Stingless Bees

Tetragonisca angustula, Trigona sp., Scaptotrigona mexicana, Melipona beecheii Lestrimelitta sp., Trigona fulviventris & Nannotrigona perilampoides

Parque Nacional Tikal (PANAT)
Reserva de la Biosfera Maya (RBM)
Peten, Guatemala

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FLAAR (USA) and FLAAR Mesoamerica (Guatemala)
May 2024

FLAAR MESOAMÉRICA

FLAAR

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2021–2025

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FRONT COVER PHOTOGRAPH

Photo by: Edwin Solares, FLAAR Mesoamerica, Jul. 21, 2022. Road to Yaxha Park.

Camera: Sony A1. Settings: 1/160; sec; f/7,1; ISO 2,000.

We appreciate a donation during November 2021 and a follow-up donation in June 2022 to help cover the costs of FLAAR research projects specifically to assist and support the current FLAAR project of exploring remote areas to find and document flora and fauna in the Reserva de la Biosfera Maya (RBM), Peten, Guatemala.

This donation is from a family in Chicago in honor of the decades of botanical field work of botanist Dr John D. Dwyer, who worked in many areas of Mesoamerica, including Peten.

This donation is also in recognition of the urgency and need for conservation of both wildlife and rare plants in the bio-diverse ecosystems of the Reserva de la Biosfera Maya (RBM) of Guatemala. Parque Nacional Yaxha, Nakum and Naranjo (PNYNN) and Parque Nacional Laguna del Tigre are the first two parts of the over 5 million acres of the RBM where we have initiated field work in 2021 and 2022. In July 2022 we initiated field work in cooperation and coordination with the biologists of Tikal to study epiphytic plants (orchids, bromeliads, cacti, ferns that grow high up in tres) plus other biology topocs of mutual interest and importance to document. Photographs are donated to the park admistrators.

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Special thanks to Quebin Bosbely Casiá Ajché from the Research Unit for the Knowledge, Use and Valuation of Biodiversity (UBIO) and from the Center for Conservation Studies (CECON), USAC. for their support in the identification of bee species in this report

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CONTENTS

CONTENTS

FLAAR team experience with Meliponas

By Nicholas Hellmuth

I have long been interested in learning about stingless bees in the Mayan-speaking areas of Mesoamerica. But since I also need to learn about snakes, frogs, toads, arachnids, waterbirds, birds of prey, mammals, and all other fauna of Guatemala and surrounding countries I do not consider myself a bee specialist whatsoever. Nonetheless, whenever we see one of their wax tubes sticking out of a house wall or a tree, we stop to do macro photography. These photos can assist entomologists and bee specialists in research, fieldwork and sampling.

When we initiated our field trip to Tikal in July 2022, one of our goals was to find and photograph stingless bees. Since the local biologists of the Tikal National Park, Gelber Aldana and Esdras García knew where to find these bees in the park, thanks to them we found several areas to do macro photography.

Here are some of the bees that we found

Date	Hour	Location	Species
Jul-21-2022	3:04pm	Uphill from aguada behind Visitors Center	*Tetragonisca angustula*
Jul-21-2022	3:38pm	Park sign for Trail to Group F	*Tetragonisca angustula*
Jul-21-2022	3:40pm	Park sign for Trail to Group F	*Tetragonisca angustula*
Jul-22-2022	10:34am	south side Temple IV, snack area	*Polybia* sp. (wasps)
Jul-22-2022	3:09pm	Road towards Ceiba	*Trigona* sp.
Jul-22-2022	3:20pm	Main road, aguada at left	*Trigona* sp.
Jul-22-2022	3:27pm	Main road, aguada at left	*Trigona* sp.

General facts about stingless bees

Habitat and Distribution:

Stingless bees are exclusively found in the tropical and subtropical regions of the planet, with the highest diversity reported in the Neotropics. Many species have large distribution ranges, spanning from Mexico to Colombia. The group as a whole is regarded as a generalist, having the ability to live and thrive in a wide range of natural environments such as rainforests, savannas, and even some urban environments like gardens and parks. But generally speaking, they prefer to inhabit spaces that harbor a high diversity of floral species (Camargo and Pedro, 2003; Ramhalo, 2004).

Out of all species of the Meliponini group, both *Tetragonisca angustula* and *Trigona nigerrima,* extend their geographic range farther south into South America. In Guatemala specifically, these bees can be found in altitudinal ranges of approximately 0–2,000 m.a.s.l (Obiols and Vásquez, 2012).

Feeding:

Stingless bees are known as nectarivorous insects because they feed on the sugar-rich nectar and pollen, produced by flowering plants. The nectar represents the building block of honey production, and its composition depends on the floral types in the surrounding habitat. In this process, these bees perform a vital ecosystemic role by pollinating a wide array of flowers. It is not surprising that many of the plants in the neotropics need these insects to reproduce, which in turn makes bees an essential part of ecosystem maintenance (Obiols and Vásquez, 2012).

For example, *Lestrimelitta* feeds on a variety of floral resources, including nectar and pollen from various plant species in families like Malpighiaceae and Rubiaceae. It plays a crucial role in pollination and is considered an important pollinator for crops such as coffee and cocoa. The composition of nectar and pollen collected by the hives of several species of stingless bees can alter the taste and look of the honey produced.

Reproduction:

One of the most interesting aspects of stingless bees is their reproductive strategy. Stingless bees belong to the order Hymenoptera (which includes bees, ants, and wasps). Hymenopterans evolved a reproductive system called "eusociality" (although this strategy can be found in other insects and even some vertebrates, it is commonly associated with hymenopterans).

Eusociality, explained in very simplistic terms, is a form of colonial existence in which members of the colony are divided into reproductive and nonreproductive (or, more accurately, less-reproductive) individuals, also referred to as castes. In these colonies, belonging to one caste or another is determined by a mix of genetic and environmental factors. In eusocial systems, some individuals sacrifice the production of their offspring to facilitate reproduction by other individuals, but the offspring are cooperatively cared for. This benefits the colony as a whole, and it permits it to grow to staggering numbers and perform complex tasks such as structure formation and coordinated attacks (Bradshaw and McMahon, 2008).

Sexual offspring in stingless bees can be produced by queens and males, but in some species, such as *Melipona beechii,* they can also be produced by workers (or semi-sterile females). Another form of reproduction for the colony as a whole also exists. Titled by scholars as "colony fission," in this type of reproduction, the mother colony divides into two or more colonies, each with a group of workers and generally one queen. This type of reproduction strikes a notorious resemblance to the way eukaryotic cells divide, which is by producing copies of all the machinery required to run the colony and then splitting it in two (Quezada-Euán, 2018).

Behavioral notes:

In many aspects, colonies of hymenopterans such as the ones listed above display and behave in similar ways to complex multicellular organisms. Interestingly, some scholars like Tautz, Heilmann, and Sandeman, refer to these colonies as "superorganisms," which mimic the structural organization of vertebrate animals. According to this author, the worker bees represent the body organs necessary for maintenance and digestion, while the queen and the drones represent the female and male genital organs. Like a vertebrate animal, the hive can sense and monitor stimuli and respond to changes in the environment by releasing chemical information that triggers a specific behavior (Tautz, Heilmann, and Sandeman, 2008).

Conservation status:

Little is known regarding the conservation status of stingless bees. Due to their relatively large geographic distribution and their generalist feeding habits, this group should be theoretically more resilient to habitat loss and degradation than species that feed only on certain species and require specific ecological conditions. On that matter, a study by Escobedo et al. (2017) shows that climate change will most likely shrink the geographic range of these and other species grouped in the Meliponini tribe. A reduction in the geographic range could also signify a loss of genetic diversity and a diminution in population size, which could put at risk the survival of the species as a whole.

In regard to conservation status, stingless bees are not protected under any international laws or agreements like CITES, nor are they considered (or even analyzed, for that matter) to be in imminent danger by the UICN Red List of Threatened Species. At a local level, no legislation exists that protects the habitat or the populations of native stingless bees. Our hope is that publications such as this may be useful in shedding some light on the importance of the existence of these seemingly unnoticed insects and highlighting their importance not only at the ecological but also at the cultural and economic levels.

1. *Lestrimelitta* sp.

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponi
- Genus: Lestrimelitta
- Species: *Lestrimelitta* sp.

Taxonomical Synonyms:

Lestrimelitta sp. has not been reclassified under any other genus nor has it been assigned another specific epithet; therefore, no taxonomical synonym exists.

Common names:

In Spanish, this species is known as: 'Abeja limoncillo' or just 'limoncillo'

Mayan names for *Lestrimelitta sp.:*

Lestrimelitta sp is known in Mayan dialect as "Limon kab" and "niitkib".

Description:

Lestrimelitta sp. are colored black bees with a smooth, silky surface all over; it is almost lacking in pilosity and has a shiny appearance, an abdomen more streamlined than the thorax, and a body length of approximately 5.5 mm (Quezada-Euán, 2018).

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jul. 8, 2019.
Camera: Nikon D5. Settings: 1/200; sec; f/10; ISO 2,500.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 24, 2023.
Camera: Sony A1. Settings: 1/160; sec; f/7,1; ISO 2,000.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jul. 8, 2019.
Camera: Nikon D5. Settings: 1/200; sec; f/10; ISO 2,500.

2. *Melipona beecheii*

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Melipona*
- Species: *Melipona beecheii* (Bennett, 1831)

Taxonomical Synonyms:

One of the most studied and well-understood members of the Meliponini tribe, *Melipona beecheii*, has been classified within its own genus several times under the names *Melipona fulvipes* and *Melipona nigripes*; it has also been reclassified (Guerin Meneville, 1835) as *Trigona ligata* and was even considered a subspecies of *T. fulvipes* (*Trigona fulvipes* var obscuripes).

Common names:

Locally, *Melipona beecheii* is known as "Congo-negro", "negro", "negrita", and "mosca de la virgen". These names are also used for the *Melipona beecheii* bee. Therefore it is crucial to accurately identify the species and employ its scientific name to prevent any confusion during the identification process. There may exist other possible common names for *M. beecheii*; the ones listed here are exclusively used in Guatemala, specifically by those who inhabit the Petén area (Escobedo et al. 2017; Yoshimoto, Cano and Orellana, 2018; Obiols and Vásquez, 2012).

Mayan names for *Melipona beecheii*:

Melipona beecheii has several mayan names; among the most popular are: "Ilkil-cab", "Colel-cab", "Xunan-cab", "Pipioli", "Mimialcuatl", "Tsaspena", "Xuna'an-kab", "Kolel-kab", "Po'ol-kab", "Abeja-aluva", "Bblanco-aluva", and "Xunaan-kaab".

Description:

Melipona beecheii is colored black with variable yellow, red, or black marks on the legs and has a body length of about 9.7 -- 10.7 mm. The upper dorsal surface of the thorax is often covered with orange/yellow hairs, while the lower surface is covered with dense orange-red hairs in strong contrast with the rest of the scutum. The abdomen is black with well-defined yellow bands (Quezada-Euán, 2018).

Photo by: Edwin Solares, FLAAR Mesoamerica, Oct. 12, 2022. Unidad de dasonomía.
Camera: Sony A1. Settings: 1/250; sec; f/6,3; ISO 1,600.

Photo by: Edwin Solares, FLAAR Mesoamerica, Oct. 12, 2022. Alta Verapaz.
Camera: Sony A1. Settings: 1/250; sec; f/6,3; ISO 1,600.

3. *Nannotrigona perilampoides*

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Nannotrigona*
- Species: *Nannotrigona perilmapoides* (Cresson, 1878)

Taxonomical Synonyms:

Previously classified as *Trigona perilampoides*, recent studies have reclassified this species into a different genus (Rasmussen and Gonzalez, 2017).

Common names:

"Chicopipe" (Costa Rica); "Sayulitas", "Trompetas" (México); "Serenitas" (Guatemala).

Mayan names for *Nannotrigona perilampoides:*

No mayan names are reported for this species in Guatemala.

Description:

Nannotrigona perilampoides is distinguished by its small size and delicate appearance. Also known as "ombligudo" or "conguito". This designation comes from the characteristics of its nest, particularly the distinctive entrance tube. Its head and thorax exhibit a matte black color, while its abdomen gleams in brilliant black tones. Yellow patterns can be observed on the dorsal part of the thorax, and its eyes have a yellowish-green hue with gray shadows. The wings stand out with their dark brown pigmentation.

This species displays timid behavior; the guard bees quickly hide and remain alert in the presence of intruders near the hive. It is important to note these characteristics for proper identification in the field of entomology (Rasmussen and Gonzalez, 2017; Romero, et.al., 2023).

Photo by: FLAAR Mesoamerica, Jan. 24, 2023.
Camera: iPhone 13 Pro Max.

Photo by: FLAAR Mesoamerica, Jan. 24, 2023. Yaxha.
Camera: iPhone 13 Pro Max.

4. *Scaptotrigona mexicana*

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Scaptotrigona*
- Species: *Scaptotrigona mexicana* (Guérin Menéville, 1844)

Taxonomical Synonyms:

Scaptotrigona mexicana was previously classified as *Trigona mexicana*, but in light of recent discoveries of the phylogenetic and morphological relationship of the aforementioned species with its closest relatives, scholars proposed to reclassify the species under the *Scaptotrigona* genus (Quezada-Euán, 2018).

Common names:

Locally, *Scaptotrigona mexicana* is known as "Congo-negro", "negro, negrita", and "mosca de la virgen".

Mayan names for *Scaptotrigona mexicana:*

In Mayan dialect, *Scaptotrigona mexicana* is known as: 'Atzicab' or 'Pisil nekmej'.

Description:

Scaptotrigona mexicana is among the most robust of the Meliponini; the body length is 5 to 7 mm. The head and thorax are rather strongly punctate, more coarsely so than the other species previously discussed. This species is colored in a darker shade of brown, almost completely black (Quezada-Euán, 2018).

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 25, 2023. Road to Yaxha.
Camera: Sony A1. Settings: 1/20; sec; f/8; ISO 4,000.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 24, 2023.
Camera: Sony A1. Settings: 1/160; sec; f/7,1; ISO 2,000.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 25, 2023. Road to Yaxha.
Camera: Sony A1. Settings: 1/20; sec; f/8; ISO 4,000.

5. *Tetragonisca angustula*

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Tetragonisca*
- Species: *Tetragonisca angustula* (Latrielle, 1811)

Taxonomical Synonyms:

Tetragonisca angustula has been identified with other names such as *Tetragonisca jaty* or *Trigona jaty.*

Common names:

Several common names are known for *T. angustula;* those more commonly reported in scientific literature are: "Chumelo", "Doncella", "Doncellita", "Anus", "Qánus", "Piquera", and "Angelita".

Mayan names for *Tetragonisca angustula:*

In the Lacandón Mayan language, spoken mainly in the region of Chiapas, Mexico, *T. angustula* is known as 'Ajuyus' or 'Yateí'

Description:

Tetragonisca angustula can be recognized by its black and yellow-colored abdomen, a black-colored thorax, and the distinctive presence of a thick and dark-colored tarsus on the hind pair of legs. Other structures may be observed on the front of the animal, such as the presence of glands that produce a resinous substance used to protect the nest and its members (Ramhalo, 2004).

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 25, 2023. Road to Yaxha.
Camera: Sony A1. Settings: 1/20; sec; f/8; ISO 4,000.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jun. 28, 2021. Road to Yaxha Park.
Camera: Sony A1. Settings: 1/320; sec; f/9; ISO 2,000.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jun. 28, 2021. Road to Yaxha Park.
Camera: Sony A1. Settings: 1/200; sec; f/10; ISO 2,500.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jul. 21, 2022. Road to Yaxha Park.
Camera: Sony A1. Settings: 1/160; sec; f/7,1; ISO 2,000.

Photo by: Haniel López, FLAAR Mesoamerica, Oct. 11, 2022. Parqueo de Visitantes.
Camera: Sony A1. Settings: 1/125; sec; f/2,8; ISO 2,000.

6. *Trigona* sp.

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Trigona*
- Species: *Trigona* sp. (Jurine, 1807).

Taxonomical Synonyms:

The genus *Trigona* has not been classified under any other taxonomic denomination.

Common names:

There are no common names for the genus *Trigona*. The known common names are specifically for the species of the genus.

Mayan names for *Trigona sp.*:

In Mayan dialect, there are no names for the genus *Trigona*; the known Mayan names are specifically for the species of the genus

Description:

The genus *Trigona* (Jurine, 1807) is exclusive to the Neotropics and is one of the largest genera of stingless bees (Marconi, et.al., 2023). They are distinguished by their small body size, ranging from 5.5 to 11 mm, reduced wing venation, lack of a sting, and a highly developed social structure, comparable to that of honeybees. They exhibit a variety of defense behaviors and nesting habits (Dollin, et.la., 1997; Marconi, et.al., 2023). Their nests can be found on plant branches, walls, inside anthills, or underground (Costa et al. 2004). They also display different foraging ecologies, from collecting pollen and nectar to being obligate necrophages (Marconi, et.al., 2023).

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 24, 2023.
Camera: Sony A1. Settings: 1/250; sec; f/6,3; ISO 1,600.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 25, 2023. Road to Yaxha.
Camera: Sony A1. Settings: 1/20; sec; f/8; ISO 4,000.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 25, 2023. Road to Yaxha.
Camera: Sony A1. Settings: 1/20; sec; f/8; ISO 4,000.

7. *Trigona fulviventris*

- Kingdom: Animalia
- Phylum: Arthropoda
- Subphylum: Hexapoda
- Class: Insecta
- Order: Hymenoptera
- Family: Apidae
- Tribe: Meliponini
- Genus: *Trigona*
- Species: *Trigona fulviventris* (Guérin-Meneville, 1844)

Taxonomical Synonyms:

There are no taxonomic synonyms for this species, however in some literature may be found with other names *Trigona argentata, Trigona fulviventris nigra* and *Trigona recursa* referring to the subspecies.

Common names:

"Culo de vaca", "Culo de buey", "Culo de vieja", "Culo de perro", "Mandinga", "Abeja anaranjada sin aguijón".

Mayan names for *Trigona fulviventris:*

"mu´ul-kab" (Yucatán, México); Not found for Guatemala.

Description:

The distribution of Trigona fulviventris extends from southeastern Mexico to Brazil and Ecuador. It prefers to nest underground, specifically at the base of logs, roots, or in soil, and is distinguished by its pollen storage in corbiculae. It features a slightly arched clypeus with long and visible hairs. Despite its tiny size, it exhibits timid behavior and is easily manageable. Measuring approximately 7 millimeters in length, it is characterized by its black color with a red or brown abdomen and five black apical teeth. Its ecological significance lies in its role as a pollinator, contributing to ecosystem biodiversity (Portal de Biodiversidad, 2021; UFM, 2024.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 24, 2023.
Camera: Sony A1. Settings: 1/250; sec; f/6,3; ISO 1,600.

Photo by: Edwin Solares, FLAAR Mesoamerica, Jan. 24, 2023.
Camera: Sony A1. Settings: 1/160; sec; f/7,1; ISO 2,000.

References Cited

BRADSHAW, C. and **MCMAHON, C.**
2008 Fecundity. Elsevier Encyclopedia of Ecology, five-volume set. 1543 Pages.

CONTRERAS, S, L.
2020 Conocimiento de las abejas nativas sin aguijón y cambio generacional entre los mayas lacandones de Nahá, Chiapas. Estudios de cultura maya, Vol 56. Pages: 205-225.

Available online:
https://www.researchgate.net/publication/342539606_Conocimiento_de_las_abejas_nativas_sin_aguijon_y_cambio_generacional_entre_los_mayas_lacandones_de_Naha_Chiapas

COSTA, M.
2003 Molecular phylogeny of the stingless bees (Apidae, Apinae, Meliponini) inferred from mitochondrial 16S rDNA sequences. Apidologie, Vol 34 (1). Pages: 73–84.

Available online: https://www.apidologie.org/articles/apido/abs/2003/01/09/09.html

COSTA K.F, BRITO R.M., and **MIYAZAWA C.S.**
2004 Karyotypic description of four species of Trigona (Jurine, 1807) (Hymenoptera, Apidae, Meli ponini) from the State of Mato Grosso, Brazil. Genetics and Molecular Biology 27(2): 187–190. https://doi.org/10.1590/S1415-47572004000200010

DOLLIN, A. E., DOLLIN, L. J., and **SAKAGAMI, S. F.**
1997 Australian stingless bees of the genus *Trigona* (Hymenoptera: Apidae). Invertebrate Taxonomy, 11, 861–896.

ESCOBEDO-KENEFIC, N.
2017 Distribución Potencial de las Abejas Nativas sin Aguijón (Apidae: Meliponini) de Guatemala ante Posibles Escenarios de Cambio Climático. Accessed on 1 February 2023.

Available online: https://digi.usac.edu.gt/bvirtual/informes/puirna/INF-2017-23.pdf

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Trigona nigerrima* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764143#null

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Tetragonisca angustula* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764083#null

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Trigona nigerrima* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764143#null

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Tetragonisca angustula* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764083#null

Most helpful references
on *Tetragonisca angustula* & *Trigona nigerrima*

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Trigona nigerrima* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764143#null

INTEGRATED TAXONOMIC INFORMATION SYSTEM (ITIS).
2023 *Tetragonisca angustula* Cresson, 1879. Accessed on 1 February 2023.

Available online:
https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=764083#null

MARCONI M., USHIÑAHUA RAMÍREZ D., CERNA MENDOZA A., VECCO-GIOVE C. D., ORMEÑO LUNA J., BAIKOVA L., DI GIULIO A., and **MANCINI E.**
2023 An updated molecular phylogeny of the stingless bees of the genus *Trigona* (Hymenoptera, Meliponini) of the northern Peruvian forests. Journal of Hymenoptera Research. 96: 751-760.

OBIOLS, C. and **VÁSQUEZ, M.**
2012 Pot-Honey: A legacy of stingless bees, Springer. Pages: 99-111.

PORTAL DE BIODIVERSIDAD
2021 *Trigona fulviventris* Guérin-Méneville, 1845. Consultado en abril de 2024.

Disponible en
https://biodiversidad.gt/portal/collections/individual/index.php?occid=285362

RASMUSSEN and **GONZALEZ**
2017 The neotropical stingless bee genus *Nannotrigona* Cockerell (Hymenoptera: Apidae: Meliponini): An illustrated key, notes on the types, and designation of lectotypes. Zootaxa, (2): 191–220.

ROMERO, L., FERNANDEZ, A., HERNANDEZ, P. and **ORTIZ, P.**
2023 Guía de identificación de abejas sin aguijón en la ciudad de San Francisco de Campeche, México. El Colegio de la Frontera Sur, México. E-ISBN: 978-607-8767-74-8.

TAUTZ, J., HEILMANN, H. R. and **SANDEMAN, D.**
2008 The buzz about bees: biology of a superorganism. Berlin: Springer, 978 Pages.

UNIVERSIDAD FRANSISCO MARROQUIN (UFM)
2023 *Trigona fulviventris*: Nombre común:Abeja anaranjada sin aguijón. Consultado en abril de 2024.

Disponible en: https://arboretum.ufm.edu/animales/trigona-fulviventris/#:~:text=Abeja%20peque%C3%B1a%20de%201%20cm,productora%20de%20miel%2C%20no%20agresiva.

WILLIE, A.
1965 Las abejas atarrá de la región mesoamericana del género y subgénero *Trigona* (*Apidae-Meliponini*). Revista de Biología Tropical, Vol 13 (2). Pages. 271-291.

Available online: https://revistas.ucr.ac.cr/index.php/rbt/article/view/28720

WITTMANN, D.
1985 Aerial defense of the nest by workers of the stingless bee *Trigona (Tetragonisca) angustula* (Latreille) (Hymenoptera: Apidae). Behavioral ecology and sociobiology, Vol 16. Pages: 111-114

Available online: https://link.springer.com/article/10.1007/BF00295143

YOSHIMOTO, J., CANO, E. ORELLANA, S.
2018 Insectos de Guatemala Guía de Identificación 2da Edición. Universidad del Valle de Guatemala. 196 Pages.

Suggested reading
on stingless bees

COSTA, M. et al.
2003 Molecular phylogeny of the stingless bees (Apidae, Apinae, Meliponini) inferred from mitochondrial 16S rDNA sequences. Apidologie, Vol 34 (1). Pages: 73–84.

Available online: https://www.apidologie.org/articles/apido/abs/2003/01/09/09.html

ESCOBEDO-KENEFIE, N. et al.
2017 Distribución Potencial de las Abejas Nativas sin Aguijón (Apidae: Meliponini) de Guatemala ante Posibles Escenarios de Cambio Climático. Accessed on 1 February 2023.

Available online:
https://digi.usac.edu.gt/bvirtual/informes/puirna/INF-2017-23.pdf

WITTMANN, D.
1985 Aerial defense of the nest by workers of the stingless bee *Trigona (Tetragonisca) angustula* (Latreille) (Hymenoptera: Apidae). Behavioral ecology and sociobiology, Vol 16. Pages: 111-114

Available online: https://link.springer.com/article/10.1007/BF00295143

APPENDIX A

FLAAR STAFF photographing bees in Parque Nacional Tikal.

FLAAR Mesoamerica team (in dark blue shirts) holding ring-lights to illuminate entry-exit wax tube of stingless bees so lead photographer Edwin Solares could accomplish macro-photography with mirror-less Sony Alpha 1 (a1). Parque Nacional Tikal (PANAT), trail turnoff towards Group F.

Park biologists are also taking photos.

Photograph by Nicholas Hellmuth with iPhone 13 Pro Max, 3:38 pm, July 21, 2022.

Edwin Solares photographing *Tetragonisca angustula* hives in Parque Nacional Yaxha Nakum y Naranjo. January 24, 2023. Photo by Vivian Hurtado.

Nicholas Hellmuth photographing *Tetragonisca angustula* hives in Parque Nacional Yaxha Nakum y Naranjo. January 25, 2023. Photo by Vivian Hurtado.

Edwin Solares photographing *Tetragonisca angustula* in Parque Nacional Tikal. January 27, 2023. Photo by Vivian Hurtado.

The team preparing to take photographs of *Lestrimelitta sp*. in Parque Nacional Tikal. January 27, 2023. Photo by Vivian Hurtado.

ACKNOWLEDGEMENTS TO FLAAR MESOAMÉRICA

Jorge Luis Arana manages the financial administration of the institution and operative activities.

Vivian Hurtado is the current project manager of the FLAAR divisions: Flora & Fauna and MayanToons. She is also an environmental engineer and a passionate researcher.

Victor Mendoza environmental engineer in charge of the photographic database and its taxonomic identification. He also helps with the coordination of research activities.

Sergio Jerez agronomy engineering student involved in the identification of plants and support in research topics.

Flor Morales is a biologist that collects information and bibliographic references to feed our electronic library of flora and fauna and support research for reports and websites.

Mariana Rivas is a biologist that edits the information of our flora and fauna reports. She also helps in other research activities.

Pamela Jerez is a biologist who manages all our social media and digital community to transfer information on biodiversity and the topics that FLAAR is interested in.

Byron Pacay is our assistant during field trips to handle GPS data. He also assists in the main office with different tasks.

Norma Cho is a helpful photography assistant during field trips. She also assists in the main office with different tasks.

Edwin Solares is a photographer and videographer during our expeditions. Later, he edits this content to be used in our different materials.

Pedro Pablo Ranero with a degree in communication is responsible for editing videos of flora and fauna to create content on our sites.

Andrea Sánchez graphic designer who helps prepare the graphic line of our publications. She is our editorial art director.

Jaqueline González graphic designer who diagrams text and photographs to create our reports.

María Alejandra Gutiérrez is an experienced photographer who is now in charge of the audiovisual team and fundraising activities.

Paulo Núñez is an engineer and our webmaster. He is the person in charge of the maintenance and programming of the entire network of FLAAR websites.

Juan Carlos Hernández is a graphic designer and part of the web team. Receive the material we produce to place on our sites.

María José García is a graphic designer and part of the web team. Receive the material we produce to place on our sites.

Andrés Fernández is a graphic designer and in charge of keeping our websites updated and more efficient for the user.

Karla Cho helps with general research and design assistant in the office.

Valeria Áviles is a graphic designer and illustrator. She is in charge of coordinating the activities of MayanToons, as well as making illustrations for the different materials that we prepare.

Laura Morales is a digital content engineer, She is in charge of directing the animation area of our MayanToons project.

Isabel Trejo is a graphic designer and illustrator for MayanToons and for social media posts.

Dafne Ramírez is an illustrator for MayanToons.

Josefina Sequén is an illustrator for MayanToons.

Karen Arana assists in the planning and management of FLAAR USA and FLAAR Mesoamerica activities. She also provides English lessons to the Mayan-speaking team working with FLAAR Mesoamerica.

RESERVA DE LA BIÓSFERA MAYA - RBM -
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Google Maps 2022; Asociación de Comunidades Forestales de Petén - ACOFOP - 2011; Wikimedia Commons 2019

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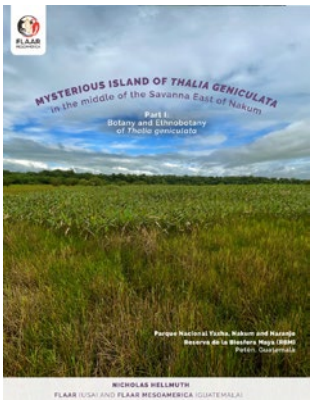

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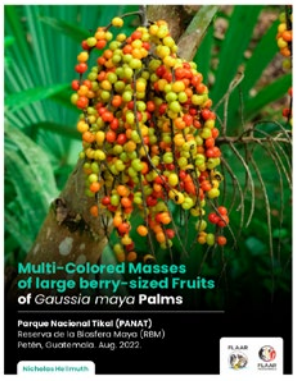

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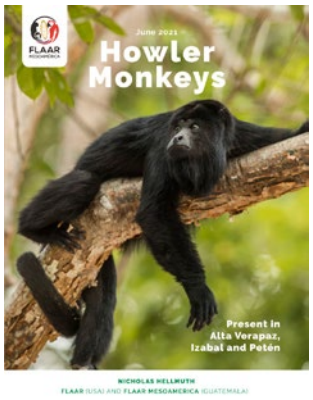

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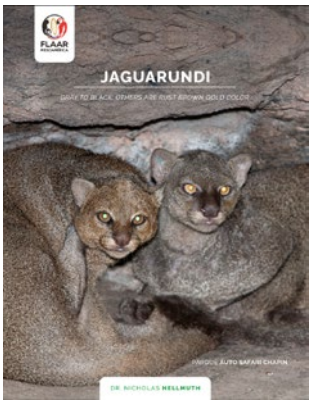

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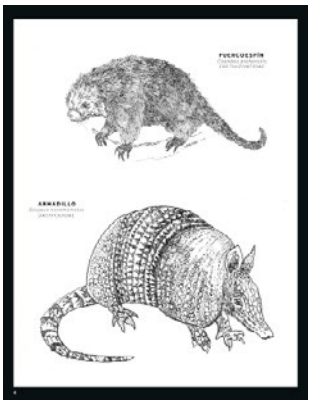

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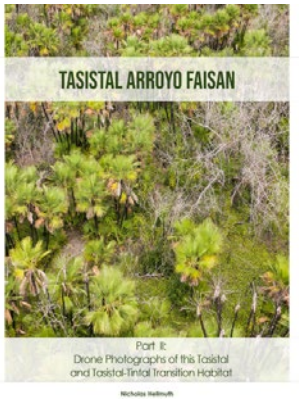

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