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An illustrated key to and diagnoses of the species of Staphylinidae (Coleoptera) associated with decaying carcasses in Argentina

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Abstract

A key to 24 Staphylinidae species associated with decaying carcasses in Argentina is presented, including diagnoses, illustrations, distributional and bionomical data for these species. This article provides a table of all species associated with carcasses, detailing the substrate from which they were collected and geographical distribution by province. All 24 Staphylinidae species recorded are grouped into three subfamilies: Aleocharinae (three species of *Aleochara* Gravenhorst and one species of *Atheta* Thomson), Oxytelinae (one species of *Anotylus* Thomson) and Staphylininae (18 species, two belonging to the tribe Xantholinini and 16 species belonging to the tribe Staphylinini). A discussion is presented on the potential forensic importance of some species collected on human and pig carcasses.

Key words: Key, Staphylinidae, Aleocharinae, Oxytelinae, Staphylininae, forensic, carcasses, Argentina

Introduction

Beetles are one of the most diverse components of carrion substrates and their forensic importance has been well documented (e.g., Smith 1986; Benecke 1988; Matuszewski *et al.* 2008; Midgley *et al.* 2010; Villet 2011). Despite the high diversity of beetles found in carcasses, most forensic studies have been focused on Diptera due to the fact that they colonize the body from the beginning of the decomposition process (Goff 1993). However, Diptera have little usefulness after several weeks or months, when the body is in advanced stages of decomposition. Beetles have been found to be the main entomological evidence present in a corpse in advanced decomposition stages and their usefulness to estimate the minimum Post Mortem Interval (PMImin) has been emphasised (Kulshrestha & Satpathy 2001; Midgley *et al.* 2010; Matuszewski 2012; Prado e Castro *et al.* 2013). The correct identification of insects and knowledge of their life history as well as the duration of each stage of development leads to accurately establishing the PMI (Turchetto & Vanin 2004). Families of beetles of forensic importance are Dermestidae, Cleridae, Histeridae, Staphylinidae, Nitidulidae, Scarabaeidae, Silphidae, Tenebrionidae, and Trogidae (Mise *et al.* 2007; Almeida & Mise 2009; Byrd & Castner 2009; Özdermir & Sert 2009; Battán Horenstein & Linhares 2011). Members of these families may play different roles in the community depending on the feeding behaviour of their adults or their immature stages. Beetles can feed on cadaveric tissues (necrophagous) or on other insects in the body, such as larvae of Diptera or other Coleoptera species (necrophilous) (Smith 1986).

The beetle family Staphylinidae, including the recently added Scydmaeninae, has become the largest in Coleoptera and in the whole of the Animal Kingdom, with over 56,000 described species (Grebennikov & Newton 2009) currently organized in 32 subfamilies (Bouchard *et al.* 2011). The overall classification, phylogeny, world distribution, morphology and biology were reviewed most recently by Thayer (2005).

Staphylinidae have been frequently cited as the most diverse coleopterous group found on carcasses. These

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beetles arrive and begin exploring a body within a few days of death and, during the bloated stage, they are present as long as there is insect activity on the corpse (Smith 1986; Villet 2011). Most carrion-frequenting Staphylinidae are predacious as both larva and adult and they feed on maggots and other larvae present on carcasses (Smith 1986; Byrd & Castner 2009). They have been repeatedly reported in forensic studies on decomposing pig carcasses (e.g., Mise *et al.* 2007; Matuszewski *et al.* 2010; Battán Horenstein & Linhares 2011; Battán Horenstein *et al.* 2012; Aballay 2012; Prado e Castro *et al.* 2013), swine carcasses (Dekeirsschieter *et al.* 2013) and human corpses (Turchetto *et al.* 2001; Arnaldos *et al.* 2005; Mariani *et al.* 2010; Aballay obs. pers.). Staphylinids have been shown to reach their highest abundance in intermediate stages of decomposition such as Active and Advanced Decay (Matuszewski *et al.* 2008; Özdermir & Sert 2009; Prado e Castro *et al.* 2013). In previous forensic studies in South America, staphylinids were identified to family level (Carvalho *et al.* 2000; Segura *et al.* 2009; Mariani *et al.* 2010), most to generic level (Wolff *et al.* 2001; Mise *et al.* 2007; Martínez *et al.* 2007; Mariani *et al.* 2014) and a few to species level mainly *Creophilus maxillosus* (Linnaeus) (Centeno *et al.* 2002; Battán Horenstein & Linhares 2011; Aballay *et al.* 2012). A key to the main families of South American Coleoptera of forensic importance was recently published (Almeida & Mise 2009), which includes staphylinids mentioned for some South American countries. In this key, only six genera and three species were determined for Staphylinidae, and it does not include most of the species collected in southern areas of South America (Aballay *et al.* 2008).

Staphylinidae are represented in southern South America (Argentina, Chile, Paraguay and Uruguay) by 22 subfamilies including nearly 455 genera and 2089 species (Newton, unpublished database). Identification tools for the genera and species of Staphylinidae from this area are fragmentary and scarce (Chani-Posse & Thayer 2008). Consequently, the role of these species in the carrion community is not fully understood and their forensic importance has been largely overlooked at the regional level. The correct identification of adult Staphylinidae is necessary in order to correlate their presence in the carcass with the different decomposition stages. The objective of this paper is to provide an illustrated key to the staphylinid species associated with decaying carcasses in Argentina to achieve their correct identification. Additionally, diagnoses for these species are presented.

Material and methods

In total, 749 specimens were collected mostly during forensic studies on decomposing pig carcasses because it is the preferred animal model for forensic entomological studies (Goff 1993). These decomposition experiments were conducted in the Argentinean provinces of Mendoza, San Juan, Catamarca, Salta and Buenos Aires. Staphylinids were collected during the entire decomposition process on 36 pig carcasses. In Mendoza, the study was carried out at the campus of Instituto Argentino de Investigaciones de las Zonas Áridas, CCT CONICET-Mendoza (32° 53' 53.3"S, 68° 52' 26.2"W, 850 m altitude) collecting staphylinids on 12 pig carcasses, during the four seasons of the year. In San Juan, staphylinids were collected on two decomposing pig carcasses in summer at the campus of Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de San Juan (31° 32' 34.1"S, 68° 34' 38.2"W, 673 m altitude). In Catamarca, staphylinids were collected on two decomposing pig carcasses during spring in Antofagasta de la Sierra (26° 01' 32.3"S, 67° 20' 36.5"W, 3600 m altitude). In Salta, specimens were sampled from 12 decomposing pig carcasses during the four seasons of the year in Campo Quijano (24° 54' 40"S, 65° 28' 16"W, 1240 m altitude; 24°45´S, 65° 35´ W, 1464 m altitude). In Buenos Aires, staphylinids were collected on eight pig carcasses, during the four seasons of the year, in Santa Catalina (34° 47' 13"S, 58° 26' 33"W, 17 m altitude). Additional specimens were collected from chicken-baited traps in Sierra San Javier, Tucumán (26° 46' 16"S, 65° 19´ 37"W, 777 m altitude; 26° 46´ 59"S, 65°19´47"W, 711 m altitude).

Collecting sites in Argentina belong to the ecoregions of Deserts and Xeric Shrublands (Mendoza and San Juan), Central Andean Puna (Catamarca), Southern Andean Yungas (Salta and Tucumán) and Humid Pampas (Buenos Aires) (Olson *et al.* 2001). For collecting and conserving specimens the methods followed were those by Centeno *et al.* (2002) and Aballay *et al.* (2008, 2012).

Other Staphylinidae specimens were obtained using two kinds of collecting procedures, the first was conducted on human corpses at various places in Mendoza province authorized by the Medical Forensic Committee of Mendoza; the second was conducted in field trips in various Argentinean provinces on carcasses of cow (*Bos taurus*), horse (*Equus caballus*), donkey (*Equus asinus*), all found outdoors. Voucher specimens are deposited in the entomological collection of the Instituto Argentino de Investigaciones de las Zonas Áridas (Mendoza, Argentina).

Beetles were examined using a Leica MZ6 dissecting microscope. Measurements (given in millimeters) were taken with an ocular micrometer. They were mostly examined as pinned dry specimens, but a few were first relaxed in warm soapy water, rinsed, disarticulated and examined as wet preparations in glycerin. Overall body length was measured from the apex of the labrum to the apex of the abdomen. Morphological terms used in the key follow essentially Blackwelder (1936). Characters employed in the key and the diagnoses mostly belong to those of previous studies (Klimaszewski 1984; Smetana 1995; Maus 2001; Newton *et al.* 2000; Navarrete-Heredia *et al.* 2002; Chatzimanolis 2004; Chani-Posse 2010 and Clarke 2011). Digital photographs of the specimens were taken with a Canon S50 adapted to a Leica MZ6 stereomicroscope. Final images of the specimens were produced with the image-stacking freeware CombineZM (Hadley 2014).

Results

Species of Staphylinidae found in the present study belong to three of the 22 subfamilies reported for southern South America (Newton, unpublished database): Aleocharinae, Oxytelinae and Staphylininae. Thus, the following key is only applied to specimens within these subfamilies in our area of study (Argentina) (Fig. 60). The list of Staphylinidae of forensic importance in Argentina comprises 24 species which were found in nine provinces during this work (Table 1). In order to enable a more accurate use of the key, diagnosis of each species with habitus photographs are provided.

Key to species of Staphylinidae associated with carcasses in Argentina

1 Antennae inserted posterior to a line drawn between anterior margin of eyes (Fig. 25) . . . . . 2. Aleocharinae
- Antennae inserted anterior to a line drawn between anterior margin of eyes (Fig. 26) 5
2 Maxillary and labial palpi with apical pseudosegment, 5-articled and 4-articled respectively (Fig. 27); tarsal formula 5-5-5 . . 3 *Aleochara* Gravenhorst
- Maxillary and labial palpi without apical pseudosegment, 4-articled and 3-articled respectively; tarsal formula 4-5-5 . . . *Atheta* Thomson
3 Pronotum with two longitudinal, subparallel rows of setiferous punctures, arranged in more or less defined lines (Fig. 30). . . . . subgenus *Coprochara* Mulsant and Rey
Head and pronotum scarcely pubescent, elytra with two small apico-medial spots not well defined and blurred (Figs. 4, 30)... . . . . *Aleochara signaticollis* Fairmaire & Germain
- Pronotum evenly pubescent (Figs. 28, 29) 4
4 Mesosternum completely carinate along midline (Fig. 31). . . . . subgenus *Xenochara* Mulsant and Rey
Antennal segments 4–6 slightly elongate to quadrate, 5–10 slightly transverse; pronotum and elytra densely pubescent; elytral pubescence directed posterad (Figs. 3, 29). . . . . *Aleochara puberula* Klug
- Mesosternum not carinate along midline (Fig. 32); body robust and compact. . . . . subgenus *Aleochara* Mulsant and Rey
Antennal segments 4–6 distinctly transverse; head and pronotum sparsely pubescent; elytra with two latero-medial brown spots (Figs. 2, 28) . . . . . *Aleochara bonariensis* Lynch
5 Abdomen with complete sternum 2 (seven sterna can be counted) (Fig. 43). . . . . Oxytelinae
Pronotum transverse, with longitudinal impressions (Fig. 35); scutellum with tripartite impression, of a fleur-de-lis shape . . . . . *Anotylus* Thomson
- Abdomen with sternum 2 absent or rudimentary, only six complete sterna are visible (Fig. 42); . . . . . 6 Staphylininae
6 With sclerotized plate (solid or divided into two sclerites) in front of prosternum (Fig. 33) . . . . . Xantholinini
6.1 Pronotal disc impunctate except near margins; head, pronotum and abdomen of metallic color; length > 20 mm (Fig. 6) . . . . . *Eulissus chalybaeus* Mannerheim
6.2 Pronotal disc with distinct dorsal and lateral rows of punctures; head, pronotum and abdomen brownish, glossy but never of metallic color; length distinctly < 20 mm (Fig. 7) . . . . . *Neohypnus* Coiffait and Sáiz
- Without distinct sclerotized plate in front of prosternum (Fig. 34). . . . . 7. Staphylinini (Staphylininae)
7 Superior line of pronotal hypomeron deflexed ventrad to join inferior line before reaching anterior angle of pronotum (Fig. 36) . . . . . 8.
- Superior line of pronotal hypomeron not deflexed ventrad, reaching anterior angle of pronotum without joining inferior line (Fig. 37). . . . . .20. Xanthopygina
8 Ligula distinctly emarginated or bilobed apically (Fig. 38); always large, length 12–30 mm . . . . . .9. Staphylinina
- Ligula distinctly entire, rounded or slightly sinuate apically (Fig. 39); usually smaller, length 4–15 mm . . . . . .12. Philonthina

9 Central part of pronotal disc densely punctate (Figs. 8, 9, 40) . . . . . 10. *Platydracus* Thomson
- Central part of pronotal disc glossy and impunctate (Figs. 10, 11, 41) . . . . . .11. *Creophilus* Leach
10 Head, pronotum and elytra of metallic color, abdomen entirely black with distinct white pubescence (usually head and pronotum metallic green to blue and elytra metallic red) (Fig. 8) . . . . . *Platydracus chrysotrichopterus* Scheerpeltz
- Head, pronotum and elytra dull black to piceous black, abdomen black with last visible segment brown to reddish brown (Fig. 9) . . . . . *Platydracus scabrosus* (Curtis)
11 With distinctive white pubescence especially on anterior angles of pronotum, across middle of elytra and on abdominal terga 4 and 5 (Fig. 10) . . . . . *Creophilus maxillosus* (Linnaeus)
- With extensive pattern of white and golden brown vestiture on anterior angles of pronotum, elytra, and abdomen (Fig. 11) . . . . . *Creophilus variegatus* Mannerheim
12 Front tarsi with first four segments more or less cylindrical with only regular, unmodified marginal setae on ventral surface (Fig. 44): lateral puncture of pronotum bearing long seta situated away from superior line at a distance at least three times as large as diameter of puncture (Fig. 50) . . . . . *Belonuchus* Nordmann
Head, pronotum and two last abdominal segments black, elytra and first four abdominal segments reddish-yellow to rufous (Fig.12) . . . . . *Belonuchus rufipennis* (Fabricius)
- Front tarsi with first four segments more or less flattened dorsoventrally and widened distally, with modified pale (adhesive) setae on ventral surface (Figs. 45); lateral puncture of pronotum bearing long seta situated close to superior line or at a distance no more than three times the diameter of puncture (Fig. 51) . . . . . 13. *Philonthus* Stephens
13 Pronotum moderately to distinctly narrowed anteriad (Figs. 55, 56) 15
- Pronotum parallel-sided (Fig. 57) 14
14 Eyes distinctly shorter than temples seen from above (Fig. 52); transverse distance between punctures on elytra distinctly larger than diameters of punctures . . . . . *Philonthus quadraticeps* Boheman
- Eyes distinctly longer than temples seen from above (Figs. 53); transverse distance between punctures on elytra about as large as to distinctly smaller than diameters of punctures . . . . . *Philonthus discoideus* (Gravenhorst)
15 Eyes about as long as or shorter than temples seen from above 16
- Eyes distinctly longer than temples seen from above (Fig. 15, 54) . . . . . *Philonthus bicoloristylus* Chani-Posse
16 Head about as wide as long 17
- Head moderately to distinctly wider than long (Fig. 16) . . . . . *Philonthus bruchianus* Chani-Posse
17 Antennal segments 8–10 distinctly elongate 19
- Antennal segments 8–10 not elongate 18
18 Pronotum with dorsal rows of punctures each with five punctures, rarely with four (if so, only at one row); first segment of hind tarsus distinctly longer than last segment (Fig. 17) . . . . . *Philonthus flavolimbatus* Erichson
- Pronotum with dorsal rows of punctures each with four punctures; first segment of hind tarsus as long as or shorter than last segment (Fig. 18) . . . . . *Philonthus bonariensis* Bernhauer
19 Pronotum with dorsal rows of punctures each with five punctures; apex of male tergum 10 not emarginate medioapically (Fig. 19) . . . . . *Philonthus longicornis* Stephens
- Pronotum with dorsal rows of punctures each with four punctures; apex of male tergum 10 emarginate medio-apically (Fig. 20) . . . . . *Philonthus argus* Herman
20 First four segments of front tarsus slightly dilated, much narrower than apex of protibia and with few translucent tenent setae on either side of ventral apex (Fig. 47); hind femur of male with posterior margin crenulate (Fig. 49) . . . . . *Styngetus* Sharp
Head and pronotum glossy black and densely punctate; elytra metallic blue, abdomen black with last visible segment brown to reddish brown (Fig. 21) . . . . . *Styngetus viduus* (Erichson)
- First four segments of front tarsus distinctly dilated, about as wide as or wider than apex of protibia and with dense pad of translucent tenent setae below (Fig.46); hind femur of male not crenulate (Fig. 48) 21
21 Eyes about as long as or shorter than temples seen from above; pronotal hypomeron with a small translucent postcoxal process very close behind coxal articulation (Fig. 58) . . . . . *Xenopygus* Bernhuer
Head, pronotum and elytra of metallic color (Fig. 22) . . . . . *Xenopygus analis* (Erichson)
- Eyes distinctly longer than temples seen from above; pronotal hypomeron without postcoxal process (Fig. 59) 22
22 Antenna with segments 7–10 transverse; head, especially the frons and vertex, with dense contiguous punctures . . . . . *Nordus* Blackwelder
Head, pronotum, elytra and scutellum golden orange, antennal segments yellow, abdomen black except apical margin of segment 7 and entire segment 8 golden orange (Fig. 23) . . . . . *Nordus elytisi* Chatzimanolis
- Antenna with segments 7–10 elongate or conical; head with frons and vertex only sparsely punctate, but often with dense microsculpture . . . . . *Oligotergus* Bierig
Head, pronotum and elytra black to piceous black, abdominal segments black to piceous black with apical margins of segments 3–6 and entire segments 7 and 8 brown to reddish brown (Fig. 24) . . . . . *Oligotergus ogloblini* Bernhauer

TABLE 1. List of Staphylinidae species collected on vertebrate carcasses and from baited traps in Argentina and their geographic distribution by provinces. * = baited trap

Species	N°	Substratum / carcasses	Province	Geographic Coordinates	Altitude (m)	Collector/reference
Aleochara (Aleochara) bonariensis	4	Pig	Buenos Aires	34°42'27"S, 58°16'46"W	20	Centeno N.
Aleochara (Aleochara) bonariensis	8	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Aleochara (Aleochara) bonariensis	26	Pig	Salta	24°55'40"S 65°28'16"W	1240	Ayón (2013)
Aleochara (Aleochara) bonariensis	2	Pig	Salta	24°45'S, 65°35'W	1464	Ayón (2013)
Aleochara (Aleochara) bonariensis	3	Chicken *	Tucumán	26°46'16"S, 65°19'37"W	777	Maldonado B.
Aleochara (Aleochara) bonariensis	5	Chicken *	Tucumán	26°46'59"S, 65°19'47"W	711	Maldonado B.
Aleochara (Coprochara) signaticollis	12	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Aleochara (Xenochara) puberula	50	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Aleochara (Xenochara) puberula	1	Human	Mendoza	32°36'04"S, 68°17'31"W	586	Aballay F. (forensic cases)
Anotylus sp.	7	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Atheta sp.	2	Pig	Buenos Aires	34°42'27"S, 58°16'46"W	20	Centeno N.
Atheta sp.	18	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Belonuchus rufipennis	1	Chicken *	Tucumán	26°46'59"S, 65°19'47"W	711	Maldonado B.
Creophilus maxillosus	1	Pig	Buenos Aires	34°47'13"S, 58°26'33"W	17	Centeno et al (2002)
Creophilus maxillosus	3	Pig	Catamarca	26°01'38"S, 67°20'32"W	3595	Aballay (2012)
Creophilus maxillosus	2	Cow	La Rioja	28°28'50"S, 67°16'59"W	1238	Aballay F.
Creophilus maxillosus	1	Chicken *	Mendoza	34°14'24"S, 69°24'18"W	2510	Aballay F.
Creophilus maxillosus	24	Chicken *	Mendoza	32°54'58"S, 69°13'23"W	1549	Aballay F.
Creophilus maxillosus	87	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Creophilus maxillosus	1	Human	Mendoza	32°49'18"S, 68°52'39"W	653	Aballay F. (forensic cases)
Creophilus maxillosus	4	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Creophilus maxillosus	11	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Creophilus maxillosus	5	Pig	Salta	24°45'S, 65°35'W	1464	Ayón (2013)
Creophilus maxillosus	29	Pig	San Juan	31°32'34"S, 68°34'38"W	674	Aballay *et al.* (2008, 2012)
Creophilus maxillosus	4	Horse	San Juan	29°56'08"S, 69°9'24"W	1762	Aballay F.
Creophilus maxillosus	5	Pig	San Juan	30°06'52"S, 68°39'55"W	1146	Aballay F.
Creophilus maxillosus	1	donkey	San Juan	30°10'24"S, 67°51'36"W	1392	Aballay F.
Creophilus maxillosus	2	Cow	San Luis	32°22'08"S, 67°09'37"W	720	Aballay F.
Creophilus variegatus	2	Cow	Corrientes	28°3'13"S, 58°08'38"W	69	Aballay F.
Eulissus chalybaeus	1	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Eulissus chalybaeus	14	Pig	Salta	24°55'40" S, 65°28'16"W	1240	Ayón (2013)
Nordus elytisi	1	Chicken *	Tucumán	26°46'16" S, 65°19'37"W	777	Maldonado B.
Oligotergus ogloblini	23	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus argus	10	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus bicoloristylus	7	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus bonariensis	1	Pig	Buenos Aires	34°42'27"S, 58°16'46"W	20	Centeno N.
Philonthus bonariensis	16	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Philonthus bonariensis	8	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)

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TABLE 1 (Continued)

Species	Nº	Substratum / carcasses	Province	Geographic Coordinates	Altitude (m)	Collector/reference
Philonthus bruchianus	3	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus discoideus	9	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus flavolimbatus	9	Pig	Salta	24°45'S, 65°35'W	1464	Ayón (2013)
Philonthus flavolimbatus	8	Pig	Salta	24°45'S, 65°35'W	1464	Ayón (2013)
Philonthus longicornis	39	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Philonthus longicornis	50	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Philonthus longicornis	3	Pig	Salta	24°45'S, 65°35'W	1464	Ayón (2013)
Philonthus longicornis	4	Pig	San Juan	31°32'34"S, 68°34'38"W	674	Aballay *et al.* (2008, 2012)
Philonthus quadraticeps	2	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Platydracus chrysotrichopterus	23	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Platydracus scabrosus	4	Chicken *	Tucumán	26°46'16"S, 65°19'37"W	711	Maldonado B.
Neohypnus sp.	17	Pig	Mendoza	32°53'49"S, 68°52'24"W	839	Aballay (2012)
Styngetus viduus	23	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Styngetus viduus	6	Chicken *	Tucumán	26°46'16"S, 65°19'37"W	777	Maldonado B.
Styngetus viduus	1	Chicken *	Tucumán	26°46'59"S, 65°19'47"W	711	Maldonado B.
Xenopygus analis	31	Pig	Salta	24°55'40"S, 65°28'16"W	1240	Ayón (2013)
Xenopygus analis	55	Chicken *	Tucumán	26°46'16"S, 65°19'37"W	777	Maldonado B.
Xenopygus analis	64	Chicken *	Tucumán	26°46'59"S, 65°19'47"W	711	Maldonado B.

Diagnoses of species

Subfamily Aleocharinae

Genus *Atheta* Thomson (Fig. 1)

Diagnosis (based on Newton *et al.* 2000). The genus *Atheta* can be characterized by the combination of the following characters: head and pronotum with weak microsculpture and shiny surface, elytra with granulose sculpture, antennal segments 4 to 9 distinctly elongate, eyes as long as or distinctly longer than temples seen from above, pubescence in midline of pronotum directed anteriorly and pubescence on sides of pronotum directed laterally, metasternal process not longer than mesosternal process, front and mid tibiae without spines and tarsi 4-5-5. Length 3.5–4.5 mm.

Distribution. Cosmopolitan (Newton & Thayer 2005).

Bionomics. Species belonging to the tribe Athetini have been reported as micropredators in many habitats such as carcasses, dung, decaying fruits, rotting vegetation, bird and mammal nests, riparian areas of lakes and streams, ant nests and occasionally on flowers (Newton *et al.* 2000). Prado e Castro *et al.* (2013) cite one species of *Atheta* in association with the fresh and bloated stages of carcasses in the descomposition process. Mariani *et al.* (2014) recorded specimens of this genus in exhumation of a human cadaver.

Remarks. *Atheta* belongs to the Athetini, the largest tribe in the subfamily Aleocharinae, comprising more than 170 genera (Newton *et al.* 2000). In most classifications, *Atheta* is by far the largest genus in Athetini, (≈ 1591 species) (Newton & Thayer 2005). Still, the delimitation of *Atheta* varies substantially between authors and it appears to be defined by a combination of plesiomorphic character states only (Elven *et al.* 2010). There is no tool that allows the identification of the South American species belonging to this genus at present. Herein we follow the generic definition by Newton *et al.* (2000) which is based on the North American representatives of the genus.

Genus *Aleochara* Gravenhorst

Aleochara (Aleochara) bonariensis Lynch
(Fig. 2, 28, 32)

Diagnosis. *Aleochara bonariensis* may be distinguished from other *Aleochara* species by its body robust and compact, the antennal segments 4–6 distinctly transverse, both head and pronotum sparsely pubescent, the mesosternum not carinate along midline and the elytra with two latero-medial brown spots. Length 5.0–7.0 mm.

Distribution. Mexico, Colombia, Venezuela, Suriname, French Guiana, Brazil, Paraguay, Argentina, Cuba (Newton, unpublished database).

Bionomics. *Aleochara bonariensis* has been found to be the most abundant staphylinid species associated with rabbit carcasses, *Oryctolagus cuniculus* Linnaeus (Lagomorpha, Leporidae) at an urban area of Northern Parana State, Southern Brazil (da Silva & Dos Santos 2012).

Aleochara (Xenochara) puberula Klug
(Figs. 3, 29, 31)

Diagnosis (based on Klimaszewski 1984: 46–48). *Aleochara puberula* may be distinguished from other *Aleochara* species by having the antennal segments 5–10 slightly transverse, the mesosternum completely carinate along midline, the basal impressions of the first three visible abdominal terga glabrous and the shape of male sternum 8, which is broadly rounded apically. Length 4.0–7.0 mm.

Distribution. Cosmopolitan (Klimaszewski 1984).

Bionomics. Adults were collected from carrion, human feces, cattle and sheep dung (Klimaszewski 1984; Klimaszewski & Jansen 1993). This species has been reported by Peschke & Fuldner (1977) from decaying plant substances and large cadavers in African savannas. A list of host records was given by Maus *et al.* (1998).

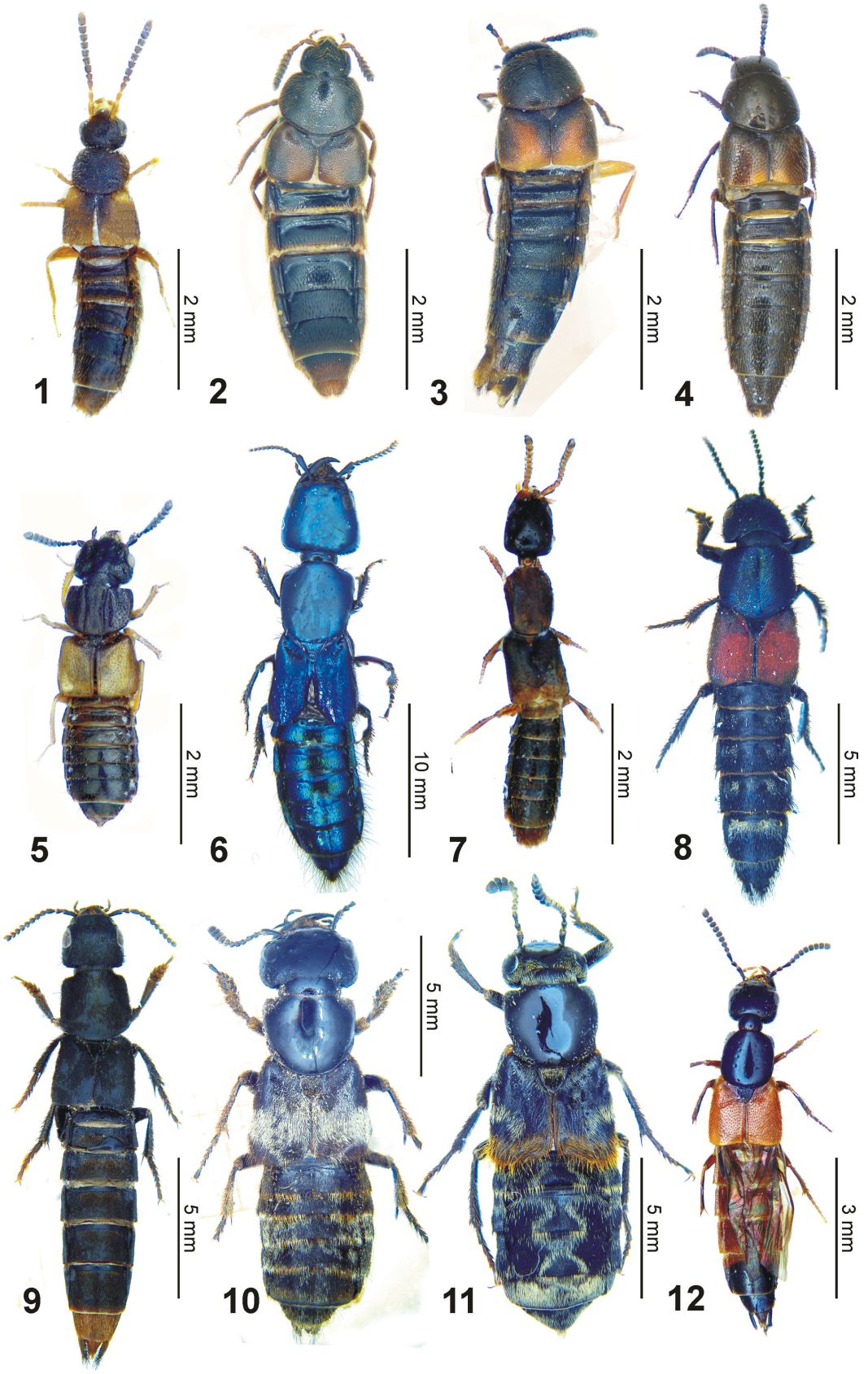

FIGURE 1–12. Habitus: 1, *Atheta* sp.; 2, *Aleochara bonariensis* Lynch; 3, *A. puberula* Klug; 4, *A. signaticollis* Fairmaire; 5, *Anotylus* Thomson; 6, *Eulissus chalybaeus* Mannerheim; 7, *Neohypnus* sp.; 8, *Platydracus chrysotrichopterus* Scheerpeltz; 9, *Platydracus scabrosus* (Curtis); 10; *Creophilus maxillosus* (Linnaeus); 11. *Creophilus variegatus* Mannerheim; 12, *Belonuchus rufipennis* (Fabricius).

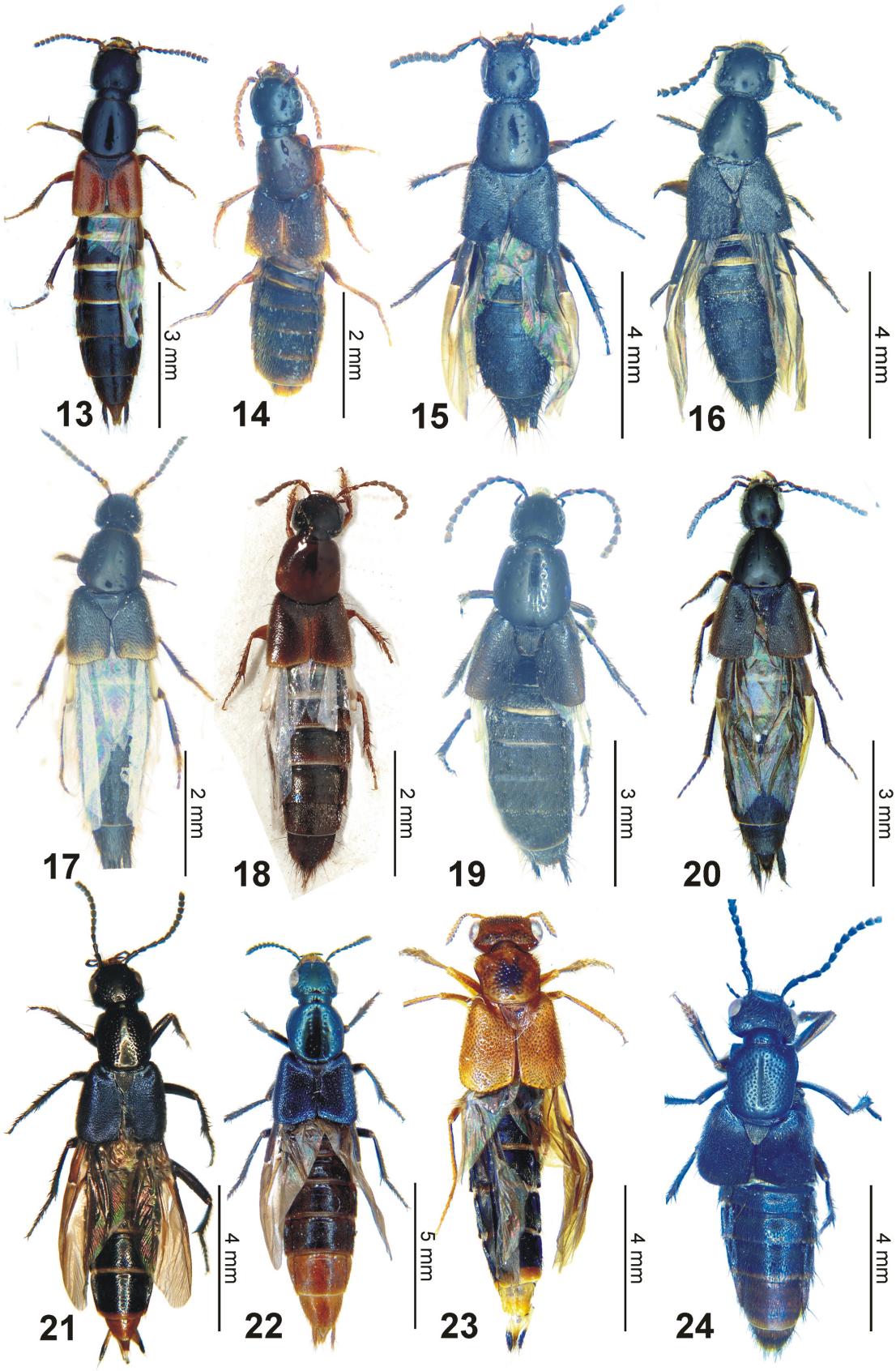

FIGURE 13–24. Habitus: 13, *Philonthus quadraticeps* Boheman; 14, *P. discoideus* (Gravenhorst); 15, *P. bicoloristylus* Chani-Posse; 16, *P. bruchianus* Chani-Posse; 17, *P. flavolimbatus* Erichson; 18, *P. bonariensis* Bernhauer; 19, *P. longicornis* Stephens; 20, *P. argus* Herman; 21, *Syngetus viduus* (Erichson); 22, *Xenopygus analis* (Erichson); 23, *Nordus elytisi* Chatzimanolis; 24, *Oligotergus ogloblini* Bernhauer.

***Aleochara (Coprochara) signaticollis* Fairmaire and Germain**
(Figs. 4, 30)

Diagnosis (based on Klimaszewski 1984: 20–22 and Maus 2001: 42–46). *Aleochara signaticollis* differs from the remaining species of the genus by the head and pronotum sparsely pubescent, the pronotum with two longitudinal, subparallel rows of setiferous punctures, arranged in more or less defined lines and each elytron with one paler, not well defined and blurred spot in the apicomedial part. Length 3.0–7.0 mm.

Distribution. Southern South America (Maus 2001).

Bionomics. Like most other species of the subgenus *Coprochara*, *A. signaticollis* is a dung-dwelling species which can also be found on carrion and other decaying organic material (Maus 2001).

Remarks. Maus (2001) provides insight into the strong external similarity shown by *A. signaticollis* and *A. notula*, being only distinguished from each other by genitalic features.

Subfamily Oxytelinae

Genus *Anotylus* Thomson
(Figs. 5, 35)

Diagnosis (based on Newton *et al.* 2000). The genus *Anotylus* can be characterized by its scutellum with a tripartite impression, usually of a fleur-de-lis shape and the abdomen having tergum 2 without a curved, basolateral ridge, and terga 3–7 each with curved basolateral ridge; pronotal hypomeron broad. Length 2–4.5 mm.

Distribution. Cosmopolitan (Newton & Thayer 2005).

Bionomics. Species belonging to *Anotylus* has been found mainly on dung, carrion and other decaying organic material (Newton *et al.* 2000). Prado e Castro *et al.* (2013) cites one *Anotylus* species in association with the fresh and bloated stages of carcasses in the descomposition process.

Remarks. *Anotylus* currently comprises more than 350 species worldwide (Newton & Thayer 2005). However, there is no tool that allows the identification of the South American species belonging to this genus at present. Herein we follow the generic definition by Newton *et al.* (2000) which is based on the North American representatives of the genus.

Subfamily Staphylininae

Tribe Xantholinini

Genus *Eulissus* Mannerheim

***Eulissus chalybaeus* Mannerheim**
(Figs. 6, 33)

Diagnosis. *Eulissus chalybaeus* may be recognized among other southern South American Xantholinini by its body large and robust, the head, pronotum, elytra and abdomen of metallic color (blue, green or violet) and the pronotal disc impunctate except near margins. Length 28–35 mm.

Distribution. From Mexico to Argentina (Márquez & Asiain 2002).

Bionomics. This species has been recorded mainly from dung, traps baited with human feces and detritus of *Atta mexicana* (Formicidae) (Márquez & Asiain 2002; Navarrete-Heredia *et al.* 2002). *Eulissus chalybaeus* has been also reported as an active predator of dung-beetles (Young 2011; Noriega & Navarrete-Heredia 2012).

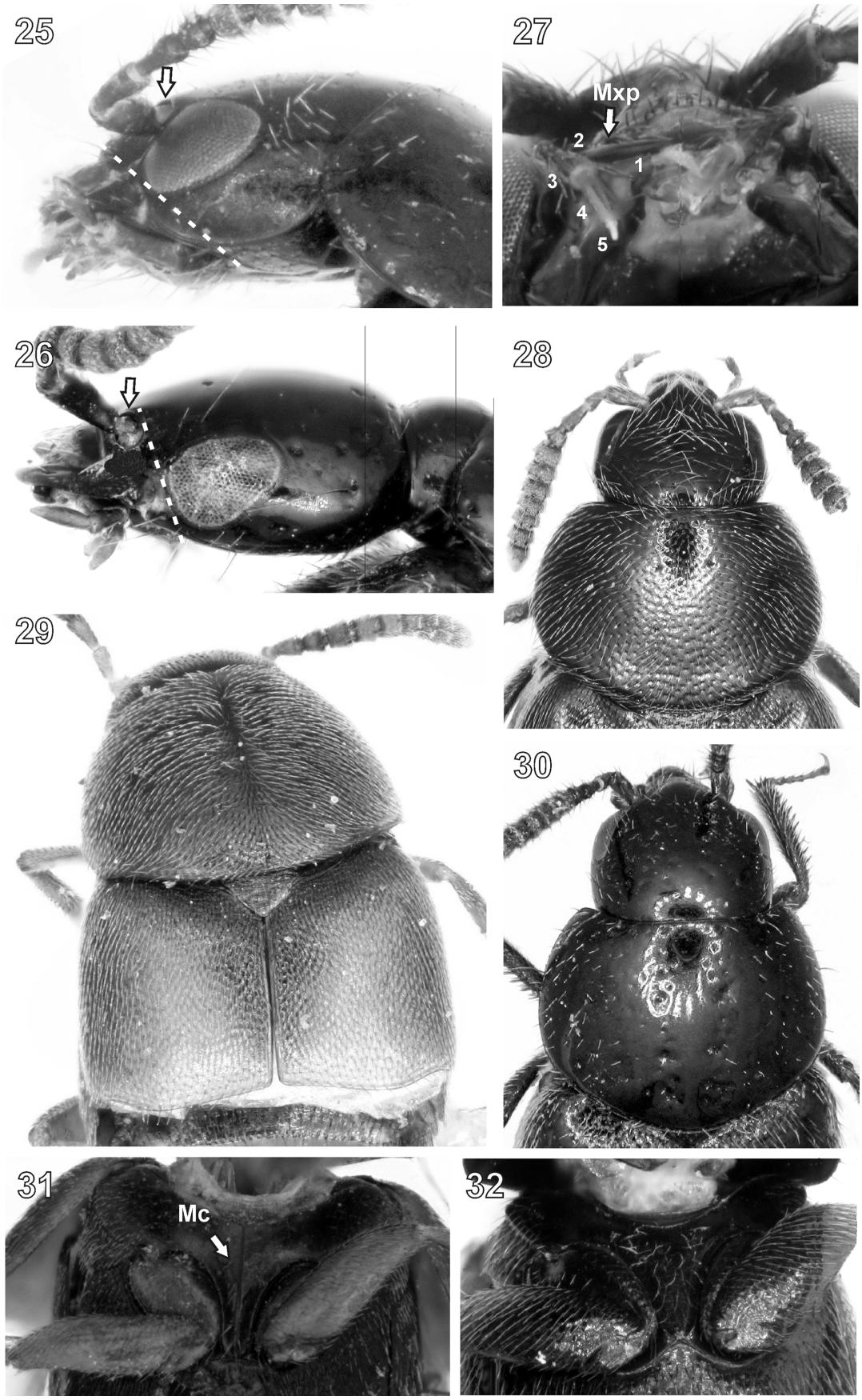

FIGURE 25–32. Head (lateral view): 25, *Aleochara puberula*; 26, *Philonthus longicornis*. Maxillary palpus: 27, *A. puberula*. Head and pronotum: 28, *A. bonariensis*; 29, *A. puberula*; 30, *A. signaticollis*. Mesosternum: 31, *A. puberula*; 32, *A.signaticollis*. Abbreviations: Mc; mesosternum carina; MxP, maxillary palpus.

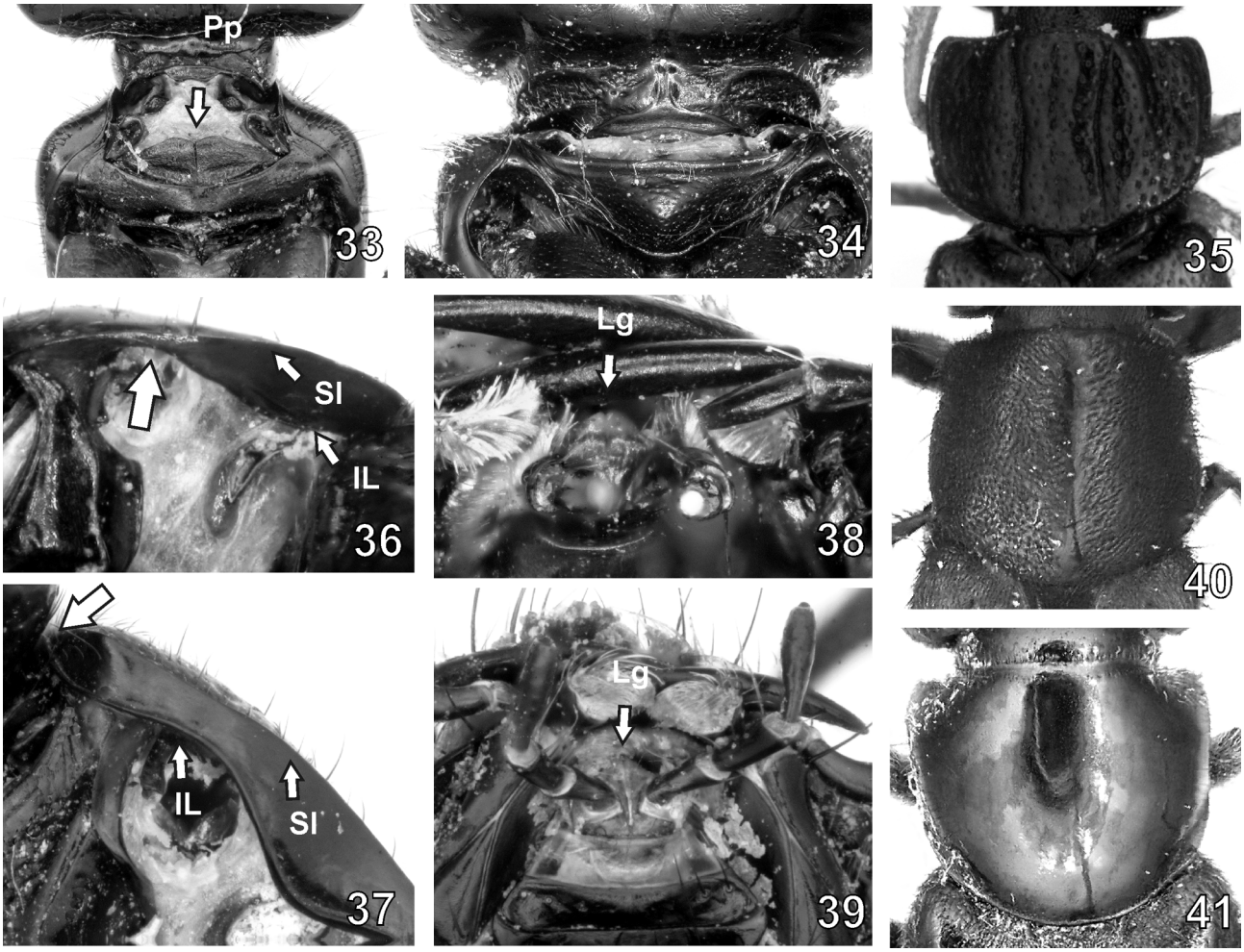

FIGURE 33–41. Prosternum: 33, *Eulissus chalybaeus*; 34, *Creophilus maxillosus*; 35, *Anotylus* sp; 40, *Platydracus chrysotrichopterus*, 41, *Creophilus maxillosus*. Pronotal hypomeron: 36, *Philonthus longicornis*; 37, *Oligotergus ogloblini*. Ligula: 38, *Creophilus maxillosus*; 39, *Xenopygus analis*. Abbreviations: Lg, ligula; IL, inferior line; Pp, plate of pronotum; SL, superior line.

Genus *Neohypnus* Coiffait and Sáiz
(Fig. 7)

Diagnosis (based on Newton *et al.* 2000). The genus *Neohypnus* can be recognized by the deflexed portion of temples distinctly flattened and separated from the dorsal side of head by an impunctate, occasionally elevated strip, the distance separating ocular punctures from each other at least three times as long as the distance separating each ocular puncture from inner margin of eye, the pronotum with distinct dorsal and lateral rows of punctures and the metatibia having only one ctenidium apically. Length 5.0–7.0 mm.

Distribution. Nearctic and Neotropical region including southern South America, introduced in Australia and New Zealand (Newton, unpublished database).

Bionomics. Species belonging to *Neohypnus* have been found in forest litter or debris near water, decaying organic material including dung, carrion and rotting cacti, or in treeholes or under bark (Newton *et al.* 2000; Márquez-Luna 2001).

Remarks. *Neohypnus* currently includes more than 50 species, nine of them distributed in Southern South America (Newton & Thayer 2005; Newton, unpublished database). There is no key that allows the identification of the Neotropical species of the genus at present. Herein we follow the generic definition by Newton *et al.* (2000) which is based on the North American representatives of the genus.

Tribe Staphylinini

Subtribe Staphylinina

Genus *Creophilus* Leach

***Creophilus maxillosus* (Linnaeus)**
(Figs. 10, 41)

Diagnosis (only referred to general habitus, modified from Clarke 2011). *Creophilus maxillosus* can be distinguished by the following characters: antennal segments 1–6 brownish-black, 7–11 greyish-black; apex of antennal segment 11 slightly to moderately emarginate medially; pronotum moderately to distinctly narrowed posteriorly, hind angles indistinct; integument, including elytra, uniformly black; vestiture on hind margins of head, anterior pronotal declivities, and pterothorax mostly black; elytra with white vestiture arranged into well-demarcated (but variable) central transverse fascia; vestiture on dorsal surface of abdomen white, arranged into definite pattern, concentrated on terga 5 and 6, with 7–10 usually partly whitish. *Creophilus maxillosus* is distinct from all other *Creophilus* species due to the definite whitish-grey elytral fascia, and dorsal pattern of body vestiture. Length 13.0–18.5 mm.

Distribution. Widespread throughout the northern hemisphere; apparently absent from austral regions (except as adventive), South East Asia, and the East Indies (Clarke 2011).

Bionomics. *Creophilus maxillosus* is probably the best-studied rove beetle species (Clarke 2011). The most complete list of literature on this species is given by Herman (2001) and updated by Clarke (2011). It has been found on carrion of all kinds where adults feed on maggots, in various kinds of both natural and synanthropic habitats (Newton *et al.* 2000). In the "area of Cuyo (Argentina)" it was mostly found in natural habitats (Aballay, pers. com.). According to Clarke (2011) who has summarized the extensive information on this species from the forensic literature, adults of *Creophilus maxillosus* arrive early at a carcass during the 'bloat' and 'decay' stages, remaining there up to 13 days post-mortem (see also Matuszewski *et al.* 2010; Matuszewski 2012; Prado e Castro *et al.* 2013; Dekeirsschieter *et al.* 2013). Matuszewski (2012) has recently proposed this species to estimate an interval preceding its appearance on a cadaver, called the preappearance interval (PAI).

***Creophilus variegatus* Mannerheim**
(Fig. 11)

Diagnosis (only referred to general habitus, modified from Clarke 2011). *Creophilus variegatus* can be recognized by the following characters: antennal segments 1–3 brownish-black, 4–11 variably yellowish-brown and black; antennal segments 9 and 10 narrowed anteriorly and thickened posteriorly, apex of antennal segment 11 convex; pronotum strongly constricted basally with sharply delimited hind angles; pronotum, elytra, and abdomen with extensive pattern of white and golden brown vestiture; elytral cuticle bicoloured, disc reddish-brown, sides and humeri yellowish; elytra with variegated golden, brown, and whitish setae; fifth visible abdominal tergum with extensive whitish setae, especially apicolaterally. *Creophilus variegatus* is distinguished from *C. maxillosus* by the body vestiture patterning, antennae and the sharply delimited basal pronotal angles. Length 14.0–17.0 mm.

Distribution. Endemic to South America: Argentina, Bolivia, Brazil, Chile, Paraguay, Peru and Uruguay (Clarke 2011).

Bionomics. *Creophilus variegatus* has been reported from carrion (Lüderwaldt 1911), and also preying on maggots of calliphorid larvae (Lynch Arribálzaga 1884)

Genus *Platydracus* Thomson

***Platydracus chrysotrichopterus* (Scheerpeltz)**
(Figs. 8, 40)

Diagnosis (based on Navarrete-Heredia *et al.* 2002). *Platydracus chrysotrichopterus* can be recognized among other South American species of *Platydracus* by its head, pronotum and elytra of metallic color (usually head and pronotum metallic green to blue and elytra metallic red) and the glossy black abdomen. Length 14.0–19.0 mm.

Distribution. Argentina, Bolivia, Peru, Paraguay (Herman 2001; Newton, unpublished database).

Bionomics. Species belonging to *Platydracus* have been found mainly in dung, carrion, rotting fungi and leaf litter in both temperate and tropical forests (Navarrete-Heredia *et al.* 2002). Species of this genus have been reported as the most abundant amphibious predators of dipterous larvae associated with *Heliconia bourgaeana* Petersen (Zingiberales: Heliconiaceae) flower bracts and also found in fallen decaying mango fruits (Frank & Morón 2012).

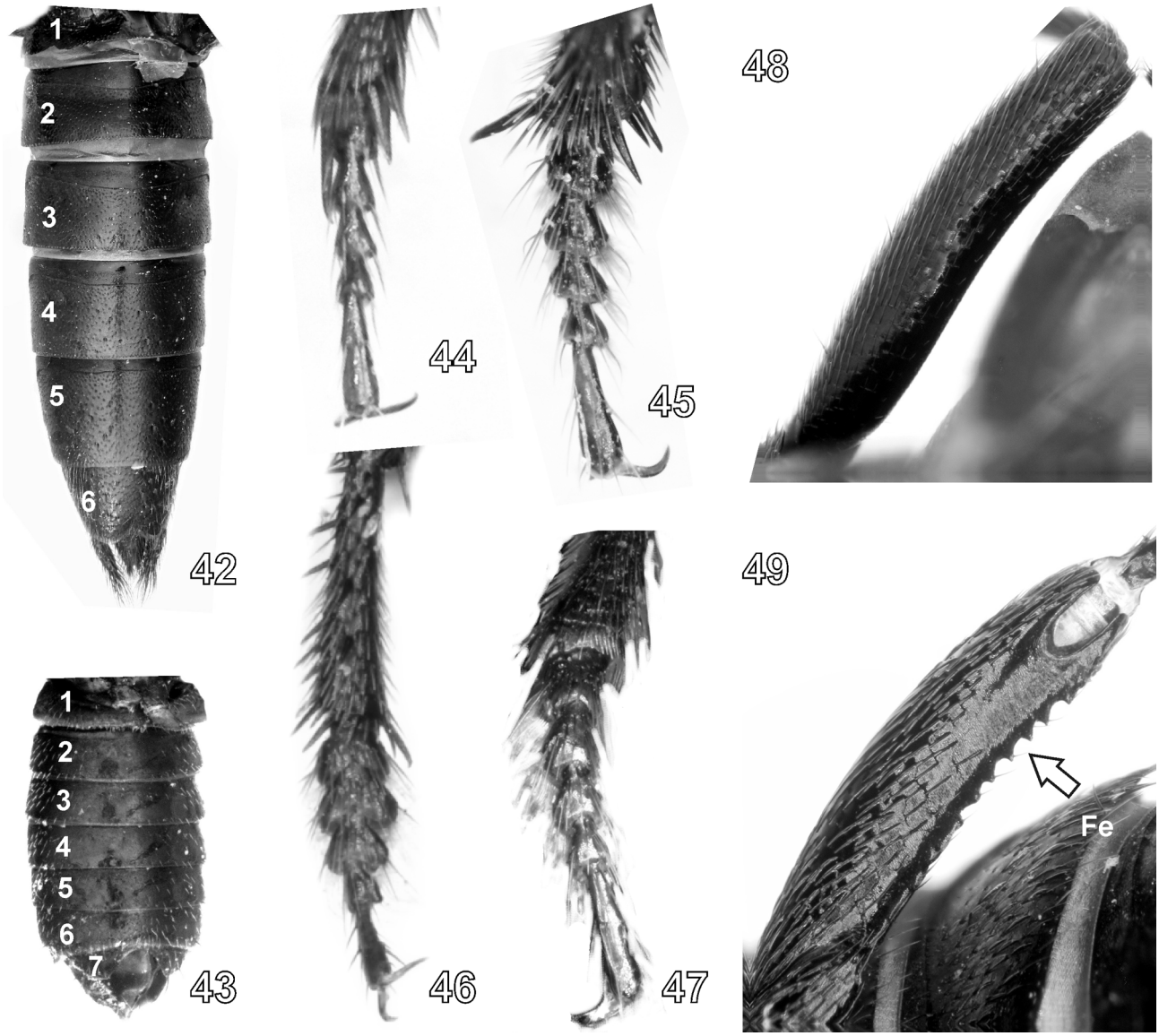

FIGURE 42–49. Abdomen: 42, *Platydracus scabrosus*; 43, *Anotylus* sp. Front tarsus: 44, *Belonuchus rufipennis*; 45, *Philonthus longicornis*; 46, *Xenopygus analis*; 47, *Styngetus viduus*. Femur: 48, *Xenopygus analis*; 49, *Styngetus viduus*. Abbreviation: Fe, femur.

***Platydracus scabrosus* (Curtis)**
(Fig. 9)

Diagnosis. *Platydracus scabrosus* can be recognized among other South American species of *Platydracus* by its head, pronotum and elytra black to piceous black, and the abdomen black with its last visible segment brown to reddish brown. Length 15.0–17.0 mm.

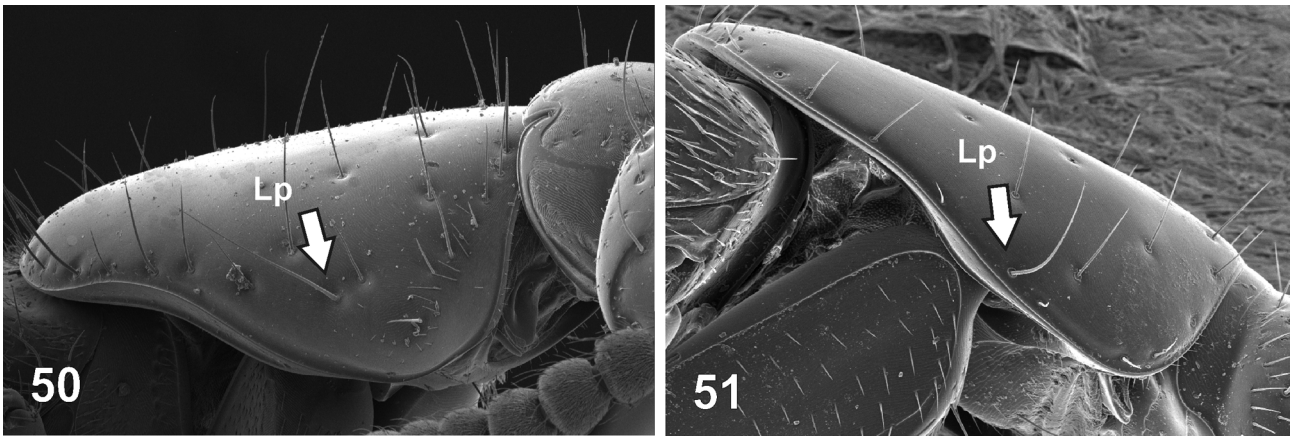

FIGURE 50–51. Pronotum (lateral view): 50, *Belonuchus rufipennis*; 51, *Philonthus bonariensis. Abbreviations*: Lp, lateral puncture of pronotum.

Distribution. From northern Argentina, Uruguay, Paraguay and southern Brazil (Herman 2001; Newton, pers. com.).

Bionomics. Unlike nearly all other Neotropical *Platydracus*, it seems to be found often outside forested areas, apparently even in urban areas, according to collection records (Newton, pers. com.).

Subtribe Philonthina

Genus *Belonuchus* Nordmann

Belonuchus rufipennis (Fabricius)

(Figs. 12, 50)

Diagnosis (based on Smetana 1995). *Belonuchus rufipennis* can be recognized among other species of *Belonuchus* by the head, pronotum and two last abdominal segments black, elytra and first four abdominal segments reddish-yellow to rufous, the antennal segments 6 to 10 transverse, the pronotum with two dorsal rows of setiferous punctures, each with five punctures, the transverse distance between punctures of elytra about as large to slightly larger than diameters of punctures and the area between the two basal lines of visible abdominal terga 2 and 3 with striate microsculpture. Length 5.0–8.0 mm.

Distribution. *Belonuchus rufipennis* is widely distributed in south-eastern North America, Central and South America (Smetana 1995; Newton, unpublished data).

Bionomics. *Belonuchus rufipennis* has been reported from various decomposing organic matter, including carrion, dung, rotting vegetation forest leaf litter (Smetana 1995). Adults of *B. rufipennis* were found in water-filled flower bracts of the genus *Heliconia* (Zingiberales: Heliconiaceae) preying upon dipterous and lepidopterous larvae in that habitat (Frank & Barrera 2010).

Genus *Philonthus* Stephens

Philonthus quadraticeps Boheman

(Figs. 13, 52, 57)

Diagnosis (based on Chani-Posse 2010). *Philonthus quadraticeps* may be identified by the head and thorax castaneous to black, the elytra castaneous to testaceous and the abdominal segments castaneous to piceous with apical margins lighter, the eyes distinctly shorter than temples seen from above, the distance separating medial interocular punctures on frons about three times as large as distance separating medial punctures from lateral punctures, and the dorsal rows of punctures on pronotum each with four punctures. It differs from other southern South American species of *Philonthus* by the absence of a postmandibular ridge and the transverse distance between punctures on elytra distinctly larger than diameters of punctures. Length 6.0–7.5 mm.

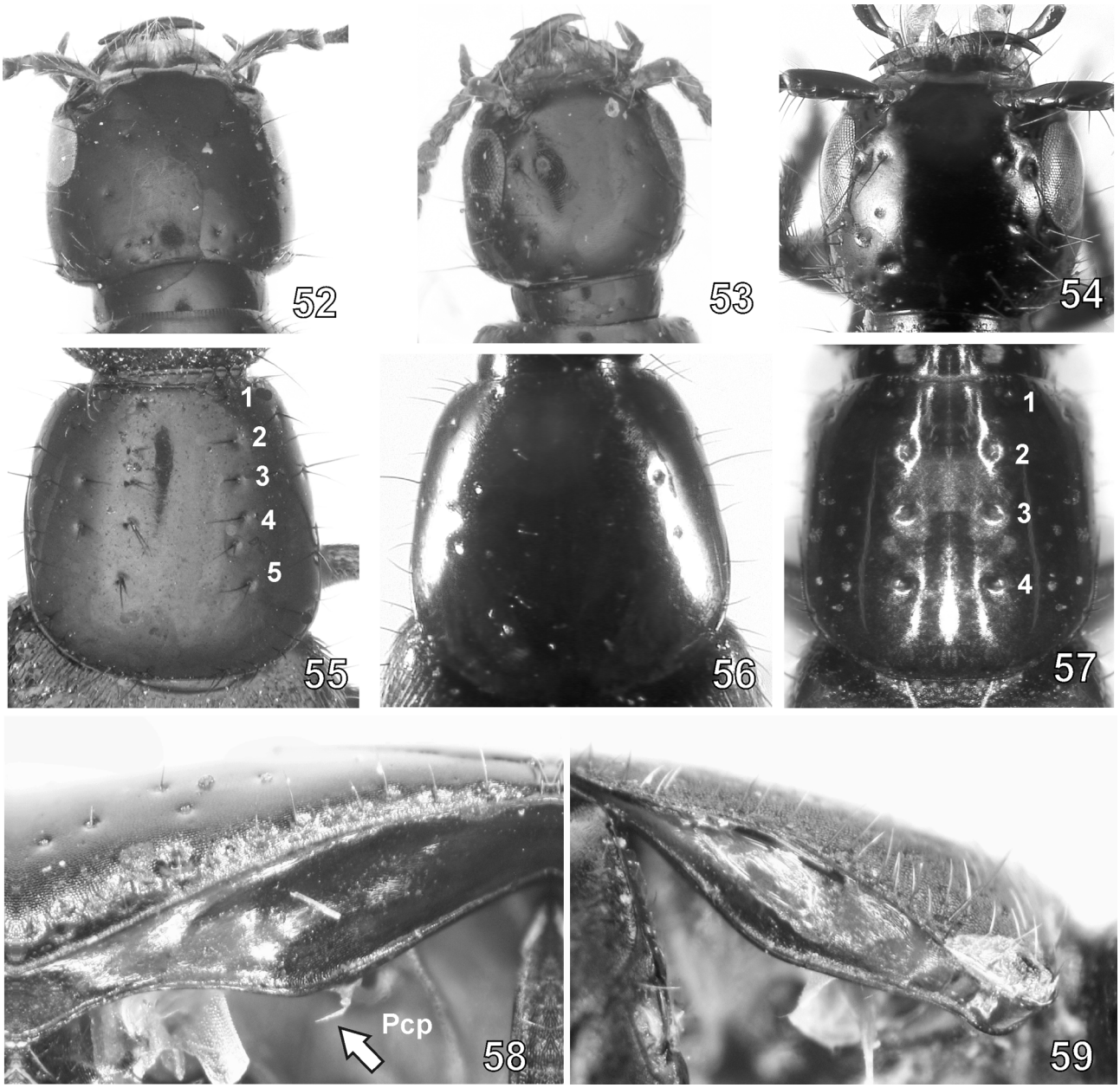

FIGURE 52–59. Head: 52, *Philonthus quadraticeps*; 53, *P. discoideus*; 54, *P. bicoloristylus*. Pronotum: 55, *P. bicoloristylus*; 56, *P. bonariensis*; 57, *Philonthus quadraticeps*. 58, 59. Pronotal hypomeron: 58, *Xenopygus analis*; 59, *Oligotergus ogloblini*. Abbreviations: 1–5, punctures on dorsal rows of pronotum; Pcp, postcoxal process.

Distribution. Argentina, Uruguay, Paraguay, Brazil and Bolivia (Chani-Posse 2010).

Bionomics. *Philonthus quadraticeps* has been reported as a common species in manure (Chani-Posse 2004, 2010). Larval stages were described by Chani-Posse (2006).

Philonthus discoideus (Gravenhorst)

(Figs. 14, 53)

Diagnosis (based on Chani-Posse 2010). *Philonthus discoideus* may be identified by the head black, thorax castaneous-brunneous, elytra castaneous-piceous to castaneous-brunneous with medial and apical margins lighter and the abdominal segments castaneous-piceous, the eyes moderately longer than temples seen from above, and the distance separating medial interocular punctures on frons about four times as large as distance separating medial punctures from lateral punctures. It differs from other southern South American species of *Philonthus* by the abdominal terga 2 and 3 with elevated area between basal lines punctuate, and the posterior basal line straight medially. Length 5.0–6.0 mm.

Distribution. *Philonthus discoideus* is a Palearctic species, currently cosmopolitan and adventive in South America through Cuba (Smetana 1995; Chani-Posse 2010).

Bionomics. This species has been found to occur in habitats associated with human settlements, cattle droppings and other organic debris (Smetana 1995).

Philonthus bicoloristylus Chani-Posse
(Figs. 15, 54, 55)

Diagnosis (based on Chani-Posse 2010). *Philonthus bicoloristylus* may be identified by the eyes longer than temples and the bicolored styli of tergum 9. It differs from other southern South American species of *Philonthus* by the antennal segment 10 quadrate, the pronotum about as long as wide, and the dorsal rows of pronotum each with five punctures. Length 8.0–9.0 mm.

Distribution. Argentina (Chani-Posse 2010).

Bionomics. *Philonthus bicoloristylus* has been found to be a common species in horse and cow droppings in northwestern and eastern Argentina (Chani-Posse 2010).

Philonthus bruchianus Chani-Posse
(Fig. 16)

Diagnosis (based on Chani-Posse, 2010). *Philonthus bruchianus* may be identified by the head wider than long, the antennal segments 4–10 elongate and the pronotum slightly narrowed anteriad to parallel-sided. It differs from other southern South American species of *Philonthus* by the eyes moderately shorter than temples, and the submentum about twice as long as mentum. Length 7.0–8.0 mm.

Distribution. Argentina (Chani-Posse 2010).

Bionomics. This species was collected from pig carcasses in the present study..

Philonthus flavolimbatus Erichson
(Fig. 17)

Diagnosis (based on Chani-Posse 2010). *Philonthus flavolimbatus* may be identified by the coloration pattern of elytra, castaneous-brunneous to castaneous-piceous and yellowish medio-apically, and the distance separating medial interocular punctures on frons about 2.5 times as large as distance separating medial punctures from lateral punctures. It differs from other southern South American species of *Philonthus* by the
eyes as long as temples, the antennal segments 2 and 3 subequal in length, and the first segment of hind tarsus as long as segments 2 and 3 combined, and longer than last segment. Length 4.5–5.5 mm.

Distribution. *Philonthus flavolimbatus* is widely distributed from Latin America through Caribbean islands, and North America where it occurs mainly in the southern portion of the continent (Smetana 1995).

Bionomics. *Philonthus flavolimbatus* is a common species in cattle droppings, where it may occur in high abundance, preying upon immature flies (e.g., Hu & Frank 1997; Guimarães & Mendes 1998; Cabrera-Walsh & Chani-Posse 2003). Smetana (1995) also cited this species from other organic debris.

Philonthus bonariensis Bernhauer
(Figs. 18, 51)

Diagnosis (based on Chani-Posse 2010). *Philonthus bonariensis* may be identified by the coloration pattern of the elytra, castaneous with medial and apical margins lighter or uniformly coloured (brunneous to testaceo-brunneus); the antennal segments 4 elongate and 5 quadrate, the last segment of labial palpi 2 times as long as the second, and the tergum 10 with 5 to 6 apical setae in both sexes. It differs from other southern South American species of *Philonthus* by the median lobe with a small tooth on the face adjacent to paramere, and the paramere elongate with 6–8 peg setae forming two short lateral rows at apex. Length 6.0–7.0 mm.

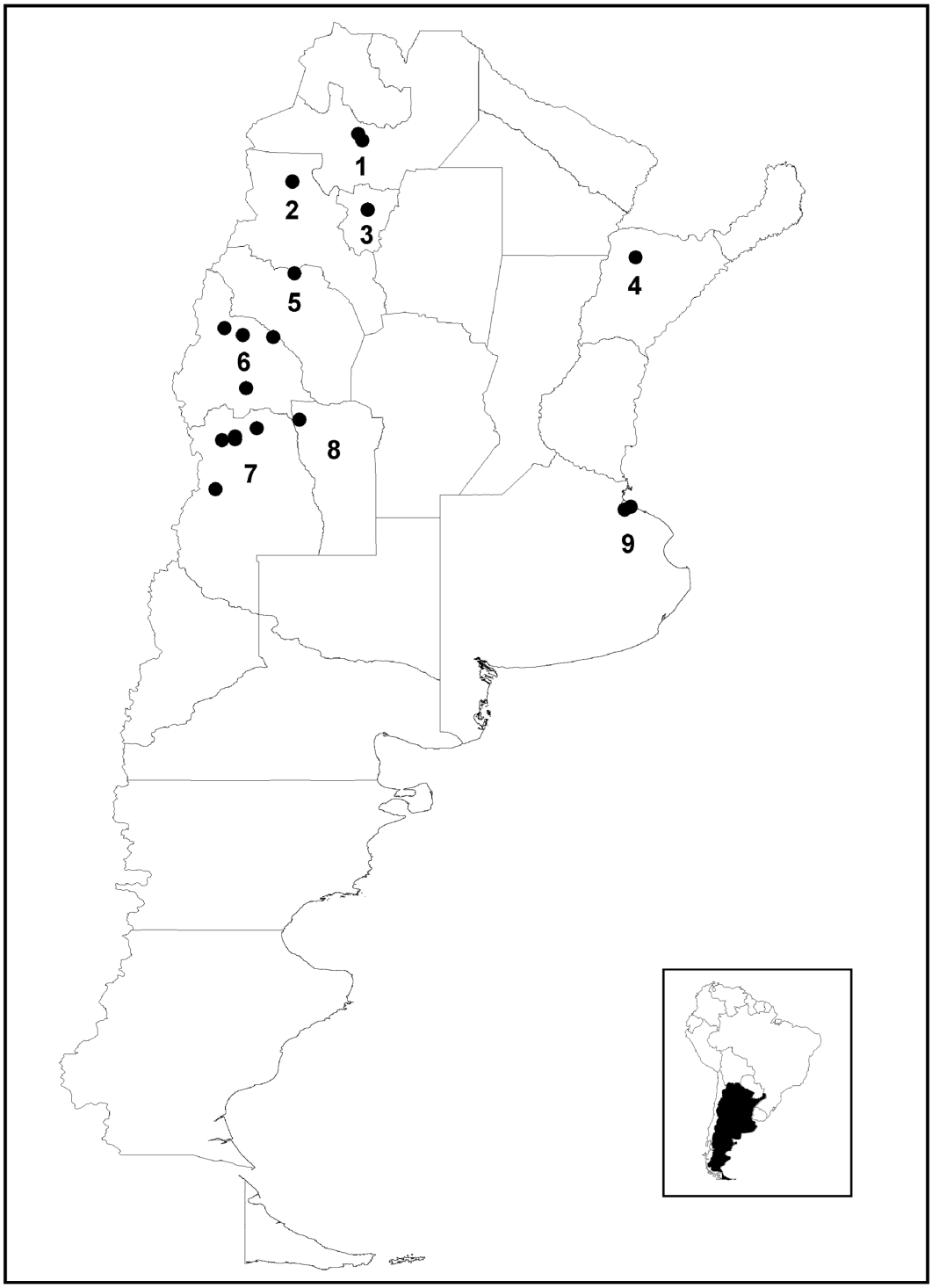

FIGURE 60. Geographical distribution of 24 species of Staphylinidae collected from carrion in nine provinces of Argentina (1–9). Provinces: **1 Salta:** *Aleochara (Aleochara) bonariensis, Creophilus maxillosus, Eulissus chalybaeus, Oligotergus ogloblini, Philonthus argus, Philonthus bicoloristylus, Philonthus bonariensis, Philonthus bruchianus, Philonthus discoideus, Philonthus flavolimbatus, Philonthus longicornis, Philonthus quadraticeps, Platydracus chrysotrichopterus, Styngetus viduus, Xenopygus analis.* **2 Catamarca***: Creophilus maxillosus.***3 Tucuman:** *Aleochara (Aleochara) bonariensis, Belonuchus rufipennis, Nordus elytisi, Platydracus scabrosus, Styngetus viduus, Styngetus viduus, Xenopygus analis.* **4 Corrientes:** *Creophilus variegatus.* **5 La Rioja:** *Creophilus maxillosus.* **6 San Juan:** *Creophilus maxillosus, Philonthus longicornis.* **7 Mendoza:** *Aleochara (Aleochara) bonariensis, Aleochara (Coprochara) signaticollis, Aleochara (Xenochara) puberula, Anotylus sp., Atheta sp., Creophilus maxillosus, Eulissus chalybaeus, Philonthus bonariensis, Philonthus longicornis, Neohypnus sp.* **8 San Luis:** *Creophilus maxillosus.* **9 Buenos Aires:** *Aleochara (Aleochara) bonariensis, Atheta sp., Creophilus maxillosus, Philonthus bonariensis.* **"●"** sampling site

Distribution. Brazil, Paraguay, Uruguay, Argentina, Chile (Chani-Posse 2010).

Bionomics. *Philonthus bonariensis* has been frequently found in cow droppings in open and wooded habitats, litter near rivers and streams, and under rocks (Chani-Posse 2010).

Philonthus longicornis Stephens
(Figs. 19, 45)

Diagnosis (based on Chani-Posse, 2010). *Philonthus longicornis* may be identified by the eyes about as long as to slightly longer than temples, the antennal segment 2 shorter than preceding segment and antennal segments 4 to 10 elongate, the dorsal rows of pronotum each with five punctures and the paramere shifted toward right margin of median lobe. Length 6.5–7.0 mm.

Distribution. *Philonthus longicornis* is currently considered a cosmopolitan species widely distributed in Central and South America (Herman 2001).

Bionomics. *Philonthus longicornis* has been frequently found in cattle manure in open pastures of North America (Hu & Frank 1997) and Argentina (Chani-Posse 2004), and also cited from other organic debris such as decaying plants, other animal droppings, carcasses, etc (Smetana 1995). This species was also collected from pig carcasses in arid environment of Argentina (Aballay *et al*. 2008, 2012).

Philonthus argus Herman
(Fig. 20)

Diagnosis (based on Chani-Posse 2010). *Philonthus argus* may be identified by the antennal segment 2 shorter than segment 3, antennal segments 4–10 elongate, the eyes as long as to slightly shorter than temples seen from above, the submentum about 1.5 times as long as mentum, the dorsal rows of pronotum each with four punctures, and the male tergum 10 emarginate medio-apically. Length 6.6–7.0 mm.

Distribution. Argentina (Chani-Posse 2010).

Bionomics. This species was collected from pig carcasses in the present study**.**

Subtribe Xanthopygina

Genus *Styngetus* Sharp

Styngetus viduus (Erichson)
(Figs. 21, 47)

Diagnosis. *Styngetus viduus* can be distinguished by the following characters: all black except the elytra, metallic blue, and the abdominal segment 8 golden-orange; antennal segments 4–7 elongate, 8–10 subquadrate; head and pronotum coarsely and sparsely puncate, disc of pronotum with a medial impunctate are; elytra finely and densely punctuate. Length 10.0–12.5 mm.

Distribution. Guatemala, Costa Rica, Panama, Colombia, Venezuela, Argentina (Herman 2001; Newton, unpublished database).

Bionomics. Species belonging to *Styngetus* has been found in carrion, dung, leaf litter and fungi in Central American pine-oak forests (Navarrete-Heredia *et al.* 2002).

Genus *Xenopygus* Bernhauer

Xenopygus analis (Erichson)
(Figs. 22, 46)

Diagnosis. *Xenopygus analis* can be distinguished by the following characters: head, pronotum and elytra of

metallic color; head and pronotum blue to greenish blue, coarsely and sparsely punctuated; elytra blue, finely and densely punctuated; abdomen shiny black with segments 7 and 8 golden-orange; antennal segments 6–10 transverse; disc of pronotum with two dorsal rows of punctures. Length 12.0–14.5 mm.

Distribution. Widespread from Mexico to Argentina (Herman 2001; Newton, unpublished database).

Bionomics. Species belonging to *Xenopygus* have been frequently found in carrion, dung and decaying fruits (Irmler 1982; Navarrete-Heredia *et al.* 2002), also in leaf litter in the Eastern Cordillera of Colombia (Gutiérrez & Chacón 2006). *Xenopygus analis* was reported as predator of both larvae and pupae of *Anastrepha* spp. (Diptera: Tephritidae) (Navarrete-Heredia *et al.* 2002), also from ant nests (Gutiérrez & Chacón 2006).

Genus *Nordus* Blackwelder

Nordus elytisi Chatzimanolis
(Fig. 23)

Diagnosis (based on Chatzimanolis 2004). *Nordus elytisi* can be distinguished from all other species of *Nordus* by the following characters: head, pronotum, elytra and scutellum golden-orange, antennal segments and legs all yellow, abdomen black except segments 1, 2, 8 and the apical third of segment 7 golden-orange; antennal segments 4 and 5 subquadrate, 6–10 transverse; disc of pronotum with large and deep punctures, medial impuctate area broadest anteriorly, large impunctate areas in anterolateral quarters and small impunctate area along posterior and posterolateral margins and the distinct shape of the aedoeagus (see Chatzimanolis 2004: 22–23). Length 9.0–9.5 mm.

Distribution. Argentina and Bolivia (Chatzimanolis 2004).

Bionomics. Species belonging to *Nordus* has been reported from fungi, carrion and human feces (Navarrete-Heredia *et al.* 2002). Chatzimanolis (2004) cites species of this genus occurring between up to 2300 m of altitude in wet tropical lowlands and cloud forests.

Genus *Oligotergus* Bierig

Oligotergus ogloblini Bernhauer
(Fig. 24)

Diagnosis. *Oligotergus ogloblini* can be distinguished by the following characters: head and pronotum dull black, coarsely and moderately punctuated, both with medial area impunctate; elytra black, finely and densely punctuated, with golden-orange pubescence; visible abdominal segments 2–7 black with apical margins increasingly golden-orange, segment golden orange; antennal segments 4–10 elongate. Length 8.5–10.0 mm.

Distribution. Argentina (Herman 2001; Newton, unpublished database).

Bionomics. Species belonging to *Oligotergus* have been mainly found in fungi, carrion, dung and decaying fruits in tropical pine forests and mountain forests (Navarrete-Heredia *et al.* 2002; Morales & Aguilar-Astudillo 2012).

Discussion

The 24 species of Staphylinidae collected in this study on carcasses in Argentina are grouped into three of the 32 subfamilies of Staphylinidae known worldwide: Aleocharinae (three species of *Aleochara* Gravenhorst and one species of *Atheta* Thomson), Oxytelinae (one species of *Anotylus* Thomson) and Staphylininae (19 species, two belonging to the tribe Xantholinini and 17 species belonging to the tribe Staphylinini).

With exception of *Anotylus* sp. (Oxytelinae), all of these species prey, as both larvae and adults, on fly immatures (necrophilous). As such, they mainly occur in fly-infested habitats such as animal droppings, carrion, and decaying organic matter such as forest litter, fungi and decaying fruits. *Aleochara* larvae are ectoparasites of

dipteran puparia (Klimaszewski 1984). The females lay their eggs in sites infested with fly larvae, and the newly emerged first-instar larvae hunt for dipteran pupae, feeding on them until pupation takes place, either in the soil or within host puparia (Klimaszewski & Jansen 1993). Species of this genus have been reported of great importance to determine the PMI (Mise *et al.* 2007; Lin & Shiao 2013). *Creophilus maxillosus* is a common fly predator associated with decomposing cadavers and carcasses and it is one of the most cited species in the forensic literature, due to its utility for the estimation of both the PMI and the PAI (e.g., Battán Horenstein *et al.* 2012; Matuszewski 2012; Matuszewski & Szafalowicz 2013). *Philonthus* species have been also repeatedly found in association with carcasses (e.g., Matuszewski *et al.* 2010; Fernández *et al.* 2010; Aballay *et al*. 2008, 2012; Matuszewski & Szafalowicz 2013), but their potential as forensic indicators has been much less assessed as well as that of species belonging to other Staphylininae genera cited in the present study.

Further research is needed to determine the specific time period in the cadaver succession for which other species studied herein could be used to estimate PMI indicators based on succession patterns. Additionally, immature stages may also be useful in forensic entomology because they are reared within the body and were collected in advanced stages of decomposition (Aballay pers. obs.). We expect that this key will contribute to further studies on the potential role of carrion-frequenting Staphylinidae as PMI indicators.

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