The spatial dynamics of the White-browed Babbler in a fragmented agricultural landscape

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Aerial photograph of remnant vegetation in Site B of the Kellerberrin study area.

Preface

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Signature

The data presented in this thesis were collected, analysed and interpreted by the author, with the following exceptions:

- The data on vegetation structure and invertebrate abundance presented in Chapters 5 and 6 were collected by A. Noack as an Honours Thesis for Curtin University (Western Australia) (Noack 1996), under the supervision of Dr. J. Major and myself. I reanalysed the raw data for the purpose of this thesis.

- The nest watch data presented in Chapter 7 were part of a collaborative project between myself and Prof. D. Bryant (Stirling University, Scotland) on the effect of the relatedness of individuals on cooperative behaviour. Approximately two thirds of the nest watches were done by Prof. D. Bryant and M. Lloyd (Stirling University), but all of the analysis and interpretation presented here is my own.

- The dispersal simulation model presented in Appendix I was developed by Lesley and Michael Brooker. My contribution to this paper was to supply the dispersal data for White-browed Babblers and to make comments on earlier drafts. The use and interpretation of this simulation model in Chapter 10 was done by myself.

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Abstract

The Kellerberrin district of the central wheatbelt of Western Australia has undergone extensive and rapid changes in its 130 years of agricultural development. These changes have severely reduced the area of the original vegetation communities (approximately 7% remains), producing landscapes with remnants, which are generally small, scattered throughout a mosaic of agricultural land uses. These landscape changes have resulted in major changes to the avifauna of the region. Although the White-browed Babbler is still relatively common in the Kellerberrin area, this does not mean that the changes to the landscapes in this area have not had adverse effects on this species. Habitat loss and fragmentation, and changes in the ecological processes within remnant vegetation (*e.g.* changes in disturbance regimes), have affected the demographics and social dynamics of babbler groups, and the population dynamics of this species.

Grazing by domestic stock was found to reduce the cover and density of the vegetation and to reduce the structural differences between the vegetation types used by White-browed Babblers. These changes did not result in obvious differences in the quality of habitat with respect to food resources, because White-browed Babblers had a high level of plasticity in their foraging behaviour. This enabled them to track changes in the availability of invertebrates.

The habitat used by White-browed Babblers varied and this affected its breeding quality and the likelihood that groups would persist in a habitat patch. Linear habitat reduced group productivity, due to higher rates of nest predation. Low foliage density reduced recruitment by increasing juvenile mortality. The combination of these two factors produced differences in habitat quality, but group size influenced the effect this habitat quality had on group dynamics. The small size of many groups meant that; although 81% of groups occupied habitat which could be considered *source* habitat (*i.e.* group productivity was sufficient to compensate for breeder mortality), only 44% of groups had productivity rates which met this definition of a *source*.

Low invertebrate abundance during Summer was found to increase the likelihood of groups leaving their breeding territory during this period, but the configuration of the local population also had an influence on these movements. Group movements occurred at a larger spatial scale than dispersals by individuals. They affected local population dynamics by providing new groups to occupy vacant home ranges in local populations, but they also resulted in declines in the number of groups in some local populations. Their influence on the spatial structure of local populations could not be determined, because groups which made permanent movements out of the study sites were never found again.

Individual White-browed Babblers made temporary visits and permanent dispersals to other groups. There was a female-bias in the dispersal of White-browed Babblers resulting from the social structure of this species. Male and post-natal female dispersals occurred at small spatial scales and were affected by the size and isolation of habitat patches. Female natal dispersals occurred over larger spatial scales and were important in defining the boundaries of local populations. However, these boundaries were not discrete. Landscape connectivity influenced dispersal patterns and consequently was an important factor in determining the size and shape of local populations.

The complex dispersal behaviour and group social structure of White-browed Babblers resulted in a population structure which had four hierarchical levels of organisation: 1) *groups* which were the basic breeding unit; 2) *social neighbourhoods* where group interactions and visits by individuals were frequent; 3) *local populations* containing social neighbourhoods which interacted via high levels of dispersal; and 4) *metapopulations* consisting of a number of local populations which were associated by low levels of dispersal. In order to manage species, such as the White-browed Babbler, in fragmented agricultural landscapes it is necessary to determine the species' population structure, and to understand how life history processes operating at different organisational levels within this structure interact with landscape processes.

Table of Contents