

TERRITORY IN THE AUSTRALIAN MAGPIE (*Gymnorhina tibicen*): AN ANALYSIS OF ITS SIZE AND CHANGE

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The Australian Magpie (*Gymnorhina tibicen*) has become famous to scholars of animal behaviour throughout the world for its extreme degree of territorial behaviour, and for the fact that territories are held by groups (a characteristic found in only a few species), not individuals or pairs. Carrick (1963), in his classic 5-year study of the Black-backed Magpie (*G. tibicen tibicen*) in Gungahlin, near Canberra, found that only members of the species living in group-held territories bred. The majority of Magpies failed to gain a territory and formed a large non-breeding flock. In this way, Carrick suggests that territory serves to limit the total population.

The present study was aimed at examining more closely the relation between the size of a territory and the number of Magpies occupying it, and the ways in which territories change over a two-year period. The study was initiated in July, 1971, and terminated in July, 1973. Eleven groups of White-backed Magpies (*G. tibicen leuconota*) whose territories covered the grounds of the Flinders University of South Australia were kept under observation at regular intervals during this period. The study area consisted of undulating open grasslands, with patches of

eucalypts (*Eucalyptus odorata*, *E. cladocalyx*, and *E. camaldulensis*), and introduced pines.

METHOD OF STUDY

Territories were plotted using two techniques. The first consisted of chasing members of a group in all possible directions. When Magpies are chased to the limit of their territory, they will turn back as if there were a large invisible wall. The second, and more precise, technique was to notice where a boundary dispute between two groups occurred. The two techniques together gave reasonably accurate data on the territorial boundaries of each group.

In addition to plotting territories, a precise record was made each year of the total number of magpies in each group, and its composition in terms of males, females, and juveniles. Magpies were not banded, and thus the fate of individual birds could not be determined.

Although periodic checks on the groups and their territories were made throughout the two-year period, the primary data were taken during the months June and July of 1971, 1972, and 1973. Casual observations suggested that by this time the adults had

already ejected some or all of the young born the previous spring, and were preparing to construct new nests.

TERRITORY AND SIZE OF THE GROUP

Carrick concluded "there is no relation between the size and quality of the territory and the number of birds that occupy it" (Carrick, 1963, p. 745). Yet this assertion would seem to contradict not only our intuition, but also prevalent theories of the function of territory, on two counts. First, many theorists (e.g., Wynne-Edwards, 1962) have suggested that one of the functions of territory is to ensure an adequate food supply for the holders of that territory. If

this is the case, one would expect that for ground-feeders such as the Magpie, a larger group would require more territory than a smaller one. Second, it seems reasonable to expect that a larger group, through its greater number of "troops," would be able to obtain and defend a larger territory than a smaller group.

Twenty-five separate observations of territory size and population were obtained during the study period (seven groups in 1971, nine in 1972, and nine in 1973); since the population and territory size fluctuated each year, a given group studied on the three different years was counted as three separate observations.

TABLE 1

The total number of groups, average territory size, and average number of acres per Magpie, calculated separately for each size of group.

Number of Magpies in Group	2	3	4	5	6	7	8
Number of groups	2	5	3	5	6	3	1
Average territory size (in acres)	7.5	13.2	15.0	19.6	19.4	17.9	15.6
Average number of acres per Magpie	3.8	4.4	3.8	3.9	3.2	2.6	2.0

The results are shown in Table 1. The first row below the double line represents the number of groups having the number of members specified for each column. Thus, there were two groups of size two, five groups of size three, three groups of size four, and so on. As is apparent from Table 1, the size of a territory is related to the number of Magpies in the group. Territories with two birds averaged 7.5 acres, territories with three birds averaged 13.2 acres, and territories with four birds averaged 15.0 acres. There is a slight reversal of this trend for groups of six, seven, and eight Magpies; yet all these groups have average territory sizes larger than groups with four or less members.

The correlation between the number of Magpies in a group and the size of their territory was found to be $r = .51$, computed from a sample size of 25. A correlation this great would occur by chance less than one time in a hundred. Thus, despite Carrick's earlier finding, we can be quite confident that there is a relation between the size of a territory and the number of Magpies on it.

Is the size of a territory directly proportional to the number of Magpies on it? That is, if group A has twice as many

Magpies as group B, will its territory be twice as large? The answer to this question is suggested by the bottom row of Table 1. The average number of acres per Magpie was computed simply by dividing the average territory size by the number of birds in the group. If the size of a territory is directly proportional to the number of Magpies on it, then the average number of acres per Magpie should remain constant. The bottom row of Table 1 indicates that this is approximately the case. The space per Magpie averages 3.3 acres, ranging from 2.0 to 4.4. The data for groups of size seven and eight suggest that for larger groups, there may be slightly less territory per Magpie than for smaller groups.

Carrick also reported that in the Gungahlin study area groups ranged in size from 2 to 10 birds with an average of three adults per group, while territories ranged from 2 to 20 acres with an average of about 10 acres. In the present study group size ranged from 2 to 8 with an average of 3.6 adults, while the size of territories ranged from 7.2 to 30.8 acres, with an average of 16.0. The group size was thus in agreement with that found by Carrick, while the territory size, both in

range and on average, was half again as large.

CHANGES IN TERRITORY

The territories studied during the two-year period are presented in Figure 1. As is readily apparent from the three maps, there is a considerable degree of stability over the two-year period. Yet there is also a considerable degree of change, and it is this that merits discussion.

There appears to be four broad categories in which one can place the changes in territory that occurred during the period under study; expansion or contraction, displacement, split, and complete gain.

Territorial expansion or contraction.

This category is by far the most common type of territory shift, and refers to a group simply grabbing territory from one of the neighbouring groups. The grabbing is accomplished through a "battle" which is not really a battle at all, but a skirmish in which the two opposing groups each try to make an imposing show of force by carolling, swooping, and diving at each other, without inflicting any serious injury. Over the course of such a skirmish, which may last anywhere up to fifteen minutes, the boundary may shift slightly in favour of the group putting up the best show of force. At the end of the skirmish, we have often observed the two groups walking along on either side of the newly established boundary line, feeding every so often. Perhaps this ceremony serves to "make official" the new boundary.

Many examples of territorial expansion and contraction are evident from the three maps in Figure 1. Thus, for example, Group V lost considerable ground to Groups X and VIB between 1971 and 1972. Similarly Group IV expanded south-westward between 1972 and 1973, gaining a large section of the student car park from a group to the south-west not included in the study.

The extreme fluidity of shifts of border is illustrated by the border between Groups VII, VIII, and IX. In July of 1971, Group VIII owned the "Large Pine" marked on the map in the north-west corner of their territory. Yet by October 23, 1971, Group VII was in clear possession of the Large Pine. By March 12, 1972, Group IX had taken firm possession of the tree. The tree and its immediate territory thus changed

hands twice in eight months. The Large Pine seemed to be a favourite roosting spot for whichever group owned it, and perhaps this made it a special prize.

Territorial displacement.

This term refers to the occurrence of a group's losing some territory in one area and simultaneously gaining territory in another. The territory thus remains approximately the same size, but is displaced. Only one clear example occurred in the present study. Sometime between July, 1971, and March, 1972, Group IX (which had not been studied in 1971, but almost certainly bordered Group VIII on the west in that year) took about three acres along the western end of Group VIII's territory. Simultaneously (or at least sometime during this period) Group VIII took about an acre from Group VIA, including almost half the grove of pines below the Hall of Residence. This shift was again evident the following year; by July, 1973, group IX had taken another acre from the west side of Group VIII's territory, and Group VIII had taken another acre of pine woods from Group VIA. Group VIII's territory was thus successively displaced eastwards over the two-year period.

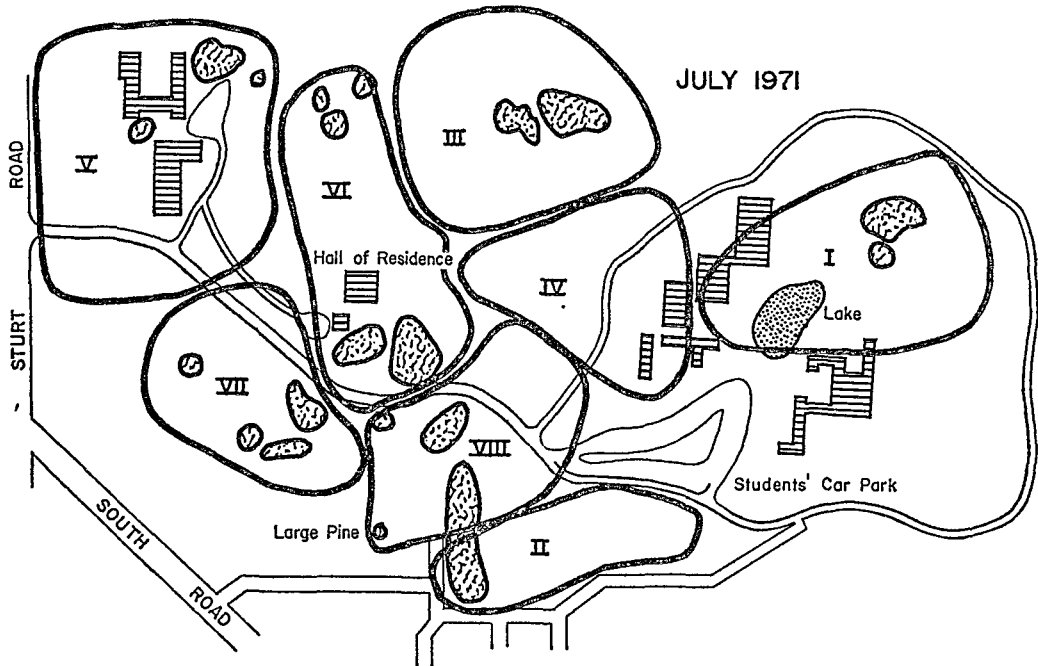
Territorial split.

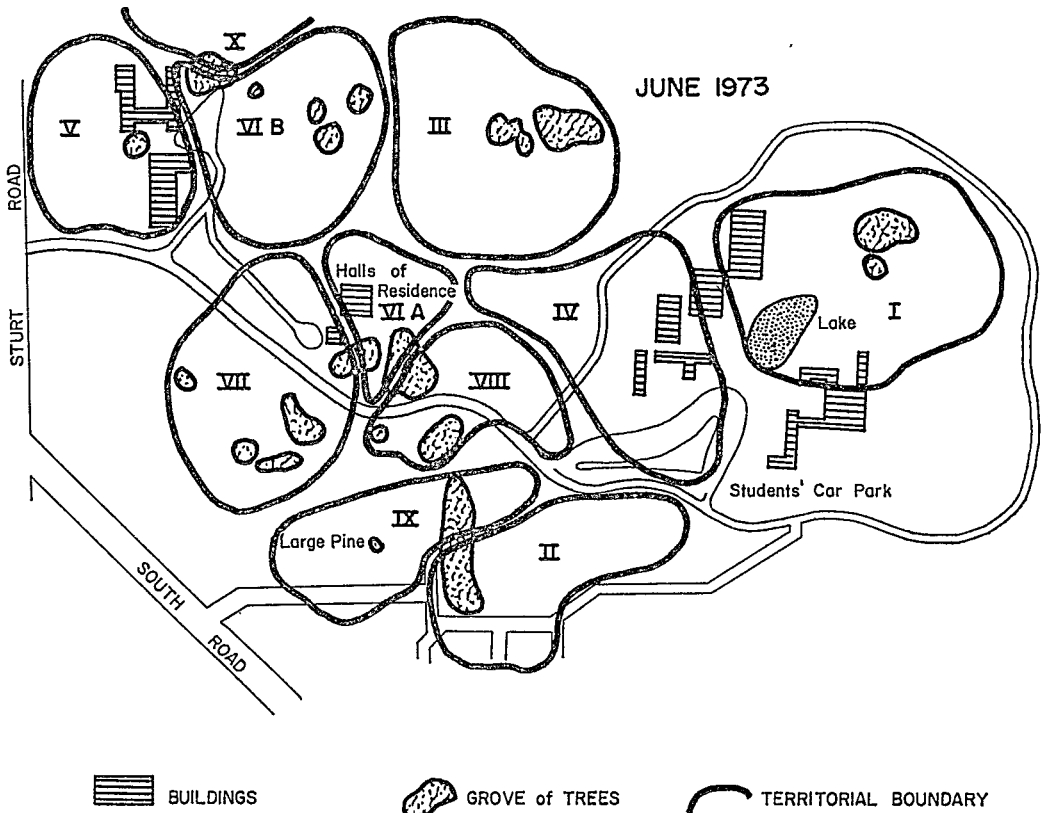
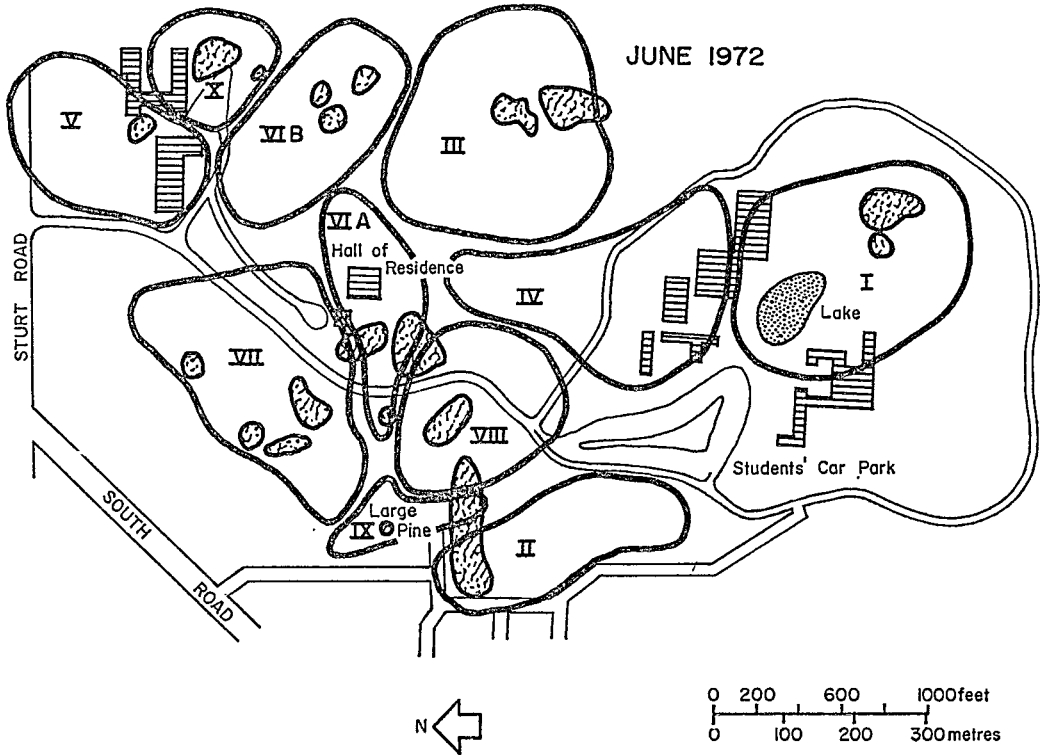
This category denotes a group's splitting in two, and dividing the territory between them. This happened only once in the present study. Group VI in 1971 occupied a large area, as indicated on the map, and in October of that year consisted of two males, three females, and three juveniles just out of the nest. By March of 1972 they had split into two groups; one, denoted VIA, consisted of one male, one female, and one juvenile, and the other, denoted VIB, consisted of one male, two females, and two juveniles. (Since the Magpies were not banded, the above conclusions are based on inference. It is possible that either VIA or VIB was a new, invading group. However, correspondence in the composition of the two new groups to the original group makes the split interpretation far more likely).

Complete territorial gain.

Occasionally, a group which has just lost its territory, or whose members were recently non-territorial, may manage to gain an entirely new territory for itself (Carrick,

Figure 1. Maps showing territorial boundaries for 1971, 1972, and 1973, on the Flinders University grounds. The boundaries appear with spaces between them only to facilitate their presentation in the figure. The boundaries shown are thus approximate only. A perfect representation would shown the boundaries of most neighbouring groups to be contiguous.





1963, cites many examples of this). Such appears to be the case with Group X. In July, 1971, Group V occupied the large territory shown in the map. Yet by October of 1971, a male and female pair had managed to gain the territory shown as X on the 1972 map, and had already nested and hatched two young (which subsequently perished.) They managed to hold this territory (although being displaced eastwards), and successfully reared two young the following spring.

In addition to the four categories described above, Carrick (1963) reports what would constitute a fifth category; territorial extinction. Here, an entire group is totally driven out of their territory. He found this only to occur after loss of one of the dominant adults, usually an adult male. Territorial extinction could thus be considered to be the complete reverse of complete territorial gain.

DISCUSSION

The present study leaves two questions: what might account for the relation between the number of Magpies in a group and the size of the territory they hold; and what might account for the various forms of changes in territory?

The relation between number in the group and territory size has two plausible explanations. First, it may be due to the larger food requirements, and hence larger feeding space, demanded by the larger group. Second, it may be due to the superior fighting ability of a group with more members. Although it would be difficult to test the latter alternative, the former alternative should be readily testable. If the relation is due to feeding requirements, then for groups of equal numbers, we would expect that territories rich in food would be smaller than those poor in food. That is, the average number of acres per Magpie should be inversely proportional to the food abundance

per acre. Such an analysis was not possible in the present study because no adequate measure of "food richness" was found. A possible way around this problem would be to provide artificial "feeding stations" for some groups, and note whether for them the average number of acres per Magpie decreases.

What might account for the various forms of changes in territory? The problem of territorial expansion or contraction will probably need to await the answer to the question of what determines the size of a territory. The same would apply to territorial displacement, complete territorial gain, and territorial extinction. Territorial split, on the other hand, may be due to the presence of more birds than the social structure of the group can accommodate. It would seem plausible to assume that there must be at least two adult males and two adult females for a split to occur. Thus, Group VI prior to the split consisted of two males, three females, and three juveniles.

If nothing else, it is hoped that this study will encourage the further investigation of *Gymnorhina tibicen*, one of the most common yet most fascinating members of Australia's avian fauna.

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