

# National Research Survey Programme

## Lakes 2021

### Kindrum Lough

IFI/2022/1-4597



Iascach Intíre Éireann  
Inland Fisheries Ireland

**Fish Stock Survey of Kindrum Lough,  
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

Kindrum Lough is located approximately 5km northwest of Portsalon on the Fanad Peninsula, Co. Donegal (Plate 1.1, Figure 1.1). The lake has a surface area of 67ha, a mean depth of 6.6m and a maximum depth of 15.0m. The lake is moderately alkaline and is categorised as typology class 8 (as designated by the EPA for the purposes of the Water Framework Directive (WFD)), i.e. deep (>4m), greater than 50ha and moderately alkaline (20-100mg/l CaCO<sub>3</sub>). The Cashlan Stream drains into the southern arm of the lake. The outflow, which is approximately 0.7km in length, flows into Mulroy Bay and has been used by Fanad Fisheries Ltd. as a water supply for their hatchery operations in the past (Gargan and Roche, 1992). The lake has been classed as at risk of failing to meet the WFD objectives by 2027.

Kindrum Lough is a lowland lake situated 9m a.s.l. It is of considerable conservation significance as a lowland oligotrophic lake, a habitat that is listed on Annex I of the EU Habitats Directive. Two rare plant species are found along the shores of the lake. Slender naiad (*Najas flexilis*) is listed on Annex II of the EU Habitats Directive and the stonewort *Nitella spanioclena* is an extremely rare species that is endemic to Ireland, where it has been recorded only from Kindrum Lough (NPWS, 2021). Kindrum Lough is also home to a population of Arctic char (*Salvelinus alpinus*) (Igoe and Hammar 2004, Kelly *et al.*, 2007) a fish species listed in the Irish Red Data Book as vulnerable (King *et al.*, 2011).

Kindrum Lough is the most popular angling water in this area of the Fanad Peninsula, with access being relatively good to a significant portion of the lake shore. O' Reilly (2007) referred to "nice" trout being present in Kindrum lake, which are taken mainly by spinning.

The lake was previously surveyed in 1992 (Gargan and Roche, 1992) confirming the presence of brown trout and Arctic char in the lake. This lake was surveyed in 2006 as part of the NSSHARE Fish in Lakes Project (Kelly *et al.*, 2007) and in 2009, 2012 and 2015 as part of the Water Framework Directive surveillance monitoring programme (Kelly *et al.*, 2010, 2013 and 2016). In all years brown trout was found to be the dominant species, followed by Arctic char, three-spined stickleback and eel.

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. Kindrum Lough, July 2021

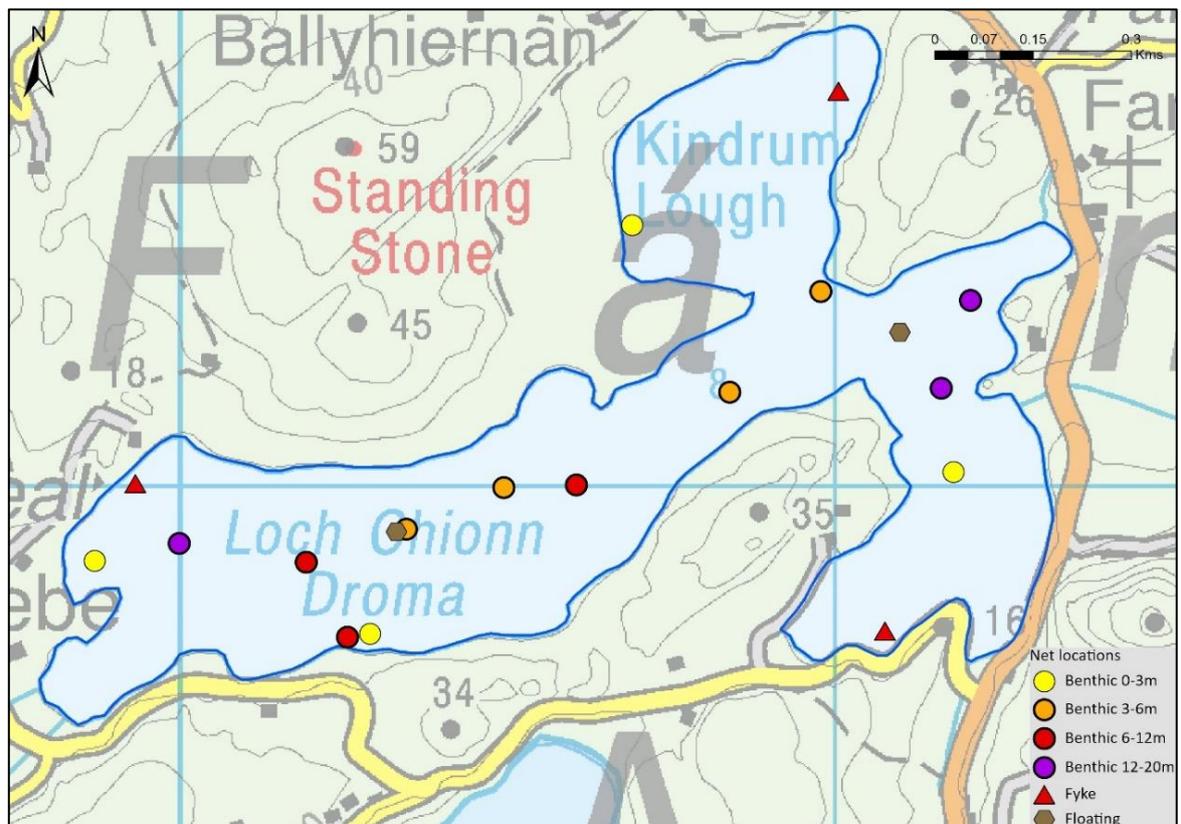


Figure 1.1. Location map of Kindrum Lough showing locations and depths of each net.

## 2. Methods

### 2.1. Netting methods

Kindrum Lough was surveyed over two nights from the 6<sup>th</sup> of July to 8<sup>th</sup> July 2021. A total of three sets of Dutch fyke nets (fyke), 14 benthic monofilament multi-mesh (BM CEN) (12 panel, 5-55mm mesh knot to knot) CEN standard survey gill nets (3 @ 0-2.9m, 4 @ 3-5.9m, 3 @ 6-11.9m and 3 @ 12-19.9m) and two surface monofilament multi-mesh (FM CEN) (12 panel, 5-55mm mesh knot to knot) CEN standard survey gill nets were deployed randomly in the lake (19 sites). Nets were deployed in the same locations as were randomly selected in the previous surveys. 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 Arctic char. 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.

### 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).

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

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 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.

### 3. Results

#### 3.1. Species Richness

Four fish species were recorded on Kindrum Lough in July 2021, with 242 fish being captured. The number of each species captured by each gear type is shown in Table 3.1. Three spined- stickleback was the most abundant fish species recorded, followed by brown trout, eels and Arctic char. During the previous surveys in 2006, 2009, 2012 and 2021 the same species composition was recorded with the exception of salmon, which were not captured during the 2009, 2015 or 2021 surveys but were recorded during the 2006 and 2012 surveys (Kelly *et al.*, 2010 and 2013).

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

Scientific name	Common name	Number of fish captured			
		BM CEN	FM CEN	Fyke	Total
<i>Salmo trutta</i>	Brown trout	92	1	0	93
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	141	1	0	142
<i>Salvelinus alpinus</i>	Artic char	5	0	0	5
<i>Anguilla anguilla</i>	European eel	0	0	2	2

#### 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. Three spined stickleback was the dominant species in terms of abundance (CPUE) and brown trout was dominant in terms of biomass (BPUE) in 2021 (Table 3.2).

CPUE and BPUE for each species captured in all surveys between 2008 and 2021 are presented in Figures 3.1 and 3.2 respectively and illustrates fish community change over time. Brown trout has remained the dominant species (wrt biomass) across all surveys. The population appears stable and there has been little variation in CPUE or BPUE. Arctic char abundance and biomass, however, have declined since the lake was first surveyed in 2008 (Figure 3.1 and 3.2).

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

Scientific name	Common name	Mean CPUE ( $\pm$ S.E)	Mean BPUE ( $\pm$ S.E)
<i>Salmo trutta</i>	Brown trout	0.163 (0.039)	32.831 (7.995)
<i>Gasterosteus aculeatus</i>	Three-spined stickleback	0.249 (0.097)	0.251 (0.098)
<i>Salvelinus alpinus</i>	Artic char	0.009 (0.005)	0.759 (0.444)
<i>Anguilla anguilla</i>	European eel	0.011 (0.011)	1.711 (1.711)

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

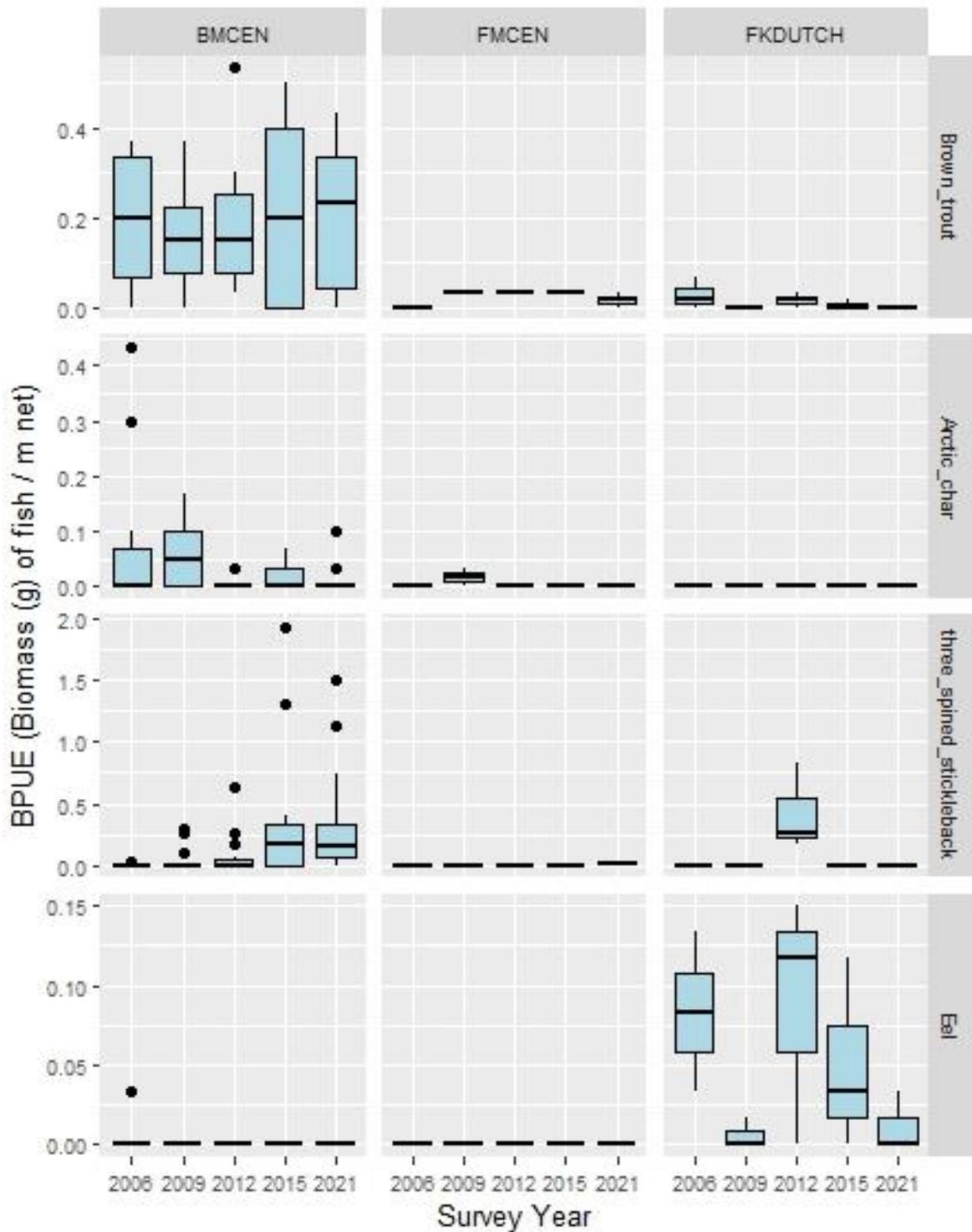


Figure 3.1. CPUE of all fish species captured in each net type during surveys of Kindrum Lough between 2006 and 2021. Figures are expressed as number of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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 (CPUE) is unique for each species.

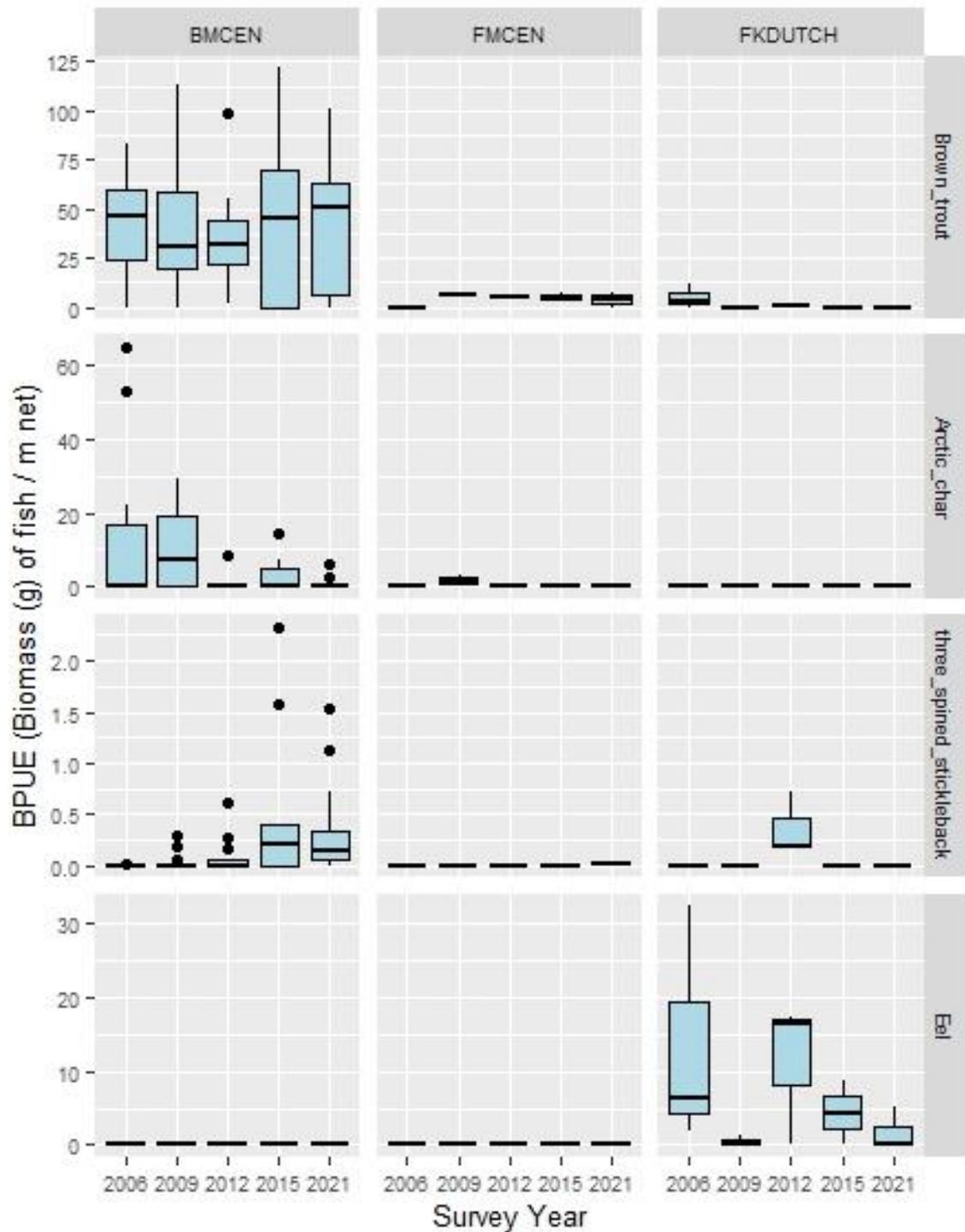
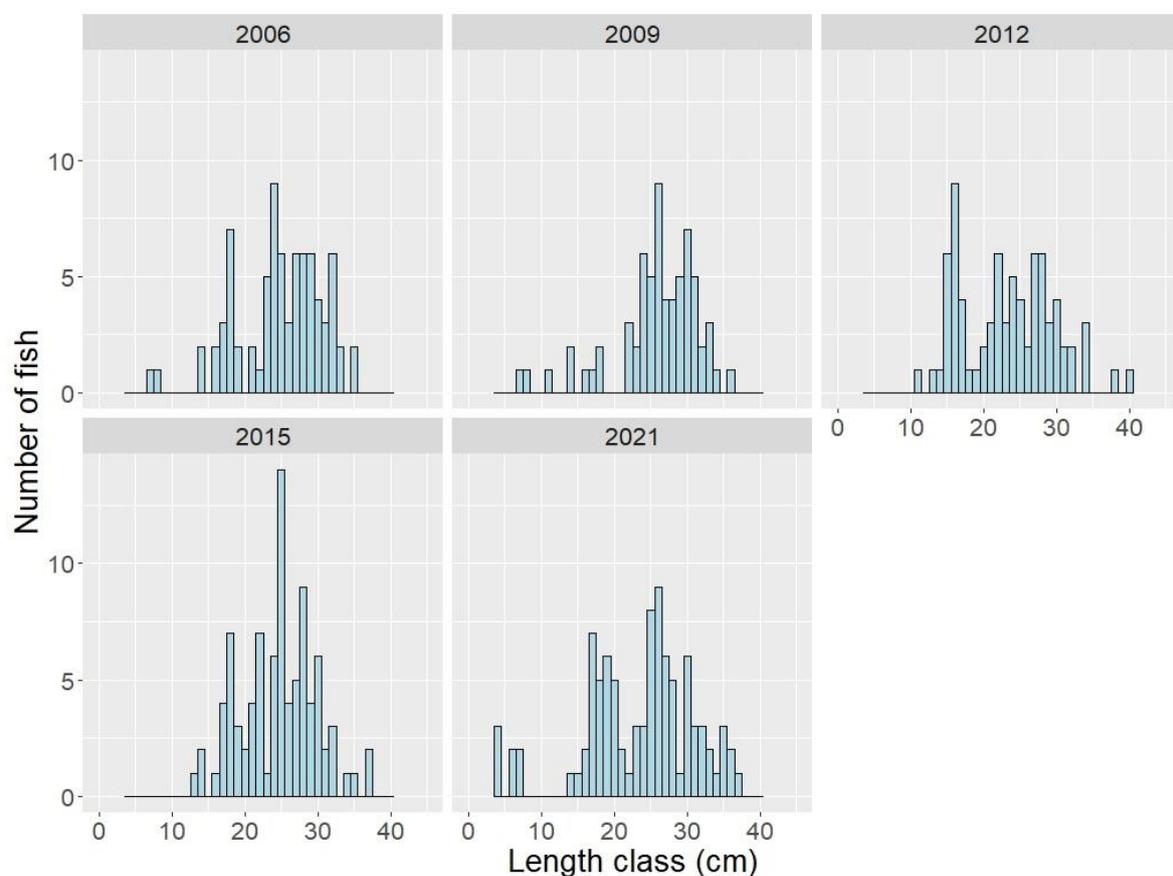


Figure 3.2. BPUE of all fish species captured in each net type during surveys of Kindrum Lough between 2006 and 2021. Figures are expressed as biomass (g) of fish captured per linear meter of net deployed. The horizontal bars represent the median value of the sample, while the 75<sup>th</sup> and 25<sup>th</sup> 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 (BPUE) is unique for each species.

### 3.3. Length frequency distributions and growth

#### Brown trout:

Brown trout captured during the 2021 survey ranged in length from 3.9cm to 36.6cm (mean =23.5cm) (Figure 3.3). Brown trout were aged from 1+ to 5+ and all intervening age classes were present. While no one dominant age class was apparent, few 5 year old fish were recorded. Mean L1 (i.e. length at the end of the first year) was 8.6cm. Mean brown trout L4 in 2021 was 27.6cm 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). The size distribution of brown trout captured has remained relatively stable across all surveys.



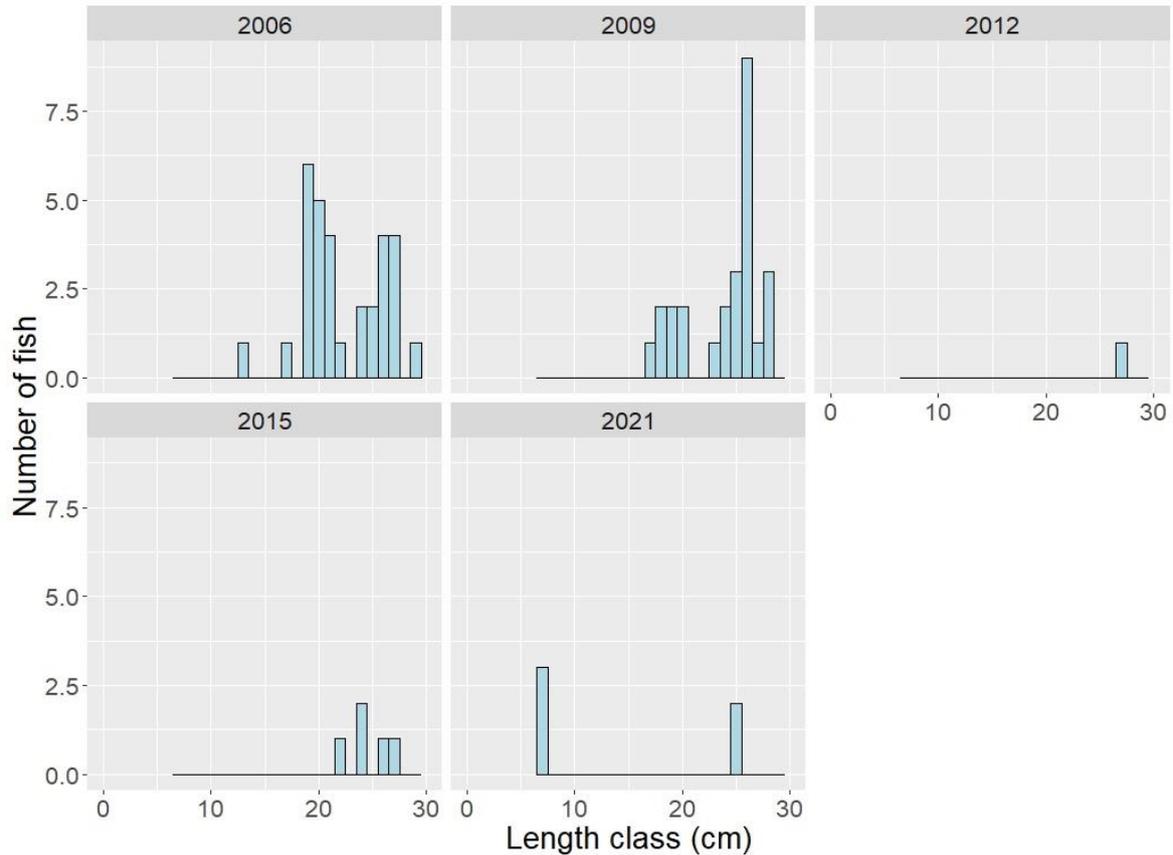
**Figure 3.3. Length frequency of brown trout captured on Kindrum Lough, 2006, 2009, 2012, 2015 and 2021**

**Table 3.3. Mean ( $\pm$ S.E.) brown trout length (cm) at age for Kindrum Lough, July 2021**

	<b>L1</b>	<b>L2</b>	<b>L3</b>	<b>L4</b>	<b>L5</b>
<b>Mean (<math>\pm</math> S.E.)</b>	8.6 (0.3)	17.6 (0.6)	23.1 (0.7)	27.6 (1.6)	31.4 (1.7)
<b>N</b>	91	61	45	17	3
<b>Range</b>	1.4-13.9	12.0-23.3	19.5-30.9	24.0-32.0	28.2-33.7

### Arctic char

Five Arctic char were captured during the 2021 survey. They ranged in length from 6.5cm to 25.0cm (mean = 14.0cm) (Figure 3.4). Relatively few Arctic char have been captured in all surveys since 2009. However, in 2021 several very small char (6.5 - 7cm and 0+) were captured, indicating that some successful spawning is occurring in the lake. (Figure 3.4).



**Figure 3.4. Length frequency of Arctic char captured on Kindrum Lough, 2006, 2009, 2012, 2015 and 2021**

### Other fish:

Two eels were captured during the 2021 survey measuring 41.9cm and 42.0cm in length. Three-spined stickleback (n = 142) ranged in length from 3.3cm to 6.0cm.

### **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 captured during the survey were examined and are presented below.

A total of 54 brown trout stomachs were examined. 24 stomachs (48%) were empty. 28 (52%) stomachs contained unidentified digested material.

## **4. Summary and ecological status**

Three spined stickleback was the dominant species in terms of abundance (CPUE) and brown trout was dominant in terms of biomass (BPUE) in 2021. Abundance of the former species have increased in recent surveys. Brown trout CPUE and BPUE have remained relatively stable across all surveys, and recruitment remains steady. Brown trout are relatively long lived in the lake, with 1 to 4+ fish dominating the population. However, few fish older than this were recorded. 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).

Relatively few Arctic char have been captured in surveys conducted since 2009 (i.e. 2012, 2015 and 2021). The size range of the population has also contracted with small numbers of larger individuals captured. However, three relatively small char (6.5 – 7cm) were captured in 2021, indicating that some recruitment to this population continues to occur at this time.

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.*, 2012). Using the FIL2 classification tool, Kindrum Lough has been assigned an ecological status of Moderate in 2021 based on the fish populations present. In previous years the lake was also assigned Moderate fish ecological status (Figure 4.1).

In the 2013 to 2018 surveillance monitoring reporting period, the EPA assigned Kindrum Lough an overall draft ecological status of Moderate, based on all monitored physico-chemical and biological elements, including fish. This status classification will be revised during 2022.

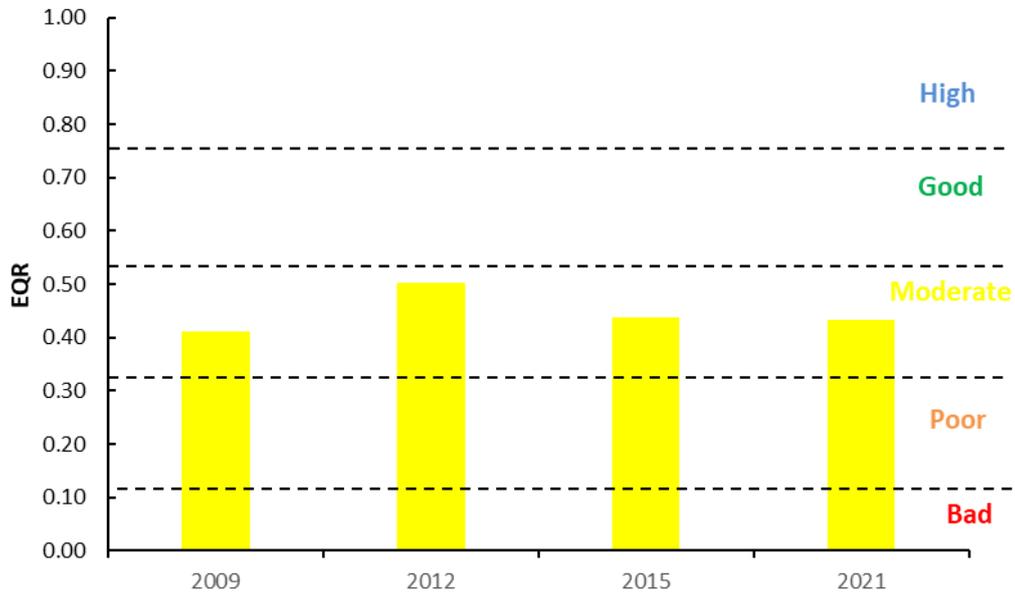


Figure 4.1 Fish ecological status, Kindrum Lough, 2009 to 2021.

## 5. References

- Amundsen, P.A., Gabler H.M., Staldvik F.J. (1996) A new approach to graphical analysis of feeding strategy from stomach contents data—modification of the Costello (1990) method. *Journal of Fish Biology*, **48**, 607–614.
- Caffrey, J. (2010) *IFI Biosecurity Protocol for Field Survey Work*. Inland Fisheries Ireland.
- Connor, L., Matson, R. and Kelly, F.L. (2017) Length-weight relationships for common freshwater fish species in Irish lakes and rivers. *Biology and Environment: Proceedings of the Royal Irish Academy*, **117 (2)**, 65-75.
- Gargan, P. and Roche, W. (1992) *A Survey of Fanad Head Lakes with Recommendations for Fisheries Development*. Central Fisheries Board unpublished report.
- Igoe, F and Hammar, J. (2004) The Arctic Char *Salvelinus alpinus* (L.) Species Complex in Ireland: A Secretive and Threatened Ice Age Relict. *Biology and Environment: Proceedings of the Royal Irish Academy*, Vol. **104B (3)**, 73-92.
- Kelly, F.L., Connor, L., and Champ, W.S.T. (2007) *A Survey of the Fish Populations in 46 lakes in the Northern Regional Fisheries Board, June to September 2005 and 2006*. Central Fisheries Board, unpublished report.
- Kelly, F.L., Harrison, A., Connor, L., Allen, M., Rosell, R. and Champ, T. (2008) *FISH IN LAKES Task 6.9: Classification tool for Fish in Lakes. FINAL REPORT*. Central Fisheries Board, NS Share project.
- Kelly, F., Harrison A., Connor, L., Matson, R., Morrissey, E., O’Callaghan, R., Wogerbauer, C., Feeney, R., Hanna, G. and Rocks, K. (2010) *Sampling Fish for the Water Framework Directive – Summary Report 2009*. The Central and Regional Fisheries Boards.
- Kelly, F.L., Harrison, A.J., Allen, M., Connor, L. and Rosell, R. (2012) Development and application of an ecological classification tool for fish in lakes in Ireland. *Ecological Indicators*, **18**, 608-619.
- Kelly, F., Connor, L., Matson, R., Feeney, R., Morrissey, E., Wogerbauer, C. and Rocks, K. (2013) *Sampling Fish for the Water Framework Directive – Summary Report 2012*. Inland Fisheries Ireland.
- Kelly, F.L., Connor, L., Delanty K., Coyne, J., Morrissey, E., Corcoran, W., Cierpial, D., Matson, R., Gordon, P., O’ Briain, R., Rocks, K., Walsh, L., O’ Reilly, S., O’Callaghan, R., Cooney, R. and Timbs, D. (2016) *Fish Stock Survey of Kindrum Lough, July 2015*. National Research Survey Programme, Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24.

Kennedy, M. and Fitzmaurice, P. (1971) Growth and food of brown trout *Salmo Trutta* (L.) in Irish Waters. *Proceedings of the Royal Irish Academy*, **71 (B) (18)**, 269-352.

King, J.J., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., Fitzpatrick, Ú., Gargan, P.G., Kelly, F.L., O' Grady, M.F., Poole, R., Roche, W.K. and Cassidy, D. (2011) *Ireland Red List No. 5: Amphibians, Reptiles and Freshwater Fish*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

NPWS (2021) *Site synopsis: Kindrum Lough, Co. Donegal. Site code 001151*. Site Synopsis report, National Parks and Wildlife Service.

<https://www.npws.ie/sites/default/files/protected-sites/natura2000/NF001151.pdf>.

O' Grady, M.F. (1981). A study of brown trout (*Salmo trutta* L.) populations in selected Irish lakes. Ph.D. Thesis, National University of Ireland.

O' Reilly, P. (2007) *Loughs of Ireland - A Flyfisher's Guide*. 4<sup>th</sup> Edition. Merlin Unwin Books.

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