MODELLING THE IMPACTS OF HABITAT DEGRADATION OR LOSS ON VERTEBRATE POPULATIONS IN WESTERN NEW SOUTH WALES

Murray Ellis and Michael Bedward

Department of Environment and Conservation, PO Box 1967, Hurstville NSW 2220

ABSTRACT

CafeAnimal is a spatially explicit, rule-based simulation program for modelling the population dynamics of territorial vertebrates. Model features include territories with floating boundaries; the use of map sequences to consider temporal and spatial changes in habitat resources; animal movement modelled in continuous space; the ability to depict various forms of social organisation; and tracking of individuals, groups and territories over time. CafeAnimal is used to model the responses of selected species to past sequences of clearing and possible future landscape scenarios; to model responses of species to varied fire regimes; to identify species at risk of continued negative responses to past land management; and to explore landscape design questions. The models are being explored to determine patterns in population structures and distributions that can be used to access the condition of real populations from snapshot or short-term field studies.

INTRODUCTION

The eastern margins of the NSW rangelands have seen a shift from simple grazing systems to multiple agricultural activities. Clearing of native woodlands in this region commenced over 150 years ago but has increased markedly since the 1950s, and fire regimes have varied greatly across time, with a corresponding change in native flora and fauna. In such altered landscapes, fauna species may take years to reach new population equilibrium levels even after clearing has ceased or new fire management programmes are implemented. CafeAnimal was developed for research into predicting biodiversity outcomes for alternative policy and management options in the agricultural landscape of western New South Wales.

METHODS

Life history parameters, such as fecundity and mortality, are set as probabilities per timestep, territory size is limited by a maximum radius and social structure is described as maximum and minimum allowable group compositions. Resources that vary in time and/or space are mapped as a series of raster datasets, and rules about the minimum requirements for each resource are set. This allows territory sizes to change with varying resource availability. The model currently uses annual time steps and at each step determines whether each individual survives, whether each group has a suitable composition and resources to remain cohesive and reproduce successfully, and the path and fate of any dispersing individuals.

Two species with published life history data were selected to trial the software. The Brown Treecreeper (*Climacteris picumnus*) was used to test the ability of the model to represent species that live in large and structured social groups, and the Malleefowl (*Leipoa ocellata*) used to test the capabilities with changing habitat quality due to fires. Resource mapping for the treecreeper simulations was sourced from a series of vegetation maps of the Nyngan region from the last 30 years reclassified to presence/absence of woodland, with the distribution of woodlands for the last year used for a further 66 years to represent the effect of cessation of clearing. Resource mapping for malleefowl was sourced from fire management simulations representing four management scenarios for mallee lands being conducted by Bradstock *et al.* (in press), giving time since last fire which was converted to a malleefowl carrying capacity based on Benshemesh (1992). The fire simulations were conducted assuming predominantly westerly winds during wildfires. Both sets of maps were at 1ha resolution and at annual increments. Each simulation was replicated 50 times covering 100 years.

RESULTS

At the higher published survival rates for treecreepers in the New England Tablelands (Cooper 2000, Higgins *et al.* 2001), the simulations were able to produce stable populations that showed a diversity of group compositions (one to seven birds per group), with the modal size varying between three and four birds, and less than 15% of groups were composed only of males. The majority of the population was restricted to the larger patches in the landscape but adjacent areas were colonised at times. At the mid to lower range of the published survival rates from the Central West of NSW (Higgins 2001) group sizes declined with time, with the proportion of all male groups increasing. Groups in isolated and marginal remnants in all simulations tended to become composed only of males, followed eventually by local extinctions. At the lowest survival rates landscape wide extinction resulted. Dispersing females were usually absorbed by neighbouring territories.

Malleefowl modelling showed that burn scenarios producing coarse age mosaics were capable of supporting malleefowl populations. For example, prescribed burns of 1% of the landscape p.a. with a 0.1 probability of wildfire ignition p.a. produced vegetation patterns supporting 13 to 121 active territories (mean 69). Unlike the modelling of Bradstock *et al.* (in press) which used the density of stands of old *Callitris verrucosa* to indicate suitable malleefowl habitat, this modelling using mallee age to determine suitability predicted that a scenario of prescribed burning of 5% of the landscape p.a. with a 0.2 probability of wildfire ignition p.a. resulted in extinction, usually within 70 years (maximum 86 years), with less than 12 territories being occupied for most of the simulations. The distribution of active territories fluctuated across all simulations but more commonly occupied the western parts of the landscape.

DISCUSSION

The software reproduced the male biases reported by Cooper (2000) for declining treecreeper populations. This was both in terms of population structure and the geographic arrangement. The limited dispersal of females can be explained by the ability of groups of territories to absorb produced females, rather than the inability of females to make long movements as hypothesised by Cooper (2000). Some predictions about malleefowl differed from previous work. While the distribution of mature *Callitris verrucosa* and mallee stand age are correlated (Bradstock *et al.* in press), which is the better predictor of malleefowl habitat would need to be assessed.

The variation in results between two modelling methods for malleefowl show that care is needed if modelling is to be applied to land management, and that field data need to be compared with model predictions after management is implemented to ensure its aims are being achieved. Models that report on a wide variety of a species' attributes allow for more possible ways of comparing field and modelled data, and for the use of snapshot samples of population structure rather trend data.

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