

## Research update: Finding solutions for eels and pumping stations

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The annual recruitment of glass eel to European waters in 2016 remained low at 2.7% of the 1960–1979 level in the “North Sea” series. In September 2008, and again in 2014, eel was listed in the IUCN Red List as a critically endangered species. This now means eels are considered more critically endangered than the giant panda.

The rate of decline in the species population is alarming and it is inconceivable that the ‘resilient’ eel is now threatened. Even those who cannot stand eels are astounded by their extraordinary life cycle – much of which still remains a mystery even with all the new technology and research.

The European Union established measures for the protection and recovery of European eel stocks in 2007 (EC Council Regulation No. 1100/2007) and this was transposed into UK law by the Eels (England & Wales) Regulations 2009. Although enacted to support an EU Regulation the requirements for passage and screening to protect eel stocks are now part of UK legislation and will continue after we leave the European Union.

The International Council for the Exploration of the Seas (ICES) advises that when the precautionary approach is applied for European eel, all anthropogenic causes of mortality of silver eels should be reduced to as close to zero as possible. Eels living in our rivers cannot spawn in freshwater and must perform a 6,000km migration to their spawning grounds in the Sargasso Sea in the northwest Atlantic Ocean. Pumping stations have been cited as a particular concern as they can present a barrier to their migration and some intakes have the potential for causing severe damage to entrained eels. Further, in unregulated rivers, their downstream migration typically occurs during periods of elevated river level, and this may coincide with periods of increased pump operation.

### Can we reduce the impact to eels of pumping stations?

The current guidance on screening of intakes, cost benefit analysis and alternative measures following the Environment Agency Guidance on Exemptions raised concerns that the best practice and engineered solutions proposed, such as fine-mesh screening, were too costly and the technology unproven on pumping stations. Intakes, including EA and IDB pumping stations, are prioritised as high, medium, low or no risk

to eels according to their distance from the tidal limit and the Fisheries Classification System prediction for the presence of eels (see Solomon and Wright 2012 report on ADA website for more information).

At present 325 pumping stations (124 in the Anglian River Basin District) have been identified as high priority and given time limited exemptions by the EA until 2021 to allow time for research to be undertaken. There has since been a ‘Defra steer’ that flood defence grant in aid should not be spent on standalone eel projects. Instead compliance with the Eel Regulations should be part of a wider flood risk management scheme and proportionate to the overall cost of the scheme. It was decided that eel protection measures should be implemented when pumping stations are being replaced or refurbished, which will make the solutions more cost effective. However there are still many questions to answer.

### Research is key

Investigations are underway with Hull International Fisheries Institute (HIFI) and Zoological Society of London (ZSL) into finding cost effective and feasible solutions for pumping stations to achieve compliance with the Eels Regulations and minimise fish kills.

The field-based research is focused on downstream migrating silver eels as they need to pass through pumping stations to undertake their spawning migration. The research includes the fate of eels entrained in pumps, how pumping station operation influences their migration through the catchment, their behaviour immediately upstream of a structures (e.g. delay to migration, searching and route choice including those with gravity bypass channels), and whether eels that pass through pumps continue their migration. The logistics of undertaking this work has been extremely difficult and limited to the time of silver eel migration which takes places between October and December.

This research would not be possible without funding from the EA, the help of commercial eel fishermen, local EA fisheries officers and IDB staff and engineers at pumping stations as well as the commitment and dedication of the researchers.

Results to date have been very worthwhile in finding a way forward to address the problem of eel protection at pumping stations, but further work will be necessary to produce practical guidance.

### The findings so far

Five pumps of varying size, design and specification were investigated during the silver eel migration in 2015. Results have shown that damage and mortality to eels depends on the size, type and speed of pumps. The smaller (0.8 m diameter), higher speed (400 rpm) axial flow pump with four blades caused severe damage and mortality to eels. Larger (>2.2m) mixed flow pumps that rotate relatively slowly (<130 rpm) with three blades in volute chambers and a ‘fish friendly’ pump, despite its small size (0.6m) and high rotation speed (872rpm), caused little mortality, but there were some abnormal behavioural effects.

Crucially, the entire pumping station and not just the pump, was assessed. It is proposed that a range of pumps will continue to be tested to allow an assessment to be made on the potential impact of specific pumping station designs.

This project is also employing a combination of catchment-wide and fine-scale acoustic telemetry and sonar imaging techniques to understand behaviour of eels in pumped systems to help identify and develop novel solutions and operational changes to maximise silver eel escapement.

While still ongoing, the study has already yielded some surprising and meaningful results. Catchment-wide acoustic telemetry has shown that:

- Tagged eels quickly moved through unobstructed reaches but the average delay between arriving at a pumping station and passage was 10 days, one eel was delayed for 33 days before passage and another spent four months in the river upstream of a pumping station before the acoustic tag’s battery expired.



A large silver eel caught as part of HIFI's research work

(Martin Redding)



Students from Hull University help attach nets at Hobhole Pumping Station (Martin Redding)

- A large proportion (93%) of eels implanted with an acoustic tag retreated back upstream after arriving at a pumping station. The largest distance an eel was recorded moving back upstream was 13.5km. Such delays and searching behaviour may deplete energy reserves in the fish because silver eels cease feeding during their migration.
- Further, six of the 14 eels that retreated back upstream were last detected on receivers upstream of the pumping station, possibly because they were predated upon.
- None of the nine eels with an acoustic transmitter implanted that exited the river through a pumping station were detected in The Wash whereas 91% (10/11) of a control batch released downstream were.

The behaviour of eels approaching and passing through the trash rack (55mm gaps and 10mm bars) were monitored using ARIS sonar cameras that enable eels to be imaged during hours of darkness and in turbid water. It was found that eels typically approach the pumping station around the new moon almost exclusively during hours of darkness. Of the eels imaged 77% retreated back upstream.

The findings gathered so far have provided the basis for the next phase of work and has led to trials with bypass channels upstream of a pumping station and operational changes that could reduce eel mortality.

It is not possible to complete all the research needed this year and funding is being sought to continue this work to mitigate the impact of pumping stations and ensure cost effective, technically feasible solutions are developed.

On going to press, 20 IDBs had collectively offered to contribute over £11,000 per year to the next two years of research. In addition, ADA has itself offered £1,000 per year towards the research, as has Anglian Central RFCC.



Netting eels downstream of Hobhole (Martin Redding)

## Case Study: Witham Fourth District IDB

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Witham Fourth District IDB is delighted to be entering the third year of a project led by the EA and HIFI, to gather base line data and conduct research on silver eel passage at our two main pumping stations.

These include a large coastal pumping station at Hobhole which ultimately outfalls into The Wash near Boston, and Lade Bank Pumping Station which drains a significant area of inner fen that feeds into Hobhole. HIFI scientists and their students continue to work directly alongside IDB staff, engineers, and a local sustainable eel fisherman, to create a greater understanding of our site specific operations and a broader catchment based approach to water level management.

This cooperation and mutual learning benefits all parties and we are now seeking to trial and monitor simple and cost effective operational changes to ease eel passage between 1<sup>st</sup> October 2016 and 31<sup>st</sup> January 2017. These measures include:

- Running the duty electric pumps during daylight hours only (not withstanding a significant rainfall event), and
- Opening the gravity sluice at Hobhole at night during black and dark moon phases on slack tides, (if tide and drain levels permit).

The project is a good example of practitioners and research working in close collaboration.

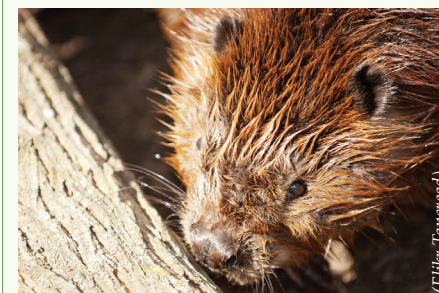


View of Hobhole Pumping Station during eel passage research in 2015 (Martin Redding)

## IN BRIEF:

**EU Nature Directives** have been deemed 'fit for purpose' by the European Environment Commissioner, Karmenu Vella, who has been undertaking the 'Fitness Check' of the Birds and Habitats Directives. It found that these Directives' challenges and problems primarily relate to the insufficient management and lack of adequate investment in the Natura 2000 network of protected sites across Europe, as well as local deficiencies such as delays, unnecessary burdens for project permits and lack of adequate different assessments in regulating individual species. The evaluation identified the need to improve the implementation of the Directives and their coherence with broader socio-economic objectives, including other EU policy areas such as energy, agriculture and fisheries.

**Beavers** Large populations of European beaver (*Castor Fiber*) living wild in the southern and western Highlands of Scotland are to be allowed to expand naturally after Scottish ministers granted them protected status. Up to 250 beavers are estimated to be living in rivers and lochs over several hundred square miles in the catchments of the rivers Tay and Earn. Dozens have been shot by landowners and farmers, who are angry about consequent flooding and tree loss.



(Flickr-Taneread)

**Glyphosate** Formulations such as Roundup Pro Biactive are currently approved for use in and near water and are often the most appropriate method of controlling non-native invasive weeds in watercourses and other habitats. The herbicide is planned for re-authorisation by the European Commission by 31<sup>st</sup> December 2017. The renewal process should be for 15 years, however, as happened last year member states may fail to reach a conclusion. The Commission instead granted the current temporary extension to allow the European Chemical Agency to conclude its review. ADA will be monitoring the renewal process in the run up to the Commission's decision in 2017 and will take action to support members' appropriate use of active substances.

## Funding for tourist trails in Cumbria after floods

On 18<sup>th</sup> November Dr Thérèse Coffey announced that the Cumbria Countryside Access Fund will help reinstate and improve public rights of way across the Lake District and rural Cumbria damaged by Storm Desmond last December. The money will reopen connections between rural towns and villages, and make it easier for visitors to explore attractions and long-distance trails.