

Assessment of drivers and pressures in the case studies – Executive Summary[1]

Overview

The EU 2020 Biodiversity Strategy aims to halt the decline of biodiversity, which continues despite of the existing system of protected areas under the EU Habitats Directive. Hence, a more comprehensive approach is needed that considers the current drivers of change and human impacts. The AQUACROSS Assessment Framework (AF) offers a guide to improve the application of ecosystem-based management (EBM) approaches in aquatic ecosystems.

This executive summary is based on AQUACROSS Deliverable 4.2, which addresses the demand-side perspective of social-ecological systems, by investigating drivers and pressures that originate from the demand on ecosystem services and abiotic outputs provided by aquatic ecosystems. Thus, the AQUACROSS case studies (CSs) characterised and investigated the demand-side of the social-ecological system in terms of drivers, pressures and states using suitable indicators. To achieve this, two approaches were taken:

- The linkage framework approach covered all aquatic realms in the CSs (freshwaters, coastal and marine).
- Specific exploratory analyses of the CSs used detailed quantitative and qualitative analyses of selected and relevant elements of the Driver-Pressure-State (D-P-S) sequence.

Linkage-based frameworks are used to characterise complex systems, such as social-ecological ones. The AQUACROSS linkage framework takes a D-P-S approach consisting of interconnected matrices describing human activities representing the manifestation of drivers, pressures, and ecosystem components representing the state, and building so-called impact chains. The application of the AQUACROSS linkage framework in the CSs identified a multitude of human

[1] *This is the executive summary of AQUACROSS Deliverable 4.2: Assessment of drivers and pressures in the case studies. The full version of this document can be found at www.aquacross.eu in project outputs.*

activities and related pressures that affect aquatic ecosystem components across Europe. Thus, this approach was successful to **characterise the complex social-ecological systems** and the causalities between the elements of the D-P-S sequence. The linkage framework is highly valuable to provide a conceptual basis for **stakeholder dialogues** based on the full linkage framework, to understand the complex social-ecological systems, or to discuss parts of the system that are especially relevant to certain stakeholder groups.

The results of the linkage framework underline the importance of **considering all relevant human activities and related pressures** in the management of aquatic ecosystems. Furthermore, activities that are spatially separate but introduce dispersing or cascading pressures that impact ecosystem components should be considered in assessments to fully comprehend the complex relationships in social-ecological systems, and thus help prioritise biodiversity protection actions.

What are the most relevant human activities affecting aquatic ecosystems in the case studies?

Based on the linkage framework, the following **key human activity types** could be identified that highly affect aquatic ecosystems. Tourism and recreation activities were highly connected within the described social-ecological systems across aquatic realms. Moreover, activities related to energy production (renewable and non-renewable) were relevant across aquatic realms. Fishing activities were highly relevant in marine contexts, as commercial fisheries in Europe are largely restricted to marine environments. While in freshwater and coastal realms, environmental management (incl. activities such as flood defence and waterway construction) were highly relevant (Figure 1).

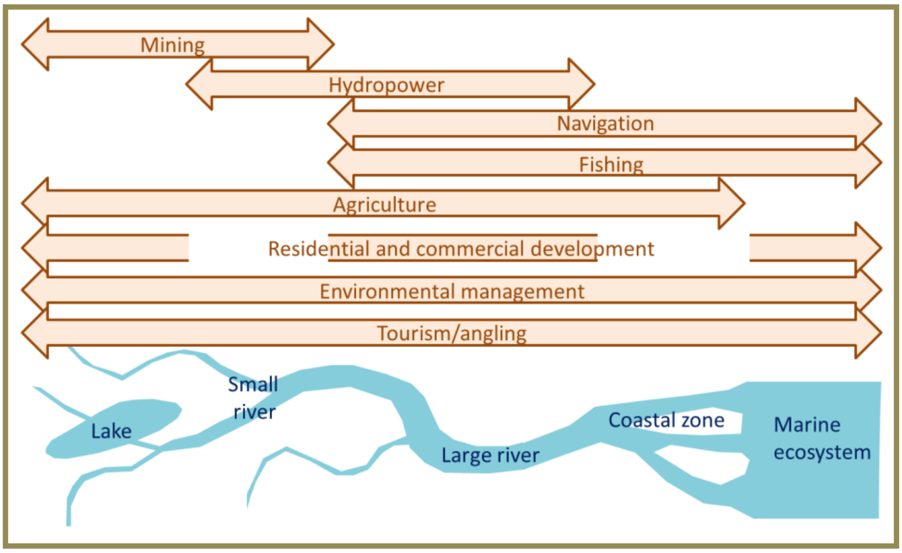

Figure 1: Human activities that most affect ecosystem types in the AQUACROSS case studies.

The implementation of the linkage framework approach was only possible due to the development of a **common typology** of human activities, pressures and ecosystem components across aquatic realms that provided a solid basis for cross-realm analysis and comparison. Such a common typology was missing, probably due, at least in part, to the fragmented policies that are relevant to different aquatic ecosystem types and the different typologies therein. Such an alignment of typologies (and underlying nomenclatures) represents a quintessential step for the integration of different EU policies across the aquatic realms. Only a common nomenclature and typology can yield a common understanding that is necessary in research and science, as well as in policy and decision making. All details on the linkage framework approach can be found in Borgwardt et al. (2019): *Exploring variability in environmental impact risk from human activities across aquatic ecosystems*; doi.org/10.1016/J.SCITOTENV.2018.10.339. available at: https://www.sciencedirect.com/science/article/pii/S0048969718342396

In the **specific exploratory analyses of drivers and pressures**, most CSs followed a quantitative approach to analyse drivers, pressures and states. These assessments were based on **indicators** proposed in AQUACROSS Deliverable 4.1 and had strong relationships to existing policies such as the EU Water Framework Directive, the EU Marine Strategy Framework Directive or included biodiversity-related indicators relevant to the EU Biodiversity Strategy.

Addressing **all aquatic realms**, the AQUACROSS CSs covered spatial extents over nearly 3 orders of magnitude in size ranging from ca. 110 km^2 (Lough Erne) up to ~800 000 km^2 (Danube Basin). Accordingly, the type and availability of data to describe the D-P-S elements were highly variable. The analyses showed that the key pressures affecting the aquatic ecosystems are related to chemical and physical changes of habitats (Figure 2).

Major differences in **data availability** make a standardised assessment of human pressures across aquatic realms challenging. In most CSs the availability of data on the status of biological quality elements was more limiting than availability of data related to drivers and pressures. Furthermore, there is no common way to develop indices and metrics for the quantification of human activities, pressures and particularly for the assessment of ecosystem state. Several CSs had relatively coarse indicator data available representing the major human activities but not covering the full D-P-S sequence affecting the aquatic ecosystems.

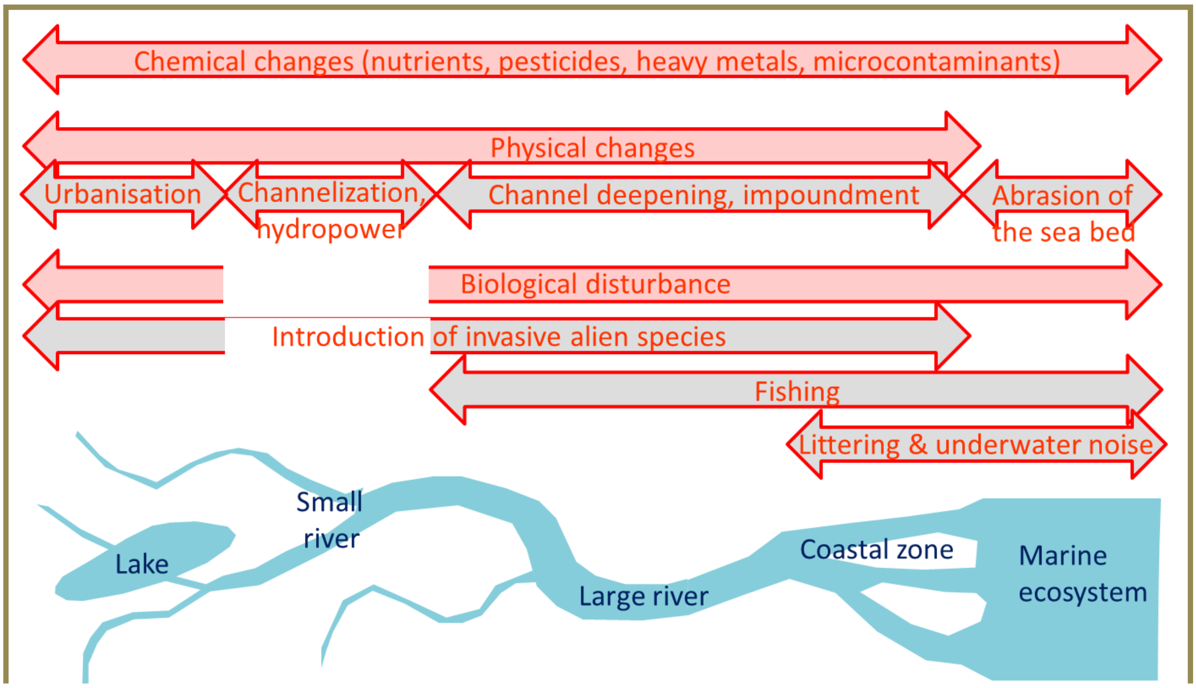

Figure 2: Human pressures that most affect the ecosystem components in the AQUACROSS case studies. Main pressures (red arrows) are partially subdivided into specific pressures (grey arrows below them) for certain water body types

Recommendations for the practical application of an EBM approach: The key drivers, human activities and pressures identified in the AQUACROSS CSs are often linked to **EU policies**. The achievement of policy goals for biodiversity protection and sustainability of ecosystem services of aquatic systems, depends on the harmonisation of EU environmental policies (EU Water Framework Directive, EU Habitat Directive, EU 2020 Biodiversity Strategy), with other EU policies relevant to aquatic ecosystems. In particular:

- **EU common agricultural policy (CAP)** (financial support so far mainly crop production-dependent instead of for conservation services),
- **EU Renewable Energy Directive** (supporting small hydropower plants with negligible contribution to energy supply but large environmental damage),
- **TEN-T (Trans-European Transport Network)** (aiming at improvements of transport infrastructure including waterways)
- **Regulation (1301/2013) on Regional Development Funds** (supports urbanisation and tourism)

In terms of **communication**, the dialogue with stakeholders has to be emphasised. However, the willingness of stakeholders is also related to the demands of underlying policies. For a more targeted dialogue with stakeholders, the linkage framework can support communication. Firstly, it can help to conceptually describe the complex interactions of social-ecological systems, advancing from narrow single sector views or single pressure-effect approaches. Secondly, it can highlight potential synergies of environmental (and economic) policies. A categorisation of the different elements along the cause-effect chain, as implemented in the linkage framework, can provide a policy-oriented tool linking different human activities, sectors and pressures.

Hence, the results indicate that there is a strong need for **inter-sectoral planning and management approaches** for the use of land, fresh waters and the sea, which considers the whole variety of political and business goals pursued by political sectors and stakeholders. This could be supported by assessments of ecosystem services provided by aquatic ecosystems, representing an integral part of the AQUACROSS Assessment Framework, and thus foster the adaptation of management practices towards an approach more linked to EBM.

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