Bees Collect Resin from *Mauritia flexuosa* in Roraima, Brazil

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1. Ripe *buriti* fruits.

Stingless bees and Africanized honey bees were observed collecting resin from immature flowers, fruits and the vegetative parts of female inflorescences of *Mauritia flexuosa*. The bees probably use the resin as nest-building material. *Mauritia* is the first known palm to attract resin-collecting bees.

Mauritia flexuosa is a dioecious, solitary-stemmed palm that grows in flooded savannas and gallery forests of the Caribbean and South America. In Brazil, the fruits are called *buriti* and are consumed in various forms and used in cosmetic products. Male and female inflorescences of *M. flexuosa* are superficially similar, although male inflorescences are larger and contain more flowers than female inflorescences. Staminate flowers are smaller than pistillate flowers and have six stamens and a minute pistillode. They produce pollen and emit a strong, sweet odor. Pistillate flowers are larger, with six staminodes and a scaly gynoecium with a superior ovary. Female flowers do not produce pollen or nectar and emit a sweet odor, although it is weaker than that of male flowers.

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Buriti fruits are round to ellipsoid, scaly, and measuring 4–6 cm in length and 3–5 cm in width (Fig. 1). The color of ripe fruits ranges from light orange to dark red. The mesocarp or pulp of ripe fruits is yellowish-orange. Fruits are usually one-seeded, and less frequently two- to three-seeded. One infructescence can produce up to eight hundred fruits, and each female individual produces an average of three to five infructescences per season, although I have observed females yielding up to 11 infructescences in one season.

The outer surface of female flower buds, the pedicels, rachillae and the developing fruits are coated with a viscid secretion that appears to be resin. I did not observe resin on male inflorescences. The resin of *M. flexuosa* is tasteless to the human palette, clear and jelly-like when fresh, eventually turning amber and hardening. When dry, the resin is slightly brittle and not malleable. Green, immature fruits are often sticky from the resin, and drops of the hardened resin can be observed on the surface of ripe fruits and dried flowers and fruits (Fig. 2). The resin does not dissolve in water, consistent with Langenheim's (2003) definition of resin. Further analyses are necessary to determine its chemical composition.

During my diurnal visitor watches in savanna and forest sites conducted between 2009–2011, I consistently noticed stingless bees (*Trigona sp.*; Apidae, Meliponini) collecting resin from immature fruits and flower buds (Figs. 3 & 4). I also observed Africanized honeybees (*Apis mellifera scutellata*) collecting resin, although in lower abundance and less frequently than *Trigona* sp. Bees most frequently foraged on unripe fruit, and the rachises and primary branches of female inflorescences. They also foraged on immature floral buds that were still green and closed, as well as floral and fruit scars where floral buds and immature fruits had abscised. Less frequently, they foraged on the floral pedicel or the calyx of the flower. Bee individuals were collected from female inflorescences and *buriti* resin was present in their corbiculae and hairs. My field observations suggest that both stingless and honey bees visit female infructescences and inflorescences only to collect resin, and do not collect nectar or pollen.

Bees collect plant resins to build their nests, taking advantage of the waterproof, anti-microbial and anti-fungal properties of the resin (Armbruster & Webster 1979, Roubik & Hanson 2004). European honeybees collect plant resins to protect the entire colony from pathogens (Simone et al. 2009). Meliponine bees may mix the resin of *M. flexuosa* with resin from the flowers of *Clusia sp.* (Armbruster 1984), which co-occurs with *M. flexuosa* in enclave savannas and gallery forests of this region.

2. Resin drops on dry, aborted, immature fruits.

The adaptive significance of this resin, from the plant's perspective, remains unclear. Resin not only protects the plant from microbes and fungus (Levin 1976), but it also deters herbivores, especially ovipositing lepidopterans (Langenheim et al. 1982). In addition, this palm may produce resin to attract bees, which in the process of collecting resin may also physically protect the plant from herbivores. However, resin does not appear to serve as a pollinator attractant in this species, given that resin is produced outside of the flowers and that bees do not collect pollen nor do they make contact with the stigma. Resin also plays a physiological role in plants by acting as a UV protectant (Leonhardt & Bluthgen 2009) and anti-transpirant (Meinzer et al. 1990). Further chemical analyses and field studies are needed to determine the chemical structure of this resin and elucidate its ecological and evolutionary functions.

Resin production in palms is not common and has been recorded only in *Daemonorops draco* (Willd.) Blume (Calamoideae) and other *Daemonorops* species of Asia. The resin from these palms, known as "dragon's blood" accumulates on the surface of maturing fruits and is commercially important (Pearson & Prendergast 2001). Another palm that secretes

3. Stingless bee collecting resin from immature fruit. Note resin drops on top fruit (top left corner).

4. Stingless bee collecting resin from female floral scar. Note that open flowers are being ignored by bees.

a resin-like substance on the surface of its rachillae and fruits is *Pritchardia viscosa* Rock, of Hawaii (Hodel 2007). The chemical nature of this substance and whether it is resin have not been determined. In his original description of *Chamaedorea resinifera* (now *C. elatior* Mart.), Wendland (1853) mentioned resinous female inflorescences, but further studies confirming the nature of this resin-like substance are lacking. Although only a few studies document resin and resin-like substances in palms, this study is the first to report interactions between a resin-producing palm and resin-collecting bees.

Acknowledgments

Permits to conduct fieldwork were issued by the Brazilian Ministry of the Environment (MMA): 22967-1 and 18307-1. I thank Fredson Guedes and Itamar de Souza for assistance in the field. Dr. Reinaldo Imbrozio Barbosa (National Institute of Amazonian Research-INPA) helped with field and permit logistics. Dr. Silvio Reis da Silva (Integrated Museum of Roraima- MIRR) identified bees. Dr. Scott Zona and Dr. Suzanne Koptur provided useful comments on the manuscript. Financial support was provided by the National Science Foundation (OISE-090608) and the Fulbright Commission.

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