2.2 Fish diet

Total stomach contents were inspected and individual items were counted and identified to the lowest taxonomic level possible. The percentage frequency occurrence (%FO) of prey items were then calculated to identify key prey items (Amundsen *et al.*, 1996).

$$\%FO_i = (N_i / N) \times 100$$

Where:

%FO_i is the percentage frequency of prey item i,
N_i is the number of a particular species with prey i in their stomach,
N is total number of a particular species with stomach contents.

1.2.3 Biosecurity - disinfection and decontamination procedures

Procedures are required for disinfection of equipment in order to prevent dispersal of alien species and other organisms to uninfected waters. A standard operating procedure was compiled by Inland



Fisheries Ireland for this purpose (Caffrey, 2010) and is followed by staff in IFI when moving between water bodies.

1.3 Results

1.3.1 Species Richness

A total of four fish species were recorded on Lough Caragh in August 2017, with 290 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Brown trout was the most common fish species recorded, followed by perch. Arctic char and salmon were also recorded. During the previous surveys in 2008, 2011 and 2014 the same species composition was recorded, with the exception of salmon which were not recorded in the 2008 survey, sea trout which were not recorded in the 2008 and 2017 survey and eels which were not recorded in the 2017 survey (Kelly *et al.*, 2009, 2012a, 2015a and 2015b).

Table 1.1. Number of each fish species captured by each gear type during the survey on Lough Caragh, August 2017

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
<i>Salmo trutta</i>	Brown trout	53	94	13	160
<i>Perca fluviatilis</i>	Perch	108	3	8	119
<i>Salvelinus alpinus</i>	Arctic char	9	0	0	9
<i>Salmo salar</i>	Salmon	2	0	0	2

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 2008, 2011 and 2014 surveys are summarised in Table 1.2 and illustrated in Figures 1.2 and 1.3.

Brown trout

Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE). Although the mean brown trout CPUE increased slightly over the four sampling occasions, these differences were not



statistically significant (Table 1.2; Fig. 1.2 and 1.3). There were also no significant differences in mean BPUE across the four sampling years, although the BPUE fluctuated slightly.

Arctic char

The mean Arctic char CPUE and BPUE also fluctuated slightly over the four sampling occasions; the 2014 CPUE was significantly lower than the figures from 2011 and 2017 (Kruskal-Wallis $H=0.272$, $P<0.01$) (Table 1.2; Fig 1.2 and 1.3). There were no significant differences in mean BPUE across the four sampling years.

Perch

The mean perch CPUE and BPUE also fluctuated slightly over the four sampling occasions; however, the 2008 CPUE was significantly lower than that from 2014 and 2017 (Kruskal-Wallis $H=11.82$, $P<0.05$) (Table 1.2; Fig 1.2 and 1.3). There were no significant differences in mean BPUE across the four sampling years.

Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lough Caragh, 2008, 2011, 2014 and 2017

Scientific name	Common name	2008	2011	2014	2017
Mean CPUE (\pmS.E.)					
<i>Salvelinus alpinus</i>	Arctic char	0.006 (0.004)	0.007 (0.004)	0.003 (0.002)	0.010 (0.006)
<i>Salmo trutta</i>	Brown trout	0.107 (0.021)	0.128 (0.025)	0.138 (0.038)	0.171 (0.057)
	Sea trout	-	0.003 (0.001)	0.001 (0.001)	-
<i>Perca fluviatilis</i>	Perch	0.053 (0.018)	0.085 (0.021)	0.1977 (0.032)	0.128 (0.026)
<i>Salmo salar</i>	Salmon	-	0.002 (0.001)	0.006 (0.004)	0.002 (0.002)
<i>Anguilla anguilla</i>	European eel	0.122 (0.081)	0.088 (0.058)	0.016 (0.016)	-
Mean BPUE (\pmS.E.)					
<i>Salvelinus alpinus</i>	Arctic char	0.725 (0.504)	0.65 (0.416)	0.378 (0.350)	1.013 (0.563)
<i>Salmo trutta</i>	Brown trout	12.287 (2.503)	15.261 (3.198)	12.405 (2.942)	15.039 (4.888)
	Sea trout	-	1.012 (0.634)	0.877 (0.877)	-
<i>Perca fluviatilis</i>	Perch	3.636 (1.472)	7.032 (2.784)	10.581 (2.185)	7.882 (1.860)
<i>Salmo salar</i>	Salmon	-	4.655 (3.240)	14.239 (10.265)	7.556 (5.986)
<i>Anguilla anguilla</i>	European eel	13.944 (9.959)	14.705 (11.467)	1.394 (1.394)	-

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

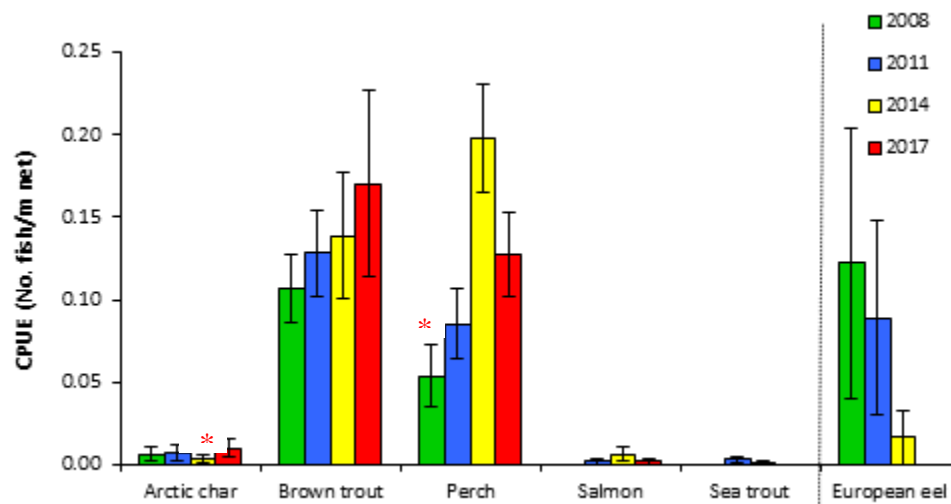


Fig. 1.2. Mean (\pm S.E.) CPUE for all fish species captured in Lough Caragh (Eel CPUE based on fyke nets only), 2008, 2011, 2014 and 2017 (* indicates a significant difference $P<0.05$)

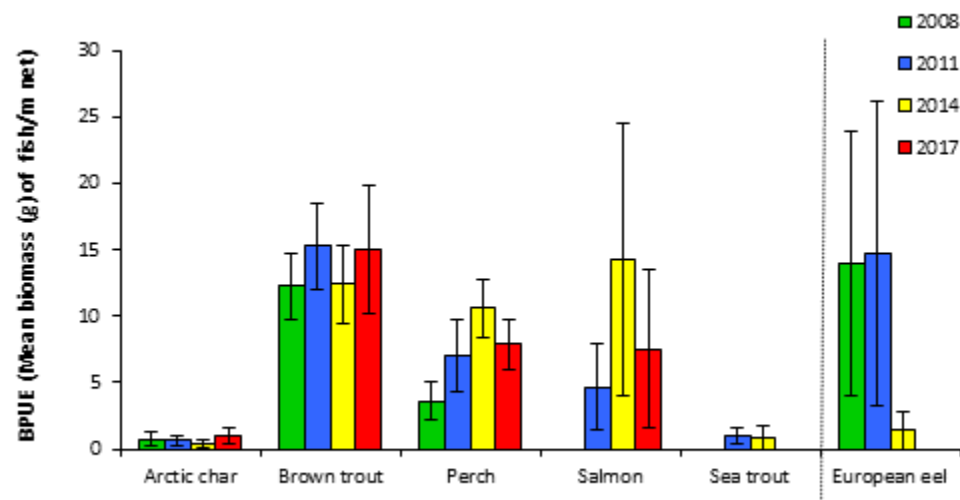


Fig. 1.3. Mean (\pm S.E.) BPUE for all fish species captured in Lough Caragh (Eel BPUE based on fyke nets only), 2008, 2011, 2014 and 2017



1.3.3 Length frequency distributions and growth

Brown trout

Brown trout captured during the 2017 survey ranged in length from 10.2cm to 29.6cm (mean = 19.3cm) (Fig. 1.4). Four age classes were present, ranging from 1+ to 4+, with a mean L1 of 6.9cm (Table 1.3). The dominant age class was 2+ (Fig. 1.4). Mean brown trout L4 in 2017 was 25.8cm indicating a slow rate of growth for brown trout in this lake according to the classification scheme of Kennedy and Fitzmaurice (1971) (Table 1.3). Brown trout captured during the 2008, 2011 and 2014 surveys had similar length and age ranges, with some larger and smaller fish recorded in the 2011 and 2017 surveys (Fig.1.4).

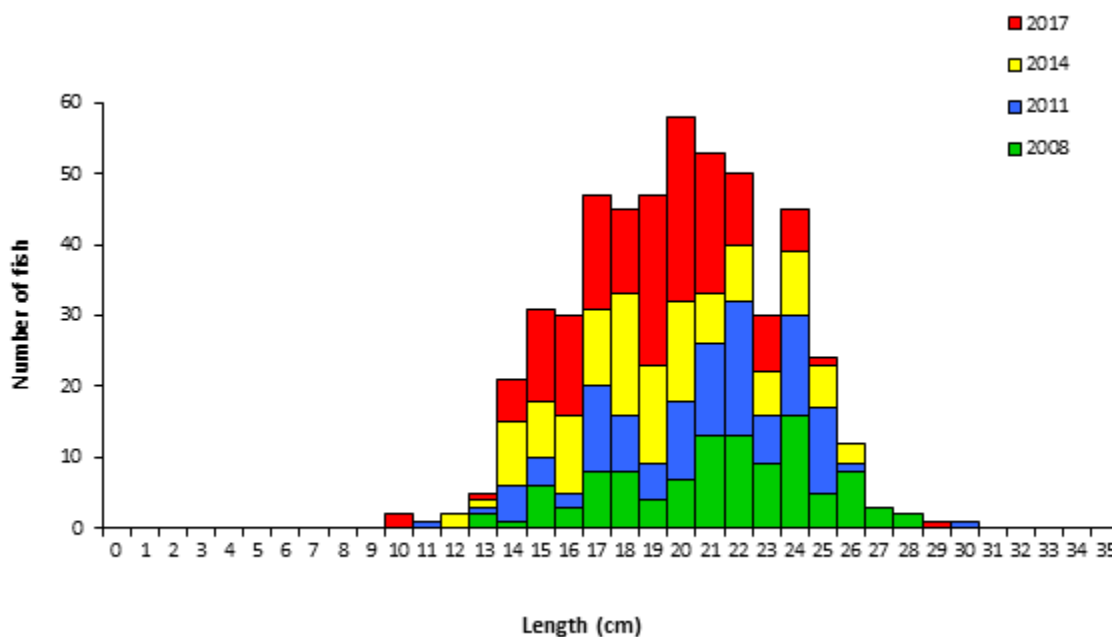


Fig. 1.4. Length frequency of brown trout captured on Lough Caragh, 2008, 2011, 2014 and 2017

Table 1.3. Mean (\pm S.E.) brown trout length (cm) at age for Lough Caragh, August 2017

	L ₁	L ₂	L ₃	L ₄	Growth Category
Mean (\pm S.E.)	6.9 (0.2)	13.8 (0.5)	19.8 (0.5)	25.8 (1.2)	Slow
N	37	30	17	2	
Range	3.6-9.1	9.4-18.2	15.5-24.1	24.6-27.0	

Perch

Perch captured during the 2017 survey ranged in length from 8.5cm to 34.9cm (mean = 15.9cm) (Fig.1.5) with seven age classes present, ranging from 0+ to 6+. The dominant age class was 3+. Perch captured during the 2008, 2011 and 2014 surveys had a similar length and age range, with some smaller younger fish recorded in the 2008 and 2014 surveys and some larger older fish recorded in these years also (Fig.1.5).

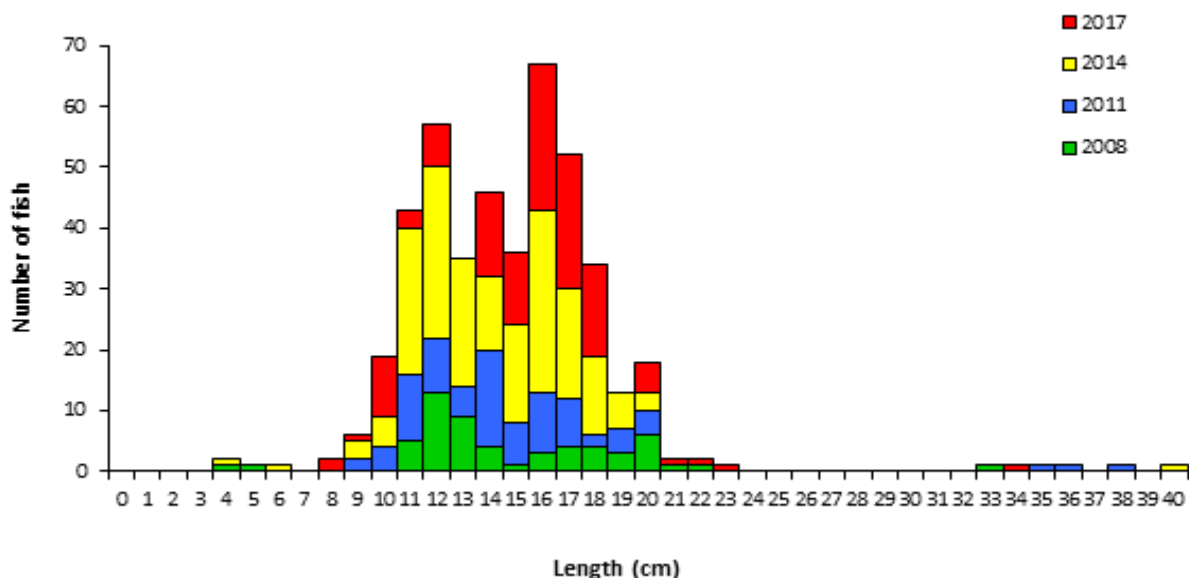


Fig. 1.5. Length frequency of perch captured on Lough Caragh, 2008, 2011, 2014 and 2017

Table 1.4. Mean (\pm S.E.) perch length (cm) at age for Lough Caragh, August 2017

	L ₁	L ₂	L ₃	L ₄	L ₅	L ₆
Mean (\pm S.E.)	6.7 (0.2)	12.7 (0.3)	15.2 (0.4)	17.0 (0.8)	19.6 (1.5)	17.7
N	25	19	16	9	3	1
Range	4.1-8.8	10.4-14.7	12.4-18.4	13.6-21.1	17.2-22.2	17.7-17.7

Other fish species

Arctic char captured during the 2017 survey ranged in length from 19.4cm to 22.9cm and were all aged 4+. Two adult salmon were measured at 55.2cm and 84.3cm (2.1+ and 2.2+).

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

Brown trout

Adult trout usually feed principally on crustaceans (*Asellus* sp. and *Gammarus* sp.), insects (principally chironomid larvae and pupae) and molluscs (snails) (Kennedy and Fitzmaurice, 1971, O'Grady, 1981). A total of 84 stomachs were examined. Of these 41 were found to contain no prey items. Of the remaining 43 stomachs containing food, 74% contained invertebrates, 12% unidentified digested material, 9% zooplankton and 5% zooplankton/invertebrates (Fig. 1.6).

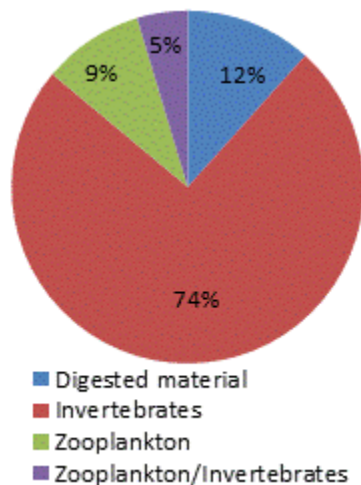


Fig 1.6. Diet of brown trout (n=43) captured on Lough Caragh, 2017 (% FO)

Arctic char

A total of nine Arctic char stomachs were examined. Of these, one was empty and the remaining eight contained 75% invertebrates, 13% zooplankton/invertebrates and 12 % unidentified digested material (Fig. 1.7).

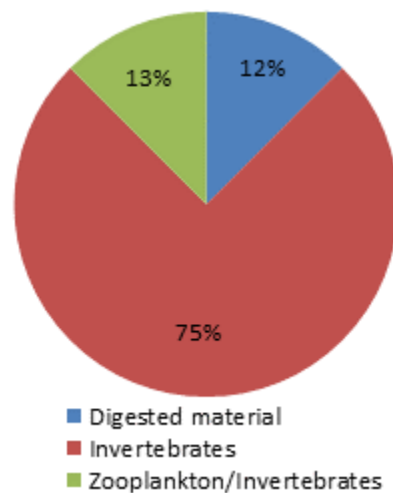


Fig 1.7. Diet of Arctic char (n=5) captured on Lough Caragh, 2017 (% FO)

Perch

Perch initially start to feed on pelagic zooplankton. Once they reach an intermediate size they start feeding on benthic resources eventually moving on to feed on fish once they are large enough (Hjelm *et al.*, 2000). A total of 33 stomachs were examined. Of these 12 were found to contain no prey items. Of the remaining 21 stomachs containing food, 43% unidentified digested material, 38% contained zooplankton and 19% invertebrates (Fig. 1.8).

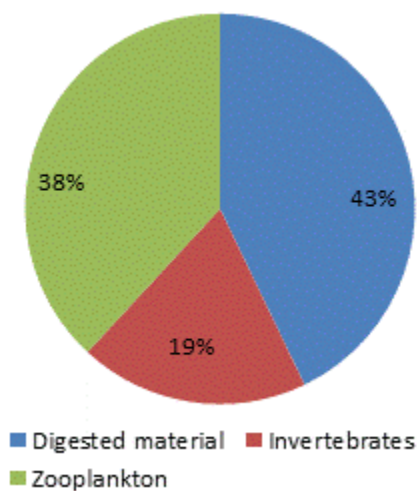


Fig 1.8. Diet of perch (n=21) captured on Lough Caragh, 2017 (% FO)



1.4 Summary and ecological status

A total of four fish species (sea trout are included as a separate 'variety' of trout) were recorded on Lough Caragh in August 2017. Brown trout was the dominant species in terms of abundance (CPUE) and biomass (BPUE) captured in the survey gill nets during the 2017 survey.

Although the mean brown trout CPUE increased slightly over the four sampling occasions, these differences were not statistically significant. There were also no significant differences in mean BPUE across the four sampling years, although the BPUE fluctuated slightly. Brown trout ranged in age from 1+ to 4+, indicating reproductive success in the previous four out of five years. The dominant age class was 2+. 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).

The mean Arctic char CPUE and BPUE fluctuated slightly over the four sampling occasions; however, the only difference was in the 2014 CPUE where it was significantly lower than 2011 and 2017. Arctic char were all aged at 4+.

The mean perch CPUE and BPUE fluctuated slightly over the four sampling occasions; however, the only difference was in the 2008 CPUE where it was significantly lower than 2014 and 2017. Perch ranged in age from 0+ to 6+, with seven age classes present.

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 Caragh has been assigned an ecological status of High for 2017 based on the fish populations present. In previous years the lake was also assigned a fish status of High in 2008, 2011 and 2014.

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



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