



A new species of *Craniodicticus* Blandford (Coleoptera: Curculionidae: Scolytinae: Carphodicticini) from Taiwan, with notes on its biology

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(Manuscript received 28 January 2023; Accepted 1 March 2023; Online published 15 March 2023)

ABSTRACT: A new species of bark beetle *Craniodicticus cinnamomi* Lin & Beaver (tribe Carphodicticini Wood, 1971) from Taiwan is described. The species is phloeophagous and harem polygynous, breeding in *Cinnamomum insulari-montanum* (Lauraceae). A key to the species of *Craniodicticus* is provided.

KEY WORDS: bark beetle, Carphodicticini, *Cinnamomum insulari-montanum*, *Craniodicticus cinnamomi*, harem polygynous.

INTRODUCTION

The tribe Carphodicticini Wood, 1971, in the weevil subfamily Scolytinae includes only three genera, *Craniodicticus* Blandford, 1895, *Dendrodecticus* Schedl, 1958, and *Carphodicticus* Wood, 1971, and only five species. Both *Carphodicticus* and *Dendrodecticus* are monotypic and are confined to South America (Alonso-Zarazaga and Lyal, 2009). *Craniodicticus* was described for a single species, *C. mucronatus* Blandford, known only from Sri Lanka. The record from Taiwan by Yushiro Miwa (1931 as *C. maculonatus* [sic]) was based on Sri Lankan specimens relabelled by Shiraki that brought with him from the Natural History Museum in London (then the British Museum (Natural History)) and is incorrect (Beaver and Liu, 2010). The genus currently includes two other species: *C. minor* Eggers, 1936, described from India (Karnataka), and also recorded from Vietnam by Schedl (1974), and *C. sabahensis* Beaver, 1999 from East Malaysia (Sabah). Details of the biology of the genus are unknown. The only host record is for *C. mucronatus*, collected from an unidentified liane (Blandford, 1895). In this paper, we describe a new species of *Craniodicticus* from Taiwan and provide details of its gallery system and biology. A key to the species of *Craniodicticus* is provided to facilitate identification.

MATERIALS AND METHODS

Specimens were collected from branches and twigs of unhealthy *Cinnamomum insulari-montanum* Hayata (Lauraceae) on 19 November 2022 in a montane area of Taiwan. Attacked branches were brought back to the laboratory and kept in boxes at room temperature to observe the biology and habits of the species until the new generation of adult beetles emerged. Specimens were examined and identified using a Leica stereomicroscope (M 205-C) equipped with an eyepiece micrometer in a Pl

10x/22 eyepiece. Length was measured from the pronotal apex to the elytral apex in dorsal view.

TAXONOMIC TREATMENT

Tribe Carphodicticini Wood, 1971

Genus *Craniodicticus* Blandford, 1895

Craniodicticus cinnamomi Lin & Beaver, *sp. nov.*

肉桂異翅擬長小蠹 Fig. 1A–H

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Type: Holotype, male, Taiwan: Nantou county, Ren'ai Township, alt. 1204 m, 24°0.6149'N, 121°0.3608'E, from *Cinnamomum insulari-montanum* (Lauraceae), 19 November 2022, C.S. Lin, deposited in National Museum of Natural Science (NMNS), Taichung, Taiwan. **Allotype**, female, the same data as the holotype (NMNS). **Paratypes:** 33 males, 33 females; as the holotype except: 24 December 2022. Paratypes are deposited in Michigan State University Arthropod Research Collection (MSUC), East Lansing, MI, USA; The Natural History Museum (NHML), London, UK; National Museum of Natural History (NMNH), Washington, DC, USA; Naturhistorisches Museum, Wien (NMW), Austria; Taiwan Agricultural Research Institute (TARI), Taichung, Taiwan; National Taiwan University Insect Museum (NTU), Taipei, Taiwan; National Chung Hsing University Museum of Entomology (NCHU), Taichung, Taiwan; University Museum of Bergen (ZMUB), Norway; A.V. Petrov's collection (AVP), Institute of Forest Science Russian Academy of Science, Russia; R. A. Beaver's private collection (RAB), Chiangmai, Thailand; 46 paratypes in the first author's collection.

Diagnosis. *Craniodicticus cinnamomi* is more similar to *C. minor* and *C. mucronatus* than to *C. sabahensis* based on body size, and characters of the head and elytral declivity. However, the sexual dimorphism of the elytra is more strongly developed than in the other species. Both sexes can be distinguished from *C. minor* by the punctures

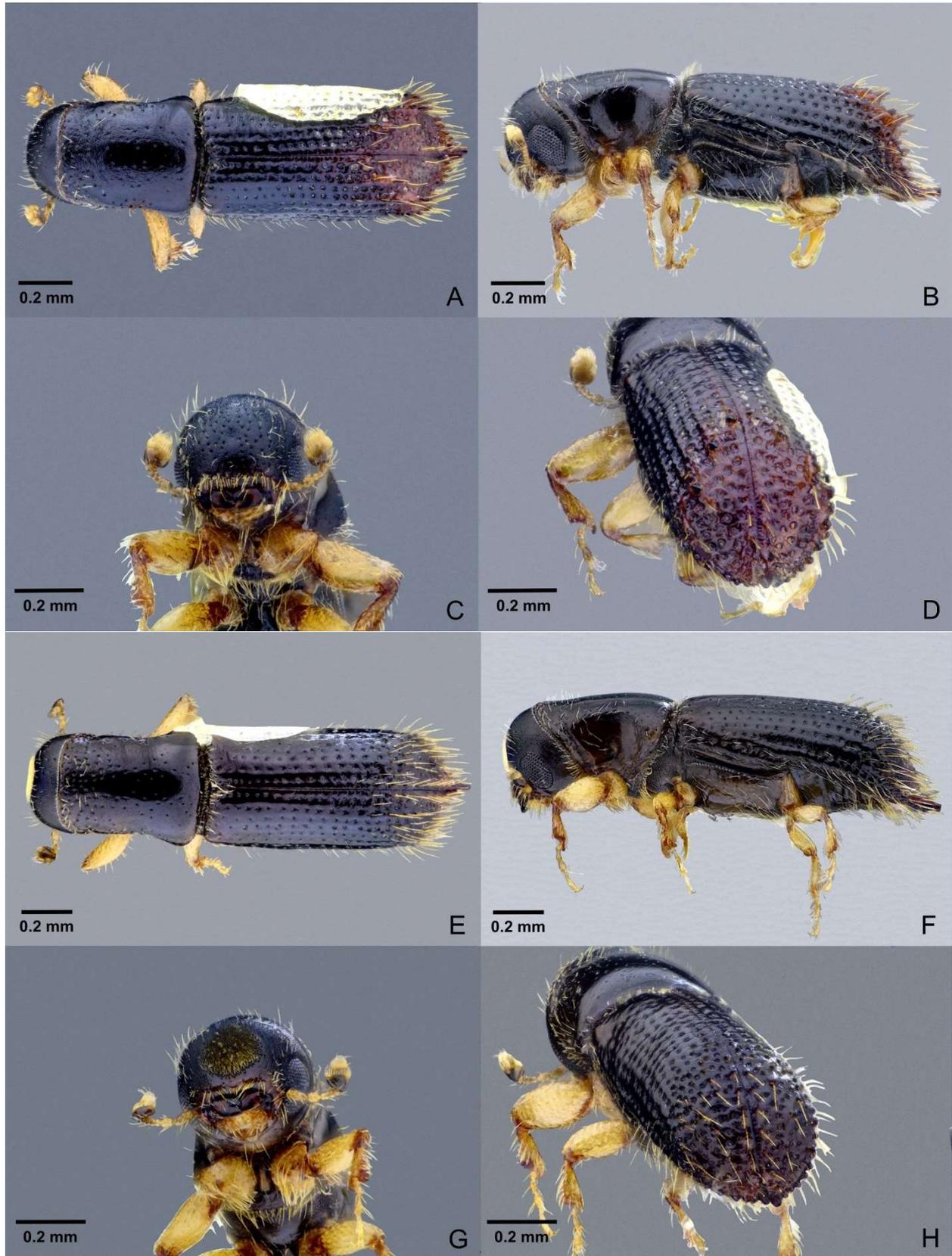


Fig. 1. *Craniodicticus cinnamomi* Lin & Beaver, sp. nov., male: A. dorsal view, B. lateral view, C. front view, D. elytral declivity, female: E. dorsal view, F. lateral view, G. front view, H. elytral declivity.



on the vertex of the head which are scarcely visible in *C. minor* and distinct in *C. cinnamomi*. The males of *C. cinnamomi* can be distinguished from other species of *Craniodicticus* by the large denticles on interstriae 3 and 5 on the upper margin of the elytral declivity of *C. cinnamomi*. These are reduced to small pointed teeth in *C. minor*, and to granules in *C. mucronatus* and *C. sabahensis*. Both sexes of *C. cinnamomi* can also be distinguished from *C. mucronatus* by their smaller size (1.60–1.80 mm vs 2.0–2.2 mm).

Description. Male: Length 1.67 ± 0.08 mm (mean \pm sd, $n = 5$), and ranging from 1.60–1.80 mm; 3.33–3.50 times as long as wide. Body slender and elongated, color of mature adults black, subshining, legs and antennae yellowish brown. Frons convex, surface weakly shining, finely reticulate, with evenly spaced, moderately dense punctures bearing fine, yellowish-white, hair-like setae, some longer hair-like setae on lateral areas of frons. Eyes large, oval, about 1.5 times as long as wide, shallowly emarginate just above the antennal insertion. Antennal scape shorter than the five-segmented funicle (including pedicel), antennal club fairly small, about 1.1 times as long as wide, with two substraight, transverse sutures marked by annuli of closely-placed hairs. Pronotum 1.38 ± 0.04 (1.32–1.43) times longer than wide, embracing the head and not declivous anteriorly, weakly convex, the summit a little before the base, widest at level of summit, deeply emarginate laterally, the ratio of maximum to minimum width 1: 0.83, the sides slightly converging anteriorly, with a distinct constriction behind the transverse anterior margin; pronotal surface subshining, anterior third reticulate with sparse, large, shallow punctures bearing moderately long, erect hair-like setae, reticulation weaker posteriorly and punctures more widely spaced. Scutellum very small, linguiform. Elytra 2.26 ± 0.04 (2.21–2.31) times longer than wide, 1.94 ± 0.06 (1.86–2.00) times longer than pronotum; elytral bases transverse, long, erect hair-like setae present along basal margin of each elytron, humeral angles rounded, parallel-sided in basal 4/5, then abruptly narrowed in posterior 1/5 to mucronate apex. Disc subshining, striae 1 and 2 weakly impressed towards declivity, striae punctate, punctures large and shallow, becoming larger and deeper towards declivity, with barely visible, very short recumbent fine microsetae; interstriae impunctate, much wider than striae near base, becoming narrower as size of striae increases posteriorly, flat basally, interstriae 1, 3, 5, and 7 becoming more convex posteriorly, near declivital summit interstriae 1 with 0–2, interstriae 3 with 1–2, interstriae 5 with 3–5 and interstriae 7 with 3–4 pointed tubercles, gradually increasing in size posteriorly, the terminal one projecting over the steeply sloping declivity, largest on interstriae 5 which terminates in a sharp spine, each tubercle bearing a long, erect golden hair-like seta; declivity occupying approximately 1/5 of elytra, steeply sloping, subshining,

weakly elevated posteriorly on either side of suture; striae punctures very large and interstriae almost obsolete on face of declivity, interstriae 1 with 3–4 small tubercles from declivital midpoint to apex, each bearing a long, erect golden hair-like seta; interstriae 1 terminating in a short, truncate apical mucro, the right mucro always larger than the left; posterolateral margin of declivity formed by a row of pointed teeth extending from interstriae 9 to the terminal mucro. Inner margin of protibia ending in a strong, curved mucro, three teeth of equal size on apical margin.

Female: similar to male except for frons and armature of elytral declivity, 1.67 ± 0.04 mm (mean \pm sd, $n = 5$), and ranging from 1.60–1.70 mm; 3.46–3.70 times as long as wide. Frons flattened to upper level of eyes, in the centre a large almost circular area (Fig. 1G), with an extremely dense vestiture of very short, very fine, erect setae, lateral areas finely reticulate with scattered punctures and long hair-like setae. Pronotum 0.56 ± 0.02 mm (mean \pm sd, $n = 5$), and ranging from 0.52–0.58 mm; 1.44 ± 0.06 (1.37–1.53) times longer than wide. Elytra 1.11 ± 0.02 mm (mean \pm sd, $n = 5$), and ranging from 1.08–1.14 mm; 2.36 ± 0.05 (2.29–2.43) times longer than wide, 1.99 ± 0.07 (1.93–2.08) times longer than pronotum; elytral declivity lacking the large denticles on interstriae 3 and 5, interstriae 1 raised on declivity and with a row of evenly spaced, pointed granules extending to apex, interstriae 2 unarmed on declivity, interstriae 3 with a few pointed granules near top of declivity, interstriae 5 raised on declivity and converging towards elytral apex, armed with a row of pointed granules, posterolateral margin formed by a row of teeth extending from interstriae 9 to the elytral apex, the teeth smaller and more rounded than in the male.

Etymology: The new species is named after the genus of its host plant, *Cinnamomum insulari-montanum*.

Biology: Adults were found on twigs and branches of unhealthy *Cinnamomum insulari-montanum* with a diameter between 1.8 and 12 cm (Fig. 2A). Branches were transported from the mountain to the laboratory on November 19, 2022, and kept in boxes at room temperature. The first generation, including both mature and immature adults in pupal cells, was collected from branches on January 01, 2023, and further adults were collected in the following days. This species is harem polygynous and phloeophagous. The male initiates the boring of a new gallery with a short oblique entrance tunnel and a nuptial chamber (Fig. 2B). Our observations show that after the first female has been attracted, and mating has occurred, up to four more females are attracted, presumably by a male-produced pheromone. Each female then extends her own egg gallery from the nuptial chamber without interfering with neighbouring galleries (Fig. 2C). The length of the egg galleries varied from 0.5 cm to 7.8 cm (Fig. 2D). Each female continues to extend her gallery, and oviposits in widely separated niches in

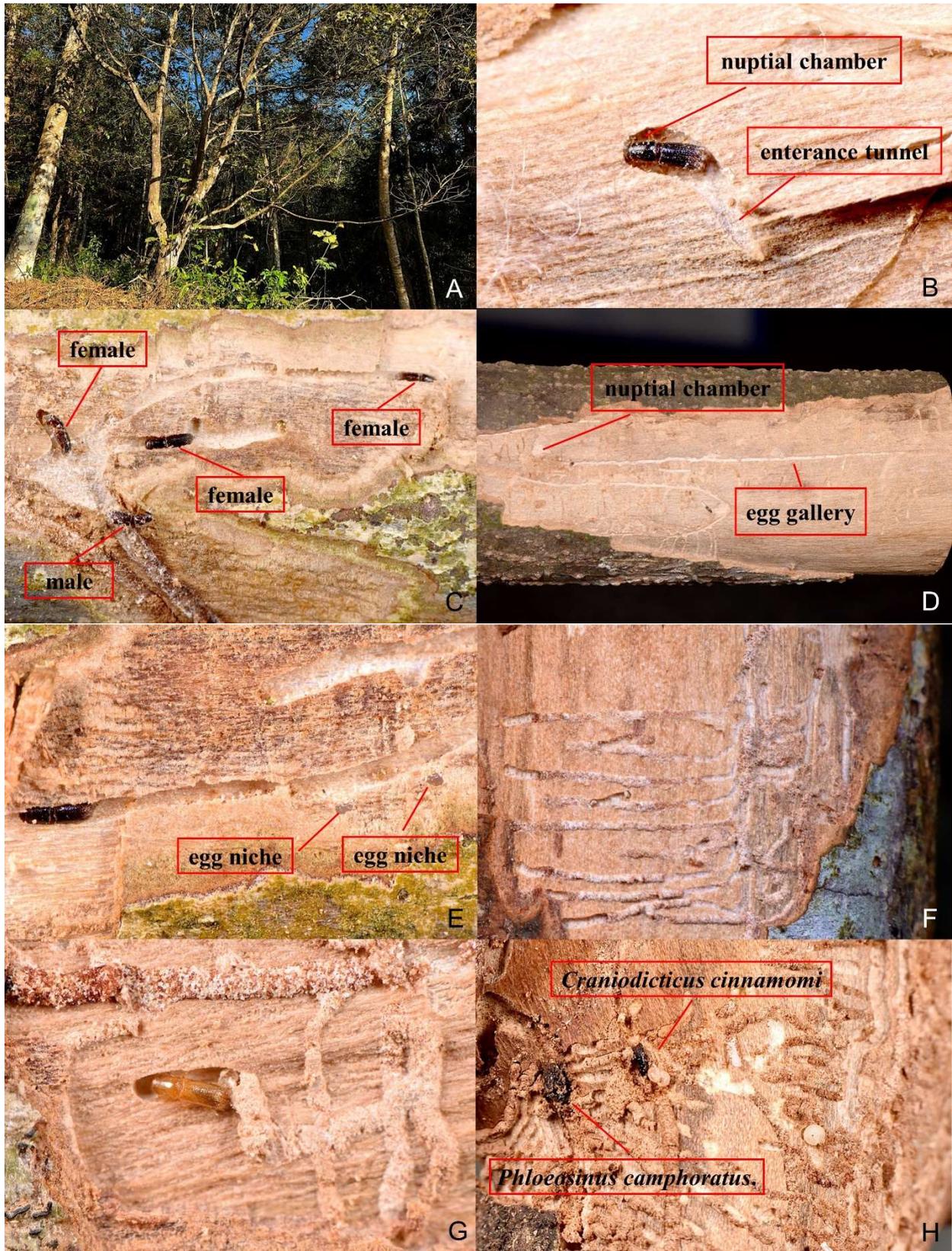


Fig. 2. *Craniodicticus cinnamomi* Lin & Beaver, sp. nov.: A. unhealthy *Cinnamomum insulari-montanum*, B. entrance tunnel and a nuptial chamber, C. female extends her own egg gallery around the nuptial chamber, D. egg gallery, E. egg niches, F. larval galleries subparallel to each other, G. general adult, H. *Phloeosinus camphoratus* breed in the same branch with *C. cinnamomi*.



the gallery wall. The male guards the entrance, removes the frass from the galleries, and prevents other males from entering his gallery system. Both male and females remain in the gallery system until they die. The eggs are pearly white, translucent and oval in shape, protected in the egg niches by a covering of frass (Fig. 2E). After hatching, the larvae mine subparallel to each other at first, then radiate outwards with the larval galleries usually crossing one another (Fig. 2F). Mature larvae prepare deep pupal cells at the end of the larval galleries. The cells can be in the wood, especially when the bark is very dry. Teneral adults (Fig. 2G) emerge from the pupal chambers by tunneling straight through the bark over it. We estimate the development time from first instar larva to adult is about 2 months in the laboratory at a temperature about 20–22°C. This would allow several generations per year in the climate of the location where the species occurred. We also found that *Phloeosinus camphoratus* Tsai & Yin bred in the same branches as *C. cinnamomi*, and the larval galleries intermingled (Fig. 2H).

Key to *Craniodicticus* species of Indo-Asia (modified from Beaver, 1999)

- 1a. Posterolateral margin of elytral declivity with a series of weakly hooked, backward-pointing teeth; interstitial setae on declivity coarsely hairlike; protibia with three equally sized denticles on truncate apical margin; 1.6–2.2 mm long. India, Sri Lanka, Taiwan and Vietnam. 2
- 1b. Posterolateral margin of elytral declivity without hooked teeth, weakly crenulate; interstitial setae on declivity cuneiform or spatulate, more strongly flattened in male than female; protibia with two denticles on truncate apical margin; 1.4–1.5 mm long. Borneo. *C. sabahensis* Beaver
- 2a. Punctures on vertex of head scarcely visible; male with upper margin of elytral declivity bearing small pointed teeth on interstriae 3 and 5, larger than those on interstriae 2 and 4. Female not described. 1.6 mm long. Southwest India and Vietnam. *C. minor* Eggers
- 2b. Punctures on vertex of head distinctly visible. Other characters variable. 3
- 3a. Smaller species, 1.6–1.8 mm long; upper margin of elytral declivity of male with large denticles on interstriae 3 and 5 (Fig. 1A, B); female elytral declivity with interstriae 5 slightly raised, converging towards elytral apex, and armed by a row of pointed granules. Taiwan *C. cinnamomi* sp. n.
- 3b. Larger species, 2.0–2.2 mm long; upper margin of elytral declivity with small pointed tubercles on interstriae 3 and 5; female with interstriae 3 slightly raised on declivity and armed with a row of small, pointed granules. Sri Lanka. *C. mucronatus* Blandford

DISCUSSION

The taxonomic position of the Carphodicticini has been subject to some argument, (e.g. Wood, 1986; Thompson, 1992; Beaver, 1999; Alonso-Zarazaga and Lyal, 2009) largely due to their general resemblance to some members of the Platypodinae. However, Alonso-Zarazaga and Lyal (2009) note that the genera lack many of the apomorphies present in the Platypodinae, and follow Wood and Bright (1992) in retaining them in Scolytinae. Wood (1986) gives a key to distinguish the three genera.

Wood (1986) suggested that *Craniodicticus mucronatus*

might be xylophagous because 'one sample was removed from wood', but there is no mention of this sample in Blandford's (1895) original paper, which mentions only specimens taken from 'jungle rope' (presumably a liane). Kirkendall *et al.* (2015) (presumably based on Wood (1986)) also list the genus as xylophagous, but we believe this to be incorrect based on our observations of *C. cinnamomi*. We note that the genus *Carphodicticus* is also phloeophagous (Wood, 1971, 2007), but the habits of the third genus in the tribe, *Dendrodecticus*, remain unknown (Kirkendall *et al.*, 2015).

The only detailed information published on the biology of any of the genera in the tribe Carphodicticini comes from Wood's (1971, 2007) observations on *Carphodicticus cristatus*. He noted that the species entered the bark through the old entrance tunnels of a species of *Phloeotribus* Latreille. The species was monogamous, with a single male and female in each gallery system in the phloem. More than one pair of beetles might use the same entrance hole, and their galleries branched off from the earlier gallery systems, so that hundreds of branching and rebranching gallery systems were present. The eggs were laid in separate niches, and the larvae mined in the phloem. The habits of *Craniodicticus cinnamomi* are similar in many ways, but the male was observed to cut its own entrance gallery into the bark, and the breeding system of harem polygyny is distinctly different, with the single male keeping out other males from the gallery system.

Harem polygyny is a relatively uncommon breeding system in Scolytinae, but has nevertheless evolved at least 11 times in eight different tribes, and is the predominant mating system in Ipini, and common in Corthylini and Polygraphini (Kirkendall *et al.*, 2015). The observations of *Craniodicticus cinnamomi* add a further example, and one further tribe to the list. Kirkendall (1983) and Kirkendall *et al.* (2015) discuss the conditions in which harem polygyny is likely to evolve. In a high quality resource, the positive effects of resource quality on fitness of a female joining a harem may outweigh the potential costs of decreased fecundity and larval mortality due to overcrowding and competition between galleries (Kirkendall, 1989). This particularly applies when, as in *C. cinnamomi*, the female galleries extend in different directions from the nuptial chamber (Fig. 2C), and the egg niches are widely spaced along the gallery (Fig. 2D). It seems likely that the breeding system found in *C. cinnamomi* has evolved from that found in *Carphodicticus cristatus* perhaps as a result of competition between males for females.

ACKNOWLEDGMENTS

We would like to thank Dr. Chi-Yu Chen (Department of Plant Pathology, National Chung Hsing University) for host tree confirmation, and Dr. Chung-Chi Lin (Department of Biology,



National Changhua University of Education) for providing photography equipment.

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