



# Sampling Fish for the Water Framework Directive

Lakes 2010

**Lickeen Lough**



Iascach Intíre Éireann  
Inland Fisheries Ireland

## ACKNOWLEDGEMENTS

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## 1.1 Introduction

Lickeen Lough (Plates 1.1 and 1.2, Fig. 1.1) is situated in the Inagh catchment in Co. Clare, approximately 3km north-east of Ennistymon. It has a surface area of 84ha, a mean depth >4m, a maximum depth of 20m and falls into typology class 8 (as designated by the EPA for the Water Framework Directive), i.e. deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l  $\text{CaCO}_3$ ).

Historically, Lickeen Lough held a stock of Arctic char (O' Reilly, 2007). However the population is now extinct in the lake. A substantial fish kill (effecting brown trout, rainbow trout and perch) occurred in the lake in June 1998, which may have contributed to their demise. Wild brown trout up to 2.3kg are taken from the lake by anglers and it is stocked annually with rainbow trout by the Lickeen Lough Trout Anglers Co-operative. The lake is subject to water abstraction, supplying drinking water to North County Clare (Lickeen Lough Trout Anglers Co-operative, 2010).

Lickeen Lough was previously surveyed in 2007 as part of the WFD surveillance monitoring programme (Kelly and Connor, 2007). During this survey rudd and brown trout were found to be the dominant species present in the lake. Three spined stickleback and eels were also captured during the survey.

During the 2010 survey, an extensive algal bloom was visible on the lake (Plates 1.3 and 1.4).



**Plate 1.1 and 1.2 Lickeen Lough**





Plate 1.3 and 1.4 Algal bloom on Lickeen Lough, September 2010

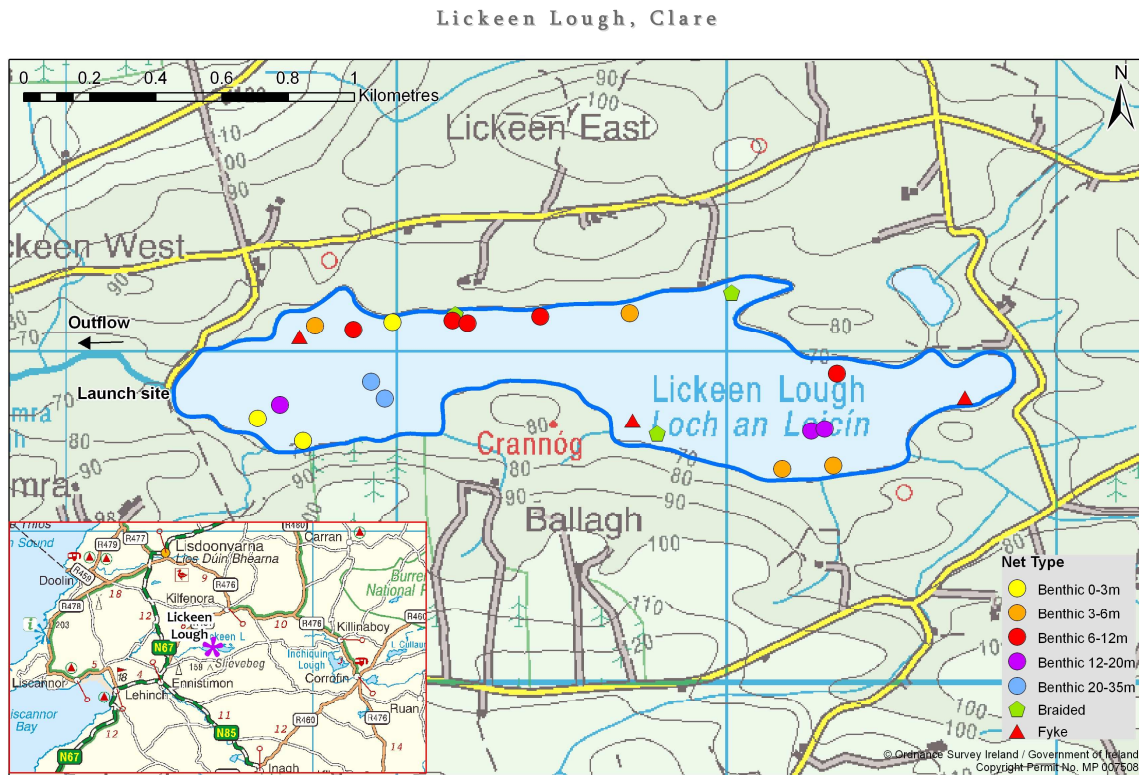


Fig. 1.1. Location map of Lickeen Lough showing net locations and depths of each net (outflow is indicated on map)

## 1.2 Methods

Lickeen Lough was surveyed over two nights from the 28<sup>th</sup> to the 30<sup>th</sup> of September 2010. A total of three sets of Dutch fyke nets and 17 benthic monofilament multi-mesh (12 panel, 5-55mm mesh size) CEN standard survey gill nets (4 @ 0-2.9m, 4 @ 3-5.9m, 4 @ 6-11.9m, 3 @ 12-19.9m and 2 @ 20-34.9m) were deployed in the lake (20 sites). The netting effort was supplemented using three benthic braided survey gill nets (62.5mm mesh knot to knot) at three additional sites. 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 were measured and weighed on site and scales were removed from all brown trout and rudd. Live fish were returned to the water whenever possible (i.e. when the likelihood of their survival was considered to be good). Samples of fish were retained for further analysis.

## 1.3 Results

### 1.3.1 Species Richness

A total of four fish species were recorded in Lickeen Lough in September 2010, with 252 fish being captured. The number of each species captured by each gear type is shown in Table 1.1. Rudd was the most abundant fish species recorded, followed by brown trout, eels and three-spined stickleback. During the previous survey in 2007 the same species composition was recorded.

**Table 1.1. Number of each fish species captured by each gear type during the survey on Lickeen Lough, September 2010**

Scientific name	Common name	Number of fish captured			
		Benthic mono multimesh gill nets	Benthic braided gill nets	Fyke nets	Total
<i>Scardinius erythrophthalmus</i>	Rudd	181	0	10	191
<i>Salmo trutta</i>	Brown trout	36	0	0	36
<i>Anguilla anguilla</i>	European eel	0	0	23	23
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0	0	2	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 2007 and 2010 surveys are summarised in Table 1.2. Mean CPUE is illustrated in Figure 1.2.

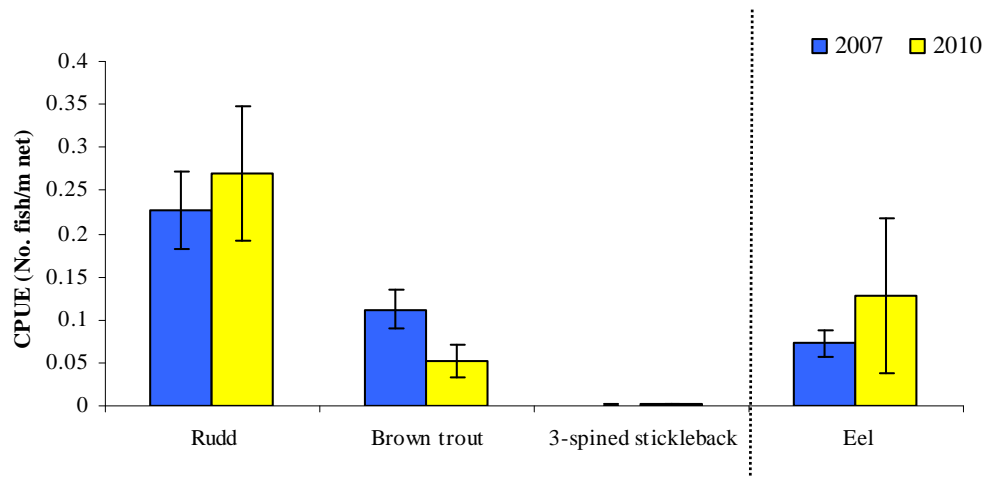
The mean brown trout CPUE was significantly lower in 2010 than in 2007 (Mann Whitney U test,  $z = -2.394$ ,  $P < 0.05$ ). The differences in the mean brown trout CPUE between Lickeen Lough and four other similar lakes were assessed and found to be statistically significant (Kruskal-Wallis,  $P < 0.05$ ) (Fig. 1.3). Independent-Samples Mann-Whitney U tests between each lake showed that Lickeen Lough had a significantly higher mean brown trout CPUE than Upper Lough Erne ( $z = -2.870$ ,  $P < 0.05$ ).

Although the mean rudd CPUE was slightly higher in 2010 than in 2007, this was not statistically significant. The differences in the mean rudd CPUE between Lickeen Lough and four other similar lakes were assessed and found to be statistically significant (Kruskal-Wallis,  $P < 0.001$ ) (Fig. 1.4). Independent-Samples Mann-Whitney U tests between each lake showed that Lickeen Lough had a significantly higher mean rudd CPUE than Lough Rea ( $z = -2.680$ ,  $P < 0.05$ ).

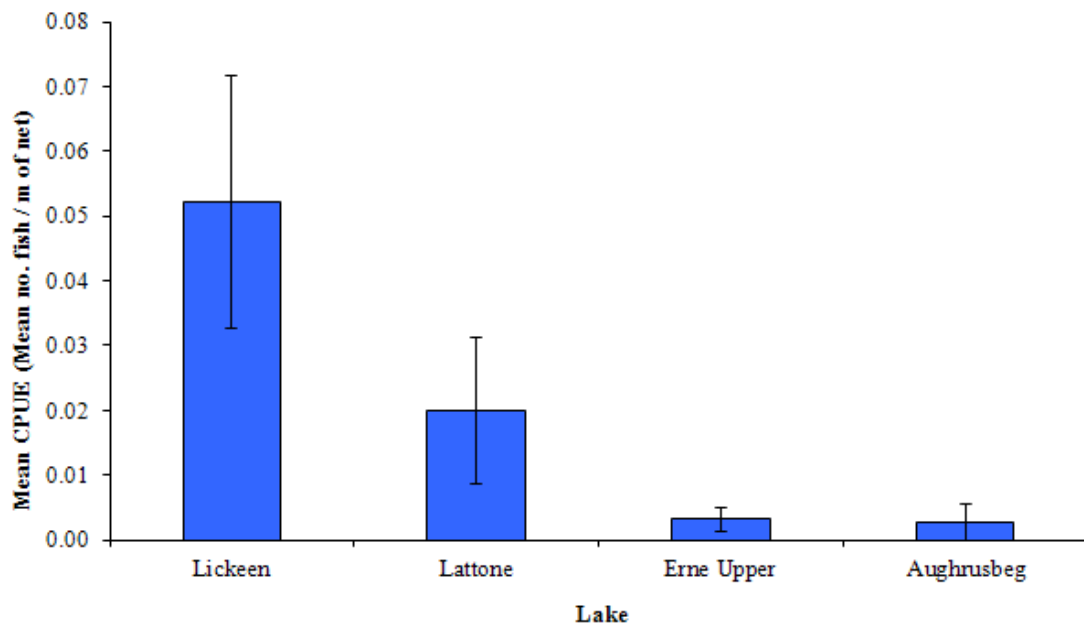
**Table 1.2. Mean (S.E.) CPUE and BPUE for all fish species captured on Lickeen Lough, 2007 and 2010**

Scientific name	Common name	2007	2010
<b>Mean CPUE</b>			
<i>Scardinius erythrophthalmus</i>	Rudd	0.226 (0.045)	0.269 (0.078)
<i>Salmo trutta</i>	Brown trout	0.112 (0.022)	0.052 (0.019)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.001 (0.001)	0.001 (0.001)
<i>Anguilla anguilla</i>	European eel	0.072 (0.015)	0.128 (0.089)
<b>Mean BPUE</b>			
<i>Scardinius erythrophthalmus</i>	Rudd	14.233 (3.684)	18.958 (5.579)
<i>Salmo trutta</i>	Brown trout	29.885 (5.605)	6.565 (2.468)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.002 (0.002)	0.001 (0.001)
<i>Anguilla anguilla</i>	European eel	14.889 (0.360)	23.100 (16.026)

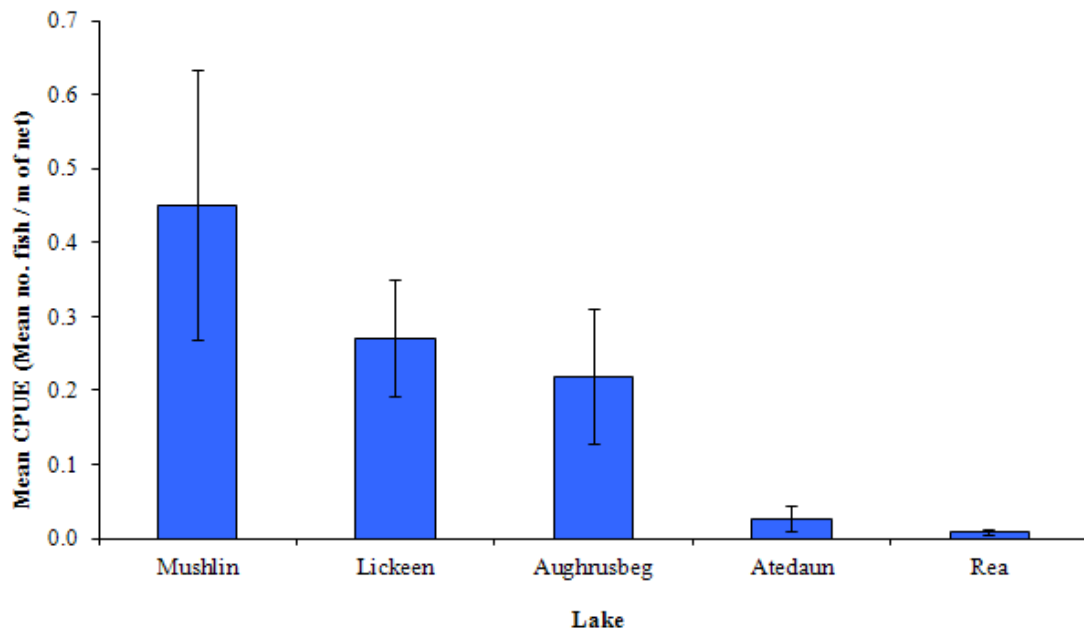
\* On the rare occasion where biomass data was unavailable for an individual fish, this was determined from a length/weight regression for that species.



**Fig. 1.2. Mean ( $\pm$ S.E.) CPUE for all fish species captured on Lickeen Lough (Eel CPUE based on fyke nets only), 2007 and 2010**



**Fig. 1.3. Mean ( $\pm$ S.E.) brown trout CPUE in four lakes surveyed during 2010**

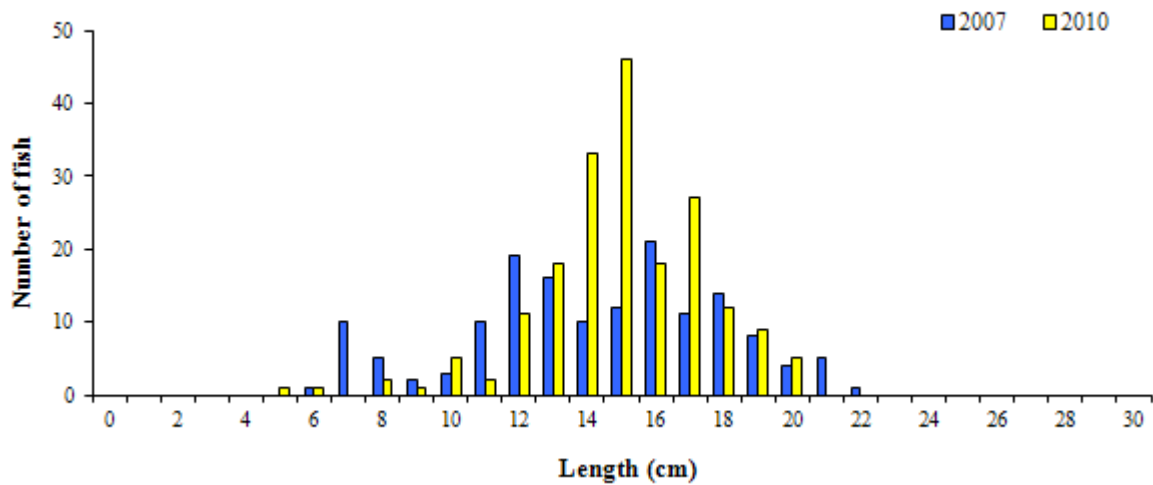


**Fig. 1.4. Mean ( $\pm$ S.E.) rudd CPUE in five lakes surveyed during 2010**

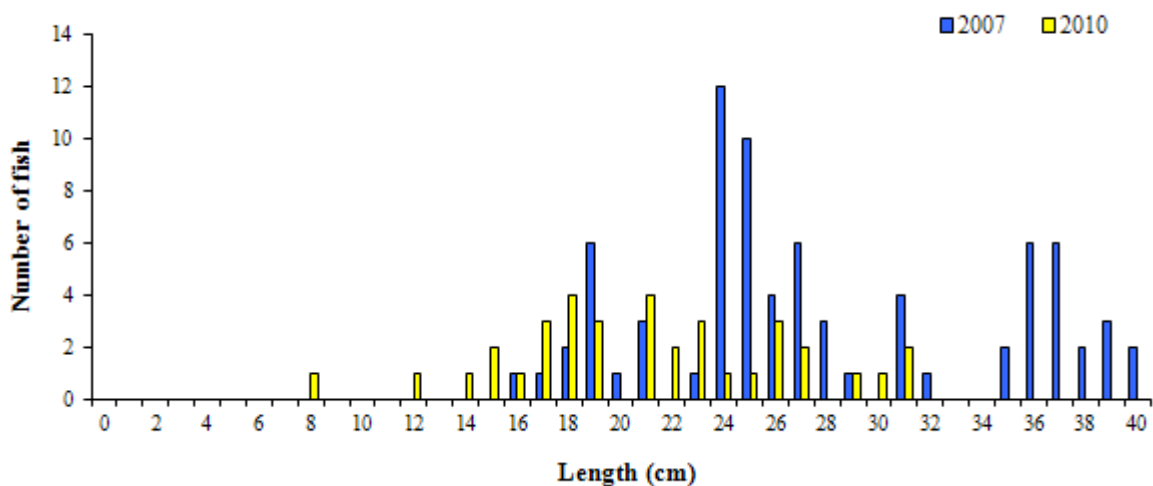
### ***1.3.3 Length frequency distributions***

Rudd captured during the 2010 survey ranged in length from 5.9cm to 20.9cm (mean = 15.4cm) (Fig. 1.5). Rudd captured during the 2007 survey ranged in length from 6.5 cm to 22.0cm (Fig. 1.5). Brown trout captured during the 2010 survey ranged in length from 8.6cm to 31.5cm (mean = 21.4cm) (Fig.1.6). Brown trout captured during the 2007 survey ranged in length from 16.0cm to 40.5cm (Fig.1.6). Eels captured during the 2010 survey ranged in length from 39.2cm to 57.0cm and the two three-spined stickleback captured measured 2.8cm in length.





**Fig. 1.5. Length frequency of rudd captured on Lickeen Lough**



**Fig. 1.6. Length frequency of brown trout captured on Lickeen Lough, 2007 and 2010**

#### ***1.3.4 Fish age and growth***

Six age classes of rudd were present, ranging from 0+ to 5+, with a mean L1 of 4.2cm (Table 1.3). In the 2007 survey, rudd ranged from 1+ to 11+ with a mean L1 of 3.2cm. .

Four age classes of brown trout were present, ranging from 0+ to 3+, with a mean L1 of 7.9cm (Table 1.4). In the 2007 survey, brown trout ranged from 1+ to 4+ with a mean L1 of 7.5cm.

**Table 1.3. Mean ( $\pm$ SE) rudd length (cm) at age for Lickeen Lough, September 2010**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	L <sub>5</sub>
Mean	4.2 (0.1)	8.7 (0.3)	12.7 (0.4)	16.1 (0.4)	19.3 (0.5)
N	55	52	47	23	4
Range	2.4-5.7	5.4-12.4	8.1-16.6	11.2-18.5	18.5-20.5

**Table 1.4. Mean ( $\pm$ SE) brown trout length (cm) at age for Lickeen Lough, September 2010**

	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>
Mean	7.9 (0.2)	18.4 (0.6)	26.3 (1.4)
N	34	25	3
Range	5.2-9.9	12.8-23.7	23.5-28.2

## 1.4 Summary

Rudd was the dominant species in terms of abundance (CPUE) and eel was the dominant species in terms of biomass (BPUE).

The mean rudd CPUE in Lickeen Lough was significantly higher than Lough Rea, but not significantly different to the other three similar lakes surveyed. Rudd ranged in age from 0+ to 5+, indicating reproductive success in each of the previous six years.

The mean brown trout CPUE was significantly lower in 2010 than in 2007. The mean brown trout CPUE in Lickeen Lough was significantly higher than Upper Lough Erne. Although it was also relatively high compared with the other two similar lakes surveyed, this was not statistically significant. Brown trout ranged in age from 0+ to 3+, indicating reproductive success in each of the previous four years.

There has been a substantial change in the fish populations in the lake since the 1990s; char and perch are absent from the lake, leading to the conclusion that the substantial fish kill in 1998 and the effects of continued eutrophication have contributed to their demise. The lake may also have been subject to the illegal stocking of rudd, a non-native fish species over the last ten years as they have been captured in the current and previous WFD lake fish surveys but were not recorded in the lake in the 1990s. The introduction of non-native species can have significant impacts on the native fish species present. Direct effects such as predation by pike on native salmonid species (Fitzmaurice, 1984) and indirect effects such as highly fecund roach populations out competing brown trout for limited resources (Fitzmaurice, 1984) can have serious ecological consequences on the native fish species. Furthermore, introduction of non-native species can serve to downgrade the ecological status of a water body for WFD purposes.

Lickeen lake is stocked annually with rainbow trout (a non native species). These hatchery reared fish have been released into the lake to create an angling amenity in the area, as the native brown trout

stock have declined in recent years and can not support large fishing pressures. No stocked rainbow trout were captured during the present survey. Research has shown that stocked rainbow trout have a poor survival rate in the wild (e.g. ranging from 15% to 50% in the USA, Canada and Australia) (Bettinger and Bettoli, 2002; Teuscher *et al.*, 2003; High and Meyer, 2009).

Stocking of fish (including non indigenous species such as rainbow trout) has been identified as an action with potential to impact on the quality status of rivers and lakes and is listed as a pressure in the WFD REFCOND guidance document (Wallin *et al.* 2003). In WFD terms, it could impact on the ecological status class scoring system and would serve to drive down the water's quality rating. While this classifying may seem arbitrary to some it does reflect the concern of WFD to identify issues that are not appropriate in water resource (in broadest terms) management. Deterioration of ecological status is not permissible under WFD, unless in cases of major public or national importance.

A review of the survival of stocked fish in Lickeen lake is recommended, and the stocking policy for the lake should also be reviewed and revised. The stocking programme developed should be consistent with EU legislation (WFD, Habitats Directive and the Fish Health Directive) and national programmes such as the National Biodiversity Plan. The revised stocking policy for the lake should include a review of habitat and spawning potential of the wild brown trout population, choice of stocked species, triploid versus diploid, timing of stocking events, catch and release policy, bag limits, and fin clipping of stocked trout.

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 2015 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. Using the FIL2 classification tool, Lickeen Lough has been assigned an ecological status of Poor/Bad based on the fish populations present.

In the 2007 to 2009 surveillance monitoring reporting period, the EPA assigned Lickeen Lough an overall ecological status of Moderate, based on all monitored physico-chemical and biological elements, including fish. This status classification will be revised at the end of 2012.

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**Inland Fisheries Ireland  
Swords Business Campus,  
Swords,  
Co. Dublin,  
Ireland.**

**Web: [www.fisheriesireland.ie](http://www.fisheriesireland.ie)  
Email: [info@fisheriesireland.ie](mailto:info@fisheriesireland.ie)  
Tel: +353 1 8842 600  
Fax: +353 1 8360 060**