Biological evaluation of water bodies in a time of climate change

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Aquatic invertebrates are used as bioindicators to evaluate the quality of Swiss watercourses. However, climate change is also leading to changes in the species composition of these organisms. Eawag has now investigated the impacts of increasing temperatures on water body evaluations on behalf of the FOEN. The findings: the indicators are expected to remain relevant at least for the coming decades.

How healthy are our water bodies? That is not an easy question to answer. Small invertebrates living on the bed of the water body – such as insect larvae, shrimp, snails, mussels and worms – can give an indication. This is because many species only thrive when the water in which they live meets their often very specific needs. It must be clean and offer a variety of habitats. Aquatic organisms thus act as bioindicators for water quality and are under careful observation throughout Switzerland.

The biotic communities are being investigated to see if they are in a near-natural state and appropriate for their location, and whether their diversity corresponds to that of only mildly impacted waters. If this is not the case, measures are indicated under the Water Protection Act to improve the water quality. One possibility is to revitalise sections of rivers.

Indices help evaluate water quality

Within Switzerland, the cantonal water protection agencies monitor water quality within the framework of cantonal and national monitoring programmes, such as NAWA (the National Surface Water Quality Monitoring Programme). The module-stage concept co-developed by Eawag describes precisely how small aquatic animals must be recorded, thereby ensuring the uniform collection of survey data

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nationwide. Various indices are calculated from this data. For example, the EPT species richness index measures the species diversity of mayflies, stoneflies and caddis flies. The IBCH index assesses the general condition of the section of the water body under investigation. The SPEARpesticides index specifically measures the chemical contamination of the water. The indices therefore form the basis for planning and implementing any water protection measures, as well as for evaluating their effectiveness.

Global warming is leading to an increase in the temperature of the water as well as the air. As a consequence, the biotic communities in Swiss water bodies are changing significantly. What does this mean for the indices? Are they still relevant? Do they continue to be useful indicators of the water quality? The aquatic research institute Eawag is investigating these questions on behalf of the Federal Office for the Environment (FOEN).

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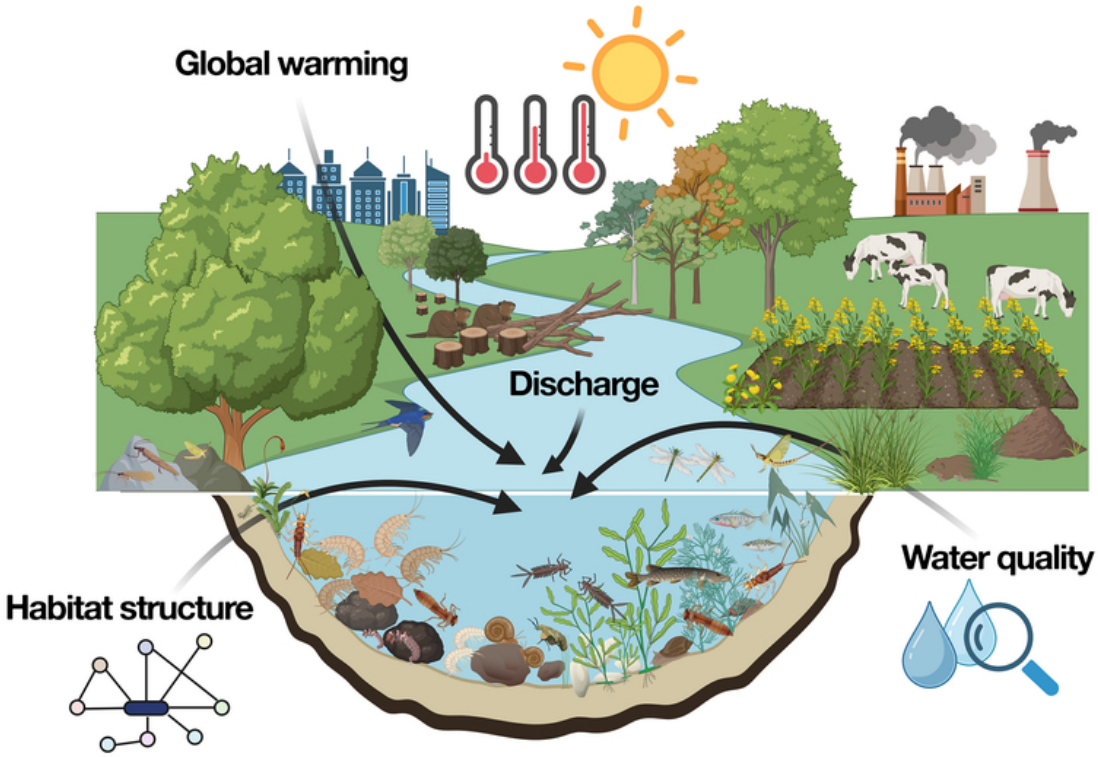

Habitat structure, discharge regimes and water quality influence the species composition of small invertebrates living on the bed of the water body – such as insect larvae, shrimps, snails, mussels and worms. Aquatic organisms thus act as bioindicators for the water quality. This study by Eawag is investigating the impact of global warming on the bioindicators (Created with BioRender.com).

A group of Eawag researchers subjected the indices to a type of stress test. They used various temperature scenarios and multivariate models for species spread to simulate how the warming of the water bodies might impact aquatic organisms in Switzerland. The occurrences of the species modelled were then used to calculate the EPT, IBCH and SPEARpesticides index values. The researchers were then able to derive how the warming climate might influence these indices during the 21st century. The base data used came from Swiss Biodiversity Monitoring (BDM), the National Surface Water Quality Monitoring Programme (NAWA) and cantonal watercourse monitoring programmes, covering a total of 1,802 samples sites for the years from 2010 to 2019.

The indices will remain relevant despite global warming

The results show that advancing climate warming will change life in Swiss watercourses. The species composition of invertebrate organisms will shift significantly: away from cold-preferring species to those that prefer warmth. Will the above indices lose their relevance? The researchers largely reject this. The simulated indices only change a little within the range of realistic temperature increases expected for this century. The researchers thus assume that the indices used will remain sufficiently robust to be able to evaluate the water quality for the coming decades. However, they stress that the predictions of the models must be interpreted with caution. The modelling of the spread is uncertain, especially for the rarer species, and the model reacts somewhat conservatively to influencing factors. A stronger effect of the warming

on the water quality indices therefore cannot be ruled out.

The study was the first project within the framework of the climate change and aquatic biodiversity research programme conducted jointly by Eawag and the FOEN.

Cover picture: Confluence of the Limmat and Aare (Photo: Jan Ryser/FOEN).

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