Environment Agency

Evidence

# Effects of run-of-river hydroelectric power schemes on small in-stream animals

This project explored the effects of existing run-of-river hydroelectric power (HEP) schemes across England and Wales on communities of small freshwater animals (macroinvertebrates). The research found a very small but statistically significant reduction in the proportion of invertebrates of different families (called evenness) after the HEP schemes were built. It's unclear whether a change in evenness is ecologically important or just a reflection of adaptation to changing conditions.

Run-of-river HEP schemes, which are usually built on existing weirs, are often presumed to be less ecologically damaging than large-scale reservoir storage schemes. However, there is currently limited scientific evidence about their ecological impact.

The aim of the study was to see whether macroinvertebrate communities associated with HEP schemes have changed in a different way from unaffected but similar sites over the same time period. The research highlighted the wide variability in invertebrate communities in streams and rivers at a given site over time and between sites at the same time. The study also demonstrated the value of looking at as many sites as possible to detect the presence or absence of effects from site-based interventions where other drivers of change may be present.

The research complements an earlier project on fish and makes use of a multi-site before–after, control–impact (BACI) study. Use was made of routine environmental surveillance data collected by the Environment Agency as part of its long-term monitoring programmes.

**Why study small invertebrates?**

Studying small invertebrates has some potential advantages over looking at fish responses to an HEP installation.

1. Small invertebrates are the most diverse group of freshwater organisms and have a wide range of environmental tolerances and sensitivities.

2. Small invertebrates are relatively sedentary and therefore representative of site-specific ecological conditions, whereas the presence or absence of some migratory fish species may reflect the conditions of their marine habitats as much as their freshwater habitats.

3. Small invertebrates have relatively short lifespans so that most invertebrate communities respond relatively quickly to environmental changes.

**What did the project involve?**

Trends at 22 systematically selected run-of-river HEP schemes and 22 paired control sites were analysed using 5 widely used measures that describe different aspects of invertebrate communities. These measures were:

- number of invertebrate families present (richness)
- balance or evenness of these families (Shannon–Wiener Index)
- response of invertebrate communities to changing river flow based on the Lotic-invertebrate Index for Flow Evaluation (LIFE)
- fine sediment as measured by the Empirically-weighted Proportion of Sediment-sensitive Invertebrates (E-PSI) index
- water quality as measured using the Walley–Hawkes–Paisley–Trigg (WHPT) index

**What were the findings?**

We found a very small but statistically significant reduction in the evenness of the invertebrate community after HEP construction. In contrast, there was a very small increase in mean evenness at control sites over the same period.

The other 4 measures all showed very small positive effects at sites after HEP installation indicating a slight improvement but not enough to be statistically significant.

Lack of statistical significance is not necessarily evidence of no effect. An important consideration is the statistical power of the study, which in this case was quite low. However, the research team is confident they would have detected any very large changes in the invertebrate communities had they been present.

This summary relates to information from a research project co-founded by the Natural Environment Research Council and the Environment Agency (grant reference NE/M019810/1). The full results are published as:

Bilotta, G.S., Burnside, N.G., Turley, M.D., Gray, J.C. and Orr, H.G., 2017. The effects of run-of-river hydroelectric power schemes on invertebrate community composition in temperate streams and rivers. *PLoS ONE*, 12 (2), e0171634.

The article can be found at:
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0171634

**Project manager:** Harriet Orr, Research, Analysis and Evaluation

**Research Collaborator**: Aquatic Research Centre, University of Brighton

**March 2017**

This project was funded by the Environment Agency's Research, Analysis and Evaluation group, which provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible.

Enquiries: enquiries@environment-agency.gov.uk.