

Environment, Marine and Fisheries Group
Department of Agriculture, Environment and Rural Affairs

Ref: Request for Scientific advice regarding Lough Neagh Eel Conservation target compliance.

Dear [REDACTED],

The Eel Management Plan (EMP) for the Neagh/ Bann River Basin District sets a silver eel escapement target within the range of 160 to 240 tonnes per year following the requirements of the EU Regulation 1100/2007. Section 13.1.2 of this EMP states that:

“should mark recapture estimation in future indicate that escapement is falling below the target of **200t** per year, measured on a rolling average basis, this will necessarily trigger measures to reduce exploitation of yellow or silver eels”.

At a recent eel data collection workshop hosted by the Chief Scientific Advisors Office, AFBI were asked to:

- provide advice to DAERA regarding the attainment of the Lough Neagh silver eel escapement target in the absence of a commercial fishery, and
- how attainment of the silver eel escapement target would be measured in the absence of a commercial fishery.

1. Attainment of the silver eel escapement target in the absence of a commercial fishery.

AFBI have developed a tool allowing the estimation of permissible catches of eels within the Lough Neagh commercial fishery, based on the Predicted Eel Population Lifetime Mortality Rate Model (Beverton & Holt Model as described in Aprahamian and Evans *et al* 2021¹), which uses known recruitment and stocking history of eels in Lough Neagh. This tool generates an annual predicted output (in tonnes) of eels from the Lough Neagh system (see Table 1). In the absence of a commercial eel fishery within Lough Neagh, and the absence of any other clearly defined anthropogenic impacts on eels within the Neagh/Bann system (as outlined within the EMP for the Neagh/ Bann River Basin District), all these eels should notionally escape to the sea.

¹ Aprahamian, M. W., Evans, D. W., Briand, C., Walker, A. M., McElarney, Y., & Allen, M. (2021). The changing times of Europe's largest remaining commercially harvested population of eel *Anguilla anguilla* L. *Journal of Fish Biology*, 99(4), 1201–1221. <https://doi.org/10.1111/jfb.14820>

Table 1: Lough Neagh predicted eel output based on a tool derived from the Predicted Eel population Lifetime mortality rate model (as published in Aprahamian and Evans *et al* 2021).

Year	Predicted eel output (tonnes)
2026	371
2027	385
2028	385
2029	401
2030	394

The data presented in Table 1 demonstrate that in the absence of a commercial eel fishery, the system is predicted to meet the 200 Tonnes silver eel escapement target in each of the next five years.

Using the tool described above we have also looked at the long-term trend of predicted output vs observed output (See Table 2 and Figure 1).

Table 2: Lough Neagh predicted eel output for the years 2020 to 2025 based on a tool derived from the Predicted Eel population Lifetime mortality rate model (as published in Aprahamian and Evans *et al* 2021) and the observed output of eels from the system in the same years. Note that the observed outputs are the sum of the catches from the yellow and silver eel commercial fisheries plus the silver eel escapement estimate for the year.

Year	Predicted eel output (tonnes)	Observed output (tonnes)
2020	378	300
2021	361	324
2022	351	331
2023	340	216
2024	346	79
2025	362	121

The data in Table 2 suggest that predicted eel output for the years 2023 to 2025 has diverged markedly from observed output.

The trend between model predictions and observed outputs has been examined over a longer period of time (1990 to 2025). In previous years, predicted versus observed values have been relatively consistent, with the model tending to slightly underestimate observed outputs (markedly so in 2018 when elevated water temperatures lead to increased feeding and a dramatic increase in the observed eel outputs from the system against those predicted), however this trend has shown a pronounced reversal during 2023-2025 (Figure 1).

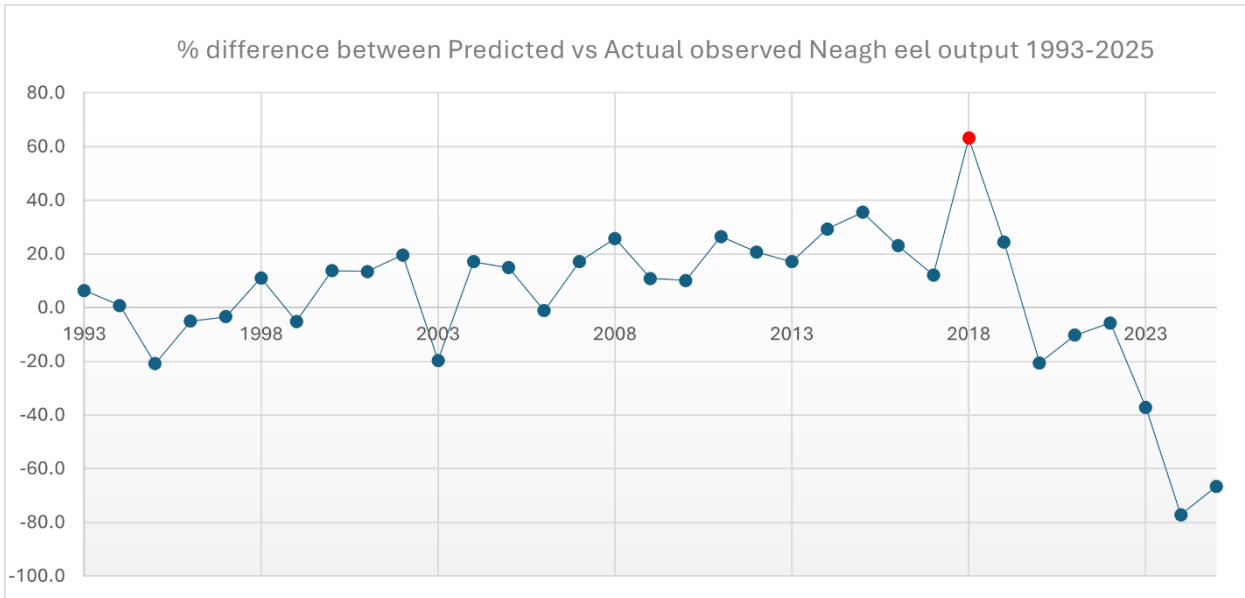


Figure 1. Long term trend of the % difference between Beverton & Holt predicted versus observed Lough Neagh eel output for the years 1990 to 2025. In 2018 (shown as the red dot on the graph) elevated water temperatures lead to increased feeding and a dramatic increase in the observed eel outputs from the system against those predicted.

The years 2023-2025 have been characterized by pronounced environmental change in the Lough. Originally detected in the early 2000's, zebra mussel populations have proliferated within the Lough in recent years. As is typical with zebra mussel invasions, these recognized ecosystem engineers initiate ecological changes to affected systems, and among the changes, Lough Neagh has seen significant increases in water clarity and the development of large macrophyte beds around its margins, and highly visible blue green algal blooms have been widely reported in the media since summer 2023.

While supporting empirical data are not currently available, the ecological changes observed may account for the reduction in observed eel output. In the absence of any mass mortality events or reports of moribund eels in the Lough, the reduced observed output infers a change in eel behavioral traits, resulting in an extended residence time within the Lake. As a result, current eel ontogeny (life course of an individual) may deviate from the values utilized within the Predicted Eel Population Lifetime Mortality Rate Model (Beverton & Holt Model as described in Aprahamian and Evans *et al* 2021).

It is worth noting that following a summer of elevated water temperatures in 2018, the observed output of eels from the Lough was significantly higher than predicted (Figure 1). Aprahamian and Evans *et al.*, (2021) noted the plasticity and rapid adaptability of the eel population in Lough Neagh to changing environmental conditions, such as heat and its effect on increased feeding stimulus, resulting in a higher proportion of yellow eels maturing into silver eels than normal. As such, more eels left the system in the Autumn of 2018, leaving a deficit for future silver eel outputs, and observed outputs in the ensuing years did indeed drop.

The average difference between predicted and observed outputs for the years 2023 to 2025 is approximately -60% (see Figure 1). Under application of the precautionary approach, we would recommend that a similar weighting is applied to the permissible catch for 2026 (i.e. a 60% reduction from predicted). The permissible catches for the years 2026 to 2030, applying the precautionary principle as described above, are shown in Table 3.

Table 3: Lough Neagh predicted eel output based on a tool derived from the Predicted Eel population Lifetime mortality rate model (as published in Aprahamian and Evans *et al.* 2021). The precautionary approach has been applied, and the predicted outputs have been reduced by 60% (as outlined in the text above).

Year	Predicted eel output (tonnes)	Adjusted predicted eel output (tonnes)
2026	371	148.4
2027	385	154
2028	385	154
2029	401	160
2030	394	157.6

The data presented in Table 3 suggest that in the absence of a commercial eel fishery, and considering the current changing ecological conditions, the system is predicted to miss the 200 Tonnes silver eel escapement target in each of the next five years. These predictions are based on current observations, however given the current rate of ecological change within the Lough, these values are subject to change and should be subject to annual review.

2. Measurement of the silver eel escapement target in the absence of a commercial fishery.

Since 2003, escapement of silver eels (defined in Council Regulation (EC) 1100/2007, as the silver eel biomass that escapes to the sea to spawn) from the Neagh Bann River Basin District (RBD) has been determined by:

- Using the catch efficiency (the proportion of the fish passing through the weir that are retained by the installed eel nets) of the two fishing weirs on the River Bann (at Kilrea and Toome) and;
- Applying the commercial catch from each weir (weights, as provided by the eel fishery) to calculate the tonnage of eels that escaped capture.

Between 2003 and 2024 the catch efficiency of the eel-fishing weirs at Toome and/or Kilrea was measured annually using a mark-recapture programme, as described in section 11 of the EMP: Neagh/Bann River Basin District. On up to three occasions during each annual fishing season, male and female silver eels were randomly selected from the previous evenings catches at the fishing weirs. The eels were anaesthetized and Floy-tags (highly visible markers) were attached to the fish. Following recovery from anaesthesia, the tagged eels were then transported back upstream and released at two locations within Lough Neagh. The number of tagged eels that were subsequently recaptured over the rest of the silver eel fishing season provides an estimation of the efficiency of the fishing weirs.

In 2025 the commercial eel fishery raised concerns around the possibility of “taint and residual contamination” from the standard anaesthetics (clove oil) used to sedate the eels for tagging as potentially impacting the quality of their product.

As a result:

- AFBI reviewed and revised the eel sampling programme;
- AFBI agreed with DAERA that for 2025 (and going forward), the long term (20 years) average weir catch efficiencies will be used to calculate escapement of silver eels.
- Consequently, compliance with the EMP 200T target can be determined with no further Floy-tagging of eels being required. However, if in future years fishing practices on the weirs change, escapement estimation may need to be revisited.

In the absence of a commercial fishery further options for estimating silver eel escapement will need to be explored. These options are outlined below:

Option 1 – Use of the predicted eel outputs as outlined in Section 1 above.

Option 2 – Operation of a scientific fishery at the Toome weir. In this scenario the total catch from the Toome weir would be weighed and then all eels released to complete their migration to the breeding grounds in the Sargasso Sea. The long-term weir efficiency value would then be applied to calculate the escapement (as applied in 2025 and described in the text above). A precedent for this option exists whereby current silver eel escapement within the North Western International River Basin District is measured through the operation of a conservation Trap and Transport fishery (as outlined within the EMP for this International River Basin District).

The data presented here concerning silver eel escapement and long-term trends in Lough Neagh eel outputs align with the current International Council for the Exploration of the Sea (ICES) Working Group on Eels (WGEEL) advice as per fishing opportunities for European eels which states that "*given current stock status there are no fishing opportunities for eel*".

Yours Sincerely,

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