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First Report of *Dere thoracica* White (Coleoptera: Cerambycidae: Cerambycinae) in the United States, with Notes on its Discovery, Recognition, Biology, and Habits

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Abstract

Dere thoracica White, a cerambycine longhorned beetle native to eastern Asia, is newly reported from Georgia, USA, where an established population was detected. A single female was collected in a flight intercept trap in Clarke County during early 2020, and 292 adults were excavated from their pupal chambers or reared from dead branches of mimosa tree, *Albizia julibrissin* Durazz. (Fabaceae), during early 2021. These are the first records of the genus and species in the Nearctic Region. *Dere thoracica* is considered to be a generalist dependent on recently dead or dying trees. It can be easily distinguished from the native Georgia fauna of longhorned beetles, and we have provided a description and diagnosis to differentiate it from one similar species.

Keywords: Chrysomeloidea, adventive species, non-native species, range extension, woodborer, southeastern United States

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Introduction

Unforeseen incursions of non-native cerambycid beetles represent a threat to forest biosecurity in all forested countries (Fan *et al.* 2019). Historically, several notable pathways have facilitated the unintentional introduction of non-native woodboring beetles into the United States (Eyre and Haack 2017; Meurisse *et al.* 2019), including the movement of nursery plants and cut branches (Liebhold *et al.* 2012; Roques 2010), solid wood packaging materials (Krishnankutty *et al.* 2020), and other finished wood products and timber (Aukema *et al.* 2010). Of these, solid wood packaging—generally composed of raw, sometimes green wood, untreated—is clearly the principal pathway for the introduction and spread of cerambycid pests (Eyre and Haack 2017; Wu *et al.* 2017). This is consistent with most interceptions of Cerambycidae at global ports and their close association with consignments of wood packaging in the form of pallets, crates, dunnage, and other unspecified structures (Brockerhoff *et al.* 2006; Eyre and Haack 2017; Wu *et al.* 2017).

Documenting new foreign introductions remains crucial for conducting pest risk analyses (Eyre and Haack 2017), even though most non-native

cerambycids do not become serious pests when they become established. At present, at least 22 species of non-native Cerambycidae have been recorded in North America (BugGuide 2021). In this paper, we give the first records for *Dere thoracica* White (Cerambycidae: Cerambycinae: Cleomenini) in the United States. Furthermore, we describe and provide high-resolution photographs of the adult female, present additional diagnostic characters to differentiate this newly detected immigrant from similar North American Cerambycidae, and review its biology and habits, including documented host plants in its native range.

Materials and Methods

Images, Measurements, and Depositories. Images of the female habitus (Figs. 1A, B) were acquired with a Canon EOS1 digital camera and the accompanying Digital Photo Professional software (Canon Inc., Tokyo, Japan). Images were taken at different focal depths and stacked using Helicon Focus 6 (Helicon Soft Ltd, Kharkiv, Ukraine) and edited with Adobe Photoshop CS4 (Adobe Inc., San Jose, United States). In total, 29 and 27 focal images were stacked for the dorsal and lateral habitus, respectively. Images of branch material (Figs. 2A–C) were taken with cell phone cameras and edited with Adobe Photoshop.

Measurements of specimens were made using an eyepiece reticle on a Zeiss Stemi 2000-C stereo microscope, 1.0× objective with 10× oculars. Body length was measured in millimeters from the front margin of the head to the apex of the elytra along the midline. Body width was measured in millimeters across the elytra at the humeral angle.

Specimens are deposited in the University of Georgia Collection of Arthropods (UGCA), Athens, Georgia, and in the United States National Museum (USNM), Smithsonian Institution, Washington, DC.

Results

Initial Discoveries in Georgia. *Dere thoracica* (Fig. 1) was collected from two localities in Athens, GA (Clarke Co.), USA during 2020 and 2021. First, one female was collected in Athens, Georgia between 25 March 2020 and 9 April 2020 in a flight intercept trap composed of two clear panels held over a 3.78-L

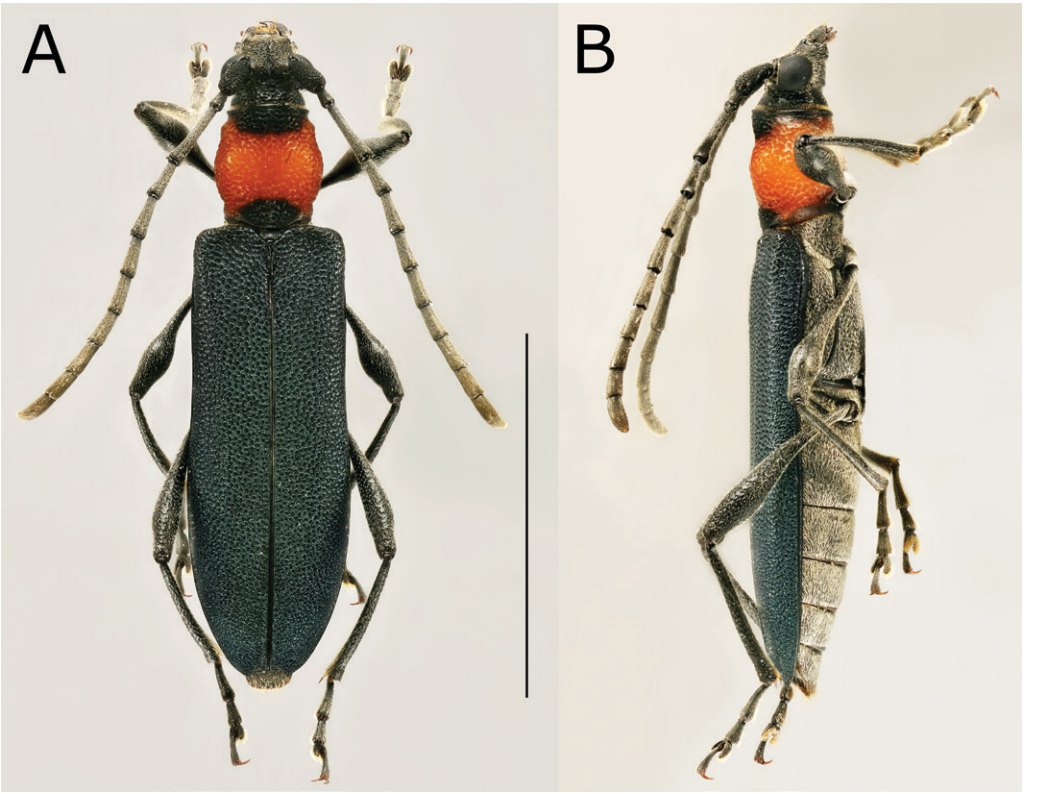

Fig. 1. *Dere thoracica*, female. A) Dorsal habitus, B) Lateral habitus. Scale bar = 5 mm.

white bucket filled with propylene glycol. The trap was baited with an ethanol lure and suspended 5 m above the ground from a mimosa tree, *Albizia julibrissin* Durazz. (Fabaceae). The forest where the specimen was trapped is roughly 40 years old, heavily invaded by non-native trees and shrubs, and directly surrounded by businesses (including Athens-Ben Epps Airport) and residential homes with similarly aged woodlots intermixed.

An additional 292 adults were collected from dead branches of *A. julibrissin* in Athens at Lake Herrick on 22 February and 6 March 2021. This area is a multi-use, forested park close to the University of Georgia, roughly 4.6 km from the first detection. The surrounding area was a forest edge with a mix of native and non-native trees (mostly *A. julibrissin*). Twenty-one adults were extracted from their pupal chambers inside the dead branches, and an additional 271 adults later emerged from the branches. The branches were 4–10 cm in diameter, decayed, with fungal growth on the underside and roughly 50% of the bark missing. The phloem layer was no longer present when the branches were found. Exit holes and pupation chambers are shown in Figs. 2A–C.

Specimens Examined. USA: Georgia: Clarke Co., Athens, 33.95481°N, 83.32828°W, 25 March to 9 April 2020, ex flight intercept trap, C. R. Traylor (1 female; UGCA); Athens, 33.93167°N, 83.36962°W, 22 February 2021, extracted ex dead branch of *Albizia julibrissin*, C. R. Traylor (8 females, 6 males; UGCA); Athens, Lake Herrick/Oconee Forest Pk., 33.93167°N, 83.36962°W, 6 March 2021, E. R. Hoebeke, extracted ex dead branch of *Albizia julibrissin* (8 females, 1 male; UGCA); Athens, 33.93167°N, 83.36962°W, March 2021, emerged ex dead branch of *Albizia julibrissin*, C. R. Traylor (16 females, 20 males; UGCA, USNM). Not all collected specimens were examined for the description and measurements.

Description. Female (Figs. 1A, B): Body elongate, slender, parallel-sided. Length 9.5 mm (8.8–10.2 mm, $n = 32$); width 2.3 mm (2.1–2.5 mm, $n = 32$). Head black, dull. Frons and occiput coarsely punctured, matte. Antennae black, with short, appressed, silvery pubescence and scattered erect setae. Antennae not reaching posterior margin of first visible abdominal ventrite when laid alongside. Pronotum reddish-orange with anterior and posterior margins black, quadrate, barrel-shaped, broadest at middle, disc rugosely punctured, matte, with vague callus or protuberance situated lateromedially on either side of midline. Prosternum also with broad, quadrate patch of fine, appressed, whitish setae immediately in front of procoxae, continuing onto prosternal process. Meso- and metathoracic venter and abdominal ventrites covered with densely matted, thick, appressed, whitish scale-like setae. Elytral base flattened. Disc dark metallic blue-green, profusely, coarsely punctured by small, contiguous, polyhedric fossae. Base of fossae minutely reticulate, matte. Elytral apex distinctly notched, inner and outer angles each with a sharp spine. Legs black with short, appressed, silvery pubescence. Pro- and mesofemora pedunculate-clavate apically. Metafemora moderately expanded in distal half.

Male: As in female, except antennae longer, reaching posterior margin of first visible abdominal ventrite when laid alongside. Length 9.0 mm (8.5–9.4 mm, $n = 27$); width 2.1 mm (1.9–2.2 mm, $n = 27$).

Sexual dimorphism in external characters is not pronounced in the genus *Dere* Fahraeus, as noted by Bjornstad (2013: 249). Without dissecting genitalia, the length of the antennae is the only apparent difference between the sexes of *D. thoracica*.

Diagnosis. One common and wide-ranging eastern US species of Cerambycidae that closely resembles *D. thoracica* is *Rhopalophora longipes* (Say), which is a member of the tribe Rhopalophorini (Lingafelter 2007). Its bicolored body is slender and moderate-sized (6.0–9.0 mm).

Lingafelter (2007) provided an illustrated key to the cerambycid beetles of the eastern United States. *Dere thoracica* will key to couplet #215 with *R. longipes*. The following changes should be made to couplet #215 (p. 76) to include *D. thoracica* (modifications to the Lingafelter key **in bold**).

215(212'). **Some femora moderately to strongly pedunculate-clavate apically. Body bicolored. Pronotum red or orange. Elytra black or metallic blue…215A**

215'. Femora linear, gradually enlarged apically, or clavate, with, at most, a small peduncle. **Body color not as above**…216

215A. **Meso- and metafemora very long and strongly pedunculate-clavate apically. Basal portion of metafemur over 3× as long as apical clavate portion. Elytra black with coarse punctures. Elytral apices truncate, outer angle dentiform…… *Rhopalophora longipes* (Say)**

215A'. **Meso- and metafemora not unusually long. Mesofemora pedunculate-clavate apically. Metafemur expanded in distal half. Elytra dark metallic blue with contiguous polyhedric fossae. Elytral apices notched, inner and outer angles each bearing a sharp spine…… *Dere thoracica* White**

(Couplet 216 unmodified)

If *D. thoracica* were to become established on the Pacific Coast of North America, it could be confused with another native cerambycine species,

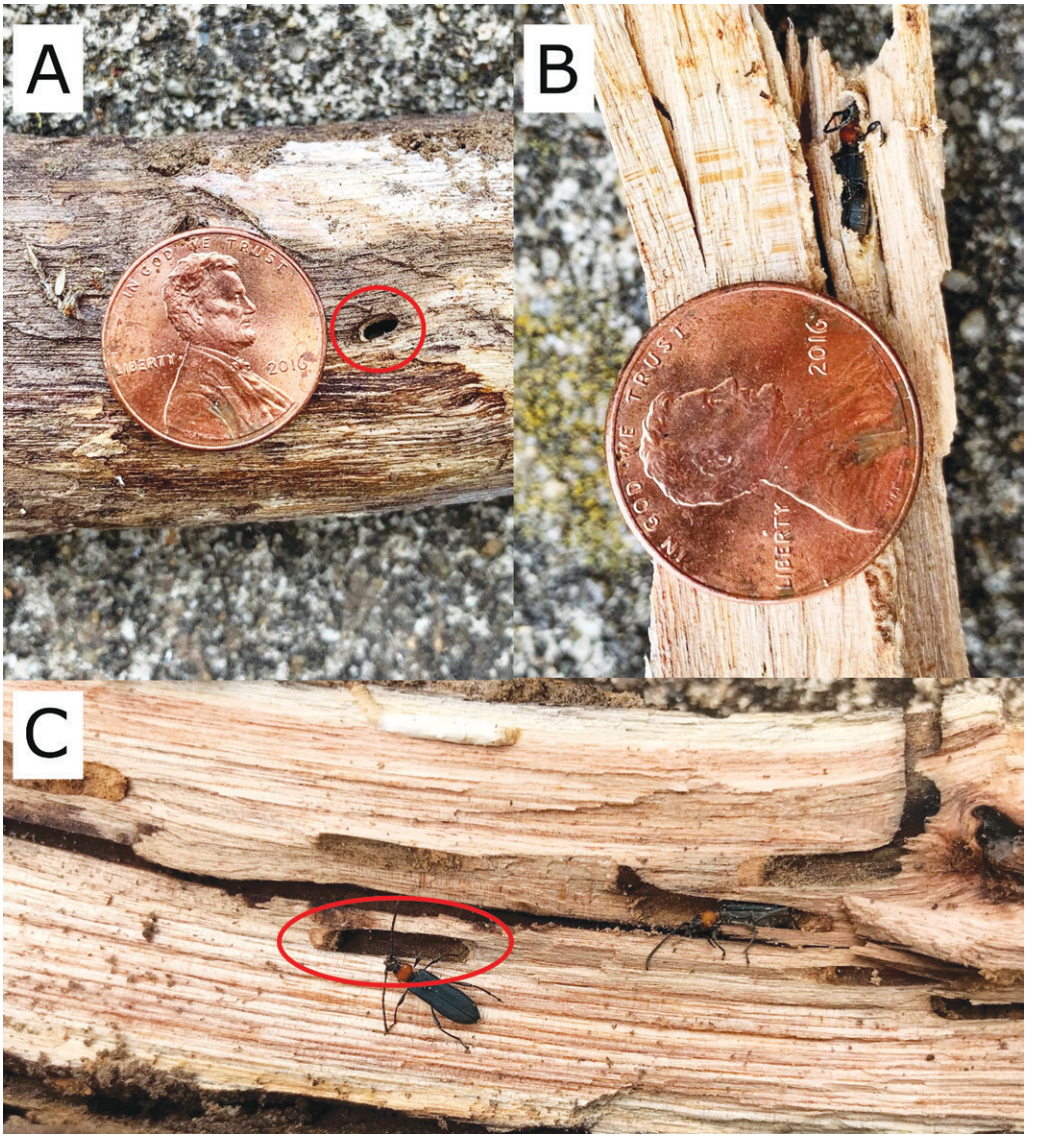

Fig. 2. Examples of *Dere thoracica* damage in dead branch of *Albizia julibrissin*. A) Exit hole, circled in red, B) Adult specimen still inside pupation chamber, C) Adults on infested wood with empty pupal chamber, circled in red. Penny for scale is 19.05 mm in diameter.

Callimus ruficollis (LeConte), which strongly resembles *D. thoracica* in size, body shape, and coloration and occurs in western North America from British Columbia to southern California. *Callimus ruficollis* is a member of the tribe Stenopterini and is characterized by a slender body with the head, thorax, abdomen, antennae, and legs black, the pronotum rufous, and the elytra dark blue or dark greenish (Linsley 1963). It differs from *D. thoracica* by the body surfaces, especially the antennae and legs, which bear numerous "flying hairs" (*i.e.*, long, erect hairs) (Linsley 1963) (*cf.* body lacking long, erect hairs in *D. thoracica*) and the elytral apices conjointly rounded with the sutural angle often dentiform (Linsley 1963) (*cf.* elytral apices deeply notched and outer and inner angles strongly dentate in *D. thoracica*).

Distribution. The native range of *D. thoracica* includes the easternmost portions of the Palearctic Region, including China (Hebei, Shandong, Henan,

Shaanxi, Hubei, Jiangsu, Jiangxi, Zhejiang, Fujian, Hunan, Guangxi, Guialiaou, Sichcuan, and Yunnan Provinces), Japan, Korea, Laos, and Vietnam (Hua *et al.* 2009; Tavakilian and Chevillotte 2020). Considered common in Japan during the mid-1900s (Nakamura 1957), it has consistently been observed there since 1931 (GBIF 2020).

Biology and Habits. In its native range, adults of *D. thoracica* are active from April through early July, with peak activity during May and June (Fujiwara and Hayashi 2007; GBIF 2020; Nakamura 1957). This species has been found streamside in forest interiors (Kato *et al.* 1990) and flying near the ground along a forest edge (Fujiwara and Hayashi 2007). In the current study, it was collected by a flight intercept trap in a forest canopy at 5 m above ground.

Adult mating and oviposition behaviors, as well as larval development, have been thoroughly documented by Nakamura (1957). Adults mate on or near the larval host, with females ovipositing directly onto the bark. Upon hatching, larvae burrow under the bark to feed at the inner bark and sapwood interface. Late instar larvae tunnel into the sapwood perpendicular to the wood grain and fill the gallery behind them with frass. Inside the sapwood, fully-grown larvae excavate a pupal chamber parallel to the wood grain. The chamber is shaped to be an elliptical cylinder, 2.5–3.5 mm in diameter and 12.0–15.0 mm long. Pupation occurs during August and lasts 8–12 days, but exact timing can vary by region. Adults overwinter in the pupal chamber and emerge in the spring, with one flight season per year (Nakamura 1957). In the current study, overwintering adults were found in their pupal chambers (Figs. 2B, C) from late February through March. Emergence holes are oval in cross-section and approximately 3 mm in length and 1.5 mm in width at the midpoint (Fig. 2A).

Host Plant Associations. *Dere thoracica* uses a variety of tree and shrub species as larval hosts, including *A. julibrissin*, *Elaeagnus umbellata* Thunb. (Elaeagnaceae), *Elaeagnus* spp., *Photinia glabra* (Thunb.) Franch. and Sav. (Rosaceae), *Prunus japonica* Thunb. (Rosaceae), *Prunus* spp., *Quercus acuta* Thunb. (Fagaceae), and *Quercus aliena* Blume (Fagaceae) (Cho 1959; Chung *et al.* 1995; Hua *et al.* 2009; Ko 1969 [as cited in Lim *et al.* 2014]; Kang *et al.* 2002; Lim *et al.* 2014; Ren and Li 2001). Other, non-specified (*i.e.*, either larval or adult) plant associations include *Pinus yunnanensis* Franch. (Pinaceae), *Paulownia* spp. (Paulowniaceae), *Pyrus* spp. (Rosaceae), and *Vitis vinifera* L. (Vitaceae) (Chen *et al.* 1959 [as cited in Zheng *et al.* 2004]; Hua *et al.* 2009; Lei and Zhibo 1998 [as cited in Zheng *et al.* 2004]; Zheng *et al.* 2004). Adults also are common flower visitors (Bates 1873), including those of fruit crops in Korea (Choi and Jung 2015) and wild *Anthriscus sylvestris sylvestris* (L.) Hoffm. (Apiaceae) in Japan (Kato *et al.* 1990).

Discussion

The introduction of *D. thoracica* in Georgia was most likely via solid wood packaging material because this mode of conveyance was already implicated in interceptions at US ports of entry (Eyre and Haack 2017). In fact, this species has been intercepted three times from shipments originating in China (J. A. Hardin, *in litt.*). It was first intercepted at Long Beach, California in 1985, followed by Savannah, Georgia in 2008, and finally Blaine, Washington in 2012 (Savannah and Blaine interceptions are identified to genus only; P. Bailey, *in litt.*).

We hypothesize that *D. thoracica* is established in the area around Athens, Georgia, as we found the species in two areas that are 4.6 km apart. The developmental and overwintering biology of the species further supports this hypothesis. Larval development and pupation occur within a single growing season, and adults overwinter in their pupal chambers (Nakamura 1957). This suggests that we collected adults from two generations: those active in 2020 and those active in 2021 (although we collected these latter adults prior to the flight season).

The geographic extent of this population's establishment has not been determined. In the surrounding region, there is no shortage of available larval hosts, as *A. julibrissin* and *E. umbellata* are well established in the southeastern United States. Both of these woody plants were intentionally introduced in the 1700s and 1800s: *A. julibrissin* as an ornamental and *E. umbellata* for wildlife habitat (Cothran 2004; Miller 2003). Today, these species are considered naturalized, invasive, and harmful to native ecosystems (Miller 2003).

The potential for *D. thoracica* to become a major pest in the southeastern United States seems low as it is not known to colonize living trees (Nakamura 1957). As many of its known hosts are invasive and/or naturalized trees and shrubs, its presence might aid in controlling weakened individuals of these species. Alternatively, *D. thoracica* might be considered a pest by owners of these ornamentals.

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