A review of dynamic occupancy models and guide to building them for applied ecology

Target Journal: Ecography

# Abstract

# Introduction

## Overview

Capturing patterns of species occupancy over space and time is a common goal for ecologists, particularly those focused on conservation and wildlife management. Advances in recent decades have provided numerous options for methods and statistical models, with sub-fields such as species distribution modelling and metapopulation modelling contributing increasingly sophisticated tools to support on-ground practitioners. No matter the method, ecologists must balance data input requirements and analyst skillsets against inferential power and suitability to purpose when determining how best to analyse data from natural systems.

Dynamic occupancy models[[1]](#footnote-1) (henceforth DOMs) balance ease of use, realistic data requirements, and assumptions with analytical capabilities suitable for answering many types of questions common in ecology and conservation science. MacKenzie et al.’s 2002 paper defining the model has been cited [XXXX] times, reflecting their importance in applied ecological modelling.

This paper has two principal objectives:

1. To review the history of DOMs development and their use in applied ecological research, including for what practitioners used these models and how they implemented them.
2. To provide practical recommendations for how to use these models to ensure outputs and predictions are as robust as possible, with a practical workflow for development to incorporate key considerations.

## Model development and history

The standard form of the dynamic occupancy models was initially described by MacKenzie et al. 2002 in their Ecology paper ‘Estimating site occupancy, colonisation, and local extinction when a species is detected imperfectly’. This title highlights one of the key benefits of the model - the ability to account for imperfect detection is a ubiquitous problem in surveying wildlife, and the subject of a great deal of discussion in this field.

Give a basic definition of the model structure, with a visualisation and directions to other key resources with further information?

Multi-species and multi-state versions?

Bayesian implementation?

Additional extensions

- elephant dispersal paper

- other imperfect detection formulations

# Review methods

## Paper elicitation

## Processing and analysis

# Results

# Discussion

# Conclusions

1. Also variously termed ‘occupancy dynamics models’ and ‘multi-season occupancy models’ [↑](#footnote-ref-1)