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Review of the genus *Microperus* Wood, 1980 (Coleoptera, Curculionidae, Scolytinae) of Taiwan with the description of two newly recorded species and the first description of males of six species

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ABSTRACT: The *Microperus* ambrosia beetle fauna of Taiwan is reviewed. *Microperus alpha* (Beeson, 1929), *M. kadoyamaensis* (Murayama, 1934), *M. kirishimanus* (Murayama, 1955), *M. perparvus* (Sampson, 1922), *M. quercicola* (Eggers, 1926) have all been previously recorded from Taiwan. *Microperus bucolicus* Sittichaya, Smith & Beaver, 2021 and *M. latesalebrinus* Smith, Beaver & Cognato, 2020 are new country records for Taiwan. Of which, the males of *M. alpha*, *M. bucolicus*, *M. kadoyamaensis*, *M. latesalebrinus, M. perparvus*, and *M. quercicola* are described for the first time. In this study, we document a likely occurrence of mycocleptism by *M. bucolicus*. Diagnostic characters, biological data and a key to species in Taiwan are provided.

KEY WORDS: Ambrosia beetle, biology, male, *Microperus*, mycocleptism, new record, Taiwan.

INTRODUCTION

Xyleborine ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) are xylomycetophagous and cultivate fungus in tunnels excavated by the beetles in the xylem which serve as food for the larvae and adults. Females have mycangia, specialized cuticular structures, to transfer ambrosia fungi from their natal gallery to a new gallery, and show intensive maternal care, including gallery extension, maintenance of the fungus gardens, removal of debris from the gallery, and blocking of the entrance tunnel for protection (Kirkendall *et al*., 1997; Hulcr and Stelinski, 2017). Xyleborines are also characterized by their haplodiploid sex determination and regular inbreeding in which an adult female produces diploid daughters and haploid dwarfed and flightless sons which mate with their sisters prior to dispersal (Kirkendall *et al*. 1997; Kirkendall *et al*., 2015). This reproductive system results in strongly female-biased offspring sex ratios where males are rarely encountered outside of their gallery. Larvae sometimes enlarge the gallery and participate in brood care and gallery hygiene, factors that have been assumed to foster advanced social behavior (Peer and Taborsky, 2011; Biedermann *et al*., 2011). Adult offspring delay dispersal in some species and rather participate in raising siblings and thereby increase brood care efficiency; such species are classified as cooperatively breeding ambrosia beetles (Peer and Taborsky, 2007; Biedermann, 2020). *Microperus* Wood, 1980, like other ambrosia beetles, bore galleries into the xylem of weakened, cut or injured trees where mutualistic ambrosia fungi are farmed for food. Our observations suggest that adult daughters delay dispersal from the natal nest and engage in communal breeding and fungus-farming tasks.

Microperus was first established by F. G. Browne in an unpublished manuscript. Wood (1980) erected the genus and designated *Xyleborus theae* Eggers as the type species. Females of *Microperus* species are diagnosed by the scutellum concealed or minute narrow, convex and slightly raised above elytra, elytral disc longer than declivity, bases slightly curved, dense tufts on elytral bases associated with a presumably present elytral mycangium but not yet studied in detail, anterior margin of pronotum rounded without a row of serrations, antennal club obliquely truncate with segment 1 continuous on both sides (type 2; Hulcr *et al*., 2007) and two sutures on the posterior face. The morphology of *Microperus* is most similar to *Coptodryas* Hopkins, 1915. Several studies have confirmed that the genera are closely related and both are in need of further taxonomic/phylogenetic investigation to clarify generic limits (Hulcr *et al*., 2007; Cognato *et al*., 2011; Mandelshtam *et al*., 2019; Smith *et al*., 2020).

Forty-seven *Microperus* species have been described and are distributed in Asia from Russia and Japan, west to Sri Lanka, east to the Solomon Islands and south to Australia and one species occurs in Africa (Smith *et al*., 2020; Sittichaya *et al*., 2021; Smith *et al*., 2022). In Taiwan, four *Microperus* species were previously recorded by Beaver and Liu (2010) and one additional species was documented by Smith *et al*. (2020). No further study or update of Taiwanese *Microperus* has occurred since 2020. Smith *et al*. (2020) described a new *Microperus* species, *M. latesalebrinus* Smith, Beaver & Cognato, 2020 from China (Hong Kong) collected from *Castanopsis* sp. (Fagaceae). Sittichaya *et al*. (2021) described a new species, *M. bucolicus* Sittichaya, Smith

Table 1. ***Microperus*** host trees and incidence of beetles in the collected host samples in Taiwan

species	*M. alpha*	*M. bucolicus*	*M. kadoyamaensis*	*M. kirishimanus*	*M. latesalebrinus*	*M. perparvus*	*M. quercicola*
Araliaceae							
Schefflera octophylla			∨ (1/1)				
Cannabaceae							
Trema orientalis	∨ (1/1)	∨ (2/2)		∨ (3/3)	∨ (1/1)		∨ (1/1)
Elaeocarpaceae							
Elaeocarpus sylvestris		∨ (1/1)			∨ (2/2)		
Euphorbiaceae							
Mallotus japonicus	∨ (2/2)	∨ (3/3)					
Mallotus phillipinensis	∨ (1/1)						
Fagaceae						**∨ (3/3)**	
Castanopsis fargesii							
Lauraceae							
Cinnamomoum osmophloeum	∨ (2/2)						
Machilus thunbergii				∨ (1/1)			
Machilus zuihoensis		∨ (1/1)		∨ (2/2)			∨ (9/9)
Moraceae	**∨ (1/1)**			**∨ (2/2)**			
Ficus fistulosa							
Oleaceae							
Fraxinus formosana	∨ (1/1)						
Rutaceae							
Tetradium glabrifolium		∨ (1/1)					
Sapindaceae							
Sapindus mukorossii	∨ (1/1)						

& Beaver, 2021 from Thailand from a singleton female collected by an ethanol baited trap in a durian orchard but no further information about its biology was reported. In this study, we document a newly discovered occurrence of mycocleptism in *Microperus* and two species are recorded in Taiwan for the first time. For each species, diagnostic characters, collecting localities and information on host plants and biology are provided where available from Taiwan. A key to the Taiwanese species of *Microperus* is provided to facilitate identification.

MARERIALS AND METHODS

Specimens were collected from October 2012 to October 2021 using twelve-unit Lindgren multi-funnel traps (Contech Enterprises, Inc., Delta, British Columbia, Canada), baited with 95% ethanol, and 95% α-pinene (Merck, Germany), or collected *Microperus* species by twigs or branches dropped from living trees to confirm the host trees, obtain rarely collected males, observe their gallery systems and breeding biology in Taiwan. Beetles were identified to species level using the keys of Smith *et al*. (2020) and Sittichaya *et al*. (2021). The pronotal morphotypes and antennal characters follow those proposed by Hulcr *et al*. (2007). 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. Beetle photographs were taken using a Canon 50D camera and macro lens MP-e65. Beetle montage images were assembled using Helicon Focus V. 6.8 (Helicon Soft.). All specimens of the newly recorded species are deposited in National Museum of Natural Science (NMNS), Taichung, Taiwan, National Taiwan University Insect Museum (NTU), Taipei, Taiwan and the collection of first author.

RESULTS AND DISCUSSION

Seven species of *Microperus* colonized 13 tree species in 10 plant families (Table 1). *Microperus kadoyamaensis* and *M. perparvus* were each collected only once from one host plant. *Microperus quercicola* was collected nine times from *Machilus zuihoensis* Hayata (Lauraceae) and once from *Trema orientalis* Blume (Cannabaceae). This species shows some preference for *M. zuihoensis* in Taiwan. Large series of *M. bucolicus* and *M. latesalebrinus* were obtained from the collected dry twigs or branches dropped from living trees. Both species apparently utilize dying or dead twigs or branches on the canopy to raise their broods. Dwarfed and flightless males of six *Microperus* species were collected and are described below. Males of *Microperus* species always remain with their more numerous sisters in their gallery systems. At most one or two males were found in each gallery, males were always smaller than the females, less sclerotized, and different in shape; they have reduced eyes and cannot fly because the hind wings is

Table 2. Gallery systems of genus ***Microperus***

Gallery system	*M. alpha*	*M.bucolicus*	*M. kadoyamaensis*	*M. latesalebrinus*	*M. perparvus*	*M. quercicola*
Transverse cavity brood chamber	∨					∨
Longitudinal cavity brood chamber		∨	∨	∨	∨	

vestigial. The gallery systems of six *Microperus* species were observed (Table 2). Two species excavated transverse cavity brood chambers and four species excavated longitudinal cavity brood chambers. We observed the presence of adult offspring in the gallery, and gregarious feeding offspring. We also observed females of *Microperus bucolicus* often excavating their galleries adjacent to those of *Tricosa metacuneolus* (Eggers, 1940). Stealing of a neighbor's fungal garden is an evolutionary strategy. The mycocleptic species seek brood galleries of other ambrosia beetles, they process unique ability of locate and create their own galleries adjacent to the host galleries and acquire mycelia from the established garden of the host species. Members of *Ambrosiophilus* Hulcr & Cognato, 2009, *Diuncus* Hulcr & Cognato, 2009, and *Xylosandrus* Reitter, 1913 had confirmed records of mycocleptae in Xyleborini (Hulcr and Cognato, 2009; 2010). We observed that females of *M. bucolicus* created their galleries adjacent to those of *T. metacuneolus* on eight occasions (Oct. 2021–Jan. 2024). The entrance hole was next to or near that of *T. metacuneolus* (Fig. 8C–D). The gallery system was irregularly branched with one small longitudinal cavity brood chamber and very close to or fused with the chambers of *T. metacuneolus* (Fig. 8E) (C. S. Lin *pers. obs*.). These observations are consistent with those of other mycocleptae (Hulcr and Cognato, 2010) but further studies involving the ambrosia fungus present in each species galleries will be necessary to confirm that the species are sharing fungi.

Unfortunately, our knowledge of the detailed behaviors of *Microperus* species is still superficial, most of what we know about behavior of ambrosia beetles has been pieced together from such observations. Our observations suggest that cooperative breeding and mycocleptism likely occur in *Microperus* species. The ambrosia beetles *Xyleborinus saxesenii* (Ratzeburg, 1837) and *Xyleborus affinis* Eichhoff, 1868 have been selected for laboratory studies of within gallery behavioral observations (Peer and Taborsky, 2011; Biedermann *et al*., 2011). *Microperus* species could be a potential candidate for behavioral studies with artificial medium which could help us to discover more about their within gallery behaviors.

TAXONOMIC TREATMENT

Key to females of *Microperus* species found in Taiwan

1 Declivity obliquely truncate in lateral view (Fig. 4B) 2
- Declivity steeply rounded in lateral view (Fig. 1B) 4
2 Declivital interstriae 2 and 3 strongly laterally broadened from base to declivital midpoint and then narrowing towards apex …….. ……..…….…..… ***M. latesalebrinus***
- Declivital interstriae parallel from base to apex, never laterally broadened ……..…... 3
3 Denticles on declivital summit and margins larger and more sharply acute than those on declivital face (Fig. 4D) …..... ***M. kirishimanus***
- Denticles on declivital summit of equal size and shape as those on declivital fac ..... ***M. perparvus***
4 Elytral slightly raised in middle of disc, declivital posterolateral costa granulate ..... ***M. kadoyamaensis***
- Elytral disc flat, declivity posterolateral costate or carinate 5
5 Posterolateral declivital margin carinate and denticulate ***M. bucolicus***
- Posterolateral declivital margin carinate 6
6 Declivital interstrial denticles sparse, each bearing a long erect hair-like seta (Fig. 1D) ..... ***M. alpha***
- Declivital interstrial granules dense, each bearing a long, fine, erect hair-like seta (Fig. 7D) ..... ***M. quercicola***

Microperus alpha (Beeson, 1929)

Microperus alpha (Beeson), Hulcr 2010: 111.
Coptodryas alpha (Beeson), Wood and Bright 1992: 823.
Xyleborus alpha Beeson, 1929: 239.
Xyleborus bicolor Blandford, var. α Sampson, 1923: 289, Nomen nudum.

脊端微楯小蠹

Identification note. Female (Fig. 1A–D): This species is distinguished by the elytral disc flat with short, steep declivity; declivity with sparse minor denticles, less abundant than strial punctures, and denticles uniform in size. *Microperus alpha* (1.7–1.8 mm) is most similar to *M. bucolicus* (vs. 1.6 mm) and can be easily distinguished by its larger size and carinate declivital posterolateral margin.

Male (Fig. 1E–H): The males are almost similar to females except smaller in size but stouter. Length 1.52–1.60 mm (mean = 1.54 ± 0.03 mm; n = 5); 2.62–2.76 times as long as wide, reddish brown. **Head**. Frons weakly convex, anterior part of frons and epistomal area weakly depressed, shagreened, surface finely reticulate, sparsely finely punctate, punctures bearing a long, erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles enlarged with a tooth in middle of inner margin. **Pronotum** 0.85–1.10 times as long as wide. In dorsal view long and rounded frontally, type 7 (Hulcr *et al.*, 2007), lateral sides parallel in basal 2/3, rounded anteriorly; anterior margin without serrations. Base weakly bisinuate, posterior angles narrowly rounded. In lateral view disc slightly longer than anterior slope, type 7 (Hulcr *et al.*, 2007), summit at apical 1/3. Disc shagreened, alutaceous, finely punctate, finely setose, setae short, erect, hair-like, some longer hair-like setae at margins, anterior slope with finely asperate, asperities close, arranged in concentric rings from midpoint of pronotum to anterior margin. **Elytra** 1.27–1.50 times longer than pronotum and 1.40–1.57 times as long as wide. Scutellum obscure and not visible from above. Tuft of setae extending along elytral

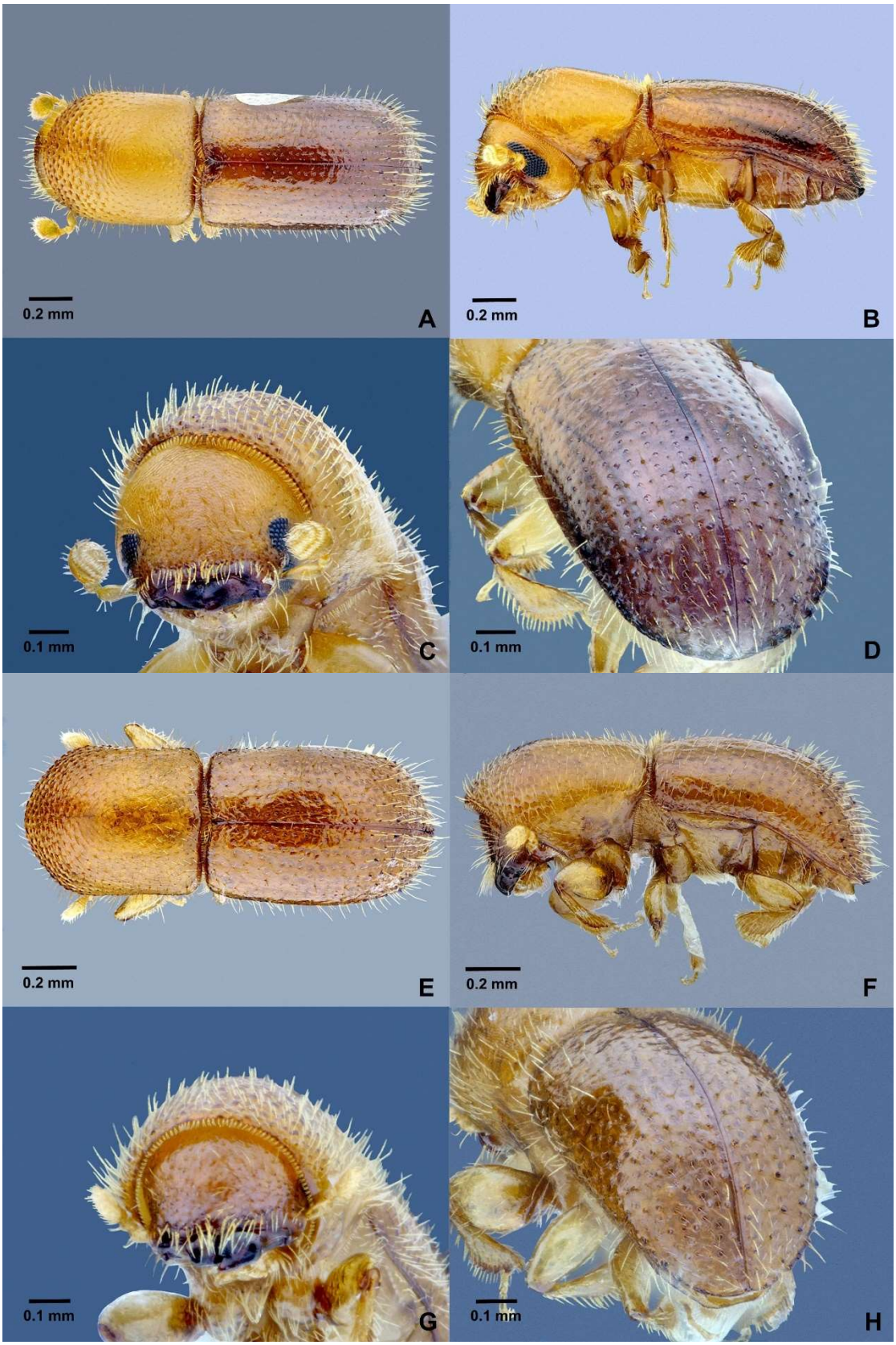

Fig. 1. ***Microperus alpha*** (Beeson), female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G.** front view, **H.** elytral declivity.

base. Elytral base weakly bisinuate, edge oblique, humeral angles rounded, parallel-sided in basal 2/3, then broadly rounded to apex. Disc slightly convex, shiny, striae slightly impressed, with small shallow punctures, punctures separated by 1–2 diameters of a puncture, punctures bearing a short, erect seta; interstriae flat, punctures minute, each puncture with long, erect seta. Declivity occupying approximately 1/2 of elytra, steeply rounded, posterolateral margin sparsely denticulate to interstriae 7, moderately shiny; striae slightly impressed, strial punctures as large as those of disc, punctures setose, setae recumbent, hair-like; interstriae 1–5 with either sparse small tubercles or granules, each granule bearing a long, recumbent or semi-erect hair-like seta.

Material examined. Nantou county, Yuchi Township (23°55.1130'N, 120°53.0780'E), 656 m, 5♀, 02. xii. 2019, C. S. Lin leg. from *Fraxinus formosana* Hayata (Oleaceae), Taichung city, Heping Dist. (24°9.1890' N, 120°57.9320'E), 947 m, 12♂154♀, 15. xi. 2020, C. S. Lin leg., from *Trema orientalis* Blume (Cannabaceae), (24°8.2060' N, 120°54.3110'E), 790 m, 14♂214♀, 02. v. 2021, C. S. Lin leg., from *Sapindus saponaria* Lam. (Sapindaceae), Nantou county, Lugu Township (23°45.4230'N, 120°49.4720'E), 945 m, 2♀, 05. xii. 2021, C. S. Lin leg. from *Mallotus phillipinensis* Muell.-Arg. (Euphorbiaceae), (23°45.3700'N, 120°49.7720'E), 1008m, 1♂3♀, 31. xii. 2021, C. S. Lin leg. from *Ficus fistulosa* Reinw. & Blume (Moraceae).

Distribution. Bangladesh, China, India, Laos, West Malaysia, Sri Lanka, Taiwan (Beaver and Liu, 2010), Thailand, Vietnam, Samoan Islands (Wood and Bright, 1992; Smith *et al*., 2020).

Biology. Bred from *Cinnamomum insulari-montanum* Hayata (Lauraceae), *Ficus fistulosa* Reinw. & Blume (Moraceae), *Fraxinus formosana* Hayata (Oleaceae), *Mallotus phillipinensis* Muell.-Arg., *M. japonicus* Muell.-Arg. (Euphorbiaceae), *Sapindus saponaria* Lam. (Sapindaceae) and *Trema orientalis* Blume (Cannabaceae) with a diameter of about 8 to 130 cm in Taiwan. Also recorded from *Chrysophyllum roxburghii* G.Don (Sapotaceae), *Cordia grandis* Roxb. (Boraginaceae), *Falcataria falcata* (L.) [=*Albizia moluccana*] (Fabaceae), *Heritiera fomes* Buch.-Ham. (Malvaceae), *Quercus serrata* Murray (Fagaceae), *Shorea assamica* Dyer, *S. robusta* C.F.Gaertn., *Vatica lanceaefolia* Blume (Dipterocarpaceae) (Wood and Bright, 1992; Maiti and Saha, 2004). The gallery system is irregularly branched with one or more transverse cavity brood chambers in which the adults and young brood lives (Fig. 8A–B) (C. S. Lin *pers. obs*.).

Microperus bucolicus Sittichaya, Smith & Beaver, 2021

Microperus bucolicus Sittichaya, Smith & Beaver, Sittichaya *et al*., 2021: 197.

齒端微楯小蠹

Identification note. Female (Fig. 2A–D): This species is distinguished by the elytral disc flat with short, steep declivity, declivital posterolateral margin denticulate, declivity with sparse minor denticles, less abundant than strial punctures, and denticles uniform in size. *Microperus bucolicus* (1.6 mm) is most similar to *M. alpha* (vs. 1.7–1.8 mm) and can be easily distinguished by its smaller size, declivital posterolateral margin costate and denticulate.

Male (Fig. 2E–H): Length 1.40–1.48 mm (mean = 1.44 ± 0.06 mm; n = 2); 2.80–2.85 times as long as wide; body yellowish brown, somewhat different from that of female. **Head**. Frons weakly convex, anterior part of frons and epistomal area weakly depressed, shiny, sparsely finely punctate, punctures bearing a long, erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles with a tooth in middle of inner margin. **Pronotum** 0.92–1.04 times as long as wide. In dorsal view basic and parallel-sided, type 2 (Hulcr *et al*., 2007), lateral sides subparallel in basal 1/2, rounded anteriorly; anterior margin without serrations. Base transverse, posterior angles narrowly rounded. In lateral view elongate with disc slightly longer than anterior slope, type 7 (Hulcr *et al*., 2007), disc flat, summit low, at apical 1/3. Disc shiny with sparsely and finely punctate, punctures bearing a long, erect hair-like seta, anterior slope without asperities. **Elytra** 1.92–2.04 times longer than pronotum and 1.60–1.68 times as long as wide. Scutellum obscure and not visible from above. Sparse setae extending along elytral base. Elytral base transverse, edge oblique, humeral angles rounded, parallel-sided in basal 2/3, then rounded to apex. Disc flat, shiny, striae slightly impressed, small shallow punctures separated by 1–3 diameters of a puncture, punctures bearing a short, erect seta; interstriae flat, sparsely minutely punctures, each puncture with long, semi-erect seta. Declivity occupying approximately 1/2 of elytra, gradually rounded, declivital face convex, shiny, posterolateral margins costate to interstriae 7; striae slightly impressed, strial punctures as large as those of disc, punctures setose, setae recumbent, hair-like; interstriae uniseriate minutely granulate, each granule bearing a long, erect hair-like seta.

Material examined. Taichung City, Heping Dist. (24°14.8000'N, 120°54.6960'E), 1188 m, 2♂8♀, 16. x. 2021, C. S. Lin leg., from *Machilus zuihoensis* Hayata (Lauraceae), (24°14.7238'N, 120°56.0556'E), 1465 m, 2♀, 13. v. 2023, C. S. Lin leg., from *Tetradium glabrifolium* (Champ. ex Benth.) T. Hartley (Rutaceae), Nantou county, Lugu Township (23°45.4354'N, 120°49.1825'E), 945 m, 2♂14♀, 03. xii. 2022, C. S. Lin leg. from *Mallotus japonicus* Muell.-Arg. (Euphorbiaceae), (23°45.5572'N, 120°49.2415'E), 939 m, 2♂8♀, 01. ii. 2023, C. S. Lin leg. from *Trema orientalis* Blume (Cannabaceae).

Note. The male is most similar to *M. latesalebrinus* and *M. perparvus* based on the shape of the elytra but can be easily distinguished from *M. latesalebrinus* and *M. perparvus* by the shiny body.

Distribution. Thailand (Sittichaya *et al*., 2021). New to Taiwan.

Biology. Bred from *Machilus zuihoensis* Hayata (Lauraceae) with a diameter of about 5.5 cm, *Mallotus japonicus* Muell.-Arg. (Euphorbiaceae) with a diameter of about 4.8 cm, *Tetradium glabrifolium* (Champ. ex Benth.) T. Hartley (Rutaceae) with a diameter of about

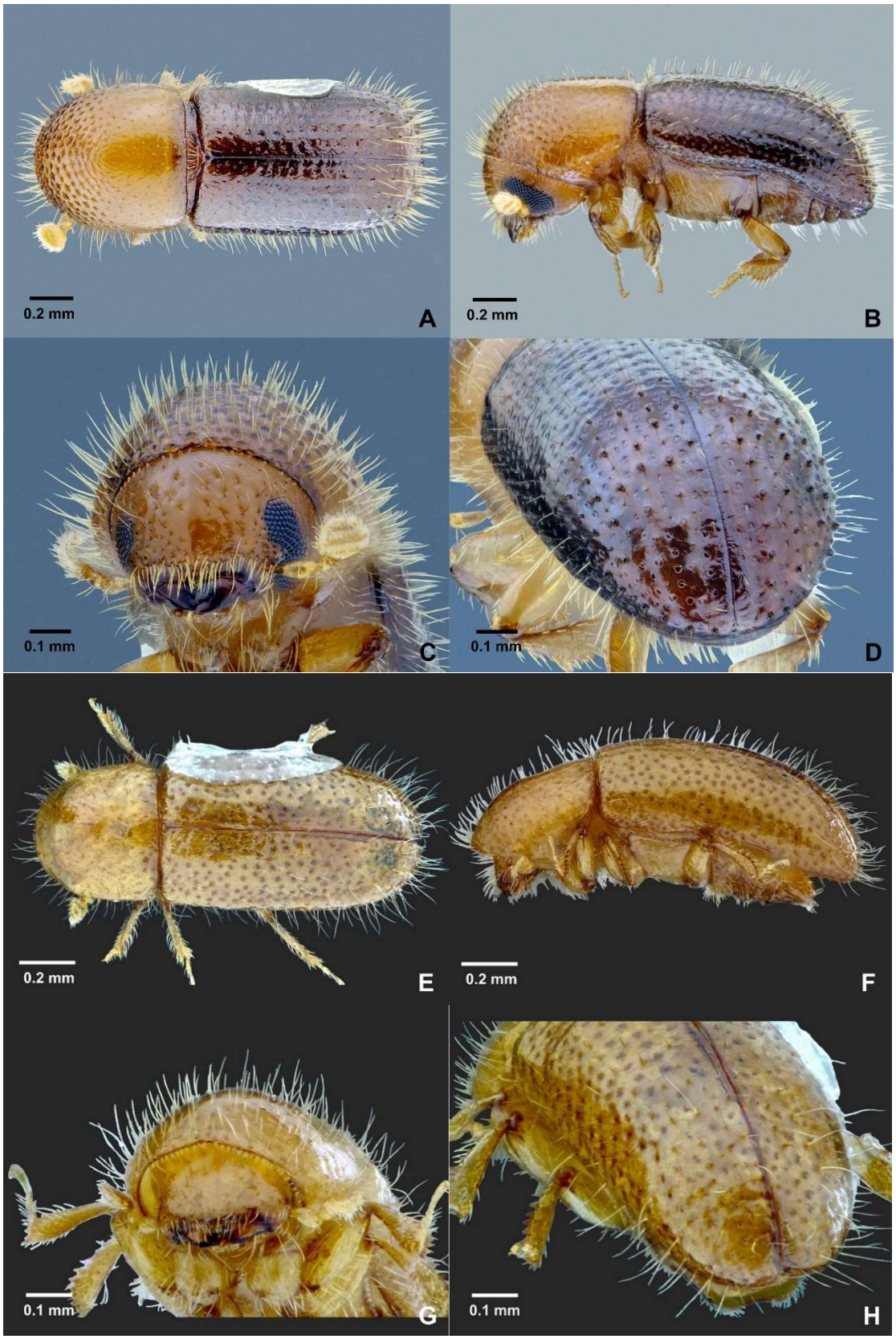

Fig. 2. ***Microperus bucolicus*** Sittichaya, Smith & Beaver, female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G.** front view, **H.** elytral declivity.

6.6 cm and *Trema orientalis* Blume (Cannabaceae) with a diameter of about 5.7 cm in Taiwan. The gallery system is irregularly branched with one or more small longitudinal cavity brood chambers (Fig. 8E–F) (C. S. Lin *pers*. *obs*.).

Microperus kadoyamaensis (Murayama, 1934)

Microperus kadoyamaensis (Murayama), Hulcr *et al*. 2007: 580.
Xyleborus kadoyamaensis Murayama, 1934: 290.
Xyleborus denseseriatus Eggers, 1941: 225; Smith *et al*. 2020: 289.
Xyleborus nameranus Murayama, 1954: 194; Smith *et al*. 2018b: 396.
Xyleborus pubipennis Schedl, 1974: 263; Smith *et al*. 2020: 289.
Xyleborus huangi Browne, 1983: 34; Beaver 2011: 285.

細瘤翅微楯小蠹

Identification note. Female (Fig. 3A–D): This species is distinguished by the elytral disc appearing humped; declivity long, gradual, face convex; all declivital interstriae uniformly granulate from base to apex; and posterolateral costa granulate. *Microperus kadoyamaensis* is most similar to *M*. *quercicola* and can be easily distinguished by the slender body and the declivital interstriae which are densely covered with short semi-erect scales.

Male (Fig. 3E–H): Length 1.48–1.50 mm (mean = 1.49 ± 0.01 mm; n = 2); 2.24–2.42 times as long as wide; body small and slender, yellowish brown. **Head**. Frons weakly convex to upper level of eyes, subshiny, sparsely finely punctate, punctures bearing a long, erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles enlarged with a tooth in middle of inner margin. **Pronotum** 0.76–1.10 times as long as wide. In dorsal view long and rounded frontally, type 7 (Hulcr *et al*., 2007), lateral sides subparallel in basal 2/3, rounded anteriorly; anterior margin without serrations. Base weakly bisinuate, posterior angles broadly rounded. In lateral view type 7 (Hulcr *et al*., 2007), disc slightly longer than anterior slope, summit at midpoint. Disc subshiny with sparsely and finely punctate, punctures bearing a long, erect hair-like seta, anterior 1/3 finely asperate, asperities sparse, anterolateral and lateral areas with comparatively long erect hair-like setae. **Elytra** 1.21–1.39 times longer than pronotum and 1.48–1.59 times as long as wide. Scutellum obscure and not visible from above. Tuft of setae extending along elytral base. Elytral base weakly bisinuate, edge oblique, humeral angles rounded, parallel-sided in basal 3/4, then broadly rounded to apex. Disc convex on basal 1/2, appearing slightly humped in lateral view, subshiny, striae not impressed, small shallow punctures separated by 1–2 diameters of a puncture, punctures each bearing a short, erect seta; interstriae flat, sparsely minutely punctures, each puncture with a long, semi-erect seta. Declivity occupying approximately 1/2 of elytra, steeply rounded, declivital face convex, posterolateral margins costate and sparsely granulate, subshiny; striae not impressed, strial punctures as large as those of disc, punctures setose, setae like those of disc; interstriae with sparse small granules, each bearing a short semi-erect scale.

Material examined. Nantou county, Yuchi Township (23° 50.6083' N, 120° 55.1983'E), 890 m, 2 ♂ 25 ♀, 29. v. 2016, C. S. Lin leg., from *Schefflera octophylla* (Lour.) Harms (Araliaceae).

Distribution. China, Japan, South Korea, Taiwan (Nobuchi, 1967; Beaver and Liu, 2010), Vietnam (Smith *et al*., 2020).

Biology. Bred from *Schefflera octophylla* (Lour.) Harms (Araliaceae) with a diameter of about 12.7 cm in Taiwan. Also recorded from *Diospyros kaki* Thunb. (Ebenaceae), *Machilus thunbergii* Siebold & Zucc. (Lauraceae), *Pasania cuspidata* (Thunb.) Schottky, *Quercus acuta* Thunb., *Q*. *myrsinifolia* Blume (Fagaceae) (Murayama, 1934; Wood and Bright, 1992). The gallery system is irregularly branched with one or more longitudinal cavity brood chambers (Fig. 8G–H) (C. S. Lin *pers*. *obs*.).

Microperus kirishimanus (Murayama, 1955)

Microperus kirishimanus (Murayama), Beaver and Liu 2010: 28.
Coptodryas kirishimanus (Murayama), Wood and Bright 1992: 825.
Xyleborus kirishimanus Murayama, 1955: 85.

霧島微楯小蠹

Identification note. Female (Fig. 4A–D): This species is distinguished by the elytral disc flat with short and steep obliquely truncate declivity; declivital interstriae straight from base to apex, never laterally broadened; denticles on declivital summit and margins larger, more sharply acute and denser than those on declivital face. *Microperus kirishimanus* is most similar to *M*. *perparvus* and can be easily distinguished by denticles on declivital summit and margins larger, more sharply acute and denser than those on declivital face.

Male: Not available for study.

Material examined. Nantou county, Yuchi Township, Sun Moon Lake (23° 50.6083' N, 120° 55.1983'E), 890 m, 2♀, 22. vi. 2016, C. S. Lin leg., from Lindgren multi-funnel traps.

Distribution. Japan, Taiwan (Beaver and Liu, 2010; Lin and Wu, 2010; Smith *et al*., 2020).

Biology. This species was collected from *Machilus zuihoensis* Hayata (Lauraceae), *Ficus fistulosa* Reinw. & Blume (Moraceae) and *Trema orientalis* Blume (Cannabaceae) in Taiwan. Also recorded from *Ilex macropoda* Miq. (Aquifoliaceae), *Quercus acuta* Thunb., *Q*. *glauca* Thunb. (Fagaceae) (Murayama, 1955; Nobuchi, 1981).

Microperus latesalebrinus Smith, Beaver & Cognato, 2020

Microperus latesalebrinus Smith, Beaver & Cognato, 2020, Smith *et al*., 2020: 292.

側溝紋微楯小蠹

Identification note. Female (Fig. 5A–D): This species is distinguished by the elytral disc flat with short and steep obliquely truncate declivity; declivital interstriae 2 and 3 strongly laterally broadened from base to declivital midpoint then narrowing towards apex.

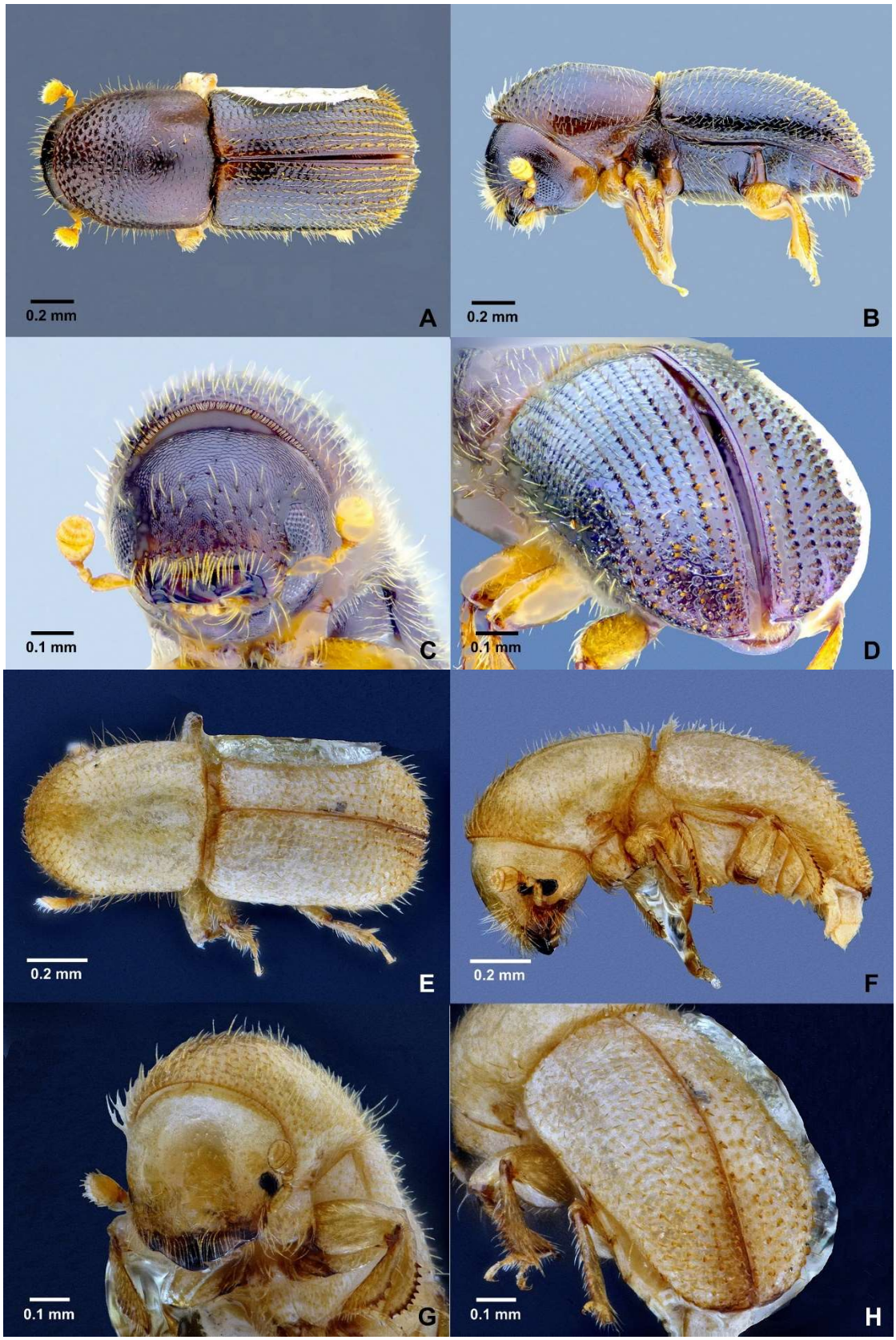

Fig. 3. ***Microperus kadoyamaensis*** (Murayama), female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G.** front view, **H.** elytral declivity.

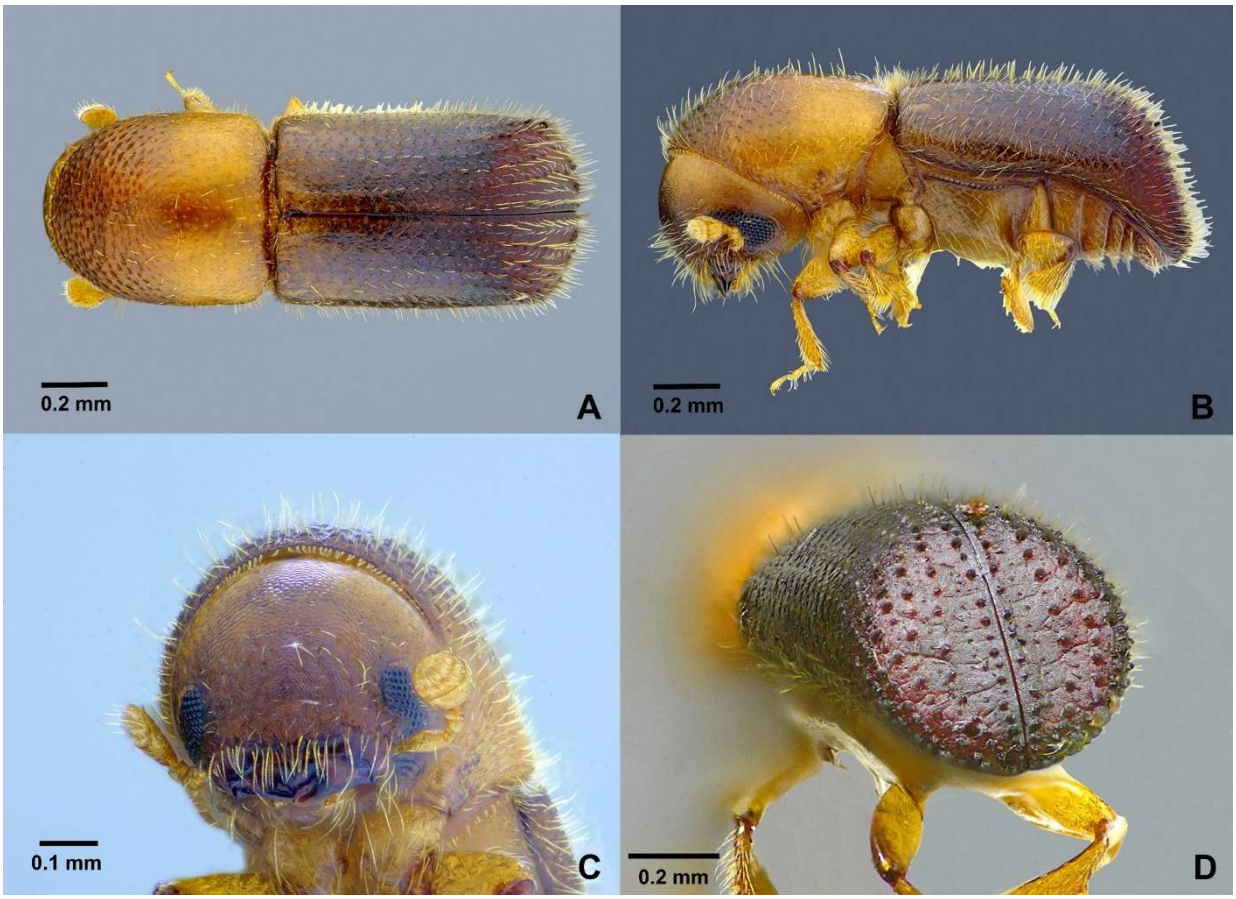

Fig. 4. *M*icroperus *kirishimanus* (Murayama), female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity.

Microperus latesalebrinus is most similar to *M. kirishimanus* and *M. perparvus* in Taiwan. It can be easily distinguished by declivital interstriae 2 and 3 strongly laterally broadened from base to declivital midpoint then narrowing towards apex.

Male (Fig. 5E–H): Length 1.42–1.56 mm (mean = 1.50 ± 0.05 mm; n = 5); 2.84–3.00 times as long as wide; body small and slender, yellowish brown. **Head**. Frons weakly convex, anterior part of frons and epistomal area weakly depressed, shagreened, surface finely reticulate, sparsely finely punctate, punctures bearing a long, erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles with a tooth in middle of inner margin. **Pronotum** 0.96–1.13 times as long as wide. In dorsal view basic and parallel-sided, type 2 (Hulcr *et al.*, 2007), lateral sides subparallel in basal 1/2, rounded anteriorly; anterior margin without serrations. Base transverse, posterior angles broadly rounded. In lateral view elongate with disc much longer than anterior slope, type 8 (Hulcr *et al.*, 2007), disc flat, summit at apical 1/3. Disc subshiny, sparsely and finely punctate, punctures bearing a long, erect hair-like seta, anterior slope without asperities. **Elytra** 1.96–2.21 times longer than pronotum and 1.66–1.85 times as long as wide. Scutellum obscure and not visible from above. Tuft of setae extending along elytral base. Elytral base transverse, edge oblique, humeral angles rounded, parallel-sided in basal 2/3, then narrowly rounded to apex. Disc flat, subshiny, striae not impressed, small shallow punctures separated by 2–4 diameters of a puncture, punctures bearing a long, erect seta; interstriae flat, sparsely minutely punctate, each puncture with a long, semi-erect seta. Declivity occupying approximately 1/2 of elytra, gradually rounded, declivital face convex, subshiny, posterolateral rounded, unarmed by granules; striae not impressed, strial punctures as large as those of disc, punctures setose, setae recumbent, hair-like; interstriae uniseriate minutely granulate, each granule bearing a long, recumbent hair-like seta.

Material examined. Taichung City, Heping Dist. (24°14.7033' N, 120°55.5552'E), 1375 m, 1♂9♀, 05. vii. 2023, C. S. Lin leg., from *Trema orientalis* Blume (Cannabaceae), 29. ix. 2023, C. S. Lin leg., from *Elaeocarpus sylvestris* (Lour.) Poir. (Elaeocarpaceae), Nantou county, Lugu Township (23°45.5385'N, 120°48.9939'E), 725 m, 2♀.

Note. The male is most similar to *M. perparvus* based on the shape of the elytra but can be easily distinguished from *M. perparvus* by the shape of anterior part of frons and epistomal area (weakly depressed in *M. latesalebrinus*, weakly convex in *M. perparvus*).

Distribution. China (Hong Kong) (Smith *et al.*, 2020). New to Taiwan.

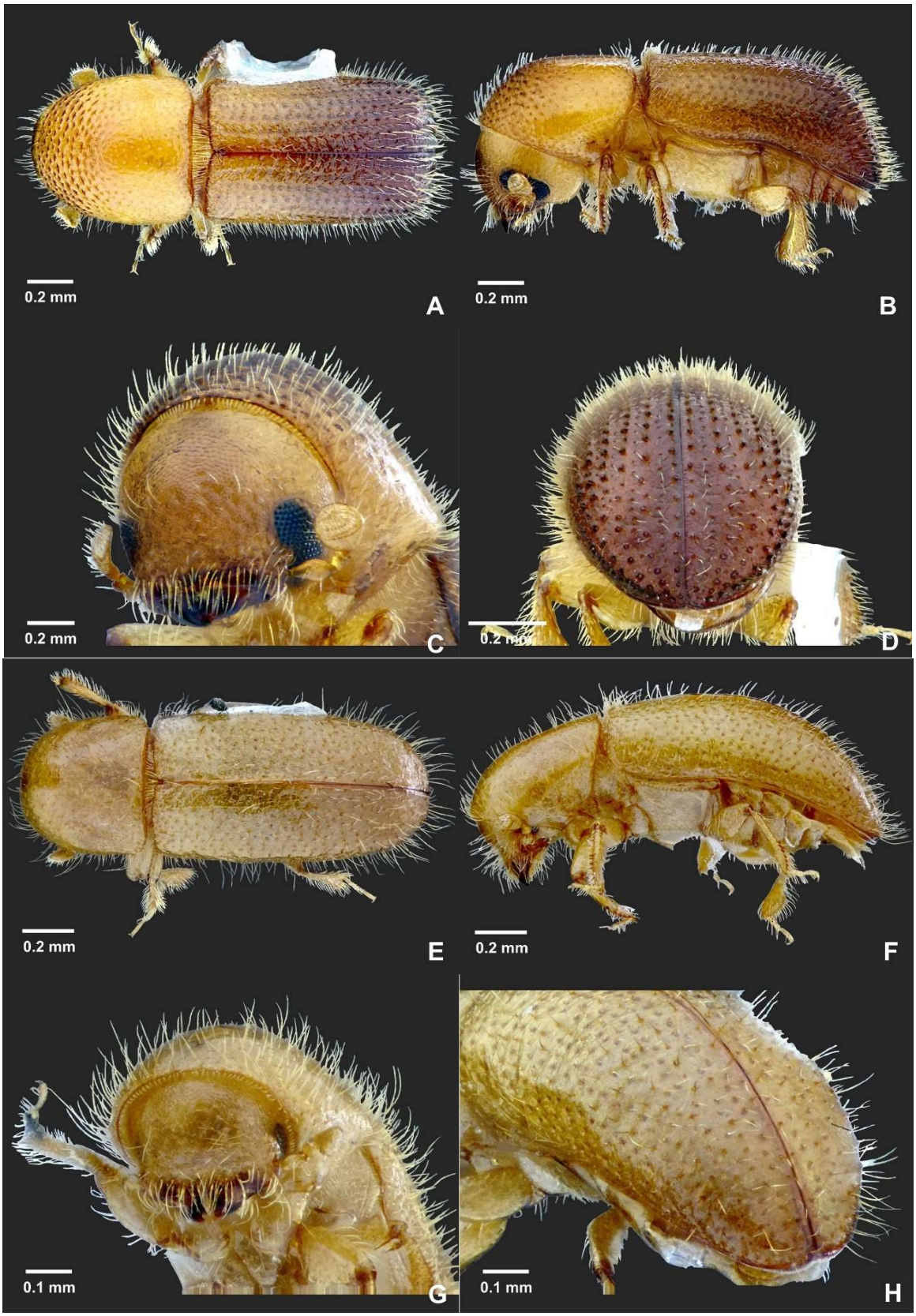

Fig. 5. ***Microperus latesalebrinus*** Smith, Beaver & Cognato, female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G**. front view, **H.** elytral declivity.

Biology. Bred from *Trema orientalis* Blume (Cannabaceae) with a diameter of about 7.3 cm in Taiwan. Also recorded from *Castanopsis* sp. (Fagaceae) (Smith *et al*., 2020). The gallery system is irregularly branched with one or more longitudinal cavity brood chambers in which the adults and young brood lives (Fig. 8I–J) (C. S. Lin *pers*. *obs*.).

Microperus perparvus (Sampson, 1922)

Microperus perparvus (Sampson), Maiti and Saha 1986: 97.
Coptodryas perparva (Sampson); Wood and Bright 1992: 826.
Xyleborus perparvus Sampson, 1922: 151.
Xyleborus tsukubanus Murayama, 1954: 184, Beaver *et al*. 2008: 233.

霧面微楯小蠹

Identification note. Female (Fig. 6A–D): This species is distinguished by the elytral disc flat with short and steep obliquely truncate declivity; declivital face shagreened, dull; declivital interstriae straight from base to apex, never laterally broadened; denticles on declivital summit denser and of equal size to those on declivital face. *Microperus perparvus* is most similar to *M*. *kirishimanus* and can be easily distinguished by denticles on declivital summit denser and of equal size to those on declivital face.

Male (Fig. 6E–H): Length 1.34–1.56 mm (mean = 1.49 ± 0.10 mm; n = 7); 3.00–3.24 times as long as wide; body yellowish brown. **Head**. Frons weakly convex to upper level of eyes, shagreened, surface finely reticulate, sparsely finely punctate, punctures bearing a long, erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles with a tooth in middle of inner margin. **Pronotum** 0.95–1.09 times as long as wide. In dorsal view long and rounded frontally, type 7 (Hulcr *et al*., 2007), lateral sides subparallel in basal 2/3, rounded anteriorly; anterior margin without serrations. Base transverse, posterior angles broadly rounded. In lateral view elongate with disc as long as declivity, type 7 (Hulcr *et al*., 2007), summit at apical 1/3. Disc subshiny, sparsely and finely punctate, punctures bearing a long, erect hair-like seta, anterior slope without asperities. **Elytra** 1.92–2.21 times longer than pronotum and 1.79–1.85 times as long as wide. Scutellum obscure and not visible from above. Sparse setae extending along elytral base. Elytral base transverse, edge oblique, humeral angles rounded, parallel-sided in basal 2/3, then narrowly rounded to apex. Disc flat, subshiny, striae not impressed, large shallow punctures separated by 1–4 diameters of a puncture, each with a short, erect seta; interstriae flat, sparsely minutely punctures, each puncture with long, semi-erect seta. Declivity occupying approximately 1/2 of elytra, gradually rounded, declivital face convex, subshiny, posterolateral rounded, unarmed by granules; striae not impressed, strial punctures as large as those of disc, punctures setose, setae recumbent, hair-like; interstriae uniseriate minutely granulate, each granule bearing a long, recumbent hair-like seta.

Material examined. Taichung City, Heping Dist. (24°14.8000'N, 120°54.6960'E), 1188 m, 17 ♂ 358 ♀, 16. x. 2021, C. S. Lin leg., from *Castanopsis fargesii* Fr. (Fagaceae).

Note. The male is most similar to *M*. *latesalebrinus* based on the shape of the elytra but can be easily distinguished from *M*. *latesalebrinus* by the shape of anterior part of frons and epistomal area (weakly convex in *M*. *perparvus*, weakly depressed in *M*. *latesalebrinus*).

Distribution. Bangladesh, China, India, Indonesia, Japan, East and West Malaysia, Myanmar, New Guinea, Solomon Islands, Taiwan (Beaver and Liu, 2010), Thailand, Vietnam (Smith *et al*., 2020).

Biology. This species is polyphagous and has been recorded from *Canarium euphylium* Kurz (Burseraceae), *Chrysophyllum roxburghii* G.Don (Sapotaceae), *Elaeocarpus petiolatus* (Jacq.) (Elaeocarpaceae), *Elateriospermum tapos* Blume, *Macaranga* sp. (Euphorbiaceae), *Castanopsis inermis* (Lindl.) Benth. & Hook. f. (syn. *C*. *sumatrana*), *Quercus acuta* Thunb. (Fagaceae), *Dipterocarpus baudii* Korth., *Dryobalanops aromatica* Gaertn.f., nom cons., *Shorea leprosula* Miq., *S*. *macroptera* Dyer, *S*. *parvifolia* Dyer, *S*. *robusta* C.F.Gaertn., *S*. *siamensis* Miq., *S*. *sumatrana* (Slooten ex Thorenaar) Desch (Dipterocarpaceae), *Palaquium stellatum* King & Gamble (Sapotaceae) (Browne, 1961; Maiti and Saha, 2004). The gallery system is irregularly branched with one or more small longitudinal cavity brood chambers in which the adults and young brood lives (Fig. 8K–L) (Beaver and Browne, 1978, C. S. Lin *pers*. *obs*.).

Microperus quercicola (Eggers, 1926)

Microperus quercicola (Eggers): Smith *et al*. 2018: 396.
Xyleborus quercicola Eggers, 1926: 146.
Xyleborus izuensis Murayama, 1952: 16, Smith *et al*. 2018: 396.

毛翅端微楯小蠹

Identification note. Female (Fig. 7A–D): This species is distinguished by the elytral disc flat; declivity short, steep; declivital surface shiny; declivity granulate from base to apex, granules small, as abundant as strial punctures; interstriae densely setose, setae fine, hair-like; and strial punctures setose, setae recumbent, hair-like. *Microperus quercicola* is most similar to *M*. *kadoyamaensis* but can be easily distinguished by its stouter body, and the declivital interstriae are covered with fine, hair-like setae.

Male (Fig. 7E–H): Length 1.74–2.10 mm (mean = 1.88 ± 0.15 mm; n = 5); 2.29–2.43 times as long as wide; body yellowish brown. **Head**. Frons convex, anterior part of frons and epistomal area acutely depressed, shagreened, surface finely reticulate with a few sparse shallow punctures, punctures bearing a erect hair-like seta, epistomal margin with fringe of distinctly long hairs, eyes small and narrow, mandibles enlarged with a tooth in middle of inner margin. **Pronotum** 0.89–1.05 times as long as wide. In dorsal view long and subquadrate, type 8 (Hulcr *et al.*, 2007), lateral sides subparallel in basal 2/3,

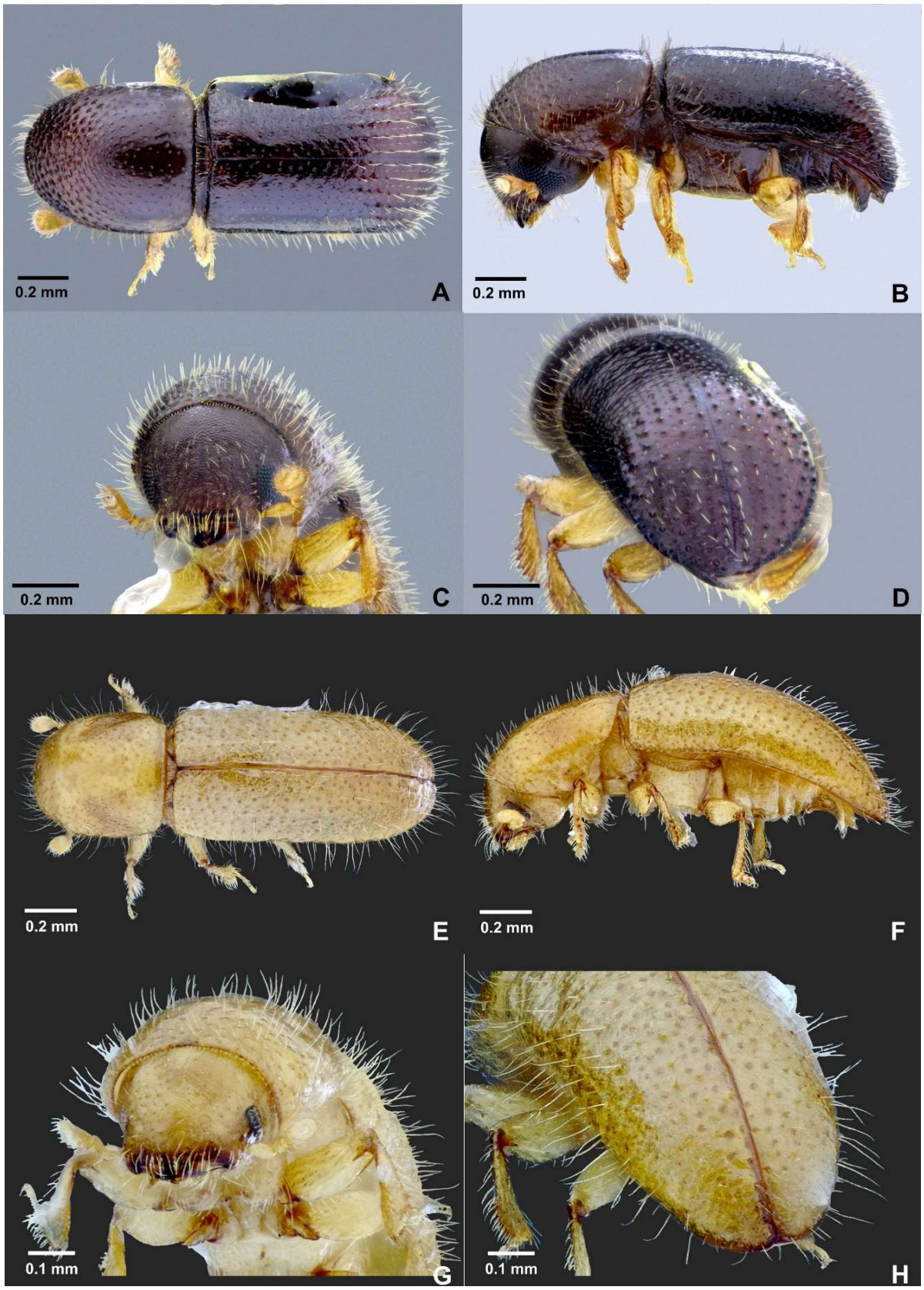

Fig. 6. ***Microperus perparvus*** (Sampson), female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G.** front view, **H.** elytral declivity.

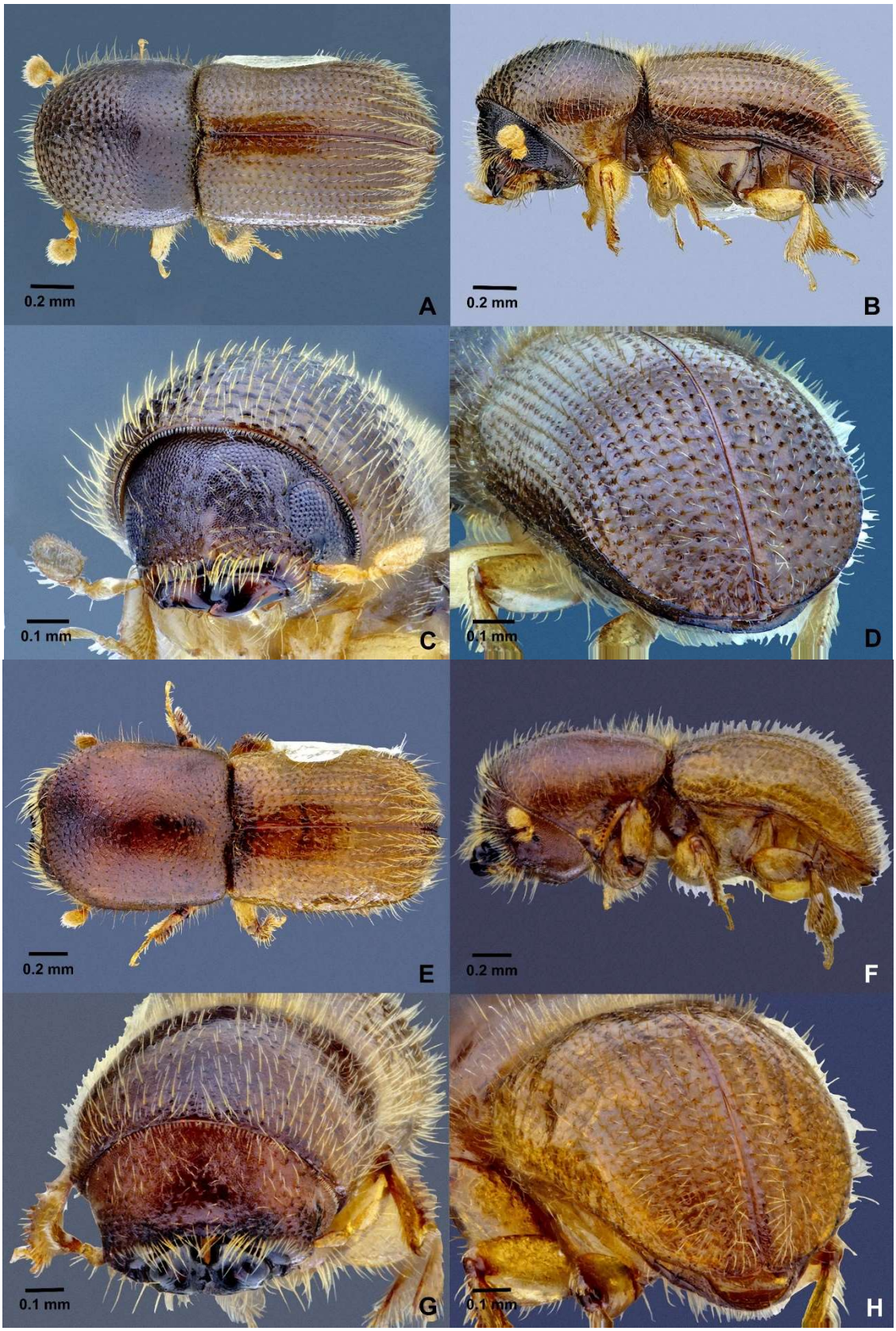

Fig. 7. ***Microperus quercicola*** (Eggers), female: **A.** dorsal view, **B.** lateral view, **C.** front view, **D.** elytral declivity, male: **E.** dorsal view, **F.** lateral view, **G.** front view, **H.** elytral declivity.


A
B
Tricosa metacuneolus
Microperus bucolicus
C
Tricosa metacuneolus
Microperus bucolicus
D
Microperus bucolicus
Tricosa metacuneolus
E
F
G
H

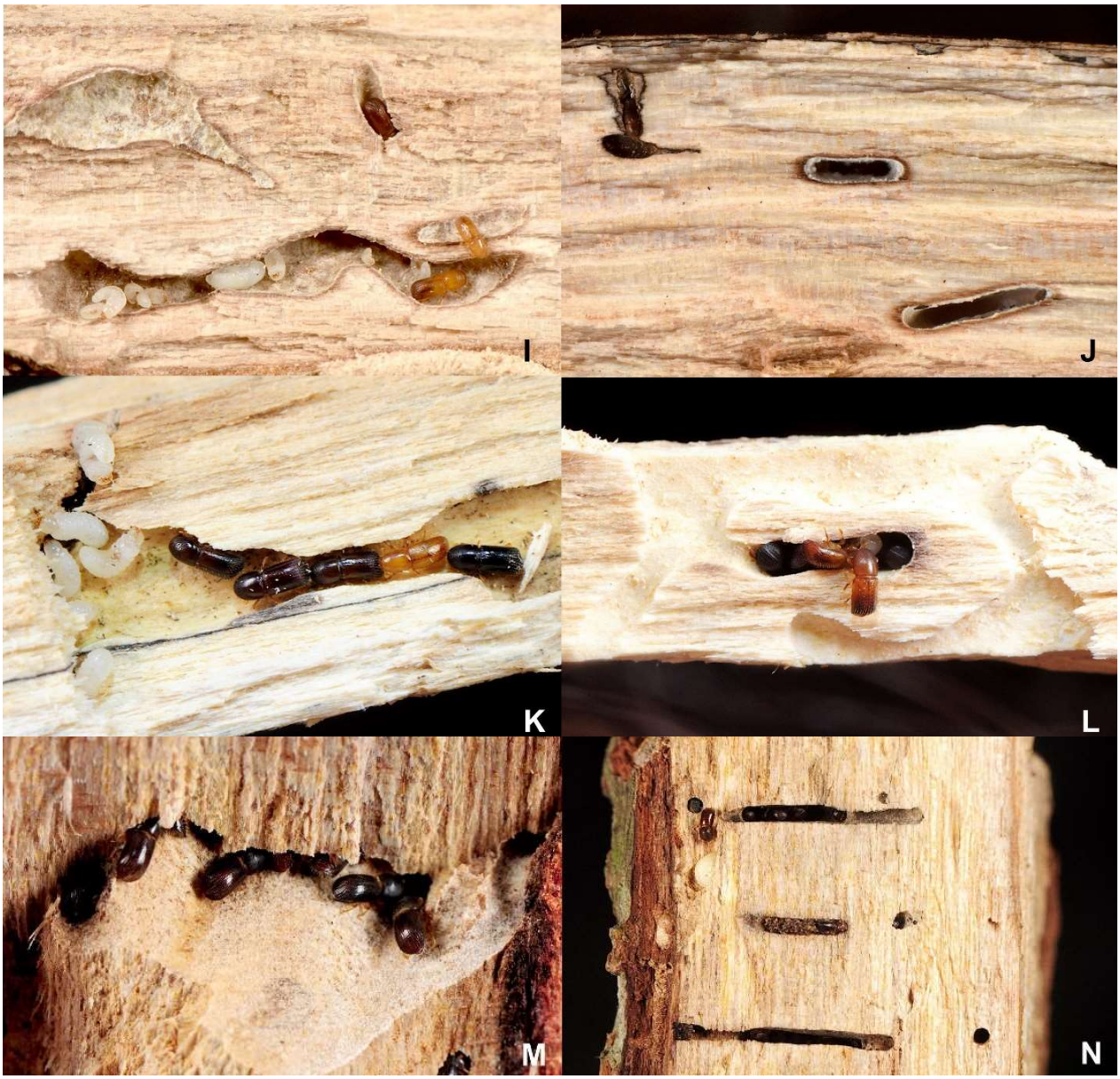

Fig. 8. Biology of ***Microperus alpha*** (Beeson), ***M. bucolicus*** Sittichaya, Smith & Beaver, ***M. kadoyamaensis*** (Murayama), ***M. latesalebrinus*** Smith, Beaver & Cognato, ***M. perparvus*** (Sampson), and ***M. quercicola*** (Eggers): **A.** transverse cavity brood chamber of *M. alpha*, **B.** adults and young brood of *M. alpha*, **C.** Female *M. bucolicus* (right) bored entrance next to *Tricosa metacuneolus* (left), **D.** entrance gallery of *M. bucolicus* (down) next to *T. metacuneolus* (up), **E.** longitudinal cavity brood chamber very close to or fused with the chambers of *T. metacuneolus*, **F.** longitudinal cavity brood chamber of *M. bucolicus*, **G.** adult offspring of *M. kadoyamaensis*, **H.** longitudinal cavity brood chamber of *M. kadoyamaensis*, **I.** larvae and adult offspring of *M. latesalebrinus*, **J.** longitudinal cavity brood chamber of *M. latesalebrinus*, **K.** larvae and adult offspring of *M. perparvus*, **L.** longitudinal cavity brood chamber of *M. perparvus*, **M.** adult offspring of *M. quercicola*, **N.** transverse cavity brood chamber of *M. quercicola*.

rounded anteriorly; anterior margin without serrations. Base weakly bisinuate, posterior angles broadly rounded. In lateral view elongate with disc as long as declivity, type 7 (Hulcr *et al.*, 2007), summit at midpoint. Disc shagreened, alutaceous, finely punctate, finely setose, setae short, erect, hair-like, some longer hair-like setae at margins, anterior slope with sparse feeble asperities, asperities arranged in concentric rings from midpoint of pronotum to anterior margin. **Elytra** 1.16–1.29 times longer than pronotum and 1.26–1.36 times as long as wide. Scutellum obscure and not visible from above. Tuft of setae extending along elytral base. Elytral base weakly bisinuate, edge oblique, humeral angles rounded, parallel-sided in basal 3/4, then broadly rounded to apex. Disc slightly ascending posteriorly, subshiny, striae slightly impressed, small shallow punctures separated by 1–3 diameters of a puncture, each with a short, erect seta; interstriae flat, punctures minute, each puncture with long,

semi-erect seta. Declivity occupying approximately 1/2 of elytra, steeply rounded, posterolateral margin costate, subshiny; striae slightly impressed, strial punctures as large as those of disc, punctures setose, setae recumbent, hair-like; interstriae uniseriate minutely granulate, each granule bearing a long, recumbent or semi-erect hair-like seta.

Material examined. Taichung city, Wufeng Dist. (24°2.8070'N, 120°47.3240'E), *395* m, 1 ♂ 12 ♀, 07. vi. 2019, Taichung city, Heping Dist. (24°14.8000'N, 120°54.6960'E), 1188 m, 12 ♂ 225 ♀, 16. x. 2021, (24°11.5200'N, 120°55.1910'E), 718 m, 12 ♀, 12. xii. 2021, (24°8.9560'N, 120°54.3550'E), 1014 m, 3 ♂ 27 ♀, 01. i. 2022, (24°8.8750'N, 120°54.2230'E), 1018 m, 12 ♂ 225 ♀, 06. ii. 2022, (24°8.9530'N, 120°54.3550'E), 999 m, 8 ♂ 38 ♀, 22. v. 2022, (24°8.3168'N, 120°54.738'E), 854 m, 2 ♂ 37 ♀, 14. i. 2023, C. S. Lin leg., from *Machilus zuihoensis* Hayata (Lauraceae).

Distribution. China, Japan, South Korea, Taiwan (Smith *et al*., 2020).

Biology. This species is polyphagous and has been recorded from *Cinnamomum camphora* (L.) J.Presl (Lauraceae), *Quercus* sp. (Fagaceae) (Murayama, 1952; Wood and Bright, 1992). The species show some preference for *Machilus zuihoensis* Hayata (Lauraceae) in Taiwan. The gallery system is irregularly branched with one or more transverse cavity brood chambers in which the adults and young brood lives (Fig. 8M–N) (C. S. Lin *pers*. *obs*.).

Remarks: The record from Russia published by Mandelshtam *et al*. (2018) is a misidentification of the morphologically similar species, *M*. *molestus* Park & Smith, 2020 which was recently described from Korea. Body size of the female (1.56–1.79 mm) is comparatively smaller than in *M*. *quercicola* (vs. 1.85–2.07 mm) and the morphology of the male is completely different from our specimen (Park *et al*., 2020).

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