AQUACROSS Case Study 7: Biodiversity management for rivers in the Swiss Plateau

Summary for Local Stakeholders

The interdisciplinary research project AQUACROSS[1] supports European efforts to protect biodiversity in Europe's lakes, rivers, coasts and oceans. These aquatic ecosystems provide numerous economic and societal benefits to Europe – but they are at risk of irreversible damage from human activities. To counter this and to support achievement of the EU Biodiversity Strategy to 2020 targets, AQUACROSS has developed practical guidance on identifying threats to biodiversity, understanding links between ecosystems and the services they provide, data management, modelling and scenario development, and policy analysis, which fit together as parts of the integrated AQUACROSS Assessment Framework for ecosystem-based management of aquatic ecosystems[2]. We have developed, tested, and applied this research in eight case studies across Europe to solve local biodiversity challenges. This brief summarises our work in **Case Study 7**, and makes recommendations for local policy.

Context

Figure 1: Typical landscape on the Swiss plateau (view from the south-west to Lake Zurich (Credit: Peter Reichert)

Case Study 7 is based in the Swiss Plateau, a relatively flat area of about 11,000 km^2 that facilitates agricultural production and settlements (Fig. 1). Maintaining biodiversity and freshwater ecosystems here is challenging due to pressures from anthropogenic land use (e.g. agricultural, urban, industrial), energy production, traffic infrastructure (roads, railroads, etc.), recreational activities, among others. Environmental managers have to find compromises and synergies between these partially competing needs on the one side and ecosystem and biodiversity protection as well as restoration on the other side. Since resources for mitigation or restoration measures are limited and some negative impacts are unavoidable to fulfil societal needs, a spatial and temporal prioritisation is essential.

The first goal of this case study is to combine (mostly) existing procedures for integrative ecological assessment at the river reach scale with innovative approaches for spatially explicit ecological assessment at the catchment scale (Kuemmerlen et al., in press). The second goal is then to apply these catchment scale assessments to search for environmental management strategies that optimise the overall ecological state at the catchment scale, while increasing or not significantly decreasing services demanded by the society. Our approach follows the principles of Ecosystem-Based Management (EBM) and is based on the AQUACROSS assessment framework. It emphasizes *ecological integrity*, *resilience*, *ecosystem services*, relevant *spatial scales*, *stakeholder involvement*, *transparency*, *policy coordination*, and *adaptive management* (see italics below).

[1] AQUACROSS (Knowledge, Assessment, and Management for AQUAtic Biodiversity and Ecosystem Services aCROSS EU policies), 2015-2018, has received funding from the European Union's Horizon 2020 Programme for Research, Technological Development and Demonstration under Grant Agreement no. 642317. More information: aquacross.eu
[2] All AQUACROSS guidance and outputs are freely available online at https://aquacross.eu/outputs

Policy Framework

The Swiss Water Protection Legislation (Gewässerschutzgesetz, GSchG, Gewässerschutzverordnung, GschV) states the main impairments to Swiss freshwater ecosystems and regulates the implementation of management alternatives. These include the structural restoration of stream and river habitats, the removal of barriers to enhance the connectivity within river networks and the upgrade of wastewater treatment plants to remove micropollutants. Furthermore, we take into account the national action plan to reduce the current ecological impact of pesticides from agriculture (Aktionsplan zur Risikoreduktion und nachhaltigen Anwendung von Pflanzenschutzmitteln). These measures also contribute to the goals of the Swiss Biodiversity Strategy (Strategie Biodiversität Schweiz) regarding the conservation and restoration of biodiversity.

Structuring and Quantifying Objectives – Stakeholder Involvement

The measures mentioned above and the corresponding budget have been agreed upon politically. For this reason, the management challenge is to restore and maximize the *ecological integrity* of the systems and of the co-benefitting *ecosystem services,* while minimizing changes in the provision of those services that lead to trade-offs with the good ecological state of freshwater ecosystems. As the implementation of these policies is mainly done by federal and cantonal authorities, supported by non-governmental organizations and environmental consulting companies, experts from these organizations were involved as *stakeholders* with whom goals and implementation strategies were discussed. Trade-offs with some societal services prevent protecting or restoring all ecosystems. This calls for an integrative evaluation of measures considering *policy coordination* across sectors and their *spatial prioritization*, at a suitable spatial unit: the catchment scale.

Procedures for the ecological assessment of river reaches have been *co-developed by partners from the Federal Office of the Environment, cantonal authorities, consulting companies and scientific institutes* over the past 20 years (http://www.modul-stufen-konzept.ch). They address physical, chemical and biological aspects of the ecological state at the river reach scale.

The main innovative approach of our case study is to extend these river reach scale assessments to a catchment scale assessment. The suggested assessment is based on the following key objectives: achieving a *good ecological state of river reaches*, a *near natural fish migration potential*, *resilience supporting habitats*, *low network fragmentation*, and *near natural diversity of habitats in good state* (see Fig. 2).

The provision of *ecosystem services* and the fulfilment of other societal needs is accounted for by constraining river restoration measures at locations with groundwater protection zones, infrastructure, or buildings close to rivers. The co-benefit of a higher recreational value of restored river sections is implicitly accounted for.

Deficit Analysis

We apply the spatial valuation procedure described in the previous section to current observations to quantify the gap between objectives and the current state, i.e. the deficit, (see Fig. 2, left panel, lower half of the boxes).

Model Building

We constructed a species distribution model to describe the dependence of the composition of the macroinvertebrate community on natural and anthropogenically modified influence factors to support finding the causes for the observed deficits and getting inspiration for remedial measures (Vermeiren et al., submitted).

Developing Scenarios and Alternatives

We compare a) the current state, b) the baseline scenario consisting of planned measures (reduction of pesticides from agriculture and micropollutants from wastewater treatment plants, as well as restoration of rivers according to the current restoration planning) and of an expected population increase of 20% until 2035 and c) a scenario in which we replaced the cantonal restoration planning with an optimised restoration strategy that maximizes the fulfilment of the newly developed spatial criteria.

Evaluation / Optimization

Figigure 2 shows the degree of fulfillment of all spatial objectives (0 = completely missed, 1 = 100% = fully met). The results correspond to one of the assessed catchments, the Mönchaldorfer Aa in the canton of Zürich, for the current state, the baseline, and an optimized restoration strategy. The proposed optimized strategy attains slightly better results than the baseline.

Final local policy recommendations

Many river restoration measures are currently, and will continue to be, implemented in Switzerland until the year 2090. The integrative planning of all measures can help to increase the efficiency of this process. With this case study we developed methods to facilitate better coordination across different sectors and policies. We proposed an integrative and spatially explicit assessment procedure at the catchment scale to support the identification and prioritization of efficient management strategies under different future scenarios. The refinement and implementation of these methods in the Swiss Water Policy requires a continued long-term collaboration with the Federal Office of the Environment, cantonal authorities and other important stakeholders.

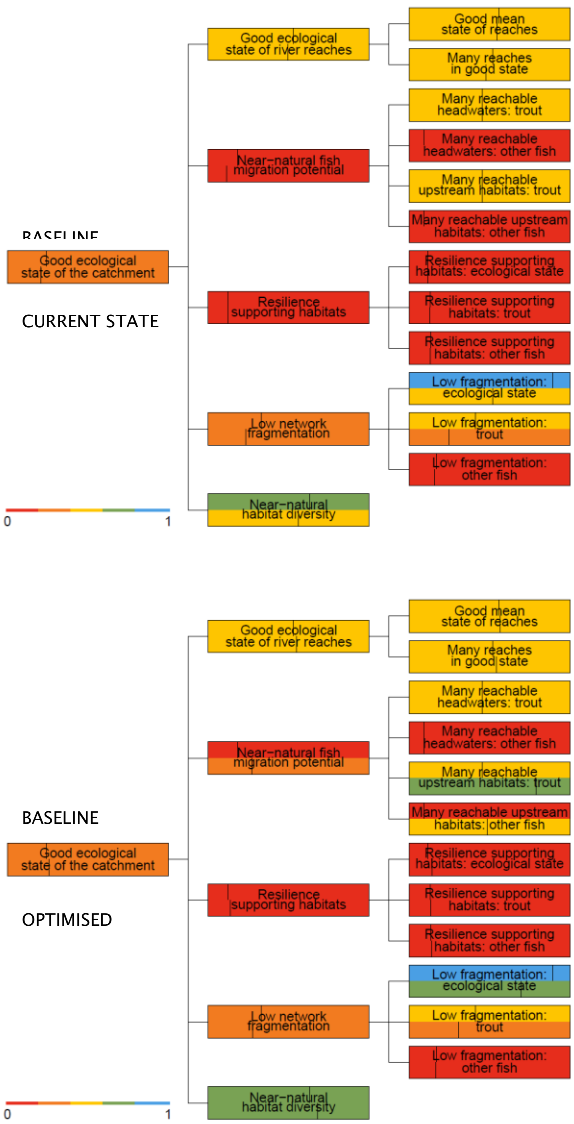

Figure 2: Hierarchically arranged objectives for a good ecological state of a catchment. The colour coding shows the fulfilment of the objectives (red=bad, orange=poor, yellow=moderate, green=good, blue=high) and the position of the black vertical lines indicate the value on a horizontal scale from 0 and 1 (see legend at the bottom left). The left panel shows the assessment of the current state (lower part of the boxes) versus the baseline scenario for 2035 according to the cantonal planning (upper part); the right panel shows our optimised restoration strategy (lower part) versus baseline (upper part).

References:
Kuemmerlen, M., Reichert, P., Siber, R., Schuwirth, N.: Ecological assessment of river networks: from reach to catchment scale. Science of the Total Environment (in press). doi:10.1016/j.scitotenv.2018.09.019
Vermeiren, P., Reichert, P., Schuwirth, N.: Pushing prediction boundaries by combining joint species distribution models with ecological trait information. (submitted)

Want to learn more? A full case study report is available online, or by contacting nele.schuwirth@eawag.ch or reichert@eawag.ch