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Original article

The bees of the Caatinga (Hymenoptera, Apoidea, Apiformes): a species list and comparative notes regarding their distribution[1]

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Abstract – A list of bee species recorded in the Caatinga region is presented, including literature and new data. Caatinga is a xerophilous vegetation characteristic of the semi-arid region of Northeastern Brazil. The species richness of its bee fauna is comparatively low with about 187 species and 77 genera (114 species and 45 genera of Apidae, 35 and 9 of Megachilidae, 18 and 7 of Halictidae, 13 and 9 of Colletidae, and 8 and 7 of Andrenidae). Some genera, that are well diversified and relatively common in the Cerrado, an adjacent but more humid biome also characterized by open vegetation, are not recorded or rare in the Caatinga, e.g. *Epicharis*, *Monoeca*, *Paratetrapedia* and *Tetrapedia*. By contrast the genera *Diadasina*, *Melitoma* and *Leiopodus* are relatively well diversified in the Caatinga.

diversity / biogeography / dry region / Brazil / South America

1. INTRODUCTION

Since the 1960s many surveys of bees and bee flowers have been made in Brazil, mainly in the Southern and Southeastern regions [see 4, 7, 9, 10, 16, 25, 30, 33, and the references therein]. In spite of the great amount of information on the geographical distribution of species presented in these surveys, there are no lists of bee species for the major Brazilian biomes. The few compilations refer to political units like those for the States of Rio Grande do Sul [41] and São Paulo [24]. Lists of species based on natural regions are therefore clearly needed, as they can serve as a large-scale source of reference, especially for biogeographical comparisons and for pollination studies.

[1] Part of the Ph.D. thesis of the author at FFCLRP/Universidade de São Paulo.

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This paper presents the first list of bee species for the Caatinga, a xerophilous vegetation area of about 800 000 km^2 in the semi-arid region of Northeastern Brazil, which extends from approximately 3° to 16° South latitude and from 35° to 44° West longitude. The Caatinga is some 1 500 km north of the Chaco, the nearest dry region, and nearly 3 000 km from the Guajira region of the Caribbean coast of Colombia and Venezuela.

The Caatinga is surrounded by and has contact only with more humid regions: the Cerrado to the South and Southwest, and the Atlantic Rain Forest to the East (Fig. 1).

The climate in the Caatinga region is characterized by low and irregular rainfall and high temperatures, which determines a severe water deficit. The mean annual rainfall varies from 276 mm, in Cabaceiras, Paraíba State, to 800–1 000 mm near the boundaries. There is also a great variation between years. The occurrence of years of extreme drought (0 mm of rainfall) is not uncommon. Average monthly temperature varies from 26 to 29 °C [1, 6, 26].

Caatinga is a deciduous vegetation, with several different fascies, depending on the local climate and pedological conditions. Differently from the Cerrado, the contiguous

Figure 1. South America, with the distribution of the Caatinga, Cerrado, Atlantic and Amazon Forest, Chaco and Guajira regions (after Ab'Saber, 1977).

open and more humid vegetation formation, Caatinga has numerous cacti, terrestrial bromeliads, thorn bushes and barrel-trunked trees. Andrade-Lima [6] recognized 12 community types in the Caatinga, including tall arboreus forests and open shrubby vegetation. According to him this later type occupies the largest area today, and its occurrence in most places may be due to human action. A detailed description of the geomorphology and plant communities of the Caatinga region is given by Ab'Saber [1] and Andrade-Lima [6].

Ducke [12, 13, 14, 15] was the first to study Caatinga bees. He collected bees in several places of the State of Ceará at the beginning of this century and made the first notes on their ecology and biogeography. Some eighty years later new surveys were made by Martins [20] in Casa Nova (Bahia State) and by Aguiar and Martins [4] in São João do Cariri (Paraíba State).

2. MATERIALS AND METHODS

The present work comprises two parts: a compilation of published records of bee species and a year's personal collecting of bees in the Caatinga. The literature surveys include data from the above mentioned works, from taxonomic revisions, descriptions of species and lists of flower visitors from pollination studies. Original data are from a year-round survey made at the "Estação Ecológica do Seridó" in Serra Negra do Norte (Rio Grande do Norte State).

The classification employed is a mixture of those of Dr. Michener and of Pe. Moure. Taxonomy specialists were consulted to resolve doubts regarding the synonyms and currently valid nomenclature (see acknowledgments). The analysis of some specimens collected by Ducke and belonging to the Goeldi Museum (Belém, Pará State), was made possible by Padre Moure (Curitiba). This guaranteed a higher degree of confidence in the determination of the species. Also the correspondence of some probably undescribed species collected by me with those collected by Martins and Aguiar was only possible through the examination of specimens that were kindly loaned by Dr. Celso Martins.

In the list below a question mark before the genus name indicates doubts regarding the correct generic assignment, e.g. when it was not possible to examine the types or when species had not been included in recent taxonomic revisions. It must also be stressed that those species which are registered only in enclaves of other biomes within the Caatinga region were not included in the list, e.g. those collected by Ducke in the high altitude wet forest of the Serra do Baturité, in the State of Ceará.

3. RESULTS AND COMPARATIVE NOTES ON THE BIOGEOGRAPHY OF THE CAATINGA BEES

About 187 bee species were listed for the Caatinga region, belonging to 77 genera (see list of species in the appendix). The family Apidae (sensu Roig-Alsina and Michener [28]) is the most diversified, with 114 species belonging to 45 genera. The Megachilidae are represented by 34 species in 9 genera, Halictidae by 18 species in 7 genera, Colletidae by 13 species in 9 genera and Andrenidae by 8 species in 7 genera.

Notwithstanding the need for more surveys to improve our knowledge of the diversity of the Caatinga bee fauna, specially in the southern half of the region, and the absence of similar compilations for other South American biomes, the available data indicate that the Caatinga bee fauna has a comparatively low species richness. The total number of recorded species for the Caatinga region is lower than that collected in small areas of the Cerrado, the Atlantic Rain Forest or grasslands of Southern Brazil (Tab. I). The Caatinga bee fauna also presents a lower number of species per

Table I. Total number of species and genera of bees collected in standardized surveys in areas of Caatinga, Cerrado, Atlantic Rain Forest and grasslands of Southern Brazil.

Site	Vegetation	Area (km^2)	Altitude (m)	Nb. of hours	Period (years)	Nb. of spp (a)	Nb. of genera (b)	a/b	Source
Serra Negra do Norte (RN) 06° 34' S, 37° 15' W	Secondary open arboreal caatinga and vegetation near a dam	n.d.	200	96	1	83	36	2.3	This work
Serra Negra do Norte (RN) 06° 35' S, 37° 16' W	Secondary open arboreal caatinga	n.d.	200	96	1	47	28	2.2	This work
São João do Cariri (PB) 07° 25' S, 36° 30' W	Open shrubby caatinga	n.d.	450–550	192	1	45	30	1.5	[4]
Casa Nova (BA) 09° 26' S, 41° 50' W	Open arboreal caatinga	1	450	192	1	42	27	1.6	[19]
Paraopeba (MG) 19° 20' S, 44° 20' W	Secondary cerrado	1.4	734–750	233	1	182	56	3.3	[32]
Cajurú (SP) 21° 20' S, 47° 16' W	Secondary cerrado	0.01	700	624	1	193	65	3.0	[22]
Corumbataí (SP) 22° 15' S, 47° 00' W	Secondary cerrado	nr. 0.0017	800	872	3	124	47	2.6	[32]
Boracéia (SP) 23° 38' S, 45° 52' W	Atlantic Rain forest	n.d.	800–950	n.d.	2.5	259	85	3.0	[40]
Alexandra (PR) 25° 33' S, 48° 38' W	Atlantic Rain forest	ca. 2	5–10	88	1	122	46	2.7	[17])
São José dos Pinhais (PR) 25° 31' S, 49° 10' W	Second growth vegetation in a region of grasslands and forests with *Araucaria*	2.1	900	140	1	167	48	3.5	[30]
Guaritas (RS) 30° 48' S, 53° 26' W	Grasslands of southern Brazil	n.d.	200–400	n.d.	nr. 3.5	219	66	3.3	[31]

n.d.: not determined.

genus. For standardized surveys made in the Caatinga region this ratio is always close to two, reaching only 2.3 species per genus, whereas in the other regions it is rarely lower than 2.7, and up to 3.5 species per genus in São José dos Pinhais, Paraná State (Tab. I)

To analyze the composition of the Caatinga bee fauna we have also to compare the list of species with the standardized surveys made in small areas of the other biomes. Because of that, the comparison must be taken with caution, considering that we cannot evaluate how representative these surveys are in relation to the whole bee fauna of the respective regions. This limitation is evident when we look at the genera *Ceblurgus*, *Dasyhalonia*, *Eulonchopria*, *Larocanthidium*, *Protodiscelis* and *Protomeliturga* (Tab. II). These may appear as exclusive to the Caatinga, but from taxonomic revisions and other anecdotal citations, we know that, with the exception of *Ceblurgus*, all occur outside the Caatinga [12, 21, 35, 38]. Despite this limitation, some interesting aspects of the composition of the Caatinga bee fauna can be addressed (see Tab. II).

Table II. Number of species of bees per genus collected in standardized surveys made in the Caatinga in comparison to those made in other regions of Brazil. Some genera absent in the Caatinga surveys were also included, as referred in the text. The genera are listed in alphabetical order, grouped per families, and, in the case of Apidae, per some major tribes. Source of data as Table I (SNN = Serra Negra do Norte, RN; SJC = São João do Cariri, PB; CSN = Casa Nova, BA; CAJ = Cajurú, SP; PAR = Paraopeba, MG; COR = Corumbataí, SP; ALX = Alexandra, PR; BOR = Boracéia, SP; SJP = São José dos Pinhais, PR ; GUA = Guaritas, RS).

Genera		Sites									
		Caatinga			Cerrado			Atlantic Rain Forest		Grasslands of Southern Brazil	
		SNN	SJC	CSN	CAJ	PAR	COR	ALX	BOR	SJP	GUA
COLLETIDAE	*Bicolletes*	–	–	–	–	–	–	–	2	–	3
	Chilicola	1	–	–	–	–	–	–	–	–	3
	Colletes	–	–	–	3	1	1	–	4	3	10
	Eulonchopria	–	–	1	–	–	–	–	–	–	–
	Hylaeus	–	1	–	6	–	5	–	–	3	7
	Nomiocolletes	1	–	–	–	–	–	–	–	–	1
	Perditomorpha	–	–	1	–	–	–	–	1	–	2
	Protodiscelis	1	–	–	–	–	–	–	–	–	–
	Sarocolletes	–	1	1	–	–	–	–	–	–	7
ANDRENIDAE	*Acamptopoeum*	1	1	–	–	–	–	1	1	1	2
	Callonychium	1	1	–	–	–	–	–	–	1	1
	Oxaea	–	–	–	1	1	2	–	–	–	–
	Parapsaenythia	–	–	–	–	–	1	–	1	–	1
	Protomeliturga	1	1	–	–	–	–	–	–	–	–
	Psaenythia	1	1	–	–	–	1	–	3	6	9
	Rhophitulus	–	–	1	–	–	–	–	–	2	–
HALICTIDAE	*Augochlora*	7	2	1	8	8	6	5	12	4	9
	Augochlorella	1	–	–	1	–	–	2	3	4	3
	Augochloropsis	2	1	–	10	12	6	11	21	15	14
	Ceblurgus	–	1	–	–	–	–	–	–	–	–

Table II. (continued).

Genera		Sites									
		Caatinga			Cerrado			Atlantic Rain Forest		Grasslands of Southern Brazil	
		SNN	SJC	CSN	CAJ	PAR	COR	ALX	BOR	SJP	GUA
HALICTIDAE	*Ceratalictus*	–	–	–	3	1	1	–	–	2	1
	Dialictus	3	2	2	4	5	2	3	20	41	5
	Habralictus	–	–	–	1	2	1	–	6	–	–
	Neocorynura	–	–	–	–	2	–	3	10	3	3
	Pereirapis	–	–	1	–	1	–	1	–	–	–
	Pseudaugochlora	1	1	–	2	1	2	1	1	1	1
MEGACHILIDAE	*Anthidium*	1	–	–	2	2	1	–	–	–	–
	Coelioxys	6	2	1	9	7	2	7	3	4	4
	Dicrantidium	1	–	1	–	–	–	–	–	–	1
	Epanthidium	2	–	–	4	1	0	–	–	1	2
	Hypanthidium	–	–	–	1	1	4	1	1	–	1
	Larocanthidium	1	–	–	–	–	–	–	–	–	–
	Lithurgus	1[a]	–	–	–	–	–	–	–	–	1
	Megachile	17	7	2	20	22	8	29	13	14	21
	Microthurge	1	–	–	–	–	–	–	–	–	1
BOMBINI	*Bombus*	1	–	–	2	2	2	3	3	3	3
CENTRIDINI	*Centris*	6	3	8	9	17	16	7	5	1	4
	Epicharis	–	–	–	10	4	12	1	3	–	–
CERATININI	*Ceratina*	1	2	–	10	6	7	5	4	3	8
	Ceratinula	1	1	–	2	2	5	3	8	2	5
EMPHORINI	*Ancyloscelis*	2	1	–	2	1	–	1	–	–	5
	Diadasina	5	–	–	–	–	–	–	–	–	4
	Melitoma	5	1	–	1	2	–	1	–	–	2
	Ptilothrix	1	–	–	–	1	–	–	–	–	2
ERICROCIDINI	*Mesocheira*	1	–	–	–	–	–	1	–	–	–
EUCERINI	*Alloscirtetica*	1	–	–	–	–	–	–	–	–	1
	Dasyhalonia	–	1	–	–	–	–	–	–	–	–
	Florilegus	2	–	–	1	–	–	–	–	–	2
	Gaesischia	4	3	–	1	3	–	–	1	4	2
	Melissodes	1	1	1	–	–	–	1	1	–	1
	Melissoptila	1	–	–	4	3	1	1	5	3	3
EUGLOSSINI	*Eufriesea*	–	–	–	1	1	1	1	3[b]	–	–
	Euglossa	–	–	–	2	1	1	1	8[b]	–	–
	Eulaema	1	1	–	1	1	1	1	2[b]	–	–
	Exaerete	–	–	–	–	–	1	–	–	–	–
EXOMALOPSINI	*Exomalopsis*	1	2	1	3	8	3	3	5	3	–
ISEPEOLINI	*Isepeolus*	–	–	–	–	–	–	–	–	2	1

Table II. (continued).

Genera		Sites									
		Caatinga			Cerrado			Atlantic Rain Forest		Grasslands of Southern Brazil	
		SNN	SJC	CSN	CAJ	PAR	COR	ALX	BOR	SJP	GUA
MELIPONINI	*Frieseomelitta*	1	1	1	1	2	–	–	1	–	–
	Geotrigona	–	–	–	1	1	–	–	–	–	–
	Lestrimelitta	–	–	1	–	–	–	–	1	–	–
	Melipona	–	–	2	2	1	1	1	4	1	–
	Paratrigona	–	–	–	1	2	1	–	1	–	–
	Partamona	–	1	1	–	1	1	1	1	–	–
	Plebeia	–	–	2	1	1	1	2	3	–	2
	Scaptotrigona	–	–	1	2	1	1	1	1	–	1
	Trigona	–	1	1	4	2	3	3	2	1	1
	Trigonisca	–	1	1	–	1	–	–	–	–	–
OSIRINI	*Osirinus*	1	–	–	1	–	–	–	–	–	–
	Parepeolus	1	–	–	1	–	–	–	–	–	–
PROTEPEOLINI	*Leiopodus*	3	–	–	–	–	–	1	–	–	–
TAPINOTASPIDINI	*Caenonomada*	1	1	1	–	–	–	–	–	–	1
	Monoeca	–	–	–	4	2	–	1	3	–	–
	Paratetrapedia[c]	1	–	–	19	16	3	3	–	–	1
TETRAPEDIINI	*Coelioxoides*	–	–	–	1	1	1	–	1	–	–
	Tetrapedia	–	–	1	6	2	2	–	1	–	–
XYLOCOPINI	*Xylocopa*	5	1	4	3	5	6	3	4	3	9

[a] Probably adventive [34].
[b] Species collected using scent fragrances.
[c] The genera *Arhysoceble* and *Trigonopedia* were kept in *Paratetrapedia*, because it is impossible to know the real identity of not determined species, without having access to the specimens.

First, we can note that some bee genera not recorded in the Caatinga are diverse and relatively common in the Cerrado, an adjacent biome also characterized by open vegetation. Examples are *Monoeca*, *Paratetrapedia*, *Ceratalictus*, *Habralictus*, *Hypanthidium* and *Oxaea*. This pattern of distribution, absence in the Caatinga and a high diversity in the neighboring Cerrado, is interesting and deserves more study to understand its causes. *Euglossa* and *Eufriesea* are similar, but Aguilar [5] collected one species of each in the Caatinga using scent traps. In the case of *Epicharis*, it was published only last year the first record for the Caatinga region. One species, presumably new, collected by Lewis and Gibbs [18] in Livramento do Brumado, Bahia State.

The Caatinga is also notably poor in species of *Augochlorella*, *Augochloropsis*, *Bombus*, *Ceratina*, *Ceratinula*, *Dialictus*, *Hylaeus*, *Tetrapedia* and *Sarocolletes*. The genera *Augochloropsis*, *Bombus*, *Ceratina* and *Ceratinula* are more diversified in all other regions analyzed. *Sarocolletes* and *Augochlorella* are more diversified in

Southern Brazil, while *Tetrapedia* is more diversified in the Cerrado.

There are a relatively high numbers of species of *Diadasina*, *Melitoma* and *Leiopodus* in the Caatinga. The first two belong to the tribe Emphorini, a group that preferentially visits flowers of plants of the family Convolvulaceae. As the species of this family are usually found near bodies of water; such as puddles, ponds and lakes, the distribution of Emphorini in the Caatinga may be restricted to these sites and be rare or absent elsewhere. The higher diversity of *Leiopodus*, in turn, can be explained by the abundance of Emphorini, since they are cleptoparasites, apparently exclusive, on species of this tribe [29].

Finally, it is interesting to note that the Caatinga bee fauna shares more genera with the grasslands of Southern Brazil than with neighboring biomes, such as the Cerrado or the Atlantic Forest. Six categories of genera shared by different biomes are recognized (Tab. II):

(a) Genera shared by Caatinga and grasslands of Southern Brazil: *Alloscirtetica*, *Caenonomada*, *Callonychium*, *Diadasina*, *Rhophitulus*, *Sarocolletes*, *Microthurge*, *Nomiocolletes*, *Chilicola*, *Dicranthidium.*
(b) Genera shared by Caatinga and Cerrado: *Anthidium*, *Osirinus*, *Parepeolus*, *Trigonisca.*
(c) Genera shared by Caatinga and Atlantic Forest: *Leiopodus*, *Mesocheira*, *Lestrimelitta.*
(d) Genera shared by Caatinga, Cerrado and grasslands of Southern Brazil: *Epanthidium*, *Florilegus*, *Hylaeus*, *Ptilothrix.*
(e) Genera shared by Caatinga, Cerrado and Atlantic Forest: *Eulaema*, *Frieseomelitta*, *Partamona*, *Pereirapis*, *Tetrapedia.*
(f) Genera shared by Caatinga, Atlantic Forest and grasslands of Southern Brazil: *Acamptopoeum*, *Melissodes*, *Perditomorpha.*

The occurrence of bee genera apparently with disjunct distribution between Caatinga and Southern Brazil, probably extending to the argentine deserts and Chaco, suggests that the flora and fauna of these regions, nowadays isolated by those of more humid regions, could have been connected in the past. According to Ab'Saber [2, 3], former connections between arid biomes in South America can be assumed for the drier periods of the Quaternary glacial cycles, when there was an expansion of xeric biomes, like Caatinga and Chaco, a retraction of humid ones, like the Atlantic Rain Forest, and a displacement of the Cerrado. The complexity of this scenario, however, requires a more complete review of the geographic distribution and the evolutionary history of the genera that exhibit this pattern of distribution to check the predictions of this hypothesis.

A preliminary analysis of the distribution patterns of 96 bee species that occur in the Caatinga indicated that about 32% are endemic in the region. A disjunct distribution between the Caatinga region and the arid regions of the South cone of South America is known only for three species, *Caenonomada unicalcarata*, *Leiopodus abnormis* and *L. trochantericus*. This pattern of disjunction is also observed in the distribution of the genera *Callonychium*, *Nomiocolletes*, *Sarocolletes*, *Dasyhalonia*, and perhaps, of *Acamptopoeum* and *Diadasina* [42]. If this pattern of disjunction is the result of the occurrence in the past of a factor, climatic or geological, that subdivided the populations of an ancestral biota associated to the dry regions of South America, one might expect to find congruence in the area cladograms of these groups of bees, and also of other organisms that occur in the dry regions of South America.

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Silveira on the Exomalopsini; Sílvia R.M. Pedro on the genus *Partamona*; Beatriz W.T. Coelho on the genus *Augochlorella* and Eduardo A.B. Almeida on the genus *Pseudaugochlora*. IBAMA (Instituto Brasileiro do Meio Ambiente) granted permission to collect bees at the ESEC-Seridó. I am especially indebted to Alvamar Queiroz and Adson, the directors of this conservation unit. The Universidade Federal da Paraíba (CSTR) collaborated during the survey made at the ESEC-Seridó. Celso F. Martins sent voucher specimens from his studies. João M.F. Camargo was my adviser during my PhD studies. He, Maria Cristina Gaglianone and Klaus Hartfelder and two anonymous referees gave many useful suggestions for the improvement of the manuscript. This study was financially supported by a scholarship from the CAPES (Coordenação de Aperfeiçoamento do Pessoal de Ensino Superior – Brasil).

Résumé – Les abeilles du Caatinga (Hymenoptera, Apoidea, Apiformes) : liste d'espèces et notes comparatives concernant leur répartition. Cette étude présente la première liste d'espèces d'abeilles du Caatinga, type de végétation xérophile présente dans la région semi-aride du nord-est du Brésil (Fig. 1). Ducke [12–15] a été le premier à étudier les abeilles du Caatinga au début des années 1900 et de nouveaux recensements d'abeilles n'ont été effectués qu'environ 80 ans plus tard. La liste présentée en annexe est une compilation de données publiées et de données originales. Lorsqu'il y a doute sur le genre, un point d'interrogation est placé devant le nom de genre. Les espèces recensées uniquement dans des enclaves d'autres biomes dans le Caatinga n'ont pas été incluses dans la liste, par exemple les espèces récoltées par Ducke dans la forêt humide de haute altitude de la Serra do Baturité, état de Ceará. 187 espèces environ sont listées, qui appartiennent à 77 genres. La famille des Apidae (sensu Roig-Alsina et Michener [28]) est la plus variée avec 114 espèces réparties en 45 genres. Les Megachilidae sont représentés par 34 espèces en 9 genres, les Halictidae par 18 espèces en 7 genres, les Colletidae par 13 espèces en 9 genres et les Andrenidae par 8 espèces en 7 genres. Le nombre total d'espèces recensées dans le Caatinga est inférieur au nombre d'espèces récoltées dans certaines petites parties du Cerrado, de la Forêt Atlantique ou des prairies du sud du Brésil (Tab. I), indiquant qu'il a une richesse spécifique comparativement faible. Une analyse préliminaire de la composition de la faune d'abeilles du Caatinga (Tab. II) montre que certains genres non recensés dans le Caatinga sont variés et relativement communs dans le Cerrado, biome adjacent mais plus humide caractérisé lui aussi par une végétation ouverte. *Monoeca, Paratetrapedia, Ceratalictus, Habralictus, Hypanthidium* et *Oxaea* en sont des exemples. Le Caatinga est pauvre en espèces de *Augochlorella, Augochloropsis, Bombus, Ceratina, Ceratinula, Dialictus, Hylaeus, Tetrapedia* et *Sarocolletes*. Les genres *Augochloropsis, Bombus, Ceratina* et *Ceratinula* sont plus diversifiés dans toutes les autres régions analysées. *Sarocolletes* et *Augochlorella* sont plus diversifiés dans le sud du Brésil, tandis que *Tetrapedia* est plus diversifié dans le Cerrado. Les quelques genres qui présentent une richesse spécifique plus grande dans le Caatinga par rapport aux autres biomes sont : *Diadasina, Melitoma* and *Leiopodus*. La présence possible de genres d'abeilles ayant une distribution disjointe entre le Caatinga et le sud du Brésil, s'étendant probablement jusqu'aux déserts argentins et au Chaco, suggère que la flore et la faune de ces régions, actuellement isolées par des régions plus humides, ont pu être reliées dans le passé.

biogéographie / diversité espèces / région sèche / Brésil / Apoidea

Zusammenfassung – Die Bienen von Kaatinga (Hymenoptera, Apiformes): Artenliste und vergleichende Bemerkungen über ihre Verbreitung. In dieser Arbeit wird die erste Liste von Bienenarten in der Kaatinga veröffentlicht, einer trockenheitsliebenden Vegetation, die in der semiariden

Region von Nordost – Brasilien vorkommt (Abb. 1). Ducke [12–15] war der erste, der am Beginn dieses Jahrhunderts die Kaatinga Bienen studiert hat. Erst 80 Jahre später wurden weitere Untersuchungen durchgeführt. Die Liste, die hier aufgeführt wird (siehe Anhang), ist eine Zusammenstellung von bereits veröffentlichten und eigenen Daten. Bei Zweifel über die Gattungszugehörigkeit steht ein Fragezeichen vor dem Gattungsnamen. Arten, die nur als Biotopenklave innerhalb des Kaatinga Gebietes vorkamen, wurden nicht in die Liste eingeschlossen, wie z.B. Proben von Ducke aus dem Bergregenwald von Serra do Baturité im Staat von Ceará.

Es wurden 187 Arten aufgelistet, die zu 77 Gattungen gehören. Die Familie Apidae (sensu Roig-Alsina und Michener [28]) ist mit 114 Arten bei 45 Gattungen am verschiedenartigsten. Die Megachilidae sind mit 34 Arten in 9 Gattungen vertreten, die Halictidae mit 18 Arten in 7 Gattungen, Colletidae mit 13 Arten in 9 Gattungen und Andrenidae mit 8 Arten in 7 Gattungen.

Die Gesamtzahl der aufgelisteten Arten in der Kaatinga ist niedriger als die in einigen kleinen Gebieten von Cerrado, im Atlantikwald oder im Grasland in Südbrasilien (Tab. I). Damit erweist sich ein vergleichsweise geringer Artenreichtum.

Eine vorläufige Analyse der Zusammensetzung der Kaatinga Bienenfauna (Tab. II) ergibt, dass einige Gattungen, die dort nicht vorkommen, in den Cerrados, einem benachbarten aber feuchterem Biotop mit offener Vegetation, mannigfaltig und häufig sind. Als Beispiele sind hier *Monoeca, Paratetrapedia, Ceratalictus, Habralictus, Hypanthidium* und *Oxaea* erwähnt. In der Kaatinga sind die Arten *Augochlorella, Augochloropsis, Bombus, Ceratina, Ceratinula, Dialictus, Hylaeus, Tetrapedia* und *Sarocolletes* selten vertreten. Die Gattungen *Augochloropsis, Bombus, Ceratina* und *Ceratinula* dagegen sind artenreicher als in allen anderen untersuchten Regionen. *Sarocolletes* und *Augochlorella* sind diverser in Südbrasilien, während *Tetrapedia* diverser in den Cerrado sind. Die wenigen Gattungen, die einen höheren Artenreichtum in der Kaatinga im Vergleich zu anderen Biotopen aufweisen, sind *Diadasina*, *Melitoma* und *Leiopodus*.

Hiermit kommen die Bienengattungen in einer unterbrochenen Verteilung in Kaatinga und Südbrasilien vor, die sich wahrscheinlich bis in die argentinische Wüste und Chaco fortsetzt. Dies lässt vermuten, dass die Flora und Fauna dieser Regionen früher möglicherweise miteinander verbunden waren, aber heute durch feuchte Gebiete voneinander isoliert sind.

diversität / Biogeographie / Trockenregion / Brasilien / Südamerika

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APPENDIX

LIST OF THE CAATINGA BEE SPECIES

COLLETIDAE

XEROMELISSINAE: **Chilicolini**: *Chilicola* (*Prosopoides*) *minima* (Ducke, 1908)[1, 8]; COLLETINAE: **Colletini**: *Colletes rufipes* Smith, 1879[2]; **Paracolletini**: *Bicolletes* sp[11]; *Eulonchopria* sp.[4]; *Nomiocolletes bicellularis* (Ducke, 1911)[2, 8]; *N. cearensis* (Ducke, 1908)[1, 2]; *Perditomorpha brunerii* (Ashmead, 1899) [= *P. laena* (Vachal, 1904)][4]; *P. decoloratus* (Ducke, 1908)[1, 2]; *Protodiscelis alismatis* (Ducke, 1908)[1, 8]; *P. palpalis* (Ducke, 1908)[1, 9]; *Sarocolletes fulva* Moure & Urban, 1992[4]; *S.* sp [5]; **Hylaeinae**: *Hylaeus* sp.[5]

ANDRENIDAE

OXAEINAE: *Oxaea austera* Gerstäcker, 1867[2]; PANURGINAE: **Calliopsini**: *Acamptopoeum prinii* (Holmberg, 1884)[1, 2, 5, 8]; *Callonychium* (*C.*) *brasiliense* (Ducke, 1907)[5, 8]; **Panurgini**: *Parapsaenythia* sp.[8, 9]; ? *Psaenythia canina* Ckll., 1912[3]; *Psaenythia variabilis* Ducke, 1908[1, 2, 5, 8]; *Rhophitulus hyptidis* Ducke, 1908[1, cf. 4]; Gên. ? [4]; **Protomeliturgini**: *Protomeliturga turnerae* (Ducke, 1907)[1, 5, 8]

HALICTIDAE

HALICTINAE: **Augochlorini**: *Augochlora* (*A.*) *esox* (Vachal, 1911)[8]; *Augochlora* (*A.*) 3 spp. [8]; *Augochlora* (*Oxystoglossella*) *thalia* Smith, 1879[4, cf. 5, 8]; *Augochlora* (*O.*) *aff. diaphractes* (Vachal, 1911) [5, 8]; *Augochlora* (*O.*) sp.[8]; *Augochlorella tredecium* (Vachal, 1911)[8]; *Augochloropsis* (*A.*) *callichroa* (Ckll., 1900)[8]; *A.* (*A.*) *diversipennis* (Lep., 1841)[3]; *A.* (*A.*) sp.[8, 11]; *A.* cf. *cockerelli* Schrottky, 1909[5]; *Pereirapis rhizophila* Moure, 1943[4]; *Pseudaugochlora pandora* (Smith, 1853)[5, 8]; **Halictini**: *Dialictus* (*Chloralictus*) *opacus* (Moure, 1940)[4, 5, 8]; *D.* (*C.*) 2 spp.[4, 5, 8];

ROPHITINAE (= DUFOUREINAE): *Ceblurgus longipalpis* Urban & Moure, 1993[4, 5, 11]

MEGACHILIDAE

MEGACHILINAE: **Anthidiini**: ? *Anthidium appendiculatum* Ducke, 1911[2]; *A.* (*Tetranthidium*) *latum* Schrottky, 1902[1, 8]; *Dicranthidium arenarium* (Ducke, 1907)[1, 3, 4, 8]; *D. luciae* Urban, 1992; *Epanthidium maculatum* Urban, 1992[8]; *E. tigrinum* (Schrottky, 1905)[8]; *Hypanthidium erytrogaster* Moure & Urban, 1993; *Larocanthidium emarginatum* Urban, 1997[8]; **Lithurgini**: *Lithurgus* (*L.*) *huberi* Ducke, 1907[1, 8]; *Microthurge friesei* (Ducke, 1907)[1, 8]; **Megachilini**: *Coelioxys* (*Acrocoelioxys*) *praetextata* Haliday, 1837[5, 8]; *Coelioxys* (*Neocoelioxys*) *assumptionis* Schrottky, 1910[8]; *Coelioxys* (*Glyptocoelioxys*) *cearensis* Friese, 1921[8]; *Coelioxys* (*G.*) *cerasiopleura* Holmberg, 1904[8]; *Coelioxys* (*G.*) *chacoensis* Holmberg, 1904[8]; *Coelioxys* (*Melanocoelioxys*) *tolteca* Cresson, 1878[5]; *Coelioxys* sp.[4, 8]; *Megachile* (*Acentron*) *bernardina* Schrottky, 1913[8]; *M.* (*A.*) *verrucosa* Brèthes, 1909[8]; *M.* (*A.*) 2 spp.[5, 8]; *M.* (*Dactylomegachile*) sp.[8]; *M.* (*Leptorachis*) *paulistana* Schrottky, 1902[8]; *M.* (*L.*) sp.[8]; *M.* (*Moureana*) sp.[8]; *M.* (*Neomegachile*) *brethesi*

Schrottky, 1909[4, 8]; *M.* (*N.*) 2 spp.[8]; *M.* (*Pseudocentron*) *lissotate* Moure, 1943[5, 8]; *M.* (*P.*) *asuncicola* Strand, 1910[5, 8]; *M.* (*P.*) 2 spp.[4, 5, 8]; *M.* (*Sayapis*) *dentipes* Vachal, 1909[4, 5, 8]; *M.* (*Tylomegachile*) *orba* (Schrottky, 1913)[8]; *M.* sp.[5, 8]

APIDAE

APINAE: **Apini**: *Apis mellifera* L., 1758[4, 5, 8, 11]; **Bombini**: *Bombus* (*Fervidobombus*) *brevivillus* Franklin, 1913[1, 3, 8]; **Centridini**: *Centris* (*C.*) *aenea* Lep., 1841[1, 2, 4, 8]; *C.* (*C.*) *caxiensis* Ducke, 1907[4]; *C.* (*C.*) sp.[5]; *C.* (*Hemisiella*) *lanipes* (Fabr. 1775)[1]; *C.* (*H.*) *tarsata* (Smith, 1874)[4, 8]; *C.* (*H.*) *trigonoides* Lep., 1841[4, 8, 11]; *C.* (*H.*) *vittata* Lep., 1841[4]; *C.* (*Heterocentris*) *analis* (Fabr., 1804)[1, 2]; *C.* (*Melacentris*) *obsoleta* Lep., 1841[1, 2]; *C.* (*Paracentris*) *burgdorfi* Friese, 1900; *C.* (*Ptilocentris*) *hyptidis* Ducke, 1908[1, 2, cf. 3, 5, 8, 11]; *C.* (*Paremisia*) *fuscata* Lep., 1841[1, 3, 4, 5, 8, 11]; *C.* (*Ptilotopus*) *moerens* (Perty, 1833)[2, 4]; *C.* (*P.*) *sponsa* (Smith, 1854)[1, 2]; *C.* (*Xanthemisia*) *bicolor* Lep., 1841[4]; *C.* sp[8, 11]; *Epicharis* sp.[16] ; **Emphorini**: *Ancyloscelis apiformis* (Fabr., 1793)[1, 8]; *A. frieseana* (Ducke, 1908)[1, cf. 11]; *A.* sp. [5, 8]; ? *Diadasia parahybensis* Ckll., 1912[3]; ? *D. murihirta* Ckll., 1912[3]; *Diadasina paraensis* (Ducke, 1912)[8]; *D. riparia* (Ducke, 1908)[1, 8]; *D.* 3 spp.[8]; *Melitoma taurea* (Say, 1873)[1]; *M. ipomoearum* (Ducke, 1913)[1, 8]; ? *M. osmioides* Ducke, 1908[1]; *M. segmentaria* (Fabr., 1804)[8, 11]; *M.* 2 spp.[8]; *Melitomella murihirta* (Cockerell, 1912)[1, 3, cf. 5, 8]; *Ptilothrix plumata* Smith, 1853[1, 8]; **Epeolini**: *Rhogepeolus mourei* Roig-Alsina, 1996; *Rhogepeolus plumbeus* (Ducke, 1911)[2, 17]; **Ericrocidini**: *Mesocheira bicolor* (Fabr., 1804)[8]; **Eucerini**: *Alloscirtetica* sp.[8]; *Dasyhalonia* (*Pachyalonia*) *cearensis* Ducke, 1911[2, 5]; ? *Eucera compositarum* Ducke, 1911[2]; *Florilegus* (*Euflorilegus*) *festivus* (Smith, 1854)[2, 8]; *F.* (*E.*) *similis* Urban, 1970[8]; *F.* (*Floriraptor*) *melectoides* (Smith, 1879)[2]; *Gaesischia* (*G.*) *buzzii* Urban, 1989; *G.* (*G.*) *carinata* Urban, 1989[8]; *G.* (*G.*) *glabrata* Urban, 1989[8]; *G.* (*G.*) *hyptidis* Ducke, 1911[2, 5, 8]; *G.* (*G.*) *fulgurans* (Holmberg, 1903)[14]; *G.* (*G.*) *interrupta* Urban, 1989; *G.* (*G.*) *labiatarum* Ducke, 1911[2]; *G.* (*G.*) *mirnae* Urban, 1989; *G.* (*G.*) *pygmaea* Urban, 1968; *G.* (*G.*) *rosadoi* Urban, 1989[5, 8]; *G.* (*G.*) *similis* Urban, 1989[5]; *Melissodes* (*Ecplectica*) *nigroaenea* (Smith, 1854)[2, 4, 5, 8]; *Melissoptila aliceae* Urban, 1998; *M. bahiana* Urban, 1998; *M. bonaerensis* (Holmberg, 1903)[15]; *M. cnecomala* (Moure, 1944)[8]; *M. minarum* (Bertoni & Schrottky, 1910)[15]; *M. pubescens* (Smith, 1789)[2]; *M. uncicornis* (Ducke, 1911)[2]; *Thygater* (*T.*) *analis* (Lep., 1841)[11]; *Trichocerapis pernambucana* Urban, 1989; **Euglossini**: *Eufriesea nordestina* Moure, 1999 [cf. 12]; *Euglossa* (*E.*) *securigera* Dressler, 1982[12]; *Eulaema* (*Apeulaema*) *nigrita* Lep., 1841[1, 2, 5, 8, 12]; **Exomalopsini**: *Exomalopsis* (*E.*) *analis* Spinola, 1853[5, 8]; *E.* (*E.*) *auropilosa* Spinola, 1853[4]; *E.* (*E.*) *vernoniae* Schrottky, 1909[10]; *E.* (*E.*) *tomentosa* Friese, 1899[1]; **Isepeolini**: *Isepeolus viperinus* (Holmberg, 1886)[1]; **Meliponini**: *Frieseomelitta aff. flavicornis* (Fabr., 1798)[1, cf. 4 e 5, 8]; *F. varia dispar* (Moure, 1950)[9]; *Geotrigona xanthopoda* Camargo & Moure, 1996; *Lestrimelitta limao* (Smith, 1863)[4]; *Melipona asilvae* Moure, 1971[4]; *M. mandacaia* Smith, 1863[4]; *M. marginata* Lep., 1836[2]; *M. subnitida* Ducke, 1911[1, 2]; *Paratrigona incerta* Camargo & Moure, 1994; *P. lineata lineata* (Lep., 1836)[6]; *Partamona* 3 spp.[4, 5, 13]; *Plebeia mosquito* (Smith, 1863); *P. flavocincta* (Ckll., 1912)[cf. 2, 3, 4]; *Scaptotrigona aff. tubiba* (Smith, 1863)[4]; *Trigona truculenta* Almeida, 1984[3]; *T.* group *fuscipennis* Friese, 1900[1]; *T. spinipes* (Fabr., 1793)[1, 3, 4, 5, 11]; *Trigonisca aff. pediculana* (Fabr., 1804) [1, 4, 5]; **Osirini**: *Osirinus parvicollis* (Ducke, 1911)[2, 8]; *Parepeolus aterrimus* (Friese, 1906)[1, 8]; **Protepeolini**: *Leiopodus abnormis* (Jörgensen, 1912)[7]; *L. lacertinus* Smith, 1854[8]; *L. trochantericus* Ducke, 1907[1, 8]; *L. nigripes* Friese, 1908[2, 8]; **Tapinotaspidini**: *Arhysoceble huberi* (Ducke, 1908)[1, 2, 8, 11]; *Caenonomada unicalcarata* (Ducke, 1908)[1, 2, 3, 4, 5, 8]; *Paratetrapedia* sp[11]; ? *Tapinotaspis heathi* Ckll., 1912[3]; **Tetrapediini**: *Coelioxoides aff. punctipennis* Cresson, 1878[11]; *Tetrapedia diversipes* Klug, 1810[4]; *T.* cf. *rugulosa* Friese, 1899[11];

NOMADINAE: **Brachynomadini**: ? *Brachynomada cearensis* (Ducke, 1911)[2]; ? *B. tomentifera* (Ducke, 1907)[1]; XYLOCOPINAE: **Ceratinini**: *Ceratina* (*Crewella*) *maculifrons* Smith, 1854[1, 2, 3, 8]; *Ceratina* 3 spp.[5]; *Ceratinula manni* (Ckll., 1912)[3, 8]; **Xylocopini**: *Xylocopa* (*Neoxylocopa*) *cearensis* Ducke, 1911[2, cf. 4, 8]; *X.* (*N.*) *grisescens* Lep., 1841[1, 3, 4, 5, 8, 11]; *X.* (*Megaxylocopa*) *frontalis* (Olivier, 1789)[1, 3, 4, 8]; *X.* (*Schoenherria*) *macrops* Lep., 1841[4]; *X.* (*S.*) *muscaria* (Fabr., 1775)[1, 2, 8]; *X.* (*S.*) *subzonata* Moure, 1949[8]; *X.* (*S.*) *aff. viridis* Smith, 1874[11]

Undetermined genus:
? *Melissa asteria* (Smith)(= *M. maculata* Friese)[1]; ? *Nomada multicolor* Ducke, 1911[2]

Collection sites (when not indicated it is known only for the localities mentioned in the description) and references:
1 Ceará State: Baturité, Humaitá or Quixadá [13].
2 Ceará State: Baturité, Caridade, Piquet Carneiro or Quixadá [15].
3 Paraíba State: Independência [11] (possibly an old name for Guarabira [39] p. 82).
4 Bahia State: Casa Nova [20].
5 Paraíba State: São João do Cariri [4].
6 [8].
7 [29].
8 Zanella. The bee fauna of the "Estação Ecológica do Seridó", Serra Negra do Norte, Rio Grande do Norte State. Original data.
9 Zanella. Additional collections made in the Patos region, Paraíba State. Original data.
10 Personal information of Dr. Fernando Silveira.
11 Pernambuco State: Alagoinha [19].
12 Bahia State: Casa Nova [5].
13 [23].
14 [36].
15 [37].
16 Bahia State: Livramento do Brumado [18].
17 [27].
