Project Plan SP 2013-001

Decision support system for prioritising and implementing biosecurity on Western Australia's islands

Animal Science

Project Core Team

Supervising Scientist	Cheryl Lohr
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Project status as of May 12, 2020, 7:25 a.m.

Approved and active

Document endorsements and approvals as of May 12, 2020, 7:25 a.m.

Project Team	granted
Program Leader	granted
Directorate	granted
Biometrician	required
Herbarium Curator	not required
Animal Ethics Committee	not required

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Biodiversity and Conservation Science Program

Animal Science

Departmental Service

Service 6: Conserving Habitats, Species and Communities

Project Staff

Role	Person	Time allocation (FTE)
Research Scientist	Cheryl Lohr	0.0
Research Scientist	Katherine Zdunic	0.0
Supervising Scientist	Keith Morris	0.0

Related Science Projects

Nil.

Proposed period of the project

July 1, 2012 – June 30, 2017

Relevance and Outcomes

Background

The broad goal of this project is to prioritize island management actions so that we maximize the number of achievable conservation outcomes for island biodiversity in the face of threats from invasive species. Western Australia has over 3,700 islands, many of which are essential for the survival of threatened species and provide critical breeding sites for seabirds and sea turtles. In some cases, islands support the last remaining populations of plant and animal species making their long term protection highly desirable. Many of Western Australia's islands are also popular sites for recreation, and tourism, and contain many culturally significant sites. Invasive species are the single biggest cause of loss of native species from islands across the globe. The increased use of islands by the public for recreation, and oil, gas and mining industries means an increased likelihood that invasive species will colonize pristine islands. Prioritization of management investments is essential because funds for turning national, state or regional conservation goals into actions are typically limited. Implementation of actions therefore generally proceeds incrementally while biodiversity continues to decline, even in areas earmarked for future management. Funds to manage established protected areas are also insufficient, so these areas too can be expected to suffer declines in biodiversity. Reversing these declines presents researchers and managers with difficult challenges. In the past prioritizing conservation actions has relied on the experience and expertise of conservation land managers. The field of Strategic Conservation Planning is an organized field of research that attempts to design explicit frameworks and models for guiding conservation actions that generate cost-effective and accountable recommendations for prioritizing actions. Four specific and relatively independent areas of research have generated models and knowledge relevant to the problem of prioritizing conservation actions. The first area of research on prioritizing or scheduling conservation investments (Pressey et al. 2004) has modeled conservation and loss of biodiversity from an area through design of variable conservation networks given spatial variability in conservation and use values (Spring et al. 2010, Visconti et al. 2010). These models do not consider the multiple threats to biodiversity or multiple actions managers may implement to mitigate biodiversity loss. The second area has ranked lists of possible actions for species management in a single area, recognizing the costs, benefits and probability of success associated with each action (Bottrill et al. 2008, Joseph et al. 2008a, Joseph et al. 2008b). Action are treated independently and prioritized according to their marginal contributions to conservation goals, with the final list of high priority projects being limited by available funds (Weitzman 1998). However, actions are rarely implemented independently, so optimal search algorithms should instead identify combinations of actions that optimize costs, benefits, probability of success and budget constraints (Westphal and Possingham 2003). A third research area has allocated different conservation actions to regions globally or across continents (Wilson et al. 2006, Wilson et al. 2007, Bode et al. 2008, Underwood et al. 2008). These studies ignored almost all spatial variation in intensity of threats, costs of actions, and responses of species and other features to management interventions. A fourth area of research allocates actions spatially using a global search algorithm (Watts et al. 2009, Klein et al. 2010, Wilson et al. 2010), but matches only one action with each area and ignore the temporal variation of threats as they respond to management or environmental variables. These studies also did not deal with uncertainty. This project will combine these four areas of research into a single comprehensive formulation that will create a decision support tool for day-to-day use in making accountable and cost-effective decisions about where to spend limited funding on management of islands. The need for this project is underlined by the limitations of the four research areas described above, all of which have limited applicability to field managers faced with immediate, real-world problems. This project fills a crucial need. The project will be developed collaboratively with practitioners to ensure that: 1. the science is properly grounded so that it provides answers useful to day-to-day management; and 2. decisions are based on the best available expert judgment where hard data are lacking.

Aims

This aim of this project will be to develop a decision support tool for day-to-day use in making accountable and cost-effective decisions about where to spend limited funding on management of islands to promote the persistence of native species. The decision support tool will assist in prioritizing WA islands for conservation surveillance and management and could contribute to a future biosecurity plans for other islands both in Western Australia and across Australia. The project will initially focus on the islands along the Pilbara coast between Exmouth Gulf and Eighty Mile Beach. The decision support tool will eventually be applied to the management all of Western Australia's islands, and potentially to all Australian islands.

Expected outcome

This project will generate several beneficial products for island conservation in Western Australia including: 1) An operational decision support tool for island management with the aim of promoting the persistence of native species on islands. 2) Training sessions to develop the capacity of DEC staff to apply the model in managing the conservation estate. DEC officers will also be able to update the decision support tool as new data become available, and will remain in contact with the research group at James Cook University, ensuring that access to improved versions of the software tool are obtainable. An MOU will be established between DEC and James Cook University to ensure ongoing collaboration. 3) Accountable and cost effective decisions that aid the conservation of WA's idyllic islands and native species. 4) A single comprehensive database on Western Australian island characteristics, fauna, flora, and threats and; 5) the project has the support of the Conservation Commission and will address several recommendations in the Commission's two Status Performance Assessments on Biodiversity Conservation on Western Australian Islands.

In developing and testing the full decision model, the project team will also create three scientific innovations. First, the method will integrate, for the first time, components of four disparate areas of research, refining each component and developing new links between them. Second, essential to addressing real-world complexity, the project will develop three new sub-models to account for the temporal and spatial dynamics of threats from invasive species, varying contributions of different management actions to management goals, and the costs of actions. Each sub-model will be an important conceptual and technical advance in its own right and will interact with the others to adjust, for example, the choice and sequence of management actions as threats to biodiversity are ameliorated. Third, the project will deal explicitly with uncertainties in key parameters, using plausible bounds and, where possible, probability distributions of abundances and extent of species and ecosystems, distributions of threats and species-specific responses, and contributions and costs of management actions

Knowledge transfer

The purpose of this project is to develop a decision support tool that will help managers make day-to-day decisions regarding island management. Conservation and resource managers are the anticipated users of the

knowledge generated by this project. DEC, as an active partner in the project, will directly absorb the improved data on island biota and management, apply the decision support tool to conservation problems, and enhance its technical capacity to prioritize management actions for the conservation of native species on islands.
Each party (JCU and DEC) retains ownership, and the rights to use, exploit, and grant licenses for the use of its pre-existing intellectual material. Each party grants the other a non-exclusive, royalty-free license to use the other party's pre-existing material. All intellectual property rights in material generated, created, or developed by this project vest immediately in DEC. DEC grants JCU an irrevocable, non-exclusive, royalty-free license to use the project material for the purposes of carrying out the project and for any other non-commercial purpose relating to environmental research or management.

Tasks and Milestones

STAGES/MILESTONES

Time after commencement
Commencement of recruitment process for JCU modeler and research assistant
1 month
Initial scoping workshop to identify suitable islands, data sources, and refine approach to eliciting model parameters from managers
4 months
Memorandum of understanding developed between DEC and James Cook University for ongoing collaboration beyond the duration of this project
4 months
First workshop with field managers to review approach and obtain preliminary parameters for model formulation
1 year
Initial model formulation and application to subset of islands
1 year
Details of formulation and approach of the decision support tool submitted for publication in an international peer-reviewed scientific journal
1 year
Year 1 progress report
1 year
Testing with managers of initial model formulation with subset of islands
1.5 years
Full threat sub-model developed
1.5 years
Field visits completed to fill data gaps on subset of islands
2 years
Second workshop with managers to review approach and refine parameters for model formulation for subset of islands
2 years
Year 2 progress report
2 years
Full sub-model for contributions of management actions developed
2.5 years
Testing with managers of refined model formulation with subset of islands
2.5 years
Mid-term peer review workshop to ensure world's best practice
2.5 years
Third workshop with managers to review approach and obtain preliminary parameters for model formulation for all islands
3 years
Year 3 progress report
3 years
Full sub-model for costs of management actions developed
3.5 years
Fourth workshop with managers to review approach and refine parameters for model formulation for all islands

4 years
Testing of decision support tool and training DEC managers in application
4 years
Field visits completed to fill data gaps on all islands with significant conservation values and a sample of other islands
4 years
Using full model to explore funding and biosecurity scenarios with managers
4 years
Year 4 progress report
4 years
Compilation of data base on islands covered by the project, based on literature, unpublished information held by DEC and others, and new field work
5 years
Sensitivity analysis to identify priority gaps in geographical and thematic data to be filled by DEC
5 years
Delivery of fully operational decision support tool, ready to use by DEC
5 years
Final report
5 years

References

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Study design

Methodology

The islands of Western Australia are a perfect study system for this project, with native species of global and national significance, interacting pressures on these species from invasive plants and animals, alternative management actions with uncertain effectiveness, and insufficient management funds to achieve all goals. This project will focus on the islands along the Pilbara coast between the Exmouth Gulf and Eighty Mile Beach. A workshop held within the first four months of this project will identify the particular islands to be used during model development. The final decision support model generated by the project will be applicable to all WA islands.

The process of designing this decision support tool has 11 components (Figure 1), which have been adapted from the stages of systematic conservation planning (Pressey and Bottrill 2009) and informed by previous work on prioritizing management actions. Details of each model component are outlined below.

1. Guiding principles (Tear et al. 2005) shape decisions about species to be managed. The guiding principles will draw on national and state conservation policy and strategies and the expertise of island managers in Western Australia and elsewhere (e.g. managers from the Pilbara region).

2. A basic requirement for the project will be accurate data on the occurrence, abundance and, population trends of native species on the islands. These data will be compiled from field work, scientific literature and unpublished information held by DEC.

3. Species weightings will guide solutions in the event (typically) that not all goals can be achieved (Polasky et al. 2008). One of the realities of management within budget constraints is that hard choices will be necessary about, for example, which native species should benefit from management intervention in a given period. While a common currency for comparing species is still hotly debated, and not part of this proposal, the project will require explicit choices and rationale for these inevitable decisions.

4. Threat models will help to define quantitative goals for each species (Pressey et al. 2003) and estimate potential losses of species in the absence of management. Understanding the potential spread of invasives, within and between islands and from outside sources, in the absence of intervention is necessary to formulate goals and identify priorities. Quantitative conservation goals will probably be larger for more highly threatened species, for example; and priorities will reflect expected declines in native species, and the options for achieving goals on the islands being studied. The threat sub-model (Figure 1) will consider temporally explicit (annual) changes and the potential effects of climate change. Year-zero of the threat sub-model will assume no management intervention, whereas subsequent years will consider management actions. The threat sub-model will also predict species-specific responses to threats, ranging from categorisation of threat status to estimates of population trends and stage-based demographic models (Bolten et al. 2011).

5. Quantitative management goals are at the core of emerging systematic methods for identifying priorities for investment. They allow managers to be explicit about what they intend to achieve over defined periods, allow progress to be tracked, and facilitate the use of the cutting-edge analytical techniques that will be applied in this project. The project team will define time-bound conservation goals for protection (prevention of decline) and/or restoration (Didier et al. 2009). Goals will recognise the need for complementary management in adjacent marine or terrestrial environments (Dryden et al. 2008).

6. Areas will be the candidate spatial units assessed for actions (Pressey and Logan 1998). These might be small islands or parts of islands defined as having relatively uniform management requirements. In the Pilbara each island (defined as land not connected to other land masses at low tide) will be considered an independent area.

7. Actions (Table 1) used to reduce or prevent the arrival of invasive species, will be assigned relative contributions toward each management goal (Edwards et al. 2010). Actions will include biosecurity measures as well as methods to eradicate populations of invasive species in situ. These could be expressed, for example, as the expected reduction in density of an invasive species per hectare of treatment in a given period. The sub-model for relative contributions of actions to goals (Figure 1) will recognise spatial variation in contributions, including probability of success, and synergies and interferences between actions. Actions may vary among targeted invasive species.

8. Management actions will be costed per hectare of treatment (Wilson et al. 2007). The cost sub-model (Figure 1) will address spatial interactions (e.g. travel times) and temporal dynamics of costs in relation to the cost-efficiencies of both early intervention and follow-up work to avoid returns to pre-treatment conditions.
9. There will be two formulations of the problem. The first, and most applicable, will maximise the achievement of goals within cost constraints (Church et al. 1996). The second will find the minimum cost required to achieve all goals.
10. Application will produce a decision-support tool for managers, allowing them to alter any of the parameters from the previous steps and identify cost-effective options for management of islands. This will involve new coding, linked interactively to a graphical user interface, and identifying multiple cost-effective solutions. Application will also explore alternative funding scenarios, such as the benefits of a biosecurity strategy (Nias et al. 2010) vs. ameliorative management after arrival of invasives, implications of funding cuts or increases on control of invasive species, and effects on overall cost-effectiveness of committing funds to particular island groups or iconic species. The application phase of the project will also explore uncertainties in key parameters as a basis for sensitivity analysis and guiding risk-averse and risk-seeking decisions (Halpern et al. 2006).

Biometrician's Endorsement

required

Data management

No. specimens

None.

Herbarium Curator's Endorsement

not required

Animal Ethics Committee's Endorsement

not required

Data management

24. Data management [how and where are data being archived/maintained? - see Guideline No 16]: Once developed, the database will be archived at a corporate level (details to be sorted with Paul Gioia).

Budget

Consolidated Funds

Source	Year 1	Year 2	Year 3
FTE Scientist			
FTE Technical			
Equipment			
Vehicle			
Travel			
Other			
Total			

External Funds

Source	Year 1	Year 2	Year 3
Salaries, Wages, OVertime			
Overheads			
Equipment			
Vehicle			
Travel			
Other			
Total			