

# Smell fruits selection behavior by a Geoffroy's spider monkey (*Ateles geoffroyi*) in Quintana Roo, México

## Comportamiento olfativo de selección de frutos por un mono araña de Geoffroy (*Ateles geoffroyi*) en Quintana Roo, México

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In primates, sensory systems play an important role in the detection and selection of resources. Here, we report a neglected ecological behavior, olfactory fruit selection in a Geoffroy's spider monkey (*Ateles geoffroyi*), a primate species found in the Mesoamerican to northern South American region. We directly observed, videotaped, and described a fruits selection behavior using the sense of smell by a free-ranging Geoffroy's spider monkey during a foraging feeding event in a *Manilkara zapota* tree, in a tropical semi-evergreen forest area of south of Quintana Roo, México. During the observations, the spider monkey examined the sapodilla (*Manilkara zapota*) fruits one by one by bringing them close to its nose, apparently allowing it to distinguish between ripe and unripe fruits. Fruits that appeared unripe, were released from the branches without tearing them. Fruits that appeared to be ripe, as the observation suggests, were picked and eaten one at a time. This olfactory-driven selection challenges the common belief that vision, and taste govern food choices. Our findings underscore the vital role of olfaction in frugivore foraging, particularly in discriminating the palatability of cryptic-ripe fruit. This has wider implications for understanding ecosystem interaction networks, encompassing the evolution of distinct odors in fleshy-fruited plant species and the role of sniffing in food discrimination.

**Key words:** Frugivory; olfactory perception; primates; sensory systems.

En primates, los sistemas sensoriales juegan un papel importante en la detección y selección de recursos. Aquí, reportamos un comportamiento ecológico poco estudiado, la selección olfativa de frutos en el mono araña de Geoffroy (*Ateles geoffroyi*), una especie de primate que se encuentra desde las regiones de Mesoamérica hasta el norte de Sudamérica. Observamos directamente, grabamos en video y describimos un comportamiento de selección de frutas usando el sentido del olfato por un mono araña de Geoffroy silvestre durante un evento de forrajeo en un árbol de *Manilkara zapota*, en una zona de selva tropical semi perennifolia al sur de Quintana Roo, México. Durante las observaciones, el mono araña examinó uno por uno los frutos de *Manilkara zapota* acercándolos a su nariz, lo que aparentemente le permitía distinguir entre frutos maduros e inmaduros. Los frutos que parecían inmaduros los soltaba de las ramas sin arrancarlos. Los frutos que parecían maduros, como sugiere la observación, eran arrancados y consumidos uno en uno. Este mecanismo de selección basado en el olfato hace frente a la creencia de que la visión y el gusto son los principales impulsores en la elección de alimentos para primates frugívoros. Destaca la relevancia de las señales sensoriales, especialmente el olfato, en la discriminación de la palatabilidad y subraya la influencia en la evolución de olores distintivos en plantas con frutas carnosas y crípticos.

**Palabras clave:** Frugivoría; percepción olfativa; primates; sistemas sensoriales.

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It has been suggested for some time that the evolution of trichromacy in some New World monkeys was linked to frugivory, as fruits frequently consumed by primates tend to be yellow or red in color, suggesting a visual selection mechanism (Glaser 1989; Laska et al. 1996; Riba-Hernández et al. 2004). However, in other primate species found in the New World, such as *Alouatta palliata*, a non-visual selection mechanism controlled primarily by the sense of smell has been proposed (Sánchez-Solano et al. 2022).

Geoffroy's spider monkey (*Ateles geoffroyi* Kuhl 1820) is one of the most studied primates in the Mesoamerican region. Its range spans continuously from southern México

through Guatemala and Belize to Costa Rica and Panamá, reaching the limits of Colombia, restricted by the Baudó Mountains (Cortés-Ortiz et al. 2021). Various aspects of the feeding ecology and dietary preferences have been documented across this distribution range. For example, this primate species spends between 57 % and 83 % of its total feeding time foraging for fruits (Cant 1990; Riba-Hernández et al. 2003; Di Fiore et al. 2008; González-Zamora et al. 2009; Cortés-Ortiz et al. 2021). Therefore, sensory systems play a crucial role in detecting and evaluating food items (Valenta et al. 2015; Cunningham et al. 2021; Sánchez-Solano et al. 2022).

The theory suggests, spider monkeys feed on a diverse range of fruits, and their selection indicates a potential use of sweetness in appraising nutritional value and toxin levels in available food sources (Laska et al. 1996; Chapman et al. 2012; Pablo-Rodríguez et al. 2015). Therefore, the species must evaluate these nutritional values through sensory cues to obtain valuable and precise information about the taste, aroma, and quality of the fruits it will consume (Pablo-Rodríguez et al. 2015). However, the method by which the species selects fruits as part of its feeding habits in the wild has been poorly understood. Here we described a fruits selection behavior using the sense of smell by a free-ranging Geoffroy's spider monkey during a foraging event in a forest area in Quintana Roo, México.

Direct observation and video recording were used to register the selection behavior of a wild Geoffroy's spider monkey foraging in a *Manilkara zapota* tree in a forest area south Quintana Roo from May 21 to 23, 2016. Specifically, the observations were carried out in the area known as Laguna Om (18° 39' 44.70" N, 89° 07' 53.53" W). Physiographically, the region is predominantly flat with some hills. The climate is classified as warm sub-humid with medium to high humidity, the mean annual precipitation ranges from 1,000 to 1,300 mm, and the average annual temperature is 22 °C. The region experiences 2 well-defined seasons, a dry season from March to June and a rainy season from July to

November (INEGI 2017). The dominant vegetation type in the area is broadleaved evergreen or semi-deciduous forest and in some areas is present a mixed of broadleaved and needle-leaved forest (Figure 1). The broadleaved evergreen or semi-deciduous forest is characterized by species such as piñon de oreja (*Enterolobium cyclocarpun*), chechén prieto (*Metopium brownie*), ceiba pentandra (*Ceiba pentandra*), and huevo de ratón (*Vitex gaumeri*; Flores and Espejel 1994). On the other hand, the mixed broadleaved and needle-leaved forest is dominated by palo de Campeche (*Haematoxylum campechianum*), naranjillo (*Hyperbaena winzerlingii*), manzanilla (*Coccoloba cozumelensis*), and sakitsa (*Neomillspaughia emarginata*; Palacio et al. 2002).

This behavior was observed on all 3 days, but it was only recorded once (on May 21). The total observation time over the 3 days was 21 min, with 10 min on May 21, 3 min on May 22, and 8 min on May 23. The Geoffroy's spider monkey picked up each fruit individually with 1 hand and brought it about 2 to 3 cm away from its nose to smell it (Figure 2; see video link in figure). Fruits that appeared unripe were released without tearing them from the branches, and the remaining fruits were evaluated in the same way. Fruits that appeared to be ripe were picked and eaten one at a time. It is noteworthy that sometimes some fruits were picked in the same way as before, but instead of being eaten they were dropped to the ground.

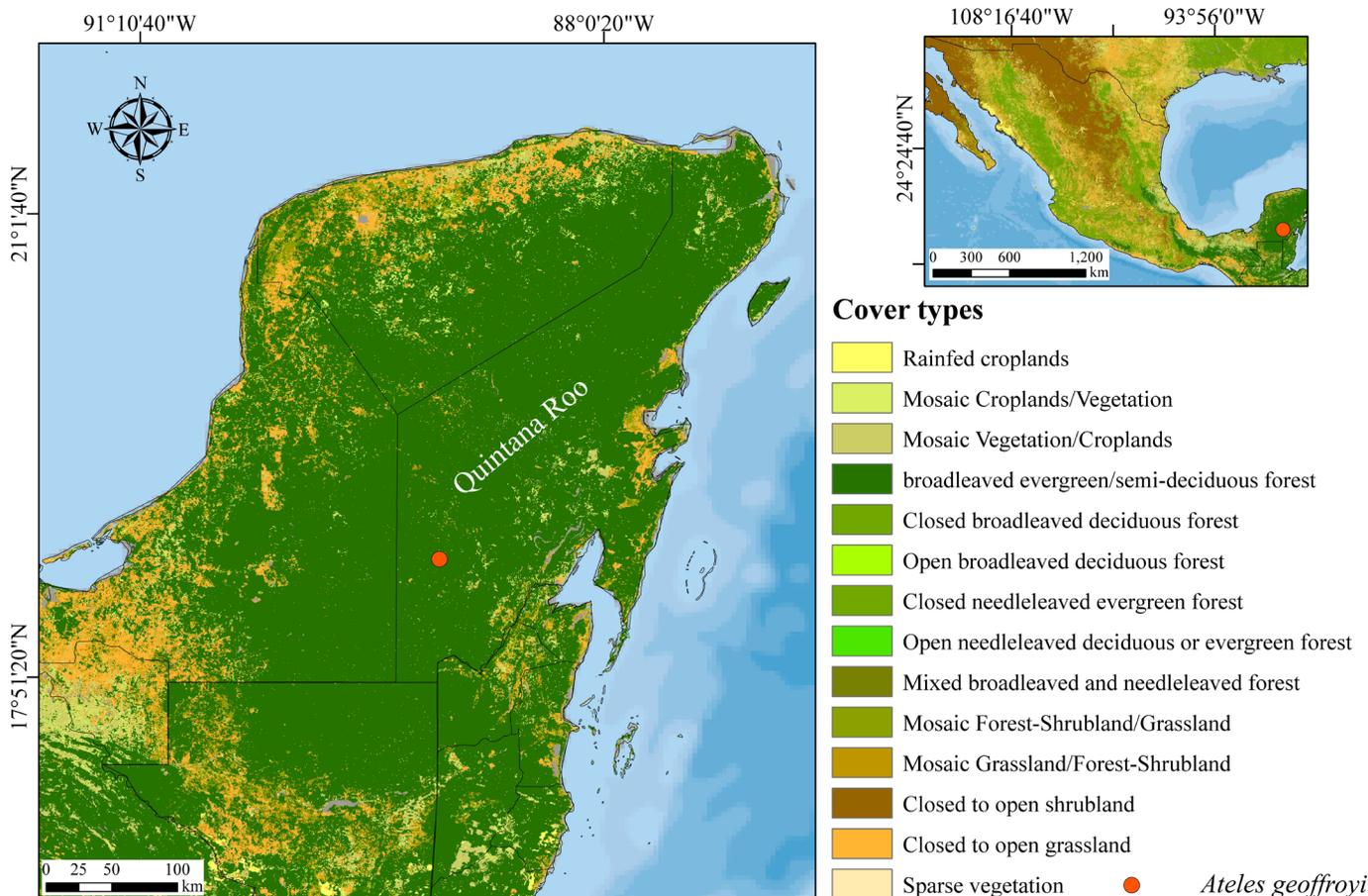


Figure 1. Wild Geoffroy's spider monkey (*Ateles geoffroyi*) observation locality in a tropical semi-evergreen forest in Quintana Roo, México (Datum WGS 84). Cover types are from Arino et al. (2022).



**Figure 2.** Wild Geoffroy's spider monkey (*Ateles geoffroyi*), a) foraging, b) displaying the smell fruits selection behavior and c) eating the fruit of *Manilkara zapota* tree. The video can be seen in the following link: <https://youtu.be/AoCpxZAGakQ>.

Here we present evidence of the smell fruit selection behavior of Geoffroy's spider monkey in its natural habitat, shedding light on its integral role within the species' foraging ecology. This skill it is known as the olfactory conditioning paradigm (Nevo et al. 2015).

Frugivorous primates such as Geoffroy's spider monkey primarily rely on carbohydrates for metabolic energy (Simmen and Sabatier 1996). Therefore, the species require precise detection of these resources while avoiding potential toxins. Research suggests that in various non-human primate species, particularly in New World monkeys including Geoffroy's spider monkey, the primary mechanisms for food selection are vision and taste (Glaser 1989; Laska et al. 1996; Riba-Hernández et al. 2004).

However, only a limited number of studies have investigated these mechanisms but has not been thoroughly described in wild individuals (Dominy 2004; Nevo et al. 2015; Pablo-Rodríguez et al. 2015; Melin et al. 2019). Nevo et al. (2015) propose that Geoffroy's spider monkey learn to associate certain scents with ripe fruits and rewards through chemical recognition. Sánchez-Solano et al. (2022) also suggested this non-visual selection mechanism in *A. palliata*. Furthermore, this behavior has also been observed in Old World species as ring-tailed lemurs (*Lemur catta*) and pig-tailed macaque (*Macaca nemestrina*; Hübener and Laska 1998; Cunningham et al. 2021).

Our observations suggest that selection by monkeys may have driven the evolution of distinct odors in plant species with fleshy fruits (Nevo et al. 2015). This may be an honest reward signal related to the nutritional value of the resource. Thus, the importance of behavioral patterns in resource selection by frugivores will help to understand the

mechanisms that give rise to the structural and functional patterns of interaction networks (Jordano et al. 2003; Acevedo-Quintero et al. 2020). Further research is needed to evaluate this behavior and to determine whether this selection strategy is common to other populations of Geoffroy's spider monkey along its geographic range and to other Neotropical primate species.

### Acknowledgements

We would like to thank D. A. Molina, and 2 anonymous reviewers for his insightful comments on the manuscript.

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Associated editor: Beatriz Bolívar Cimé.

Submitted: January 12, 2024; Reviewed: March 5, 2024.

Accepted: March 22, 2024; Published on line: April 22, 2024.