

## **BEE DIVERSITY OF THE COASTAL SAND DUNES OF BRAZIL**

Blandina Felipe Viana and Isabel Alves dos Santos

### **ABSTRACT**

A summary of the bee fauna on the Brazilian coastal sand dunes is presented. The data used in this synthesis come from the results of apifauna surveys undertaken in five sites on the Brazilian coast: 2°30'S, 7°S, 12°56'S, 25°30'S and 30°S. This preliminary synthesis allows an overview of the composition and richness of the bee species in the dune and beach environments along the Brazilian coast.

### **INTRODUCTION**

One of the features of the Brazilian coast is the presence of vast sedimentary sand plains which are the result of the transgressions and regressions of the sea in the Holocene (Araújo and Lacerda 1987). These plains include areas termed beaches, foredunes, dunes, low zones and boundary zone, which differ in the plant cover. This set of environments is termed "restinga". The complexity of the restinga communities increases as far as we are from the ocean.

In spite of their homogeneous appearance the dunes have interdependent micro-environments and several particularities related to their flora, which is constantly under nutritional and hydric stress. The dunes vary in shape and position because of wind changes. but the vegetation is little affected by such changes being easily adapted to the movements of the mobile substrate. There are also extensive zones in which the dunes are fixed due to the presence of trees and shrubs.

The dune belt along the Brazilian Atlantic Coast is not continuous in width and alignment. In Rio Grande do Sul, for instance, the coastal plain is wide, low, and slightly undulating. It is made up of four belts of recent and ancestral dunes, interspersed by "restingas" and lagoons. In other areas one may find high dunes (up to 90m) such as the ones in the NE region, or portions of clipped littoral marked by the presence of bays, like the ones in the northern part of the state of São Paulo.

Except in neighbour wood of restingas and mangroves, over most of their north-south extension the dunes have the Atlantic Rainforest inland to the west. This ecosystem certainly has a strong influence from the fauna and flora of the dunes.

Temperature and relative humidity are usually more constant on the coast during the year because of the direct influence of the sea. This is especially true in tropical zones (0°-23.5°S). In the south of Brazil, the influence of polar winds (south winds) may bring instability and may cause drastic changes in the temperature and in the precipitation rate in the coastal region. Regional differences may also be found, such as in the north of the state of Rio de Janeiro, near the Paraíba River (22°S) which may present a dry zone with semiarid aspect. The low

humidity in this latitude caused by the colder sea water that brings dry air to the coast (the resurgence zone of Cabo Frio).

### **The Dunes Vegetation**

In the initial portion of the dunes (foredunes or pioner zone) there are halophyte (salt tolerant), succulent and creeper plant species. In the limit between the high tides and the dunes, we find a flora that is cosmopolitan to the tropical coast with species of grasses, weeds and shrubs (Ciperaceae, Gramineae, Asteraceae, Convolvulaceae and others) Toward inland the vegetation gets denser and fixed on the sand, generating the fixed dunes with woody plants. In the south coast of Rio Grande do Sul we may find small portions of forest with giant individuals of *Ficus organensis*, *Erythrina cristagalli*, *Salix*, *Myrcia* spp and other species.

Some studies show new species and some endemism of Bromeliaceae, Orchidaceae, and Lameaceae in restinga areas. However, the main vegetation type may be dominated by other groups, with many typical elements of the families Arecaceae, Cactaceae, Araceae, Velloziaceae, Asteraceae and Leguminosae (Caesalpinaceae, Fabaceae and Mimosaceae) (Britto *et al.* 1993; Araújo and Henriques 1984).

Opposite to what occurs with the dune vegetation in the temperate region, which features many anemophilous and few entomophilous species (Knuth 1896, Gottsberger *et al.* 1988), many of the plant species on the tropical dunes are entomophilous and, more specifically, melittophilous that is, their flowers are visited by Hymenoptera, especially bees. These bees are frequently the pollinators of these plant species, therefore responsible for their sexual reproduction (Gottsberger *et al.* 1988).

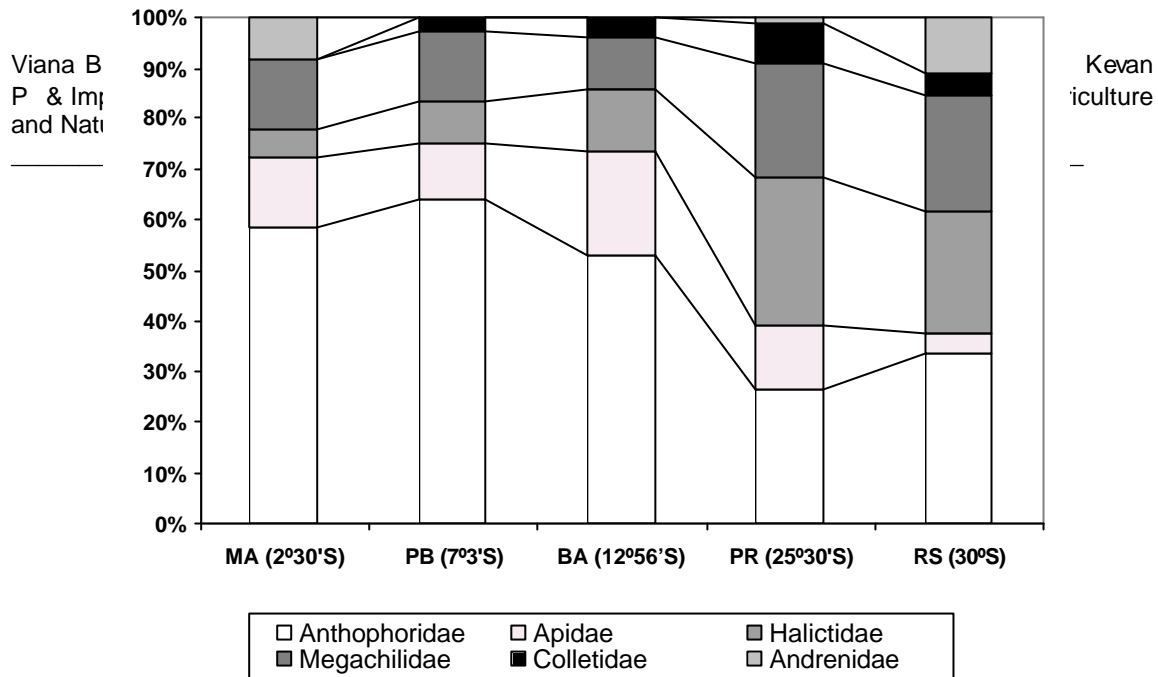
### **The Apifauna of the Dunes**

The results of five apifauna surveys carried out or including the coastal dune of Brazil show the diversity of the bees and their importance for the pollination of local vegetation.

In the South of Brazil Alves dos Santos (1996 and 1999) found 206 species of bees in the lowland areas in the broad coastal plain of Rio Grande do Sul (30°S/51°W). Of these, 129 species were found exclusively between sea level and 50 meters altitude (in areas of dunes and restinga). Still in the South of Brazil 75 species were recorded in Ilha do Mel, 122 species in Alexandra and 57 species in Ilha das Cobras (Laroca 1974, Schwartz Filho 1993, Zanella 1991, Zanella *et al.*1998). All these localities belong to the coastal plain of the state of Paraná at 25°30'S and 48°30'W.

In the Northeastern Brazil bee surveys were conducted by Gottsberger *et al.* (1988), Albuquerque (1998), Madeira da Silva (1998) and Viana (in prep.) between the latitudes of 2° and 12°S. All showed the presence of less than one hundred species. The large solitary bees of the family Anthophoridae were predominant for they are able to forage under the adverse dry conditions of the dunes.

In Maranhão, the two surveyed areas were located near the city of São Luis (2°29'S/ 44°18'W and 2°30'S/ 44°17'W), reaching an altitude of 30 meters above sea level. The climate is hot, semi-humid with well defined dry and rainy seasons, annual mean temperature around



26,7°C and rainfall around 1950mm. Humidity is high almost all year round with an annual mean of about 81%.

In Bahia, the studied area is located in an Environmental Protected Area of the Abaeté Lagoon and Dunes (12°56'S /38°21'W), near Salvador, between 5 and 15 meters above sea level (Viana, in prep.). In Paraíba, the survey was undertaken in the restinga of the Praia de Intermares (7°3'S; 34°50'W), in the municipality of Cabedelo, 10 km from João Pessoa, at an altitude between 0 and 10 m above sea level (Madeira da Silva 1998). The climate in these two localities is hot and humid, with no dry season. Rainfall is highest from March to August. Annual mean temperatures range from 24° to 27°C and annual rainfall is around 2000 mm. Humidity has an annual mean of 70-80%.

In Rio Grande do Sul, the surveys were conducted in the north littoral of the state (30°S; 50°-51° W). In Paraná, Zanella *et al.* (1998) surveyed 3 localities in the coastal plain of the state (25° 30'S; 48° 25'W). The climate in these two regions is temperate humid with rain distributed among all months of the year. The temperature in the warmer months is above 22°C and above 3°C in the colder months. Intense rainfall occurs in the summer, reaching 2000mm. In Rio Grande do Sul the relative humidity is higher in the winter (90%) and lower in December (75-85%).

Table 1 shows the list of species in the five localities. It is worth noting that the local bee fauna of Maranhão (São Luís), Bahia (Abaeté) and Paraíba (Cabedelo) are similar in number of species and in frequency of the family Apoidea (Fig. 1).

FIGURE 1. Variation in the taxonomic composition of the apifauna of coastal sand dunes of Brazil, summarized by number of species per family. MA - Maranhão, PB - Praia de Intermares, BA - Bahia, PR - Paraná, RS - Rio Grande do Sul

However, species composition is dissimilar among these areas, in spite of the fact that the vegetation physiognomies are similar. Between Abaeté and Cabedelo = 47%, between Abaeté and São Luís = 31% and between São Luís and Cabedelo = 36% (Sorensen coefficient of similarity). The composition of the Apifauna in these localities is influenced by neighbouring habitats and by the local variation in abiotic factors. It must also be related to

the plant species composition, which varies widely at the species level among these areas, as may be seen in table 2. Anthophorinae and Xylocopinae are the two most represented groups in these three localities. According to the authors of these surveys, most species in these groups are local residents with several nests in the areas.

Bees of the tribes Melitomini (mainly in the genera *Ancyloscelis*, *Diadasina*, *Melitoma* and *Ptilothrix*) and *Centridini* (*Centris* and *Epicharis*) may be typical of open areas and sandy soils (important for their nest construction) in Rio Grande do Sul. Bees of the family Megachilidae are typical of and well distributed in the lowlands mainly in the South of Brazil, whereas this family is not very represented in the Northeastern region (Fig. 1). Halictidae presents a high number of species in south Brazil, and is the most diverse bee family at the coastal plain of Paraná. Andrenidae appears with small number of species in each of these localities, except in Rio Grande do Sul where many bees of the tribe Panurgini were recorded (table 1).

### **Dispersal of the Species**

Because of the large North-South extension of the Brazilian coast, the dunes may serve as a corridor for the movement and dispersal of bee species. However, if there are geographic barriers (physical or thermal), such as the section of the coastal belt by mountains that reach the littoral, or large rivers, their dispersion may be discontinuous.

Because the dunes receive influences from and exchanges with neighbouring ecosystems to the West, some similarity may be expected among the groups on the contact areas or transition zones among the ecosystems.

Surveys undertaken with similar methods of collecting bees on flowers and with the record of different types of ecologically relevant information can result in rich sources of data for comparative studies. Also, similarity analysis of such data can bring some knowledge about the species diversity, relative abundance, dominance and structure of the community, and about the interactions among bees and plants and the partition of resources among the Apoidea.

For a complete biogeographic analysis of the Apoidea distribution on the dune ecosystem, a comparison between the bee fauna and the plants which are important for their survival in different latitudes would be interesting. Although 5000 km of the Brazilian coast are occupied by "restingas" and dunes, the flora and fauna of these ecosystems are still little studied.

The dunes is the most fragile environment among all ecosystems on the coast. The deleterious effects of human activities such as the rapid construction of houses and buildings, the taking away of sand, building roads and streets, commercial facilities and car traffic are marked in this environment. We provide our data from the fire sites as a record of what has been found. Clearly, much work and analysis is required to fully place our findings in this context of biogeography and conservation.

### **ACKNOWLEDGMENTS**

Our sincere thanks to the Dr Astrid M. P. Kleinert from Universidade de São Paulo, for her suggestions for improving this manuscript. We also thank CNPq, CADCT/SEPLANTEC-BA and PICD/CAPES for research grants.

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

---

## REFERENCES

- Albuquerque P. Abelhas silvestres (Hymenoptera, Apoidea) e suas fontes de alimento em um ecossistema de dunas, na Ilha do Maranhão, Maranhão, Brasil: composição, fenologia e interações [tese de doutoramento]. Ribeirão Preto: Universidade de São Paulo; 1998.
- Alves dos Santos I. Bienen und melittophile Blütenpflanzen in der Küstenregion und im Atlantischen Regenwald von Rio Grande do Sul (Brasilien), mit einer Fallstudie zu Langzungenbienen und tristylen Wasserhyazinthen [PhD thesis]. Tübingen: Universidade de Tübingen; 1996.
- Alves dos Santos I. Abelhas e plantas melíferas da Mata Atlântica, restinga e dunas do Litoral norte do Estado do Rio Grande do Sul. *Revista Brasileira de Entomologia* 1999; 43(3/4): 191-223.
- Alves dos Santos I. Distribuição vertical de uma comunidade de abelhas do Rio Grande do Sul. *Revista Brasileira de Entomologia* 1999; 43(3/4): 225-8.
- Araújo DSD, Henriques RPB. Análise florística das restingas do Estado do Rio de Janeiro. In: Lacerda LD, et al, organizadores. Restinga: origem, estrutura e processos. Niterói: CEUFF; 1984. p.159-93.
- Araújo DSD, Lacerda LD. A natureza das restingas. *Ciência Hoje* 1987; 6(33): 42-8.
- Gottsberger G, Camargo JMF, Silberbauer-Gottsberger I. A bee-pollinated tropical community: the beach dune vegetation of Ilha de São Luís, Maranhão, Brazil. *Botanische Jahrbücher für Systematik* 1988; 109(4): 469-500.
- Laroca S. Estudo feno-ecológico em apoidea do litoral e Primeiro Planalto Paranaense [dissertação de mestrado]. Curitiba: Universidade Federal do Paraná; 1974.
- Madeira da Silva MC. Estrutura da comunidade de abelhas (Hymenoptera, Apoidea) de uma área de restinga (Praia de Intermares, Cabedelo – Paraíba, Nordeste do Brasil) [dissertação de mestrado]. João Pessoa: Universidade Federal da Paraíba; 1998.
- Queiroz LP, Guedes MLS, Oliveira NC, Silva LB. Flora fanerogâmica das dunas e lagoas de Abaeté, Salvador, Bahia. *Sitientibus* 1993; 11: 31-46.
- Schwartz Filho DL. A comunidade de abelhas silvestres (Hymenoptera, Apoidea) da Ilha das Cobras (Paraná, Brasil): aspectos ecológicos e biogeográficos [dissertação de mestrado]. Curitiba: Universidade Federal do Paraná; 1993.
- Zanella FCV. Estrutura da comunidade de abelhas silvestres (Hymenoptera, Apoidea) da Ilha do Mel, Planície Litorânea Paranaense, Sul do Brasil [dissertação de mestrado]. Curitiba: Universidade Federal do Paraná; 1991.
- Zanella FCV, Schwartz Filho DL, Laroca S. Tropical bee island biogeography: diversity and abundance patterns. *Biogeographica* 1998; 74(3): 103-15.

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

---

**Table 1. Bee species of coastal sand dunes in Brazil**

Bee family	Bee species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
<b>ANDRENIDAE</b>						
<b>PANURGINAE</b>						
CALLIOPSINI	<i>Acamptopoeum prinii</i> (Holmberg, 1884)	X			X	X
	<i>Callonychium petuniae</i> Cure & Wittmann, 1990					X
	<i>Callonychium</i> sp. 1					X
	<i>Callonychium</i> sp. 2					X
PANURGINI	<i>Cephalurgus anomalus</i> Moure & Lucas de Oliveria, 1962				X	
	<i>Anthrenoides meridionalis</i> (Schrottky, 1906)					X
	<i>Anthrenoides micans</i> Urban, 1995					X
	<i>Panurgillus flavitarsis</i> Schindwein & Moure 1998					X
	<i>Panurgillus hamatus</i> Schindwein & Moure 1998					X
	<i>Panurgillus minutus</i> Schindwein & Moure 1998					X
	<i>Panurgillus pereziae</i> Schindwein & Moure 1998					X
	<i>Parapsaenythia paspalis</i> (Schrottky, 1909)					X
	<i>Parapsaenythia puncticutis</i> (Vachal, 1909)					X
	<i>Parapsaenythia serripes</i> (Ducke, 1908)					X
	<i>Protomelliturga turnerae</i> (Ducke, 1907)	X				
	<i>Psaenythia annulata</i> Gerstaecker, 1868					X
	<i>Psaenythia bergi</i> Holmberg, 1884					X
	<i>Psaenythia chrysorrhoea</i> Gerstaecker, 1868					X
	<i>Psaenythia collaris</i> Schrottky, 1907					X
	<i>Psaenythia demissa</i> Holmberg, 1923					X
	<i>Psaenythia quadrifasciata</i> Friese, 1908					X
<i>Psaenythia</i> sp. 2					X	
<b>OXAEINAE</b>						
OXAEINI	<i>Oxaea austera</i> Gerstaecker, 1868					X
	<i>Oxaea festiva</i> Smith, 1854	X				
<b>COLLETIDAE</b>						
<b>COLLETINAE</b>						
COLLETIN	<i>Colletes petropolitanus</i> Delatorre, 1896			X	X	
	<i>Colletes punctatissimus</i> Schrottky, 1902					X
	<i>Colletes rufipes</i> Smith, 1879					X
PARACOLLETINI	<i>Bicolletes leucostoma</i> (Cockerell, 1917)					X
	<i>Cephalocolletes isabelae</i> Urban, 1995					X
	<i>Hexanthea petuniae</i>					X
	<i>Hexanthea perissomera</i>					X
	<i>Niltonia virgilli</i> Moure, 1964				X	
	<i>Perditomorpha</i> sp. 3					X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Bee family	Bee species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Tetraglossula bigamica</i> (Strand, 1910)					X
<b>DIPHAGLOSSINAE</b>						
CAUPOLICANI	<i>Ptiloglossa pretiosa</i> (Friese, 1898)					X
<b>HYLAEINAE</b>						
HYLAEINI	<i>Hylaeus</i> sp1		X			
	<i>Hylaeus</i> sp.1				X	
	<i>Hylaeus</i> sp.2				X	
	<i>Hylaeus</i> sp.3				X	
	<i>Hylaeus</i> sp.4				X	
	<i>Hylaeus</i> sp.5				X	
	<i>Hylaeus</i> sp.6				X	
	<i>Hylaeus</i> sp.7				X	
	<i>Hylaeus</i> sp.8				X	
	<i>Hylaeus</i> sp.9				X	
	<i>Hylaeus</i> sp.10				X	
	<i>Hylaeus</i> sp.11				X	
<b>XEROMELISSINAE</b>						
<b>HALICTIDAE</b>						
<b>HALICTINAE</b>						
AUGOCHLORINI	<i>Chilicola (Stenocelis) faviscapis</i> n. sp.			X		
	<i>Augochlora (Augochl.) amphitrite</i> (Schrottky, 1909)				X	
	<i>Augochlora (Augochlora) caerulior</i> Cockerell, 1900				X	X
	<i>Augochlora (Augochlora) dolichocephala</i> (Moure, 1941)					X
	<i>Augochlora flavipes</i> n. sp. Moure, n.p.			X		
	<i>Augochlora (Augochlora) cf nitidior</i>					X
	<i>Augochlora (Augochlora) aff. pyrgo</i>				X	
	<i>Augochlora obscuripes</i> n. sp. Moure, n.p.			X		
	<i>Augochlora (Augochlora) sp. 1</i>				X	
	<i>Augochlora (Augochlora) sp1</i>		X			
	<i>Augochlora (Augochlora) sp 2</i>				X	
	<i>Augochlora (Augochlora) sp 3</i>				X	
	<i>Augochlora (Augochlora) sp. 4</i>					X
	<i>Augochlora (Augochlora) sp 4</i>				X	
	<i>Augochlora (Augochlora) sp 5</i>				X	
	<i>Augochlora (Augochlora) sp 10</i>					X
	<i>Augochlora (Augochlora) sp 11</i>					X
	<i>Augochlora (Augochlora) sp. nov.</i>					X
	<i>Augochlora (Oxystoglossella) morrae</i> (Strand, 1909)				X	
	<i>Augochlora (Oxystoglossella) esox</i> (Vachal, 1911)					X
	<i>Augochlora (Oxystogl.) semiramis</i> (Schrottky, 1910)					X
	<i>Augochlora (Oxystoglossella) thalia</i> Smith, 1879					X
	<i>Augochlora (Oxystoglossella) sp. 4</i>					X



Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Bee family	Bee species	MA	PB	X	PR	RS (30°S)
		(2°30'S)	(7°3'S)	BA (12°56'S)	(25°30'S)	
	<i>Augochlora (Oxystoglossela) sp. nov.</i>					X
	<i>Augochlora sp. 8</i>					X
	<i>Augochlorella sp.1</i>				X	
	<i>Augochlorella sp.</i>	X				
	<i>Augochlorella ephyra</i> (Schrottky, 1910)				X	X
	<i>Augochlorella michaelis</i> (Vachal, 1911)				X	X
	<i>Augochloropsis acis</i> (Smith, 1879)					X
	<i>Augochloropsis anisitsi</i> (Schrottky, 1908)					X
	<i>Augochloropsis callichroa</i> (Cockerell, 1900)			X		
	<i>Augochloropsis caerulans</i> (Vachal, 1903)					X
	<i>Augochloropsis cleopatra</i> (Schrottky, 1902)					X
	<i>Augochloropsis cupreola</i> (Cockerell, 1900)				X	X
	<i>Augochloropsis cloera</i> Moure, 1940				X	
	<i>Augochloropsis cyanea</i> (Schrottky, 1901)					X
	<i>Augochloropsis luderwaldti</i> Moure, 1940				X	
	<i>Augochloropsis multiplex</i> (Vachal, 1903)				X	X
	<i>Augochloropsis notophos</i> sp1 (Vachal, 1903)		X			X
	<i>Augochloropsis pandrosos</i> (Schrottky, 1909)					X
	<i>Augochloropsis sympleres</i> (Vachal, 1903)					X
	<i>Augochloropsis terrestris</i> (Vachal, 1903)					X
	<i>Augochloropsis (Paraug.) euterpe</i> (Holmberg, 1886)					X
	<i>Augochloropsis (Paraug.) sparsilis</i> (Vachal, 1903)					X
	<i>Augochloropsis sp. 1</i>				X	
	<i>Augochloropsis sp 1</i>			X		
	<i>Augochloropsis sp. 2</i>				X	
	<i>Augochloropsis sp. 2</i>				X	
	<i>Augochloropsis sp. 4</i>				X	
	<i>Augochloropsis sp. 5</i>				X	
	<i>Augochloropsis sp. 6</i>				X	
	<i>Augochloropsis sp. 7</i>				X	
	<i>Augochloropsis sp. 8</i>				X	
	<i>Augochloropsis sp. 9</i>				X	
	<i>Augochloropsis sp. 10</i>				X	
	<i>Augochloropsis sp. 11</i>				X	
	<i>Augochloropsis sp. 12</i>				X	
	<i>Augochloropsis sp. 14</i>					X
	<i>Augochloropsis sp. 15</i>					X
	<i>Augochloropsis sp. nov.</i>					X
	<i>Halictus loureroi</i> (Moure, 1941)					X
	<i>Neocorynura (Neocorynura) atromarginata</i> (Cockerell, 1901)				X	
	<i>Neocorynura (Neocorynura) pseudocaccha</i> (Cockerell, 1901)				X	
	<i>Neocorynura sp.1</i>				X	

	<i>Neocorynura</i> sp.2				X	
	<i>Neocorynura</i> sp.3				X	
	<i>Pereirapis</i> sp.				X	
	<i>Paroxystoglossa jocasta</i> (Schrottky, 1910)					X
	<i>Pseudaugochloropsis graminea</i> (Fabricius, 1804)				X	X
	<i>Pseudaugochloropsis pandora</i> (Smith, 1853)	X		X		
	<i>Temnosoma</i> sp.				X	
	<i>Thectochlora alaris</i> (Vachal, 1904)				X	X
HALICTINI	<i>Agapostemon semimelleus</i> (Holmberg, 1884)				X	
	<i>Coenohalictus incertus</i> (Schrottky, 1902)				X	
	<i>Dialictus (Chloralictus) opacus</i> (Moure, 1940)		X	X	X	X
	<i>Dialictus (Chloralictus)</i> sp. 1				X	
	<i>Dialictus (Chloralictus)</i> sp. 2				X	X
	<i>Dialictus (Chloralictus)</i> sp. 2					X
	<i>Dialictus (Chloralictus)</i> sp. 3				X	
	<i>Dialictus (Chloralictus)</i> sp. 3					X
	<i>Dialictus (Chloralictus)</i> sp. 4					X
	<i>Dialictus (Chloralictus)</i> sp. 4				X	
	<i>Dialictus (Chloralictus)</i> sp. 5					X
	<i>Dialictus (Chloralictus)</i> sp. 5				X	
	<i>Dialictus (Dialictus)</i> sp. 2					X
	<i>Dialictus (Rhynchalictus) rostratus</i> (Moure, 1947)					X
	<i>Pseudagapostemon (P.) arenarius</i> (Schrottky, 1902)					X
	<i>Pseudagapostemon (P.) brasiliensis</i> Cure, 1989					X
	<i>Pseudagapostemon (P.) pruinus</i> Moure & Sakagami, 1984					X
	<i>Sphecodes</i> sp.				X	
<b>MEGACHILIDAE</b>						
<b>ANTHIDINAE</b>						
ANTHIDINI	<i>Anthidium manicatum</i> (Linnaeus, 1758)				X	X
	<i>Dicranthidium arenarium</i> Ducke, 1907	X		X		
	<i>Dicranthidium luciae</i> Urban, 1992			X		
<b>Bee family</b>	<b>Bee species</b>	<b>MA</b> (2°30'S)	<b>PB</b> (7°3'S)	<b>BA</b> (12°56'S)	<b>PR</b> (25°30'S)	<b>RS (30°S)</b>
DIANTHIDINI	<i>Anthodioctes</i> sp. 1				X	
	<i>Anthodioctes</i> sp. 3				X	
	<i>Epanthidium confusum</i> (Smith, 1879)				X	X
	<i>Epanthidium tigrinum</i> (Schrottky, 1905)		X		X	X
	<i>Hypanthidium flavomarginatum</i> (Smith, 1879)				X	X
	<i>Hypanthidium</i> sp1		X			
	<i>Larocanthidium emarginatum</i> (Urban, 1997)		X			
MEGACHILINI	<i>Coelioxys (Acrocoelioxys) australis</i> Holmberg, 1886					X
	<i>Coelioxys (Cyrtocoelioxys) quaerens</i> Holmberg, 1903					X
	<i>Coelioxys (Glyptocoelioxys) vidua</i> Smith, 1854					X
	<i>Coelioxys (Melanocoelioxys) tolteca</i> Cresson, 1878					X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

---

1878		
<i>Coelioxys (Rhinocoelioxys) zapoteca</i> Cresson, 1878		X
<i>Coelioxys</i> sp.1	X	
<i>Coelioxys</i> sp.2	X	
<i>Coelioxys</i> sp.3	X	
<i>Coelioxys</i> sp.4	X	
<i>Coelioxys</i> sp.5	X	
<i>Coelioxys</i> sp.6	X	
<i>Coelioxys</i> sp.7	X	
<i>Megachile (Acentrina) apicipennis</i> Schrottky, 1902		X
<i>Megachile (Acentrina) moureana</i> Mitchell, 1930		X
<i>Megachile (Acentrina) nigropilosa</i> Schrottky, 1902		X
<i>Megachile (Acentrina) pampeana</i> Vachal, 1909		X
<i>Megachile (Acentron) bernardina</i> Schrottky, 1913		X
<i>Megachile (Acentron) lentifera</i> Vachal, 1909		X
<i>Megachile (Acentron) limae</i> Schrottky, 1913		X
<i>Megachile (Acentron)</i> sp.1		X
<i>Megachile (Acentron)</i> sp.1	X	
<i>Megachile (Archimegachile)</i> sp. 1		X
<i>Megachile (Austromegachile) corona</i> Mitchell, 1930	X	
<i>Megachile (Austromegachile) oligosticta</i> Moure, 1955	X	
<i>Megachile (Austromegachile) trigonaspis</i> Schrottky, 1913	X	
<i>Megachile (Austromegachile) susurrans</i> Haliday, 1836		X
<i>Megachile (Austromegachile)</i> sp. 1	X	
<i>Megachile (Austromegachile)</i> sp.2	X	
<i>Megachile (Austromegachile)</i> sp.3	X	
<i>Megachile (Austromegachile)</i> sp. 4	X	
<i>Megachile (Austromegachile)</i> sp. 5	X	
<i>Megachile (Chaetochile) golbachi</i> Schwimmer, 1980		X
<i>Megachile (Chrysosarus)</i> sp. 1	X	
<i>Megachile (Chrysosarus)</i> sp. 2	X	
<i>Megachile (Chrysosarus)</i> sp. 3		X
<i>Megachile (Dactylomegachile) affabilis</i> Mitchell, 1930	X	
<i>Megachile (Dactylomegachile)</i> sp.1	X	
<i>Megachile (Grafella) crotalariae</i> Mitchell, 1930		X
<i>Megachile (Leptorachis) aetheria</i> Mitchell, 1930	X	X
<i>Megachile (Leptorachis) angularis</i> Mitchell, 1930		X
<i>Megachile (Leptorachis) atritegulis</i> Moure, in litt.		X
<i>Megachile (Leptorachis) cf beniensis</i> Cockerell, 1927		X
<i>Megachile (Leptorachis) paulistana</i> Schrottky, 1902	X	X
<i>Megachile (Leptorachis) tenuitarsis</i> Schrottky, 1902		X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Bee family	Bee species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Megachile (Leptorachis) sp1</i>	X				
	<i>Megachile (Leptorachis) sp2</i>	X				
	<i>Megachile (Leptorachis) sp. 4</i>					X
	<i>Megachile (Leptorachis) sp. 5</i>					X
	<i>Megachile (Leptorachis) sp. 6</i>					X
	<i>Megachile (Melanosarus) brasiliensis</i> Dalla Torre, 1896 RS					X
	<i>Megachile cf (Melanosarus) sp. 1</i>					X
	<i>Megachile (Neomegachile) sp.</i>				X	
	<i>Megachile (Neomegachile) sp. 1</i>					X
	<i>Megachile (Prionepist.) tuberculifera</i> Schrottky, 1913					X
	<i>Megachile (Pseudocentron) curviceps</i> Smith, 1853				X	
	<i>Megachile (Pseudocentron) electrum</i> Mitchell, 1930					X
	<i>Megachile (Pseudocentron) framea</i> Schrottky, 1913					X
	<i>Megachile (Pseudocentron) nudiventris</i> Smith, 1853				X	X
	<i>Megachile (Pseudocentron) pyrrogastra</i> Cockerell, 1913				X	
	<i>Megachile (Pseudocentron) terrestris</i> Schrottky, 1902				X	X
	<i>Megachile (Pseudocentron) sp. 1</i>				X	
	<i>Megachile (Pseudocentron) sp1</i>	X				
	<i>Megachile (Pseudocentron) sp2</i>	X				
	<i>Megachile (Pseudocentron) sp. 2</i>				X	
	<i>Megachile (Pseudocentron) sp3</i>	X				
	<i>Megachile (Pseudocentron) sp. 3</i>				X	
	<i>Megachile (Pseudocentron) sp. 4</i>				X	
	<i>Megachile (Pseudocentron) sp. 10</i>					X
	<i>Megachile (Ptilosarus) sp.</i>				X	
	<i>Megachile (Sayapis) dentipes</i> Vachal, 1909		X			X
	<i>Megachile (Sayapis) obdurata</i> Mitchell, 1930					X
	<i>Megachile (Tylomegachile) orba</i> Schrottky, 1913				X	
	<i>Megachile (Willinkella) anthidioides</i> Smith, 1853				X	
	<i>Megachile (Willinkella) apicipennis</i> Schrottky, 1902				X	
	<i>Megachile (Willinkella) sp. 1</i>				X	
	<i>Megachile sp 1</i>		X			
	<i>Pseudocentron (Pseudocentron) leucomelaena</i> n.sp.			X		
	<i>Pseudocentron (Pseudocentron) leucosera</i> n.sp.			X		
	<i>Pseudocentron (Pseudocentron) xanthosera</i> n.sp.			X		
<b>ANTHOPHORIDAE</b>						
<b>ANTHOPHORINAE</b>						
	<i>Centris (Centris) aenea</i> Lepeletier, 1841	X	X	X		
	<i>Centris (Centris) caxienseis</i> Ducke, 1907		X	X		
	<i>Centris (Centris) flavifrons</i> Fabricius, 1775	X	X	X	X	

Bee family	Bee species	MA	PB	BA	PR	RS (30°S)
		(2°30'S)	(7°3'S)	(12°56'S)	(25°30'S)	
	<i>Centris (Centris) leprieuri</i> Spinola, 1841	X	X	X		
	<i>Centris (Centris) nitens</i> Lepeletier, 1841		X	X		
	<i>Centris (Centris) spilopoda</i> Moure, 1969	X	X	X		
	<i>Centris (Centris) varia</i> (Erichson, 1948)				X	
	<i>Centris (Hemisiella) sp1</i>	X				
	<i>Centris (Hemisiella) sp. 1</i>					X
	<i>Centris (Hemisiella) nigripes</i> Friese, 1899					X
	<i>Centris (Hemisiella) tarsata</i> Smith, 1874	X	X	X	X	
	<i>Centris (Hemisiella) trigonoides</i> Lepeletier, 1841		X	X		
	<i>Centris (Heterocentris) analis</i> Lepetier, 1841				X	
	<i>Centris (Melanocentris) atra</i> Friese, 1899				X	
	<i>Centris (Melanocentris) dorsata</i> Lepeletier, 1841				X	X
	<i>Centris (Melanocentris) fluviatilis</i> Friese					
	<i>Centris (Melanocentris) obsoleta</i> Lepeletier, 1841					X
	<i>Centris (Paracentris) burgdorfi</i> Friese, 1900					X
	<i>Centris (Paremisia) fuscata</i> Lepeletier, 1841	X	X	X		X
	<i>Centris (Paremisia) proxima</i> Friese, 1899					X
	<i>Centris (Paremisia) pulchra</i> n.sp.			X		
	<i>Centris (Paremisia) similis</i> Fabricius , 1804				X	
	<i>Centris (Ptilopus) sponsa</i> Smith, 1854			X		
	<i>Centris (Xanthemis) lutea</i> Friese, 1899			X		
	<i>Epicharis (Anepicharis) dejeani</i> Lepeletier, 1841				X	
	<i>Epicharis (Xanthepicharis) bicolor</i> Smith, 1854		X	X		
	<i>Epicharis (Xanthepicharis) nigrita</i> Friese, 1900			X		
	<i>Epicharis</i> sp.1				X	
CTENIOSCHELINI	<i>Mesocheira bicolor</i> (Fabricius, 1804)				X	
	<i>Mesonychium asteria</i> (Smith, 1854)	X	X			
	<i>Mesonychium littoreum</i> Moure, 1944			X		X
ERICROCIDINI	<i>Mesoplia rufipes</i> (Perty, 1833)	X			X	
	<i>Mesoplia regalis</i> (Smith)	X				
	<i>Mesopliasp 1</i>		X			
	<i>Mesopliasp 1</i>			X		
	<i>Mesopliasp 2</i>			X		
EUCERINI	<i>Florilegus (Euflorilegus) festivus</i> (Smith, 1854)		X			X
	<i>Florilegus (Euflorilegus) fulvipes</i> (Smith, 1854)					X
	<i>Florilegus (Euflorilegus) riparius</i> Ogloblin, 1955					X
	<i>Florilegus similis</i> Urban, 1970		X	X		
	<i>Gaesischia (Gaesischia) fulgurans</i> (Holmberg, 1933)					X
	<i>Gaesischia (Gaesischia) nigra</i> Moure, 1948					X
	<i>Gaesischia (Gaesischia) sparsa</i> Brethes, 1910					X
	<i>Gaesischia (Gaesischia) trifasciata</i> Urban, 1968					X
	<i>Melissodes (Ecplectia) nigroaenea</i> (Smith, 1854)					X
	<i>Melissodes (Ecplectia) sexcincta</i> (Lepeletier, 1841)				X	

Bee family	Bee species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
EXOMALOPSINI	1841) <i>Melissoptila (Comeptila) paraguayensis</i> (Brethes, 1909)					X
	<i>Melissoptila (Ptilomelissa) aureocincta</i> Urban 1966				X	
	<i>Melissoptila (Ptilomelissa) bonaerensis</i> Holmberg, 1903					X
	<i>Melissoptila (Ptilomelissa) claudii</i> Urban 1998					X
	<i>Melissoptila (Ptilomelissa) cnecomala</i> (Moure, 1944)					X
	<i>Thygater (Thygater) analis</i> (Lepelletier, 1841)				X	X
	<i>Thygater (Thygater) paranaensis</i> Urban, 1967					X
	<i>Exomalopsis analis</i>	X				
	<i>Exomalopsis aureopilosa</i> Spinola, 1853					X
	<i>Exomalopsis</i> sp.1				X	
	<i>Exomalopsis</i> sp.2				X	
	<i>Exomalopsis</i> sp.3				X	
	<i>Exomalopsis</i> sp.4				X	
	<i>Lanthanomelissa (L.) goeldiana</i> (Friese, 1899)					X
<i>Paratetrapedia melanpoda</i> Moure, 1948					X	
MELITOMINI	<i>Paratetrapedia</i> sp.1				X	
	<i>Paratetrapedia</i> sp.2				X	
	<i>Paratetrapedia</i> sp.3				X	
	<i>Paratetrapedia</i> sp.4				X	
	<i>Tapinotaspis (Tapinotaspis) pernigra</i> (Schrottky, 1920)					X
	<i>Tapinotaspis (Tapinotaspis) tucumana</i> (Vachal, 1904)					X
	<i>Tapinotaspoides</i> sp.				X	
	<i>Ancyloscelis apiformis</i> (Fabricius, 1793)	X				X
	<i>Ancyloscelis</i> sp.				X	
	<i>Ancyloscelis fiebrigi</i> (Brethes, 1909)					X
	<i>Ancyloscelis gigas</i> Friese, 1904					X
	<i>Ancyloscelis turmalis</i> Vachal, 1904					X
	<i>Ancyloscelis ursinus</i> Haliday, 1837					X
	<i>Diadasina distincta</i> (Holmberg, 1903)					X
<i>Diadasina riparia</i> (Ducke, 1907)					X	
<i>Diadasina</i> sp	X					
<i>Melitoma segmentaria</i> (Fabricius, 1804)	X				X	
<i>Melitoma</i> sp.				X		
<i>Melitoma</i> sp. 1					X	
<i>Ptilothrix fructifera</i> (Holmberg, 1903)					X	
<i>Ptilothrix plumata</i> Smith, 1853	X					
<i>Ptilothrix relata</i> (Holmberg, 1903)						
RHATHYMINI						
TETRAPEDINI	<i>Tetrapedia diversipes</i> Klug, 1810					X
	<i>Tetrapedia rugulosa</i> Friese, 1899					X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

<b>NOMADINAE</b>						
ISEOPEOLINI	<i>Leiopodus</i> sp.				X	
	<i>Psilepeolus</i> sp. nov.					X
	<i>Trophocleptria</i> sp.				X	
NOMADINI	<i>Nomada</i> sp.				X	
PROTOEPEOLINI	<i>Nomadinae</i> (gen. nov. / sp. nov.)					X
<b>XYLOCOPINAE</b>						
CERATININI	<i>Ceratina asunciana</i> Strand, 1910					X
	<i>Ceratina correntina</i> Schrottky, 1907					X
	<i>Ceratina (Calloceratina) chloris</i> (Fabricius, 1804)				X	X
	<i>Ceratina (Crewella) asuncionis</i> Strand, 1910					X
	<i>Ceratina (Crewella) maculifrons</i> Smith, 1844	X			X	X
	<i>Ceratina (Crewella) paraguayensis</i> (Schrottky, 1907)		X			X
	<i>Ceratina (Crewella) rupestris</i> (Holmberg, 1884)					X
	<i>Ceratina (Crewella)</i> sp. 1		X		X	
	<i>Ceratina (Crewella)</i> sp. 2				X	
	<i>Ceratina (Rhyzoceratina) stilbonota</i> Moure, 1941					X
	<i>Ceratina (Rhyzoceratina) volitans</i> Schrottky, 1907					X
	<i>Ceratina</i> sp. 1				X	
	<i>Ceratina</i> sp.2				X	
	<i>Ceratina</i> sp. nov.					X
	<i>Ceratinula pirifera</i> n.sp.				X	
	<i>Ceratinula sclerops</i> (Schrottky, 1907)					X
	<i>Ceratinula transcincta</i> n.sp.				X	
<b>Bee family</b>	<b>Bee species</b>	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Ceratinula</i> sp1		X			
	<i>Ceratinula</i> sp1	X				
	<i>Ceratinula</i> sp. 1				X	
	<i>Ceratinula</i> sp. 2				X	
	<i>Ceratinula</i> sp2		X			
	<i>Ceratinula</i> sp2	X				
	<i>Ceratinula</i> sp. 3				X	
	<i>Ceratinula</i> sp. 4				X	
	<i>Ceratinula</i> sp. 5				X	
	<i>Ceratinula</i> sp. n.	X				
XYLOCOPINI	<i>Xylocopa (Megaxylocopa) frontalis</i> (Olivier, 1789)	X	X	X	X	X
	<i>Xylocopa (Neoxylocopa) augusti</i> Lepeletier, 1841					X
	<i>Xylocopa (Neoxyloc.) brasilianorum</i> (Linnaeus, 1767)				X	X
	<i>Xylocopa (Neoxylocopa) carbonaria</i> Smith, 1854	X				
	<i>Xylocopa (Neoxylocopa) cearensis</i> Ducke, 1910	X	X	X		
	<i>Xylocopa (Nanoxylocopa) ciliata</i> Burmeister, 1876					X
	<i>Xylocopa (Neoxylocopa) griseascens</i> Lepeletier, 1841		X	X		
	<i>Xylocopa (Neoxylocopa) nigrocincta</i> Smith, 1854			X		X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

	<i>Xylocopa (Neoxylocopa) orthogonaspis</i> Moure	X					
	<i>Xylocopa (Neoxylocopa) suspecta</i> Moure & Camargo, 1988		X		X		
	<i>Xylocopa (Schoenherria) varians</i> (Smith, 1874)						X
	<i>Xylocopa (Schoenherria) macrops</i> (Lepeletier, 1841)					X	X
	<i>Xylocopa (Schoenherria) muscaria</i> (Fabricius, 1775)	X	X				
	<i>Xylocopa (Schoenherria) prov. subcyanea</i> Pérez, 1901				X		
	<i>Xylocopa (Stenoxycopa) artifex</i> Smith, 1874						X
	<i>Xylocopa (Xylocospila) bambusae</i> Schrottky, 1902						X
<b>APIDAE</b>							
<b>APINAE</b>							
APINI	<i>Apis mellifera</i> Linnaeus, 1758	X	X		X		X
<b>BOMBINAE</b>							
BOMBINI	<i>Bombus (Fervidobombus) atratus</i> Franklin, 1913					X	X
	<i>Bombus (Fervidobombus) brasiliensis</i> Lepeletier, 1836					X	
	<i>Bombus (Fervidobombus) morio</i> (Swederus, 1787)				X	X	X
EUGLOSSINI	<i>Euglossa cordata</i> (Linnaeus, 1758)	X	X		X		X
	<i>Euglossa cyanozoma</i> (Dressler, 1982)					X	
	<i>Euglossasp.1</i>					X	
	<i>Eufriesea surinamensis</i> (Linnaeus, 1758)	X					
	<i>Eulaema (Apeulaema) nigrita</i> Lepeletier, 1841	X	X		X	X	
	<i>Eulaema meriana flavescens</i> Friese, 1899				X		
	<i>Euplusia dentilabris</i> Mocsary, 1897					X	
	<i>Euplusia hatchbachii</i> Moure					X	
	<i>Euplusia mussitans</i> Fabricius, 1787				X		
	<i>Euplusia violacea</i>						X
<b>MELIPONINAE</b>							
MELIPONINI	<i>Melipona marginata</i> Lepeletier, 1836					X	
	<i>Melipona marginata obscurior</i> Moure, 1971						X
TRIGONINI	<i>Cephalotrigona capitata</i> (Smith, 1854)					X	
	<i>Frieseomellita doederleini</i> (Friese, 1900)				X		
	<i>Frieseomellita silvestri languida</i> Moure, 1989				X		
	<i>Mourella caerulea</i> Friese, 1900						X
	<i>Nannotrigona testaceicornis</i> Lepeletier, 1836					X	
	<i>Oxytrigona tataira</i> Mueller, 1874)					X	
<b>Bee family</b>	<b>Bee species</b>	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)		RS (30°S)
	<i>Partamona helleri</i>				X		
	<i>Plebeia droryana</i> (Friese, 1900)				X		
	<i>Plebeia remota</i> (Holmberg, 1903)				X		
	<i>Plebeia emerina</i> (Friese, 1900)						X
	<i>Scaptotrigona xanthotricha</i> Moure, 1950				X		
	<i>Scaura latitarsis</i> (Friese, 1900)				X		
	<i>Tetragonisca angustula</i> (Smith, 1863)				X		



Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

	<i>Trigona fulviventris guianae</i> Cockerell, 1910				X
	<i>Trigona fuscipennis</i> Friese, 1900				X
	<i>Trigona spinipes</i> (Fabricius, 1793)	X	X	X	X
	<i>Trigonsca</i> sp 1		X		
<b>Number of bee species</b>	<b>42</b>	<b>36</b>	<b>49</b>	<b>164</b>	<b>187</b>

**Table 2. Bee plants species of coastal sand dunes in Brazil**

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
ACANTHACEAE	<i>Justicia brasiliانا</i> Roth					X
ALISMATACEAE	<i>Echinodorus grandiflorus</i> (Cham. et Schlecht.) Micheli					X
AMARANTHACEAE	<i>Alternanthera philoxeroides</i> (Mart.)Griseb.					X
	<i>Philoxerus portulacoides</i> St.Hil.					X
AMARYLLIDACEAE	<i>Crinum Habranthus salsum</i> Rav.				X	
ANACARDIACEAE	<i>Anacardium occidentale</i> L.		X			
	<i>Schinus terebinthifolius</i> Raddi.				X	
	<i>Tapirira guianensis</i> Aubl			X	X	
APIACEAE	<i>Eryngium nudicaule</i> Lam					X
APOCYNACEAE	<i>Catharanthus roseus</i> (L.) G. Don				X	
	<i>Forsteronia leptocarpa</i> Hoker et Amot				X	
	<i>Mandevilla funiformis</i> (Vell) K. Schum.			X		
	<i>Temnadenia stellaris</i> (Lindl.) Miers				X	
ARACEAE	<i>Anthurium longipes</i> Schott			X		
ARECACEAE	<i>Allagoptera brevicalyx</i> M. Moraes			X		
	<i>Syagrus romanzoffianum</i> Cham				X	
ASCLEPIADACEAE	<i>Ditassa blanchetti</i> Decne			X		
	<i>Oxypetalum banksii</i> Roem. & Schult.				X	
ASTERACEAE	<i>Acanthospermum australe</i> (Loefling) Kuntze				X	
	<i>Achyrocline satuireioides</i> (Lam.)DC.				X	X
	<i>Aspilia pascaloides</i> Griseb.					X
	<i>Ageratum conyzoides</i> L.				X	
	<i>Baccharis cassinifolia</i> DC.				X	
	<i>Baccharis dracunculifolia</i> DC.				X	
	<i>Baccharis erioclada</i> DC				X	
	<i>Baccharis pseudovillosa</i> Teodoro					X
	<i>Baccharis semiserrata</i> DC.				X	
	<i>Baccharis trimera</i> (Less.) DC.				X	
	<i>Baccharis</i> sp 1				X	
	<i>Baccharis</i> sp2				X	
	<i>Baccharis</i> sp 3				X	
	<i>Baccharis</i> sp 4				X	

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Bidens pilosa</i> L.				X	
	<i>Centratherum punctatum</i> Cassini				X	
	<i>Conocliniopsis prasiifolia</i> (DC) K & R			X		
	<i>Conyza</i> sp. 1				X	
	<i>Conyza</i> sp. 2				X	
	<i>Elephantopus mollis</i> H.B.K.				X	X
	<i>Erechthites valerianaefolia</i> (Wolf)DC.					X
	<i>Emilia sonchifolia</i> (DC) Benth.				X	
	<i>Enhydra sessilis</i> DC				X	
	<i>Erechthites valerianaefolia</i> (Wolf)DC.				X	
	<i>Eupatorium betonicaeforme</i> Baker				X	
	<i>Eupatorium inulaefolium</i> H.B.K.				X	
	<i>Eupatorium vautherianum</i> DC				X	
	<i>Eupatorium</i> sp. 1				X	
	<i>Eupatorium</i> sp. 2				X	
	<i>Eupatorium</i> sp.3				X	
ASTERACEAE	<i>Eupatorium</i> sp.4				X	
	<i>Hypochoeris rosengusti</i>					X
	<i>Mikania campanulata</i> Gardner				X	
	<i>Mikania micrantha</i> H.B.K.	X			X	X
	<i>Mikania nitida</i> (DC) King & Robinson			X		
	<i>Mikania</i> sp. 1				X	
	<i>Mikania</i> sp. 2				X	
	<i>Mikania</i> sp. 3				X	
	<i>Noticastrum gnaphalioides</i> (Bak.) Cuatr.					X
	<i>Orthopappus augustifolius</i> (Sw.) Gleason				X	
	<i>Pluchea sagittalis</i> (Lam.)Cabr.					X
	<i>Porophyllum ruderale</i> (Jacquin) Cassini				X	
	<i>Pterocaulon alopecuroideum</i> DC.				X	
	<i>Senecio brasiliensis</i> (Spreng.) Less.				X	X
	<i>Senecio crassiflorus</i> (Poir.) DC.					X
	<i>Senecio leptolobus</i> DC.					X
	<i>Senecio</i> sp				X	
	<i>Solidago microglossa</i> DC				X	
	<i>Spilanthes decumbens</i> (Smith)A.H.More					X
	<i>Spilanthes stolonifera</i> DC.					X
	<i>Stilpnopappus scaposus</i> DC			X		
	<i>Symphyopappus cuneatus</i> DC				X	
	<i>Tagetes minuta</i> L.				X	X
	<i>Vernonia arenaria</i> Mart.	X		X		
	<i>Vernonia beyrichii</i> Lessing				X	
	<i>Vernonia cognata</i> Lessing, L.					X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Vernonia constricta</i> Matzenbacher et Mafioleti					X
	<i>Vernonia edmundoi</i> Barroso			X		
	<i>Vernonia flexuosa</i> Sims.					X
	<i>Vernonia tweediana</i> Baker					X
	<i>Vernonia scorpioides</i> (Lamarck) Persoon				X	
	<i>Vernonia</i> sp.1				X	
	<i>Vernonia</i> sp.2				X	
	<i>Wedelia paludosa</i> DC				X	
BIGNONIACEAE	<i>Wulffia baccata</i> (Lf.) O. Kuntze	X				
	<i>Arrabidaea brachypoda</i> (DC) Bur.					
	<i>Jacaranda puberula</i> Cham.				X	
BORAGINACEAE	<i>Tabebuia elliptica</i> (dc.) SANDW.		X	X		
	<i>Cordia curassavica</i> DC.				X	
	<i>Cordia verbenacea</i> DC.					X
	<i>Heliotropium clausenii</i> Dc.		X			
BROMELIACEAE	<i>Heliotropium polyphyllum</i> Lenn.	X				
	<i>Aechmea</i> sp			X		
	<i>Hohembergia ramageana</i> Mez		X			
BURCERACEAE	<i>Protium bahianum</i> Daly			X		
	<i>Protium heptaphyllum</i> (Aubl.) March.	X				
	<i>Protium icicariba</i> DC March			X		
CACTACEAE	<i>Cereus pernanbucensis</i> Hort. Wuerzb ex Pfeiffer		X			
	<i>Cassia occidentalis</i> L.					X
CAESALPINIACEAE	<i>Chamaecrista (Cassia) hispidula</i> Vahl. Irwin & Barneby	X				
	<i>Chamaecrista flexuosa</i> (L.) Greene	X				
	<i>Chamaecrista ramosa</i> (Vog.) I & B var <i>ramosa</i>		X	X		
	<i>Moldenhawera nutans</i> Queiroz & Allkin n. p.			X		
CALYCERACEAE	<i>Acicarpa spathulata</i> R. Br.				X	
	<i>Acicarpa tribuloides</i> Jussieu					X
CAPPARACEAE	<i>Capparis flexuosa</i> L.		X			
	<i>Dactylaena microphylla</i> Eichl			X		
CLUSIACEAE	<i>Kielmeyera argentea</i> Choisy			X		
COMBRETACEAE	<i>Laguncularia racemosa</i> Gaertner f.				X	
	<i>Terminalia catappa</i> L.				X	
COMMELINACEAE	<i>Commelina elegans</i> H.B.K.				X	
	<i>Commelina cf. Virginica</i> L.	X			X	
CONVOLVULACEAE	<i>Evolvulus</i> sp			X		
	<i>Ipomoea cairica</i> (L.) Sweet				X	X
	<i>Ipomoea litoralis</i> (L.) Choisy	X				
	<i>Ipomoea longicuspis</i> Meissn.				X	
	<i>Ipomoea mauritiana</i> Jacq.	X				
	<i>Ipomoea pes-caprae</i> (L) R. Brow	X			X	

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Ipomoea</i> sp.1				X	
	<i>Ipomoea</i> sp.2				X	
	<i>Ipomoea</i> sp.3				X	
	<i>Merremia dissecta</i> (Jacq.) Hall.				X	
	<i>Merremia aegyptia</i> (L.) Hallier	X				
CRUCIFERACEAE	<i>Lepidium virginicum</i> L.				X	
CURCUBITACEAE	<i>Cucurbita pepo</i> L.				X	
CYPERACEAE	<i>Carex</i> sp				X	
	<i>Cyperus sesquiflorus</i> (Torrey)Mattf.et Kükenth.					X
	<i>Fimobristylis</i> sp.				X	
ERICACEAE	<i>Agaristha revoluta</i> (Spr.) DC			X		
	<i>Rhododendrom</i> sp. 1				X	
ERIOCALACEAE	<i>Eriocaulon modestum</i> Kunth					X
EUPHORBIACEAE	<i>Croton glandulosus</i> L.				X	
	<i>Croton cf. helichrysum</i> Baillon					X
	<i>Croton migrans</i> Casaretto					X
	<i>Dalechampia scandens</i> L.		X			
	<i>Euphorbia gymnoclada</i> Boiss.			X		
	<i>Phyllanthus niruri</i> L.				X	
	<i>Ricinus communis</i> L.				X	
FABACEAE	<i>Adesmia latifolia</i> (Spreng.) Vogel, L.					X
	<i>Acosmium bijugum</i> (Vog.) Yakovl			X		
	<i>Canavalia maritima</i> Piper				X	
	<i>Canavalia rosea</i> L.	X				
	<i>Centrosema brasilianum</i> (L.) Benth	X	X	X		
	<i>Centrosema coriaceum</i>			X		
	<i>Centrosema pubescens</i> Benth	X				
	<i>Centrosema virginianum</i> (L.) Benth.					X
	<i>Centrosema</i> sp	X				
	<i>Clitoria cajanifolia</i> Benth	X				
FABACEAE	<i>Crotalaria mucronata</i> Desv.				X	
	<i>Crotalaria pallida</i> Ait.		X			
	<i>Crotalaria retusa</i> L.	X				
	<i>Desmodium adscendens</i> (Sw.) DC.				X	X
	<i>Desmodium incanum</i> DC.				X	
	<i>Desmodium</i> sp.				X	
	<i>Galactia jussiaeana</i> H.B.K.	X				
	<i>Indigofera hirsuta</i> L.	X				
	<i>Indigofera suffruticosa</i>				X	
	<i>Macroptilium atropurpureum</i> Urb	X				
	<i>Poecilanthe itapuana</i> GP Lewis			X		
	<i>Sesbania punicea</i> (Cav.)Bentham					X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Sophora tomentosa</i> L.		X			
	<i>Stilosanthes viscosa</i> Sw			X		
	<i>Stylosanthes viscosa</i> Swartz				X	
	<i>Swartia apetala</i> Raddi var. <i>subcordata</i> Cowan			X		
	<i>Tephrosia cinerea</i> (L.) Pers.		X			
	<i>Vigna halophila</i> (Piper) Maréchal, Mascherpa & Stainier			X		
	<i>Vigna luteola</i> (Jacq.) Benth.				X	X
	<i>Vigna peduncularis</i> (Kunth) Fawa et Rendle		X			
	<i>Zornia curvata</i> Mohl.	X				
GRAMINAE	<i>Echnoclea crus-galli</i> L.				X	
	<i>Paspalum conjugatum</i> Berg.				X	
HUMIRIACEAE	<i>Humiria balsamifera</i> (Aubl) St. Hil. var. <i>parvifolia</i> (Juss) Cuatr			X		
ICACINACEAE	<i>Emmotum affine</i> Miers			X		
KRAMERIACEAE	<i>Krameria bahiana</i> B B Simpson			X		
LAMIACEAE	<i>Eriope blanchetti</i> (Benth) R Harley			X		
	<i>Glechon marifolia</i>					X
	<i>Hyptis fasciculata</i> Benth.				X	
	<i>Hyptis lacustris</i> St. Hill ex. Benth.				X	
	<i>Hyptis mutabilis</i> (Rich) Briquet					X
	<i>Marsiphanthes chamaedris</i> (Vahl.) Ktze.				X	
	<i>Marsipianthes hyptoides</i> Mart. Ex Benth	X				
	<i>Ocinum cf. selloi</i> Bentham					X
LAURACEAE	<i>Aiouea saligna</i> Meissner				X	
	<i>Cassytha americana</i> L.		X			
	<i>Ocotea notata</i> Miers			X		
LECYTHIDACEAE	<i>Gustavia augusta</i> L.	X				
LILIACEAE	<i>Cordyline terminalis</i> (Kunth)				X	
	<i>Hypoxis decumbens</i> L.				X	
LORANTHACEAE	<i>Struthanthus flexicaulis</i> Mart.			X		
	<i>Struthanthus polyrhizus</i> Mart.			X		
LYTHRACEAE	<i>Cuphea branchiata</i> Koehne			X		
	<i>Cuphea calophylla</i> Cham. et Schlecht.				X	
	<i>Cuphea flava</i> Spreng		X			
	<i>Cuphea mesostemon</i> Koehne				X	
MALPIGHIACEAE	<i>Byrsonima gardneriana</i> Juss.		X			
	<i>Byrsonima coccolobifolia</i> (Spreng.) Kunth			X		
	<i>Byrsonima microphylla</i> A. Juss			X		
	<i>Byrsonima sericea</i> DC			X		
	<i>Stigmaphyllon paralias</i> A. Juss			X		
	<i>Stigmatophyllum ciliatum</i> Lam				X	
	<i>Tetrapteryx</i> sp	X				
MALVACEAE	<i>Hibiscus pernambucensis</i> (Bertoloni) Johnston				X	

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

	<i>Hibiscus</i> sp			X	
	<i>Malvaviscus arboreus</i> Cav.			X	
	<i>Pavonia cancellata</i> Cav.	X			
	<i>Sida carpinifolia</i> L.f.			X	X
	<i>Sida cordifolia</i> L.			X	
	<i>Sida rhombifolia</i> L.			X	X
	<i>Sida</i> sp			X	
	<i>Urena lobata</i> L.			X	
MELASTOMATACEAE	<i>Comolia ovulifolia</i> DC Triana		X		
	<i>Leandra australis</i> (Cham) Cogn.			X	
	<i>Pterolepis aglomerata</i> Rottb&Mig.			X	
	<i>Pterolepis edmundoi</i> Brade & Markgraf		X		
	<i>Tibouchina clavata</i> (Persoon) Wurdack			X	
	<i>Tibouchina gracilis</i> (Bonpl.) Cogn.				X
	<i>Tibouchina multiceps</i> Cogn.			X	
	<i>Tibouchina pulchra</i> Chamisso			X	
	<i>Tibouchina sellowiana</i> (Cham.)			X	
	<i>Tibouchina urvilleana</i> (DC:) Cogn.			X	X
MELIACEAE	<i>Melia azedarach</i> L.				X
MIMOSACEAE	<i>Abarema filomentosa</i> (Benth) Piltifer		X		
	<i>Inga edulis</i> Mart.			X	
	<i>Mimosa diplotricha</i> Wrigth	X			
	<i>Mimosa somnians</i> Humb. & Bonpl. Ex. Willd		X		
MYRTACEAE	<i>Calycolpus legrandii</i> Mattos			X	
	<i>Eugenia pistaciifolia</i> DC			X	
	<i>Myrcia</i> sp1			X	
	<i>Myrcia</i> sp2			X	
	<i>Myrcia paniculata</i> (H.B.K.) Kz. Et Chb.		X		
	<i>Psidium cattleayanum</i> Sab.				X
	<i>Psidium guayava</i> Raddi				X
OCHNACEAE	<i>Ouratea rotundifolia</i> (Gardn.) Engl.		X		
ONAGRACEAE	<i>Ludwigia caparosa</i> (Camb.) Hara				X
	<i>Ludwigia elegans</i> (Camb.) Hara				X
	<i>Ludwigia leptocarpa</i> (Nutt.) Hara				X
	<i>Ludwigia longifolia</i> (DC.)Hara				X
	<i>Ludwigia peploides</i> (Kunth) Raven				X
	<i>Ludwigia peruviana</i> (L.) Hara				X
	<i>Ludwigia suffruticosa</i> L.			X	
	<i>Ludwigia uruguayensis</i>				X
PAPILIONACEAE	<i>Erythrina crista-galli</i> L.				X
PASSIFLORACEAE	<i>Passiflora edulis</i> Sims		X	X	
	<i>Passiflora foetida</i>	X			
	<i>Passiflora jileki</i> Wawra			X	
PHYTOLACACEAE	<i>Microteca scabrida</i> Urban				X

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
POLYGALACEAE	<i>Polygala cyparissias</i> St. Hilaire & Moquin	X			X	
	<i>Polygala laureola</i> St. Hil. & Moq				X	
	<i>Polygala monticola</i> H.B.K.	X				
	<i>Polygala psomophila</i> Chod. & Hub.			X		
	<i>Polygala</i> sp			X		
POLYGONACEAE	<i>Antigonon leptotus</i> Hook & Arn				X	
	<i>Coccoloba arborescens</i> (Vell) How .		X			
	<i>Coccoloba cordifolia</i> Meier			X		
	<i>Coccoloba ramosissima</i> Wedd			X		
	<i>Polygonum punctatum</i> var. aq Elliot				X	X
PONTEDERIACEAE	<i>Pontederia lanceolata</i> L.					X
PORTULACACEAE	<i>Talinum</i> sp.	X				
RHAMNIACEAE	<i>Rhamnus</i> sp.				X	
ROSACEAE	<i>Rubus urticaefolius</i> Poir				X	
	<i>Rubus rosifolius</i> Sm.				X	
RUBIACEAE	<i>Alibertia</i> sp			X		
	<i>Borreria cymosa</i> Cham. & Schlecht.			X		
	<i>Borreria latifolia</i> Schum				X	
	<i>Borreria verticillata</i> (L) G F W Meye	X	X	X	X	
	<i>Borreria</i> sp			X		
	<i>Chiococca alba</i> (L.)				X	
	<i>Diodia apiculata</i> (R.et S.) Schum.					X
	<i>Diodia radula</i> (R. et S.) Cham. et Schlecht.				X	
	<i>Guettarda platypoda</i> D C		X	X		
	<i>Mitracarpus discolor</i> Miq.		X			
	<i>Richardia brasiliensis</i> Gomez.				X	
	<i>Rudgea villiflora</i> K. Schum.				X	
	<i>Tocoyena sellowiana</i> (Cham. Et Schlecht.) K. Schum		X			
RUTACEAE	<i>Citrus medica</i> L.				X	
SAPINDACEAE	<i>Cardiospermum integerrimum</i> Radlk			X		
	<i>Dodonaea viscosa</i> (L.) Jacquin				X	
	<i>Paullinia trigonia</i> Vell.				X	
	<i>Pseudima fritescens</i> Radlk.	X				
SAPOTACEAE	<i>Manilkara salzmanni</i> (DC) H J Lam.			X		
SCROPHULARIACEAE	<i>Bacopa tweedii</i> (Benth.) Parodi					X
	<i>Achetaria ocynoides</i> C.et S.Wetts				X	
	<i>Scoparia dulcis</i> L.		X			
SMILACEAE	<i>Smilax campestris</i> Griseb.				X	
SOLANACEAE	<i>Physalis neesiana</i> Sendtn.				X	
	<i>Solanum cf. Micrathum</i> Britton.	X				
	<i>Solanum paludosum</i> Moric		X			
	<i>Solanum paniculatum</i> L.		X			

Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

Plant family	Plant species	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
	<i>Solanum sisymbriifolium</i> Lam.					X
	<i>Solanum stagnale</i> Moric			X		
STERCULIACEAE	<i>Waltheria cinerescens</i> St. Hil.			X		
	<i>Waltheria indica</i> L.		X			
SYMPLOMEACEAE	<i>Symplocos</i> sp				X	
THEACEAE	<i>Ternstroemia</i> sp			X		
TILIACEAE	<i>Triumfetta semitriloba</i> L.					
TURNERACEAE	<i>Turnera melochioides</i> Camb. Var. <i>arenaria</i> Spruce ex. Urb.	X				
TURNERACEAE	<i>Turnera ulmifolia</i> L.	X	X			
VELLOZACEAE	<i>Vellozia dasytus</i> L B Smith			X		
VERBENACEAE	<i>Glandularia selloi</i> (Spreng) Tronc.					X
	<i>Lantana camara</i> L.			X	X	
	<i>Stachytarpheta cayennensis</i> (L.C.Richard) Vahl				X	
	<i>Verbena montevidensis</i> Spreng.					X
	<i>Vitex cymosa</i> Benth			X		
	<i>Vitex megapotamica</i>					X
VIOLACEAE	<i>Hybanthus</i> sp				X	
ZINGIBERACEAE	<i>Hedychium coronarium</i> Koenig				X	
<b>Number of bee plant families and plants visited by bees</b>		<b>22/33</b>	<b>21/29</b>	<b>39/66</b>	<b>44/140</b>	<b>26/62</b>

Número de espécies por família de Apoidea coletados nas dunas brasileiras	MA (2°30'S)	PB (7°3'S)	BA (12°56'S)	PR (25°30'S)	RS (30°S)
Anthophoridae	21	23	26	43	61
Apidae	5	4	10	21	9
Halictidae	2	3	6	48	46
Megachilidae	5	5	5	37	41
Colletidae	0	1	2	13	9
Andrenidae	3	0	0	2	21
	36	36	49	164	187



Viana BF & Alves dos Santos I. 2002 Bee Diversity of the Coastal Sand Dunes Of Brazil. IN: Kevan P & Imperatriz Fonseca VL (eds) - Pollinating Bees - The Conservation Link Between Agriculture and Nature - Ministry of Environment / Brasília. p.135-153.

---