BioOne COMPLETE

Potential Pest Bark and Ambrosia Beetles from Cuba Not Present in the Continental United States

Authors: Gomez, Demian F., Johnson, Andrew J., and Hulcr, Jiri

Source: Florida Entomologist, 103(1) : 96-102

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.103.0416

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

Potential pest bark and ambrosia beetles from Cuba not present in the continental United States

Demian F. Gomez[1], Andrew J. Johnson[1], and Jiri Hulcr[2,]*

Abstract

Early detection of potential threats relies on solid knowledge of exotic species and potential pathways of introduction. Here we provide a review of potential pest bark and ambrosia beetles recorded from Cuba but not present in the USA. Highlighted are genera which contain species known to have caused significant economic damage. This information is highly relevant to entomologists and practitioners involved in forest and tree industries, as well as biosecurity.

Key Words: wood borer; invasive species; emerging threat

Resumen

La detección temprana de plagas emergentes se basa en la existencia de conocimiento sólido en especies exóticas y las potenciales vías de introducción. Proporcionamos aquí un compendio de escarabajos de corteza y ambrosía como potenciales plagas, que han sido registrados previamente en Cuba, pero no se encuentran presentes en Estados Unidos. Se enfatizan géneros que contienen especies que causan daño económico significativo. Esta información es altamente relevante para entomólogos y practicantes involucrados en bosques, industrias forestales y bioseguridad.

Palabras Clave: perforador de madera; especies invasoras; daños emergentes

Exotic bark and ambrosia beetles are among the most commonly intercepted taxa at ports of entry in the USA (Haack 2006). In the USA alone, despite increasing regulations, the rate of new wood borers have increased significantly in the last decades (Aukema et al. 2010). One of the most invasive groups is the tribe Xyleborini, in which all species are inbred and haplodiploid, and able to establish new populations easily. In the last 10 yr, 15 new ambrosia beetles in the tribe Xyleborini have become established in the USA (Gomez et al. 2018). The majority of the species do not have an economic impact, because they develop in dead or dying material. However, a few species attack living trees causing damage (Raffa et al. 2015).

The Caribbean is one of the most biologically diverse regions in the Western Hemisphere. From the North American perspective, it also represents one of the pathways for imports of agricultural and forestry products (Penca et al 2016). Because of the geographic proximity with Cuba, where several economically important groups of insects are under-documented, potential pests can become established if mutual trade reestablishes. For example, 3 new species within the genus *Xylosandrus* Reitter (Scolytinae: Xyleborini), economically important for nurseries and commercial plantations across the world, have been recorded recently from the island, including 2 new species to science (Bright 2019; Gomez et al. 2019). Although none of these new records were considered to be pests in Cuba, attention should be paid to new species within *Xyleborus* Eichhoff (Scolytinae: Xyleborini) and *Xylosandrus* (Bright 2019; Gomez et al 2019), because other members of these genera have caused significant damage in the USA when introduced into a naïve environment. In addition, the presence of *Ips calligraphus interstitialis* (Eichhoff) (Coleoptera: Curculionidae), a sub-species of *Ips calligraphus* (Germar) (Coleoptera: Curculionidae) present in the Caribbean, can become a pest in the pine forest ecosystems in the southeastern USA.

Here we provide a list of potential pest bark and ambrosia beetles previously recorded from Cuba but not present in the USA. Increasing international trade has led to an unprecedented movement of invasive species (Westphal et al. 2008); therefore, early detection of potential threats relies on solid knowledge of exotic species and potential pathways of introduction. Given the limited and scattered nature of information on Cuban bark beetles, we believe that this review will be of use to biogeographers and entomologists, as well as to practitioners involved in biosecurity regulation. Our review specifically focuses on genera that contain species known to have caused significant economic damage to forests and forest commodities.

Materials and Methods

Specimens examined for this review were obtained from the cryopreserved Bark Beetle Collection at the University of Florida Forest Entomology lab managed by JH (University of Florida, Gainesville, Florida, USA), the Florida State Collection of Arthropods (Gainesville, Florida, USA), the Basic Collection of the Instituto de Ecología y Sistemática (Instituto de Ecología y Sistemática, Havana, Cuba), the Canadian Museum of Nature (Ottawa, Canada), the National Museum of Natural

[1]School of Forest Resources and Conservation, University of Florida/IFAS, PO Box 110410, Gainesville, Florida, USA; E-mail: demiangz@gmail.com (D. F. G.); andrewjavanjohnson@gmail.com (A. J. J.)

[2]School of Forest Resources and Conservation and Entomology and Nematology Department, University of Florida/IFAS, P.O. Box 110620, Gainesville, Florida 32611-0620, USA; E-mail: hulcr@ufl.edu (J. H.)

*Corresponding author; E-mail: hulcr@ufl.edu

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

History (Washington DC, USA), or collected by the authors in Cuba. Distribution records are as reported in Atkinson (2019), Bright (2019), Gomez et al. (2019), and Wood and Bright (1992). Details on locality were included only for Cuba. Synonyms listed for each species are from Bright (2019), and Wood and Bright (1992). Images and relevant morphological characters to genus and species are included. Photographs were provided by the various museums or taken by DFG using an Olympus SZX16 stereomicroscope (AmScope, Irvine, California, USA). Each image is a composite of up to 50 separate images taken with a Canon EOS Rebel T3i camera (Canon, Tokyo, Japan), and later stacked using the Helicon Focus software (v 6.0, Helicon Soft, Kharkov, Ukraine).

EXOTIC BARK AND AMBROSIA BEETLES TO THE USA

Corthylus Erichson (Coleoptera: Curculionidae)

Species within *Corthylus* (Coleoptera: Curculionidae) can be distinguished by the apparently absent antennal funicle (only 1 segment), the asymmetrical antennal club, and the raised line on the lateral margins of the pronotum (Bright 2019). All species strictly feed on symbiotic ambrosia fungus, usually attacking cut or broken branches or twigs, with records of colonizing living trees (Wood 2007). Some species, such as *Corthylus columbianus* Eichhoff (Coleoptera: Curculionidae), are of economic importance because they colonize the sapwood of healthy trees used for commercial purposes, and can lower the value by 25% (Solomon 1995). Some of the recorded hosts include oaks (*Quercus*; Fagaceae), maples (*Acer*; Sapindaceae), sycamore (*Platanus occidentalis* L.; Platanaceae), poplar (*Populus*; Salicaceae), elm (*Ulmus*; Ulmaceae), and beech (*Fagus*; Fagaceae), and while the beetle does not kill the host, the defects may seriously affect its use for veneer or structural purposes (Burns 1970; Abrahamson & McCracken 1971). Other species such as *Corthylus punctatissimus* (Zimmermann) (Coleoptera: Curculionidae) attacks live saplings, especially maple, in the eastern USA.

Corthylus subasperulus Eggers (Coleoptera: Curculionidae) (Fig. 1)

Diagnosis: This species is distinguished by the black or red-brown color, small size (less than 2 mm), and convex elytral declivity with a row of long setae in interstriae 1, 3, 5, and 7. Females have a glabrous frons with a margin of incurved setae. *Corthylus papulans* Eichoff (Coleoptera: Curculionidae), present in southeastern USA, can be distinguished by its larger size, and small granules on the declivity.

Distribution: Caribbean: Cuba (Santiago Province), Dominica, Guadeloupe, Puerto Rico.

Hosts: unknown.

Notes: Details on ecology are unknown.

Euwallacea Hopkins (Coleoptera: Curculionidae)

Species within *Euwallacea* (Coleoptera: Curculionidae) are distinguished by the subquadrate pronotum (subcircular in some species) and elevated posterolateral margins of the declivity (forming a sharp ridge or costa). This genus became relevant in the last decade due to the invasive species *Euwallacea fornicatus* (Eichhoff), *Euwallacea kuroshio* Gomez & Hulcr, and *Euwallacea perbrevis* (Schedl) (all Coleoptera: Curculionidae), causing severe damage in their native and introduced environments (Mendel et al. 2012; Owens et al. 2018; Paap et al. 2018).

Euwallacea posticus (Eichhoff) (Coleoptera: Curculionidae) (Fig. 2)

Xyleborus posticus Eichhoff (Coleoptera: Curculionidae)

Diagnosis: This species is distinguished from other *Euwallacea* by dull and steep elytral declivity, weakly impressed striae, and interstriae with a row of small granules and fine setae. Adult females are 2.4 to 2.7 mm. This species is most difficult to distinguish from several *Xyleborus* species such as *Xyleborus affinis* Eichhoff and *Xyleborus volvulus* (Fa-

Fig. 1. Dorsal and lateral view of female *Corthylus subasperulus*. Scale bar: 1 mm. Permission to publish from the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Fig. 2. Dorsal and lateral view of female *Euwallacea posticus*. Scale bar: 1 mm.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

bricius) (both Coleoptera: Curculionidae), distinguished by the genus-level characters. *Euwallacea posticus* has a subquadrate pronotum, versus evenly rounded in both *X. affinis* and *X. volvulus*.

Distribution: Caribbean: Cuba (Cienfuegos Province, Sancti Spiritus Province), Dominica, Guadeloupe, Puerto Rico, Saint Lucia; Central America: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama; North America: Mexico; South America: Argentina, Bolivia, Brazil, Colombia, Ecuador, Peru, Trinidad, Venezuela.

Hosts: polyphagous, with several records in the families Agavaceae, Anacardiaceae, Cupressaceae, Cyrillaceae, Lecythidaceae, Mimosaceae, Moraceae, Papilionaceae, Piperaceae, Rubiaceae, Rutaceae, Sterculiaceae, Tiliaceae.

Notes: Like other *Euwallacea* species, *E. posticus* is xylomycetophagous and colonizes a large number of hosts commonly found in injured, broken, or fallen branches and logs of wet forests (Wood 2007). Pérez-De La Cruz et al. (2009) and Mazón et al. (2013) recorded this species associated with cacao plantations in Mexico and Venezuela; Coto et al. (1995) recorded it as a pest of *Citrus* (Rutaceae) spp. in Central America. The species is widespread, but there is considerable variation between specimens from different locations that may represent cryptic species.

Ips DeGeer (Coleoptera: Curculionidae)

Ips is distinguished by 3 to 6 spines in the lateral margin of the elytral declivity, and by sinuate antennal sutures.

Ips calligraphus interstitialis (Eichhoff) (Coleoptera: Curculionidae) (Fig. 3)

Diagnosis: Distinguished by 7 pairs of spines along the declivity. The subspecies is morphologically distinct, distinguished by blunt fourth declivital spine in the declivity (acute in *I. calligraphus*) and interstrial punctures on elytra that are half the diameter of the strial punctures (smaller in *I. calligraphus*).

Fig. 3. Dorsal and lateral view of female *Ips calligraphus interstitialis*. Scale bar: 1 mm.

Distribution: Caribbean: Bahamas, Cuba (Havana Province, Isla de la Juventud Province, Matanzas Province, Oriente Province, Pinar del Río Province, Sancti Spíritus Province), Dominican Republic, Haiti, Jamaica.

Hosts: *Pinus caribaea*, *Pinus cubensis*, *Pinus occidentalis*, *Pinus tropicalis* (all Pinaceae).

Notes: Bright (2019) recognizes the Caribbean populations as a subspecies based on work of Lanier et al. (1991) using morphology, karyology, ecology, breeding experiments, and distribution. Further studies on *I. calligraphus interstitialis* should be conducted because it has been considered a synonym of *I. calligraphus* until recently, and we know little of how it would behave in the southeastern USA pine forests. Notes on biology and ecology have been extensively documented in Cuba, where it is one of the main threats to pine forests on the island (Zorrilla 1975, 1985; López-Castilla et al. 2009, 2010).

Phloeotribus Latreille (Coleoptera: Curculionidae)

The genus *Phloeotribus* is distinguished by the deeply divided antennal club in 3 segments (pseudo-lamellate antennae). All species are phloeophagous and colonize various trees, shrubs and vines, and typically colonizes limbs and branches larger than 2 cm (Wood 2007). *Phloeotribus liminaris* (Harris) (Coleoptera: Curculionidae) is recorded as a minor pest of *Prunus*, especially *Prunus serrotina* Ehrh. (Rosaceae) in the eastern USA and southern Europe (Rexrode 1981; Pennachio et al. 2004).

Phloeotribus atlanticus Schedl (Coleoptera: Curculionidae) (Fig. 4)

Diagnosis: Distinguished by narrow antennal club segments and small rounded granules in the interstriae. Adults are 1.9 to 2.3 mm. Distinguished from the USA species of *Phloeotribus* by the stout body proportions of less than 2.0 times as long as wide (all other southeastern USA species are greater than 2.1 times as long as wide) with numerous long setae on the male's antennal scape.

Distribution: Caribbean: Cuba (Matanzas Province), Dominican Republic, Jamaica.

Hosts: Recorded from 14 species in the families Araliaceae, Euphorbiaceae, Meliaceae, Moraceae, and Ulmaceae.

Notes: Bright (2019) resurrected this species previously synonymized with the similar *Phloeotribus setulosus* Eichhoff (Coleoptera: Curculionidae) based on characters in the epistoma of males and the frons in females. The species in this genus in the USA are restricted each to a different family of host trees, whereas *P. setulosus* appears to be polyphagous, and may be capable of developing in several ornamental or specialty fruit crops in southern Florida.

Pityophthorus Eichhoff (Coleoptera: Curculionidae)

Species within *Pityophthorus* can be diagnosed by pronotal asperities and the presence of a sclerotized septum in both antennal sutures of the club, and by usually sparse vestiture and bisulcate declivity. Individuals of this genus colonize cut or broken twigs and small branches of several conifers and broadleaves (Bright 1981). A few species in this large genus vector diseases such as the conifer pathogen *Fusarium circinatum* Nirenberg & O'Donnell (Nectriaceae), carried by *Pityophthorus setosus* Blackman and *Pityophthorus carmeli* Swaine (both Coleoptera: Curculionidae), or the walnut pathogen *Geosmithia morbida* Kolarik, Freeland, Utley & Tisserat (unassigned), carried by *Pityophthorus juglandis* Blackman (Coleoptera: Curculionidae), a species endemic to Mexico and the southwestern USA.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

Fig. 4. Dorsal and lateral view of female *Phloeotribus atlanticus*. Scale bar: 1 mm. Permission to publish from the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Fig. 5. Dorsal and lateral view of female *Pityophthorus laevis*. Scale bar: 1 mm. This image may be protected by copyright or have other legal restrictions on use. Permission to publish from the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Pityophthorus eccentricus Bright (Coleoptera: Curculionidae)

Diagnosis: Adults are 2.5 mm. Distinguished from similar *Pityophthorus* by its large size, scattered pronotal asperities (not arranged in concentric rows), confused interstrial punctures on the elytral disc, convex elytral declivity, and by lack of granules in the interstriae 1. This species is similar to *Pityophthorus pulicarius* (Zimmermann) (Coleoptera: Curculionidae) but *P. eccentricus* can be distinguished by the declivity which is entirely convex (slightly impressed in *P. pulicarius*) (Bright 2019).

Distribution: Caribbean: Cuba (Santiago Province).

Hosts: Unknown. The similar species, *P. pulicarius*, feeds on small twigs of *Pinus* spp.

Pityophthorus laevis (Schedl) (Coleoptera: Curculionidae) (Fig. 5)

Neopityophthorus laevis Schedl (Coleoptera: Curculionidae)
Araptus laevis Schedl (Coleoptera: Curculionidae)
Pityophthoroides pudens Blackman (Coleoptera: Curculionidae)
Pityophthorus pudens Blackman (Coleoptera: Curculionidae)
Pityophthorus formosus Bright (Coleoptera: Curculionidae)

Diagnosis: Distinguished from similar *Pityophthorus* in the USA by their small size (1.3 mm), flattened scales in the interstriae, non-impressed strial punctures, broadly rounded declivity, and by the posterior region of the pronotum without punctures.

Distribution: Caribbean: Cuba (Cienfuegos Province, Holguin Province), Dominica, Dominican Republic, Guadeloupe, Jamaica, Montserrat, Puerto Rico, Saint Lucia, and Virgin Islands.

Hosts: unknown.

Pityophthorus procerus Bright (Coleoptera: Curculionidae)

Diagnosis: Diagnosed from similar species in southeastern USA by the absence of a groove along the posterolateral margin of the pronotum, elongated body, size (1.8 mm); the female frons is flat with a dense brush of setae with scattered pronotal asperities (not arranged in concentric rows), and a steep and bisulcate elytral declivity.

Distribution: Caribbean: Cuba (Oriente Province).

Hosts: unknown. Species in this genus infest small branches, twigs, and seedlings of several species of shrubs, vines, as well as coniferous and deciduous trees.

Notes: Details on ecology are unknown.

Pityophthorus regularis Blackman (Coleoptera: Curculionidae) (Fig. 6)

Diagnosis: Distinguished by its small size (1.2 mm), concentric rows of asperities in the pronotum, and evenly convex elytral declivity.

Distribution: Caribbean: Cuba (Cienfuegos Province).

Hosts: Blackman gives no host information when describing this species. *Mangifera* (Anacardiaceae) is recorded as host by Vázquez et al. (2003).

Notes: Similar to *Pityophthorus concentralis* Eichhoff (Coleoptera: Curculionidae) present in Cuba and Florida, and known from *Metopium* sp (Anacardiaceae), but differs in the declivity which is distinctly impressed in *P. concentralis*.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

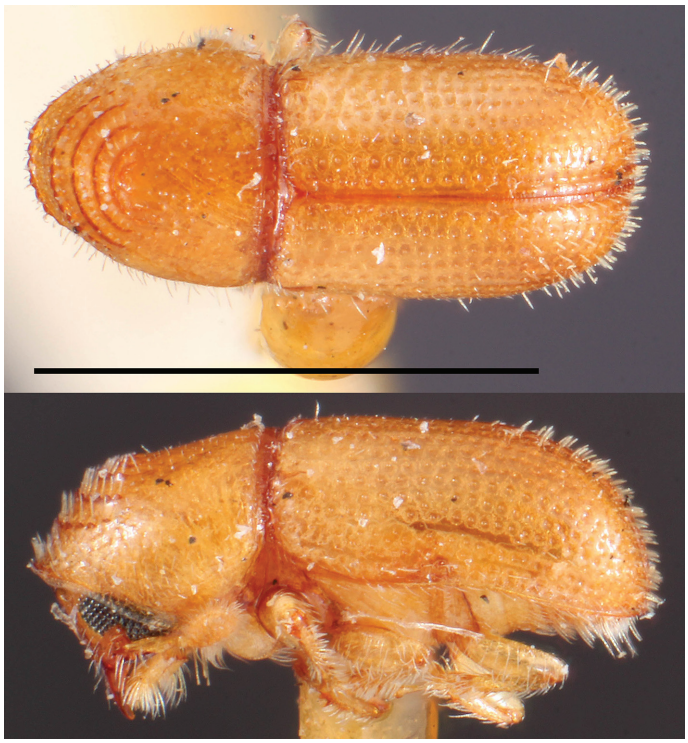

Fig. 6. Dorsal and lateral view of female *Pityophthorus regularis*. Scale bar: 1 mm. Permission to publish from the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Scolytus Geoffroy (Coleoptera: Curculionidae)

This genus can be distinguished by the single curved process in the outer margin of the protibiae, ascendant second abdominal ventrite, and straight elytral lateral margins (Smith & Cognato 2014; Bright 2019). Species within this genus are phloeophagous and colonize trunks or large branches where transverse parental galleries invade the cambial area (Wood 2007). *Scolytus multistriatus* (Marsham) (Coleoptera: Curculionidae), one of the most economically important species in this genus, caused severe impacts to *Ulmus* in the introduced distribution, where the pathogen *Ophiostoma novo-ulmi* Brasier (Ophiostomataceae) has killed millions of American elms (Furniss & Carolin 1977).

Scolytus dimidiatus Chapuis (Coleoptera: Curculionidae) (Fig. 7)

Diagnosis: Males are distinguished by a simple large spine in the sternum 2 with a tuft of hair in the base, frons not strongly elevated. Females have a dense brush of hair above the eyes. Adults are 2.1 to 3.2 mm.

Distribution: Caribbean: Cuba (Cienfuegos Province), Jamaica; Central America: Costa Rica, El Salvador, Guatemala, Honduras, Panama; North America: Mexico; South America: Venezuela.

Hosts: Recorded from Papilionaceae (*Lonchocarpus*) and Rhamnaceae (*Rhamnus*).

Notes: This is the only *Scolytus* species recorded from the Caribbean.

Xyleborus Eichhoff (Coleoptera: Curculionidae)

Species within *Xyleborus* can be distinguished by the truncate antennal club (with a corneus first segment), and inflated posterocoxal process. Most species are highly polyphagous colonizing broken or damaged hosts (Wood 2007). The redbay ambrosia beetles, *Xyleborus glabratus* Eichhoff (Coleoptera: Curculionidae), is one of the most devastating species of this genus, having introduced a pathogenic ambrosia fungus that killed more than 300 million red bays in the USA (Hughes et al. 2017).

Xyleborus anthracinus Bright (Coleoptera: Curculionidae) (Fig. 8)

Diagnosis: Distinguished by the black color of adult females, similar tubercles on interstriae 1 and 3 of the elytral declivity (between 2 and 4 tubercles on each interstriae), and straight profile of the elytral declivity in the lower half. Adult females are 2.5 mm.

Distribution: Caribbean: Cuba (Santiago Province).

Hosts: unknown.

Notes: Details on ecology are unknown, type specimen collected from lights.

Xylosandrus Reitter (Coleoptera: Curculionidae)

Species within *Xylosandrus* are distinguished by a stout body and widely separated procoxae. All species are xylomycetophagous colonizing a large variety of tree branches. The black twig borer, *Xylosandrus compactus* Wood & Bright (Coleoptera: Curculionidae), is one of the most economically important species in this genus, because it attacks healthy twigs of living trees and twigs of a great variety of hosts. *Xylosandrus crassiusculus* Motschulski and *Xylosandrus germanus* (Blandford) (both Coleoptera: Curculionidae) are major nursery pests.

Xylosandrus aurinegro Gomez & Hulcr (Coleoptera: Curculionidae) (Fig. 9)

Diagnosis: This species can be distinguished from all other known *Xylosandrus* species by the combination of its color pattern (pronotum yellowish-brown and elytra dark brown to black) and distinct tubercles on the interstriae 1, 2, and 3 of the elytral declivity. Adult females are 2.0 to 2.2 mm.

Distribution: Caribbean: Cuba (Artemisa Province).

Hosts: *Psychotria* (Rubiaceae) sp.

Notes: Details on ecology are unknown. The only known specimens were collected in one single event from a dying tree.

Xylosandrus cubensis Bright (Coleoptera: Curculionidae) (Fig. 10)

Diagnosis: Distinguished from other *Xylosandrus* by the more slender body, slightly notched elytral apex, and serrated postero-lateral margin of the declivity. Adult females are 1.9 to 2.9 mm.

Distribution: Caribbean: Cuba (Camagüay Province).

Hosts: unknown.

Notes: Details on ecology are unknown, type specimen collected from lights. The generic placement of this species should be revised because many characters on this species, such as the elevated and serrate posterolateral margin of the elytra, are not seen in the rest of *Xylosandrus* (Bright 2019).

Acknowledgments

We thank Lourdes Chamorro from the National Museum of Natural History, and Robert Anderson and Jean-Marc Gagnon from the Canadian Museum of Nature for providing images. This research was funded by the USDA-APHIS Farm Bill Project Section 10007, and by the USDA-ARS Insect Systematics Laboratory.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

Fig. 7. Dorsal and lateral view of female (left) and male (right) *Scolytus dimidiatus*. Scale bar: 2 mm. Permission to publish from the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA.

Fig. 8. Dorsal and lateral view of female *Xyleborus anthracinus*. Scale bar: 1 mm. Permission to publish from the Canadian Museum of Nature, Ottawa, Canada.

Fig. 9. Dorsal and lateral view of female *Xylosandrus aurinegro*. Scale bar: 1 mm.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use

Fig. 10. Dorsal and lateral view of female *Xylosandrus cubensis*. Scale bar: 1 mm. Permission to publish from the Canadian Museum of Nature, Ottawa, Canada.

References Cited

Abrahamson LP, McCracken FI. 1971. Insect and disease pests of southern hardwoods, pp. 80–89 *In* USDA-Forest Service, Southeastern Area, State and Private Forestry [eds.], Symposium on Southeastern Hardwoods, Atlanta, Georgia, USA.

Atkinson TH. 2019. Bark and Ambrosia Beetles. http://www.barkbeetles.info (last accessed 22 Dec 2019).

Aukema JE, McCullough DG, Von Holle B, Liebhold AM, Britton K, Frankel SJ. 2010. Historical accumulation of non-indigenous forest pests in the continental US. BioScience 60: 886–897.

Bright DE. 1981. Taxonomic Monograph of the Genus *Pityophthorus* Eichhoff in North and Central America (Coleoptera: Scolytidae). The Memoirs of the Entomological Society of Canada 113: 1–378.

Bright D. 2019. A Taxonomic Monograph of the Bark and Ambrosia Beetles of the West Indies (Coleoptera: Curculionoidea: Scolytidae). Studies on West Indian Scolytidae (Coleoptera) 7. Occasional Papers of the Florida State Collection of Arthropods 12: 1–491.

Burns DP. 1970. Insect enemies of yellow-poplar. Research Paper NE-159. USDA, Forest Service, Northeastern Forest Experiment Station, Upper Darby, Pennsylvania, USA.

Coto D, Saunders JL, Vargas CL, King AB. 1995. Plagas invertebradas de cultivos tropicales con énfasis en América Central: un inventario (No. 12). CATIE, Turrialba, Costa Rica.

Furniss RL, Carolin VM. 1977. Western forest insects (Vol. 1339). USDA, Forest Service, Washington, DC, USA.

Gomez DF, Rabaglia RJ, Fairbanks KE, Hulcr J. 2018. North American Xyleborini north of Mexico: a review and key to genera and species (Coleoptera, Curculionidae, Scolytinae). ZooKeys 768: 19–68.

Gomez DF, Johnson AJ, Carton de Grammont P, Alfonso-Simonetti J, Montaigne J, Elizondo AI, Muiño BL, Ojeda D, Vidal J, Hulcr J. 2019. New records of bark and ambrosia beetles (Coleoptera: Scolytinae) from Cuba with description of a new species. Florida Entomologist 102: 717–724.

Haack RA. 2006. Exotic bark-and wood-boring Coleoptera in the United States: recent establishments and interceptions. Canadian Journal of Forest Research 36: 269–288.

Hughes MA, Riggins JJ, Koch FH, Cognato AI, Anderson C, Formby JP, Dreaden TJ, Ploetz RC, Smith JA. 2017. No rest for the laurels: symbiotic invaders cause unprecedented damage to southern USA forests. Biological Invasions 19: 2143–2157.

Lanier GN, Teale SA, Pajares JA. 1991. Biosystematics of the genus *Ips* (Coleoptera: Scolytidae) in North America: review of the *Ips calligraphus* group. The Canadian Entomologist 123: 1103–1124.

López Castilla RA, Rojas FG, Rivero CG, Izaguirre EDZ, Vera AF, Isasi NT. 2009. Contribución para el diagnóstico y control de los descortezadores del género *Ips* (Coleoptera: Scolytidae) en los bosques de pinos de Cuba. Ra Ximhai: revista científica de sociedad, cultura y desarrollo sostenible 5: 281–296.

López Castilla RA, Fernández Vera A, Triguero Isasi N. 2010. Determinación de la incidencia diferencial de los descortezadores del género *Ips* (Coleoptera: Scolytidae: Ipini) a *Pinus caribaea* Morelet y *Pinus tropicalis* Morelet en Viñales. Fitosanidad 14: 91–95.

Mazón M, Díaz F, Gaviria JC. 2013. Effectiveness of different trap types for control of bark and ambrosia beetles (Scolytinae) in Criollo cacao farms of Mérida, Venezuela. International Journal of Pest Management 59: 189–196.

Mendel Z, Protasov A, Sharon M, Zveibil A, Yehuda SB, O'Donnell K, Rabaglia R, Wysoki M, Freeman S. 2012. An Asian ambrosia beetle *Euwallacea fornicatus* and its novel symbiotic fungus *Fusarium* sp. pose a serious threat to the Israeli avocado industry. Phytoparasitica 40: 235–238.

Owens D, Cruz LF, Montgomery WS, Narvaez TI, Schnell EQ, Tabanca N, Duncan RE, Carrillo D, Kendra PE. 2018. Host range expansion and increasing damage potential of *Euwallacea* nr. *fornicatus* (Coleoptera: Curculionidae) in Florida. Florida Entomologist 101: 229–237.

Paap T, De Beer ZW, Migliorini D, Nel WJ, Wingfield MJ. 2018. The polyphagous shot hole borer (PSHB) and its fungal symbiont *Fusarium euwallaceae*: a new invasion in South Africa. Australasian Plant Pathology 47: 231–237.

Penca C, Adams DC, Hulcr J. 2016. The Cuba-Florida plant-pest pathway. Insecta Mundi 490: 1–17.

Pennacchio F, Faggi M, Gatti E, Caronni F, Colombo M, Roversi PF. 2004. First record of *Phloeotribus liminaris* (Harris) from Europe (Coleoptera Scolytidae). Redia 87: 85–89.

Perez-De La Cruz M, Equihua-Martinez A, Romero-Napoles J, Sanchez-Soto S, Garcia-Lopez E. 2009. Diversity, dynamic population and host plants of bark and ambrosia beetles (Coleoptera: Curculionidae) associated to the cocoa agroecosystem in Tabasco, Mexico. Revista Mexicana de Biodiversidad 80: 779–791.

Raffa KF, Gregoire JC, Lindgren BS. 2015. Natural history and ecology of bark beetles, pp. 1–40 *In* Vega FE, Hofstetter RW [eds.], Bark Beetles: Biology and Ecology of Native and Invasive Species. Elsevier Inc., San Diego, California, USA.

Rexrode CO. 1981. Gum spots in black cherry caused by natural attacks of peach bark beetle. Research Papers NE-474. USDA, Forest Service, Northeastern Forest Experiment Station, Broomall, Pennsylvania, USA.

Smith SM, Cognato AI. 2014. A taxonomic monograph of Nearctic *Scolytus* Geoffroy (Coleoptera, Curculionidae, Scolytinae). ZooKeys 450: 1–182.

Solomon JD. 1995. Guide to insect borers in North American broadleaf trees and shrubs. Agriculture Handbook AH-706. Washington, DC, USA.

Vázquez L, Rodríguez M, Zorrilla MA. 2003. Lista de escolítidos (Coleoptera) de Cuba y sus plantas hospedantes. Fitosanidad 7: 17–21.

Westphal MI, Browne M, MacKinnon K, Noble I. 2008. The link between international trade and the global distribution of invasive alien species. Biological invasions 10: 391–398.

Wood SL. 2007. Bark and Ambrosia Beetles of South America (Coleoptera, Scolytidae). Monte L. Bean Life Science Museum, Brigham Young University, Provo, Utah, USA.

Wood SL, Bright DE. 1992. A catalog of Scolytidae and Platypodidae (Coleoptera), Part 2: Taxonomic index, volumes A and B. Great Basin Naturalist Memoirs 13: 1–1553.

Zorrilla MA. 1975. Informe sobre las plagas del género *Ips* De Geer (Coleoptera: Scolytidae). Sección Protección Forestal. CICF-INDAF, Havana, Cuba.

Zorrilla MA. 1985. Notas bionomicas de *Ips interstitialis* (Eichhoff) (Coleoptera: Scolytidae), descortezador de pinos en Cuba. Memoria de los Simposia Nacionales de Parasitología Forestal II y III 46: 1–212.

Downloaded From: https://bioone.org/journals/Florida-Entomologist on 05 May 2024
Terms of Use: https://bioone.org/terms-of-use