



## Two remarkable new species of *Hypothenemus* Westwood (Curculionidae: Scolytinae) from Southeastern USA

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### Abstract

Two new *Hypothenemus* species found in southern and southeastern USA are described: *Hypothenemus piaparolinae* sp. n. and *Hypothenemus subterrestris* sp. n. The distribution and habits suggest these species are native and widely distributed, but elusive, and not recently arrived exotics. Both appear to have unusual biology: *H. subterrestris* appears to live in material on or in the ground, and *H. piaparolinae* has only been collected from the xylem of extensively rotten, fungus-filled twigs.

**Key words:** Cryphalini, Bark beetles, pygmy borers

### Introduction

*Hypothenemus* Westwood, 1836 is the most speciose genus in the tribe Cryphalini (Curculionidae: Scolytinae), with 181 species described (Vega *et al.* 2015). Of these, there are 23 species currently known from North America (Atkinson 2015).

The species of *Hypothenemus* are known from an incredibly diverse selection of plant families and plant material. Individuals colonize the bark or pith of twigs, leaf petioles, vines, fruits and even live seeds (Vega *et al.* 2015). Some even make short communal galleries in the nutrient-poor xylem and have adaptations similar to fungus-farming ambrosia beetles (Beaver 1986). The genus was described from specimens found living in the bindings of a book (Westwood 1836). *Hypothenemus* live not only in a diverse range of plant tissues and level of decay, but they are also known from a very broad diversity of host plants, living in almost every plant family available.

The diagnostic characters for the genus are the partially visible metepisternum, a thin line marking the dorsolateral edge of the pronotum, antennae with 3–5 funicle segments, and the antennal club with sutures and, at least according to literature, a partial septum on the first suture (Wood 2007). The males are flightless, dwarfed, and rarely encountered, therefore never used to diagnose species.

The North American bark beetle fauna (Curculionidae: Scolytinae) is very well-known, and new native species are rarely discovered. Current study of the North American Cryphalini by AJJ revealed several specimens that were collected or observed that had distinct combinations of morphological and ecological characters. These specimens could not be assigned to any described species. Based on a morphological species concept *sensu* Cronquist (1978), two new species of *Hypothenemus* are described herein.

## Materials and methods

In addition to the specimens described herein, representative specimens of all other North American *Hypothenemus* have been observed from S. L. Wood's collection at the USNM, as well as additional material from the BMNH, TAMU, FSCA and the UFFE. In particular, this includes the types and representatives of the most similar species including *Hypothenemus ascitus* Wood 1971, *H. distinctus* Wood 1954, *H. parvistriatus* Wood 2007 and *H. pubescens* Hopkins 1915.

Terminology loosely follows that of S. L. Wood and the bulk of current literature. Particularly i) the antennal funicle includes the pedicel, ii) "interstitial bristles" refers to the larger setae along the rows of interstitial punctures on the elytra, iii) "interstitial ground vestiture" refers to all other setae in the interstriae iv) "marginal asperities" refers to the asperities on the anterior margin of the pronotum.

Specimens collected by AJJ were initially observed in ethanol before mounting. Specimens were observed with Olympus SZX16 stereomicroscope up to 135x magnification, and observed and photographed using a compound microscope (Olympus BX53) with a mounted DSLR camera. Photographs were focus-stacked with up to 40 different images using Helicon focus version 5 (Helicon Soft Ltd.)

Specimens have been deposited in the following repositories indicated by the acronyms: (ABS) Archbold Biological Station, Lake Placid, Florida, USA; (BMNH) The Natural History Museum, London, United Kingdom; (FSCA) Florida State Collection of Arthropods, Gainesville, Florida, USA; (TAMU) Texas A&M University, College Station, Texas, USA; (UFFE) University of Florida Forest Entomology collection, Gainesville, Florida, USA, and (USNM) United States National Museum of Natural History, Washington D.C., USA.

## Results

### *Hypothenemus piaparolinae* sp. n. Johnson, Atkinson & Hulcr

**Type material:** **Holotype** "U.S., FL, High Springs, Boatramp Road; 27/X/2013; Johnson, A.J; Hippocastanaceae: *Aesculus pavia*." (USNM). **Paratypes:** same label information as the holotype (USNM, 1, FSCA, 1, BMNH, 1, TAMU, 1, UFFE, 1); "U.S., FL, Archbold Biol. Sta.; 15/XII/1982; Deyrup, M.A.; Fagaceae: *Quercus geminata*" (ABS, 1); "U.S., FL, Archbold Biol. Sta.; 18/II/1985; Deyrup, M.A." (USNM, 1); "U.S., FL, Archbold Biol. Sta.; 30/III/1986; Deyrup, M.A.; Solanaceae: *Cestrum nocturnum*." (FSCA, 1); "U.S., FL, Highland Hammock St. Pk.; 20/I/1986; Deyrup, M.A.; Anacardiaceae: *Toxicodendron radicans*." (FSCA, 1); "U.S., TX, Sabine County, Hemphill, 9 mi E; 5/VI/1989; Anderson, R.S.; Morris, E.; trap: flight intercept." (TAMU, 1); "U.S., FL, Gainesville; 2014-06-11; *Acer rubrum*; S. Steininger; (UFFE, 1); "U.S., FL, Gainesville; M. Moore 2014; *Aesculus pavia*." (UFFE, 1).

**Description.** Holotype (female): Length 1.0 mm, 2.8 times longer than width. Color of head and pronotum orange-brown; elytra darker than pronotum; legs and antennae yellow-brown; vestiture cream colored.

Frons convex, broad, lacking distinctive sculpturing. Antennal funicle four segmented. Antennal club sutures procurved, weakly visible, with no indication of septum. Eye weakly emarginated, emargination slightly above the center of the eye.

Pronotum approximately as long as wide, and approximately 0.4 times the total length. Anterior margin slightly projected, narrowly rounded, with four marginal asperities, median pair contiguous at base and larger. Anterior slope with approximately 38 asperities, those at the summit smaller. Setae hair-like. Surface weakly micropunctate, with larger punctures at the base of setae.

Elytra 1.7 times as long as wide, 0.6 times the total length. Sides straight, converging to narrowly rounded apex. Strial punctures weakly defined. Interstitial bristles hair-like with pointed apices and arising from small punctures, which are slightly raised and tubercle-like, especially on the declivity. Interstitial punctures and bristles much sparser on disc than declivity. Declivity evenly convex, except apex weakly flared; sculpturing and vestiture not abruptly different from disc.

Male: Similar in all respects to female except smaller (0.8mm), with a smaller eye, and reduced wings. The one specimen observed was damaged, and was therefore not selected as an allotype.

**Diagnosis.** This species can be easily distinguished from all other known *Hypothenemus* by the antennal club without a septum, by the sparse, hair like interstitial bristles on the elytra, the complete absence of interstitial ground vestiture on the elytra, and by the gently sloping elytral declivity.

Although there are no comprehensive keys to species of *Hypothenemus*, this species can be added to the key to *Hypothenemus* of the Americas (Wood 2007, pp. 498–504) by making the following corrections, which are also necessary for correct identification of similar species:

For the second part of couplet 15, add

“(interstitial ground vestiture absent in *H. miles*, *H. distinctus* and *H. piaparolinae*, and interstitial bristles hair-like in *H. piaparolinae*) . . . . . 32”

Replace all of couplet 39 with:

- “39a. Anterior margin bearing narrowly produced into a slender, horn-like median process with a single asperity, sometimes with additional smaller flanking asperities . . . . . *miles* LeConte  
 - Anterior margin bearing 4 asperities, median pair larger . . . . . 39b  
 39b. Interstitial bristles flattened with rounded tips. Elytral declivity broadly rounded, without a flared apex . . . . . *distinctus* Wood  
 - Interstitial bristles entirely hair-like with pointed tips. Elytral declivity broadly rounded with a slightly flared apex . . . . .  
 . . . . . *piaparolinae* Johnson, Atkinson & Hulcr”

**Biology.** The specimens were collected exclusively from visibly decayed twigs in deep shaded, humid forests. Galleries were among the xylem tissue of degraded twigs with a patchwork of fungal colonies separated by black barriers, the fungal zones of competition. The galleries seemed entirely restricted to white-rotted decayed material.

This species lives in a taxonomically broad range of host plants, which is typical of the genus, and unsurprising considering the level of decay.



**FIGURE 1.** Dorsal and lateral photograph of *Hypothenemus piaparolinae*. Scale bar 1mm with 0.1mm increments.





**FIGURE 2.** *Hypothenemus piaparolinae* photographed inside its gallery (preserved in ethanol). Notice the gallery apparently restricted to the degraded woody material within a fungus barrier zone.

Although numerous galleries were dissected, only one damaged male was obtained. This is typical of other known *Hypothenemus* which have strongly skewed sex ratios with few males.

**Remarks.** There was little variation within the collected specimens of this proposed species, except for some being much lighter in color, probably due to being callow adults.

This species shows greatest similarity to *Hypothenemus distinctus* Wood, which can be distinguished from it by the hair-like interstitial bristles, which are scale-like in *H. distinctus*. *Hypothenemus distinctus* is also similar in its elusiveness, and apparently not attracted to any conventional traps. Lastly *H. distinctus* has a similar antennal structure lacking a septum, despite it being a diagnostic character for the genus (Wood 1987). Only two other North American species are known to have hair-like interstitial bristles with pointed apices (*H. dissimilis* (Zimmermann, 1868) and *H. hirsutus* Wood, 2007). These are very easily distinguished based on their much larger size (1.8–2.4mm), much more robust shape (less than 2.2 times as wide as long), having two marginal asperities, few (less than 20) asperities on the anterior slope of the pronotum, and dense vestiture on the elytral declivity.

The antennal club lacking a septum also occurs in the genera *Trischidias* Hopkins, 1915 and *Periocryphalus* Wood, 1971. *Trischidias* is very similar to *Hypothenemus*, and dubiously diagnosed by apparently entire eyes (which are actually emarginated in most specimens, but variable within species) and the lack of antennal septa. *Periocryphalus* lacks both antennal sutures and septa. All *Trischidias* and *Periocryphalus* are similar to *Hypothenemus piaparolinae* in size, structure of pronotal marginal asperities and the lack of a septum in the antennal club. *Hypothenemus* may actually be paraphyletic with respect to *Trischidias* (Wood 1954), and *H. piaparolinae* appears to be an intermediate species. Since the most morphologically similar species to the one being described is *H. distinctus*, it would be most appropriate to place this new species in the same genus until the uncertainty between the three genera is resolved.

The sparse setae and antennal structure give *H. piaparolinae* a similar appearance to species in *Cryptocarenum* Eggers, 1937. This species was not determined as belonging to the genus *Cryptocarenum* based on the shape of the pronotum, and the distinction has since been confirmed with molecular phylogenetics (Johnson *et al.* in prep). Despite being in an entirely different tribe, *Thysanoes* LeConte, 1876 (Micracidini) has a similar overall appearance, and also occurs in a similar habitat. *Hypothenemus piaparolinae* can be easily distinguished from *Thysanoes* by having the mesocoxae separated by a much greater width than the metacoxae, and the near vertical declivital apex.

**Etymology.** The specific epithet honors Pia Parolin, a generous sponsor of nature conservation.

### ***Hypothenemus subterrestris* sp. n. Johnson, Atkinson & Hulcr**

**Type material: Holotype:** "FLORIDA: Putnam Co. 3mi E. Melrose, K. Ordway. Pres.: 25-II-1998. P. E. Skelly. deer dung." (FSCA). **Paratypes:** "Ala. Dale Co. Ft. Rucker Mil. Res. 27 Mar 1998. R. Turnbow." (FSCA, 1); "FLA., Franklin Co. 3 mi NW Alligator Pt. March 12 1976. C. W. O'Brien & Marshall. Berlese mixed hardwood litter." (USNM, 1); "FLA., Gadsden Co. 1 mi. E. Havana. Jan 6 1977. C. W. O'Brien et al. Berlese pine-hardwood litter." (USNM, 1); "FLA., Lafayette Co. 10 mi NW Mayo Hwy. 27, Mar 24. 1977. CW.O'Brien et al." (FSCA, 6, USNM, 1); "FLA., Leon Co., Tallahassee, 20-IV-1976. L. D. Justice. Berlese mixed hardwood litter." (FSCA, 1); "FLA., Leon Co., Tallahassee, 28 June, 1976 G. B. Marshall & Justice. Berlese hardwood litter." (FSCA, 4); "FLA., Leon Co., Tallahassee, March 11 1977. GB Marshall. Berlese hardwood litter" (FSCA, 1, USNM, 1); "FLA., Tallahassee, Leon Co., 2 Dec 1976; Berlese hardwood litter. GB Marshall." (FSCA, 2); "FLA., Tallahassee. Berlese hardwood litter. 6-V-1976. C. W. O'Brien et al." (FSCA, 2); "FLA., Tallahassee. Leon Co. 27-X-1976. Berlese mixed hardwood litter. LD Justice." (FSCA, 2); "FLA., Tallahassee. Leon Co. 4-III-1976. G. B. Marshall. Berlese mixed hardwood litter." (FSCA, 1); "FLORIDA: Alachua Co., Gainesville, Green Acres Pk; 25-VI-8-VII-1991; P. W Skelly, leaf litter." (FSCA, 1); "FLORIDA: Walton Co. Eglin AFB, 4 mi. S. I-10 on Rt 331 & 2mi W; nr Blount creek. 21-XI-1998 P. Skelly; Beech litter Berlese." (FSCA, 1); "FLORIDA: Walton Co. Eglin AFB, S. DeFuniak Springs. 20-XII-1998. R. Turnbow, P Skelly. Beech litter Berlese." (FSCA, 2); "Ga. Clark Co. UGA Botanical Garden. Berlese of duff. 4 Oct, 1974. R. Turnbow." (FSCA, 1); "GA. Decatur Co. 4 mi. N. Faceville, 28 Feb 1977. C. W. O'Brien & G. B. Marshall. Berlese hardwood litter." (FSCA, 4); "Ga. Emanuel Co. Ochopee Dunes Nat. Area., 19 Jan 2002. C. O'Brien & R. Turnbow." (FSCA, 1); "GA. Grady Co. 3mi. NE Reachton Hwy. 319, Mar 24 1977. CW O'Brien et al. Berlese pine-oak litter." (FSCA, 4); "Ga. Richmond Co. Jct. Hephzibah-McBean Rd & Old Waynesboro Rd. 10 Jan 2004. C. W. O'Brien & R. Turnbow. Berlese leaf litter." (FSCA, 3); "Ga. Richmond Co. Jct. Hephzibah-McBean Rd & Old Waynesboro Rd. 20 Jan 2002. C. O'Brien & R. Turnbow. Berlese sifted oak-pine-wiregrass litter." (FSCA, 2, USNM, 1, BMNH, 1); "Ga. Screven Co. hwy. 21 5.4 mi W. jct. 301, 21 Jan 2002. C. O'Brien & R. Turnbow. Berlese sifted roadside pine-oak-grass litter." (FSCA, 4); "GEORGIA, Lowndes Co. 2.8mi N Valdosta. 1-5-2005, C. W. O'Brien & M. Haseeb. Berlese sifted pine & oak litter." (FSCA, 1); "OKLAHOMA: Latimer Co. -IV-1991. Karl Stephan." (FSCA, 1); "OKLAHOMA: Latimer Co. -IX-1991. Karl Stephan." (FSCA, 1); "OKLAHOMA: Latimer Co. -V-1990. Karl Stephan." (FSCA, 2); "OKLAHOMA: Latimer Co. -V-1991. Karl Stephan." (USNM, 1); "OKLAHOMA: Latimer Co. -V-1991. Karl Stephan." (FSCA, 1); "OKLAHOMA: Latimer Co. VI-1989. Karl Stephan." (FSCA, 1); "OKLAHOMA: Latimer Co. -VII-1991. Karl Stephan." (USNM, 1, UFFE, 1); "OKLAHOMA: Latimer Co. -VIII-1990. Karl Stephan." (FSCA, 1); "OKLAHOMA: Latimer Co. -VIII-1991. Karl Stephan." (FSCA, 1); "Tex. Tyler Co. Big Thicket Nat. Pres. 21 Feb 2004, C. W. O'Brien & R. Turnbow. Beech woods trail, Berlese beech litter." (FSCA, 1).

**Description.** Holotype (Female): Length 1.35mm, 2.3 times as long as wide. Head, pronotum and elytra black; legs and antennae yellow-brown; vestiture cream colored.

Frons convex without distinct sculpturing. Antennal funicle four segmented. Antennal club with three sutures marked by setae; septum visible. Eye unusually small with few omatidia (approx. 35), some obscured by shining cuticle.

Pronotum 0.85 times as long as wide. 0.4 times the total length. Anterior margin armed with six marginal asperities; the median pair only slightly larger than others; marginal asperities slightly longer than wide; rounded, and not contiguous at the base; approximately 30 asperities on the pronotal slope, of a similar size and shape to those on the margin. Lateral and dorsal areas punctate, surface shining. Disc covered with a mixture of scale-like and hair-like setae.



Elytra 1.5 times as long as wide, 0.6 times the total length. Sides straight, converging to a broadly rounded apex. Elytra with prominent large striae punctures; elytral surface shining. Disc long, occupying at least two-thirds of the elytral length. Declivity evenly rounded, to a near vertical apex. Interstitial ground vestiture present on all specimens observed, dagger-like, recumbent, mostly on the elytral apex; interstitial bristles flattened, twice as long as wide, widest near apex. Apex subquadrate.



**FIGURE 3.** Dorsal and lateral photograph of *Hypothenemus subterrestris*. Scale bar 1mm with 0.1mm increments.

Males: Similar to females, but smaller (0.9mm), with even smaller eyes, and longer interstitial bristles (1 observed).

This species can be added to Wood's (2007) key to American *Hypothenemus* by the following modifications:

Replace all of couplet 35 with:

- “35a. Cuticle within the punctures on posteriolateral areas of pronotum with granulate texture. Interstitial punctures on elytra conspicuous and about as large as the distance between them . . . . . 35b
- Cuticle within the punctures on posteriolateral areas on the pronotum shining. Interstitial punctures on the elytral disc are small, smaller than the distance between them . . . . . 36
- 35b. Punctures on dorsolateral regions of pronotum close or contiguous. Elytra broadly rounded with the elytral disc occupying less than half the length of the elytra. Costa Rica to Panama . . . . . *ascitus* Wood
- Punctures on dorsolateral regions of pronotum separated by shining, micropunctate cuticle. Elytra broadly rounded with the elytral disc occupying at least half of the length. Texas to Florida . . . . . *subterrestris* Johnson, Atkinson & Hulcr.”

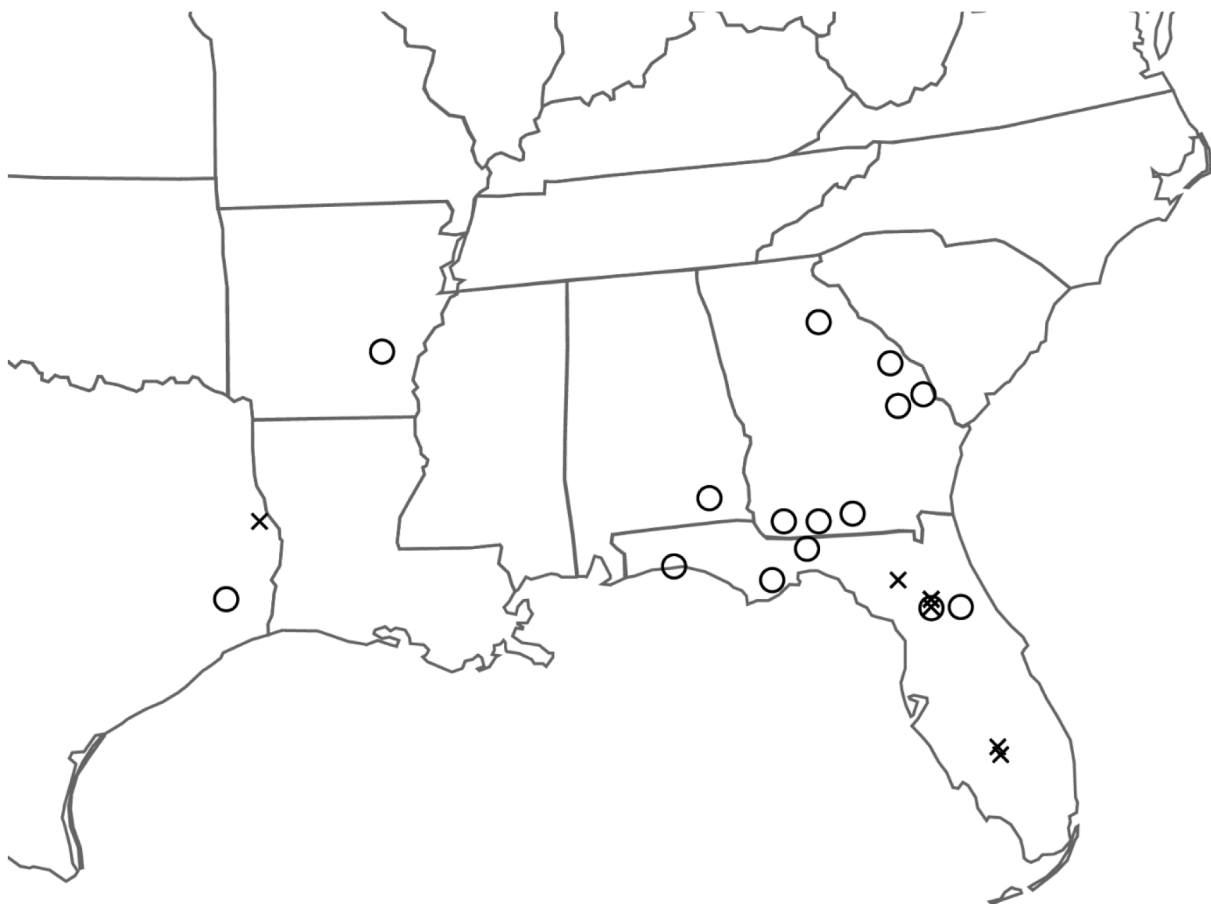


FIGURE 4. Known collection localities of *Hypothenemus piaparolinae* (X) and *H. subterrestris* (O).

**Biology.** The majority of specimens collected are from leaf litter samples. Out of the 33 separate collection events for the type series, 21 were from leaf litter samples; the others had no recorded collection method. The three most morphologically similar species are also found in unique niches; *H. parvistriatus* Wood 2007, one of two scolytines collected from ferns (Wood 2007), *H. pubescens*, which has been collected exclusively from coastal grasses, and *H. ascitus* has only been collected from the bark of a large, living tree. It is unclear whether these are true specialists, or just rarely encountered species capable of living in unusual hosts.

**Notes.** This species can be distinguished from the morphologically similar *H. parvistriatus* and *H. vesculus* Wood 1982 by the granulate texture within the punctures in the posteriolateral region of the pronotum, by the much larger elytral stria punctures, by the wider flattened interstitial bristles, and by the larger elytral disc. This species can be distinguished from *H. ascitus* by the more elongate body with a longer elytral disc and by the less closely punctured dorsolateral regions of the pronotum. The coloration of the holotype of *H. ascitus*, which has a reddish-

brown head and pronotum, with a darker elytra, is not represented in any of the specimens of *H. subterrestris*, even those that are apparently not fully mature.

The widely spaced and long marginal asperities, plus the deeply punctured lateral regions of the pronotum may confuse this species with *H. californicus* Hopkins 1915 and *H. gossypii* Hopkins 1915, but these can easily be distinguished by the much more slender and narrower body shape, the slightly confused striae and interstriae, and the absence of dagger-like interstitial vestiture at the base of the declivity. All specimens of *H. californicus* and *H. gossypii* observed from North America also have distinctly bicolored appearance, with reddish brown pronotum and a dark elytron, while all known *H. subterrestris* are uniformly black.

The presence of a small eye is shared with *H. parvistriatus* and *H. pubescens*. This is similar to that of males of other *Hypothenemus* species, which may indicate the eyes are non-functional (as in *Hypothenemus hampei* Ferrari, 1867 males (Vega 2014)).

**Etymology.** The specific epithet is derived from the apparent habits of the species, being found in soil and leaf litter samples.

## Discussion

Most North American *Hypothenemus* species were described over 100 years ago, mostly in Hopkins' review of the tribe (1915). Since then, seven additional species have been described (Wood 1954, Wood 2007). Of these, only three are still recognized, including *Hypothenemus hirsutus*, which is restricted to the Florida Keys, plus *H. parvistriatus*, a rarely encountered species possibly restricted to ferns, and *H. distinctus*, a rarely collected but widespread species. The two species described herein are morphologically most similar to the latter two. Their shared unusual habits appear to make them elusive and poorly known. It is unlikely that the two species are non-native introductions given the very widespread distribution, similarity to local species, and elusive ecology.

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