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Taxonomic revision of the *Dichotomius speciosus* (Waterhouse, 1891) species group (Coleoptera: Scarabaeidae: Scarabaeinae)

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Abstract

The *Dichotomius speciosus* species group, endemic to the highlands of the Brazilian Atlantic Forest and included in the subgenus *Luederwaldtinia* is taxonomically revised. *Dichotomius alvarengai* **new species** and *D. malyi* **new species** are described. *Dichotomius bucki* is here considered to be a **new synonym** of *D. opalescens*, for which a **lectotype is designated**. The group, as well as its species, is diagnosed. A taxonomic key, illustrations and discussions on systematics and conservation of the group are provided.

Key words: Atlantic forest, highlands, dung beetles, new species, Dichotomiini

Resumo

O grupo de espécies de *Dichotomius speciosus,* endêmico de áreas altas da Floresta Atlântica Brasileira e inserido no subgênero *Luederwaldtinia* é revisado taxonomicamente. *Dichotomius alvarengai* **nova espécie** e *D. malyi* **nova espécie** são descritos. *D. bucki* é aqui considerado como **novo sinônimo** de *D. opalescens*, para o qual um **lectótipo é designado.** O grupo, assim como suas espécies, são diagnosticados. Uma chave taxonômica, ilustrações e discussões em sistemática e conservação do grupo são apresentadas.

Introduction

Beetles of the family Scarabaeidae are copro-necrophagous and play an important role in nutrient cycling because they bury dung and carcasses, thus promoting several ecosystem functions (Halffter & Matthews 1966, Nichols *et al*. 2008). The subfamily Scarabaeinae, commonly known as dung beetles, is mainly distributed in all tropical and subtropical landmasses of the world (Davis & Scholtz 2001). Since the 1990's, this *taxon* has been a focus of ecological and conservation research (Halffter & Favilla 1993; Spector 2006; Nichols *et al.* 2008; Culot *et al*. 2013).

Dichotomius (Hope, 1838) is one of many Scarabaeinae genera exclusive to the Americas (Vaz-de-Mello *et al.* 2011). The more than 150 species of the genus are present in almost all neotropical terrestrial habitats, sometimes in great abundance (Louzada & Carvalho e Silva 2009) or with extremely restricted distributions (Nunes & Vaz-de-Mello 2013), and even in danger of extinction (Vieira *et al*. 2011). The genus is divided in four subgenera (Martínez 1951): *Dichotomius s. str., Homocanthonides, Selenocopris,* and *Luederwaldtinia.*

The subgenus *Luederwaldtinia* includes more than 60 species divided into thirteen species groups by their morphological affinities and geographical distributions, each named after the oldest described species

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(Luederwaldt 1929; Nunes & Vaz-de-Mello 2013). Some of these groups are widely distributed and speciose—with more than ten species each (*e.g.: inachus, batesi* and *crinicollis* groups). Others, like the *assifer* and *speciosus* species groups are restricted mainly to the Brazilian Atlantic Forest and have fewer species. Although some of these groups appear to be natural (monophyletic), these divisions serve mainly for operational purpose to the ongoing extensive taxonomic revision of *Luederwaldtinia* (Nunes & Vaz-de-Mello 2013).

The *speciosus* species group was first recognized by Luederwaldt in 1929 (p. 104–105) and revised by Pereira (1953), who assigned three species to it: *Dichotomius speciosus* (Waterhouse, 1891), *D. opalescens* (Felsche, 1910), and *D. bucki* (Pereira, 1953). Since then, nothing taxonomic or ecological concerning *Dichotomius specious* and its related species has been published, except for their mention in the Brazilian list of Scarabaeinae (Vaz-de-Mello 2000) and the positioning of the group in a taxonomic key for the species-groups of *Luederwaldtinia* (Nunes & Vaz-de-Mello 2013).

The problems in dealing with the exceptional color and morphological variation of *Dichotomius speciosus* and *D. opalescens*, the impossibility to diagnose some specimens from the works of Luederwaldt (1929) and Pereira (1953), and the interesting and restricted distribution patterns of the species led us to start a taxonomic revision of the *Dichotomius (L.) speciosus* species group. Additionally, we investigated some aspects of the biological conservation of these rare species. They are found only in forest habitat above 1,000 meters altitude in the Brazilian Atlantic Forest, which supports only 8-14% of its original habitat (Myers *et al*. 2000, Ribeiro *et al.* 2009).

In this work, our aims were: 1) to revise taxonomically the *Dichotomius speciosus* species group; 2) to discuss biogeographical concerns in the group, and 3) to provide conservation information concerning its species.

Material and methods

We examined specimens belonging to the following collections (curators in parenthesis):

CEMT	Setor de Entomologia da Coleção Zoológica da Universidade Federal de Mato Grosso, Departamento de Biologia e Zoologia, Cuiabá, Mato Grosso, Brazil (Fernando Vaz-de-Mello).
DZUP	Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná Brazil (Lúcia M. Almeida and Paschoal Grossi).
IRSN	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (Alain Drumont)
MZSP	Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (Carlos Campaner and Sonia Casari).
NHML	The Natural History Museum, London, United Kingdom (Max Barclay and Malcolm Kerley).
SMTD	Staatliches Museum für Tierkunde, Dresden, Germany (Olaf Jaeger and Klaus Klass)
VMPC	Vladislav Malý Personal Collection, Prague, Czech Republic (Vladislav Malý).

The terminology of the structures used here follows Vaz-de-Mello *et al.* (2011) and Nunes & Vaz-de-Mello (2013). Conservation status was evaluated according to the IUCN red list criteria (IUCN 2015).

Results and discussion

Diagnosis of the *Dichotomius speciosus* species group

"Secção Speciosus"; Luederwaldt 1929: 105
"Secção speciosus"; Pereira 1953: 293
"Dichotomius speciosus species group"; Nunes & Vaz-de-Mello 2013: 418

The *Dichotomius speciosus* species group is included in the subgenus *Luederwaldtinia* due to the presence of the following combination of characters: two distinct clypeal teeth separated by an emargination; head margin rounded and lacking angulation at the clypeo-genal junction; metasternal setae abundant laterally and along the margins of the anterior lobe, and female 6th abdominal sternite/ventrite not shortened medially, lacking tubercles or carinas (Luederwaldt 1929, Vaz-de-Mello *et al.* 2011, Nunes & Vaz-de-Mello 2013).

Within the subgenus, the *speciosus* species group is here diagnosed by the combination of the following characters: blue, red, brown or green body surface with red, gold, green or blue sheen (Figs. 1–6) ; male fore calcar strongly curved downward and falciform at apex (Fig. 1B, 1C); metatibial apex acute, not bifurcated; sides and margins of anterior portions of metasternum, mesepisterna, and femoral borders bearing dense black setae (Fig. 1A); abdominal ventrites with setae restricted to the sides (Fig. 1A). Contrary to Luederwaldt (1929), Pereira (1953), and Nunes & Vaz-de-Mello (2013), we do not consider the cephalic carina of males as a diagnostic character of the group because *D. malyi,* described here, lacks it.

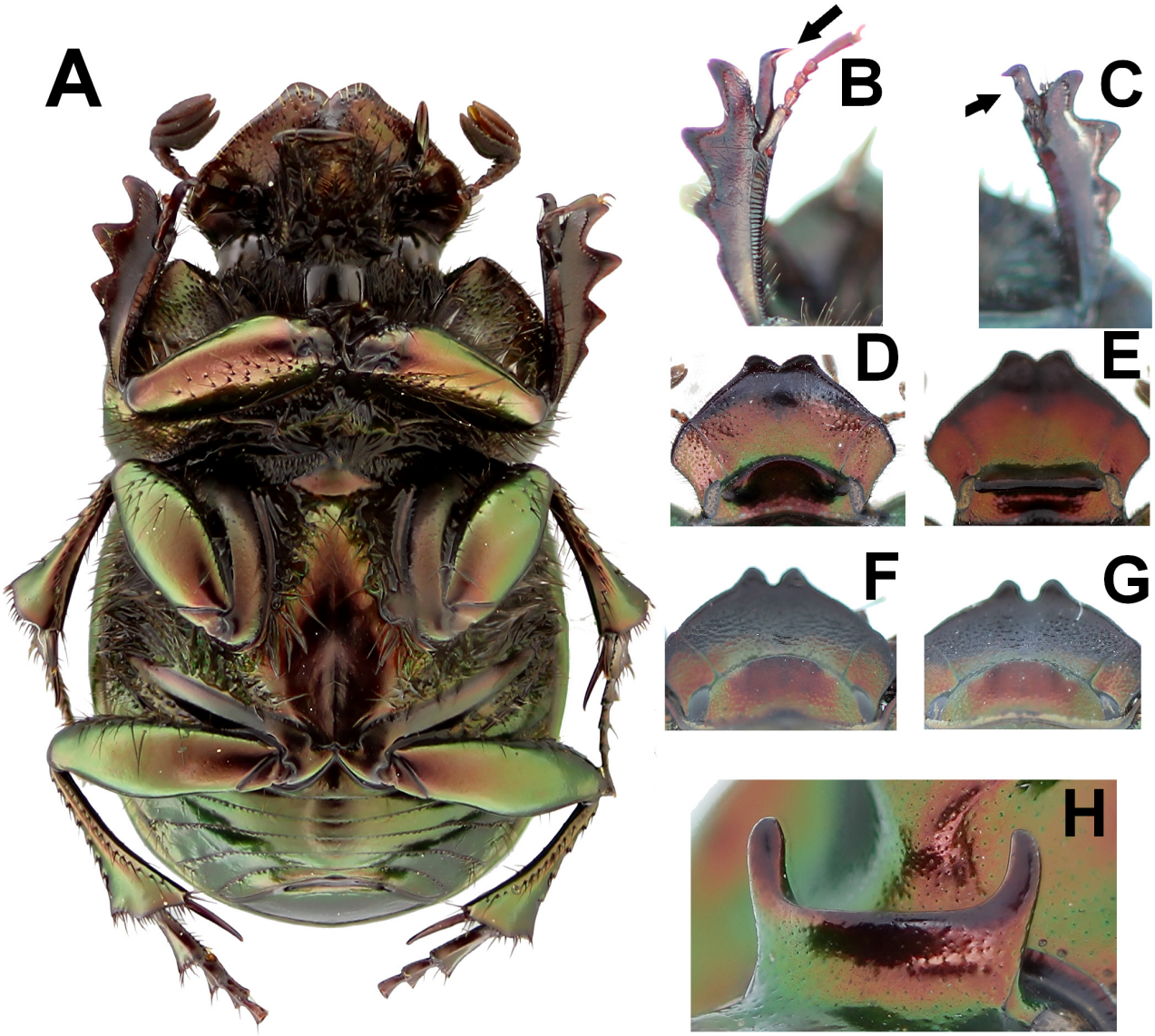

FIGURE 1. Diagnostic characters of the *Dichotomius speciosus* species group. **(A)** Ventral view of a male *Dichotomius speciosus* (Waterhouse) from Campos do Jordão—SP. **(B)** Anterior falciform calcar of a male *Dichotomius speciosus*. **(C)** Anterior falciform calcar of a male *Dichotomius malyi* **n. sp. (D)** Curved cephalic carina of a male *D. speciosus*. **(E)** Straight cephalic carina of a male *D. speciosus*. **(F)** Curved cephalic carina of a female *D. speciosus*. **(G)** Straight cephalic carina of a female *D. speciosus.* **(H)** Frontal view of the cephalic carina of a male *D. speciosus.*

Identification key to members of the *Dichotomius speciosus* group

The following key allows the identification of the four species currently included in the *speciosus* species group. Identification of females can be confusing if no males or localities are associated with them (*e.g.*: green females of *D. speciosus* and females of *D. alvarengai*, Figs. 4, 6). When not specified, the characteristics fit both males and females.

1 Head bearing a single central ill-defined tumosity or knob; pronotum simply convex, lacking projections, horns, declivities or knobs. Pronotal disc covered with ocellated coarse punctures. Dark blue (Fig. 5A, B). Unspecified locality, São Paulo, Brazil . . . . ***Dichotomius (L.) malyi*** **new species** (Fig. 5)

\- Head bearing a transverse carina, more developed on males; male pronotum with a central bilobed projection. Pronotal disc bearing fine punctures. Dorsal surface with blue, green, red or brown colors and reflections (Figs. 2–4, 6). Above 1000 meters at the Mantiqueira (SP, RJ, MG), Bocaina (SP), and Serra Geral mountain ranges (RS, SC) (Fig. 7 B,C) 2

2 Male pronotum bearing a central triangular projection (Fig. 2A). Male pronotum strongly excavated at the anterior declivity (best seen in latero-frontal view). Cephalic carina straight to broadly curved (Fig. 1D–G), with one horn at each end (Fig. 1H). Body surface red or with red reflections (may be very weak on the green specimens) (Figs. 1–2, 6). Serra da Mantiqueira mountain range: São Paulo (Campos do Jordão), Minas Gerais (Aiuruoca), and Rio de Janeiro (Itatiaia), Brazil (Fig.7) . . . . ***Dichotomius speciosus*** **(Waterhouse, 1891)** (Figs. 1–2, 6)

\- Pronotum of males bearing a central rectangular or rounded lobed projection (Figs. 3A, 4A). Pronotal projection weakly bifurcated longitudinally and bearing a pair of tubercles (Figs 3A, 4A). Anterior portion of male pronotum weakly excavated, excavation restricted to beneath the central lobe. Cephalic carina straight, with one tubercle on each end. Body surface blue or with blue reflections (Figs. 3–4,6). Serra da Bocaina and Serra Geral Mountain ranges, Brazil (Fig.7A). 3

3 Male pronotum bearing a longitudinal sulcus producing a pair of tubercles. Cephalic carina with one acute tubercle at each end. Elytral striae feebly marked, with very fine punctures. Dark blue—some individuals with light brown elytra. Serra Geral mountain range (states of Santa Catarina and Rio Grande do Sul), Brazil (Fig. 7C) . . . . ***Dichotomius (L.) opalescens*** **(Felsche, 1910)** (Fig. 3)

\- Male pronotum with a weak longitudinal sulcus producing two weak knobs. Male cephalic carina bearing a tubercle on each end, while female cephalic carina lacks them. Elytral striae deeply impressed, bearing well defined punctures. Green to blue. Restricted to the Serra da Bocaina Mountain Range, state of São Paulo, Brazil (Fig. 7B) . . . . ***Dichotomius (L.) alvarengai*** **new species** (Fig. 4)

Taxonomy

Dichotomius (Luederwaldtinia) speciosus (Waterhouse, 1891)
(Fig. 2)

Pinotus speciosus Waterhouse 1891: 362 (description); Felsche 1901: 145; Felsche 1910: 342; Gillet 1911: 63; Blackwelder 1944: 208 (citations);
Pinotus (Selenocopris) speciosus Luederwaldt 1929: 105;
Pinotus (*Selenocopris) opalescens* Luederwaldt, 1929: 106 (misidentification);
Dichotomius (*Luederwaldtinia*) *speciosus* Pereira 1953: 293–298 (redescription); Vaz-de-Mello 2000: 193; Nunes & Vaz-de-Mello 2013: 417 (citations);
Dichotomius (Luederwaldtinia) opalescens Pereira 1953: 298 (misidentification);

Specimens studied. Type: Holotype: *Copris speciosa*. mihi Waterh. L. in Brasilia Lacordaire (handwritten green label) / Type (round red bordered label)/ 367 / 6745 [NHML].

Non-type material. BRASIL: **Minas Gerais:** Aiuruoca. 1700m. X.1993. A. Machado [8♂ 6♀ CEMT]; **Rio de Janeiro:** Itatiaia. III.1995. C. Godinho Jr. [2♂ ♀ CEMT]; ♀ same data but XII.1991 [CEMT]; **São Paulo:** Campos do Jordão. hum. faec. 26.XII.1998. Lincoln P. Almeida [7♂ 3♀ CEMT]; same locality but 06.II-1999. E. A. Pereira [5♂, 5♀ CEMT]; same locality, 1780m. 23.XII.1998. G. P. Almeida Neto [♂ ♀ CEMT]; same data but 1800m, XII.2003 [3♂ 3♀ CEMT]; same data, but 1780m. 20.XII.1998 [6♂ 2♀ CEMT]; same data, but I.2004 [6♂ 22♀ CEMT]; same data, but X.2002 [5♂ ♀ CEMT]; same locality but 16.XI.1984 [1♂ 3♀ CEMT].

Diagnosis. Within its species group, *D. speciosus* is separated by the following combination of characters: body surface green to red, always bearing red reflections (Fig. 1–2, 6); male cephalic carina bearing one horn at each end (Fig. 1H); male pronotum strongly excavated bearing a central triangular lobed projection (Fig. 2A).

Remarks. Luederwaldt (1929) considered that males of *P. speciosus* with a straight cephalic carina (Fig. 1E) should be classified as *P. opalescens* Felsche, citing both species from same or nearby localities. This was followed by Pereira (1953), who argued that these species might be synonymous. There is a comprehensive redescription of this species in Pereira (1953), including descriptions of the male genitalia and mouth parts. Therefore, we consider that a new redescription is not necessary as the species is diagnosed and included in the key herein. One should consider that *Dichotomius speciosus* may have a straight (Fig. 1E, 1G) or an arcuate (Fig. 1D, 1F) carina. The characteristics that Luederwaldt (1929) and Pereira (1953) used to recognize *Dichotomius opalescens* must be considered as morphological variations of *D. speciosus*. We based our diagnosis on the intraspecific variation because it occurs in males and females at all localities and without a specific association with color or any other

morphological trait. Among our studied material, some individuals are almost entirely red or green, but they conserve other invariant characteristics of this species, including the form of the male paramera (Fig. 2C–D).

Distribution and conservation. Highlands of the Mantiqueira mountain range, around the triple border of the states of Minas Gerais, São Paulo, and Rio de Janeiro (Fig. 7B).

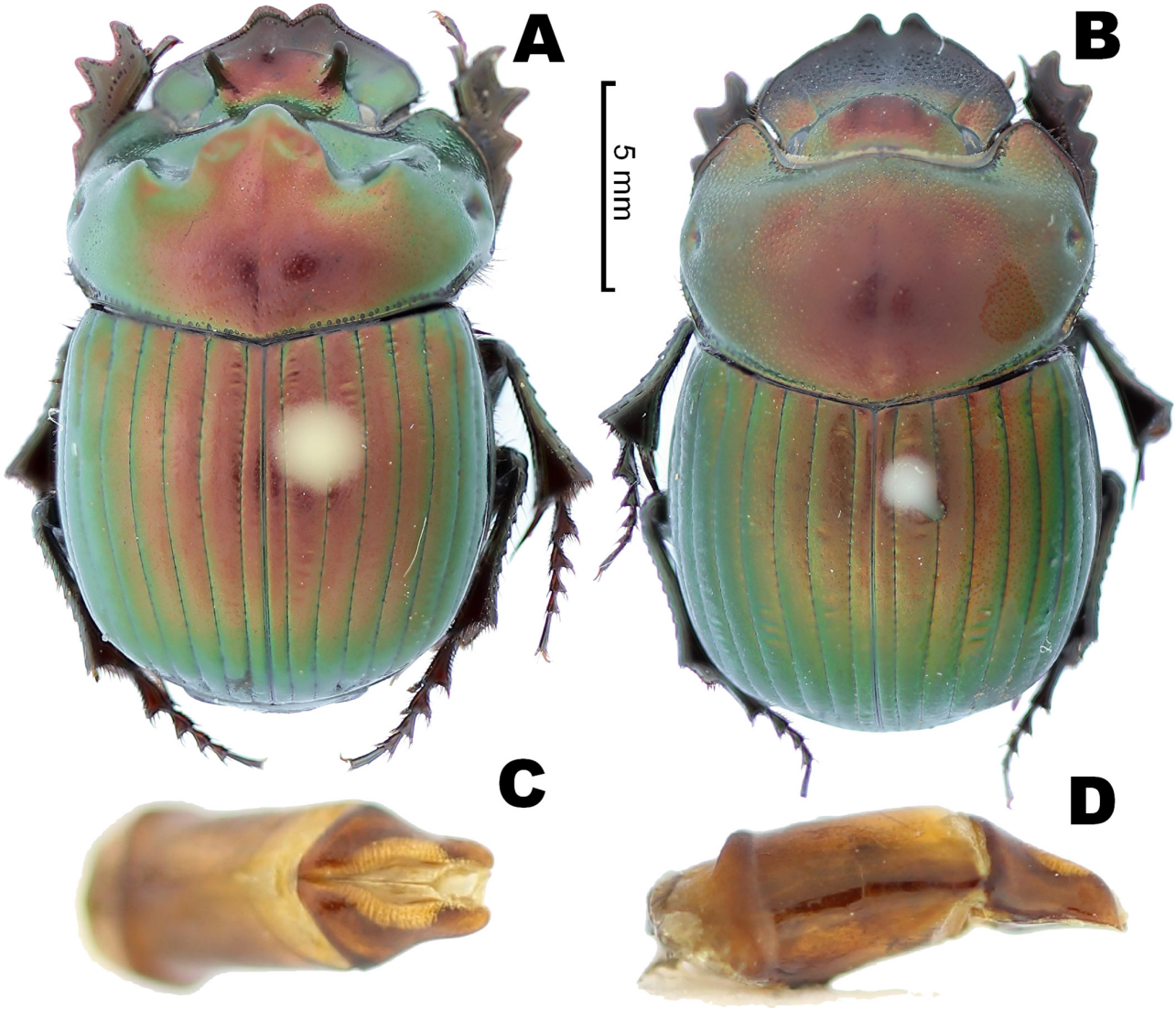

FIGURE 2. (A) dorsal habitus of a male *Dichotomius speciosus* (Waterhouse). **(B)** Dorsal habitus of a female *D. speciosus*. **(C)** Ventral view of a male paramera. **(D)** Lateral view of a male paramera.

Dichotomius (Luederwaldtinia) opalescens (Felsche, 1910)

(Fig. 3)

Pinotus speciosus Waterhouse pro part: Felsche 1901: 145 (misidentification);
Pinotus opalescens Felsche 1910: 342 (original description); Gillet 1911: 61 (catalog); Blackwelder 1944: 207 (checklist);
Dichotomius (Luederwaldtinia) bucki Pereira 1953: 290–293 (original description); Vaz-de-Mello 2000: 193 (checklist); **new synonym**;
Dichotomius (Luederwaldtinia) opalescens; Vaz-de-Mello 2000: 193 (citation)

Specimens studied. Types: of *P. opalescens*: **Lectotype here designated:** ♂ Coll. Nonfried. BRASILIA / Typus / Coll. C. Felsche Kauf 20, 1918 / opalescens Felsche Brasilien [SMTD]. **Paralectotypes:** 3 ♂ 1 ♀: same as lectotype but without identification label (♂1, ♂2 and ♀); Brasilien St. Catharina (♂3). See remarks below.

Of *D. bucki*: **Holotype:** S. F. Paula 1.35 / HOLÓTIPO / *Dichotomius* ♂ *bucki* sp. n. P. Pereira det.953 [MZSP]. **Allotype and paratypes**: same locality (20 specimens MZSP; 1♂ 1 ♀ NHML; 1♂ 1 ♀ IRSN).

Non-type material. BRASIL: **Rio Grande do Sul**: São Francisco de Paula. FLONA, floresta ombrófila mista. Hum. faec. 13.I.2008. L. Audino [6♂ 8♀ CEMT]; same locality but FLONA, eucalipto. 13.I.2008 [♂ ♀ CEMT]; same locality but FLONA, PROMATA. 10–13.XII.2009. P. C. Grossi [♀ CEMT]; Taimbezinho. Parque Nacional dos Aparados da Serra. II.1960 [♀ CEMT]; Cambará do Sul. 06.I.1985 [♂ CEMT]; **Santa Catarina**: Bom Jardim da Serra. Mantiqueira. 03.I.2002. C. Arioli [13♂; 6♀ CEMT]; same locality XII.2001 [♂ 2♀ CEMT]; Urubici. P. N. São Joaquim. 16–19.III.2012. -28.1206S/-49.4943W. Grossi, Parizotto & Leivas. [♂ 3♀ CEMT].

Diagnosis. Within the group, *D. opalescens* is the only species bearing the following combination of characters: body surface blue to bluish green with some individuals having reddish brown elytra (Fig. 3A–B, 6); males cephalic carina bearing one acute tubercle at each end; male pronotum bearing a centrally projected lobe, with a longitudinal sulcus producing a pair of tubercles (Fig. 3A). This species has a detailed published description made by Pereira (1953) under *D. bucki*.

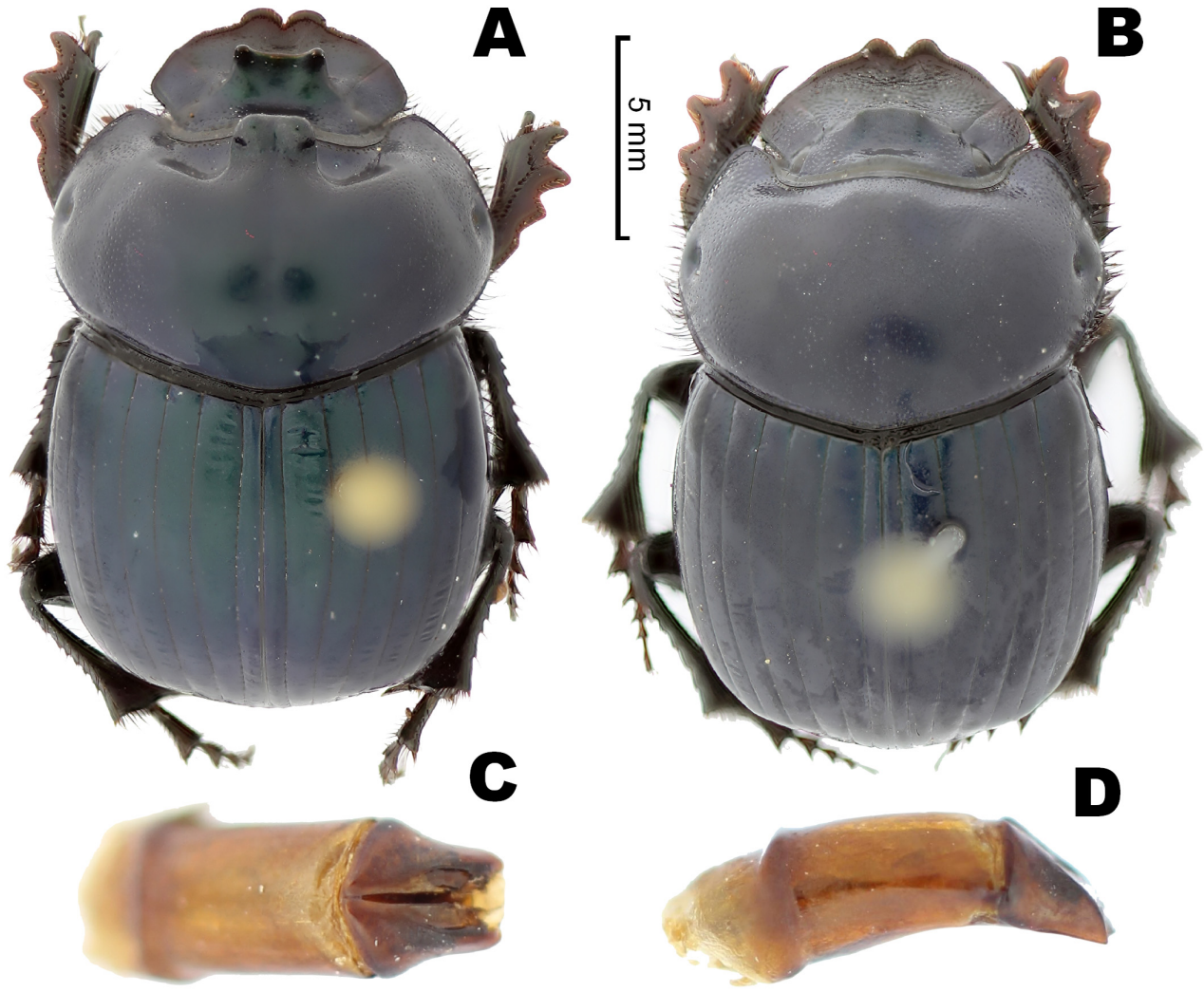

FIGURE 3. (A) dorsal habitus of a male *Dichotomius opalescens* (Felsche). **(B)** Dorsal habitus of a female *D. opalescens*. **(C)** Ventral view of a male paramera. **(D)** Lateral view of a male paramera.

Remarks. Felsche (1901) cited that his specimens of *P. speciosus* had colors different from those described by Waterhouse (1891): Those of Felsche were entirely grayish blue or blue with brown elytra (Fig. 6), and he first considered this as a color variation within *D. speciosus.* Nine years later, Felsche (1910) reinterpreted these variations considering these specimens to be the types of the new species *P. opalescens*. Pereira (1953), considered that maybe *D. speciosus* and *D. opalescens* were synonymous, because the specimens he analyzed came from the same location, and he thus described *D. bucki* as a new species. Examination of the types of *D. opalescens* allowed us to resolve the correct application of this last name, relegating *D. bucki* to synonymy. The syntype ♂1 (here

considered as paralectotype) of *P. opalescens* is in fact a specimen of *D. alvarengai* **new species.** Paralectotype ♂2 is blue with red/brown elytra, a color variation that may be characteristic of younger/teneral individuals (Fig. 6).

Distribution. Above 1000 meters in the Serra Geral mountain range, known from the south of the state of Santa Catarina and north of the state of Rio Grande do Sul, but could be present also in northern areas of Santa Catarina and Southern Paraná states (Fig. 7A, C).

***Dichotomius (Luederwaldtinia) alvarengai,* new species**
(Fig. 4)

Specimens studied. Holotype: ♂ BRASIL: **São Paulo**: São José do Barreiro. Serra da Bocaina. 1500m. 4.XI.1965. F. M. Oliveira. [DZUP]. **Paratypes:** BRASIL: **São Paulo**: São José do Barreiro. Serra da Bocaina. 1500m. 4.XI.1965. F. M. Oliveira. [17♂ 8 ♀ DZUP; 6♂ 4♀ CEMT].

Diagnosis. Within the group, *D. alvarengai* **n. sp.** is unique in having the following combination of characters: body surface green to blue; males with cephalic carina straight, bearing one tubercle at each end, pronotum bearing a centrally projected lobe which is feebly bifurcated longitudinally.

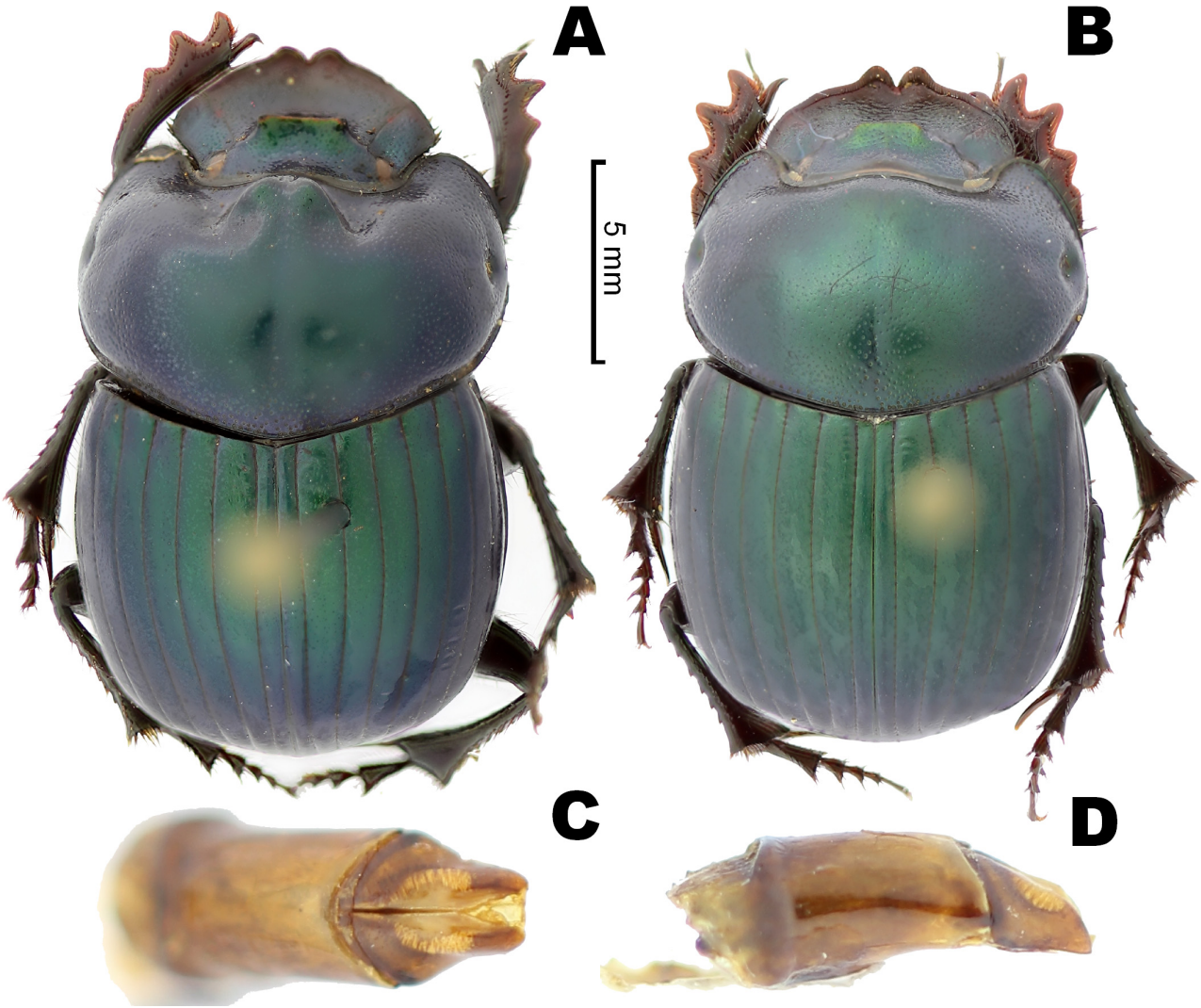

FIGURE 4. (A) dorsal habitus of a male *Dichotomius alvarengai* **n. sp. (B)** Dorsal habitus of a female *D. alvarengai* **n. sp. (C)** Ventral view of a male paramera. **(D)** Lateral view of a male paramera.

Holotype. Male: Length: 14mm. Maximum width (pronotum)**:** 9mm. Surface metallic, bluish-green. **Head:** Clypeo-genal junction rounded. Cephalic carina straight, bearing one horn on each end. Clypeal surface covered by

ocellate punctures. **Pronotum:** Bearing an anterior central lobe which is weakly bifurcated longitudinally with two weak knobs. Pronotal disc, posterior and lateral borders with ocellate punctures evenly spaced. Anterior angles rounded. **Hypomeron:** with dense lateral setae similar to that on metasternum and femora, some of setae dorsally visible. **Mesosternum:** Covered by ocellate punctures with dense setae. **Metasternum:** Bearing dense setae at the sides and near the borders of the anterior lobe. Setae the same kind and length as those found on hypomeron, femora, and mesepisternum. Mesometasternal suture distinct. **Elytra:** Striae deeply impressed and bearing ocellate punctures spaced one and a half times their diameter. Interstriae bearing fine punctures (30x). **Legs:** Ventral surface of fore femur with strong ocellate punctures all over surface. Middle and hind femora with few setose points. Anterior and posterior borders of all femora bearing dense dark brown setae, the same type as those on hypomeron and metasternum. Middle tibiae with green and blue sheen. **Abdomen:** 6th ventrite strongly shortened medially in relation to the other ventrites. setae restricted to the sides of the abdominal ventrites. Ventrites with ocellate punctures along anterior margin. **Pygidium:** As long as wide, covered by fine punctures (30x) equally spaced, with weak purple/violet sheen. **Paramera:** apex, in dorsal view rounded and slightly curved inward; in lateral view, apex with abrupt end, almost truncated (Fig. 4C, D)

Variation. Total length varying from 11 to 16 mm. Small males may have cephalic carina and pronotal central lobe reduced. Females differ from males in the following respects: **Head:** Clypeo-frontal carina lower than on males, straight and lacking tubercles at each end, sometimes almost lacking. **Pronotum:** Simply convex, lacking anterior lobed projection or strong declivities. **Legs:** Fore calcar straight, not curved downward apically. **Abdomen:** Sixth ventrite with the same medial width of the others.

Distribution. Apparently restricted to the Bocaina mountain range, known only from the type locality in São Paulo state, Brazil (Fig. 7).

Etymology. Named after Moacyr Alvarenga (1915–2010), one of the great Brazilian Coleopterists, who has six genera and more than one hundred species named after him and from whose collection the type series originally came.

***Dichotomius (Luederwaldtinia) malyi*, new species**
(Fig. 5)

Specimens studied. Holotype: ♂. BRAZIL: São Paulo, no additional locality data [CEMT]. **Paratype:** ♀, same data as holotype [VMCP].

Diagnosis. Within the group, *D. malyi* is the only species that bears a single cephalic tubercle in both sexes, lacking carinae, horns, depressions, projections or other ornaments both on head and pronotum (Fig. 5A, B). It is also the only species within the group bearing ocellate punctures on the pronotal disc, in a manner similar to that of the species assigned to the *batesi* species group (Nunes &Vaz-de-Mello 2013). To avoid misidentifications, one should consider the males fore calcar (Figs. 1B, 1C), which is falciform (simple in *batesi*) and its Atlantic Forest distribution (*batesi* species group are all Amazonic).

Holotype. Male: Length: 12mm. Width (pronotum): 6mm. Dorsal and ventral surface barely shinny, dark blue. **Head:** Clypeal surface almost entirely smooth, bearing punctures only on gena and near eyes. Cephalic process almost absent, consisting of single tubercle. Clypeo-genal junction rounded. **Pronotum:** Simply convex, lacking knobs, anterior declivity or excavations. Pronotal disc with ocellate punctures evenly spaced, mainly concentrated at the center of it, anterior angles and along posterior pronotal border. Anterior angles rounded. **Hypomeron:** With dense lateral setae, similar to that found on metasternum and femora. **Mesosternum:** Smooth, shinny, lacking setae or punctures, expanded medially. **Metasternum:** Bearing dense setae at sides and near borders of the anterior lobe. Setae similar to those on hypomeron, femora and mesepisternum. **Elytra:** Striae deeply impressed with conspicuous points. Punctures separated by their diameter. Interstriae smooth and lacking strong reflections, with very fine punctures (30x). **Legs:** Ventral surface of anterior femur with strong ocellate punctures all over its extension. Middle and hind femora with few setigerous points. Anterior and posterior borders of all femora bearing dense setae, as those on the hypomeron, metasternum and mesepisternum. Middle tibiae with green sheen. **Abdomen:** setae restricted to the sides of the abdominal ventrites, these with ocellate punctures following the anterior margin. **Pygidium:** As long as wide and lacking punctures or reflections. **Paramera**: dorsal view: with a rounded and divergent apexes. one lateral view, gradually tapering to apex, having an acute angle (Fig 5C, D).

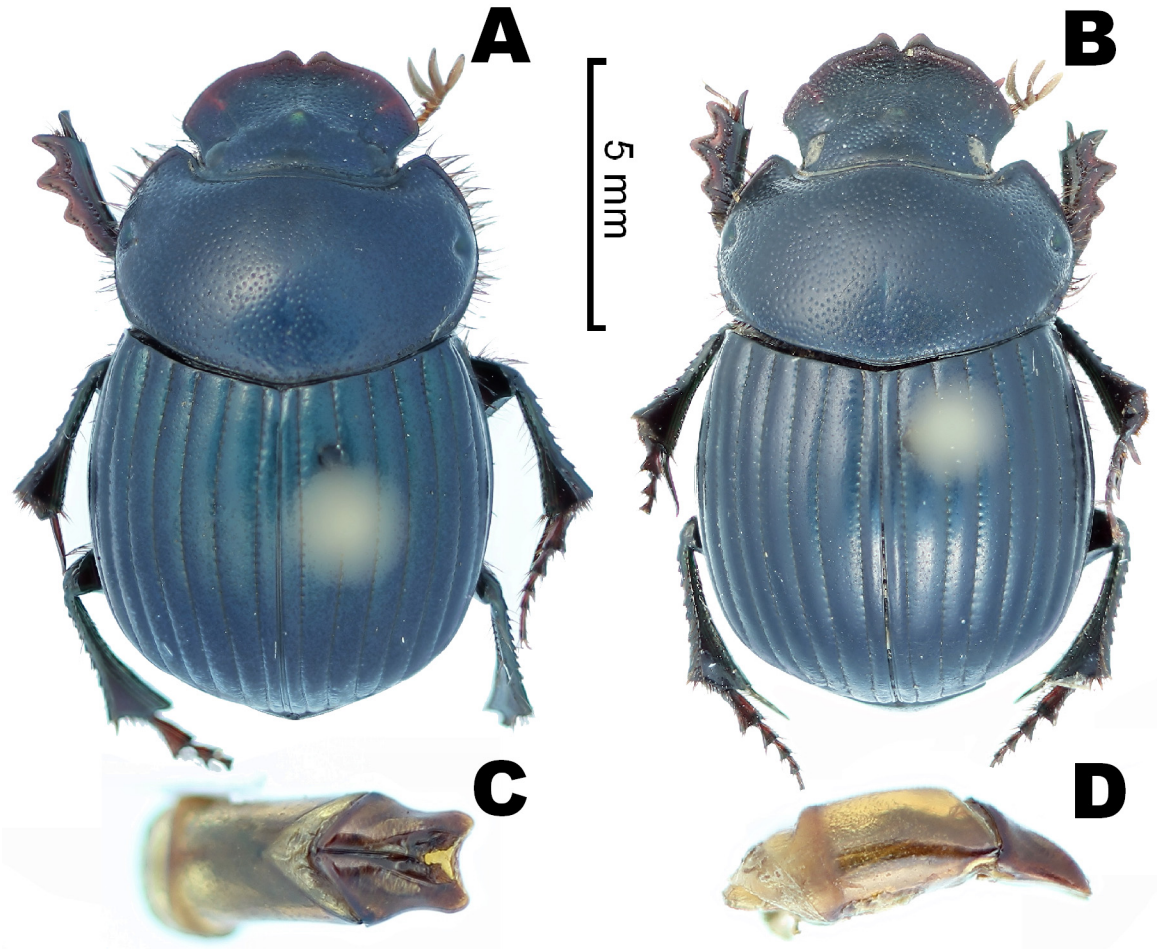

FIGURE 5. (A) dorsal habitus of a male *Dichotomius malyi* **n. sp. (B)** Dorsal habitus of a female *D. malyi* **n. sp**. **(C)** Ventral view of a male paramera. **(D)** Lateral view of a male paramera.

Variation. Female: Very similar to male. As in other species of the group, females of *D. malyi* bear a plain straight fore calcar and their 6th abdominal ventrite has the same medial width as the others.

Distribution. Unknown, probably São Paulo state, Brazil.

Etymology. Named after Vladislav Malý, Czech scarabaeoidologist, in whose collection the only known specimens have been found, and who has been so kind to donate the only known male to CEMT to be designated as the holotype.

Remarks. According to the key by Nunes & Vaz-de-Mello (2013), this species could be diagnosed as belonging to the *Dichotomius batesi* species group, because it bears a knob/tubercle on the head and its pronotal disc bears ocellate setose punctures. However, unlike the species in the *batesi* group, males of *D. malyi* bear an apically curved and falciform fore calcar, setae restricted to the sides of the abdominal ventrites and are blue on the ventral surface (some species in the *D. batesi* complex do have bluish reflections, but in that case, the integument is dark grey or black).

Distribution and conservation.

Species of the *Dichotomius speciosus* group (locality data unknown for *D. malyi*) are restricted to the highlands (above 1000 m) of the Brazilian Atlantic Forest domain. The group's geographical distribution comprises three mountain ranges: Serra da Bocaina in São Paulo state (*Dichotomius alvarengai*); Serra da Mantiqueira on the limits of Rio de Janeiro, Minas Gerais, and São Paulo states (*Dichotomius speciosus*); and Serra Geral including parts of Rio Grande do Sul, Santa Catarina, and Paraná states (*Dichotomius opalescens*) (Fig. 7). Species with known

localities are all allopatric, and their occurrence is limited by lower areas. Other Atlantic forest mountain ranges that reach similar altitudes are: the Caparaó range, on the border between Minas Gerais and Espírito Santo states; and the Serra dos Órgãos range, in Rio de Janeiro state. Both ranges (mainly Serra dos Órgãos) have been collected extensively and no specimens of the *speciosus* group have been found in either one so far. For *Dichotomius malyi*, São Paulo is given as the type locality, which may refer to the state or not, unfortunately no more information is available; and no localities named São Paulo are known in the other two mountain ranges cited for the group.

The southeastern and southern regions of Brazil have the best known dung beetle faunas in Brazil because the earliest entomological collections were done in Rio de Janeiro and São Paulo states (Vaz-de-Mello 2000) and those areas thus have a long and extensive collection history. Therefore, we have long term records available for some species of the *speciosus* group, which allows us to draw some conclusions on their conservation. The conclusions are based mainly on distributional records, because natural history data are almost nonexistent. We base our conservation *status* assessments on the extent of occurrence (B1 criteria), which is predicted by drawing a polygon using the points where the species were recorded (IUCN 2015). *D. malyi* **n. sp.** is promptly discarded from this analysis due to the lack of distributional information, thus we considered this species as Data Deficient (DD).

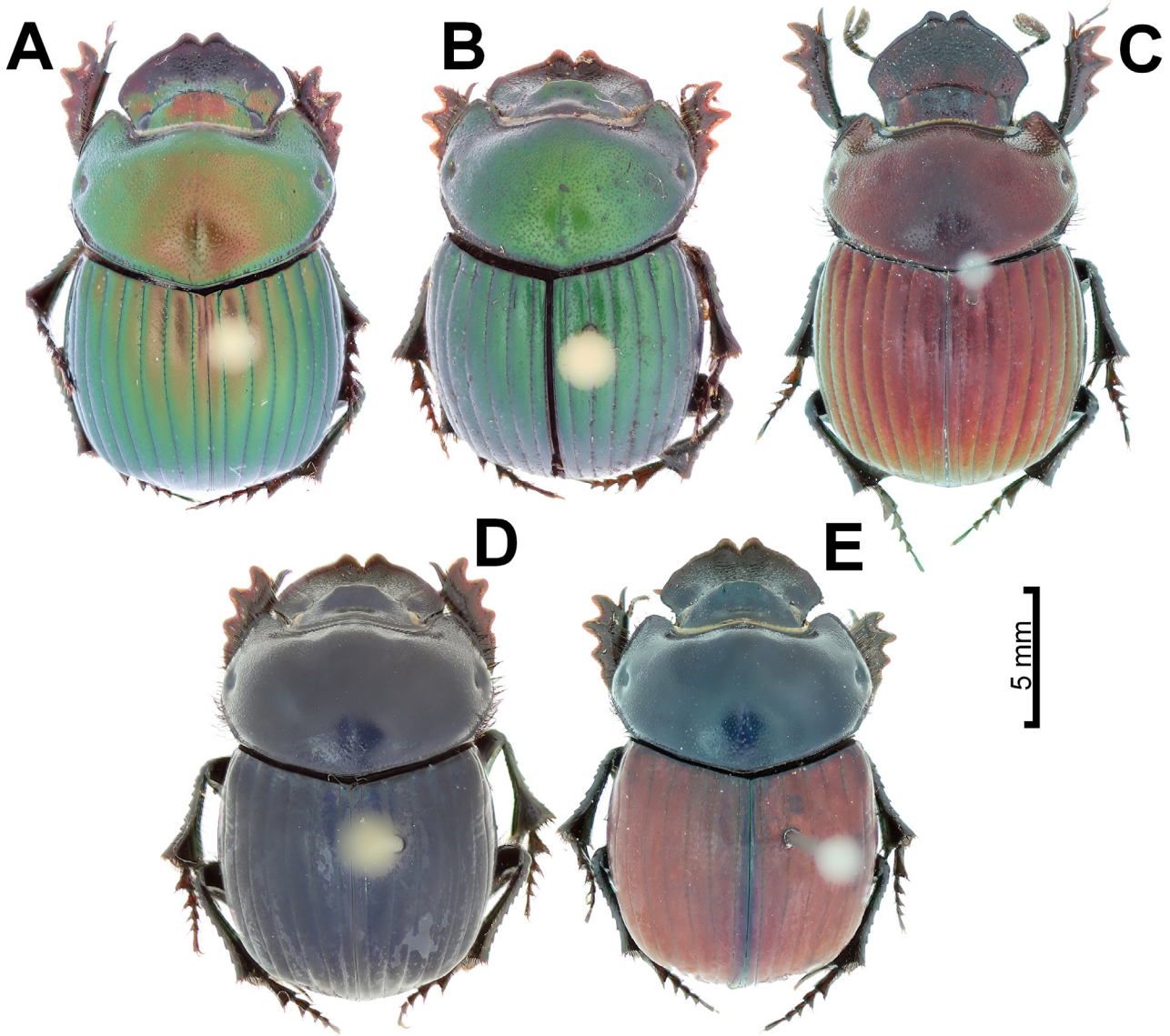

FIGURE 6. color variation of *Dichotomius speciosus* and *D. opalescens.* **(A)** green-to-red female *D. speciosus.* **(B)** green female *D. speciosus.* **(C)** red female *D. speciosus.* **(D)** dark blue female *D. opalescens*. **(E)** female *D. opalescens* with light brown elytra. All specimens of *D. speciosus* are from Campos do Jordão and all specimens of D. *opalescens* are from São Francisco de Paula.

Dichotomius alvarengai **n. sp**. can be classified as Critically Endangered (CR), criteria B1(a,b)—which means an occurrence extent (OE) of less than 100 km², its habitat is severely fragmented (Ribeiro *et al*. 2000), and there is only one locality (nl) attributed to the species (IUCN 2015). Following the same criteria, *Dichotomius speciosus* (OE= 2,398 km², nl=*4*) and *D. opalescens* (OE=1,965 km², nl=5) shall be considered as Endangered (EN), as they have more recorded localities and consequently a wider OE. These three species join a vast list of Atlantic Forest species that are in danger of extinction (IUCN 2015).

Conservation of populations of the species treated here will require the conservation of their habitats. Because there is almost no recorded natural history data for these species, alternative conservation measures such as reintroduction or *ex-situ* raising are not currently possible. Some of the higher altitude remnants of the Brazilian Atlantic Forest are protected by conservation units including Itatiaia National Park, where *Dichotomius speciosus* occurs, São Joaquim National Park, Aparados da Serra National Park, and São Francisco de Paula National Forest, where *D. opalescens* occurs. Outside of these reserves, despite protection measures, the higher areas of the Brazilian Atlantic Forest have been severely fragmented, which may have caused local extinctions (Ribeiro *et al*. 2009). We strongly hope an extant population of *D. malyi* may be found somewhere, perhaps in some unexpected region.

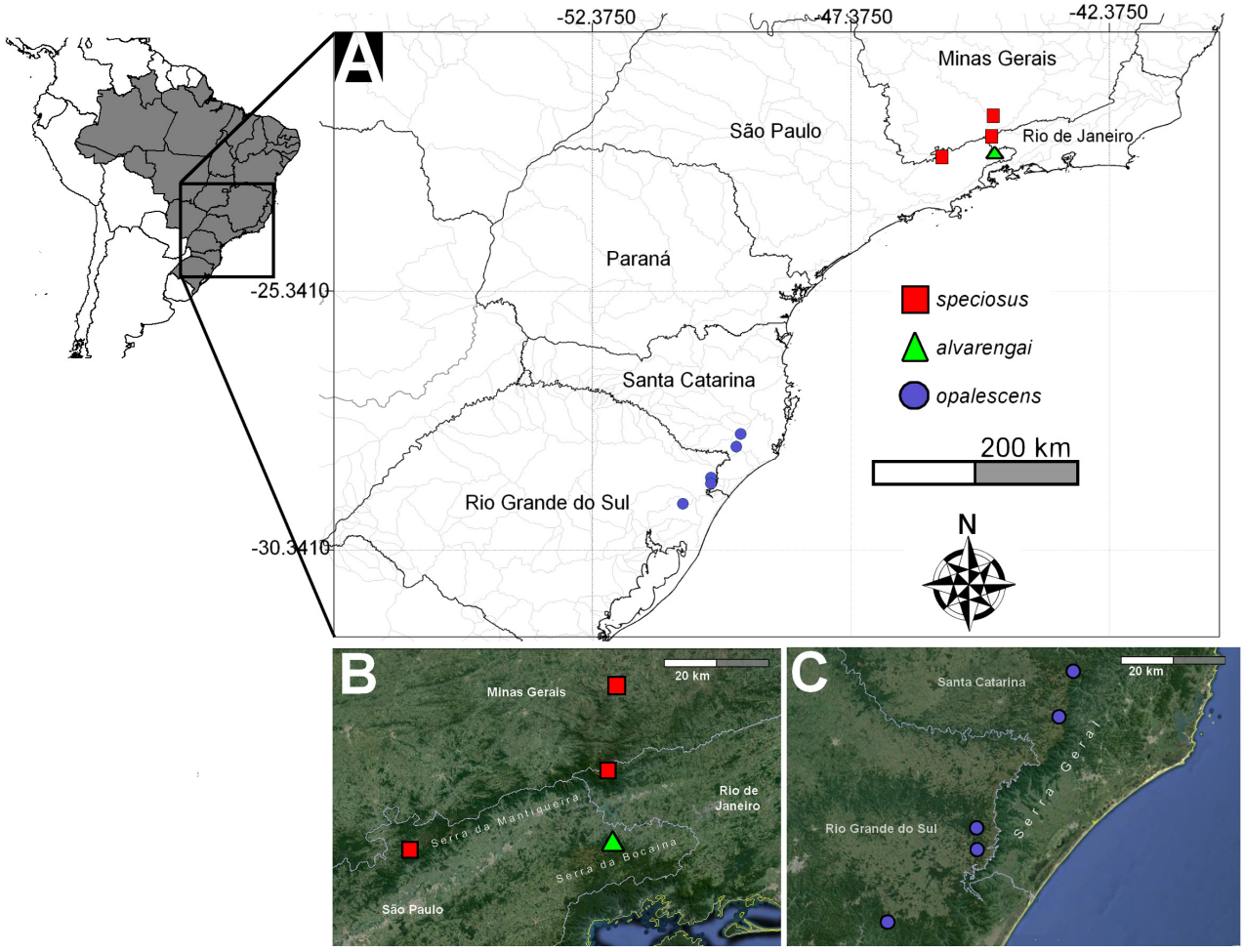

FIGURE 7. distribution map of the *Dichotomius speciosus* (Waterhouse) species group, except for *D. malyi,* with uncertain locality. **(A)** Distribution of *D. speciosus, D. opalescens* (Felsche) and *D. alvarengai* **n. sp. (B)** detailed map of the distribution of *D. speciosus* and *D. alvarengai* **n. sp.** showing Serra da Mantiqueira and Serra da Boqueira Ranges. **(C)** Detailed distribution of *D. opalescens* showing the Serra Geral range.

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