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A newly recorded species of the genus *Lopaphus* Westwood, 1859 (Phasmida: Lonchodidae: Necrosciinae) from China

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ABSTRACT. One species of *Lopaphus* (Phasmida: Lonchodidae: Necrosciinae), namely *L. sphalerus* (Redtenbacher, 1908), is reported from China for the first time. The identification of this species is primarily based on female morphological characters: cerci triangular, distally tapering to an acute apex, projecting beyond posterior margin of anal segment; subgenital plate with distinct median carina, boat-shaped and strongly keeled, gradually tapering posteriorly, posterior margin narrowly rounded and acuminate, extending conspicuously beyond the posterior margin of anal segment. Mating pairs of males and females were captured in the wild. Information regarding the descriptions and morphological illustrations of both sexes and eggs and photographs of their natural habitat are provided. All the examined specimens are deposited in GXNU.

Keywords: Guangxi, Necrosciini, new record, Oriental, Phasmatodea

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INTRODUCTION

The genus *Lopaphus* (Phasmatodea: Lonchodidae: Necrosciini) comprises 36 described species, with a geographic range spanning Southeast Asia and the Indo-Malayan region (Brock et al., 2025). In China, nine species of *Lopaphus* have been recorded in Guangxi (Chen & He, 1999; Ho, 2013a), Hainan (Chen et al., 2002; Ho, 2013b), Xizang (Bi, 1995; Chen & He, 1995a, 2008), and Yunnan (Chen & He, 1995b). The species *Cercophylla sphalera* was first erected by Redtenbacher (1908) based on a female specimen from Than-Moi, Vietnam. Hennemann et al. (1998) transferred it to *Lopaphus*. Later, Otte and Brock (2005) treated *Candaules caesius* Redtenbacher, 1908 as a synonym of *Cercophylla sphalera* Redtenbacher, 1908. To date, *Lopaphus sphalerus* has only been distributed in Vietnam. Guangxi's unique geographical environment and climatic conditions have jointly shaped its rich insect diversity. The diverse terrain, warm and humid climate, and abundant vegetation types provide suitable living environments for insects, including stick insects. From 2021 to 2024, we conducted a detailed field investigation of stick insects in Guangxi, China. Here, we report the species *Lopaphus sphalerus* from China for the first time.

MATERIAL AND METHODS

The specimens were collected at night during several expeditions between 2021 and 2024. The adult males were preserved in ethanol and the females collected were kept in tubes for several days to lay

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eggs. All the specimens were examined by Nikon® SMZ745 stereomicroscope and photographed with a Nikon® D7200 equipped with a 105mm f/2.8G IF-ED macro lens. The photographs were processed in Adobe® Photoshop CS 2018. Measurements were taken with a digital caliper at a precision of 0.1 mm. The terminology used for the descriptions of egg structures follows that of Clark-Sellick (1997, 1998). All specimens were preserved in Guangxi Normal University.

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1875

Order Phasmida Leach, 1815

Family Lonchodidae Brunner von Wattenwyl, 1893

Subfamily Necrosciinae Brunner von Wattenwyl, 1893

Tribe Necrosciini Brunner von Wattenwyl, 1893

Genus *Lopaphus* Westwood, 1859

Lopaphus sphalerus (Redtenbacher, 1908) (Figs 1–5)

Cercophylla sphalera Redtenbacher, 1908:531; Brock, 1998:59; *Candaules caesius* Redtenbacher, 1908:539; Hennemann et al., 1998:198; Clark-Sellick, 1998:211; Brock, 1998: 20; Baxter, 2002:11. (Synonymised by Otte and Brock, 2005:187); *Lopaphus sphalerus*: Hennemann et al., 1998:197; Hennemann, 1999: 19; Seiler et al., 2000:93; Whiting et al., 2003:265; Otte & Brock, 2005:186; Harman, 2012:17; Yamada et al., 2021:269; Brock & Büscher, 2022:535.

Distribution. Vietnam: Than-Moi, China (**New record**).

Diagnosis. Medium-sized insects, with some species exhibiting fully developed wings. Sexual dimorphism pronounced: female robust, integument rugose with sparse granules laterally flanking the median carina; male more gracile, integument comparatively smoother. Head oval in dorsal view; antennae filiform, distinctly segmented, typically exceeding foreleg length. Female cerci triangular, distally tapering to an acute apex, projecting beyond posterior margin of anal segment. Female subgenital plate with distinct median carina, boat-shaped and strongly keeled, gradually tapering posteriorly; posterior margin narrowly rounded and acuminate, extending conspicuously beyond the posterior margin of anal segment. Legs elongate, lacking spines or denticulations; femora and tibiae unarmed, surfaces smooth and glabrous.

Material examined. 1 ♂, 1 ♀, China, Guangxi, Diding, 810 m, 11.IX.2022, leg. Xiangyi Lu & Qianwen Zhang; 2 ♂♂, 2 ♀♀, China, Guangxi, Diding, 1024 m, 30.VII.2024, leg. Yanting Qin, Zhilu Yu & Bingming Zhu; 2 ♂♂, China, Guangxi, Cenwanglaoshan, 1680 m, 3.VIII.2024, leg. Yanting Qin, Zhilu Yu & Bingming Zhu; 2 ♂♂, China, Guangxi, Leye, 428 m, 9.VIII.2024, leg. Yanting Qin & Zhilu Yu.

Description. **Female.** Large-sized. Body slender, brown (Fig. 5). Entirely brown, with lighter spots over body (Fig. 2). *Head:* Small, oval. Longer than wide. Compound eyes large and prominent. Occiput slightly convex. Head capsule with a prominent median carina extending uninterrupted from the frons to the posterior margin of the mesonotum. Antennal socket obvious; antenna filiform, about 70 segments, longer than profemora; scape cylindrical and depressed, pedicel cylindrical, flagellomeres indistinct, covered with setae (Figs 2A–B, 2E). *Thorax:* Pronotum subrectangular, longer than wide, covered with conspicuous granules, anterior third slightly constricted, the lateral margins gently concave; middle area with distinct transverse sulci extending to the pronotum's lateral margins. Mesonotum roughly trapezoidal, longer than the length of metanotum and median segment combined, with small, regularly aligned spines on both sides of the median carina. Metanotum characterized by a distinctly expanded posterior portion (Fig. 2D). *Abdomen:* Cylindrical, covered with inconspicuous granules and wrinkles. Median segment rectangular. Lateral margins of tergum II to tergum VI almost parallel, tergum II to V increasing in length; tergum VII–IX decreasing in length, tergum VIII and tergum IX equal in width. Anterior margin of anal segment expanded, posterior margin trapezoidally excavate covered with wrinkles.

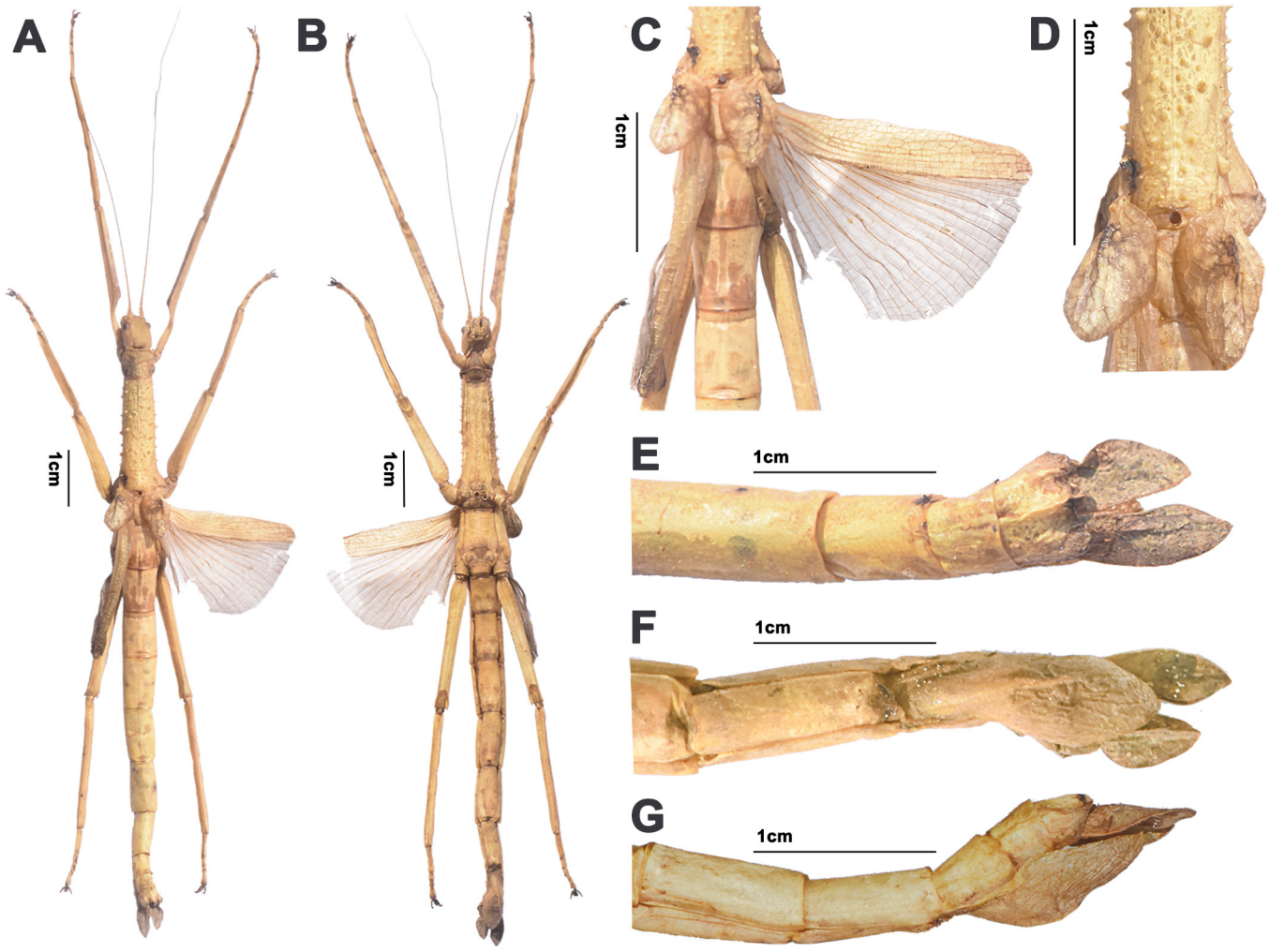

Figure 1. *Lopaphus sphalerus* (Redtenbacher, 1908), female. **A.** Habitus, dorsal view; **B.** Habitus, ventral view; **C.** Wing, dorsal view; **D.** Forewing, dorsal view; **E.** Apex of abdomen, cerci, dorsal view; **F.** Apex of abdomen, cerci, ventral view; **G.** Apex of abdomen, cerci, lateral view.

Subgenital plate with distinct median carina, boat-shaped and strongly keeled, gradually narrowing to backward, surpassing the posterior margin of anal segment, posterior margin narrow and slightly projecting. Cerci small, triangular, strongly elongated, and dorsoventrally flattened that extends beyond the posterior margin of anal segment (Fig. 1E–G). *Legs:* Thick. Hindlegs slightly longer than forelegs; midlegs shortest. Profemora distinctly curved basally, with distinct carina; internal margins triangular. All femora and the corresponding tibiae about equal in length. *Wings:* Tegmina coriaceous, pale yellow with irregular light brown maculae, extending to the midlength of metanotum, apex rounded, venation discernible. Hindwings 5× as long as tegmina, membranous, translucent light gray, at rest folded and extending to posterior margin of tergum III (Figs 1A–D, 2F–G).

Male. Body medium, much smaller and slender than female (Table 1, Fig. 3). Entirely brown, with lighter spots over body (Fig. 3A–C). The last three abdominal tergites black. *Head:* Oval, longer than wide; occiput distinctly depressed. Compound eyes strongly protuberant. Antennal socket obvious. Antenna filiform, composed of approximately 70 segments. Scape cylindrical, slightly depressed; pedicel cylindrical; flagellomeres each bearing dense setae (Fig. 3G). *Thorax:* Pronotum trapezoidal, beige, bearing distinct longitudinal and transverse sulci; median transverse sulcus extending to lateral margins. Mesonotum sub-trapezoidal, dark green, with a longitudinal carina along midline; white punctations bilaterally arranged along midline. Metanotum posteriorly expanded. *Abdomen:* Slender, covered with inconspicuous granules and wrinkles. Median segment rectangular. Lateral margins of tergum II to tergum VI subparallel; tergum II to V progressively increasing in length and slenderness; tergum VIII to X progressively enlarging.

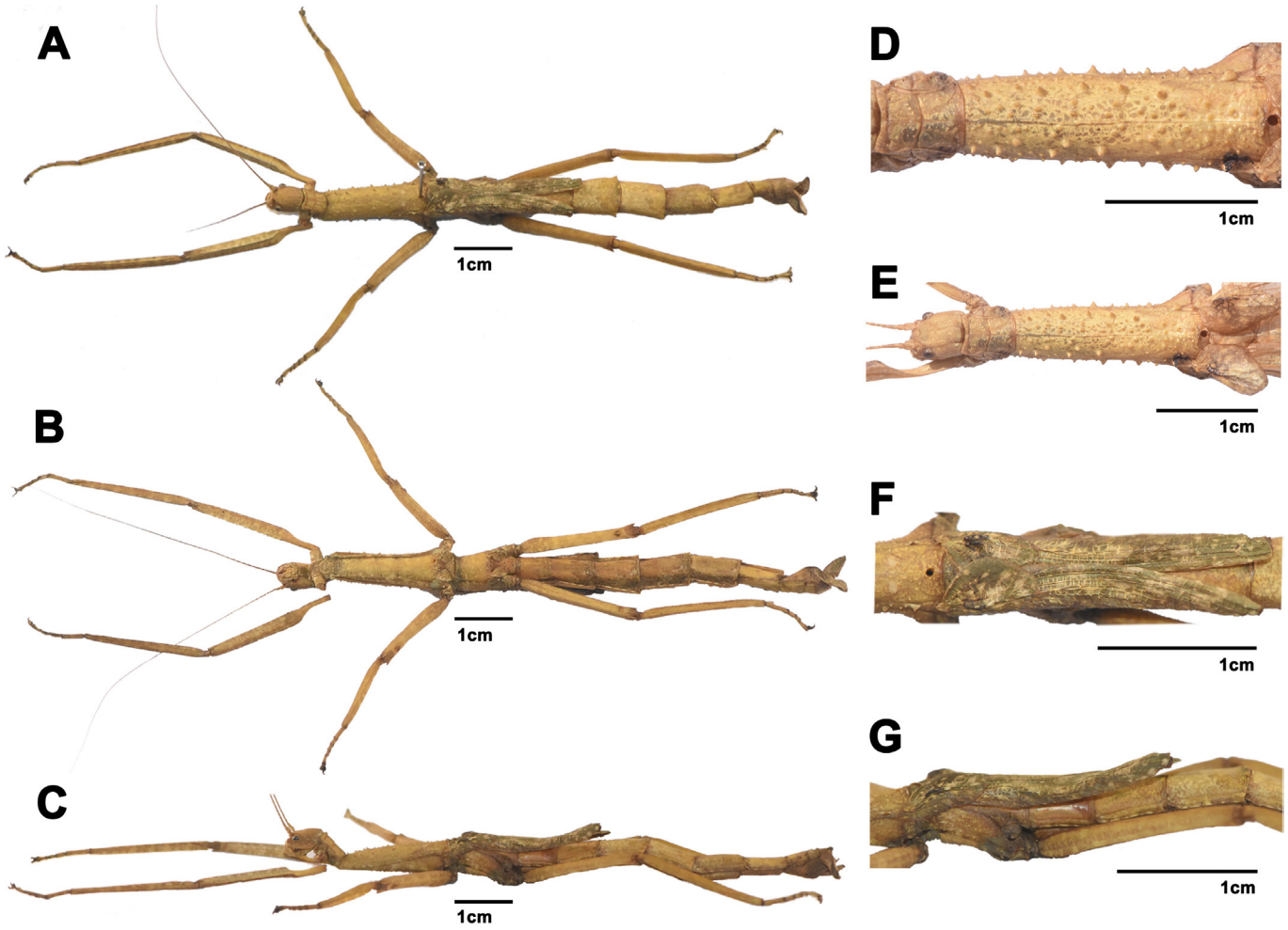

Figure 2. *Lopaphus sphalerus* (Redtenbacher, 1908), female. **A.** Habitus, dorsal view; **B.** Habitus, ventral view; **C.** Habitus, lateral view; **D.** Pro- and mesothorax, dorsal view; **E.** Head, mesothorax and forewing, dorsal view; **F.** Wings, dorsal view; **G.** Wings, lateral view.

Anal segment cleft, densely covered with long setae and minute spinules. Subgenital plate spoon-shaped, extending to the anterior margin of the anal segment. Cerci obvious, shorter than operculum, slightly curved, cylindrical, exceeding the end of anal segment, apices rounded, covered with long setae (Fig. 3D–F). *Legs:* Similar to female. Femora and tibiae with dense setae, tarsi covered with setae. *Wings:* Tegmina coriaceous, light brown, extending to the midlength of metanotum, apex rounded, venation clearly discernible. Hindwings elongate, broadly fan-shaped, brown, membranous, extending to tergum III with distinctly radiate venation, semitransparent; folded beneath forewings at rest.

Eggs (Fig. 4)**.** Spherical, dark gray overall (Fig. 4A, C). Capsule black, oval in cross-section. Operculum oval, black, distinctly separated from capitulum by a smooth, black terminal rim. Capitulum oval, dark gray, with short shanks smoothly fused to operculum. Micropylar plate elongate, spoon-shaped, length ≈0.75× egg length, margins sharply defined (black); micropylar cup black, positioned adjacent to posterior end of plate. Surface sculpture: smooth, with slight gloss on terminal rim and capitulum (Fig. 4B).

Remarks. Morphological examination revealed notable similarities between *Acrophylla sichuanensis* and *Lopaphus sphalerus*, but they could be distinguished by the following characteristics: in *Lopaphus sphalerus*, the body size is smaller than that of *Acrophylla sichuanensis*; ocelli absent; the antennae are longer than the proferomora; and the legs lack spines or teeth. In *Acrophylla sichuanensis*, the tegmina are elongate-ovate, extending to the posterior margin of the metanotum, whereas in *Lopaphus sphalerus*, the tegmina are smaller, teardrop shaped, and reach only the middle of the metanotum.

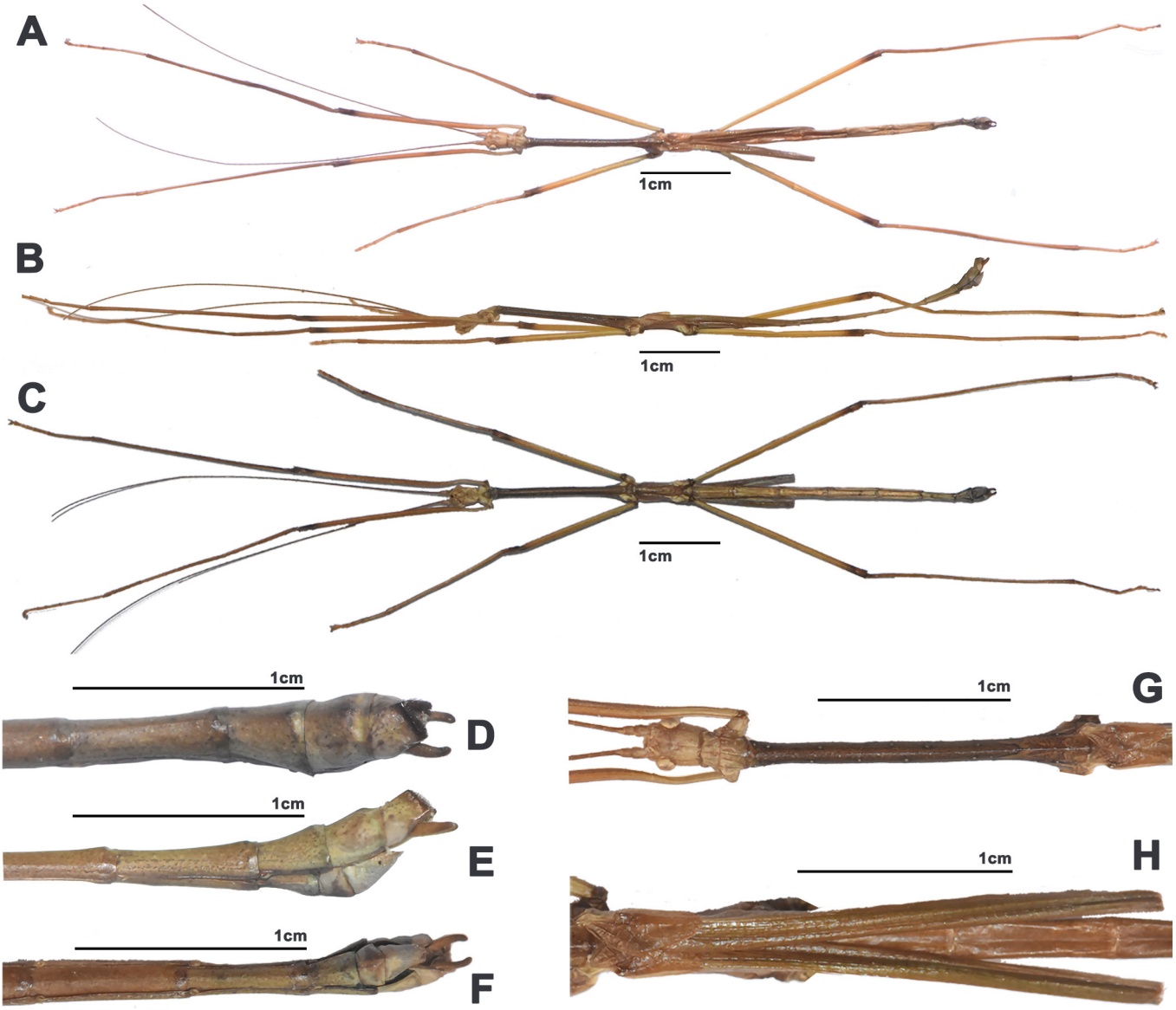

Figure 3. *Lopaphus sphalerus* (Redtenbacher, 1908), male. **A.** Habitus, dorsal view; **B.** Habitus, lateral view; **C.** Habitus, ventral view; **D.** Apex of abdomen and cerci, dorsal view; **E.** Apex of abdomen and cerci, lateral view; **F.** Apex of abdomen and cerci, ventral view; **G.** Head, mesothorax and forewing, dorsal view; **H.** Wings, dorsal view.

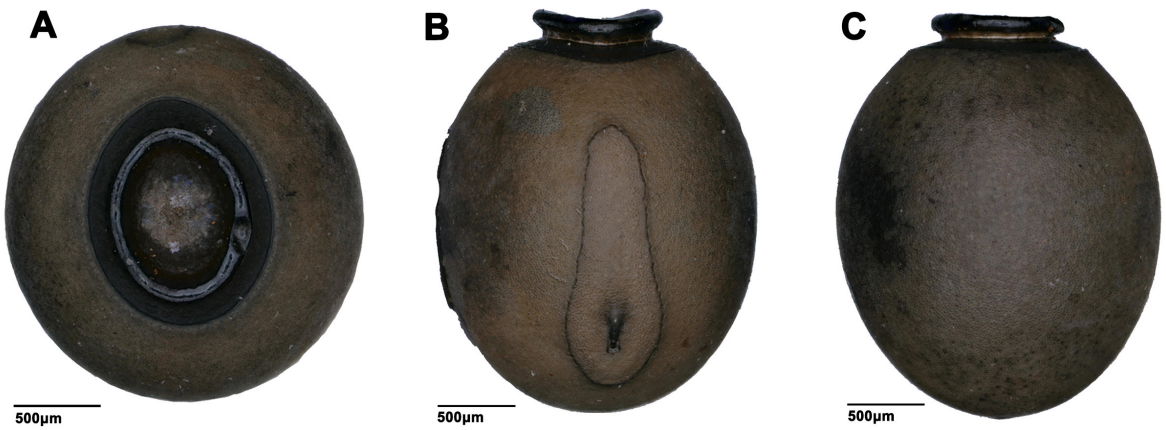

Figure 4. *Lopaphus sphalerus* (Redtenbacher, 1908), egg. **A.** Opercular view; **B.** Dorsal view; **C.** Lateral view.

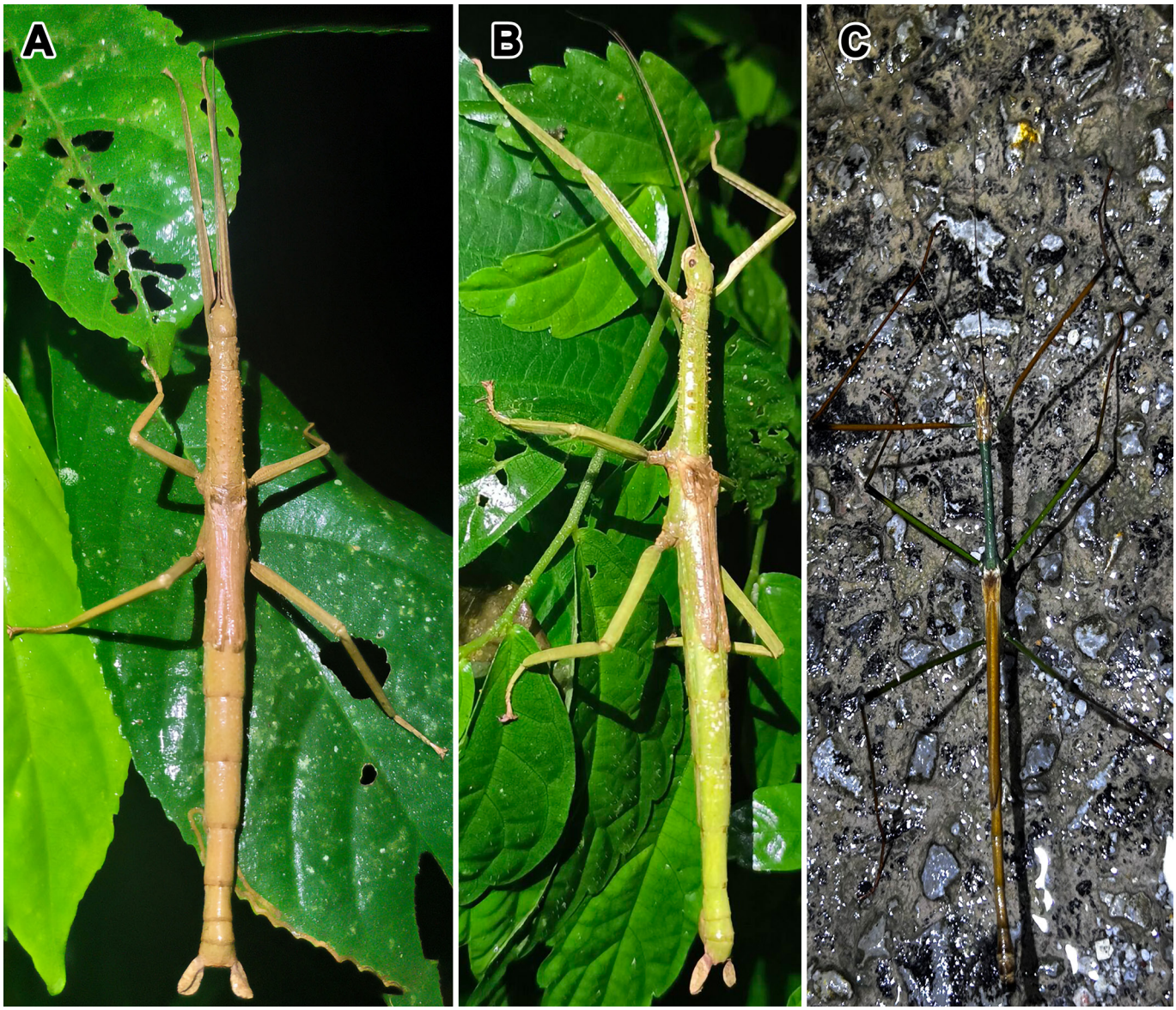

Figure 5. *Lopaphus sphalerus* (Redtenbacher, 1908) alive in situ. **A–B.** Female; **C.** **M**ale.

Table 1. Measurements of *Lopaphus sphalerus* (Redtenbacher, 1908) (in mm).

Segments	Female	Male
Length of body	97.3–99.6	75.5–78.1
Pronotum	4.80–6.20	3.00–4.10
Mesonotum	19.5–20.7	19.8–21.5
Metanotum (include middle segment)	11.5–12.6	5.70–6.80
Forelegs	43.1–44.3	64.6–65.1
Mesolegs	25.1–26.3	45.1–46.3
Metalegs	39.9–40.7	62.1–64.0
Abdomen	45.1–46.3	39.8–41.0
Tegmina	8.10–9.30	4.30–5.00
Alae	24.7–26.1	19.8–21.7

The cerci of female *Acrophylla sichuanensis* are elongate, flattened and leaf-like, and female subgenital plate is elongate-navicular, barely reaching the base of the cerci. In contrast, the cerci of female *Lopaphus sphalerus* are triangular, and the female subgenital plate is boat-shaped and strongly keeled, and the opercular valves are spatulate, which are longer than those of *Acrophylla sichuanensis*, extending to the middle of the female cerci.

DISCUSSION

The Oriental Realm, one of the world's thirteen major zoogeographic regions, is defined by its unique species composition, which has been shaped by distinct climatic and geographical features (Holt et al., 2013; Wallace, 1876). Its core area, including Guangxi and the Indochina Peninsula, lies within the tropical-subtropical monsoon zone and is dominated by tropical rainforests and evergreen broad-leaved forests (Udvardy, 1975). These areas are recognized as global biodiversity hotspots, characterized by rich species diversity (Myers, 1988; Mittermeier et al., 2004). The habitat supports diverse arboreal, amphibious, and tropical insects, collectively characterizing the region's fauna (Ficetola et al., 2017). The genus *Lopaphus* is primarily distributed within the Oriental Realm, and nine species are concentrated in the southwestern and southern regions of China (Table 2). From the perspective of zoogeographical regionalization, Yunnan, Guangxi, and Hainan are within the Oriental Realm, whereas Xizang is predominantly part of the Qinghai-Xizang Plateau subregion of the Palaearctic Realm (Ren, 1985; Xie, 2004). Despite Xizang's classification as within the Palaearctic Realm, the southeastern fringe of the region exhibits transitional geographical features, displaying certain characteristics of the Oriental Realm (Chen, 2004, Chen et al., 2008).

Currently, *Lopaphus sphalerus* is distributed primarily in northern Vietnam, with recent records extending its range to southern Guangxi, China. Both regions are situated within the biogeographic Oriental Realm, suggesting a continuous distribution pattern across the Sino-Vietnamese karst landscape. Geo-evolutionary evidence indicates that the South China continent and the Indochina terrane have maintained crustal continuity since the Indosinian Orogeny, without significant geographic isolation (De Bruyn et al., 2014; Metcalfe, 2006, 2009, 2013; Shu et al., 2021). During the Last Glacial Maximum (LGM; ~26.5–19 ka), an ~120-metre sea-level drop exposed the Beibu Gulf continental shelf, forming a landmass connecting the Indochina Peninsula, Hainan Island, and the South China coast (Hanebuth, 2000, 2002; Sathiamurthy & Voris, 2006; Voris, 2000). This land bridge facilitated the dispersal of terrestrial biota, particularly coastal and karst-adapted species, as supported by submerged fluvial deposits and fossil evidence (Jiang et al., 2019; Zhu, 2016). The contiguous karst landscapes of southwestern Guangxi and northern Vietnam have further reduced dispersal barriers, enhancing cross-border biotic exchanges between the Indochina Peninsula and Guangxi (Hu et al., 2024; Sayer, 2017; Xu et al., 2012).

Table 2. Biogeographical distribution of the genus *Lopaphusi* Westwood, 1859 in China.

Species	Distribution in China	General distribution
Lopaphus angusticauda	Xizang (Chen & He, 2008)	Oriental, Southwest China
Lopaphus balteatus	Hainan (Chen & He, 2002)	Oriental, Hainan Subregion
Lopaphus guangxiensis	Guangxi (Chen & He, 1999)	Oriental, South China Subregion
Lopaphus micropterus	Guangxi (Ho, 2013a)	Oriental, South China Subregion
Lopaphus shenglii	Hainan (Ho, 2013b)	Oriental, Hainan Subregion
Lopaphus sinensis	Xizang (Bi, 1995)	Palaearctic, Qinghai-Xizang Plateau
Lopaphus unidentatus	Xizang, Yunnan (Chen & He, 1995a)	Oriental, Palaearctic; Qinghai-Xizang Plateau subregion, Southwest China
Lopaphus yunnanensis	Yunnan (Chen & He, 1995b)	Oriental, Southwest China Subregion
Lopaphus zayuensis	Xizang (Chen & He, 2008)	Palaearctic, Qinghai-Xizang Plateau

Studies have shown that Guangxi and the central and southern Indochina Peninsula have experienced close species exchanges and evolutionary relationships throughout long-term biological evolution. This connection is fully reflected in the distribution patterns of tropical plants, birds, amphibians, reptiles, and other animals in these two regions (Liao et al., 2012; Skeels et al., 2023). For example, in terms of plants, species such as Dipterocarpaceae and Ochnaceae are found in both Guangxi and the central and southern Indochina Peninsula (Bansal et al., 2022; Meng et al., 2022; Trang & Triest, 2016). There is also a clear continuity in the distribution of birds in the two areas (Bain & Hurley, 2011; Hughes et al., 2003; Lim et al., 2020). Among amphibians and reptiles, *Rhinocerotidae* and *Rhinoceros* are distributed in both regions (Bain & Hurley, 2011; Ellepola & Meegaskumbura, 2023; Luo et al., 2023; Ngo et al., 2022). In addition, snakes, primates, aphid flies, and ants are also widely distributed in the karst forests along the border between these regions (Alfaro et al., 2008; Hosoishi, 2023; Lok & Xue, 2008; Liang, 2015; Zheng et al., 2014). The distribution patterns of these taxa further confirmed the exchange of species between the two areas.

During the investigation of the stick insect diversity in Guangxi, in our study, we have identified a new recorded species within the order Phasmatodea, which further enriches the species richness of stick insects in the region. This discovery underscores the existing gaps in our knowledge of stick insect biodiversity in Guangxi. The discovery of this newly recorded species highlights the need for further research into stick insects in Guangxi, China, and northern Vietnam. Future studies should focus on biodiversity patterns and the creation of transboundary ecological corridors to support species migration and conservation. Such efforts will enhance understanding of stick insects' evolutionary history, biogeographic dynamics, and adaptive radiation in Asia.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: X. Bian, QW. Zhang: Conceptualization; YT. Qin: Microscopic photography; YT. Qin, X. Bian: Writing – original draft; X. Bian: Writing – review and editing. The authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens referenced in this study are deposited in the Guangxi Normal University and collections are detailed in the "Material and Methods" section and can be accessed upon request through the authors.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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یک گونه تازه ثبت شده از جنس *Lopaphus* Westwood, 1859 (Phasmida: Lonchodidae: Necrosciinae) از چین

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چکیـده: یک گونه از جنس *Lopaphus* (Phasmida: Lonchodidae: Necrosciinae)، به نام *L. sphalerus* (Redtenbacher, 1908)، برای اولین بار از چین گزارش می‌شود. شناسایی این گونه عمدتاً بر اساس ویژگی‌های مورفولوژیک ماده‌ها انجام شده است: سِرسی‌ها مثلثی شکل، به سمت انتهایی باریک می‌شود و از حاشیه پشتی بخش آنال فراتر می‌رود؛ صفحه زیرجنسی با خط برجستهٔ میانی مشخص، قایقی شکل، با لبه قوی، که به تدریج به سمت عقب باریک می‌شود، حاشیه پشتی به طور باریک گرد و نوک تیز است و به طور قابل توجهی فراتر از حاشیه پشتی بخش آنال امتداد می‌یابد. جفت‌های نر و ماده در طبیعت جمع‌آوری شدند. اطلاعات مربوط به توصیف‌ها و تصاویر مورفولوژیک هر دو جنس و تخم‌ها و عکس‌هایی از زیستگاه طبیعی آنها ارایه شد. تمامی نمونه‌های بررسی شده در GXNU نگهداری می‌شوند.

واژگـان کلیدی: گوانگشی، Necrosciini، گزارش جدید، خاورزمین، چوبک‌مانند