A mixed integer programming approach for multi-action planning for threat management

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Abstract

Planning for management actions that address threats to biodiversity is important for securing its long term persistence. However, systematic conservation planning (SCP) has traditionally overlooked this aspect and just focused on identifying priority areas without any recommendation on actions needed. This paper develops a mixed integer mathematical programming (MIP) approach for the multi-action management planning problem (MAMP), where the goal is to find an optimal combination of management actions that abate threats, in an efficient way while accounting for connectivity. An extended version of the MAMP model (MAMP-E) is also proposed that adds an expression for minimizing fragmentation between different actions. To evaluate the efficiency of the two models, they were applied to a case study corresponding to a large area of the Mitchell River in Northern Australia, where 45 species of freshwater fish are exposed to the presence of four threats. The evaluation compares our exact MIP approach with the conservation planning software Marxan and the heuristic approach developed in Cattarino et al. (2015). The results obtained show that our MIP models have three advantages over their heuristic counterparts: shorter execution times, higher solutions quality, and a solution quality guarantee. Hence, the proposed MIP methodology provides a more effective framework for addressing the multi-action conservation problem.

Palabras clave

Palabras clave de autor: Conservation planning; Wildlife management; Mixed integer programming; Conservation management plans
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