



Blooming meal: flower eating by the Blue-crowned Trogon *Trogon curucui*

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Abstract: Flowers provide birds with a range of dietary resources, although few data are available on flower eating for birds that have mixed diets. We report here a new food type for the Blue-crowned Trogon (*Trogon curucui*), describing two flower eating events. The individuals fed on the yellow trumpet tree flowers (*Handroanthus* spp.) at the peak of the dry season in the Cerrado and Pantanal biomes. The birds picked up the flowers by sally-glean flying and a brief hovering, and then perched on a nearby branch to swallow the flower whole. Florivory appears to be seasonal and, while a minor component of this species' diet, flowers may be an important alternative resource during periods when fruits are scarce.

Keywords: feeding behavior; flowers as food, Trogonidae, Cerrado, Pantanal.

Refeição florida: consumo de flores pelo surucuá-de-barriga-vermelha *Trogon curucui*

Resumo: As flores fornecem às aves uma variedade de recursos alimentares, embora poucos dados estejam disponíveis sobre o consumo de flores por aves de dieta mista. Relatamos aqui um novo item alimentar para o surucuá-de-barriga-vermelha (*Trogon curucui*), descrevendo dois eventos de ingestão de flores. Os surucuás se alimentaram das flores de ipê-amarelo (*Handroanthus* spp.) no ápice da estação seca nos biomas Cerrado e Pantanal. As aves apanharam as flores em voo "sally-glean" e em seguida pousaram em um ramo próximo para engoli-las por inteiro. A florivoria parece ser sazonal e embora seja um componente secundário da dieta desta espécie, as flores podem ser um recurso alternativo importante durante os períodos em que os frutos são escassos.

Palavras-chave: comportamento alimentar; flores como alimento, Trogonidae, Cerrado, Pantanal.

Introduction

Trogonidae (Aves, Trogoniformes) are forest dwellers that include eight genera and 43 species with a Panropical distribution, except in Australasia (Collar 2020). African species are exclusively insectivores, whereas the Asian and Neotropical species have mixed diets of arthropods and fruits, with occasional small vertebrate preys, although the exact composition of the diet varies considerably among the different taxa (Remsen et al. 1993, Sick 1997, Collar 2000, Pizo 2007, Winkler et al. 2020). For species of the genus *Trogon*, analyses of the stomach contents of 17 species revealed a mixed diet of arthropods and fruits (Schubart et al. 1965, Remsen et al. 1993).

Florivory (or floral herbivory) is defined as the consumption of all or part of the structure of a flower, which may damage the floral bud or mature flower prior to the development of the seed capsule (Burgess 1991). Floral components are an important feeding resource for many Brazilian birds (Silva and Rubio 2007, Parrini & Raposo 2008, 2010, Parrini 2015). Nevertheless, the consumption of flowers by omnivorous birds and the importance of floral resources in their diets are still poorly understood. Most studies focus on the consumption of nectar for acquisition of nutrients, energy, and water (Silva 2019), typically without causing damage to the flowers (Parrini 2015). However, some studies describe feeding on petals and other floral components by several bird species (Sazima & Sazima 2007, Silva & Rubio 2007, Parrini & Pacheco 2013, Parrini 2015, Silva 2019).

We describe herein two events of flower eating by the Blue-crowned Trogon, *Trogon curucui*, during the dry season in the Brazilian Cerrado

savanna and Pantanal wetland biomes. This species is reported as having a typical *Trogon* diet of invertebrates and fruit (Remsen et al. 1993).

Material and Methods

The records from the Cerrado were obtained in the village of Brejo do Peixe (5°24'56" S, 43°31'34" W), in the municipality of Parnarama, eastern Maranhão (Figure 1). The observations were conducted in September, at the peak of the dry season, which coincides with the blooming of the yellow trumpet tree (*Handroanthus* sp.). The vegetation of the studied area is composed of extensive areas of Cerrado *sensu lato*, interspersed with tracts of *Mauritia flexuosa* palm swamps (veredas), small villages, and subsistence farmland. The local climate is highly seasonal, with a dry season from June to November and a rainy season from December to May. Another observation was obtained on the Transpantaneira highway (16°20'21" S, 56°38'40" W), in the municipality of Poconé, southern Mato Grosso. The vegetation of this studied area is composed of extensive swampland typical of the Pantanal, interspersed with tracts of gallery forests, and large cattle-raising farms. The climate is highly seasonal, with a dry season from May to September and a rainy season from October to April (Tarifa 1986). The observations at both areas were conducted using Nikon 10x42 or Pentax 10x50 binoculars, and the photographs were taken with a Canon 7D camera.

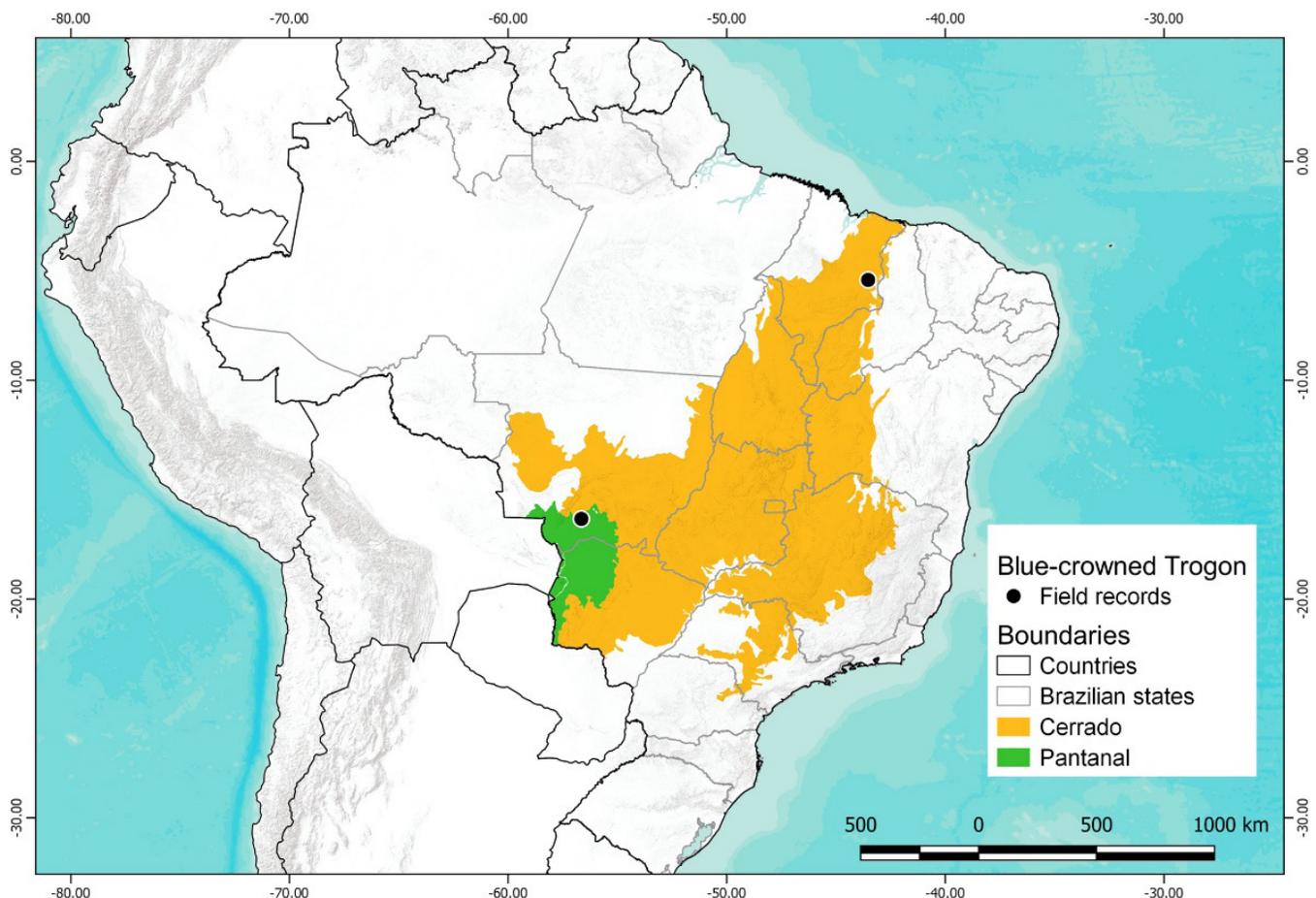


Figure 1. Map with the biomes Cerrado and Pantanal in Brazil, and the two field records of Blue-crowned Trogon (*Trogon curucui*) consuming trumpet tree (*Handroanthus* spp.) flowers.

Results

On the Transpantaneira highway, on September 1982, at approximately 13:00 h, a pair of *T. curucui* was observed on a full blooming yellow trumpet tree (*Handroanthus* cf. *ochraceus*). The two birds were perched near one another and flew towards a flowering branch three or four times, using a sally-glean flight and picked a flower while hovering briefly. The birds then returned to their perch to swallow the flower whole. The female was observed picking and swallowing two flowers, while the male did this once before the pair left the perch and disappeared from view.

At the village of Brejo do Peixe, at 10:40 h on 9 September 2019, a flock of six Blue-crowned Trogon individuals was observed moving in the crown of a yellow trumpet tree (*Handroanthus* sp.) in full bloom. During the intense movements of the individuals among the crowns of the trees adjacent to the trumpet tree, a female Blue-crowned Trogon was observed carrying a yellow flower in its bill. Afterwards the flower was swallowed whole. Subsequently, a male was observed perching alongside a number of flowers and then descended in a short, rapid flight to collect a flower after a sally-glean maneuver, which consisted of swooping down onto a food item and capturing it in a brief hovering. The bird then perched in an adjacent tree and swallowed the flower whole (Figure 2).

Discussion

Our observations validate and document flower eating for the Blue-crowned Trogon, *Trogon curucui*, an apparently uncommon feeding behavior among Trogonidae. In an observational dietary study of three *Trogon* species in the Atlantic Forest, a single unidentified flower was eaten by a Green-backed Trogon *T. viridis* individual during the dry season (Pizo 2007). On the other hand, the Cuban Trogon *Priotelus temnurus* seems to feed mostly on flowers, besides fruits and insects (Collar 2020).

Many *Trogon* species, including *T. curucui*, have a mixed diet composed mainly of fruits and arthropods. Schubart et al. (1965) analyzed 10 individuals of *T. curucui* (including *T. variegatus*), and found that 60% of the stomach contents were composed exclusively by arthropods while 40% had a mix of arthropods, fruits, seeds, and plant tissue. Remsen et al. (1993) analyzed 36 individuals and found that 52.8% of the stomach contents was composed by arthropods only, while 44.4% contained a combination of fruits and arthropods (2.8% contained unidentified material).

While feeding on flowers, trogons and other birds may obtain a considerable combination of nutrients and sugars, such as glucose,

fructose, and saccharose, particularly when fleshy fruits are scarce (Baker & Baker 1983, Terborgh 1986, Galetto & Bernardello 2003). Indeed, the flowers of trumpet trees (*Handroanthus* and *Tabebuia*) produce nectar with a high (23–30%) concentration of sugars (Barros 2001; Souza et al. 2004). *Handroanthus ochraceus* blooms profusely for about one month during the dry season, and the time of the trogon feeding event recorded at Parnarama coincided with the 11:00 h peak of nectar concentration recorded for *H. ochraceus* and *Tabebuia aurea* (Barros 2001). In addition to making available an important alternative source of nutrients and energy, flowers may meet the birds' requirements for water, a scarce resource in the dry season (Mlcek & Rop 2011, Silva et al. 2015, Silva 2019). The fleshy petals of *Acca sellowiana* may be an important nutritional resource for nestlings of the Sayaca Tanager *Thraupis sayaca*, the Chestnut-backed Tanager *Stilpnia preciosa*, and other passerines as well, when fruits are scarce (Sazima & Sazima 2007).

The consumption of flowers is considered an opportunistic behavior in many birds and recorded mostly during the dry season when the availability of fruit and water is reduced (Parrini 2015, Silva 2019). Floral resources can be exploited in a number of ways, both destructive and non-destructive. Hummingbirds (Trochilidae) and a number of passeriforms feed on nectar and act as pollinators without changing the flower structure (Parrini & Raposo 2010), whereas some species of Cracidae, Psittacidae, Ramphastidae, Thraupidae, and Icteridae are known to be flower predators (Ragusa-Netto 2005, Parrini & Pacheco 2013, Parrini 2015, Mendes et al. 2017, Valtuille et al. 2017).

Primarily frugivorous birds may also occasionally include flowers in their diets, independently of the scarcity of fruit, as is the example of the Saffron Toucanet *Pteroglossus bailloni* in the Brazilian Atlantic Forest, and the Emerald Toucanet *Aulacorhynchus prasinus* in Costa Rica (Riley & Smith 1986, Galetti et al. 2000). It thus seems that at least some toucans may feed regularly on non-fruit foods, even if in small amounts, in particular during the breeding season (Riley & Smith 1986). However, the Toco Toucan *Ramphastos toco* appears to eat flowers opportunistically in the Pantanal biome (Ragusa-Netto 2006).

In the Pantanal, Blue-throated Piping-Guan *Pipile cumanensis* regularly eats the flowers of the pink trumpet tree (*Handroanthus impetiginosus*) during the dry season, when it may congregate in blooming trees together with Chaco Chachalaca *Ortalis canicollis*, Bare-faced Curassow *Crax fasciolata*, and Chestnut-bellied Guan *Penelope ochrogaster* (Del Hoyo et al. 2020). In the Pantanal, which has an intense dry season, the Yellow-chevroned Parakeet *Brotogeris chiriri*, Peach-fronted Parakeet *Eupsittula aurea*, and Turquoise-fronted Parrot *Amazona aestiva*, exploited *Erythrina fusca* ripping the flowers off the



Figure 2. A Blue-crowned Trogon (*Trogon curucui*) male swallows a whole trumpet tree flower (*Handroanthus* sp.) in the Cerrado savanna at Brejo do Peixe,

branch to feed on nectar, while the Chestnut-eared Aracari *Pteroglossus castanotis* and *R. toco* swallowed the flowers whole (Parrini & Raposo 2010). On the other hand, the Sayaca Tanager, the Palm Tanager *Thraupis palmarum*, and the Grayish Saltator *Saltator coerulescens* were observed tearing off and eat the petals (Parrini & Raposo 2010). As would be expected, wide-gaped birds swallow the flowers whole, whereas narrow-gaped ones feed on flower pieces.

Despite the apparent rarity and seasonality, feeding on flowers by the Blue-crowned Trogon indicates that this bird searches actively for alternative sources of nutrients to meet water and nutrients requirements during periods of fruit scarcity. However, studies on the relationship between birds and blooming trumpet trees (*Handroanthus* and *Tabebuia*) in the Cerrado and Pantanal are still scarce. Both these biomes have an intense dry season when they are vulnerable to extensive wildfires, which may have a significant impact on the abundance of feeding resources for birds during this part of the year. Thus, availability of alternative food, such as flowers, may be fundamental to their survival.

The Blue-crowned Trogon and Green-backed Trogon are phylogenetically close (Espinosa de los Monteros 1998, Moyle 2005), and both species occasionally feed on flowers (Pizo 2007; present paper). The Cuban Trogon *Priotelus temnurus* is placed among the first branching lineages in the phylogeny of the Neotropical trogons (Espinosa de los Monteros 1998, Moyle 2005), and feed mostly on flowers (Collar 2020). Given the absence of flower-eating in most *Trogon* species, we submit that this feeding behavior could have been lost throughout the evolution of the variable feeding habits of most Neotropical trogons (Collar 2020, Winkler et al. 2020). Alternatively, florivory is actually a rare behavior and has been mostly unnoticed. We predict that a few additional flower eating *Trogon* species will be reported with further observational, natural history-oriented studies, especially in biomes with marked seasonal differences.

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Author Contributions

Gustavo Gonsioroski: Contribution to data collection; manuscript preparation; contribution to critical revision, adding intellectual content.

Ivan Sazima: Contribution to data collection; manuscript preparation; contribution to critical revision, adding intellectual content.

Marcos Augusto Rodrigues Silva: Contribution to data collection; manuscript preparation.

Flávio Kulaif Ubaid: Manuscript preparation; contribution to critical revision, adding intellectual content.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

Ethics

We declare that the procedures used in this study have no conflict with the Brazilian Laws regarding the use of vertebrates in scientific research.

Data availability

Besides the map, photographs and descriptions included here, other data was compiled from published literature, and appropriated cited along the manuscript.

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