White-browed Babblers *Pomatostomus superciliosus* had overlapping home ranges during the non-breeding season. During the breeding season these home ranges were restricted in area and there was little overlap between groups. There were three types of interaction associated with this spacing behaviour. Foraging interactions involved the aggregation of two or more groups to forage in a common area, and were more common during the non-breeding season. Calling displays involved members of two groups calling to each other. This occasionally led to the third interaction, chases, where one bird from each group chased each other. Calling displays and chases resulted in the separation of groups and occurred almost exclusively during the breeding season.

The most parsimonious explanation for the behaviour of these White-browed Babbler groups was that they held territories during the breeding season, but became non-territorial for the rest of the year. The lack of territorial behaviour during the non-breeding season may be related to limited food supplies during the summer.

In this paper I describe interactions between White-browed Babbler groups within remnant vegetation of the central wheatbelt of Western Australia. I then address the specific question; are White-browed Babblers territorial?

**METHODS**

**Study area**

This study was carried out within a 1,680 square kilometre area just north of Kellerberrin, which is approximately 200 kilometres east of Perth, Western Australia. This area is part of the Western Australian wheatbelt that has undergone extensive clearing for the purposes of agriculture. Over 500 remnants of the original vegetation remain within the study area, 77 per cent of these are less than 20 hectares in size and only 4 per cent are larger than 100 hectares (Arnold and Weedenburg 1991). White-browed Babbler groups were monitored in 20 remnants varying in size from 2 to 70 hectares.

**Monitoring of groups**

From 1994 to 1996 I caught and colour-banded 357 White-browed Babblers. Most were caught using mist nets, by attracting the group to the nets with the taped call of a fledgling. I also banded nestlings before they fledged and occasionally caught newly fledged young by hand. Each bird was given a unique colour band combination consisting of a colour band over the metal band on one leg and two colour bands on the other leg. Where possible all birds from the same group were given the same colour band over metal combination and adjacent groups were given a different combination. This made it easier to identify groups and to determine when adjacent groups were aggregating.

For all babbler groups found in the study sites I defined a Habitat Patch based on the distribution of vegetation considered suitable for the permanent occupation of a group (Cale 1999). The boundaries of these habitat patches were determined from a hardcopy of the 1994 Landsat image and were then verified on the ground. Areas of suitable vegetation were considered to be discrete remnant patches if they were separated by more than 100 metres of unsuitable vegetation.

I visited most habitat patches regularly (approximately 1–4 times per month) throughout the breeding seasons (July–October) of 1994 to 1996. Visits during the non-breeding season were less frequent, but given the longer period, the total number of visits was approximately the same as for the breeding season. During visits to a habitat patch I attempted to locate all groups of babblers occupying it. The locations of all groups were mapped using aerial photographs for analysis of home range size and shape.
Sometimes members of several groups were observed together. In these cases I considered both groups to be present if I recorded at least two banded birds from each group, the total number of birds was consistent with the expected number in both groups, and I could find no sign of these groups elsewhere. I considered these periods of group mixing as interactions if group composition was not clear or some physical or acoustic behaviour occurred. Differences in the frequency of interactions between the breeding and non-breeding (combined pre-breeding and post-breeding) seasons was tested using Chi-square analysis with correction for continuity (Zar 1996). Calling displays and chases were combined in this analysis, because of the low expected frequencies for chases.

Home ranges

The home range of a group was defined by the smallest polygon that encompassed all observed locations of that group. The boundaries of this home range were restricted to native vegetation. All locations recorded for a group throughout the three years of the study were combined to estimate its home range size. Estimates of home range size were calculated for groups that were followed through at least one full year. Because the size of most home ranges was determined from accumulating data over several years, they are slight over-estimates of the area used by a group in any one year. However, the purpose of these home range estimates is to compare the change in area used between the breeding and non-breeding season, and since both are biased in the same way this comparison remains valid.

Two measures, linear dimension and area, were used to describe the size of home ranges. The linear dimension was defined as the straight line distance between the farthest two points on the boundary polygon of the home range. The area of each home range was measured to the nearest 0.1 hectare, while the linear dimension was measured to the nearest 10 metres. These measurements were made for the total area occupied by each group and for the area each group occupied during the breeding season (defined as July to October).

RESULTS

Home range size

Home ranges varied in size from 1.5 to 15.3 hectares, with an average of 6.6 hectares (Table 1). The total home range of a babbler group was on average 65 per cent larger in size and 85 per cent longer than the area they occupied during the breeding season (Table 1). A group's total home range frequently overlapped with those of adjacent groups but there was very little overlap between home ranges during the breeding season.

<table>
<thead>
<tr>
<th>Interaction type</th>
<th>Breeding (July-Oct)</th>
<th>Foraging (Nov-Feb)</th>
<th>Calling (Mar-June)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calling displays</td>
<td>8</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Chases</td>
<td>8</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Factors affecting the frequency of occurrence of interactions

Most foraging interactions occurred during the breeding season, and the non-breeding season differed significantly ($\chi^2 = 4.65, p = 0.031$). The most common type of interaction was for members of two or more groups to forage as a single group (Foraging interaction). These interactions could last for several hours. The end of a foraging interaction was never obvious, because individuals slowly coalesced back into their respective groups. Most foraging interactions occurred during the non-breeding period. Three of the eight foraging interactions observed during the breeding season occurred between groups that had finished nesting and had young juveniles. Therefore, these cases could be considered post-breeding interactions. Another four of the foraging interactions during the breeding season involved newly budded groups interacting with their original group. These interactions occurred while the budded groups were establishing their new territory and building their first nest.

<table>
<thead>
<tr>
<th>Type of interaction</th>
<th>Breeding (July-Oct)</th>
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<td>0</td>
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</tr>
</tbody>
</table>

Almost all of the other interactions occurred during the breeding season (13 of 14 observations) and all involved calling between members of different groups (Calling displays) (Table 2). Calling displays generally involved more than one bird from each group, but not all members of groups were involved on all occasions. Calling displays sometimes led to the third type of interaction (Chases) where two birds, one from each group, chased each other. I was never able to determine which individuals were involved in chases. During calling displays and chases it was common for some members of the different groups to forage together. However, in contrast to foraging interactions these interactions were short (less than 20 minutes) and always led to both groups moving some distance away from each other.

DISCUSSION

Some of the observed interactions (calling displays and chases) between groups of White-browed Babblers resulted in these groups separating from each other. These behaviours were also associated with a reduction in the overlap between group home ranges during the breeding season. These observations are consistent with Hinde's (1956) definition of territorial behaviour, and are broadly similar to the territorial disputes described for the Grey-crowned Babbler (Counsilman 1977; King 1980) and Hall's Babbler (Balda and Brown 1977). However, calling displays and chases in White-browed Babbler groups were only evident during the breeding season, and though calling displays often involved many group members, chases only involved individuals. This differed from the territorial division of territories among birds of different species.
that White-browed Babblers in the Inverell district of New South Wales became nomadic after breeding, but she did not give any details of this behaviour. This suggests that at least some groups in this area were not territorial during the non-breeding season. However, this area has also been modified by agricultural activity, though the extent of this modification is likely to be less extreme than in the current study area.

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REFERENCES


