Movements and Habitat Use of the Torresian Crow in a Subtropical Suburban Environment

Susanne Everding and Robert Montgomerie

Summary: We studied the movements and habitat use of Torresian Crows *Corvus orru* in Brisbane, Australia, between December 1991 and December 1994. Home ranges were 5–2246 ha in area, and overlapped with each other and with sightings of 38 wing-tagged crows. Home ranges of radio-tracked crows were elongated, with roosts and centres of activity near the perimeters of these home ranges. Crows were radio-tracked for 1-5 weeks during which time there was relatively little change in the size, shape or location of their home ranges. Crows tended to move greater distances on days after nights spent at large roosts, but the correlation was not significant. Crows significantly preferred park and edge habitats to forest and suburban habitats, presumably because these areas provide resources for feeding and roosting.

During the past 30 years of urban growth, most of Brisbane’s natural subtropical and eucalypt forests have been replaced by suburbs and parkland. Associated with this change, Torresian Crows *Corvus orru* have proliferated (Jones & Everding 1993), and are often considered a nuisance. To date, however, no studies have been conducted on Australian corvids in urban areas and current knowledge of crow movements and habitat use is limited to investigations of their general ecology in rural environments (Rowley 1970, 1973; Rowley & Vestjens 1973).

An understanding of home range size and fidelity, local movements, and habitat use of suburban Torresian Crows is fundamental to developing management recommendations. Our goals in this study were to: (1) describe the features of crow home ranges; (2) estimate variation in home range fidelity; and (3) determine habitat preference of crows relative to availability.

Methods

The field work was conducted by SE in a residential area near Toohey Forest, a large (220 ha) remnant of eucalypt forest within the suburbs of southern Brisbane, Australia (Fig. 1a). Two campuses of Griffith University (Nathan and Mt. Gravatt), a cemetery, and a large sports stadium were within the study area. Average rainfall is about 1150 mm per year, and the climate is subtropical. A detailed description of the area is given in Catterall & Wallace (1987).

Trapping

Crows were trapped on the Mt. Gravatt campus of Griffith University using a modification of the ‘crow trap’ in Holllom and Brownlow (1955) and the portable ‘dangler’ trap in Rowley (1968). Each trap was a large cage, $2 \times 2 \times 2$ m, with a small side door through which a person could enter to remove the birds. Birds entered the trap through either a 1 m long funnel in the roof or a $30 \times 20$ cm hole adjacent to the funnel framed with loose, dangling wires to prevent captured crows from escaping.

Banding, marking and morphometrics

Forty-six crows were captured between 19 December 1991 and 26 June 1994. Each was fitted with a stainless steel Australian Bird and Bat Banding Scheme (ABBBS) leg band and a lemon-yellow PVC cattle ear tag ($5.7 \times 4$ cm, 13.6 g; Allflex Tag Co., Collingwood, Queensland) punched through the patagium of each wing using the standard tool designed for that purpose. Tags were individually numbered with a black permanent marker (supplied by manufacturer).

For all crows recorded, we noted the colour of the iris, mouth and tongue and sketched the pattern of the iris. Rowley (1970) found that eye and gape are good indicators of age in Australian *Corvus* species; in the Torresian Crow, eye colour changes from Sky Blue (colour names in capitals from Smithe 1975) at 1-3 months, to Ground Cinnamon at 3-11 months, to mottled Ground Cinnamon and white at 11-21 months.
and finally to white beyond 21 months. The mouth lining and tongue of a nestling crow are Pink. With age, the mouth lining and tongue gradually become more black than Pink until the bird reaches its second year; then both are black (Rowley 1970).

Radio-tracking

Five crows were successfully fitted with radio-transmitters (Titley Electronics, Ballina, New South Wales) attached using a harness (see Kenward 1987). Based on eye and gape colour, four of these crows were adults and the other was in its first year.

Transmitter frequencies ranged from 151.279 to 151.880 MHz and were distinctive enough to allow us to identify individual crows despite some frequency drift. We used a 3-element hand-held Yagi antenna and a Regal 2000 telemetry receiver (Titley Electronics) to track the crows. Tracking was done either by car or on foot and continued until the transmitter battery failed, typically about one month, except for crow A who tore the harness and removed the transmitter after 7 d.

We tried to obtain one fix for each crow within each of the following time periods each day: one half hour after sunrise (between 0558 and 0637)–0800, 0900–1100, 1200–1400, 1500–one half hour before sunset (between 1710 and 1745) and after dark, between 1900 and 2400, to find the evening roost. Occasionally we also visited roosts before sunrise (between 0558 and 0637) to establish whether or not crows had changed roosts during the night, but they did not.

The location of each crow at any time was plotted on Queensland Department of Mapping and Surveying 1:2500 orthophoto maps. The precise locations of crow D were the only ones we could not regularly confirm by sight as the bird was often obstructed by vegetation or flew away as we approached. The locations of this crow were therefore found by triangulation; in the few instances where we only used two bearings, we assumed the location to be the intersection of the two bearings (Pyke & O’Connor 1990). For all crows except for D, we estimated that map locations were accurate to within 5-10 m.

Visual sightings of marked birds

The locations of crows marked with individually numbered patagial tags were reported by residents of the Brisbane area between 18 December 1991 and 23 December 1994. These sightings were plotted on 1:2500 orthophoto maps.

Habitat use

In this study, we were interested only in the use of habitats within the home ranges of the radio-tracked crows. We identified four general, easily identifiable habitat types in the crows’ home ranges: ‘Forest’ was primarily Toohey Forest, a large tract of native forest and woodland in south-east Brisbane (Catterall & Wallace 1987). All other large, forested, undisturbed areas were defined as ‘Forest’ as well. ‘Edge’ was that band of forest 20 m wide at the forest-suburb interface. We defined a ‘Park’ area as any large, maintained, grassy area, such as football fields and city parks, which also had large trees suitable for crows to perch on. ‘Suburb’ included the remaining habitat: residential areas, shopping malls, and university buildings and adjacent grounds. Orthophoto maps were used to measure the areas of four habitat types within each crow’s home range.

Data analyses

The sizes and configurations of home ranges and measures of fidelity were determined using Wildtrak (Version 1.11; Todd 1993). Home range sizes and shapes were estimated with the minimum convex polygon (MCP) method (Odum & Kuenzler 1955). Home range drift for each crow was measured as the per cent of 100 × 100 m grid cells in which the crow was sighted that changed from week to week (Doncaster & Macdonald 1991; Todd 1993).

We present both 95% and 100% MCPs, but use only 100% MCPs in the analyses (Kenward 1987). The centre of activity within the estimated home range was calculated as the mean of the x and y coordinates (Todd 1993). However, we excluded the coordinates of roosts for this analysis so that the centres of activity are based solely on diurnal sightings.

We used the technique of Neu et al. (1974) to test for habitat preferences. For each crow we calculated a selection index for each habitat type as the per cent of fixes in each habitat divided by the per cent of each habitat in the crow’s home range (Krebs 1999). If a crow used a habitat type in proportion to its abundance, the selection index would be 1.0. The significance of departures from 1.0 were tested with Bonferroni–corrected confidence limits, with indices significantly > 1.0 indicating habitat preference and < 1.0 indicating avoidance.
Results

The winter home ranges of five radio-tracked crows and reported sightings of birds marked with patagial tags are shown in Figure 1. There was considerable variation in the sizes of home ranges within the study site and considerable overlap between home ranges and the ranges of sighted birds. The youngest crow had the smallest home range size, but since we were unable to accurately age the remaining 4 birds, we do not know if a correlation exists between age and home range size. Complete home ranges (i.e. 100% MCPs) were 50% larger (706.2 ± 917.79 ha; mean ± s.d., Table 1) than the 95% MCPs (471.06 ± 702.17 ha). Thus, about one third of the home ranges of these crows was little used.

All home ranges (both 95% and 100% MCPs) were irregular but elongated in shape (Fig. 2). The centres of activity were generally close to primary roosts and near the perimeter of the home ranges. Roosts tended to be closer to the periphery of the home ranges than were the centres of activity. Crow C differed slightly from this pattern as its primary roost was centrally situated within its home range and far from the centre of activity.

The mean per cent home range drift of all 5 radio-tracked birds combined was 46%. The home ranges of crows B, D and E drifted somewhat from week to week (weekly drift ranging from 25-86%) whereas that of crow C was stable for 3 consecutive weeks, after drifting only 33% in the first week of study.

Crows did not use habitats in proportion to their abundance in our study area (Fig. 3). Edge and park habitats were used significantly more frequently than expected and forest habitats, in particular, were signifi-

Table 1 Home range sizes (minimum convex polygons) of five Torresian Crows *Corvus orru* radio-tracked in winter 1994.

<table>
<thead>
<tr>
<th>Crow</th>
<th>Age (yr)</th>
<th>Home Range (MCP in ha)</th>
<th>Total fixes</th>
<th>Dates tracked</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 1</td>
<td>4.81</td>
<td>2.58</td>
<td>31</td>
</tr>
<tr>
<td>B</td>
<td>≥ 2</td>
<td>2245.57</td>
<td>1686.46</td>
<td>65</td>
</tr>
<tr>
<td>C</td>
<td>≥ 2</td>
<td>30.71</td>
<td>2.31</td>
<td>146</td>
</tr>
<tr>
<td>D</td>
<td>≥ 4.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>486.66</td>
<td>239.64</td>
<td>103</td>
</tr>
<tr>
<td>E</td>
<td>≥ 2</td>
<td>763.28</td>
<td>424.29</td>
<td>87</td>
</tr>
</tbody>
</table>

<sup>a</sup> first banded December 1991 when it was already more than two years old.

Figure 1 Maps of (a) winter (May, June and July 1994) home ranges of five Torresian Crows, and (b) all sightings of patagial-tagged crows seen in the same area between January 1992 and November 1994. Capital letters in (a) refer to home ranges shown in detail in Figure 2. Shading in (b) encompasses the ranges shown in (a). * = Mt. Gravatt Cemetery.
cantly avoided. The suburb habitat was significantly avoided by two of the crows, and not preferred by any crow. For Crows B–E, the difference between habitat use and availability was highly significant overall ($\chi^2 = 208-409, P < 0.001, d.f. = 3$ in each case), whereas Crow A, who was followed for only one week, showed no difference between habitat use and availability ($\chi^2 = 2.3, P > 0.50, d.f. = 3$).

The total distance that a crow travelled per day was positively correlated with the size of the roost that it stayed in the previous night, but the correlation was not significant (Spearman Rank Correlation: $r_s = 0.43, P = 0.22, n = 10$ crow × roost combinations). For this analysis we calculated mean travel distance per day for each crow tracked from each roost, thus assuming that crow × roost combinations were independent. Each mean travel distance was based on at least 7 d data. For the one crow that visited four different roosts, the correlation between mean travel distance and roost size was significant ($r_s = 0.95, P = 0.05, n = 4$ roosts).

**Discussion**

**Home ranges**

The home ranges of the five radio-tracked crows were variable in size (Table 1) but, on average, the 100% MCPs were about five times the mean territory size of breeding Torresian Crows at Jandowae (131 ha) recorded by Rowley (1973). While four of the five...
radio-tracked crows were adults at the time of capture (more than two years old), we did not know whether crows B, C and E were breeders, as this species does not normally breed until its third or fourth year (Rowley et al. 1973). Only crow D was known to be of breeding age (recaptured 2.5 years after it was aged at ≥ 2 years), and thus likely to be a territory holder, but even its home range was more than three times as big as the average at Jandowae. Although our sample size is small, these results suggest that crows in urban areas may have larger home ranges than those in more rural habitats.

**Daily movements**

Our data suggest that the crows used roosts close to their feeding areas, probably to minimise travel costs. For the two birds (B and E) that used more than one roost, roost location seemed to determine the sites visited the next day; when a bird changed to a different roost, it usually foraged close to the new roost the following day (SE pers. obs.). This finding is consistent with the ‘patch-sitting’ hypothesis of Caccamise & Morrison (1986). Under this hypothesis, birds are expected to roost close to their diurnal activity centre or the current superabundant food supply, and use that feeding area in the morning when their energy needs are the greatest. At the end of the day, individuals can afford to travel greater distances to other roosts located near other feeding areas.

Other studies have found similar patterns: Resident Hooded Crows *Corvus corone* in Denmark roosted near feeding areas apparently to decrease commuting costs and maximise the amount of time spent feeding (Møller 1983). In Britain, flocks of Common Ravens *C. corax* often roosted near locally abundant food supplies, such as refuse tips (Ewins et al. 1986). Roosts of American Crows *C. brachyrhynchos* in New Jersey were also spatially associated with abundant food patches (Stouffer & Caccamise 1991).

Torresian Crows were more likely to travel greater distances on a given day when they had roosted in a relatively large roost the night before. Although the relationship between travel distance and roost size was not significant, this analysis has low statistical power and should be further explored with a much larger sample size. Hamilton & Gilbert (1969) also found a relationship between roost size and distance travelled in European Starlings *Sturnus vulgaris*; individual European Starlings dispersing from small roosts moved only a few kilometres, whereas birds using large roosts moved up to 80 km. They suggested that intraspecific competition promoted distant dispersal from the roost, and that birds travelling greater distances were compensated by the increased availability of food at those areas due to lack of competition. Engel & Young (1992) and Engel et al. (1992) also found that dispersal distance increased with roost population size in Common Ravens in Idaho. Two of the four roosts they studied were near dense food supplies and fewer birds were using those roosts, compared with the other two larger roosts.

The relationship we observed between distance travelled and roost size is also consistent with the much-touted ‘information centre hypothesis’ (Ward & Zahavi 1973). This hypothesis suggests that individuals using a communal roost transfer information among themselves about the location of good feeding areas. Thus, on any given day, less-successful foragers recognize successful foragers and follow them from the roost to the feeding site the following day (Ward & Zahavi 1973). Crows using large roosts would be more likely to glean information about distant food supplies from knowledgeable birds by virtue of the larger information ‘pool’ available to them.

**Habitat use**

An animal is said to prefer a particular habitat, when time spent in that habitat is proportionately greater than
would be expected by chance alone (White & Garrott 1990). Three of the five crows we radio-tracked exhibited significant preferences for park and edge habitats, and four of the five significantly avoided forested areas (Fig. 3). These results suggest that the park and edge habitats supply suburban crows with resources needed for foraging, loafing, and roosting which may not be available in the forest and suburban areas.

Our finding that crows show a preference for edge habitats is supported by a study of winter habitat use by birds near Toohey Forest, Brisbane. Here, Catterall et al. (1991) classified Torresian Crows as an ‘edge species’. They found that edge species were, on average, large birds (26-55 cm) that fed most often on open ground, eating insects and some other food items. Edge species used trees for perching and nesting, and the researchers concluded that the edge area provided a favourable combination of resources.

Invertebrates have been found to make up a large proportion of the diet of the crow in areas outside of Brisbane. Rowley & Vestjens (1973), in a study of the diet of Australian crows, found 47% of the stomachs of 90 Torresian Crows collected in the eastern states contained invertebrates, 37% contained plant material (primarily seeds but some fruit), and 16% contained carrion.

The park and edge habitats in Brisbane may indeed provide a wealth of invertebrate fauna that provides food for crows. Green et al. (1989) found that the abundance of invertebrates in Brisbane was much greater than in Melbourne, a city with a temperate climate. They suggested that the warmer winters in Brisbane were responsible for the large differences in the number of pupae, egg masses, spiders and crawling insects found in the two cities.

Management implications

The results of this study suggest some management options that may help reduce crow numbers where the species is considered a pest. Crows preferred park and edge habitats to suburb and forest areas presumably for their value as profitable foraging, loafing and roosting sites. Although city parks would not likely be altered to simply discourage crows, edge habitats could be modified by the householder. Since park and edge habitats are characterized by being well-watered and rich in invertebrate fauna and edible refuse, residents could (1) practice judicial watering of lawns and gardens beds, (2) be careful in the disposal of waste by keeping all refuse covered, (3) prevent access to food meant for pets by covering food or keeping food indoors, and (4) not feed crows and other birds. In conjunction with these recommendations, wildlife managers should develop methods that discourage, frighten or remove crows from problem areas.

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References


