

## BREEDING BIOLOGY OF COLUMBIDAE IN CENTRAL BRAZIL

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**Resumo. – Biologia reprodutiva de Columbidae no Brasil Central.** – Relatamos aspectos da biologia da nidificação de columbídeos, em especial características dos ninhos e ovos, período de incubação e de ninhego, em cerrado natural e vegetações alteradas do Distrito Federal, Brasil central. Durante as estações reprodutivas de 2002 a 2009 estudamos 99 ninhos de *Columbina talpacoti*, *C. squammata*, *Patagioenas picazuro* e *P. cayennensis*. Os ninhos de *P. picazuro* (n = 60) foram encontrados principalmente no interior de uma reserva, em alturas de 0,9 a 6,5 m com um ovo ou ninhego, mas em raras ocasiões com dois ovos. O período de incubação foi de 14 dias e o período de ninhego foi de  $19,2 \pm 7,4$  dias. Encontramos os ninhos de *C. talpacoti* (n = 34) principalmente em áreas alteradas, em alturas de 0,4 a 7,0 m, com um ou dois ovos ou ninhegos. O período de incubação foi de 14 dias e o período de ninhego  $12,9 \pm 2,4$  dias (mínimo 10 e máximo 18 dias). Os ninhos de *C. squammata* (n = 3) foram encontrados em áreas alteradas, em alturas de 1,1 a 3,0 m, com dois ovos ou ninhegos. Dois ninhos de *P. cayennensis* foram encontrados em veredas no interior da reserva em alturas de 1,7 e 2,3 m e possuíam um ovo cada. Os padrões reprodutivos (ex. habitat de nidificação, altura dos ninhos, tamanho da ninhada, períodos de incubação e de ninhego, cor e dimensões dos ovos) encontrados neste estudo estão de acordo com os padrões gerais observados na família, bem como com o relatado na literatura para cada uma das espécies estudadas.

**Abstract.** We report several aspects of the nesting biology of columbids, with emphasis on nest and egg characteristics, incubation and nestling period, in natural Cerrado formations and disturbed areas in the Distrito Federal, central Brazil. During the reproductive seasons of 2002 through 2009 we monitored 99 columbid nests, including Ruddy Ground-dove (*Columbina talpacoti*), Scaled Dove (*C. squammata*), Picazuro Pigeon (*Patagioenas picazuro*), and Pale-vented Pigeon (*P. cayennensis*). Nests of Picazuro Pigeons (n = 60) were mostly within a reserve, at heights from 0.9 to 6.5 m and clutch size was usually one. On average, incubation period lasted 14 days and nestling period lasted  $19.2 \pm 7.4$  days. Nests of Ruddy Ground-doves (n = 34) were mainly in the disturbed area at heights from 0.4 to 7.0 m and clutch size was one or two. Incubation period lasted 14 days and nestling period lasted  $12.9 \pm 2.4$  days (minimum 10 and maximum 18 days). Nests of Scaled Doves (n = 3) were in the disturbed area, placed from

1.1 to 3.0 m and had two eggs or nestlings. Nests of Pale-vented Pigeons ( $n = 2$ ) were at heights of 1.7 and 2.3 m in a palm swamp in the reserve interior and clutch size was one. The breeding patterns (e.g. nesting habitats, nest height, clutch size, incubation and nestling periods, egg color and measurements) found in this study are in accordance with those of columbids in general and other studies done with species from Central and South America. *Accepted 22 November 2010.*

**Key words:** Columbidae, nests, eggs, reproduction, Cerrado, central Brazil.

## INTRODUCTION

Understanding bird reproduction biology is important to explain ecological, evolutionary, and behavioral patterns among species (Stutchbury & Morton 2001, 2008). Bird breeding studies also provide valuable data for conservation and management (Duca *et al.* 2009) or to avoid species invasion and pests (Bruggers *et al.* 1998). Detailed studies on avian reproductive biology exist only for a few Neotropical regions (Oniki & Willis 1983, Robinson *et al.* 2000, Auer *et al.* 2007). For many Brazilian bird species the only available information is the description of nests and eggs, most of them presented in old studies for which date or location are rarely mentioned (Euler 1900, Ihering 1900).

The Cerrado, a Neotropical biome restricted mostly to Brazil, is the largest tropical savanna in the world and the second largest vegetation province in South America (Ratter *et al.* 1997). It is classified as one of the most threatened biomes on Earth and considered a biodiversity hotspot (Myers *et al.* 2000, Silva & Bates 2002). Breeding biology of Cerrado birds is still scarce to date, despite some efforts have been made to study the reproductive biology of birds here (Alves & Cavalcanti 1990, Lopes & Marini 2005, Duca 2007, Carvalho *et al.* 2007, Gressler 2008, Marini *et al.* 2009a, b, Santos & Marini 2010).

The 308 known Columbidae species (Clements 2007) may be found from deserts to forests and many species are adapted to disturbed or man-made habitats (Baptista *et al.* 1997). In general, most columbids breed throughout the year or have an extended

breeding season (e.g., Neff 1947, Murton 1958, Snow & Snow 1964, Baptista *et al.* 1997). Some species breed during all months of the year, but most of nesting attempts are concentrated over a few months (Baptista *et al.* 1997). In spite of their plasticity, some species have suffered from habitat loss, hunting, competition with invasive species and introduced predators (Baptista *et al.* 1997).

From the 50 species of doves native to South America, 22 are found in Brazil (Rensen *et al.* 2009). The 18 Columbidae species in the Cerrado (Silva 1995) inhabits forests, savannas and open fields (Sick 1997). Furthermore, many species associated to open fields and grasslands are benefited from deforestation, agriculture, and urbanization (Sick 1997). There is some brief information on columbid reproduction available in some publications in the Cerrado (Antas & Cavalcanti 1988). However, detailed studies describe only the Ruddy Ground-dove (Cintra & Cavalcanti 1997; Cintra 1998), in Distrito Federal, central Brazil, and Eared Doves (Bucher & Ranvaud 2006) in sugar cane plantations of São Paulo state, southeastern Brazil.

In spite of the Columbidae diversity in the Cerrado, their reproductive biology is poorly known. Here we describe aspects of the breeding biology, specifically characteristics of nests and eggs, incubation and nestling periods of four species breeding in the Cerrado of central Brazil.

## METHODS

*Study area.* We conducted this study at Estação Ecológica de Águas Emendadas (ESECAE,

10,500 ha), Distrito Federal, Brazil (15°29–15°36S and 47°31–47°41W; 1040 m a.s.l.) and in an adjacent rural area (Jardim Morumbi) (15°30–15°31S and 47°37–47°39W). ESE-CAE has been protected since 1988, with few anthropogenic impacts, except for sporadic burns, invasion by exotic grasses, illegal hunting and domestic animals, especially feral dogs. ESECAE is in the Cerrado Biome and its vegetation is composed by three main savanna formations: *cerrado denso* (dense woodland with closed scrub and trees 5–8 m high), *cerrado típico* (woodland with closed scrub and scattered trees 3–6 m high), *cerrado ralo* (open scrubland with few trees). ESE-CAE is also composed by patches of *veredas* (*Mauritia flexuosa* palm swamps with a rich grass layer), *campo sujo* (grasslands with some shrubs), *campo limpo* (pure grasslands) and *mata de galeria* (gallery forest) (vegetation classification follows Ribeiro & Walter 1998). The surrounding area, called Jardim Morumbi, is a mosaic of 2 ha rural properties with different degrees of disturbance. Some are uninhabited and retain all vegetation, even though disturbed, others retain part of the vegetation and some were completely destroyed and have only pastures. There are several paved roads around the reserve and dirt roads and occasional houses in Jardim Morumbi (details in Borges & Marini 2010).

*Nest searches and monitoring.* We divided the searching in four areas: areas more than 1 km inside the reserve (reserve interior, 100 ha), areas less than 100 m from reserve edge (reserve edge, 20 ha), *veredas* (5 ha), and the surrounding rural areas (disturbed area, 300 ha). We searched for nests of all bird species, including Columbidae, from August to December 2002–2009 in the reserve interior, from September to December 2005 and 2009 in the reserve border, from August to December 2009 in the *veredas* and, from September to December 2006 in the disturbed area. We

eventually searched for nests from March to June, however we did not search systematically. We usually found nests by inspecting potential nest sites, following adults and by chance.

We checked nests at 3–4 days intervals until they failed or nestlings fledged successfully. Laying, hatching and fledgling date were considered as the middle date between two consecutive nest check visits (Mayfield 1975). Because of checking intervals, the laying, hatching and fledgling date can vary up to two days less or more. This can cause a variation of up to four days on incubation and nestling periods estimates. This methodology gives better estimates as the number of nests increases. However, we were able to estimate these periods for only a few nests.

Considering that Columbidae females generally lay one egg per day during evening or night session on the nest (Skutch 1956, 1991) and begin incubation after laying the first egg (Haverschmidt 1953, Skutch 1956, Goodwin 1983, Cintra 1988), we estimated duration of incubation period by the number of days between the estimated dates of first egg laid and first egg hatched and the nestling period as the number of days from the estimated dates of first hatching to the first fledgling. We excluded data from nests that were already found with eggs or nestlings to estimate incubation or nestling period, respectively. We considered failed nests those with damaged nest contents, such as broken egg shells or dead nestlings, or those in which eggs and nestlings disappeared before hatching or the minimum expected fledgling date, respectively. We considered a successful fledge when nestlings in advanced development condition (that is, with all body covered with feathers) in the previous nest check were absent from nests on the last monitoring date, and nests were intact or without signs of depredation. To estimate the expected fledgling date we used nestling plumage characteristics,

such as presence and coverage proportion of feathers.

We weighted eggs, usually between day 1 and day 3 of the incubation period, using a spring scale (precision 0.1 g) and measured their length and width with calipers (precision 0.1 mm). We measured nest diameter after they became inactive and identified plant support species using a field guide (Silva Júnior 2005).

## RESULTS

We found 99 nests of four species from 2002 to 2009. During the months under study, most active nests were in September ( $n = 47$ ). Most nests were of Picaçuro Pigeons (*Patagoaenas picaçuro*,  $n = 60$ ) and Ruddy Ground-doves (*Columbina talpacoti*,  $n = 34$ ). We also found three nests of Scaled Doves (*Columbina squammata*) and two nests of Pale-vented Pigeons (*Patagoaenas cayennensis*). Nest location and habitat for all species are presented on Table 1, nest height and clutch size on Table 2, nest fates on Table 3, and specific data about each species are presented as follows.

*Picaçuro Pigeon*. Most active nests were found in September ( $n = 24$ ), but also in October ( $n = 12$ ), August ( $n = 8$ ), November ( $n = 5$ ), May ( $n = 3$ ), and one each in March and April. Nests were found in all monitored areas (Table 1) in the following plant species: *Stryphnodendron adstringens* (Fabaceae) ( $n = 6$ ), *Qualea* sp. (Vochysiaceae) ( $n = 5$ ), *Ouratea hexasperma* (Ochnaceae) ( $n = 3$ ), and *Dimorphandra mollis* (Fabaceae) ( $n = 3$ ). Two nests were found in each plant species: *Davilla elliptica* (Dilleniaceae), *Dalbergia miscolobium* (Fabaceae), *Miconia polyandra* (Melastomataceae), and *Q. parviflora* (Vochysiaceae). Only one nest was found in each plant species: *Q. multiflora* (Vochysiaceae), *Q. grandiflora* (Vochysiaceae), *Sclerolobium paniculatum* (Fabaceae),

*Pterodon* sp. (Fabaceae), *Palicourea rigida* (Rubiaceae), *M. ferruginata* (Melastomataceae), *Miconia* sp., *Caryocar brasiliense* (Caryocaraceae), and *Annona crassiflora* (Annonaceae). Two nests were on dead trees. The external diameter of two nests was about 20 cm. Eggs were white and oval, short-oval or elliptical. Egg dimensions were  $39.2 \pm 2.7$  mm in length,  $27.1 \pm 1.7$  mm in width ( $n = 6$ ), and weighed  $1.6 \pm 0.2$  g ( $n = 3$ ). Incubation period was 14 days ( $n = 1$ ) and nestling period  $19.2 \pm 7.4$  days ( $n = 2$ ).

*Ruddy Ground-dove*. Most active nests were found in September ( $n = 21$ ), but also in October ( $n = 11$ ) and November ( $n = 2$ ). Nests were on native ( $n = 8$ ) and mostly on non-native ( $n = 12$ ) plant species like Mango trees (*Mangifera indica*, Anacardiaceae) ( $n = 5$ ), Benjamin's Fig (*Ficus benjamina*, Moraceae) ( $n = 5$ ), Jackfruit (*Artocarpus heterophyllus*, Moraceae) ( $n = 1$ ), and Rangpur Lime (*Citrus limonia*, Rutaceae) ( $n = 1$ ). Eight nests were on native plant species like *Davilla elliptica* (Dilleniaceae) ( $n = 7$ ) and *Qualea parviflora* (Vochysiaceae) ( $n = 1$ ). Eggs were white and oval or short-oval. Incubation period lasted 14 days ( $n = 1$ ) and nestling period lasted  $12.9 \pm 2.4$  days (minimum = 10 and maximum = 18) ( $n = 8$ ).

*Scaled Dove*. We found three nests, one in September and two in October 2006. All nests were in the disturbed area (Table 1). Eggs were white and oval or short-oval.

*Pale-vented Pigeon*. We found two nests in October 2009. The only egg observed was white and short-oval.

## DISCUSSION

*Picaçuro Pigeon*. This species had the majority of active nests from August to November and some nests from March to May. However,

TABLE 1. Location and habitat of columbid nests in the region of 'Estação Ecológica de Águas Emendadas', Distrito Federal, Brazil.

Species	Location			Habitat within ESECAE		
	Disturbed	Reserve edge	Reserve interior	<i>cerrado típico</i>	<i>cerrado ralo</i>	<i>vereda</i>
Picazuro Pigeon	3	5	52	48	8	1
Ruddy Ground-dove	24	10	0	8	2	0
Scaled Dove	3	0	0	0	0	0
Pale-vented Pigeon	0	0	2	0	0	2

nests were also found in the Distrito Federal, near ESECAE, in June and July (Marini *et al.* unpubl.), indicating that this species reproduces in the region almost year-round. Picazuro Pigeons built the majority of nests within the reserve, occasionally on the edge of the reserve and in the disturbed area. This species is the most common columbid within the reserve, but can also be seen in urbanized areas of Distrito Federal (Marini *et al.* unpubl.). Nests ranged from 0.9 to 6.5 m high, similar to that previously reported (2 to 30 m) in Brazil (Oniki & Willis 2000) and Argentina (De la Peña 2005, Di Giacomo 2005). The external diameter of two nests was about 20 cm, within the range of other studies (17 to 30 cm) (De la Peña 2005).

Clutch size of the Picazuro Pigeon was usually one, but two nests had two eggs. This is apparently the first record of two eggs in Brazil, and contradicts the affirmation that this clutch size occurs only in the south (Oniki & Willis 2000). All other studies reported one egg or young per nest in Brazil (Ihering 1900, Wilson 1924, Carman 1971, Belton 1984, Oniki & Willis 2000). In Argentina some studies report clutch size of one (Wetmore 1926, De la Peña 1987, 2005, Di Giacomo 2005), but also casual nests with two eggs (Hudson 1920). The clutch size of some species varies geographically. Scaled pigeons, for example, lay one egg in Costa Rica but two eggs in Trinidad, at the same latitude (Skutch 1991).

Eggs of Picazuro Pigeon were smaller and lighter than reported in Argentina (De la Peña 2005, Di Giacomo 2005) that ranged from 40.2 to 43.7 mm in length, from 27.5 to 30.7 mm in width and weighed from 1.45 to 1.95 g. Incubation period lasted 14 days and was shorter than other reports in Argentina that range from 17 to 19 days (De la Peña 2005, Di Giacomo 2005). Nestling period of two nests lasted 14 and 24.5 days, although in Argentina the reports are from 18 to 22 days (De la Peña 2005, Di Giacomo 2005). The large variability we found was probably caused by the uncertainty regarding our methodology to estimate laying, hatching and fledging dates or because of our small sample sizes.

*Ruddy Ground-dove.* All nests were in the disturbed area or on the edge of the reserve and no nest was found within the reserve, where this species was rarely seen (Marini *et al.* unpubl.). Nests of this species are built in low thicket, bushy field, pasture, plantation, doorway or hedgerow (Skutch 1956). We found eight nests in native plant species and 12 in non-native plant species. Nests are usually built in trees, shrubs, herbs (Haverschmidt 1953, Skutch 1956, Di Giacomo 2005), and on the ground in Brazilian Cerrado (Cintra 1988). The Ruddy Ground-dove nests mainly in non-native plant species (Cintra 1988) probably because this species inhabits edge or disturbed areas for nesting. We found no nest of Ruddy Ground-doves in the reserve inte-

TABLE 2. Nest height and clutch size of columbids in the region of 'Estação Ecológica de Águas Emendadas', Distrito Federal, Brazil.

Species	Nest height (m)	Clutch size
	Median, Mean $\pm$ SD (n)	Mode (Clutch Size, n)
Picazuro Pigeon	2.3, 2.6 $\pm$ 1.2 (59)	1 (1 egg, 46; 2 eggs, 2)
Ruddy Ground-dove	1.3, 1.7 $\pm$ 1.4 (34)	2 (1 egg, 2; 2 eggs, 30)
Scaled Dove	1.5, 1.9 $\pm$ 1.0 (3)	2 (2 eggs, 3)
Pale-vented Pigeon	2.0, 2.0 $\pm$ 0.4 (2)	1 (1 egg, 2)

rior after nine years of nest searching and over 2000 active nests monitored (Marini unpubl.). In ESECAE, 58.8% nests were depredated in contrast with 42% nests depredated on Fazenda Água Limpa, DF (Cintra 1988).

Nest height was the same as those reported in other studies in Brazilian Cerrado (Cintra 1988), Argentina (De la Peña 2005, Di Giacomo 2005), Panama (Wetmore 1968), and Surinam (Haverschmidt 1953) but we did not find nests on the ground as did Cintra (1988). Also, clutch size of one or two did not diverge from studies in Brazilian Cerrado (Cintra 1988), Argentina (De la Peña 2005, Di Giacomo 2005), Panama (Wetmore 1968), Surinam (Haverschmidt 1953), Trinidad and Tobago (Belcher & Smooker 1936), Colombia, Costa Rica, Guatemala, and Panama (Skutch 1956).

We estimated incubation period (14 days) of only one nest, a value within the range (11 to 14 days) of other studies (Haverschmidt 1953, Skutch 1956, Cintra 1988, Baptista *et al.* 1997). Nestling period lasted from 10 to 18 days, more variable than other studies. Other reports range from 9 to 15 days in Brazilian Cerrado (Cintra 1988), 11 to 12 days in Surinam (Haverschmidt 1953), 12 to 14 days in Colombia, Costa Rica, Guatemala, and Panama (Skutch 1956), but it usually lasts from 11 to 13 days (Baptista *et al.* 1997). As for the Picazuro Pigeon, this variability probably was caused by the methodology inaccuracy.

*Scaled Dove.* No nest was found within the reserve, only in the disturbed area. This species has never been registered within the reserve, but it is frequently seen in the disturbed area. Nests were at heights from 1.1 to 3.0 m, similar to other studies, but never on the ground (Baptista *et al.* 1997). However, in Venezuela nests were usually on the ground and occasionally in low trees and bushes (Cherrie 1916). Clutch size was two, similar to studies in Brazil (*Caatinga*) (Lamm 1948) and Venezuela (Cherrie 1916).

*Pale-vented Pigeon.* We found two nests in *vereda*, within the reserve. This species is occasionally seen in this vegetation type, but rarely in *cerrados*. Nests averaged 2.0  $\pm$  0.4 m high, similar to other studies which reported nests from 2 to 5 m (Cherrie 1916), 4.57 m (Belcher & Smooker 1936) and at heights of 1.06 m and 1.22 m (Skutch 1964). Clutch size was one, similar to other studies in Venezuela (Cherrie 1916), Trinidad and Tobago (Belcher & Smooker 1936), Guatemala (Skutch 1964), and Panama (Wetmore 1968).

#### Columbidae breeding patterns

*Breeding season.* We were not able to determine the duration of the breeding season of these species (see Methods). In spite of some nests being found during the dry season, most of them were in September during the beginning of the rainy season. In Trinidad and Tobago, for example, nests of Ruddy Ground-doves

TABLE 3. Fate of columbid nests in the region of 'Estação Ecológica de Águas Emendadas', Distrito Federal, Brazil.

Species	Nest fate			Other nests		Total
	Success	Depredated	Abandoned	Not monitored	Empty	
Picazuro Pigeon	6	37	2	3	12	60
Ruddy Ground-dove	14	19	0	1	0	34
Scaled Dove	1	2	0	0	0	3
Pale-vented Pigeon	1	1	0	0	0	2

may be found in any months of the year, but most frequently in May, June, and December (Belcher & Smooker 1936). It is known that many columbids have prolonged breeding seasons probably to compensate for their small broods (Skutch 1991). However, the few months in which breeding attempts are concentrated (Baptista *et al.* 1997) are probably related to the summer rainy season when seeds (Murton *et al.* 1974, Rivera-Milán 1996) or other food (Rivera-Milán *et al.* 2003) become abundant.

*Clutch size.* The small clutch size we found matches the pattern found worldwide, with pigeons and doves always laying one or two eggs (Goodwin 1983, Baptista *et al.* 1997). Sets of two eggs are more frequent for pigeons, but many species lay one egg and about half of the species of *Patagioenas* appear regularly to incubate single eggs. Clutch size is partially determined by the energetic costs of raising the chicks and partially by diet quality (Baptista *et al.* 1997). The crop-milk phase seems to be the period that imposes the strongest physiological limit and probably sets an upper limit to clutch size for columbids (Murton *et al.* 1974, Westmoreland & Best 1987). Furthermore, species dependent entirely or almost entirely on fruit lay one egg, while seed-eating doves generally lay two eggs (Skutch 1991, Baptista *et al.* 1997). Both the Picazuro Pigeon and the Pale-vented Pigeon, which feed mainly on small fruits, berries,

buds, and young leaves (Goodwin 1983) but also on grains (Di Giacomo 2005), laid mostly one egg. On the other hand, the Ruddy Ground-dove and the Scaled Dove, which feed mainly on seeds and grains (Goodwin 1983, Baptista *et al.* 1997), laid two eggs.

*Egg color.* All eggs we found were white. Open cup nests usually have spotted eggs to minimize predation while white eggs are typical of birds that have less vulnerable nests, like holes or enclosed nests (Kilner 2006). In columbids, the eggs are generally immaculate white (Goodwin 1983, Skutch 1991). Buff or cream eggs are rare and laid only by some species (Goodwin 1983). This conspicuous egg pattern is related to shared incubation (male and female incubation) (Skutch 1991, Baptista *et al.* 1997). As both parents do not leave their eggs exposed for long periods, the constant incubation may have led to the evolution of non-cryptic egg coloration (Westmoreland *et al.* 1986). Moreover, pigeons do not readily abandon their nests, they burst when the predator has found it and there is no utility of eggs protective coloration (Skutch 1991).

*Habitat and vegetation types.* There was an apparent selection of nesting habitats probably related to the habitat requirements of each species. Ruddy Ground-doves and Scaled Doves breed mostly in disturbed areas. The Ruddy Ground-dove is common in savannas, second growth forest with open areas, culti-

vated lands, plantations, waste lands near human settlements, gardens, and sometimes in towns and suburbs (Goodwin 1983). In the same way, the Scaled Dove is common in disturbed areas, like cultivated areas, gardens and near human habitations (Goodwin 1983). There are Ruddy Ground-dove nest reports in bushy fields, pastures, plantations (Skutch 1956), trees (Muñoz *et al.* 2007, Vasconcelos & Vasconcelos 2007), or even in buildings in urbanized areas (Skutch 1956, Muñoz *et al.* 2007). On the other hand, Picazuro Pigeons and Pale-vented Pigeons breed mostly within the reserve. Both species inhabit open country with trees and savannas, but the Picazuro Pigeon also prefers woodland and may occur near human habitations and the Pale-vented Pigeon occur in open forest and in mangrove swamps (Goodwin 1983). The Picazuro Pigeon builds its nests in savannas (Antas & Cavalcanti 1988, Di Giacomo 2005), open places with trees or shrubs, near roadsides (Di Giacomo 2005), and in urbanized areas with occasional trees and shrubs (Oniki & Willis 2000). The Pale-vented Pigeon nests in and around *veredas*, in moriche palms, tangled thickets, scrub oaks scattered over savannas (Cherrie 1916), *cerradões* (Antas & Cavalcanti 1988), and low shrubs in pastures (Skutch 1964).

The species seemed to not distinguish from native and non native plant species for nest placement. In general, nest placement is related partly to habitat and partially to the preferred suitable sites (Baptista *et al.* 1997), while the height of the nest and the plant species utilized for nesting is of secondary importance (Murton 1958). The breeding requirements of all species seem to follow their habitat preferences. Altogether, these species occupy disturbed and non-disturbed habitats and a wide range of vegetation types.

We described the reproductive biology of four of the nine Columbidae species that occur in ESECAE (Bagno 1998). The breed-

ing patterns (e.g. nesting habitats, nest height, clutch size, incubation and nestling periods, egg color and measurements) found in this study are in accordance with breeding patterns of columbids in general and other studies done with these species over Central and South America.

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