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Tools: Modelling approaches supporting Ecosystem-Based Management

Modelling approaches are essential to assess the status quo of the interplay between biodiversity, ecological function and ecosystem services, and to subsequently generate scenario projections of alternative management actions or environmental changes. Key causal links between biodiversity and ecosystem services can be considered in order to forecast potential future changes allowing for their linkages and interactions (Figure 1). By assessing trade-offs between ecosystem services and biodiversity conservation goals, management decisions regarding different – even potentially conflicting – policy goals can be evaluated (e.g. between the EU Biodiversity Strategy to 2020, the EU Water Framework Directive, and the Renewable Energy Directive).

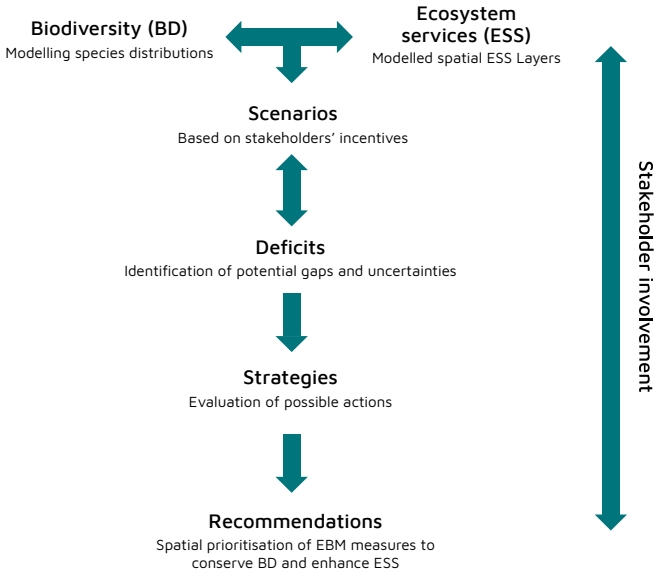

Figure 1 Simplified workflow of the spatial modelling approach in AQUACROSS. Scenarios are defined by stakeholder needs and e.g. represent alternative management scenarios or consider external scenarios such as climate or land use change.

Useful tools to approximate biodiversity and indicate possible hotspots are Species Distribution Models (SDMs) that use species geographic occurrences and environmental factors at those locations to simulate the range-wide potential habitat suitability across a study area. Ecosystem service flow as ecosystem potential on the one hand, and the service demand on the other hand can be analysed with the ARtificial Intelligence for Ecosystem Services (ARIES). The predictions of biodiversity, ecosystem service supply and demand are then used to spatially prioritise different management zones. The modelling outputs, including maps, enable stakeholders to visualise potential outcomes of scenarios, and facilitate decision-making processes to, e.g. achieve conservation goals and socio-economic targets. In agreement with the EBM principles, the outputs lead to potential identification of critical areas for particular management actions. It supports the assessment of trade-offs between protection of biodiversity and use of ecosystem services, satisfying different stakeholder demands.

Modelling in the AQUACROSS case studies tackled e.g. the EBM key issues of taking an interdisciplinary approach, considering societal choices, aiming at ecological integrity and biodiversity protection, or considering ecosystem connection:

- Within the Andalusia and Morocco case study (see Case Study: Spain/Morocco), the modelling approach allowed **a separate view of freshwater, coastal and marine areas.** A higher probability of conflicts between conservation and exploitation goals was identified in freshwater areas, while fewer conflicts were expected in the marine and coastal areas.
- Within the Danube case study (see Case Study: Danube), strategic planning including **spatial prioritisation** of river-floodplain segments for conservation and restoration considered aspects of multi-functionality, availability of remaining semi-natural areas, and reversibility of human activities (e.g., flood protection, hydropower and navigation).
- The Aveiro case study (see Case Study: Ria de Aveiro, Portugal) relied on substantial **stakeholder involvement** for framing the baseline condition, formulating the objectives, screening of measures and instruments, formulating a narrative reflecting the foreseen management measures, the stakeholders' perception on ES valuation, and an evaluation of the proposed measures by EBM criteria regarding policies and feasibility.
- To decide on most effective river restoration locations in catchments in coordination with other management activities (e.g. improving water quality), the Swiss case study considered **ecological network properties** such as connectivity in their models.

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Further information

This is one of 38 short briefs summarising the key results of the AQUACROSS Project. For more detailed information on the topics covered in this brief, see the following:

- Domisch et al. (2017) Modelling approaches for the assessment of projected impacts of drivers of change on biodiversity, ecosystem functions and aquatic ecosystems services delivery. Deliverable 7.1, European Union's Horizon 2020 Framework Programme for Research and Innovation grant agreement No. 642317. (Deliverable and Executive Summary)
- Kakouei et al. (2018) Assessing modelling approaches in selected case studies. Deliverable 7.3, European Union's Horizon 2020 Framework Programme for Research and Innovation grant agreement No. 642317. (Deliverable and Executive Summary)
- O'Higgins et al. (2016) Review and analysis of policy data, information requirements and lessons learnt in the context of aquatic ecosystems. Deliverable 2.2, European Union's Horizon 2020 Framework Programme for Research and Innovation grant agreement No. 642317. (Deliverable)
- Barbosa et al. (2018) Cost-effective restoration and conservation planning in Green and Blue Infrastructure designs. A case study on the Intercontinental Biosphere Reserve of the Mediterranean: Andalusia (Spain) – Morocco. Science of The Total Environment 652: 1463-1473. https://doi.org/10.1016/j.scitotenv.2018.10.416
- Domisch et al. (2019) Social equity shapes zone-selection: Balancing aquatic biodiversity conservation and ecosystem services delivery in the transnational Danube River Basin. Science of the Total Environment 656:797-807. https://doi.org/10.1016/j.scitotenv.2018.11.348
- Langhans et al (2019) Combining eight research areas to foster the uptake of ecosystem-based management in fresh waters. Aquatic Conservation: Marine and Freshwater Ecosystems. doi: 10.1002/ aqc.3012

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