**Comparing spatial prioritization methods for biodiversity conservation and ecosystem service supply in Europe**

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**Abstract:**

Identifying priority areas that simultaneously target safeguarding the supply of ecosystem services as well as biodiversity underlying the supply of ecosystem services is essential for well-informed decision-making on land use and conservation planning. Multiple methods for the spatial prioritization of locations supplying individual or multiple ecosystem services, and for the balanced or optimal allocation of biodiversity conservation actions exist, but the benefits and disadvantages of using these methods are seldom explored. Furthermore, the technical complexity, data requirements and the transparency of the method parameterization further make a great difference in the usability of each method in practical work. Here, we compare a simple scoring method, heuristic prioritization software Zonation, and an exact spatial optimization method in prioritizing locations important for multiple ecosystem services and biodiversity at the European scale. Each method is used within a realistic, but hypothetical decision-making context. We show that for very simple analysis types, the scoring-type of approach performs very similarly to Zonation and the exact optimization method. However, more complex - and arguably more policy-relevant - analysis types can only be accommodated by the more complex methods. We demonstrate the practical implications of using each approach in operationalizing the concept ecosystem services and biodiversity conservation planning into more widespread practical use. We argue that the road forward in using planning methods is a combination of technical credibility, decision-making relevance, and effort in opening up the planning process to the stakeholders involved.

**Keywords:** spatial prioritization; ecosystem services; biodiversity conservation; Zonation; optimization; environmental decision-making

**Software and/or data availability:**

# 1. Introduction

Valuing our living environment based on the services that ecosystems provide has become one the leading paradigms of both research (REFS) and policy (REFS) in Europe. Developing and implementing methods capable of identifying areas important for the supply of ecosystem services has received substantial attention, but because of the complex nature of many ecosystem service, few comparative studies on such methods exist.

In the field of conservation science, approaches such as systematic conservation planning (Margules and Pressey, 2000) and spatial conservation prioritization (Moilanen et al., 2009) have already been used to support real-life spatial planning (Lehtomäki et al., 2009; Whitehead et al., 2016). Furthermore, several authors have studied spatial prioritization of areas with both ecosystem service capacity and potential for biodiversity conservation (Chan et al., 2006; Moilanen et al., 2011; Schröter et al., 2014), but for the most part using methods initially develop for spatial conservation prioritization of biodiversity. To which extent these approached are suitable to prioritizing areas for ecosystem services supply remains unclear.

# 2. Material and methods

# 3. Results

# 4. Discussion

# 5. Conclusions

# 6. Acknowledgements

# 7. References

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