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Notes and comments

Rapid assessment of the orchid bee fauna (Hymenoptera: Apidae: Euglossini) in the vicinity of an urban Atlantic Forest remnant in São Paulo, Brazil

*M. Cordeiro[a], A. R. S. Garraffoni[b] and A. P. Lourenço[a]**

[a]Departamento de Ciências Biológicas, Universidade Federal dos Vales do Jequitinhonha e Mucuri – UFVJM, Campus JK, Rodovia MGT 367, Km 583, 5000, Bairro Alto da Jacuba, CEP 39100-000, Diamantina, MG, Brasil

[b]Departamento de Biologia Animal, Instituto de Biologia, Universidade Estadual de Campinas – UNICAMP, Rua Monteiro Lobato, 255, Cidade Universitária, CEP 13083-862, Campinas, SP, Brasil

*e-mail: anetelourenco@gmail.com

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(With 1 figure)

Euglossini (Hymenoptera: Apidae, Apini), also known as orchid bees, are endemic to the Neotropical region (Nemésio and Rasmussem, 2011). They are well-known and widely distributed taxon in the Atlantic Forest with more than 60 species (included in four distinct genera) registered in this biome (Nemésio, 2009; Garraffoni et al., 2017). The Atlantic Rain Forest originally occupied about 15% of the Brazilian territory, but it was completely fragmented in forest remnants, and now covers 11-16% of its original area (Ribeiro et al., 2009; Joly et al., 2014). Our knowledge about orchid bee diversity in urban forest fragments is very scarce (Nemésio and Silveira, 2007; Cordeiro et al., 2013), although diverse communities of wild bees have been surprisingly found in cities around the world (Nemésio and Silveira, 2007; Burr et al., 2016). Thus, our aim in this study was a rapid assessment of the orchid bee fauna in the vicinity of an Atlantic Forest remain. The strategy of intensive sampling over a few days in the rainy season are common and has been demonstrated to be very useful to know the orchid bee fauna of an area (Nemésio, 2013a, b).

Data were collected in an urban area (22º49'40"S - 47º06'10"W; altitude 630 m), among fruit and ornamental trees, distant 200 m of the east edge of an Atlantic Forest remnant called Santa Genebra Forest (Campinas, SP), the second larger urban forest in Brazil (252 ha). It is a semideciduous forest and the regional climate is the Cfa of Köppen (humid subtropical with a hot summer). Orchid bee males were collected at a fixed site using seven bait traps as described in Viotti et al. (2013), and bottles of 0.5 L. Each trap received one of the seven baits: 1,8-cineole, eugenol, vanillin, β-ionone, benzyl acetate, methyl trans-cinnamate, and methyl salicylate; and were randomly hanged in shaded branches at about 1.5 m above the ground and distant at least 2 m from each other. The collections were done during five consecutive days (from day 6th to 10th) in February of both 2015 and 2016, from 9:00 to 17:00 h (when the bees are most active). The scents were replaced every day, and cineole three times a day. Captured bees were pinned, identified and deposited at *Coleção de Abelhas da Universidade Federal dos Vales do Jequitinhonha e Mucuri*. Taxonomic decisions were based on Moure's Bee Catalogue (Moure et al., 2012). Species accumulation curves were constructed for the data set from each sampling year separately or for both years jointly. Sampling efficiency was also evaluated by nonparametric richness estimators (Chao 1, Chao 2, Jackknife 1, Jackknife 2, and Bootstrap) available in the EstimateS 9.1.0 software (Colwell, 2006).

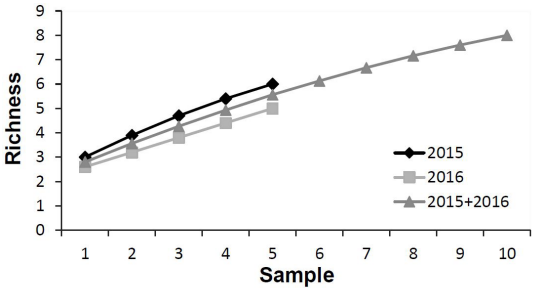
We collected a total of 480 males, belonging to three genera (*Euglossa*, *Eulaema* and *Exaerete*) and eight species (Table 1). In 2015, 331 males and six species were recorded, and in 2016, 149 males and eight species were registered. The most abundant species in both years was *Euglossa cordata* with 384 males (corresponding to 78.5% and 83.2% in 2015 and 2016, respectively), followed by *Eulaema nigrita* with 86 males (19.3% and 14.7% in 2015 and 2016, respectively) (Table 1). *Euglossa cordata* and *Eulaema nigrita* were also the two-dominant species in the Santa Genebra forest in 2008 (Cordeiro et al., 2013) and in other Atlantic Forest fragments (Aguiar and Gaglianone, 2008, 2012; Ramalho et al., 2009; Rocha-Filho and Garófalo, 2013; Oliveira et al., 2015). Both species are distributed throughout the Atlantic Forest (Garraffoni et al., 2017), and can be found in disturbed and fragmented areas as well as in open preserved areas (*e.g.*, Viana and Kleinert, 2006; Ramalho et al., 2009; Aguiar and Gaglianone, 2012).

We also recorded for the first time *Euglossa securigera* Dressler, 1982 and *Euglossa townsendi* Cockerell, 1904 in the area. These two species, together with *Euglossa frimbiata* Moure, 1968, *Euglossa pleostica* Dressler, 1982, *Euglossa truncata* Rebêlo and Moure, 1996 (collected in the present study and by Cordeiro et al., 2013) and *Euglossa annectans* (registered only by Cordeiro et al., 2013) were considered rare in this area. However, those five species have broad distribution patterns spanning nearly 20° of latitude (Nemésio, 2009; Garraffoni et al., 2017).

The species accumulation curves did not stabilize (Figure 1), and according to the estimators 60-89% of the orchid bee species were collected (estimators' value in Figure 1). Using bait traps, we registered eight species collecting over five days in two consecutive years. The remnant area was surveyed in a single day in February 2008 using

Table 1. Number of specimens and percentage of each species collected in the vicinity of an urban Atlantic Forest remnant in Campinas, São Paulo state.

Species	2015 Number (%)	2016 Number (%)	Total
Euglossa cordata (Linnaeus, 1758)	260 (78.5)	124 (83.2)	384 (80)
Euglossa fimbriata Moure, 1968	3 (0.9)	0	3 (0.6)
Euglossa pleosticta Dressler, 1982	1 (0.3)	0	1 (0.2)
Euglossa securigera Dressler, 1982	1 (0.3)	1 (0.7)	2 (0.4)
Euglossa townsendi Cockerell, 1904	2 (0.6)	0	2 (0.4)
Euglossa truncata Rebelo and Moure, 1996	0	1 (0.7)	1 (0.2)
Eulaema nigrita Lepeletier, 1841	64 (19.3)	22 (14.7)	86 (18)
Exaerete smaragdina (Guérin, 1844)	0	1 (0.7)	1 (0.2)
Total individuals	331	149	480
Total species	6	5	8



	Species richness accumulation ±SD				
	Chao 1	Chao 2	Jack 1	Jack 2	Bootstrap
2015+2016	9±1.81	9.8±2.63	11.6±2.4	13.38±0	9.61±0

Figure 1. Species accumulation curves and richness estimators for the orchid bees captured in 2015 and 2016 in the vicinity of an urban Atlantic Forest remnant in Campinas, São Paulo state.

traps and insect net to collect the bait attracted bees, and six species were recorded (Cordeiro et al., 2013). Usually, the use of bait traps to collect orchid bees is successful in open areas (*e.g.*, Ferreira et al., 2011; Viotti et al., 2013). However, the use of this methodology is very debated, because insect net seems to be more effective in biomes with high abundance and richness (see Nemésio and Vasconcelos, 2014). This may explain why we found orchid bee richness lower than expected.

Among the scents, cineole was the most visited scent, collecting 77% (six species) and 90% (three species) of the individuals in 2015 and 2016, respectively, followed by β-ionone (15%; 1 species), vanillin (7.5%; 1 species) and eugenol (0.5%; 1 species) in 2015 and vanillin (4.5%; 2 species), β-ionone (3.3%; 1 species), eugenol (1.3%; 1 species) and methyl salicylate (0.9%; 1 species) in 2016. Cineole (eucalyptol) is known to be one of the most attractive scents and an attractant of many species (*e.g.*, Storck-Tonon et al., 2011; Cordeiro et al., 2013; Rocha-Filho and Garófalo, 2014). Males of *Euglossa cordata* and *Eulaema nigrita* demonstrated a preference of cineol (326 and 55 individuals, respectively) as also observed in other surveys in the Atlantic Forest (Rocha-Filho and Garófalo, 2014). Cineol is an important scent to collect orchid bees and one of the most volatile compound; thus, it is essential to recharge this scent regularly during the collecting days (Nemésio, 2013a).

As the history of the fragmentation in largest urban forest remnants is far to be understand (Nemésio and Silveira, 2007), it is important to monitoring such populations to check whether these species are declining over time and to better understand the effects of habitat fragmentation on their populations.

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