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First Field Observations of the Courtship Behavior in the Ambrosia Beetle, *Scolytoplatypus pubescens* Hagedorn, 1904 (Coleoptera: Curculionidae: Scolytinae) in Taiwan

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ABSTRACT

The ambrosia beetle genus *Scolytoplatypus* Schaufuss, 1891, exhibits pronounced sexual dimorphism. Males possess specialized morphological structures—including a concave frons, frontal setal brushes, and modified prosternal processes—whose functions have remained poorly understood. Based on field observations of *S. pubescens* in Taiwan, this study reveals that males utilize these structures in highly specialized courtship behavior. Specifically, males employ the long, flexible setal brushes on the frons to wrap around the elytral declivity of the female, using the prosternum as a lever to facilitate acoustic, drum-like tapping signals generated by the forelegs. These findings elucidate the functional evolution of extreme sexual dimorphism and provide the first evidence of tactile and vibrational communication in this genus.

Key words: Ambrosia beetles, *Scolytoplatypus*, Sexual dimorphism, Courtship behavior, Acoustic communication, Prosternal process, Functional morphology, Taiwan

Introduction

The genus *Scolytoplatypus* Schaufuss, 1891, belonging to the tribe Scolytoplatypodini, is distributed throughout Asia, Madagascar, and Africa (Browne, 1971; Schedl, 1975; Wood and Bright, 1992; Jordal, 2013). These ambrosia beetles are characterized by the cultivation of fungi within gallery systems as the sole food source for both larvae and adults (Beeson, 1961; Browne, 1961; Beaver and Gebhardt, 2006). Species within this genus exhibit marked sexual dimorphism. In males, the head is antero-posteriorly compressed, and the frons is concave, abruptly separated from the vertex and often bearing brushes of long setae along the lateral and/or upper margins. In contrast, the female head is globose, with a more-or-less convex frons that rounds into the vertex and consistently lacks such setal brushes. Antennae of Asian

species, unlike their African counterparts (Browne, 1971; Jordal, 2013), are sexually dimorphic, being longer and more triangular in males. The female pronotum in most species bears a large, median mycangial pore in the anterior half, which is absent only in seven Oriental species. Males of almost all Asian species possess a deep fovea of unknown function at the anteroventral angle of the pronotum, a feature absent in African species (Beaver and Gebhardt, 2006). In Oriental *Scolytoplatypus* species, the various modifications of the male prosternum were originally noted by Blandford (1893); these features provide useful diagnostic characters at the species level (Beaver and Gebhardt, 2006; Gebhardt *et al*., 2021; Liao *et al*., 2022). However, the functions of the frontal setal brushes and these prosternal modifications have never been examined in living individuals. In this paper, we present the first field observations of courtship behavior in *Scolytoplatypus pubescens* Hagedorn, 1904 from Taiwan, specifically elucidating the roles of the concave frons, curved frontal setal brushes, and prosternum.

Materials and Methods

Field observations

All observations were recorded using a Nikon D7200 camera equipped with a NIKKOR 105mm f/2.8G AF-S VR Micro lens, two Nikon SB-R200 Wireless Remote Speedlights (Nikon, Japan), and two 36 mm extension tubes (Kenko, Japan). Field observations were carried out on the trunk of a fallen *Machilus zuihoensis* Hayata (Lauraceae) in Ren'ai Township, Nantou County, Taiwan (24°0.6028′N, 121°0.3541′E; alt. 1,205 m) on February 22, 2026.

Morphological examination

Specimens were identified using the key of Beaver and Gebhardt (2006) and examined using a Leica M205-C stereomicroscope equipped with a Pl 10x/22 eyepiece and an eyepiece micrometer.

Results

Characteristics of *Scolytoplatypus pubescens*

Male (Fig. 1A–D): Frons concave to vertex, with a medial, suboval patch of dense, short setae between eyes. Upper eye margins with tufts of long, S-shaped setae extending over frons and meeting medially; lateral margins with long setae densest near epistoma. Prosternum with two anterior triangular processes, widely separated at base with convergent tips. Pronotum with a deep antero-ventral fovea.

Female (Fig. 2A–C): Similar to male, but frons convex and lacking setal brushes. Prosternal processes absent. Pronotum with a distinct mycetangium opening behind the anterior third, and lacking antero-ventral fovea.

Field observations

Reference video link: https://youtu.be/SKtIpCqJ2Ng; https://youtu.be/DpDyjniGQ4c

Two instances of courtship behavior were observed in this study: one lasted approximately 30 minutes, while the other lasted only about five minutes. Both were interrupted by interference from other males. Additionally, two copulation events were recorded.

In *Scolytoplatypus*, the female is the pioneer sex that initiates the gallery system, where she is joined later by the male for mating. Females of *Scolytoplatypus pubescens* were attracted to fallen trees and initiated the construction of entrance galleries on small stems. Males, presumably attracted by pheromones released by the females, alighted on the stems and searched for the entrance holes where the females were excavating. Upon discovering a gallery where a female was excavating, the male used its forelegs to perform push-up-like motions, repeatedly tapping her elytral apex with his mouthparts (Figs. 3A–B). Occasionally, when exerting excessive force against the female, the male would even lift one of his forelegs off the substrate. In response to this tapping, the female emerged slightly from the tunnel, exposing her elytral declivity; the male then approached her declivital surface with his head. He used the bristle brush on his forehead to rapidly rotate his head from side to side, rubbing against the declivity of the female's elytra while simultaneously clearing dirt and debris. By pushing firmly against the female while continuing this rapid head-swiveling, the male engaged her declivity with his curved, flexible frontal setal brushes. Consequently,

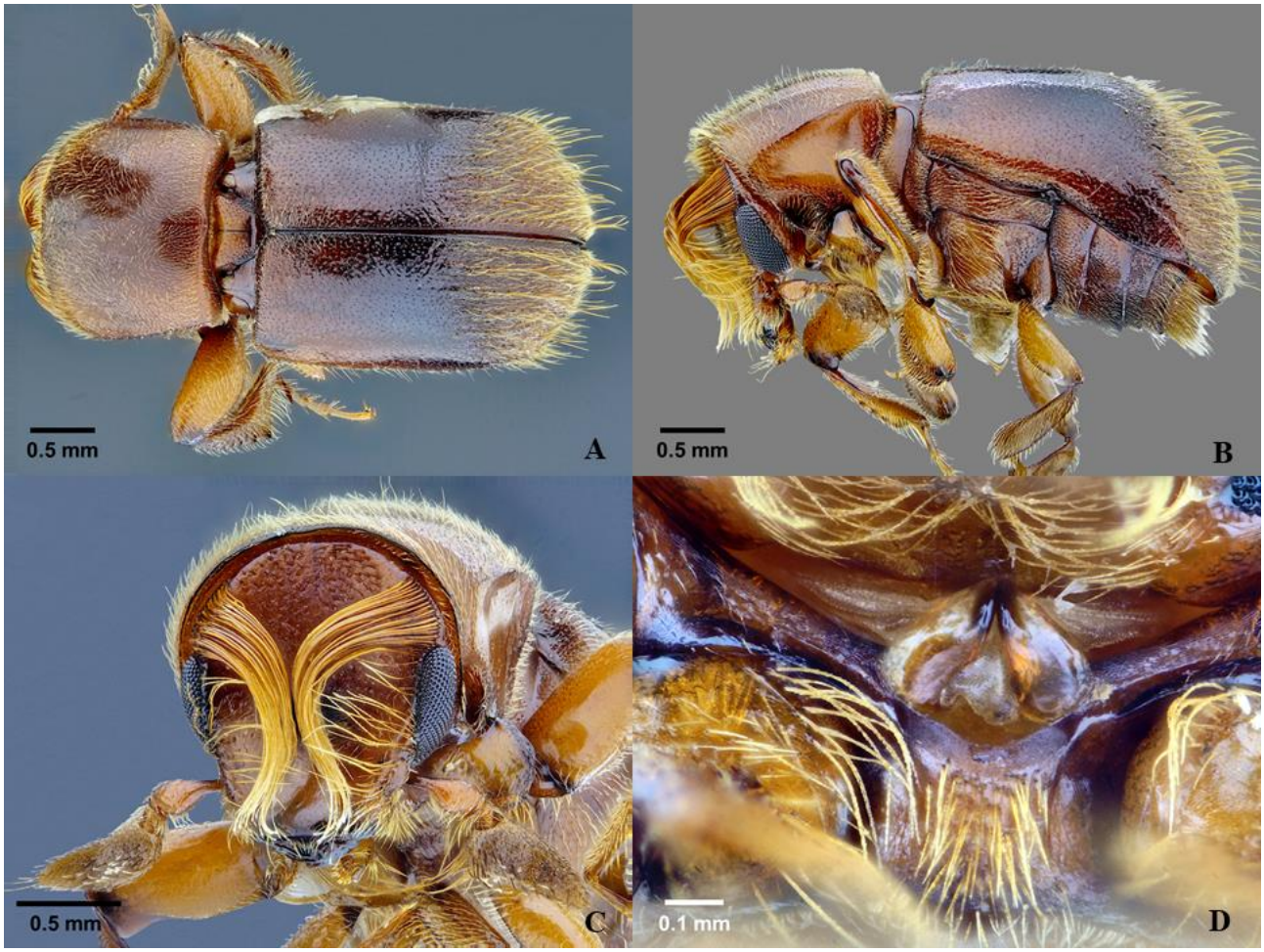

Fig. 1. ***Scolytoplatypus pubescens*, male.** (A) Dorsal view; (B) Lateral view; (C) Frons, showing two tufts of long setae; (D) Prosternum.

these brushes resembled two spiral springs wrapping around her elytra and a portion of her abdomen, complemented by his concave frons, which perfectly match the curvature of her elytral declivity. (Figs. 3C–D). The male continued swiveling his head in this integrated position until the female withdrew deeper into the tunnel to continue gallery boring, or the male moved backward, leading to their separation. If necessary, the male then groomed his frontal setal brushes with his forelegs. Additionally, the male supported himself with his mid and hind legs while leveraging the pair of processes at the anterior end of the prosternum as a fulcrum against the female's elytral declivital surface. This elevated his posterior end into a stable 'head-down, tail-high' posture, enabling the forelegs to repeatedly and rapidly strike both sides of the entrance hole (Figs. 4A–B). These two behaviors alternated without a regular pattern. Before copulation, the male was observed repeatedly rubbing the female's elytral declivity with his frontal setal brushes; however, during this behavior, the male's setae did not encircle the female's elytra and abdomen. Copulation was in the typical position for Scolytinae (Kirkendall *et al*., 2015), with the male grasping the female's dorsum with his legs. Copulation lasted approximately one minute. The sample size was insufficient to determine which specific behavior triggered the mating process. These behaviors occurred outside the entrance hole; the female engaged exclusively in copulation (Figs. 4C–D) and gallery boring, with her head never emerging from the tunnel during these interactions.

Discussion

Tactile and acoustic stimuli—including tapping, bumping, setal brushing, and mandibular gnawing—have been documented

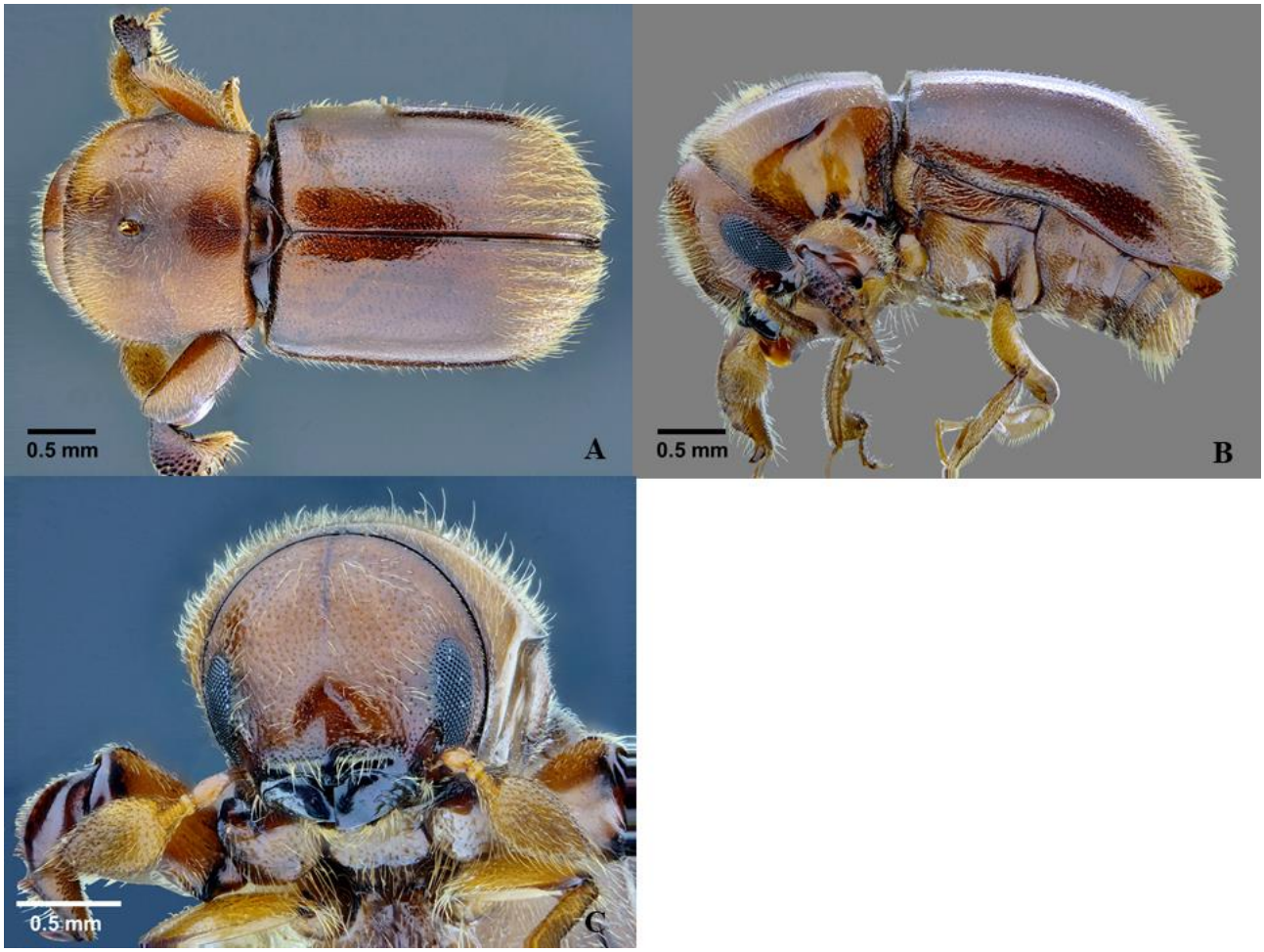

Fig. 2. ***Scolytoplatypus pubescens*, female.** (A) Dorsal view; (B) Lateral view; (C) Frons.

during the courtship behavior of Scolytinae (Kirkendall *et al*., 2015; Arjomani *et al*., 2024; Bedoya *et al*., 2024). Bark beetles produce sounds that are generally associated with species recognition, premating interactions, pair formation, mate selection, intraspecific aggression, territoriality, and predator deterrence (Bedoya *et al*., 2019, 2024). Sexual dimorphism is particularly prevalent in the frons, declivity, and abdominal venter; these traits often evolve more rapidly than other morphological features because of their direct involvement in mating (Kirkendall *et al*., 2015). Stridulatory structures are frequently sexually dimorphic, being less developed or absent in the sex that initiates gallery construction (Barr, 1969; Hofstetter *et al*., 2019). Despite the extreme sexual dimorphism observed in the frons and thoracic regions of Asian *Scolytoplatypus* males—particularly the anterior prosternal processes, which are capable of moving independently in both horizontal and vertical planes—no literature to date has reported the presence of stridulatory organs in this genus (Blandford, 1896; Beaver and Gebhardt, 2006; Gebhardt *et al*., 2021), and we have been unable to locate stridulatory structures of the three main types: elytro-tergal, vertex-pronotal, gular prosternal (Arjomani *et al*., 2024; Barr, 1969; Bedoya *et al*., 2019), in any of the 10 Taiwanese and Thai species examined.

Our observations provide functional evidence for the roles of the concave frons, curved frontal setal brushes, and the anterior prosternal process in courtship behavior. The behavior of the male rubbing his frons against the female's elytral declivity has likely driven the evolution of a concave frons that perfectly matches the curvature of the female's declivity in *Scolytoplatypus*. By using the long, flexible, and curved frontal setae to wrap around the female's elytra and abdomen, the male aligns his concave frons with the female declivity, ensuring that setal communication is maintained and

Fig. 3. **Observations of courtship behavior in *Scolytoplatypus pubescens* on *Machilus zuihoensis*.** (A) Male using mouthparts to knock on the female's elytral apex, frontal view; (B) Male knocking on the female's elytral apex, lateral view; (C–D) Male's curved setal brushes and concave frons fitting the curvature of the female's elytral declivity.

accurately delivered. Furthermore, the male uses the anterior processes of the prosternum as a fulcrum to adopt a head-down, tail-high posture, allowing him to communicate with the female inside the tunnel by rapidly and repeatedly drumming his forelegs against the wood substrate. The female likely perceives vibrations generated through the wood (Hofstetter *et al*., 2019), although acoustic transmission through the air is also possible. The male can adjust his body posture via the anterior prosternal processes; this "lever-like" mechanism ensures stability, thereby facilitating rapid foreleg strikes that generate rhythmic vibrations. This unique use of the anterior processes of the prosternum as a fulcrum represents a highly specialized mechanical adaptation. Acoustic and vibrational signaling are widespread in bark beetles, although less common in ambrosia beetles (Arjomani *et al.*, 2024; Bedoya *et al*., 2019, 2024). This study provides the first field record of *Scolytoplatypus* transmitting vibrational signals through drum-like tapping on the substrate, rather than relying on endogenous stridulatory organs. The location of the receptors in the female remains unknown in this or any other scolytine (Arjomani *et al.*, 2024).

Further studies of courtship behavior in both *S. pubescens* and other *Scolytoplatypus* are clearly needed. In some species, the anterior prosternal processes are immovable because they lack independent muscle attachments at their bases (Gebhardt *et al*., 2021), rendering them unable to function as in *S. pubescens*. There appears to be a correlation between the absence of well-developed frontal brushes (e.g., in *S. brahma* Blandford, *S. javanus* Eggers, *S.*

Fig. 4 **Observations of courtship behavior in *Scolytoplatypus pubescens* on *Machilus zuihoensis*.** (A) Male striking his forelegs against both sides of the entrance hole; (B) Male supported by his mid and hind legs, bracing his prosternal processes against the female's elytral declivity; (C) Copulation, frontal view; (D) Copulation, posterior view.

lopchuensis Maiti & Saha, *S. mikado* Blandford, and *S. raja* Blandford) and the presence of well-developed procoxal hair brushes. These brushes are exceptionally long in *S. lopchuensis*, extending posteriorly to the mid-abdomen; however, this trait has not been previously recorded in the literature. Although *S. calvus* also lacks frontal brushes, it possesses only poorly developed hair brushes on the procoxae. We suggest that the courtship behavior of these species differs from that of species with well-developed frontal brushes, such as *S. pubescen*s, in at least some respects.

These findings suggest that the remarkable sexual dimorphism in this genus is driven by complex tactile and acoustic communication, offering new insights into the evolutionary diversification of mating strategies among bark and ambrosia beetles. The courtship behavior of *S. pubescens* observed in this study highlights a sophisticated coordination between specialized morphological structures and behavioral sequences.

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台灣茸翅銼小蠹（*Scolytoplatypus pubescens* Hagedorn, 1904）求偶行為之首度野外觀察（鞘翅目：象鼻蟲科：小蠹亞科）

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摘　　要

菌小蠹蟲的銼小蠹屬具有顯著的雌雄兩型性；雄蟲擁有特化的形態結構，包括凹陷的額部、額部剛毛刷以及特化的前胸腹板突起，這些結構的功能長期以來未被完全理解。本研究基於對台灣茸翅銼小蠹（*S. pubescens*）的野外觀察，揭示了雄蟲利用這些結構進行高度特化的求偶行為。具體而言，雄蟲利用額部長而靈活的剛毛刷同時纏繞雌蟲的鞘翅與腹部，並以前胸腹板為槓桿，藉由前肢發出類似鼓聲的敲擊訊號。這些發現闡明了極端兩性異形的功能演化，並首次提供了該屬昆蟲存在觸覺與振動通訊的證據。

關鍵詞：銼小蠹屬、茸翅銼小蠹、雌雄兩型性、求偶行為、振動通訊、形態功能、菌小蠹蟲