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Analysing the impact of drivers and pressures on the conservation goals of protected areas along a large navigable river, the Danube River

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Keywords

Natura 2000, Habitat Directive, Bayesian network

Summary

Large river–floodplain systems are among the most endangered ecosystems worldwide. They are target to EU water as well as EU nature legislation. The importance of the EU Water Framework Directive (EU WFD, EC 2000) for river-floodplain management is widely recognized, since no other EU-strategy has initiated more water body related measures. Across Europe a specifically high proportion of remaining floodplain areas are protected by habitats directive (HD) and birds directive (BD) (SCHINDLER et al. 2016), owing to its high biodiversity value. Additionally, the EU floods directive (FD) aims reducing risk of flooding along watercourses e.g. due to natural water retention measures, or floodplains are target to EU Green Infrastructure Strategy (ICPDR, 2015). In turn, the EU TEN-T Regulation envisages a 'good navigation status' of inland waterways. Additionally, hydropower generation and agriculture or forestry within the riparian area are examples of important socio-economic benefit of large rivers.

Environmental problems are particularly acute in the case of the Danube (HEIN et al. 2016). Along the navigable stretch of the River Danube approx. 70% of river-floodplain length is protected by BD and HD, while these river stretches are at the same time assigned as heavily modified water bodies according to the EU WFD (HMWB). Therefore, it is especially challenging to achieve conservation goals for protected areas since the maintenance or improvement of the water status under EU WFD is an important factor in their protection. The environmental objectives for water bodies are lowered to good ecological potential, since the respective hydro-morphological measures to reach good ecological status would significantly affect water uses such as navigation, flood protection or hydropower generation (KAIL & WOLTER, 2013). These restrictions limit the potential to achieve the EU nature protection goals.

Analysing the importance of main hydro-morphological drivers and pressures for the conservation status of multiple species and their habitats is an important step for the integration of those targets. Therefore, we spatially link data on drivers, pressures and state within ArcGIS and analyse the relationships using a quantitative Bayesian network approach. We use open access data including a continuous hydro-morphological assessment for the navigable Danube River compliant with WFD requirements (SCHWARZ, 2014). Land cover/Land use (LCLU) data were obtained from the European Riparian Zones dataset developed by the local component of Copernicus Land Monitoring Services. In addition, data collected on the status of the waterway, critical locations for navigation and navigation class, as well as information on position and impacted river length for hydropower plants were included. Finally, information on conservation status of widely distributed protected species, including fish and amphibians, collected for HD and BD for approx. 120 sites (Fig. 1) along the navigable stretch of the river Danube were added. For Natura 2000 sites information is provided within a pan-European database.

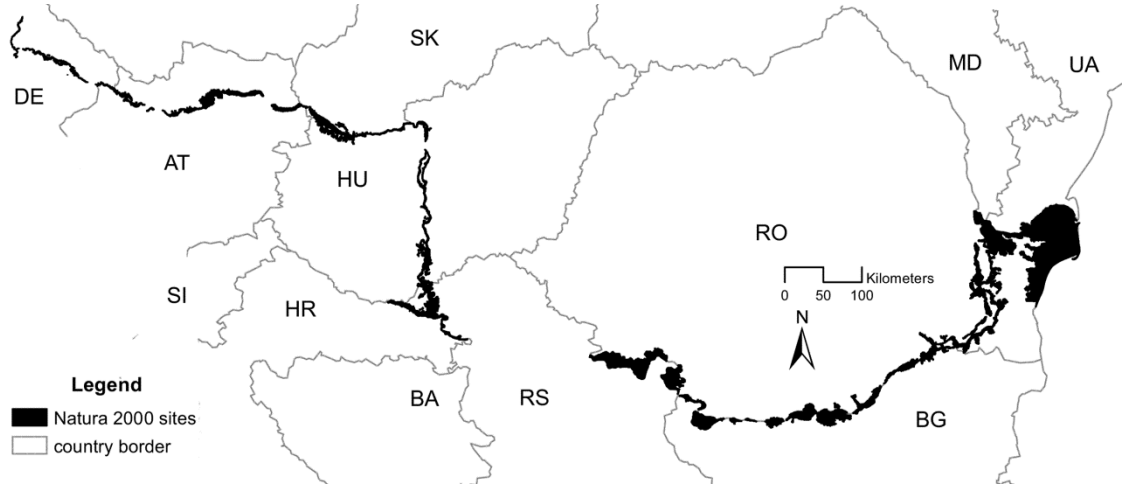

Figure 1: Protected areas (Natura 2000) along the navigable main stem of the Danube River

Our result show that interactions between drivers and pressures are complex and intertwined. Nevertheless, our Bayesian approach indicates that the relative importance of different drivers and pressures varies markedly between the indicators of the nature directives, and is significantly related to species traits. Impact assessment within the models also allows us to quantify species thresholds related to manageable hydro-morphological pressures. Therefore, our approach gives a first statistical proof of driver-pressure-state relationships along the navigable stretch of a large river-floodplain system, the Danube River, and can serve as a basis for a strategic and more integrated management approach and restoration planning at large scales.

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