Environment Agency

Evidence

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Testing the effectiveness of fish screens for hydropower intakes

Project summary SC120079

We have undertaken a study into the effectiveness of screens designed to prevent fish from being drawn into in-river (run-of-river) hydropower schemes. Our aim was to find out the level of protection provided to salmon smolts and silver eel by the screen designs recommended in the Environment Agency's guidance.

In run-of river hydropower schemes in England, fish screens are fitted to protect fish. Most schemes are screened by physical barriers to divert fish away from the turbine to a suitable bypass or fish pass. These are known as positive exclusion screens. However, if the speed of the water flow just upstream of the screen (the escape velocity) is too great for fish to swim away from they may become caught on the screens (impinged) or pass through the screen and be drawn into the turbine (entrained). Impingement or entrainment is likely to cause injury or death to the fish.

Existing guidance is based on a range of published studies on different fish species at intakes or outfalls in a variety of locations. The specific recommendations in our guide have not been tested in hydropower scheme situations typical of English rivers.

This study included a literature review and field-based testing. Atlantic salmon (*Salmo salar*) smolts and European silver eels (*Anguilla anguilla*) were chosen as the focus of the study as they have a drive to migrate downstream and out to sea and will therefore want to swim past the experimental site. In addition, fish of this size of fish are amenable to tagging and tracking.

Few studies have tested the effect of screen bar spacing or mesh size on how easily fish are able to by-pass screens (known as deflection efficiency). Where studies have been undertaken, different screen apertures from those in our guidance were often used and deflection efficiencies were highly variable.

The field-testing investigated how well fish were able to navigate past screens with the screen bar spacings recommended in Environment Agency guidance (10 and 12.5mm).

This involved the capture and acoustic tagging of individual fish, their subsequent release upstream of a test screen and their recapture downstream.

The study site (on the River Test) was chosen as it has a channel in which a simulated intake screen structure could be installed and where the introduction and capture of tagged fish could be controlled. Two trials were carried out: one for salmon smolts using 10mm and 12.5mm screens in spring 2014 and one for silver eels using 12.5mm screens in winter 2014.

The report presents the following results:

- Two of the 214 salmon smolts interacting with the screens in the trials may have been temporarily impinged and four salmon smolts were potentially entrained. The exact position of the four smolts is uncertain and they may just have been close to the screen.
- None of the 27 silver eels was impinged on or entrained through the screen, despite the fact that eels are capable of squeezing through very small spaces and at least some of those tested were estimated to be capable of passing between the screen bars.
- In both trials we evaluated the confidence we could have in the results. Some fish may have bypassed the screens by chance and this can be evaluated statistically. In the case of the eels the sample size was particularly small which also affects the confidence we have in the conclusion that eels successfully bypass the screens. We used these statistics to evaluate the deflection efficiency for each trial at a 95% confidence level.
- Measured deflection efficiencies for salmon smolts using 10mm screens is at least 92% and for 12.5mm screens at least 88%.
- For silver eels, deflection efficiency with the 12.5mm screen is at least 89%.

This summary relates to information from project SC120079, reported in detail in the following output(s):

Report: SC120079/R1
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