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The Cyclommatini stag beetles (Coleoptera: Lucanidae) of Taiwan, with a key to the species

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Abstract. An examination of the three species of stag beetles from the tribe Cyclommatini Huang & Chen, 2013 (Coleoptera: Lucanidae) in Taiwan is presented, including new distribution records and revised identification. Furthermore, this study casts doubt on the authenticity of *Cyclommatus giraffa* in Taiwan and recommends that it be removed from the Taiwanese Lucanidae list.

INTRODUCTION

The classification of Cyclommatini Huang & Chen, 2013 (Coleoptera: Lucanidae) has long been contentious, with numerous revisions primarily based on external morphology (Parry 1863, Didier 1927, Maes 1992). This group is particularly notable for its remarkable male polymorphism, characterized by conspicuous allometric mandibles, clear sexual dimorphism, and diverse color variations (Zhu et al. 2023). Globally, the genus encompasses 60 species distributed across the Indochina Peninsula, the Sino-Himalayan region, Southeast Asian archipelagos, and parts of New Guinea. Specifically, three species have been documented in Taiwan (Chang 1993, 2006, Yang 2007, Fujita 2010, Huang & Chen 2013, 2017).

Recent genetic studies have identified significant distances and stable morphological variations that suggest intergeneric distinctions between two clades. As a result, it is proposed that the Cyclommatini be divided into two distinct genera: *Cyclommatus* Parry, 1863 and *Cyclommatinus* Didier, 1927 (Zhu et al. 2023).

In this context, the present study offers a comprehensive catalog of the Cyclommatini fauna of Taiwan, accompanied by detailed notes on their distribution patterns. This contribution aims to enhance the understanding of the diversity and taxonomy of this group, providing valuable insights for researchers and enthusiasts in the field of entomology.

MATERIAL AND METHODS

The present study is based on 96 specimens deposited in the author's private collection (JZLT), Taipei, Taiwan. Localities and dates of collection are provided in the species list following the scientific names, with the number of specimens collected given in brackets.

All specimens were obtained from legal sources. Species found in protected areas were documented through photographs. Identification was primarily based on, and compared

with, recent literature on stag beetles (Huang & Chen, 2013, 2017; Zhu et al., 2023). The distribution records are based on the works of Chang (1993, 2006), Huang & Chen (2017), and the author of the present study.

RESULT

Tribe Cyclommatini Huang & Chen, 2013
Genus *Cyclommatus* Parry, 1863

Chinese common name: 細身赤鍬形蟲屬/環鍬甲屬

Cyclommatus mniszechi (Thomson, 1856)
(Figs. 1 A-a)

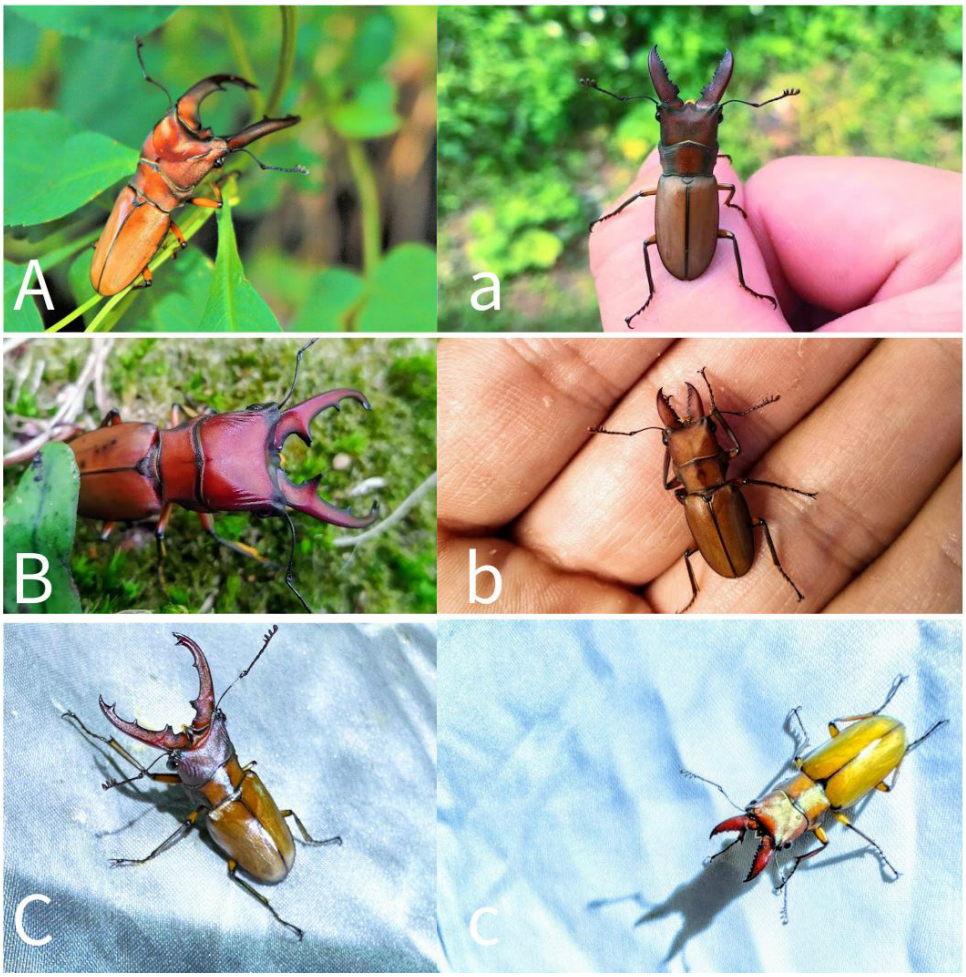
Chinese common name: 雞冠細身赤鍬形蟲/雞冠環鍬甲

Material examined: Taiwan: 1 ♂, Taipei, Neihu, 20.V.2011, J.-Z.Lin leg., (JZLT); 2 ♂♂, New Taipei City, Xindian, 07.VI.2011, local collector leg., (JZLT); 1 ♂, New Taipei City, Wulai, 08.VII.2011, local collector leg., (JZLT); 1 ♂, 2 ♀, New Taipei, Tamsui 19.VII.2023, bred., (JZLT); 1 ♀, New Taipei., Sanxia Dist., 05.VI.2015, local collector leg ., (JZLT); 1 ♂, New Taipei City, Wulai, 20.VI.2019, J.-Z. Lin leg., (JZLT); 3 ♂♂, 1 ♀, Taitung City, 05.IV.2021, local collector leg., (JZLT); 6 ♂♂, 3 ♀♀, Keelung City, Anle Dist., 21.VII.2019, bred., (JZLT).

Distribution: Taiwan: Taipei City, New Taipei City, Keelung City, Yilan County, Taoyuan City, Hsinchu County, Miaoli County, Hualien County, (new record) Taitung County, (new record) Guishan Island (new record) 0-800 m.

REMARKS

It was previously thought that *Cyclommatus mniszechi* was restricted to the northern hilly areas of Taiwan (Chang 1993, 2006, Yang 2007), but it now appears to be more widespread than originally believed. This study has confirmed that suitable habitats exist in the outer islands and coastal areas of eastern Taiwan, where the population is stable. Interestingly, the discovery of *Cyclommatus mniszechi* supports the statement made by Zhu et al. (2023), which reads: “There is an interesting question about the origin of this genus and how it spread from the islands of Southeast Asia to southern China. To test whether the establishment of *Cyclommatus* fits the ‘upstream’ hypothesis (colonization of continents by island fauna) or the ‘downstream’ hypothesis (colonization of islands by continental fauna), the RASP analysis suggested that these beetles probably originated in the Philippine archipelago and then dispersed to other Southeast Asian archipelagos, the Indochinese peninsula, the southeastern Himalayas, and southern China.” Therefore, the species was expected to be found in the eastern part of Taiwan.



Figs. 1A, B, C. Taiwanese species of Cyclommatini: *Cyclommatus mniszechi*: A- large male; a- small male, recorded on Guishan Island, 2017/06/25, photo by Du Ming-kun; *Cyclommatinus asahinai*: B- large male; b- small male; *Cyclommatinus scutellaris*: C- large male; c- small male.

Genus *Cyclommatinus* Didier, 1927

Chinese common name: 皺細身赤鍬形蟲屬/皺環鍬甲屬

Cyclommatinus scutellaris (Möllenkamp 1912)

(Figs. 1 B-b)

Chinese common name: 皺細身赤鍬形蟲/黯皺環鍬甲

Material examined: Taiwan: 1 ♂, 2 ♀♀, New Taipei City, Wulai, 20.V.2008, J.-Z.Lin leg., (JZLT); 2 ♂♂, New Taipei City, Sanxia, 17.VII.2018, local collector leg., (JZLT); 1 ♂, New Taipei City, Wulai, 28.VII.2019, local collector leg., (JZLT); 6 ♂♂, 2 ♀♀, Taoyuan, Northern Cross-Island Highway, 09.VI.2013, bred., (JZLT); 1 ♀, New Taipei., Sanxia,11.VI.2022, local collector leg., (JZLT); 3 ♂♂, New Taipei City, Wulai, 20.VI.2019, J.-Z.Lin leg., (JZLT); 3 ♂♂, Hsinchu, Jianshi Township, 15.IV.2021, local collector leg., (JZLT); 6 ♂♂, 3 ♀♀, Kaohsiung, Erjituan. 13.VII.2018, bred., (JZLT).

Distribution: Taiwan: New Taipei, Yilan, Taoyuan, Hsinchu, Miaoli, Taichung, Nantou, Chiayi, Kaohsiung, Pingtung, Taitung, Hualien, and Taitung (the altitude across Taiwan ranges from 300 to 1.500 m).

Cyclommatinus asahinai asahinai (Kurosawa, 1974)

(Figs. 1 C-c)

Chinese common name: **艷皺細身赤鍬形蟲/短刷皺環鍬甲**

Material examined: Taiwan: 3 ♂♂, Hsinchu, Jianshi Township, 5-6.VIII.2019, J.-Z.Lin leg., (JZLT); 4 ♂♂, Yilan, Siyuan , 27.VII.2019, local collector leg., (JZLT); 3 ♂♂, 2 ♀♀, Miaoli, Guanwu, 08.VI.2009, local collector leg., (JZLT); 6 ♂♂, 4 ♀♀, Kaohsiung, Tengjhih 02.VI.2022, bred., (JZLT); 1 ♀, Taoyuan, Northern Cross-Island Highway., 05.VII.2013, J.-Z.Lin leg., (JZLT); 3 ♂♂, Taichung, Anmashan, 20.VII. 2015, J.-Z.Lin leg., (JZLT); 8 ♂♂, 9 ♀♀, Nantou, Shan Lin Xi,21. 2013, J.-Z. Lin leg., (JZLT).

Distribution: Taiwan: New Taipei, Yilan, Taoyuan, Hsinchu, Miaoli, Taichung, Nantou, Chiayi, Kaohsiung, Pingtung, Taitung, Hualien, Taitung (the altitude across Taiwan ranges from 800-2000 m).

KEY TO THE TAIWANESE SPECIES OF CYCLOMMATINI (MALES)

1 Major form of the male lack's lateral wrinkles outside the lateral carinae on the head. The clypeolabrum is broader, and the mandible does not have both basal and median teeth. The head has sharper lateral carinae, which are placed more laterally. The pronotum has a strong anterior third of the lateral margin strongly arched. The yellow setae on the protibia are more widely distributed along the inner margin. The aedeagus is relatively slender and strongly sclerotize d, with the parameres long, pointed apically, and longer than the basal piece. The permanently everted internal sac is relatively short, usually no more than twice the length of the aedeagus ..... *Cyclommatus mniszechi*

- Major form of the male exhibits lateral wrinkles outside the lateral carinae on the head, which are strongly pronounced in the largest males of many species. The body is less metallic. The post-ocular margin of most species is somewhat rounded. The mandibles are less developed, usually never longer than the combined length of the head and prothorax, even in large males. The aedeagus is relatively stout and moderately sclerotized, with the parameres rounded and blunt apically, nearly as long as the basal piece. The permanently everted internal sac is relatively long, at least twice the length of the aedeagus. 2

2. Dorsal surface of the entire body is matte, not shiny. The yellow setae on the inner margin of the protibia is more extensive. The pronotum features incomplete lateral black bands ..... *Cyclommatinus scutellaris*

- Dorsal surface of the entire body is shiny. The yellow setae on the inner margin of the protibia are extremely short. The pronotum usually has a longitudinal central black band that is more distinctly marked .... *Cyclommatinus asahinai asahinai*

Fig. 2. *Cyclommatus giraffa* Möllenkamp, 1904
Kenting, Pintung Hsien Taiwan 26-V1-1988,HuiYung Lee leg./ NMNS ENT 6420-7897 (Stored in National Museum of Natural Science, Taiwan)

KEY TO THE TAIWANESE SPECIES OF *CYCLOMMATINI* (FEMALES)

1. Pronotum with a pair of lateral black bands, distant from the lateral margins. Vertex usually with a pair of black spots, the genitalia have a much shorter bursa copulatrix than in other Taiwanese species..... *Cyclommatus mniszechi*
- Pronotum with a complete longitudinal central black band; spermathecal gland and spermatheca almost attached to the base of the bursacopulatrix. 2
2. Elytra with a pair of longitudinal black stripes ..... *Cyclommatinus asahinai asahinai*
- Elytra without blackstripes..... *Cyclommatinus scutellaris*

BIOLOGICAL NOTES

Adult *Cyclommatus mniszechi* is known to feed on plant secretions and fruits, with a preference for tangerine and Griffith's ash secretions (Chang 2006). In this study, the author recorded the species feeding on the secretions of thatched screw pine, jackfruit, paper mulberry fruit, and flame gold rain tree. Additionally, *Cyclommatinus scutellaris* and

Cyclommatinus asahinai asahinai were observed feeding on plant secretions, such as those from ring-cupped oak, long-glans oak, and red chinkapin.

DISCUSSION

In addition to the two genera and three species mentioned above, Taiwan also has a brief report by Sato and Lee (2003), which recorded *Cyclommatus giraffa* Möllenkamp, 1904 from Taiwan. The authors noted, "We are not sure whether they escaped from captivity or adapted to the Taiwanese environment." More than 20 years have passed since this publication, and 35 years since the specimen was collected, yet no additional records of this species have been reported in Taiwan. *C. giraffa* is native to the mid-altitude forests of Borneo, and the coastal forests of Kenting, Taiwan are not considered suitable habitats for this species. Geographically, it is unlikely that *C. giraffa* would have naturally migrated to Taiwan, or been introduced by man, particularly given that Taiwan was not a major importer of exotic beetle species at the time. Therefore, this study questions the authenticity of the species in Taiwan and recommends removing *C. giraffa* from the Taiwanese Lucanidae list.

Considering the new records presented in this report, the Lucanidae fauna of Taiwan remains largely unexplored. Nonetheless, the preliminary findings underscore the need for further surveys and research. Future field surveys to collect additional specimens are essential to confirm the natural distribution of these species and assess the need for conservation efforts for *Cyclommatus* and related species in Taiwan.

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