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The stingless bees of Santa Catarina State, Southern Brazil

Abelhas sem ferrão do estado de Santa Catarina, sul do Brasil

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ABSTRACT
Aiming to know the diversity of stingless bees in southern Brazil, a review of 27 publications, reporting sampling of stingless bees in the state of Santa Catarina, covering a period of 30 years, was performed. The studies have been related to plant formations where they took place. A total of 51 species of 17 genera were obtained, six species (with four subspecies) in the genus *Melipona*. The studies took place in 19 municipalities. The vegetation type where more collections were undertaken was the rain forest. Most surveys were performed in the southern and northern mesoregions. Differences in the number of species reported by different authors refer to genera *Cephalotrigona, Frieseomelitta, Lestrimelitta, Melipona, Mourella, Nannotrigona, Oxytrigona, Paratrigona, Partamona, Plebeia, Scaptotrigona, Schwarziana, Tetragonisca* and *Trigona*. The causes of the differences may include anthropogenic factors. Santa Catarina State, in view of the verified number of species, stands as the last high diversity spot for stingless bees in Brazil, in a northern-southern perspective.
Keywords: Apifauna; geographic distribution; surveys; meliponines.

RESUMO
Visando conhecer a diversidade de abelhas sem ferrão em Santa Catarina, foi realizada uma revisão de 27 publicações que relatam amostragem de meliponíneos no estado, cobrindo um período de 30 anos. Os trabalhos foram relacionados às formações vegetais onde ocorreram. Um total de 51 espécies de 17 gêneros foi obtido, com seis espécies (e quatro subespécies) no gênero *Melipona*. Os estudos analisados ocorreram em 19 municípios. O tipo de fitofisionomia onde ocorreram mais amostragens foi a floresta ombrófila densa. A maioria dos estudos deu-se nas mesorregiões sul e norte. Diferenças no número de espécies relatado por diferentes autores referem-se aos gêneros *Cephalotrigona*, *Frieseomelitta*, *Lestrimelitta*, *Melipona*, *Mourella*, *Nannotrigona*, *Oxytrigona*, *Paratrigona*, *Partamona*, *Plebeia*, *Scaptotrigona*, *Schwarziana*, *Tetragonisca* e *Trigona*. As causas das diferenças podem incluir fatores antrópicos. O estado de Santa Catarina, tendo em vista o número de espécies verificadas, constitui o último ponto com alta diversidade de abelhas sem ferrão no Brasil, em uma perspectiva norte-sul.
Palavras-chave: Apifauna; distribuição geográfica; levantamentos; meliponíneos.

INTRODUCTION

Meliponine bees are popularly known as stingless bees, for having stunted sting and thus be unable to sting. They exist throughout Brazil and occur in tropical regions of the world, even reaching some subtropical regions (MICHENER, 2000). The popular name is not entirely appropriate as males of all groups of bees and females of Ceratinini and Andrenidae also cannot sting. The Meliponini tribe includes about 440 species

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worldwide (MICHENER, 2007), 384 in the Americas, 240 in Brazil, with 10 subspecies (CAMARGO; PEDRO, 2007). In a review, Pedro (2014) suggests 224 valid species, with at least 89 undescribed forms in the Brazilian territory, and, for Santa Catarina State, the compilation of the species listed in her work totals 23 species. No detailed listings are available for stingless bees, either for the state of Santa Catarina (SC). Stingless bees belong to the subfamily Apinae (*sensu* MELO; GONÇALVES, 2005) altogether with the other corbiculate bees - honeybees (Apina), social bumblebees (Bombina) and orchid bees (Euglossina) (SILVEIRA *et al*., 2002). They occupy much of the tropical regions and some of subtropical temperate ones (NOGUEIRA-NETO, 1997).

The delimitation of the distribution areas of the *taxa* allows, among other things, drawing inferences on phylogeny, which in turn seek to clarify the nowadays diversity patterns of the groups (COX; MOORE, 2010). The occurrence and distribution of stingless bees species is related to climatic aspects and predominant vegetation cover (WITTER *et al*., 2009). Santa Catarina State is located in the southern part of Brazil and has an extension of 95,400 km^2 (an area equivalent to Austria or Hungary or Ireland or Portugal), between the geographical coordinates 25º-30º S and 48º-54º W, bordering Argentina (which, in this area of the country, displays an humid subtropical climate and rainforest). The climate is medium/mild mesothermal type, with rainfall conditions of under dryness to no dryness, being included in the temperate climate zone, with milder weather on the coast (IBGE, 1998). The whole territory of the state is part of the Atlantic Forest Domain, whose natural forest cover originally encompassed 81.5% of the area of SC (FUNDAÇÃO SOS MATA ATLÂNTICA; INPE, 2001). The Atlantic Forest biome, in SC, includes some vegetation subformations: Rain Forest (Tropical Rain Forest), Araucarian Forest (Araucaria Forest), Deciduous Seasonal Forest (Forest of Uruguay River), southern steppe (*plateau* grasslands, high grasslands), pioneer formations with marine influence (sandbanks, mangroves), pioneer formations with fluvial or lacustrine influence (alluvial vegetation), areas of ecological tension and contacts (IBGE, 2004. These subformations spread along an increasing altitudinal gradient from east to west, of milder tropical types to temperate ones, in a range of about 750 km of distance. Because of its location on the continent, it is a region of interest in terms of limits in distribution and dispersion of species in the north-south direction as, in areas of low elevation, it appears as a transitional surface between subtropical and temperate climates and, in high places, as a temperate area (WALTER, 1986).

Some data on species richness of meliponines are known for some States of Brazil (SILVEIRA, 2010) and, among these, are the neighboring states of Rio Grande do Sul (RS) (WITTER *et al.,* 2009) and Paraná (PR) (INSTITUTO AMBIENTAL DO PARANÁ, 2009). No listings of only stingless bees are available for SC. The size of the actual diversity of stingless bees concerns issues related to the genetic variability of local populations, possible regional adaptations, recommendations to prioritize native pollinators and their beekeeping, the conservation status of the species, the management that should be implemented in view of historical records, the habitat degradation and other anthropogenic influences (IMPERATRIZ-FONSECA *et al.,* 2012). Information on bee diversity in Brazil is dispersed in several texts which include species surveys and, for SC, some censuses of Apidae were undertaken. Many of these scientific results constitute academic work (Masters' thesis, PhD thesis) and represent the sources of information on bees for the State. Mouga (2009) summarized this information and also included data from authors who formerly sampled Apidae in SC, namely Fritz Muller (1822-1897) and Fritz Plaumann (1902-1994), whose writings were reported in Nogueira-Neto (1966).

This study aimed to verify the stingless bees that occur in SC, through the survey of the species collected in this State, verifying the geographical location of samplings, the botanic formations encompassed by the *taxa*, the species richness by environments, as well as to conduct a comparison with the *taxa* listed in Moure *et al.* (2013), as a support for actions of study, conservation and management of these bees in the State.

MATERIAL AND METHODS

In order to survey the stingless bee species sampled in SC, a review of data from 27 scientific works was performed, listed in the references. For the compilation, the nomenclature of the species was updated, according to the classification of species of Melo and Gonçalves (2005). The phytophysiognomies where the samplings took place were compiled altogether the other data. The vouchers of the bees are deposited in the places described in the works consulted. Inventory of the

stingless bees which have signaled distribution for SC was made through systematic listing of the species mentioned in Moure *et al.* (2013) *(Moure Catalog of Bees*), which provides reference for taxonomic information on neotropical bees. Information was established in a database, with distribution elements according to vegetation formations of the State and municipalities. The resulting listings of bees were analyzed in terms of the cited species and sampling frequency. The boundaries of the areas of the Atlantic Forest vegetation formations were based on Klein (1978).

RESULTS AND DISCUSSION

The survey of the stingless bee species reported for SC is provided in table 1. The systematic compilation of stingless bee species mentioned in *Moure Catalogue of Bees* totals 39 species. The inventory of the stingless bee species sampled by several authors in SC gather 36 species.

The studies were conducted in 20 municipalities of SC, which are located in the fifth mesoregions of the State and in several plant formations (figure 1 and figure 2). There is more work done in the southern region and northern region (table 2). Regarding vegetation formations, there is more work done in the *Serra Geral* Rain Forest (RF) (lowland part) and *Serra do Mar* Rain Forest (RF) (lowland, submontane, montane, high grassland parts) (table 3).

It was observed that 16 species of stingless bees appear only in Moure *et al.* (2013): *Friesella schrottkyi* (Friese, 1900); *Geotrigona argentina* Camargo & Moure, 1996; *Geotrigona mombuca* (Smith, 1863); *Geotrigona subterranea* (Friese, 1901*); Lestrimelitta ehrhardti* (Friese, 1931); *Lestrimelitta rufipes* (Friese, 1903); *Leurotrigona muelleri* (Friese, 1900); *Melipona (Melikerria) quinquefasciata* Lepeletier, 1836; *Paratrigona wasbaueri* Gonzalez & Griswold, 2011; *Plebeia catamarcensis* (Holmberg, 1903); *Plebeia meridionalis* (Ducke, 1916); *Plebeia nigriceps* (Friese, 1901); *Plebeia wittmanni* Moure & Camargo, 1989; *Scaptotrigona depilis* (Moure, 1942); *Scaptotrigona xanthotricha* Moure, 1950; *Tetragona clavipes* (Fabricius, 1804).

Table 1 – List of stingless bee species of Santa Catarina state. Legend: ARAF=Araucaria Forest; DUN=Dunes; HGL=high grasslands; LRF=Lowland Rain Forest; MRF=Montane Rain Forest; SDF=Seasonal Decidous Forest; SMRF=Submontane Rain Forest.

	Genus	Subgenus	Species	Subspecies	Author	References	Vegetational formation	Municipality
1	*Melipona*	*(Eomelipona)*	*bicolor*			Muller; Plaumann; Luz *et al*. (2010); Mouga and Nogueira-Neto (2012); Moure *et al*. (2013)	LRF, SDF, HGL, MRF, SMRF	Blumenau, Garuva, Seara
2	*Melipona*	*(Eomelipona)*	*bicolor*	*bicolor*	Lepeletier, 1836	Mouga *et al*. (2014)	ARAF, HGL	Urubici
3	*Melipona*	*(Eomelipona)*	*bicolor*	*schencki*	Gribodo, 1893	Krug (2010); Mouga and Krug (2010); Mouga *et al*. (2012); Moure *et al*. (2013)	SMRF, MRF	Blumenau, Joinville, São Bento do Sul
4	*Melipona*	*(Eomelipona)*	*marginata*		Lepeletier, 1836	Plaumann; Mouga (2004); Krug and Alves-dos-Santos (2008); Dorneles (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Mouga *et al*. (2012); Mouga and Nogueira-Neto (2012); Mouga *et al*. (2014); Mouga and Nogueira-Neto (2015)	LRF, ARAF, DUN, MRF, SMRF, HGL, SDF	Blumenau, Garuva, Joinville, Indaial, Florianópolis, Mafra, Porto União, São Francisco do Sul, Seara, Urubici

	Genus	Subgenus	Species	Subspecies	Author	References	Vegetational formation	Municipality
5	*Melipona*	*(Michmelia)*	*mondury*		Smith, 1863	Dorneles (2010); Krug (2010); Luz *et al*. (2010); Moure *et al*. (2013); Mouga and Nogueira-Neto (2015)	DUN, LRF, SMRF, MRF	Blumenau, Florianópolis, Indaial, São Francisco do Sul
6	*Melipona*	*(Eomelipona)*	*obscurior*		Moure, 1971	Orth (1983); Krug (2010); Moure *et al*. (2013)	ARAF, LRF, SDF	Blumenau, Caçador, Concórdia
7	*Melipona*	*(Melikerria)*	*quinquefasciata*		Lepeletier, 1836	Moure *et al*. (2013)		
8	*Melipona*	*(Melipona)*	*quadrifasciata*			Plaumann; Muller; Dorneles (2010)	LRF, SDF, SMRF	Blumenau, Florianópolis, Seara
9	*Melipona*	*(Melipona)*	*quadrifasciata*	*anthidioides*	Lepeletier, 1836	Mouga and Krug (2010); Mouga *et al*. (2012); Mouga *et al*. (2014)	MRF, ARAF, HGL	Joinville, São Bento do Sul, Urubici
10	*Melipona*	*(Melipona)*	*quadrifasciata*	*quadrifasciata*	Lepeletier, 1836	Orth (1983); Mouga (2004); Steiner *et al*. (2006); Krug (2010); Steiner *et al*. (2010); Mouga *et al*. (2012); Mouga and Nogueira-Neto (2012); Mouga *et al*. (2014)	ARAF, LRF, HGL, SMRF, MRF	Blumenau, Caçador, Florianópolis, Joinville, Mafra, Urubici
11	*Cephalotrigona*		*capitata*		(Smith, 1854)	Plaumann; Moure *et al*. (2013); Mouga and Krug (2010)	MRF, SDF	São Bento do Sul, Seara
12	*Friesella*		*schrottkyi*		(Friese, 1900)	Moure *et al*. (2013)		
13	*Frieseomelitta*		*varia*		(Lepeletier, 1836)	Muller	SMRF	Blumenau
14	*Geotrigona*		*argentina*		Camargo and Moure, 1996	Moure *et al*. (2013)		
15	*Geotrigona*		*mombuca*		(Smith, 1863)	Moure *et al*. (2013)		
16	*Geotrigona*		*subterranea*		(Friese, 1901)	Moure *et al*. (2013)		
17	*Lestrimelitta*		*ehrhardti*		(Friese, 1931)	Moure *et al*. (2013)		
18	*Lestrimelitta*		*limao*		(Smith, 1863)	Muller	SMRF	Blumenau
19	*Lestrimelitta*		*rufipes*		(Friese, 1903)	Moure *et al*. (2013)		
20	*Lestrimelitta*		*sulina*		Marchi and Melo, 2006	Luz *et al*. (2010)	MRF, SMRF	Blumenau, Indaial
21	*Leurotrigona*		*muelleri*		(Friese, 1900)	Moure *et al*. (2013)		
22	*Mourella*		*caerulea*		(Friese, 1900)	Ortolan (1989); Ortolan and Laroca (1996); Moure *et al*. (2013)	ARAF	Lages
23	*Nannotrigona*		*testaceicornis*		(Lepeletier, 1836)	Krug (2010); Moure *et al*. (2013)	SDF	Concórdia

	Genus	Subgenus	Species	Subspecies	Author	References	Vegetational formation	Municipality
24	*Oxytrigona*		*tataira*		(Smith, 1863)	Muller; Mouga (2004); Silva (2005); Krug and Alves-dos-Santos (2008); Krug (2010); Mouga *et al*. (2012); Moure *et al*. (2013)	LRF, SMRF, ARAF, MRF	Blumenau, Cocal do Sul, Criciúma, Joinville, Nova Veneza, Porto União, São Francisco do Sul
25	*Paratrigona*		*lineata*		(Lepeletier, 1836)	Cardoso Sobrinho (2004); Moure *et al*. (2013)	LRF	Siderópolis
26	*Paratrigona*		*subnuda*		Moure, 1947	Silva (2005); Krug (2010); Luz *et al*. (2010); Moure *et al*. (2013)	LRF, SMRF, MRF	Blumenau, Cocal do Sul, Criciúma, Nova Veneza
27	*Paratrigona*		*wasbaueri*		Gonzalez and Griswold, 2011	Moure *et al*. (2013)		
28	*Partamona*		*criptica*		Schwarz, 1938	Steiner *et al*. (2010)	LRF	Florianópolis
29	*Partamona*		*cupira*		(Smith, 1863)	Muller	SMRF	Blumenau
30	*Partamona*		*helleri*		(Friese, 1900)	Luz *et al*. (2010); Steiner *et al*. (2010); Moure *et al*. (2013); Dec and Mouga (2014); Mouga *et al*. (2015)	LRF, SMRF, MRF	Blumenau, Florianópolis, Indaial, Joinville, São Francisco do Sul
31	*Plebeia*		*catamarcensis*		(Holmberg, 1903)	Moure *et al*. (2013)		
32	*Plebeia*		*droryana*		(Friese, 1900)	Steiner *et al*. (2006); Dorneles (2010); Krug (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Schmid *et al*. (2011); Moure *et al*. (2013); Dec and Mouga (2014); Mouga *et al*. (2015)	DUN, LRF, SMRF, MRF	Blumenau, Florianópolis, Joinville, Indaial, São Francisco do Sul
33	*Plebeia*		*emerina*		(Friese, 1900)	Orth (1983); Ortolan (1989); Ortolan and Laroca (1996); Mouga (2004); Steiner *et al*. (2006); Dorneles (2010); Krug (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Mouga and Nogueira-Neto (2012); Moure *et al*. (2013); Mouga *et al*. (2014)	ARAF, LRF, SDF, HGL, SMRF	Blumenau, Caçador, Concórdia, Florianópolis, Garuva, Lages, Mafra, Urubici
34	*Plebeia*		*julianii*		Moure, 1962	Krug (2010); Moure *et al*. (2013)	SDF	Concórdia
35	*Plebeia*		*meridionalis*		(Ducke, 1916)	Moure *et al*. (2013)		
36	*Plebeia*		*nigriceps*		(Friese, 1901)	Moure *et al*. (2013)		

	Genus	Subgenus	Species	Subspecies	Author	References	Vegetational formation	Municipality
37	*Plebeia*		*remota*		(Holmberg, 1903)	Muller; Orth (1983); Lenzi *et al*. (2003); Mouga (2004); Steiner *et al*. (2006); Krug and Alves-dos-Santos (2008); Dorneles (2010); Krug (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Moure *et al*. (2013); Dec and Mouga (2014); Mouga and Nogueira-Neto (2015)	LRF, ARAF, DUN, MRF, SMRF	Blumenau, Caçador, Florianópolis, Indaial, Joinville, Mafra, Porto União, São Francisco do Sul
38	*Plebeia*		*saiqui*		(Friese, 1900)	Orth (1983); Krug and Alves-dos-Santos (2008); Luz *et al*. (2010); Mouga and Nogueira-Neto (2012); Mouga *et al*. (2012); Moure *et al*. (2013); Mouga *et al*. (2014)	ARAF, LRF, MRF, HGL, SMRF	Blumenau, Caçador, Garuva, Indaial, Joinville, Porto União, Urubici
39	*Plebeia*		*wittmanni*		Moure and Camargo, 1989	Moure *et al*. (2013)		
40	*Scaptotrigona*		*bipunctata*		(Lepeletier, 1836)	Orth (1983); Steiner *et al*. (2006); Krug and Alves-dos-Santos (2008); Krug (2010); Luz *et al*. (2010); Mouga and Krug (2010); Steiner *et al*. (2010); Mouga *et al*. (2012); Moure *et al*. (2013)	ARAF, LRF, MRF, SMRF	Blumenau, Caçador, Florianópolis, Indaial, Joinville, Porto União, São Bento do Sul
41	*Scaptotrigona*		*depilis*		(Moure, 1942)	Moure *et al*. (2013)		
42	*Scaptotrigona*		*postica*		(Latreille, 1807)	Muller	SMRF	Blumenau
43	*Scaptotrigona*		*tubiba*		(Smith, 1863)	Luz and Althoff (2009); Luz *et al*. (2010)	MRF	Indaial
44	*Scaptotrigona*		*xanthotricha*		Moure, 1950	Moure *et al*. (201)		
45	*Schwarziana*		*quadripunctata*		(Lepeletier, 1836)	Plaumann; Orth (1983); Ortolan (1989); Ortolan and Laroca (1996); Krug and Alves-dos-Santos (2008); Krug (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Mouga and Nogueira-Neto, (2012); Mouga *et al*. (2012); Moure *et al*. (2013); Mouga *et al*. (2014)	ARAF, LRF, SDF, MRF, HGL, SMRF	Blumenau, Bom Jardim da Serra, Caçador, Concórdia, Florianópolis, Garuva, Indaial, Joinville, Lages, Porto União, Seara, Urubici

	Genus	Subgenus	Species	Subspecies	Author	References	Vegetational formation	Municipality
46	*Tetragona*		*clavipes*		(Fabricius, 1804)	Moure *et al*. (2013)		
47	*Tetragonisca*		*angustula*		(Latreille, 1811)	Muller; Plaumann; Mouga *et al*. (2014); Silva (2005); Steiner *et al*. (2006); Krug and Alves-dos-Santos (2008); Dorneles (2010); Krug (2010); Luz *et al*. (2010); Steiner *et al*. (2010); Mouga *et al*. (2012); Moure *et al*. (2013); Dec and Mouga (2014)	ARAF, LRF, SMRF, MRF, SDF	Blumenau, Cocal do Sul, Criciúma, Florianópolis, Indaial, Joinville, Nova Veneza, Porto União, São Francisco do Sul, Seara
48	*Tetragonisca*		*fiebrigi*		(Schwarz, 1938)	Krug (2010); Moure *et al*. (2013)	SDF	Concórdia
49	*Trigona*		*braueri*		Friese, 1900	Moure *et al*. (2013)		
50	*Trigona*		*fulviventris*		Guérin, 1844	Mouga *et al*. (2014)	LRF	São Francisco do Sul
51	*Trigona*		*spinipes*		(Fabricius, 1793)	Muller; Plaumann; Orth (1983); Ortolan (1989); Ortolan and Laroca (1996); Lenzi *et al*. (2003); Minussi (2003); Mouga (2004); Cardoso Sobrinho (2004); Silva (2005); Steiner *et al*. (2006); Krug and Alves-dos-Santos (2008); Dorneles (2010); Krug (2010); Luz *et al*. (2010); Mouga and Krug (2010); Steiner *et al*. (2010); Lenzi and Orth (2011); Schmid *et al*. (2011); Mouga and Nogueira-Neto (2012); Mouga *et al*. (2012); Moure *et al*. (2013); Dec and Mouga (2014); Mouga *et al*. (2014); Mouga and Nogueira-Neto (2015); Mouga *et al*. (2015)	ARAF, LRF, SMRF, MRF, HGL, DUN, SDF	Blumenau, Bom Jardim da Serra, Caçador, Cocal do Sul, Concórdia, Criciúma, Florianópolis, Garuva, Indaial, Joinville, Lages, Mafra, Nova Veneza, Porto União, Santa Rosa do Sul, São Bento do Sul, São Francisco do Sul, Siderópolis, Seara, Urubici

Figure 1 – Map of Santa Catarina State with the mesoregions where stingless bees were sampled, according to other authors. Legend: 1-Muller; 2-Plaumann; 3-Orth (1983); 4-Ortolan (1989); 5-Ortolan and Laroca (1996); 6-Minussi (2003); 7-Steiner *et al.* (2006); 8-Mouga (2004); 9-Cardoso Sobrinho (2004); 10a,b,c-Silva (2005); 11-Steiner *et al.* (2010); 12-Krug and Alves-dos-Santos (2008); 13-Luz and Althoff (2009); 14-Luz *et al.* (2010); 15a,b-Krug (2010); 16-Dorneles (2010); 17-Mouga and Krug (2010); 18-Lenzi and Orth (2011); 19-Schmid *et al.* (2011); 20-Lenzi *et al.* (2003); 21-Mouga *et al.* (2012); 22-Mouga and Nogueira-Neto (2012); 23a,b-Mouga *et al.* (2014); 24-Dec and Mouga (2014); 25-Mouga *et al.* (2015); 26-Mouga and Nogueira-Neto (2015).

On the other hand, 10 species of stingless bees are reported by other authors: *Melipona (Eomelipona) bicolor* Lepeletier, 1836; *Melipona (Eomelipona) marginata* Lepeletier, 1836; *Melipona (Melipona) quadrifasciata anthidioides* Lepeletier, 1836; *Frieseomelitta varia* (Lepeletier, 1836); *Lestrimelitta limao* (Smith, 1863); *Partamona criptica* Schwarz, 1938; *Partamona cupira* (Smith, 1863); *Scaptotrigona postica* (Latreille, 1807); *Scaptotrigona tubiba* (Smith, 1863); *Trigona fulviventris* Guérin, 1844.

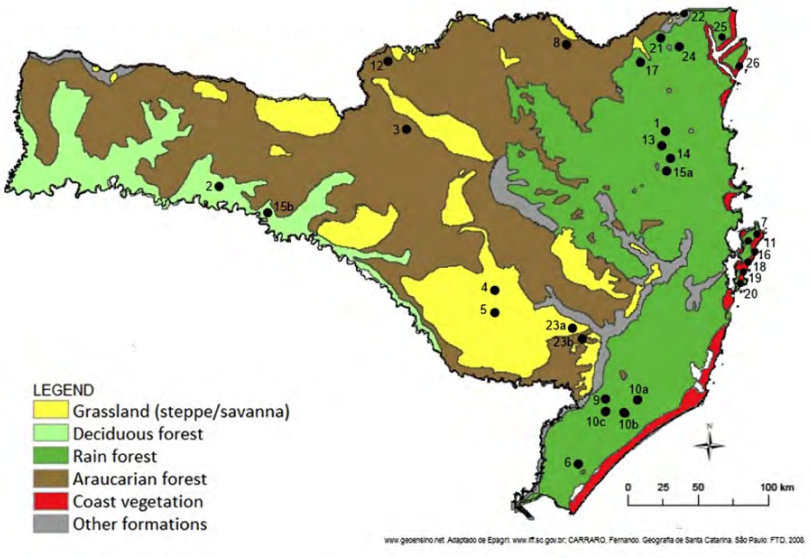

Figure 2 – Map of Santa Catarina State with vegetation formations, according to other authors. Legend: 1-Muller; 2-Plaumann; 3-Orth (1983); 4-Ortolan (1989); 5-Ortolan and Laroca (1996); 6-Minussi (2003); 7-Steiner *et al.* (2006); 8-Mouga (2004); 9-Cardoso Sobrinho (2004); 10a,b,c-Silva (2005); 11-Steiner *et al.* (2010); 12-Krug and Alves-dos-Santos (2008); 13-Luz and Althoff (2009); 14-Luz *et al.* (2010); 15a,b-Krug (2010); 16-Dorneles (2010); 17-Mouga and Krug (2010); 18-Lenzi and Orth (2011); 19-Schmid *et al.* (2011); 20-Lenzi *et al.* (2003); 21-Mouga *et al.* (2012); 22-Mouga and Nogueira-Neto (2012); 23a,b-Mouga *et al.* (2014); 24-Dec and Mouga (2014); 25-Mouga *et al.* (2015); 26-Mouga and Nogueira-Neto (2015).

In common between Moure *et al.* (2013) and the other authors, there are 24 species: *Melipona (Eomelipona) bicolor* Lepeletier, 1836; *Melipona (Eomelipona) bicolor schencki* Gribodo, 1893; *Melipona (Michmelia) mondury* Smith, 1863; *Melipona (Eomelipona) obscurior* Moure, 1971; *Melipona* (*M.*) *quadrifasciata* Lepeletier 1836); *Melipona (Melipona) quadrifasciata quadrifasciata* Lepeletier, 1836; *Cephalotrigona capitata* (Smith, 1854); *Lestrimelitta sulina* Marchi & Melo, 2006; *Mourella caerulea* (Friese, 1900); *Nannotrigona testaceicornis* (Lepeletier, 1836); *Oxytrigona tataira* (Smith, 1863); *Paratrigona lineata* (Lepeletier, 1836); *Paratrigona subnuda* Moure, 1947; *Partamona helleri* (Friese, 1900); *Plebeia droryana* (Friese, 1900); *Plebeia emerina* (Friese, 1900); *Plebeia julianii* Moure, 1962; *Plebeia remota* (Holmberg, 1903); *Plebeia saiqui* (Friese, 1900); *Scaptotrigona bipunctata* (Lepeletier, 1836); *Schwarziana quadripunctata* (Lepeletier, 1836); *Tetragonisca angustula* (Latreille, 1811); *Tetragonisca fiebrigi* (Schwarz, 1838); *Trigona spinipes* (Fabricius, 1793). The species of bees cited by Pedro (2014) are all cited in Moure *et al.* (2013) and don't add to this list of stingless bees of Santa Catarina State.

Table 2 – Municipalities, in the mesoregions of Santa Catarina State, where stingless bees were sampled, according to other authors. Legend: N=quantity of municipalities.

Mesorregion	Municipalities	N
Grande Florianópolis	Ilha de Santa Catarina	1
Norte catarinense	Garuva, Joinville, Mafra, Porto União, São Bento do Sul, São Francisco do Sul	6
Oeste catarinense	Caçador, Concórdia, Seara	3
Serrana	Bom Jardim da Serra, Lages, Urubici	3
Sul catarinense	Cocal do Sul, Criciúma, Nova Veneza, Santa Rosa do Sul, Siderópolis	5
Vale do Itajaí	Blumenau, Indaial	2
Total		20

Table 3 – Vegetation formations where stingless bees were sampled in Santa Catarina State, according to other authors. Legend: N=quantity of citations.

Vegetation formation	Municipality	N
Rain Forest *Serra do Mar*	Blumenau, Garuva, Joinville, São Bento do Sul, São Francisco do Sul (Vila da Glória), Indaial	6
Rain Forest *Serra Geral*	Cocal do Sul, Criciúma, Nova Veneza, Santa Rosa do Sul, Siderópolis	5
Araucaria Forest	Caçador , Mafra, Porto União	3
High grasslands	Bom Jardim da Serra, Lages, Urubici	3
Deciduous Seasonal Forest	Concórdia, Seara	2
Pioneer formations	Ilha de Santa Catarina, São Francisco do Sul (Ervino)	2
Total		21

The two lists combined, excluding overlaps, total 51 species. Regarding the *taxa* that are discordant between two groups of data (figure 3), it is observed that genera *Friesella*, *Geotrigona* and *Leurotrigona* are present only in Moure *et al.* (2013) and represent, together, five species. *Taxa* that show differences in the number of species in relation to the *Moure Catalogue of Bees,* only reported by other authors, are the genera *Lestrimelitta*, *Paratrigona*, *Plebeia* and *Scaptotrigona* (with smaller numbers of species); *Melipona* and *Partamona* (with higher number of species) and *Frieseomelitta* (genus not mentioned in Moure *et al. (*2013)). The genera *Cephalotrigona*, *Mourella*, *Nannotrigona*, *Oxytrigona*, *Schwarziana*, *Tetragonisca* and *Trigona* have the same number of *taxa* in the two data sources. The species most often encountered by the other authors are (in descending order) (table 4, figure 4): *Trigona spinipes*, *Melipona marginata*, *Plebeia remota*, *Tetragonisca angustula*, *Schwarziana quadripunctata*, *Plebeia emerina* and *Scaptotrigona bipunctata*.

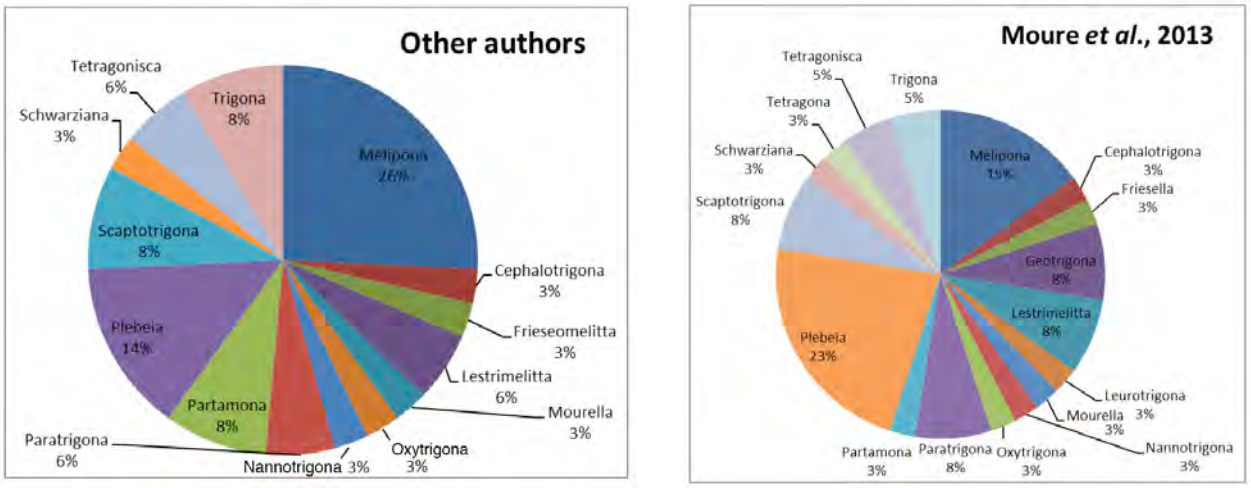

Figure 3 – Relative frequency of stingless bees species in Santa Catarina State, according to to others authors and Moure *et al.* (2013).

The 24 surveys of native bees in SC are characterized as community studies of regional bees: Orth (1983), Ortolan (1989), Ortolan and Laroca (1996), Minussi (2003), Lenzi *et al*. (2003), Cardoso Sobrinho (2004), Mouga (2004), Silva (2005), Steiner *et al.* (2006), Krug and Alves-dos-Santos (2008), Luz and Althoff (2009), Steiner *et al.* (2010), Mouga and Krug (2010), Dorneles (2010), Krug (2010), Luz *et al.* (2010), Lenzi and Orth (2011), Schmid *et al.* (2011), Mouga *et al.* (2012), Mouga and Nogueira-Neto (2012), Dec and Mouga (2014), Mouga *et al.* (2014), Mouga *et al.* (2015), Mouga and Nogueira-Neto (2015).

In a general way, these works do not particularize taxonomic groups of Apidae. The specimens of bees reported by the pioneering studies of Muller and Plaumann were not always deposited at specific locations and the citations of *taxa*, authored by these scholars and presented in this paper, come from listings of specimens present in the Entomological Museum Fritz Plaumann located at Seara (SC) and from Nogueira-Neto (1966). Bees collected in the other studies are cited by their respective authors about the place where they were deposited.

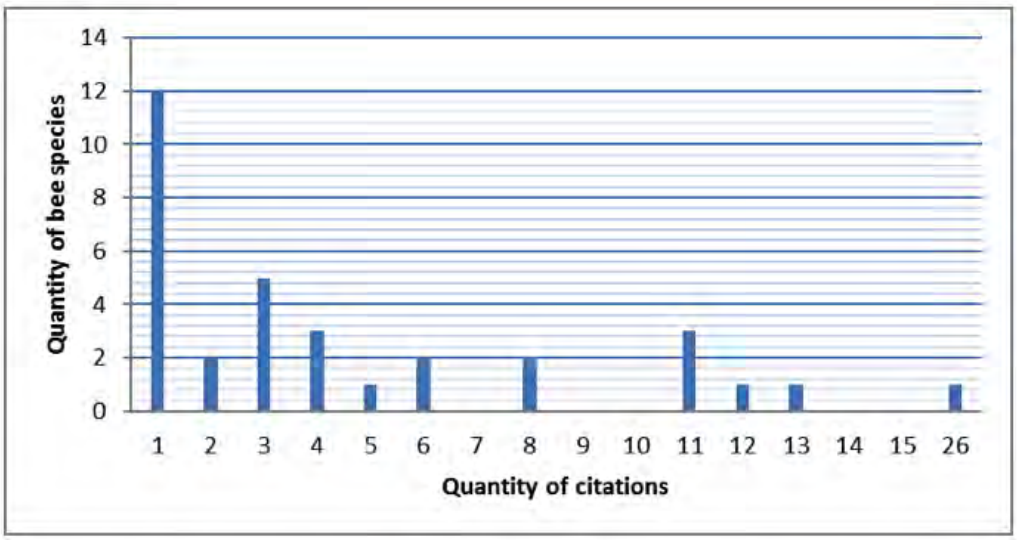

Figure 4 – Quantity of stingless bee species and quantity of citations that they received by other authors.

The first list of bee species for the state of SC was published by Mouga (2009) and included 37 species of stingless bees. The current data increases that number to 51 species. The stingless bees species, with potential occurrence in SC because of their geographic distribution near SC location (indicated in Moure *et al.* (2013)), are *Friesella Schrottky*, *Geotrigona argentina*, *Geotrigona mombuca*, *Geotrigona subterranea*, *Paratrigona lineata*, *Paratrigona wasbaueri*, *Plebeia catamarcensis*, *Plebeia julianii*, *Plebeia meridionalis*, *Plebeia wittmanni*, *Scaptotrigona depilis*, *Tetragonisca fiebrigi*, *Trigona braueri* and would total the current sum.

On the other hand, the differences observed when comparing the two sets of works cited, *Moure Catalog of bees* and others authors, can be attributed to a few causes: misidentification of specimens leading to underestimates of species, lack of taxonomic keys for stingless bees at specific level, insufficient publications, lack of specialists to identify the stingless bees, type of sampling mainly using the method developed by Sakagami *et al.* (1967), species rarity due to the ending of the geographic distribution of some species in SC, shortage due to human interventions in the environment (deforestation, ecosystem fragmentation, introduction of the honeybee) (BLOCHTEIN; HARTER-MARQUES, 2003), predatory gathering of nests (NOGUEIRA-NETO, 1997). Kamke *et al.* (2011) linked the absence of stingless bees, among other factors, to the lack of suitable sites for nesting and scarce resources for large colonies. According to Silveira *et al.* (2002), it is possible that many stingless bee species that were, until about 500 years ago, widely distributed in the coastal region originally covered by the forest, can now be confined to a few isolated forest areas (refuges).

However, the fact that several species of stingless bees, marked in Moure *et al.* (2013), have not been found in any of the reviewed studies, covering a time period of 30 years, gives rise to the issue of endangered species and eventual extinction in the sampled environments, a fact that has already been reported by Martins and Melo (2010), for instance, related to *Bombus bellicosus,* in its northern limit of geographical distribution. Lists of threatened species, compiled for the southern states of Brazil, mention species of stingless bees (BLOCHTEIN; HARTER-MARQUES, 2003; SCHWARTZ-FILHO *et al*., 2004; FATMA, 2011). One must make the caveat which, eventually, the species of stingless bees sampled by other authors and not mentioned in Moure *et al.* (2013) as components of SC apifauna, came from beekeeping next to the sampling locations of the works or that these species have escaped these places and are naturalized in the environments. Anyway, the number of species of stingless bees checked for SC (51 *taxa*) compared to that reported for the PR (35) (INSTITUTO AMBIENTAL DO PARANÁ, 2009) and the RS (21) (WITTER *et al.* 2009) situates the State, in the north-south transition gradient, as a threshold of favorable conditions for the existence of these bees. Pinheiro-Machado *et al.* (2006) reports that the panorama of diversity of Brazilian bees may be subject to some bias, since surveys of regional distribution can produce underestimates of some groups and that this could be the case of stingless bees, known to be richer in species in equatorial regions. Thus, those authors say that, in subtropical or temperate rainforests, species richness of Apini (*sensu* MELO; GONÇALVES, 2005) is 4.6%, in temperate grasslands 5.9% with 3.8% Meliponina and that, in general, in the habitats of southern Brazil, there is a decrease in the importance of the latter group (PINHEIRO-MACHADO *et al*., 2006) compared to other groups. The causes for these results include the geographical distribution of the group, its taxonomic status (meaning the amount of effort put into taxonomic revisions and descriptions), the demographic characteristics of some species (low-density populations or crepuscular habits) as well as the methodology and the sampling effort.

Table 4 – Stingless bee species more often cited, according to other authors. Legend: N=quantity of citations.

Species	N
Trigona spinipes Fabricius, 1793	26
Melipona marginata Lepeletier, 1836	12
Plebeia remota Holmberg, 1903	13
Tetragonisca angustula Latreille, 1811	11
Schwarziana quadripunctata Lepeletier, 1836	11
Plebeia emerina Friese, 1900	11
Scaptotrigona bipunctata Lepeletier, 1836	8
Plebeia droryana Friese, 1900	8

Species	N
Melipona quadrifasciata quadrifasciata Lepeletier, 1836	6
Oxytrigona tataira Smith, 1863	5
Melipona bicolor Lepeletier, 1836	4
Plebeia saiqui Friese, 1900	6
Melipona quadrifasciata Lepeletier, 1836	3
Paratrigona subnuda Moure, 1947	3
Melipona bicolor schencki Gribodo, 1893	3
Melipona quadrifasciata anthidioides Lepeletier, 1836	3
Melipona obscurior Moure, 1971	3
Partamona helleri Friese, 1900	4
Melipona mondury Smith, 1863	4
Cephalotrigona capitata Smith, 1854	2
Mourella caerulea Friese, 1900	2
Melipona bicolor bicolor Lepeletier, 1836	1
Frieseomelitta varia Lepeletier, 1836	1
Lestrimelitta limao Smith, 1863	1
Nannotrigona testaceicornis Lepeletier, 1836	1
Paratrigona lineata Lepeletier, 1836	1
Partamona criptica Pedro & Camargo, 2003	1
Partamona cupira Smith, 1863	1
Plebeia julianii Moure, 1962	1
Scaptotrigona depilis Moure, 1942	1
Scaptotrigona postica Latreille, 1807	1
Tetragonisca fiebrigi Schwarz, 1938	1
Trigona fulviventris Guérin, 1844	1

Stingless bees maintain perennial colonies, with docile individuals, species are easily adaptable to beekeeping in artificial hives, their honey has palate, digestive and medicinal qualities and their beekeeping constitute a traditional and environmental imprint of activity. However, its major importance lies in promoting pollination of native trees. They exhibit a complex social organization comparable to that of honeybees (highly social) and are considered an alternative possibility in the tropics and subtropics to address the lack/ decline of pollinators, *i.e.*, appropriate to the context of the disappearance of honey bees – CCD (Colony Collapse Disorder) (IMPERATRIZ-FONSECA *et al.*, 2007).

Santa Catarina State, in view of the data found, stands as a last high diversity spot for stingless bees in Brazil, in a northern-southern perspective, knowing that RS represents the southernmost limit of distribution of most Brazilian stingless bees (NOGUEIRA-NETO, 1997). This condition is linked, among other factors, to biotic thresholds that must be evaluated. The prediction of climate change to occur has generated studies that indicate that the translocation of bee species may be necessary to ensure their preservation (SARAIVA *et al*., 2012). In this case, in view of the importance of stingless bees as a biological heritage, knowledge of their diversity, geographic distribution and bionomics are placed as important and promising condition for their conservation.

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