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# A preliminary checklist of the Bostrichidae (Coleoptera) of Paraguay

# Lista preliminar de los Bostrichidae (Coleoptera) del Paraguay

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http://zoobank.org/References/C9786E66-6493-4F9E-A645-74BB93ACE75B

**Abstract.-** The first checklist of the family Bostrichidae of Paraguay is presented, including thirty-five species in seventeen genera. There are five new country records for Paraguay: *Bostrychopsis trimorpha* Lesne, 1899, *Lichenophanes bicornis* (Weber, 1801), *Tetrapriocera caprina* Lesne, 1931, *Xyloperthella picea* (Olivier, 1790) and *Lyctus simplex* Reitter, 1879. Eight species have a cosmopolitan distribution, *Xyloperthella picea* has Mediterranean and Afrotropical distribution, *Lichenophanes bicornis* has Nearctic distribution, *Tetrapriocera longicornis* (Olivier, 1795) has a New World distribution, and the remaining twenty-four species (69%) have Neotropical distributions including one endemic species (*Micrapate amplicollis* (Lesne, 1899)).

***Key words****: Bostrichidae, Paraguay, checklist, new records.*

**Abstract.-** Se presenta la primera lista para la familia Bostrichidae en Paraguay, incluyendo treinta y cinco especies en diecisiete géneros. Se presentan cinco nuevos reportes para el país: *Bostrychopsis trimorpha* Lesne, 1899, *Lichenophanes bicornis* (Weber, 1801), *Tetrapriocera caprina* Lesne, 1931, *Xyloperthella picea* (Olivier, 1790) y *Lyctus simplex* Reitter, 1879. Ocho especies tienen distribución cosmopolita, *Xyloperthella picea* tiene distribución Mediterránea y Afrotropical, *Lichenophanes bicornis* tiene distribución Neártica distribution, *Tetrapriocera longicornis* (Olivier, 1795) se distribuye en el Nuevo Mundo, y las veinticuatro especies restantes (69%) tienen distribución Neotropical, incluyendo una especie endémica (*Micrapate amplicollis* (Lesne, 1899)).

***Palabras clave****: Bostrichidae, Paraguay, lista, reportes nuevos.*

The bostrichid beetles are commonly known as powder-post beetles and are of considerable economic importance to forestry and the lumber dependent industries because of the ability of the larvae and some adults to reduce bamboo and sapwood timber into a powdery frass (Liu, 2010; Liu & Beaver, 2018; Liu & Geis, 2019). Many species are adapted to live in environments with low humidity (Crowson, 1981), hence their importance as pests of dried wood and products made of wood. Bostrichids are frequently transported between countries in dry wood, especially in wood-packing materials such as crates, pallets and dunnage, and are often intercepted at ports and cargo distribution centers (Haack, 2006; Eyre *et al*., 2018). Sometimes these species become established in the country to which they have been imported (e.g. Fisher, 1950; Gerberg, 1957; Ivie, 2002; Haack, 2006; Liu, 2010; Liu & Beaver, 2018; Liu & Geis, 2019).

The members of family Bostrichidae have a worldwide distribution but are mainly found in tropical and arid areas (Ivie, 2002; Liu, 2016). There are about 550 described species in this family and the latest phylogenetic study based on morphological data (Liu & Schönitzer, 2011) divided the family into eight subfamilies and nine tribes. The first complete catalogue of worldwide Bostrichidae was

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**Figure 1.** Department map of Paraguay (Source: Wikipedia, access time: 2021/7/25).

given by Lesne (1938), and one year later, Lesne (1939) studied more on the bostrichid fauna of Central America. Blackwelder (1945) compiled the first checklist of bostrichid fauna of the Neotropical region that has been amended by Reichardt (1964a). Santoro (1955-1960) mainly studied the members of the subfamily Lyctinae of Argentina, whereas others worked on the Brazilian fauna and invasive species of bostrichids (Reichardt, 1962a, 1962b, 1964b; Dall'Oglio & Peres Filho, 1997; Peres Filho *et al.*, 2006). Binda and Joly (1991) studied the bostrichid fauna of Venezuela and Reichardt (1970) studied the Galapagos fauna. Reichardt (1964c) and Teixeira (1992) studied the Neotropical fauna of genus *Bostrychopsis*. Liu (2010) added more new geographical records from all over the world, but there are few known from Paraguay and the bostrichid fauna of Paraguay has been neglected for a long time.

Paraguay (Fig. 1) is divided by the "Río Paraguay" into eastern and western regions, the western part also known as the Chaco, a part of the Gran Chaco, contains the departments of Alto Paraguay, Boquerón and Preseidente Hayes, and the eastern part contains the remaining of the political departments and the bulk of the human population of the country. The overall climate of Paraguay is tropical to subtropical with only wet and dry periods. The absence of mountain ranges to provide a natural barrier allows winds blowing from the Amazon Basin in the north, while the period between May and August brings cold winds from the Andes. The Köppen-Geiger climate classification map (1980-2016) (Beck *et al.*, 2018) divided Paraguay into five climate regions (Fig. 2), the western part likely being more suitable habitat to bostrichid beetles.

In December of 2019 the second author's field work included a collecting expedition across four Departments of southern/eastern Paraguay (Guairá, Itapúa, Misiones, Paraguarí) and produced voucher specimens representing several new country and provincial records for Paraguay, as well as confirming the Paraguay distribution for known cosmopolitan species. Combining historical literature with these new records, this paper provides the first checklist of the Bostrichidae of Paraguay, which is by no means considered to be well known yet.

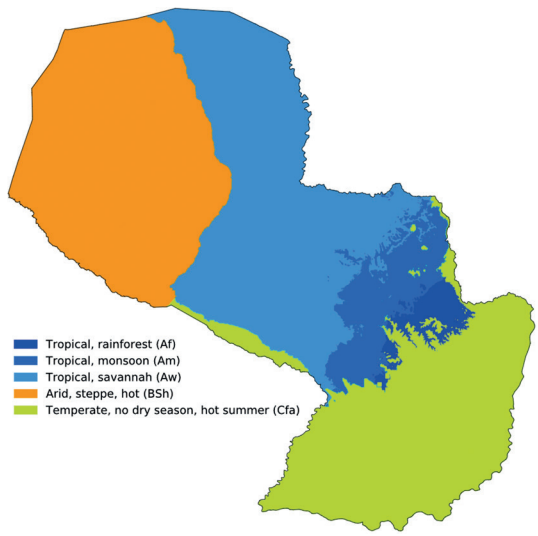


**Figure 2.** Köppen-Geiger climate classification map of Paraguay (1980-2016) (Beck *et al.*, 2018).

## Results and Discussion

The present work summarizes previous taxonomical works on worldwide and neotropical bostrichids (Blackwelder, 1945; Fisher, 1950; Reichardt, 1964c; Gerberg, 1957; Teixeira, 1992; Borowski & Wégrzynowicz, 2007, 2012; Liu, 2010), and builds upon our knowledge of the fauna of Paraguay with recent records produced by the second author's 2019 expedition. This paper uses the taxonomic system of Liu & Schönitzer (2011), whose phylogeny analyzed the family Bostrichidae at the suprageneric level. For each subfamily the tribes are listed in alphabetical order, as are the genera within tribes, and species within genera. For each species, we give the currently accepted name, the original generic and specific names, and a reference to the original description. The distributions of Neotropical countries are listed from West to East and then North to South. Species new to Paraguay are indicated by an asterisk (*). The collection data from vouchers of the second author's expedition in Paraguay are presented under each species entry. Synonyms are not listed but can be obtained from the catalogue of Borowski & Wégrzynowicz (2007), Ivie (2010) for important corrections to the 2007 catalogue, and the appendix to Borowski & Wégrzynowicz (2012). The vouchers are deposited in the JMLC (John M. Leavengood, Jr. private collection, Tampa, Florida) and LLY (Lan-Yu Liu private collection, Pingtung City, Taiwan).

### Family Bostrichidae Latreille, 1802
### Subfamily Bostrichinae Latreille, 1802
### Tribe Apatini Liu & Schönitzer, 2011
### Genus *Bostrychopsis* Lesne, 1899

#### *Bostrychopsis eremita* (Erichson)

(Figs. 3A-B)

*Bostrichus eremita* Erichson, 1847: 87.

**Distribution in Paraguay:** Four specimens collected from the western arid area (see also Fig. 2), Chaco-Filadelfia, in Paraguay (Liu, 2010).

**Other distribution**: Colombia, Peru, Uruguay, Argentina (Borowski & Wégrzynowicz, 2007 under *Dominikia peruana*, Liu, 2010).

**Biology**: This species has been reported as a borer in woody parts of *Vitis* sp. in Peru (Teixeira, 1992).

#### *Bostrychopsis freyi* Vrydagh

(Fig. 3C)

*Bostrychopsis freyi* Vrydagh, 1959: 6.

**Distribution in Paraguay:** The type of the species from Asunción, Paraguay (Vrydagh, 1959).

**Other distribution**: Brazil (Reichardt, 1962a).

**Biology.** Unknown, but should resemble other members of the genus *Bostrychopsis*.

#### *Bostrychopsis laminifer* Lesne

(Figs. 3D-G)

*Bostrychopsis laminifer* Lesne, 1895: 174.

**Distribution in Paraguay:** Asunción and Concepción (Reichardt, 1962a). New record to Guairá Dept*.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069' W 56°16.443. 617 ft., JE Eger & JM Leavengood (1♀, LLY).

**Other distribution:** Suriname, Ecuador, Brazil, Bolivia, Uruguay, Argentina (Reichardt, 1962a; Teixeira, 1992).

**Biology.** Teixeira (1992) recorded *Piptadenia colubrina* (Vell.) Benth. as the host plant in Três Lagoas.

#### *Bostrychopsis trimorpha* Lesne*

(Figs. 3E-F)

*Bostrychopsis trimorpha* Lesne, 1899: 550.

**Distribution in Paraguay:** New record to Paraguay. Guairá Dept.: Hotel Independencia, vic. Independencia, 20-XII-2019, black light + mercury vapor, S 25°43.069' W 56°16.443', JE Eger & JM Leavengood

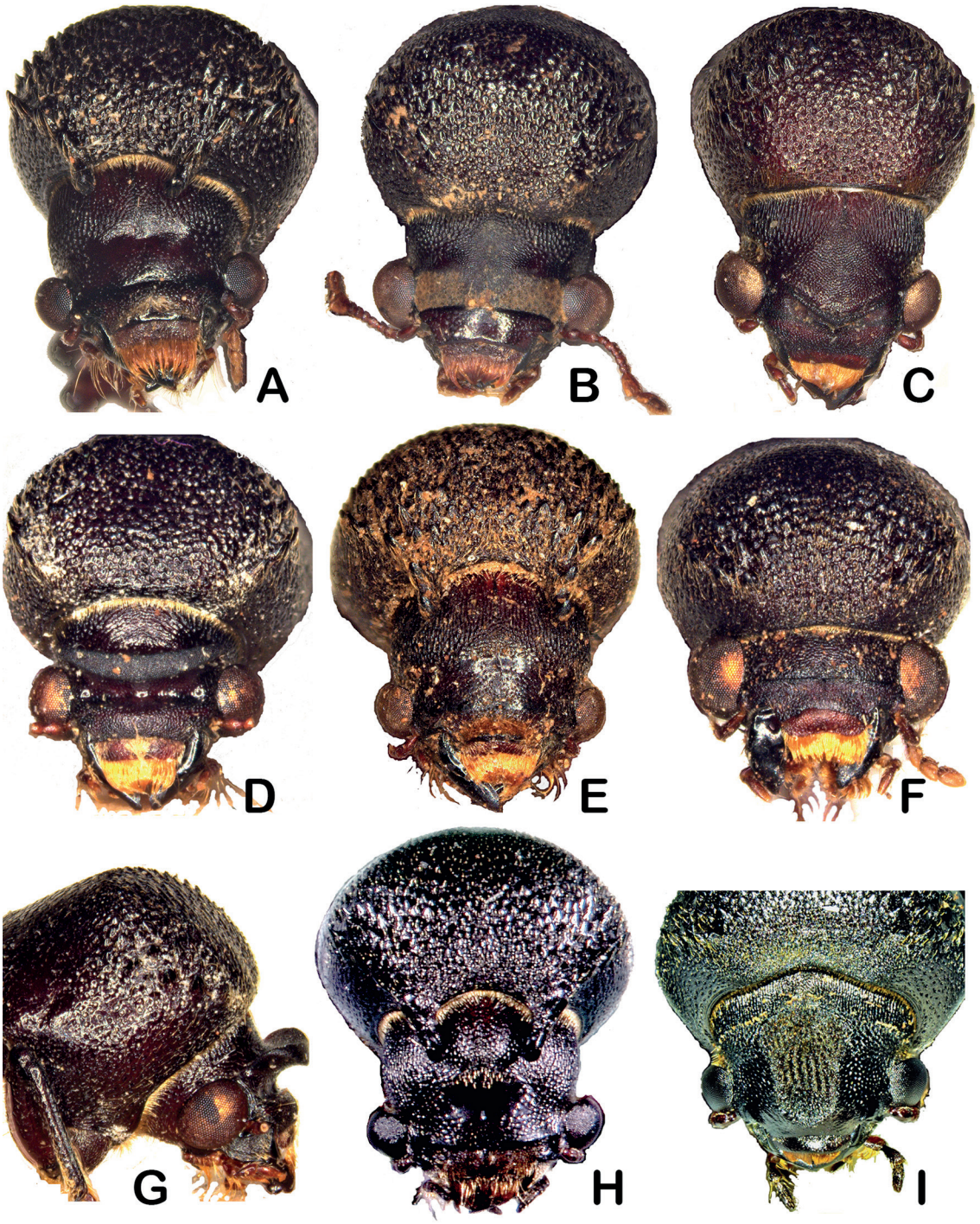


**Figure 3.** Frontal view of member of the genus *Bostrychopsis*. **A-B)** *B. eremita* (Erichson, 1847). **C)** *B. freyi* Vrydagh, 1959. D, G) *B. laminifer* Lesne, 1895. **E-F)** *B. trimorpha* Lesne, 1899. **H-I)** *B. unicinata* (Germar, 1824). **A, D, E, H)** Males. **B, C, F, G, I)** Females.

(1♂, LLY). Blackwelder (1945) recorded the species distributed around "S. America", but until this work it had not been reported for Paraguay.

**Other distribution:** Venezuela, Colombia, Brazil, Bolivia, Argentina (Borowski & Wégrzynowicz, 2007; Liu, 2010).

**Biology.** The species is attracted to light.

***Bostrychopsis uncinata* (Germar)**

(Figs. 3H-I)

*Apate uncinata* Germar, 1824: 463.

**Distribution in Paraguay:** Blackwelder (1945) and Teixeira (1992) noted this species has a wide distribution in South America. This work confirmed the Paraguay distribution, Misiones Dept.: San Ignacio, vic. Hotel Rural, 5-8-XII-2019, S 26°52.508' W 056°59.355', 451 ft, BL + MV lights, JE Eger, W Tyson & JM Leavengood, Jr. (1♂1♀, LLY); Guairá Dept.: Hotel Independencia, vic. Independencia, 20-XII-2019, black light + mercury vapor, S 25°43.069' W 56°16.443', 617ft, JE Eger & JM Leavengood (4♀, LLY); Itapúa Dept.: vic. Pro Cosara Nature Reserve, 9-10-XII-2019, S 26°38.271' W 55°39.850', 933 ft., MercVap + Blacklight, J E Eger, W Tyson, J B Heppner & J M Leavengood (2♀, LLY).

**Other distribution:** The distribution from Borowski & Wégrzynowicz (2007) is herein corrected to Colombia, French Guiana, Suriname, Venezuela, Brazil, Bolivia, Peru, Uruguay, and Argentina.

**Biology**. Typical polyphagous beetles, this species has been recorded from host plants from a wide range of families: Anacardiaceae, Bombacaceae, Combretaceae, Euphorbiaceae, Lauraceae, Leguminosae, Meliaceae, Mytaceae, Rhamnaceae, Rosaceae, Rubiaceae, Tiliaceae, Sapotaceae, Vitaceae and liana (Teixeira, 1992). The preferred wood is generally neither in an advanced state of decomposition nor freshly cut, with the galleries limited to the sapwood. Regarding the longevity in the laboratory of adults fed with a solution of water + honey (10%), the variation was from 21 to 42 days, in 10 individuals observed (Teixeira, 1992).

The species is nocturnal, flying at dusk, and is attracted by light and collected in large numbers of specimens in galleries of certain species of lianas, as well as mango, avocado and grape vine (Teixeira, 1992). Teixeira (1992) recorded the species occurring all year round; in southern Brazil the highest frequency occurs in hot and rainy months. The method of collection using traps with ethanol was very efficient in studies carried out in the States of São Paulo and Paraná, Brazil (Teixeira, 1992).

**Tribe Bostrichini Liu & Schönitzer, 2011**

**Genus *Dolichobostrychus* Lesne, 1899**

***Dolichobostrychus angustus* (Steinheil)**

(Fig. 4A)

*Bostrychus angustus* Steinheil, 1872: 575.

**Distribution in Paraguay:** San Pedro (Liu, 2010). This work confirmed Liu (2010) with new records from Paraguay. Guairá Dept*.: Hotel Independencia, vic. Independencia, 20-XII-2019, black light + mercury vapor, S 25°43.069' W 56°16.443', JE Eger & JM Leavengood (1, JMLC; 1, LLY).

**Other distribution:** Colombia, Brazil, Argentina (Borowski & Wégrzynowicz, 2007).

**Biology**. Unknown.

**Genus *Lichenophanes* Lesne, 1899**

***Lichenophanes bicornis* (Weber)***

(Fig. 4B)

*Apate bicornis* Weber, 1801: 91.

**Distribution in Paraguay:** New record for Paraguay. Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, S 25°35.630' W 057°07.495', Elevation 504 ft., 1-4-XII-2019. JE Eger & JM Leavengood (1, LLY).

**Other distribution:** Canada, USA (Borowski & Wégrzynowicz, 2007).

**Biology**. Fisher (1950) recorded the

Nearctic species from sycamore, hackberry, oak, pecan, hickory, apple, beech and elm. It is usually found under the dead bark or in the dead wood, but also found once in the dead cambium of a live sycamore tree (Fisher, 1950). The new record probably means the species already invaded the Neotropical region from Nearctic region via intercontinental trade and shipping.

***Lichenophanes fasciatus* (Lesne)**

(Fig. 4D)

*Bostrychus fasciatus* (Lesne, 1895: 172).

**Distribution in Paraguay:** Hohenau (Liu, 2010).

**Other distribution.** Colombia, Brazil.

**Biology.** Unknown, but should be similar to other members of the genus *Lichenophanes*.

***Lichenophanes plicatus* (Guérin-Méneville)**

(Fig. 4C)

*Bostrichus plicatus* Guérin-Méneville, 1844: 185.

**Distribution in Paraguay:** Unspecified in Borowski & Wégrzynowicz (2007). The present study produced specimens from Guairá Dept.: Hotel Independencia, vic. Independencia, 20-XII-2019, black light + mercury vapor, S 25°43.069' W 56°16.443', 617 ft., JE Eger & JM Leavengood (2, LLY); Misiones Dept.: San Ignacio, vic. Hotel Rural, 5-8-XII-2019, S 26°52.508' W 056°59.355', 451 ft, BL + MV lights, JE Eger, W Tyson & JM Leavengood, Jr. (1, JMLC; 1, LLY).

**Other distribution:** Guatemala, Colombia, Venezuela, French Guiana, Brazil, Argentina.

**Biology.** Unknown, but likely to resemble other members of this genus *Lichenophanes*.

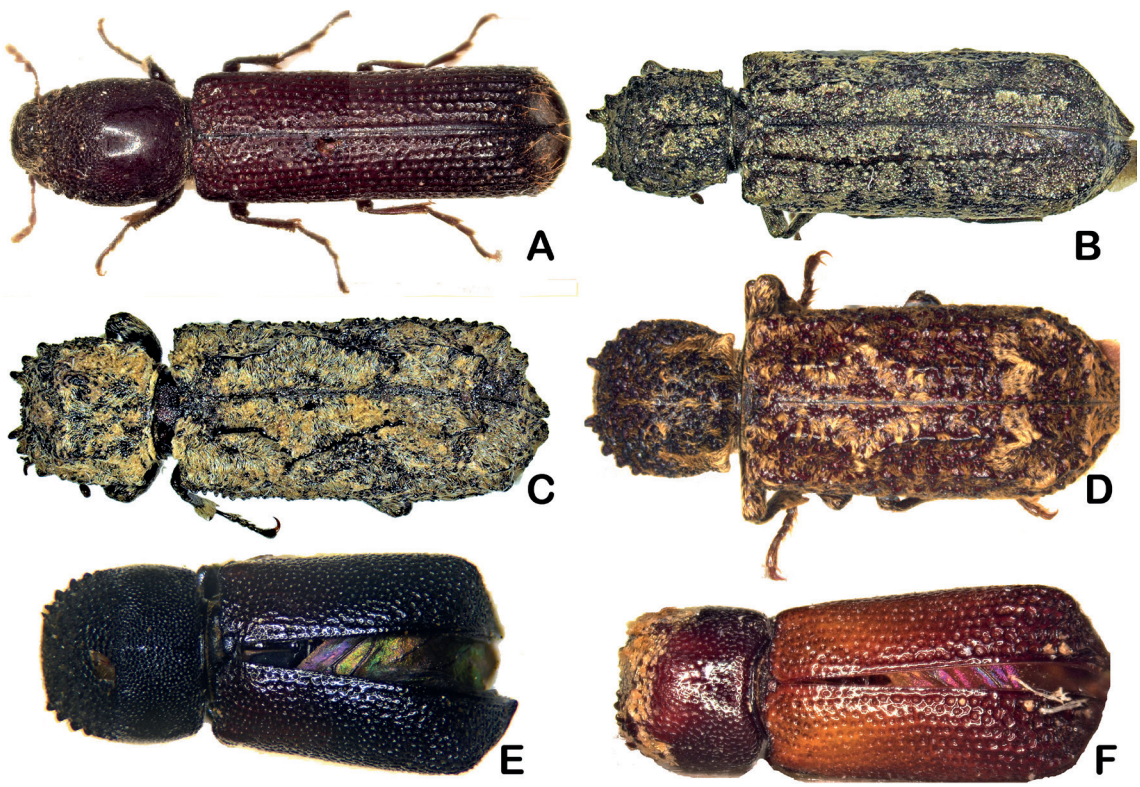


**Figure 4.** Dorsal view of specimens of the tribe Bostrichini. **A)** *Dolichobostrychus angustus* (Steinheil, 1827). **B)** *Lichenophanes bicornis* (Weber, 1801). **C)** *L. plicatus* (Guérin-Méneville, 1844). **D)** *L. fasciatus* (Lesne, 1895). **E)** *Micrapte amplicollis* (Lesne, 1899). **F)** *M. germaini* (Lesne, 1899).

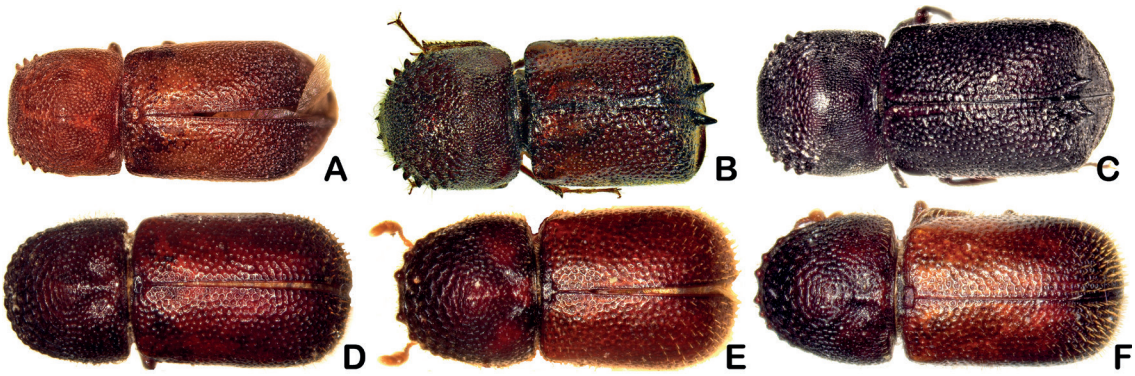


**Figure 5.** Dorsal view of members of the tribe Sinoxylini and of the subfamily Dinoderinae. **A)** *Sinoxylodes curtulus* (Erichson, 1847). **B)** *Sinoxylon anale* Lesne, 1897. **C)** *S. unidentatum* (Fabricius, 1801). **D)** *Dinoderus bifoveolatus* (Wollaston, 1858). **E)** *D. brevis* Horn, 1878. **F)** *D. minutus* (Fabricius, 1775).

### Genus *Micrapate* Casey, 1898

***Micrapate amplicollis* (Lesne)**

(Fig. 4E)

*Bostrychulus amplicollis* Lesne, 1899: 615.

**Distribution in Paraguay:** Central region of Paraguay (Borowski & Wégrzynowicz, 2007).

**Other distribution:** Endemic to Paraguay.

**Biology.** The type was collected from central Paraguay, tropical monsoon area (Borowski & Wégrzynowicz, 2007, see also Fig. 2).

***Micrapate germaini*** (Lesne, 1899)

(Fig. 4F)

*Bostrychulus germaini* Lesne, 1899: 609.

**Distribution in Paraguay:** Unspecified in Borowski & Wégrzynowicz (2007).

**Other distribution:** Brazil.

**Biology.** Unknown. The members of this genus seem to prefer less arid climates, like the higher humidity of the woods.

### Tribe Sinoxylini Liu & Schönitzer, 2011

### Genus *Sinoxylodes* Lesne, 1899

***Sinoxylodes curtulus* (Erichson)**

(Fig. 5A)

*Bostrichus curtulus* Erichson, 1847: 87.

**Distribution in Paraguay:** Chaco-Filadelfia, S. Bernardino and Hohenau (Liu, 2010). Blackwelder (1945) listed "S. America" (Liu, 2010).

**Other distribution:** Guatemala, Brazil, Peru, Argentina (Borowski & Wégrzynowicz, 2007).

**Biology.** In Paraguay, the species has been collected from western arid area to eastern dry temperate area (see also Fig. 2), implying the species prefers arid habitats.

### Genus *Sinoxylon* Duftschmid, 1825

In this genus, both records are cosmopolitan species without accurate locality data of Paraguay prior to the present work, which confirms the distribution of *Sinoxylon anale* in Paraguay. The two species are dangerous pests of woody and bamboo products, as they have been spread worldwide by commerce, so we list both species here as a quarantine concern.

***Sinoxylon anale* Lesne***

(Fig. 5B)

*Sinoxylon anale* Lesne, 1897: 21.

**Distribution in Paraguay:** This collection record confirms the cosmopolitan species also occurs in Paraguay, Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630' W 057°07.495', Elevation 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood, 1-4-XII-2019 (1, JMLC).

**Other distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). Species probably native in China, India, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand. Introduced to Europe and to the African, American and Australian continents, New Zealand and the Middle East (Liu *et al*., 2016). The species has probably been introduced to Paraguay through international trade and shipping.

**Biology.** This species is considered to be one of the most destructive wood borers in India, and the adults attack a great variety of plants (Fisher, 1950; Liu *et al.*, 2016). The beetles breed in the sapwood of dead or dying trees, but adults sometimes bore into living shoots to feed or hibernate, and may cause damage to young saplings (Liu *et al.*, 2016). The life cycle is quite variable in length and can take from a minimum of three months to a maximum of over four years, the adults emerge throughout the year, with generations strongly overlapping (Liu *et al*., 2016).

### *Sinoxylon unidentatum* (Fabricius)

(Fig. 5C)

*Sinodendron unidentatum* Fabricius, 1801: 377.

**Distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). Species probably native in Asia and introduced to a wide range of tropical and temperate regions.

**Biology**. The adults are nocturnal and are attracted to lights (Fisher, 1950). Fisher (1950) listed *Acacia* sp., *Adina cordifolia*, *Albizzia cimara*, *Holoptelea integrifolia*, *Mangifera indica*, *Shorea robusta*, *Terminalia bialata*, *Terminalia myriocarpa* and *Grewia tiliaefolia* as host plants, and also observed to damage lead cable in Hawaii. Savoldelli & Regalin (2009) reported the species infesting *Shorea* wood pallets used to stack tea sacks from Sri Lanka to Italy. Xavier *et al*. (2018) intercepted the species in Rio de Janeiro port, Brazil on pallets originating from Indonesia and found that methyl bromide was not sufficient to inhibit the activity of the insects on the pallets, so one would have to set up ethanol traps in storage sites and in transit of wood for more efficient means to control the beetles.

## Tribe Xyloperthini Lesne, 1921

## Genus *Tetrapriocera* Horn, 1878

### *Tetrapriocera caprina* Lesne*

(Fig. 6A)

*Tetrapriocera caprina* Lesne, 1931: 104.

**Distribution in Paraguay:** New record to Paraguay, Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630’ W 057°07.495’, Elevation 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood (2, JMLC; 1♂1♀, LLY); Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069’ W 56°16.443’, 617 ft, JE Eger & JM Leavengood (2, JMLC; 1♂1♀, LLY).

**Other distribution:** Argentina (Borowski & Wégrzynowicz, 2007).

**Biology.** Unknown.

### *Tetrapriocera defracta* Lesne

(Fig. 6B)

*Tetrapriocera defracta* Lesne, 1901: 487.

**Distribution in Paraguay:** Although unspecified in Borowski & Wégrzynowicz (2007), the records presented in this work confirm the distribution in Paraguay from Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069’ W 56°16.443’, 617 ft, JE Eger & JM Leavengood (1♂, LLY), Hotel Independencia, vic. Independencia, 20-XII-2019, black light + mercury vapor, S 25°43.069’ W 56°16.443’, 617 ft., JE Eger & JM Leavengood (1, JMLC); Itapúa Dept.: vic. Pro Cosara Nature Reserve, 9-10-XII-2019, S 26°38.271’ W 55°39.850’, 933 ft., MercVap + Blacklight, J E Eger, W Tyson, J B Heppner & J M Leavengood (1, JMLC); Misiones Dept.: San Ignacio, vic. Hotel Rural, 5-8-XII-2019, S 26°52.508’

W 056°59.355', 451 ft, BL + MV lights, JE Eger, W Tyson & JM Leavengood, Jr. (1, JMLC); Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630' W 057°07.495', 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood (5, JMLC; 1♂, LLY).

**Other distribution:** Brazil, Argentina (Borowski & Wégrzynowicz, 2007).

**Biology**. Unknown.

***Tetrapriocera longicornis* (Olivier)**

(Fig. 6C)

*Bostrichus longicornis* Olivier, 1795: 77.

**Distribution in Paraguay:** Asunción (Liu, 2010).

**Other distribution:** USA, Cuba, Jamaica, Haiti, Santo Domingo, Puerto Rico, Saint Thomas, Grenada, Mexico, Colombia, Venezuela, Peru, Brazil, Ecuador, Paraguay. Introduced to Germany (Borowski & Wégrzynowicz, 2007; Liu, 2010).

**Biology.** Unknown.

**Genus *Xyloperthella* Fisher, 1950**

***Xyloperthella picea* (Olivier)***

(Fig. 6G)

*Bostrichus piceus* Olivier, 1790: 110.

**Distribution in Paraguay:** New record to Paraguay: Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069' W 56°16.443', 617ft, BL + MV light, JE Eger & JM Leavengood (1, LLY).

**Other distribution:** Southern Europe, Arabian Peninsula, Africa, Madagascar.

This species likely originated from the Afrotropical region and has been introduced into Southern Europe later, then invading

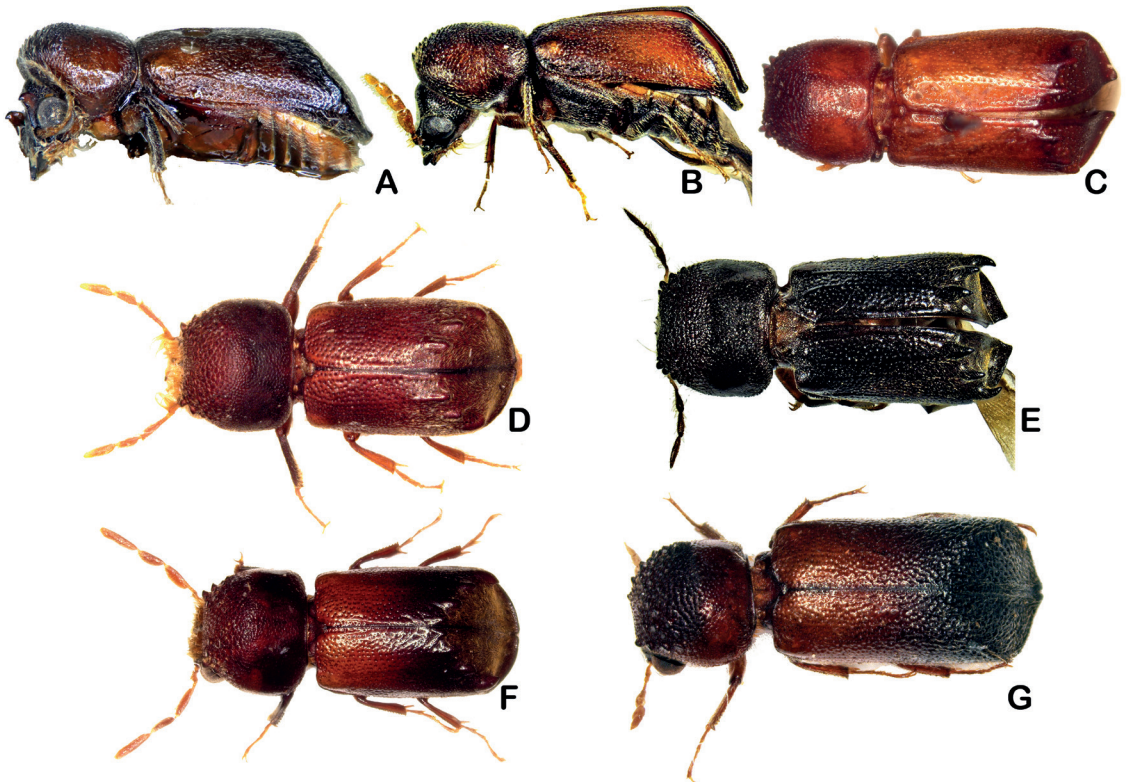


**Figure 6.** Dorsal and lateral views of individuals of the tribe Xyloperthini. **A)** *Tetrapriocera caprina* Lesne, 1931. **B)** *T. defracta* Lesne, 1901. **C)** *T. longicornis* (Olivier, 1795). **D)** *Xylopristra arcellata* Lesne, 1901. **E)** *X. hexacantha* (Fairmaire, 1892). **F)** *X. praemorsa* (Erichson, 1847). **G)** *Xyloperthella picea* (Olivier, 1790).

Turkey (Aksit & Cakmak, 2005), Great Britain (Geis, 2014), and Brazil (Filhol *et al*., 2012).

**Biology.** Various species of genus *Acacia* have been reported as the host plant (Lesne, 1924; Baena & Zuzarte, 2013; Kahuthia-Gathu *et al*., 2018) in Neotropical, African and Mediterranean regions; Akşit and Çakmak (2005) reported *Ficus carica* L. as host plant in Mediterranean region; and *Adansonia digitata* L., *Quercus mirbecki* Dur., *Hevea* spp., *Khaya* spp., and *Zizyphus* spp. as well as the building materials of *Bambusa* spp. two years post-construction all have been attacked by *X. picea* (Lesne, 1924).

Peres Filho *et al*. (2012) studied the flight behavior of these bostrichids in Mato Grosso, Brazil with ethanol traps for one year, discovering *X. picea* as the dominant taxon with peaks of activity in June and February. The adult is nocturnal and attracted by light during dusk and night (Lesne, 1924). *Cylindrus fasciatus* Castelnau (Cleridae), *Teretrius pulex* Fairmaire and *Teretriosoma saginatum* Lew (Histeridae) all have been recorded as predators of *X. picea* (Lesne, 1924; Baena & Zuzarte, 2013).

### Genus *Xyloprista* Lesne, 1901

#### *Xyloprista arcellata* Lesne

(Fig. 6D)

*Xyloprista arcellata* Lesne, 1901: 499.

**Distribution in Paraguay:** Asunción (Liu, 2010).

**Other distribution:** Brazil (Borowski & Wégrzynowicz, 2007), Peru (personal observation by the senior author).

**Biology**. The senior author collected specimens from the wooden house of a research site in Panguana, Peru. The species probably was introduced with imported seasoned wood for building the house and established in the house in the rather dry conditions but was doubtfully established in the surrounding rainforest.

#### *Xyloprista hexacantha* (Fairmaire)

(Fig. 6E)

*Xylopertha hexacantha* Fairmaire, 1892: 245.

**Distribution in Paraguay:** Although unspecified in Borowski & Wégrzynowicz (2007), the present study produced specimens from Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019. S 25°35.630' W 057°07.495'. 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood (1, JMLC; 1, LLY).

**Other Distribution:** Colombia, Brazil, Bolivia, Paraguay, Argentina. Introduced to USA (Borowski & Wégrzynowicz, 2007).

**Biology.** Unknown.

#### *Xyloprista praemorsa* (Erichson)

(Fig. 6F)

*Xylopertha praemorsa* Erichson, 1847: 87.

**Distribution in Paraguay:** Although unspecified in Borowski & Wégrzynowicz (2007), the present study produced specimens from Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069' W 56°16.443', 617ft, JE Eger & JM Leavengood (4, JMLC; 4, LLY); Itapúa Dept.: vic. Pro Cosara Nature Reserve, 9-10-XII-2019, S 26°38.271' W 55°39.850', 933 ft., MercVap + Blacklight, Coll: J E Eger, W Tyson, J B Heppner & J M Leavengood (2, JMLC; 2, LLY); Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630' W 057°07.495', 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood (2, JMLC).

**Other distribution:** Colombia, Venezuela, Peru, Brazil, Bolivia.

**Biology.** Unknown.

### Subfamily Dinoderinae Thomson, 1863

Four species are recorded in the subfamily. All have cosmopolitan distributions without specific records in Paraguay besides *Rhyzopertha dominica* (Fabricius, 1792). These species all are pests of stored grains, bamboo, and wood products, having been

spread worldwide by commerce. We list them here for quarantine consideration.

### Genus *Dinoderus* Stephens, 1830

#### *Dinoderus bifoveolatus* (Wollaston)

(Fig. 5D)

*Rhizopertha bifoveolata* Wollaston, 1858: 409.

**Distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). The species has probably been introduced to Paraguay through international trade and shipping of foods.

**Biology**. The types of the species were collected from a barrel of flour which had spoiled over a year in the customhouse, and subsequent records also proved the species is a well-known pest of grain (Fisher, 1950). Fisher (1950) also recorded the species from *Artocarpus hirsutus*, *Kydia calycina*, *Mangifera indica* in India and as a borer of canes and palm leaves used for making baskets and cases, and the dry roots of manioc and yam in Africa and the stalk of *Calamus* sp. used for making baskets in New Guinea.

#### *Dinoderus brevis* Horn

(Fig. 5E)

*Dinoderus brevis* Horn, 1878: 549.

**Distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). The species has an Oriental origin, but has been spread worldwide by international trade of foods, wood and bamboo products, and probably has also been introduced to Paraguay.

**Biology**: Fisher (1950) posited that this species primarily breeds in bamboos and the food plants of the larvae are restricted to bamboos and canes. However, Beeson and Bhatia (1937) listed *Albizzia odoratissima*, *Artocarpus hirsutus*, *Balanites roxburghii*, *Butea frondosa*, *Ficus bengalensis*, *Lannea grandis*, *Mangifera indica*, *Pinus khasya*, *Shorea robusta*, *Sonneratia apetala*, *Sterculia campanulata*, *Bambusa polymorpha*, *B. arundinacea*, *Dendrocalamus strictus*, and *Tectona grandis* as host plants. Borowski & Wégrzynowicz (2012) reported the species is frequently introduced to various countries on all continents with bamboo products and may acclimatize in tropical and subtropical countries whether food-plants occur.

#### *Dinoderus minutus* (Fabricius)

(Fig. 5F)

*Apate minutus* Fabricius, 1775: 54.

**Distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). It is cosmopolitan throughout the tropical regions, but has been carried in commerce to all parts of the temperate regions (Fisher, 1950).

**Biology**. Fisher (1950) reported the species is the most important pest of maize in Mauritius and Zanzibar, and can reduce all structures built of bamboo to dust in a few years. This species prefers the wood of bamboo, principally in the genera *Dendrocalamus* and *Phyllostachys*. The adults are also recorded attacking sugarcane, dried sweet potatoes, banana preparations, and is frequently found breeding in rattan articles and wood packing cases (Fisher, 1950).

### Genus *Rhyzopertha* Stephens, 1830

#### *Rhyzopertha dominica* (Fabricius, 1792)

*Synodendron dominicum* Fabricius, 1792: 359.

**Distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). The species probably originated on the Indian subcontinent, but has been spread worldwide by commerce (Liu *et al*., 2016). This work produced specimens confirming that this cosmopolitan species has spread to Paraguay: Paraguarí Dept.: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630' W 057°07.495', 504 ft., MV + BL, Colls: W Tyson, JE Eger & JM Leavengood (2, JMLC; 1, LLY).

**Biology.** This species has been bred in dead wood but is known primarily as an economically important pest of stored grain, recorded from various husked and unhusked grains, dried fruits and starchy dried foods in Iran and multiple woody hosts in India and

Israel (Fisher, 1950; Liu *et al*., 2016)

This species is one of the most difficult stored product insect pests to control using insecticide grain protectants. Prevention is by far the best control option, but may be impractical given the ability of *R. dominica* to migrate into grain storage (Liu *et al*., 2016). Liu *et al*. (2016) reported *Anisopteromalus calandrae* (Howard, 1881) and *Theocolax elegans* (Westwood, 1874) (Hymenoptera: Pteromalidae) from Golestan, Iran as parasitoids of the pupae.

**Subfamily Dysidinae Lesne, 1921**

**Genus *Dysides* Perty, 1832**

***Dysides obscurus* Perty**

(Fig. 7H)

*Dysides obscurus* Perty, 1832: 113.

**Distribution in Paraguay:** Although unspecified in Borowski & Wégrzynowicz (2007), the present study produced specimens from Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069' W 56°16.443', 617ft, BL + MV light, JE Eger & JM Leavengood (1, JMLC; 1, LLY).

**Other distribution:** Colombia, French Guiana, Brazil, Peru, Bolivia (Borowski & Wégrzynowicz, 2007).

**Biology.** Unknown, but the present records imply the species can be attracted by light traps.

***Dysides platensis* Fairmaire**

(Fig. 7I)

*Dysides platensis* Fairmaire, 1892: 245.

**Distribution in Paraguay:** Unspecified in Borowski & Wégrzynowicz (2007).

**Other distribution:** Venezuela, Brazil, Argentina (Borowski & Wégrzynowicz, 2007).

**Biology**. Unknown.

**Subfamily Polycaoninae Lesne, 1896**

**Genus *Melalgus* Dejean, 1833**

***Melalgus rufipes* (Blanchard)**

*Psoa rufipes* Blanchard, 1843: 205.

**Distribution in Paraguay:** Unspecified in Borowski & Wégrzynowicz (2007).

**Other distribution:** Bolivia, Argentina (Borowski & Wégrzynowicz, 2007; Liu, 2010).

**Biology.** Unknown.

**Subfamily Lyctinae Billberg, 1820**

**Tribe Lyctini Billberg, 1820**

***Genus Lyctus* Fabricius, 1792**

***Lyctus brunneus* (Stephens)**

(Fig. 7A)

*Xylotrogus brunneus* Stephens, 1830: 116.

**Distribution in Paraguay:** Unspecified in Borowski & Wégrzynowicz (2007).

**Other distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). This species may have been originally neotropical, but has invaded most of the faunal regions (Gerberg, 1957). Borowski and Wégrzynowicz (2012) thought this species prefers tropical and subtropical regions as well as marine temperate climate.

**Biology**. Beeson & Bhatia (1937) reported Anacardiaceae, Bombacaceae, Burseraceae, Combretaceae, Dipterocarpaceae, Fabaceae, Fagaceae, Magnoliaceae, Malvaceae, Moraceae, Pinaceae, Poaceae (bamboo), and Proteaceae as host families. Gerberg (1957) reported the species has been found in bamboo, oak, dry tree fern, magnolia lumber, elm wood, bales of cycad leaves imported to USA and in wood of *Phyllanthus salviaefolius*, *Triplaris felipensis*, *Caesalpinia coriaria* and *Lonchocarpus crucisrubierae* in Venezuela.

This is one of the most widespread and damaging species of Lyctinae to hardwood timber. Like all lyctines, the species oviposits in pores in the wood, whereas softwoods without pores are not normally attacked, nor are hardwoods with pores smaller than the diameter of the female's ovipositor (Liu *et al*., 2016). The larvae can develop only in sapwood with a sufficiently high starch and moisture content, and the heartwood is never infested. Larvae are attacked by various parasitoid

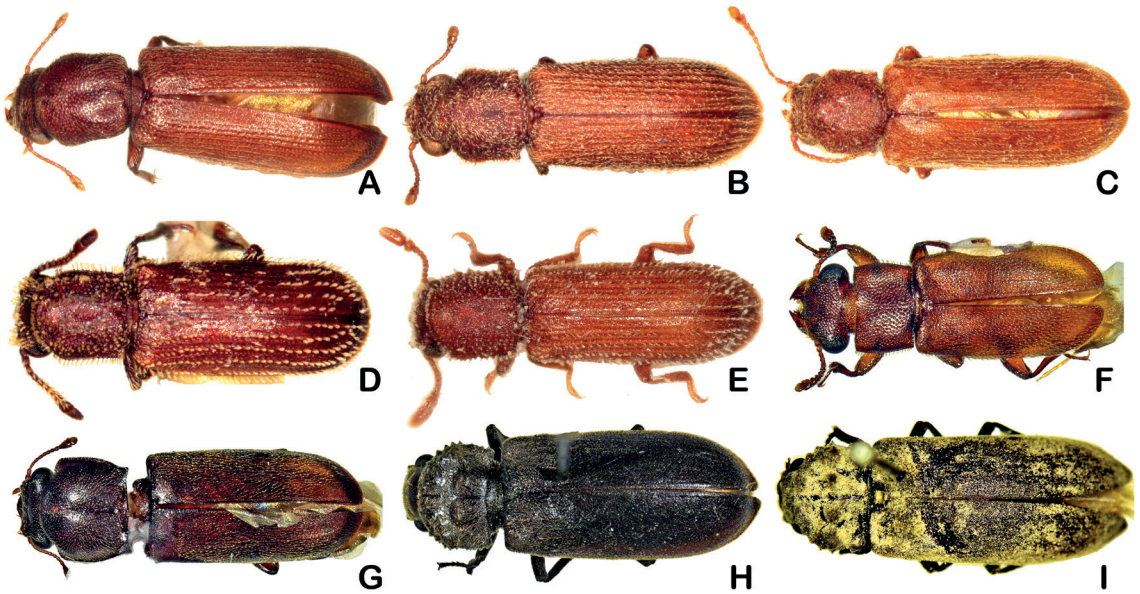


**Figure 7.** Dorsal view of subfamilies Lyctinae and Dysidinae. **A)** *Lyctus brunneus* (Stephens, 1830). **B)** *L. caribeanus* Lesne, 1931. **C)** *L. simplex* Reitter, 1879. **D)** *Minthea rugicollis* (Walker, 1858). **E)** *M. squamigera* Pascoe, 1866. **F)** *Phyllyctus gounellei* (Gouvelle, 1896). **G)** *Trogoxylon giacobbii* Santoro, 1957. **H)** *Dysides obscurus* Perty, 1832. **I)** *D. platensis* Fairmaire, 1892.

(Hymenoptera: Braconidae) and predaceous insects (Coleoptera: Cleridae), but not in high enough numbers to ensure efficient biological control (Liu *et al*., 2016).

### *Lyctus caribeanus* Lesne

(Fig. 7B)

*Lyctus caribeanus* Lesne, 1931: 96.

**Distribution in Paraguay:** Presidente Hayes (Liu, 2010).

**Other Distribution:** USA, Mexico, Guatemala, Panama, Santo Domingo, Puerto Rico, Guadeloupe and Paraguay. The species is apparently a neotropical species, occurring mainly in the Central American and Caribbean regions (Gerberg, 1957), and introduced to the USA (Borowski & Wégrzynowicz, 2007).

**Biology.** The species has been collected from the tropical savannah area of Paraguay (Liu, 2010, see also fig. 2). Gerberg (1957) recorded the species has been found in kola root, dead wood of avocado and leguminous trees.

### *Lyctus simplex* Reitter*

(Fig. 7C)

*Lyctus simplex* Reitter, 1879: 198.

**Distribution in Paraguay:** New record to Paraguay: Guairá Dept.: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069’ W 56°16.443’, 617 ft, JE Eger & JM Leavengood (1, LLY).

**Other distribution:** Colombia, Ecuador, Peru, Bolivia, Argentina. Introduced to Germany (Borowski & Wégrzynowicz, 2007).

**Biology**. The species emerges throughout the whole year in neotropical areas (Gerberg, 1957).

### Genus *Minthea* Pascoe, 1866
### *Minthea rugicollis* (Walker)

(Fig. 7D)

*Ditoma rugicollis* Walker, 1858: 206.

**Distribution in Paraguay:** Unspecified in Paraguay.

**Other distribution:** Cosmopolitan (Borowski & Wégrzynowicz, 2007). This species is considered an important pest in

many parts of Southeast Asia. It has a rather cosmopolitan distribution, but mainly occurs in arid and pan-tropical areas (Liu & Geis, 2019).

**Biology**. Gerberg (1957) reported the species has been found in wood, representing 24 families, 52 genera and 93 species, but the following genera are most susceptible: *Afzelia*, *Artocarpus*, *Avicennia*, *Bombax*, *Helicia*, *Koompassia*, *Parashorea* and *Shorea*.

***Minthea squamigera* Pascoe**

(Fig. 7E)

*Minthea squamigera* Pascoe, 1866: 97.

**Distribution in Paraguay:** Unspecified in Paraguay (Blackwelder, 1945; Borowski and Wégrzynowicz, 2012).

**Other distribution:** Colombia, Guyana, Surinam, Peru, Brazil, Argentina and introduced to Europe. (Borowski & Wégrzynowicz, 2007; Liu, 2010)

**Biology.** Unknown.

**Tribe Trogoxylini Liu & Schönitzer, 2011**

**Genus *Phyllyctus* Lesne, 1911**

***Phyllyctus gounellei* (Grouvelle)**

(Fig. 7F)

*Tristaria gounellei* Grouvelle, 1896: 193.

**Distribution in Paraguay:** Chaco (Liu, 2010), and this study has a new record in Paraguay: Paraguarí Dept.*: vic. Hotel Gabriela, nr. Paraguarí, 1-4-XII-2019, S 25°35.630' W 057°07.495', 504 ft., MV + BL, W Tyson, JE Eger & JM Leavengood (1, LLY).

**Other distribution:** Brazil, Argentina (Borowski & Wégrzynowicz, 2007).

**Biology.** Unknown.

**Genus *Trogoxylon* LeConte, 1862**

***Trogoxylon giacobbii* Santoro**

(Fig. 7G)

*Trogoxylon giacobbii* Santoro, 1957: 153.

**Distribution in Paraguay:** San Pedro (Liu, 2010), and this study has a new record in Paraguay: Guairá Dept.*: Hotel Independencia, vic. Independencia, 10-20-XII-2019, S 25°43.069' W 56°16.443', 617 ft, JE Eger & JM Leavengood (3, JMLC; 1, LLY).

**Other distribution:** Argentina (Borowski & Wégrzynowicz, 2007).

**Biology.** Unknown.

## Conclusions

The Bostrichidae comprises eight subfamilies: Bostrichinae (includes four tribes), Dinoderinae, Dysidinae, Endecatominae, Euderinae, Lyctinae (includes three tribes), Polycaoninae, and Psoinae (includes two tribes). Paraguay's fauna includes five of the eight subfamilies, one of which (Dinoderinae) has a cosmopolitan distribution. Three genera and eight species (23%) of the total sixteen genera and thirty-four species of Paraguay's fauna are of cosmopolitan distribution. But of the cosmopolitan species, we only report new records in Paraguay for *Rhyzopertha dominica* (Fabricius, 1792). Beside these cosmopolitan taxa, twenty-four species (69%) have Neotropical distributions including one endemic species (*Micrapate amplicollis* (Lesne, 1899)), two newly recorded species have Nearctic (*Lichenophanes bicornus* (Weber, 1801)) and Mediterranean and Afrotropical distributions (*Xyloperthella picea* (Olivier, 1790)) respectively, and one species (*Tetrapriocera longicornis* (Olivier, 1795)) has a New World distribution.

The faunal elements of Bostrichidae suggest that the Neotropical and Nearctic species form a group that probably originated from eastern Gondwanaland (Liu, 2016), then dispersed to the present Nearctic region from the Neotropical region. This first checklist of Bostrichidae of Paraguay shows that Paraguay has rather Neotropical fauna, but one must be wary of all the cosmopolitan bostrichid pests and Nearctic bostrichids invading Paraguay and spreading throughout the Neotropical region.

The previous studies of Neotropical

bostrichids (Binda & Joly, 1991; Reichardt, 1962a, 1962b, 1964b, 1970) did not cover comparable geography or climates, or focused only on particular taxa (Santoro, 1955, 1956, 1957, 1958, 1959, 1960; Reichardt, 1964c; Teixeira, 1992). This work is the first attempt to organize an overview of the bostrichid fauna of one neotropical country and creates a foundation for the study of the bostrichid fauna in the surrounding Neotropical regions.

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