Environment Agency

Evidence

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Effects of run-of-river hydroelectric power schemes on fish

Project summary

This project investigated small-scale hydroelectric power (HEP) schemes with the aim of improving understanding of the environmental effects of HEP schemes in rivers. The study looked at changes in fish communities from run-of-river HEP schemes compared with a set of control sites without hydropower across a range of river types and locations. The research showed that the impact of these schemes on fish is limited, although the small number of samples means that subtle changes may not have been detected.

Run-of-river HEP schemes make use of river flow and operate without water storage. Channel structures, typically existing weirs, are normally used to regulate water levels, allowing a proportion of flow to be diverted through a turbine before returning it to the river downstream. Run-of-river HEP schemes have lower greenhouse gas emissions than other energy sources, but their physical and ecological impacts are unclear.

The study used data collected by the Environment Agency as part of routine long-term monitoring programmes. To look at before and after effects, the researchers examined 23 sites where run-of-river HEP schemes had been operating for several years (average of 4 years). They also identified 23 paired control sites without HEP schemes to see what variation in fish populations might have occurred for other reasons.

Six measures of fish community composition were analysed that might be expected to be affected by HEP and which are widely monitored by the Environment Agency. These were:

- number of fish species (recorded as a density for a given area)
- number of fish
- number of Atlantic salmon
- number of >1 year-old Atlantic salmon
- number of brown trout
- number of >1 year-old brown trout

No significant change was found in 5 of the measures. However, a statistically significant but very small decrease in the mean number of fish species (-0.06 species per $100m^2$ of surface water area) was found in the period after HEP construction relative to the period before construction. At the same time there was a small increase in the mean number of species (+0.13 species per $100m^2$) at the control sites.

These results indicate that the construction and operation of run-of-river HEP schemes could suppress small increases in species richness that might have been observed in the absence of these schemes. The reasons for increased species richness at non-HEP sites are unclear.

In summary, no statistically significant impacts from HEP on 5 out of 6 widely used fish metrics were detected at 23 run-of-river HEP sites. But there are limitations to this study as its statistical power, which is the probability of correctly detecting a statistically significant effect, was low.

Measuring the statistical power of a study helps to indicate the level of confidence in the results; where reported, this is often low in environmental studies. In this study the low explanatory power is a result of the high variability in fish numbers over time and between the control and impact sites. This variability is probably due to natural biological cycles, unpredictable events and the precision of the fish survey technique. Low statistical power is also associated with the relatively low number of study sites with suitable data.

Statistical power analysis can also help to indicate the size of any effect that can be detected. In this study the researchers are confident they would have been able to detect any large changes that had occurred within the timescale examined.

This summary relates to information from the following project published in PLOS ONE:

Title: The Effects of Run-of-River Hydroelectric Power Schemes on Fish Community Composition in Temperate Streams and Rivers

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