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Annotated Checklist of Aphodiinae (Coleoptera: Scarabaeidae) from Rio Grande do Sul and Santa Catarina, Brazil

Pedro Giovâni da Silva

Programa de Pós-Graduação em Ecologia, Universidade Federal de Santa Catarina, e-mail: pedrogiovanidasilva@yahoo.com.br.

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Abstract. An extensive literature review was performed to determine the list of Aphodiinae species reported in Rio Grande do Sul and Santa Catarina states. A total of 35 Aphodiinae species belonging to two tribes and 12 genera have been recorded in southern Brazil. Twenty-nine species (82.8%) were recorded in Santa Catarina and 16 (45.7%) in Rio Grande do Sul. Only nine species (25.7%) were reported to occur in both states. *Ataenius* Harold, 1867 was the genus with the greatest number of species (20), followed by *Saprosites* Redtenbacher, 1858 with only three species. Other genera were represented by one or two species. New lists should be made for other Brazilian states.

Keywords: Atlantic Forest; Dung beetles; Pampa; Southern Brazil.

Lista dos Aphodiinae (Coleoptera: Scarabaeidae) do Rio Grande do Sul e Santa Catarina, Brasil

Resumo. Uma extensiva revisão da literatura foi realizada para listar as espécies de Aphodiinae dos estados de Santa Catarina e Rio Grande do Sul. Um total de 35 espécies de Aphodiinae pertencentes a duas tribos e 12 gêneros foi registrado para a região estudada. Vinte e nove espécies (82,8%) foram registradas para Santa Catarina e 16 (45,7%) para o Rio Grande do Sul. Apenas nove espécies (25,7%) foram compartilhadas por ambos os estados. *Ataenius* Harold, 1867 foi o gênero com o maior número de espécies (20), seguindo por *Saprosites* Redtenbacher, 1858 com apenas três espécies. Os outros gêneros foram representados por uma ou duas espécies. Novas listas devem ser feitas para outros estados brasileiros.

Palavras-Chave: Escarabeídeos; Mata Atlântica; Pampa; Sul do Brasil.

Growing biodiversity extinction rates are a major problem for maintenance of the environmental characteristics and conditions that allow the existence of most living organisms on Earth (Myers *et al.* 2000). The maintenance of ecological processes related to biodiversity will depend on the development of effective conservation measures (Rands *et al.* 2010). However, for many species groups there is relatively little data on taxonomy and geographical distribution, conditions called Linnean and Wallacean deficiencies, respectively (Whittaker *et al.* 2005). A better understanding of local and regional biodiversity is fundamental to achieving the goals of conservation strategies.

Among the insects, dung beetles (Coleoptera: Scarabaeidae: Aphodiinae and Scarabaeinae) perform several ecological functions, such as decomposition and burial of feces, and natural biological control of parasites developing in cattle dung (Halffter & Matthews 1966; Fincher 1975; Ridsdill-Smith & Hayles 1990; Hanski & Cambefort 1991; Aidar *et al.* 2000; Simmons & Ridsdill-Smith 2011). By building tunnels and burying feces in the ground, dung beetles contribute to the improvement of soil and pasture characteristics (Haynes & Williams 1993) and decrease of the emission of toxic gases to the atmosphere (Penttilä *et al.* 2013). These insects are highly diverse and well-distributed throughout the world.

Scarabaeinae beetles have been well studied in southern Brazil (*e.g.* Silva *et al.* 2008, 2009, 2010, 2011, 2012a, 2012b, 2013; Audino *et al.* 2011; Silva 2011; Silva & Audino 2011; Silva & Di Mare 2012; Campos & Hernández 2013; Silva & Bogoni 2014; Viegas *et al.* 2014), yet the Aphodiinae have been neglected (but see Audino *et al.* 2007), possibly because of their relationship with livestock environments and cattle feces, and their endocoprid behavior. The paucity of studies is not restricted to southern Brazil; in fact, few studies on Neotropical dung beetle communities have taken Aphodiinae into consideration (Cabrero-Sañudo & Lobo 2009). Compared to Scarabaeinae species there are relatively few species in Aphodiinae beetle communities, however they can be very abundant (*e.g.* Andresen 2002; Koller *et al.* 2007; Rodrigues *et al.* 2010, 2013) and can play important ecological roles.

Aphodiinae is one of the most diverse and widely distributed subfamilies of Scarabaeidae (Dellacasa *et al.* 2001; Cabrero-Sañudo *et al.* 2010), with more than 200 genera and 3,100 species of small size (0.8 to 16 mm in length). This taxon has endocoprid behavior and generally has coprophagous or saprophagous feeding habits, where larvae and adults can occupy different niches (Stebnicka 2001a; Smith & Skelley 2007; Cabrero-Sañudo & Lobo 2009). Aphodiinae species feed and nest on the ground in various types of feces and/or plant debris (Stebnicka 2001b). Aphodiinae is the predominant group in Palearctic and Nearctic region dung beetle communities (Hanski 1991; Lobo 2000; Cabrero-Sañudo & Lobo 2009), while Scarabaeinae predominates in Neotropical regions (Halffter & Matthews 1966). The objective of this study is to present a list of Aphodiinae species occurring in Rio Grande do Sul and Santa Catarina states in southern Brazil.

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MATERIAL AND METHODS

I performed an extensive review of recent literature, searching specifically for reviews of tribes and genera of Aphodiinae recorded in the Neotropical region, and mainly in Brazil, as highlighted by Dellacasa *et al.* (2001) and Skelley *et al.* (2007a). The list is based on extensive search of published records complemented by information from the Scientific Electronic Library Online, Google Scholar and "Portal de Periódicos CAPES". Searches were conducted using combined specific keywords such as: Aphodiinae, Aphodiidae, Rio Grande do Sul, Santa Catarina, southern Brazil, and South of Brazil (and equivalent terms in Portuguese), to find published sources with information on Aphodiinae species in southern Brazil. Reference bibliographies were also used to find additional references. The literature review was conducted between September 2013 and August 2014.

Several reviews on Aphodiinae genera in Neotropical regions were used in the literature review to compose the species list presented in this study (*e.g.* Dellacasa *et al.* 1998, 2001a, 2001b, 2002, 2003, 2004, 2007a, 2007b, 2007c, 2007d, 2008, 2009, 2010, 2011, 2012; Stebnicka 1998, 2000a, 2000b, 2001a, 2001b, 2001c, 2002a, 2002b, 2003a, 2003b, 2003c, 2003d, 2004, 2005, 2006, 2007c, 2008, 2009, 2011; Dellacasa & Dellacasa 2000a, 2000b, 2003, 2005; Dellacasa & Stebnicka 2001; Stebnicka *et al.* 2003; Stebnicka & Skelley 2005, 2009a, 2009b; Skelley 2006, 2007a, 2007b; Stebnicka & Lago 2005; Stebnicka & Galante 2007; Bordat 2009; Skelley *et al.* 2009; Rakovic & Mencl 2013). The list of tribes, subtribes, genera and species was prepared following the nomenclature described in Gordon & Skelley (2007), Skelley *et al.* (2007), Cabrero-Sañudo *et al.* (2010) and Bouchard *et al.* (2011). Published works on Coleoptera or soil insects conducted in Rio Grande do Sul and Santa Catarina including Aphodiinae species were also reviewed and included.

The species list is arranged in alphabetical order of tribes, genera and species, with indication of references in which the species were reported to occur in southern Brazil, and with known species geographical distributions (including distribution in the Rio Grande do Sul and Santa Catarina) highlighted. Additional information on species biology can be found within the references cited.

RESULTS AND DISCUSSION

A total of 35 Aphodiinae species belonging to two tribes and 12 genera were recorded for Rio Grande do Sul and Santa Catarina. Twenty-nine (82.8%) species were recorded for Santa Catarina and 16 (45.7%) for Rio Grande do Sul. Only nine species (25.7%) were shared between states. *Ataenius* Harold, 1867 was the genus with the greatest number of species (20), followed by *Saprosites* Redtenbacher, 1858 with only three species. *Aidophus* Balthasar, 1963, *Arupaia* Stebnicka, 1999, *Blackburneus* Schmidt, 1913, *Labarrus* Mulsant & Rey, 1870, *Lomanoxia* Martínez, 1951, *Parataenius* Balthasar, 1961 and *Passaliolla* Balthasar, 1945 were represented by two species each. *Auperia* Chevrolat, 1864, *Iarupea* Martínez, 1953 and *Paraplesiataenius* Chalumeau, 1992 were represented by only two species each. The genus *Ataenius* has about 300 Neotropical and Nearctic species, being one of the largest and most diverse genera of the subfamily Aphodiinae, and was revised by Stebnicka (2001c, 2002b, 2003d, 2004, 2005, 2006, 2007c) and Stebnicka & Lago (2005). *Saprosites* has about 130 species, 17 of which occur in the New World (Stebnicka 2001a).

I found no lists of Aphodiinae species for other locations or Brazilian states, and it seems that this study is the first of its kind conducted in Brazil. However, Smith & Skelley (2007) reported 27 species of Aphodiinae in southern South America, including southern regions of Argentina and Chile (including the Central Chilean, Patagonian and Subantarctic biogeographical provinces) (Morrone 2006). The larger number of species found in southern Brazil (i.e., compared to southern regions of Argentina and Chile) may be related to differences in climate and/or vegetation, or perhaps differences in Aphodiinae faunal origin due to the occurrence of distinct historical events.

In Brazil, several studies have reported Aphodiinae in Mato Grosso do Sul state (*e.g.* Flechtmann *et al.* 1995a, 1995b, 1995c; Aidar *et al.* 2000; Koller *et al.* 1999, 2007; Rodrigues *et al.* 2010, 2013; Abot *et al.* 2012), although many have not been identified to species level. In conducting this review I was able to verify that many new Aphodiinae species (and genera) have been described with material collected in Mato Grosso do Sul. This fact reinforces the need for greater sampling effort and collection of this fauna in other Brazilian states. Aphodiinae are sampled using pitfall traps baited with fresh cattle feces (Koller *et al.* 2007; Rodrigues *et al.* 2013), flight interception traps (Rodrigues *et al.* 2010), and light traps (Flechtmann *et al.* 1995a, 1995b, 1995c; Ronqui & Lopes 2006; Abot *et al.* 2012). Some Brazilian Aphodiinae can be attracted to carrion (Medri & Lopes 2001). Dissection of fecal masses is also viable option (Flechtmann *et al.* 1995a, 1995b, 1995c), depending on the objective of the study.

The next step for Aphodiinae researchers, in addition to performing new inventories of this fauna, will be to consult and update the Brazilian entomological collections, to accomodate changes in nomenclature and better describe new genera and species. This update may increase the number of Aphodiinae species on the list presented here. I invite other researchers to compile lists of Aphodiinae species from other Brazilian states or regions, as this information is fundamental to our knowledge of faunal distribution and conservation strategies that may be needed in the near future.

Checklist of Aphodiinae from Rio Grande do Sul and Santa Catarina, Brazil

Aphodiinae Leach, 1815

Aphodiini Leach, 1815

Aphodiina Leach, 1815

***Blackburneus* Schmidt, 1913**

***Blackburneus caracaensis* (Petrovitz, 1970)**

Geographical distribution: Argentina, Brazil, Paraguay. In Santa Catarina: Seara (formerly called Nova Teutônia) (Dellacasa *et al.* 2011). Brazilian biome: Atlantic Forest.

***Labarrus* Mulsant & Rey, 1870**

***Labarrus pseudolividus* (Balthasar, 1941)**

Geographical distribution: North, Central and South America, Australia, Oceania, Central and Southern Africa. In Santa Catarina: Jaraguá do Sul (Flechtmann & Rodrigues 1995). Brazilian biome: Atlantic Forest.

Didactyliina Pittino, 1985

***Aidophus* Balthasar, 1963**

***Aidophus infuscatopennis* (Schmidt, 1909)**

Geographical distribution: Argentina, Bolivia, Brazil, Paraguay, Peru, Uruguay. In Rio Grande do Sul: unknown (Dellacasa *et al.* 2001b). Brazilian biome: unknown.

Eupariini Schmidt, 1910

***Auperia* Chevrolat, 1864**

***Auperia denominata* Chevrolat, 1864**

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Geographical distribution: Americas. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2002a). Brazilian biome: Atlantic Forest.

***Auperia teutoniae* Stebnicka, 2002**

Reference: Stebnicka (2002a). Geographical distribution: Brazil. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2002a). Brazilian biome: Atlantic Forest.

***Arupaia* Stebnicka, 1999**

***Arupaia friedenreichi* (Harold, 1870)**

Geographical distribution: Brazil. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 1999b). Brazilian biome: Atlantic Forest.

***Ataenius* Harold, 1867**

***Ataenius blapoides* Balthasar, 1947**

Geographical distribution: South America. In Rio Grande do Sul: Canela (Parque do Caracol) (Stebnicka 2001c). Brazilian biome: Atlantic Forest.

***Ataenius canoasus* Stebnicka, 2007**

Geographical distribution: South America. In Rio Grande do Sul: Capão da Canoa (Stebnicka 2007c). Brazilian biome: Atlantic Forest.

***Ataenius catarinaensis* Stebnicka, 2007**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2007c; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest.

***Ataenius clitellarius* Petrovitz, 1973**

Geographical distribution: Central South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2005, 2007b; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest.

***Ataenius columbicus* Harold, 1880**

Geographical distribution: South America. In Rio Grande do Sul: Pelotas. In Santa Catarina: Águas Mornas (formerly called Theresópolis), Seara (formerly called Nova Teutônia) (Stebnicka 2004; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest and Pampa.

***Ataenius crenulatus* Schmidt, 1910**

Geographical distribution: Central and South America, West Indies. In Rio Grande do Sul: Pelotas. In Santa Catarina: Seara (formerly called Nova Teutônia) (Galante *et al.* 2003; Stebnicka 2006, 2007b). Brazilian biome: Atlantic Forest and Pampa.

***Ataenius forsteri* Balthasar, 1960**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2006). Brazilian biome: Atlantic Forest.

***Ataenius impiger* Schmidt, 1916**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka & Lago 2005). Brazilian biome: Atlantic Forest.

***Ataenius lenkoi* Petrovitz, 1973**

Geographical distribution: Brazil. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2005; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest.

***Ataenius londrinae* Stebnicka, 2007**

Geographical distribution: South America. In Rio Grande do Sul: [Rio] Pardinho, [Barra do] Rio Azul. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2007c; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest.

***Ataenius longiclavus* Petrovitz, 1970**

Geographical distribution: Brazil. In Rio Grande do Sul: Porto Alegre (Stebnicka 2005). Brazilian biome: Pampa.

***Ataenius opatrinus* Harold, 1867**

Geographical distribution: Central and South America. In Rio Grande do Sul: Porto Alegre. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2001c). Brazilian biome: Atlantic Forest and Pampa.

***Ataenius picinus* Harold, 1868**

Geographical distribution: Americas. In Rio Grande do Sul: Cachoeira [do Sul]. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2004). Brazilian biome: Atlantic Forest and Pampa.

***Ataenius platensis* (Blanchard, 1846)**

Geographical distribution: Americas, West Indies. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2005). Brazilian biome: Atlantic Forest.

***Ataenius plaumanni* Petrovitz, 1973**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2005; Favretto *et al.* 2013). Brazilian biome: Atlantic Forest.

***Ataenius purator* Harold, 1868**

Geographical distribution: South America. In Rio Grande do Sul: Pelotas (Stebnicka 1998; Stebnicka & Lago 2005). Brazilian biome: Pampa.

***Ataenius schmidti* Stebnicka, 2003**

Geographical distribution: South America. In Rio Grande do Sul: unknown (Stebnicka 2003d). Brazilian biome: unknown.

***Ataenius sculptilis* Harold, 1868**

Geographical distribution: South America, West Indies. In Santa Catarina: Guaramirim, Jaraguá do Sul (Stebnicka 2006). Brazilian biome: Atlantic Forest.

***Ataenius stercorator* (Fabricius, 1775)**

Geographical distribution: South America. In Rio Grande do Sul: Pelotas, Porto Alegre. In Santa Catarina: Guaramirim (Stebnicka 2003d). Brazilian biome: Atlantic Forest and Pampa.

***Ataenius strigicaudus* Bates, 1887**

Geographical distribution: Central and South America, West Indies. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2004). Brazilian biome: Atlantic Forest.

***Iarupea* Martínez, 1953**

***Iarupea attenuata* (Harold, 1870)**

Geographical distribution: Brazil. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2007a). Brazilian biome: Atlantic Forest.

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***Iarupea serratipennis* (Petrovitz, 1973)**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 1999, 2007a). Brazilian biome: Atlantic Forest.

***Lomanoxia* Martínez, 1951**

***Lomanoxia costulata* (Harold, 1867)**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 1999a). Brazilian biome: Atlantic Forest.

***Paraplesiataenius* Chalumeau, 1992**

***Paraplesiataenius catarinaensis* Stebnicka, 2003**

Geographical distribution: Brazil. In Rio Grande do Sul: Porto Alegre. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2003b). Brazilian biome: Atlantic Forest and Pampa.

***Paraplesiataenius genieri* Stebnicka, 2003**

Geographical distribution: Brazil. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2003b). Brazilian biome: Atlantic Forest.

***Parataenius* Balthasar, 1961**

***Parataenius simulator* (Harold, 1868)**

Geographical distribution: Neotropical Region, southeastern United States; introduced to Australia, New Zealand, Africa and Europe (Portugal). In Rio Grande do Sul: Capão da Canoa, Pelotas (Stebnicka & Skelley 2009). Brazilian biome: Atlantic Forest and Pampa.

***Passaliolla* Balthasar, 1945**

***Passaliolla eugastrica* (Harold, 1869)**

Geographical distribution: South America. In Santa Catarina: Seara (formerly called Nova Teutônia) (Stebnicka 2000b). Brazilian biome: Atlantic Forest.

***Saprosites* Redtenbacher, 1858**

***Saprosites breviusculus* Harold, 1867**

Geographical distribution: South America. In Rio Grande do Sul: Porto Alegre. In Santa Catarina: Seara (formerly called Nova Teutônia). (Stebnicka 2001a). Brazilian biome: Atlantic Forest and Pampa.

***Saprosites dentipes* Harold, 1867**

Geographical distribution: South America. In Rio Grande do Sul: Porto Alegre. In Santa Catarina: Jaraguá do Sul, Seara (formerly called Nova Teutônia) (Stebnicka 2001a). Brazilian biome: Atlantic Forest and Pampa.

***Saprosites puncticollis* Harold, 1867**

Geographical distribution: Brazil. In Santa Catarina: Águas Mornas (formerly called Theresópolis) (Stebnicka 2001a). Brazilian biome: Atlantic Forest.

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