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Decision support tools for waterway managers: Spatially explicit data, models, engagement, and monitoring

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ABSTRACT

Waterway managers face complex challenges in protecting and enhancing the health and social benefits of freshwater systems from a range of current and future threats, including climate change and urbanization. Key questions that need to be addressed by waterway managers include relative importance of future threats, where to focus limited resources, what actions are likely to result in measurable benefits, how to set meaningful targets, and how to integrate and achieve system-scale outcomes. This paper presents 5 key tools in a proposed decision support system (DSS) to enable waterway managers to identify needs, then assess and prioritize interventions throughout a spatially explicit stream network using geospatial data, modeling, stakeholder engagement, decision-making, and monitoring to optimize cost-effective management actions. Through case studies from diverse regional waterway management agencies in Australia (Melbourne, Victoria) and the United States (Denver, Colorado; Southern California; and Austin, Texas), we compare approaches that include habitat suitability models, physics-based watershed models, and predictive analytics to guide intervention strategies, resulting in more efficient, effective, and equitable waterway management decisions. The proposed DSS emphasizes the importance of connectivity, scale, and spatial context in stream management, enabling managers to predict outcomes, set quantitative targets, and more clearly communicate benefits to stakeholders. By harnessing objective data in service of social values, the tools presented and a DSS approach helps overcome potential technical, economic, and social challenges by improving decision-making rigor and transparency, supporting accountability and adaptive management, and fostering trust through the reproducibility of decision processes.