Planning research and development in poor data and urgent decision-making contexts as an adaptive management problem

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Abstract: Investing in Research and Development (R&D) is necessary for the preservation of biodiversity. However, allocating resources across technology development projects remains a mathematical challenge as significant uncertainties arise in R&D processes and their outcomes for biodiversity.

Here, we present a novel approach to guide decision making in R&D for biodiversity conservation. Our approach is based on adaptive management, which is a practice to manage systems with unknown dynamics mainly used in ecology and natural resource management. Adaptive management strategies seek to simultaneously reduce uncertainty and maximize management outcomes. We use a case study based on the management of the Great Barrier Reef to demonstrate how resource allocation across technologies can be treated as an adaptive management problem and solved with Partially Observable Markov Decision Processes (Chadès et al., 2012).

Our analysis of the value of information demonstrates that reducing uncertainty results, on average, in 20% better outcomes for biodiversity (up to 50%). This finding suggests that this technology development problem is a good candidate for an adaptive management program. Additionally, we compared our adaptive framework to non-adaptive and naïve methods and found that our approach outperformed non-adaptive strategies in 70% of the tested scenarios, resulting in an average increase of 11% in outcomes.

Here, we present the first mathematical framework to provide investment recommendations adapted to the specific needs of R&D for conservation purposes. Our adaptive framework finds applications in other urgent decision-making domains such as natural resource management or epidemiology. We hope our research will inspire other scientists and promote the uptake of adaptive management and artificial intelligence in applied ecology.

REFERENCES

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