National Environmental Research Program

LANDSCAPES AND POLICY hub

SPADE (Spatial Population Abundance Dynamics Engine): A Model to Aid Invasive Species Management

The Landscapes and Policy Research Hub is collaborating with Parks Victoria and NSW National Parks and Wildlife Service to develop a new tool to assist cost-effective decision-making for invasive species management.

Key Research Goals

To develop a spatially-specific model that:

- **Can map the current and likely future range and population densities of invasive species under different management scenarios, to assist the cost-effective management of invasive animals and diseases.**
- **Incorporates a wide range of control methods and management strategies suited to different landscape zones and densities of invasive species.**
- **Is sensitive to environmental drivers (for example, preferred habitat and ease of movement through the landscape), social drivers (preferred control methods), and management costs and risks.**
- **Has a user-friendly interface to enable land managers to run the model on a desktop computer to test the cost-effectiveness of different management strategies and produce reports that will help communicate the likely impacts of different strategies to senior decision makers, land managers and interest groups.**

1. Why are we building a decision support tool for invasive species?

Invasive species are having a major impact on vegetation communities and ecosystem processes throughout Australia. The impacts of invasive species, such as wild horses in alpine areas, present a major challenge to land managers, especially in national parks. Prioritising conservation activities requires an understanding of the location and spread of invasive species and the likely effectiveness of different control methods. Effective management of invasive species is also challenging due to the social acceptability of management options.

The decision support tool grew from discussions at a Science Management Forum hosted by the Australian Alps Liaison Committee and the Landscapes and Policy NERP Hub at Jindabyne in November 2012. As a result, we are developing a spatially-specific model to guide cost-effective management of invasive species, such as wild horses and fallow deer.

SPADE

Called SPADE (*Spatial Population Abundance Dynamics Engine*), we are initially developing the model for the management of wild horses in the Australian Alps and fallow deer in Tasmania. The goal is to assist government agencies and interest groups make decisions about the most cost-effective and socially acceptable approaches to managing invasive animals and diseases.

We are using input data on wild horse range and abundance collected by park rangers. The involvement of park rangers in the project is essential to the design and testing of the model.

2. How will this tool help with biodiversity conservation?

The model enables managers to project the likely range and population density of invasive species, under a range of different scenarios of population growth rates, dispersal patterns and management. It allows policymakers and park managers to explore the impacts and costs of different management intervention strategies.

For example, in the Australian Alps the population of wild horses is estimated to be in the order of 12,000 animals. The agencies responsible for managing the impacts of wild horses have annual targets for capture and relocation of wild horses. However, they aren't confident they are having sufficient impact to limit the spread of animals and the damage to wetlands and bogs that lie at the headwaters of critically important Alps catchments such as the Murray and Snowy Rivers. To coordinate their efforts for a greater effect, park managers may consider a collaborative project with neighbouring jurisdictions. Using SPADE, the park managers could run the model numerous times using different assumptions for the current range, population growth rates, combination of control methods, and the timing and intensity of control. SPADE could be used to provide an assessment of the likely cost-effectiveness of different approaches that can be readily communicated to community groups, senior managers and other decision makers.

3. How does it work?

The model uses information on the current and potential abundance of a species (for example, *deer or wild horses*), across a specified landscape (for example, *the Australian Alps* or *the Tasmanian Midlands*), combined with relevant information about species demography, (for example, *breeding and mortality*) to calculate a spatially-explicit estimate (for example, *a map or graph*) of the species' abundance over time.

We then run the model using different input parameters to simulate management strategies and gauge their potential effectiveness. For example, determining the cost-effectiveness of a 'high early removal' strategy in the first few years followed by more selective control methods once the population recovers to detectable levels. The model enables the user to determine how long it will take for the population to recover to detectable levels and compares the cost-effectiveness of a strategy with more modest annual targets.

The model includes options to automatically score management strategies against a variety of goals, for example benefit-cost ratio, species density in high-priority areas and 'welfare score' (control methods that minimise stress to the animals).

The SPADE model also includes advanced features such as the capability to model the interactions between multiple species in the landscape over time, as well as incorporating more detailed input data such as spatial variation in management cost (for example, some areas in the landscape may be more difficult to access).

How SPADE Works

Step 1: Input current knowledge about species to SPADE

Carrying Capacity
How many animals can be supported in a given area. (food dependent)

Initial Conditions
What's currently happening on the ground.

Demographic Information
Information about how the animal lives & behaves.

Dispersal Characteristics
How the animal spreads.

Step 2 – Run SPADE with current management scenario

What we are currently doing to manage the invasive species.

Step 3 – Run SPADE again with different management goals

What happens if we do this? What can we do to get a desired outcome?

Possible Outputs

- *Maps*
- *Changes to population size*
- *Resources needed*
- *Eradication Costs*

4. Where to from here?

In February 2014, park rangers from NSW and Victoria will visit Dr Beeton in the lab to refine the model and test potential management scenarios using datasets collected in the field by the rangers. Demographic parameters, carrying capacities and dispersal rates will be used in the model to ensure the tool captures as best it can what is happening on the ground. These rangers will become '*SPADE Champions*' within in their organisations, using their knowledge of the model to assist others within their organisations to use it for a range of applications. It is hoped the model will be operational by mid-2014.

5. Who are the researchers involved?

Dr Nicholas Beeton

Nick is an ecological modeller who specialises in novel ways of estimating species distributions and population dynamics. He completed his PhD in 2011 studying the Tasmanian devil and Devil Facial Tumour Disease (DFTD), in particular looking at the effectiveness of potential management strategies.

Professor Chris Johnson

Chris leads the hub's Wildlife Project that is developing distribution models for selected mammal, bird and reptile species. They are examining patterns of concordance of habitat and climatic refugia for Tasmania, and modelling species distributions for priority invasive animals in the Australian Alps.

Where can I find out more?

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Further Reading:

McMahon CR, Brook BW, Collier N & Bradshaw CJA (2010) Spatially explicit spreadsheet modelling for optimising the efficiency of reducing invasive animal density. *Methods in Ecology and Evolution* 1: 53-68.

About the NERP Landscapes and Policy Hub

The Landscapes and Policy Hub is a research collaboration that focuses on integrating ecology and social science to provide guidance for policy makers on planning and management of biodiversity at a regional scale. The research hub is developing tools, techniques and policy options to integrate biodiversity into regional scale planning.

The University of Tasmania hosts the multi-disciplinary research collaboration that is one of five research hubs funded to study biodiversity conservation by the National Environmental Research Program (NERP) for four years (2011-2014).

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