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Description of the female reproductive system of four species of *Micropodabrus* Pic (Coleoptera, Cantharidae)

Qi Ya-Qing, Qiu Teng-Fei and Yang Yu-Xia

Abstract
The morphological characters of female reproductive system of four species of *Micropodabrus* Pic, 1921 are illustrated and described for the first time, including *M. cochleatus* (Wittmer, 1978), *M. oudai* (Švihla, 2004), *M. rectiangulatus* (Švihla, 2005) and *M. singularis* (Wittmer, 1997). The species, *M. cochleatus*, whose type was located in Vietnam, is recorded in China for the first time.

Keywords: Cantharidae, *Micropodabrus*, female reproductive system, morphology, new faunistic record

1. Introduction
Traditionally, in the taxonomy of cantharid beetles, the differentiation among the species, even some genera, relies on the characters of males. However, the characters of females remain little known. This makes some troubles in the determination of the species or genera, especially when the male specimens are unavailable in a mess cantharid collection. For example, the genus *Micropodabrus* Pic, 1921 differs from *Fissocantharis* Pic, 1920 only in the aedeagus which is present with laterophyses or not [1]. Within the genus, some species could not be separated easily, since that their difference in the characters of males are minor. Thus, it is urgent for us to find some additional characters, especially those of females, to improve the taxonomic study of *Micropodabrus*.
Most recently, the female reproductive system was considered as a useful structure and applied in the taxonomy of several genera, such as *Lycocerus* Gorham, 1889 [2-4], *Fissocantharis* Pic, 1921 [5-7], and *Themus* Motschulsky, 1858 [8-9]. In the present study, the female reproductive system of four species of *Micropodabrus* are illustrated and described for the first time, including *M. cochleatus* (Wittmer, 1978), *M. oudai* (Švihla, 2004), *M. rectiangulatus* (Švihla, 2005) and *M. singularis* (Wittmer, 1997), in order to make some supplementary information for the specific recognition.

2. Material and methods
The studied material is deposited in the Museum of Hebei University, Baoding, China (MHBU) and Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZAS). The dry specimen was sunk in the room-temperature water for about 10 hours and then the abdomen was detached from the body. The soften abdomen was sunk in 10% NaOH solution for about 10 minutes and then dissected. The female reproductive system was dyed with hematoxylin and cleared in the distilled water under the stereomicroscope Nikon SMZ1500. All photos were taken using a Leica M205 A microscope and edited in the Adobe Photoshop 8.0.1.
Morphological terminology of female genitalia follows that of Brancucci [10] and the description format of Okushima [2]. The abbreviations in the figures are as follows, ag: accessory gland; di: diverticulum; ov: common oviduct; sd: spermathecal duct; sp: spermatheca; va: vagina.

3. Results
3.1 *Micropodabrus cochleatus* (Wittmer, 1978)
Fig. 1A
Material. 1♀ (MHBU): China, Guangxi, Wuming, Damingshan, 1230-1423 m, 20.V.2011, leg. H.Y. Liu.

Description. Internal organ of reproductive system (Fig. 1A): vagina stout, abruptly thinned and extended into a moderately long duct at ventroapical portion; diverticulum and spermathecal duct arising from the end of the duct of vagina; diverticulum moderately long, spiral and evenly thin in the whole length; spermathecal duct slightly shorter and thicker than diverticulum; spermatheca composed of a spiral tube which is distinctly longer than diverticulum, provided with a thin accessory gland which is nearly as long as the spiral tube of spermatheca; common oviduct situated at basal portion of vagina.

Remarks. In the original publication (Wittmer, 1978), the type of this species was located from Vietnam, here it is recorded from China (Guangxi) for the first time. Except the above studied material, this determination is based on some additional specimens as follows. China, Guangxi: 1♂ (MHBU): Wuming, Damingshan, 1230-1423 m, 20.V.2011, leg. H.Y. Liu; 1♂ (IZAS): Longsheng, Hongmaochong, 900m, 10.VI.1963, leg. S.Y.Wang; 1♀ (IZAS): Longsheng, Tianpingshan, 740m, 5.VI.1963, leg. S.Y.Wang.

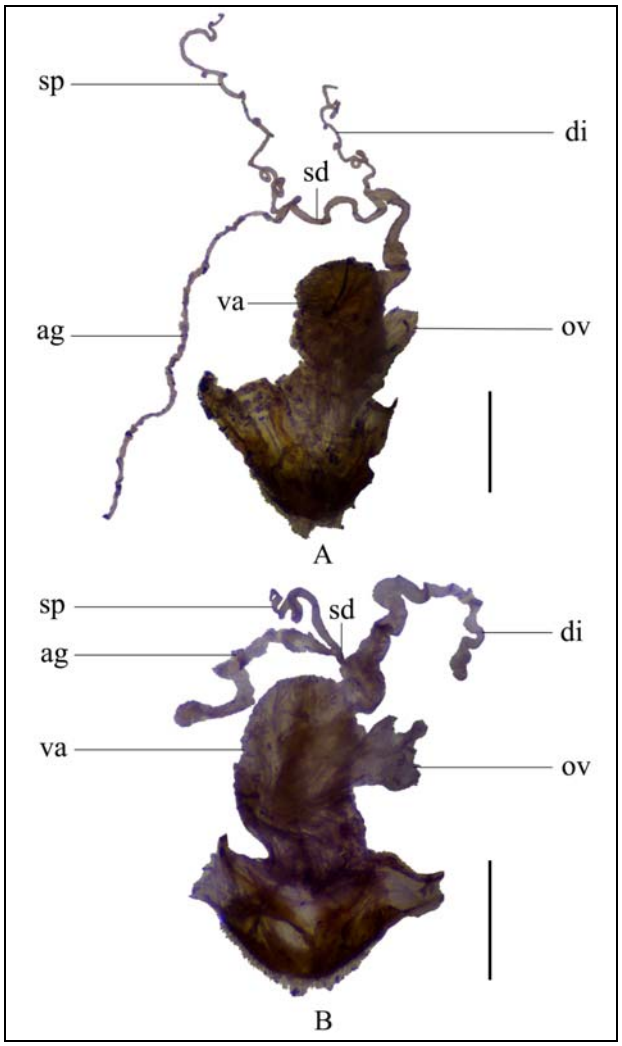

Fig 1: Internal organ of female reproductive system, lateral view: A. *Micropodabrus cochleatus* (Wittmer, 1978); B. *M. oudai* (Švihla, 2004). Scale bar: 0.5 mm.

3.2 *Micropodabrus oudai* (Švihla, 2004)

Fig. 1B

Material. 1♀ (IZAS): China, Sichuan, Kangding, 2500 m, 27.V.1983, leg. Y.Q. Chen.

Description. Internal organ of reproductive system (Fig. 1B): vagina stout, abruptly thinned and extended into a short duct at ventroapical portion; diverticulum and spermathecal duct arising from the end of the duct of vagina; diverticulum moderately long, spiral and distinctly thinned apically; spermathecal duct very short and distinctly thinner than diverticulum; spermatheca composed of a spiral tube which is distinctly shorter and thinner than diverticulum, provided with a thin accessory gland which is slightly longer than the spiral tube of spermatheca; common oviduct situated near middle of vagina.

3.3 *Micropodabrus rectiangulatus* (Švihla, 2005)

Fig. 2A

Material. 1♀ (IZAS): China, Sichuan, Emeishan, 1800-2100 m, 24.VI.1955, leg. X.K. Yang.

Description. Internal organ of reproductive system (Fig. 2A): vagina stout; diverticulum and spermathecal duct arising from the middle portion of ventral side of vagina; diverticulum slightly long and stout tube-shaped, slightly thinned apically; spermathecal duct very short and distinctly thinner than diverticulum; spermatheca composed of a spiral tube which is distinctly longer and thinner than diverticulum, provided with a thin accessory gland which is nearly as long as the spiral tube of spermatheca; common oviduct situated at basal portion of vagina.

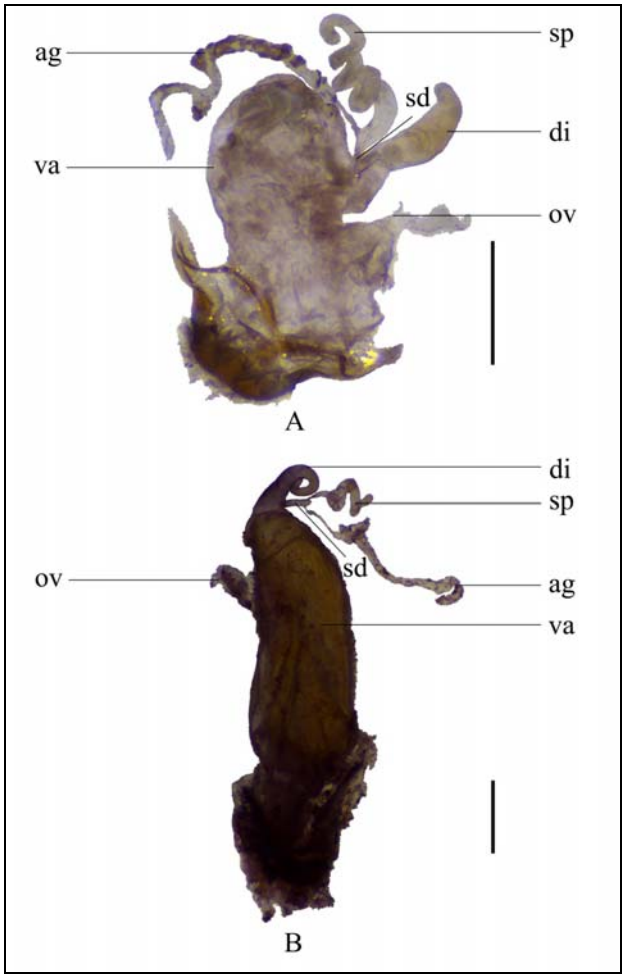

Fig 2: Internal organ of female reproductive system, lateral view: A. *Micropodabrus rectiangulatus* (Švihla, 2005); B. *M. singularis* (Wittmer, 1997). Scale bar: 0.5 mm.

3.4 *Micropodabrus singularis* (Wittmer, 1997)

Fig. 2B

Material. 1♀ (IZAS): China, Guizhou, Zunyi, Shuiyang County, Kuankuoshui Nation. Nat. Res., 1400-1514 m, 3.VI.2010, leg. Z.L. Wang.

Description. Internal organ of reproductive system (Fig. 2B): vagina stout, abruptly thinned and extended into a short duct at ventroapical portion; diverticulum and spermathecal duct arising from the end of the duct of vagina; diverticulum slightly long and stout tube-shaped, distinctly thinned apically; spermathecal duct short and distinctly thinner than diverticulum; spermatheca composed of a spiral tube which is slightly longer and thinner than diverticulum. Basal portion of spermatheca extended into a very short tube, where accessory gland opening and slightly longer than the spiral tube of spermatheca; common oviduct situated at apical portion of vagina.

4. Discussion

Except *Micropodabrus obscurior* (Wittmer, 1954) [11], the results in the present study show that the species of *Micropodabrus* are definitely different from one another in the female reproductive system, which is again proved to a useful morphological character in the taxonomy of cantharis, as those in other genera, such as *Lycocerus* Gorham, *Themus* Motschulsky and *Fissocantharis* Pic. The interspecific difference of this genus is predominant with respect to shape, situation and relative length of diverticulum and spermatheca. The present study strongly suggests that applying the female reproductive system in the differentiation of *Micropodabrus* species, especially those similar species, could provide more evidence to confirm the specific validity, in near future.

5. Acknowledgment

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