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ARTICLE

Home range size of the Collared Crescentchest, *Melanopareia torquata* (Melanopareiidae) during the reproductive period in southeastern Brazil

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ABSTRACT: The Collared Crescentchest (*Melanopareia torquata*) is an endemic bird of the Brazilian Cerrado that is regionally threatened with extinction. The goal of the present study was to estimate the Collared Crescentchest's home range size during the reproductive period in a preserved reserve of Cerrado, where its population is small and declining. Data was obtained in October and November 2007 from 10 to 44 radio-locations for a total of 10 individuals. Only five individuals had their home range accumulation curves stabilized (average 36.4 ± 7.4 radio-locations). With the method of fixed Kernel (95%) average home range was 1.51 ± 0.52 ha and the core area (75%) was 0.68 ± 0.23 ha. I found that the species occupies a small home range during the reproductive period and that there was no home range overlap among the birds, although, some of them were observed very close to a neighbor's area. The small home ranges and the large availability of its preferred habitat indicate that area alone is not a limiting factor explaining the population decline of the species in the area.

KEY-WORDS: endemic bird, savanna, home range.

The Collared Crescentchest (*Melanopareia torquata*, Family Melanopareidae) is an insectivorous bird endemic to the Cerrado (Silva & Bates 2002) in Brazil and eastern Bolivia and northeastern Paraguay (Ridgely & Tudor 1994). It is most common in secondary and open savanna areas within the Cerrado, especially with greater density of tall shrubs where it is commonly observed near or on the ground and may also use armadillo and rodent holes (Kanegae & Reis 2011, Kanegae *et al.* 2012). The nest is globular and built in a grass clump close to the ground. Both males and females share incubation and care of young (Kanegae *et al.* 2010).

The Collared Crescentchest is "endangered" according to the List of Endangered Animals in the state of São Paulo, where it is found in two fragmented reserves, the "Estação Ecológica de Itirapina" (hereafter EEI) and the "Estação Ecológica de Águas de Santa Bárbara" (2,712 ha) (São Paulo 2009). Its population in the EEI is small, around 57 individuals (Kanegae 2011), and declining (Willis 2004).

Studies of home range dynamics are important not only to understand spatial distribution, but also for management and conservation strategies and determining reserve minimum size (Woodroffe & Ginsberg 1998, Wiktander *et al.* 2001, Bellis *et al.* 2004). Here, I estimate home range size of the Collared Crescentchest during the reproductive period at EEI.

MATERIAL AND METHODS

Study Area.-The study was carried out at the Estação Ecológica de Itirapina (EEI), a conservation area of 2,720 ha located in the state of São Paulo, in southeastern Brazil (22°15¢S; 47°49¢W, 700-750 m in elevation). The Collared Crescentchest was studied in contiguous areas that form a mosaic of grassland with sparse shrubs (*campo sujo*) and *parque cerrado*, which is dominated by shrubs and herbaceous plants with some tree cover (Ribeiro & Walter 1998). Mean annual precipitation is 1,376 mm with a dry season between April and September (rainfall ranging from 32 to 88 mm monthly) and a rainy season between October and March (rainfall ranging from 117 to 257 mm; DAEE Posto D4-014, Itirapina, SP). The mean monthly temperatures in 2006 ranged between 19.5º and 21.9º

C in the dry season and 18.9º - 21.7º C in the rainy season (DAEE Posto D4-014, Itirapina, SP).

Radio transmitters.- I captured birds in October and November 2007, both during the morning (6 h - 12 h) and afternoon (16 h - 18 h). Birds were captured in 12 x 2 m mist-nets using playback to attract them. Captured birds were banded with a metal band (provided by National Research Center for the Conservation of Wild Birds - CEMAVE) and a unique combination of colour bands on the other leg. Blood samples (0.1 ml) were taken from all captured birds from the jugular vein for genetic sex determination (Griffiths *et al.* 1998).

I used a total of 12 radio transmitters (Holohil Systems model LB-2) to track Collared Crescentchest individuals. Each transmitter weighted 0.52 (3.3 % of the birds' weight). Several types of techniques to attach the transmitters to the back of the birds were used. Initially, I used a non-latex eyelash glue (modified from Raim 1978) in two birds, a Cyanocrylate based glue on ten birds, and Super-Bonder (Bowman *et al*. 2002) in seven birds. Neither technique worked well. I then tried a bag tied onto the back of the bird with ribbon (weight = 0.1 g, modified from Hill *et al.* 1998) on which the transmitter was taped (90% polyester and 5% nylon), thereby forming a 0.1g backpack (Navjot & Oliphant 1992, Kenward 2001, Millspaugh & Marzluff 2001). An LA 12-Q (AVMA) receiver with a Yagi antenna with three elements was used to track the birds.

For greater accuracy during radio-location, I practiced detecting radio transmitters placed under clumps of grasses in the Cerrado before we attached them to the birds. The birds were monitored during the breeding season in October and November 2007. I monitored birds in intervals of around 5 hours distributed in the beginning and end of the morning and late afternoon. Only the strongest signal was used for the bird point detection, which was recorded by GPS (Global Positioning System, Garmin - Etrex Summit). As the Collared Crescentchest is a territorial species that moves little during the observer's approach (*pers. obs.*), records were noted based on the direct observation (visual or auditory) method (White & Garrott 1990).

Data analysis.- Home range was estimated using the Minimum Convex Polygon (MCP) and Fixed Kernel methods (FK) with least-square-cross-validation parameters (Mohr 1947) (Table 1) using the TRACKER 1.1 program. Despite some problems with MCP (White & Garrot 1990, Burgman & Fox 2003, Borger *et al.* 2006), this method is simple and easy to calculate._I calculated the area accumulation curve for each individual tracked based on the 95% MCP (Minimum Convex Polygon; Odum & Kuenzler 1955, Leary *et al.* 1998) to determine when the number of sightings was sufficient to estimate home range size. The first five points of radio-locations were selected to calculate the home range using the 95% MPC. Then, these procedures were repeated until all points were included. The point of stabilization in the accumulation curve was that where the addition of data points represented less than a 1% increase in home range size (Leary *et al.* 1998).

RESULTS

Techniques used to attach the radio transmitter.- In October and November of 2007, 20 individual Collared Crescentchests were captured and 13 birds had the radio transmitters fall off due to the inefficacy of the first two techniques (eyelash glue and cyanoacrylate based glue) used (Table 1). Five of these individuals were recaptured and the transmitter was reattached with the backpack technique. In the end, I tracked 10 individuals for which I had > 10 radio-recordings, including seven with radios attached with the backpack technique and three with the transmitter attached with cyanoacrylate glue.

The first technique with eyelash glue was used in five individuals and lasted three to five days. The second technique, the cyanoacrylate based glue, was used in 10 individuals and remained attached from 3 to 11 days. Finally, the backpack technique was tested in seven individuals, two of which were preyed upon. Around one week after the individual bird predations, their former territories were rapidly occupied by another vocalizing bird, which indicates competition for a higher quality territory. Recaptured animals showed no physical damage as a result of the bonding techniques employed.

Variation in home range and core area. - The number of radio-locations of individual birds monitored ranged from 10 to 44. The individuals monitored were 10 males that occurred in *campo sujo* (n = 2 individuals), *parque cerrado* (n = 5 individuals) and in areas with both vegetation types (n = 3 individuals). Area accumulation curves for home range size measurements stabilized for five birds only (24 to 44 radio locations), with an average of 36.4 ± 7.4 radio-locations. Area accumulation curves did not stabilize for four of the individual birds that had < 24 radio-locations and another individual (M6), even though it had 35 radio-locations (1.04 ha).

Home range size in individuals with stabilized accumulation curves varied from 0.59 ha to 1.63 ha (mean ± standard deviation, 1.09 ± 0.34 ha, Table 1). Home ranges calculated with the fixed Kernel method ranged from 0.78 ha to 2.2 ha and had an average of 1.51 ± 0.52 ha. The core area (75%) of home ranges also showed a wide variation, from 0.43 ha to 1.0 ha, with an average of 0.68 ± 0.23 ha. Despite the small home range size, some radio-locations were observed very close to a neighbors' home range, as observed for M7 and M4, and M4 and M6. However, there was no home range overlap among the individuals monitored.

TABLE 1. Estimates of home range size of 10 males of the Collared Crescentchest *Melanopareia torquata* (identification number of individuals - ID) monitored during October and November of 2007 at EEI in the southeastern region of the State of São Paulo, Brazil. The phytophisionomies where birds were captured were Cs: *campo sujo*, and Pc: *parque cerrado*. The techniques used to attach the radio transmitter on the bird's back were cyanocrylate based glue, eyelash glue, and a backpack with ribbon. Some individuals were recaptured and had the radio transmitter attached again, but with the backpack technique. Home range sizes were calculated with the 95% Minimum Polygon Convex (MPC) and Kernel techniques. The core area 75% was calculated exclusively based on the Kernel technique. Dates represent the first and last day of the bird tracking. In bold are the males monitored during the nesting period.

Individuals (ID)	Habitat	Technique (captures)	Monitoring period (number of days)	Recapture period (number of days)	Technique (recapture)	Locations	MCP 95% (ha)	Kernel 95% (ha)	Core area 75% (ha)
M1	Pc	Cyanocrylate	16–21 Oct (5)	N	-	10	0.55	1.22	0.29
M2	Pc	Eyelash glue	6–10 Nov (2)	27-01 Nov (6)	Backpack (rec [2])	11	0.22	0.79	0.44
M3	Cs + Pc	Cyanocrylate	15–20 Oct (6)	N	-	15	0.97	1.68	0.83
M4	Cs + Pc	Cyanocrylate	15-25 Oct (9)	N	-	21	1.25	2.20	0.55
M5*[1]	Pc	Eyelash glue	7-9 Oct (2)	26–12 Nov (14)	Backpack (rec)	24	0.59	0.78	0.43
M6	Cs + Pc	Cyanocrylate	12–20 Oct (4)	2-24 Nov (19)	Backpack	35	1.04	1.01	0.81
M7*	Cs	Cyanocrylate	12–20 Oct (4)	2-24 Nov (19)	Backpack	37	1.05	1.62	0.48
M8*	Cs	Backpack	7-25 Nov (18)	N	-	38	0.56	0.87	0.16
M9*	Pc	Backpack	8 -24 Nov (16)	N	-	39	0.54	0.66	0.24
M10*	Pc	Cyanocrylate	13–15 Oct (2)	15 Oct - 7 Nov (20)	Backpack	44	1.63	1.78	1.0

[1]* home range curve stabilized
[2]* recaptured individuals

Two individuals (M8 and M9) were monitored when attending nests with nestlings. Their nests were located at the edge of the core area of their home ranges. Both individuals had a similar number of radio-locations and home range sizes (around 0.55 ha with MPC, and 0.75 ha with FK, Table 1).

DISCUSSION

Variation in home range and core area.- Home ranges of Collared Crescentchests EEI varied significantly among individuals. Males with nests had home range sizes around 0.55 ha (MPC) to 0.75 ha (FK), smaller than in the other individuals analyzed. They participated in the care of offspring with periodic visits to the nest, which probably affected calculations of home range size due to the energetic cost to maintain them (Kanegae *et al.* 2010).

The home range size of Collared Crescentchests was much smaller than those reported for other typical Cerrado bird species. The home range of *Neothraupis fasciata* (Emberizidae) was 3.7 ± 0.6 ha (weight 28.6 g, n = 38 groups monitored with flocks of 2-7 individuals) in areas of sparse and typical Cerrado (Duca 2007). A similar result was obtained for the same species by Alves (1990), who estimated a home range size of 4.3 ha (one group monitored with three individuals). Larger species of the family Corvidae, such as the jay *Cyanocorax cristatellus* (134 g), live in groups of about ten individuals and have an estimated home range size of 172 ± 46 ha; however, during the reproductive period the occupied area decreases considerably, being restricted to 29 ha around the nest (Amaral & Macedo 2003).

For small species of flycatchers such as *Culicivora caudacuta*, it is estimated that home range size is at least 17.5 ha (5.7 g, two groups with three to seven individuals monitored) in open field and open Cerrado areas (Sousa & Marini 2007). Other Cerrado flycatchers found in pairs or in mixed-species flocks, such as *Suiriri affinis* (20.6 g, n = 12 groups monitored), had an estimated home range of 14 ± 1.9 ha in typical and dense Cerrado. *Suiriri islerorum* (20.1 g, n = 11 groups) has an estimated home range area of 11.2 ± 0.6 ha in a sparse Cerrado (Lopes & Marini 2006). In contrast, home range sizes of species associated with *campo rupestre* were calculated for *Knipolegus lophotes* (32 g, n = 2 pairs, 6.5 and 7.7 ha; Ribeiro *et al.* 2002), *Embernagra longicauda* (2.52 ± 0.77 ha with MPC and 3.35 ± 0.90 ha with Kernel; Freitas & Rodrigues 2012), *Poospiza cinerea* (16.10-17.10 g, one pair, 15.02 ha with MPC and 16.56 ha with Kernel; Costa & Rodrigues 2013) and *Schistochlamys ruficapillus* (two groups, average of 6.4-8.4 ha) (Domingues & Rodrigues 2007).

These home range comparisons show that differences in home range size may be correlated with flock size and body weight. Individuals with a large body masses need more energy to live, reflecting in a more extensive home range. The same is true for species that occur in monospecific flocks, which can be as small as *Culicivora caudacuta*, a species that needs wide foraging areas for maintenance. The core area is more often used than any other area within the home-range and likely contains the places of lodging, shelter and the most important food resources (Burt 1943, Kaufmann 1962, Ewer 1968). In this study, the location of nests at the edge of the core area, may indicate that males, despite participating in the care of offspring (Kanegae *et al.*, 2010), do not do it very intensely. Furthermore, a study with crows, *Corvus corax,* indicated a distinct behavior where the core area of males and females is centered around the nest and food resources (Roth *et al.* 2004). The core area can also be associated with centers of vocalizations, as observed by males of *Dendroica cerulea* who selected locations with a high density of trees (*Carya cordiformis*) for perching (Barg *et al*. 2006).

Techniques used to attach the radio transmitter. -The radio transmitter attachment technique is a limitation factor to be considered in our study. The high temperatures in the Cerrado may have contributed to the detachment of the radio-transmitter. During the studied months, the mean daily temperatures ranged from 18.1º ± 2.4º C to 31.1º ± 4.3 º C (ADEE Tour D4-014, Itirapina, SP). Daily temperature variations were high, around 13º C on average, reaching up to 20º C. Moreover, birds movements between clumps of grasses and shrubs can pull off the radio transmitter. It was not possible to test whether the backpack technique contributed to predation. However, it performed better than the non-latex eyelash glue and the cyanoacrylate based glue because the period of attachment on the bird was longer.

Final considerations.- The home range size estimates of the Collared Crescentchest indicate that there are large areas of *campo sujo* (around 800 ha) and *parque cerrado* (571 ha) for population expansion. The small population of the species in the EEI (Kanegae 2011) and its decline (Willis 2004) indicate that other factors are preventing the species to expand its population. Factors such as the presence of predators (snakes, jays and falcons) and intra- and interspecific competition could affect the Collared Crescentchest population and inhibit its expansion in the EEI. Importantly, the expansion of exotic grasses (*Urochloa decumbens* and *Melinis minutiflora*) could alter the Collared Crescentchest's microhabitat and inhibit the expansion of its population as well (Kanegae *et al.* 2012). Therefore, it is of paramount importance to understand the Collared Crescentchest's interactions with biotic factors to develop conservation strategies and improve its population size in the EEI.

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