Diagnosis and key of the main families and species of South American Coleoptera of forensic importance[1]

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ABSTRACT. Diagnosis and key of the main families and species of South American Coleoptera of forensic importance. The objective of this paper is to provide diagnosis and keys of the families and species, with illustrations of the main groups. A table of all related species recorded from South America is presented, including the substrate in which they were collected and their geographical distribution. The list comprises 221 species included in 15 families, of which 70% of the species are from Brazil. Scarabaeidae is the most diverse family with 121 species, followed by Staphylinidae with 68. Also we provide one database of Coleoptera species associated with carcasses in South America.

KEYWORDS. Forensic entomology; necrophilous beetles; Neotropical region; taxonomy.

RESUMO. Diagnose e chave de identificação para as principais famílias e espécies de Coleoptera de importância forense da América do Sul. O objetivo deste trabalho é apresentar diagnoses e chaves de identificação das principais famílias e espécies de importância forense, com ilustrações dos principais grupos. É apresentada uma tabela de todas as espécies de ocorrência na América do Sul, incluindo o substrato nas quais foram coletadas e sua distribuição geográfica. A lista compreende 221 espécies incluídas em 15 famílias, das quais pelo menos 70% das espécies são distribuídas no Brasil. Scarabaeidae é a família com maior diversidade com 121 espécies, seguida por Staphylinidae com 68. Também é fornecida uma base de dados para as espécies de Coleoptera associadas a carcaças na América do Sul.

PALAVRAS-CHAVE. Besouros necrófilos; entomologia forense; neotropical; taxonomia.

Coleoptera is the second largest order of forensic interest, with several necrophagous representatives, most being predators but their feeding habit may change between larval stages and adulthood. The species of Coleoptera increase in number both of individuals and species during advanced stages of decomposition in open environment and are absent or less represented indoors (Goff 1991). Beetles are encountered in great numbers during the faunal succession process, moreover their biological traits may be used to estimate the *post mortem* interval.

According to Smith (1986) the families of Coleoptera of forensic interest are: Carabidae, Hydrophilidae, Silphidae, Leiodidae, Staphylinidae, Histeridae, Cleridae, Anthicidae, Dermestidae, Nitidulidae, Rhizophagidae, Ptinidae, Tenebrionidae, Scarabaeidae, Geotrupidae and Trogidae.

In Brazil one of the most comprehensive studies of this fauna was done by Luederwaldt (1911), who found about 62 species related to carcasses. Subsequently papers were mainly focused on Diptera, but some of them reported Coleoptera species.

Some authors aimed on specific families contributing with taxonomic or survey studies of necrophilous beetles. Pessôa & Lane (1941) did studies on Scarabaeinae fauna of legal medicine interest, found in São Paulo and neighborhood (southeast of Brazil) comprising 113 species of 26 genera.

The fauna of Staphylinidae was studied by Jimenez-Sanchez *et al.* (2000) on Nanchititla, Mexico. The 50 species in their study were collected with traps using squid as bait.

Scampini *et al.* (2002) found six species of Carabidae from Buenos Aires (Santa Catalina), Argentina, using pig carcasses and pit-fall traps during three months.

Souza & Linhares (1997) studied Diptera and Coleoptera collected in pig carcass and reported 13 species in five families, of which Staphylinidae had greater number of species, only two being identified to the species level.

A study conducted by Mise *et al.* (2007) focusing on Coleoptera took place in Curitiba for one year using pig carcass with Shannon modified, pit-fall traps and active sampling. There were found 4,360 beetles belonging to 112 species of 26 families, 12 of them were considered of forensic potential.

In South America and in Brazil, the majority of studies focuses mainly on Diptera, one of the reasons is due to difficulties in identifying the species of Coleoptera. There are no published records of Coleoptera of forensic importance in South America in a checklist and this data will be useful to start a database of the fauna of Coleoptera associated with different kinds of carcasses.

Due to the importance of the beetles to forensic sciences and the few studies in the Coleoptera fauna of South America, the purpose of this paper is to provide data about the families

and species, with brief descriptions, identification keys and illustrations for the main groups. Also when available the alimentary habits of the species had been added.

MATERIAL AND METHODS

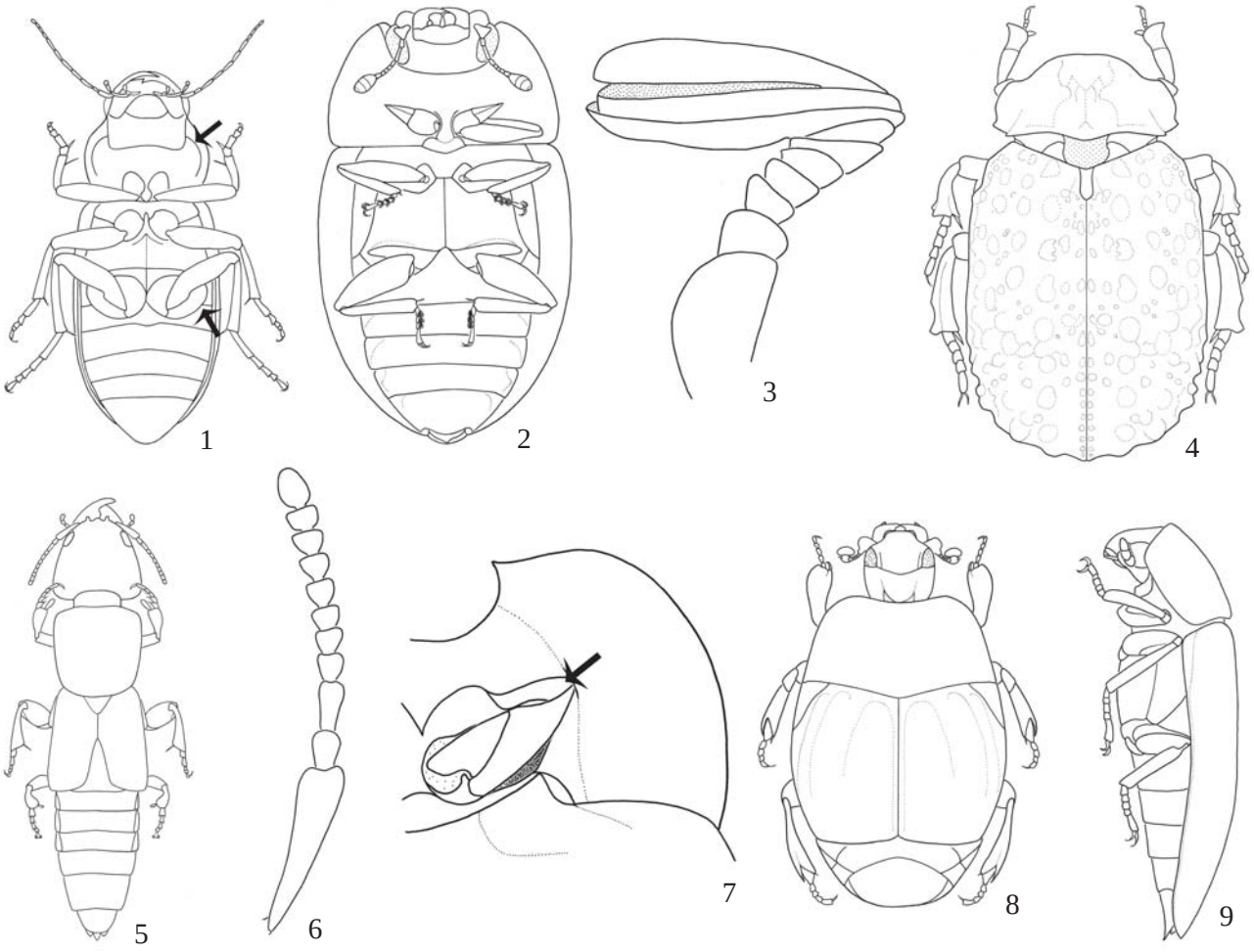
Taxa were arranged in alphabetical order at family, genera and species level, when possible, followed by the substratum, geographical distribution and references. White (1983), Booth *et al.* (1990), Kingsolver (1991), Borror *et al.* (1992), Costa (2000), Newton *et al*. (2005) and Costa *et al.* (2006) were used for the families descriptions, their ecological data and number of genera and species.

The list of the important groups of Coleoptera show different species found on different animal carcasses across the Neotropical region. Many species were reported only once because there is a huge difference among regions. This could be due to the endemism of certain species, outlining the importance of regional surveys, which could indicate the species of Coleoptera of potential forensic importance.

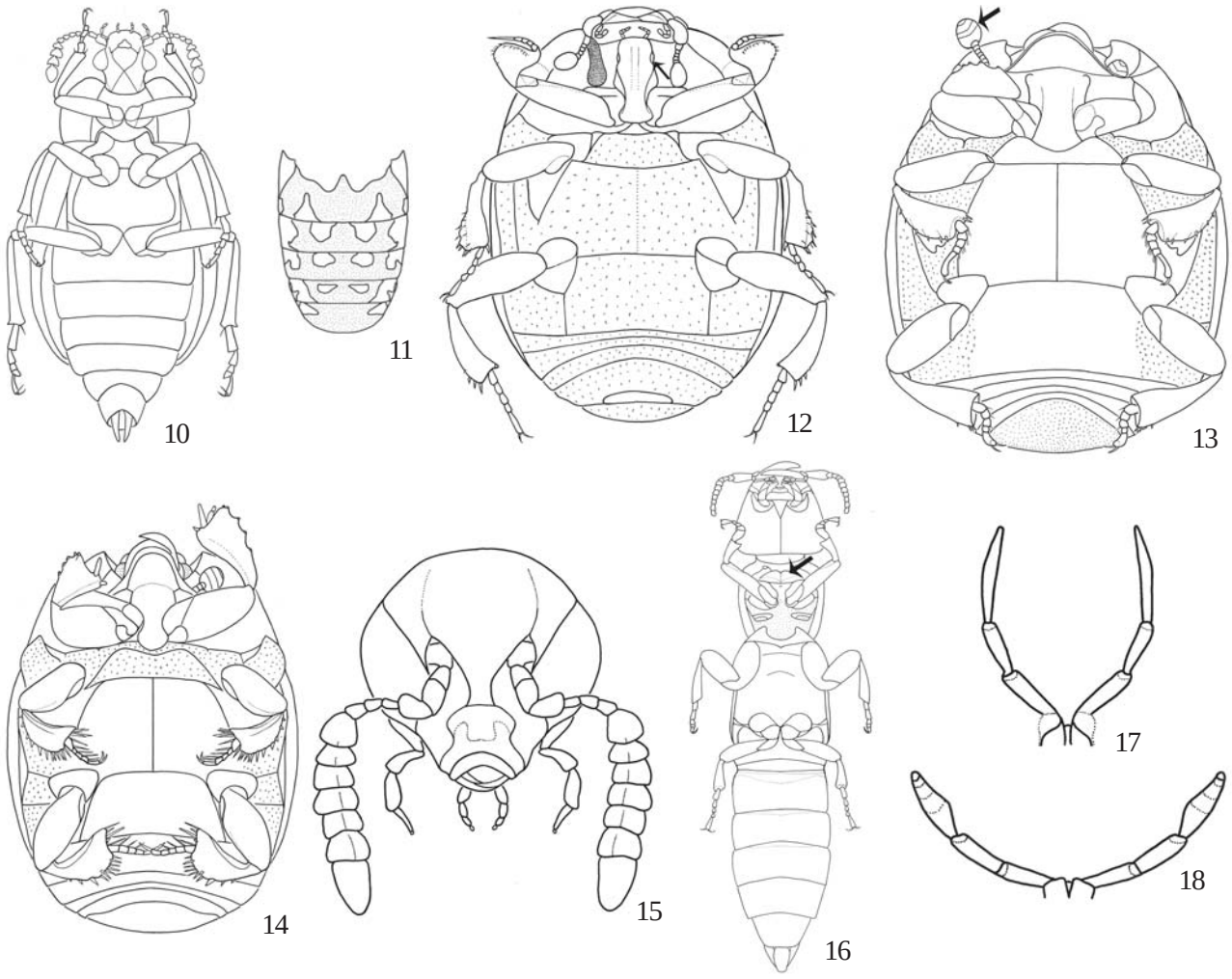
The keys from the most general to the most specific, deal with beetles associated with decomposing animal carcasses. Accidental families, genera and species are not included because the lack of specimens or literature.

RESULTS

The list of the main Coleoptera species of forensic importance has 221 species included in 15 families; however this is a conservative estimate, considering that most of the specimens cited in papers are not identified at species level (Table I). At least 70% of the species occurs in Brazil, being Scarabaeidae the most diverse family with 122 species, followed by Staphylinidae with 69. Also we provide a diagnosis and keys of the families and species, with illustrations to enable the identification of the main groups.



Figs. 1–9. Ventral view: 1, Adephaga (notopleural suture; first abdominal sternite divided by metacoxal cavities); 2, Polyphaga; 3, lamellated antennae: Scarabaeidae; dorsal view: 4, *Polynoncus* sp. (Trogidae); 5, *Eulissus chalybaeus* (Staphylinidae); 6, antennae: Staphylinidae; 7, prothorax ventral view: *Oxelytrum discicolle* (Silphidae) (exposed trochantin); 8, dorsal view: Histeridae; 9, lateral view: *Dermestes maculatus* (Dermestidae).



Figs. 10–18. Ventral view: 10, *Oxelytrum discicolle* (Silphidae); 11, abdomen: *Dermestes ater* (Dermestidae); 12, *Euspilotus nigrita* (Histeridae) (preapical fovea); 13, *Omalodes* sp. (Histeridae) (V-shaped antennal sutures); 14, *Hister* sp. (Histeridae); 15, frontal view of head: *Aleochara* sp. (Staphylinidae); 16, ventral view: *Eulissus chalybaeus* (Staphylinidae) (sclerotized plate in front of prosternum); maxillary palpi: 17, *Belonuchus* sp.; 18, *Philonthus* sp. (Staphylinidae).

Key of South American Coleoptera of forensic importance

1. Notopleural suture distinct; metatrochanter very large; first visible abdominal sternite divided by metacoxae (Fig. 1) ..... (Suborder Adephaga) Carabidae
   Without notopleural suture; first visible abdominal sternite entire (Fig. 2) ..... (Suborder Polyphaga) 2

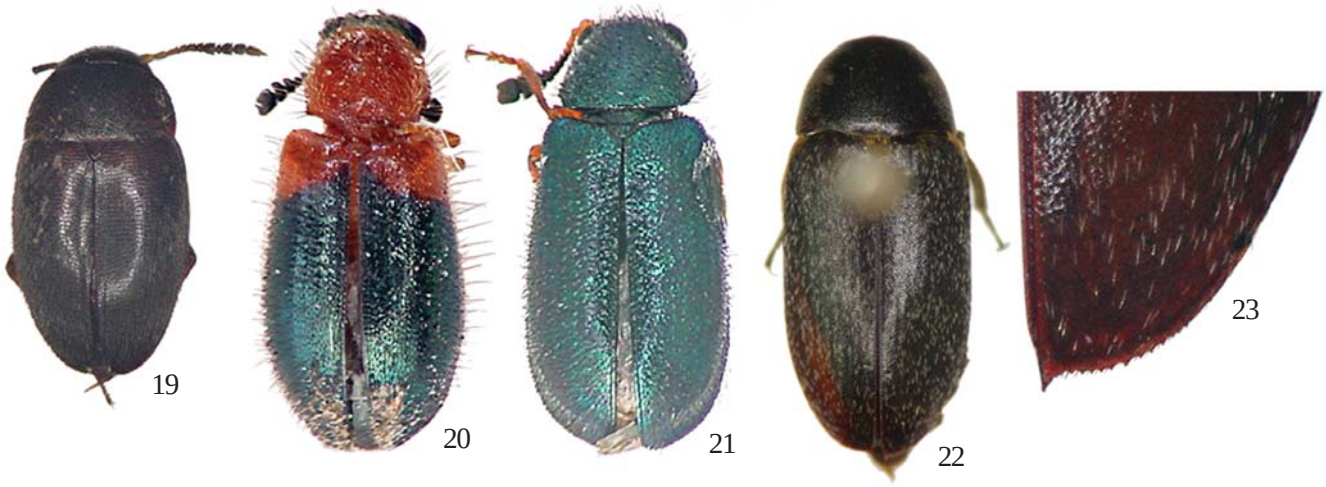
2. Antennae lamellated (Fig. 3) 3
   Antennae not lamellated 4

3. Clypeus large covering labrum in dorsal view; mandible usually hidden from above; abdomen with 5 or 6 visible segments ..... Scarabaeidae
   Head bent down almost hypognathous; labrum distinct and bent down; mandible proeminent not covered by clypeus; elytra often with tubercles (Fig. 4); abdomen with 5 visible segments ..... Trogidae

4. Head prognathous; elytra usually very short and truncate, exposing more than three abdominal tergites (Fig. 5); antennae filiform or moniliform, occasionally with weak club (Fig. 6); tarsal formula variable, 3-3-3 to 5-5-5; abdomen usually capable of being flexed ... Staphylinidae
   Without the above combination of characters 5

5. Antennae with a compact club; elytra often short and truncate exposing abdominal tergites or entire 6
   Without the above combination of characters 7

6. Procoxae transverse with exposed trochantin (Fig. 7); tarsal formula often 5-5-5 with 4th reduced ..... Nitidulidae
   Procoxae transverse without exposed trochantin; elytra often short and truncate exposing pygidium and propygidium (Fig. 8); tibiae flattened with spines or teeth, tarsal formula 5-5-5, rarely 5-5-4 ..... Histeridae



Figs. 19–23. Habitus: 19, *Dissochaetus murray* (Leiodidae); 20, *Necrobia ruficollis*; 21, *Necrobia rufipes* (Cleridae); 22, *Dermestes maculatus*; 23, elytral apex: *Dermestes maculatus* (Dermestidae).

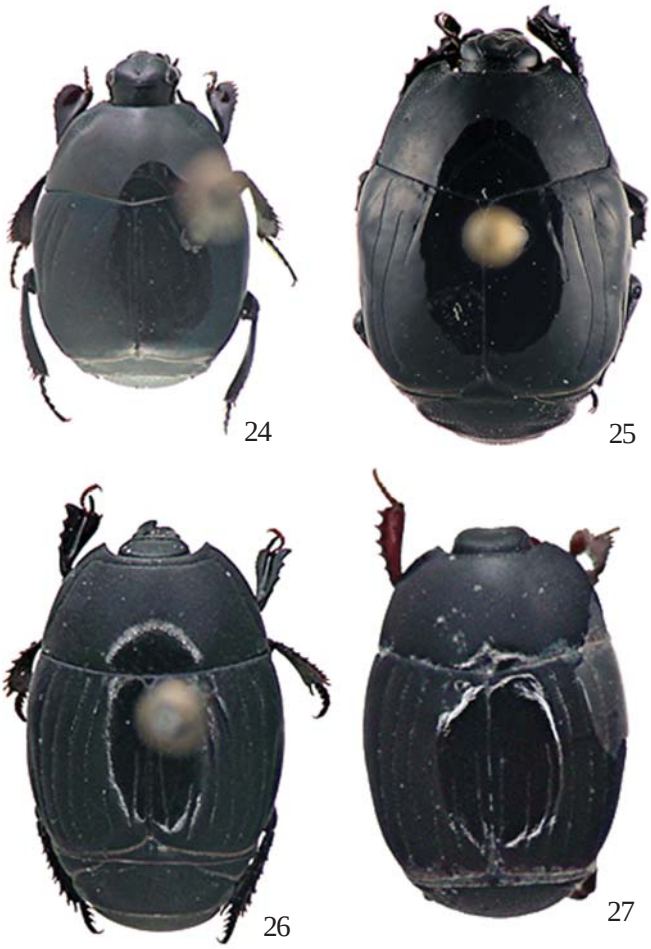
7. Body usually oval in shape; sometimes parallel sided; antennae short with a four segmented club, basal segment shiny, the apical three segments pubescent; maxillary palpi long often longer than antennae; procoxae conical; tibiae often spinose with two usually large spurs; tarsi usually 5-5-5; abdomen with 5 visible sternites ..... Hydrophilidae
   Without the above combination of characters 8

8. Tarsal formula 5-5-4 ..... Tenebrionidae
   Tarsal formula 5-5-5 9

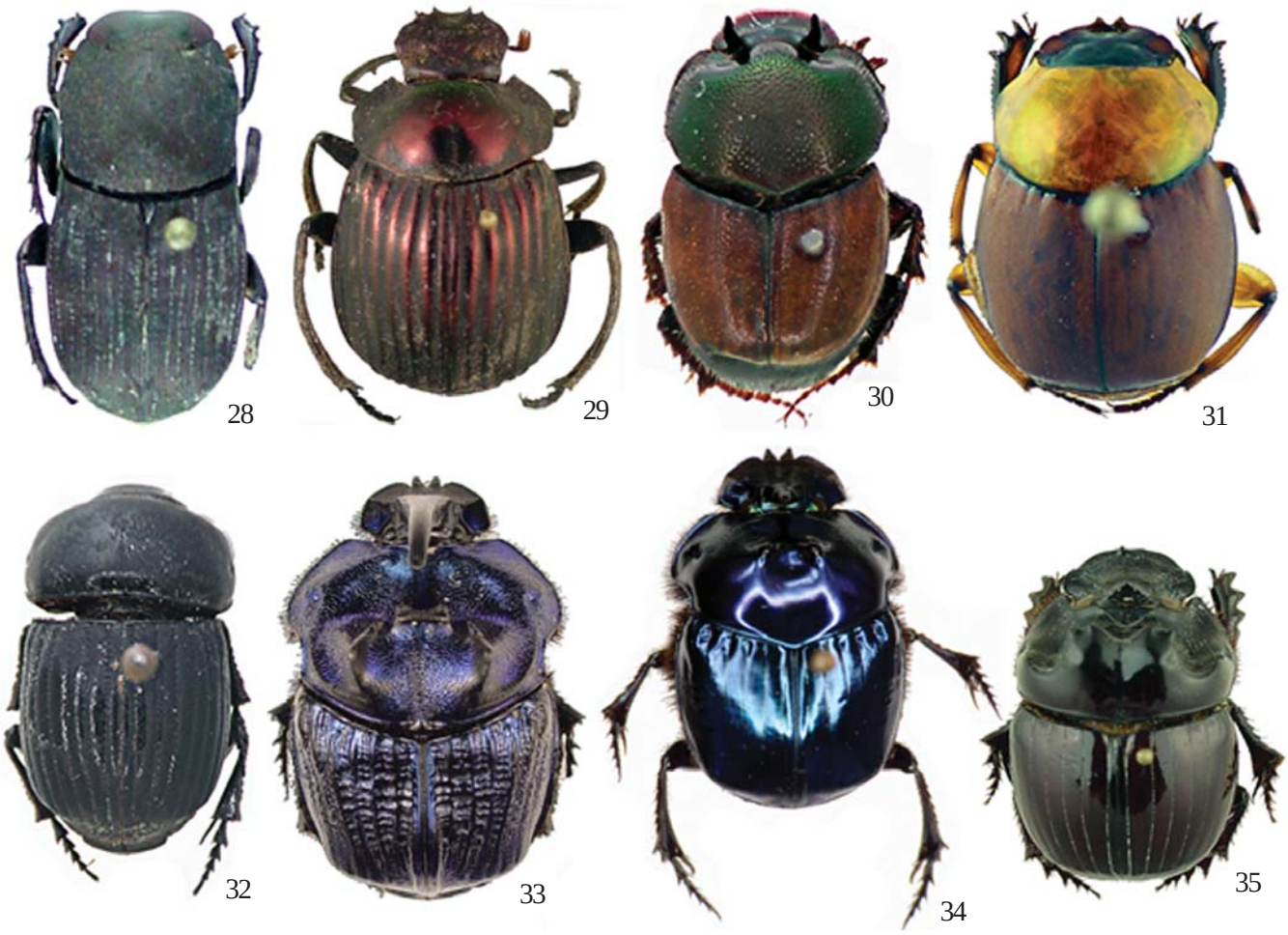
9. Head flattened, inserted in broad imargination of pronotum; antennae 10-11 segmented usually capitate with a loose club but may be compact, club 3-5 segmented; abdomen with 5 visible sternites the sixth often partially visible ..... Leiodidae
   Body castaneus covered with decumbent hairs; antennae with a loose club, the eighth segment reduced and the eleventh pointed; approximately 2,33 mm (Fig. 19) ..... *Dissochaetus murray* Reitter, 1884
   Without the above combination of characters 10

10. Head hypognathous (Fig. 9) 11
    Head not as above; antennae sub-clubbed or clubbed with 10 or 11 segments (Fig. 10), segments 9-11 with dense pubescence; trochantin exposed (Fig. 7); elytra often with longitudinal striae, color black, testaceous, or black with orange or yellow markings, sometimes with pronotum tomentose, parcial or totally colored of yellow or reddish ..... Silphidae

11. Metacoxae often excavated for reception of metafemora; frons often with median ocellus; antennae short usually clubbed often received into grooves on underside of prothorax; five visible sternites ..... Dermestidae
    Body elongated, covered with bristly hairs; frons oblique and eyes large; antennae not received into grooves on underside of prothorax; pronotum narrower than elytra, often nearly cylindrical; procoxae usually conical; tarsal formula 5-5-5 or sometimes pseudotetramerous .. Cleridae



Figs. 24–27. Habitus of Histeridae. 24, *Euspilotus nigrita*; 25, *Omalodes bifoveolatus*; 26, *Hister* sp.; 27, *Phelister* sp..



Figs. 28–35. Habitus of Scarabaeidae. 28, *Eurysternus* sp.; 29, *Deltochilum icarus*; 30, *Onthophagus buculus*; 31, *Canthon triangularis*; 32, *Ontherus* sp.; 33, *Coprophanaeus lancifer*; 34, *Coprophanaeus saphirinus*; 35, *Dichotomius boreus*.

Key to species of Cleridae

1. Head, pronotum and elytra base reddish brown and the rest of the elytra metallic blue; approximately 4,77 mm (Fig. 20) ..... *Necrobia ruficollis* (Fabricius, 1775)
   Body metallic blue (Fig. 21); approximately 5,17 mm .... *Necrobia rufipes* (De Geer, 1775)

Key to species of Dermestidae

1. Elytra apex serrate with a small terminal spine (Figs. 22 e 23); approximately 9,16 mm .... *Dermestes maculatus* (De Geer, 1774)
   Elytra apex entire lacking serration and spines 2

2. Abdominal venter without pattern; lateral sulcus of abdominal sternum I closely parallel to lateral margin; approximately 8,5 mm .... *Dermestes peruvianus* Laporte, 1840
   Abdominal venter patterned (Fig. 11); lateral sulcus of abdominal sternum I not closely parallel to lateral margin; approximately 8 mm ..... *Dermestes ater* (De Geer, 1774)

Key to species of Histeridae

1. Small sized beetles (<0,3mm); antennal insertions usually exposed; elytra at most with vague impressions; scutellum hidden; hind tarsi with four segments .. *Aeletes*
   Without the above combination of characters; large sized beetles (>0,3mm) 2

2. Prosternum with an antennal cavity for reception of antennae 3
   Prosternum not as above 4

3. Prosternal process with a preapical fovea (Fig. 12) .... *Euspilotus*
   Lateral lobe of the abdominal 8th tergite with rounded apex; pygidial line rounded at apex (sometimes weakly sinuated or interrupted); size approximately 7,66 mm (Fig. 24) ..... *Euspilotus nigrita* (Blanchard, 1842)
   Prosternal process without a preapical fovea ..... *Saprinus*

4. Antennal club with two oblique sutures, V-shaped (Figs. 13 e 25) ..... *Omalodes*

36 37 38

Figs. 36–38. Habitus of Silphidae. 36, *Oxelytrum discicolle*; 37, *Oxelytrum erythrurum*; 38, *Oxelytrum cayennense*.

Pronotum with two fovea on the lateral sides; size approximately 11 mm (Fig. 25) .... *Omalodes bifoveolatus* (Marseul, 1853)
Antennal club not as above 4

5. Antennal club with two annuli (Fig. 14); frontal suture, if present, distant from antennal base (Fig. 26) ..... *Hister*
Antennal club with only a straight, transverse subapical annulus of short setae; frontal striae reaching the antennal base, if present (Fig. 27) ..... *Phelister*

Key to species of Scarabaeidae

1. Mid coxae with external lateral border parallel to the body axis and located in the lateral of the metasternum in the limit of the lateral border of the body (Fig. 28) .... *Eurysternus*
Without the above combination of characters 2

2. Elytral apex with carinae or distinct tubercles between the interstriae ..... *Deltochilum*
Clypeus with four teeth; elytrae with numerous striae; metallic colored; size approximately 26 mm (Fig. 29) ..... *Deltochilum icarus* (Olivier, 1789)
Without the above combination of characters 3

3. Body length less than 12 mm; elytra and pronotum hairy; first tarsal segment of posterior leg almost as longer as the others together (Fig. 30) ..... *Onthophagus*
Without the above combination of characters 4

4. Pigidium flattened, with dull shine ..... *Canthon*
Pronotum shining yellow colored; elytrae brownish-yellow and opacous; size approximately 11 mm (Fig. 31) .... *Canthon triangularis* (Drury, 1770)
Without the above combination of characters 5

5. Body oval elongated; colour usually black, sometimes green or blue; abdominal sternites fused and very short (Fig. 32) ..... *Ontherus*
Without the above combination of characters 6

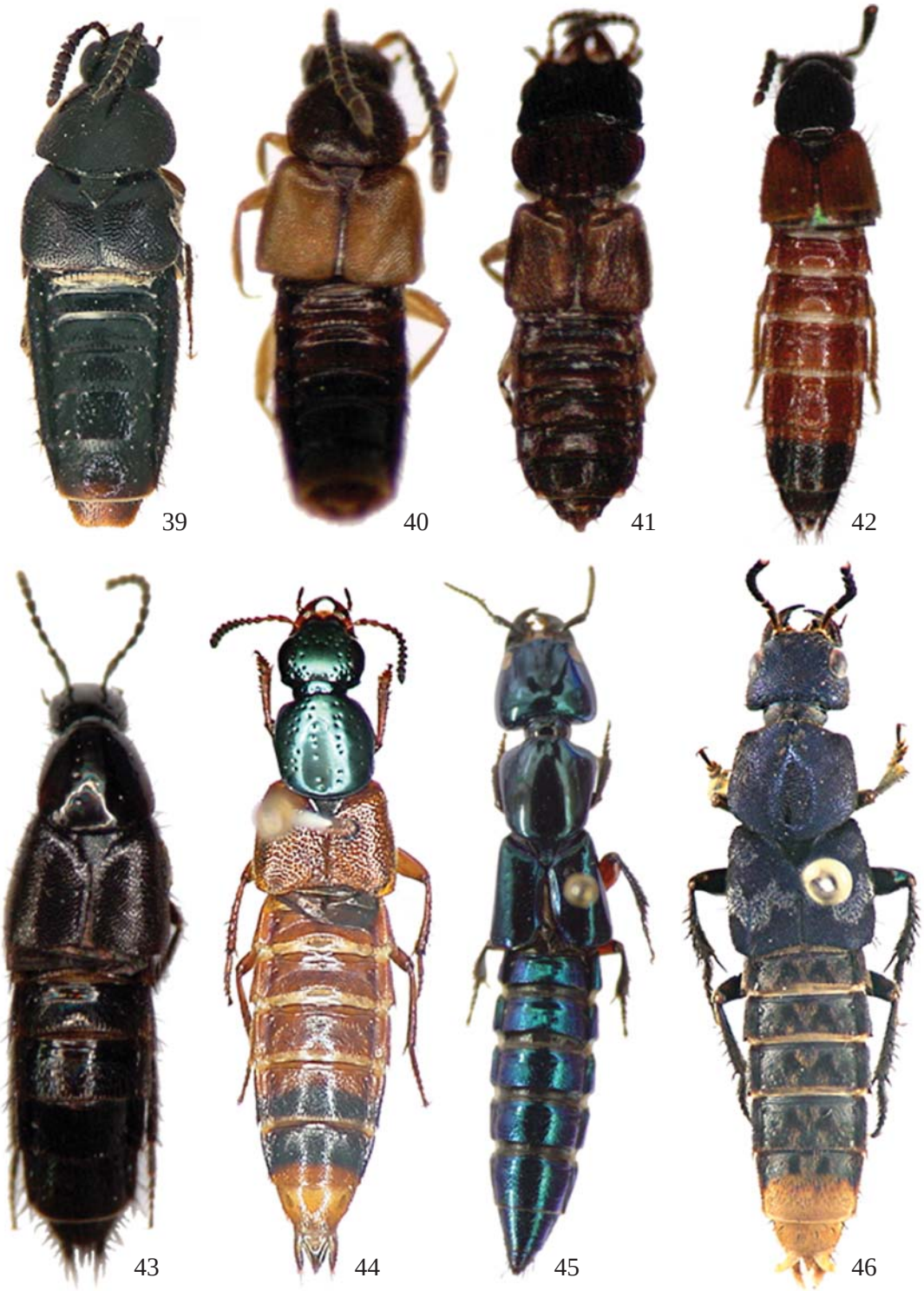
6. Antennal club with segments wide and flattened; anterior margin of clypeus with three emarginations, with two proeminent teeth and two lateral round angles; first segment of mid and hind tarsus elongated, longer than wide ..... *Coprophanaeus*
Metallic bluish colored with integument hardly puncturate; size approximately 37 mm (Fig. 33) .... *Coprophaneus lancifer* (Linnaeus, 1767)
Metallic bluish colored with integument smooth; size approximately 19 mm (Fig. 34) .... *Coprophaneus saphirinus* (Sturm, 1826)

7. Antennal club with segments elongated and thin; anterior margin of clypeus without emargination, with two short teeth ..... *Dichotomius*
Protibiae with a slender spine in the apice; size approximately 22 mm (Fig. 35) ..... *Dichotomius boreus* (Olivier, 1789)

Key to species of Silphidae

1. With a tooth in the humeral region of the elytra; size approximately 17 mm (Fig. 36) .... *Oxelytrum discicolle* (Brullé, 1840)
Without a tooth or only with a small protuberance in the humeral region of the elytra; size approximately 16 mm 2

2. Pronotum with a maculae quadrangular-shaped, occupying most of the pronotal disk (Fig. 37) .... *Oxelytrum erythrurum* (Blanchard, 1840)



Figs. 39–46. Habitus of Staphylinidae. 39, *Aleochara* sp.; 40, *Atheta* sp.; 41, *Anotylus* sp.; 42, *Belonuchus* sp.; 43, *Philonthus* sp.; 44, *Xanthopygus bicolor*; 45, *Eulissus chalybaeus*; 46, *Platydracus ochropygus*.

Pronotum with uniform color or with the maculae rounded, occupying the center of the pronotal disk (Fig. 38) .... *Oxelytrum cayennense* (Sturm, 1826)

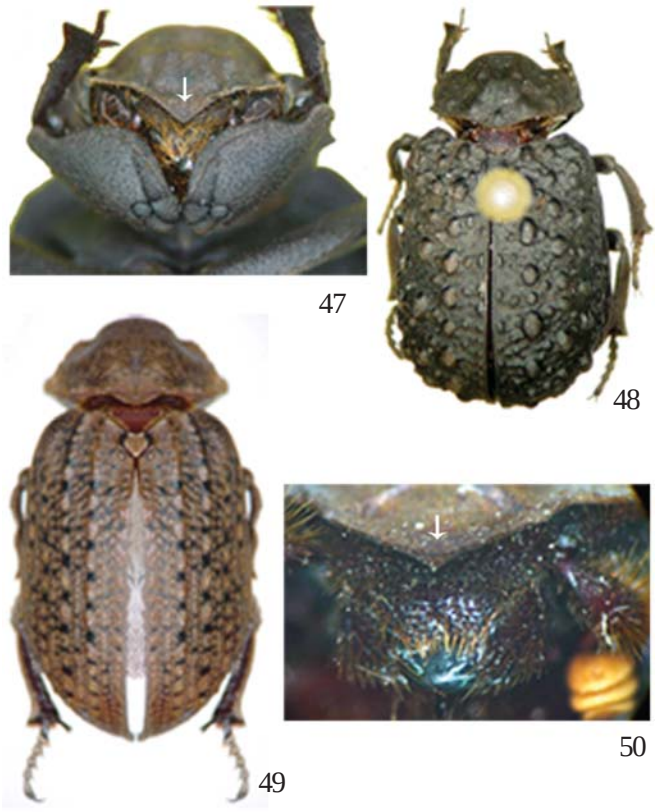
Key to species of Staphylinidae

1. Antennae inserted before anterior margin of eyes 2

Antennae inserted between eyes (Fig. 15) .... Aleocharinae

Maxilar palpi with five segments, the apical minute (pseudosegment) (Figs. 15 e 39) ..... *Aleochara*

Maxilar palpi with four segments, without pseudosegment (Fig. 40) ..... *Atheta*



Figs. 47–50. Trogidae. Head, frontal view: 47, *Polynonchus* sp. (clypeus); Habitus: 48, *Polynonchus* sp.; 49, *Omorgus* sp.; head, frontal view: 50, *Omorgus* sp. (clypeus).

2. Abdomen with seven visible sternites ..... Oxytelinae
Scutellum with a diamond shaped impression; abdominal tergum II with curved basal lateral ridge ..... *Oxytelus*
Scutellum with a tri- or bilobed impression; abdominal tergum II without curved basal lateral ridge (Fig. 41) ..... *Anotylus*

2'. Abdomen with six visible sternites ..... Staphylininae
a. The first visible segment of abdominal terga with impressed curved line ..... *Xanthopygus*
Head and pronotum green bluish colored; elytrae and basal segments of abdomen yellow brownish; size approximately 14 mm (Fig. 44) .... *Xanthopygus bicolor* (LaPorte, 1835)
a'. Without above combination of characters ..... b
b. With sclerotized plate in front of prosternum (Figs. 16) ..... *Eulissus*
Body green bluish, size approximately 21 mm (Fig. 45) .... *Eulissus chalybaeus* (Mannerheim, 1830)
b'. Without sclerotized plate in front of prosternum c
c. Pronotum with translucent post-coxal process . *Platydracus*
Head, pronotum and elytrae metallic bluish; abdomen black, with the three last segments yellow colored; size approximately 16 mm (Fig. 46) .... *Platydracus ochropygus* (Nordman, 1837)
c'. Without above combination of characters ..... d
d. Apical segment of maxilar palpi twice the size of the penultimate segment (Figs. 17, 42) ..... *Belonuchus*
d'. Apical segment of maxilar palpi more or less of the same size of the penultimate segment (Figs. 18, 43) .... *Philonthus*

Key to species of Trogidae
1. Clypeus forming a 90° angle with frons (Figs. 47, 48) ..... *Polynoncus*
Clypeus not forming a 90° angle with frons (Figs. 49, 50) ..... *Omorgus*

Characteristics of families and species

Carabidae. Ground beetles. A family with about 1,500 genera and 30,000 species, with 336 genera and 6,258 species in the Neotropical region. Usually found under stones, logs, leaves, bark and debris. The larvae and adults hide during the day and feed at night, preferring to walk rather than fly. Most of them are predators of other insects and may be used in biological control. Some species feed on dead or dying insects and others on living insects, such as maggots, beetle larvae, etc.

Cleridae. Checkered beetles. A family with about 150 genera and 4,000 species, with 61 genera and 886 species in the Neotropical region. They attack insects specially wood-boring beetles. The adults are very active specially during the day. They are often found on flowers, foliage and tree trunks. *Necrobia ruficollis* (Fabricius, 1775) and *Necrobia rufipes* (DeGeer, 1775) occur in carrion and products of animal origin.

Necrobia rufipes is predator of dipteran and coleopteran larvae. It is also associated with stored meats, such as dry fish, skin, dead animal bones, some oily seeds and stored products, mainly those with high protein indices, being also found in animal rations (Gredilha *et al.* 2005; Ashman 1963).

Dermestidae. Odd beetles. A family with about 45 genera and 850 species, with 20 genera and 248 species in the Neotropical region. Also known as skin beetles, they are primarily scavengers that feed on dried skin and other soft remains of animals such as fur, feathers, wool and leather. They also feed on carpets, silk, dried meats and dead insects. Some are pests of storage products such as grains, seeds, corks or cereal products.

Dermestes maculatus De Geer is a notorious pest of dried fish and fish meal, is known to damage wooden frames as well as polystyrene and glass fibre wadding in premises when the last instar larva is about to pupate (Turner 1986; Wildey & Wayman 1979). The insect pests of dried animal products also attack living insects *Dermestes* spp. on silkworm pupae and adults (Kumar *et al.* 1988; Veer *et al.* 1996). Use of infested woolen materials can cause allergic reactions like urticarial and papulovesicular lesions in man (Ahmed *et al.* 1981).

Histeridae. Clown beetles. A family with about 200 genera and 3,000 species, with 139 genera and 1,047 species in the

Table I. List of the main Coleoptera species of forensic importance from South America and their respective substratum/carcasses, geographic distribution and references.

Families/species	Substratum/ carcasses	Geographic distribution	References
Carabidae			
Argutoridius bonariensis (Dejean)	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Bradycellus (*Bradycellus*) sp.	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Loxandrus confusus (Dejean)	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Loxandrus planicollis Straneo	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Loxandrus simplex (Dejean)	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Taeniolobus crenulatus Chaudoir (?)	general	São Paulo, Brazil	Luederwaldt 1911
Trirammatus (*Feroniomorpha*) *striatulus* (Fabricius)	Pig	Buenos Aires, Argentina	Scampini *et al.* 2002
Carabidae sp.	Human corpses; pig	Campinas, Brazil	Carvalho *et al.* 2000
Carabidae sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Carabidae sp.	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Carabidae sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Carabidae sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Carabidae sp.3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Carabidae sp.4	Pig	Curitiba, Brazil	Mise *et al.* 2007
Carabidae sp.5	Pig	Curitiba, Brazil	Mise *et al.* 2007
Cleridae			
Necrobia ruficollis (Fabricius)	Pig and other carcasses	Campinas, São Paulo and Curitiba, Brazil; Buenos Aires, Argentina	Luederwaldt 1911; Centeno *et al.* 2002; Mise *et al.* 2007
Necrobia rufipes (De Geer)	Human corpses; pig and other carcasses	São Paulo, Campinas and Curitiba, Brazil; Medellín, Colombia; Buenos Aires, Argentina; Callao, Peru	Luederwaldt 1911; Souza & Linhares 1997; Carvalho *et al.* 2000; Wolff *et al.* 2001; Centeno *et al.* 2002; Iannacone 2003; Carvalho *et al.* 2004; Mise *et al.*2007
Cleridae sp.	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Dermestidae			
Dermestes ater De Geer	Pig	Buenos Aires, Argentina	Centeno *et al.* 2002
Dermestes carnivorus (Fabricius)	Dog	San José, Costa Rica	Jirón & Cartín 1981
Dermestes maculatus (De Geer)	Human corpses; pig, rat and other carcasses	Campinas and Curitiba, Brazil; Buenos Aires, Argentina; Altos de Pipe (Caracas), Venezuela; Callao, Peru	Souza & Linhares 1997; Carvalho *et al.* 2000; Centeno *et al.* 2002; Iannacone 2003; Velásquez 2007; Carvalho *et al.* 2004; Mise *et al.* 2007
Dermestes peruvianus Laporte	Pig	Campinas, Brazil	Souza & Linhares 1997
Dermestes sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Dermestes sp.	general	São Paulo, Brazil	Luederwaldt 1911
Geotrupidae	Dog	San José, Costa Rica	Jirón & Cartín 1981
Histeridae			
Euspilotus aenicollis Marshall	Dog	San José, Costa Rica	Jirón & Cartín 1981
Euspilotus nigrita (Blanchard) (=*Euspilotus azureus)*	Pig	Curitiba, Brazil	Mise *et al.* 2007
Euspilotus sp.	Pig	Campinas, Brazil	Souza & Linhares 1997
Euspilotus sp.	Pig	Campinas, Brazil	Carvalho *et al.* 2000
Euspilotus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Geomysaprinus (Priscosaprinus) belioculus (Marseul)	Dog	San José, Costa Rica	Jirón & Cartín 1981
Hister punctiger LeConte	Dog	San José, Costa Rica	Jirón & Cartín 1981
Hister sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Hister sp.	Pig	Buenos Aires, Argentina	Centeno *et al.* 2002
Hister sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Saprinus aeneus Fabricius	Pig	Callao, Peru	Iannacone 2003
Saprinus azureus (Sahlberg)	Pig	Campinas, Brazil	Souza & Linhares 1997
Saprinus patagonicus Blanchard	Pig	Buenos Aires, Argentina	Centeno et al. 2002
Omalodes bifoveolatus (Marseul)	Pig	Manaus, Brazil	in this paper
Omalodes sp.	Pig	Campinas, Brazil	Souza & Linhares 1997
Omalodes sp.	Pig	Campinas, Brazil	Carvalho *et al.* 2000
Phelister sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Histeridae sp.	Rat	Campinas, Brazil	Monteiro-Filho & Penereiro 1987
Histeridae sp.	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Histeridae sp.	Rat	Altos de Pipe (Caracas), Venezuela	Velásquez 2007
Histeridae spp.	Pig and other carcasses	Campinas and São Paulo, Brazil	Luederwaldt 1911; Carvalho *et al.* 2004
Hydrophilidae			
Hydrophilidae sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Hydrophilidae sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Hydrophilidae sp.3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Hydrophilidae sp.4	Pig	Curitiba, Brazil	Mise *et al.* 2007
Leiodidae (=Cholevidae)			
Dissochaetus murray Reitter	Rat	Curitiba, Brazil	Moura *et al.* 1997
Hydnobius sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Leiodidae sp.	Rat	Altos de Pipe (Caracas), Venezuela	Velásquez 2007
Nitidulidae			
Carpophilus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Nitidulidae sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Nitidulidae sp.	Rat	Campinas, Brazil	Monteiro-Filho & Penereiro 1987
Nitidulidae sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Nitidulidae sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Nitidulidae sp.3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Ptiliidae			
Ptiliidae sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Rhizophagidae			
Rhizophagidae sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Scarabaeidae			
Aphengium sordidum Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Ataenius picinus Harold	Pig	Curitiba, Brazil	Mise *et al.* 2007
Bdelyrus lagopus (Harold)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Boucomontius convexus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthidium apicatum (Harold) (=*Ateuchus apicatum*)	general	São Paulo, Brazil	Luederwaldt 1911
Canthidium breve (Germar)	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthidium decoratum Perty	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthidium dispar Harold	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthidium lucidum Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthidium politum Politum (?)	general	São Paulo, Brazil	Luederwaldt 1911
Canthidium splendidum Preudhomme de Borre	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthidium sp.	Rat	Curitiba, Brazil	Moura *et al.* 1997
Canthidium sp.	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthidium spp.	general	São Paulo, Brazil	Luederwaldt 1911
Canthon angularis Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
*Canthon conformis*Harold	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthon curvipes Harold	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthon dives Harold	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthon lituratus (Germar)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon mutabilis Lucas	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon muticus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon nigriceps Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon opacus Lucas	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon podagricus (Harold)	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthon rutilans Laporte	Rat and other carcasses	São Paulo and neighborhood, Campinas, Brazil	Luederwaldt 1911; Pessôa & Lane 1941; Monteiro-Filho & Penereiro 1987
Canthon septemmaculatum (Latreille)	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Canthon smaragdulus (Fabricius)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon speculifer Laporte	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon substriatus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon tetraodon Blanchard	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Canthon triangularis (Drury)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon tristis Harold	general	São Paulo, Brazil	Luederwaldt 1911
Canthon virens Mannerheim	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Canthon sp.	Pig	Campinas, Brazil	Carvalho *et al.* 2000
Chalcocopris hesperus (Olivier)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium breve Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium carbonarium Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium mutilatum Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium pauperatum (Germar)	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Choeridium striatulum Preudhomme de Borre	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium subquadratum Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Choeridium vividum (Germar)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus arrowi Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus camargoi Pessôa	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus cerberus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus cyanescens Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus dardanus MacLeay	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus ensifer (Germar)	Pig and other carcasses	São Paulo and neighborhood, Campinas, Brazil	Pessôa & Lane 1941; Carvalho *et al.* 2000
Coprophanaeus jasius Olivier	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus milon Blanchard	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus punctatus Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus spitzi Pessôa	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus thalassinus Perti	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Coprophanaeus sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Deltochilum brasiliensis Laporte	Human corpses; pig and other carcasses	São Paulo and neighborhood, Campinas, Brazil	Luederwaldt 1911; Pessôa & Lane 1941; Carvalho *et al.* 2000
Deltochilum carinatum Westwood	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum dentipes Eschscholtz	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum furcatum (Laporte)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum icarus (Olivier)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum ivoratum (Laporte)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum morbillosum Burmeister	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Deltochilum orbiculare Lansberge	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum rubripenne Gory	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum sulphuratum	general	São Paulo, Brazil	Luederwaldt 1911
Deltochilum trisignatum Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Deltochilum sp.	Rat	Altos de Pipe (Caracas), Venezuela;	Velásquez, 2007
Deltorrhinum sp.	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon crenatostriatus Felsche	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon denticollis Felsche	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon fractipes Felsche	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon ganglbaueri Felsche	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon hirticollis Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon montei Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon viridipennis Laporte	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon viridis Perty	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dendropaemon waterhousei Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Dichotomius sericeus Harold	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Dichotomius sp.	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Dichotomius sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Dyscinetus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Eudinopus dytiscoides (Schreibers)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Eurysternus calligrammus Dalman	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Eurysternus femoralis Lucas	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Eurysternus foedus Guérin	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Eurysternus impressicollis Laporte	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Eurysternus opacus Lucas	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Eurysternus parallelus Laporte	Human corpses; pig and other carcasses	São Paulo and neighborhood, Campinas, Brazil	Pessôa & Lane 1941; Carvalho *et al.* 2000
Eurysternus scotinoides Laporte	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Euristernus nr.*velutinus* (sic)	Rat	Altos de Pipe (Caracas), Venezuela;	Velásquez, 2007
Eurysternus sp.	Rat	Curitiba, Brazil	Moura *et al.* 1997
Gromphas lacordairei Brullé	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Holocephalus eridanus (Olivier)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Leucotyreus sp. (=*Leucothyreus* sp.)	Pig	Curitiba, Brazil	Mise *et al.* 2007
Megathopa aenicollis Waterhouse	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Megathopa virens Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Megathopa sp.	Rat	Campinas, Brazil	Monteiro-Filho & Penereiro 1987
Megathopa sp.	Rat	Curitiba, Brazil	Moura *et al.* 1997
Ontherus appendiculatus (Mannerheim)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Ontherus cephalotes Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Ontherus digitatus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Ontherus nisus (Laporte)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Ontherus sp.	Pig	São Paulo, Brazil	Luederwaldt 1911
Ontherus sp.	general	Curitiba, Brazil	Mise *et al.* 2007
Onthocharis sp.	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Onthophagus bidentatus Drapiez	general	São Paulo, Brazil	Luederwaldt 1911
Onthophagus buculus Mannerheim	Pig	Campinas, Brazil	Souza & Linhares 1997
Onthophagus hirculus Mannerheim	general	São Paulo, Brazil	Luederwaldt 1911
Onthophagus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Oxysternon conspicillatum Weber	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Oxysternon curvispinum Olsoufieff	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Oxysternon palaemon Laporte	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pedaridium hirsutum (Harold)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) dejeani Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) faunus Fabricius	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) floriger Kirby	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) kirbyi Vigors	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) palaeno Blanchard	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus (Phanaeus) splendidus (Fabricius)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus bellicosus (Olivier) (=*Coprophanaeus bellicosus*)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus bonariensis Gory (=*Coprophanaeus bonariensis*)	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Phanaeus horus Waterhouse (=*Coprophanaeus horus*)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Phanaeus saphirinus Sturm (=*Coprophanaeus saphirinus*)	Rat and other carcasses	São Paulo and neighborhood, Curitiba, Brazil	Pessôa & Lane 1941; Moura *et al.* 1997
Pinotus agesilaus Waterhouse	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus ascanius Harold	general	São Paulo, Brazil	Luederwaldt 1911
Pinotus fissus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus inhiatus Germar	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus longiceps Taschenberg	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus nisus (Olivier)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus semiaeneus Germar	general	São Paulo, Brazil	Luederwaldt 1911
Pinotus smaragdinus (Perty)	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Pinotus sp.	Rat	Curitiba, Brazil	Moura *et al.* 1997
Scatimus bicarenatus Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Scatonomus fasciculatus Erichson	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Scatonomus insignis Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Scybalocanthon sp.	Pig	Campinas, Brazil	Carvalho *et al.* 2000

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Taurocopris luderwaldti Pessôa	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Taurocopris mimas Linnaeus	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Taurocopris mirabilis Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Trichillum externepunctatum Preudhomme de Borre	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Trichillum heydeni Harold	general	São Paulo and neighborhood, Brazil	Luederwaldt 1911; Pessôa & Lane 1941
Trichillum hirsutum Boucomont	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Trichillum sp.	general	São Paulo, Brazil	Luederwaldt 1911
Uroxys metallecens Harold	general	São Paulo and neighborhood, Brazil	Pessôa & Lane 1941
Aphodiinae sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Scarabaeidae sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Scarabaeidae spp.	Pig	Campinas, Brazil	Carvalho *et al.* 2004
Silphidae			
Hyponecrodes sp.	Pig	Buenos Aires, Argentina	Centeno *et al.* 2002
Oxelytrum discicolle (Brulle)	Human cadaver; rat and pig	Cali, Colombia; Altos de Pipe (Caracas), Venezuela;Curitiba, Brazil	Barreto *et al.* 2002; Velásquez 2007; Mise *et al.* 2007
Oxyletrum discicolle (*sic*)	Rat	Curitiba, Brazil	Moura *et al.* 1997
Oxyletrum disciolle (*sic*)	Pig	Campinas, Brazil	Carvalho *et al.* 2000
Oxelytrum sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Silpha cayennensis (Sturm) (=*Oxelytrum cayennense*)	general	São Paulo, Brazil	Luederwaldt 1911
Silphidae sp.	Rat	Campinas, Brazil	Monteiro-Filho & Penereiro 1987
Silphidae sp.	Dog	San José, Costa Rica	Jirón & Cartín 1981
Staphylinidae			
Achenomorphus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Aleochara lateralis Erichson	Pig	Campinas; São Paulo, Brazil	Luederwaldt 1911 and Souza & Linhares 1997
Aleochara notula Erichson	general	São Paulo, Brazil	Luederwaldt 1911
Aleochara taeniata Erichson	general	São Paulo, Brazil	Luederwaldt 1911
Aleochara sp.1 (=*Aleochara pseudochrysorrhoa*)	Pig	Curitiba, Brazil	Mise *et al.* 2007
Aleochara sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Aleochara sp. 3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Amblyopinus gahani Fauvel	general	São Paulo, Brazil	Luederwaldt 1911
Anotylus aff. *fragilis*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Anotylus aff. *insignitus*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Anotylus aff. *nanus*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Anotylus aff. *spinifrons*	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Anotylus sp.1	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Anotylus sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Anotylus sp.2	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Anotylus sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Astenus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Atheta brasiliana Bernhauer	general	São Paulo, Brazil	Luederwaldt 1911
Atheta luederwaldti (Bernhauer) (=*Stethusa luederwaldti*)	general	São Paulo, Brazil	Luederwaldt 1911
Atheta lurida (Erichson) (=*Stethusa lurida*)	general	São Paulo, Brazil	Luederwaldt 1911
Atheta mayalis Bernhauer	general	São Paulo, Brazil	Luederwaldt 1911
Baeocera sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Baeocera sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus apiciventris (Sharp)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Belonuchus basiventris (Sharp)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Belonuchus oxyporinus (Sharp)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Belonuchus pollens Sharp	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
			Luna 2001
Belonuchus rufipennis (Fabricius)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Belonuchus trochanterinus (Sharp)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus viridipennis Baudi	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus xanthomelas Solsky	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Belonuchus xanthopus Solsky	general	São Paulo, Brazil	Luederwaldt 1911
Belonuchus sp. "group" *rufipennis*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Belonuchus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Belonuchus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Biocrypta sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Bryoporus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Bryoporus sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Carpelinus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Chroaptomus flagrans (Erichson)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Cilea sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Coproporus hepaticus (Erichson)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Coproporus aff. *arizonae*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Coproporus aff. *segnis*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Coproporus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez et al. 2000
Creophilus maxillosus (Linnaeus)	Pig and squid	Tlayacapan, Mexico; Buenos Aires, Argentina	Márquez-Luna 2001; Centeno *et al.* 2002
Creophilus variegatus (Linnaeus)	general	São Paulo, Brazil	Luederwaldt 1911
Cyparium aff. *terminale*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Dibelonetes sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Echiaster sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Eleusis bicolor Erichson	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Eleusis sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Eulissus chalibaeus (Mannerheim)	Pig	Campinas, Brazil	Souza & Linhares 1997
Eulissus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Falagria fissula (Erichson)	general	São Paulo, Brazil	Luederwaldt 1911
Gabrius sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Gastrisus newtonorum Navarrete & Márquez	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Hamotus sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Heterothops boops Bernhauer	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Heterothops tenuicornis Sharp	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Heterotops sp. (=*Heterothops* sp.)	Pig	Curitiba, Brazil	Mise *et al.* 2007
Hipotelus sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Homaeotarsus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Hoplandria aleocharoides Bernhauer	general	São Paulo, Brazil	Luederwaldt 1911
Ischnosoma ashei Campbell	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Jubomorphus sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Lepitacnus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Lispinus sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Lissohypnus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Lordithon antennatus Campbell	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Lordithon howdeni Campbell	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Megalopinus sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Megarthrus aff. *altivagans*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Megarthrus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Monista sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Nacaeus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Neohypnus championi (Sharp)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Neohypnus sp.	Squid	Tlayacapan, Mexico;	Márquez-Luna 2001
Neohypnus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Ocalea sp.1 (sic) Atheta iheringi	Pig	Curitiba, Brazil	Mise *et al.* 2007
Ocalea sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Osorius sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Oxytelus laqueatus (Marsham)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Oxytelus subnitidus Bernhauer	general	São Paulo, Brazil	Luederwaldt 1911
Paederomimus angularius (Erichson)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Paederomimus gentillis Sharp	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Paederominus sp.1	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Paederus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Paederus sp.	Pig	Buenos Aires, Argentina	Centeno *et al.* 2002
Philonthus brasilianus Bernhauer	general	São Paulo, Brazil	Luederwaldt 1911
Philonthus ferialis Erichson (sic)	general	São Paulo, Brazil	Luederwaldt 1911
Philonthus flavolimbatus Erichson	general	São Paulo, Brazil	Luederwaldt 1911
Philonthus iris Sharp	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus longicornis Stephens	Pig and squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus piceatus Nordman	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus sericans (Gravenhorst)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus testaceipennis Erichson	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus aff. *apheles*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus sp.1	Pig	Campinas, Brazil	Souza & Linhares 1997
Philonthus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philonthus sp.1	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthus sp.2	Pig	Campinas, Brazil	Souza & Linhares 1997
Philonthus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Philonthus sp.2	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthus sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philonthus sp.3	Pig	Campinas, Brazil	Souza & Linhares 1997
Philonthus sp.3	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthus sp.3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philonthus sp.4	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthus sp.4	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philonthus sp.5	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthus sp.5	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philonthus sp.6	Pig	Curitiba, Brazil	Mise *et al.* 2007
Philothalpus paederiformis Sharp	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Philothalpus subtilis Sharp	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Phloeonomus centralis Sharp	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Phloeonomus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Phloeonomus sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Platydracus biseriatus (Sharp)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Platydracus castaneus (Nordmann)	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Platydracus fervidus Sharp	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Platydracus marcidus (Sharp)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Platydracus mendicus (Sharp)	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Platydracus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Platydracus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Platydracus sp.1	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Platydracus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Platydracus sp.2	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Platydracus sp.3	Squid	Tlayacapan, Mexico	Márquez-Luna 2001

Table I. Cont.

Families/species	Substratum/ carcasses	Geographic distribution	References
Platydracus sp.3	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Proteinus sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Pseudopsis sp. complexo "*sulcata*"	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Pseudopsis sp.	Pig	Medellín, Colombia	Wolff *et al.* 2001
Quedius sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Quedius sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Quedius sp.1	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Quedius sp.2	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Reichenbachia sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Rugilus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Rugilus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
*Sepedophilus*sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Sepedophilus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Sepedophilus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Spedophilus sp.(*sic*)	Pig	Medellín, Colombia	Wolff *et al.* 2001
Stamnoderus sp.	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Stamnoderus sp.1	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Stamnoderus sp.2	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Stenus aff. *popocatepetlensis*	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Stenus sp.(?)	Pig	Medellín, Colombia	Wolff *et al.* 2001
Styngetus adrianae Navarrete	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Tachinomorphus grandis (Solsky)	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Thinocharis sp.	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Thoracophorus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Thyreocephalus puncticeps Sharp	Squid	Tlayacapan and Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000; Márquez-Luna 2001
Toxidium punctatum Matthews	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Xanthopygus sp.	Pig	Campinas, Brazil	Souza & Linhares 1997
Xenopygus analis (Erichson)	Squid	Tejupilco, Mexico	Jiménez-Sánchez *et al.* 2000
Philonthina sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Trimiina sp.	Squid	Tlayacapan, Mexico	Márquez-Luna 2001
Oxypodini sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Staphylininae sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Staphylinidae sp.	Dog	San José, Costa Rica	Jirón & Cartín 1981
Staphylinidae sp.	Rat	Campinas, Brazil	Monteiro-Filho & Penereiro 1987
Staphylinidae sp. 1	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Staphylinidae sp. 2	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Staphylinidae sp.	Rat	Altos de Pipe (Caracas), Venezuela	Velásquez, 2007
Staphylinidae spp.	Pig	Campinas, Brazil; Medellín, Colombia	Carvalho *et al.* 2000; Wolf *et al.* 2001; Carvalho *et al.* 2004
Tenebrionidae			
Lagria vilosa (Fabricius)	Pig	Curitiba, Brazil	Mise *et al.* 2007
Prostenus periscelis (Perty)	general	São Paulo, Brazil	Luederwaldt 1911
Xystropus femoratus (Germar)	general	São Paulo, Brazil	Luederwaldt 1911
Allecullidae sp. (=Tenebrionidae)	Pig	Recife, Brazil	Cruz & Vasconcelos 2006
Tenebrionidae sp.1	Pig	Curitiba, Brazil	Mise *et al.* 2007
Tenebrionidae sp.2	Pig	Curitiba, Brazil	Mise *et al.* 2007
Tenebrionidae sp.3	Pig	Curitiba, Brazil	Mise *et al.* 2007
Tenebrionidae sp.4	Pig	Curitiba, Brazil	Mise *et al.* 2007
Trogidae			
Omorgus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Polynoncus sp.	Pig	Curitiba, Brazil	Mise *et al.* 2007
Trox gemmingeri (Harold) (=*Polynoncus*)	general	São Paulo, Brazil	Luederwaldt 1911
Trox pilularius (Germar) (=*Polynoncus*)	general	São Paulo, Brazil	Luederwaldt 1911
Trox suberosus (Fabricius)	general	São Paulo, Brazil	Luederwaldt 1911
Trogidae sp.	Rat	Curitiba, Brazil	Moura *et al.* 1997

Neotropical region. They are mainly predators of soft body insects larvae and eggs, particularly those of Cyclorraphan Diptera. Most occur in carrion, dung, decomposing plant materials, such as fungi, and tree wounds. Some live under loose bark or in galleries of wood-boring insects, where they prey on other organisms. The greatly flattened species live under bark of dead or dying trees. Cylindrical species occur in tunnels of bark beetles and other wood-boring insects. Most species are neither flattened nor cylindrical and are abundant in the early stages of decay of carcasses.

Hydrophilidae. Water scavenger beetles. A family with about 140 genera and 2,025 species, with 42 genera and 3,064 species in the Neotropical region. Larvae and adults of many are aquatic or semiaquatic, but some live in fresh mammal dung, humus-rich soil, or decaying leaves. Adults are mainly scavengers but the larvae are usually predacious. The terrestrial species occur in dung.

Leiodidae. Round fungus beetles. A family with about 334 genera and 4,240 species, with 38 genera and 279 species in the Neotropical region. Most species occur in carrion but some are found in fungi, some feed on slime molds, and others occur in ant nests.

Nitidulidae. Sap beetles. A family with about 160 genera and 3,000 species, with 79 genera and 770 species in the Neotropical region. They have a varied biology. Many are phytophagous, including pollen feeders, seeds, tree sap, others feed on dead or decaying plants, rotten fruits, leaf litter and a few are carrion feeders. Some are predators of scale insects.

Scarabaeidae. Scarab beetles. A family with about 2,000 genera and 25,000 species, with 362 genera and 4,706 species in the Neotropical region. Adults and larvae may be detritivorous, saprophagous, herbivorous, necrophagous or coprophagous. Larvae of most injurious species live in soil, feeding on roots, others may feed in rotten wood, dry carrion or skins.

Silphidae. Carrion beetles. A family with about 14 genera and 175 species, with 9 genera and 82 species in the Neotropical region. Most common on carrion but sometimes found on decaying vegetation or living plants. They feed on maggots and also are associated with vertebrate carcasses.

Staphylinidae. Rove beetles. A family with about 659 genera and 48,000 species, with 652 genera and 8,124 species in the Neotropical region. Adults are found in a wide range of habitats, under stones and other objects on ground, along shores of streams and lakes. Some live along ocean shores, on carrion, in manure, on fungi, on flowers in ant and termite nests, under bark, in soil or soil litter and in caves. They are among the most proficient fliers of all beetles. Many species run with the tip of abdomen raised. Larvae usually occur in the same habitat as adults. Most species are saprophagous feeding on dead or decaying plant or animal materials, such as carrion, dung, dead logs, etc. Most species are predacious and a few are parasites of other insects.

Tenebrionidae. Darkling beetles. A family with about 1,700 genera and 18,000 species, with 478 genera and 4,624 species in the Neotropical region. Adults and larvae live in a variety of terrestrial habitats. Some lives in rooting wood, on plant materials, under logs and stones, in termite and ant nests, in houses, in fungi and in debris. They feed on material of plant origin including decaying plant litter, dead wood, fungal fruiting bodies. Some feed on dead animal material and a few are predators. A few species are pests of stored products and the root-feeding larvae can also be agricultural pests specially of young plants and during dry conditions.

Trogidae. Hide beetles. A family with about 5 genera and 300 species, with 3 genera and 48 species in the Neotropical region. Adults and larvae are among the last inhabitants of fish, amphibians, reptiles, birds and mammals carcasses. The species of the genus *Trox* occur in nests of birds and burrows of mammals, especially those with masses of fur or feathers. When disturbed these beetles draw in their legs and lie motionless resembling dirt and rubbish and are often overlooked.

Acknowledgments**.** The authors thank to doctors José Roberto Pujol-Luz, Universidade de Brasília; José Albertino Rafael and Ruth Leila Ferreira Keppler, Instituto Nacional de Pesquisas da Amazônia; Marta Wolff, Instituto de Biología de la Universidad de Antioquia; Janyra Oliveira-Costa, Universidade Castelo Branco and Rodrigo Krüger, Universidade Federal de Viçosa, for loan of the material. To Nicolas Dégallier; Carla de Lima Bicho (Histeridae); Pedro Gnaspini Netto (Leiodidae); Edilson Caron (Staphylinidae) and Paschoal Coelho Grossi (Scarabaeidae) for aid in identifying the material.

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Received 31/10/2008; accepted 20/03/2009