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SHORT NOTE

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GEOPHAGY IN PFRIMER'S PARAKEET (*PYRRHURA PFRIMERI*), A CRITICALLY THREATENED AND ENDEMIC PARAKEET OF DRY FORESTS IN CENTRAL BRAZIL

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ABSTRACT · Geophagy refers to the behavior of ingesting soil by animals which has often been reported for parrots (Psittacidae), and is hypothesized to have a detoxifying function and/or to provide essential minerals. Here, we document this behaviour in Pfrimer's Parakeet (*Pyrrhura pfrimeri*), an endangered species that inhabits dry forest environments in central Brasil. Between 2012 and 2014, we observed four cases of geophagy in this species in the states of Tocantins and Goiás. All observations took place near streams where parrots were recorded scraping at limestone walls and rocky outcrops. This is the first record of geophagy for this species, besides expanding the known geographic distribution of this behavior eastwards in South America.

RESUMO · Geofagia em Tiriba-de-pfrimer (*Pyrrhura pfrimeri*), periquito endêmico e criticamente ameaçado das Mata Secas do Brasil-Central
Geofagia refere-se ao comportamento da ingestão de solo por animais, o que tem sido frequentemente relatado para papagaios, periquitos e afins (Psittacidae). As hipótese que explicam este comportamento seria uma tentativa de desintoxicação ou para o fornecimento de minerais essenciais. Nós documentamos esse comportamento em Tiriba-de-pfrimer (*Pyrrhura pfrimeri*), espécie ameaçada de extinção que habita as Matas Secas da porção central do Brasil. Entre 2012 e 2014 foram observados quatro casos de geofagia para a espécie nos estados de Tocantins e Goiás. Todas as observações ocorreu próximo de córregos e as aves foram registradas raspando paredes de afloramentos rochosos. Este é o primeiro registro de geofagia para a espécie e amplia a distribuição geográfica deste comportamento para o leste da América do Sul.

Key words: Dry forest · Endemic · Limestone outcrops · Paranã Valley · Psittacidae · *Pyrrhura pfrimeri* · Sediment ingestion · Threatened species · Tocantins State

INTRODUCTION

Geophagy is a behavior characterized by the ingestion of sediments observed in different vertebrate species (Abrahams & Parsons 1996). In birds, it has been noted in different families, such as Columbidae, Cracidae, Ramphastidae, and especially in Psittacidae (Diamond et al. 1999). Two potential explanations for the consumption of clay by Psittacidae (parrots and allies) include: detoxification, due to the high concentration of toxic compounds in the parrots' diet, and secondly, the intake of micronutrients, specifically sodium (Diamond et al. 1999, Gilardi et al. 1999, Brightsmith & Aramburé 2004).

In South America, geophagy in parrots has been widely observed in Peru and Bolivia (Brightsmith & Aramburé 2004, Mee et al. 2005, Lee et al. 2010), predominantly along the eastern slopes of the Andes (Lee et al. 2010). Although this behavior is not well documented throughout Brazil, there are some records of geophagy in Brazil associated with parrots in the Amazon and Pantanal regions (Silveira, 2010, Lee et al. 2010, Severo-Neto 2012).

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In the Amazon, large flocks of parrots concentrate on the banks of the Madeira River, in Rondonia state. Sometimes these flocks include hundreds or even thousands of birds (Lee et al. 2009, Silveira et al. 2011). Many of these flocks are composed by Red-and-green Macaws (*Ara chloropterus*), Orange-cheeked Parrots (*Pyrilia barrabandi*), and Mealy Parrots (*Amazona farinosa*) (Silveira et al. 2011). In the Pantanal region, there are records of geophagy in Blue-and-yellow Macaw (*Ara ararauna*) and Nanday Parakeet (*Aratinga nenday*) (Severo-Neto 2012). Furthermore, geophagy in parrots has been documented in Aripuanã and Cristalino Rivers, in Mato Grosso state (Lee et al. 2010).

The Pfrimer's Parakeet (*Pyrrhura pfrimeri*) is a 'Critically endangered' (MMA 2014, IUCN 2015) endemic to the dry forests of the Paranã River Basin, on the border between the states of Goiás and Tocantins, in Central Brazil. The clearance of the forests to create pasture for cattle and the exploitation of limestone outcrops for the production of cement and fertilizers is the cause of widespread habitat loss and population decline in these parakeets (Olmos et al. 1998, Bianchi 2010).

One of the various popular names for the species is "Barreirinha" (pers. observ.). Local inhabitants developed this name in reference to the Portuguese term for mud (from the Portuguese "barro") based on the fact that they noticed the species feeding in muddy areas, on the banks of rivers, by the side of roads and also on the rocky cliffs common in this region. However, geophagy has not been previously documented for this species. Here we report two observations of geophagy in Pfrimer's Parakeet. We also present other two instances, in which geophagy was deduced from the birds' behavior and/or from evidence left on the substrates.

OBSERVATIONS

Between April of 2012 and May of 2014, monthly expeditions of about 10 days were carried out in the dry forests of the municipalities of Taguatinga and Aurora do Tocantins, in Tocantins State, and in the municipalities of São Domingos and Divinópolis, in Goiás State. The field work had as main objectives to investigate the feeding and breeding biology of Pfrimer's Parakeet and to carry out ornithological inventories associated to the dry forest and limestone outcrops of the region.

On 4 April 2012 at about 09:30 h, at the Angélica farm along a limestone wall (13°31'S, 46°22'W), 1 km south from Angélica Cave, in the municipality of Santo Domingo, in Goiás state, we observed a flock of approximately 30 parrots entering a hollow area in the rocky wall, where they remained for a few minutes. Afterwards, flocks of 8–10 individuals left the hollow areas in the wall while others arrived, switching places with each other (Figure 1A). All of the birds came out with their dusty and dirty feathers suggesting that they were scraping the rocks with their beaks, presumably to create tunnels and/or to feed.

The second observation took place in the dry riverbed of a small stream (12°38'S, 46°27'W) at the Dona Renilda farm, in the municipality of Aurora do Tocantins, in Tocantins state, on 8 March 2013 at c. 13:00 h. When crossing the dry riverbed of the stream (Figure 1B), we observed 20 parakeets scraping frantically the small bank above the stream's riverbed with their beaks. The behaviour was observed for about half a minute, from a distance of about 6 m. However, during our attempt to document this event with photographs, the flock took off and flew to more distant trees on a limestone outcrop 300 m away. Photos of the site where the scraping had taken place, and photos of fragments of the rock that had been scraped away were taken (Figure 1B–1D).

The third observation occurred in a narrow watercourse formed by the flow of rainwater on complex limestone outcrops of the Conceição stream (12°21'S, 46°28'W) in the municipality of Taguatinga, in Tocantins state, on 22 January 2014, at c. 17:00 h. Approximately 6 m away from the narrow riverbed, a flock of eight parrots flew from the ground landing in the canopy of a nearby tree. Immediately after the group left this location we inspected the site and found that the soil where the flock landed had been dug, and scratches were visible in the clay.

Finally, on 11 February 2014 at around 10:30 h, the fourth event occurred along the Lapa stream (13°44'S, 46°21'W), very close to the opening of the Terra Ronca II cave in the municipality of São Domingos, in Goiás state. A flock of about 20 parrots were observed clustered against a distant limestone wall. The flock was at a height of approximately 8 m on the limestone wall and was observed making frantic scraping motions with their beaks (Figure 1E). Proper precautions were taken to avoid disturbing the flock, so that the observation of the flock eating shaved particles of rock could continue, uninterruptedly, for a little over an hour.

After satisfactory collecting photographic and video documentation (https://youtu.be/ysHNQrUs-LvA) we climbed the wall and were able to see in greater detail the site where the sediment had been ingested by the birds. It was noticed that part of the rock seemed like a natural container with semi-circular shape (resembling a bowl). Here a large amount of powder, with an extremely fine granular appearance, was accumulated. After a few minutes, we verified that this was indeed the scraping point. We left the site and hid behind some rocks. Promptly, we observed the return of the flock which resumed the ingestion of the sediment.

DISCUSSION

The geophagy behavior described for Pfrimer's Parakeet constitutes the fifth case identified within the genus. Such behavior has been reported for Madeira Parakeet (*Pyrrhura snethlageae*) (Silveira 2010),

Figure 1. (A) Pfrimer's Parakeet (*Pyrrhura pfrimeri*) flock resting on a rock, moments before venturing into the open hollow in the wall on 4 April 2012 at Angélica farm, Tocantins, Brazil. (B) Dry riverbed on stream in Aurora do Tocantins marked (gray arrow) where the parakeets scraped the rock on 8 March 2013, Dona Renilda farm. (C) Details of scraped rock. A cell phone is used as a reference scale. (D) Piece of rock showing coloration and geological aspect. (E) Flock scraping and eating mineral powder on 11 February 2014, in Lapa stream. Photos: Tulio Dornas.

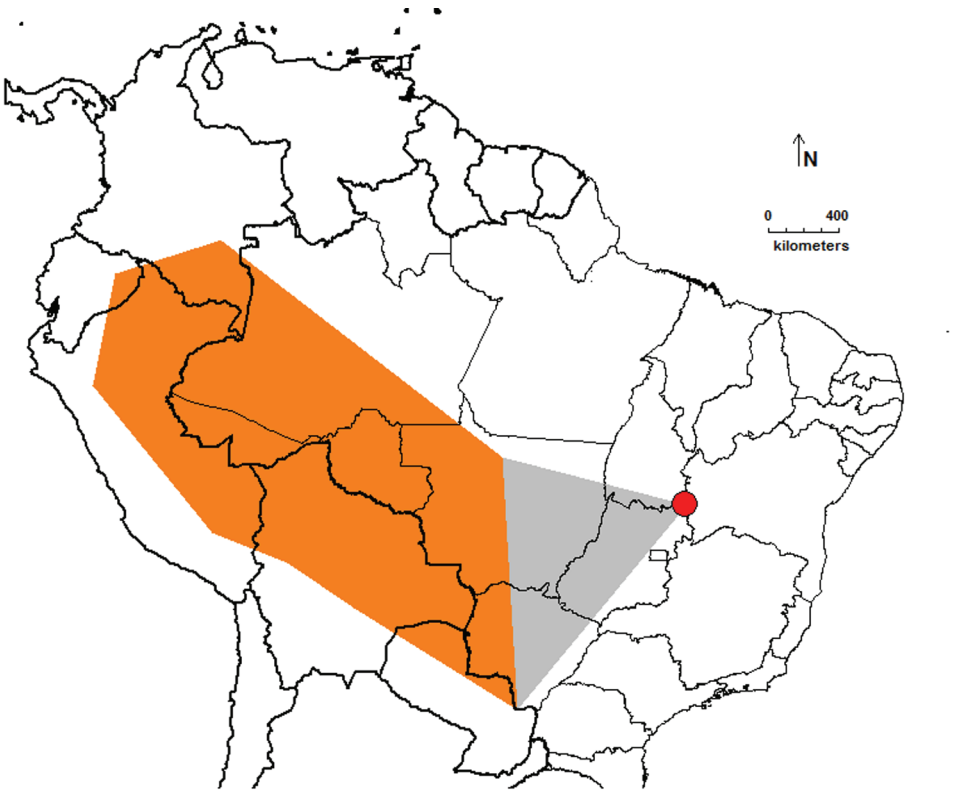

Figure 2. Model of the currently known geographic distribution (Maximum Convex Polygon - MCP) of geophagy in South America based on Lee et al. (2010) and own observations. Orange: MCP proposed by Lee et al. (2010); gray: hypothetical area to the MCP resulting from the new geophagy records (red dot; this study) in Pfrimer's Parakeet (*Pyrrhura pfrimeri*).

Black-capped Parakeet (*P. rupicola*) (Lee 2010), Rose-fronted Parakeet (*P. roseifrons*) (Lee 2010), and Crimson-bellied Parakeet (*P. perlata*) (Alex Lees in litt.). Probably the same behavior is widespread among other species of the genus, particularly Gray-breasted Parakeet (*P. griseipectus*). The last species was previously only known to inhabit the humid upland forests in the interior of the Caatinga, in Ceará state. However, an established population was recently discovered in the rocky outcrops of Quixadá, in the central region of Ceará (Girão et al. 2010).

In sympatry with Pfrimer's Parakeet, there are other species of parrots like Red-and-Green Macaw *Ara chloropteus,* Hyacinth Macaw (*Anodorhynchus hyacinthinus*), and Yellow-faced Parrot (*Alipiopsitta xanthops*), all of which are threatened to some degree (MMA 2014, IUCN 2015). Presumably, these species may also be using the limestone outcrops of the region making these rocky outcrops a key resource for the conservation of these species as well.

These instances of geophagy by the Pfrimer's Parakeet illustrate the importance of rocky outcrops in breeding areas beyond being nesting sites. They contribute to the diet of the species, further justifying the conservation of the dry forest and its limestone outcrops. The second observation (in the dry stream margins in Aurora do Tocantins) suggests that geophagy could also be related to the reproductive behavior of the species. Hours before of the reported event, we observed a large flock of Pfrimer's Parakeets (including over 30 pairs) partaking in continuous copulation behaviour in a site located approximately 500 m from the limestone outcrop. The same pairs were observed flying in and out of hollow trees near the limestone outcrop. The observation of copulations occurring at the same time as geophagy allows us to speculate that the observations were made during the reproductive period, with formations of nests, postures, and posteriorly in incubation. In this same location, 40 days later another visit revealed that the number of pairs was drastically reduced. There were no more than four pairs and no copulations were observed. However, we cannot exclude that geophagy occurs throughout the year, outside of the reproductive period.

Finally, the observations described for the Pfrimer's Parakeet in this study broaden the currently recognized geographical distribution of geophagy behavior in South America. The distribution proposed by Lee et al. (2010) did not include the dry forests of the Paranã river basin in the central region of Brazil (Figure 2), and the same applies to the geophagy occurrence modeling for South America also proposed by Lee et al. (2010). The detection of this foraging behavior in Pfrimer's Parakeet indicates that the eastern regions of Brazil, especially those areas where there is a strong relationship between the presence of parrots and rocky outcrops, may provide in the future additional cases (species and areas) of geophagy.

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