



A new species of cylindrical bark beetle (Zopheridae: Colydiinae) from Vanuatu establishes in Hawaii

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Abstract

We describe *Bulasconotus scaccarius* **sp. nov.**, a new species of cylindrical bark beetle (Zopheridae: Colydiinae: Synchitini), elevating the number of described species in its genus to two. Despite discovering this species in Hawaii, we suspect, based on collections and survey data, that it is endemic to the South Pacific archipelago of Vanuatu and has only recently arrived in Hawaii. Evidence of the diet of closely related genera indicates that the new species may be a predator of ambrosia beetles (Curculionidae: Scolytinae), conceivably posing a risk to those that are endemic to Hawaii.

Key words: Colydiidae, invasive species, Melanesia, New Hebrides, Oahu, Tenebrionoidea

Introduction

Hawaii is a valuable location for studying the establishment of non-native species, because despite being a classic example of an extremely remote archipelago with associated high endemism (Gillespie *et al.* 2008), it is now a hub for international trade and a hotspot for invasive species (Dawson *et al.* 2017). The insect fauna that existed before the arrival of humans was over 98% endemic, but the pace of insect establishments has exploded from the prehistoric average of once every 70,000 years to ~20 per year. Now non-native insects account for over 33% of the insect fauna in Hawaii, thereby reducing endemism to 66% (Ziegler 2002). Entomologists in the archipelago hence publish multitudes of new species records that can scarcely keep up with hordes of arrivals (*e.g.*, Matsunaga *et al.* 2019).

While surveying for endemic Hawaiian ambrosia beetles (Curculionidae: Scolytinae: Xyleborini LeConte 1876) in native forests on the island of Oahu, we encountered a cylindrical bark beetle (Zopheridae: Colydiinae: Synchitini Erichson 1845) not yet reported in the Hawaiian archipelago, which is remarkable because it is also an undescribed species. It belongs to the genus *Bulasconotus* Ślipiński & Lawrence 1997, characterized by having antennal clubs that are clearly three-segmented, pronounced pronotal and elytral carinae, an acute intercoxal process on the first ventrite, and externally open procoxal cavities (Ślipiński & Lawrence 1997).

Until now this genus has contained only a single species from the Solomon Islands, *Bulasconotus solomon* Ślipiński & Lawrence 1997, although the authors hint that undescribed congeners exist in other Melanesian archipelagos (Ślipiński & Lawrence 1997). Indeed, the Bernice Pauahi Bishop Museum (BPBM) in Honolulu has 164 specimens that match our unknown species, all of which are from Vanuatu (Fig. 1A). BPBM also has a handful of specimens of *B. solomon*, in addition to other undescribed congeners from nearby islands. Entomologists from BPBM collected these specimens while documenting Pacific biodiversity during the mid-20th century (*e.g.*, Samuelson 1966). The same entomologists did not find this new species on surveys of Hawaiian forests during this period, instead finding other cylindrical bark beetles despite searching the same plants and nearby locations to our new finding (Ford 1968). Not until 2009 did entomologists collect this new species in Hawaii. Therefore, although a reasonable conclusion upon finding an undescribed species in a native forest is that it is endemic to that location, we strongly suspect that the new species originates from Vanuatu and has only recently established on Oahu (Fig. 1B). Below we describe this new species: *Bulasconotus scaccarius* **sp. nov.**

We found the new species under the bark of endemic Hawaiian trees among galleries of endemic Hawaiian am-

brosia beetles. Given that some related cylindrical bark beetles are predators of ambrosia beetles (Hackwell 1973; Podoler *et al.* 1990), we discuss below the potential for *B. scaccarius* **sp. nov.** to negatively impact Hawaii's native species.

Materials and methods

On Oahu Island in October 2019, we collected 15 specimens of *Bulasconotus scaccarius* **sp. nov.** from under the bark of an endemic Hawaiian tree, *Planchonella sandwicensis* (A.Gray) Pierre 1890 (Sapotaceae), in the Honouliuli Forest Reserve in the Waianae Mountains. We extracted the specimens from galleries of the endemic ambrosia beetle *Xyleborus lanaiensis* Perkins 1900 (Fig. 1C). In 2009 and 2019 respectively, Paul Krushelnycky and David Honsberger collected matching specimens in additional locations across Oahu (Fig. 1B) and in other native trees, including *Acacia koa* A.Gray 1854 (Fabaceae) and *Cheirodendron* Nutt. ex Seem. 1867 (Araliaceae) that Hawaiian ambrosia beetles also use as hosts (Samuelson 1981). We attempted to identify our specimens using relevant taxonomic literature (Ford 1968; Ślipiński & Lawrence 1997; Aoki 2013; Lord & Leschen 2014; Lee *et al.* 2017; Aoki 2018; Ivie *et al.* 2016; Lord & Ivie 2016; Leschen & Lord 2017) and by comparing our specimens to those at the Honolulu-based insect collections listed below. Ultimately, we based our description of *B. scaccarius* **sp. nov.** upon the 164 matching Vanuatuan specimens at BPBM.

We photographed specimens with a Leica MC170HD camera mounted on a Leica M165c stereo microscope, captured with Leica Application Suite 4.12 software (Leica Microsystems GmbH, Wetzlar, Germany). After morphological analysis, we pinned all but four of the specimens we collected on Oahu, which we deposited into collections as noted below. We preserved the remaining four in 95% ethanol for future genetic assessment.

Repositories

BMNH—Natural History Museum, London, UK

BPBM—Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA

HDOA—Hawaii Department of Agriculture, Honolulu, Hawaii, USA

MGCB—M. P. T. Gillett Collection, Birmingham, UK

MHNG—Muséum d'Histoire Naturelle, Geneva, Switzerland

UHIM—University of Hawaii Insect Museum, Honolulu, Hawaii, USA

USNM—National Museum of Natural History, Washington, DC, USA

Bulasconotus scaccarius **sp. nov.**

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Holotype: Vanuatu (labelled as New Hebrides): 1, NW Efate Island, N of Maat, 19.viii.1957, coll. J.L. Gressitt, 100 m, limestone plateau (BPBM).

Paratypes: Vanuatu (labelled as New Hebrides): 45, Epi Island, Vaemali, 6–10.viii.1967, colls J. & M. Sedlacek, 100–150 m (43, BPBM; 1, UHIM; 1, USNM); 1, same data as previous, 16–21.viii.1967; 1, same data as previous, 10.viii.1967, 150 m; 43, same data as previous, 11–18.viii.1967, 80–150 m (42, BPBM; 1, MHNG); 9, Malekula Island, Lamap, 8–21.ix.1967, colls J. & M. Sedlacek (8, BPBM; 1, BMNH); 2, same data as previous, 18–21.ix.1967; 5, same data as previous, 19–21.ix.1967; 1, same data as previous, 8–21.ix.1970; 38, Malekula Island, N Lakatoro, 22–30.ix.1967, colls J. & M. Sedlacek (BPBM); 1, Malekula Island, Lakatoro, 23.ix.1967, colls J. & M. Sedlacek (BPBM); 1, same data as previous, 23.ix–19.x.1967; 6, same data as previous, 29.ix.1967; 3, N Malekula Island, 15 km NW of Norsup, 28.ix.1967, coll. J. Sedlacek (BPBM); 7, Santo Island, Big Bay, E Jordan River, 16.ix.1979, coll. W.C. Gagne, 5 m, under bark of dead trees (BPBM, Accession 1979.380).

Other material examined: Hawaii: 1, Oahu Island, N Waianae Mtns, Kahanahaiki Valley, 8.v.2009, coll. P. Krushelnycky, 600 m, pitfall trap (P. Krushelnycky #AR0569, PKSP8323, loaned to BPBM); 2, Oahu Island, Ahupuaa O Kahana SP (21°33.41' N, 157°52.67' W), 25.vi.2019, coll. D. Honsberger, ex. *Hibiscus tiliaceus*, 10–20 m (UHIM); 3, same data as previous, 20.viii.2019; 3, Oahu Island, Koolau Mtns, Waahila Ridge, 4.x.2019, coll. D.

Honsberger, ex. *Acacia koa* (UHIM); 1, Oahu Island, Koolau Mtns, Mt Tantalus, x.2019, coll. D. Honsberger, ex. *Cheirodendron* (UHIM); 8, Oahu Island, Waianae Mtns, Honouliuli FR, Kaluaa Gulch (21°27.64' N, 158°6.00' W), 29.x.2019, coll. J. Bernard, ex. *Planchonella sandwicensis*, c. 650 m (2, BPBM; 2 pinned, 2 in 95% EtOH, UHIM; 2, HDOA); 7, same data as previous, coll. C.P.D.T. Gillett (2 pinned, 2 in 95% EtOH, UHIM; 2, MGCB; 1, MHNG); 9, same data as previous, coll. D. Honsberger (5, UHIM; 2, BPBM; 2, HDOA).

Diagnosis. *Bulasconotus scaccarius* **sp. nov.** has a chequered pattern on the elytra and redoubled medial carinae on the pronotal disc, whereas *B. solomon* has a uniformly brown body and medial pronotal carinae that are not redoubled (Ślipiński & Lawrence 1997).

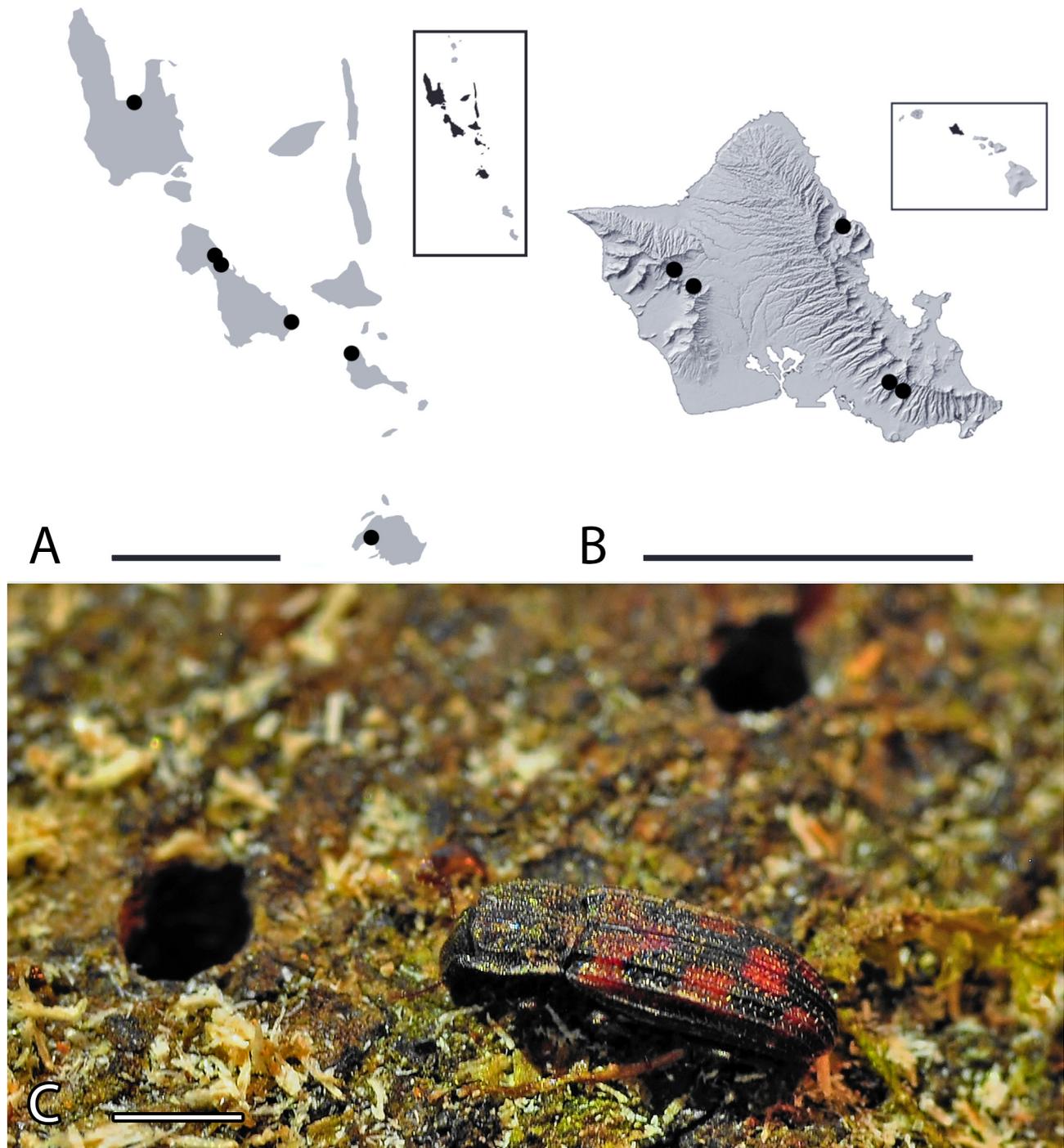


FIGURE 1. Known locations of *Bulasconotus scaccarius* **sp. nov.** in A) the Vanuatu archipelago, scale bar: 100 km; and B) Oahu in the Hawaiian archipelago, scale bar: 50 km. C) Living *B. scaccarius* **sp. nov.** among entrance tunnels and frass of Hawaiian ambrosia beetles (*Xyleborus lanaiensis*) on Hawaiian trees (*Planchonella sandwicensis*) from the Honouliuli Forest Reserve on Oahu, scale bar: 1 mm.

Description. $n = 164$. Length from anterior pronotal margin to elytral apex 3.11–3.92 mm, 2.65–2.85 \times longer than wide; testaceous orange to ferruginous red body with black markings on elytra (Fig. 2A); testaceous orange-red legs with pro-, meso-, and meta-tarsi clearly four-segmented (*i.e.*, formula, 4-4-4) (Fig. 2B).

Head: 0.66–0.79 mm long, 1.14–1.16 \times wider than long, widest at eyes (Fig. 2); fuscous orange-red; vertex-frons-clypeus region continuous and with no canthal folds between frons and clypeal margins at eye, integument slightly rugose, slightly convex medially, uniformly and densely covered in minute translucent setae; clypeus with lateral margins rounded and somewhat raised, medial anterior margin with shallow indentation \sim 0.03 mm deep and 0.20 mm wide; compound eyes black, large, and spherical, occupying nearly half the length of the head visible dorsally (0.29–0.35 mm), lacking supraorbital carinae, long slender antennal grooves ventrally; antennae 11-segmented with long translucent setae (0.03–0.04 mm) emerging from distal margin of each segment, antennomere III length subequal to that of following two segments combined, distal three segments forming a loose club, with antennomere IX subtrapezoidal, antennomere X transverse, and antennomere XI rounded (Fig. 3A).



FIGURE 2. Micrograph of *Bulasconotus scaccarius* sp. nov. collected by Josef and Marie Sedlacek on Vanuatu's Malekula Island in 1967, depicting coloration of A) dorsal and B) ventral aspects. Scale bars: 1 mm.

Pronotum: 0.84–1.10 mm long, 1.21–1.31 \times wider than long, slightly rugose (Fig. 3B), uniformly but sparsely covered in minute translucent setae; fuscous orange-red with indistinct nearly black mark covering posterior two-thirds of pronotal disc aside from dull orange area at medial posterior margin, sometimes with brighter orange lat-

eral margins; lateral margins convexly bowed and finely crenulate, separated from pronotal disc by lateral explanate regions 0.17–0.22 mm wide, each anterolateral margin extending ~0.10 mm anterior of pronotal disc anterior margin to form nearly equilateral triangular projection; pronotal disc somewhat convex but sculpted by 2 pairs of longitudinal carinae, between which form shallow troughs; outer lateral carinae slightly curved, roughly parallel to lateral pronotal margins; inner medial carinae diverging posteriorly, each bifurcating at posterior third to form faint almond-shaped loop extending to posterior margin; both lateral and medial carinae merge with convexly rounded anterior margin, and both pairs of carinae crested with row of minute translucent recumbent setae; raised rounded edge at base of pronotum.

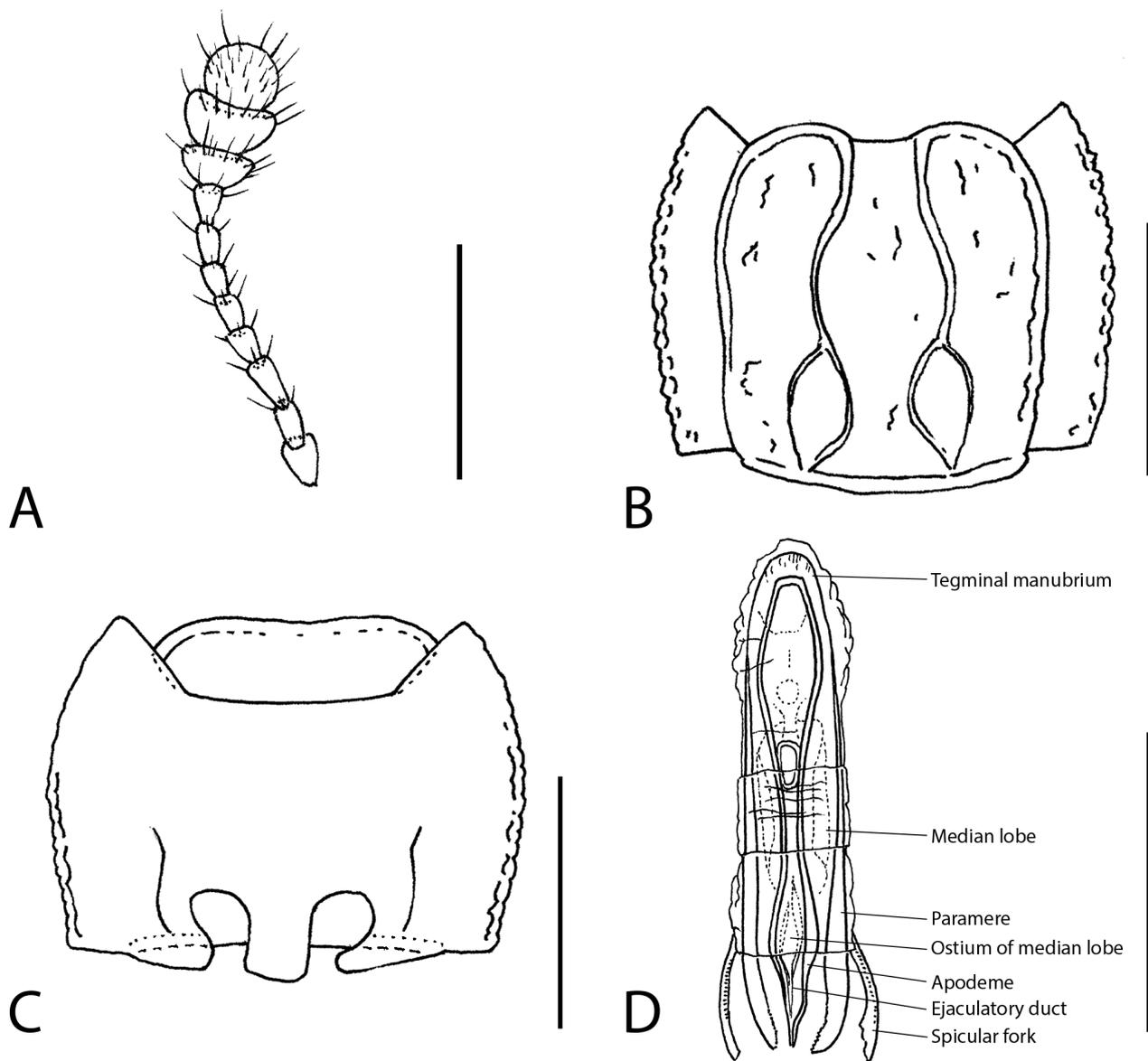


FIGURE 3. *Bulasconotus scaccarius* sp. nov. **A)** antenna, scale bar: 0.25 mm; **B)** pronotum, scale bar: 0.5 mm; **C)** ventral prothorax, scale bar: 0.5 mm; **D)** dorsal aedeagus, scale bar: 0.5 mm.

Scutellum: 0.05–0.06 mm wide minute square; fuscous orange-red.

Elytra: 2.09–2.86 mm long, 1.93–1.95× longer than width of combined elytra, anterior half more or less parallel sided, posterior half gradually tapered to rounded apex (Fig. 2A); testaceous orange to ferruginous red with 5 more or less distinct rectangular–trapezoidal black marks arranged in a chequered grid, each mark ~0.30 mm wide and 0.49–0.62 mm long; obscure black mark at each lateral margin more or less aligned with grid; medial black oval or triangular mark posterior to grid and extending to elytral apex; strong longitudinal carinae extend length of interstriae I, III, V, VII, and IX, each somewhat crenulate anteriorly, each crested with more or less continuous row of

short recumbent translucent setae, anterior part of carina on interstria I demarcates scutellary striole; stria punctures large, 0.03–0.05 mm diameter, each bearing a recurved translucent yellowish seta 0.04–0.06 mm long.

Venter: testaceous orange-red, prosternum fuscous with more or less distinct dark rufous or black mark covering prosternal episterna but not usually extending to prothoracic margins that are testaceous orange, ventrites I–II somewhat ferruginous (Fig. 2B); venter sparsely but uniformly covered in fine translucent setae; procoxal cavities broadly open externally (Fig. 3C); acuminate medial intercoxal process of ventrite I; ventrite V with scalloped transverse groove parallel to apex. Aedeagus ~0.85 mm long with both parameres and apodemes unfused (Fig. 3D).

Etymology. The specific epithet is the adjective form of the nominative singular noun *scaccarium*, meaning a chessboard, in reference to the chequered pattern on the elytra. This name thereby conforms to article 11.9.1.1 of the International Code of Zoological Nomenclature. Because the adjective suffix agrees with the masculinity of the generic name, the binomial name also conforms to article 31.2 even though the eponym is neuter.

Distribution. Vanuatu archipelago; Oahu (Hawaiian Islands)

Discussion

Nothing is yet known about the dietary niche of *Bulasconotus*, but we can glean clues from studies of other genera within tribe Synchitini. Some, such as *Lasconotus* Erichson 1845, are predators of ambrosia beetles (Hackwell 1973) while others like *Bitoma* Herbst 1793 are fungivorous and may be vectors of fungal pathogens of plants (Stephan 1989; Lawrence 1991). Hackwell (1973) determined that early larval instars of *Lasconotus* eat the fungus cultivated by ambrosia beetles and late instars hunt ambrosia beetle larvae within their galleries. Because we found *Bulasconotus scaccarius* **sp. nov.** within galleries of ambrosia beetles (Fig. 1C), we speculate that it may have a predatory niche like *Lasconotus*.

A phylogeny of synchitine genera does not exist to help us place *Bulasconotus*, which has morphological similarities to both *Lasconotus* and *Bitoma*, thereby precluding our use of morphology to infer its ecology. Specifically, *Bulasconotus* resembles *Lasconotus* in having antennal clubs with three distinct segments yet differs by having procoxal cavities that are externally open (Ślipiński & Lawrence 1997; Ivie *et al.* 2016). It shares the latter trait with a few genera including *Bitoma*, which have clearly two-segmented antennal clubs (Ślipiński & Lawrence 1997; Ivie *et al.* 2016). Direct investigations into its relationship with wood-boring insects are thus necessary to understand both its role in native ecosystems in Vanuatu and as a potentially impactful invader in Hawaii.

If our suspicions are correct about it being a very recent arrival in the Hawaiian Islands, *B. scaccarius* **sp. nov.** could detrimentally affect populations of native Hawaiian ambrosia beetles, most of which have evolved specialized obligatory relationships with their host plants (Samuelson 1981). Although not listed as threatened, Hawaii's ambrosia beetles have lost a substantial amount of habitat as a result of human activity (Gon *et al.* 2018) and entomologists scarcely encounter some species (Gillett *et al.* 2018; Gillett *et al.* 2019). The collection localities we listed herein for *B. scaccarius* **sp. nov.** are on both of Oahu's mountain ranges (Fig. 1B), indicating that it is well established across the island. Nevertheless, we have not found this species on any other Hawaiian island after 2.5 years of archipelago-wide surveys of endemic Hawaiian ambrosia beetles in similar habitats. This is therefore a prudent time to learn more about the nature of *B. scaccarius* **sp. nov.** so that we may take action to mitigate potentially negative effects it may have on Hawaii's native wood borers.

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