Stingless Bees of Pará

Based on the Scientific Expeditions of João M. F. Camargo

Editors

Vera L. Imperatriz-Fonseca
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INSTITUTO TECNOLÓGICO VALE

VALE

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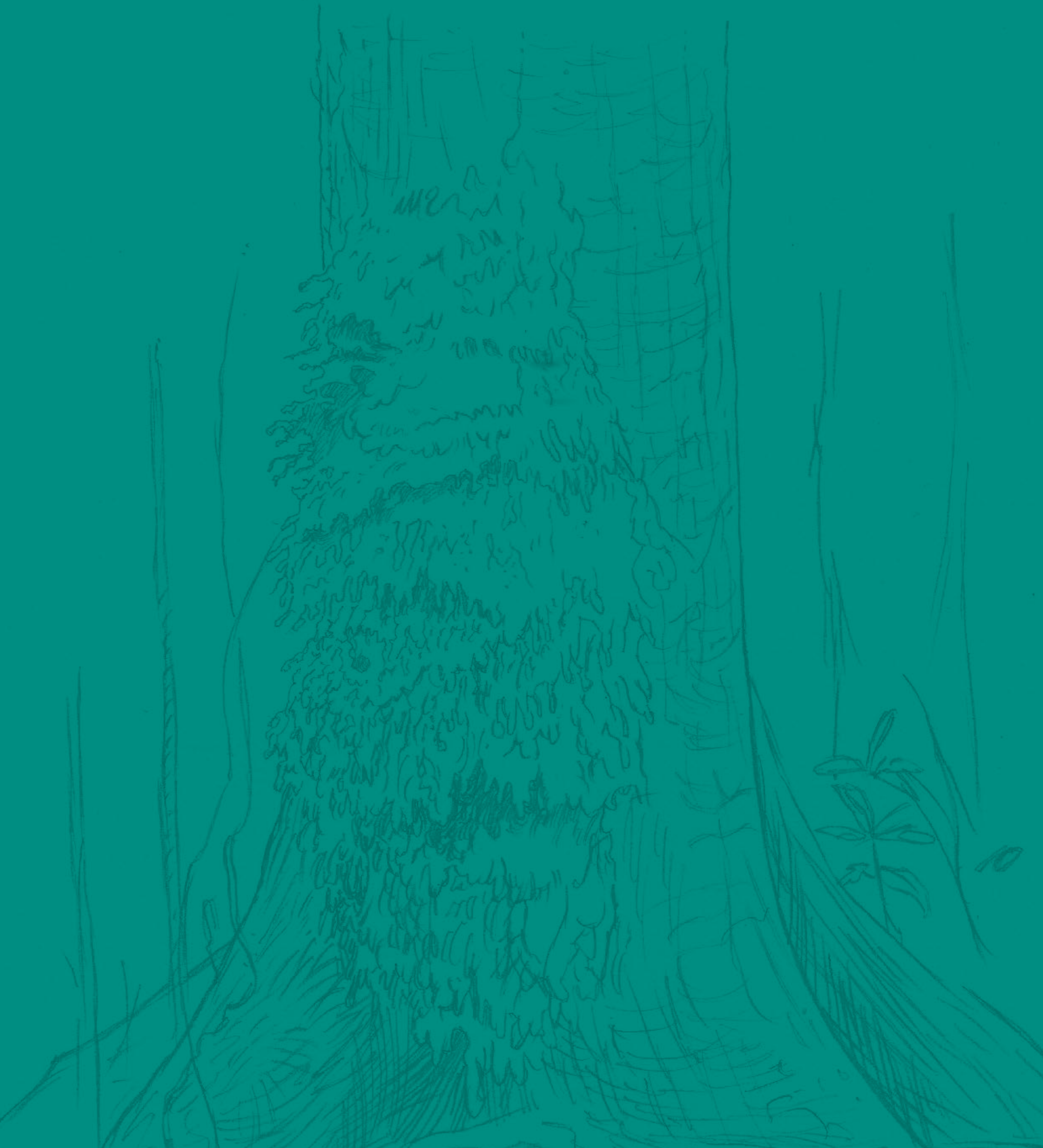

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Foreword

José Oswaldo Siqueira

Director of the Instituto Tecnológico Vale – Desenvolvimento Sustentável (ITV-DS)

There are many species of stingless bees in Brazil, especially in the Amazon, a region that requires more scientific knowledge about these social insects. In the literature, there are usually few references to their nests, life habits and products, such as honey, resins, cerumen and pollen. Information related to the use of stingless bee colonies by the pre-Columbian peoples of the Americas shows many points in common among the various ethnic groups. When evaluating the global biocultural aspects, there is often a similar basis in this recognition of bees and their products, such as medicines, offerings, importance in the social hierarchy, commercial use, and ecological role.

The scientific expeditions conducted by João M. F. Camargo to the Amazon, in search of native stingless bees' nests, allowed the identification of new information on one of the most biodiverse ecosystems in the world and its peculiarities. The photographic record of the nests of these social bees, as compiled in this publication, allows us to reflect on new biocultural horizons.

The idealization of this book allowed the gathering of both the information valued by scientific publications and the care with which this record was made and organized in an entomological reference collection at the Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto of Universidade de São Paulo. The retrieval of some of this information was made possible by digitizing Prof. João M. F. Camargo's photo library, which will certainly contribute to the identification of species of bees whose nests are rescued in areas of authorized plant suppression, as occurs in a legal and responsible manner in Carajás National Forest and many other ventures.

At a time when the whole world is concerned with the decline in bee populations, we illustrate here the biodiversity of stingless bees in the Amazon, especially in Carajás, in the state of Pará. This is a relevant work for the communities in the region that are increasingly interested in the rearing and sustainable use of social bees, which generates income and thus socio-environmental development.

Preface

Hugo Barreto

Director of Sustainability and Social Investment of Vale

Biological collections are dynamic and permanent sources of knowledge on biodiversity: they provide essential information on the morphological and genetic components of species diversity, and geographic distribution records, among other important aspects of diversity. Often, they are the only archive of extinct species, which makes them essential for the development of scientific research on biodiversity. Information that has been collected over many decades is vital to define priority areas for research and conservation as well as for the identification of understudied taxa, among other functions.

We know how collaborative work brings better outcomes and consolidates new opportunities. In this sense, the publication *Stingless bees of Pará* is a reference, in that it gathers the results of scientific expeditions to the Amazon with a focus on the occurrence and distribution of stingless bees and their nests, collaborations between researchers and alliances that have been established among institutions.

It also celebrates the activities of researchers, who were transformative figures, i.e., that produced works of extraordinary quality, and which traverse the boundaries of science and art: Warwick E. Kerr, a great scientist who pioneered bee studies in the Amazon, the taxonomist João M. F. Camargo, the anthropologist Darrell A. Posey and Kwyrà-Kà, the bee expert of Gorotire Village. Together, they illuminated, for example, the vast wealth of traditional knowledge on bees of the Kayapó people, which domesticated nine bee species, among the 56 that they knew by name and utilised in everyday activities.

The results of this collaborative action, including researchers from Instituto Tecnológico Vale (ITV), is what is shared here for the purpose of creating opportunities for the generation of knowledge on the sustainable use of natural resources, based on the triad of research, education and entrepreneurship. By making this selection available, we also sought to mobilize society on the urgency of preserving biological collections and encourage the discovery of new horizons for the sustainable use and conservation of natural resources.

In memory of João M. F. Camargo,
Darrell A. Posey, and Warwick E. Kerr.
They were transforming scientists
who crossed the barriers of knowledge
and built bridges between different
fields through their integrative way of
scientific thinking.

Prologue

The stingless bees (Meliponini) in the Amazonian Region were carefully studied by João Maria Franco de Camargo during his expeditions to the Amazon between 1963-2001, when he covered 16,000 km of waterways. This great naturalist was also an amazing artist and observer. Self-taught and expert with remarkable knowledge, he deeply knew the social bees of Brazil. Therefore, in 1976, he was accepted for a Master's degree at the Universidade Federal do Paraná, guided by the studies on bee taxonomy of Father Jesus S. Moure. His abilities defined him as one of the great naturalists of bees of the twentieth century, whose work included data obtained in the field and subsequent publications, as well as the collection designed by him and implemented by the Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto of Universidade de São Paulo (FFCLRP-USP), where he was a professor. Deceased in 2009, the contribution of João Camargo was also evidenced in the 'Meliponini' section published in the Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region, when he reviewed, with his collaborator Silvia R. M. Pedro, all the existing scientific literature on the species of stingless bees in the Neotropical Region until 2004, including comments on the taxonomic identifications of the species.

João Camargo made several expeditions to the Amazon, where he sought stingless bees' nests, which he collected for his studies (more than 900 nests were studied in detail, among many observed). During these collections, he made notes in his travel diaries about where the nest was found and sketches of the landscape and related bioecological characteristics (aggressiveness, associations with other insects and microorganisms, number of nests found) and recorded images, which generated rich and extensive photographic material, recently digitized. In addition, when he returned to his laboratory at FFCLRP-USP, the data collected were consolidated in the illustrations made with a quill pen, some of which are presented here.

The Coleção Entomológica "Prof. J. M. F. Camargo" has been reorganized by the current curator, Prof. Eduardo A. B. Almeida, and its computerization was greatly aided by Dr. Fabio B. Quinteiro and Dr. Anne M. Costa. The scientific collaboration between the Instituto Tecnológico Vale – Desenvolvimento Sustentável (ITV-DS) and the Coleção Entomológica "Prof. J. M. F. Camargo" enabled the retrieval of photographic material and the reorganization of the collection, a small part of which is presented here.

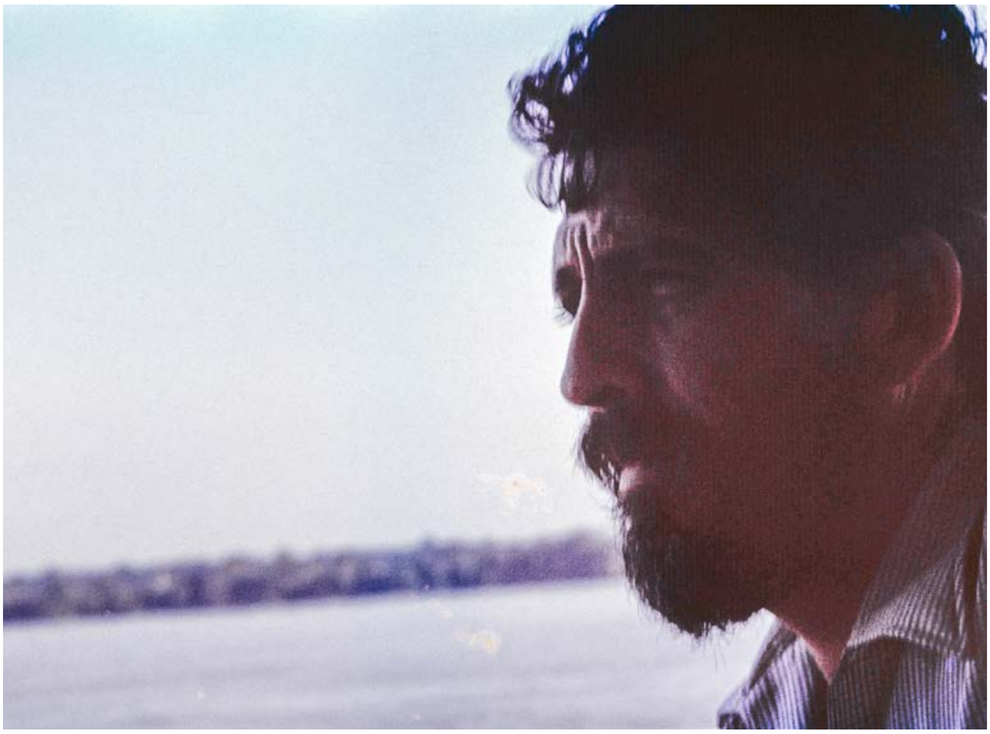
We are very interested in the bees of Pará, as the species that occur in the Serra dos Carajás have been intensively studied by the biodiversity team of the ITV-DS. However, for certified taxonomic identification of these bees, we needed reference material, which was carefully prepared by the collection curator; the specimens presented here are accompanied by the respective identification tags: who collected it and when, who identified it and the geographical origin of the specimens. Often, the specimens photographed are not from Pará but are within the area of occurrence of these species and were compared with the material from the nests deposited. The species of stingless bees selected for this collection were listed as occurring in the state of Pará (part of Eastern Amazon) in the review of the occurrence of bee species in Brazil.

Although the diversity of stingless bees in the Amazon is high, they have been little studied thus far. Therefore, recognizing the identity of forest species and their nests is not a trivial task. In his activities as a taxonomist and systematist, Camargo described three genera and 89 species of bees. In addition to this monumental work, he described the unusual habits of many of these species, which differed from the general pattern known up to that time for Brazilian social bees, for example, 1) *Ptilotrigona* and the storage of large amounts of dry pollen, through the association with the fungus *Candida* sp., and propolis in pots; 2) *Lestrimelitta* specialized in robbing resources stored in the nests of other species; 3) *Trichotrigona* sampled in the Amazon, with very small nests, without food pots, suggesting a pillage pattern different from that of *Lestrimelitta*; 4) obligatory necrophagous bees of the *Trigona hypogea* group; 5) *Schwarzula*, which obtain wax produced by the scale insects associated with their nests; 6) the minute bees and their habits of collecting salt and sweat; 7) *Duckeola ghilianii* defends its nests, and those close to their own, from the attack of the *Lestrimelitta* robbers; and many other examples that show us the diversity of behaviours and community of bees.

The work of Camargo with the Kayapó indians of Gorotire deserves special mention: he compiled, illustrated and recorded the knowledge of the great masters of bees (especially the shaman Kwyrà-Kà). These wiseman (*waianga*) deeply knew the bees and their products, which were much appreciated and had many biocultural meanings that were transmitted orally. Together with the anthropologist Darrell A. Posey, with Prof. Warwick E. Kerr and other distinguished researchers at the time, he helped to record the indigenous knowledge for future generations, having contributed to the development of an important glossary of technical terms for the bees in Kayapó, in English and Portuguese.

In this book, we compile the diversity of stingless bees in the state of Pará, showing the main characteristics of the Amazon vegetation in the initial chapter. The collected bees were deposited in the collection organized by the researcher at FFCLRP-USP, his institution, the Coleção Entomológica "Prof. J. M. F. Camargo". To introduce the biocultural approach to bees and their role in societies, we based ourselves on the indigenous knowledge of the Kayapó people. Next, we present the richness of the behavioural repertoire of some Amazonian stingless bee species, whose characteristics differ from the patterns common to other Meliponini species. Illustrations of bee nests that could be documented through photographs retrieved from Camargo's photo library, in addition to diagrams published by the researcher, are accompanied by geographic distribution maps obtained in the Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region. The information presented here is important for the recognition of Amazonian species and for the biodiversity and maintenance of ecosystem services.

Vera Lucia Imperatriz-Fonseca



João Camargo during one of the Amazon expeditions

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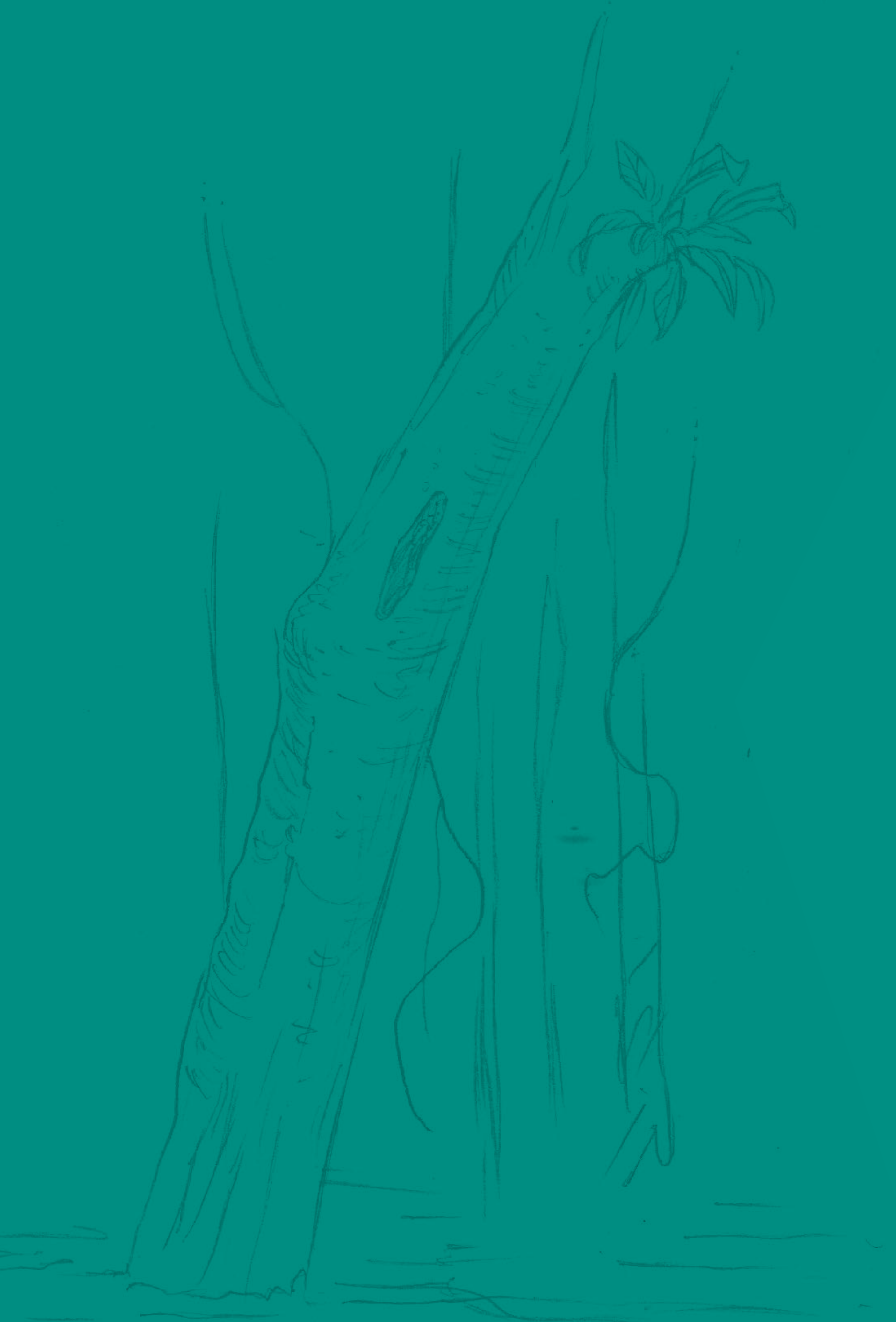

Coleção Entomológica “Prof. J. M. F. Camargo”, a legacy of the scientist

EDUARDO A. B. ALMEIDA

Universidade de São Paulo

Biological collections are scientific depositories of key importance in the preservation and generation of knowledge about the diversity of living beings. Collections are one of the most essential sources of information supporting research on biodiversity, encompassing fields as diverse as taxonomy, ecology, biogeography, evolution, and genetics. This text addresses the Entomological Collection housed at the Biology Department, Faculdade de Filosofia, Ciências e Letras (FFCLRP) of Universidade de São Paulo, which was started between 1963 and 1965 by Professor João Maria Franco de Camargo (1941-2009). In 2011, this collection was officially named *Coleção Entomológica “Prof. J. M. F. Camargo”*, as a posthumous tribute to the researcher who greatly contributed to its establishment and growth for more than four decades.

The scientific trajectory of João Camargo was marked by scientific contributions of great importance for the description and understanding of the diversity of bees in the Neotropical Region, especially stingless bees (Apidae: Meliponini). His scientific production is reflected in more than 80 publications, which meant the construction of a magnificent framework of knowledge on the bee taxonomy, as well as their evolution and behavior (Pedro, 2009; Rasmussen, 2010). Throughout his career, Camargo built a research collection that initially consisted of a personal resource for his research needs, but that later became a scientific collection of global importance.

In the first decades of the development of what is currently represented by the Entomological Collection, the field expeditions carried out by João Camargo himself and his research team to various regions of Brazil (with a special interest in the Amazon) allowed the acquisition of material very relevant for the research on bees and other insects (Pedro, 2009). With its development, the collection also grew through the incorporation of material from research developed by students and collaborating researchers as well as by the exchange of specimens with other institutions. Currently, the Entomological Collection is rich in various groups of insects but is particularly representative for bees, especially stingless bees. In this case, more than 80% of the Meliponini species of the Neotropical Region are accounted for, and a wide representation of the fauna of the Paleotropical and Indo-Australasian regions is also present.

The number of insects mounted on pins exceeds 250,000 specimens deposited at *Coleção Entomológica "Prof. J. M. F. Camargo"*, which is complemented by an extensive number of specimens preserved in liquid fixative. Type specimens (holotypes, paratypes, and paralectotypes) stand out – this material has a unique relevance in taxonomic research because they allow the names of the species to be safely associated with the biological entities represented by the species themselves.

The collection houses 3,832 type specimens of the order Hymenoptera and Diptera, of which 91 are holotypes and together represent 202 species of insects. Of these, the majority refers to names of Meliponini species (127 species), but it also includes species representing 6 other Apidae tribes and 9 other families of wasps and bees (Hymenoptera). The collection also houses an exceptional archive of 905 stingless bee nests, which includes works built by bees (pieces of nests) and more than 5,000 slides that depict aspects of the biology of these bees. The Entomological Collection began to be computerized in 2004, and currently, there is information (data and photographs) available for more than 100,000 specimens in the *species*Link (http://www.splink.org.br) and GBIF – Global Biodiversity Information Facility (Almeida, 2019) databases.

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Types of vegetation in the Amazon, with a focus on Pará

DANIELA CRISTINA ZAPPI

Instituto Tecnológico Vale – Desenvolvimento Sustentável

Pará is the second largest Brazilian state, occupying an area of 1,248,000 km^2, between 2 degrees north and almost 10 degrees south of the equator. Pará, which is mostly composed of the Amazon biome, is on the northwest border of the Brazilian Cerrado (savanna), and currently, a total of 332 species of bryophytes (mosses and liverworts), 293 species of pteridophytes and lycophytes, 7 gymnosperms and 6,536 angiosperms have been recorded in its territory (FBO2020 in preparation).

Plant species most common in a given vegetation type are called dominant species, such as the açaí palm (*Euterpe oleracea*), a very common palm on the riverbanks in all of Pará and dominant in the *várzea* (whitewater-flooded) forests and *igapó* (blackwater-flooded) forests. This concept of dominance may lead one to believe that the Amazon plant species are very common and occur throughout the biome, with a predominance of one hundred species widely distributed; however, in fact, there are many others that, at times, go unnoticed because they are less common or have a restricted distribution (ter Steege et al., 2013). A forest is defined as vegetation in which trees are the main component that most contributes to the biomass, and there may be one or more layers composed of different habits (shrubs, saplings) under a more or less continuous tree canopy. Due to the predominance of trees, the understory is shaded, and the herbaceous stratum is never continuous, as we see in grassland or open vegetation. To facilitate the understanding and consultation of this information, the text was subdivided into forest vegetation and grassland vegetation.

Types of forest vegetation

The forests of the state of Pará are very diverse and known locally as *igapó* forest, *várzea* forest, *terra firme* (unflooded) forest, liana forest and dry forest.

The presence of different forest types is determined by the soil type, with different characteristics, such as humidity, altitude, slope, pH, permeability, degree of flooding, etc.

To recognize the different forest types, we considered the height, density, number of layers within the forest, number of lianas or climbers, presence of palm trees, density of the understory, and geographic and geological characteristics of the site, such as presence of rivers, type of water, frequency of flooding, substrate and slope. Some species or genera that are more frequent and considered dominant for each type of forest vegetation are also taken into account.

Dense ombrophilous forest (*terra firme* forest)

Generally located in flat sites, with little slope, and away from the influence of rivers, these are the highest forests in the Amazon. In them, the tallest trees form a cover called a canopy, with the treetops between 25 and 35 m in height. Some taller trees rise above this canopy, called emergent trees, with branches and canopy extending approximately 10 m above the rest, among which we commonly found Brazil nut (*Bertholletia excelsa*), *quaruba* (*Vochysia maxima*), *quarubarana* (*Erisma uncinatum*), manbarklak (*Eschweilera* spp.), *tauari* (*Couratari* spp.) and *fava-arara-tucupi* (*Parkia multijuga*).

Dense ombrophilous forest in Carajás, PA (photo: J.M. Rosa)

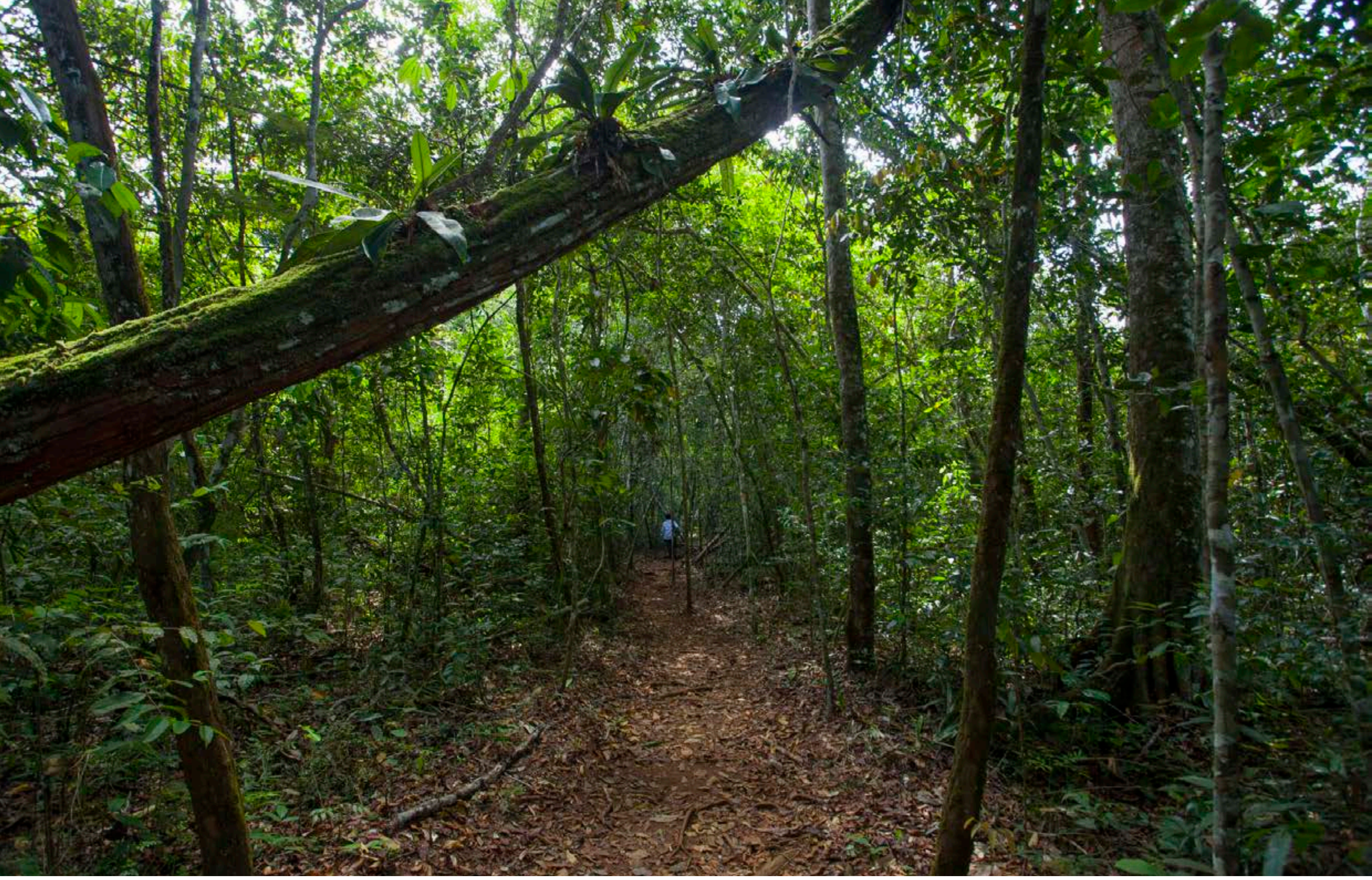
In the forks of large trees, especially those with thick bark and horizontal branches, one can find epiphytes, which are brought by wind or by animals, such as orchids and bromeliads, or hemiepiphytes. These germinate in the soil and begin their life cycle as vines and later adopt an epiphytic habit, as in the case of Araceae, which often reach large size, with aerial roots hanging towards the forest soil.

Under the canopy, it is possible to observe shrubs and saplings up to 10 m in height, which will not reach the light and thus live permanently in the shade. Additionally, herbaceous plants and dark-leaved ferns adapted to extremely low luminosity and very high humidity also occur.

In the soil, in between and on the roots of the trees, we see a large accumulation of dry leaves, wood stumps, fungi, petals and fruits, which together form a layer called litterfall, but usually, there is no water accumulated in puddles. In the middle of the litterfall, we can find small herbs with varied colours, such as white, yellow, pink and red, some parasitizing roots, such as *Helosis cayennensis* and *Langsdorffia hypogaea*, and some decomposers, such as *Voyria* species. It is this moist layer of leaves that protects a hidden universe, where the roots develop and breathe and establish associations with various microorganisms that are responsible for nutrient cycling.

Open ombrophilous forest (liana forest)

In the Southeast and Southern regions of Pará, where the Amazon biome borders the Cerrado (Veloso et al., 1991), the forest is more open than the dense ombrophilous forest. Known as open ombrophilous forest with lianas, it is popularly known as liana forest. This type of forest occupies both flat sites and hillsides. Its characteristics include a discontinuous canopy, formed by scattered trees, ranging between 15 and 25 m in height, and emergent trees generally shorter than what we find in dense forests. In this environment, it is very common to find woody vines (also known as lianas) interspersed along the paths, making this type of forest one of the most difficult environments to penetrate. These vines use the support of the trees to reach the sunlight, growing, blooming and fruiting above the tree canopy, and possess winged fruits and seeds that hover over the forest and are dispersed by the wind. *Escadas-de-jabuti* (*Schnella* spp.) and other woody lianas, also known as vines, can be seen from the ground, with their twisted branches rise until getting lost in the canopy. The density of vines is one of the factors that makes the trees weaker, causing canopy obliteration and falling branches that, in turn, leads to these forests not reaching the same height as the dense ombrophilous forest. Some of the most common trees are pequi (*Caryocar villosum*), *cacauí* (*Theobroma speciosum*), and sterculias (*Sterculia* spp.) – which are relatives of cocoa and cotton – in addition to several Fabaceae, such as *paricá* (*Schizolobium parahyba* var. *amazonicum*) and *caneleiro* (*Cenostigma tocantinum*), with tortuous and hollow trunks. Also notable is the presence of several palm trees, such as babassu palm (*Attalea speciosa*), urucuri palm (*Attalea phalerata*), *bacaba-de-leque* (*Oenocarpus distichus*) and tucuma (*Astrocaryum aculeatum*), used



Open ombrophilous forest surrounding the Laguna da Mata Trail, Carajás National Forest, PA (photo: J.M. Rosa)

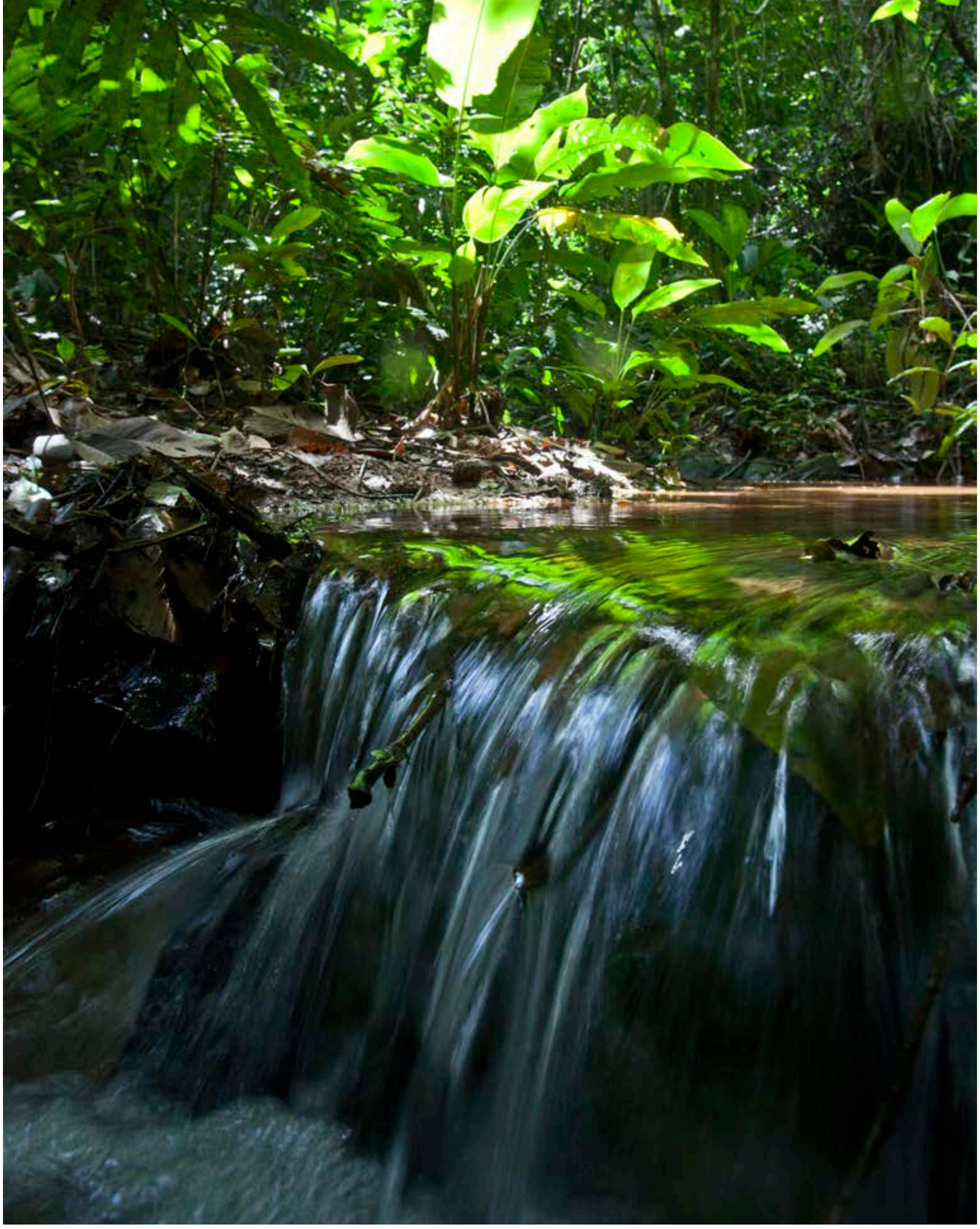
as food by fauna and by the local human population in different ways.

During the rainy season, the winds can break branches or even the emerging part of trees weakened by strangling vines and termites and even by the weight of large climbing vines, such as cat's claw (*Uncaria guianensis*), whose curved spines get hooked in the vegetation, while monkey orange (*Strychnos* spp.) and tayuya (*Cayaponia tayuya*) have simple or more complex tendrils that attach to the branches of other plants. The old branches of the *escada-de-jabuti* (*Schnella* spp.) form true zigzagging stairs, which seem to disappear into the canopy. The forest soil is shallow and offers little support for the roots, with frequent falling of entire trees.

Semideciduous forest in Harpia Stone, Carajás National Forest, PA (photo: J.M. Rosa)

Semideciduous forest (dry forest)

On rocky soils and in more exposed areas or with greater slope, especially on granite or even sandy substrate, we can observe another type of vegetation, the dry forest, or semideciduous forest (Veloso et al., 1991). In these locations, the water does not remain in the soil for a long time, draining immediately after the rainy season. Reaching 10 to 15 m in height and forming a more or less continuous canopy, the trees and shrubs that grow in these locations are more resistant to drought, and many of them lose their leaves during the dry season, hence the name 'semideciduous'. In this habitat, there is a predominance of plants with thorny branches and trunks with thorns and other curious excrescences in the bark, in addition to a large number of lianas. *Mamica-de-porca* (*Zanthoxylum rhoifolium*), *mulungu* (*Erythrina ulei*), monjoleiro (*Senegalia polyphylla*), jaborandi (*Pilocarpus* spp.), *carapança-vermelha* (*Coutarea hexandra*), glassywood (*Astronium graveolens*), *imbiruçu* (*Pseudobombax longiflorum*) and ipe (*Handroanthus* spp.) are common woody species in this habitat type. In the soil, the litterfall layer is dense, and in places where the tree cover is thinner and there is greater penetration of light, terrestrial bromeliads and other plants with thorns grow, making it difficult to penetrate. Semideciduous forests are often associated with rocky outcrops, with some cacti, orchids and rupicolous begonias.



Igapó forest in Carajás National Forest, PA (photo: J.M. Rosa)

Igapó forest

In the area of influence of the drainage of the Amazon river's clear water, known as clearwater or blackwater rivers, we find the *igapó* forests. These habitats are influenced by the movement of waters that temporarily flood the forest and occupy a narrow strip between the river margins and *terra firme* forest. There are some species of plants able to grow in these locations that are submerged for months, remaining inactive for part of the year. The waters rise up to 5 or more metres in height, flooding much of the forest during the flood season and dropping again during the ebb period. These periodic floods are influenced by rains that occur at the headwaters of tributaries many kilometres away and not necessarily due to local rainfall. Occasionally, some trees reach at least 30 m in height, such as kapok (*Ceiba pentandra*), interspersed by a dense canopy.

The tolerance capacity of flooded forest species, whose trunks remain under water for months during the rainy season, is impressive. The walking palm or cashapona

(*Socratea exorrhiza*), adapted to grow in flooded soil, has stilt roots that contribute to its fixation. Other species, such as manpara renaco (*Macrolobium acaciifolium*) and *ingazeiro* (*Inga flagelliformis*), are common on the edge of the igapó forest, along with several species of strawberry guava and little guava that knock fruits into the water that are then consumed by pacu fish and other frugivorous fish. The *pente-de-macaco* (*Apeiba tibourbou*) is a tree with strange, light and hairy fruits, which float in the river currents, using water to disperse its seeds. The general aspect of this vegetation is fascinating, with semi-submerged trunks and branches and trees with stilt roots of varied morphologies reflected on the calm surface of rivers.

Várzea forest

In the vicinity of large rivers of turbid water, known as whitewater rivers, there are backwater areas flooded and constantly fertilized by the water flow that rises during the rainy season and drops during the dry season. In these locations, the *várzea* forest, or flooded ombrophilous forest, is established (Veloso et al., 1991). In the *várzea* forest, the canopy is discontinuous and difficult to distinguish.

Species such as andiroba (*Carapa guianensis*), kapok (*Ceiba pentandra*), and several palms, in addition to the so popular açaí (*Euterpe oleracea*) and buriti or miriti (*Mauritia flexuosa*), also occur in flooded areas. Other palms, such as

Várzea forest in Carajás National Forest, PA (photo: J.M. Rosa) moretillo palm (*Mauritiella armata*) and ubussu (*Manicaria saccifera*), also grow in the floodplains of these rivers.

Many types of aquatic plants occur in floodplains: free floating plants and floating-leaved plants attached to the soil of the lagoons and that depend on buoy-like structures for flotation (Zappi, 2017). Other plants are totally or partially submerged and are usually fixed to the substrate in the margins of rivers and lakes. Emergent plants, where only the base and roots remain permanently or even temporarily under water, form large populations on the riverbanks. Those include Amazon water lily (*Victoria amazonica*), the region's iconic plant, and *aninga* (*Montrichardia linifera*), with large populations.

Types of grassland vegetation

Amazonian savanna and *campinaranas*

Locations generally associated with sandbanks formed by rivers or with sandstone or even granite rocky outcrops, where the soil is poor and shallow and often temporarily flooded, favour the establishment of different physiognomies of open and grassland vegetation known as *campinarana* (low open forests on white-sand savannas), Amazonian savanna (found at a certain altitude and distant from the most expressive waterways) and Amazonian rocky fields (on rocky outcrops) (Pires and Prance, 1985). In these locations, we observed similar physiognomies to those found in the Cerrado biome. Even some widely distributed

Amazonian savanna in the Itauajuri Mountains, Monte Alegre, PA (photo: D.C. Zappi)

Campinarana in the Ariramba Fields, Óbidos, PA (photo: D.C. Zappi)

species associated with the Cerrado, such as the sandpaper tree (*Curatella americana*), *bananeira* (*Salvertia convallariodora*), *carne-de-vaca* (*Roupala montana*) and several mirixis (*Byrsonima* spp.) may be found in these types of vegetation. One of the dominant species is tauroniro (*Humiria balsamifera*), which may be present in many environments, ranging from subshrubby to arboreal habit. Regarding the herbaceous stratum, it is more or less continuous and includes several Poaceae, Cyperaceae, Eriocaulaceae and Xyridaceae in more marshy areas and subshrubs and shrubs of the families Melastomataceae and Myrtaceae but also *marmelinho* (*Licania incana*).

The *campinaranas* are open environments, with no tree specimens, that occur in sedimentary plains formed by river courses. The presence of flat rocks at shallow depths underneath the sandy substrate causes these habitats to have a significant herbaceous stratum, and the shrubs and subshrubs that occur there have superficial roots. Sometimes, temporary lakes or marshy soils form, favouring the presence of aquatic plants.

The savanna physiognomy is found in deeper soils that are also sandy and poor, with or without the presence of rocky outcrops. Another physiognomy found is rocky fields on rocky outcrops, as seen in Monte Alegre and Alter do Chão, in the middle

Amazon region. The specific compositions of *campinaranas*, Amazonian rocky fields and Amazonian savannas in the same site are very similar. On the other hand, there is much variability from one site to another due to the isolation of these open environments within a forest matrix.

The relationship between the Amazonian savannas and the Cerrado biome is tenuous (Ratter et al., 2003), and the isolation dates back to before the Quaternary (Buzatti et al., 2017; Resende-Moreira et al., 2019).

Rocky fields on *canga*

In the Carajás region, usually above 600 m altitude, the iron ore-rich lateritic crusts, known as *canga* (ironstone outcrops), contain a specific type of rocky field (Viana et al., 2016; Mota et al., 2018; Zappi et al., 2019), researchers at the Museu Paraense Emílio Goeldi (MPEG). At approximately 6 degrees south of the equator and surrounded by open ombrophilous forest, the *canga* outcrops provide an inhospitable, rocky, open environment where the generally open and sparse vegetation is deciduous during the dry season and very exuberant due to the annual herbs that develop during and after the torrential rains that fall between November and May (Zappi, 2017). The *canga* substrate may be more or less compacted, which, together with different altitudes and drainage, allows the development of microhabitats, such as lakes, marshy fields, grasslands, shrubs and bushes, with many species of endemic plants. There are also caves formed by recesses of the lateritic crust, especially at the boundaries between the *canga* and the forest around it.

Most of the plants reach less than 2 m in height, and the soil is often exposed or covered by a dense grassy-woody layer with annual subshrubs and herbs. Between 1 and 3 m, shrubs and saplings appear isolated or in small groups on the landscape. The most common species are *vassourinha* (*Callisthene microphylla*), *canela-de-ema* (*Vellozia glauca*) and *murici* (*Byrsonima chrysophylla*), associated with the climbing shrub known as red hot poker vine (*Norantea guianensis*), *pata-de-vaca-miúda* (*Bauhinia pulchella*) and *erva-cidreira-da-canga* (*Lippia grata*). We can observe among these species the predominance of small and hard leaves, some hairy, many of them positioned vertically relative to the soil, a strategy that minimizes the direct effect of strong sunlight. The structure of small leaves may also be related to greater resistance to dehydration than thinner and expanded leaves, which are common in forest environments.

On the shrubs, we see vines, such as *flor-de-carajás* (*Ipomoea cavalcantei*), with attractive red flowers pollinated by hummingbirds. Other climbing plants belonging to the *mangaba* family (*Mandevilla scabra, Blepharodon pictum*) are pollinated by butterflies and bees. In the wettest and rocky parts, populations of *cara-de-cavalo* (*Philodendron wullschaegelii)* and bamboo-orchids (*Sobralia liliastrum*) can be found; on exposed rocks, we find lady of the night cactus (*Cereus hexagonus*) and *gravatá-da-canga* (*Dyckia duckei*). During the rainy season, *canga lajedos* (flat rocky surfaces where the bedrock is exposed) give rise to marshes and temporary lagoons that house large populations of endemic species, such as *boca-de-leão-da-canga* (*Utricularia physoceras*), *Perama carajensis* and *Brasilianthus carajasensis*, in addition to *sempre-vivas* (*Paepalanthus fasciculatus* and *Xyris brachyphylla*) and species of *Polygala, Sauvagesia* and *Burmannia* amid a high abundance and diversity of Poaceae and Cyperaceae. The high rainfall alternating with the dry season, the wind and even lichens, mosses and roots of plants that germinate and grow in the crevices of the rocks cause weathering and the formation of a thin layer of soil. Dried leaves and other plant residues accumulate in the area and, on this mixture of organic and inorganic deposits, grow mats of Poaceae (*Paspalum spissum, Trachypogon spicatus* and *Mesosetum* sp.) Cyperaceae (*Rhynchospora globosa*), which reach between 50 and 80 cm in height and are interspersed with shrubs.

The *canga* is a dense and partly impenetrable substrate, and the water forms puddles on its surface or accumulates and runs according to the slope of the terrain. Small watercourses are formed in larger crevices, converging into waterfalls that become dry between the months of May and September and active again in the rainy season. The rapid life cycle of annual *canga* species is a strategy to survive in habitats with a marked dry season. The seeds of these plants germinate as soon as the first rains fall between October and November. Foliage develops rapidly, and flowering begins in April. During the months of August to October, there is no sign of the presence of these species in the region.

Rocky field on the *canga* in Carajás National Forest, PA (photo: J.M. Rosa)

Recent studies have outlined the importance of vegetation on *canga* as a resource for bees that inhabit the surrounding forests (Guimarães et al., in press), recording the path of the pollinator between habitats during the flowering peaks of species that occur in the *canga*.

Amazon restinga

The coastal region of Pará includes large sandy areas formed by the Amazon River estuary, where dunes, lakes and *veredas* (palm swamps) of lush vegetation are established. Known as restinga (sandy coastal plains), these coastal formations are extremely heterogeneous and can be represented by a gradient ranging from coastal dunes to forests with canopies in the Atlantic Forest biome. On the Amazonian coast, they comprise mangroves, dense scrub or *veredas* and periodically flooded coastal fields (Amaral et al., 2008).

The most common species in the dense-scrub-type restinga include bushes dominated by perennial shrub species such as cocoplum (*Chrysobalanus icaco*), cashew tree (*Anacardium*

Restinga of Princesa beach, Algodoal, PA (photo: D.C. Zappi) *occidentale*), *olho-de-pomba* (*Pagamea guianensis*) and limber caper (*Cynophalla flexuosa*), in addition to tauroniro (*Humiria balsamifera*), which are also common in the Amazon savannas and *campinaranas*. In the most inland area, it is common to observe populations of bacuri (*Platonia insignis*). In permanently flooded areas, we find buriti or miriti (*Mauritia flexuosa*) and moretillo palm (*Mauritiella armata*), accompanied by annual herbaceous plants of the families Cyperaceae, Xyridaceae and Eriocaulaceae, which are more predominant during the rainy season.

Anthropogenic influence on vegetation

Currently, we know that even before the arrival of the Europeans to the Amazon, the indigenous tribes that populated the region had knowledge about the management of local flora and fauna (Posey, 1985; Balée, 1993), creating environments similar to vegetable gardens and transporting seeds and plant seedlings from one location to another. Evidence of soil management that includes a partial process of felling and burning (*coivara*) combined with recycling of ceramic fragments and food waste, forming the so-called Indian black earth (*terra preta de índio* – TPI), are common in the Amazon territory. In these areas, there is an accumulation of useful species for humans, such as Brazil nut (*Bertholletia excelsa*), cupui (*Theobroma subincanum*), *pequia* (*Caryocar villosum*), passion flowers (*Passiflora* spp.), cassava (*Manihot esculenta*) and maize (*Zea mays*), suggesting the existence of an agroforestry system developed over thousands of years in the Amazon territory (Clement et al., 2015; Levis et al., 2018).

In northeastern Pará, the Bragantina region was home to the first experiences of deforestation for food farming, which mostly followed European agricultural practices, without taking into account the equatorial climate or the methods used by the Amerindians. Much of the destruction of forests in the region dates back to the period of the rubber boom in the Amazon (1873 to 1912) and the growth in demand for food products within this biome.

Conversely, southwestern Pará and northern Mato Grosso were the scenes of a more recent expansion, which started with the inauguration of the Belém-Brasília highway in 1959, expanding deforestation with the relocation of loggers from the southern states of the country to the region and, later, with the formation of pastures and the development of extensive livestock production. This region is known as the arc of deforestation, where deforestation and the management procedures adopted, including burning and sowing of exotic grasses, dramatically modified the forest vegetation. This region is considered of great vulnerability for the advancement of deforestation in the Amazon (Zappi et al., 2016).

A system more compatible with the preservation of the Amazon physiognomy and the maintenance of carbon sequestration performed in this biome are agroforestry systems (Nunes et al., 2017), including the concept of polyculture, which involves several species dividing the same space (opposite to monocultures), the presence of productive trees shading and protecting the soil, the use of natural recycling of leaves and branches in the forest soil and the seeding of seed mixes (*muvuca de sementes*). These systems evoke the land use practices of the Amazonian tribes in pre-Columbian times, pointing to new possibilities based on ancestral experiences. It is worth remembering that unlike what was previously thought, there was a period in which the Amazon accommodated large human populations in its forests (Palace et al., 2017).

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Indigenous knowledge of the Kayapó people regarding stingless bees

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Introduction

The Kayapó people were intensively studied by the anthropologist Darrell A. Posey and his collaborators between 1970 and 1990. Knowledge about cosmology, the environment, and cultural traditions, that had previously only been transmitted orally, was for the first time, documented and disseminated, based on the traditional knowledge of the Gorotire Village indigenous community in Pará. Their focus on agriculture and forest resource management (for example, Kerr and Posey, 1984; Posey, 1985) has been emphasized in several previously published reviews on this subject. However, the study of bees, their products and their use by indigenous people (Posey 1983; Posey and Camargo, 1985; Camargo and Posey, 1990) deserves further attention due to the wealth of local knowledge on these insects found among members of the Gorotire Village community, and to ensure this knowledge is accurately transcribed and recorded in scientific collections and publications for diverse future audiences.

In rereading these works, my main aim was to understand how indigenous people, who lived in such diverse Amazon forest habitats, perceived bees, how they used bee products, and what they knew about bee biology and management. Bees, as well as wasps and other social insects, are part of their cosmology and serve as an example of social organization in the villages. The Kayapó people knew 56 species of stingless bees and semi-domesticated 9 of them for the collection of honey and other products. They ate the pollen and larvae stored in bees' nests and used other bee products as medicines. In addition, cerumen, which is used for different purposes by indigenous people of many ethnic groups in the Americas (Quezada-Euán et al., 2018; Hill et al., 2019), was traded as raw material for the production of headdresses, bows and arrows, and to waterproof baskets. For the Kayapós, cerumen had greater meaning, because it was used to make a traditional helmet (the *mê-kutôm*) used during shamanic rituals in which young men receive their adult name. This is a significant ancestral rite in social organization, uniting the past and present of Kayapó life.

Among the Kayapó people of Gorotire Village, there were experts who had a vast knowledge of bee nesting habits, biology, use of bee products in daily life and links with cosmology. The specific vocabulary used to name the body parts of bees and nests, exemplified in the illustrations of this chapter, demonstrates the in-depth knowledge of these experts, which had been passed on only through oral teachings until it was documented by Posey and collaborators and in other publications. Since the beginning of research on the bees used by the Kayapó people, Camargo followed with interest the development of the field of ethnobiology, identified the bees collected by Posey, and participated in a trip to the village, where he lived alongside these local experts of bees. This is one of the richest parts of his research, dealing with the relations between indigenous peoples and natural resources, comparing his observations with the scientific knowledge of the time and establishing deep ties of respect for the masters Kwyrà-Kà (who communicated in Portuguese), Irã and Krã.

João Camargo was also an artist and, using his sketches, wrote down the names given to the different structures of nests, body parts, stages of development, behaviour, and names of bees, among others. Thus, a glossary with these Kayapó names was created and translated into Portuguese and English. The drawings presented here were authored by him and were graciously shared for reproduction by the Annals of Carnegie Museum, where they were first published by Posey and Camargo (1985). Subsequently, with additional notes in Portuguese, this work was published in the Boletim do Museu Paraense Emílio Goeldi. The annotations presented here were transcribed by Posey (1983), Posey and Camargo (1985) and Camargo and Posey (1990).

Bees and cosmology

Cerumen, the primary building material of stingless bee nests, consists of wax produced by bees mixed with plant resins collected from the surrounding habitats. However, for the Kayapó, it has a direct connection with cosmology. They believed that their ancestors lived in the sky and descended to earth by a cotton rope, which landed in the burrow of an armadillo, a much-sought after game species. Their ancestors also brought with them a ball of cerumen, with which they made the hat, *mê-kutôm*, to fit the head of a young man receiving his full name. This cerumen ball is buried in the floor of the family home and reused in other rituals. The *mê-kutôm* (Fig. 1), described below (Posey, 1983), has a special symbolic role because it is the link between the Kayapó of today and their ancestors:

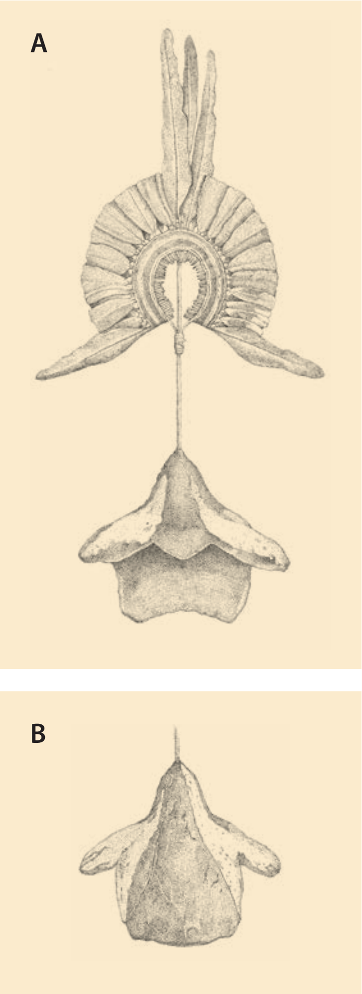

Fig. 1. Photograph reproduction of the *mẽ-kutôm*. Based on Campos (2006). (art: J. Silveira)

> *"The mê-kutôm has a very symbolic shape. The front points to the east (where the sun rises, kaikwa kratx); the back points to the west (sunset, kaikwa-not). It includes 2 "legs" (pa) that correspond with the cardinal directions, pointing north and south. Areas that represent the geographic relationships between the village (nipok) and the fields are painted on these "legs". The central circle, slightly elevated, represents the village but also represents the sun. Within the nipok, there is another small circle that represents the moon superimposed on the sun. From the cardinal points emerge small representations that indicate the path of the sun and the moon through the sky (kaikwa) and over the earth (pyka):*
>
> *The small circle (nipok) seen from above is an elevation where a rod is fixed, over which a bamboo and cotton arch are woven. Macaw feathers are inserted in the bamboo to produce an arch of red and blue feathers, which represent the sky (kaikwa)".*

Other cosmological aspects of the Kayapó people were reviewed by Campos (2006). He also emphasized the importance of observing celestial movements by the Kayapó to guide the beginning and end of the fishing, hunting, and planting seasons, among others.

Hunting and honey

Male and female activities in Kayapó villages are pre-established socially. During hunting, which is carried out by men, the captured animal is delivered to the wives or to the oldest woman in the house, who distribute it among the family members. The hunting of bee nests in the search for honey and cerumen is also a male activity performed in Gorotire Village, mainly by shamans. They are not afraid of the spirits and search for the nests at night, guided by the bee fanning noise, which they can distinguish for each species. They mentally mark where the nests are and return during the day to harvest the honey, which rarely makes it to the village. It is consumed where it is collected and in a very peculiar way. Using several banana leaves, they make a container where honey is stored. They chew the stalk base of wild ginger, which becomes spongy and is used as a spoon, which is dipped in the honey and shared that way. The brood combs and pollen contained in the pots are also considered a delicacy and eaten *in situ* by the hunting party. Sometimes honey,

Fig. 2. A. Kwyrà-Kà collecting honey from a stingless bee nest. **B.** Kwyrà-Kà and honey stored in a container made of leaves, ready for transport. (photo: J. M. F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo")

which may be partly fermented causes drunkenness (Posey, 1981). Any man who finds a tree with a nest, especially if it is in the capoeira (secondary forests) of his family, has the right to enjoy it: he warns his companions exactly where he found the nest, the ecological zone, the tree, and the name of the bee, and the nest becomes his property. When the tree is tall, a small support platform is prepared with sticks and branches tied with lianas, so that the man can use an axe (Camargo and Posey, 1990) (Fig. 3).

When the honey and the offspring are removed from a nest, one part is left in the tree hollow for Bep-kororoti, who is a powerful shaman that was carried to the sky by a ray of light. Therefore, Bep-kororoti lives in the clouds, from where he sends rain, thunder, and lightning. Bep-kororoti likes honey, which encourages the indigenous to leave for him part of the nest, brood combs and food pots. Thus, the colony is re-established and can be reused the following year.

The worship of Bep-kororoti has ensured that populations of stingless bees near hunting areas have remained high over many years. The wax is also related to Bep-kororoti. When burned, it produces a cloud of smoke that wards off evil spirits, purges the houses of the ancestral spirits who did not leave and protects the children from witchcraft. Its use in the manufacture of artifacts is also common – bows and arrows are made with cerumen as the means to attach feathers, and the resin (*breu*) of plants

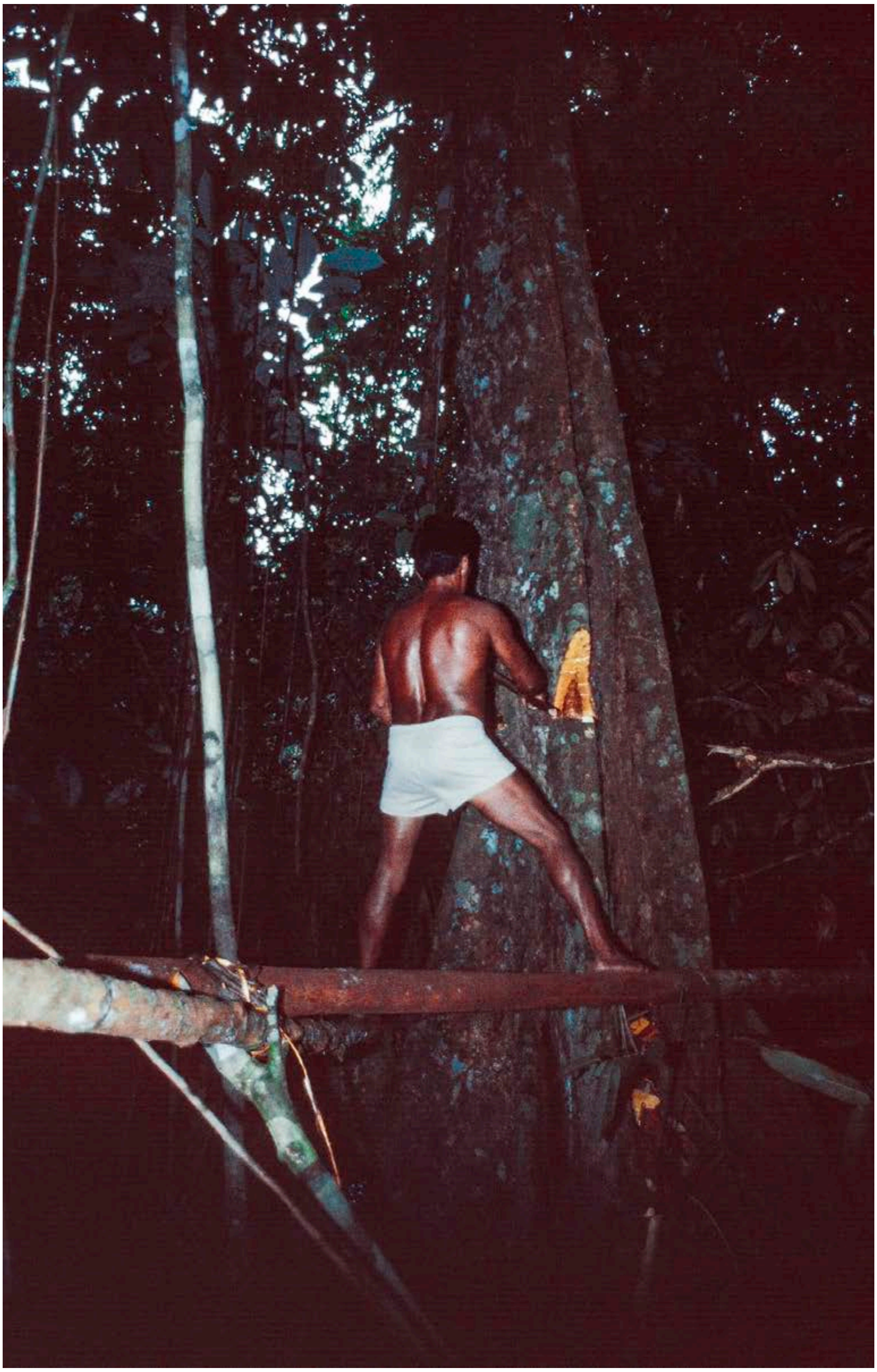

Fig. 3. The collection of products from a *Melipona paraensis* nest. (photo: J. M. F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo")

Fig. 4. *Apis mellifera* in Gorotire, PA. (photo: J. M. F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo")

collected by bees and deposited in nests is used to make the bow more malleable and robust.

The management of bees

Several bee species are known to men and women in the village and are usually associated with nests. Among these, some are widely known, such as *Melipona flavolineata*, *Trigona dallatorreana* and *Apis mellifera*. Reports of the arrival of Africanized bees (*Apis mellifera scutellata*, Fig. 4) in the village during the full moon of February 1966 are noteworthy. They are known for their defensiveness, for their high production of very sweet honey, and for having greatly decreased the availability of honey from other species of stingless bees. Camargo and Posey (1990) reported that the defensiveness of *Apis* decreased with time and that these bees were considered the strongest, replacing other species. In the classification of bees by their defensive behaviour, Africanized bees were considered very aggressive, and they sting; therefore, other management methods were necessary for this species. Shavings of the toxic vine *Tanaecium nocturnum* was placed in small quantities at the entrance of aggressive colonies, and the bees either fall asleep or die. Camargo and Posey (1990) reported that this vine was placed for a short period of time in the entrance of a *M. flavolineata* nest and, within 1.5 min, the bees began to die.

The Kayapó people recognize species of stingless bees whose nests can be explored periodically, either by harvests in successive years (a) or by bringing the nests near their houses (b) – *Melipona fasciculata* (a), *M. flavolineata* (a, b), *M. seminigra* (a, b), *Trigona amalthea* (a, b), *T. dallatorreana* (a, b), *Trigona cilipes*, *T. pellucida*, *Scaura longula*, and *Frieseomelitta* sp. (a). *Apis mellifera* is also managed every year for the collection of honey, which has commercial value; however, many among the community prefer the taste of stingless bee honey. *Melipona flavolineata* (*ngài-kumrex*) is a notable species because its wax can be used to manufacture *mê-kutôm* and the honey is greatly appreciated.

Stingless bee nests

For each vegetation type, the indigenous experts know which species of bees can be found and where they nest. The nests are grouped into basic categories identified by the Kayapó people and were described by Camargo and Posey (1990) (Fig. 5) – the wide diversity of nesting habits of stingless bee species is presented in the collection of stingless species and their nests. The entrances of nests also vary according to each species, such that they are important for identification and, therefore, also have special names (Fig. 6). The shape, texture, colour and smell of the entrance, in addition to the material used in its construction (clay, resin, cerumen, plant particles), are considered for bee identification.

Internal architecture of nests and food

The nests of stingless bees have a basic shared organization, such as a *Melipona* sp. nest occupying a pre-existing tree hollow (Fig. 7). All parts of the nest have Kayapó names, which is well explained by Camargo and Posey (1990). They recognize that pollen (*A-ũ*) is collected in flowers and transported to the nest, where it is placed in pots (*nhum'ê*). They also describe that the pollen taken to the nest is mixed with water droplets from the bee's mouth to form *nhum*, which is then fermented and semi-liquid pollen in some species. *Nhum* is the food of larvae. They also mention that the royal cells (the offspring of the queen bees) are fed a mixture of *nhum* and *mehn-kangô* (honey and pollen, respectively).

Camargo also describes how honey (*mehn-kangô*) is formed, according to the accurate observations of the community experts. It comes from the water of flowers (nectar, *pidjôrã- kangô*), collected and transported by bees and stored in pots (*mehn-ê-krê*). The nectar of different flowers has different densities and flavours, and the mixture results in honey with good quality and flavour (*mehn-kangô-abenkôt*). When the mixture is complete (*arup-metx*), the pots (*nhiên-djà*) are closed with wax (*ãn-je*). Brood cells are individually constructed to form clusters, as in *Frieseomelitta*, or stacked horizontal combs, as in most genera of stingless bees. When brood cell construction is complete, the queen and some workers gather in a characteristic ritual for each

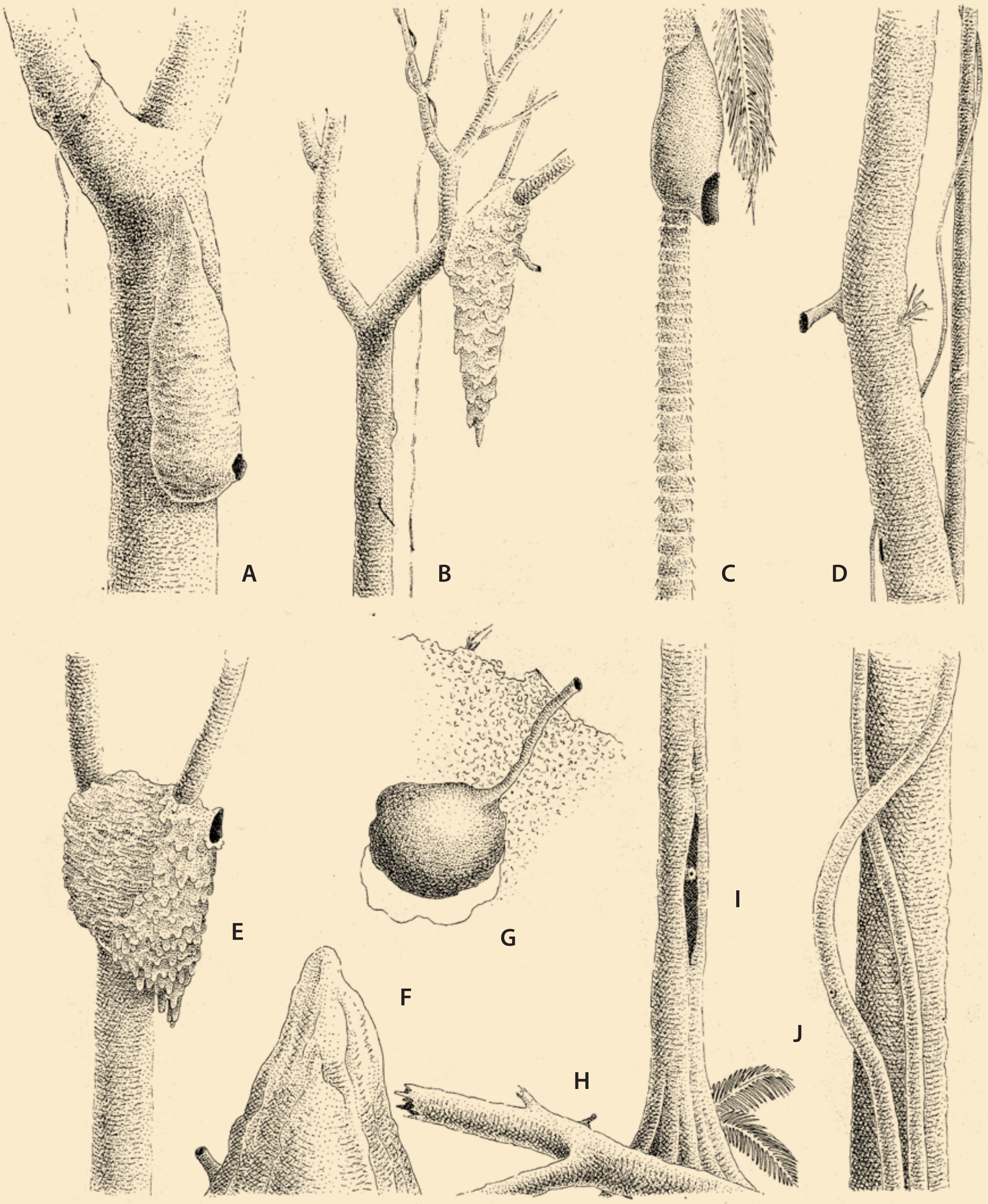

Fig. 5. Location of stingless bees recognized by the Kayapó people. **A.** *ku-krãi-ti* (*Trigona amazonensis*) has exposed nests fixed in large tree trunks or rocks in mountainous regions; **B.** *me-nô-rà-kamrek* (*Trigona cilipes*) usually builds nests in ant nests of *Azteca* sp. or in arboreal termite nests of *Nasutitermes*; **C.** *mehñy-tyk* (*Trigona branneri*) often has exposed nests fixed in the upper part of palm trunks; **D.** *imerê-ñy-kamrek* (*Scaptotrigona nigrohirta*) nests in tree hollows and the entrance tube is made with cerumen; **E.** *myre-ti* (*Partamona* cf. *cupira*) nests in arboreal termite nests; **F.** djô (*Trigona fulviventris*) is commonly found close to tree trunks; **G.** *puka-kan-mehn* (*Trigona recursa*), subterranean nests near termite nests; **H.** *my-krwàt* (*Tetragonisca angustula*), usually nests in dead trunks near the soil; **I.** *ngài-kumrenx* (*Melipona flavolineata*), with the nest entrance hidden inside the tree hollow; **J.** *mehnô-djành* (*Frieseomelitta* sp.) nests in liana and bamboo hollow. (original drawing by J. M. F. Camargo; courtesy: Annals of Carnegie Museum (1985), Boletim do Museu Paraense Emílio Goeldi, série Zoologia 6: 17-42 (1990))

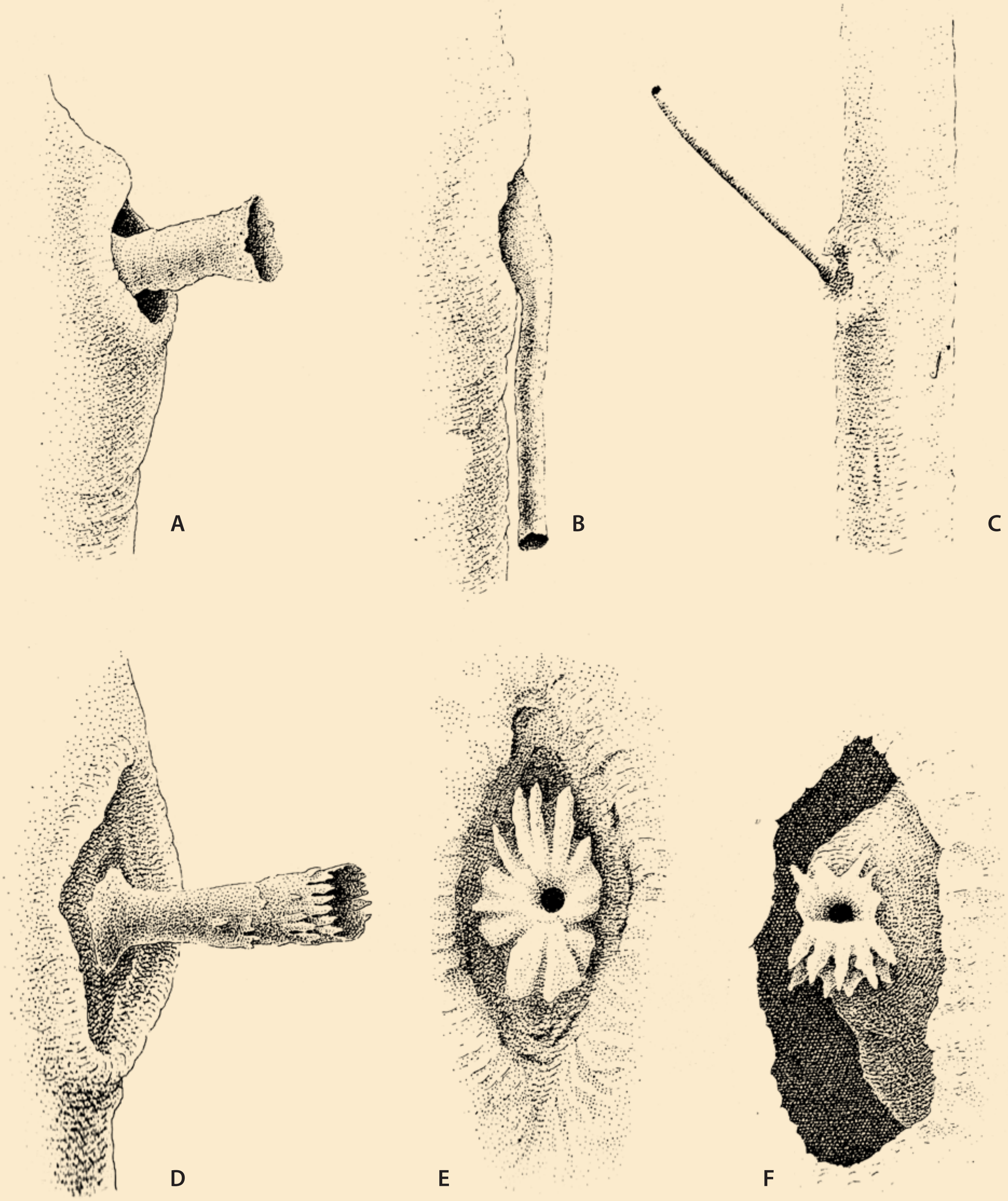

Fig. 6. Nest etrances of stingless bees recognized by the Kayapó people. **A.** *imerê-ñy-kamrek* (*Scaptotrigona nigrohirta*); **B.** *imerê-ti* (*Scaptotrigona polysticta*); **C.** õ-i (*Tetragona truncata*); **D.** *udjy* (*Melipona seminigra pernigra*); **E.** *menhirê-udjà* (*Melipona melanoventer*); **F.** *ngài-kumrenx* (*Melipona flavolineata*). (original drawings by J. M. F. Camargo; courtesy: Annals of Carnegie Museum (1985), Boletim do Museu Paraense Emílio Goeldi, série Zoologia 6: 17-42 (1990))

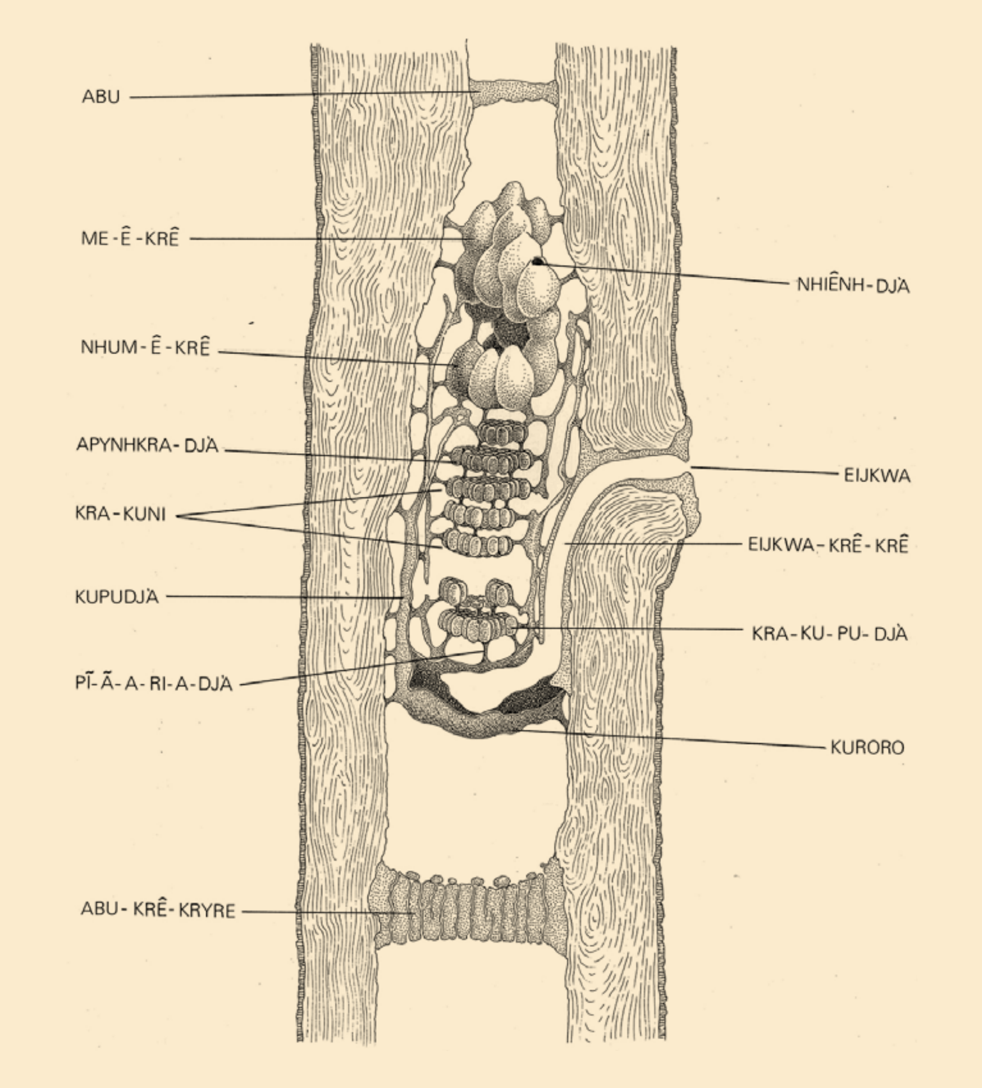

Fig. 7. Schematic representation of a *Melipona* nest and the names used by the Kayapó people: *abu* (batumen [dividing wall of a hive made of mud or wax]), *me-ê-krê* (honey pot), *apynhkra-djà* (brood cell), *kra-kuni* (brood comb), *kupudjà* (involucrum, sheets), *pi-ã-a-ri-a-djà* (supporting pillar of the combs), *abu-krê-kryre* (lower batumen for drainage), *nhiênh-djà* (open food pot), *eijkwa* (nest entrance structure), *eijkwa-krê-krê* (entrance gallery), *kra-ku-pu-djà* (cocoon) and *kuroro* (sheets, nest cover). (original drawing by J. M. F. Camargo; courtesy: Annals of Carnegie Museum (1985), Boletim do Museu Paraense Emílio Goeldi, série Zoologia 6: 17-42 (1990))

species. The edges of the recently constructed brood cells are taller than the brood cells already closed because the workers use this "collar" to seal the cells after the queen lays eggs. During this process, the liquid larval food is regurgitated into the brood cells by groups of nurse bees, after which the queen can then lay her eggs. Thus, the larva has at its disposal all the food necessary for its development and growth. This "mass provisioning" of the brood cells – one of the main characteristics of stingless bees – comprises a liquid mixture of honey, pollen and glandular secretions of the workers and fills approximately three-quarters of the internal volume of the cell. Thus, the entire development cycle, from egg to adult stage, occurs within the brood cell, which was well known by Kayapó experts, who named each stage of development from egg to adult (Fig. 8).

The Kayapó believe that adult bees have several functions: warrior bees (*mehn-akrê*) that defend the nest; scout bees (*mehn-ô-kabin-djwynh*) who work in the field in search of food and places to establish new nests and guard the nest; and the master bee (*benadjwyrà-ratx*), who is the queen and lives in the central part of the comb, coordinating and ordering all the activities of the nest. They also recognize virgin queens (*benadjwyrà*) and brood feeders (*benadjwyrà-prõn*) as special categories.

Identification of bees

The various body parts (Fig. 9), as well as the colour of the bees and/or their wings, are important in the identification of species. The grouping of species of bees into categories allowed the identification of *imerê* (*Scaptotrigona* and *Lestrimelitta*) bees by scent, honey and cerumen and *kangàrà* (*Oxytrigona*) for their different types of defence because they burn intruders with glandular secretions. They also separate the *Trigona* spp. that build exposed arboreal nests (e.g., *T. dallatorreana* and *T. amazonensis*). The Kayapó people recognize the vegetation where bees are found (várzea, igapó, wet forest, dry forest, cerrado) and the preferred substrate for nesting (e.g., tree hollows, tree limbs, ant nests, and arboreal or subterranean termite nests). In these cases, the shape of the nest entrance and its smell are important for the identification of the species. They identify the flight pattern of bees around the entrance of the nest and how they defend it. They also know the species that visit dead animals, faeces and clay. In the field, they are able to identify species that nest alone on a tree, those that form clusters of nests and the possible associations between species. Of the various observations made by Camargo and Posey (1990), the following stand out:

- *Melipona flavolineata* has a very characteristic strong smell when swarming, allowing an experienced hunter to find a new nest; they produce good honey throughout the year;
- *Melipona melanoventer* is not aggressive, with very distinct noise during the night, which allows location of nests; considered semi-domesticated;
- *Melipona seminigra pernigra* is found in the high forest; is semi-domesticated and produces honey throughout the year; and is used in witchcraft.
- *Partamona cupira* is very aggressive, chases after intruders; produces little honey; and is important in medicine;

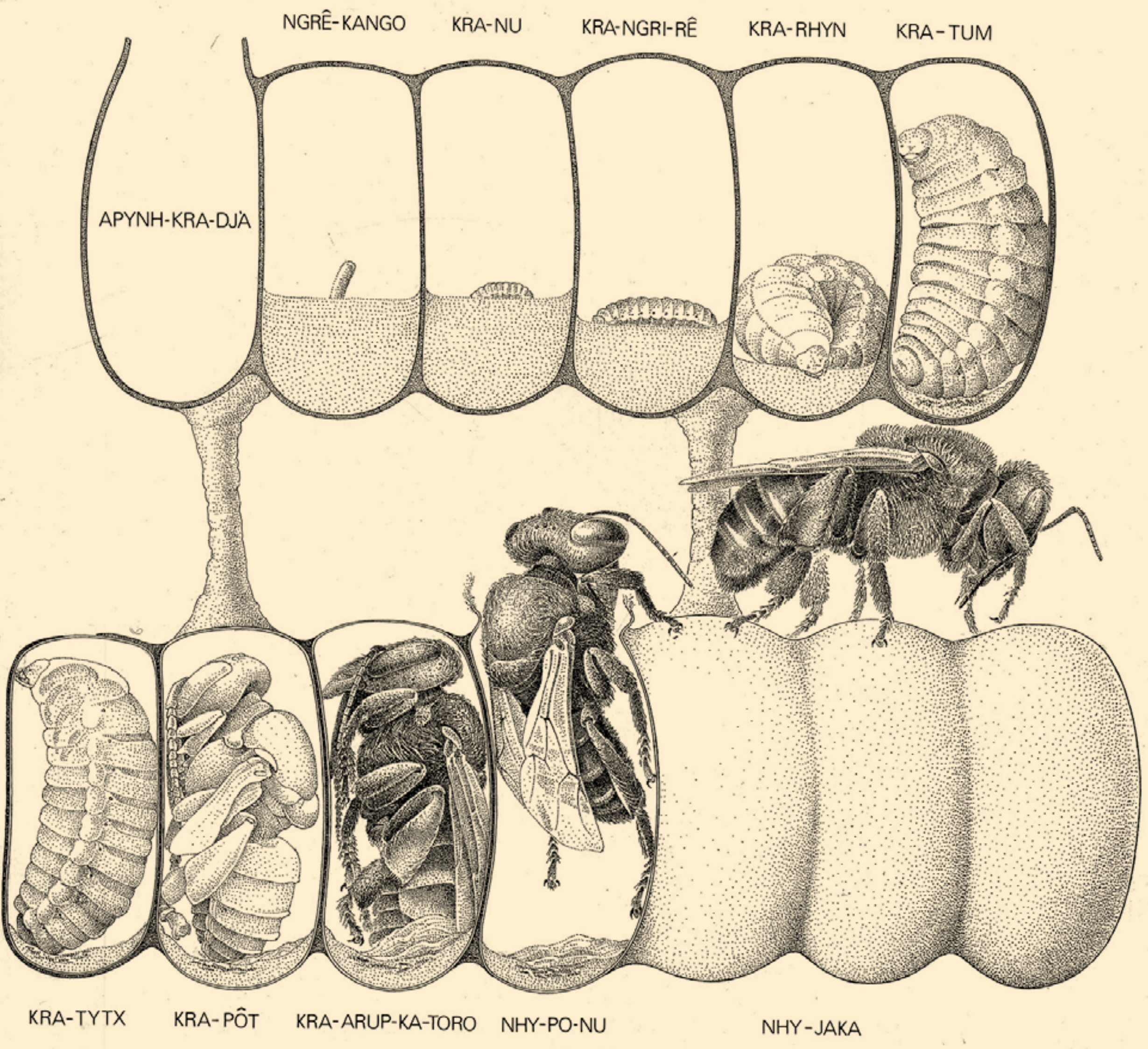

Fig. 8. Diagram of the stages of brood development, from egg to adult, for *Melipona fasciculata* (*ngai-re*). *Apynh-kra-djà* (brood cell); *ngrê-kango* (egg); *kra-nu* (first-stage larva); *kra-ngri-rê* (second-stage larva); *kra-rhyn* (pre-defecating larva, yellow larva); *kra-tum* (post-defecating larva); *kra-tytx* (prepupa); *kra-pôt* (unpigmented pupa); *kra-arup-ka-toro* (pigmented pupa, with movement); *nhy-po-nu* (emerging bee, imago); *nhy-jaka* (recently emerged bee, cleaning stage). (original drawing by J. M. F. Camargo; courtesy: Annals of Carnegie Museum (1985), Boletim do Museu Paraense Emílio Goeldi, série Zoologia 6: 17-42 (1990))

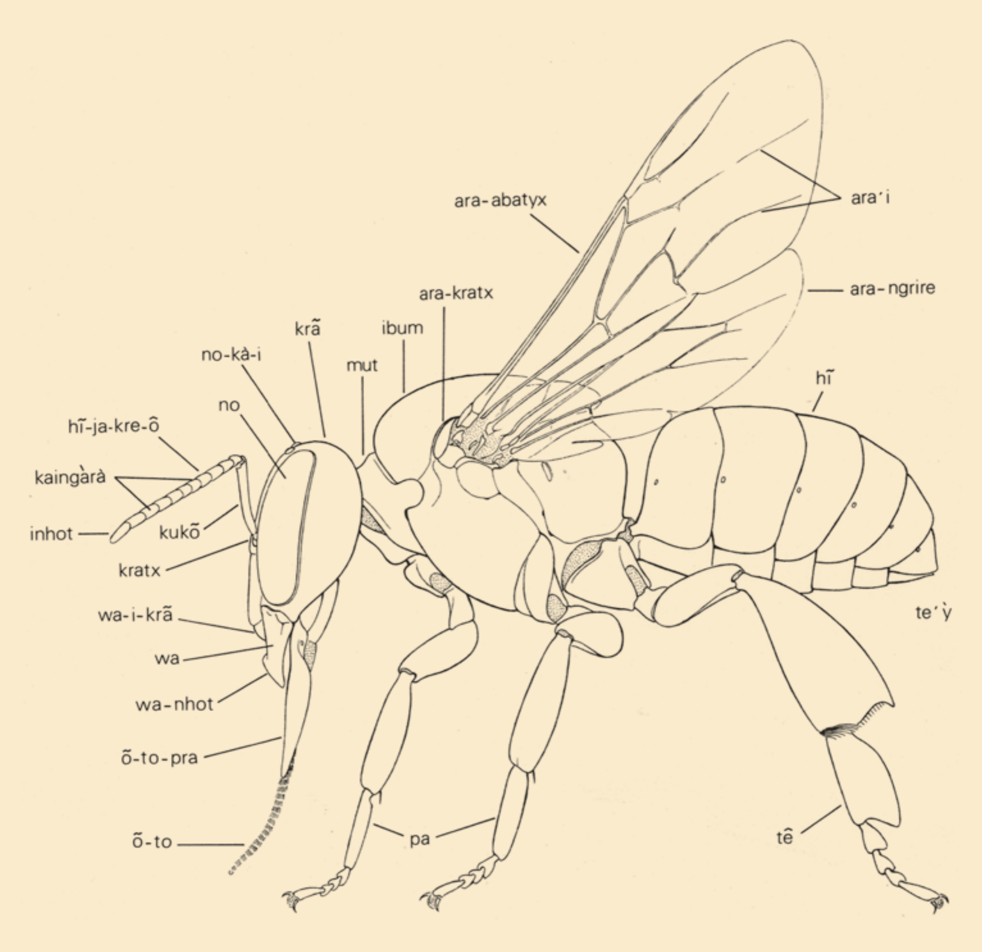

Fig. 9. Schematic representation of some morphological structures of a bee recognized by the Kayapó people: *ara-abatyx* (forewing, large wing); *ara ngrire* (small wing, hindwing); *ara-i* (wing veins), *ara-kratx* (wing joint); *krã* (head); *no-kà-i* (ocelli, simple eyes); *no* (composite eye); *hi-ja-kre-ô* (antenna); *kaingàra* (antennal segments); *inhot* (end, tip); *kukõ* (base of the antenna); *kratx* (joint); *wa-i-krã* (labrum); *wa* (mandible); *wa-nhot* (teeth of the mandible); *õ-to-pra* (proboscis, hanging tongue); *õ-to* (tongue), *mut* (neck, prothorax); *ibum* (back, mesothorax); *pa* (arm, front legs); *tê* (foot, hind legs); *hĩ* (abdomen); *tê-y* (tip of the abdomen). (original drawing by J. M. F. Camargo; courtesy: Annals of Carnegie Museum (1985), Boletim do Museu Paraense Emílio Goeldi, série Zoologia 6: 17-42 (1990))

- *Scaptotrigona nigrohirta* is very aggressive, bites and chases; attacks other bees by biting their wings; produces good honey throughout the year; the nest may have more than one queen; because of its sweetness, they eat pollen, if it is yellow; the cerumen is used for making the *mê-kutôm*, and only the descendants of the chiefs are named the bee (*imerê*) and own the helmets;
- *Scaptotrigona polysticta* is very docile; cerumen is also used for making the mĕkutôm; and it produces honey in large quantities during the dry season;

- *Tetragona clavipes* throws away old honey in the dry season;
- *Tetragona dorsalis* produces a special noise when dividing its colonies in the swarming process and produces good honey throughout the year; the resins collected by the bees are used for burning, and the smoke purifies the house and the body, mainly of sick or weak people; the burned cerumen and batumen cure dizziness; and the nest can be located by the song of the towapê-tê bird (*Hypocnemis* cf. *cantator*), a predator of adult bees; and
- *Trigona amazonensis* is very aggressive, bites and chases and produces highly appreciated honey in large quantities during the dry season; the crushed bees are rubbed on the bodies of hunting dogs so that they remain fearless and aggressive.

The indigenous knowledge about bees does not address the pollination process itself, but the Kayapó people plant species that the bees visit because the harvests are abundant in the presence of bees. In their farmed fields, they leave logs that can be used by bees as nesting sites. They know the animals that steal honey from bees (tayra, *Eira barbara*, and wasps, *Polybia emaciata* and *P. sericea*). They also know the bumblebees (*kungnt*), *Bombus*, which steal only pollen.

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Lifestyle diversity of Amazonian bees

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The stingless bees (Apidae, Meliponini) comprise a highly diverse group concerning body size, colony size, nesting biology, and behaviour (Michener, 1974; Roubik, 1989; Pedro, 2014). Approximately 75% of the species described for the Brazilian territory (177 out of 244 species) have been registered in the Amazon Rainforest (Pedro, 2014), which highlights the leading role of this biome for the country's biodiversity. The elevated richness of meliponine species, and the consequent competition over resources and nesting space, gave rise to a rich variety of different lifestyles among the Amazonian stingless bees. Yet, the biology of most species has remained largely unknown to this date, which is mainly due to the difficulty in access their natural habitats.

On his expeditions to the Amazon Rainforest, João Camargo collected detailed information on the occurrence of stingless bees in this biome and described meticulously the morphological features of the individuals and the characteristics of each species' nest architecture. Moreover, being a holistic naturalist, he made important observations on several biological peculiarities of the meliponines of the Amazon region. Many of these had been unprecedented and unexpected for social bees, such as the mutualistic association with wax-producing scale insects (Camargo and Pedro, 2002a, b), the storage of pollen together with yeast (Camargo and Pedro, 2004), the complete absence of food storage (Camargo and Pedro, 2007), the storage of resins in specialized pots (Camargo and Pedro, 2004), the specialisation in robbing resources from the nests of other bee species (Camargo and Moure, 1989; Camargo and Pedro, 2008), and necrophagy (Camargo and Roubik, 1991). These observations formed the solid basis for a variety of studies by national and international research teams, thus underlining their scientific importance and relevance.

The mutualistic association with scale insects in *Schwarzula* spp.

Scale insects (Hemiptera, Coccoidea) are small hemipterans, usually measuring less than 5 mm, that feed on the saps of their host plants (Gullan and Kosztarab, 1997). In most species, the insects secrete wax, covering the entire body with a protective layer (Tamaki et al., 1969). This wax shield, which amounts to approximately 75% of the individuals' body mass, resembles the scales of fish or reptiles, which coined the common name of these bugs (Gullan and Kosztarab, 1997). In addition to wax, the animals excrete a solution composed of carbohydrates and amino acids (Way, 1963) that attracts ants and bees (Way, 1963; Santos et al., 2019).

Stingless bees, usually, collect both the sugary solution and the wax secreted by the scale insects opportunistically, when encountering agglomerations of these hemipterans on their respective host plants (Cortopassi-Laurino, 1977; Santos et al., 2019). An exceptional case in this context are the meliponine species *Schwarzula timida* and *S. coccidophila* (Camargo and Pedro, 2002b). In strict contrast to the opportunistic associations with scale insects, known for various stingless bees, colonies of *Schwarzula* herd groups of more than 200 coccids in the galleries of their nests (Camargo and Pedro, 2002a), where they harvest both the sugary solution and the wax produced by the hemipterans. The basitarsi and the mandibles of the workers of *Schwarzula*, used in wax collection and transport, are modified in comparison to phylogenetically closely related species (Camargo and Pedro, 2002a, b). After the harvest, the bees stock the wax in specific deposits for posterior use as material in nest construction. The sugary secretions of the coccids are stored in the honey pots and, presumably, are the main source of carbohydrates for the colonies of *Schwarzula*, given that the foragers collect mainly pollen and secretions rich in salt (Camargo and Pedro, 2002a). In exchange for providing resources for the bees, the scale insects receive shelter and protection against predators.

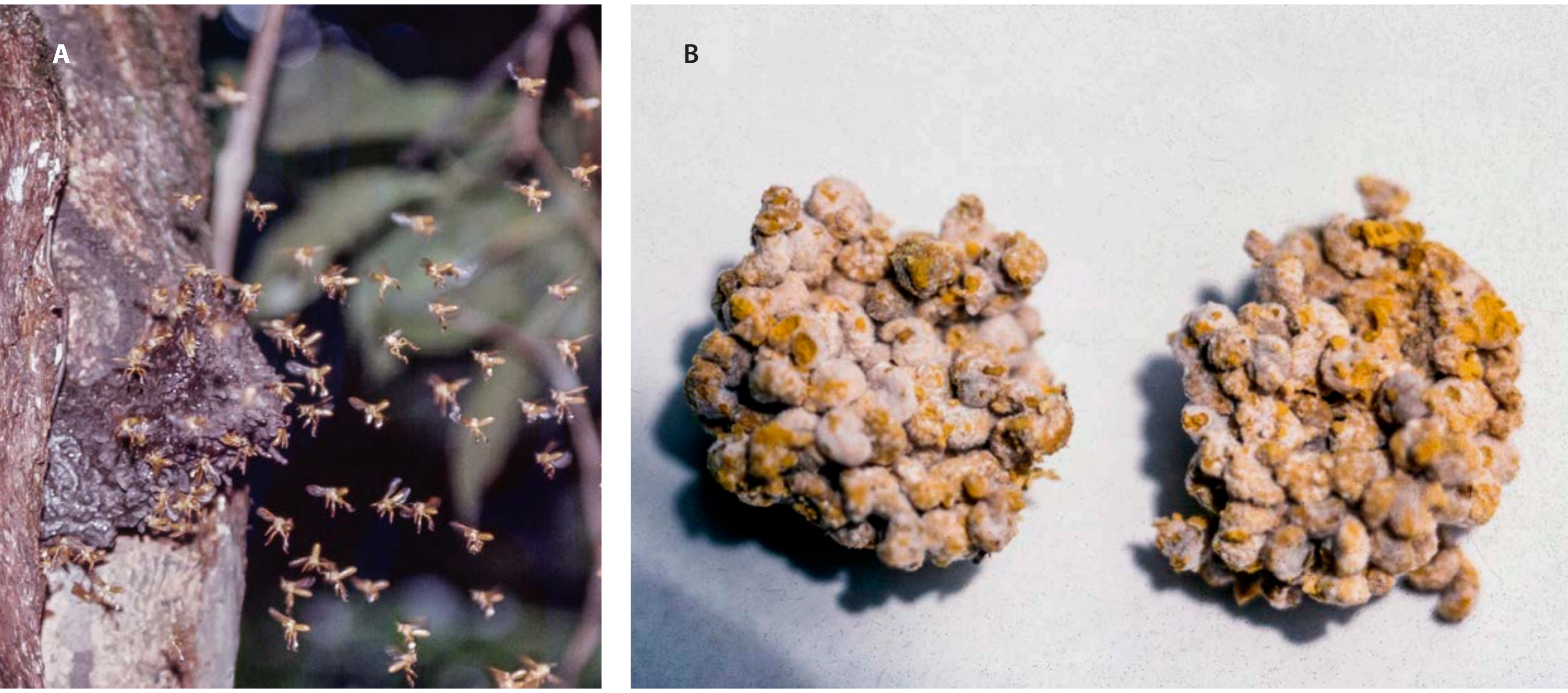
Mutualistic associations between scale insects and social insects are well known in ants, which guard agglomerations of these hemipterans on their host plants in exchange for the sugary secretions (Way, 1963). However, only few ant species rear and maintain coccids within their nests (Flanders, 1957) as observed in *Schwarzula*, which highlights the exceptionality of this biological characteristic for social insects.

The peculiar stocks of *Ptilotrigona lurida*

Social bees with perennial colonies, such as the stingless bees, collect food when it is abundant in the environment and stock it in the nest to overcome dearth periods (Michener, 1974; Hrncir et al., 2019). The food products harvested comprise carbohydrates (mainly nectar) as energy supply for the adults, and proteins (usually pollen) as key nutrient for the larvae (Michener, 1974). As has been demonstrated in honey bees (*Apis mellifera*), a colony's tendency to collect more or less pollen is determined genetically (Hunt et al., 1995). Given that pollen is the main source of proteins for larval development, brood production and, consequently, population size of a colony increases with increasing foraging effort for this resource (Page and Fondrk, 1995).

In addition to variations in brood production over the year, associated with pollen availability in the field (Roubik, 1982a; Maia-Silva et al., 2015), stingless bee species differ concerning their pollen foraging activity (Leonhardt et al., 2007), which may explain differences in colony size between species, varying from a few dozens to tens of thousands workers (Wille, 1983). An interesting case in this context is *Ptilotrigona lurida*, one of the most conspicuous and aggressive stingless bee species of the Amazon region (Camargo et al., 1992; Camargo and Pedro, 2004). In general, the nests of this species are huge, and worker populations may comprise more than 20,000 individuals (Camargo et al., 1992; Camargo and Pedro, 2004). One of the peculiarities of *P. lurida* is the exuberant pollen storage in the nests, which may reach up to more than 2 kg. The stored pollen is extremely dry, and it is even possible to distinguish the individual pollen loads deposited by the foragers (Camargo et al., 1992). Usually, the pollen storage contains *Candida* yeast that causes dehydration of the stored food, therewith increasing its durability (Camargo et al., 1992). Moreover, the fungi hamper or even impede the infestation of the pollen pots by phorid flies, well-known parasites in stingless bee colonies that feed on the colonies' pollen storage (Camargo et al., 1992). Recent studies point to additional advantages of such mutualistic associations between meliponine bees and fungi: *Zygosaccharomyces* sp. yeast produce steroids that have a key function in the metamorphosis of the larvae in *Scaptotrigona depilis* (Paludo et al., 2018). Thus, the colonies need to cultivate these fungi to facilitate the complete development of the individuals and, consequently, promote colony survival (Menezes et al., 2015). Interactions between different types of yeast, common in the food storage pots of stingless bees, may stimulate (*Candida* sp.) or inhibit (*Monascus ruber*) the growth of *Zygosaccharomyces* sp., therewith modulating the larval development of the colonies (Paludo et al., 2019).

Another peculiarity of *P. lurida* is that honey pots are rare or even absent. On the other hand, the nests contain a considerable number of pots that contain resins, particularly from flowers of *Clusia* spp. (Camargo et al., 1992; Camargo and Pedro, 2004) that offer resins as reward for pollinators (Mesquita and Franciscon, 1995). Stingless bees collect this resource as raw material for nest construction or for nest defence (Roubik, 2006; Leonhardt et al., 2010) and, usually, store it in small resin deposits on the nest's wall or between the layers of the involucrum (Roubik, 2006). Thus, the way *P. lurida* stores this resource is unique among the meliponines. The large stocks of *Clusia* spp. resins may be associated with the conservation of yeast in the pollen pots. Plant resins, typically, show a strong antimicrobial activity (Drescher et al., 2014). However, *Clusia* spp. resins, although inhibiting the growth of bacteria, have no effect on yeasts (Lokvam and Braddok, 1999). Thus, by using this type of resin in the construction of food storage pots and brood cells (Camargo and Pedro, 2004), colonies of *P. lurida* may facilitate the growth of yeast in pollen pots that are free of any bacterial contamination.



A. *Ptilotrigona lurida* nest entrance. **B.** Pollen pellets dehydrated by *Candida* sp. (photos: J. M. F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo")

The absence of food storage in *Trichotrigona* spp.

Contrasting the premise that food storage is crucial for maintaining perennial colonies, food storage pots are completely missing in nest of *Trichotrigona extranea* (Camargo and Moure, 1983; Camargo and Pedro, 2007) and *T. camargoiana* (Pedro and Cordeiro, 2015). Both these meliponine species have small colonies, comprising between several dozens to few hundreds of adult workers. On most occasions, their nests were found close to those of *Frieseomelitta* spp., or even sharing the same tree cavity, separated by hard and compact layers of batumen (Camargo and Moure, 1983; Camargo and Pedro, 2007; Pedro and Cordeiro, 2015). Even though *Trichotrigona* bees, just as other meliponines, provision their brood cells with pollen (Camargo and Pedro, 2007), foragers returning with pollen loads on their corbiculae have not been observed so far (Pedro and Cordeiro, 2015). Presumably, the workers carry pollen together with nectar inside their honey stomach and use this mixture directly for brood cell provisioning (Pedro and Cordeiro, 2015). The absence of any type of food storage pots together with the reduction of body structures associated with the collection and manipulation of pollen (Camargo and Pedro, 2007; Pedro and Cordeiro, 2015) suggests a cleptobiotic lifestyle of *Trichotrigona* spp.

Cleptobiosis, the robbing of resources from the nests of other bee species, is a behaviour well known for the meliponine genus *Lestrimelitta* (Nogueira-Neto, 1970; Wittmann et al., 1990; Sakagami et al., 1993). Yet, in contrast to *Trichotrigona* spp., the colonies of *Lestrimelitta* spp. contains several thousand individuals, and the invasion of the nests of other stingless bee species occurs in mass attacks (Nogueira-Neto, 1970; Sakagami et al., 1993) coordinated through pheromones (Wittmann et al., 1990). The robbers quickly plunder the entire pollen and honey stock as well as the brood's food provisions of the host colonies, and carry their loot within the honey stomach to their own nests, where the store the resources in pots of mixed content (Sakagami and Laroca, 1963; Quezada-Euán and González-Acereto, 2002).

All species of the genus *Lestrimelitta* have an obligate cleptobiotic lifestyle, which means that they do not collect any food at flowers and, consequently, the survival of the colonies depends solely on the success of their raids (Nogueira-Neto, 1970). However, some meliponine species

A. *Trichotrigona extranea* nest entrance. **B.** Internal view of the nest, showing the brood combs and the lack of food pots. (photos: J. M. F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo") loot the nests of other social bees facultatively, among them *Melipona fuliginosa*, one of the biggest stingless bees (Cortopassi-Laurino, 2004; Camargo and Pedro, 2008). The colonies of this species are populous, containing approximately one thousand adult individuals, and show aggressive nest defence (Cortopassi-Laurino, 2004). *M. fuliginosa* colonies plunder the nests of other social bees in the close neighbourhood. The raids, during which the invaders steal mainly honey and wax, may go on for several days and, frequently, cause severe damage or even lead to the death of the colonies attacked (Costa et al., 2018). However, workers of *M. fuliginosa* also forage for nectar and pollen at flowers (Cortopassi-Laurino, 2004). Only when floral abundance is low, the colonies switch to opportunistic nest raiding (Costa et al., 2018).

Just like the species of *Lestrimelitta*, colonies of *M. fuliginosa* deposit the food, collected at flowers or robbed from other nests, in storage pots (Camargo and Pedro, 2008), which highlights the singularity of the absence of food storage in *Trichotrigona* (Camargo and Moure, 1983; Camargo and Pedro, 2007; Pedro and Cordeiro, 2015). A possible explanation for this peculiar feature is the reduced need for hoarding food owing to the small number of adults and the low brood cell production by the colonies. However, both the true cause for the absence of food storage pots in *Trichotrigona* spp. and their cleptobiotic lifestyle have remained open questions to this day.

Necrophagy

Curiously, many stingless bee genera (*Camargoia*, *Cephalotrigona*, *Frieseomelitta*, *Geotrigona*, *Melipona*, *Nannotrigona*, *Oxytrigona*, *Paratrigona*, *Partamona*, *Plebeia*, *Scaptotrigona*, *Scaura*, *Tetragona*, *Trigona* and *Trigonisca*) visit the carcasses of dead animals, where they collect liquids and small pieces of meat (Müller, 1874; Cockerell, 1920; Schwarz, 1948; Cornaby, 1974; Baumgartner and Roubik, 1989; Lorenzon and Matrangolo, 2005). The collection of animal proteins by social insects is well known from wasps and ants (Reed, 1958). Initially, this behaviour, peculiar for bees, was thought to be associated with the collection of nest construction material (Schwarz, 1948; Wille, 1983). Yet, foraging at animal carcasses may have alternative explanations. First, the bees obtain important salts and minerals from the collected liquids (Baumgartner and Roubik, 1989). Second, similarly to wasps and ants, they may use the meat itself as protein supplement for feeding the larvae (Roubik, 1989; Noll et al., 1996).

In this context, a unique meliponine group are the obligate necrophagous bees, *Trigona hypogea*, *T. necrophaga* e *T. crassipes*. In strict contrast to facultative necrophages, these stingless bee species do not visit flowers for food (Camargo and Roubik, 1992; Noll et al., 1996). The colonies obtain their carbohydrates, stored in honey pots, from liquids with high sugar content, collected at fruits of extrafloral nectaries (Camargo and Roubik, 1992; Noll et al., 1996). An interesting morphological feature of the obligate necrophages is the complete absence of corbiculae in workers (Roubik, 1982b; Camargo and Roubik, 1991), which indicates that these bees lost any capacity to collect pollen at flowers. Thus, meat, collected at animal carcasses, is the exclusive source of proteins for these stingless bees (Roubik, 1982b). When the scouts find a recently dead animal, they quickly recruit many additional foragers (Jarau et al., 2003) that remove fur, or plumage, and skin form the carcass (Roubik, 1982b). Thereafter, they cut pieces of meat with their strong mandibles, and chew them for several minutes prior to carrying the resulting, pasty material in their honey stomach to the nest (Gilliam et al., 1985; Camargo and Roubik, 1991). Subsequently, the foragers deposit the pre-digested meat in special pots that contain a viscous mixture of animal protein and honey (Camargo and Roubik, 1991; Noll et al., 1996).

In the tropics, the meat of dead animals rots quickly if not conserved appropriately. Thus, the long-term storage of animal proteins represents a challenge for bees. The necrophagous species solve this problem through chemical transformations of the stored protein (Noll et al., 1996). After filling a storage pot, it is sealed by the workers, and the mixture of pre-digested animal protein and honey matures for about two weeks within the closed environment. During this maturation process, the quantity of soluble proteins diminishes as the content of amino acids and sugars increases, and the pasty material is transformed into a homogenous viscous liquid (Noll et al., 1996). This chemical conversion, presumably, is mediated by *Bacillus* spp. bacteria, whose enzymatic activity accelerates the metabolic conversion of proteins and lipids, yet has little effect on carbohydrates (Gilliam et al., 1985). In addition to enzymes, *Bacillus* spp. produce antibiotic substances (Katz e Demain, 1977) that inhibit the occurrence of other microorganisms in the storage pots (Gilliam et al., 1985) and, consequently, conserve the animal protein over long time periods.

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The nests of stingless bees, from nature to museums

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TEREZA CRISTINA GIANNINI
AND DENISE ARAUJO ALVES
*Instituto Tecnológico Vale – Desenvolvimento Sustentável
and Universidade de São Paulo*

In nature, the nests of stingless bees (Meliponini) can be found in different substrates. They occupy pre-existing cavities in living or dead trees, in the ground, and the nest of other social insects, including ants, termites, and sometimes even wasps. Lianas may also serve as a nesting substrate. Some stingless bee species, like those from the genus *Trigona*, built exposed nests.

The expeditions of João M. F. Camargo to the Amazon region allowed the detailed study of stingless bees with vastly different nesting habits and nest architecture. Despite the diversity in many behavioural aspects, all stingless bee species share the same general nesting pattern, characterised through brood cells, constructed by the workers with mixtures of wax and resin (called cerumen) and provisioned with all food necessary for the larval development, followed by the queen's oviposition. The brood cells are used only once and are destroyed as soon as the new bees emerge from them. Honey and pollen are stored in food pots.

The nests presented in the following compilation, clearly evidence the rich information on stingless bee species previously unknown to science. The detailed study of the bees' nest architecture shows diversity in size and shape and points to behaviours unknown before. After the expeditions, series of nest specimens and, others, conserved in liquid had been deposited at the entomological collection "Coleção Entomológica da Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto da Universidade de São Paulo (FFCLRP-USP)", today named Coleção Entomológica "Prof. J. M. F. Camargo". The collection as well comprises the nest entrances, meticulously described and drawn in every detail. They are fundamental for the identification of the particular stingless bee species. Hence, when available, images of the nest entrances are provided in the following compilation.

The plates of the stingless bees portrayed in this book show a worker of each species collected in the State of Pará so that they can be identified through specialised identification keys or for comparison. Each bee, or specimen, receives several labels on its origin and identification. One of these indicates the location at which the bee had been collected and by whom. Another tag provides information on who identified the species. All this information is crucial to certificate the identity of the individual bee species, and, therefore, the labels are presented in the plates together with the bees.

We call it a catalogue when all information on a given species is compiled in a database. This information includes, among others, the list of world museums and collections with specimens under the given specific name and the number of existent samples in each museum where this species has been listed. Currently, these databases are linked to images and other existing data. Once available in digital form, this information will facilitate the species identification, given that the original material of the collections is precious and access is granted, mostly, only to specialist researchers. For stingless bees, João M. F. Camargo and Silvia R. M. Pedro revised the content of all collections as well as the bibliography available until 2004 for their contribution on stingless bees in the Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region (Camargo and Pedro, 2013).

All data of the Coleção Entomológica "Prof. J. M. F. Camargo" were made available for public access through the project "*Distributed information system for biological collections, the integration of Species Analyst and SinBiota*", with financial support from the São Paulo Research Foundation (FAPESP) in its initial stage in 2005.

The Coleção Entomológica "Prof. J. M. F. Camargo" has been reorganised by the current curator Prof. Eduardo A. B. de Almeida. The digitisation of the information was made possible with the help of Dr. Fabio B. Quinteiro and Dr. Anne M. Costa, both financially supported by the Instituto Tecnológico Vale – Desenvolvimento Sustentável (ITV-DS). The complete digitised photo library has also been made publicly available by the *Scientific information system about neotropical bees*. The specimens studied in research performed by the ITV-DS have been deposited in the collection of the Museu Paraense Emílio Goeldi.

Studies on the bees of Carajás performed by the ITV-DS

We have two main lines of research on bees from Serra dos Carajás in the State of Pará. The first is an inventory of pre-existing information on the local bee diversity (including all bee species, not only the stingless bees) and bee collections in the field. The second line includes studies on the local stingless bee species and their nests that could be rescued during ongoing processes of removal of native vegetation (Costa, 2019).

Research projects by the ITV-DS have studied various aspects of the bees in the National Forest of Carajás. The first step was to establish a list of species previously described for the region, using online data providers like speciesLink (open access) as well as the ITV-DS institutional database. This preliminary list was compared with specimens deposited in two entomological collections, the collection of Museu Paraense Emílio Goeldi and the collection of the Universidade Federal de Minas Gerais that has a section for insects from Carajás. These data, together with the previously collected species, were crucial for establishing a list of species, for which we now have a robust and reliable database. For these species we determined several functional characteristics – such as body size, nesting habit, sociality, whether they are known as crop pollinators or not – that allow more detailed analyses of the main functions and ecosystem services provided by the different species in nature.

The next step was new collections of bees in the field. For these, we used standard methods for insect collections in areas of *canga* vegetation in Carajás, which are vegetational islands isolated from the Amazon Rainforest vegetation. In each region, we collected bees in standardised surveys using different methodological approaches (insect nets, olfactory traps, trap nests). Moreover, to understand the relationship between bees and plants in these natural environments, we determined patterns of interaction between bees and flowers. These interactions constitute complex networks that allow very insightful analyses concerning the conservation ecology of the involved species. In addition to the surveys in the areas with *canga* vegetation, we collect bees in after mining recovery zones for comparisons of bee diversity and bee-plant interactions with control areas with original forest vegetation. Thus, we continuously add new information to the initial knowledge, including new bee species and their interactions with plants, an essential piece of information that has been missing so far. All this information is crucial for establishing strategies to restore degraded areas, which includes not only the recovery of species but the restoration of the interactions between the plants and their pollinators.

Based on the structured data, it was possible to evaluate the potential impact of climate changes on the bees that occur at Carajás. These species represent approximately 80% of all species reported for the State of Pará and, therefore, are a useful reference for the potential impact of the ongoing climate change on the bee communities in the region. The results suggest that more than 85% of the species at Carajás may not find appropriate habitats in the future. This effect is more significant for species known to pollinate crops as well as for species with very restricted geographic distribution. However, some regions show a more stable climate situation, particularly areas to the west and north of Carajás. These regions may be considered climatic refuges that will be key to protect native species in the future.

Moreover, we tried to determine the ecosystem service value of pollination by bees in the State of Pará. For this, we analysed crops in various municipalities of the state, many of which depend to a high degree on bees for their productivity. Some of the plants are particularly important for the economy of the municipalities, such as açaí, which yields hugely high profits and depends on bee pollination. Studies like these are essential to understand the benefits of the bee species for regional food production.

The second line of activities concerning the bees of Carajás is the rescue of bee nests in areas where the native vegetation is being removed, authorised by the law of enterprise development. The support provided by the biological material compiled in the present volume will be crucial for identifying the rescued bee species, many of which are little known. It will form the foundation of new studies on bee diversity and bee products in the Amazon. Currently, species preselected for high honey production are used as matrices in a program on increasing the income of local communities.

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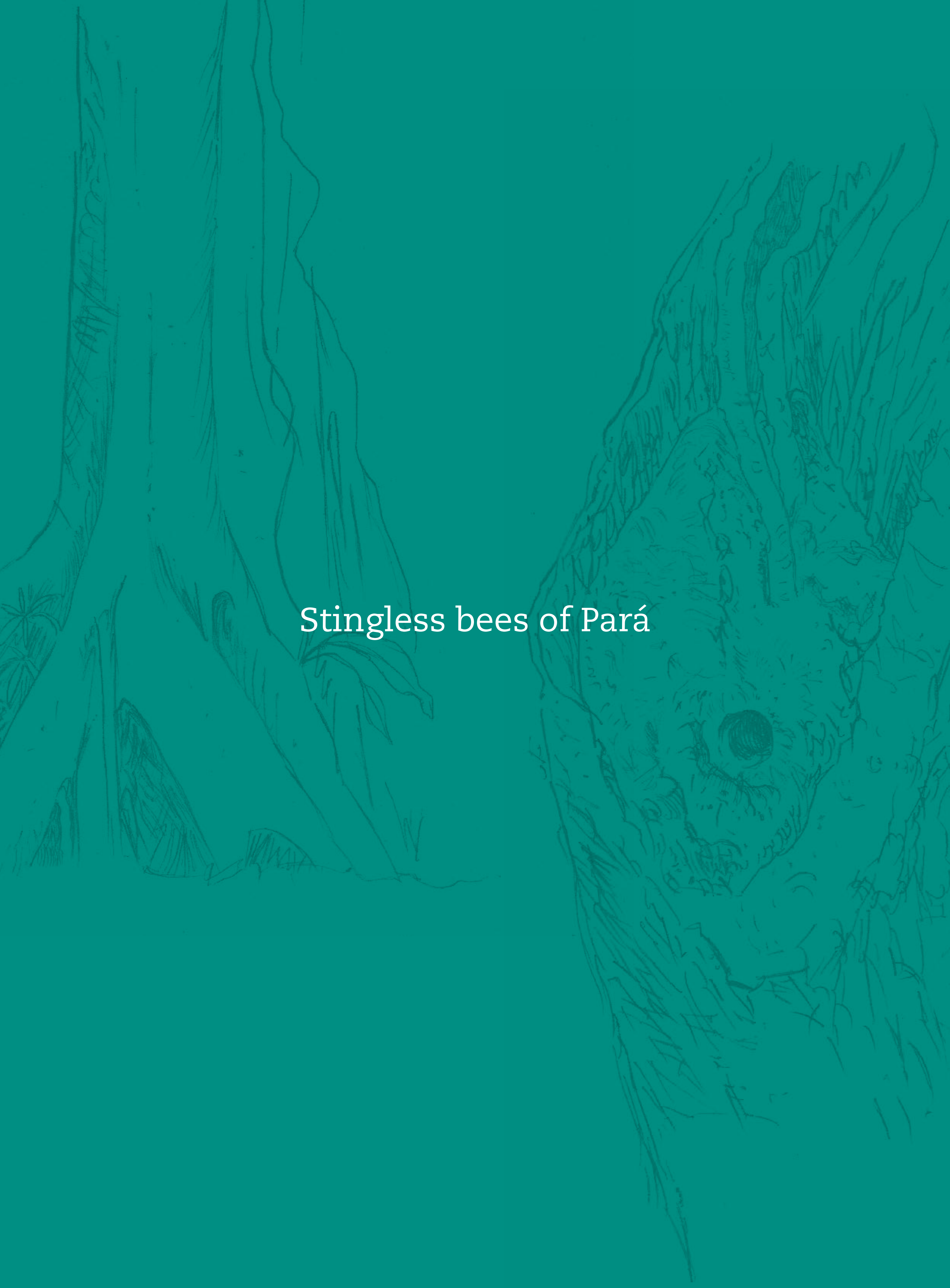


Stingless bees of Pará

Scientific collaboration between the Instituto Tecnológico Vale – Desenvolvimento Sustentável (ITV-DS) and the Coleção Entomológica "Prof. J. M. F. Camargo" enabled the retrieval of photographic material and the reorganization of this collection. The photographs of bees and nests shown below represent part of the holdings of Coleção Entomológica "Prof. J. M. F. Camargo".

To facilitate your reading...

Trichotrigona extranea

species name

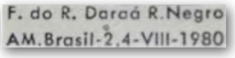
Camargo & Moure, 1983

Name(s) of the author(s) and year of publication

The scientific research that pursues the classification of biological diversity is called Taxonomy. The taxonomic practice involves the designation of some specimens representing each species to have a very special role. These specimens are called **types** and the set of type specimens is called a **type series**. In the process of describing a new species, scientists designate one or more specimens to compose the type series. This process guarantees confidence regarding the association between the scientific concept of species recognized by science and specimens preserved in scientific collections and archives. Type specimens such as *holotypes*, *paratypes*, and *paralectotypes* are therefore very relevant in the process of describing and interpreting the biological diversity.

Occurrence map

Origin and identification labels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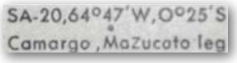
AM.Brasil-2,4-VIII-1980

1st label: locality and date of collection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Camargo ,MaZucoto leg

2nd label: geographical coordinates for the collection site and name of the collector(s)


HOLOTIPO
Trichotrigona extranea
Camargo & Moure

3rd label (for type specimen): holotype, paratype or paralectotype, species name and author(s) name. Different colours are used to indicate the type specimen

The number and shape of the labels may vary, but the key information is the location, date, collector(s) and the taxonomic identity of the specimen.

Genus

Aparatrigona Moure, 1951

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

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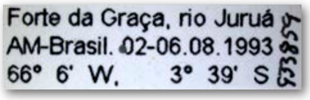
Aparatrigona impunctata (Ducke, 1916)

Common name:
mosquito-cupira.

Small bees (4.3 mm body length) that pollinate cupuaçu (*Theobroma grandiflorum*) and acapu (*Vouacapoua americana*) flowers and visit Brazil nut (*Bertholletia excelsa*) flowers.


Forte da Graça, rio Juruá
AM-Brasil. 02-06.08.1993
66° 6' W, 3° 39' S
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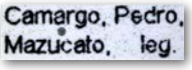

Camargo, Pedro,
Mazucato, leg.

Colony within active termite nest in tarumã trunk, located at a height of 3 m. • Habitat: Old *capoeira* on *terra fime* • Carauari, Rio Juruá, AM • 23/07/1979

Small nest entrance, which allows the passage of only one bee at a time • Habitat: Old *capoeira* in *terra firme*, wood • Carauari, Rio Juruá, AM • 23/07/1979

The nest is housed inside an active termite nest in a pre-existing hollow and it is surrounded by a thin layer of involucrum. Brood cells are arranged into horizontal combs, and royal cells of much larger size are built at the margins of these combs. Honey and pollen are stored in egg-shaped pots.

Genus
Celetrigona Moure, 1950

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Camargo JMF, Pedro SRM (2009) Neotropical Meliponini: the genus *Celetrigona* Moure (Hymenoptera: Apidae, Apinae). Zootaxa 2155: 37-54.

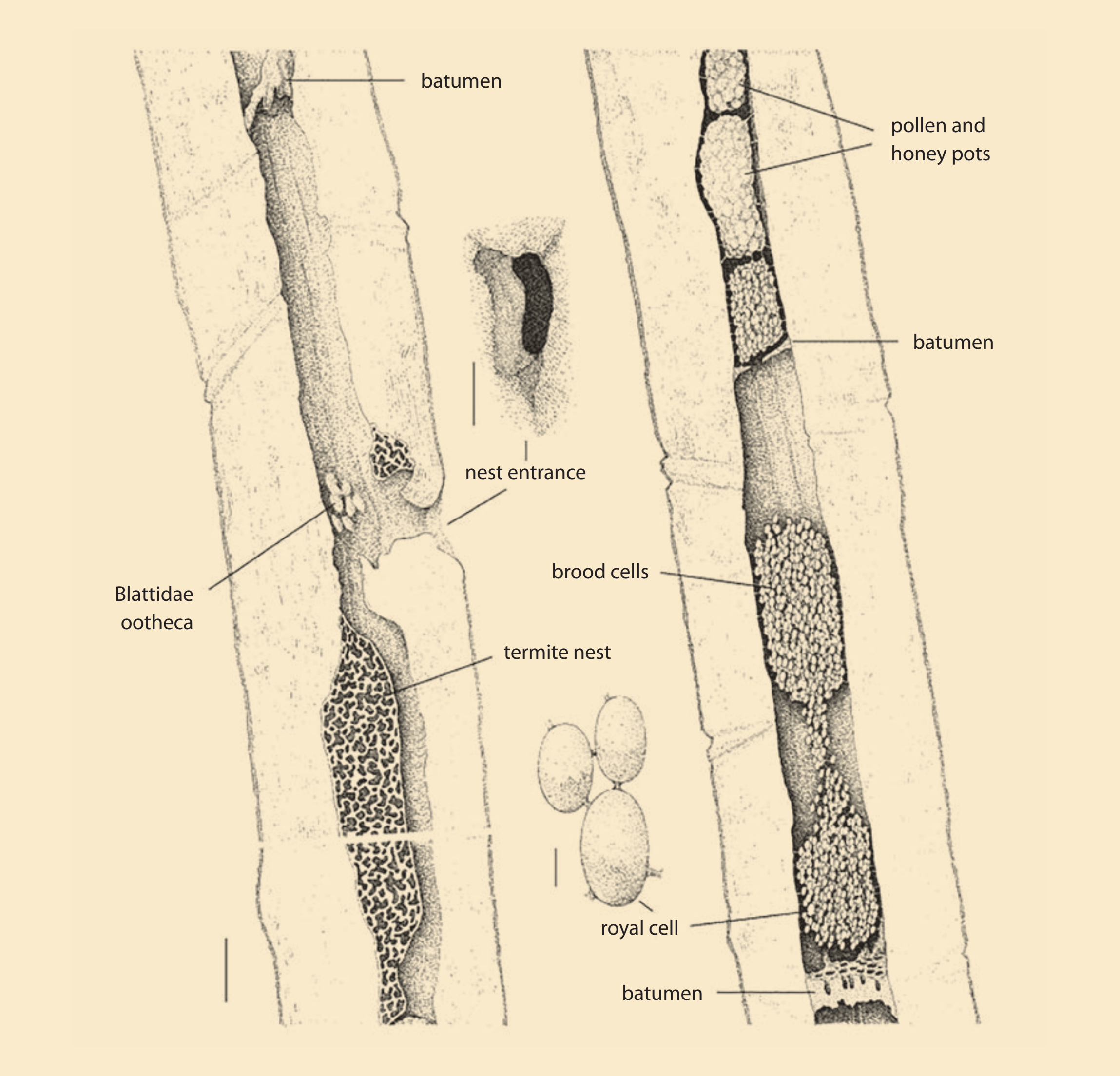
Celetrigona longicornis (Friese, 1903)

Common name: abelha-formiga.
This is a genus of small bees (3.5–4.3 mm body length). Found in Carajás, PA.


Barra do Garças
MT. BRASIL

10·24·I· 1971
Col. Camargo

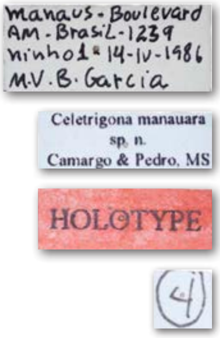
Celetrigona
longicornis
(Friese, 1903)
Det. Camargo 1977



Source: Camargo JMF, Pedro SRM (2009) Neotropical Meliponini: the genus *Celetrigona* Moure (Hymenoptera: Apidae, Apinae). Zootaxa 2155: 37-54.

Celetrigona manauara Camargo e Pedro, 2009

Worker body length is 3.4 mm. *Manauara* means born in Manaus.



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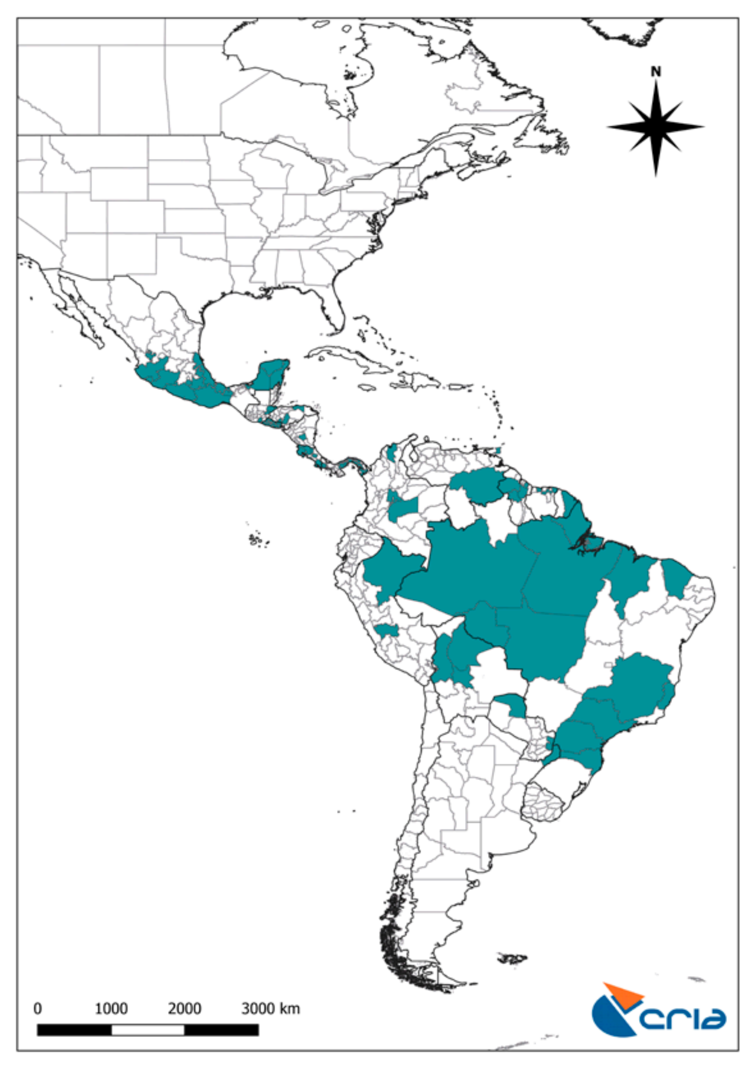
AM - Brasil - 1239
ninho 1ª 14-IV-1986
M.V.B. Garcia

Celetrigona manauara
sp. n.
Camargo & Pedro, MS

HOLOTYPE

(4)

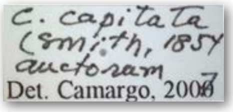
Genus
Cephalotrigona Schwarz, 1940

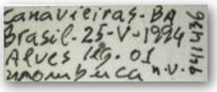


Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Cephalotrigona capitata (Smith, 1854)

Common names: abelha papa-terra, mombucão, quare negra, mombuca, eiruzu, mergrito, eiruzu grande. Has a wide geographical distribution. Its nests are found within live tree cavities, where large quantities of honey is stored. Medium-sized bees (8.6 mm body length) are very gentle. Pollinates annato (*Bixa orellana*) flowers and visits coffee (*Coffea arabica*) and sunflower (*Helianthus annuus*) flowers.


C. capitata
(Smith, 1854
auctoram 7
Det. Camargo, 2006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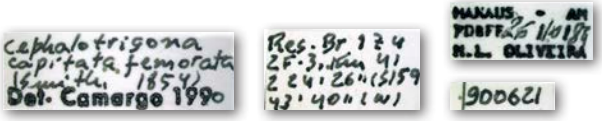
941436

Cephalotrigona femorata (Smith, 1854)

Common names: mombucão-da-Amazônia, língua de Einstein. Nests within hollow trees in *terra firme* forest. Nest entrance with a tongue-like projection. Large horizontal brood combs, nearly 22 cm in diameter. Medium-sized bees (10.3 mm body length). Visits Brazil nut (*Bertholletia excelsa*) flowers.



cephalotrigona
capitata femorata
(Smith, 1854)
Det. Camargo 1990

Res. Br 174
ZF-3, km 41
2°24'26"(S)59
43'40"(W)

MANAUS - AM
PDBFF 25 1/0 18
M.L. OLIVEIRA

900621

Genus
Dolichotrigona Moure, 1950

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

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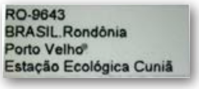
Dolichotrigona longitarsis (Ducke, 1916)

Common name: lambe-olhos. Workers are small (3.6 mm body length). When workers face predation at their nest, a cloud of defending bees attack, flying into the nose, ears and eyes. Other defensive mechanism includes caustic secretions left by dead workers, that cause irritation to the eyes.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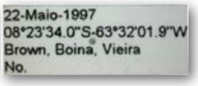
BRASIL.Rondônia
Porto Velho
Estação Ecológica Cuniã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08°23'34.0"S-63°32'01.9"W
Brown, Boina, Vieira
No.

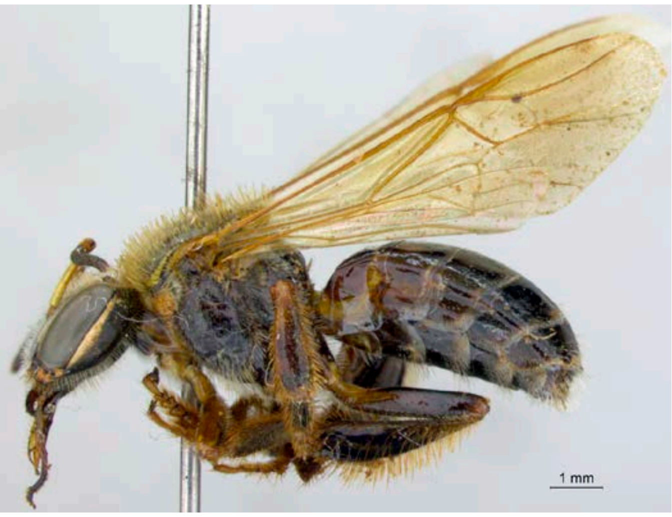

Dolichotrigona
longitarsis
(Ducke, 1916)
Det. Camargo, 2004

Genus
Duckeola Moure, 1944

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Duckeola ghilianii (Spinola, 1853)

Medium-sized bees (7–10 mm body length). Although very gentle, it is the only stingless bee species that fights back against the obligate robber bee *Lestrimelitta*.




JANAUCA
Manaus-AM

BRASIL
XII-.1975
V.P. Araújo-leg

27

T. (Duckeola)
ghilianii
(Spinola)
Det. Camargo, 1976

Nest entrance with yellow resin. Nest within a hollow of a dry "cumari" trunk. • Habitat: *roçado* (traditional cultivated areas), *terra firme*, margin on the Maraã side • Maraã, Japurá River, AM • 18/08/1980

The nest occupied a hollow tree with 4 m in length and 10 cm in width. Generally, colonies are composed by thousands of workers. The brood area is large (65 cm in length and 10 cm in diameter) and is not surrounded by involucrum layers. Cerumen pillars are used as anchors of nest elements, extending to the cavity walls.

Nest within a hollow of a dry trunk • Habitat: Old *igapó*, *terra firme* margin, tall trees • Ponta do Gavião, Rio Negro, AM • 31/07/1999

Nest with many food pots, which can store more than 3 litres of honey. The mass-compacted food pots have twinned walls, and are composed by dark brown cerumen.

Brood cells are more or less spherical (10 mm in length and 7 mm in diameter) arranged into horizontal combs, regularly spaced by 5–10 mm.

Habitat: *Roçado*, *terra firme*, margin on the Maraã side • Maraã, Rio Japurá, AM • 18/08/1980

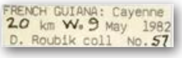
Genus

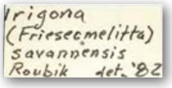
Frieseomelitta Ihering, 1912

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Frieseomelitta flavicornis (Fabricius, 1798)

Common names: marmelada amarela mais mansa, branca.
Nests in live trees.
Visits tomato (*Solanum lycopersicum*) flowers.

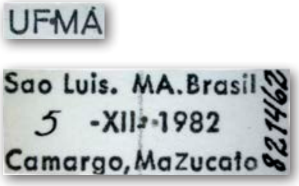

FRENCH GUIANA: Cayenne
20 km W. 9 May 1982
D. Roubik coll No. 57


Trigona
(Frieseomelitta)
savannensis
Roubik det. '82

Nest in a live tree cavity. • Habitat: *Terra firme* forest, *roçado* edge • São Jorge, Rio Negro, AM • 26/06/1999

Egg-shapped food pots (2.0 x 1.3 cm) removed from a nest within a live tree cavity. • Habitat: *Terra firme* forest, *roçado* edge • São Jorge, Rio Negro, AM • 26/06/1999

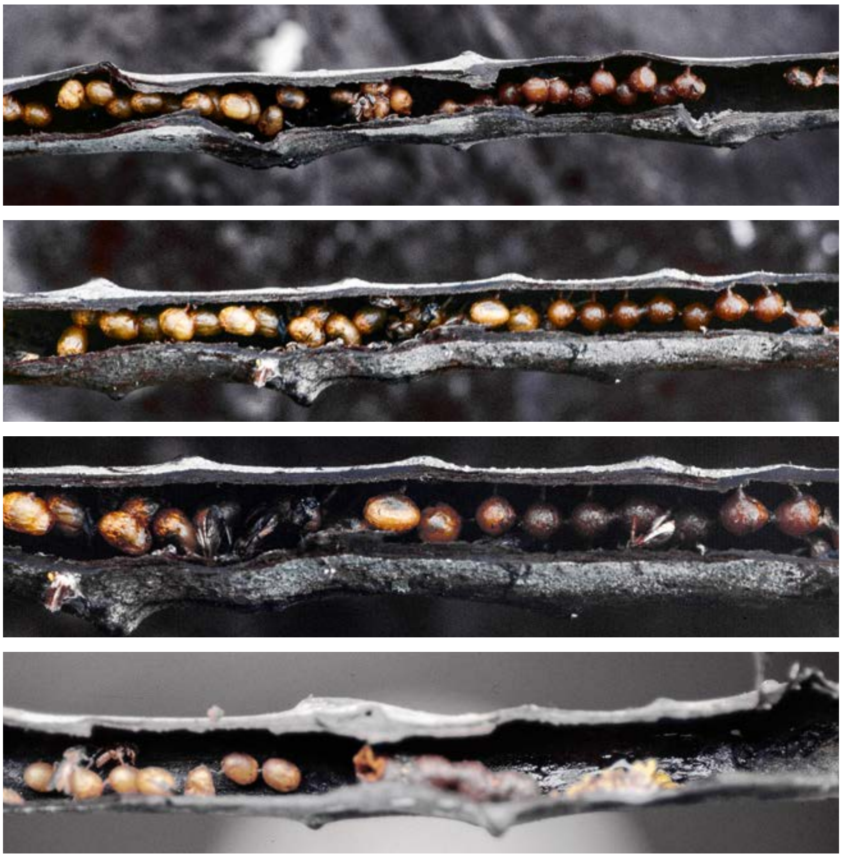
Frieseomelitta portoi (Friese, 1900)


UFMA

Sao Luis. MA.Brasil
5 -XII-1982
Camargo, MaZucato
821462

A single hollow in a dry embauba trunk houses three nests. Nest entrance with 2 mm in diameter. The bees are aggressive, flying fast and into the hair. • Habitat: *Capoeira*, *terra firme* • Igarapé-Açu, Rio Negro, AM 07/08/1999

Nest in a dry *cipó-ambé*. • Habitat: *Igapó* forest, island bank • Santa Isabel do Rio Negro, AM • 12/07/1999

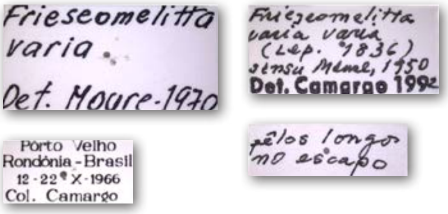


Clustered brood cells inside a nest in a very thin vine, with 1.8 cm in diameter.

Food pots inside the nest in a very thin vine.

Frieseomelitta trichocerata Moure, 1990

Medium-sized bees (6 mm body length). Establishes new nests in decomposing logs, in sunny locations, such as *roçados*, *igapós* and the margins of blackwater lakes. Visits Brazil nut (*Bertholletia excelsa*) flowers.



Frieseomelitta
varia
Det. Moure-1970

Frieseomelitta
varia varia
(Lep. 1836)
sensu Moure, 1950
Det. Camargo 1992

Pôrto Velho
Rondônia - Brasil
12 - 22 X - 1966
Col. Camargo

pêlos longos
no escapo

Entrance of nest housed in a dead *marimari* tree cavity. • Habitat: *Igapó*, at the boundary with *terra firme* • Igapó Jaraqui, Rio Juruá, AM • 27/07/1993

Clustered brood cells • Habitat: Dense forest, lowlands, plateaus • Santa Maria do Boiaçu, RR • 19-20/08/1980

Genus

Geotrigona Moure, 1943

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Camargo JMF, Moure JS (1996) Meliponini Neotropicais: o gênero *Geotrigona* Moure, 1943 (Apinae, Apidae, Hymenoptera), com especial referência à filogenia e biogeografia. Arquivos de Zoologia 33: 95-161.

Geotrigona aequinoctialis (Ducke, 1925)

Common name: mombuca. Body length is 5.0–5.4 mm and head width measures 2.44 mm. Body with bright colour.

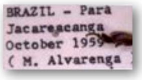

UFMA

Sao Luis: MA.Brasil
21-III 1982
Mazucato,Camargo
782028

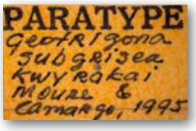
Geotrigona
aequinoctialis
(Ducke, 1925)
Det. Camargo 1994

Geotrigona kwyrakai Camargo & Moure, 1996

Body length is 5.56 mm and head width measures 2.48 mm.



BRAZIL - Para
Jacareacanga
October 1959
(M. Alvarenga)



PARATYPE
Geotrigona
subgrisea
kwyrakai
Moure &
Camargo, 1995

Geotrigona mattogrossensis (Ducke, 1925)

Body length is 5.2 mm and head width measures 2.32–2.56 mm, in specimens collected in Muçum, PA (labels mention Mussum), near the Rio Tapajós.


Mussum — Rio Tapajós
PA. Brasil

151c(T-37)

SA-21,55°25'W;3°40'S
24,28-1-1979. Camargo

Geotrigona ☿
mattogrossensis
(Ducke, 1925)
Det. Moure 19

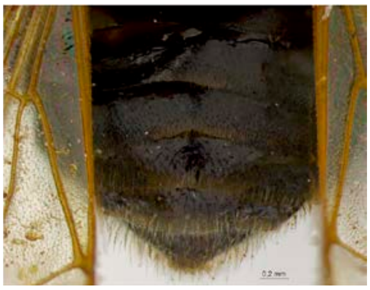
Timid bees that do not attack the observer.

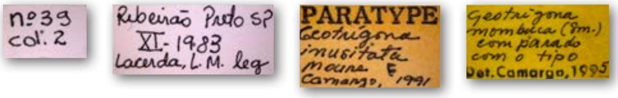
In the immediate vicinity of *G. mattogrossensis* nest, either termite or ant nests were absent. The stingless bee nest was surrounded by a multilayered black involucrum. Thinner layers of involucrum involved the brood area, composed by 14 spiral combs (the largest comb was 8 cm in diameter). Honey pots measured 7.0–9.0 cm in height and 1.7 cm in diameter.

Underground nest • Habitat: Terrace forests, Brazil nut stand • Mussum, 15 km S Aveiro, PA • 24-28/01/1979

Geotrigona mombuca (Smith, 1863)

Common names: guira, guiruçu, iruçu-mineiro. Body length is 5.4 mm and head width measures 2.48 mm. Timid bees that do not attack the observer. Nests are underground. Visits cotton (*Gossypium hirsutum*) flowers.





nº39
col. 2

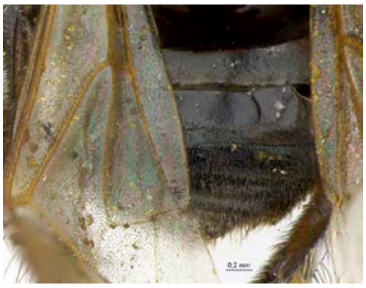
Ribeirão Preto SP.
XI-1983
Lacerda, L.M. leg

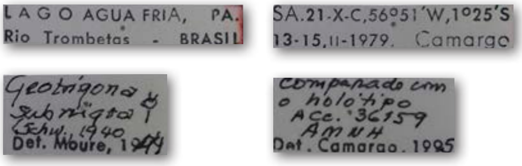
PARATYPE
Geotrigona
inusitata
Moure &
Camargo, 1991

Geotrigona
mombuca (Sm.)
com parado
com o tipo
Det. Camargo, 1995

Geotrigona subnigra (Schwarz, 1940)

Body length is 5.23 mm and head width measures 2.36 mm. Nesting habits are unknown.




LAGO AGUA FRIA, PA.
Rio Trombetas - BRASIL

SA.21-X-C,56°51'W,1°25'S
13-15,II-1979. Camargo

Geotrigona ♀
subnigra
Schw. 1940
Det. Moure, 1944

comparado com
o holótipo
Acc. 36159
AMNH
Det. Camargo. 1995

Genus

Lestrimelitta Friese, 1903

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Marchi P, Melo GAR (2006) Revisão taxonômica das espécies brasileiras de abelhas do gênero *Lestrimelitta* Friese (Hymenoptera, Apidae, Meliponina). Revista Brasileira de Entomologia 50: 6-30.

Lestrimelitta monodonta Camargo & Moure, 1989

Common name: limão. Body length is 6.08 mm and head width measures 2.16 mm. Workers produce a strong lemon-like odour (citral), when they attack nests of other stingless bee species. During attack, this odour causes retreat of host species and *L. limao* successfully conquer the nests.

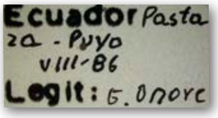
Ilha de Maracá - RR
Brasil 5-10/10/1987
Lucio A.O. Campos
Marcos V. B. Garcia

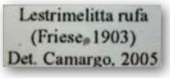
HOLOTYPE
Lestrimelitta
monodonta
Camargo &
Moure, 1988

Nest within a hollow tree • Habitat: Tall *terra firme* forest • Ponta do Gavião, Rio Negro, AM • 30/07/1999

Lestrimelitta rufa (Friese, 1903)

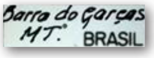
Body length is 7.05 mm and head width measures 2.3 mm.

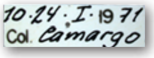

Ecuador Pasta
za - Puyo
VIII-86
Legit: G. Onore


Lestrimelitta rufa
(Friese, 1903)
Det. Camargo, 2005

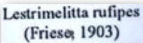
Lestrimelitta rufipes (Friese, 1903)

Common names: limão, iraxim. Body length is 7.25 mm and head width measures 2.28 mm. Nests within living trees that sometimes are shared with other stingless bee species.


Barra do Garças
MT. BRASIL


10.24 · I · 1971
Col. Camargo


Lestrimelitta
limão
(Smith, 1863)
Det. Camargo 1979


Lestrimelitta rufipes
(Friese, 1903)
Det. Camargo, 2005

Lestrimelitta rufipes

Nest entrance in a live tree cavity. • Habitat: Cerrado, *vereda* margin • Mateiros, TO • 10-12/07/1995

Nest within a hollow tree • Habitat: Dense forest, lowlands, plateaus • Acanga, Rio Negro, AM • 06-08/08/1980

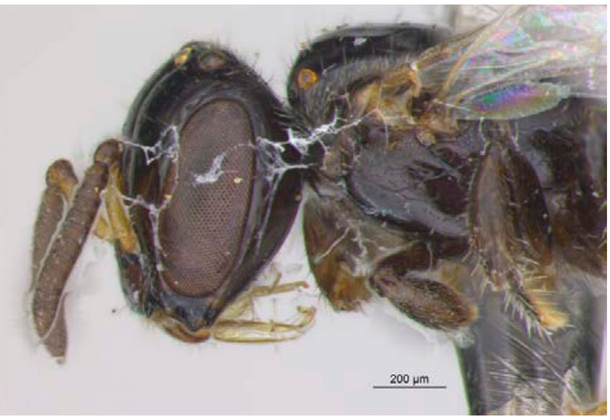
Genus

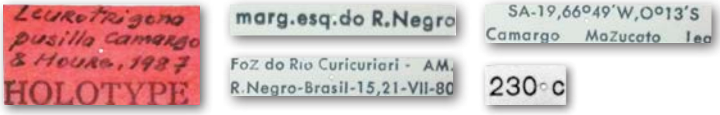
Leurotrigona Moure, 1950

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Leurotrigona pusilla Moure & Camargo, 1988

Common name:
lábios de morena.
Its nests are found in small cavities built by Cerambycinae beetles, and by termites in dry wood, wooden poles and building walls. Pollinates cupuaçu (*Theobroma grandiflorum*) flowers.





Leurotrigona
pusilla camargo
& Moure, 1987
HOLOTYPE

marg.esq.do R.Negro

Foz do Rio Curicuriari - AM.
R.Negro-Brasil-15,21-VII-80

SA-19,66°49'W,0°13'S
Camargo MaZucato lea

230 c

Nest within a building wall • Habitat: Forest, sub-montane, dissected relief • Mouth of the Rio Curicuriari, AM • 15-21/07/1980

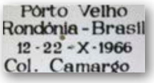
Genus
Melipona Illiger, 1806

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

(In this map, the geographic distribution of the genus *Melipona* corresponds to countries – not states or provinces, as shown for other stingless bee genera in this work)

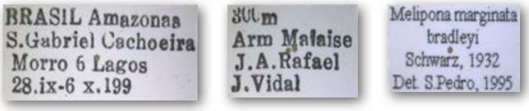
Melipona (Eomelipona) amazonica Schulz, 1905

Among the species of the genus *Melipona*, this is considered one of the smallest bees. Nests in pequi tree (*Caryocar* sp.) cavities. Visits açaí (*Euterpe oleracea*) flowers.


Pôrto Velho
Rondônia - Brasil
12 - 22 - X - 1966
Col. Camargo


M. marginata
amazonica Schulz
Det. Camargo 1979

Melipona (Eomelipona) bradleyi Schwarz, 1932

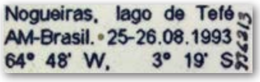


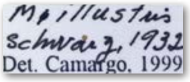
BRASIL Amazonas
S.Gabriel Cachoeira
Morro 6 Lagos
28.ix-6 x.199

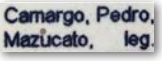
300m
Arm Malaise
J.A.Rafael
J.Vidal

Melipona marginata
bradleyi
Schwarz, 1932
Det. S.Pedro, 1995

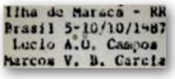
Melipona (Eomelipona) illustris Schwarz, 1932

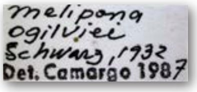

Nogueiras, lago de Tefé
AM-Brasil. 25-26.08.1993
64° 48' W, 3° 19' S
976213


M. illustris
Schwarz, 1932
Det. Camargo, 1999


Camargo, Pedro,
Mazucato, leg.

Melipona (Eomelipona) ogilviei Schwarz, 1932


Ilha de Maracá - RR
Brasil 5-10/10/1987
Lucio A.O. Campos
Marcos V. B. Garcia

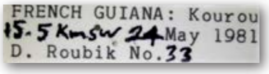

Melipona
ogilviei
Schwarz, 1932
Det. Camargo 1987

Melipona (Eomelipona) ogilviei

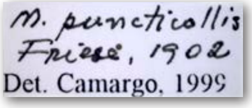
Nest within a hollow tree • Habitat: Dense floodplain forest and flattened relief • Tauari, PA • 29/01/1979

Melipona (Eomelipona) puncticollis Friese, 1902

Common name: uruçu-amarela-preguiçosa.



FRENCH GUIANA: Kourou
15.5 Km SW 24 May 1981
D. Roubik No. 33



M. puncticollis
Friese, 1902
Det. Camargo, 1999

Melipona (Eomelipona) schwarzi Moure, 1963

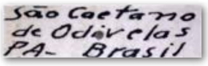

TEFF Am. Br.
1-4-XII 61
F. M. Oliveira.


PARATYPE
Melipona
schwarzi
J. S. Moure 1962

Nest within a hollow tree • Habitat: *Igapó* forest, tall forest, shaded • Ponta do Gavião, Rio Negro, AM • 30/07/1999

Melipona (Melikerria) fasciculata Smith, 1854

Common names: tiúba, tiúba-grande, jandaíra-preta-da-amazônia, ngái-re. Pollinates cassava (*Manihot esculenta*) flowers, camu-camu (*Myrciaria dubia*), bell pepper (*Capsicum annuum*), habanero type pepper (*Capsicum chinense*), tomato (*Solanum lycopersicum*), eggplant (*Solanum melongena*), açaí (*Euterpe oleracea*), annato (*Bixa orellana*) and yellow mombin (*Spondias mombin*).


São Caetano
de Odivelas
PA- Brasil


M. compressipes
fasciculata
Sm. 1854
Det. Camargo 1979

Nest within a pequi tree (*Caryocar brasiliense*, Caryocaraceae) cavity • Habitat: Open cerrado • Krahó Reserve, Galheiros, TO • 18/01/1993

Melipona (Melikerria) interrupta Latreille, 1811

Common names: jandaíra-preta-da-amazônia, jupará. Important species for stingless beekeeping, due to its high honey production and optimized management practices. Visits cotton (*Gossypium hirsutum*) flowers.

VENEZUELA: Zulia, El
Tucuco (51 Km. S.O. de
Machiques).
IV- 1986

MALUZ
HYM
345

Colectores:
E. Inciarte
E. Rubio E.
T. Borrego

M. interrupta
Lat. 1811
Det. Camargo, 2008

Nest within a hollow tree; perforated batumen • Habitat: Floodplain • Santa Maria, Itaituba, PA • 18-20/01/1977

Melipona (Michmelia) flavolineata Friese, 1900

Common names: uruçu-amarela, ira-açu, ngái-kumrenx, mehn-krak-krak-ti. Due to the production of highly appreciated honey, this is one of the most important species for stingless beekeeping in Pará State. Visits açaí (*Euterpe oleracea*), yellow mombin (*Spondias mombin*) and eggplant (*Solanum melongena*) flowers.

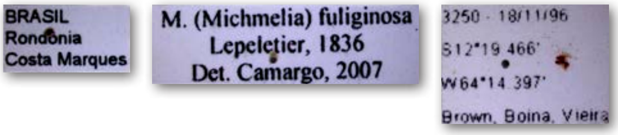
W.E.KERR
830625

SAO LUIS. MA
Brasil.7.v.1983

Melipona rufiventris
flavolineata
Friese, 1900
Det. Camargo 1991

Melipona (Michmelia) fuliginosa Lepeletier, 1836

Common names: uruçu, turucu, mandury-preto, erereú-negra, mel-de-anta, tapii-ei, tapieira. This species does not adapt well to wooden hives. By pillaging nests of other stingless bee species, *M. fuliginosa* can also obtain food.



BRASIL
Rondonia
Costa Marques

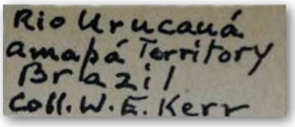
M. (Michmelia) fuliginosa
Lepeletier, 1836
Det. Camargo, 2007

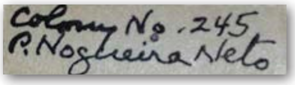
3250 - 18/11/96
S12°19.466'
W64°14.397'
Brown, Boina, Vieira

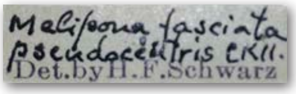
Melipona (Michmelia) fuliginosa

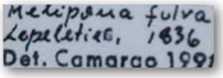
Nest within a live tree cavity • Habitat: *Terra firme* forest, Brazil nut stand, shaded tall forest • Tapera, Caurés, Rio Negro, AM • 27/07/1999

Melipona (Michmelia) fulva Lepeletier, 1836


Rio Urucauá
amapá Territory
Brazil
Coll. W. E. Kerr


Colony No. 245
P. Nogueira Neto

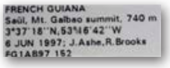

Melipona fasciata
pseudocentris Ckll.
Det. by H. F. Schwarz


Melipona fulva
Lepeletier, 1836
Det. Camargo 1991

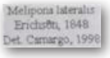
Nest within a hollow tree • Habitat: Dense forest, plateau • Lago Carimum, PA • 16-17/02/1979

Melipona (Michmelia) lateralis Erichson, 1848

Visits Brazil nut (*Bertholletia excelsa*) flowers.


FRENCH GUIANA
Saül, Mt. Galbao summit, 740 m
3°37'18''N,53°16'42''W
6 JUN 1997; J.Ashe,R.Brooks
FG1A897 152

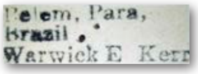

SM0103061
KUNHM-ENT

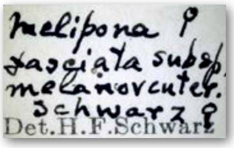

Melipona lateralis
Erichson, 1848
Det. Camargo, 1998

Nest within yellow mombin tree cavity • Habitat: Transitional forest • Catrimani, Rio Branco, RR • 18/08/1980

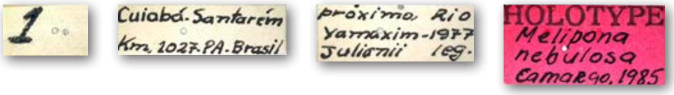
Melipona (Michmelia) melanoventer Schwarz, 1932

Common name: menhirê-udjà. Visits eggplant (*Solanum melongena*) and annato (*Bixa orellana*) flowers.


Belem, Para,
Brazil.
Warwick E Kerr


melipona ♀
fasciata subsp.
melanoventer.
Schwarz ♀
Det. H. F. Schwarz

Melipona (Michmelia) nebulosa Camargo, 1988



1

Cuiabá. Santarém
Km. 1027. PA. Brasil

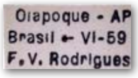
próximo Rio
Yamaxim - 1977
Julianii leg.

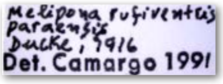
HOLOTYPE
Melipona
nebulosa
Camargo, 1985

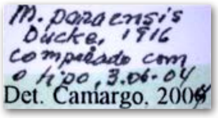
Nest within a live *puleiro de pato* tree cavity, at 9 m above the ground • Habitat: *Igapó* forest, shaded • Grate Forte, Rio Juruá, AM • 08/08/1993

Melipona (Michmelia) paraensis Ducke, 1916

Common names: uruçu-boca-de-ralo, i-tekere.
Visits acerola (*Malpighia punicifolia*) flowers.


Oiapoque - AP
Brasil - VI-59
F.V. Rodrigues


Melipona rufiventris
paraensis
Ducke, 1916
Det. Camargo 1991


M. paraensis
Ducke, 1916
comparado com
o tipo, 3.06.04
Det. Camargo, 2004

Nest within a hollow tree • Habitat: *Igapó* forest • Ponta do Gavião, Rio Negro, AM • 30/07/1999

Nest within a hollow tree • Habitat: *Terra firme* forest, Brazil nut stand • Maraã, Rio Japurá, AM • 19/08/1993

Melipona (Michmelia) seminigra Friese, 1903

Visits yellow mombin (*Spondias mombin*) and eggplant (*Solanum melongena*) flowers.


Rio Trairão. PA – Brasil
(50 km NE Gradaús)

SB-22,51º49'W,7º21'S
21,24-VII-79. Mazucato

Melipona seminigra
pernigra
Moure & Kerr, 1950
Det. Camargo 199

M. seminigra seminigra Friese, 1903 • Nest entrance in an *envirola* tree cavity • Habitat: Dense forest, lowlands • Igapó Castanho, Rio Branco, RR • 21/08/1980

M. seminigra seminigra Friese, 1903 • Nest entrance in a live *mapatirana* tree cavity • Habitat: *Terra firme* forest • Maraã, Rio Japurá, AM • 18/08/1993

M. seminigra abunensis Cockerell, 1912 • Nest entrance in a live *itaubarana* tree cavity at 4 m above the water level • Habitat: *Igapó* (lago Jacaré) • Arimã, Purus, AM • 08/02/1986

Melipona (Michmelia) seminigra

M. seminigra pernigra Moure & Kerr, 1950 • Nest wihthin a hollow tree, at 4 m above the ground • Habitat: *Várzea* forest, margin of the Rio Fresco • Gotire, PA • 05-20/08/1983

M. seminigra seminigra Friese, 1903 • Nest within an *envirola* tree cavity• Habitat: Dense forest, lowlands, plateaus • Santa Maria do Boiaçu, RR • 19-20/08/1980

M. seminigra seminigra Friese, 1903 • Nest within a live *capurana* tree cavity • Habitat: *Igapó* forest • Lago Uará, Rio Solimões, AM • 12/08/1993

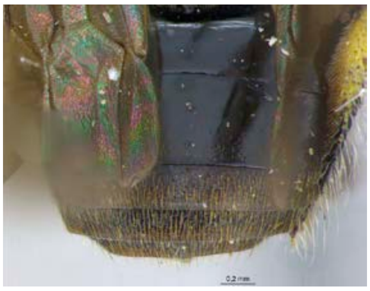
Genus

Nannotrigona Cockerell, 1922

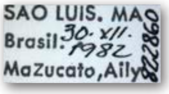
Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Rasmussen C, Gonzalez VH (2017) The neotropical stingless bee genus *Nannotrigona* Cockerell (Hymenoptera: Apidae: Meliponini): An illustrated key, notes on the types, and designation of lectotypes. Zootaxa 4299: 191-220.

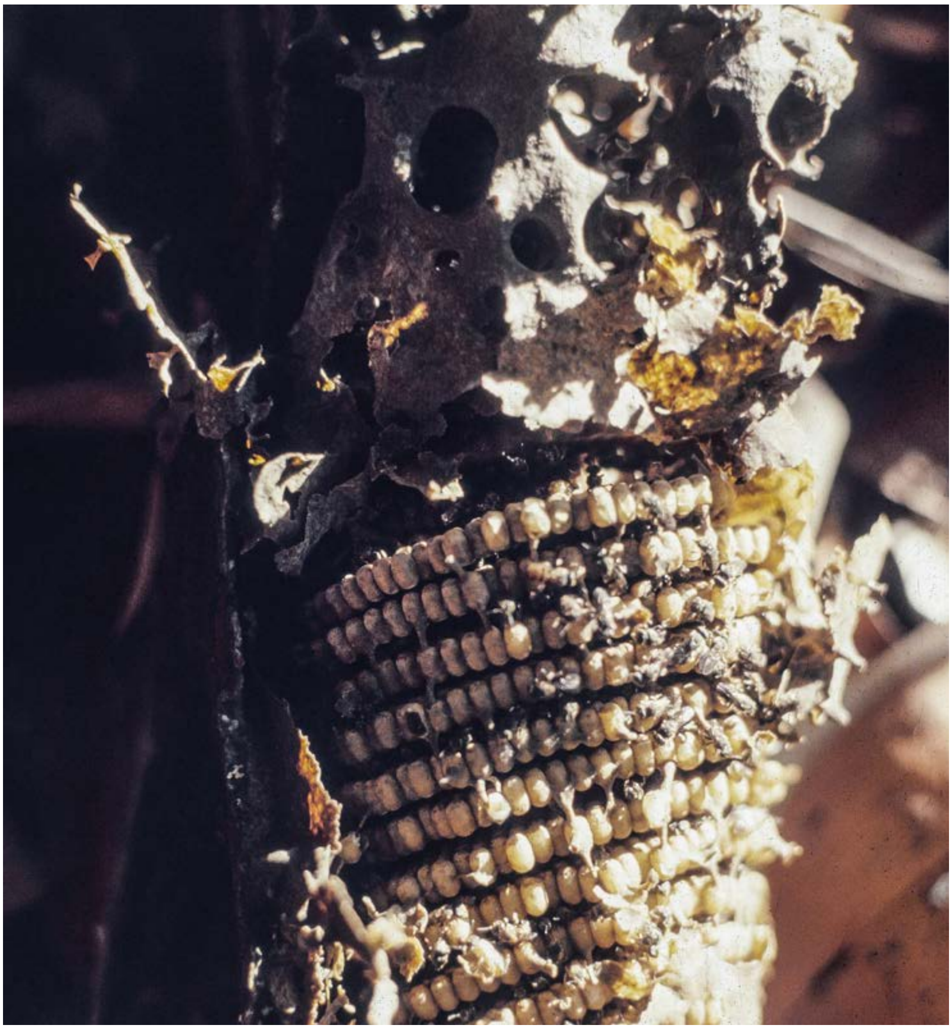
Nannotrigona minuta (Lepeletier, 1836)



🟩 *Nannotrigona minuta*


SAO LUIS. MA
Brasil: 30. XII. 1982
MaZucato, Aily
822860

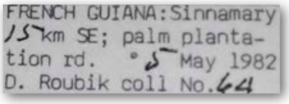
Nest within a hollow tree • Habitat: Cerrado enclave • Alter do Chão, PA • 03-04/02/1979



Nest within a hollow tree • Habitat: Cerrado enclave • Alter do Chão, PA • 03-04/02/1979

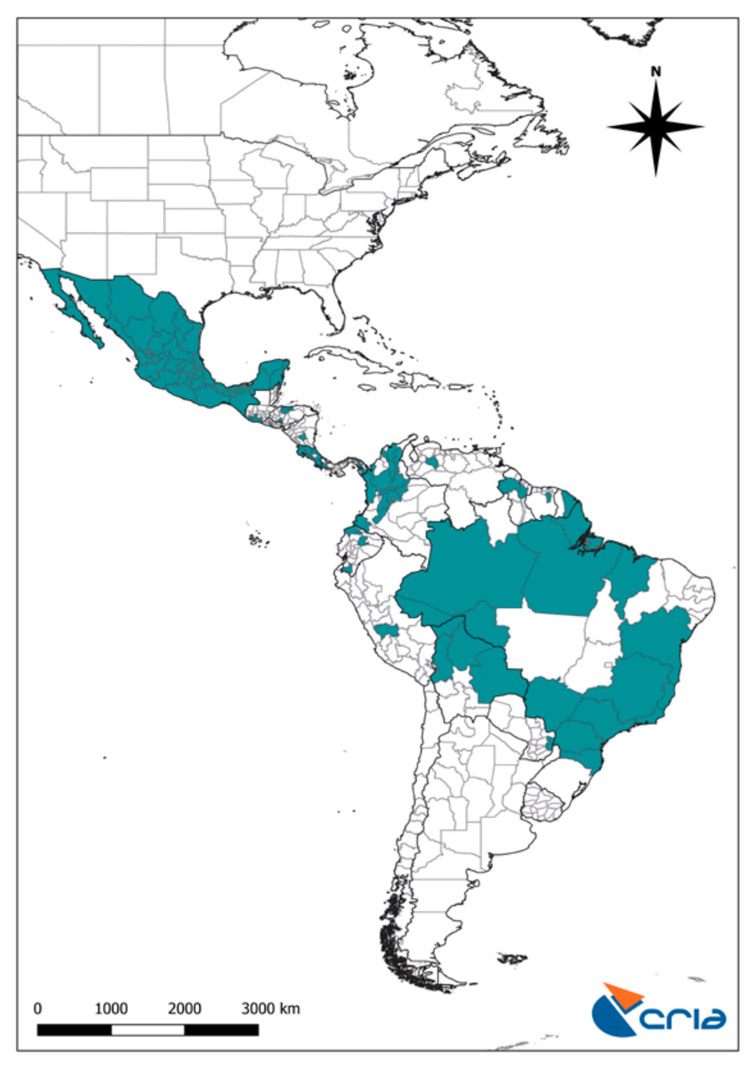
Nannotrigona punctata (Smith, 1854)

Visits murici (*Byrsonima crassifolia*), guava (*Psidium guajava*) and rambutan (*Nephelium lappaceum*) flowers.


FRENCH GUIANA:Sinnamary
15 km SE; palm planta-
tion rd. 5 May 1982
D. Roubik coll No.64

Genus

Oxytrigona Cockerell, 1917



Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Camargo JMF (1984) Notas sobre o gênero *Oxytrigona* (Meliponinae, Apidae, Hymenoptera). Boletim do Museu Paraense Emílio Goeldi 1: 115-124.

Oxytrigona ignis Camargo, 1984

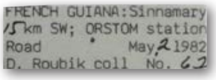
SB-22,51°49'W,7°21'S
21,24-VII-79. MaZucato

Oxytrigona
ignis
Camargo, 1983
HOLOTYPE

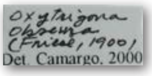
Rio Trairão. PA – Brasil
(50 km NE Gradaús)

Oxytrigona obscura (Friese, 1900)

Common name: sicaé-negra.



FRENCH GUIANA:Sinnamary
15km SW; ORSTOM station
Road May,2 1982
D. Roubik coll No. 62



Oxytrigona
obscura
(Friese, 1900)
Det. Camargo. 2000

Nest within a live tree cavity, at 10 m above
the ground • Habitat: Tall forest, *terra firme* •
Forte da Graça, Rio Juruá, AM • 05/08/1993

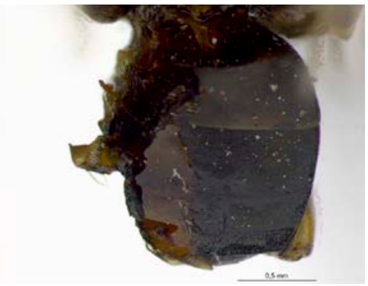
Genus

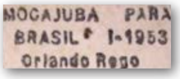
Paratrigona Schwarz, 1938

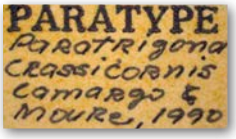
Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Camargo JMF, Moure JS (1994) Meliponini Neotropicais: os gêneros *Paratrigona* Schwarz, 1938 e *Aparatrigona* Moure, 1951 (Hymenoptera, Apidae). Arquivos de Zoologia 32: 33-109.

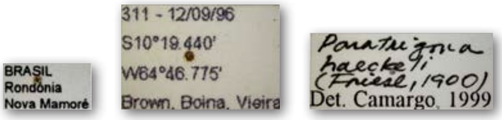
Paratrigona crassicornis Camargo & Moure, 1994




MOCAJUBA PARA
BRASIL 1-1953
Orlando Rego


PARATYPE
Parotrigona
crassicornis
Camargo &
Moure, 1990

Paratrigona haeckeli (Friese, 1900)

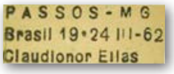

BRASIL
Rondônia
Nova Mamoré

311 - 12/09/96
S10°19.440'
W64°46.775'
Brown, Boina, Vieira

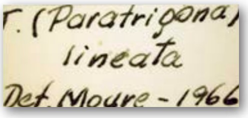
Paratrigona
haeckeli
(Friese, 1900)
Det. Camargo, 1999

Paratrigona lineata (Lepeletier, 1836)

Common name: jataí-da-terra. Visits cotton (*Gossypium hirsutum*), sunflower (*Helianthus annuus*) and tomato (*Solanum lycopersicum*) flowers.



PASSOS-MG
Brasil 19•24 III-62
Claudionor Elias



T. (Paratrigona)
lineata
Det. Moure - 1966

Paratrigona lineatifrons (Schwarz, 1938)

F. do R. Daraá R. Negro
AM. Brasil-2.4-VIII-1980

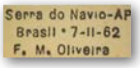
SA-20,64°47'W,0°25'S
Camargo, MaZucato leg

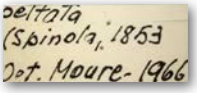
Paratrigona
lineatifrons
(Schwarz, 1938)
Det. Camargo 1980

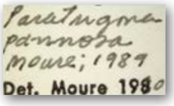
Nest entrance

Nest within an arboreal termite nest • Habitat: Dense forest, transitional area, undulated relief • Mouth of the Rio Daraá, AM • 02-04/08/1980

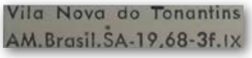
Paratrigona pannosa Moure, 1989

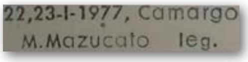

Serra do Navio-AP
Brasil • 7-II-62
F. M. Oliveira

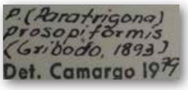

peltata
(Spinola, 1853
Det. Moure - 1966


Paratrigona
pannosa
Moure; 1989
Det. Moure 1980

Paratrigona prosopiformis (Gribodo, 1893)


Vila Nova do Tonantins
AM.Brasil.SA-19.68-3f.IX


22,23-I-1977, Camargo
M.Mazucato leg.


P. (Paratrigona)
prosopiformis
(Gribodo, 1893)
Det. Camargo 1977

Genus

Partamona Schwarz, 1939

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Pedro SRM, Camargo JMF (2003) Meliponini neotropicais: o gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae). Revista Brasileira de Entomologia 47: 1-117.

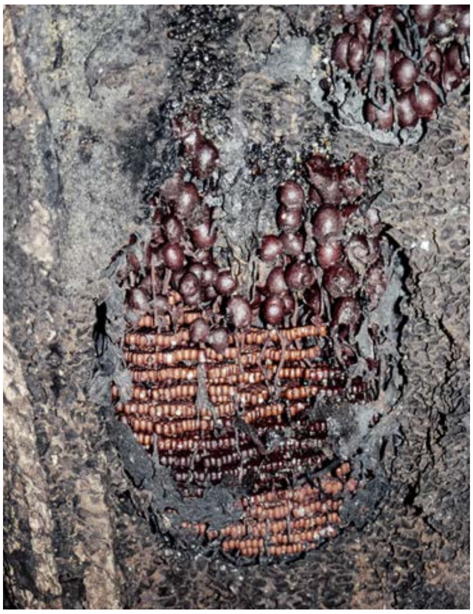
Partamona ailyae Camargo, 1980

COLEÇÃO
CAMPOS SEABRA

TEFÉ
Amazonas Brasil
IX-1959
R. Carvalho

DZUFP

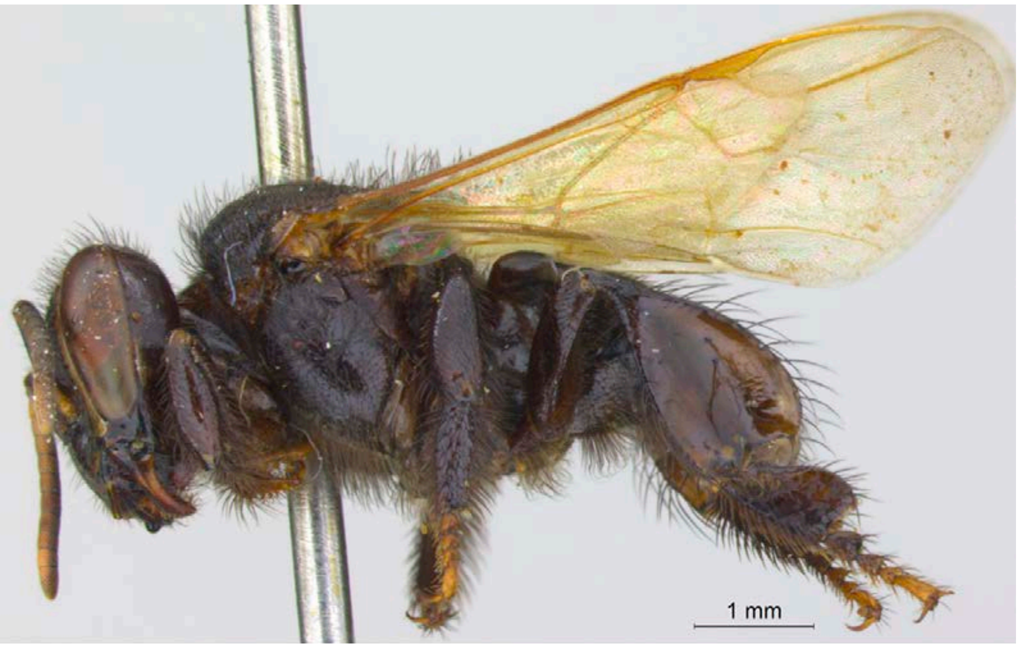
Partamona ailyae
Camargo, 1980
Det. S. Pedro, 1996

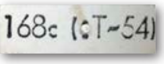


Nest within an active termite nest in dry, rotten trunk • Habitat: *Terra firme* forest – at 30 to 40 m above the ground • Maraã, Rio Japurá, AM • 17/08/1993

Nests: in a termite nest in a rotten trunk **(A)**; in a trunk of a live Brazil nut tree **(B)**; under tree trunk (underground nest) **(C)**; above the ground **(D)**. Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona auripennis Pedro & Camargo, 2003




168c (CT-54)


GENETICA
F.M. R.PRETO


TAUARI, PA.
Rio TAPAJÓS Brasil
SA.21-55°7'W;3°5'S
29-I,1-II-79.Camargo


HOLOTYPE
Partamona
auripennis Pedro
& Camargo,1988

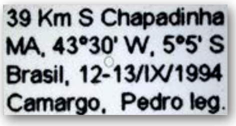
Nest within an abandoned arboreal termite nest (in an *igarapé* [typical watercourse of the Amazon region]) • Habitat: Dense floodplain forest and flattened relief • Tauari, PA • 01-01/29/1979

Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona chapadicola Pedro & Camargo, 2003

Common name:
boca-de-barro.


665c


39 Km S Chapadinha
MA, 43°30' W, 5°5' S
Brasil, 12-13/IX/1994
Camargo, Pedro leg.


HOLOTYPE


HOLOTYPE
Partamona
chapadicola Pedro
& Camargo, 1988

Nest entrance in a hollow tree (possibly along with a termite nest) • Habitat: Cerrado, plateau • Chapadinha, 39 km, MA • 13/11/1994

Nest entrance at the base of live tree trunk, at 50 cm above the ground • Habitat: Open cerrado • Krahó Reserve, Galheiros, TO • 18/01/1993

Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona combinata Pedro & Camargo, 2003

Common names:
ngài-kàk-ñy, myre-ti, hasi-mane-bakuki.
Visits cucurbit (*Cucurbita* spp.) flowers.

4c·

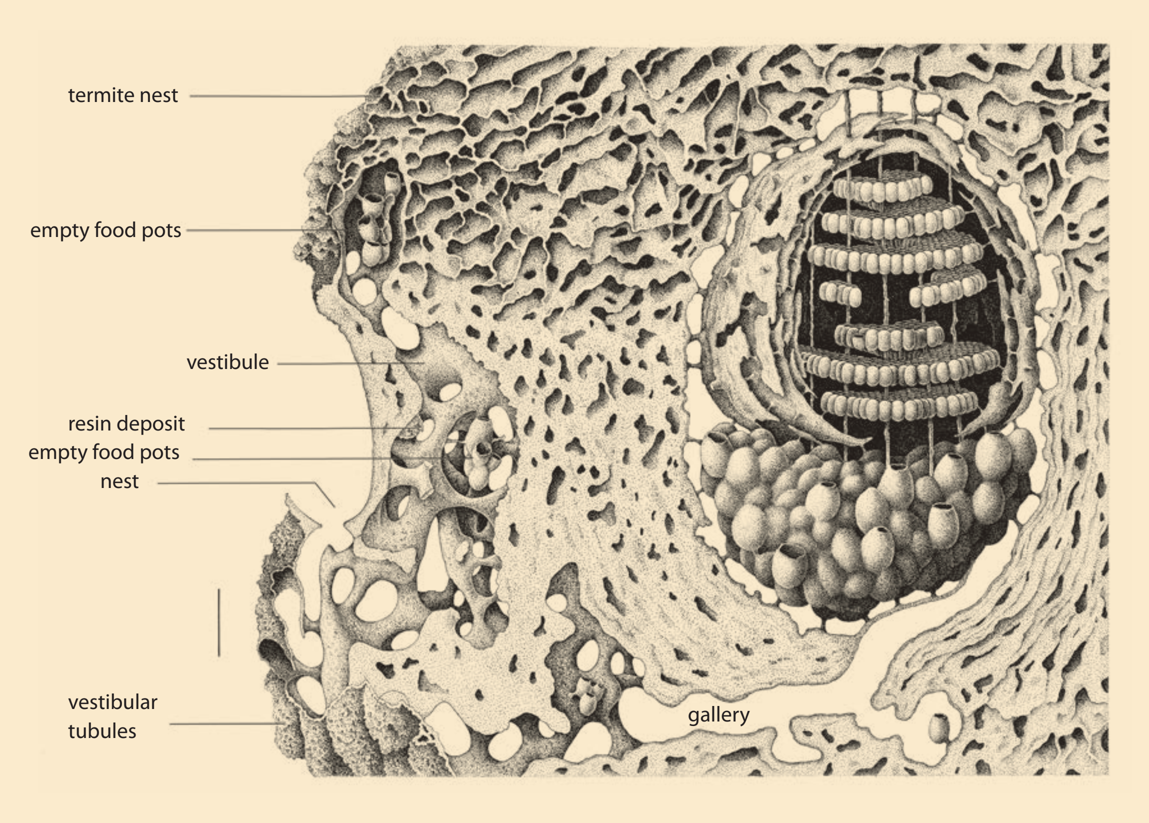
GENÉTICA
F.M.R.PRETO

Barra do Garças
MT. BRASIL
10·24·I·1971
Col. W.E.Kerr

HOLOTYPE

HOLOTYPE
Partamona
combinata Pedro
& Camargo, 1988

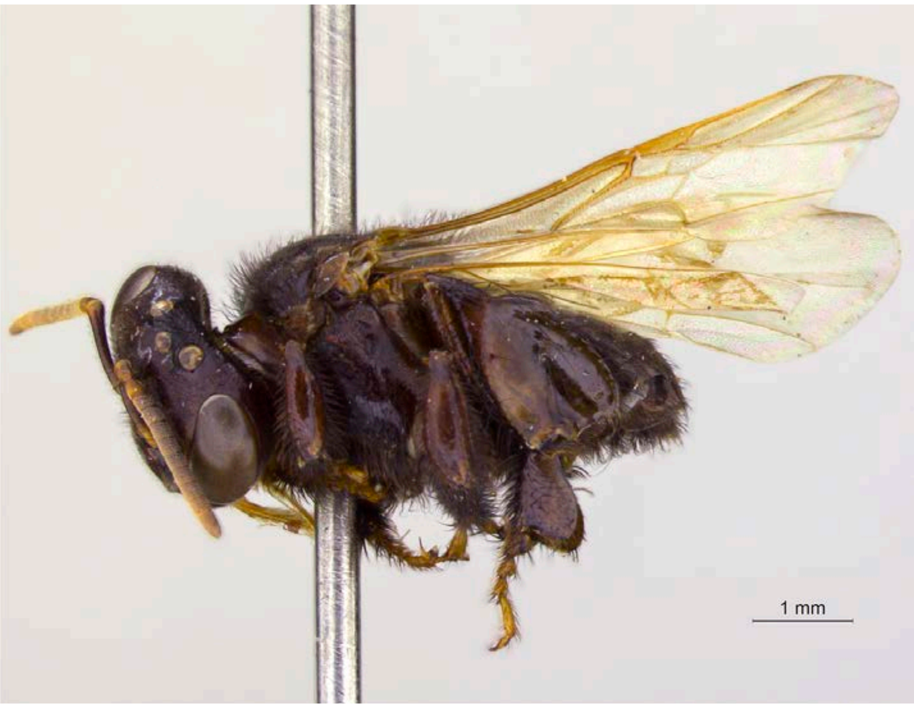
Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.



Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Nest within an active arboreal termite nest, at 2 m above the ground • Habitat: Gallery forest edge, at the border with the cerrado • Krahó Reserve, Galheiros, TO • 21/01/1993

Partamona ferreirai Pedro & Camargo, 2003



GENETICA
F.M. R.PRÊTO

183c (:T-69)

LAGO AGUA FRIA, PA.
Rio Trombetas - BRASIL
SA.21-X-C,56°51'W,1°25'S
13-15,II-1979. Camargo

HOLOTYPE

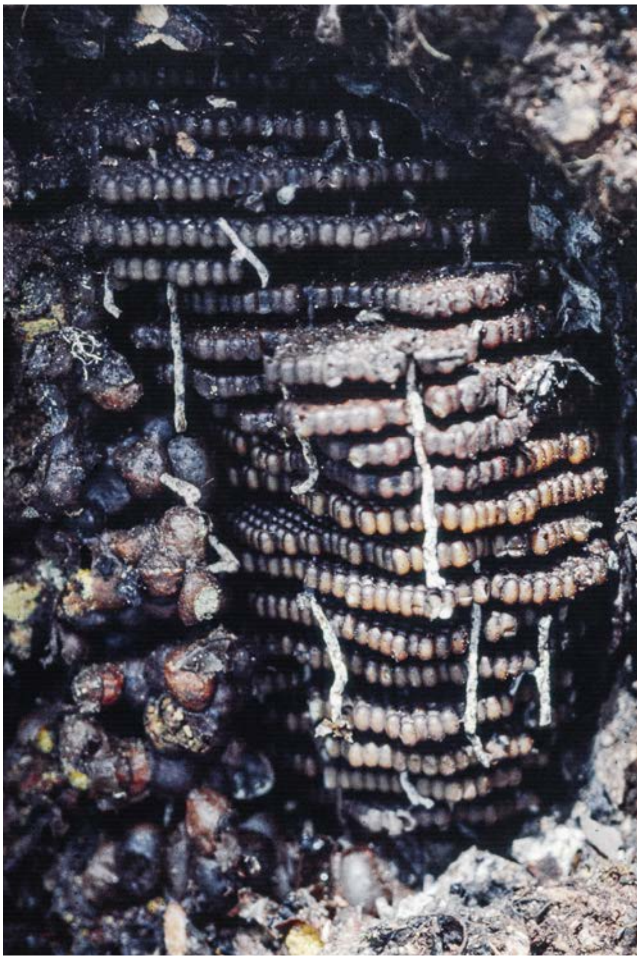
HOLOTYPE
Partamona
ferreirai Pedro
& Camargo, 198[illegible]

Nest within an active termite nest in a hollow tree • Habitat: Dense forest, transitional area, undulated relief • Mouth of the Rio Daraá, AM • 02-04/08/1980

Nest within a termite nest fixed to a trunk • Habitat: *Igapó* forest, riverbank • Nazaré, Rio Negro, AM • 16/07/1999

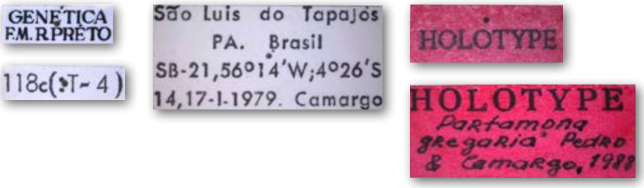
Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Nest within a termite nest fixed to a trunk • Habitat: *Igapó* forest, riverbank • Nazaré, Rio Negro, AM • 16/07/1999



Nest within a termite nest in a hollow tree • Habitat: Sub-montane forest, Lago Água Fria, PA • 13-15/02/1979

Partamona gregaria Pedro & Camargo, 2003


GENÉTICA
F.M.R.PRETO

118c(:T- 4)

São Luis do Tapajós
PA. Brasil
SB-21,56°14'W;4°26'S
14,17-1-1979. Camargo

HOLOTYPE

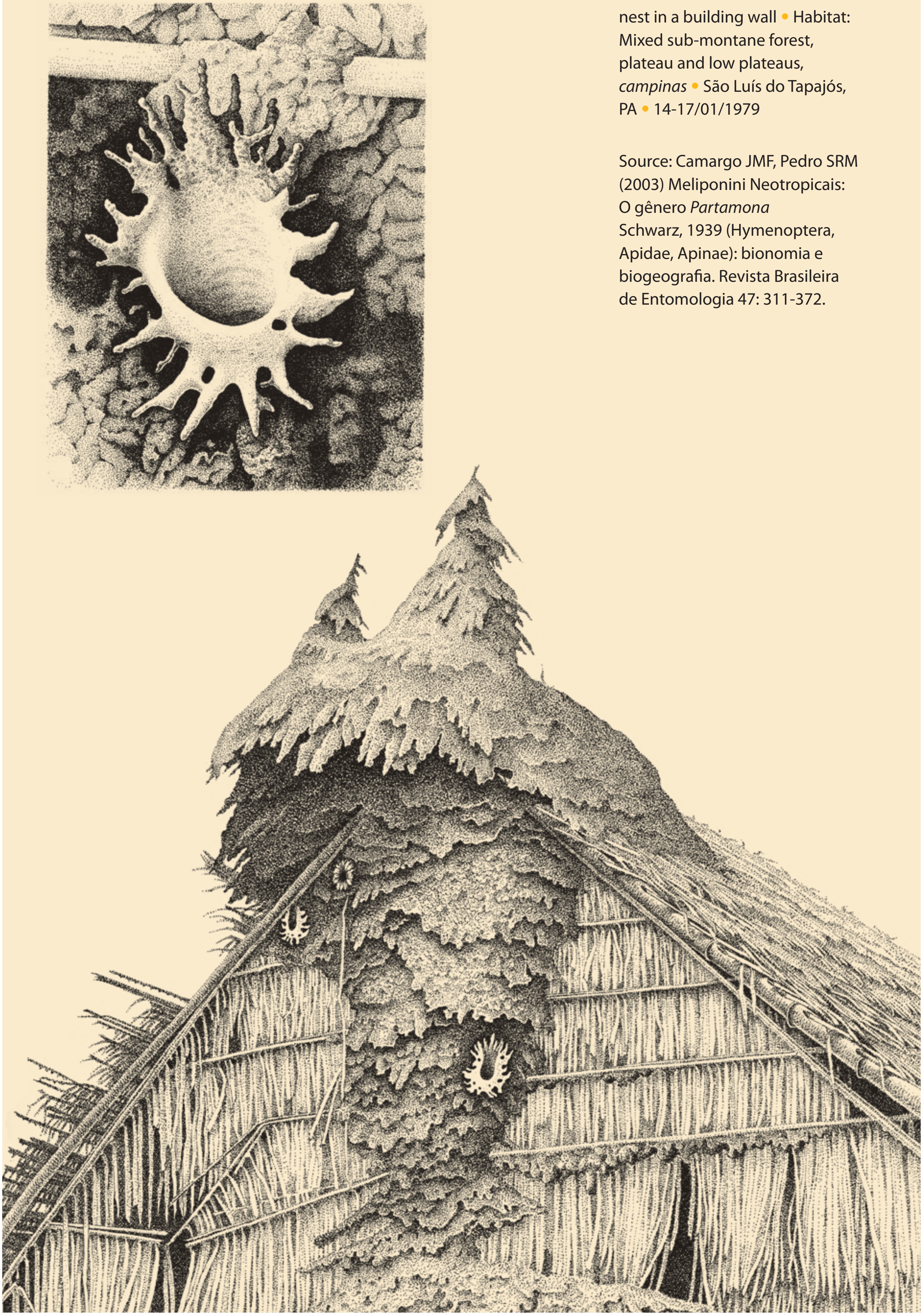
HOLOTYPE
Partamona
gregaria Pedro
& Camargo, 1988

Nest within an active termite nest in a building wall • Habitat: Sub-montane mixed forest, plateau and low plateaus, *campinas* (open fields on white-sand savannas). São Luís do Tapajós, PA • 14-17/01/1979

Nest in an active arboreal termite nest • Habitat: Terrace forests, Brazil nut stand • Mussum, 15 km S Aveiro, PA • 24-28/01/1979

Nest within an active termite nest in a building wall • Habitat: Dense floodplain forest and flattened relief • Tauari, PA • 29/01/1999

Partamona gregaria

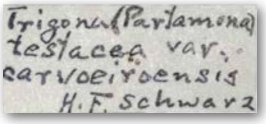


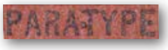
Nest within an active termite nest in a building wall • Habitat: Mixed sub-montane forest, plateau and low plateaus, *campinas* • São Luís do Tapajós, PA • 14-17/01/1979

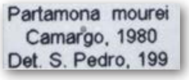
Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona mourei Camargo, 1980


Carvoeiro
RioNegro-
RioBranco
Amazonas
26·VIII·24


Trigona (Partamona)
testacea var.
carvoeiroensis
H. F. Schwarz

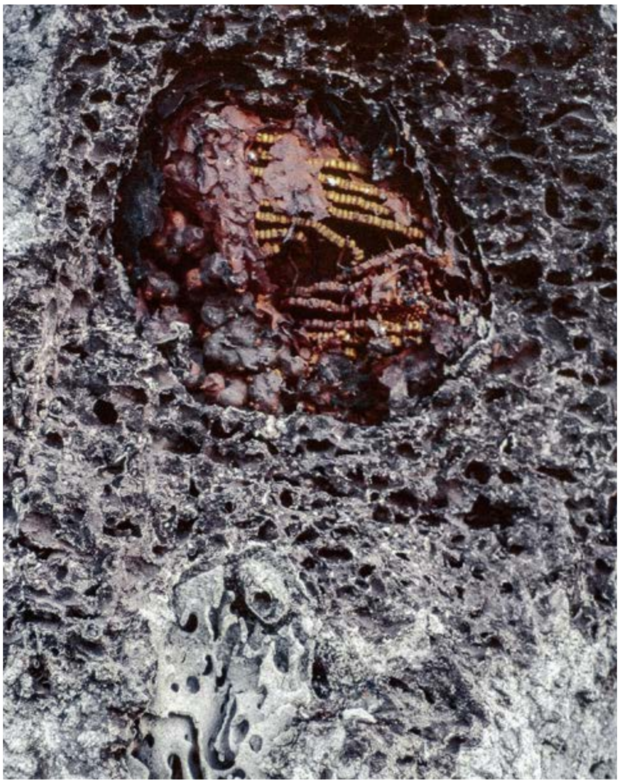

PARATYPE


Partamona mourei
Camargo, 1980
Det. S. Pedro, 199

Nest within an arboreal termite nest • Habitat: Dense forest, plateau • Rio Carimum, PA • 16-17/02/1979

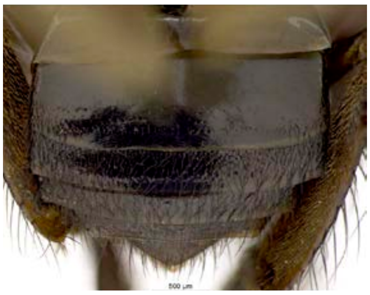
Nest within an active termite nest in a building wall • Habitat: Dense forest, lowlands, plateaus • Livramento, Rio Negro, AM • 24-26/07/1980

Nest within an active termite nest • Habitat: Sedimentary tablelands, transitional area, dissected relief • Caracaraí, RR • 13-15/08/1980



Nest within an active termite nest in a maripa palm trunk • Habitat: *Roçado* • Nazaré, Rio Negro, AM • 15/07/1999

Partamona nhambiquara Pedro & Camargo, 2003



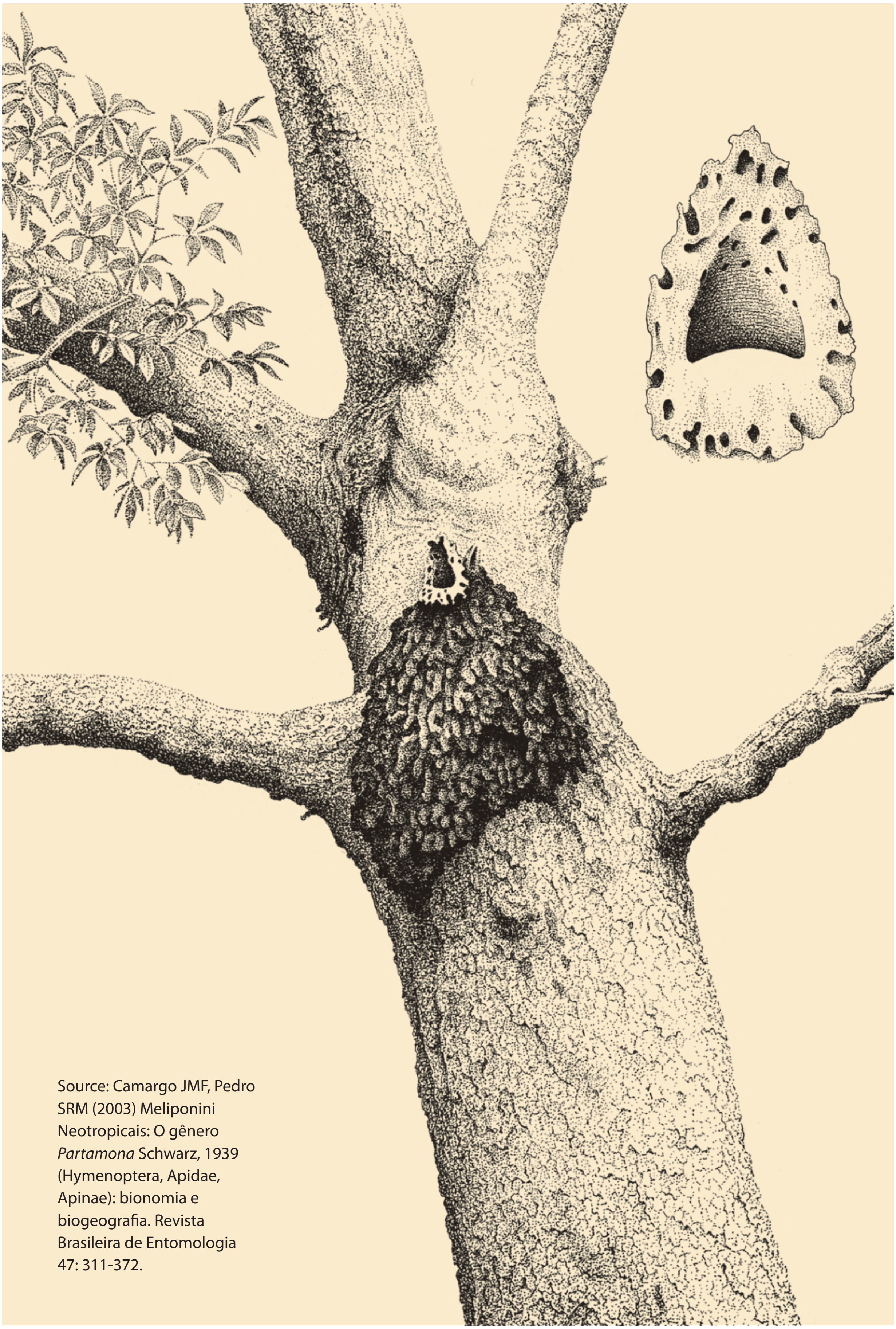
Brasil. Rondônia
Guajará - Mirim
Sa. Pacaás Novos

20 /janeiro/1996
M.L.OLIVEIRA col

PN 0810

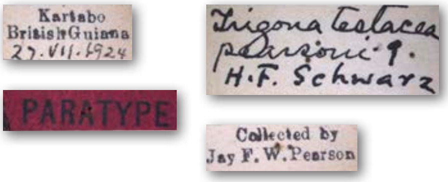
HOLOTYPE

HOLOTYPE
Partamona
nhambiquara Pedro
& Camargo, 1988



Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona pearsoni (Schwarz, 1938)


Kartabo
BrisishGuiana
27.VII.1924

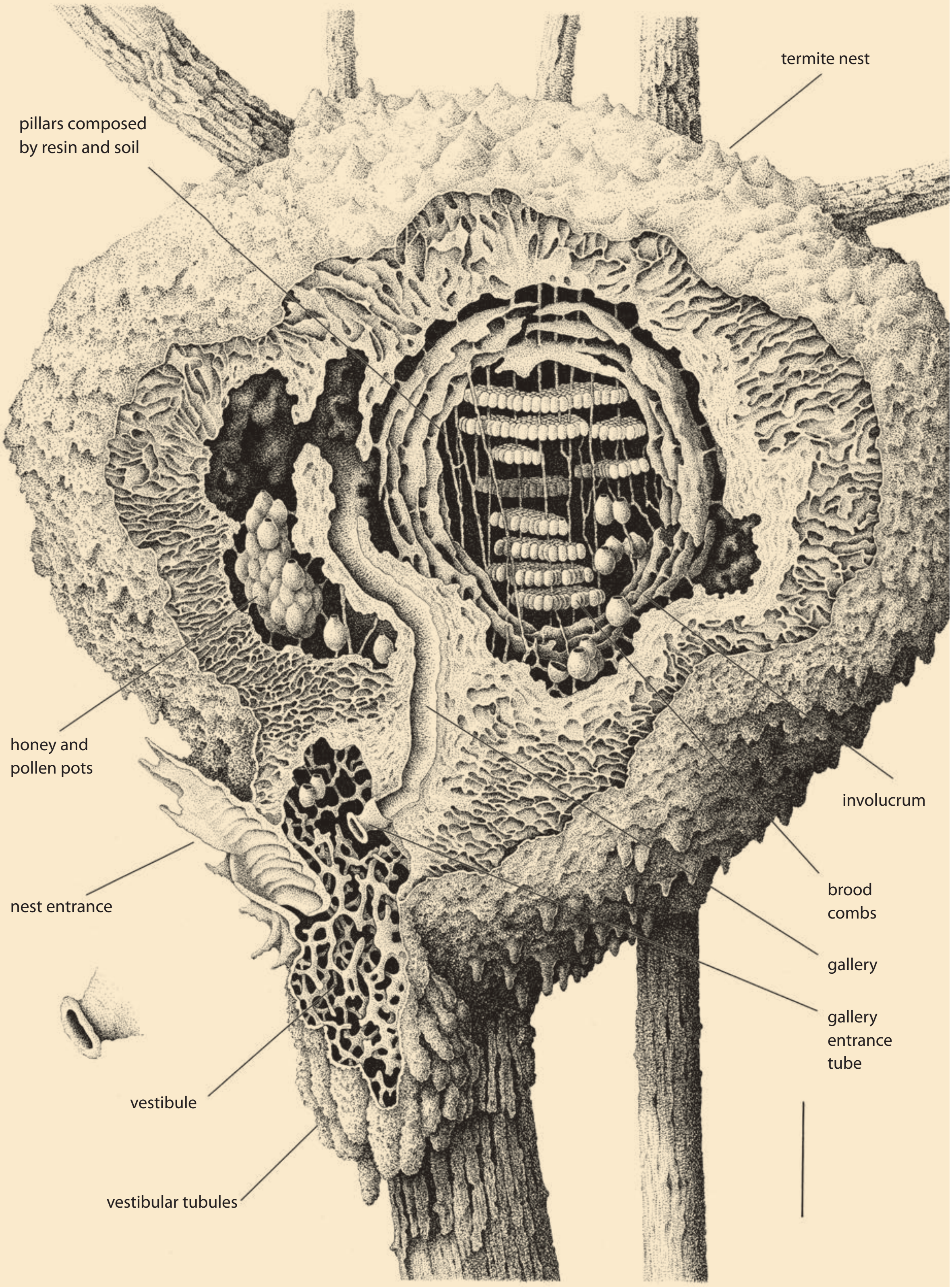
PARATYPE

Trigona testacea
pearsoni ♀.
H.F. Schwarz

Collected by
Jay F. W. Pearson

Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

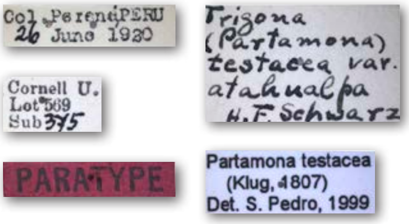
Nest within an active arboreal termite nest • Habitat: Dense forest, lowlands, plateaus • Mouth of the Rio Marié, AM • 26-27/07/1980



Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372

Partamona testacea (Klug, 1807)

Visits açaí (*Euterpe oleracea*) flowers.



Col. Perené PERU
26 June 1930

Cornell U.
Lot 569
Sub 375

PARATYPE

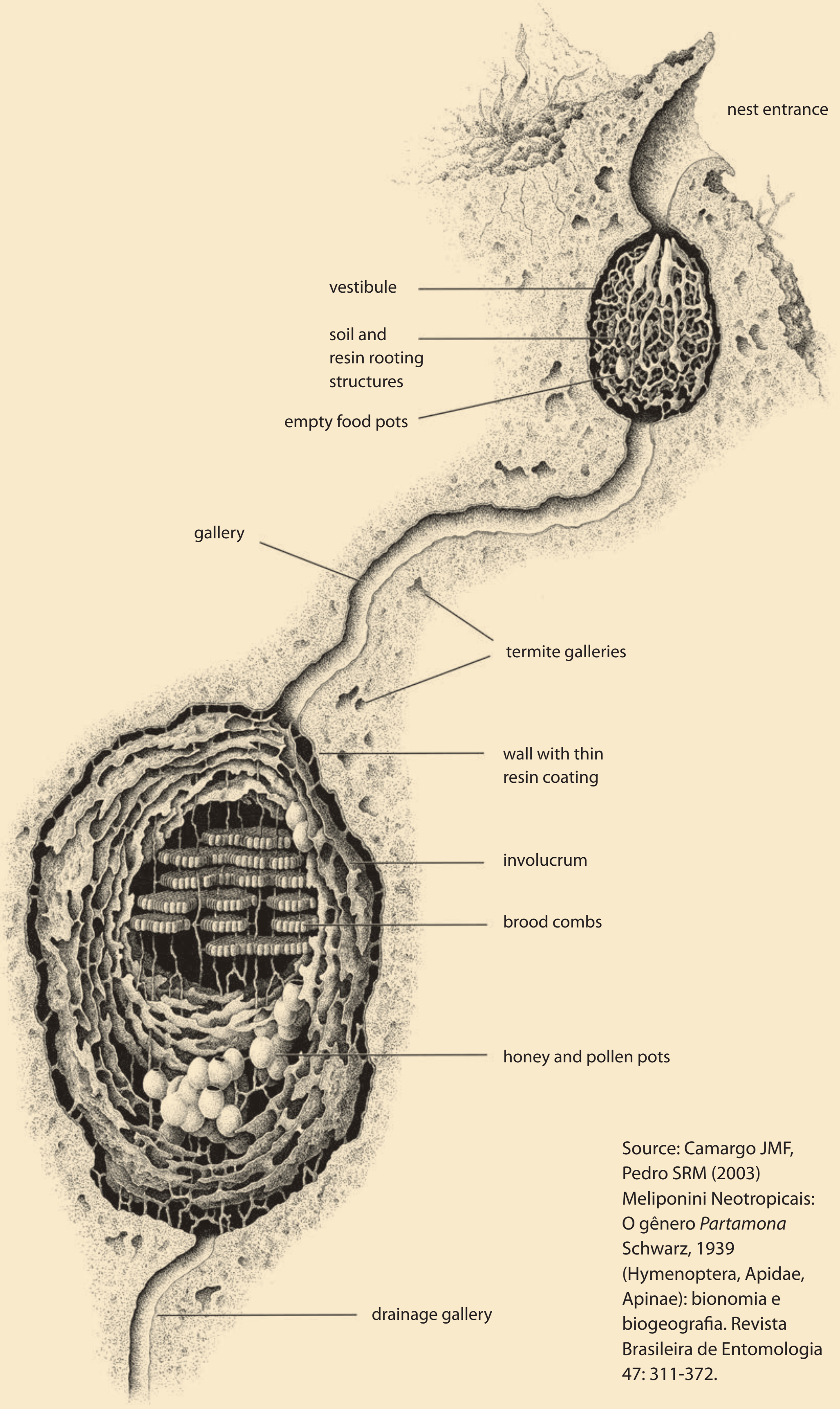
Trigona
(Partamona)
testacea var.
atahualpa
H.F. Schwarz

Partamona testacea
(Klug, 1807)
Det. S. Pedro, 1999

Underground nest close to tree trunk • Habitat: Terra firme forest next to *Igapó* forest • Vendaval, Rio Solimões, AM • 17/01/1977

Underground nest close to tree trunk (termites are present) • Habitat: Terra firme forest next to *Igapó* forest • Vendaval, Rio Solimões, AM • 16/01/1977

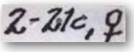
Underground nest • Habitat:
Terra firme field; forest felled in
1990 • Bacururu, Rio Juruá, AM
• 30/07/1993



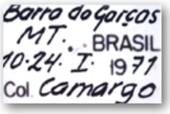
Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

Partamona vicina Camargo, 1980

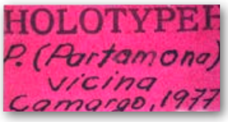
Common name: kangàrrà-kàk-ti. Visits Brazil nut (*Bertholletia excelsa*) flowers.



2-Z1c, ♀

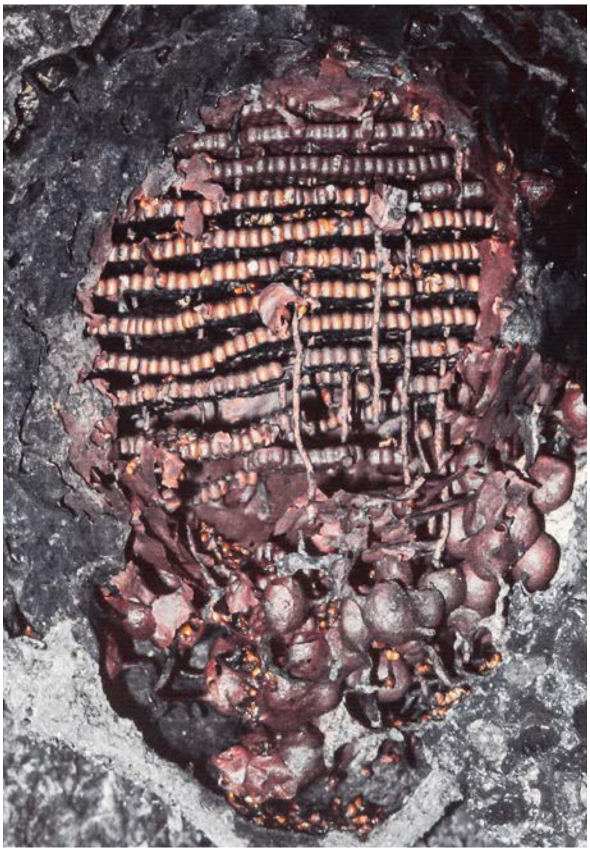


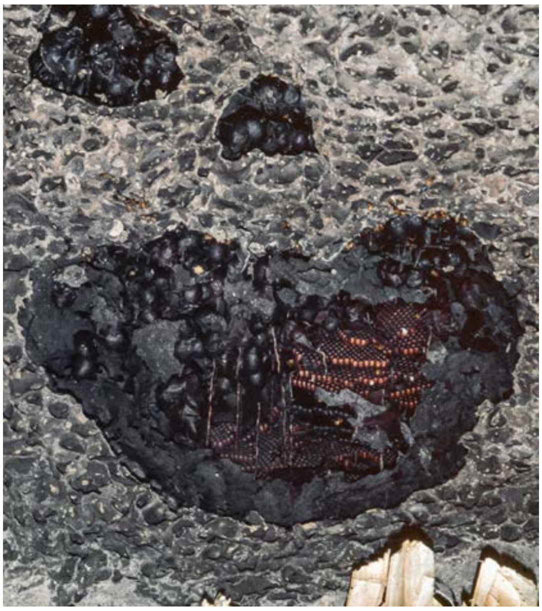
Barro do Garças
MT. BRASIL
10·24· I· 1977
Col. Camargo



HOLOTYPE
P. (Partamona)
vicina
Camargo, 1977

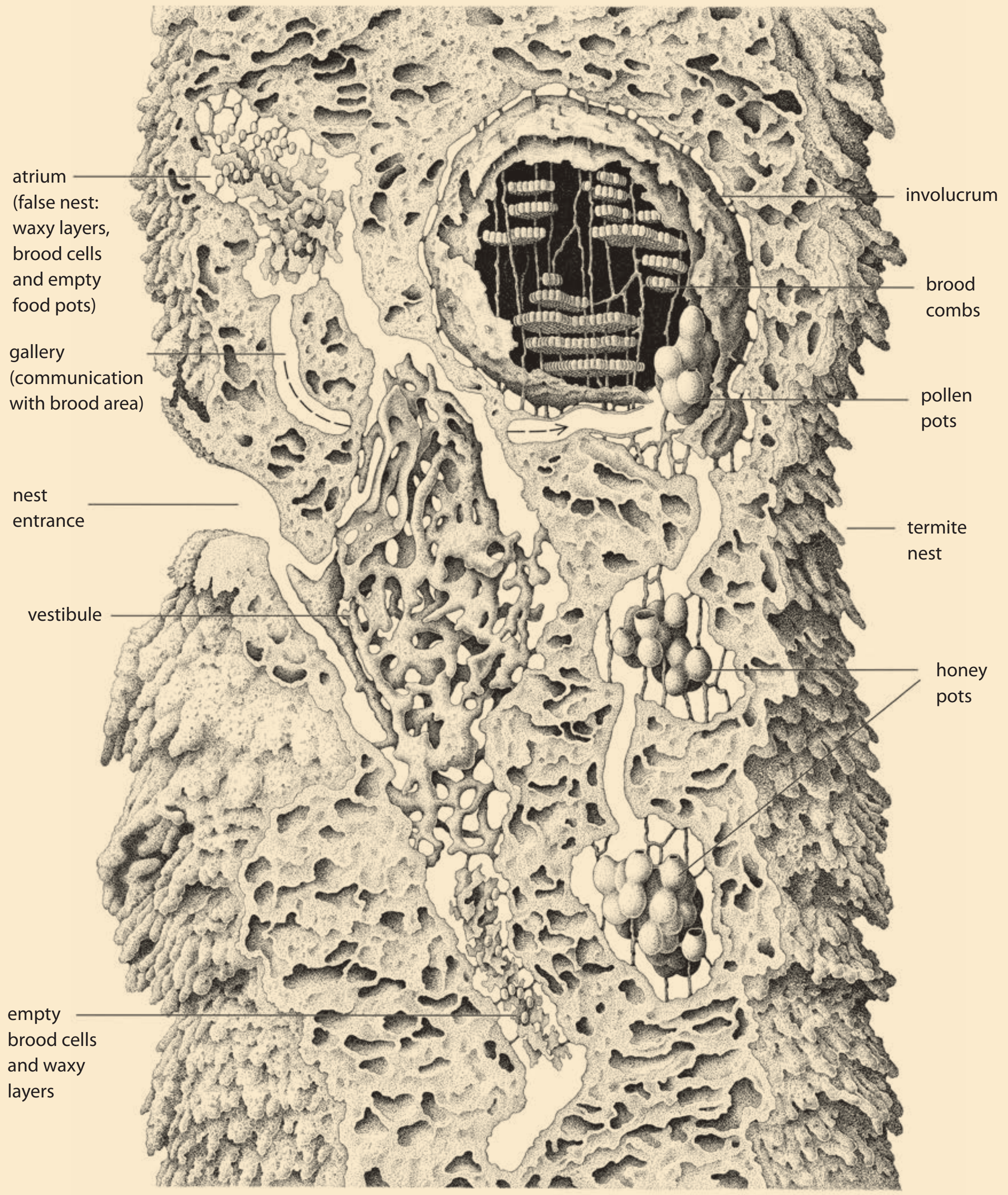
Nest within an active termite nest in a building wall • Habitat: Cerrado enclave • Alter do Chão, PA • 03-04/02/1979





Nest within an active termite nest in a building wall • Habitat: Dense floodplain forest and flattened relief • Tauari, PA • 01-29/01/1979

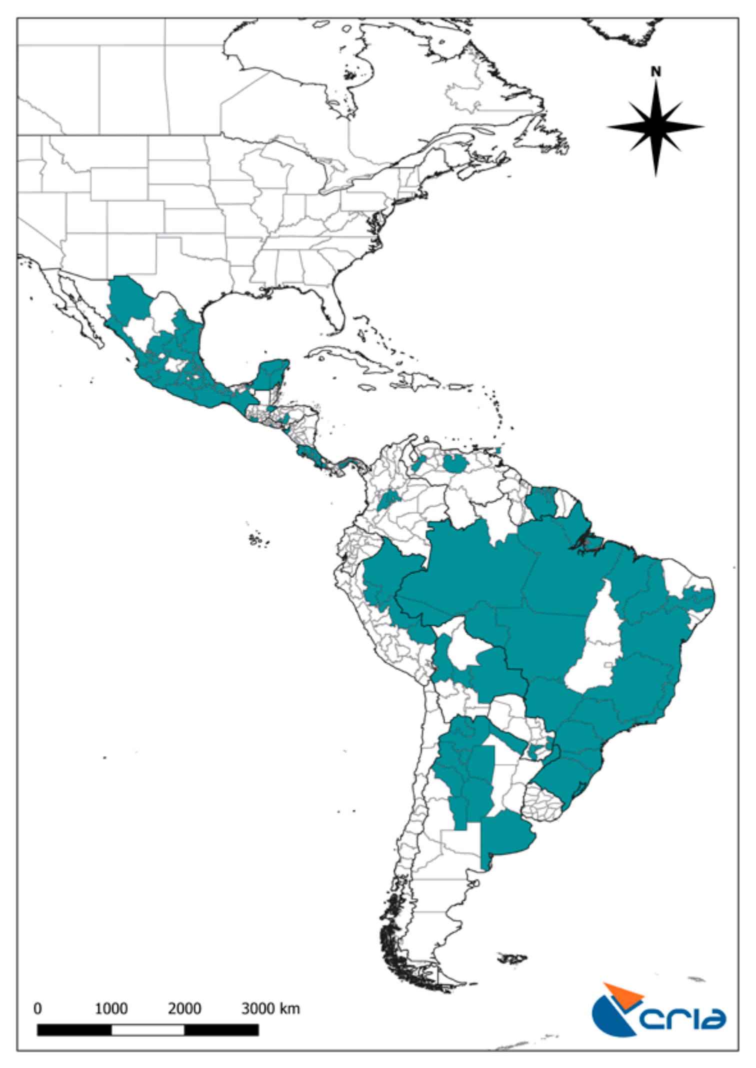
Nest within arboreal termite nest • Habitat: Terrace forest, Brazil nut stand • Mussum, 15 km S Aveiro, PA • 24-28/01/1979



Source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372.

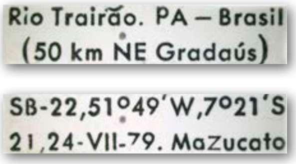
Genus

Plebeia Schwarz, 1938



Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

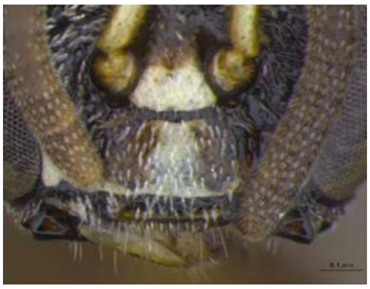
Plebeia alvarengai Moure, 1994


Rio Trairão. PA – Brasil
(50 km NE Gradaús)

SB-22,51°49'W,7°21'S
21,24-VII-79. MaZucato

Plebeia minima (Gribodo, 1893)

Common name: lameojos.
Visits açaí (*Euterpe oleracea*) flowers.




Barra do Garças
MT. BRASIL

21. I. 1971
Col. Camargo

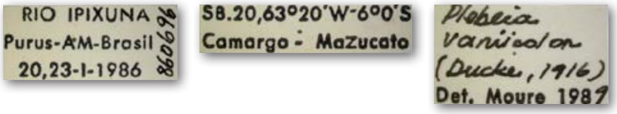
P (Plebeia)
cf. minima
(Gribodo, 1893)
Det. Camargo 1975

Nest entrance in a fence post cavitiy • Habitat: Dense forest, lowlands • Livramento, Rio Negro, AM • 24-26/07/1980

Nest within a fence post cavitiy • Habitat: Dense forest, lowlands • Livramento, Rio Negro, AM • 24-26/07/1980

Nest within a dry *capitari* branch • Habitat: *Igapó* beach, margin of the Lago Tefé • Nogueiras, Lago Tefé, AM • 25/08/1993

Plebeia variicolor (Ducke, 1916)


RIO IPIXUNA
Purus-AM-Brosil
20,23-I-1986
860696

SB.20,63°20'W-6°0'S
Camargo - Mazucato

Plebeia
variicolor
(Ducke, 1916)
Det. Moure 1987

Genus

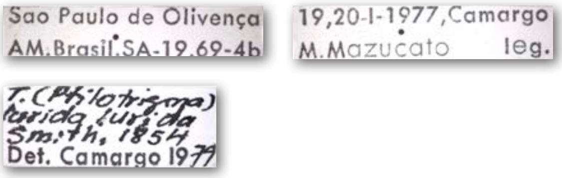
Ptilotrigona Moure, 1951

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Camargo JMF, Pedro SRM (2004) Meliponini neotropicais: o gênero *Ptilotrigona* Moure (Hymenoptera, Apidae, Apinae). Revista Brasileira de Entomologia 48: 353-377.

Ptilotrigona lurida (Smith, 1854)

Common names: aramá, borá-boi, borá-cavalo, borá, tataíra-grande, abelha-piranha, moça-branca.



Sao Paulo de Olivença
AM.Brasil.SA-19.69-4b

19,20-I-1977,Camargo
M.Mazucato leg.

T.(Ptilotrigona)
lurida lurida
Smith, 1854
Det. Camargo 1977

Nest within a hollow tree • Habitat: Sub-montane forest • Location: Mouth of the Rio Curicuriari, AM • Data: 15-21/07/1980

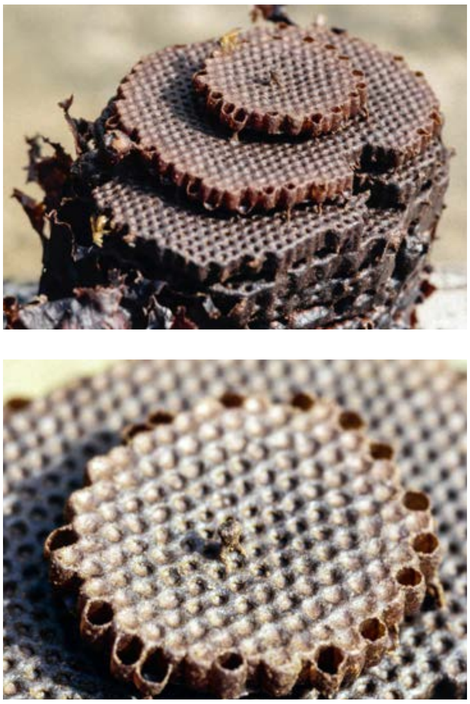
Nest within a live tree cavity • Habitat: *Terra firme* forest, caatinga type • Tapurucuara Mirim, Rio Negro, AM • 04/07/1999

Nest entrance in a hollow tree• Habitat: Cerrado enclave • Alter do Chão, PA • 03-04/02/1979

Nest entrance in a live *macaricão* tree cavity • Habitat: *Terra firme* forest • Camanaus, Rio Negro, AM • 29/06/1999

Ptilotrigona lurida


Nest within a hollow tree • Habitat: Sedimentary tablelands, transitional area, dissected relief • Caracaraí, RR • 13-15/08/1980


Brood combs • Habitat: Sub-montane forest, dissected relief • Mouth of the Rio Curicuriari, AM • 15-21/07/1980


Larvae in a comb • Habitat: Cerrado enclave • Alter do Chão, PA • 03-04/02/1979


Pots contain *Candida* yeast that causes dehydration of the stored pollen • Habitat: Sub-montane forest, dissected relief • Mouth of the Rio Curicuriari, AM • 15-21/07/1980

Genus

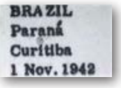
Scaptotrigona Moure, 1942

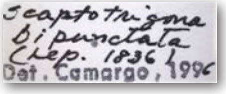
Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Scaptotrigona bipunctata (Lepeletier, 1836)

Common names: canudo, tubuna, tapesuá.

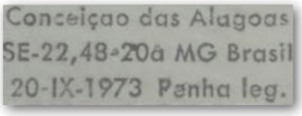
Pollinates carrot (*Daucus carota*), sunflower (*Helianthus annuus*) and canola (*Brassica napus*) flowers. Visits coffee (*Coffea arabica*) flowers.


BRAZIL
Paraná
Curitiba
1 Nov. 1942


Scaptotrigona
bipunctata
(Lep. 1836)
Det. Camargo, 1996

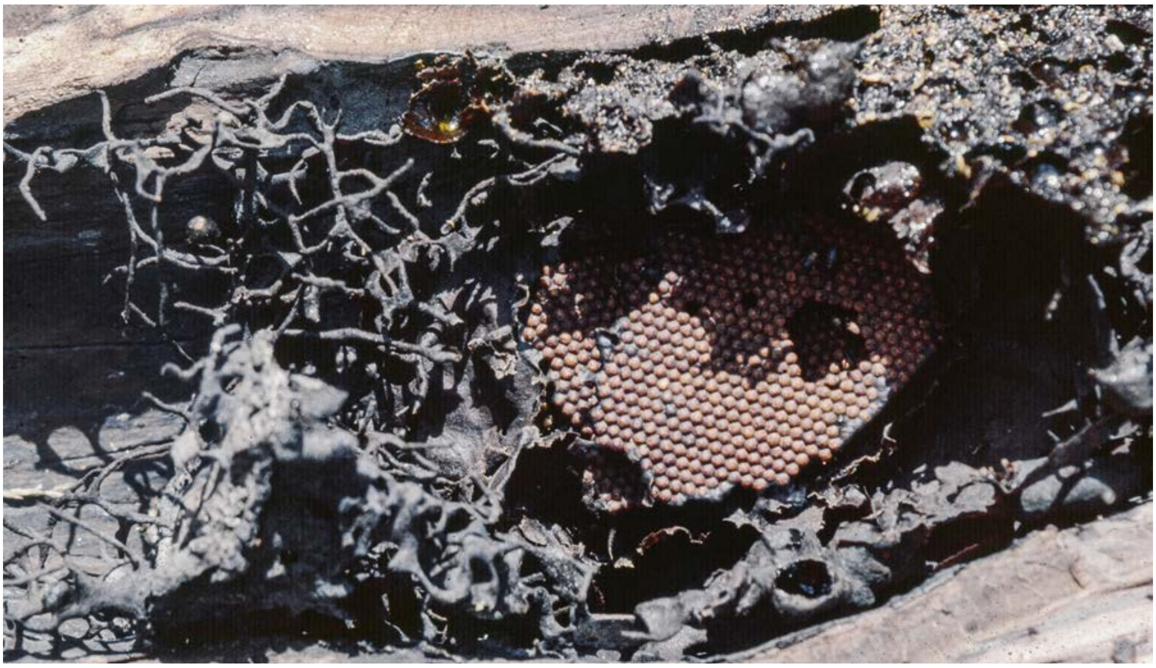
Scaptotrigona polysticta Moure, 1950

Common names: benjoi, bijui, abelha-canudão, mijui, bui-kaiaki, imrê-ti.


Conceiçao das Alagoas
SE-22,48-20a MG Brasil
20-IX-1973 Penha leg.

Nest entrance in a hollow tree • Habitat: Sub-montane forest, dissected relief • Cachoeira da Porteira, PA • 09-12/02/1979

Nest entrance in an *acapú* tree cavity • Habitat: Tall *terra firme* forest, Brazil nut stand • Maraã, Rio Japurá, AM • 16/08/1993

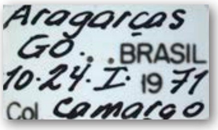


Nest within a hollow tree • Habitat: Sub-montane forest, dissected relief • Cachoeira da Porteira, PA • 09-12/02/1979

Scaptotrigona postica (Latreille, 1807)

Common names: mandaguari, canudo, timba-amarela.

Pollinates umbu (*Spondias tuberosa*) flowers and visits coffee (*Coffea arabica*), murici (*Byrsonima crassifolia*) and yellow mombin (*Spondias mombin*) flowers.


Aragarças
GO. BRASIL
10·24·I·1971
Col Camargo

Nest within a live *cooti* tree cavity • Habitat: Gallery forest, *brejo* (marsh), surrounded by cerrado • Krahó Reserve, Galheiros, TO • 20/01/1993

Nest within a live *pau-terra* tree cavity • Habitat: Typical cerrado • Mateiros, TO • 10-12/07/1995

Nest within a live *coóti* tree cavity • Habitat: Gallery forest, *brejo*, surrounded by cerrado • Krahó Reserve, Galheiros, TO • 20/01/1993

Genus

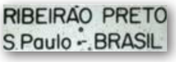
Scaura Schwarz, 1938

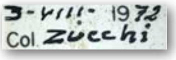
Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

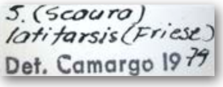
Nogueira DS, Santos-Júnior JE, Oliveira FF, Oliveira ML (2019) Review of *Scaura* Schwarz, 1938 (Hymenoptera: Apidae: Meliponini. Zootaxa 4712:451-496.

Scaura latitarsis (Friese, 1900)

Common names: peconcito, sharabata, txashkù-mexupa.


RIBEIRÃO PRETO
S.Paulo - BRASIL


3-VIII- 1972
Col. Zucchi


S. (Scaura)
latitarsis (Friese)
Det. Camargo 1979

Nest within a live arboreal termite nest • Habitat: Dense forest, lowlands, plateaus • Aruti, Rio Negro, AM • 22-23/07/1980

Nest entrance

Brood combs within a live termite nest found in a tree branch • Habitat: *igapó* forest • Santa Isabel do Rio Negro, AM • 11/07/1999

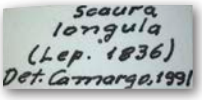
Brood combs within an arboreal termite nest • Habitat: Dense forest, lowlands, plateaus • Aruti, Rio Negro, AM • 22-23/07/1980

Food pots within a live arboreal termite nest • Habitat: Dense forest, lowlands, plateaus • Location: Aruti, Rio Negro, AM • 22-23/07/1980

Scaura longula (Lepeletier, 1836)

Common names: jataí-negra, jataí-preta, ramichi-negra-grande, mehnô-rã-tyk.

LUZIANIA
JATIARA
GO. BRASIL
17. 1. 1991
NOGUEIRA. NETO



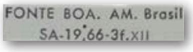
Scaura
longula
(Lep. 1836)
Det. Camargo, 1991

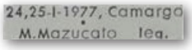
Nest entrance in a live tree cavity • Habitat: *Igapó* • Ponta do Gavião, Rio Negro, AM • 31/07/1999

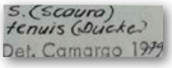
Vertical brood combs • Habitat: *Igapó* • Ponta do Gavião, Rio Negro, AM • 31/07/1999

Scaura tenuis (Ducke, 1916)

Common name: ramichi-negra.


FONTE BOA. AM. Brasil
SA-19.66-3f.XII


24,25-I-1977, Camargo
M.Mazucato leg.


S.(Scaura)
tenuis (Ducke)
Det. Camargo 1979

Nest entrance • Habitat: Broadleaved, open forest and floodplain • Santa Maria, Itaituba, PA • 18-20/01/1979

Nest within a rotten trunk • Habitat: *Igapó* • Ponta do Gavião, Rio Negro, AM • 31/07/1999

Nest within a termite nest • Habitat: *Várzea* forest • Igapó Jaraqui, Rio Juruá, AM • 28/07/1993

Genus
Schwarzula Moure, 1946

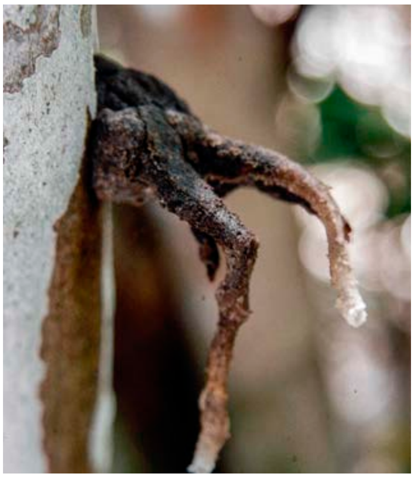
Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Schwarzula coccidophila Camargo & Pedro, 2002


RPSP
878c

Tapurucuara-mirim,
rio Negro, AM, BRASIL
00°23'28"S, 66°26'07"W
15.II.2001 Camargo leg.

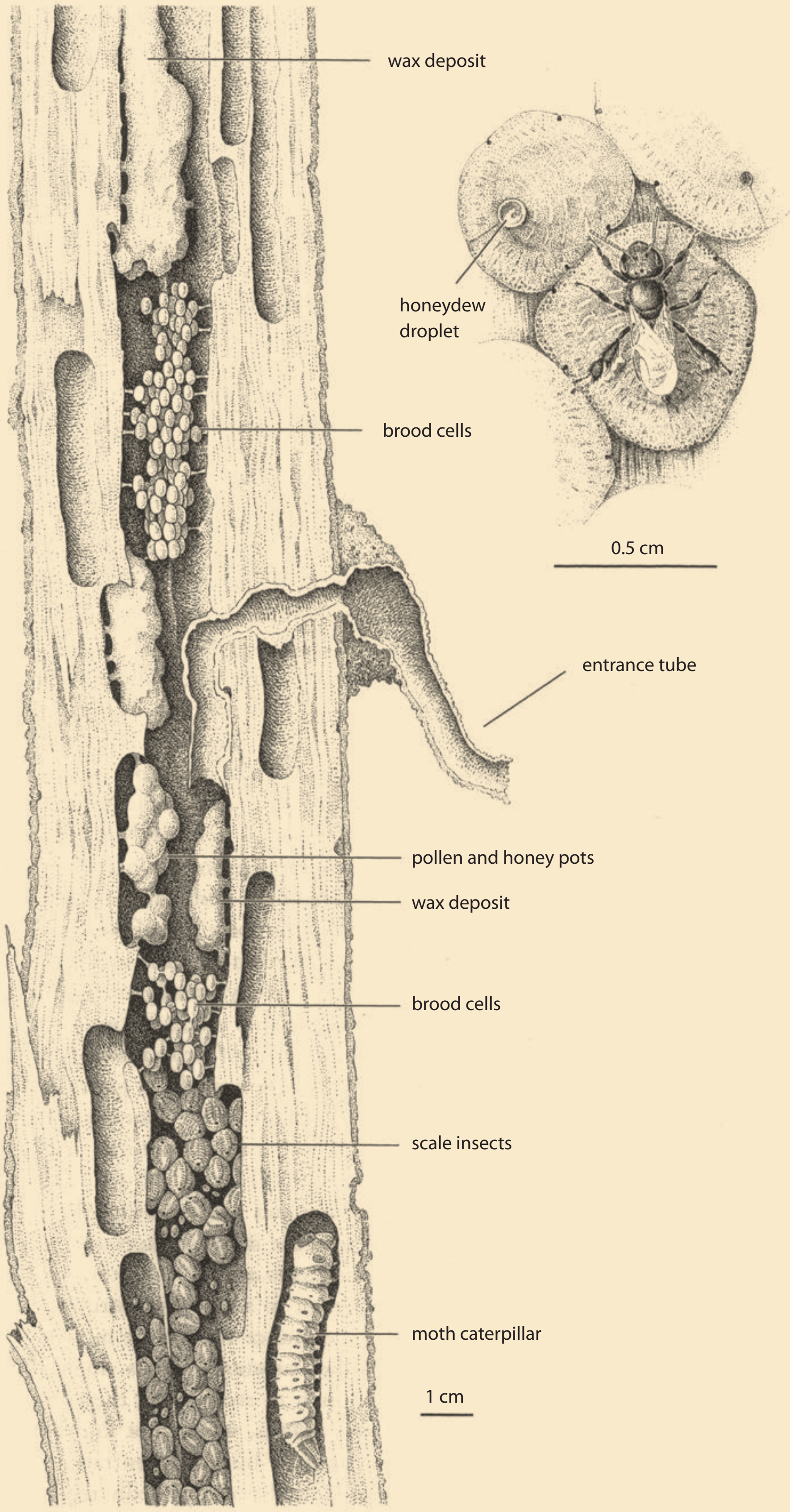
HOLOTYPE
Schwarzula
coccidophila
Camargo & Pedro
2001



Nest entrances

Scale insects within *S. coccidophila* nest

Nests within galleries excavated by moth larvae (*Cossula* sp.), in *cumandá* branches • Habitat: *igapó* forest, riverbank • Tapurucuara Mirim, Rio Negro, AM • 02/15/2001

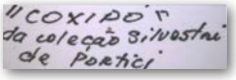


Source: Camargo JMF, Pedro SRM (2002) Mutualistic association between a tiny Amazonian stingless bee and a wax-producing scale insect. Biotropica 34: 446-451.

Schwarzula timida (Silvestri, 1902)

Common names: lambe-olhos, frecheira, mosquito-do-ouvido.


PARALECTOTYPE
Schwarzula timida
(Silvestri, 1902)
Des. Camargo, 1984


"COXIPÓ"
da coleção Silvestri
de Portici

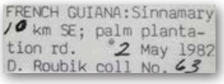
Genus

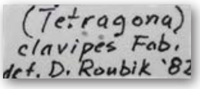
Tetragona Lepeletier & Serville, 1828

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Tetragona clavipes (Fabricius, 1804)

Common names: borá, vorá, vamos-embora, i-kàikà. Pollinates cassava (*Manihot esculenta*) flowers and visits coffee (*Coffea arabica*), guava (*Psidium guajava*), acerola (*Malpighia punicifolia*) and cotton (*Gossypium hirsutum*).


FRENCH GUIANA:Sinnamary
10 km SE; palm planta-
tion rd. 2 May 1982
D. Roubik coll No. 63


(Tetragona)
clavipes Fab.
det. D. Roubik '82

Nest entrance within a mango tree cavity • Habitat: Cerrado mixed with gallery forest • Lizarda, 60 km L, MA • 11/18/1994

Brood combs removed from a live *taubarana* tree cavity, at more than 20 m above the ground • Habitat: *Igapó* forest • Forte da Graça, Rio Juruá, AM • 04/08/1993

Nest within dead tree cavity • Habitat: *Terra firme* forest, next to the *roçado* • Lago Uará, Rio Solimões, AM • 10/08/1993

Tetragona dorsalis (Smith, 1854)

Common names:
borá-bico-de-vidro,
tôtn-my, tôtn-my're.


SAO LUIS- MA.
Brasil: 24-XII
1982
822540

MaZuçato, Aily
Camargo leg.

Nest entrance

Nest within a live *coóti* tree cavity • Habitat: Gallery forest, *brejo*, surrounded by cerrado • Krahó Reserve, Galheiros, TO • 20/01/19

Tetragona goettei (Friese, 1900)

Common names:
tataíra-pequena,
mehr-si-we'i,
shawa-puiki-buná.
Visits Brazil nut
(*Bertholletia excelsa*)
flowers.

Sao Paulo de Olivença
AM.Brasil.SA-19,69-4b

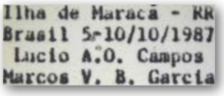
19,20-I-1977,Camargo
M.Mazucato leg.

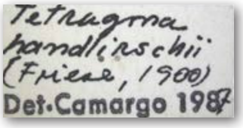
T. (Tetragona)
goettei Fr., 1900
Det. Camargo 1979

Nest entrance in a rotten, dead tree cavity • Habitat: *Terra firme* forest, next to *igapó* forest (Rio Jacaré) • Arimã, Purus, AM • 07/02/1986

Brood combs from nest within a hollow tree • Habitat: Terrace forest, Brazil nut stand • Mussum, 15 km S Aveiro, PA • 24-28/01/1979

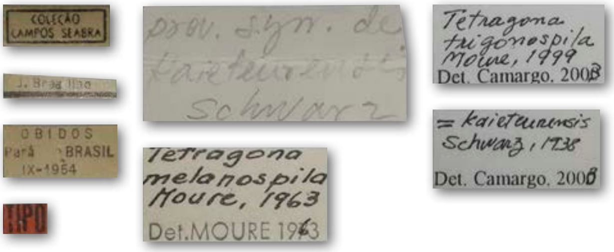
Tetragona handlirschii (Friese, 1900)


Ilha de Maracá - RR
Brasil 5-10/10/1987
Lucio A.O. Campos
Marcos V. B. Garcia


Tetragona
handlirschii
(Friese, 1900)
Det.Camargo 1987

Tetragona kaieteurensis (Schwarz, 1938)

Visits Brazil nut (*Bertholletia excelsa*) flowers.



COLEÇÃO
CAMPOS SEABRA

J. Bragalilho

OBIDOS
Parâ BRASIL
IX-1954

TIPO

prov. syn. de
kaieteurensis
Schwarz

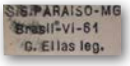
Tetragona
melanospila
Moure, 1963
Det.MOURE 1963

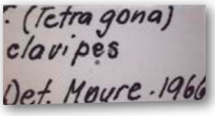
Tetragona
trigonospila
Moure, 1999
Det. Camargo. 2008

= kaieteurensis
Schwarz, 1938
Det. Camargo. 2008

Tetragona quadrangula (Lepeletier, 1836)

Common name:
menire-udja.


S.S.PARAISO-MG
Brasil-VI-61
G. Elias leg.

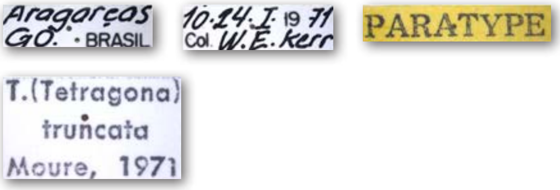

(Tetragona)
clavipes
Det. Moure .1966

Nest entrance

Nest within a live *ubeiro* tree cavity • Habitat: *Brejo* forest, together with buriti palm stand, surrounded by cerrado • Krahó Reserve, Galheiros, TO • 19/01/1993

Tetragona truncata Moure, 1971

Common names:
borá-de-canudo, õ-i.



Aragarças
GO. · BRASIL

10·24·I·19 71
Col. W.E. Kerr

PARATYPE

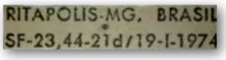
T.(Tetragona)
truncata
Moure, 1971

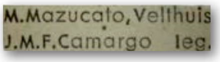
Genus
Tetragonisca Moure, 1946

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

Tetragonisca angustula (Latreille, 1811)

Common names: jataí, jataí-verdadeira, vangelitas, maria-seca, virginitas, virgencitas, abelhas-ouro, mosquitinha-verdadeira, my-krwàt. Pollinates strawberry (*Fragaria x ananassa*), avocado (*Persea americana*), umbu (*Spondias tuberosa*), annato (*Bixa orellana*), bell pepper (*Capsicum annuum*), orange (*Citrus sinensis*), mandarin orange (*Citrus reticulata*), mango (*Mangifera indica*), canola (*Brassica napus*), onion (*Allium cepa*), acapu (*Vouacapoua americana*), cupuaçu (*Theobroma grandiflorum*), wild carrot (*Daucus carota*), cucumber (*Cucumis sativus*), coffee (*Coffea arabica*), watermelon (*Citrullus lanatus*) and acerola (*Malpighia punicifolia*) flowers.


RITAPOLIS-MG. BRASIL
SF-23,44-21d/19-I-1974


M.Mazucato,Velthuis
J.M.F.Camargo leg.

Nest entrance in a dry tree cavity • Habitat: *Roçado, terra firme* • Nogueiras, Lago Tefé, AM • 26/08/1993

Nest entrance in a hollow at the base of an enormous *tauari* trunk • Habitat: *Terra firme* forest • Maraã, Rio Japurá, AM • 17/08/1993

Nest within a dead tree cavity • Habitat: Dense forest, lowlands • Curiuaú Lake, Rio Negro, AM • 24-25/08/1980

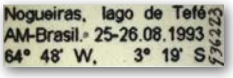
Nest within a hollow at the base
of an enormous *tauari* trunk •
Habitat: *Terra firme* forest • Maraã,
Rio Japurá, AM • 17/08/1993

Genus

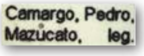
Trigona Jurine, 1807

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

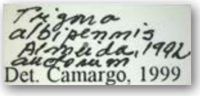
Trigona albipennis Almeida, 1995



Nogueiras, lago de Tefé
AM-Brasil. 25-26.08.1993
64° 48' W, 3° 19' S
936223



Camargo, Pedro,
Mazúcato, leg.



Trigona
albipennis
Almeida, 1992
auctorum
Det. Camargo, 1999

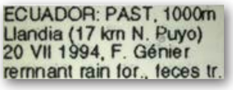
Nest within a live arboreal termite nest (in vine) • Habitat: Tall *várzea* forest • Camaruã, Purus, AM • 29/01/1986

Brood combs (top) and food pots (bottom)

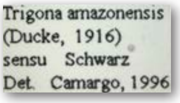
Nest within a live termite nest, fixed to an embauba tree and vines • Habitat: Várzea, island • Paraíso, Rio Japurá, AM • 20/08/1993

Trigona amazonensis (Ducke, 1916)

Common names: xupé-grande, xupé-mangangá, mangangá, amo, corta-pelo, arapuá-preto-médio, txashku-buiki, nawa-bakû, ku-krãi-ti, abeja-arambaso. Visits Malay apple (*Syzygium malaccense*) flowers.



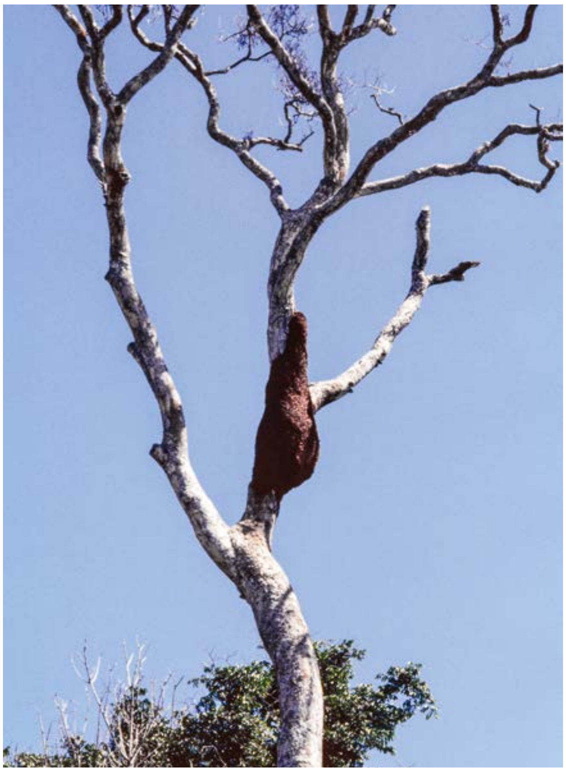
ECUADOR: PAST, 1000m
Llandia (17 km N. Puyo)
20 VII 1994, F. Génier
remnant rain for., feces tr.



Trigona amazonensis
(Ducke, 1916)
sensu Schwarz
Det. Camargo, 1996

Exposed nest in a jauari palm tree, at 10 m above the ground • Habitat: Tall *terra firme* forest, Brazil nut stand • Camaruã, 15 km, Purus, AM • 31/01/1986

Nest fixed to a live tree trunk • Habitat: *Várzea* • Paraíso, Rio Japurá, AM • 20/08/1993



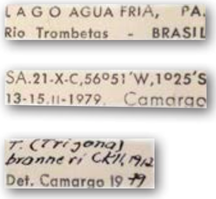
Arboreal nest, fixed to a trunk • Habitat: Dense forest, island • Camanaus, Rio Negro, AM • 12-14/07/1980

Nest entrance

Brood combs from an exposed nest fixed to a trunk • Habitat: Dense forest, island • Camanaus, Negro River, AM • 12-14/07/1980

Trigona branneri Cockerell, 1912

Common names: guaxupé, abelha-corta-cabelo, arapuá, irapuá, topoé-negra, mehñy-tyk, nawa-bakû, mbulo-oni, kankantii-oni. Pollinates acapu (*Vouacapoua americana*) and camu-camu (*Myrciaria dubia*) flowers. Visits Brazil nut (*Bertholletia excelsa*) flowers.

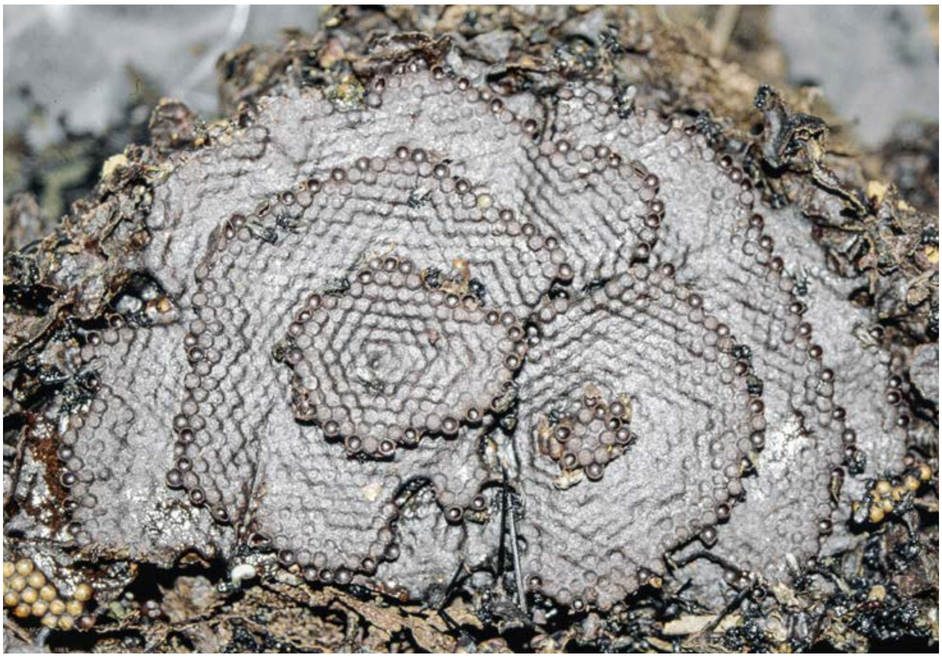

LAGO AGUA FRIA, PA.
Rio Trombetas - BRASIL

SA.21-X-C,56°51'W,1°25'S
13-15.II-1979. Camargo

T. (Trigona)
branneri Ckll, 1912
Det. Camargo 1979

Exposed nest fixed to a *tucumã* trunk, at 3 m above the ground • Habitat: *Roçado*, *terra firme* • Bacururu, Juruá River, AM • 01/08/1993

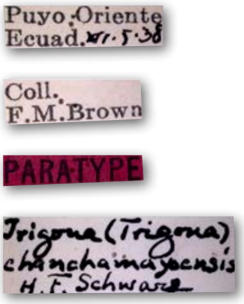
Arboreal nest fixed to a jauari palm trunk • Habitat: Terra firme, *igapó* margin, Tall forest of Brazil nut trees • Ipixuna, Purus 57 km, Tapauá, AM • 17/01/1986



Brood combs from an exposed nest fixed to a *tucumã* trunk, at 3 m above the ground • Habitat: *Roçado, terra firme* • Bacururu, Rio Juruá, AM • 01/08/1993

Trigona chanchamayoensis Schwarz, 1948

Common names:
cupira, imrê-ti-re,
arapuá-amarelo-menor.



Puyo:Oriente
Ecuad. XI·5·38

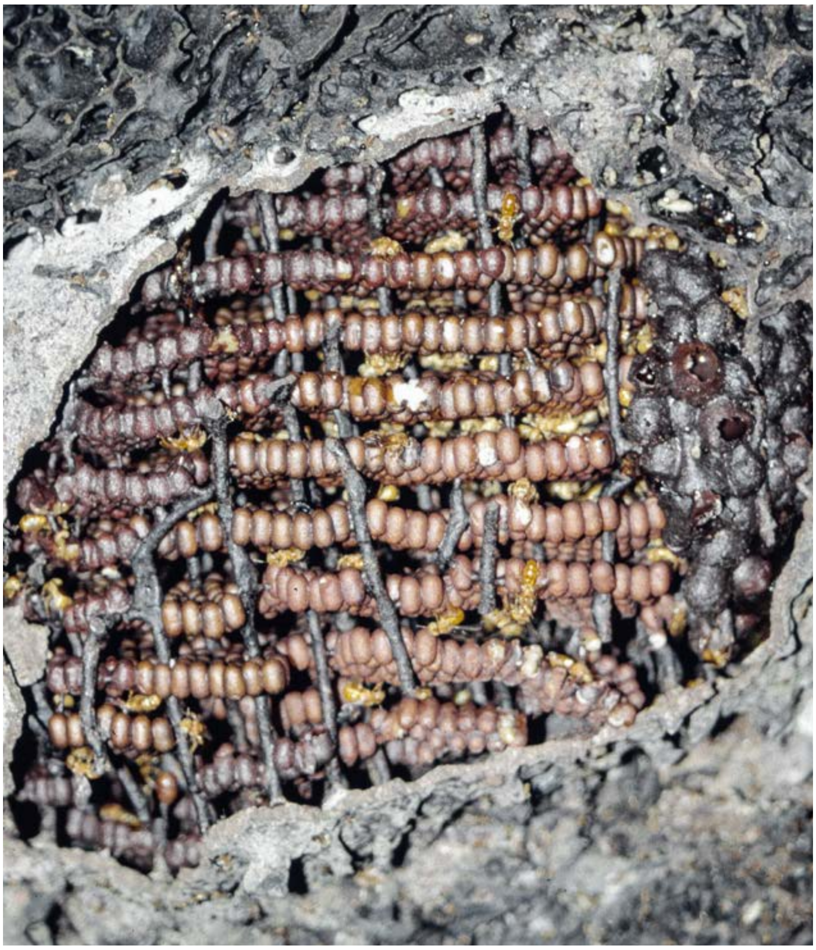
Coll.
F.M. Brown

PARATYPE

Trigona (Trigona)
chanchamayoensis
H.F. Schwarz

🟩 *Trigona chanchamayoensis*

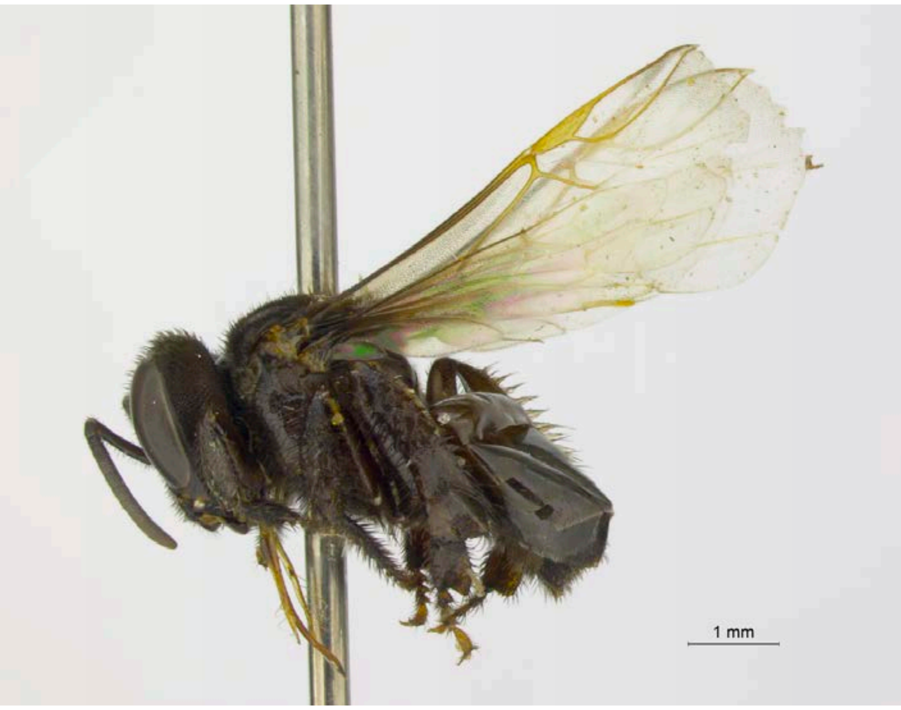
Nest within an arboreal termite nest, also inhabited by *taragua* ants • Habitat: Dense floodplain forest and flattened relief • Tauari, PA • 01-29/01/1979

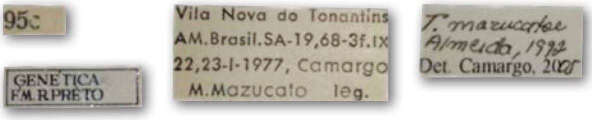


Nest within a termite nest that was overtaken by *taraqua* ants, fixed to a vine at 3 m above the ground • Habitat: *Várzea* forest • Igarapó Jaraqui, Rio Juruá, AM • 28/07/1993

Trigona cilipes (Fabricius, 1804)

Common names: angelita, buhnide, mehnôrá-kamrek.





95c

GENETICA
F.M.R.PRETO

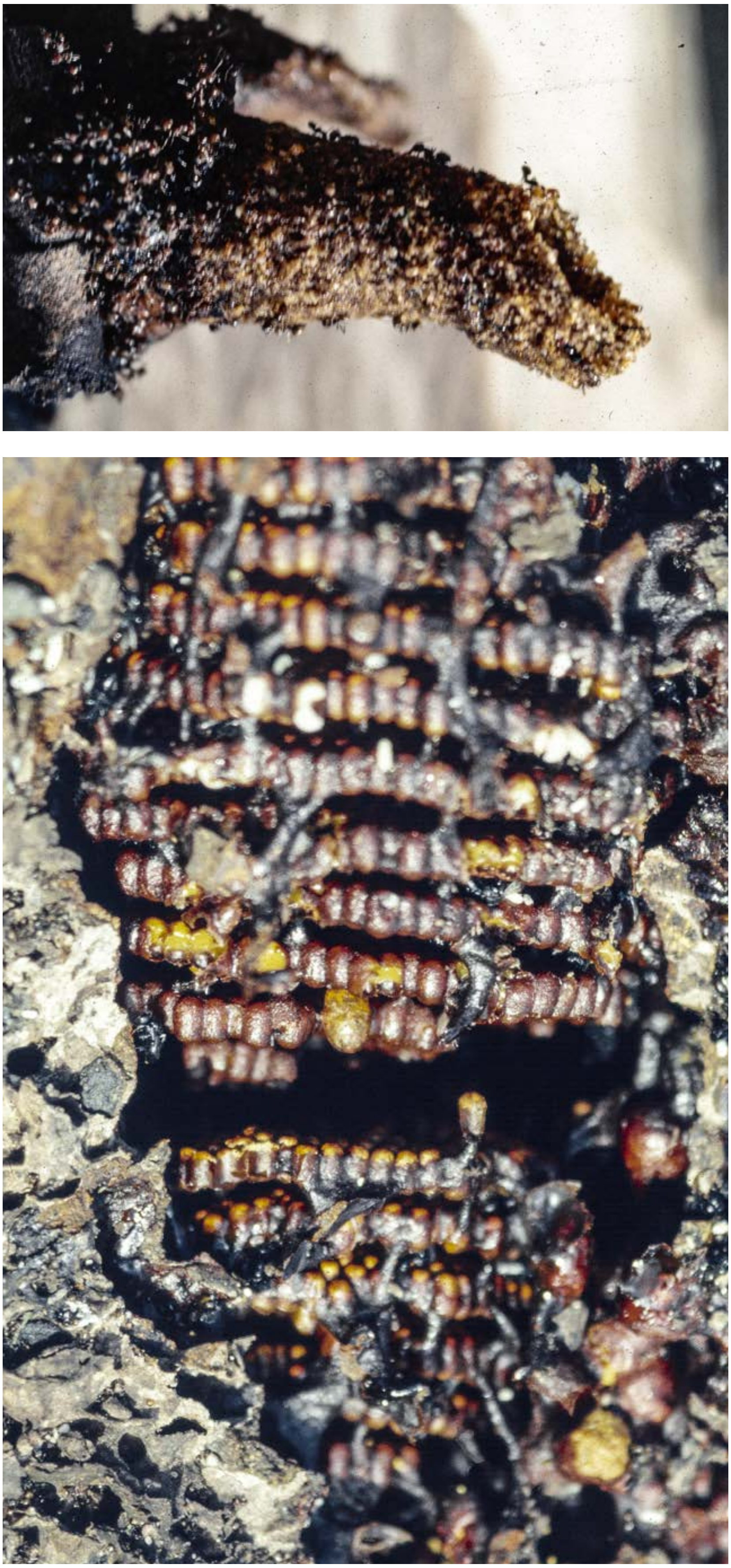
Vila Nova do Tonantins
AM.Brasil.SA-19,68-3f.IX
22,23-I-1977, Camargo
M.Mazucato leg.

T. mazucatoi
Almeida, 1992
Det. Camargo, 2005

Nest within a termite nest on a dry tree trunk • Habitat: *Igapó* • Carixeno, Rio Negro, AM • 08/07/1999

Nest within a live arboreal ant nest (*tachi*), in an orange tree • Habitat: Dense, sub-montane forest, dissected relief • Mouth of the Rio Curicuriari, AM • 15-21/07/1980

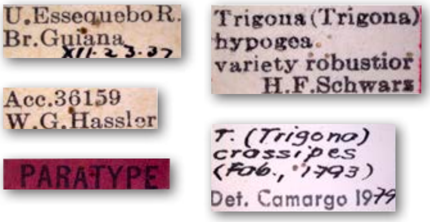
Trigona cilipes



Nest within a live arboreal ant nest (*tachi*), in an orange tree • Habitat: Dense, sub-montane forest, dissected relief • Mouth of the Rio Curicuriari, AM • 15-21/07/1980

Trigona crassipes (Fabricius, 1793)

Common names: sombra-de-sucha, fisi-wasi-wasi-oni.



U.Essequebo R.
Br.Guiana
XII-23-37

Acc.36159
W.G.Hassler

PARATYPE

Trigona (Trigona)
hypogea
variety robustior
H.F.Schwarz

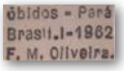
T. (Trigona)
crassipes
(Fab., 1793)
Det. Camargo 1979

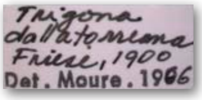
Nest entrance in a cream nut tree cavity • Habitat: *Roçado, terra firme* • Lago Uará, Rio Solimões, AM • 13/08/1993

Nest within a live *fava* tree cavity, at 5 m above the ground • Habitat: *Terra firme* forest, 30 to 40 m high • Ipixuna, Purus, 42 km Tapauá, AM • 22/01/1986

Trigona dallatorreana Friese, 1900

Common names: sicae-amarilla-chica, kukraire, tu.


óbidos - Pará
Brasil.I-1962
F. M. Oliveira.


Trigona
dallatorreana
Friese, 1900
Det. Moure. 1966

Exposed nest, fixed to
marimari tree branches
• Habitat: *Várzea* forest •
Paraíso, Rio Japurá, AM •
21/08/1993

Trigona dimidiata Smith, 1854

Visits Brazil nut (*Bertholletia excelsa*) flowers.

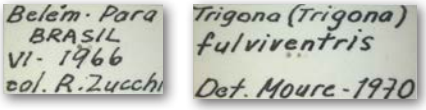
Rio Trairão. PA – Brasil
(50 km NE Gradaús)

SB-22,51°49'W,7°21'S
21,24-VII-79. Mazucato

T. dimidiata
Smith, 1854
Det. Camargo, 200~~6~~7

Trigona guianae Cockerell, 1910

Common names: txashkû-taxipa, djô. Pollinates coconut (*Cocos nucifera*) flowers and visits Brazil nut (*Bertholletia excelsa*) flowers.


Belém · Pará
BRASIL
VI - 1966
col. R. Zucchi

Trigona (Trigona)
fulviventris
Det. Moure - 1970

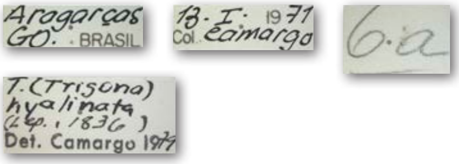
Nest within a dry trunk, with termites • Habitat: Mixed sub-montane forest, plateau and low plateaus, *campinas* • São Luís do Tapajós, PA • 14-17/01/1979

Underground nest • Habitat: Dense forest, lowlands, plateaus • Aruti, Rio Negro, AM • Data: 22-23/07/1980

Brood combs

Trigona hyalinata (Lepeletier, 1836)

Common names: xupé, abelha-brava, guaxupé, arapuá, timba-preta. Pollinates guava (*Psidium guajava*), sunflower (*Helianthus annuus*) and cucurbits (*Cucurbita* spp.) flowers. Visits cotton (*Gossypium hirsutum*) and coffee (*Coffea arabica*) flowers.


Aragarças
GO. BRASIL

13·I· 1971
Col. Camargo

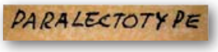
6·a

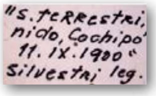
T.(Trigona)
hyalinata
(Lep., 1836)
Det. Camargo 1979

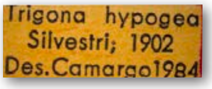
Exposed nest • Habitat: Hillside, with a very smooth vertical layer of sandstone • Alto Parnaíba, 18 km SW, MA • 23/01/1993

Trigona hypogea Silvestri, 1902

Common name:
mombuca-carnívora.

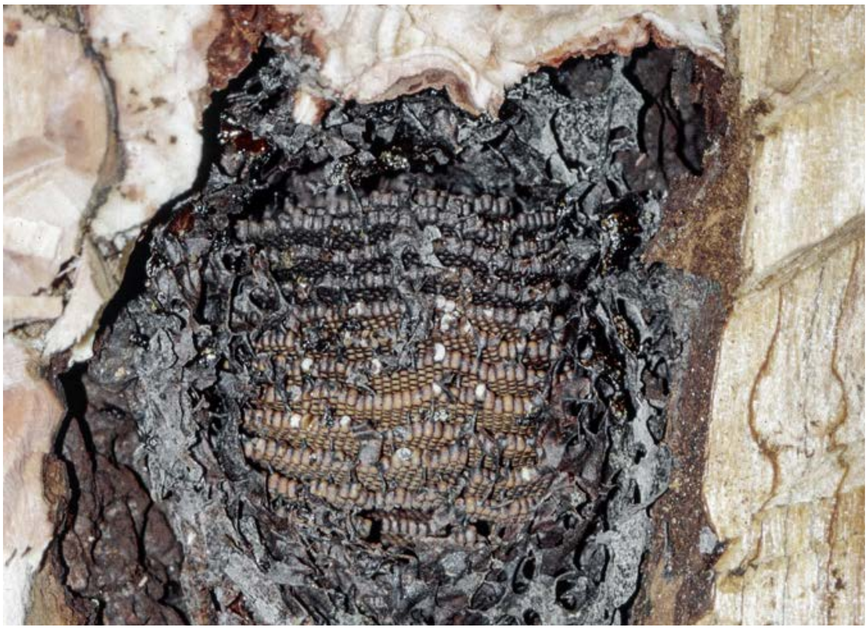

PARALECTOTYPE


"S. terrestri,
nido, Cochipo'
11. IX. 1900"
Silvestri leg.


Trigona hypogea
Silvestri; 1902
Des. Camargo 1984

Nest entrance in a fallen, dead tree cavity • Habitat: Floodplain • Santa Maria, Itaituba, PA • 18-20/01/1979

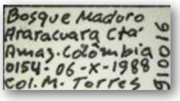
Nest in a fallen, dead tree cavity • Habitat: Floodplain • Santa Maria, Itaituba, PA • 18-20/01/1979



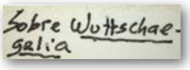
Nest within a live yellow mombin tree cavity • Habitat: *Terra firme*, pasture, forest fallen in 1990 • Bacururu, Rio Juruá, AM • 31/07/1993

Trigona pallens (Fabricius, 1798)

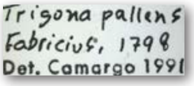
Common names: cutia-o-de-purga, colatakwa, tuu, myre, oloman-oni, lebi, redi-oni. Pollinates murici (*Byrsonima crassifolia*), acapu (*Vouacapoua americana*), camu-camu (*Myrciaria dubia*), açaí (*Euterpe oleracea*) and yellow mombin (*Spondias mombin*) flowers. Visits cupuaçu (*Theobroma grandiflorum*) and muskmelon (*Cucumis melo*) flowers.



Bosque Madoro
Araracuara Cta'
Amaz. Colombia
0154-06-X-1988
Col. M. Torres
910016



Sobre Wuttschae-
galia



Trigona pallens
Fabricius, 1798
Det. Camargo 1991

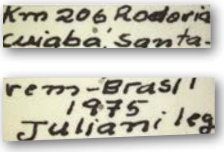
Nest within a termite nest in a hollow tree • Habitat: Tall forest, *terra firme* • Tefé, AM • 28/01/1977

Nest within hollow tree • Habitat: Dense forest, lowlands • Acanga, Rio Negro, AM • 06-08/08/1980

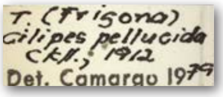
Nest within a hollow tree • Habitat: Dense forest, lowlands, plateaus • Acanga, Rio Negro, AM • 06-08/08/1980

Nest within a termite in a hollow tree • Habitat: Tall forest, *terra firme* • Tefé, AM • 28/01/1977

Trigona pellucida Cockerell, 1912



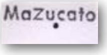
Km 206 Rodoria
cuiabá Santa-
rem-Brasil
1975
Juliani leg

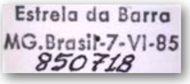


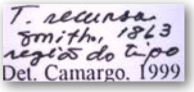
T. (Trigona)
cilipes pellucida
Ckll.; 1912
Det. Camargo 1979

Trigona recursa Smith, 1863

Common names: vamos-embora, feiticeira, vamo-nos-embora, puka-kam-mehn. Pollinates camu-camu (*Myrciaria dubia*), bell pepper (*Capsicum annuum*) and strawberry (*Fragaria x ananassa*) flowers. Visits cotton (*Gossypium hirsutum*) flowers.


Mazucato

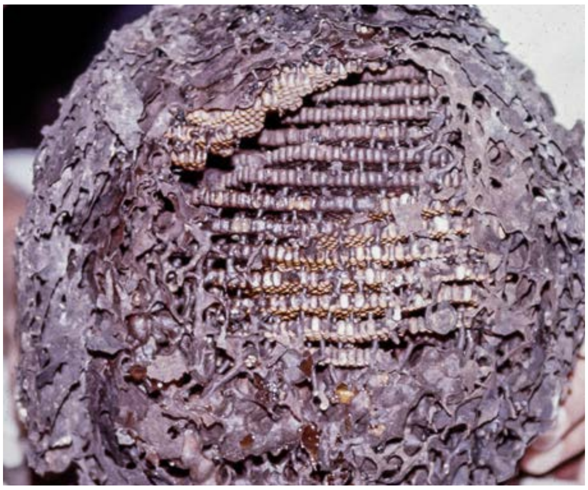

Estrela da Barra
MG.Brasil-7-VI-85
850718


T. recursa
Smith, 1863
região do tipo
Det. Camargo. 1999

Trigona recursa

Original drawing by J. M. F. Camargo; (Diário de Viagem Negro River, 1999).

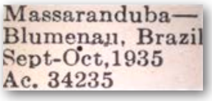
Underground nest, at 90 cm below ground, without termites or ants • Habitat: *Roçado* close to tall, *terra firme* forest • Location: São Paulo de Olivença, AM • Data: 20/01/1977



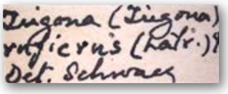
Trigona spinipes (Fabricius, 1793)

Common names: irapuá, arapuá, abelha-de-cachorro, xupé-pequeno, urapuca, mbá-pý, carabozá, mehñykamrek.

Pollinates canola (*Brassica napus*), guava (*Psidium guajava*), cucurbits (*Cucurbita* spp.), umbu (*Spondias tuberosa*), muskmelon (*Cucumis melo*), yellow mombin (*Spondias mombin*), coconut (*Cocos nucifera*), macadamia nut (*Macadamia integrifolia*), annato (*Bixa orellana*), sunflower (*Helianthus annuus*), orange (*Citrus sinensis*), eggplant (*Solanum melongena*), mandarin orange (*Citrus reticulata*), onion (*Allium cepa*), strawberry (*Fragaria x ananassa*), chayote (*Sechium edule*), avocado (*Persea americana*), acerola (*Malpighia emarginata* and *M. glabra*), peach (*Prunus persica*), Barbados nut (*Jatropha curcas*), bell pepper (*Capsicum annuum*), wild carrot (*Daucus carota*), pomegranate (*Punica granatum*), watermelon (*Citrullus lanatus*) flowers.



Massaranduba—
Blumenau, Brazil
Sept-Oct,1935
Ac. 34235

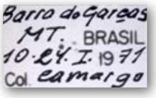


Trigona (Trigona)
ruficrus (Latr.)
Det. Schwarz

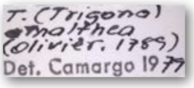
Exposed nest • Habitat: Coconut tree stand – Cerrado-Caatinga transition (babassu palm, carnauba palm, *cerrados* • Nina Rodrigues, MA • 17/07/1982

Trigona truculenta Almeida, 1984

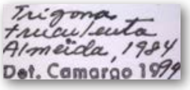
Common names:
sanharó, sanharão.



Barro do Garças
MT. BRASIL
10-24. I. 1971
Col. Camargo



T. (Trigona)
amalthea
(Olivier, 1789)
Det. Camargo 1977

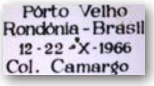


Trigona
truculenta
Almeida, 1984
Det. Camargo 1994

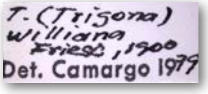
Nest within a dead *apuí* tree, strangling vine • Habitat: *Terra firme* forest • Nazaré, Rio Negro, AM • 16/07/1999

Trigona williana Friese, 1900

Common name: kajawo-dawa.



Pôrto Velho
Rondônia - Brasil
12 - 22 - X - 1966
Col. Camargo



T. (Trigona)
williana
Friese, 1900
Det. Camargo 1979

Trigona williana

Nest entrance

Nest within a dry, rotten tree • Habitat: *Capoeira, terra firme* • Forte da Graça, Juruá River, AM • 03/08/1993

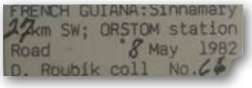
Genus

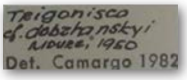
Trigonisca Moure, 1950

Source: Camargo JMF, Pedro SRM (2013) Meliponini Lepeletier, 1836. In: Moure JS, Urban D, Melo GAR (Orgs) Catalogue of Bees (Hymenoptera, Apoidea) in the Neotropical Region – online version.

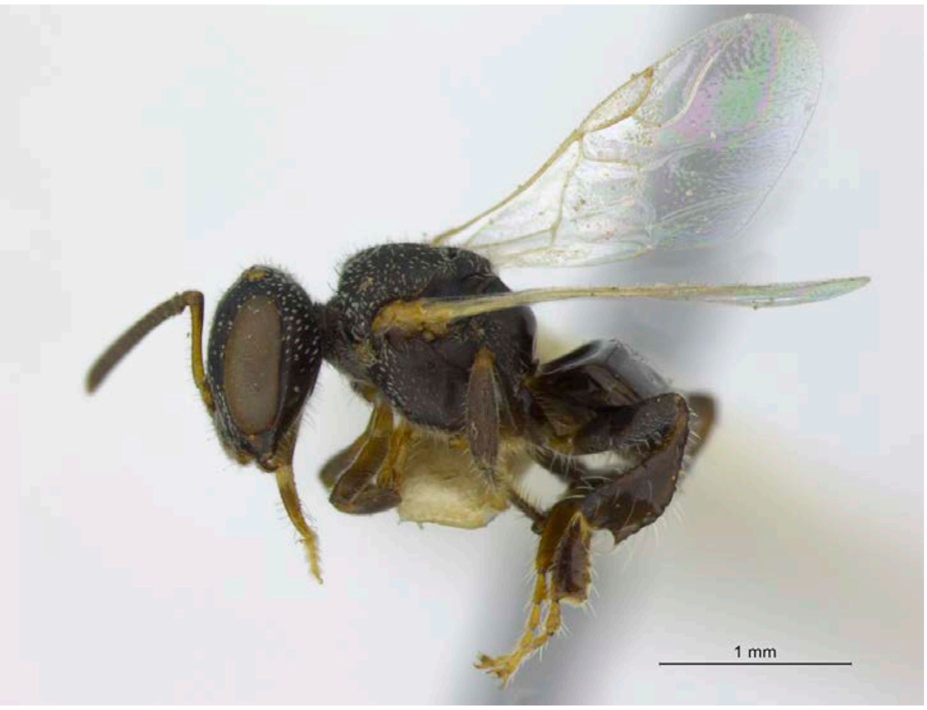
Trigonisca dobzhanskyi (Moure, 1950)

🟩 *Trigonisca dobzhanskyi*

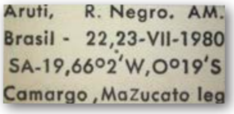

FRENCH GUIANA:Sinnamary
27km SW; ORSTOM station
Road 8 May 1982
D. Roubik coll No.66

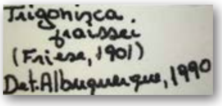

Trigonisca
cf. dobzhanskyi
Moure, 1950
Det. Camargo 1982

Trigonisca fraissei (Friese, 1901)

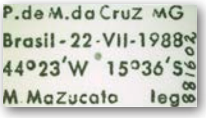



GENETICA
F.M.R.PRETO


Aruti, R. Negro. AM.
Brasil - 22,23-VII-1980
SA-19,66°2'W,0°19'S
Camargo ,MaZucato leg


Trigonisca.
fraissei
(Friese, 1901)
Det. Albuquerque, 1990

Trigonisca meridionalis Albuquerque & Camargo, 2007



P.de M.da CruZ MG
Brasil - 22 - VII - 1988
44°23'W 15°36'S
M. MaZucato leg
8816902

HOLOTYPE
Trigonisca
meridionalis
Albuquerque &
Camargo, 2006

Trigonisca variegatifrons Albuquerque & Camargo, 2007

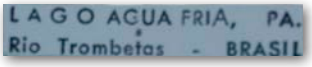

LAGO AGUA FRIA, PA.
Rio Trombetas - BRASIL

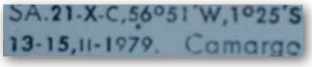
SA.21-X-C,56°51'W,1°25'S
13-15,II-1979. Camargo

HOLOTYPE
Trigonisca
variegatifrons
Camargo, 1990

Trigonisca vitrifrons Albuquerque & Camargo, 2007

Visits Brazil nut (*Bertholletia excelsa*) flowers.


LAGO AGUA FRIA, PA.
Rio Trombetas - BRASIL


SA.21-X-C,56°51'W,1°25'S
13-15,II-1979. Camargo


HOLOTYPE
Trigonisca
vitrifrons
Camargo, 1990

Organism index

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Photos and Drawings

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Daniela C. Zappi: 25, 28

Coleção Entomológica "Prof. J. M. F. Camargo": Front cover, 36, 37, 38, 50, 51, 67, 81, 85, 87, 89, 95, 101, 104, 107, 114, 117, 119, 121, 124, 126, 128, 131, 133, 135, 136, 139, 144, 150, 155, 157, 159, 162, 164, 165, 167, 170, 174, 177, 178, 181, 186, 191, 192, 196, 198, 201, 202, 204, 206, 209, 215, 217, 219, 223, 227, 228, 231, 233, 234, 236, 237, 239, 241, 242, 244, 246, 249, 251, 253, 254, 256, 257, 260, 262, 264, 266

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Title page: *Trigona pallens* (photo by J.M.F. Camargo; Coleção Entomológica "Prof. J. M. F. Camargo")

Forth cover: *Partamona* nests in Amazonian landscape (source: Camargo JMF, Pedro SRM (2003) Meliponini Neotropicais: O gênero *Partamona* Schwarz, 1939 (Hymenoptera, Apidae, Apinae): bionomia e biogeografia. Revista Brasileira de Entomologia 47: 311-372)

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