

Which rivers and streams should be rehabilitated first?

In the coming decades, around 4000 kilometres of degraded watercourses are to be rehabilitated in Switzerland. On the basis of scientific criteria, researchers at Eawag have developed a prioritization procedure which makes it possible to identify sections of watercourses where, from an ecological perspective, enhancement measures are particularly promising. This should help to establish the conditions for restoration of the natural dynamics of river systems *Text: Andres Jordi*



Armin Peter

Fig. 1: Rehabilitation measures should seek to re-establish the natural dynamics of river systems.

Over the next 80 years, under the revised Waters Protection Act of 2011, the cantons are required to rehabilitate a quarter of those rivers and streams which are heavily engineered and whose ecological status is classified as poor. Nationwide, this amounts to around 4000 kilometres of watercourses. For this programme, the right priorities need to be set. But where are rehabilitation measures particularly worthwhile, and what criteria should be used to identify the watercourses in question? What types of measures are needed in the selected areas? To assist the cantons in their prioritization and planning efforts, the Federal Office for the Environment

requested Eawag to develop appropriate decision-support materials. Armin Peter, one of the scientists involved, explains: “Our recommendations are restricted to ecological aspects. But the setting of priorities is also determined by social and economic considerations, so naturally they will also need to be taken into account in the evaluation process.”

A long list of deficiencies

The ecological goal of rehabilitation measures is specified by the Waters Protection Act: they should enable watercourses to return to a near-natural state in which ecosystem processes are restored and the level of biodiversity is appropriate to the site. To assess the potential for recovery of river and stream sections, the researchers propose a multi-step procedure based on a prioritization flow chart.

The first step involves an analysis of existing deficits. One of the most striking deficiencies of Switzerland’s river systems noted by the researchers is the lack of habitat connectivity. Watercourses are fragmented by artificial sills and weirs, which represent impassable barriers for many aquatic organisms. Exchanges with surrounding areas are impeded by reinforced riverbanks and consolidated beds. Hydropower operations are associated with marked fluctuations in water levels, low residual flows and altered sediment dynamics, with adverse impacts on numerous species. Water quality is impaired by micropollutants and nutrients. Water temperatures and habitat conditions are influenced by climate change and by discharges of heated cooling water or cold water released from reservoirs. Monotonous habitats are typical of channelized and stabilized rivers and streams.



Fig. 2: Poor connectivity: exchanges with surrounding areas are prevented by bank reinforcements and consolidated river beds – as in the case of this tributary of Lake Neuchâtel.

Armin Peter

To remedy the multiple ecological deficiencies, the researchers recommend a variety of concrete measures, including the removal of reinforcements, channel widening, the creation of vegetated riparian strips and buffer zones, modifications of flow management and improvements in wastewater treatment. Peter emphasizes: "Rehabilitation measures should be adapted to the site in question, benefiting as many species as possible and restoring dynamic processes."

Assessing recovery potential and ecological status

In selecting the river reaches which should be rehabilitated as a matter of priority, it is important to estimate their potential for recovery. This is determined in particular by the condition of the catchment and connections with the wider river network: ecological deficiencies in one part of a catchment can have adverse effects elsewhere, thus compromising rehabilitation efforts. Catchments play a crucial role as species pools in the recolonization of rehabilitated areas. To permit the migration of new species, ecologically enhanced areas must be geographically connected with such source populations. For example, in a study of the Mönchaltorfer Aa river (Canton Zurich) carried out by Eawag researchers Gregor Thomas and Armin Peter, it was shown that areas of high connectivity could be recolonized by various fish species in less than a month. Conversely, studies performed by the same researchers on the Lochrütibach (Canton Nidwalden) show that, if the upper reaches have low connectivity, there will be no migration of new species from nearby areas despite rehabilitation efforts.

When setting priorities, it should also be taken into account that not all watercourse sections are equally valuable from an ecological perspective. For example, rehabilitation efforts should focus in particular on areas with rare or diverse species and habitats. High priority also attaches to reaches with a special function – e.g. containing spawning grounds or serving as corridors for migratory species. To assess the ecological status of surface waters, various methods are available, such as the Modular Stepwise Procedure (www.modul-stufen-konzept.ch). According to the researchers, the stability of near-natural ecosystems can be increased by improving the condition of extensive, connected reaches. Peter explains: "That can be done by expanding, or filling the gaps between, existing intact areas." The chances of success can be increased, he adds, by also addressing other deficiencies – e.g. in water quality or the hydrological regime.

Connectivity with nearby habitats

Once the priority areas for rehabilitation have been identified on the basis of the flow chart, the next step is the prioritization of measures. The prime goal, according to Eawag's recommendations, should be improved connectivity. Fragmented reaches and isolated habitats should therefore first be better integrated into the river network. "Rehabilitation measures", says Peter, "should be initiated close to near-natural reaches so that, from there, species can rapidly migrate into the newly enhanced areas." Additional measures should promote near-natural hydro- and sediment dynamics and ensure good water quality. The importance of clean water for macroinvertebrates such as insect larvae or crustaceans is demonstrated by another Eawag study involving the Mönchaltorfer Aa: Simone Baumgartner and Christopher Robinson found

that a rehabilitated section showed no increase in macroinvertebrate species diversity because nutrients continue to enter the river.

A characteristic feature of natural river systems is that their habitats are subject to constant change. This is essential for many species, as their life cycle is dependent on such changes. As Peter points out, "Rehabilitation measures must create the conditions that allow rivers to recover their natural dynamics." Accordingly, another useful measure may be restoration of the riparian zone so as to promote the required erosion processes and inputs of deadwood. Changes in river morphology may also be necessary in order to establish structure-rich, dynamic habitats.

Peter Reichert, who was responsible for the modelling and decision-support components of the project, adds: "In our view, predicting how specific measures will affect a river reach is an essential part of the prioritization process. This provides the basis for rational decision-making." Here, important information can be obtained by reviewing the outcome of completed rehabilitation projects. For example, an evaluation of 62 rehabilitation projects carried out in Germany and Switzerland indicates that small-scale habitat enhancement measures did not substantially improve the situation for fish fauna. Mathematical models are also a valuable predictive tool: the Streambugs model (developed by Eawag) can be used to assess the effects of enhancement measures on freshwater macroinvertebrate communities.

[>>Synthesis report](#) (in German)

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