

Feeding rates of Rufous-capped Motmot *Baryphtengus ruficapillus* nestlings in Atlantic Forest of Ilha Grande, RJ, Brazil

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RESUMO. Taxa de alimentação a ninhegos de *Baryphtengus ruficapillus* em área de Mata Atlântica da Ilha Grande, RJ, Brasil. A taxa de visitas alimentares a um ninho de *Baryphtengus ruficapillus* foi estudada em uma área de Mata Atlântica pouco perturbada. Realizamos as observações em dois períodos de permanência dos filhotes no ninho, totalizando 47 h (19 h na fase inicial e 28 h na fase final). A taxa de visitação foi duas vezes maior para um dos membros do par reprodutor em ambas as fases de observação do ninho. Os itens alimentares levados aos ninhegos incluíram artrópodos (41,8%), frutos (32,8%), minhocas (7,4%), pequenos vertebrados (6,6%), moluscos (0,8%), e itens não identificados (10,6%). A frequência relativa dos itens alimentares levados ao ninho variou significativamente entre as fases inicial e final de assistência ao ninho, principalmente com relação aos artrópodos, que foram menos frequentes na fase final, e aos frutos, que aumentaram aproximadamente duas vezes na fase final, comparada com a fase inicial.

PALAVRAS-CHAVE: taxas alimentares, comportamento reprodutivo, *Baryphtengus ruficapillus*, Mata Atlântica.

Quantitative studies on parental care and reproduction of Neotropical birds such as motmots (Orejuela 1977, Scott and Martin 1983, Martin and Martin 1985) are few. Also, quantitative analyses of the diet of most Neotropical forest bird species, such as the one carried out by Remsen *et al.* (1993), are rare and are often based on stomach contents. Information on the diet of birds is difficult to collect in the field, yet is essential to the understanding of interspecific interactions at the community level (Remsen *et al.* 1993). Large forest birds foraging at understory levels are ideal candidates for such studies on diet because they are easy to observe, and hence, have their diet contents identified more easily than smaller birds, especially if they exhibit perching behavior before entering the nest.

Rufous-capped Motmot, *Baryphtengus ruficapillus*, usually uses tall woodland and rarely goes into second growth, is generally solitary or lives in pairs, breeding in banks near ground level (Willis 1981). Except for the known fact that it characteristically nests in a chamber along a tunnel excavated in banks by both members of the breeding pair, information on the breeding ecology and diet of *B. ruficapillus* is almost inexistent (Sick 1997). *Baryphtengus ruficapillus* is known to follow army ants for flushed prey mainly taken from the ground (Willis 1981).

During a study on bird communities in remnants of Atlantic Forest, we found a nest of *B. ruficapillus* that was systematically attended by members of a reproductive pair. The nest entrance was located in a position that facilitated the observation of food items brought by members of the pair.

Here we report our observations at this nest to answer the following questions: a) do members of the breeding pair differ in their parental investment, as measured by nestling feeding rates? b) does the time spent feeding

nestlings at the nest differ between members of the breeding pair? c) which food items are brought to the nestlings and at what frequency?

STUDY AREA AND METHODS

The work was carried out at Ilha Grande, RJ, in a relatively undisturbed area of Atlantic Forest. Ilha Grande is an island located on the south coast of Rio de Janeiro State, 150 km away from Rio de Janeiro city in the municipality of Angra dos Reis (23°11'S, 44°12'W). The island has an area of approximately 19,000 ha, covered by Atlantic Forest in different successional stages. The climate is hot and humid, with undefined dry and wet seasons; mean annual precipitation is approximately 1,500 mm (Oliveira and Netto 1996).

The nest (09 October 1997) was located along a tunnel excavated on a bank on the ground inside a large burrow covered by a stone, the entrance of which was used for the members of the pair to access the nest (figure 1). Due to the structure of the nest, it was impossible for us to access the nest without destroying it. Consequently, the number of nestlings was unknown. To avoid disrupting the behaviour of adults, we made an effort to minimize disturbance during the study.

Observations on time spent at the nest were made using binoculars (8x40); observers were approximately 10 m from the nest entrance, and observations occurred in two periods of the nesting stage: 10-13 October and 6-9 November 1997. The total observation period (47h) was divided into 19h during the initial period over three successive days, and 28h for the final period, over four days. One member of the breeding pair had been individually marked (with metal and color rings) previously (August 1997); however, we could not determine its sex.

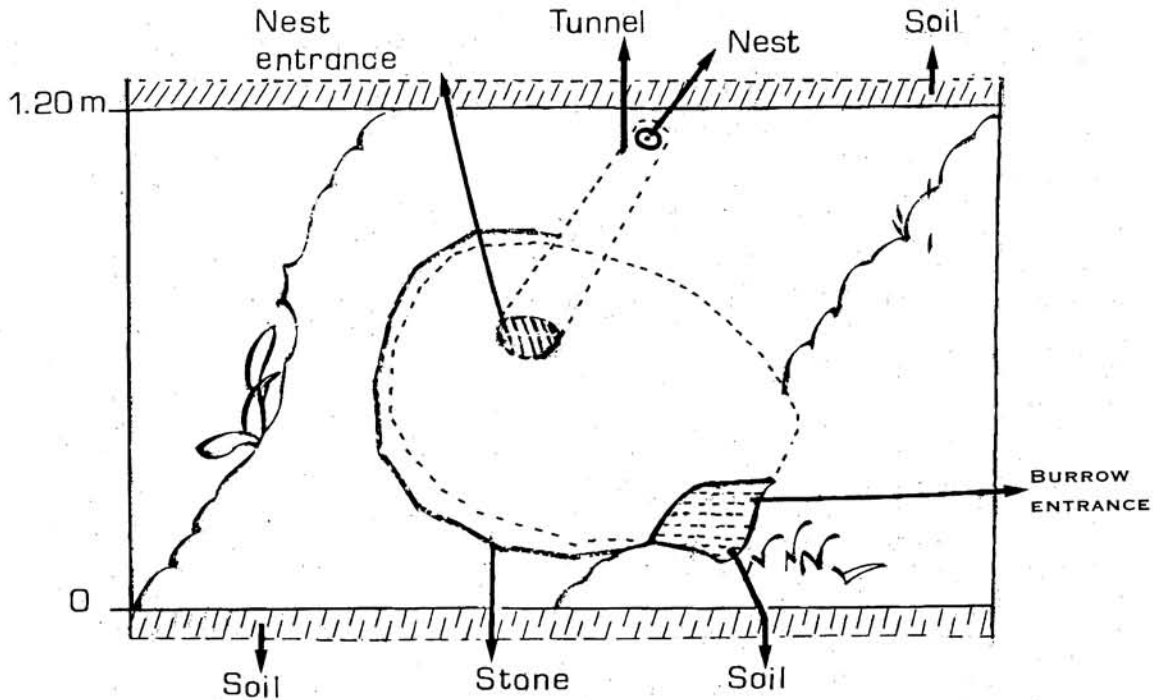


Figure 1. Diagram of the nest of *Baryptengus ruficapillus* found in an area of Atlantic Forest of Ilha Grande, RJ, showing the location of the nest (tunnel length not in scale) and the burrow entrance used by both members of the breeding pair to access the nest.

We recorded the time spent in the nest by each individual, the number of feeding visits and the food items brought to the nest by the breeding pair. For each of the two periods of the study we furnish the range of number of feeding visits and time spent in the nest by each member of the pair. We tested normality of the data, and used non-parametric tests when the data was non-normal (Zar 1984). Differences in visitation and feeding rates between the two periods were tested using a Kruskal-Wallis test. To evaluate the similarity of the food resources carried to the nest by each member of the pair we used a Chi-square test. To compare the feeding rates and the time spent in the nest by both members of the breeding pair, we used the number of visits and time spent in the nest per hour.

RESULTS AND DISCUSSION

The nest, feeding rates and time spent in the nest. The nesting site of *B. ruficapillus* is similar to that of the Blue-crowned Motmot, *Momotus momota*, in Central America. *Momotus momota* constructs its tunnel from the side of some pit or hollow on the ground, such as the den of a burrowing animal (Skutch 1964), as was observed for *B. ruficapillus*. In the present study, we could only see the tunnel entrance using an artificial light. We could not see the nestlings to know their age, but we assumed eggs had hatched by the time of the first observations, since both members of the pair were bringing food to the nest frequently. As nestlings of Motmotidae are known to stay in the nest for approximately one month (Sick 1997), periods of observation probably included the initial and final rearing stages. In addition, after the observations of the last period, we could hear the nestlings

calling near the burrow entrance, suggesting they were about to leave the nest.

Both members of the breeding pair were very cautious before entering the burrow, usually perching on several branches around the nest site before entering. Several times we observed their perching movements previous to entering the nest: the birds surveyed their surroundings, frequently moving their tails like a pendulum while approaching the nest. Pendulum-like movements of the tail are characteristic of motmots, and are most intensive and regular during the breeding season (Wagner 1950).

We did not see more than two individuals together. Usually there was one in the nest while the other was waiting perched outside. Therefore, although only one individual was marked, we assume that there were only two individuals involved in the nestling care, the presumed parents. This is a logical assumption considering what is known about the species or its closely related congeners (see Skutch 1945, 1947, 1964, Orejuela 1977).

The number of visits to the nest was significantly higher (almost twice) for the unmarked individual (median = 2.0, range 0-5 visits/h) when compared to the marked individual (median = 1.0, range 0-3 visits/h) (Kruskal-Wallis test, $H = 10.31$, $df = 1$, $p = 0.001$, $N = 19$) in the initial nest period. Similarly, the unmarked individual (median = 1.0, range 0-5 visits/h) had higher visitation rates than the marked individual (median = 1.0, range 0-4 visits/h) during the second observation period (Kruskal-Wallis test, $H = 3.64$, $df = 1$, $p = 0.056$, $N = 28$). Feeding rates were not significantly higher in the initial period ($N = 19$) compared to the final period ($N = 28$) for the marked bird (Kruskal-Wallis test, $H = 0.89$, $df = 1$, $p = 0.346$), but they did differ for the unmarked

individual, being higher in the initial stage (Kruskal-Wallis test, $H = 6.11$, $df = 1$, $p = 0.014$). Time spent in the nest was significantly higher in the initial period when compared to the final period for the marked ($H = 7.79$, $df = 1$, $p < 0.001$) and unmarked ($H = 21.93$, $df = 1$, $p < 0.001$) individuals. Yet, there was no difference in the time spent in the nest during the chick rearing stage by the two parents in the initial (median = 14.5 min/h, range 3-41 and median = 8.84 min/h, range 0.83-57, marked and unmarked individuals, respectively; Kruskal-Wallis test, $H = 1.56$, $df = 1$, $p = 0.211$) or the final period (median = 0.470 min/h, range 0.18-25.77 and median = 0.84 min/h, range 0.23-3.17 for marked and unmarked individuals, respectively; Kruskal-Wallis test, $H = 1.72$, $df = 1$, $p = 0.190$).

To our knowledge, there is no information on the feeding rate or the time spent in the nest by *B. ruficapillus*. In the present study, the feeding rate of the unmarked individual was approximately twice that of the marked individual. In a study with *Momotus momota*, one member of the couple (the one remaining in the nest at night) brought food more frequently than did the other (Skutch 1964), but sex of these individuals was not known. Martin and Martin (1985), observing an unsexed color-marked pair of *Eumomota superciliosa*, also found that one parent visited the nest with nestlings significantly more than the other one. Orejuela (1977), working with individuals of known sex, found that the female performed more feedings than the male. The fact that one member of the pair invests more in parental care may be compensated by greater investment in defense of the territory and anti-predator behavior by the other member. Yet, it may also

simply reflect differences in parental investment between the sexes.

Baryptengus ruficapillus formed pairs, but rarely foraged near each other. The presence of only single birds or pairs, as in *Momotus momota*, suggests strong territoriality (Willis 1981).

The food items brought to the nest. Food brought to the nestlings consisted mainly of arthropods (41.8%), fruits (32.8%, $N = 122$; table 1). Worms, small vertebrates (frogs and lizards) and mollusks were occasionally brought (table 1). The arthropods consisted mainly of insects (74.5%, $N = 122$), and diplopods. The insects which could be identified ($N = 10$) were: Coleoptera (10%), Orthoptera (stick insects, 30%), Hymenoptera (mainly ants, but also bees, 60%) and caterpillars (30%). Sometimes the members of the breeding pair were seen trying to catch food on the ground, and the prey captured seemed to be in most instances dead by the time the parents arrived on the perches they waited on before entering the burrow. *Baryptengus ruficapillus* is similar to *Momotus momota* in foliage/ground foraging (Willis 1981) and usually catches more prey on the ground and less on the trunks and foliage than does another Momotidae, *Electron platyrinchum* (Willis *et al.* 1982).

The relative frequency of items brought to the nest differed between observation periods (initial and final stages), for arthropods and fruits. Arthropods decreased and fruit doubled in the final stage (Chi-square, $X^2 = 14.41$, $df = 3$, $p < 0.01$). The food item categories used for the Chi-square test were: 1) arthropods, 2) fruits, 3) worms, frogs, lizards and mollusks combined, and 4) unidentified.

Species of Momotidae are considered to have a mixed diet of arthropods, fruits and small vertebrates, with fruits

Table 1. Feeding items taken by adult Rufous-capped Motmot, *Baryptengus ruficapillus*, to their nestlings in Atlantic Forest, Ilha Grande, RJ. Unidentified means that we could not see if the individual was marked or not.

Nest period	Bird	Food items							Total
		arthropods	fruits	worms	frogs	lizards	mollusks	unidentified	
Initial (Oct. 1997)	Marked	9	4	0	0	0	0	5	18
	Unmarked	22	8	2	2	3	0	6	43
	Sub-total	31	12	2	2	3	0	11	61
Final (Nov. 1997)	marked	5	7	5	3	0	0	0	20
	unmarked	14	19	2	0	0	1	2	38
	unidentified	1	2	0	0	0	0	0	3
	Sub-total	20	28	7	3	0	1	2	61
TOTAL		51	40	9	5	3	1	13	122
%		41.8	32.8	7.4	4.1	2.5	0.8	10.6	

being a supplementary category (Remsen *et al.* 1993, Sick 1997). However, quantitative data on species within the family suggests that some species are insectivorous, while others, such as the Rufous Motmot, *B. martii*, have mixed diets (including invertebrates, vertebrates, and fruits). An earlier study found that fruits composed 31.4% of the items ingested (Remsen *et al.* 1993), a value similar to the one we observed for the congener *B. ruficapillus* (32.8%).

One species of fruit brought to the nest by *B. ruficapillus* was *Virola gardineri*, which corresponded to 20% of the total fruit brought to nestlings (including both periods of observation), suggesting *B. ruficapillus* may be an important potential disperser of this plant species in the Atlantic Forest of Ilha Grande. This hypothesis can be corroborated by whole seeds of this fruit being found in the feces of the marked *B. ruficapillus* when it was captured in a mist net (M.A.S. Alves pers. obs.). *Baryphtengus martii* has been considered an important disperser of the fruits of *Virola surinamensis* in Panama (Remsen *et al.* 1993) and, probably, these birds are important seed dispersers in the rainforests where they occur. *Virola gardineri* has a large seed (about 2 cm long) covered by a brilliant red aril. Large seeds with red aril were also observed in 23% of the meals given to nestlings of *Momotus momota* in Central America (Skutch 1964). Another identified fruit brought to the nest by the studied species belongs to the family Myrtaceae (12.5% of the items brought to the nest). We also found many seeds (of an unidentified species) on the ground just below the burrow entrance to the nest. Regurgitated seeds were found in burrows of others motmots, such as *Momotus momota* (Skutch 1964).

Therefore, the present study shows that adult *B. ruficapillus* feed their young a mixed diet, and that it may be a potential disperser of Atlantic Forest fruits. The importance of *B. ruficapillus* as a seed disperser in the area, however, is an issue that deserves further studies.

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