

A Bark Beetle *Hypothenemus eruditus* Westwood (1836) (Insecta: Coleoptera: Curculionidae: Scolytinae)¹

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Introduction

Hypothenemus eruditus species and from all subtropical and tropical regions (Wood 1982). This species is the type species of the bark beetle genus *Hypothenemus* (Coleoptera: Curculionidae: Scolytinae), which belongs to the tribe Cryphalini, the pygmy borers. With over 180 described species, *Hypothenemus* is one of the most species-rich genera among bark beetles. In addition, it appears to be the most common scolytine in the world (Wood 2007). In Florida, *Hypothenemus* are probably the most common bark beetles (Johnson et al. 2016). They are ubiquitous in forests and by far the most common bark beetles in urban and suburban areas, but they are virtually unknown to the public due to their minute size (only up to 1.3 mm). *Hypothenemus eruditus* is the most common cryphaline species in Florida. It is highly attracted to ethanol and it often hovers above alcoholic drinks.

Despite its prevalence, this species causes no apparent damage to plants. Most economic impacts caused by other *Hypothenemus* species are attributed to beetles that bore into seeds or fruits, e.g. the coffee berry borer, *Hypothenemus hampei* (Hulcr 2013), and the tropical nut borer, *Hypothenemus obscurus*.

In addition to being recorded from diverse plant tissues (e.g., leaf petioles or twigs) *Hypothenemus eruditus* has also

been recovered from many unexpected locations, e.g. galleries of other beetles (Deyrup 1987), fungal fruiting bodies (Browne 1961), manufactured objects such as drawing boards (Browne 1961), and book bindings, from which the name (*eruditus*, i.e. erudite) was derived (Westwood 1836).

Taxonomy

The genus *Hypothenemus* was established based on the type species, *Hypothenemus eruditus* Westwood (Westwood 1836), and the genus name was given in reference to the downward facing mouthparts (“Hypo” means under, “thenemus” is an unusual variant of a Greek word for “mouth”, Westwood 1836). The taxonomic status of *Hypothenemus eruditus* is extraordinarily complicated, as it includes over 70 taxonomic synonyms. The small body size (1–1.3 mm for female and 0.7 mm for male), and the subtle but extensive within-species morphological diversity may be the explanation for its unclear taxonomic placement.

The large within-species variation of *Hypothenemus eruditus* is also reflected in molecular markers. Beetles of this species collected at a single locality in Central America had genetic diversity equal to generic-level diversity found in other insects (Kambestad 2011). These results suggest that *Hypothenemus eruditus* is a complex of many cryptic species. Many of the dozens of synonyms may in fact be different species. Further comparison between morphological

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and molecular data is needed to resolve the taxonomy of this species.

Distribution

Hypothenemus eruditus is present in all tropical and subtropical regions of the world and is also known to extend to many temperate regions. It has been recorded across the Americas from Argentina to Michigan (Figure 1). The most comprehensive records can be accessed on the www.barkbeetles.info online database (Atkinson 2016).



Figure 1. Collection localities of *Hypothenemus eruditus* in the Americas as of January 2016. This species is also widely distributed in other tropical and subtropical regions around the world. Credits: Atkinson (2016)

Description

Adults

The adult females are 1.0–1.3 mm long, and 2.4 times as long as wide. Coloration is variable: dark brown or black. Some individuals are distinctly bicolored with a light brown to orange pronotum (the upper or dorsal surface of the first thoracic segment) and black to brown elytra (the two external and hardened forewings of adult Coleoptera). The pronotum is widest at its base, 0.9 times as long as wide, broadly rounded frontally, highest at middle. The frontal slope of the pronotum is asperate: covered with distinct flat projections bent backwards. The anterior margin of the pronotum bears six such projections (asperities) and the medium pair is usually narrowly separated. The elytra are 1.7 times as long as wide. Elytral striae (longitudinally arranged lines on the elytron) consist of small punctures. The interstriae (spaces between the striae) are twice as wide as the striae, smooth, somewhat glossy, each with a straight row of minute punctures. An important character for this genus is the arrangement of setae on the elytra: they resemble flattened erect scales arranged in simple rows. The elytral end (the “declivity”) is convex and steep.

The adult males are 0.7 mm long. Male eyes are only half as large as female eyes, and many other morphological features are poorly formed. Males do not fly; they only have vestiges of wings and their elytra are fused and therefore functionless. The males are less common than females in a single gallery, typically only a single male is produced per family.

Eggs

The eggs are oval in shape, and white in color. They are approximately 0.3–0.5 mm long and 0.2–0.25 mm wide. Eggs are laid loosely in the larger central chamber of gallery system (tunnels engraved by beetles).

Larvae

The larvae are white, C-shaped, and legless. They are approximately 0.6–1.2 mm long.

Biology

A new gallery (the nest of a bark beetle) is initiated with one single entrance hole by an adult female, usually located at leaf nodes or stems of a dead twig (Figure 2). Each initiating female has typically been fertilized by her brother in her natal gallery, so she does not need to attract a mate. If a branch is occupied by multiple families and galleries are intermingled, females can also mate with non-sibling males (Browne 1961).



Figure 2. A typical placement of the gallery of *Hypothenemus eruditus* in a notch under a leaf node in a dead twig. Credits: Yin-Tse Huang, UF/IFAS

During gallery excavation, the female pushes frass and debris out of the entrance hole. While excavating, she also lays eggs loosely in the gallery system, typically in the larger central chamber. The eggs are very large in comparison to the size of the female. After hatching, the larvae extend the irregular parental tunnel as they feed (Wood 2007).

In the field, development from egg to adult takes approximately 28 days (Browne 1961). There is a skewed sex ratio favoring females. Sex determination in *Hypothenemus* is an example of pseudo-arrhenotoky, where the male develops from a fertilized egg but the father's genome in most cells of his body is never "unfolded" and remains unused, resulting in an individual that only uses a single copy of its mother's genome ("functional haploidy") (Borsa and Kjellberg 1996).

Female adults may remain in the galleries after mating with males, either for maturation feeding or to wait for proper environmental conditions to disperse. Dispersing females may come out via the original entrance hole or through new exit holes.

Diagnosis

Hypothenemus eruditus can frequently be confused with two commonly encountered *Hypothenemus* species in tropical and subtropical regions (e.g. Florida) such as *Hypothenemus seriatus* and *Hypothenemus birmanus*. Among adult females of all three species, *Hypothenemus birmanus* is the largest (1.5–2.2 mm), followed by *Hypothenemus seriatus* (1.3–1.5 mm), then *Hypothenemus eruditus* (1.0–1.3 mm) (Figure 3). *Hypothenemus birmanus* can be easily distinguished by its distinct pronotal asperities: the edge of the pronotum has only four teeth, the median pair is larger than the outer pair. *Hypothenemus seriatus* and *Hypothenemus eruditus* usually possess six marginal asperities of similar size and spacing (Figure 4). *Hypothenemus seriatus* has a groove on its frons (the upper anterior part of the head capsule); the groove is absent or not obvious in *Hypothenemus birmanus* and *Hypothenemus eruditus* (Wood 2007) (Figure 5). However, the presence of the groove is variable, even for individuals from the same gallery (A. J. Johnson, unpublished). The interstitial bristles (bristles between the striations) of *Hypothenemus birmanus* are denser on the abdominal end of elytra than on the top of elytra, while relatively evenly distributed in *Hypothenemus seriatus* and *Hypothenemus eruditus*. The end of elytra is less steep in *Hypothenemus seriatus* and has distinct stria rows. The elytral declivity in *Hypothenemus eruditus* and *Hypothenemus birmanus* is relatively steep, and the stria or interstitial rows are not arrayed as neatly as in *Hypothenemus seriatus* (Figure 6).

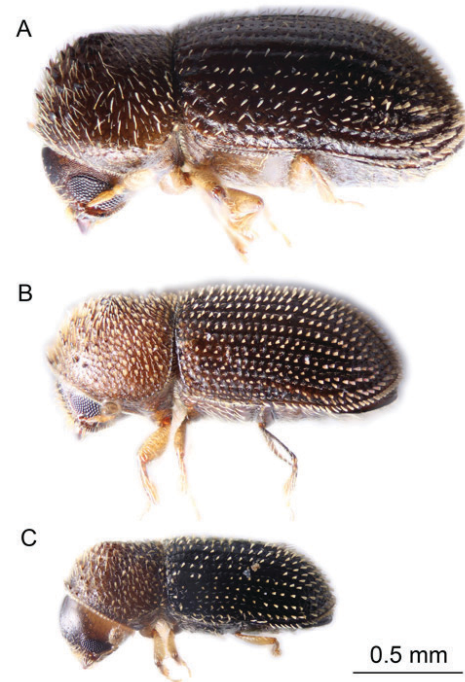


Figure 3. Comparison of the three most common *Hypothenemus* species (female adults) in Florida. A) *Hypothenemus birmanus*; B) *Hypothenemus seriatus*; C) *Hypothenemus eruditus*. Credits: Yin-Tse Huang, UF/IFAS

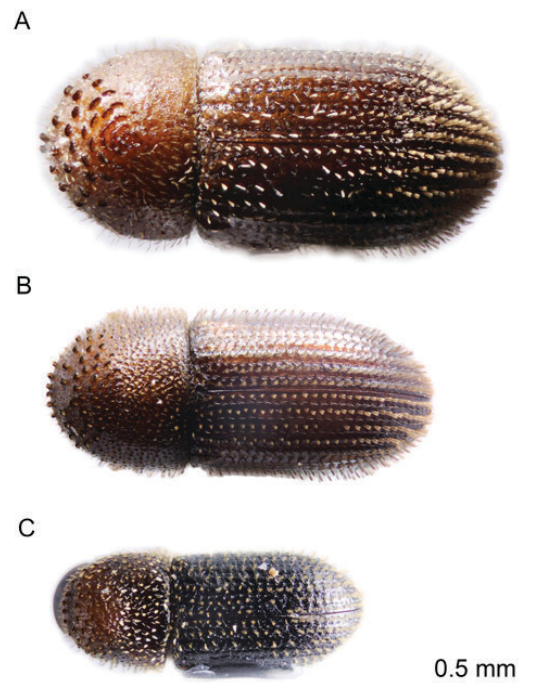


Figure 4. Comparison of the marginal asperities of *Hypothenemus* species in Florida (female adults). A) *Hypothenemus birmanus*; B) *Hypothenemus seriatus*; C) *Hypothenemus eruditus*. Credits: Yin-Tse Huang, UF/IFAS



Figure 5. Comparison of the frons groove of *Hypothenemus* species in Florida (female adults). A) *Hypothenemus birmanus*; B) *Hypothenemus seriatus*; C) *Hypothenemus eruditus*.
Credits: Yin-Tse Huang, UF/IFAS

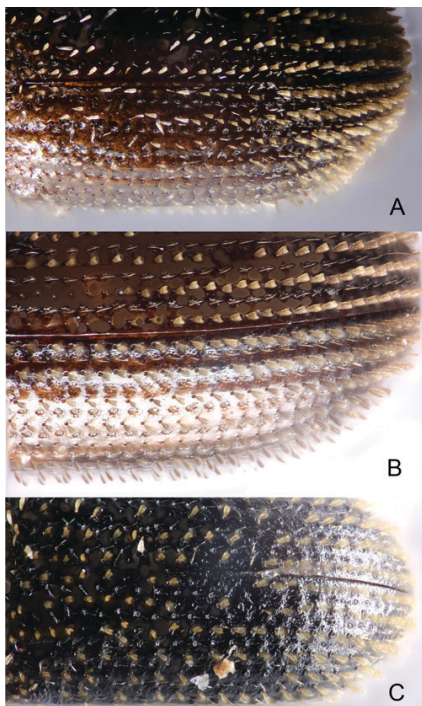


Figure 6. Comparison of the dorsal view of elytron showing scales and texture of *Hypothenemus* species in Florida. A) *Hypothenemus birmanus*; B) *Hypothenemus seriatus*; C) *Hypothenemus eruditus*.
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Hosts

Hypothenemus eruditus is often described as a “super generalist” since it can feed on a wide variety of phylogenetically diverse plants. It can also use various plant organs, from leaf petioles and twigs to seeds and fruits. The most comprehensive host list is available in Atkinson (2016).

Damage and Management

Hypothenemus eruditus has been reported inside coffee berries, but it does not consume the seeds and does not reproduce in them (Garcia Martell 1980). The damage caused by this species is quite limited. Actually, the term false coffee berry borer has been used to describe *Hypothenemus* species that appear in coffee berries without causing significant damage to the host (Garcia Martell 1980).

Despite its abundance in Florida and around the world, *Hypothenemus eruditus* does not cause any significant economic damage and requires no management.

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