Water quality reflected in trout genes

April 4, 2018 | Christine Arnold
Topics: Wastewater | Ecosystems | Pollutants

Monitoring the effects of chemicals on environmental systems with many species has always been a challenge. On behalf of the Federal Office for the Environment (FOEN), Eawag and the Ecotox Centre-EPFL investigated how the regulation of genes in fish and in single fish cells allow scientists to deduce water quality and fish health.

The regulation of gene expression in living organisms is the mechanism by which the various proteins are synthesized in cells. This mechanism enables organisms to react to pollution from harmful chemicals in such a way as to protect their bodies. In order to observe these changes in the aquatic ecosystem, scientists from Eawag and the Ecotox Centre-EPFL have identified a set of genes in the brook trout *(Salmo trutta)* and the rainbow trout *(Oncorhynchus mykiss)* that act as biomarkers for various harmful chemicals. The goal was to draw conclusions about the harmful substances in water and their potential effects on the fish by means of the regulation of these genes. This process has already been used routinely under laboratory conditions and with standard model organisms. The major challenge of this project was to carry out these investigations in the field under non-standardized conditions with fish caught in the wild.

Biomonitoring functions in the field

“We were pleasantly surprised that this method also functioned so well in the field,” says Stephan Fischer, who served as project leader at Eawag. The organisation of the sampling process above all was no easy task: “In order to make a direct comparison, we needed locations at which trout were to be found above and below a waste-water treatment plant. The water above the plant could not be polluted.” The team found the desired conditions in Steinach, Herisau, Ellikon and Elgg. They then analysed how the regulation of the genes in the fish above and below the plant differed. Concurrently, the centre for fish and wild-animal medicine (Zentrum für Fisch- und Wildtiermedizin) in Bern

investigated the health of the fish.

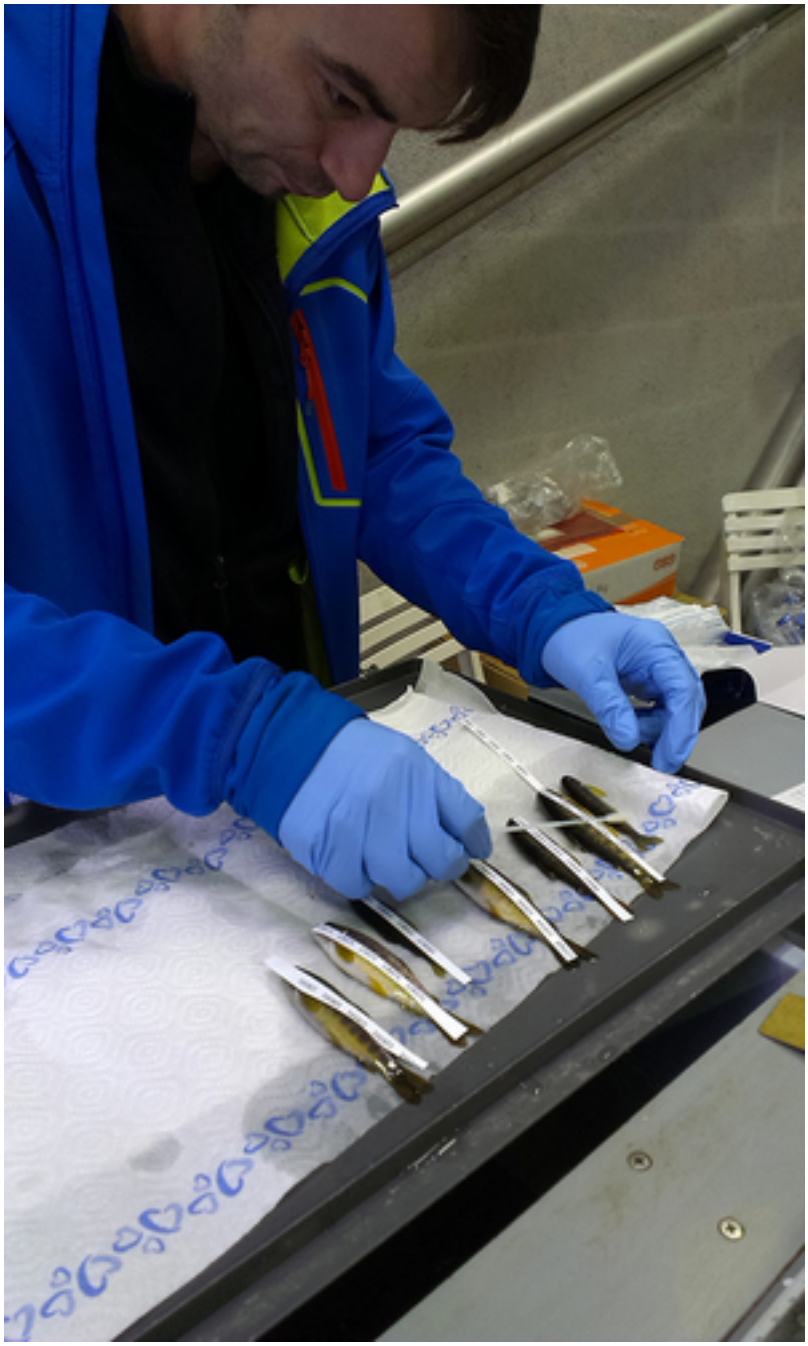
The results are very encouraging: the regulated genes enabled the researchers to show that the fish below the treatment plant were more stressed. They were even able to identify to which group of micropollutants the fish were exposed – pharmaceuticals, pesticides or chemicals that affect the hormonal balance. The results agreed with the chemical analysis of the water samples. Fischer stresses, however, that the project should be regarded as a type of pre-study: “We were able to show that biomonitoring also functions in the field, where a variety of chemicals are present and in which conditions such as light or temperature are not constant. Before the method can be used routinely to verify limiting values, for example, further studies are needed.”

Tests on cell lines

In the long run, Eawag aims to carry out biomonitoring using liver and gill cell cultures from rainbow trout. Stephan Fischer is pursuing this strategy further at Eawag and the Eawag spin-off aQuaTox-Solutions, which he founded along with other Eawag colleagues. “It would be a great advantage if we no longer needed animals for the tests,” he says. In addition, cell line tests are quicker, simpler to standardise and less resource intensive. Early results are very encouraging.

Original publication (concluding report)

Stephan Fischer, Melanie Fischer, Kristin Schirmer, Inge Werner: Wirkungsorientierte Gewässerüberwachung: Biomonitoring mit Forellen



Picture

The trout catch is being thoroughly investigated. Not only the regulation of their genes interested the researchers, but also their general health.

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https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/water-quality-reflected-in-trout-genes