

Checklist of Orchid bees (Hymenoptera: Apidae) of “Lago do Silêncio” Area, Boca do Acre, Amazonas, Brazil

Danielle Storck-Tonon^{1*}, Marilene Vasconcelos Silva² and Elder Ferreira Morato³

1 Instituto Nacional de Pesquisas da Amazônia, Coordenação de Pesquisas em Entomologia. Avenida André Araújo, 1753, C.P. 478. CEP 69011-970. Manaus, AM, Brazil.

2 Instituto para Manejo e Conservação da Fauna Silvestre – AmazonFauna. Rua Antônio da Rocha Viana, s/nº Horto Florestal – Vila Ivonete. CEP 69914-610. Rio Branco, AC, Brazil.

3 Universidade Federal do Acre, Departamento de Ciências da Natureza. BR 364, Km 04, n 6637, C.P. 500. CEP 69915-900. Rio Branco, AC, Brazil.

* Corresponding author. E-mail: danistorck@yahoo.com.br

ABSTRACT: This study presents a list of euglossine-bee species collected in the Lago do Silêncio region, municipality of Boca do Acre, in the Brazilian state of Amazonas, southwestern Amazonia. Euglossine males were attracted to odoriferous baits on December 3 and 4, 2004. A total of 234 individuals belonging to four genera and 25 species were collected. Despite the small sampling effort, the local euglossine fauna is abundant and rich, when compared to those of other areas in the Brazilian Amazonia where higher sampling efforts were performed. Therefore, further studies in the region can be important for improving our knowledge of the bees in the Amazon region.

INTRODUCTION

The Amazonian region is considered to be the most diverse of the planet and innumerable studies have been undertaken in the region (WWF 2010). However, many areas in the region have not been inventoried and are considered knowledge gaps as far as biological diversity is concerned.

The orchid bees belong to the subtribe Euglossina, comprising five genera and about 200 species distributed in the Neotropical region, with some species occurring beyond the tropics (Dressler 1982; Roubik and Hanson 2004). Their diversity is highest in humid forests, with few species occurring in savannas and gallery forests (Dressler 1982). In Brazil, according to Nemésio and Silveira (2007), the Amazonian region is the richest in euglossine species. In general, the greatest richness of euglossine bees has been found in preserved forests, however, some species such as *Eulaema nigrita* Lepeletier, 1841 are found in open or disturbed areas (Morato *et al.* 1992; Peruquetti *et al.* 1999; Nemésio and Silveira 2007). Thus, the group is considered a good indicator of the conservation status of pristine environments (Morato 1994).

Although several studies have been carried out on the Amazonian orchid bees in recent decades (Braga 1976; Powell and Powell 1987; Becker *et al.* 1991; Morato *et al.* 1992; Morato 1994; Oliveira and Campos 1995, 1996; Otero and Sandino 2003; Nemésio and Morato 2004, 2005, 2006; Rasmussen 2009; Storck-Tonon *et al.* 2009; Oliveira *et al.* 2010), Roubik and Hanson (2004) estimated that only 1/3 of the existing euglossine species in the region have been described.

The “Lago do Silêncio” (Silence Lake) area, in southwestern Amazonia, represents one knowledge gap for the euglossine bees, since there is no record of euglossine sampling. Thus, sampling this region is important for extending the knowledge on the biogeography and on the composition of the local euglossine bee faunas in Amazonia.

MATERIALS AND METHODS

Study area

The region known as “Lago do Silêncio” is characterized as an abandoned meander lake, located in southwestern Amazonia, in the municipality of Boca do Acre, Amazonas state, Brazil (08°50'56" S, 68°42'26" W), on the left margin of the Purus River. The regional climate is classified as hot and humid with high humidity throughout the year and monthly averages ranging between 80 and 90%; maximum temperature may exceed 33°C and average rainfall is 2,532.4 mm (Acre 2006). The periods of flood and drought vary according to the rainfall in the headwaters of the Purus River. The surroundings of the Lagoa do Silêncio are covered by rainforest remnants.

Data collection

Bees were collected in December 3 and 4, 2004, between 7:00 and 14:00 h. According to Oliveira and Campos (1999) the time of highest activity of Euglossine is between 9:00 and 16:00 h, however, as of 13:00 h the number of individuals captured tends to lessen considerably. Male euglossines were attracted to chemical baits made with cotton swabs dipped into one of the following odoriferous substances: vanillin, cineol (eucalyptol), methyl salicylate, benzyl acetate, and methyl cinnamate. These substances are considered the most attractive to the regional euglossine bees (Oliveira and Campos 1996; Nemésio and Morato 2006; Storck-Tonon *et al.* 2009).

Eighteen collecting sites were located throughout the area covered by the lake. Nine sites were sampled on the first day and nine on the second day. At each site, a set of chemical baits were hung from a nylon string, approximately 1.5 m above the ground. Bees attracted to the baits were collected with insect nets. The collected specimens were identified and deposited in the invertebrate's collection of the “INPA - Instituto Nacional de Pesquisas da Amazônia”.

RESULTS AND DISCUSSION

Two-hundred-thirty-four euglossine males belonging to four genera and 25 species were collected (Table 1), representing about 40% of the *ca* 63 euglossine species listed for the Amazon region (e.g. Braga 1976; Powell and Powell 1987; Becker et al. 1991; Morato et al. 1992; Morato 1994; Oliveira and Campos 1995; Nemésio and Morato 2004, 2005, 2006; Nemésio and Silveira, 2007; Storck-Tonon et al. 2009; Oliveira et al. 2010).

The genus *Euglossa* Latreille was the most abundant (159 specimens; 68% of all bees collected), followed by *Eulaema* Lepeletier with 49 specimens (20%), *Exaerete* Hoffmannsegg with 14 specimens (6%) and *Eufriesea* Cockerell with 12 specimens (5%). However, in other studies in the region, *Eulaema* is usually the most abundant. In the studies of Storck-Tonon et al. (2009) and of Nemésio and Morato (2006) more than 50% of the individuals belong to *Eulaema*.

The most abundant species was *Euglossa ignita* (Smith, 1854), which represented 30% of all bees collected. A similar result was found in the Amazonian region by Braga (1976) and Otero and Sandino (2003). However, this species was not abundant in the studies of Storck-Tonon et al. (2009) (5%) and Nemésio and Morato (2006) (7%). *Eulaema meriana* (Olivier, 1789) was the second most abundant species (17%). This species was more abundant in the work carried out in Acre state (e.g. Nemésio and Morato 2004; Storck, Tonon et al. 2009) but was abundant

in some studies in the Amazon (e.g. Oliveira and Campos 1995). The other species were less abundant, each accounting for less than 10% of the total abundance.

Only five individuals (2%) of *Eulaema cingulata* (Fabricius, 1804) were collected in this study. However, this species was the most abundant in the studies by Storck-Tonon et al. (2009) (24%) and Nemésio and Morato (2006) (27%).

Cineole was the substance that attracted more bee specimens and species (Table 1). This was also the most attractive bait in the work of Becker et al. (1991) and Morato (1994). Methyl salicylate was the second most attractive and this was the substance that attracted more species of Euglossina in others studies in the region (Powell and Powell 1987; Morato et al. 1992; Oliveira and Campos 1996; Storck-Tonon et al. 2009).

Although this is a well preserved area, one individual of *Eulaema nigrita* was collected. This is remarkable, since this species is not usually collected in pristine forests in the Amazonian region, and has been considered a bioindicator of disturbed areas (Morato et al. 1992; 1994; Peruquetti et al. 1999; Nemésio and Silveira 2007). It is also important to note that Storck-Tonon et al. (2009) collected a large amount of *E. nigrita* individuals in urban areas in the vicinity of the municipality of Rio Branco, Acre state. This species has been found to be more abundant in the southern, southeastern and western regions of

TABLE 1. Abundance and richness of orchid bees attracted by different odorous substances in the Lago do Silêncio region, AM, Brazil. MC = methyl cinnamate, BA = benzyl acetate, CI = cineol, MS = methyl salicylate, VA = vanillin and ND = not defined (species collected at the sampling site, before choosing any of the baits).

SPECIES	MC	BA	CI	MS	VA	ND	TOTAL
<i>Eufriesea surinamensis</i> (Linnaeus, 1758)		3		1	3		7
<i>Eufriesea superba</i> (Hoffmannsegg, 1817)				3	1		4
<i>Eufriesea pulchra</i> (Smith, 1854)			1				1
<i>Euglossa amazonica</i> Dressler, 1982		1	5				6
<i>Euglossa augaspis</i> Dressler, 1982			1				1
<i>Euglossa chlorina</i> Dressler, 1982	1		12				13
<i>Euglossa cognata</i> Moure, 1970				1			1
<i>Euglossa ignita</i> Smith, 1874	2	9	27	25	1	8	72
<i>Euglossa imperialis</i> Cockerell, 1922			1	4			5
<i>Euglossa modestior</i> Dressler, 1982			7				7
<i>Euglossa mourei</i> Dressler, 1982	2	1	9	1	10	1	24
<i>Euglossa mixta</i> Friese, 1899	1			4			5
<i>Euglossa orellana</i> Roubik, 2004	3		6	6	2	4	21
<i>Euglossa pleosticta</i> Dressler, 1982			2				2
<i>Euglossa variabilis</i> Friese, 1899				1			1
<i>Euglossa viridifrons</i> Dressler, 1982			1				1
<i>Eulaema bombiformis</i> (Packard, 1869)				1			1
<i>Eulaema cingulata</i> (Fabricius, 1804)	1	2			2		5
<i>Eulaema meriana</i> (Olivier, 1789)	6	12	4	12	1	5	40
<i>Eulaema mocsaryi</i> (Friese, 1899)			1				1
<i>Eulaema nigrita</i> Lepeletier, 1841						1	1
<i>Eulaema pseudocingulata</i> (Oliveira, 2006)					1		1
<i>Exaerete frontalis</i> (Guérin-Méneville, 1844)		1					1
<i>Exaerete lepeletieri</i> Oliveira e Nemésio, 2003		1	5	1	1		8
<i>Exaerete smaragdina</i> (Guérin-Méneville, 1844)			4	1			5
Species Richness	7	8	15	13	9	5	25
Abundance	16	30	86	61	22	19	234

Brazil, where the sampling sites are usually placed in more disturbed and smaller forest fragments (Rebêlo and Garófalo 1997; Neves and Viana 1997, 1999; Peruquetti et al. 1999; Bezerra and Martins 2001; Nemésio 2002; Sofia and Suzuki 2004; Souza et al. 2005).

Despite the fact that only two sampling days were performed, the study area showed high abundance and species richness of euglossine bees. According to Roubik and Hanson (2004), six consecutive days should be sufficient to sample the euglossine richness of a given area. This study, and the works carried out by Nemésio (2010, 2011a, 2011b), suggest that shorter sampling protocols may be useful for Euglossina as long as they are conducted in the period of greatest activity of these bees. However, this study had nine points sampled simultaneously. Thus, greater number of sampling points may be important in rapid surveys. According to Storck-Tonon et al. (2009), the greater the sampling effort, the sample disaggregation, and the environmental heterogeneity, the higher is the probability of sampling

higher euglossine richness.

Some species of *Eufriesea* are highly seasonal, being active for only one or two months in the year (Dressler 1982). In this study, because the collections occurred during the period of greatest activity of the genus in the region (Oliveira and Campos 1999), three species of *Eufriesea* were collected: *Eufriesea pulchra*, *Eufriesea superba*, *Eufriesea surinamensis*. Storck-Tonon et al. (2009) collected only five species of the genus during 10 collection months.

The results obtained in this study were compared with those of other studies in the Brazilian Amazon for the abundance and richness of bees. This study has a high diversity and low dominance compared with other studies conducted in the region (Table 2).

Therefore, further studies in the Lago do Silêncio area, with a larger sampling effort, distributed throughout the dry and rainy seasons may reveal the presence of additional species, better contributing to the knowledge of the orchid bees in the Amazonian region.

TABLE 2. Orchid-bee abundance and richness in different localities of Brazilian Amazonia. AM = Amazonas; AC = Acre.

REFERENCES	STATE	ABUNDANCE	RICHNESS	DIVERSITY
Braga 1976	AM	76	8	1,39
Powell and Powell 1987	AM	992	12	1,90
Becker et al. 1991	AM	290	16	1,36
Morato et al. 1992	AM	1.242	27	2,21
Morato 1994	AM	838	25	2,27
Oliveira and Campos 1995	AM	2.422	38	2,34
Nemésio and Morato 2004	AC	254	22	2,01
Storck-Tonon et al. 2009	AC	3.675	36	2,54
This study	AM	234	25	2,36

ACKNOWLEDGMENTS: We thank Dr. Marcos Silveira, coordinator of the graduate program in Ecology and Natural Resource Management of the Universidade Federal do Acre, and students who participated in the collections during the field course of 2004. We also thank Dr. Marcio L. Oliveira for species identification. Dr. Fernando Silveira and an anonymous referee made valuable comments on the first version of the manuscript. Dr. André Nemésio and Dr. Luiz Roberto Ribeiro Faria Junior provided constructive comments and important suggestions to the final version. Anne Taffin d'Heursel Baldisseri reviewed the English language.

LITERATURE CITED

Acre. 2006. *Governo do Estado do Acre. Programa Estadual de Zoneamento Ecológico Econômico Fase II: documento Síntese – Escala 1:250.000*. Rio Branco: SEMA. 356 p.

Becker, P., J.S. Moure and F.J.A. Peralta. 1991. More about Euglossine bees in Amazonian forest fragments. *Biotropica* 23(4b): 586-591.

Bezerra, C.P. and C.F. Martins. 2001. Diversidade de Euglossinae (Hymenoptera, Apidae) em dois fragmentos de Mata Atlântica localizados na região urbana de João Pessoa, Paraíba, Brasil. *Revista Brasileira de Zoologia* 18(3): 823-835.

Braga, P.I.S. 1976. Atração de abelhas polinizadoras de Orchidaceae com auxílio de iscas-odores na campina, campinarana e floresta tropical úmida da região de Manaus. *Ciência e Cultura* 28(7): 767-773.

Dressler, R.L. 1982. Biology of the orchid bees (Euglossini). *Annual Review of Ecology and Systematics* 13: 373-394.

Morato, E.F. 1994. Abundância e riqueza de machos de Euglossini (Hymenoptera: Apidae) em áreas de terra firme e áreas de derrubada, nas vizinhanças de Manaus (Brasil). *Boletim do Museu Paraense Emílio Goeldi, Série Zoologia* 10(1): 95-105.

Morato, E.F., L.A.O. Campos and J.S. Moure. 1992. Abelhas Euglossini (Hymenoptera, Apidae) coletadas na Amazônia Central. *Revista Brasileira de Entomologia* 36(4): 767-771.

Nemésio, A. 2002. Notes on the occurrence of an aberrant coloration in *Eulaema nigrita* (Hymenoptera: Apidae: Euglossina) in forest fragments in Southeastern Brazil. *Lundiana* 3(1): 75-77.

Nemésio, A. 2010. The orchid-bee fauna (Hymenoptera: Apidae) of a forest remnant in northeastern Brazil, with new geographic records and an identification key to the known species of the Atlantic Forest of northeastern Brazil. *Zootaxa* 2656: 55-66.

Nemésio, A. 2011a. The orchid-bee fauna (Hymenoptera: Apidae) of a forest remnant in southern Bahia, Brazil, with new geographic records and an identification key to the known species of the area. *Zootaxa* 2821: 47-54.

Nemésio, A. 2011b. *Euglossa marianae* sp. n. (Hymenoptera: Apidae): a new orchid bee from the Brazilian Atlantic Forest and the possible first documented local extinction of a forest-dependent orchid bee. *Zootaxa* 2892: 59-68.

Nemésio, A. and E.F. Morato. 2004. Euglossina (Hymenoptera: Apidae) of the Humaitá Reserve, Acre state, Brazilian Amazon, with comments on bait trap efficiency. *Revista de Tecnologia e Ambiente* 10(2): 71-80.

Nemésio, A. and E.F. Morato. 2005. A diversidade de abelhas Euglossina (Hymenoptera: Apidae: Apini) do estado do Acre; p. 41-51. In P.M. Drumond (ed.). *Fauna do Acre*. Rio Branco: EDUFAC.

Nemésio, A. and E.F. Morato. 2006. The orchid-bee fauna (Hymenoptera: Apidae) of Acre state (northwestern Brazil) and a re-evaluation of euglossine bait-trapping. *Lundiana* 7(1): 59-64.

Nemésio, A. and F.A. Silveira. 2007. Orchid Bee Fauna (Hymenoptera: Apidae: Euglossina) of Atlantic Forest Fragments inside an Urban Area in Southeastern Brazil. *Neotropical Entomology* 36(2): 186-191.

Neves, E.D. das and B.F. Viana. 1997. Inventário da fauna de Euglossinae (Hymenoptera, Apidae) do baixo Sul da Bahia, Brasil. *Revista Brasileira de Zoologia* 14(4): 831-837.

Neves, E.D. das and B.F. Viana. 1999. Comunidade de machos de Euglossinae (Hymenoptera, Apidae) das matas ciliares da margem esquerda do médio rio São Francisco, Bahia. *Anais da Sociedade Entomológica do Brasil*, 28(2): 201-210.

Oliveira, M.L. 1999. Sazonalidade e horário de atividade de abelhas Euglossinae (Hymenoptera, Apidae) em florestas de terra firme na Amazônia Central. *Revista Brasileira de Zoologia* 16(1): 83-90.

Oliveira, M.L. and L.A.O. Campos. 1995. Abundância, riqueza e diversidade de abelhas Euglossinae (Hymenoptera, Apidae) em florestas

- contínuas de terra firme na Amazônia Central, Brasil. *Revista Brasileira de Zoologia* 12(3): 101-118.
- Oliveira, M.L. and L.A.O. Campos. 1996. Preferência por estratos florestais e por substâncias odoríferas em abelhas Euglossinae (Hymenoptera, Apidae). *Revista Brasileira de Zoologia* 13(4): 1075-1085.
- Oliveira, M.L., S.J.R. Silva, M.C. Silva, A.C.O. Araújo, M.I.C. Albuquerque and S.F.Tavares. 2010. Abelhas de Roraima: Por que tantas espécies em tão pouco espaço?; p. 523-540. In R.I. Barbosa and V.F. Melo (ed.). *Roraima: Homem, Ambiente e Ecologia*. Boa Vista: FEMACT.
- Otero, J.T. and J.C. Sandino. 2003. Capture Rates of Male Euglossine Bees across a Human Intervention Gradient, Chocó Region, Colombia. *Biotropica* 35(4): 520-529.
- Peruquetti, R.C., L.A.O. Campos, C.D.P. Coelho, C.V.M. Abrantes and L.C.O. Lisboa. 1999. Abelhas Euglossini (Apidae) de áreas de Mata Atlântica: Abundância, riqueza e aspectos biológicos. *Revista Brasileira de Zoologia* 16(Supl.2): 101-118.
- Powell, A.H. and G.V.N. Powell. 1987. Population Dynamics of Male Euglossine Bees in Amazonian Forest Fragments. *Biotropica* 19(2): 176-179.
- Rebêlo, J.M.M. and C.A. Garófalo. 1997. Comunidades de machos de Euglossini (Hymenoptera: Apidae) em matas semidecíduas do nordeste do estado de São Paulo. *Anais da Sociedade Entomológica do Brasil* 26(2): 243-255.
- Roubik, D.W. and P.E. Hanson. 2004. *Orchid bees of tropical America Biology and field guide*. Santo Domingo de Heredia: INBio. 370 p.
- Silveira, F.A., G.A.R. Melo and E.A.B. Almeida. 2002. *Abelhas brasileiras: sistemática e identificação*. Belo Horizonte: Ministério do Meio Ambiente / Fundação Araucária. 253 p.
- Sofia, S.H. and K.M. Suzuki. 2004. Comunidades de Machos de Abelhas Euglossina (Hymenoptera: Apidae) em fragmentos Florestais no Sul do Brasil. *Neotropical Entomology*, 33(6): 693-702.
- Souza, A.K.P., M.I.M. Hernández and C.F. Martins. 2005. Riqueza, abundância e diversidade de Euglossina (Hymenoptera, Apidae) em três áreas da Reserva Biológica Guaribas, Paraíba, Brasil. *Revista Brasileira de Zoologia* 22(2): 320-325.
- Storck-Tonon, D., E.F. Morato and M.L. Oliveira. 2009. Fauna de Euglossina (Hymenoptera: Apidae) da Amazônia Sul-Occidental, Acre, Brasil. *Acta Amazonica* 39(3): 693-706.
- Williams, N.H. 1982. The biology of orchids and Euglossine bees; p. 120-171 In J. Arditti (ed.). *Orchid biology: reviews and perspectives*. Ithaca: Cornell University Press.
- Williams, N.H. and C.H. Dodson. 1972. Selective attraction of male euglossine bees to orchid floral fragrances and its importance in long-distance pollen flow. *Evolution* 26: 84-95.
- Williams, N.H. and W.M. Whitten. 1983. Orchid floral fragrances and male euglossine bees: methods and advances in the last sesquidecade. *Biology Bulletin* 164(3): 355-395.
- WWF. 2010. *Por dentro da floresta amazonica*. Electronic Database accessible at <<http://www.wwf.org.br>>. Captured on 12 May 2010.

RECEIVED: July 2011

LAST REVISED: August 2011

ACCEPTED: September 2011

PUBLISHED ONLINE: October 2011

EDITORIAL RESPONSIBILITY: Rodrigo M. Feitosa