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## Decline of freshwater species - a loss of natural capital

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The decline of biodiversity represents a loss of natural capital for future generations. Freshwater ecosystems are particularly affected, as they harbour disproportionately high levels of biodiversity. But knowledge of the development and decline of diversity in freshwaters remains patchy. So far, measures to protect genetic diversity in rivers and lakes have failed to halt the downward trend. What is widely underestimated, according to Eawag scientists, is the extent to which reduced habitat diversity also prevents species formation, thus accelerating the spiral of decline.

At this year's Eawag Info Day - held on Tuesday, 22 June - the latest findings of research on freshwater biodiversity are being presented to more than 200 scientists, water professionals, administration officials and policymakers. The 'proceedings' of this event (initially published in German as Eawag News no. 69) are available at the website below.

A mere 0.3% of the Earth's surface is covered by lakes, rivers and wetlands. Even in Switzerland - Europe's 'water tower' - the proportion is barely 4%. But these habitats harbour a huge variety of species: 40% of the world's 30,000 recognised fish species and over 100,000 invertebrates are found in freshwaters. This diversity is at risk. Not just relative to the surface area but also in absolute terms, extinction rates are considerably higher for freshwater than for terrestrial and marine species. In Switzerland, for example, 17 of just over 100 known fish species are extinct. More than 60% of all aquatic plants are believed to be threatened. Present-day extinction rates are comparable to those seen during the greatest mass extinction events in the Earth's history. Eawag research has now shown that, in addition, ever-fewer new species are being formed. Evolutionary ecologist Ole Seehausen calls this doubly negative trend a 'catastrophic biodiversity debt.'

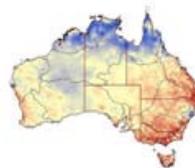
Seehausen and his group have demonstrated that changes in the same processes which led to the development of existing species are often responsible for a decrease in the formation of new species - e.g. when environmental changes reduce the size or diversity of habitats. Genetic adaptations to ecologically distinct niches are then no longer required,



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young species merge into a single hybrid form, and the emergence of new species ceases. In the case of the 32 different whitefish species described in Swiss lakes, at least a third have disappeared over the past 50 years. 'There's not much time left to save the rest,' says Seehausen, who advocates greater cooperation between research and applied conservation.

The group led by aquatic ecologist Piet Spaak showed that - contrary to the assumptions of traditional conservation science - evolutionary processes can often produce marked changes and adaptations in species within a few generations. In this study, 50-year-old resting stages of water fleas (*Daphnia*) were retrieved from Greifensee sediment cores, and viable eggs were then hatched in the laboratory. Compared with more recent specimens, these water fleas were significantly more resistant to the elevated lead concentrations which prevailed in the 1960s. Another remarkable finding emerged from Seehausen's studies of trout: The five types of trout described in Switzerland - originating from ice age refugia - are evidently adapted to different ecological conditions and can still coexist, without merging, in near-natural rivers. In highly degraded rivers, by contrast, they are displaced by the Rhine trout, which has been widely released. Seehausen notes: 'There are virtually no coordinated programmes to conserve trout diversity.'

Species loss is attributable not only to the fact that habitats have disappeared or become monotonous, but also to a lack of connectivity. Artificial barriers impede the passage of fish. On the lower reaches of the Toess river in Canton Zurich, for example, Eawag biologists counted 23 fish species below a 6m-high weir, but only 12 above this barrier. On the Sitter (Cantons St Gallen/Appenzell Outer Rhodes/Appenzell Inner Rhodes), 46 of 54 tributaries were found to be inaccessible for the bullhead, a small fish species of the upper reaches. Conversely, the number of fish species in the Lichtensteiner Binnenkanal rose from 6 to 16 within only 4 years after a steep drop where the artificial channel entered the alpine Rhine was reshaped to make it passable for fish.

'On account of its abundant water resources, its topography and its role as a hinge between different biogeographical regions, Switzerland has a particular responsibility for freshwaters and their biodiversity,' says Eawag researcher Mark Gessner, who is also a member of the Swiss Biodiversity Forum. He compares biodiversity to a broad investment portfolio, offering 'insurance for the future.' He argues that high levels of species richness and genetic diversity provide greater stability in the face of environmental changes, which in turn ensures the provision of ecosystem services for human populations. These include, for example, fish catches, but also clean water, flood protection or attractive recreational spaces. Gessner therefore calls on researchers to focus increasingly not only on the extent and causes of declining biodiversity, but also on its consequences. Isolated local measures need to be replaced by an integrated and interdisciplinary approach to water resource management. This requires the kind of rethink in the water management sector which has already begun in the area of flood protection. Here, the Eawag biologist is supported by Evelyne Marendaz Guignet, head of the Species Management division at the Federal Office for the Environment (FOEN). In her paper, Marendaz said it was clear that, despite all the conservation efforts made to date, it would not be possible to reverse the downward trend with existing instruments and resources. She highlighted the current lack of targets and priorities, and the need for better coordination of enforcement - e.g. between agriculture and water protection policy. The FOEN is therefore developing a Biodiversity Strategy, which is to be presented to the Federal Council later this year.

Source: [EAWAG: Swiss Federal Institute of Aquatic Science and Technology](#)

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