FINE-SCALE HABITAT MODELLING OF WILDLIFE SPECIES USING SPATIAL INFORMATION TOOLS

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ABSTRACT

Species habitat models (SHM) or species distribution models are numerical tools that combine observations of species occurrence or abundance with environmental estimates. Models that predict distributions of species by combining known occurrence records with digital layers from satellite imagery and Geographic Information System (GIS) inputs together with environmental variables have much potential for conservation applications and scenario modelling. In this research, four analytical techniques for multispecies modelling, i.e. maximum entropy (Maxent), random forest, artificial neural network, and mahalanobis typicality, will be explored to assess the species distribution. A methodological approach will be at the fine (5-10m) spatial scale, where studies at this level are lacking. Spotted-tail-quoll, Darling Downs Earless Dragon, Black-Breasted-Button-Quail, and Bulloak Jewel Butterfly, which are endangered and threatened species had been selected as case studies to test this framework.

Keywords: Species habitat modelling, multispecies, fine scale, maximum entropy, random forest, neural network, mahalanobis typicalities.

INTRODUCTION

Habitat models are now broadly used especially in conservation planning on regional scale or public lands. Determining the size, type and location of habitat to conserve is a complex area of conservation biology. Although difficult to measure and predict, the conservation value of a habitat is often a reflection of the quality (e.g. species abundance and diversity), endangerment of encompassing ecosystems, and spatial distribution of that habitat [1]. Habitat modelling is a transparent and repeatable technique for describing and mapping biodiversity values [2] either for flora or fauna or both. In this paper, a standardized modelling and newly developed models based on widely accepted techniques will be used to improve the conservation plans for four endangered and threatened fauna species. The integration of spatial information tools such as aerial and satellite remote sensing imagery, the Global Positioning System (GPS), and computerized GIS will enhance the habitat modeling outputs. We reviewed current habitat modelling methods and provide a habitat modelling review paper as a case study in the Southern Queensland region that we hope will serve as a methodological template for conservation planners and managers.

FINE SCALE MAPPING

Habitat mapping uses the term ‘scale’ in a generic manner to cover the complex interaction between area and size of habitat detail of mapping [3]. Scale therefore helps to define the approaches to habitat mapping. The applications of remote sensing data in landscape ecological studies are pervasive [4]. The use of fine scale mapping from high spatial resolution satellite images and digital layers of GIS base will enhance the modelling output. Models that can predict species distribution by combining known occurrence data with digital layers of environmental variables have much potential for conservation purpose.

MULTISPECIES HABITAT MODELLING

Habitat is a species-specific concept [3], in theory it demands the mapping needs to be conducted at the individual species level. Therefore, many researches in SHM are focused on a selected species, e.g. for adaptive management of horseshoe crabs and red knot [1], threaten reptiles such golden-tailed gecko and grey snake [5], marine communities. The single-species approach to habitat mapping has certain advantages for conservation planning but a focus on multispecies (but in the same taxonomic rank, e/.g. order) approach could be more justifiable in some condition [5].

ANALYTICAL ALGORITHMS

Several modelling techniques can be applied in SHM. The selection of method is largely depending on the type of available survey data to be used in model development: few or no data, presence-only data, presence-absence data, ordinal categories data and counts [6]. Some recent studies include bagging and random forests for ecological prediction [7], maximum entropy (Maxent) for modelling with presence-only data [8], malanobis typicality algorithm as a land change modeler in IDRISI [9], and artificial neural network [10]. Every single method has their own advantages and disadvantages that need to be considered prior to model development. In this research, four analytical techniques for multispecies modelling, i.e. maximum entropy (Maxent), random forest, artificial neural network, and mahalanobis typicality, will be used to assess the species distribution. These selections are related to test new models that had been developed special for ecological aspect and also these sorts of models can fit into different aspect of data that we are dealing with such as few or no data, presence-only data, and presence-absence data.

CONCLUSION

This study has demonstrated the possibility of a habitat map for a group of endangered and threatened species. This layout assumes that some species of this endangered and threatened species in the study area share certain common habitat requirement and preference [6]. For conservation planning and wildlife management, specifically in reserved or protected areas, a habitat map for multispecies of endangered and threatened species can be more justified than a single species approach. A shared habitat for these selected species will become a best case for rehabilitation and preservation.

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