Revista Brasileira de Ornitologia, 22(3), 270-277
September 2014

ARTICLE

Reproductive biology and nest-site selection of the Mato Grosso Antbird *Cercomacra melanaria* in the Brazilian Pantanal

Bianca Bernardon[1, 2, 3], Paula Fernanda Albonette de Nóbrega[1] and João Batista de Pinho[1]

[1] Laboratório de Ornitologia, Núcleo de Estudos Ecológicos do Pantanal, Instituto de Biociências, Universidade Federal de Mato Grosso – UFMT, Avenida Fernando Corrêa, s/nº, Coxipó, CEP 78060-900, Cuiabá, MT, Brazil
[2] Current Address: Grupo de Pesquisa em Ecologia de Vertebrados Terrestres, Instituto de Desenvolvimento Sustentável Mamirauá – IDSM, Estrada do Bexiga, 2584, CEP 69553-225, Tefé, AM, Brazil
[3] Corresponding author: biabernardon@yahoo.com.br

Received on 27 December 2013. Accepted on 26 June 2014.

ABSTRACT: Economic activities, such as extensive cattle ranching, may seriously threaten the types of forest most important to the Mato Grosso Antbird *Cercomacra melanaria*, and information on reproductive biology is essential for defining sound conservation and management strategies for the species. Here, we report on the reproductive biology of this species in the Brazilian Pantanal, focusing on attributes such as incubation and nestling periods, as well as characteristics of parental care. The hypothesis that nest occurrence is associated with canopy opening was also tested. Average nest height was 0.98 m; mean nest construction and egg incubation periods were 12.2 and 14 days, respectively; average nestling period was 9.4 days. Both males and females participated in nest construction, egg incubation, and feeding of nestlings. The canopy was consistently more open away from the nests (18.74%) than at nest sites (10.10%; $P < 0.0001$), indicating that *C. melanaria* selects nest sites with dense vegetation.

KEY-WORDS: Canopy opening, nesting biology, reproductive attributes, Thamnophilidae.

INTRODUCTION

Through study of the reproductive biology of a species, a better understanding of its life history is gained (Bartholomew 1986). Nests characteristics are among the key attributes of the life history of birds, and are strictly tied to their reproductive success (Ricklefs 1969, Mason 1985, Ricketts & Ritchison 2000, Mezquida & Marone 2001).

Reproductive parameters such as the size of eggs and brood, extent of incubation period, and care for nestlings are subject to selection and are therefore important to individual fitness (Ricklefs 2003). However, these parameters are poorly studied and, for most species, remain unknown (Robinson *et al*. 2000, Ricklefs 2003).

Nest site selection occurs early in the breeding season and is made within the pair's territory. In some cases, the male and female choose the nest-building location together (Burger 1985), and this choice is described in terms of general habitat characteristics, vegetation and environmental factors (Clark *et al*. 1983, Jones 2001).

The Mato Grosso Antbird *Cercomacra melanaria* (Passeriformes, Thamnophilidae) inhabits the sub canopy in semi deciduous and gallery forests of the Brazilian Pantanal, as well as the Guaporé Pantanal, and the Bolivian Chaco (Zimmer & Isler 2003). This species relies heavily on two forest types for survival in the region and might become locally threatened because of economic activities such as hydroelectric power plants of the Paraguay-Paraná waterway and extensive cattle ranching (Pinho *et al*. 2006, Pinho & Marini 2012). Thus, information on reproductive biology is essential to set safe strategies for the conservation and management of the species. Pinho *et al*. (2006) presented the first description of the nest and eggs of *Cercomacra melanaria,* as well as some aspects of natural history and reproductive biology; nevertheless, important information on the species' breeding biology remains unknown.

The aim of this study was to understand the reproductive attributes of the Mato Grosso Antbird. As such, incubation period and the amount of time nestlings remained in the nest were determined. Furthermore, parental care and morphological characteristics of nests and eggs were described, and the hypothesis that nest occurrence is associated with canopy opening was tested.

METHODS

Study area

This study was conducted from August to December 2005, July to August 2006, and October to December 2006, at the Retiro Novo Farm (16º 22' 0.4''S, 56º 17' 56.6'' W, 130 m alt.) in the Pirizal region, municipality of Poconé, state of Mato Grosso (MT), Brazil.

The predominant vegetation in the study area is associated with forest habitats, such as *Cambarazal*, *Landi*, *Carvoeiro* and *Cordilheira* forests. Our study was conducted in *Cambarazal*, a seasonally flooded semi-evergreen forest dominated by *Vochysia divergens* Pohl. Nascimento & Nunes da Cunha (1989), Nunes da Cunha & Junk (2001) and Arieira & Nunes da Cunha (2006) have presented details on vegetation structure and composition in the Poconé Pantanal. The climate in this region is characterized by two seasons: dry from April to September, and wet from October to March (Nunes da Cunha & Junk 2004). The average annual temperature is 25.8º C, with October being the warmest month and July the coldest. Average rainfall is 1,250 mm/year, of which 80% occurs between November and March (Allem & Valls 1987).

Field methods

Nest search and monitoring

With the intention of locating nests, understory vegetation was thoroughly inspected throughout 29 ha of *Cambarazal* forest from September to December 2005, in August 2006, and from October to December 2006. Spotting and following birds carrying nest material or food was also a way of locating nests. While searching for and monitoring nests, precautions were taken to minimize impact to the surroundings, avoid damage to vegetation, and minimize time at the site. To avoid attracting predators, the position of each nest was marked with a colored ribbon at least three meters away from it.

Nests were monitored through visits at intervals of three to four days, at which time their status was recorded (eggs, nestlings, or predated). However, a subset of nests was monitored more regularly during critical periods, such as egg laying, hatching, and nestling (every day or every other day) in order to improve the confidence level of our estimates. When the status of a nest (*e.g.* egg laying, hatching, predated) changed between two consecutive visits, it was assumed that the change occurred mid-period. Our methodology was adapted from Martin & Geupel (1993) and Robinson *et al.* (2000).

Morphometric variables of each nest were measured (internal and external diameter of the opening, internal depth, and external length), as well as its height above the ground. These measurements were taken after the nests became inactive in order to avoid interference with nest activities; nests were considered active while still with eggs or nestlings, and inactive after the nestlings had left or when the nest had been predated.

The following information on each egg was recorded: measurement of length and width, mass, incubation period, and amount of time nestlings remained in the nest. Egg period was defined as the interval between oviposition of the first and last egg (Mayfield 1975). Incubation period was defined as the interval between oviposition of the last egg until hatching of the first nestling (Mayfield 1975). The last period, occurring from hatching of the first egg until the last nestling fledged, was considered the nestling period (Mayfield 1975). When chicks were about seven days old they received a metal band provided by CEMAVE/ICMBio (Brazilian banding agency; banding permit number 1281/1), and two plastic color bands for subsequent studies on territoriality.

Canopy openness

Hemispherical photographs provide estimates of canopy openness and leaf area index (Frazer *et al.* 1997) that are used in ecological and forestry studies (Frazer *et al.* 2000, 2001, Beaudet & Messier 2002, Melloh *et al.* 2003, Rubio & Pinho 2008). In order to investigate whether nest occurrence was associated with canopy density, two photographs were taken: one from just above the nest and another five meters to the north of it, taken at the same height as the nest. The second photograph (control site) was captured as a way of sampling a site not selected by the species for nesting. The Pantanal flooded forests present mosaics of understory and open areas dominated by grasslands (Nascimento & Nunes da Cunha 1989, Nunes da Cunha & Junk 2001, Arieira & Nunes da Cunha 2006). Due to these characteristics of the environment and the characteristics of the nest site, which are always well hidden between dense tangles of vegetation (Pinho *et al.* 2006), we considered the selection of five meters from the nest a sufficient distance to serve as the control site.

A hemispheric photograph was captured using a Nikkor 8 mm fisheye lens, which provided a 180º angle view of the canopy opening similar to that of the sky hemisphere (Frazer *et al.* 1997, Melloh *et al.* 2003). The lens was attached to a Nikon Coolpix E4300 digital camera, 4.1 megapixels, and the top of the camera was oriented northward with the aid of a compass (Frazer *et al.* 2001). No flash was used while taking photographs to avoid changes in image brightness. All images were taken in December 2006 at dawn or dusk, or on days when the cloud cover was uniform, to avoid reflections and sun rays passing through the canopy, as these could be confused with portions of the sky. Photographs were

taken when the wind was not blowing in order to avoid blurred images of moving vegetation (Frazer *et al*. 2001).

Data analysis

Hemispheric photographs were analyzed in the program Gap Light Analyzer 2.0 (GLA) (Frazer *et al*. 1999), which determined the percentage of open sky seen from underneath the vegetation, each analyzed image having 128 pixels. The opening in the canopy, over the nest and away from it, was subjected to a logistic regression to examine whether the probability of finding a nest was associated with opening in the canopy. Statistical analyses were performed using the Systat® 10 software package (Wilkinson 2000) following Zar (1984). The significance level of 5% was adopted.

RESULTS

Nest searching effort in 2005 was 153 h (September to December) and 157 h in 2006 (August - December), resulting in a total sampling effort of 310 hours. Fifty-one nests of the Mato Grosso Antbird were found, of which 47 were monitored until they became inactive. Among those 47 nests, seven (14.89%) were abandoned and one was damaged during construction; the remaining 39 nests being active, 12 (30.78%) of them successful. Regarding the 51 nests, 41.18% were located during the building phase, 49.02% during the incubation period, and 9.8% inhabited by fledglings.

Adult behavior near the nests facilitated locating them, and males capturing insects and giving them to females was a common observation (n = 8). Other behaviors that were often observed were: adults growing very agitated while carrying nest-building material, releasing items from their beaks when surprised by an observer; pairs in active nests displaying persistent vocalization and aggressive behavior when approached by an observer; during the incubation period, adults approaching nests quietly, being more tolerant of the presence of an observer; adult birds surprised by an observer while delivering food to their chicks, becoming very agitated and vocalizing, but retaining the food in their beaks; adults not feeding nestlings in the presence of an observer.

The first nest in construction was found on September 30, 2005, and the highest number of consecutive active nests (n = 10) was recorded in the second half of October (Figure 1 a). The first egg was observed on October 8th, and the first eggs hatched on October 25th.

In 2006, the first active nest was found on August 5th and the first eggs hatched on October 14th. The highest number of consecutive active nests (n = 11) was recorded in October, and the last nest was found on November 27th, which remained active until December 10th (Figure 1 b).

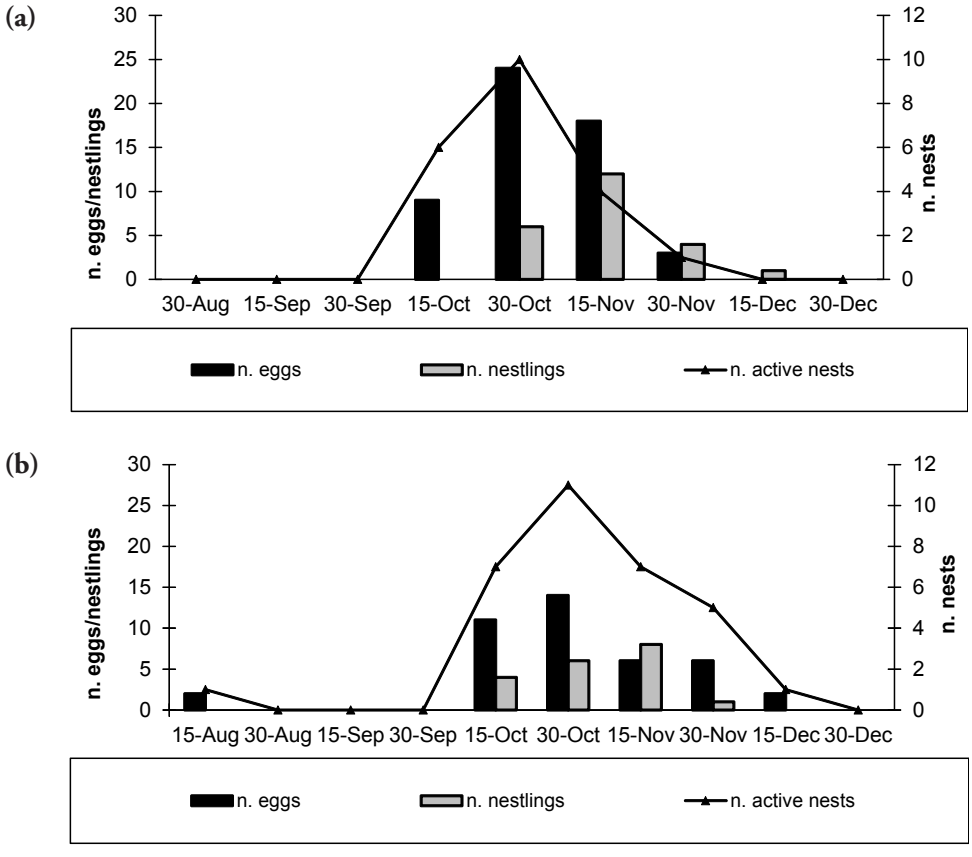

FIGURE 1. Number of active nests and number of eggs and offspring of the Mato Grosso Antbird recorded in the Pantanal, Brazil, during (a) 2005 and (b) 2006 breeding seasons.

Nests of Mato Grosso Antbirds are *low cup/lateral*, according to the classification of Simon & Pacheco (2005), constructed with fine fibers derived mainly from aerial roots of *Cissus spinosa* Camb. and *C. sicyoides* L., as well as dried leaves mostly from *Licania parvifolia* Huber (Chrysobalanaceae). These items are placed on the outside along with some grass (not identified) and other unidentified leaves, and all materials are secured with spider webs (Figure 2).

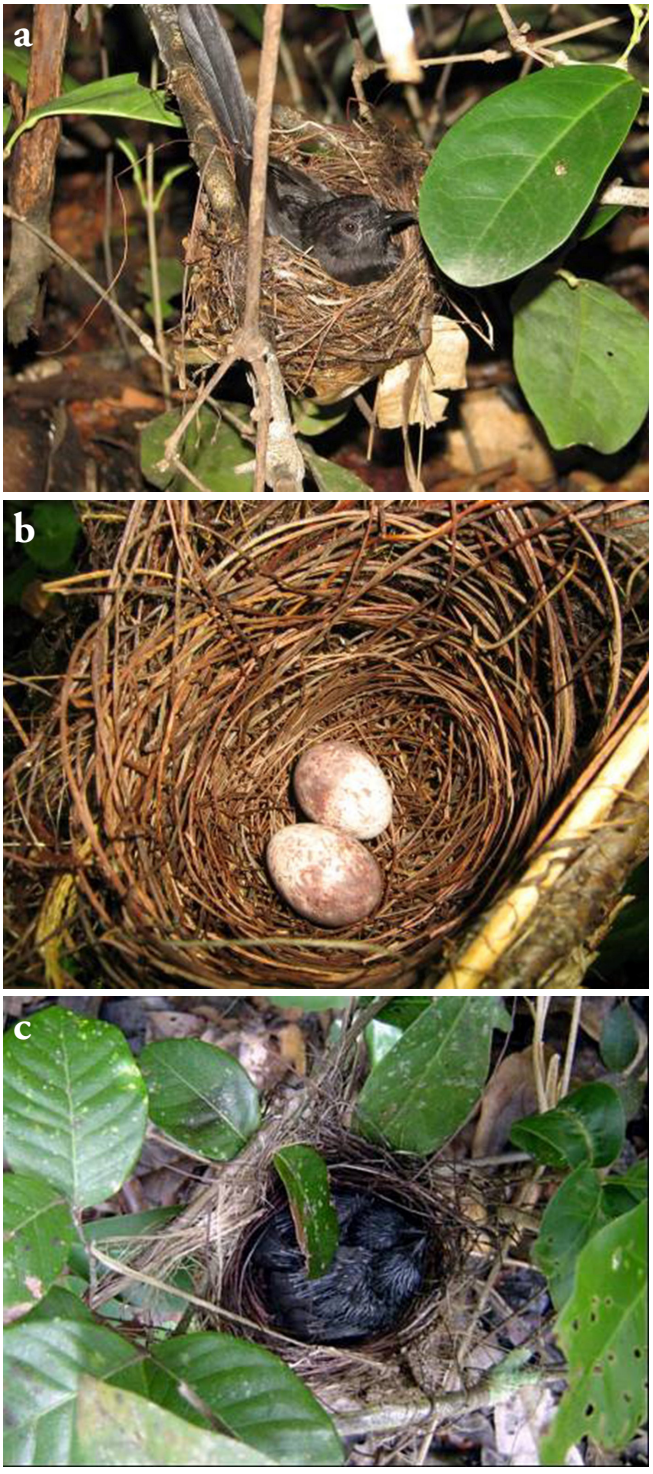

FIGURE 2. (a) Lateral view of a nest of the Mato Grosso Antbird, with a male incubating the eggs; (b) detail of the interior of the nest with eggs; (c) overview of the nest with nestlings.

Plant species used as support for the construction of the nests were *Licania parvifolia*, both young shrubs (n = 13) and branches of mature trees (n = 11), *Bactris glaucescens* Drude ("tucum") (n = 1), *Vochysia divergens* Pohl ("cambará") (n = 2), and several vines such as *Rhynchospora* sp. (razor grass) (n = 5). Construction also occurs inside bushes or trees with entangled vines (n = 6), on *Cissus spinosa* and *C. sicyoides* (n = 4), and on other herbaceous plants (n = 9).

The mean nest construction time observed was 12.20 ± 2.39 days (n = 5), and the range was 10-16 days. Males and females participated in nest building, and nests were not repaired after eggs were laid.

Nest height was 0.98 m ± 0.89 (n = 51), ranging between 0.23-4.50 m. External height of nests was 76 mm ± 5 (n = 18), ranging between 63-84 mm; internal height was 62 mm ± 8 (n = 18), ranging between 50-75 mm. External diameter was 86 mm ± 6 (n = 18), ranging from 74 to 98 mm; internal diameter was 59 mm ± 6 (n = 18), ranging between 44 to 70 mm.

Mean values of eggs were as follows: mass 2.5 g ± 0.2, length 20.9 mm ± 0.6, and width 15.1 mm ± 0.4 (n = 30). Maximum number of eggs per nest was two (n = 32) and in two cases only one egg was found, the average number being 1.9 (n = 34).

Average incubation period was 14 ± 0.71 days (n = 4), ranging from 13 to 14.5 days. Assuming that the period of egg-laying by this species is two days (Pinho *et al*. 2006), the egg period in this study was 16 days. Among 27 visits to the nest in which one parent was incubating, a female was observed 10 times and a male 17 times.

The nestling period ranged from eight to eleven days, averaging 9.4 ± 1.1 days (n = 10). Both males and females fed nestlings and uttered alarm calls at the approach of potential predators.

Two adult females were preyed upon in the nest, evidenced by the presence of feathers and bones on the ground near the destroyed nest. On November 3, 2005 one male whose female had been preyed upon paired with another female on the same day.

Three couples were observed feeding their fledglings outside the nest. On one occasion we observed a male being followed by a fledgling, while the mother was followed by and fed the other. At this stage, however, fledglings do not have sexual dimorphism and their plumage resembles that of the females.

Predated nests were not re-used, even by other bird species. Multiple attempts at reproducing were observed, and the same pair was witnessed trying to build a nest three times. After reproductive success, however, pairs no longer mated (n = 12).

The canopy was significantly more open away from the nests than on nest sites ($P < 0.0001$; Rho = 0323, Gal = 1) (Figure 3), suggesting that the species selected nest

sites with dense vegetation. The mean (n = 26) percentage of open sky seen from underneath the vegetation among selected sites (nest) was 10.10%, SD = 2.5, and for control sites (5 m from the nest) 18.74%, SD = 10.5 (Table 1).

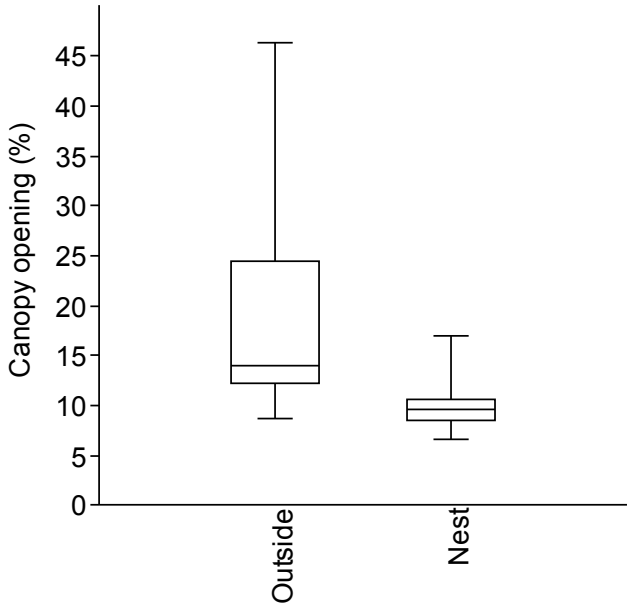

FIGURE 3. Percent of canopy opening (measured as the percentage of open sky seen from underneath the vegetation) at and 5 m away from nests of the Mato Grosso Antbird in the Pantanal, Brazil.

TABLE 1. Opening of the canopy (measured as the percentage of open sky seen from underneath the vegetation) above the nest sites of the Mato Grosso Antbird and away from nests (n = 26) in the Brazilian Pantanal.

	At nest sites	Away from nest sites
Min. (%)	6.56	8.64
Max. (%)	16.92	46.25
Mean ± SD (%)	10.10 ± 2.53	18.74 ± 10.50

DISCUSSION

Active nests of *C. melanaria* reach their peak in October, coinciding with the beginning of the wet season at Poconé Pantanal. In 2005 and 2006, the first active nest was found on October 8th and August 5th, respectively, the difference in the nesting period possibly being related to the rainy season and food availability in the Pantanal (Poulin *et al.* 1992, Rubio & Pinho 2008). In 2005 there was a period of marked drought without rain in July (0 mm), followed by a dry period in August (1 mm), and rain beginning in September (43.3 mm) (INMET 2008). In 2006, a complete drought did not occur, with rain in July (17.1 mm), August (24.3 mm) and September (112 mm) (INMET 2008). However, even with this difference in the onset of nest construction, both breeding seasons followed the pattern of reproduction common to most Neotropical passerines at this time of year (Aguilar *et al.* 1999, 2000, Aguilar 2001, Hau 2001, Duca & Marini 2004, Lopes & Marini 2005, Pinho 2005, Pinho *et al.* 2006, Marini *et al.* 2012). Aside from precipitation, food abundance also has been shown to affect breeding cycles in other tropical regions (Poulin *et al.* 1992, Stutchbury & Morton 2001, Hau *et al.* 2008), as insects migrate to more favorable environments among seasons (Adis *et al.* 2001, Battirola *et al.* 2007). Rainfall is probably a stronger determinant of food abundance in many tropical areas (Ahumada 2001), and food abundance for insectivorous antbirds increases dramatically during early rainy season, marking the beginning of their breeding periods (Willis 1972b).

The breeding period of the Mato Grosso Antbird, (approximately 90 days), is shorter than the entire wet season (150 days), with the first half of December experiencing a remarkable decrease in nest activity. During this period with abundant rainfall and flooding of primary areas, environmental conditions mainly in the sub canopy grow adverse for bird reproduction as nests are low; during the wet season, floodwater levels in Cambarazal forests can reach 1.4 m (Arieira & Nunes da Cunha 2006). The minimum and maximum nest heights found in this study for *C. melanaria* were 0.23 m and 4.5 m respectively, whereas those found in 2001 and 2002 for the same species varied from 0.3 to 2.0 m (Pinho *et al.* 2006), with average heights being similar in both studies (0.98 m in the present study versus 0.83 m in Pinho *et al.* 2006).

As previously stated, individuals of the Mato Grosso Antbird, as well as those of the Band-tailed Antbird *Hypocnemoides maculicauda*, use fibers of *Cissus spinosa* Camb. to build their nests (Pinho *et al.* 2006, 2009). Plant species (*Licania parvifolia*, *Bactris glaucescens* Drude, *Vochysia divergens* Pohl, *Rhynchospora* sp.) used by the Mato Grosso Antbirds to build nests and as nest support are abundant in the Poconé Pantanal, as demonstrated by floristic studies carried out at a local *Cambarazal* (Nascimento & Nunes da Cunha 1989, Arieira & Nunes da Cunha 2006). Many factors may be involved in the choice of plants used as support, such as density of shrubs in the nest area, height of shrub, and degree to which a plant can conceal the nest (Martin 1995, Howlett & Stutchbury 1996). As observed at the study area, nest sites had a higher concentration of shrubs, providing camouflage for the nests.

The *low cup/lateral* nests of Mato Grosso Antbirds are consistent with nests of other Thamnophilidae species (Johnson 1953, Greeney & Gelis 2007, Lebbin *et al.* 2007) and can be deep or shallow. Descriptions including dimensions are not common (Lebbin *et al.* 2007, Crozariol 2011), but are needed to ascertain whether there is any constant or significant variation in the

construction of these nests (Zimmer & Isler 2003). Pinho *et al*. (2006) obtained measurements of only one nest of *C. melanaria* (external height = 92 mm, diameter = 65 mm, depth = 74 mm), which differed from those in our study (n = 18) where the external height ranged between 63-84 mm (mean = 76 mm ± 5); the external diameter from 74 to 98 mm (mean = 86 mm ± 6), and the depth between 44 to 70 mm (mean = 59 mm ± 6). According to the classification of Simon & Pacheco (2005), the total height of *a low cup* nest must be less than or equal to its external diameter. Thus, the results found by Pinho *et al*. (2006), based on the measurements of just one nest, fit the *high cup/lateral* classification better than the *low cup/lateral* one reported herein. From a total of 18 nests measured in our study, two nests were found with total heights slightly greater than their diameters, being 78 x 74 mm and 84 x 81 mm, respectively. Regarding these exceptions, it may be concluded that most nests are *low/ cup lateral*, yet a few can be *high cup/lateral*.

The time spent on nest building varies greatly among species and even among couples of the same species (Zimmer & Isler 2003). The Mato Grosso Antbird presents a long nest-building period (10 – 16 days) compared to other species of the same family. For example, a nesting pair of the Plain Antvireo *Dysithamnus mentalis* (Thamnophilidae) was observed building a nest in less than two days (Skutch 1996). Nest building time for *Thamnophilus* species is five to six days, and more than eight days for the Checker-throated Antwren *Epinecrophylla fulviventris*. Usually, there is a pause of about two days between nest completion and the first egg laid (Zimmer & Isler 2003).

Throughout the breeding season, we observed males offering food items to females (n = 8), demonstrating an initial investment that contributes greatly to the formation of eggs (Greenberg & Gradwhol 1983). In Thamnophilidae, it is common, if not universal, for a male to nurture the female (Skutch 1996); the duration and extent of such behavior varies considerably among species and among couples of the same species (Zimmer & Isler 2003).

On average, in the present study egg incubation in Mato Grosso antbirds lasted 14 days, and the nestling phase 9.4 days. In a study conducted in 2001 and 2002, incubation and nestling periods were estimated to last 13.5 and 10.9 days, respectively (Pinho *et al*. 2006). In the Thamnophilidae family, duration of nestling period is more variable than the duration of incubation period, which is 14-16 days (Zimmer & Isler 2003). Nestling period was estimated at eight to nine days in the White-flanked Antwren *Myrmotherula axillaris*, Dot-winged Antwren *Microrhopias quixensis*, and Rusty-backed Antwren *Formicivora rufa* (Willis & Oniki 1988). Robinson *et al*. (2000) reported 16.9 days of incubation and 9.8 days of nestling for the Dusky Antbird *Cercomacra tyrannina*; in another study on the same species, a nestling period of 11 days was recorded (Skutch 1945). In Thamnophilidae nestling periods are shorter than incubation periods (Skutch 1945, Zimmer & Isler 2003). Dusky antbirds have nests in the shape of a deep pocket, which may allow a longer incubation period with less risk of predation (Zimmer & Isler 2003). It is noteworthy that nest predation rates during incubation and nestling periods are lower in closed nests than in open nests (Mason 1985) such as the *low cup/lateral* nest of the Mato Grosso Antbird.

The predation of two females in their nests possibly occurred during the night, as evidence of both events was found in early morning, and traces of predation appeared to be recent. No records of predation on adult males were found. In this study, no nocturnal visits to nests were made, yet it is known that only females of Mato Grosso antbirds incubate at night (Pinho *et al*. 2006). A similar result was found for several species of *Cercomacra* and for the Thamnophilidae in general (Skutch 1969, 1996, Kratter 1998, Morton & Stutchbury 2000, Zimmer & Isler 2003), suggesting that males participate in egg incubation especially during the day. This is consistent with information on other species of the same family, in which males replace females in early morning and incubate for prolonged periods (Skutch 1945).

Mato Grosso antbirds lay two eggs, the usual number for the *Cercomacra* genus and Thamnophilidae in general (Skutch 1969, Wetmore 1972, Robinson *et al*. 2000, Zimmer & Isler 2003, Pinho *et al*. 2006). In this family, nests with one egg are regarded as rare (Skutch 1996, Robinson *et al*. 2000, Zimmer & Isler 2003).

With respect to a fledgling's attachment to a particular parent, according to Willis (1972a), when a nestling leaves a nest it is called by one parent, resulting in the young one staying close to that parent, while the other parent assumes responsibility for the nestling remaining in the nest. This behavior probably reduces the risk of predation for both nestlings. It is unclear whether the division in offspring care after leaving the nest is a general rule for all Thamnophilidae species (Zimmer & Isler 2003).

Data on the time required for a *C. melanaria* chick to reach adulthood and reproduce has been obtained in this study for the first time. A nestling banded in 2005 was found in 2006 at the age of about thirteen months as a paired female. For most Thamnophilidae, although the exact age at first reproduction is unknown, it occurs approximately at one year of life. The White-cheeked Antbird *Gymnopithys leucaspis* forms pairs at four to six months of life, and a female of this species already mates and produces eggs by only 6.5 months (Zimmer & Isler 2003).

Information documenting the number of breeding attempts made per pair, per year, is available for only a

few species (Robinson *et al*. 2000). However, in this study we did not observe any pairs making further attempts at breeding after they had achieved reproductive success; this fact had been recorded for Band-tailed antbirds in the same study area (Evangelista 2008).

During this study, the canopy was observed to be consistently more open away from nests, suggesting that the species selected nest sites with dense vegetation. In confirmation, nesting sites of this species have been described as being well hidden among dense vegetation (Pinho *et al*. 2006). Quality of habitat in which nests are built is an important factor in reproductive success, fecundity, and survivorship (Martin 1995). Some sites offer safer habitats for nest building and provide defense against predators, or offer better protection against climatic variations (Wittenberger 1980).

This study was the first to describe several characteristics of the reproductive biology of the Mato Grosso Antbird *Cercomacra melanaria*, such as nest site selection, species of plants used to build nests, and parental behavior around the nest while interacting with nestlings and fledglings. Such basic natural history information is essential to support future studies on population dynamics and ecology of the range restricted *C. melanaria* in the Brazilian Pantanal.

ACKNOWLEDGMENTS

We thank Núcleo de Estudos Ecológicos do Pantanal (NEPA), Centro de Pesquisa do Pantanal (CPP), Instituto de Áreas Úmidas (INAU), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Ministério de Ciência, Tecnologia e Inovação (MCTI) and Programa de Pós Graduação em Ecologia e Conservação da Biodiversidade – UFMT for financial assistance. The authors were supported by the following grants: B. Bernardon by Fundação de Amparo à Pesquisa do Estado de Mato Grosso (FAPEMAT) during her Masters degree, and also by CNPq while writing this article, P.F.A. Nóbrega by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). We thank T. C. Rubio, M. E. Gaebler, T. M. Aguilar, C. Strüsmann, M. A. Carvalho, L. E. Lopes, M. Aragona , J.M. Penha and D. Plumpton, for constructive criticism to earlier versions of this manuscript. We also thank the anonymous reviewers and Instituto de Desenvolvimento Sustentável Mamirauá (IDSM) for support during manuscript writing.

REFERENCES

Adis, J., Marques, M. I. & Wantzen, K. M. 2001. First observations on the survival strategies of terricolous arthropods in the northern Pantanal Wetland of Brazil. *Andrias*, 15: 127-128.

Aguilar, T. M., Leite, L. O. & Marini, M. Â. 1999. Biologia de nidificação de *Lathrotricus euleri* (Cabanis 1968) (Tyrannidae) em fragmento de mata em Minas Gerais. *Ararajuba*, 7: 125-133.

Aguilar, T. M., Maldonado-Coelho, M. & Marini, M. Â. 2000. Nesting biology of the Gray-hooded Flycatcher (*Mionectes rufiventris*). *Ornitologia Neotropical*, 11: 223-230.

Aguilar, T. M. 2001. Biologia reprodutiva e seleção de habitat por *Leptopogon amaurocephalus* (Aves, Tyrannidae), e fragmentos de Mata Atlântica em Minas Gerais. Master thesis. Belo Horizonte: Universidade Federal de Minas Gerais.

Ahumada, J. A. 2001. Comparison of the reproductive biology of two Neotropical Wrens in an unpredictable environment in Northeastern Colombia. *Auk*, 118: 191-210.

Allem, A. C. & Valls, J. F. M. 1987. Recursos forrageiros nativos do Pantanal matogrossense. 1st ed. Brasília: EMBRAPA.

Arieira, J. & Nunes da Cunha, C. 2006. Fitossociologia de uma floresta inundável monodominante de *Vochysia divergens* Pohl (Vochysiaceae), no Pantanal Norte, MT, Brasil. *Acta Botanica Brasileira*, 20: 569-580.

Battirola, L. D., Adis, J., Marques, M. I. & Silva, F. H. O. 2007. Comunidade de artrópodes associada à copa de *Attalea phalerata* Mart. (Arecaceae), durante o período de cheia no Pantanal de Poconé, Mato Grosso, Brasil. *Neotroical Entomology*, 36: 640-651.

Bartholomew, G. A. 1986. The role of natural history in contemporary Biology. Bioscience 36: 324-329.

Beaudet, M., & Messier, C. 2002. Variation in canopy openness and light transmission following selection cutting in northern hardwood stands: an assessment based on hemispherical photographs. *Agricultural and Forest Meteorology*, 110: 217-228.

Burger, J. 1985. Habitat selection in temperate marsh-nesting birds, p. 253-281. In: CODY, M. L. (ed.) Habitat selection in birds. Toronto, Canada: Academic Press.

Clark, L., Ricklefs, R. E. & Schreiber, R. W. 1983. Nest-site selection by the Red-tailed Tropicbird. *Auk*, 100: 953-959.

Crozariol, M. A. 2011. Territorialidade e Reprodução do Chororó do Araguaia *Cercomacra ferdinandi* Snethlage, 1928 (Passeriformes:Thamnophilidae) em uma área ecotonal no estado de Tocantins. Master thesis. Palmas: Universidade Federal do Tocantins.

Duca, C. & Marini, M. Â. 2004. Aspectos da nidificação de *Cacicus haemorrhous* (Passeriformes, Icterinae) no sudeste do Brasil. *Ararajuba*, 12: 23-30.

Evangelista, M. M. 2008. Biologia Reprodutiva e Territorialidade de *Hypocnemoides maculicauda* (Pelzeln, 1868) (Passeriforme, Thamnophilidae) na região de Pirizal - Pantanal de Poconé - MT. Master thesis. Cuiabá: Universidade Federal de Mato Grosso.

Frazer, G. W., Trofymow, J. A. & Lertzman, K. P. 1997. A method for estimating canopy openness, effective leaf area index, and photosynthetically active photon flux density using hemispherical photography and computerized image analysis techniques. Pacific Forestry Centre, v. 373. Victoria, B.C.

Frazer, G. W., Canham, C. D., & Lertzman, K. P. 1999. Gap light analyzer (GLA), Version 2.0: Imaging software to extract canopy structure and gap light transmission indices from true-color fisheye photographs, users manual and program documentation New York. Copyright © 1999: Simon Frazer University, Burnaby, British Columbia, and the Institute of Ecosystem Studies, Millbrook, New York. http://www.rem.sfu.ca/forestry/downloads/gaplightanalyzer.htm (access on 19 November 2006).

Frazer, G., Trofymow, J. A. & Lertzman, K. P. 2000. Canopy openness and leaf area in chronosequences of coastal temperate rainforests. *Canadian Journal of Forest Research*, 30: 239-256.

Frazer, G. W., Fournier, R. A., Trofymow, J. A. & Hall, R. J. 2001. A comparison of digital and film fisheye photography for analysis of forest canopy structure and gap light transmission. *Agricultural and Forest Meteorology*, 109: 249-263.

Greenberg, R. & Gradwohl, J. 1983. Sexual roles in the Dot-winged Antwren (*Microrhopias quixensis*), a Tropical Forest Passerine. *Auk*, 100: 920-925.

Greeney, H. F. & Gelis, R. A. 2007. Breeding records from the north-east Andean foothills of Ecuador. *Bulletin of the British Ornithologists Club*, 127: 236-241.

Hau, M. 2001. Timing of Breeding in Variable Environments: Tropical birds as model systems. *Hormones and Behavior*, 40: 281-290.

Hau, M., Perfito, N. & Moore, I. T. 2008. Timing of breeding in tropical birds: mechanisms and evolutionary implications. *Ornitologia Neotropical*, 19: 39-59.

Howlett, J. S. & Stutchbury, B. J. 1996. Nest concealment and predation in Hooded Warblers: Experimental removal of nest cover. *Auk*, 113: 1-9.

INMET. Instituto Nacional de Meteorologia. 2008. Parâmetros Meteorológicos do 9º Distrito de Meteorologia. Cuiabá.

Jones, J. 2001. Habitat Selection Studies in Avian Ecology: A Critical Review. *Auk*, 118: 557-562.

Johnson, R. A. 1953. Breeding notes on two Panamanian Antbirds. *Auk,* 70: 494-496.

Kratter, A. W. 1998. The nest of two bamboo specialists: *Celeus spectabilis* and *Cercomacra manu*. *Journal of Field Ornithology*, 69: 37-44.

Lebbin, D. L., Hosner, P. A., Andersen, M. J., Valdez, U. & Tori, W. P. 2007. First description of nest and eggs of the White-lined Antbird (*Percnostola lophotes*), and breeding observations of poorly known birds inhabiting *Guadua* bamboo in southeastern Peru. *Boletin SAO*, 17: 119-132.

Lopes, L. E. & Marini, M. Â. 2005. Biologia reprodutiva de *Suiriri affinis* e *S. islerorum* (Aves: Tyrannidae) no Cerrado do Brasil Central. *Papéis Avulsos de Zoologia*, 45: 127-141.

Marini, M. Â., Borges, F. J. A., Lopes, L. E., Sousa, N. O. M., Gressler, D. T., Santos, L. R., Paiva, L. V., Duca, C. G., Manica, L. T., Rodrigues, S. S., França, L. F., Costa, P. M., França, L. C., Heming, N. M., Silveira, M. B., Pereira, Z. P., Lobo, Y. P., Medeiros, R. C. S. & Roper, J. 2012. Breeding biology of birds in the cerrado of central Brazil. *Ornitologia Neotropical*, 23: 385-405.

Martin, T. E & Geupel, R. G. 1993. Nest-monitoring plots: methods for locating nests and monitoring success. *Journal of Field Ornithology*, 64: 507-519.

Martin, T. E. 1995. Avian life history evolution in relation to nest sites, nest predation and Food. *Ecological Monographs,* 65: 101-127.

Mason, P. 1985. The nesting biology of some passerines of Buenos Aires, Argentina. *Ornithological Monographs*, 36: 96-104.

Mayfield, H. 1975. Suggestions for calculating nest success. *Wilson Bulletin*, 87: 456-466.

Melloh, R., Ballard, J., Hardy, J., Woodcock, C., Liu, J., Smith, J., Koenig, G. & Davis, R. 2003. Spatial Distribution of Canopy Gaps in Lodgepole Pine Forest. In: *60th Eastern Snow Conference*, Sherbrooke, Québec, Canada, p. 11-123.

Mezquida, E. T. & Marone, L. 2001. Factors affecting nesting success of a bird assembly in the central Monte Desert, Argentina. *Journal of Avian Biology*, 32: 287-296.

Morton, E. S. & Stutchbury, B. J. M. 2000. Demography and reproductive success in the Dusky Antbird, a sedentary tropical passerine. *Journal of Field Ornithology*, 71: 493-500.

Nascimento, M. T. & Nunes da Cunha, C. 1989. Estrutura e composição florística de um Cambarazal no Pantanal de Poconé-MT. *Acta Botânica Brasilicca*, 3: 3-23.

Nunes da Cunha, C. & Junk, W. J. 2001. Distribution of wood plant communities along the flood gradient in the Pantanal of Poconé, Mato Grosso, Brazil. *International Journal of Ecology and Environmental Science*, 27: 63-70.

Nunes da Cunha, C. & Junk, W. J. 2004. Year-to-year changes in water level drive the invasion of *Vochysia divergens* in Pantanal grasslands. *Applied Vegetation Science*, 7: 103-110.

Pinho, J. B. 2005. Riqueza de espécies, padrões de migração e biologia reprodutiva de aves em quatro ambientes florestais do Pantanal de Poconé, MT. Ph.D dissertation. Belo Horizonte: Universidade Federal de Minas Gerais.

Pinho, J. B., Lopes, L. E., Morais, D. H. & Fernandes. A. M. 2006. Life history of the Mato Grosso Antbird *Cercomacra melanaria* in the Brazilian Pantanal. *Ibis*, 148: 321-329.

Pinho, J. B., Lopes, L. E., Maldonado-Coelho, M., Rubio, T. C. & Bernardon, B. 2009. Habitat associations and nests of Band-Tailed Antbirds (*Hypocnemoides maculicauda*) in the Brazilian Pantanal. *Wilson Journal of Ornithology*, 121: 153-159.

Pinho, J. B. & Marini, M. A. 2012. Using birds to set conservation priorities for Pantanal wetland forests, Brazil. *Bird Conservation International*, 22: 155-169.

Poulin, B., Lefebvre, G. & MCeil, R. 1992. Tropical avian phenology in relation to abundance and exploitation of food resources. *Ecology*, 73: 2295-2309.

Ricketts, M. S. & Ritchison, G. 2000. Nesting success of Yellow-breasted Chats: effects of nest site and territory vegetation structure. *Wilson Bulletin*, 112: 510-516.

Ricklefs, R. E. 1969. An analysis of nesting mortality in birds. *Smithsonian Contrib. Zool*. 9: 1-48.

Ricklefs, R. E. 2003. *A Economia da Natureza*. 5ª ed. Rio de Janeiro: Guanabara Koogan.

Robinson, W. D., Robinson, T. R., Robinson, S. K. & Brawn, J. D. 2000. Nesting success of understory forest birds in central Panama. *Journal of Avian Biology*, 31: 151-164.

Rubio, T. C. & Pinho, J. B. 2008. Biologia reprodutiva de *Synallaxis albilora* (aves: Furnariidae) no Pantanal de Poconé, Mato Grosso. *Papéis Avulsos de Zoologia*, 48: 181-197.

Simon, J. E., & Pacheco, S. 2005. On the standardization of nest descriptions of neotropical birds. *Revista Brasileira de Ornitologia*, 13: 143-154.

Skutch, A. F. 1945. Incubation and nestling periods of Central American birds. *Auk*, 6: 8-37.

Skutch, A. F. 1969. *Life histories of Central American birds III - Families Cotingidae, Pipridae, Formicariidae, Furnariidae, Dendrocolaptidae, and Picidae*. Berkeley, USA: Cooper Ornithological Society.

Skutch, A. F. 1996. *Antbirds and Ovenbirds: their lives and homes*. USA: University of Texas Press.

Stutchbury, B. J. M. & Morton, E. S. 2001. *Behavioral ecology of tropical birds*. San Diego, USA: Academic Press.

Wetmore, A. 1972. The Birds of the Republic of Panama - Part 3. Passeriformes: Dendrocolaptidae (Woodcreepers) to Oxyruncidae (Sharpbills). *Smithson Miscellaneous Collections*, 150: 1-631.

Wilkinson, L. 2000. Systat 10: Statistics I. Spss Inc." Chicago, Illinois.

Willis, E. O. 1972a. Breeding of the With-plumed Antbird (*Pithys albifrons*). *Auk*, 89: 192-193.

Willis, E. O. 1972b. The behaviour of Spotted Antbirds. *Ornithological Monographs*. 10: 1-157.

Willis, E. O. & Oniki, Y. 1988. Nesting of the Rusty-backed Antwren, *Formicivora rufa* (Wied, 1831) (Aves, Foemicariidae). *Brazilian Journal of Biology*, 48: 635-637.

Wittenberger, J. F. 1980. Vegetation structure, food supply, and polygyny in bobolinks (*Dolichonyx oryzivorus*). *Ecology*, 61: 140-150.

Zar, J. H. 1984. *Biostatistical Analysis*. 2nd ed. EUA: Prentice-Hall International, Inc., Englewood Cliffs.

Zimmer, K. J. & Isler, M. L. 2003. Family Thamnophilidae (Typical antbirds), p. 448-681. In: Del Hoyo, J., Elliot, A. & Christie, D. A. (eds.). Handbook of the birds of the world: Broadbills to Tapaculos, v. 8. Spain, Barcelona: Lynx Edicions.

Associate Editor: Carla Fontana