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MELISSOPALYNOLOGY IN THE BRAZILIAN AMAZON: A DATABANK OF POLLEN TYPES CITED IN THE LITERATURE

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Abstract

This manuscript presents a compilation of publications concerning Melissopalynology in the Brazilian Amazon region, including a databank of the pollen types cited in those works reflecting the regional floras used by those bees, and a list of 28 publications that cite 610 pollen types from 94 botanical families. The best represented plant families in terms of the numbers of pollen types encountered were Fabaceae, Euphorbiaceae, Asteraceae, and Malvaceae. Of the 49 bee species (17 genera) cited in the databank, *Apis mellifera* L. was the most frequent (10 publications). The pollen types shared by the largest numbers of bee species included *Cecropia*, *Tapirira guianensis*, *Byrsonima*, and *Miconia*. The publications examined focused on the Brazilian states of Amazonas, Pará, Rondônia, and Roraima in the northern region of that country, as well as Amazon Forest areas in Maranhão State (northeastern Brazil). There are still extensive areas of the Amazon in which no melissopalynological studies have yet been undertaken, so that additional research will be needed to fill this gap in our knowledge of the palyno-diversity in that region.

Key-words: Honey. Palynology. Pollen. State of the art.

Resumo

Este manuscrito compila os trabalhos publicados sobre Melissopalinologia na Amazônia brasileira. É apresentado um banco de dados reunindo todos os tipos polínicos citados nesses trabalhos, refletindo a flora regional explorada pelas abelhas. Foram registradas 28 publicações, as quais incluem 610 tipos polínicos, reunidos em 94 famílias botânicas. Dentre estas, as mais bem representadas em número de tipos polínicos foram Fabaceae, Euphorbiaceae, Asteraceae e Malvaceae. Das 49 espécies de abelhas (17 gêneros) incluídas no banco de dados, *Apis mellifera* L. foi a mais frequente (10 publicações). Os tipos polínicos compartilhados pelo maior número de espécies de abelhas incluíram *Cecropia*, *Tapirira guianensis*, *Byrsonima* e *Miconia*. Os trabalhos inventariados abrangem os estados do Amazonas, Pará, Rondônia e Roraima, na região Norte, e áreas amazônicas do estado do Maranhão, no Nordeste do Brasil. Ainda há uma extensa área geográfica da Amazônia para a qual inexistem estudos melissopalinológicos. Sendo assim, pesquisas abrangentes são necessárias, a fim de preencher essa lacuna no conhecimento sobre a palinodiversidade brasileira.

Palavras-chave: Estado da Arte. Mel. Palinologia. Pólen.

1 Introduction

Melissopalynology is the study of the botanical and geographical origins of the products made by or collected by bees (such as honey, pollen, "bee-bread", propolis, and royal jelly) undertaken by examining the pollen grains encountered in those substances (Louveaux *et al.*, 1978; Nair, 1985; Jones & Bryant, 1996; Bhattacharya *et al.*, 2006; Sánchez-Sánchez & Baldi-Coronel, 2010).

Systematic studies of the pollen types encountered in apicolous products (those produced from the foraging activities of *Apis mellifera* L., 1758) and those of meliponini origin (produced

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from the foraging activities of native stingless bees) are still quite scarce in Brazil, and practically inexistent in some of its geographical regions. This situation makes the palynological and botanical identification of bee-derived products quite difficult – information that might otherwise contribute to the commercial value of those products.

Melissopalynology has been studied in Brazil only since the 1960s (Santos, 1964), and these investigations were originally restricted to just a few states for many decades due to the shortage of qualified human resources and adequate laboratory infrastructures. As such, very little systematized information is available concerning the identities of the pollen grains encountered in apicolous and meliponini products, and while than 100 native bee species are thought to exist in the Amazon region (Silveira *et al*., 2002) – some of them with potential for producing honey (and other commercial products) – almost nothing is known about the floral resources they use.

The only compilation of information concerning Melissopalynology in Brazil was published by Barth (2004), but just two paragraphs were dedicated to work in the Amazon region (*e.g.*, Absy *et al*., 1980; Santos, 1991; Marques-Souza & Kerr, 2003). This author did, however, cite a number of pollen types referred to in those papers – but did not mention the bee species associated with them.

The present manuscript therefore sought to inventory the published information concerning Melissopalynology, focusing on the Brazilian Amazon, and elaborate a databank listing all of the pollen types cited in those works (derived from the pollen spectra of apicolous and meliponini products). This information is intended to be useful to future melissopalynological projects in the Amazon, especially in geographical regions that have not yet been carefully examined.

2 Methodology

An inventory of melissopalynological publications from the Brazilian Amazon was undertaken by consulting digital databases and appropriate scientific periodicals (*e.g.*, CAPES – www.periodicos.capes.gov.br – and SciELO – www.scielo.br), using key-words related to melissopalynological themes (*e.g.* bee, pollen analysis, honey, melissopalynology, palynology); Masters dissertations and Doctoral theses, especially those of the Postgraduate Program of the National Institute of Amazonian Research (Manaus, Amazonas) were likewise consulted. Dissertations and theses were included only if the data had not yet been published in scientific journals.

Based on the published articles encountered, we consulted the *curriculum vitae* (available on the *Plataforma Lattes* – lattes.cnpq.br) of all of the researchers that had published at least one article about Melissopalynology in the Amazon region. This allowed us to investigate the existence of published articles not encountered in our earlier digital and library searches; when necessary, the authors were contacted (by e-mail) to secure copies of their works.

Information from all of the publications was entered into a databank (using Microsoft Excel® software), considering the following descriptors: plant family; pollen type; bee species; collection locality; reference. All of the botanical entries (morphological and taxonomic) were reviewed and updated by consulting the Missouri Botanical Garden online database (www.tropicos.org). The bee species names were reviewed and updated according to Moure's Bee Catalogue (moure.cria.org.br/catalogue).

3 Results and conclusions

3.1 The Melissopalynology in the Brazilian Amazon

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The earliest study of Melissopalynology in the Brazilian Amazon was published by Absy & Kerr (1977), followed by Absy *et al*. (1980, 1984).

Dr. Maria Lúcia Absy, together with Dr. Warwick Estevam Kerr, initiated melissopalynological studies in the Amazon region as researchers at the National Institute of Amazonian Research (INPA). The contributions of Dr. Absy to the Melissopalynology of the Amazon region have been enormous, principally in the decades after 1980, in the execution of research projects and in orienting dissertations and theses in the graduate program at INPA (Santos, 1991; Marques-Souza, 1993, 1999; Oliveira, 2003; Silva, 1998, 2005; Rech, 2010; Novais, 2013). Some of the professionals that graduated in Palynology continue to work in the Amazon region.

In addition to INPA, the Paraense Emílio Goeldi Museum in Belém, Pará State, has contributed for many decades to palynological studies in the Amazon (Carreira *et al*., 1986; Carreira & Jardim, 1994). Dr. Léa Maria Medeiros Carreira, a researcher at that institution, has authored a number of important pollen catalogs for the Amazon region (Carreira *et al*., 1996; Carreira & Barth, 2003), although most palynological work undertaken at the Goeldi Museum (at the Botany's Coordination) has been related to pollen morphology. Moreover, at the Earth Sciences and Ecology's Coordination of the Goeldi Museum, Dr. Cristina do Socorro Fernandes de Senna has worked especially with palaeopalynology.

Other laboratories established more recently in the Amazon region have undertaken melissopalynological studies, including: the Laboratory of Apicolous and Pollination Studies at the Federal University of Pará (Altamira campus), headed by Dr. Francisco Plácido Magalhães Oliveira; ; the Laboratory of Taxonomic Botany at the Federal University of Western Pará, in Santarém, where the present authors work; and the Laboratory of Bee Research at the Federal University of Maranhão (Northeastern Brazil), in São Luís, where Dr. Patrícia Maia Correia de Albuquerque studies melissopalynology and bee ecology (and has research projects in the Amazon region).

3.2 Melissopalynological databank for the Brazilian Amazon

The databank presented here includes data from 28 texts published between 1977 and 2013 citing 610 pollen types from 94 botanical families (Appendix I).

In the Appendix II, we have tried to list some Brazilian palynothecas where the slides resultant from the publications cited here are probably deposited. Most of these data can be found in Gonçalves-Esteves *et al*. (in press). Pollen libraries remain fundamental to increase our knowledge on plant biodiversity and its interactions with the surrounding fauna.

The family Fabaceae comprises the largest number of pollen types encountered in our databank – 129 types, with 48 being included within the subfamily Caesalpinioideae, 36 in Faboideae, 44 in Mimosoideae, and one type identified only as Fabaceae (Fig. 1). *Mimosa* (Mimosoideae) and *Cassia* (Caesalpinioideae), with 14 and 12 pollen types respectively, were the most well represented genera of Fabaceae in the databank (Appendix I). After Fabaceae, the most well represented families were: Euphorbiaceae (30 pollen types), Arecaceae and Malvaceae (28 types each), Rubiaceae (25), Asteraceae (22), and Myrtaceae (21) (Fig. 1).

A total of 49 bee species are included in the databank, with 17 genera being represented: *Aparatrigona* Moure, 1951 (1 sp.); *Apis* Linnaeus, 1758 (1 sp.); *Cephalotrigona* Schwarz, 1940 (1 sp.); *Frieseomelitta* Ihering, 1912 (3 spp.); *Melipona* Illiger, 1806 (10 spp.); *Nannotrigona* Cockerell, 1922 (2 spp.); *Nogueirapis* Moure, 1953 (1 sp.);

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Oxytrigona Cockerell, 1917 (2 spp.); *Partamona* Schwarz, 1939 (8 spp.); *Plebeia* Schwarz, 1938 (1 sp.); *Ptilotrigona* Moure, 1951 (1 sp.); *Scaptotrigona* Moure, 1942 (3 spp.); *Scaura* Schwarz, 1938 (2 spp.); *Schwarzula* Moure, 1946 (1 sp.); *Tetragona* Lepeletier & Serville, 1828 (1 sp.); *Tetragonisca* Moure, 1946 (1 sp.); and *Trigona* Jurine, 1807 (10 spp.) (Appendix III).

The pollen types most frequently shared by these bees (considering the publications inventoried) were: *Cecropia* (Urticaceae), cited as being associated with 51.02% of the bee species; *Tapirira guianenses* (Anacardiaceae), 46.94%; *Byrsonima* (Malpighiaceae), 46.94%; and *Miconia* (Melastomataceae), 44.90% (Fig. 2).

Apis mellifera was associated with the greatest richness of pollen types (256) in the databank (Appendix I, Fig. 3), although this high pollen species richness may also reflect the fact that this bee has been the object of the largest number of publications (Carreira *et al*., 1986; Marques-Souza *et al*., 1993; Carreira & Jardim, 1994; Oliveira *et al*., 1998; Silva & Rebouças, 1996; Silva, 1998; Silva & Absy, 2000; Marques-Souza & Kerr, 2003; Silva, 2005; Marques-Souza *et al*., 2011) (Appendices I and IV) due to its abundant honey production. Native bee species should receive more research attention, however, in light of their roles in pollinating most of the native plant species that constitute the enormous biodiversity of the Amazon region.

Pollen – both corbicular and stocked – was the principal material analyzed in 16 of the publications inventoried (Appendix IV). Honey was analyzed in 13 publications, while stomach nectar was examined only by Absy *et al*. (1980) (Appendix IV). Ferreira & Absy (2013) examined (for the first time) post-emergence residues of *Melipona* (*Melikerria*) *interrupta* Latreille, 1811.

3.3 Geographical extensions of the inventoried research publications

Melissopalynology studies have been restricted to just a few localities in the Brazilian Amazon within the states of Amazonas (16 publications), Pará (6), Roraima (3), and Rondônia (1), all of which are located in the northern region of that country (Appendix IV). Few research projects have been undertaken in Maranhão State in areas with Amazon forest vegetation (Kerr *et al*., 1987; Marques *et al*., 2011; Martins *et al*., 2011) (Appendix IV).

Among the 39 municipalities cited in the publications, Manaus (Amazonas State) was the focus of 12 research projects (Appendix IV), no doubt due to the fact that INPA is headquartered in that city.

Considering the vast territorial extent of the Amazon region, melissopalynological research will need to be expanded dramatically to be able to fill the gaps in our knowledge concerning the plants used by native bees, and the scarcity of human resources in the area of Amazonian Melissopalynology will need to be remedied by investments in the training and fixation of qualified professionals in institutions of higher learning and research in the region.

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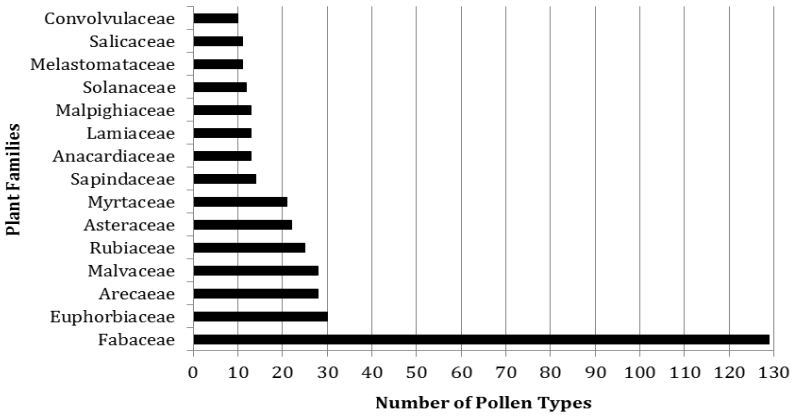

Figure 1. Plant families most well-represented in the inventory, in terms of their numbers of pollen types.

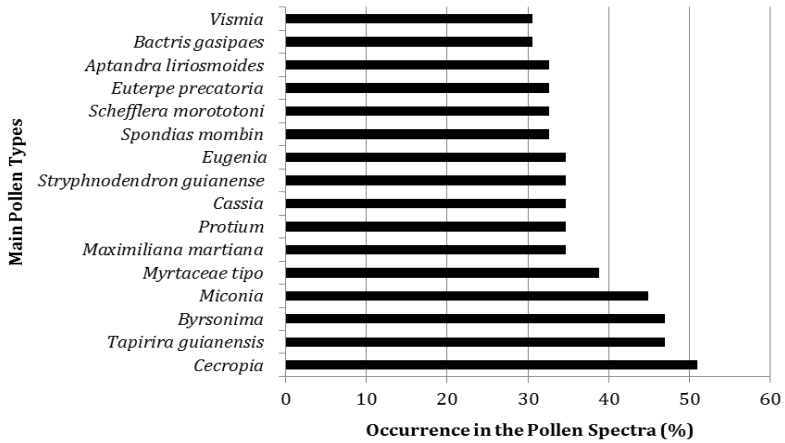

Figure 2. Pollen types associated with more than 30% of the bee species cited in the publications examined.

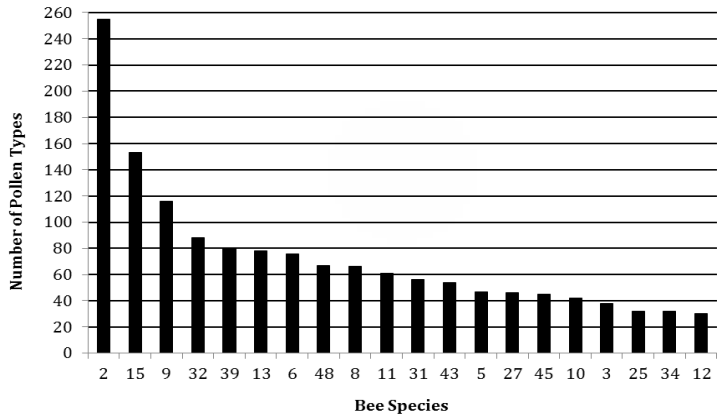

Figure 3. Bee species that demonstrated the greatest numbers of pollen types in the publications examined. The numbers assigned to the bee species correspond to the list presented in Appendix III.

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APPENDIX I - Databank of the pollen types cited in melissopalynological studies undertaken in the Brazilian Amazon between 1977 and 2013. The numbers assigned to the bee species correspond to the list presented in Appendix III. The letters assigned to the references are according to the Appendix IV.

Plant Family*	Pollen Type	Bee Species																																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
ACAN	*Avicennia nitida*									E																																										
	Acanthaceae type						O																										S																		
ACHA	*Lindackeria*		G			H			J O					H		F H O																																	K	
	Lindackeria paludosa						O					O												X												X				Z Y		X		X						
	Achariaceae type		U																																																
ALIS	*Echinodorus*						O																																												
	Sagittaria		N																																																
AMAR	*Alternanthera*		G P						O	E				B		B O																	S							Z Y										
	Alternanthera brasiliana		U																																																
	Alternanthera jicoidea		M																																																
	Alternanthera tenella		L	T																																										T				
	Amaranthus viridis																																							Z Y										
	Celosia						O																																											K	
	Celosia argentea									E																																									
	Cyathula prostata																														W																				
	Gomphrena																																							Y										
ANAC	*Anacardium*									E																																									
	Anacardium occidentale		L N P											B		B																								Y										
	Anacardium officinale									E																																								
	Anarcadium microcarpum									V																																								
	Astronium		N P																																															
	Mangifera indica		L				O			E																																								
	Spondias													B		F																																		
	Spondias mombin				C	H	O		O			O		H	C	H O T	C									C X		C	C				S								C		C						K	

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	Tapirira		G Q																									C																							
	Tapirira guianensis		M R U			H	O		J O	E V	β	O	T	B C H	C	A B F H O T α		C							X	C		C	C			C W	S		W					Z Y	C		C	C							
	Thyrsodium						O		O														X										S																		
	Thyrsodium spruceanum																																							Z											
	Anacardiaceae type		G I			H				E				C				C										C															C	C						
ANNO	*Rollinia*		D																																																
	Annonaceae type		D																																																
APIA	*Killinga*		R																																																
APOC	*Aspidosperma*						O					O																					S																		
	Couma utilis																														W													X						
	Geissospermum																																																	X	
	Geissospermum sericeum																																											C							
	Rauwolfia grandiflora															B																																			
	Tabernaemontana								O																																										
	Apocynaceae type		M I								β												X																					C							
AQUI	*Ilex*															O																	S																		
	Ilex divaricata																																									X		X							
ARAL	*Didymopanax*		G							E																																									
	Didymopanax morototoni													B	C	B		C								C		C													C										
	Schefflera morototoni			T		H	O					O	T	H		H O α				W											W		S							Z Y		X		X		T			K	X
AREC	*Astrocaryum*		G			H						O									W		X	X		X																							K	
	Astrocaryum aculeatum															T																								Z Y						T				
	Astrocaryum mumbaca		M																																																
	Attalea maripa			T									T			T					W				X	X																X				T			X	
	Bactris gasipaes					H	O									O		C		W						C		C X	C		W	C	S						C								C		K	X
	Cocos																																S																		
	Cocos nucifera		G			H			J	E				H		H				W			X								W																			K	

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	Elaeis										β																													Y										
	Elaeis guineenses																							X																										
	Elaeis oleifera					H																																											K	
	Euterpe		G R				O			E		O				α																	S																	
	Euterpe edulis									E																																								
	Euterpe oleracea		M	T			O																																							T			K	
	Euterpe precatoria		G U	T			O									O				W	W		X		X	X						W	S			X						X		X	X	T				
	Iriartella		G																																															
	Iriartella setigera						O					O																																						
	Leopoldinia pulchra																								X						W													X						
	Mauritia		D I																																															
	Mauritia flexuosa		G M Q R U				O									A F O T							X		X			X					S			X										T			K	
	Maximiliana		G				O																																											
	Maximiliana maripa		Q U R						O			O				O																	S																	
	Maximiliana martiana		M					C		E	C		C	B	C	B F T α		C				C				C		C				C									C		C					C	K	
	Oenocarpus						O																										S																	
	Oenocarpus bacaba																																																K	
	Orbignia martiana		G																																															
	Orbignia phalerata		U							V																																								
	Socratea exorrhiza																						X			X																									
	Arecaceae type		G I R			H	O					O				A O																	S														T			K	
ASPA	*Herreria*																															W																			
ASTE	*Ambrosia*													B		O																	S																		
	Aster															O																	S																		
	Aster amellus																																		O																
	Baccharis																														W	W																			
	Chromolaena maximilianii		R																																															
	Cosmos caudatus		G																																															

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	Emilia fosbergii																																							Z Y										
	Emilia sonchifolia		G																																															
	Eupatorium		I	T																																				Z Y										
	Helianthus annus									E																																								
	Latuca sativa		G																																															
	Melampodium camphorantum													B		B																																		
	Mikania		G M	T						V	β		T			A F																	S																	
	Mikania congesta		G																																															
	Mikania roraimensis													B		B																												C						
	Senecio		D																																															
	Vernonia		D I R																																					Z Y										
	Vernonia brasiliana									E																																								
	Vernonia scabra		G M											B		A B F																																		
	Wedelia paludosa															T																																		
	Wulffia baccata		M							V																																								
	Asteraceae type		I																							X																							X	
BIGN	*Anemopaegma floridum*		R																																															
	Arrabidaea																																																K	
	Memora		G			H	O		O			O																																					K	
	Tabebuia		G Q				O		O			O				O α																								Z Y										
	Tabebuia serratifolia					H	O		O																								S																K	
	Tecoma										β																				W				W															
	Bignoniaceae type		G M													H															W									Y				C					K	
BIXA	*Bixa orellana*		G				O		O	E V		O	T	B	C	A B F O T																W	S																	
	Cochlospermum		P						J O	V																																								

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BORA	*Campsiandra comosa*																																	C																	
	Cordia		G								β					O										C						C																		
	Cordia lanata															A F																																			
	Cordia nodosa																						X																												
	Cordia sellowiana													B		B																																			
	Cordia tetranda										C				C			C																																	
	Heliotropium polyphyllum									E																																									
	Hydrophyllum									E																																									
	Boraginaceae type		G I																									C																							
BRAS	Brassicaceae type		R																																																
BROM	*Pepinia sprucei*																						X																												
BURS	*Protium*		G I Q						O	V	β	O		C	C	H O α							X	X								W	S							Z Y			C	X					X	X
	Protium heptaphyllum			T							C		C T	B	C	A B F T										C		C																C		T				
	Protium spruceanum		L																																																
	Burseraceae type								J							H																																			
CALO	*Calophyllum*		R											B																																					
	Calophyllum brasiliense																																	C																	
	Caraipa densifolia		R																																																
CANN	*Celtis*		G																																																
	Trema																																														C				
	Trema micrantha													B		B																								W				C							
CAPP	*Cleome aculeata*		N																																																
CARI	*Carica papaya*						O		O							H O																	S																	K	
CARYOC	*Caryocar villosum*									E																						W								W											
CARYOP	Caryophyllaceae type		P																																																
CHRY	*Hirtella racemosa*									E																																									
CLEO	*Cleome spinosa*									V																																									
CLUS	*Clusia*					H																																												K	
	Clusia aff. *nemorosa*															B																																			
	Clusia columnaris										C																					C																			

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	Clusia odorata																																							Y										
	Symphonia		G																																															
	Clusiaceae type		G													A																		C																
COMB	*Agerantum conyzoides*													B		B																																		
	Combretum		I P				O																																											
	Combretum franquilifolium		N L																																															
	Combretum laxum		L																																															
	Terminalia						O					O																																						
	Terminalia lucida									E																																								
	Combretaceae type		G I																																															
CONV	*Aniseia*																											C																						
	Bonamia ferruginea																															W																		
	Evolvulus		N																																															
	Ipomoea		G																																															
	Ipomoea bahienses									E																																								
	Merremia															O																																	K	
	Merremia aegyptia									E																																								
	Merremia cassoides									E																																								
	Merremia umbellata		G																																															
	Convolvulaceae type									E																														Y										
CUCU	*Cucumis anguria*									E																																								
	Cucumis sativus									E																																								
	Cucurbita																																																K	
	Curcubita pepo									E																																								
	Gurania Bignoniacea																						X																											
	Gurania coccinea			T																																														
	Melothria																																							W										
CUNO	Cunoniaceae type		D																																															
CYPE	*Cyperus*		N				O																																							T	C			
	Fimbristylis																																							W										
	Rhynchospora pubera															T																																		
	Scleria																																			X														X
	Cyperaceae type		D I																																															

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DILL	*Curatella americana*		N P																																																
	Davilla										C				C													C				C		C									C							
	Davilla kunthii		R																																					Z										
	Dillenia									E																																									
	Doliocarpus			W					J					H		H																																			
	Doliocarpus spraguei													B																		C																			
	Tetracera															α																																			
	Dilleniaceae type		M																																																
DIOS	*Dioscorea trifida*																															W																			
ERYT	*Erythroxylum suberosum*		N																																																
EUPH	*Acalypha*																																							Z										
	Alchornea		G		C						C β				C	A F															W	W	S		O	X		W						X						X
	Alchornea castaneifolia												T																																						
	Alchornea discolor		R			H								B		B		C	C			C				C																	C	C			C			
	Alchornea schomburgkii					H	O					O				O																																			
	Alchornea triplinervia															α																								Y										
	Anomalocalyx																																							W										
	Aparisthmium													H		H																																			
	Aparisthmium cordatum						O					O				F O																	S			X				W Z										X
	Conceveiba		R																																																
	Croton		G R																																					Z Y										
	Croton jacobinense									E																																									
	Croton lanjonvensis					H	O		O			O		B		A B F O			C													C			O									C				C		
	Croton matourensis		M							E																							S																		
	Croton pullei									V																																									
	Croton sonderiamus									E																																									
	Cynometra		G				O		O																			C				C																		K	
	Dalechampia																																							Y										
	Euphorbia								O																								S																		
	Hevea brasiliensis									E						B																																			
	Hevea spruceana																																							W										

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	Hyeronima		G																																																	
	Mabea		G					C	J	E								C								C		C			W	C W	S																		
	Mabea caudata																																																	K	
	Mabea nitida													B		B												C				C											C								
	Mabea occidentalis							C																																										K	
	Micrandra																															W																			
	Pogonophora chomburgkiana																															C																			
	Sapium																								X		X									X	X					X			X					
	Euphorbiaceae type		G U				O																					C					S		O																
FABA	Fabaceae type		G	W			O							B																																	T				
FABA-C	*Bauhinia*		G																																															X	
	Bauhinia glabra									E																																									
	Bauhinia purpurea																																																	K	
	Bauhinia rutilans																																S																		
	Bauhinia ungulata		N L P																																																
	Caesalpinia			T		H							T			T																														T				
	Caesalpinia pulcherrima					H																																													
	Cassia		G		C	H	O		J O	V			T		C	H O	C	C										C											C			X	C			T			K X	
	Cassia grandis								O							O																			O																
	Cassia latifolia		G				O		O					B				C															S																	K	
	Cassia moschata		N																																															
	Cassia multijuga																																													T				
	Cassia occidentalis		L			H																																												
	Cassia quangulata													H		H																																		K	
	Cassia quinquangulata						O		J O			O				O																														T				
	Cassia reticulata													B		B																																		
	Cassia siamea									E	C			B		B		C										C						C								C								K	
	Cassia tora																									X																									
	Cassia undulata																																											X						
	Cenostigma tocantinum			T		H							T																																					
	Chamaecrista															α				W												W								W											
	Copaifera		L																																					Y											
	Copaifera multijuga																								X	X	X	X							W																

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	Copaifera officinalis		N P R																																																
	Crudia amazonica									W																						C																C		
	Cynometra bauhiniaefolia										C																																							
	Dialium															O																																		
	Eperua duckeana																															W																		
	Hymenaea		R							V	β																																							
	Hymenaea courbaril								O			O																																						
	Macrolobium																																																K	
	Macrolobium multijugum																										X																	X						
	Mora						O											C										C																						
	Mora paraensis	W									C					α																C																		
	Peltogyne		L																																															
	Peltogyne paniculata		N																																															
	Peltogyne purpurea		R																																															
	Peltogyne venosa																										X																							
	Recordoxylon									V																																								
	Schizolobium																																							Y										
	Schizolobium amazonicum			W							β																						S																	
	Sclerolobium															T																														T				
	Senna									V						α																W								Y										
	Senna alata									V																																								
	Senna/Cassia																																							Z										
	Tachigalia hypoleuca																								X			X							W							X		X						
	Tamarindus indicus		L							V																																								
	Caesalpinioidae type		D G R																							X																								
FABA-F	*Aeschynomene*		G						J	E		O				T																																		
	Aeschynomene sensititiva													B C		B																											C	C						
	Aldina		G																																															
	Aldina latifolia																						X			X									W		X													
	Andira															O																	S																	

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	Bowdichia virgilioides		N L																																																	
	Clitoria racemosa			T																																															
	Dalbergia								J							O																		O															K	
	Derris		M																													S																	K	
	Derris sericea									E																																									
	Desmodium																																	W	X				W Y									K	
	Desmodium tortuosum		G																																																
	Dioclea																						X																					X							
	Dipterix																															S																		
	Erythrina		I																																										T					
	Hymenolobium petraeum									E																																									
	Machaerium		G						J					H		H																S												C						
	Machaerium inundatum		G																																																
	Monopteryx uaucu																															W																		
	Mucuna		R																																																
	Phaseolus																						X																	Z											
	Poecilanthe effusa		M																																																
	Pueraria phaseoloides																															W																		
	Stylosanthes												T																																						
	Swartzia		G					C	J O					C												C		C																C					K	
	Swartzia dolichopoda																														W	W			W			W												
	Swartzia pendula																								X																									
	Swartzia laurifolia		N																																																
	Tephrosia brevipes																																			X														
	Vatairea						O																																												
	Vataireopsis															T																	S		O															
	Vataireopsis speciosa						O									O																																			
	Zollernia paraensis																																							Y											
	Zornia																																							Y											
	Zornia echinocarpa															α																																			
	Faboidae type		M																																																
FABA-M	*Acacia*		I P																																																
	Acacia lorentensis		N L																																																

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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
	Acacia polyphylla		N																																																	
	Anadenanthera																															W																				
	Dinizia excelsea			T																																																
	Entada									V																						W																				
	Enterolobium schomburgkii		R						O																								S																			
	Inga		I M			H			J		C β			H		H																C W	S					W		Y											
	Inga alba			T												T																														T				
	Inga chrysantta		N																																																
	Inga edulis													B	C	A B F T												C						C												T				
	Inga paraensis																	C										C											C												
	Leucaena					H	O		J O			O		H		F H O																	S																		
	Leucaena leucocephala		G										T			T																														T				
	Mimosa		D G L R						O				C			A									X	X		C				C	S			X								C						
	Mimosa arenosa										β																													Y											
	Mimosa asperata									E																																										
	Mimosa caesalpiniifolia		U							E V																																										
	Mimosa guilandinae			T							β																																									
	Mimosa invisa					H	O		O		β	O		B H		B										C							S																		
	Mimosa microcephala		G																														S																		
	Mimosa pigra											O																																								
	Mimosa polydactyla		N P																																																	
	Mimosa pudica		D I L M R U				O		O	V	β	O		B		A B F O α										C														Z Y									K	
	Mimosa quadrivalvis		R																																																	

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	Mimosa sensitiva															F																																			
	Mimosa somnians		N P																																																
	Mimosa spruceana										β																																								
	Neptunia plena									V																																									
	Newtonia		M																																																
	Parkia		R									O				O																	S																		
	Parkia panurensis																																											X							
	Parkia platicephala									E																																									
	Pentaclethra						O		O			O				O F																																			
	Piptadenia		G			H					β	O		H																			S																		
	Piptadenia moniliformes									E																																									
	Piptadenia peregrina		N P																																																
	Pithecellobium		D G									O																					S																		
	Prosopis juliflora									E																																									
	Schrankia leptocarpa		M																																																
	Stryphnodendron		U													F																								Y											
	Stryphnodendron guianense		M	T			O		O		C β	O	T	H B		B H O T		C	C									C					S	C					C					C		T				
	Stryphnodendron pulcherrimum																																S							Z											
	Mimosoideae type													C					C																												C				
GENT	*Schultesia*																																							Y											
GOUP	*Goupia glabra*																																							Z											
HUMI	*Humiriastrum*			W																																															
	Humiriastrum cuspidatum																																																	X	
HYPE	*Vismia*		G								β					F A					W		X		X						W	W	S					W		W		X		X					X	X
	Vismia cayennensis		R																																																
	Vismia guianensis		R	T						E				B		B																												C							
ICAC	*Poraqueiba sericea*						O							H		O																																			
LACI	*Lacistema*									V																																X									
	Lacistema pubescens		M																																																
LAMI	*Aegiphila amazonica*																																							W											

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	Eriope																																							Z Y										
	Hyptis		G I U						J	V						A																			O															
	Hyptis atrorubens		M N L																																															
	Hyptis brevipes							C			C			B		B																	C											C				C		
	Hyptis lophanta		G																																															
	Paraqueiba sericea										C																																							
	Salvia		D																																					Y										
	Vitex		G			H	O			E		O		H	C	O			C									C					S																K	
	Vitex cymosa																																		W															
	Vitex schomburgkiana		N																																															
	Vitex triflora									V													X																			X							X	
	Lamiaceae type		G											B																																				
LAUR	*Persea americana*		L							E																																								
	Lauraceae type													B																																				
LECY	*Bertholetia*		G																																															
	Bertholetia excelsa								O																																C			C						
	Corythophora								O																								S																	
	Eschveilera		R																																															
	Eschweilera fracta															A F																																		
	Gustavia augusta									V																																								
	Lecythidaceae type		G			H										A										C		C				C												C				C		
LORA	*Oryctanthus*																																							W										
	Phthirusa		I M						J					H		A F H																																		
	Phthirusa micrantha			T									T	B		B T																														T				
	Phthirusa rufa																																											X						
	Psittacanthus																																							Z										
	Loranthaceae type		D																														S		O													C		
LYTH	*Cuphea*		G																														S																	
	Physocalymma scaberrimum						O		J O			O				O																W	S																	
	Lythraceae type		Q																																															
MALP	*Banisteriopsis*		G																				X																					X						
	Banisteriopsis parviflora					H	O																																											

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	Bunchosia glandulifera					H																																														
	Burdachia prismatocarpa																																									X		X							
	Byrsonima		G P Q	W		H	O	C	J O	E	β	O		H B		A B F O α									X	X						C	S				X			Z Y		X	C	C				C	K X	X
	Byrsonima chrysophylla			T									T			H T																														T				
	Byrsonima ciliata			T									T																																	T				
	Byrsonima crassifolia															T																																		
	Byrsonima crispa		R																																																
	Malpighia punicifolia																																													T				
	Stigmatophyllon																															W																		
	Tetrapteris									V																																									
	Malpighiaceae type		G																																					Y										
MALV	*Bombax munguba*										β																																			T				
	Byttneria											O																																							
	Catostemma sclerophyllum																							X																											
	Ceiba pentandra		G																														O																		
	Eriotheca globosa		R																																																
	Gaya		G																																																
	Hybiscus		Q																																																
	Hybiscus furcellatus		G																																																
	Matisia cordata															O																																		K	
	Melochia		P																																																
	Melochia hirsuta		L																																																
	Melochia parvifolia		N L																																																
	Melochia villosa		N																																																
	Pachira aquatica		G																																																
	Pavonia malacophylla		M																																																
	Pavonia sessiliflora		N L																																																
	Pseudobombax																															W																		
	Rhodognaphalopsis																															W																		
	Sida		L																																																
	Sida cordifolia		G																																																

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	Sida glomerata		N R																																																
	Theobroma grandiflorum																															W																	X	
	Triumfetta altheoides		N																																															
	Urena lobata			T																																														
	Waltheria		L P																																					Y										
	Waltheria americana		L N																																															
	Waltheria vicosissima		N																																															
	Malvaceae type		G			H																																										K	
MARA	Marantaceae type		R																																														
MAYA	*Mayaca*		N																																														
MELA	*Bellucia grossularioides*			T		H	O		J O			O		H		H O																W	S													T			K	
	Bellucia imperialis													B		A B F																					X												X	
	Clidemia															α																																		
	Clidemia hirta																																							Z Y										
	Miconia		Q R	T	C	H	O		J O	E	C β	O		B C H	C	B F H T							X		X	X		C					C	O	X								C					K	X
	Miconia myrianthera			T		H	O		J O			O	T	H		F H O T																S														T				
	Miconia poeppigii																																S													T				
	Mouriri									E V		O																																		T				
	Pterolepis									V																																								
	Tibouchina									V																																								
	Melastomataceae type		G					C						C		A												C						C									C							
MELI	*Carapa guianensis*																																																X	
	Melia						O					O				O																	S																	
	Swietenia macrophylla					H																											S																	
	Trichilia hirta																																							Y										
	Meliaceae type								J							O																S		O																

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MORA	*Artocarpus*																																													T				
	Artocarpus incisa																																																K	
	Brosimum						O									α																																		
	Brosimum paraense																																							Z										
	Ficus												T																																					
	Morus		G Q R				O									T																														T				
	Trymatococcus amazonicus																				W		X																	W				X	X					X
	Moraceae type																C					C						C				C												C						
MYRI	*Virola*															H																W								W				C						
	Virola venosa			T												T																														T				
MYRS	*Conomorpha spicatus*																								X																									
MYRT	*Calyptranthes*		G							E																																								
	Eucalyptus															T																								Y										
	Eucalyptus robusta									E																																								
	Eucalyptus saligna									E																																								
	Eugenia		G						O	E V	C β	O	C	B	C	B F H O		C		W						C			C		W	W	S						C										
	Eugenia patrisii											O																																						
	Eugenia stipitata												T																											Z						T			K	
	Myrcia		I			H			J O					H		F H α																								Z Y									K	
	Myrcia amazonica					H	O		J O			O		H		H O T																	S																K	
	Myrcia eximia		M							V																																								
	Myrcia fallax			T						V			T			T																														T				
	Myrcia silvatica		M							V						T																														T				
	Myrciaria															H																																		
	Psidium		P Q R						O							F T																	S		O					Z									K	
	Psidium acutangulum																																																K	
	Psidium guajava		N							V																																								
	Psidium guianensis		N																																															
	Syzigium																																							Y										

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	Syzigium jambolanum		G			H	O		O			O		B H		B H O										C							S																K	
	Syzigium malaccensis			T		H							T			T																														T				
	Myrtaceae type		D G U							E	β			B C		A	C						X		X	C X		C	C	C		C	S				X		C		C			C X						X
NYCT	*Neea*																																																K	
OCHN	*Ouratea*																											C																C					K	
	Ouratea castanaefolia									V																																								
OLAC	*Aptandra*						O																																											
	Aptandra liriosmoides				C														C				X		X	C		C	C			C		C				W	C	W	C		C	C				C		
ONAG	*Ludwigia*		N R																																															
	Onagraceae type		I M																																															
OXAL	*Averrhoa carambola*			T			O																										S																		
	Oxalis frutescens		N																																															
	Oxalis juruensis									V																																								
PASS	*Passiflora*		I P						O		β																					W				X															
	Passiflora coccinea		G M			H																																			C							C		
	Passiflora foetida		N L																																															
	Piriqueta cistoides		G																																															
	Turnera		N																																															
	Turnera coriacea									E																																								
	Turnera ulmifolia		I U							E			T																											Y						T				
PEDA	*Sesamum indicum*		L																																															
PHYL	*Amanoa*														A F																																			
	Phyllantus																																							Y										
PHYT	*Microtea*																																							Z Y										
PIPE	*Peperomia*		G				O			E		O																					S																	
	Piper		G	T												O															W		S		O					Y						T		C		X
	Piper hispidum		G																																															
PLAN	*Conobea*																																S																	

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	Scoparia dulcis																																							Y										
POAC	*Andropogon*		M										T																																	T				
	Lasiacis																																							W										X
	Pariana																																			X														X
	Paspalum		I																																															
	Zea mays		U																																															
	Poaceae type		R Q G I				O																					C				W	S		O					Y							C		K	
PODO	*Podocarpus*						O																																											
POLYGA	*Polygala*																																															C		
	Securidaca longifolia																						X																											
	Polygalaceae type		G																																															
POLYGO	*Antigonum leptopus*		L							E																																								
	Polygonum									E																																								
	Symmeria															A																																		
	Tryplaris										β																																							
POLYP	Polypodiacae type		G																																															
PONT	*Eichornia*		N P																																															
	Eichornia azurea									V																																								
	Eichornia crassipes									V																																								
	Eichornia diversifolia		N																																															
	Eichornia heterosperma		N																																															
	Pontederia									V																																								
	Pontederia parviflora									V																																								
PORT	*Portulaca*		R							E																																								
PROT	*Roupala montana*		G										C			H																												C						
	Proteaceae type										C		C	B	C	A B																																		
RHIZ	*Rhizophora mangle*									E																																								
	Sterigmapetalum obovatum	W																													W																			
RUBI	*Amaioua corymbosa*																								X																									
	Borreria		D G U						O		C			B		A B F												C					S												C					

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	Borreria capitata		N L											B		B																																				
	Borreria latifolia													B		B																														T				
	Borreria verticillata		I M							E																														Z Y										
	Bothriospora																															W																		
	Citrus		N							E																					W																			
	Diodia																																							Y						T				
	Diodia hyssopifolia		R																																																
	Duroia						O																																									C		
	Ferdinandusa paraensis		R																																															
	Genipa americana		N L			H	O		O			O																					S																	
	Isertia hypoleuca																																											X					X	X
	Pagamea																																		W															
	Palicourea														C																																			
	Palicourea guianensis		M																																															
	Spermacoce																																																X	
	Spermacoce tenella									V																																								
	Spermacoce verticilata		R																																															
	Spondias lutea		P												C	F		C																																
	Warszewiczia coccinea								O			O		B		A B F O												C					S							Y				C						
	Warszewiczia schwackei															T																																		
	Zanthoxylum		D G I									O																																						
	Zanthoxylum rhoifolium																						X													X									X		T				
	Rubiaceae type		G			H	O		O																	C		C					S		O															
SALI	*Banara guianensis*		M																																															
	Casearia		G			H								H	C	O												C																						
	Casearia arborea		Q								C																	C																						
	Casearia commersoniana		R																																															
	Casearia grandiflora			T																																														
	Casearia sylvestres																																											C						
	Laetia suaveolens																								X	X																								

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	Ryania speciosa																																											X						
	Salix		G							E									C																															
	Sanchezia						O																																											
	Salicaceae type									E																					W																			
SAPI	*Allophyllus*		R																																															
	Cupania										β			H														C																						
	Cupania hispida																																S																	
	Matayba			T			O	C	O			O				O		C					X										S		O															
	Matayba spruceana																	C										C																						
	Paullinia biocarpa		N																																															
	Paullinia cupana											O								W												W			W															
	Sapindus saponaria									E																																								
	Serjania										β	O		H	C	O T α																	S		O															
	Talisia		Q	T								O	T	B		O B T		C															S		O										C						
	Talisia esculenta		L							E																																								
	Talisia firma		N																																															
	Toulicia		O			H			O					H									X		X																										
	Sapindaceae type		M G R		C									B														C				C	S		O									C				C		
SAPO	*Manilkara*															O																	S																		
	Pouteria						O		O			O				O α																	S							Z										
	Pouteria caimito						O					O				O																																		
	Pouteria macrophylla						O					O				O																																		
	Ragala											O				O																																		
	Sapotaceae type		D G			H	O		J			O				H																	S		O															
SIMA	*Simaba*																																	C																
	Simaba cuspidata																																					W												
	Simarouba amara		M																																															
SOLA	*Capsicum*									E																																								
	Capsicum annum									E																																								
	Solanum		G				O	C	J O	E	C β	O		H	C	A B F H O																S							Y								C		

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Plant Family*	Pollen Type	Bee Species																																																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
	Solanum annuum									E																																										
	Solanum caavurana						O		J O			O		H	C	H	C											C																						K	
	Solanum grandiflorum									V																																									
	Solanum juripeba								J	V																																									
	Solanum macrocarpon									E																																									
	Solanum melongena									E																																									
	Solanum myrianthum		G																																																
	Solanum paniculatum															α																																			
	Solanaceae type		R																																																
SYMP	*Symplocos*																																											C							
TALI	*Talinum*																																																K	
	Talinum paterns									E																																									
	Talinum racemosum		G																																																
URTI	*Cecropia*		G P Q R U	T	C	H	O		O	E		O		H B		A B F H O T α		C			W		X			X		C X	C	C		C W	S		O				C	W Z Y						T	C			X
	Cecropia palmata		M																																																
	Pourouma																																												X					X
	Pourouma acuminata																																													T				
	Urticaceae type																															C			W												C			
VERB	*Citharexyllum macrophyllum*																														W	W					X														
	Lantana camara						O			V		O																					S																		
	Lippia																																							Y											
	Petrea		G																																																
	Stachytarpheta cayennensis		G										T	H		A B F T																																	K	
	Verbenaceae type					H																						C																							
VITA	*Cissus*						O					O				H O																	S																		
VOCH	*Vochysia*		G							E																																									

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Plant Family*	**Pollen Type**	**Bee Species**																																																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
	Vochysia guianensis		L																																															

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Abbreviations (Appendix I) *ACAN, Acanthaceae. ACHA, Achariaceae. ALIS, Alismataceae. AMAR, Amaranthaceae. ANAC, Anacardiaceae. ANNO, Annonaceae. APIA, Apiaceae. APOC, Apocynaceae. AQUI, Aquifoliaceae. ARAL, Araliaceae. AREC, Arecaceae. ASPA, Asparagaceae. ASTE, Asteraceae. BIGN, Bignoniaceae. BIXA, Bixaceae. BORA, Boraginaceae. BRAS, Brassicaceae. BROM, Bromeliaceae. BURS, Burseraceae. CALO, Calophyllaceae. CANN, Cannabaceae. CAPP, Capparaceae. CARI, Caricaceae. CARYOC, Caryocaraceae. CARYOP, Caryophyllaceae. CHRY, Chrysobalanaceae. CLEO, Cleomaceae. CLUS, Clusiaceae. COMB, Combretaceae. CONV, Convolvuulaceae. CUCU, Cucurbitaceae. CUNO, Cunoniaceae. CYPE, Cyperaceae. DILL, Dilleniaceae. DIOS, Dioscoreaceae. ERYT, Erythroxylaceae. EUPH, Euphorbiaceae. FABA, Fabaceae. FABA-C, Fabaceae-Caesalpinioideae. FABA-F, Fabaceae-Faboideae. FABA-M, Fabaceae-Mimosoideae. GENT, Gentianaceae. GOUP, Goupiaceae. HUMI, Humiriaceae. HYPE, Hypericaceae. ICAC, Icacinaceae. LACI, Lacistemataceae. LAMI, Lamiaceae. LAUR, Lauraceae. LECY, Lecythidaceae. LORA, Loranthaceae. LYTH, Lythraceae. MALP, Malpighiaceae. MALV, Malvaceae. MARA, Maranthaceae. MAYA, Mayacaceae. MELA, Melastomataceae. MELI, Meliaceae. MORA, Moraceae. MYRI, Myristicaceae. MYRS, Myrsinaceae. MYRT, Myrtaceae. NYCT, Nyctaginaceae. OCHN, Ochnaceae. OLAC, Olacaceae. ONAG, Onagraceae. OXAL, Oxalidaceae. PASS, Passifloraceae. PEDA, Pedaliaceae, PHYL, Phyllanthaceae. PHYT, Phytolaccaceae. PIPE, Piperaceae. PLAN, Plantaginaceae. POAC, Poaceae. PODO, Podocarpaceae. POLYGA, Polygalaceae. POLYGO, Polygonaceae. POLYP, Polypodiaceae. PONT, Pontederiaceae. PORT, Portulaccaceae. PROT, Proteaceae. RHIZ, Rhizophoraceae. RUBI, Rubiaceae. SALI, Salicaceae. SAPI, Sapindaceae. SAPO, Sapotaceae. SIMA, Simaroubaceae. SOLA, Solanaceae. SYMP, Symploccaceae. TALI, Talinaceae. URTI, Urticaceae. VERB, Verbenaceae. VITA, Vitaceae. VOCH, Vochysiaceae.

APPENDIX II – Information about some Brazilian palynothecas where the slides resultant from the publications cited in this manuscript are probably deposited. Brazilian States: AM, Amazonas; MA, Maranhão; PA, Pará; RR, Roraima. Time Scale: A/P, Actuopalynology/Palaeopalynology.

State	Institution	Palynotheca's Curator	A/P
AM	Instituto Nacional de Pesquisas da Amazônia (INPA)	Dr. Maria Lúcia Absy	A/P
MA	Universidade Federal do Maranhão (UFMA)	Dr. Patrícia Maia Correia de Albuquerque	A
PA	Museu Paraense Emílio Goeldi (MPEG)	Dr. Léa Maria Medeiros Carreira	A/P
PA	Universidade Federal do Oeste do Pará (UFOPA)	Dr. Jaílson Santos de Novais	A
PA	Universidade Federal do Pará (UFPA)	Dr. Francisco Plácido Magalhães de Oliveira	A
RR	Museu Integrado de Roraima (MIRR)	Lic. Cice Maduro Batalha	A

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APPENDIX III – List of the bee species cited in melissopalynological studies undertaken in the Brazilian Amazon (1977 - 2013).

Code	Bee Species
1	*Aparatrigona impunctata* Ducke, 1916
2	*Apis mellifera* Linnaeus, 1758
3	*Cephalotrigona femorata* Smith, 1854
4	*Frieseomelitta silvestrii faceta* [*nom. nud.*]*
5	*Frieseomelitta varia* Lepeletier, 1836
6	*Frieseomelitta* sp.
7	*Melipona (Eomelipona) tumupasae* Schwarz, 1932
8	*Melipona (Melikerria) compressipes* Fabricius, 1804
9	*Melipona (Melikerria) fasciculata* Smith, 1854
10	*Melipona (Melikerria) interrupta* Latreille, 1811
11	*Melipona (Michmelia) seminigra seminigra* Friese, 1903
12	*Melipona (Michmelia) fulva* Lepeletier 1836
13	*Melipona (Michmelia) paraensis* Ducke, 1916
14	*Melipona (Michmelia) rufiventris* Lepeletier, 1836
15	*Melipona (Michmelia) seminigra merrillae Friese, 1903*
16	*Melipona (Michmelia) seminigra pernigra* Moure & Kerr, 1950
17	*Nannotrigona (Scaptotrigona) postica flavisetis* [*nom. nud.*]*
18	*Nannotrigona minuta* (Lepeletier, 1836)
19	*Nogueirapis butteli* Friese, 1900
20	*Oxytrigona flaveola* Friese, 1900
21	*Oxytrigona tataira* (Smith, 1863)
22	*Partamona ailyae* Camargo, 1980
23	*Partamona epiphytophila* Pedro & Camargo, 2007
24	*Partamona ferreirai* Pedro & Camargo, 2003
25	*Partamona mourei* Camargo, 1980
26	*Partamona pearsoni* (Schwarz, 1938)
27	*Partamona vicina* Camargo, 1980
28	*Partamona* sp.1
29	*Partamona* sp.2
30	*Plebeia minima* Gribodo, 1893
31	*Ptilotrigona lurida* (Smith, 1854)
32	*Scaptotrigona fulvicutis* Moure, 1964
33	*Scaptotrigona polysticta* Moure, 1950
34	*Scaptotrigona* sp.
35	*Scaura tenuis* (Ducke, 1916)
36	*Scaura latitarsis* (Friese, 1900)
37	*Schwarzula coccidophila* Camargo & Pedro, 2002
38	*Tetragona goettei* (Friese, 1900)
39	*Tetragonisca angustula* (Latreille, 1811)
40	*Trigona amalthea* (Olivier, 1789)
41	*Trigona branneri* Cockerell, 1912
42	*Trigona chanchamayoensis* Schwarz, 1948
43	*Trigona cilipes* (Fabricius, 1804)
44	*Trigona dalatorreana* Friese, 1900
45	*Trigona fulviventris* Guérin, 1844
46	*Trigona fuscipennis* Friese, 1900
47	*Trigona pallens* (Fabricius, 1798)
48	*Trigona williana* Friese, 1900
49	*Trigona recursa* Smith, 1863

*incertae sedis (Camargo & Pedro, 2013).

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APPENDIX IV - Scientific publications concerning Melissopalynology in the Brazilian Amazon (1977 - 2013), listing the references, the geographical origins of the samples, the types of materials utilized in the studies, and the bee species examined. Brazilian states cited: AM, Amazonas; MA, Maranhão; PA, Pará; RO, Rondônia; RR, Roraima. The numbers assigned to the bee species correspond to the list presented in Appendix III.

Code	Reference	Locality	Material	Bee Species
A	Absy & Kerr, 1977	Manaus (AM)	Pollen	15
B	Absy *et al*., 1980	Manaus (AM)	Stomach Nectar	13, 15
C	Absy *et al*., 1984	Parintins (AM) São Sebastião do Uatumã (AM) Aveiro (PA) Brasília Legal (PA) Capanema (PA) Itaituba (PA) Oriximiná (PA) Santarém (PA)	Pollen	4, 7, 10, 12, 13, 14, 16, 17, 18, 21, 25, 27, 28, 29, 31, 38, 40, 42, 43, 46, 47
D	Carreira *et al*., 1986	Belém (PA) Benevides (PA) São Francisco do Pará (PA) Tomé-Açu (PA)	Honey	2
E	Kerr *et al*., 1986/1987	São Luís (MA)	Pollen, Honey	9
F	Santos, 1991	Manaus (AM)	Pollen	15
G	Marques-Souza, 1993	Manaus (AM)	Pollen	5, 8, 13, 15, 48
H	Marques-Souza *et al*., 1993	Ji-Paraná (RO)	Pollen	2
I	Carreira & Jardim, 1994	Afuá (PA) Peixe-Boi (PA) São Caetano de Odivelas (PA) Vigia (PA)	Honey	2
J	Marques-Souza, 1996	Manaus (AM)	Pollen	8
K	Marques-Souza *et al*., 1996	Manaus (AM)	Pollen	48
L	Silva & Rebouças, 1996	Almirante Tamandaré (RR) Alto Alegre (RR) Boa Vista (RR) Cantá (RR) Uiramutã (RR)	Honey	2
M	Oliveira *et al*., 1998	Igarapé-Açu (PA)	Honey	2
N	Silva, 1998	Manaus (AM)	Pollen, Honey	2
O	Marques Souza, 1999	Manaus (AM)	Pollen	6, 8, 11, 15, 34
P	Silva & Absy, 2000	Uiramutã (RR)	Honey	2
Q	Marques-Souza & Kerr, 2003	Mucajaí (RR)	Honey	2
R	Silva, 2005	Manaus (AM)	Pollen, Honey	2
S	Marques-Souza *et al*., 2007	Manaus (AM)	Pollen	32
T	Oliveira *et al*., 2009	Manaus (AM)	Pollen	3, 12, 15, 45
U	Marques *et al*., 2011	Santa Luzia do Paruá (MA)	Honey	2
V	Martins *et al*., 2011	Palmeirândia (MA)	Honey	9
W	Rech & Absy, 2011a	Barcelos (AM) Santa Isabel do Rio Negro (AM) São Gabriel da Cachoeira (AM)	Pollen	1, 3, 19, 20, 30, 31, 34, 37, 39

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Code	Reference	Locality	Material	Bee Species
X	Rech & Absy, 2011b	Barcelos (AM) Iranduba (AM) Novo Airão (AM) Santa Isabel do Rio Negro (AM) São Gabriel da Cachoeira (AM)	Pollen	22, 23, 24, 25, 26, 27, 35, 36, 41, 43, 44, 48, 49
Y	Ferreira & Absy (2013)	Manacapuru (AM)	Post-Emergence Residue	10
Z	Novais & Absy, 2013	Belterra (PA) Santarém (PA)	Pollen	39
α	Silva *et al*., 2013	Boca do Acre (AM) Coari (AM) Lábrea (AM) Manaus (AM) Maués (AM) Pauiní (AM) Rio Preto da Eva (AM)	Honey	15
β	Novais & Absy (2014)	Belterra (PA) Santarém (PA)	Honey	39