Notes on the breeding of Blue-bellied Parrot *Triclaria malachitacea*

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Três ninhos de sabiá-cica *Triclaria malachitacea* foram descobertos e estudados em Monte Alverne, no centro-leste do Rio Grande do Sul, Brasil, entre 1994–1996. Na região, o sabiá-cica nidifica entre outubro e janeiro. Os ninhos estudados estavam localizados em cavidades naturais de árvores vivas, entre 3,43 e 5,13 m acima do solo. Em um dos ninhos, a fêmea incubou os ovos sozinha e foi alimentada pelo macho em média quatro vezes ao dia. As sessões de incubação diurnas duraram, em média, 162,4 min, com um intervalo médio entre elas de 19,0 min. O período de incubação foi estimado em 26,8–28 dias. Em outro ninho, descoberto já com filhotes, as visitas dos adultos para alimentar os ninhegos ocorreram em média a cada 100,64 min (cerca de 7 visitas/dia ao ninho). A fêmea alimentou os filhotes mais freqüentemente do que o macho. Dois filhotes foram produzidos. Um terceiro ninho encontrado havia sido foi saqueado por um predador natural antes de sua descoberta. As características dos 8 ninhos conhecidos de sabiá-cica (altura média de 4,6 m) sugerem que a espécie pode apresentar uma preferência por cavidades relativamente baixas para nidificar. Um levantamento de ocos e árvores potenciais para nidificação revelou que as florestas sobre topos de morros são aparentemente os ambientes com maior disponibilidade de cavidades naturais na área de estudo. As espécies *Trichilia claussenii, Eugenia rostrifolia, Alchornea triplinervea* e *Cupania vernalis* foram identificadas como as espécies de árvores que mais freqüentemente portam ocos naturais. Não há indícios de que *T. malachitacea* esteja enfrentando uma escassez de cavidades para nidificação na área de estudo.

Tres nidos del Loro Cica *Triclaria malachitacea* fueron descubiertos y estudiados en Monte Alverne, en el centro-este de Rio Grande do Sul, Brasil, entre 1994 y 1996. En la región, el Loro Cica nidifica entre octubre y enero. Los nidos estudiados estaban localizados en cavidades naturales de árboles vivos, entre 3,43 y 5,13 m de altura. En uno de los nidos la hembra incubó los huevos sola y era alimentada por el macho en un promedio de cuatro veces al día. Las sesiones de incubación diurnas duraron un promedio de 162,4 min, con un intervalo medio entre las mismas de 19 min. Se estimó el período de incubación entre 26,8 y 28 días. En otro nido que fue descubierto con pichones, las visitas de los adultos para alimentar a la cría eran efectuadas, en promedio, cada 100,64 minutos (cerca de 7 visitas por día). La hembra alimentó a los pichones con mayor frecuencia que el macho. Dos pichones fueron criados. Un tercer nido encontrado había sido saqueado por un predador natural antes de ser descubierto. Las características de los 8 nidos conocidos del Loro Cica (cuya altura media ronda los 4,6 m) sugieren que la especie puede presentar una preferencia por cavidades relativamente bajas para nidificar. Un relevamiento de los huecos y árboles potenciales para la nidificación reveló que las selvas sobre las cimas de los morros son aparentemente los ambientes con mayor disponibilidad de cavidades naturales en el área de estudio. *Trichilia claussenii*, *Eugenia rostrifolia*, *Alchornea triplinervea* y *Cupania vernalis* fueron identificados como las especies de árboles que más frecuentemente contienen huecos naturales. No existen indicios de que *T. malachitacea* enfrente una escasez de cavidades para nidificar en el área de estudio.

Introduction

The breeding biology of the threatened Blue-bellied Parrot *Triclaria malachitacea* of south-east South America is poorly known and most of the existing information results from the study of birds in captivity[3,6,7,10,11]. To date, the species' nesting behaviour seems not to have been investigated in the wild and only three nests are briefly described in the literature[5,21]. Here I report on the observations made at three nests discovered in the course of a 16-month field research on the ecology of *T. malachitacea* in forest remnants in the centre-east of Rio Grande do Sul state, southern Brazil. Information on habitat, feeding, ecological requirements and conservation of the Blue-bellied Parrot in this region will be presented elsewhere.

On 27–28 October 1994, a field partner and I located and monitored a tree hole that was being visited at irregular intervals by a pair of *T. malachitacea*. Subsequent observations revealed that this pair was nesting. Although the nest contents could not be examined due to the cavity structure, there probably were one or more eggs at the time of discovery. Unfortunately, this nest failed early in the nestling stage after a capture attempt by parrot trappers, and my observations were restricted to the incubation period. In the following breeding season, on 11 November 1995, a nest with young was located and studied throughout the rest of the chick-rearing period. A third nest was found on 7 January 1996. This nest failed shortly before its discovery due to an unidentified natural predator.

The observations at the active nests were made either from hides or with the observer concealed in vegetation in three day-long sessions at intervals of 2–4 days. Vocalisations were recorded on cassette with a Sony TCM-74V recorder and a Sennheiser ME 66 shotgun microphone or on video with a VHS-C Panasonic PV-IQ404A camera (and later copied to cassette with a Sony TC-W435 Cabinet Deck). An assessment of potential nest tree species and nest site density was made by counting all cavities in trees sampled during a phytosociological survey (point-centred quarter method) conducted in the study area. Only cavities above 3 m from the ground and likely to be used by *T. malachitacea* for nesting on the basis of their size and position were included in the sample. Mean values are reported with standard errors throughout the text.

Nests

All nests were located in natural cavities of live trees within a 100-ha remnant of primary subtropical forest along the ridge of a mountain (530 m) near the village of Monte Alverne (29°33'S 52°20'W), on the hilly Serra Geral escarpment in the centre-east of Rio Grande do Sul. Surrounding areas comprised small plantations (mainly tobacco and maize) bordered by narrow strips of second-growth woodlands and riparian vegetation at varying stages of succession. The forest at this site had a relatively closed canopy averaging c.20 m in height.

Figure 1. Male Blue-bellied Parrot *T. malachitacea* emerging from nest 2. (G. Bencke).

The nest discovered in 1994 (nest 1) had a single elliptical entrance and was in a primary branch of a catiguá *Trichilia claussenii* (Meliaceae) on the level ridge of the mountain. In July 1993, the same hole was being used by a pair of Reddish-bellied Parakeets *Pyrrhura frontalis* for roosting, and as soon as the hole became vacant after the unsuccessful breeding attempt by the Blue-bellied Parrots, a pair of *P. frontalis* (the same as in 1993?) and a pair of Short-tailed Antthrushes *Chamaeza campanisona* took it over alternately for a few days,

Table 1. Characteristics and measurements of all known nests and nest trees of *Triclaria malachitacea*. D/L = dead or live; hA = nest tree height (m); DBH = diameter at breast height (cm); DNH = diameter at nest height (cm); hN = nest height, from ground to the lower lip of entrance (m); E = nest entrance measurements (cm); D = depth of nest (cm); SP, PR and RS = São Paulo, Paraná and Rio Grande do Sul states.

Locality	Tree species	D/L	hA	DBH	Position of nest	DNH	hN	E	D	Source
Boracéia, Salesópolis (SP)	"tapiá-guaçu"	L?	-	-	-	-	4.5	30 x 5	90	1
Boracéia, Salesópolis (SP)	"patinga"	L?	-	-	-	-	1.5	35 x 5	220	1
Matinhos (PR)	?	L?	-	-	-	-	2	20 x 16	-	2
Monte Alverne (RS)	*Trichilia claussenii*	L	12	-	primary branch	-	5.13	16 x 8	+100[b]	3
Monte Alverne (RS)	*Eugenia rostrifolia*	L	20	-	trunk	45.8	3.43	20.5 x 3.5	35–40[b]	3
Monte Alverne (RS)	*Alchornea triplinervea*	L	-	86.6	primary branch	-	4.3[a]	10 x 7[c]	-	3
Camburí, São Sebastião (SP)	?	L?	-	-	-	-	12	-	-	4
Camburí, São Sebastião (SP)	?	L?	-	-	-	-	4	-	-	4

Sources: 1—Camargo[5]; 2—Straube & Scherer-Neto[21]; 3—this study; 4—information supplied by Dante Buzzetti (*in litt.* 1996).
[a] Estimated from the ground;
[b] Estimation;
[c] Height of this nest apparently cited erroneously as 2.2 m in Collar *et al.*[6].

presumably intending to nest. Therefore, the nesting pair of *T. malachitacea* apparently did not use this cavity outside the breeding season.

The nest discovered in 1995 (nest 2) had a slit-shaped entrance and was located in the trunk of a large batinga *Eugenia rostrifolia* (Myrtaceae) c.300 m from nest 1 and on the north-facing edge of the mountain ridge. The entrance was so narrow that the adults had to turn sideways and wriggle through it to come in or out of the hole (Fig. 1). This cavity had a few other openings too small to be used by the birds.

The third nest (nest 3) was discovered owing to the presence on the ground around the nest tree of fresh remains of a nestling that had been killed and eaten by an unknown predator. This nest was in a primary branch of a large tapiá-guaçu *Alchornea triplinervea* (Euphorbiaceae) on the south-east-facing slope of the mountain. Its two openings had scratched lower lips, suggesting that the nest had two active entrances while in use. The larger entrance faced upwards and was located about one metre below the round-shaped, smaller one. This nest failed well before the fledging period, as indicated by the size of the nestling's tail feathers (between one-third and one-half grown). I suspect that the predator was a mammal as the flight feathers of the young were chewed at the base. However, both owl feathers and cat footprints were found near the nest tree.

Table 1 presents characteristics and measurements of all nests and nest trees of *T. malachitacea* known to date. Except for one nest from Camburí, São Paulo state, all were located in relatively low cavities in the forest understorey (mean c.4.6 m above ground level).

Copulation

Copulation was observed only once, on 28 October 1995 at 16h53 in a site equidistant from nests 1 and 2. The pair copulated for 65 seconds on a horizontal liana suspended at a height of c.7 m, with the male perched to the right of the female. Copulation followed the typical pattern described for Neotropical psittacines[17,19,20] and was preceded by courtship feeding.

Incubation

In 1994, the female incubated alone, and also roosted inside the nest hole at night throughout the incubation period. During the observations, the male was not seen entering the nest cavity and his roosting site was unknown. Incubation was apparently initiated on 28 October in the afternoon, when the female commenced to sit regularly (Fig. 2). On this day, she also began to roost overnight in the nest hole. Mean duration of daytime incubation sessions was 162.4 ± 22.0 min. (n = 18; first and last days of incubation excluded from the sample). Intervals between incubation sessions averaged 19.0 ± 5.8 min. (median = 8 min., n = 30; first and last days of incubation excluded from the sample) and increased markedly on the last three days of incubation (Fig. 2). Night incubation sessions ranged from 751.0 to 928.0 min. (mean = 820.8 ± 22.9 min., n = 7). The female usually entered the nest hole to roost between 1–2.5 hours before dusk (range 15h39–18h21; dusk between 19h00–19h15 in the period) and left it the next morning between 1–2.5 hours after dawn (range 06h11–07h58; dawn between 04h45–05h00). She always entered the nest hole head-first, i.e. without first turning around to face outward as reported for some other psittacines[16,19].

During the incubation period, the female fed exclusively on the food brought by her mate. The male fed her by regurgitation on average four times a day (range 3–5, n = 4 full-day observation sessions spaced throughout the incubation period; first and last day of incubation excluded from the sample). On arrival in the nest area, the male usually approached the nest tree silently and perched on a branch near the cavity entrance. He then advertised his presence to the female with very weak and soft vocalisations. Within a short period (from a few seconds to 26 min., but usually less than 3 min.), the female would emerge from the nest hole and fly about 30 m to be fed in a rather dark and dense portion of the forest. She usually gave resonant take-off calls (Figure 3A) upon leaving the nest site. The female's return to the nest, however, was

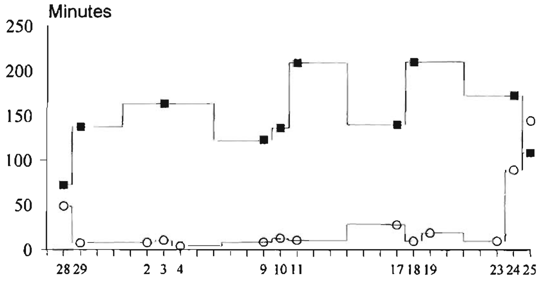

Figure 2. Mean duration of incubation sessions (line with squares) and periods of absence from the nest (line with circles) of an incubating female of *Triclaria malachitacea* between 28 October–25 November 1994. Days not appearing in the X-axis are those in which no data were collected. The incubation presumably commenced on 28 October and lasted until 24 November, approximately when the two lines cross.

secretive and not accompanied by loud vocalisations.

On the two occasions I succeeded in observing the male feeding the female (4 and 17 October), she begged by bobbing her head up and down rhythmically in front of the male, just as described for other Neotropical parrot species[19,23]. The male then transferred food into her gape ±10 and 8 times in sequence, from a perch slightly higher than that of the female. Both feeding sessions were less then 1 min. long. On a few occasions the female did not leave the nest upon the male's approach, and at least twice she left the nest without being fed by her mate. The reasons for this are unknown. She also did not leave the nest hole after the male's approach when Brown Capuchin monkeys *Cebus apella* were nearby (n = 2).

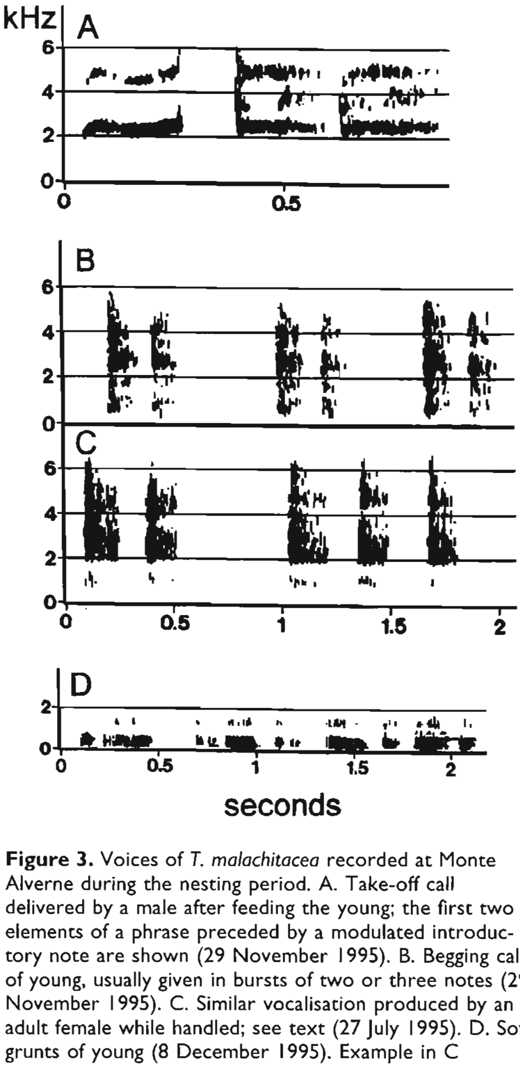

Figure 3. Voices of *T. malachitacea* recorded at Monte Alverne during the nesting period. A. Take-off call delivered by a male after feeding the young; the first two elements of a phrase preceded by a modulated introductory note are shown (29 November 1995). B. Begging calls of young, usually given in bursts of two or three notes (29 November 1995). C. Similar vocalisation produced by an adult female while handled; see text (27 July 1995). D. Soft grunts of young (8 December 1995). Example in C originally recorded in video. Sonagrams produced with MacRecorder Sound System 2.0.5 (Micromin.d Paracomp); recordings are archived at the Laboratório de Bioacústica, Universidade Estadual Paulista, Rio Claro, São Paulo.

The female's first long absence from the nest (62 min.) was on 24 November (the 28th day of incubation) between 08h07–09h09. Thereafter intervals between periods of nest attendance increased sharply. Also on this day, the female presumably fed by herself for the first time since the incubation began, between 15h30–17h33; after this time she approached the nest tree and remained in the vicinity, repeatedly opening her beak wide as if relaxing her jaw muscles (up to that time, she had been feeding only on the fluid meals supplied by the male, which do not need to be processed before ingestion). The first confirmed feeding of the nestlings took place during a brief visit of the female to the nest on the 25th between 13h25–13h45. Based on the above information, the time taken by the female to incubate the eggs in this nesting attempt was estimated to be between 26.8–28 days, very close to incubation periods of 28–29 days cited for *T. malachitacea* in captivity[6,10,18]. Forshaw[7] mentions a very short incubation period of only about three weeks for a pair of *T. malachitacea* breeding in captivity.

No instances of territorial defence against conspecific intruders were observed around the nest site, even though other pairs or individuals of *T. malachitacea* were occasionally seen in the vicinity of the nest tree during the incubation period.

Nestling period

In 1995, the adults visited the nest to feed the young on average about seven times a day, with a mean interval between visits of 100.64 ± 12.9 min. and range of 20–190 min. (n = 17, last day of observation excluded from the sample; see below). Although the parents always approached the nest together, in most feeding sessions the female alone fed the young. In those feeding sessions in which both adults entered the nest, she entered first. The male was observed feeding the young alone only twice.

Each feeding session comprised up to four successive bouts, corresponding to a single adult's entry into the nest to feed the young. Of a total of 41 feeding bouts witnessed, the female fed the young on 17 and the male on only seven. In the other 17 it was not possible to sex the adult. Feeding bouts lasted on average 2.67 ± 0.32 min. (n = 38, range 0.5–8 min.). Those by the female tended to be longer (mean = 3.11 min., n = 17) than those by the male (mean = 2.11 min., n = 7), but this difference was not statistically significant (Mann-Whitney *U* test).

The young called persistently all through the feeding sessions (Figure 3B) and continued to beg for a few minutes after the parents' departure from the nest area. The nestlings also delivered soft, surprisingly low grunts (Figure 3D) from the bottom of the nest hole when I climbed the nest tree to take measurements (age estimated at c.35–40 days old).

On the two days that followed the nest's discovery (11–12 November), the male was seen transferring food to the female before she fed the young. On such occasions, the male would either feed the young after the female or leave the nest area without entering the hole. These feeding sessions by the female took place in the forest around the nest area and were similar to those observed during the incubation period of the previous year, but were much longer and involved more individual food transfers (+14 and +32 on two occasions). Between the successive food transfers of a feeding session, the female usually delivered low harsh calls nearly identical to the begging calls of the young (Figure 3C), and also bobbed her head in front of the male. On two occasions, she did not feed the young after receiving food from her mate; these food transfers also took place near the nest.

The parents usually left the nest area together after feeding the young, and both typically delivered loud take-off calls on departing. Occasionally, however, one bird (especially the male) would leave the nest site alone. The female roosted overnight in the nest cavity only on the first days of observation. This may suggest that the incubating female roosts inside the nest hole only early in the chick-rearing period.

Table 2. Tree species bearing natural cavities in a sample of 300 individuals at Monte Alverne.

Species	***n***	**no. of cavities**	**cavities/ ind.**	**density***
Trichilia claussenii	10	15	1.5	69.7
Alchornea triplinervea	4	10	2.5	19.7
Eugenia rostrifolia	4	7	1.75	65.2
Cupania vernalis	3	3	1	13.6
Myrocarpus frondosus	1	+2	-	1.5
Ficus sp.	1	+2	-	1.5
Cabralea canjerana	1	1	-	6.1
Chrysophyllum marginatum	1	1	-	9.1
Chrysophyllum gonocarpum	1	1	-	9.1
Unidentified	3	6	-	19.7

* Density (ind./ha) of the species based on a larger sample of 436 individuals (0.66 ha).

The two nestlings were already completely feathered on 8 December and on 12 December they were seen at the nest entrance for the first time. The young fledged between 20–29 December.

As is usual in parrots[8,20], the parents appeared to stimulate the exit of the juveniles from the nest hole as fledging approached by calling persistently from a nearby perch whilst reducing the amount of food supplied to them. This behaviour was observed for *T. malachitacea* on 19 December. On this day (and presumably also on the following ones), the adults spent long periods calling softly near the nest entrance, and fed the nestlings only three times, with a nine-hour interval between the second and third feeding sessions.

In contrast to the 1994 breeding attempt, some antagonistic behaviour directed toward intruders was recorded near the nest. On 19 December, the breeding pair chased away another pair that approached the nest, pursuing them for c.20–30 m from the nest tree.

Nest tree and nest site availability

Table 2 presents the results of a survey of potential nest tree species and nest site density in a sample of 300 trees (144 over flat terrain on the mountain ridge and 156 on nearby slopes) of 50 species, corresponding to a sampling area of 0.439 ha. Twenty-nine individuals (9.7%) in the sample bore one or more natural cavities (mean of 1.72 cavities/tree) likely to be used by *T. malachitacea* for nesting, corresponding to densities of 66.06 cavity-bearing trees with dbh ≈ 10 cm/ha and 113.9 cavities/ha. The majority (23) were on the mountain ridge (density = 106.5 trees/ha), whilst the density estimated for the nearby slopes was only 26.9 trees/ha. Thus, this survey indicates that tall primary forest on flat terrain along mountain ridges is the most suitable nesting area for *T. malachitacea* (the forests that formerly covered the lowlands or bottom of valleys may also have provided good nesting sites, but no significant areas of such habitat remain in the region).

The data obviously do not reflect an actual density of nest cavities. A large percentage of the holes included in the sample may not possess the characteristics or dimensions (currently unknown) required by *T. malachitacea* for nesting. Moreover, the use of natural cavities by *T. malachitacea* probably depends on their distribution within the forest (cavities located in the same tree or too close to one another are presumably not utilised by more than one pair of Blue-bellied Parrots) and competition with other hole-nesting species[15,19].

The survey revealed *Trichilia claussenii*, *Eugenia rostrifolia*, *Alchornea triplinervea* and camboatá *Cupania vernalis* (Meliaceae) as the tree species most frequently possessing natural cavities potentially suitable as nest sites for *T. malachitacea* around Monte Alverne (Table 2). The nests discovered in the study area support this finding. Judging from common names alone, nest tree species cited by Camargo[5] in his description of two nests from São Paulo ("patinga" and "tapiá-guaçu") may be the same or related species.

Discussion

Parrots are very conservative with regard to their breeding behaviour. Limiting factors such as their dependence on natural cavities for nest sites and the slow growth rate of young[4,23] have probably reduced the opportunities to diverge from the ancestral pattern. Unsurprisingly, the nesting behaviour exhibited by the pairs of *T. malachitacea* observed in the present study was remarkably similar to that of other psittacines, especially medium-sized Neotropical species, with only minor differences.

In central-east Rio Grande do Sul, *T. malachitacea* nests in October–January, a period which coincides with the usual breeding season of most other bird species in the region[2]. This is also a period of high to moderate overall fruiting species diversity in primary forest, when most of the food items consumed by *T. malachitacea* are available (G. Bencke unpubl.).

Hatching is generally asynchronous in parrots[1,7,19,20]. Moreover, incubation may be irregular in the first days, as reported by Snyder *et al.*[19] for Puerto Rican Parrot *Amazona vittata*, and in some species the female's attentive behaviour does not change in the first days post-hatching[8,23,25]. Thus, the incubation period found for *T. malachitacea* in the present study may be overestimated, as it was based solely on the female's behaviour.

The inconspicuous behaviour of adult parrots in the nest area has been interpreted as an adaptive trait that reduces the vulnerability of nests to predators[25]. It is unclear why nesting *T. malachitacea* deliver loud vocalisations close to their nest so frequently, particularly when leaving the nest area. This may reflect a weak nest predation pressure faced by this species[19]. The few data available, however, do not appear to support this hypothesis. One of the three nests discovered at Monte Alverne failed due to a natural predator. Moreover, the incubating female in 1994 appeared to avoid leaving the nest hole to be fed by her mate when potential nest predators such as Brown Capuchins were nearby. Interestingly, nesting *T. malachitacea* consistently behaved secretively only when returning to the nest, whilst departures from the nest area were often very evident and the nesting pair in 1995 vocalised conspicuously within 5–30 m of the nest after feeding the young. This may suggest that the parents' entries into the nest to resume incubation or feed the young are the only critical periods when the nest hole is more easily located by predators or the adults themselves are most vulnerable. Other psittacines, e.g. Cuban Amazon *Amazona leucocephala*, Hispaniolan Amazon *A. ventralis*, Thick-billed Parrot *Rhynchopsitta pachyrhyncha* and Yellow-tailed Black Cockatoo *Calyptorhynchus funereus* appear to be equally or more conspicuous than *T. malachitacea* in the nest area and may be quite vocal even when returning to the nest or at the nest entrance[8,9,19]. In contrast, nesting Puerto Rican Amazon *Amazona vittata* are always very secretive around the nest[19,25]. This species apparently faces higher risks of nest predation and intra- and interspecific nest site competition than *T. malachitacea* and some other psittacines[19,24], so that keeping the nest area secret in addition to the nest itself may be an important strategy against cavity-prospecting, visually or vocally oriented predators such as conspecifics or Pearly-eyed Thrashers *Margarops fuscatus*. It is possible, therefore, that the nature of the risks faced by a nesting parrot (i.e. predation or nest site competition), in addition to their intensity, may play an important role in shaping the behaviour of breeding adults around the nest.

The young's vocalisations, other than food-begging calls, are rarely reported for psittacines in the wild. The soft grunts produced by the nestlings of *T. malachitacea* are remarkable for their extremely low frequency (range c.80–700 Hz, narrow band analysis) and are reminiscent of a toad or large frog.

Table 3. Mean height of nests of some Neotropical parrots. Mean height and range values sometimes taken from different sources.

Species	Mean height	Range	Source
Yellow-headed Amazon *Amazona oratrix*	6.5	4–15	6, 13
Green-cheeked Amazon *A. viridigenalis*	8.3	6–20	6, 13
Blue-fronted Amazon *A. aestiva*	4.9	1.55–20	15
Red-spectacled Amazon *A. pretrei*	6.9	3–10	14, 22
Red-tailed Amazon *A. brasiliensis*	5.8	1–15	12
Puerto Rican Amazon *A. vittata*	8.0	3.2–16.8	19
Hispaniolan Amazon *A. ventralis*	10.4	2.2–20.7	19
Blue-bellied Parrot *Triclaria malachitacea*	4.6	1.5–12	this study

Judging from the context in which it was delivered, this vocalisation appears to be a disturbance call. Snyder *et al.*[19] describe at least two vocalisations delivered by captive-reared young *Amazona vittata* in contexts of disturbance: a loud rasping call given by startled young after c.17 days old and a drawn-out wailing given when both young and adults are disturbed in the dark after c.32 days old. Although no sonagram of the former vocalisation is available, neither appears similar to the grunts of *T. malachitacea* in frequency and structure. These grunts are probably generic and the discovery of similar low-pitched vocalisations in other psittacines could reveal more about *T. malachitacea* relationships.

Nest holes of *T. malachitacea* appear to be rather low compared to those of other Neotropical parrots that nest in forests or woodlands (Table 3), although the data supporting this conclusion are strongly biased toward *Amazona*. Besides reflecting differences in sample size and vegetation stature in each area, this also certainly reflects the species' preference for middle and lower strata, rather than the canopy, unlike most other parrots (G. Bencke unpubl.). The apparent preference of *T. malachitacea* for cavities at low to intermediate heights indicates that the density of potential nest sites is lower than estimated above because many canopy and subcanopy holes would not be selected for nesting.

Finally, there is no indication that *T. malachitacea* has been suffering from nest site scarcity in primary forest remnants around Monte Alverne. All known nest tree species are common to abundant in the study area and all frequently bear natural cavities. In particularly, *Trichilia claussenii* may prove to be an important nest tree species in central-east Rio Grande do Sul as it is an abundant mid-storey tree in primary forests with a high propensity to shed branches, forming low, deep cavities with relatively small openings.

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