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## **Observations of Pallas's long-tongued bat, *Glossophaga soricina* (Pallas, 1766) (Chiroptera, Glossophaginae), visiting *Dracaena reflexa* Lam (Aspargaceae) flowers in an urban area of Rio de Janeiro (Brazil)**

Observações do morcego beija-flor, *Glossophaga soricina* (Pallas, 1766) (Chiroptera, Glossophaginae), visitando flores de *Dracaena reflexa* Lam (Aspargaceae) numa área urbana do Rio de Janeiro (Brasil)

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**Resumo** O Gênero *Dracaena* reúne 40 espécies de árvores e arbustos, nativos da África, Madagascar, Ilhas Maurício, sul da Ásia e América Central. *Dracaena reflexa* Lam é uma espécie exótica arbórea nativa de Madagascar e ilhas próximas, com aproximadamente quatro a seis metros de altura, amplamente utilizada no paisagismo urbano e decoração de interiores. É uma monocotiledônea tropical vistosa e de crescimento moderado, podendo ser plantada isolada, ou em grupos. A floração inicia-se no final do inverno se estendendo até o final da primavera. As flores são pequenas e brancas, reunidas em inflorescências terminais. São conhecidos apenas abelhas e vespas como visitantes/polinizadores no Brasil. As observações noturnas da visita de morcegos às flores de *D. reflexa* ocorreram no Campus da Fundação Técnico - Educacional Souza Marques, na cidade do Rio de Janeiro, sob a luz do luar e luminosidade local. Para a identificação dos

morcegos visitantes das flores, foram estendidas redes de neblina próximas aos vegetais em floração. Isto resultou na captura de oito espécimes de *Glossophaga soricina* (Pallas, 1766). Esses Glossophaginae abordaram as flores por meio de breves voos, quando tocaram os órgãos reprodutivos das flores com a porção ventral do corpo. Foi possível observar que os *G. soricina* pairavam à frente das flores, em movimento de adejo, introduziam a língua para recolher néctar e pólen e se afastavam, rodeando o vegetal e abordando outras flores da inflorescência. Esse comportamento facilita a troca de material polínico entre as flores, mesmo que não ocorra polinização efetiva. No presente estudo, o uso de *D. reflexa* na alimentação de morcegos é descrita pela primeira vez na Região Neotropical. Neste sentido, trata-se de um importante registro para melhor compreensão das interações animal-planta que ocorrem em áreas urbanas.

**Palavras-chave:** morcegos, flor, fauna sinantrópica, quiropterofilia.

**Abstract** The genus *Dracaena* includes 40 species of tree and bush native to Africa, Madagascar, Mauritius, Southern Asia, and Central America. *Dracaena reflexa* Lam is an arboreal species native to Madagascar and adjacent islands, which reaches four to six meters in height, and is used widely for urban landscaping and interior decoration. This attractive tropical monocotyledon grows at a moderate rate, and can be planted alone or in groups. Flowering begins towards the end of the austral winter, and continues until the end of the spring. The flowers are small and white, and are grouped in terminal inflorescences. The only known visitors/pollinators in Brazil are bees and wasps. Data were collected during the nocturnal monitoring of visitors to the flowers of *D. reflexa* plants on the Cascadura campus of the Souza Marques Technical Education Foundation in the city of Rio de Janeiro under moonlight and local illumination. For the identification of the bat species visiting the flowers, specimens were captured in mist nets set adjacent to the flowering plants. This resulted in the capture of eight specimens of *Glossophaga soricina* (Pallas, 1766). These Glossophaginae approached flowers through short flights, during which the ventral portion of their bodies came into contact with the reproductive organs of the flower. The bats were observed hovering in front of the flowers, into which they introduced the tongue to collect the nectar and the pollen and moved away, surrounding the plant and approaching other flowers of the inflorescence. This behavior facilitates the exchange of pollinic material between the flowers, even if an effective pollination does not occur. In the present study, the use of *D. reflexa* flowers in bat feeding is described for the first time in the Neotropical region. In this way, this is a relevant record for the better understanding of the animal-plant interactions that occur in urban areas.

**Key words:** bat, flower, synanthropic fauna, chiropterophily.

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## Introduction

It is widely known that plant reproductive

processes such as pollination and seed dispersal are facilitated by the ecological iterations between animals and plants. According to Wheelwright *et al.* (1982), these associations reduce the incidence of hybrid plants, the loss of pollen material, and the unviability of seeds, thus increasing the number of new individuals. Bats are known to visit and presumably pollinate approximately 573 plant species and disperse the seeds of 549 species in the Neotropical region (AVILA-CABADILLA *et al.*, 2012), and these mammals are considered by many authors as responsible for the maintenance of tropical forests.

Lima (2008) recognized a total of 63 Brazilian bat species that can be found in urban environments (such as piazzas, parks, and residential areas), in particular frugivorous species such as *Artibeus lituratus* (Olfers, 1818), *Carollia perspicillata* (Linnaeus, 1758), and *Sturnira lilium* (E. Geoffroy, 1810), and the nectarivore *Glossophaga soricina* (Pallas, 1766). These species generally roost in dense tree crowns, cellars, manholes, and storm drains (BREDT *et al.*, 1996; REIS *et al.*, 2002). In the city of Rio de Janeiro, Esbérard *et al.* (1999) identified 27 bat species which included nectarivorous and frugivorous species that roost in the roofs of houses and other constructions, such as ceilings, basements, abandoned houses, bridges etc.

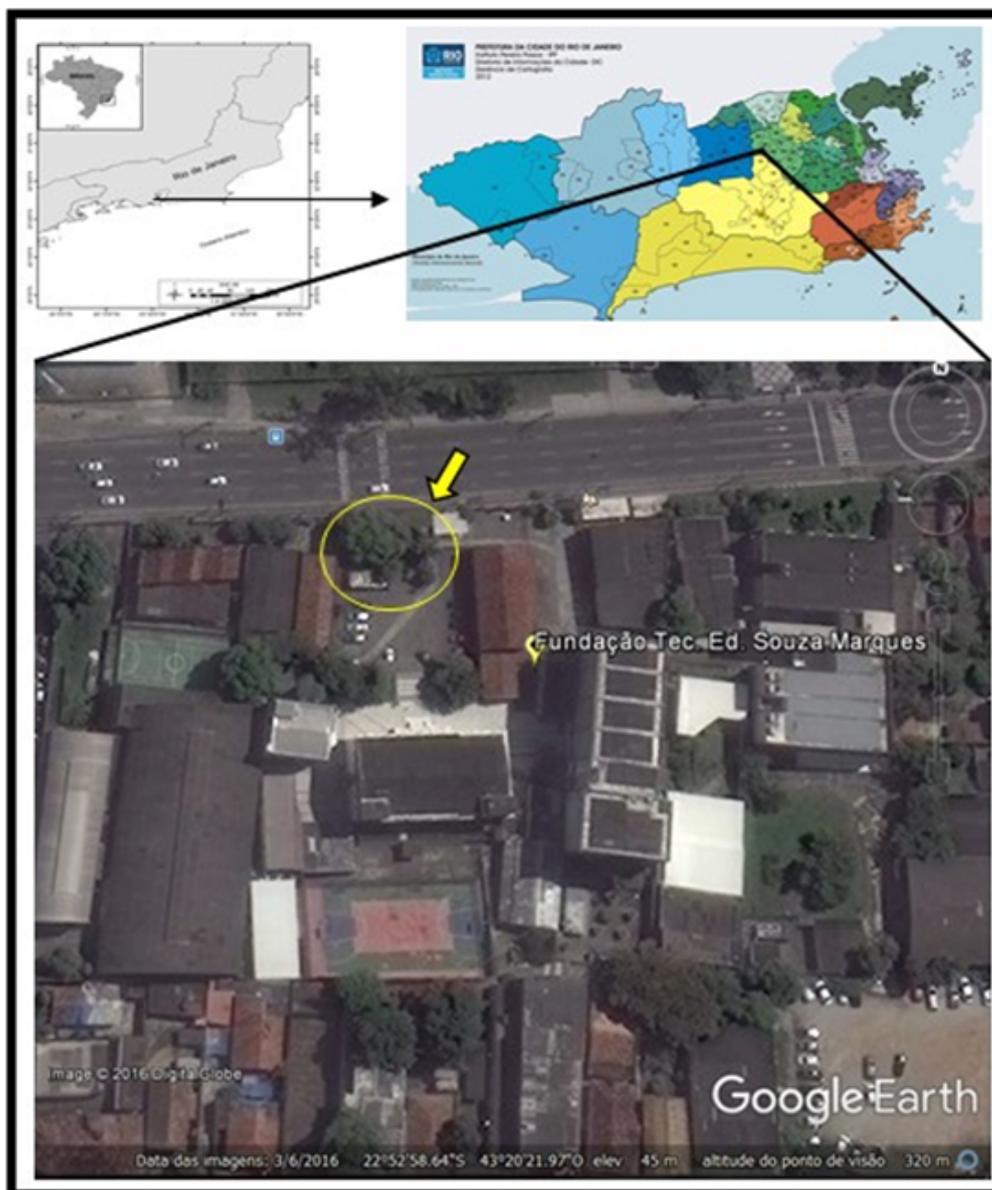
Here we describe the visit of *G. soricina* specimens to an exotic plant species, *Dracaena reflexa* Lam. The Pallas's long-tongued bat, *G. soricina* is a small Phyllostomidae characterized by its morpho-physiological and behavioral adaptations for the dietary exploitation of nectar and pollen. These adaptations include an elongated tongue and snout, hairs with scales that trap pollen, and specific behaviors that allow the animal to visit flowers (HOWELL; HODKING, 1976, FINDLEY; WILSON, 1982, HEITHAUS, 1982). This species is found in a variety of habitats, including the urban areas of a number of different Brazilian cities (BREDT *et al.*, 1996). The diet includes insects, fruits, and parts of flowers; however, it is considered to be preferentially nectarivorous (GARDNER, 1977).

*D. reflexa* is a monocotyledonous plant species of the Aspargaceae, found originally on Madagascar, Mauritius, and neighboring islands in the southwestern Indian Ocean; in Brazil is known as the "Pleomele" or "song of India", being largely used in landscaping and interior decoration (ANGIOSPERM

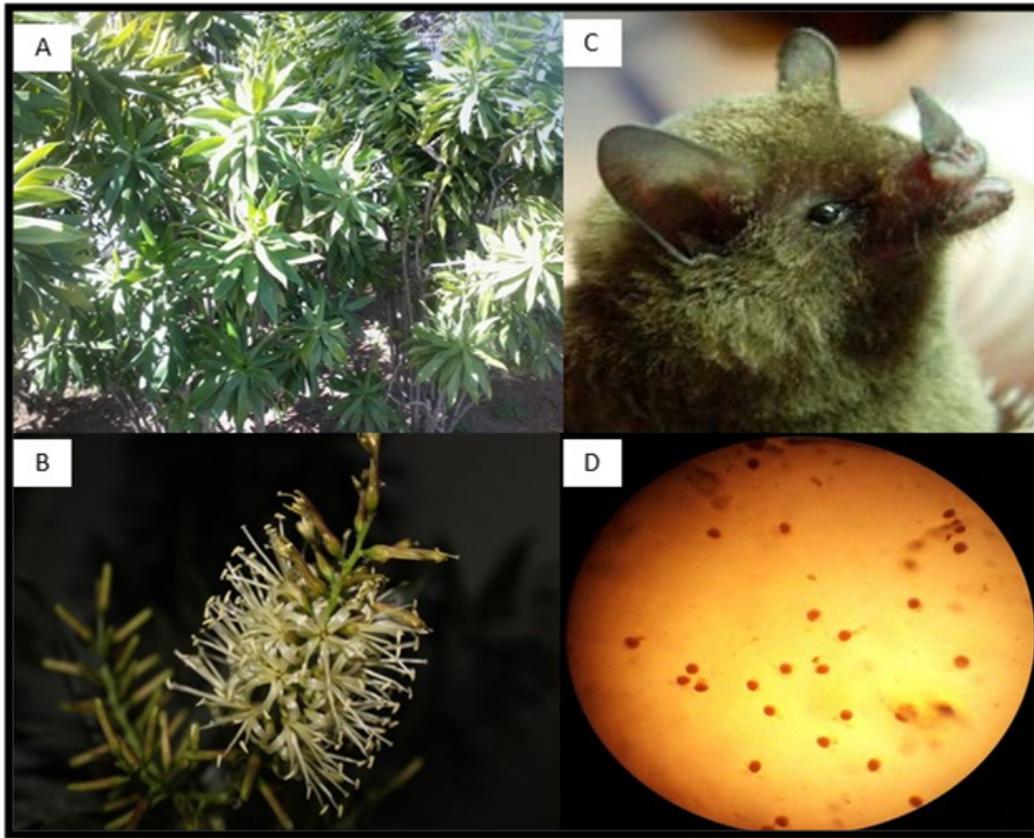
PHYLOGENY GROUP, 2003). This tree-size plant can reach a height of four to six meters and has a semi-woody texture and upright trunk with branches; Its leaves are simple, slightly wavy, dark green coriaceous arranged in a spiral forming a rosette. They produce small white flowers arranged in bunches of terminal inflorescences and their flowers and fruits are not very attractive (SOUZA; LORENZI, 2008). Britt (2000) registered this species as an important component of the diet of the black-and-white ruffed lemur (*Varecia*

*variegata variegata*) from Madagascar. According to this author, fruits ferment whilst still on the stalk.

To date, there is no report of *G. soricina* or any other bat visiting the flowers of *D. reflexa*. Silbebauer-Gottsberger, Gottsberger (1975) conducted the only published study of the pollination of *Dracaena* in Brazil, in which they identified bees, flies, and wasps as the pollinators of this species.



**Figure 1** Aerial view of the SMTEF Cascadura Campus, Rio de Janeiro/Brazil. The circle/arrow indicates the location of the *Dracaena reflexa* plants monitored during the present study (Source: Map-PMRJ/ Aerial view - Google Earth-2016).



**Figure 2** (A) Specimens of *D. reflexa* inside the SMTEF campus, Rio de Janeiro/Brazil (photograph: Shirley S.P. Silva); (B) detail of the inflorescence of *D. reflexa* (photograph: Patrícia G. Guedes); (C) Specimen of *G. soricina* collected during visit to flowers of *D. reflexa* (photograph: Shirley S.P. Silva); (D) Pollen of *D. reflexa* extracted from the pelage of *G. soricina* (400 x) (photograph: Shirley S.P. Silva).

## Material and Methods

The study was based initially on opportunistic observations of bats behavior on the Cascadura campus of the Souza Marques Technical Education Foundation, SMTEF (22° 52'37"S, 43° 20'00" W) (Rio de Janeiro, Brazil) (Figure 1). After these initial observations, a protocol for monitoring the visitation of *D. reflexa* flowers visited by bats during the month of September (Spring in the Southern Hemisphere) was carried out.

Three mist nets measuring 6x 2,5 m were installed in the vicinity of the *D. reflexa* plants between 6:00 and 10:00 p.m. for the trapping of bats during the visit to flowers. The captured animals were placed in individual cotton bags and sent to the SMFET Laboratory of Marine Biology and Zoology for identification with the aid of specific bibliography, obtaining biometric data and collection of pollen material from the

specimens' coat. These observations were made under moonlight and local lighting, and the behavior of the animals and the number of individuals who visited the flowers each day were registered.

The hair of the muzzle, belly and back of the animals were observed and pollen material was removed with the aid of brush and tweezers, being stored in tubes containing 70% alcohol. Blades of the flowers were also assembled for comparison with the material found on the coat of the animals. The palynological slides were assembled from the material collected in the coat of bats and flowers through the direct method using glycerinated gelatin. The slides were considered as proof of the visitation of bats to flowers when they had at least 30 pollen grains (as suggested in SILVA; PERACCHI, 1995). All animals were released at the end of the field session. Exsiccates were set up and sent to the Botanical Garden of Rio de Janeiro in order to confirm the plant species identification.

## Results

Five specimens of *Dracena reflexa*, planted grouped, were identified in the SMTEF parking lot (Figure 2A).

The floral anthesis started at approximately 6:00 p.m. and the inflorescences show white petal flowers (Figure 2B) and strong, sweet odor. It was observed that each night a number of open flowers arose and that they were feasible for only one night, being wilted the next morning.

Soon after the anthesis, the first visitors were observed at around 7:45 p.m. On average, 18 bats visited *D. reflexa* flower each night, arriving in pairs and approaching the flowers through brief hovering flights. After feeding, the bats pulled away, and circled the crown of the plant to visit other flowers in the inflorescence. During foraging, bats visited the open flowers of all five *D. reflexa* individuals in the same night.

Eight specimens of *Glossophaga soricina* were captured while visiting *D. reflexa* flowers (Figure 2C). The comparative analysis of the palynological slides revealed the presence of *D. reflexa* pollen in the hair of all the bats (Figure 2D). Despite the probable transfer of the pollen between plants, none of the *D. reflexa* produced fruit during the subsequent months.

## Discussion

The exploitation of native and exotic plant species by synanthropic bats in the urban landscape allows them to become potential pollinators of these plants, and even possibly dispersers of their seeds. Based on a systematic analysis of the relationship between plants and glossophagine bats, Chittka; Thomson (2001) suggest that the plant increases its ability to compete for pollinators, improving the cost-benefit ratio for its visitors by providing food resources for long periods; so plants can adopt a protracted flowering strategy, especially during the dry season when food resources are scarce. In big cities such as Rio de Janeiro, the study of synanthropic bats and their feeding behavior and reproductive patterns may provide important insights into their adaptability to the anthropogenic modifications of the environment and thus contribute in decisions concerning the remaining diversity conservation.

The flowers visited by bats present a set of

characteristics that favor mutualistic interactions with these animals, and have been denominated as “chiropterophily syndrome” by Faegri, Pijl (1971), in which the plant specifically attracts nectarivorous bats and rewards them with nectar and pollen when they visit the flowers (TSCHAPKA; DRESSLER, 2002). *D. reflexa* flowers present a number of the characteristics of the “chiropterophily syndrome” including: nocturnal anthesis, pallid flowers, and terminal inflorescences. The crepuscular timing of anthesis observed in *D. reflexa* has also been recorded for other specimens by Heithaus et al. (1974), Sazima et al. (1982), Bergallo (1990), Buzato; Franco (1992), Silva; Peracchi (1995, 1999) and Silva et al. (1996, 1997). The observed presence of buds and flowers at different stages of development indicate a strategy of increasing the supply of resources (nectar/pollen) over a prolonged period, thereby guaranteeing the flow of visitors.

The behavior of *G. soricina* during the visits to *D. reflexa* was similar to that reported by Sazima et al. (1982) while pollinating *Luechea speciosa* (Tiliaceae) and Silva et al. (1995, 1996) while visiting *Eugenia jambos* (Myrtaceae) and *Bauhinia cupulata* (Leguminosae). These authors describe the visit in groups during the peak of the flowering period and then in pair or single visits in the end of the period.

According to Waser et al. (1996) the exploitation of floral resources often requires behavioral abilities of pollinators to detect signs and associate them with the resources, as well as the morphological and physiological abilities to explore them, so that these abilities can differentiate a floral visitor from an effective pollinator. Despite the presence of pollen material in the *G. soricina* coat, this was not a guarantee of effective pollination for *D. reflexa*. Since no fruit production was observed in the subsequent months, *G. soricina* can be considered as a floral visitor of *D. reflexa*.

The visit/pollination of plant species by *G. soricina* near or within forested areas was recorded by several authors (e.g. SAZIMA; SAZIMA, 1975, SAZIMA et al., 1982, SILVA; PERACCHI, 1995, SILVA et al., 1996, SILVA et al., 1997).

The use of floral resources by bats and other mammals in urban areas in Brazil is still poorly known. In this sense, studies on animal diet and behavior are important and necessary for a better knowledge of animal-plant associations in these areas.

Regarding the visit of bats to exotic plant flowers, Silva et al. (1996) and Meghan et al. (2016)

observed specimens of *Eugenia jambos* (Myrtaceae) and *Musa acuminata* (Musaceae), respectively, being visited by *G. soricina* in a rural area. Fábian *et al.* (2008) presented a list containing 189 species from 85 genera and 44 families of plants used by phyllostomids in Brazil, being 14 exotic/cultivated species; only the exotic *Musa acuminata* is reported being used by *G. soricina* and *Carollia perspicillata* (Linnaeus, 1758), but no further comments about the local (rural or urban) were provided by the authors.

There are no records about plants from the Aspargaceae associated to bats in Brazil. In this sense, the use of *D. reflexa* flowers by a bat species, here described for the first time, is a relevant record for the better understanding of the interactions that occur in urban environments.

The described relationship demonstrates the importance of arboreal vegetables, even the exotic used in urban landscaping, in the feeding of synanthropic species and also demands new investigations in order to evaluate the impact of the exotic species on the feeding behavior of the chiropterans and other animals.

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