Predicting ecosystem-wide impacts of conservation actions to improve environmental management.

Dr Chistopher M Baker, Prof Hugh Possingham University of Queensland

The current species extinction rate is one thousand times faster than the background rate, predominantly due to human impacts. Where possible, we try to manage ecosystems to prevent further loss, but ecosystem dynamics are complex and hard to predict; historically, many well-intended interventions have ended in disaster. This is further complicated because conservation resources are severely limited.

Developing cost-effective and risk-aware management strategies for these systems is a key challenge in conservation science and is the core of this research project. Ecosystem management calls for interdisciplinary collaboration because the challenges are varied and require detailed understanding of the ecosystem, in addition to biological, ecological, economic and mathematical knowledge. A key management strategy involves manipulating the makeup of species within an ecosystem, either by eradicating or introducing a species.

The first aspect of this project was developing and applying mathematical methods to predict ecosystem wide changes following management actions. Four publications came from this aspect, one which developed mathematical methods, and three investigating the management of networks at Booderee National Park, Christmas Island and of Mallee fowl management across the south of Australia. This work has spurred further ongoing mathematical work into modelling complex and dynamic systems incorporating up-to-date date using state of the art statistical modelling methods and assisted environmental managers in conserving important ecosystems.

The second aspect to this project was developing cost-effective management strategies. Eight papers were published on this topic and one of the most interesting was about invasive week management on Lord Howe Island. Working with the weed eradication managers, a mathematical model of invasive weed spread was developed. This enabled testing of proposed strategies for searching the island for invasive weeds. By varying the search frequency and intensity, we were able to show that increasing search frequency would be an effective option – even if it comes at the cost of reducing the thoroughness of individual searches.

This project has enabled a range of collaborations and assisted environmental managers across Australia. Further, the methods and results from this project are being used internationally to assist decision-making in environmental conservation. Beyond the practical applications of this work, it has spurred research in the field of applied mathematics and in optimising decision-making, leading to collaborative work with researchers in America and Europe.