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The black flies (Diptera: Simuliidae) from Santa Catarina, Brazil

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ABSTRACT. The Simuliidae fauna from the Santa Catarina state, Brazil, was documented, based primarily on specimens deposited in the collections of the Instituto Oswaldo Cruz, Brazil and the La Plata Museum, Argentina. The results of our survey are organized by mesoregion and by municipality. Of the 51 municipalities where black flies were recorded, 46 represented new unpublished locality records. A total of 29 species belonging to two genera and eight subgenera were found, among which five are new records for the Santa Catarina state. The species recorded are (new records are marked with a *): *Lutzsimulium hirticosta*, *Simuliium* (*Chirostilbia*) *acarayense*, *S.* (*Chirostilbia*) *distinctum*, *S.* (*Chirostilbia*) *empascae*, *S.* (*Chirostilbia*) *pertinax*, *S.* (*Chirostilbia*) *riograndense*, *S.* (*Chirostilbia*) *subpallidum*, *S.* (*Ectemnaspis*) *dinellii*, *S.* (*Ectemnaspis*) *lutzianum*, *S.* (*Ectemnaspis*) *perflavum*, *S.* (*Hemicnetha*) *rubrithorax*, *S.* (*Inaequalium) botulibranchium*, *S.* (*Inaequalium) clavibranchium*, *S.* (*Inaequalium) inaequale*, *S.* (*Inaequalium) itaunense*, *S.* (*Inaequalium) nogueirai*, *S.* (*Inaequalium) subclavibranchium*, *S.* (*Inaequalium) subnigrum*, *S.* (*Inaequalium) travassosi*, *S.* (*Notolepria*) *paraguayense**, *S.* (*Psaroniocompsa*) *anamariae**, *S.* (*Psaroniocompsa*) *angrense*, *S.* (*Psaroniocompsa*) *auripellitum*, *S.* (*Psaroniocompsa*) *auristriatum**, *S.* (*Psaroniocompsa*) *incrustatum*, *S.* (*Psaroniocompsa*) *jujuyense*, *S.* (*Psaroniocompsa*) *limbatum**, *S.* (*Psaroniocompsa*) *minuanum**, and *S.* (*Thyrsopelma*) *orbitale*.

KEY WORDS. Black flies; *Lutzsimulium*; *Simulium*; biodiversity.

Black flies, a common nuisance for humans and domestic animals, often pose a public health problem as well. Besides causing severe immunological reactions, black flies are vectors of several diseases such as onchocerciasis and mansonellosis (Shelley *et al*. 2010). In the Southern region of Brazil, black flies have an important socio-economic impact (Dellome-Filho 1991). In this context, the appropriated knowledge of existing black fly collections and biotaxonomy, together with socio-economic information about the regions affected by them, are extremely important to establish the measures for their control and prevention of diseases related to them as well.

There are only two preliminary studies on the black fly diversity for the Santa Catarina state (Moreira & Py-Daniel 1986, Mouga *et al*. 2005). These studies reported 25 species for the Joinville municipality, located in the Northern mesoregion, where the importance of nuisance caused by black fly bites has been recognized for a long time, with respect to both humans and livestock. Herein, we document the black fly distribution for all the Santa Catarina state mesoregions, presenting a biodiversity analysis by calculating the species abundance in each mesoregion.

MATERIAL AND METHODS

The state of Santa Catarina is situated in southern Brazil, between latitude 25º57'41" and 29º23'55"S, and longitude 48º19'37" and 53º50'00"W, and is divided into six distinct mesoregions (Governo do Estado de Santa Catarina 2002, Pandolfo *et al*. 2002, IBGE 2007; Fig. 1). The state economy relies primarily on agriculture, which accounts for most of the national poultry, beef and pork exports. About 40% of the inhabitants reside in rural areas, with the remaining population living in urban areas (IBGE 2007). With several well preserved beaches, the Atlantic coast is known for its tourism activity mainly during the summer. Two major vegetation types are present: the coastal forest (= Atlantic Rain Forest), in the east (mesoregions B, D-F), and the Semi-deciduous forest, which covers the western portion of the State (mesoregion A). The

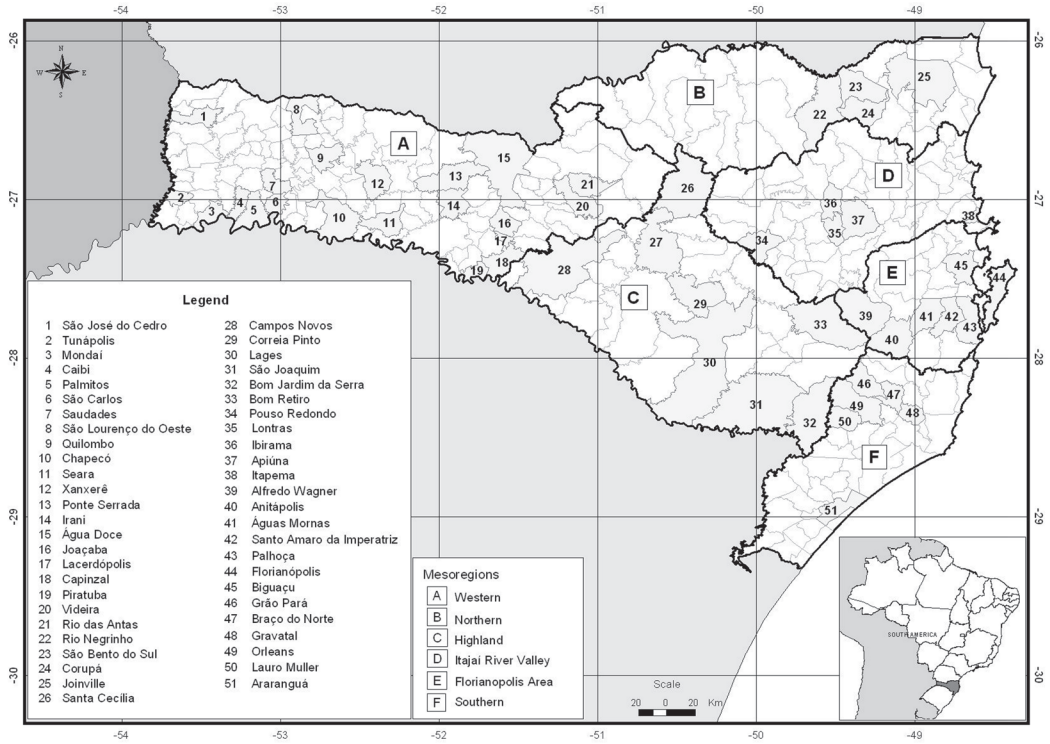

Figure 1. Santa Catarina municipalities where Simuliidae have been recorded, grouped by mesoregion.

former experiences warm and wet weather throughout the year, whereas the latter has a dry season (reviewed by Morellato & Haddad 2000). Between these two areas, the Highlands (mesoregion C) form a plateau at the top of the mountain chain that runs along the coastline from southern to northeastern Brazil, and is covered by a mosaic of grasslands and *Araucaria* forests, also called "Campos" (see Overbeck *et al.* 2007).

The specimens used in this study are deposited in the Simuliidae and Onchocerciasis Laboratory collection of the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil, and in the Simuliidae collection of the La Plata Museum, La Plata, Argentina. Access to the material from the Simuliidae and Onchocerciasis Laboratory collection was done through the database "Access Platform" – BIOCOLLECTION System Administrator for Biological Collections 1.0 – LSO/IOC/FIOCRUZ. Immature (pupae and larvae) and adults were preserved in 80% ethanol. Identification was conducted using a stereoscopic microscope and, when necessary, specimens were slide-mounted and examined under a compound microscope. Morphological characters of the adult, larva and pupa were used for the identification, adopting the taxonomic criteria described in Coscarón & Coscarón-Arias (2007). Black flies host preference data are based on information from Coscarón & Coscarón-Arias (2007) and Shelley *et al.* (2010). The distribution of each species was quantified for each municipality of the Santa Catarina State.

RESULTS AND DISCUSSION

A total of 3,520 specimens of 29 black fly species were examined, with five new records for the state of Santa Catarina: *Simulium (Notolepria) paraguayense* Schrottky, 1909, *Simulium (Psaroniocompsa) anamariae* Vulcano, 1962, *Simulium (Psaroniocompsa) auristriatum* Lutz, 1910, *Simulium (Psaroniocompsa) limbatum* Knab, 1915 and *Simulium (Psaroniocompsa) minuanum* Strieder & Coscarón, 2000. The distribution of the species in the 51 municipalities is shown in Table I. Considering the size of the sample, it was observed that the municipalities of Joinville, Água Doce, Irani, Rio das Antas, Saudades, and Seara (Western mesoregion), Campos Novos (Highland mesoregion), Araranguá, Grão Pará, and Orleans (Southern mesoregion) account for most of the specimens collected.

The data showed that the subgenus *Chirostilbia* Enderlein, 1921 with six species, and *Psaroniocompsa* Enderlein, 1934 with eight species have the greatest representation in the Santa Catarina black fly fauna. Considering the proportional distribution within the 51 municipalities where the survey took place, the subgenus *Inaequalium* Coscarón & Wygodzinsky, 1984 was poorly represented, with nine species. Some species – *Simulium (Chirostilbia) pertinax* Kollar, 1832, *Simulium (Ectemnaspis) dinellii* Joan, 1912, *Simulium (Notolepria) paraguayense*, *Simulium (Psaroniocompsa) incrustatum* Lutz, 1910, and *Simulium*

Table I. Simuliidae records in the municipalities (grouped by mesoregion) of Santa Catarina state, Brazil. Economic activities: (A) agriculture, (CM) commerce, (CT) construction, (E) extraction, (FA) farming, (FI) fishing, (I) industry, (TO) tourism, (TC); technology: (*Z) zoophilic species, (*A) anthropophilic species.

Mesoregion	Municipality	Coordinates S	Coordinates W	Altitude (m)	Activities	*S. acarayense*	*S. angrense*	*S. auripellitum* *Z, *A	*S. botulibranchium*	*S. distinctum* *Z	*S. inaequale* *A	*S. incrustatum* *A	*S. jujuyense* *Z, *A	*S. minuanum*	*S. orbitale* *Z, *A	*S. paraguayense*	*S. perflavum* *Z,	*S. pertinax* *Z, *A	*S. riograndense*	*S. rubrithorax*	*S. subclavibranchium*	*S. subnigrum* *Z, *A	*S. subpallidum*	Total Collected
Western	Água Doce	26°59′52″	51°33′22″	847	A		10					97		9	47			1						164
	Caibi	27°04′18″	53°14′52″	337	FA			2															3	5
	Capinzal	27°20′37″	51°36′43″	480	FA, T, I, CM			41							2			8						51
	Chapecó	27°5′45″	52°37′4″	670	FA, I								1											1
	Irani	27°01′29″	51°54′06″	1047	FA, T, I, CM	2		56		27		29			1			1				9		125
	Joaçaba	27°10′41″	51°30′17″	522	T, I, CM	8		21							5			3				5		42
	Lacerdópolis	27°15′36″	51°33′21″	513	FA			50	1		4			31				4				7		97
	Mondaí	27°06′10″	53°24′07″	220	A-Citrus			5															5	10
	Palmitos	27°04′04″	53°9′39″	406	A, T						10						9	1						20
	Piratuba	27°25′11″	51°46′19″	430	FA, T	2		4							1			7	2					16
	Ponte Serrada	26°52′18″	52°00′57″	1067	FA			42										1						43
	Quilombo	26°43′33″	52°43′15″	425	T			8								3		62		3		4		80
	Rio das Antas	26°53′55″	51°04′28″	830	FA, I			108																108
	São Carlos	27°04′39″	53°00′14″	264	T			2															3	5
	São José do Cedro	26°27′18″	53°29′39″	823	I			1															5	6
	São Lourenço do Oeste	26°21′32″	52°51′03″	880	FA, T			4										11					15	30
	Saudades	26°55′27″	53°00′11″	280	T			5							9								93	107
	Seara	27°08′58″	52°18′38″	550	FA, T	21		1				1			87			13						123
	Tunápolis	26°58′08″	53°38′21″	430	FA										1								12	13
	Videira	27°00′30″	51°09′06″	750	FA, T			7							3			87						97
	Xanxerê	26°52′37″	52°24′14″	800	A, FA, I			7										48			6		3	64
Itajaí River Valley	Apiúna	27°02′08″	49°23′23″	87	A, I, T							1											1	2
	Ibirama	27°03′25″	49°31′04″	150	A, CM, I	14		48						2	11									75
	Itapema	27°05′25″	48°36′41″	2	TO													6				2		8
	Lontras	27°09′58″	49°32′31″	330	A, I													1						1
	Pouso Redondo	27°15′29″	49°56′02″	354	FA, I	2					1													3

Table I. Continued.

Mesoregion	Municipality	Coordinates S	Coordinates W	Altitude (m)	Activities	*L. hirticosta*	*S. acarayense*	*S. anamariae* *Z, *A	*S. auripellitum* *Z, *A	*S. auristriatum*	*S. botulibranchium*	*S. clavibranchium*	*S. dinelli* *A	*S. distinctum* *Z	*S. diversibranchium*	*S. empascae*	*S. hauseri*	*S. inaequale* *Z, *A	*S. incrustatum* *A	*S. itaunense*	*S. limbatum* *A	*S. lutzianum*	Total Collected
Florianópolis Area	Águas Mornas	27°41′38″	48°49′26″	70	FA, TO			1			4								8				24
	Alfredo Wagner	27°42′01″	49°20′01″	480	FA																		5
	Anitápolis	27°54′07″	49°07′43″	430	A																		15
	Biguaçu	27°29′38″	48°39′21″	3	FA, FI	1	1		29									16					81
	Florianópolis	27°35′49″	48°32′56″	0	CM, CT, I, TO				4														4
	Palhoça	27°38′42″	48°40′4″	3	CM, I, FI, TO																		3
	Santo Amaro da Imperatriz	27°41′16″	48°46′44″	18	A, CM, I, TO														18				28
Northern	Corupá	26°25′31″	49°14′35″	75	A	1	6	1										1	32				42
	Joinville	26°18′14″	48°50′45″	4	TC	74	110	45	6	2	58	2	31	108	1	45		68	102	39	10	4	1098
	Rio Negrinho	26°15′16″	49°31′06″	790	FA, E		4		5														9
	São Bento do Sul	26°15′01″	49°22′43″	838	A				18									12	7				55
Highland	Bom Jardim da Serra	28°20′13″	49°37′29″	1245	A	1			84								1						89
	Bom Retiro	27°47′50″	49°29′21″	1827	A, I, FA				2										52				55
	Campos Novos	27°24′06″	51°13′30″	947	A	1			112														121
	Correia Pinto	27°35′05″	50°21′40″	847	Logging														63				63
	Curitibanos	27°16′58″	50°35′04″	987	A				7					3									17
	Lages	27°48′57″	50°19′33″	916	FA														38				39
	Santa Cecília	26°57′39″	50°25′37″	1100	A		12																17
	São Joaquim	28°17′38″	49°55′54″	1360	FA, TO				10														12
Southern	Araranguá	28°56′05″	49°29′09″	13	A, CM, I, TO																		130
	Braço do Norte	28°16′30″	49°09′57″	75	I, FA, TO				2														17
	Grão Pará	28°11′06″	49°12′53″	110	CM, I, FA																		158
	Gravatal	28°19′52″	49°02′07″	30	TO													10					10
	Lauro Muller	28°23′34″	49°23′48″	220	E							4											26
	Orleans	28°21′32″	49°17′27″	132	C, I, FA												32			1			135

Table I. Continued.

Mesoregion	Municipality	Coordinates S	Coordinates W	Altitude (m)	Activities	*S. minuanum*	*S. nogueirai* *Z	*S. orbitale* *Z, *A	*S. peflavum* *Z	*S. pertinax* *Z, *A	*S. subclavibranchium*	*S. subnigrum* *Z, *A	*S. subpallidum*	*S. travassosi*	Total Collected
Florianópolis Area	Águas Mornas	27°41′38″	48°49′26″	70	FA, TO					8		3	4		24
	Alfredo Wagner	27°42′01″	49°20′01″	480	FA							1			5
	Anitápolis	27°54′07″	49°07′43″	430	A					15					15
	Biguaçu	27°29′38″	48°39′21″	3	FA, FI				6	28					81
	Florianópolis	27°35′49″	48°32′56″	0	CM, CT, I, TO										4
	Palhoça	27°38′42″	48°40′4″	3	CM, I, FI, TO					3					3
	Santo Amaro da Imperatriz	27°41′16″	48°46′44″	18	A, CM, I, TO					8			2		28
Northern	Corupá	26°25′31″	49°14′35″	75	A					1					42
	Joinville	26°18′14″	48°50′45″	4	TC		45	57	40	175	3	47	3	23	1098
	Rio Negrinho	26°15′16″	49°31′06″	790	FA, E										9
	São Bento do Sul	26°15′01″	49°22′43″	838	A							18			55
Highland	Bom Jardim da Serra	28°20′13″	49°37′29″	1245	A					3					89
	Bom Retiro	27°47′50″	49°29′21″	1827	A, I, FA					1					55
	Campos Novos	27°24′06″	51°13′30″	947	A					4		4			121
	Correia Pinto	27°35′05″	50°21′40″	847	Logging										63
	Curitibanos	27°16′58″	50°35′04″	987	A					5		2			17
	Lages	27°48′57″	50°19′33″	916	FA					1					39
	Santa Cecília	26°57′39″	50°25′37″	1100	A			5							17
	São Joaquim	28°17′38″	49°55′54″	1360	FA, TO					1		1			12
Southern	Araranguá	28°56′05″	49°29′09″	13	A, CM, I, TO	130									130
	Braço do Norte	28°16′30″	49°09′57″	75	I, FA, TO					15					17
	Grão Pará	28°11′06″	49°12′53″	110	CM, I, FA					120					158
	Gravatal	28°19′52″	49°02′07″	30	TO										10
	Lauro Muller	28°23′34″	49°23′48″	220	E				22						26
	Orleans	28°21′32″	49°17′27″	132	C, I, FA			1	43	35		21	2		135

(Psaroniocompsa) limbatum – are considered voracious pests in the region, regardless of their host preferences (according to the author's experience during collecting).

The new records for the Santa Catarina state are not surprising, thus demonstrating only the existence of gaps in the knowledge of this family for Santa Catarina. Most of them can be certainly associated with the black fly fauna that is characteristic of the Paraná sub region and their provinces (sensu Morrone 2006), to which some are certainly recognized as endemic (Shelley *et al.* 2010). Our results show that anthropophilic and zoophilic black fly species, in spite of varying in diversity within a short spatial scale, are widespread in the Santa Catarina State. The apparent similarity between the Western and Highland black fly fauna should be further explored; it could be explained by the geographical characteristics that are shared by such areas, since both are located within Semi-deciduous Atlantic forest. From a broad scale perspective, their diversity, and maybe abundance, is apparently greater on the Eastern and Western portions of the State. Compared to the middle highlands where plateau grasslands prevail, these regions, and specially those located in the coastal forest are richer on streams and rivers that run on the strong slopes of mountain chains existing locally, besides being wetter and warmer throughout the year, favoring the abundance and diversity (Morellato *et al.* 2000). Together, these aspects would certainly contribute to such a pattern of typical heterothermic, restricted water flow immature stage inhabitants, such as black flies.

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LITERATURE CITED

Coscarón, S. & C.L. Coscarón-Arias. 2007. Neotropical Simuliidae (Diptera: Insecta). J. Adis; J.R. Arias; G. Rueda-Delgado & K.M. Wantzen (Eds). **Aquatic Biodiversity in Latin America.** Sofia, Pensoft, vol. 3, 685p.

Dellome-Filho, J. 1991. Simuliofauna do rio Marumbi (Morretes, PR, Brasil). I. Coleta e criação; dados meteorológicos e físico-químicos do criadouro; adultos (Diptera, Simuliidae). **Acta Biológica Paranaense 20** (1, 2, 3, 4): 145-156.

Governo do Estado de Santa Catarina. 2002. **Plano integrado de recursos hídricos da bacia hidrográfica do rio Tubarão e complexo lagunar.** Florianópolis, Governo do Estado de Santa Catarina, Atividades Preliminares, Tomo I, Florianópolis, vol. 1, 295p.

IBGE. 2007. Geociências – Divisão regional do Brasil em zonas fisiogeográficas. Available online at: http://www.ibge.gov.br[Accessed: 01.IX.2009].

Moreira, G.R.P. & V. Py-Daniel. 1986. **Levantamento das espécies de simulídeos da região de Joinville, Santa Catarina. Secretaria da Agricultura e do Abastecimento.** Florianópolis. Empresa Catarinense de Pesquisa Agropecuária, Relatório Técnico – Pesquisa em Andamento, vol. 59, 3p.

Morellato, L.P.; D.C. Talora; A. Takahasi; C.C. Bencke; E.C. Romera & V.B. Zipparro. 2000. Phenology of Atlantic Rain Forest trees: A comparative study. **Biotropica 32**: 811-823.

Morrone, J.J. 2006. Biogeographic areas and transition zones of Latin-America and the Caribbean Islands based on panbiogeographic and cladistics analyses of the entomofauna. **Annual Review of Entomology 51**: 467-494.

Mouga, D.M.D.; O. Souza & S. Setti. 2005. **Levantamento das espécies de borrachudos (Diptera, Simuliidae) ocorrentes no Município de Joinville, Santa Catarina.** Available online at: http://www.seb-ecologia.org.br/viiceb/resumos/417a.pdf [Accessed: 01.IX.2009].

Overbeck, G.E.; S.C. Muller; A. Fidelis; J. Pfadehauer; V.D. Pillar; C.C. Blanco; I. Boldrini; R. Botha & E.D. Forneck. 2007. Brazil's neglected biome: The South Brazilian *Campos*. **Perspectives in Plant Ecology, Evolution and Systematics 9**: 101-116.

Pandolfo, C.; H.J. Braga; V.P. Silva; A.M. Massignan & V.M.R.Thorme. 2002. **Atlas climatológico digital do Estado de Santa Catarina. Epagri.** Available online at: http://www.epagri.rct.sc.br [Accessed: 01.IX.2009].

Shelley, A. J.; L. M. Hernández; M. Maia-Herzog; A. P. A. Luna Dias & P. R. Garritano. 2010. The Blackflies (Diptera: Simuliidae) of Brazil. *In*: J.R. Arias; S. Golovatch; K.M. Wantzen & E. Dominguez (Eds). **Aquatic Biodiversity in Latin America.** Sofia, Pensoft, vol. 1, 821p.

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