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BEE FAUNA OF SOME TROPICAL AND EXOTIC FRUITS: POTENCIAL POLLINATORS AND THEIR CONSERVATION

Marina Siqueira de Castro

ABSTRACT

Pollinators play an important role in the reproductive success and gene flow in many agricultural and native plants and the plants produce important food sources for the pollinators. The bee community of a mixed orchard was studied at an experimental Station in the state of Bahia, Brazil. At this station, 32 species of native tropical and exotic fruits were studied.

The data showed the importance of stingless bees (Apidae; Meliponinae) as potential pollinators for some native tropical fruit trees. Apidae was the most abundant bee family, while Anthophoridae showed higher diversity (species richness). A total of 95 species of Apoidea were observed and collected. Some patterns of bee species composition and relative abundance was studied. These ecological studies are important for the conservation of plants and bee biodiversity.

INTRODUCTION

Maintaining the biological diversity of potential pollinators in agricultural ecosystems is not easy. However, it is necessary for the sustainability of agricultural crops that depend on these pollinators. In this context, bees play a prominent role in pollen transfer.

Agricultural politics still emphasize the short term gains and high productivity often leading to the erosion of soil, contamination of water, fragmentation of natural ecosystems, loss of cultural and biological diversity and other environmental problems. The severity of these impacts depend on the technological level the production system adopted. The expansion of the agricultural borders is always linked to the use of a reduced number of agricultural crops with few varieties. Thus, monocultures occupy great expanses of land which degrades the genetic diversity of all wildlife.

New perspectives for the expansion of agriculture in a global economy are opening in the direction for sustainable production. Although biodiversity does not stem from the concept of sustainability, it is essential for agricultural production. It is the key for production of balanced agricultural systems, offering both socioeconomic and environmental benefits. Crop productivity is a benefit that is entirely dependent upon pollination to produce fruit and seeds. Many bee species contribute to the pollination of the agricultural crops, the most common of which (Africanised honey bee) is neither the only or the most important pollinator.

At the regional level, several ecosystems of Bahia State, northeast of Brazil, present a great diversity of bees. The Apoidea diversity of the natural ecosystems of Bahia has been systematically studied for the last ten years as follows:

- Caatinga - Casa Nova (Martins 1990; Castro 1994)
- Milagres (Castro in preparation)
- Itatim (Monteiro *et al.* 1998)
- Campos rupestres with cerrado elements
- Lençóis (Martins 1995; Viana 1992)

- Fragments of Atlantic forest - Conceição do Almeida, (Castro and Oliveira 1998), Caravelas and Mucuri (Lima *et al.* 1998)
- Fragments of dunes (litorâneas) with "restinga" vegetation - Abaeté/Salvador, (Viana in preparation) and Parque Pituaçu, (Ramalho *et al.* 1998; Ramalho and Silva 1998)
- Dunes of San Francisco river - Ibiraba, (Viana in preparation); forests of Ibiraba - San Francisco River (Neves and Viana 1998)

Studies on agricultural crops in Bahia are scarce. Thus, with the objective of enhancing knowledge about the diversity of potential pollinators in agricultural ecosystems in Bahia, we conducted field observations of bees visiting 32 fruit trees of various species, in a mixed orchard.

METHODS

The study site

Location: the study was conducted at the Experimental Station of Tropical Fruits (Empresa Baiana de Desenvolvimento Agrícola - EBDA), 159 km northwest from Salvador and 60 km from the Atlantic ocean coast. The Station is located at Conceição do Almeida Province, Bahia State, Northeast of Brazil, 12º45'S; 39º11'W, altitude 190m (Fig 1). The local climate is hot (28ºC mean annual temperature) and humid (65 - 90% mean annual relative humidity). At the study site, 60 native tropical and exotic fruit species grow in an area of 82-ha. In addition, this Station was comprised of a small Atlantic forest fragment (18 ha) subject to intense human activity.

Bee sampling

Sampling of bees visiting the flowers of 20 fruit tree species was carried out systematically, from September 1996 to March 1998. The sampling of pollinators was based on the standardised methods from Sakagami, Laroca and Moure (1967). In addition, 12 fruit species were sporadically observed.

Over 4,809 bees were collected visiting fruit flowers The bees were identified by Dr. Jesus de Santiago Moure. Voucher specimens of our survey were deposited at the Bee Laboratory Collection of EBDA.

RESULTS

A total of 95 bee species (Apoidea) were recorded in the mixed orchard containing 32 fruit species. Apidae was the most abundant family, representing about 79.5 % of the observations.

Despite the relatively small number of species (14), highly eusocial bees represented more than 3/4 of all fruit flower-visiting bees. The Africanized honey bee *(Apis mellifera scutelatta* L.) was the most abundant species, representing 41.1% of all individuals or 51.7% of all highly eusocial bees. Of the stingless bees (fig. 2), 5 species can be considered frequent visitors to the flowers, representing 1% or more of the sample, and 8 species can be considered rare. Anthophoridae family showed higher diversity (38 species).

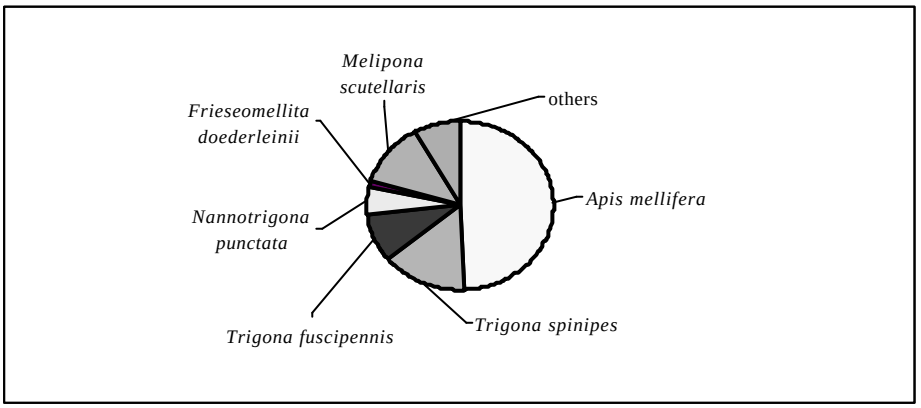

FIGURE 2 - Abundance of flower visiting highly eusocial bees. Others: *Partamona helleri* (Friese, 1900), *Trigonisca* sp1*, Trigonisca* sp2, *Nannotrigona testaceicornis* (Lepeletier, 1836), *Melipona asilvai* (Moure, 1971)*, Melipona subnitida*.(Ducke, 1910).

Fruit trees and their potential pollinators

The bee visitors of the 32 species of fruit tree studied systematically (20) and sporadically (12) are represented in table 1 and fig. 3. The visiting bees of the fruit trees are considered in greater detail as follows:

ACEROLA (*Malphighia punicifolia* L.)

Presently some of the largest plantations of acerola are in Brazil. These small trees with red, pink and white flowers have fruits that are being used more and more as a rich source of vitamin C. Some botanical families, like Malphighiaceae, have oil glands in their flowers which is collected by certain species of the Anthophoridae family, mainly *Centris*. *Centris* is one of the most important groups of pollinators of Tropical America. Several species of *Centris* were observed visiting the "acerola" flowers: *Centris dirrhoda* (Raw 1979); *Centris*

fuscata, C. aenea and *C. sponsa* (Melo *et al.* 1997) and *Centris flavifrons*, (Magalhães and Oliveira 1998). This trend continued at the study site in Bahia where the acerola was mainly visited by species of the genus *Centris* and *Centris aenea* was the most abundant (42.6%) (Castro, 1998). In the caatinga, a semi arid ecosystem, it was found that *Centris (Hemisiella) tarsata* (71.4%) was the most important visitor of acerola flowers (observations done in the period of October/1996 to March/1999 in Milagres (12º53' S and 39º51' W), Bahia.

AVOCADO (*Persea americana* Mill.)
In many places, the avocado has the honey bee (*Apis mellifera* L.) as its main pollinator (Ish-Am and Eisikowitch, 1993). In Brazil, Silva *et al.* (1998) found a predominance of the Africanised honey bees (89.3%) visiting flowers of avocado, mainly for pollen collection. Other less abundant species found were *Trigona spinipes* (4.7%) and *Tetragonisca angustula* (1%). These results also demonstrated a predominance of the Africanised honey bee visiting avocado flowers (85.8%). Other less abundant species were *Melipona scutellaris* (5.6%), *Frieseomelitta doederleinii* (4.2%) (Castro and Silva, 1998) and the rare ones were *Nannotrigona punctata, Partamona helleri, Trigona spinipes* and *Melipona subnitida.*

COCONUT - (*Cocus nucifera* L.)
Coconut is an important palm on the northeast coast of Brazil. It is a known nectar source for the honey bees (Crane *et al*. 1984). In Bahia, in Mata de São João, "Praia do Forte" beach (12º 31' 47"S, 38º18' 00"W), the coconut was visited mainly by the Africanised honey bee (76%) and by *Auglochlora (Augochlora*) *sp.* n. Moure (about 23%). Other species of Halictidae *Dialictus (Dialictus*) *sp.* n. Moure, was a rare visitor. Africanised honey bees mainly visited the high palms (more than 10 meters), while *Augochlora (Augochlora*) visited shorter palms(Castro and Viana 1997). In this study, the flowers of the coconut were predominately visited by the stingless bee *Trigona spinipes*.

GUAVA (*Psidium guajava* L.)
Some species of the Myrtaceae family are economically important in Brazil. Species with fruits are known and cultivated in the coastal area: guava; rose apple, malay rose apple, watery rose apple and jambolam (*Eugenia spp.*). Despite of the economic importance of Myrtaceae, very little is known about its pollination and importance to bees. In the mixed orchard, the bee visitors of some cultivars of guava (araçá, thais large guava and rubby supreme) were observed. Apidae was the most abundant family (82.8%). *Apis mellifera* (21.6%), *Nannotrigona punctata* (19.8%), *Trigona spinipes* (19%) and *Melipona scutellaris* (12.9%) were the predominant species (Castro and Araújo, 1998).

MABOLO (*Diospyrus discolor*) and PERSIMMON (*Diospyrus kaki*)
The family Ebenaceae comprises 4 genera distributed in the tropical and subtropical areas. The genus *Diospyrus* includes the well-known fruit tree species khaki (*Diospyrus kaki* L.) and the less known mabolo (*Diospyrus discolor* Willd). These fruit trees are being successfully cultivated in the Bahia State. Our sporadic observations on persimmon flowers revealed visitation by the Africanised honey bee (85.7%) and *Centris* (*Paremisia*) *fuscata* (14.3%). McGregor (1976) found honey bees collecting nectar and pollen from persimmon flowers and he listed mabolo as dependent on insects for pollination (McGregor, 1975). We found females of *Euglossa securigera* (52.8%) as the most abundant bee visiting male mabolo flowers. Other less abundant visitors were the Africanised honey bee (19.8%) and *Xylocopa* (*Neoxylocopa*) *gricescens* (Anthophoridae) (5.7%).

MACADAMIA (*Macadamia integrifolia*)
Macadamia nuts are becoming more and more commercially important in the Bahia State. The varieties grown come from Hawaii. It adapts very well to climates with abundant precipitation distributed thoughout the year (1200 to 1600mm). Queensland Studies in Queensland, Autralia the 1980s showed that *Trigona* were more effective pollinators than honey bees (Roubik, 1995). We collected 13 species of Apoidea visiting macadamia flowers,

with 90% being Apidae. The most abundant visiting species were *Trigona spinipes* (44.1%), *Apis mellifera scutellata* (28.6%), *Nannotrigona punctata* (9.4%) and *Trigona fuscipennis* (7.7%) (Castro *et al.* 1998).

PHALSA (*Grewia asiatica*)
A large number of insects visit the yellow flowers of *Grewia asiatica*. In India, Manzoor-ul-haq *et al.* (1979) found 27 species of Hymenoptera, Lepdoptera and Diptera visiting phalsa flowers. *Apis florea* and several species of *Halictus* (Halictidae) and *Andrena* (Andrenidae) were the most common visitors. Parmar (1976), also in India, observed that honey bees were the most abundant visitors, and pollinated the flowers while collecting nectar. In this study, it was found that 30 bee species visited phalsa flowers. The most abundant among them were the Africanised honey bees (32.5%), *Melipona scutellaris* (28.1%), *Exomalopsis* (*Phanomalopsis*) sp.1 (18.1%) and *Xylocopa* (*Neoxylocopa*) *suspecta* (6.6%) and can be considered the potential pollinators of phalsa flowers.

PITOMBA (*Talisia esculenta*)
The family Sapindaceae, with 140 genera distributed in the tropical and subtropical areas, includes several species of *Talisia* that are important edible fruits in the Amazon region and northeastern Brazil. We found 11 different bee species visited the "pitomba" flowers. The most abundant were the Africanised honey bee (54.6%), the stingless bee *Melipona scutellaris* (32.2%) and *Augochloropsis* (*Augochloropsis*) *calicroa* (Halictidae*)* (6.2%).

STARFRUIT (*Averrhoa carambola* L.)
The Asian tropical starfruit (*Averrhoa carambola* L.) is generally dispersed along the Brazilian coast. Their flowers are visited by honey bees (*Apis cerana*), flies and other insects in India (Nand, 1971). Phoon (1985) observed *Apis cerana* and *Trigona thoracicia* as the most common bee visitors of starfruit in Malaysia. In this study, it was found that there were 39 bee species visiting the pink flowers of starfruit distributed amoung 5 bee families of which Anthophoridae was the most diverse (17 species). The most abundant bees were the Africanised honey bees (50%), *Exomalopsis* (*Phanomalopsis*) sp1 (11%), *Augochloropsis* (*Augochloropsis*) *calicroa* (8.1%) and *Exomalopsis* (*Exomalopsis*) *auropilosa* (5.5%).

TAMARIND (*Tamarindus indica*)
Pollination experiments conducted on tamarind trees indicate that cross-pollination is required. The bee *Apis dorsata* is the main bee pollinator of this fruit tree in its native India (Free 1993). The bee visitors of the tamarind flowers were observed in two areas in Bahia, in a mixed orchard (sub-humid climate) and at caatinga (a semi arid ecosystem), in Milagres. In total, 22 species were found visiting the tamarind flowers in the mixed orchard and 14 species at caatinga. Three species were collected in both areas: *Apis mellifera, Centris (Centris) aenea* and *Centris (Paremisia) fuscata*. *Apis mellifera* was not important to tamarind flowers in the mixed orchard (1 specimen). At caatinga it was relatively abundant (18.5%). The most abundant bee visitors of the *Tamarindus* flowers in the mixed orchard were *Centris (Heterocentris) analis* (20.8%), *Centris (Centris) aenea* (18.2%), *Xylocopa (Neoxylocopa) suspecta* (14.3%) and *Centris (Paremisia) fuscata* (11.7%). At caatinga the most abundant bee visitors were *Partamona cupira* (34.1%); *Apis mellifera scutelatta* (18.5%); *Trigona spinipes* (13.7%); *Centris (Hemisiella) tarsata* (12.3%) and *Ceratina (Crewella) madeirae* (10.3%). The results above indicate that these species are the possible pollinators of the tamarind (Castro and Oliveira,1998).

WAMPI (*Clausena lanseum*); SWEET ORANGE *(Citrus sinensis)* and SAPOTA BRANCA (*Casimora edulis*)
Some species of the family Rutaceae are often visited by bees. *Citrus* species are well known for its fruits. Other Rutaceae fruit trees are less known but also pollinated by bees. In this study, bees were found visiting *Citrus sinensis*, *Casimora edulis* (sapota branca) and

Clausena lausium (wampi). Apidae was the most abundant family visiting. Wampi was mainly visited by the Africanised bee (92%) and sapota branca by *Trigona spinipes* (95.7%). *Citrus* was visited by 13 different species of bees but *Trigona spinipes* (60.2%) and *Apis mellifera* (26.7%) were the most abundant in its flowers.

The questions for conservation and sustainable use of pollinators, with emphasis on bees and recommendations.

Efforts to preserve and restore the wild bee populations in urban, natural and agricultural ecosystems have been made through scientific research, and by several governmental and non governmental agencies, but it must be improved. Some questions are relevant: What is the role of natural ecosystem fragments of different sizes in the maintenance of the diversity of tropical crops? Would mixed orchard be one of the solutions to increase the local diversity of bees (alpha diversity)? What is the role of stingless bees in the pollination of tropical and introduced crops? How does the introduced *Apis mellifera* L. affect the native bees populations? What are the consequences to pollination?

Special programs are needed to improve:
1 - the heterogeneity of agricultural landscape;
2 - the control of pesticides in agricultural areas;
3 - the knowledge on the role of tropical forest fragments to the maintenance of pollinators.

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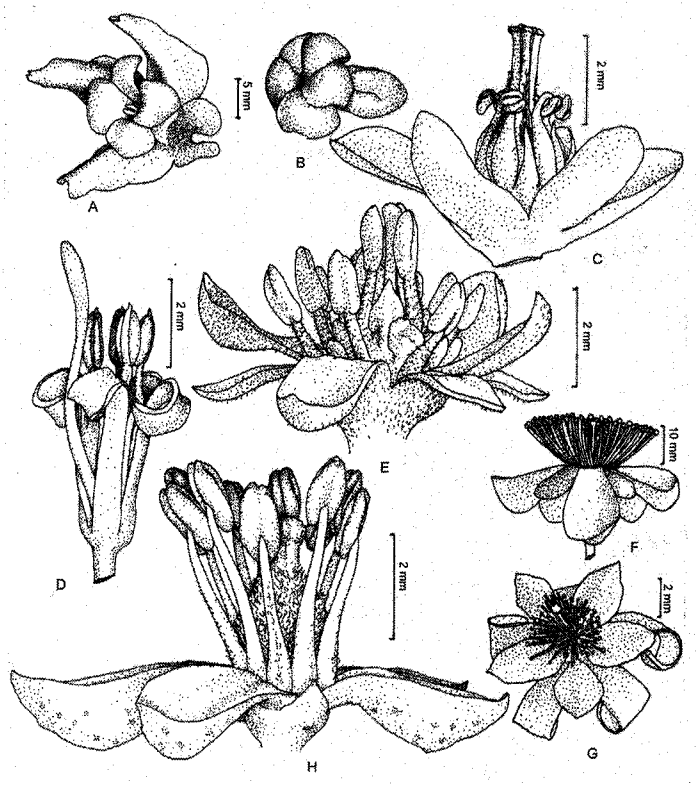
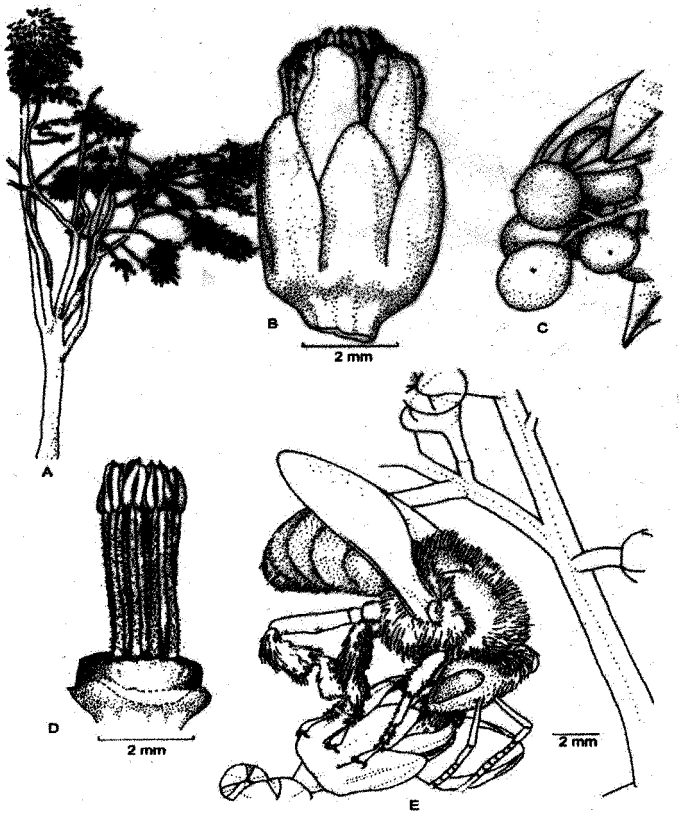
FIGURE 3 - Some studied fruit flowers. (Drawings from Ivan Farias Castro).



A - *Diospyrus kaki*; B - *Diospyrus discolor*; C - *Averrhoa carambola*; D - *Macadamia integrifolia*; E - *Persea americana*; F - *Psidium guajava*; G - *Grewia asiatica*; H - *Clausema lausium*.

FIGURE 4: *Talisia esculenta* Radlk. (Drawings from Ivan Farias Castro).



A - HABIT B - MALE FLOWER C - FRUIT D - NECTARIFEROUS DISC E - *Melipona scutellaris*

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TABLE 1: List of fruits and their potential pollinators (Bahia, Northeast - Brazil) (12º45' s ; 39º11' w)

I - Systematic Observations:

FRUIT SPECIES	**FRUIT FAMILY**	**COMMON NAME**	**APOIDEA FAMILY (relative abundance -** a **- diversity)**	**POTENTIAL POLLINATORS (Abundance - > 5%)**
Averrhoa carambola L.	Oxalidaceae	Starfruit (Carambola)	Apidae (56..3% - 8) Anthophoridae (28.6% - 17) Halictidae (11.3% - 9) Megachilidae (3.7% - 4) Andrenidae (0.1% - 1)	*Apis mellifera scutellata* (50%) *Exomalopsis* (*Phanomalopsis*) sp1 (11%) *Exomalopsis (Exomalopsis) auropilosa* (5,5%) *Augochloropsis* (*Augochloropsis*) *calicroa* (8.1%)
Blighia sapida Koen	Sapindaceae	Ackee (Akee)	Apidae (97.6% - 3) Halictidae (2.4% - 1)	*Trigona fuscipennis* (63.4%) *Apis mellifera scutellata* (33.8%)
Citrus sinensis Osbeck	Rutaceae	Orange (Laranja)	Apidae (90.7% - 4) Anthophoridae (6.8% - 7) Halictidae (2.5% - 2)	*Trigona spinipes* (60.2%) *Apis mellifera scutellata* (26.7%)
Clausena lansium	Rutaceae	Wampi (Uampi)	Apidae (97.2% - 7) Halictidae (0.4% - 1)	*Apis mellifera scutellata* (92%) *Trigona spinipes* (6.4%)
Cocus nucifera L. (*)	Asteraceae	Coconut (Coco)	Apidae (76.9% - 2) Halictidae (23.1% - 2)	*Apis mellifera scutellata* (76%) *Auglochlora* (*Augochora*) sp. n. Moure (22.8%)
Diospyrus discolor Willd.	Ebenaceae	"Mabolo"	Apidae (82.1% - 4) Anthophoridae (11.3% - 5) Halictidae (5.7% - 3) Colletidae (0.9% - 1)	*Euglossa securigera* (52.8%) *Apis mellifera scutellata* (19.8%) *Xylocopa* (*Neoxylocopa*) *gricescens* (5.7%)
Durio zibethinus Mill	Bombacaceae	Durian (Durião)	Apidae (100% - 4)	*Trigona spinipes* (61.7%) *Trigona fuscipennis* (28.6%) *Melipona scutellaris* (7.5%)
Eugenia aquea N.L. Burm.	Myrtaceae	Watery rose apple	Apidae (91.8% - 4) Anthophoridae (8.2% - 2)	*Melipona scutellaris* (55.1%) *Apis mellifera scutellata* (24.5%)
Eugenia jambolana Lam	Myrtaceae	Jambolam (Jamelão)	Apidae (96% - 2) Halictidae (3% - 2) Megachilidae (1% - 1)	*Apis mellifera scutellata* (92%)
Eugenia jambosi L.	Myrtaceae	Rose apple	Apidae (97.2% - 6) Anthophoridae (2.4% - 3) Halictidae (0.4% - 1)	*Trigona fuscipennis* (50.5%) *Apis mellifera scutellata* (26.6%) *Melipona scutellaris* (13.1%) *Trigona spinipes* (5.6%)
Eugenia malaccensis L	Myrtaceae	Malay rose apple (Jambo)	Apidae (100% - 3)	*Apis mellifera scutellata* (95.8%)
Eugenia uniflora L.	Myrtaceae	Brazil cherry (Pitanga)	Apidae (99.4% - 4) Anthophoridae (0.3% - 1) Halictidae (0.3 - 1)	*Melipona scutellaris* (40,2%) *Apis mellifera scutellata* (33,6%) *Trigona spinipes* (22,9%)
Grewia asiatica L.	Tiliaceae	Phalsa (Falsa)	Apidae (64.4% - 6) Anthophoridae (31.6% - 14) Halictidae (3.4% - 8) Megachilidae (1% - 1) Andrenidae (1% - 1)	*Apis mellifera scutellata* (32.5%) *Melipona scutellaris* (28.1%) *Exomalopsis* (*Phanomalopsis*) sp1 (18.1%) *Xylocopa* (*Neoxylocopa*) *suspecta* (6.6%)
Litchi chinensis Sonn	Sapindaceae	Lychee (Lichia)	Apidae (88% - 5) Halictidae (12% - 3)	*Apis mellifera scutellata* (70%) *Nannotrigona punctata* (10%) *Dialictus* (*Chloralictus*) *opacus*

				(8%)
Macadamia integrifolia L.S. Smith	Proteaceae	Macadamia (Macadamia)	Apidae (90.2% - 5) Anthophoridae (4.7% - 2) Halictidae (4.7% - 5) Megachilidae (0.4% - 1)	*Trigona spinipes* (44.1%) *Apis mellifera scutellata* (28.6%) *Nannotrigona punctata* (9.4%) *Trigona fuscipennis* (7.7%)
Malphighia punicifolia L.	Malphighiaceae	Acerola (cereja das antilhas)	Anthophoridae (90.8% - 17) Apidae (8.9% - 4)	*Centris* (*Centris*) *aenea* (42.6%) *Centris* (*Hemisiella*) *tarsata* (11.6%) *Trigona spinipes* (7.6%) *Centris* (*Centris*) *nitens* (6.6%) *Centris* (*Centris*) cfr. *rufiventris* (6.6%) *Epicharis* (*Epicharis*) *flava* (5.3%) *Centris* (*Heterocentris*) *analis* (5%)
Nephelium lappaceum L.	Sapindaceae	Rambutan (Rambutão)	Apidae (79% - 7) Halictidae (18.9% - 5) Anthophoridae (1.2% - 3) Megachilidae (0.2% - 1) Colletidae (0.2% - 1)	*Nannotrigona punctata* (23.9%) *Trigona spinipes* (25.6%) *Apis mellifera scutellata* (23.1%) *Augochloropsis (Augochloropsis) calicroa* (17.2%)
Persea americana Mill.	Lauraceae	Avocado (Abacate)	Apidae (99.0% - 7) Halictidae (1% - 2)	*Apis mellifera scutellata* (85.8%) *Melipona scutellaris* (5.6%)
Psidium guajava L	Myrtaceae	Guava (Goiaba)	Apidae (82.8% - 11) Anthophoridae (12.9% - 5) Halictidae (3.4% - 1) Colletidae (0.9% -1)	*Apis mellifera scutellata* (21.6%) *Nannotrigona punctata* (19.8%) *Trigona spinipes* (19%) *Melipona scutellaris* (12.9%) *Centris* (*Centris*) *aenea* (6%)
Talisia esculenta Radlk.	Sapindaceae	"Pitomba"	Apidae (92.8% - 7) Halictidae (6.2% - 2) Anthophoridae (0.4% - 2)	*Apis mellifera scutellata* (54.6%) *Melipona scutellaris* (32.2%) *Augochloropsis (Augochloropsis) calicroa* (6.2%)
Tamarindus indica L.	Caesalpiniaceae	Tamarind (Tamarindo)	Anthophoridae (79.2% - 8) Apidae (10.3% - 5) Megachilidae (6.6% - 4) Halictidae (3.9% - 2)	*Centris* (*Centris*) *aenea* (18.1%) *Xylocopa* (*Neoxylocopa*) *suspecta* (14.3%) *Centris* (*Paremisia*) *fuscata* (11.7%) *Centris* (*Centris*) *analis* (11.7%) *Trigona spinipes* (7%) *Epicharis* (*Xanthepicharis) bicolor* (6.5%) *Centris* (*Centris*) *spilopoda* (5.2%) *Xylocopa (Neoxylocopa) nigrocincta* (5.2%)

(*) Observations from "Praia do Forte" beach (North of Bahia State) - (Castro & Viana, 1997).

II - Sporadic observations:

Anacardium occidentale L.	Anacardiaceae	Cashew nut (Cajú)	Apidae (100% - 1)	*Apis mellifera scutellata* (100%)
Artocarpus integra (Thumb.) Merr.	Moraceae	Champedack (champedaque)	Halictidae (100% - 1)	*Augochoropsis* (*Paraugochloropsis*) sp. n. Moure & Castro (100%)
Carica papaya L.	Caricaceae	Papaya (Mamão)	Apidae (100% - 1)	*Trigona spinipes* (100%)
Casimoroa edulis Llav.	Rutaceae	"Sapota branca"	Apidae (95.7% - 1)	*Trigona spinipes* (95.7%)

& Alex.			Colletidae (4.3% - 1)	
Diospyrus kaki L.	Ebenaceae	Kaki,Persimmon (Caqui)	Apidae (85.7% - 1) Anthophoridae (14.3% - 1)	*Apis mellifera scutellata* (100%) *Centris* (*Paremisia) fuscata* (100%)
Eryobotrya japonica (Thumb.) Lindl.	Rosaceae	Loquat (Nespera)	Anthophoridae (66.7% - 2) Apidae (33.3% - 2)	*Xylocopa (Neoxylocopa) suspecta* (55.6%) *Trigona spinipes* (22.2%) *Epicharis* (*Epicharis*) *flava* (11.1%) *Melipona scutellaris* (11.1%)
Flacourtia indica (Burm. F) Merr	Flacourtiaceae	"Cereja forasteira"	Apidae (40% - 1) Anthophoridae (13.3% - 2) Halictidae (46.7% - 3)	*Apis mellifera scutellata* (40%) *Dialictus (Chloralictus) sp* (26.7%) *Augochloropsis (A)* prov. *leucotricha* (13.3%)
Mammea americana L.	Guttiferae	Abricot (Abricó)	Apidae (100% - 1)	*Trigona spinipes* (100%)
Mangifera indica L	Anacardiaceae	Mango (Manga)	Anthophoridae (100% - 1)	*Exomalopsis* (*Phanomalopsis)* sp (100%)
Passiflora sp	Passifloraceae	Passion fruit (Maracujá)	Anthophoridae (100% - 1)	*Xylocopa (Neoxylocopa) suspecta* (100%)
Terminalia kaernbachi Warb	Combretaceae	Noz Okari	Apidae (100% - 1)	*Apis mellifera scutellata* (100%)