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The genus *Paraplotes* Laboissière, 1933 in Taiwan, a speciose group with brachelytrous females (Coleoptera: Chrysomelidae: Galerucinae)

CHI-FENG LEE

Applied Zoology Division, Taiwan Agricultural Research Institute, Taichung 413, TAIWAN. E-mail: chifeng@tari.gov.tw

Abstract

Taiwanese members of the genus *Paraplotes* comprise a group of species that are not distinguishable based on external morphology but are diagnosed using distributions, aedeagal, and gonocoxal morphologies. Females of all species are brachelytrous. The group includes one previously described species, *Paraplotes taiwana* Chûjô, 1963, and nine new species, *P. cheni* sp. nov., *P. jengi* sp. nov., *P. meihuai* sp. nov., *P. tahsiangi* sp. nov., *P. tatakaensis* sp. nov., *P. tsoui* sp. nov., *P. tsuenensis* sp. nov., *P. yaoi* sp. nov., and *P. yuae* sp. nov. Diagnostic characters and hind wings of both sexes are illustrated. Models of speciation for the high diversity of *Paraplotes* in Taiwan are discussed. A novel hypothesis for brachelytrous leaf beetles occurring in tropical forest habitats (selva) is proposed.

Key words: Leaf beetles, taxonomy, physogastry, brachyptery, nocturnal behavior

Introduction

The genus *Paraplotes* Laboissière, 1933, consists of small sized, broad, parallel-sided galerucines, with one pair of longitudinal ridges on the elytra extending from the lateral angles. Some species of this genus have been confused with another genus, *Japonitata* Strand, 1935 (Zhang *et al.* 2008), probably the elytral ridges occur in both. However, *Paraplotes* is easily separated from *Japonitata* by the closed anterior coxal cavities and the margined basal border of the pronotum (anterior coxal cavities open and basal border of the pronotum unmarginated in *Japonitata*).

Paraplotes includes few species and seems rare in the historical museum collections. Zhang *et al.*, (2008) listed eight species in this genus: *Paraplotes frontalis* Laboissière, 1933 and *P. rugosa* Laboissière, 1933 were described from Vietnam based on single male specimens; four species are described from China: *P. clavicornis* Gressitt & Kimoto, 1963 based on five type specimens, *P. antennalis* Chen, 1942 based on one female type, *P. rugatipennis* (Chen & Jiang, 1986), and *P. semifulva* (Jiang, 1989), each based on one male type. *Paraplotes taiwana* Chûjô, 1963 was described from Taiwan based on one male type. *P. nepalensis* Medvedev, 1998 (in Medvedev & Sprecher-Uebersax 1998) was described from Nepal based on four types. One additional species occurs in Indonesia: *P. granulate* Medvedev, 2008, based on five female types.

The Taiwan Chrysomelid Research Team (TCRT) was founded in 2005 and is composed of 10 members. All of them are amateurs interested in making an inventory of all chrysomelid species in Taiwan. Basic bionomics of Taiwanese populations can be summarized as follows: adults are nocturnal and closely associated with the host plants—various species of Urticaceae (*Pilea* spp. and *Lecanthus peduncularis*). Effective collection is possible by searching for adults on host plants at night. More than 500 specimens have been collected throughout Taiwan by members of the TCRT. This taxonomic revision demonstrates the diversity of *Paraplotes* in Taiwan.

Material and methods

Most adults of *Paraplotes* are nocturnal in Taiwan. They appear on host plants at night, especially on *Lecanthus peduncularis* (Fig. 2) and various species of *Pilea* (Urticaceae), including *Pilea rotundinucula*, *P. aquarum* subsp.

which appears to be sympatric with *P. meihuai* in Motien and Liyuan and with *P. cheni* in Tahanshan, respectively. In fact, *Paraplotes taiwana* is not sympatric with *P. cheni* since *P. cheni* is only found above 1400 m while *P. taiwana* is only found below 1000 m in Tahashan mountains. In sympatric situations, *Paraplotes taiwana* can be separated from *P. meihuai* by external morphology. The former has wider elytra and yellowish brown coloration (Figs 39–44) but the latter has slender elytra and dark or blackish brown coloration (Figs 21–26).

Reduction of hind wings in females varies greatly among inter- or infraspecific populations although such variation is much less within the same population. Most females of the same populations, based on proximity of collections, have similar lengths of hind wings. Widths may vary greatly in females of *Paraplotes cheni* (Fig. 82), *P. jengi* (Fig. 83), and *P. meihuai* (Fig. 84). Reduction of hind wings may vary greatly among different populations. For example, the population of *Paraplotes yuae* collected from Wushihkeng (Fig. 91a) has the least reduced hind wings (38%), by the contrast, reduction is extreme in Wuchihshan (18%: Fig. 91c). Such variations may result from the occasional occurrence of diurnal behavior for the population in Wushihkeng. Possibly, nocturnal behavior may promote reduction of hind wings in females. Moreover, all females of Taiwanese *Paraplotes* are physogastric. Their abdomens are strongly expanded by large egg loads, such as investment of energy on the abdomen might also result in reduction of hind wings and shortened elytra. The nocturnal behavior seems to be advantageous for flightless females for survival because natural enemies are comparatively fewer during the night than those at the daytime. Beenen & Jolivet (2008) indicated that brachelytrous leaf beetles occur in alpine habitats, deserts, oceanic islands, and in some spots in tropical rainforests. The hypothesis to explain brachelytry in the former three types of habitats has been proposed. However, no reasonable explanation was provided for the situation in tropical forests—selva. Here a possible cause of brachelytry for selva is proposed: reduction of hind wings may result from the production of the physogastric females. Nocturnal behavior increases survival since natural enemies are less of a threat. Males respond in order to search for mates. Flight is less necessary at night and energy can be diverted to egg production. Brachelytry is predicted as the final outcome of this hypothesis. In Taiwan, all wingless granulines including *Apterogaleruca* Chûjô (Fig. 92), *Hirtigaleruca* Chûjô (Fig. 93), *Shaira* Maulik (Fig. 94), *Shairella* Chûjô (Fig. 95), *Taiwanolepta* Kimoto (Fig. 96), *Furusawaia* Chûjô (Fig. 97) were collected effectively at night. These observations seem to support this present hypothesis.

Lee *et al.* (2010) indicated that allopatric speciation occurred in the *Agetocera taiwana* species group, although all species are winged. All of them were restricted to mountains above 1000 m, separated from other mountains by large valleys. Only one species of *Agetocera* inhabits and is widespread in lowlands. By contrast, more species of *Paraplotes* are found and separated by different mountains and elevations. This result may reflect that dispersal of *Paraplotes* is comparatively lower due to winglessness of females.

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