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## Morphology of the female reproductive system of *Cantharis* Linnaeus (Coleoptera, Cantharidae)

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**Abstract**

The morphological characters of female reproductive system of *Cantharis* Linnaeus, 1758 are summarized. Those of the following five species of this genus are described and compared, including *Cantharis* (s. str.) *brunneipennis* Heyden, 1889, *C.* (s. str.) *rufa* Linnaeus, 1758, *C.* (s. str.) *minutemaculata* Wittmer, 1997, *C.* (s.str.) *knizeki* Švihla, 2004 and *C.* (*Cyrtomoptila*) *plagiata* Heyden, 1889.

**Keywords:** Cantharidae, *Cantharis*, female reproductive system, morphology

**1. Introduction**

In the taxonomy of cantharid beetles, the female reproductive system is considered to be useful and has been applied in several genera, such as *Lycocerus* Gorham, 1889<sup>[1-3]</sup>, *Fissocantharis* Pic, 1921<sup>[4-6]</sup>, and *Themus* Motschulsky, 1858<sup>[7-8]</sup>. However, this structure has not been introduced to the genus *Cantharis* Linnaeus, 1758 until now.

In the present study, the morphology of the female reproductive system for five *Cantharis* species are described in detail, including *C.* (s. str.) *brunneipennis* Heyden, 1889, *C.* (s. str.) *rufa* Linnaeus, 1758, *C.* (s. str.) *minutemaculata* Wittmer, 1997, *C.* (s. str.) *knizeki* Švihla, 2004 and *C.* (*Cyrtomoptila*) *plagiata* Heyden, 1889. Based on the morphological comparison of these species, the diagnostic characters of female reproductive system for *Cantharis* are summarized in the generic level. The aim of the study is to find more useful morphological characters in the taxonomy of *Cantharis*.

**2. Material and methods**

The studied material is deposited in the Museum of Hebei University, Baoding, China (MHBUS) and Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZAS).

The live specimen was killed by the 75% alcohol and then the abdomen was dissected immediately. In this way, we could get the female reproductive system (including the ovary and lateral oviduct) in natural state. The dry specimen was sunk in the room-temperature water for about 10 hours and then the abdomen was detached from the body. The soft 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<sup>[9]</sup> and the description format of Okushima<sup>[1]</sup>. The abbreviations in the figures are as follows, ag: accessory gland; di: diverticulum; gen: external genitalia; lov: lateral oviduct; ov: common oviduct; ova: ovariole; sd: spermathecal duct; sp: spermatheca; va: vagina.

**3. Results****3.1 *Cantharis* Linnaeus, 1758**

Generic diagnosis (Female reproductive system). The external genitalia consists of a pair of valvifers, coxites, styli and paraprocts, and a proctiger (Brancucci, 1980)<sup>[9]</sup>. The internal reproductive organ is composed of a pair of ovaries, two lateral and one common oviduct, a diverticulum, a spermatheca, an accessory gland and a vagina.

Lateral oviduct surrounded by the ovarioles. The number of the ovarioles varies around 30. Vagina stout. Common oviduct opening on ventral side of vagina. Diverticulum and spermatheca or spermathecal duct arising from ventroapical portion of vagina.

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Diverticulum stout at basal portion and more or less thinned apically. Spermathecal duct short or absent. Spermatheca composed of one thin spiral tube, provided with a thin accessory gland, more or less long.

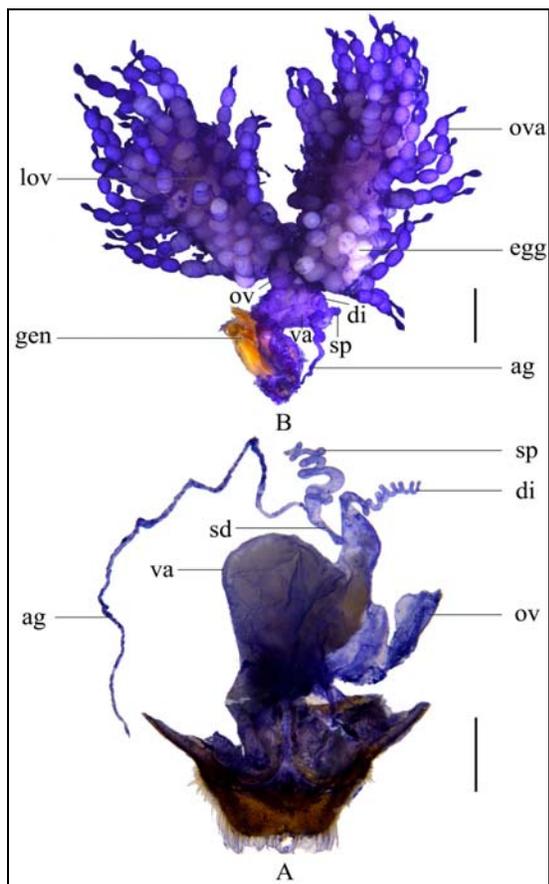
Remarks. The structures of the female reproductive organ (without ovary and lateral oviducts) of *Cantharis fusca* Linnaeus, 1758, *C. tristis* Fabricius, 1797, *C. rustica* Fallén, 1807 and *C. obscura* Linnaeus, 1758 were illustrated by Brancucci (1980: Figs 230-232, 234; 306-310). In the present study, the ovary and lateral oviducts of cantharid species is shown for the first time, taking *C. brunneipennis* Heyden, 1889 as an example (Fig. 1A).

**3.2 *Cantharis* (s.str.) *brunneipennis* Heyden, 1889**

Figs 1A-B

Material. 1♀ (HBUM): China, Hebei, Zhangjiakou, Xiaowutai Mt., 27.VI. 2012, leg. Y. Li, Z.W. Cheng & H.X. Wang.

Description. Vagina abruptly thinned at ventroapical portion and extended into a stout and short duct. Diverticulum and spermathecal duct arising from the end of the duct of vagina. Diverticulum moderately long, stout at basal portion and abruptly thinned apically, seeming long, spiral tube-shape at apical four-fifths portion. Spermathecal duct short, distinctly thinner than basal portion of diverticulum. Spermatheca slightly thinned apically and nearly as long as diverticulum. Accessory gland much longer than the spiral tube of spermatheca. Common oviduct situated near middle of vagina.



**Fig 1:** *Cantharis* (s.str.) *brunneipennis* Heyden, 1889: A. female reproductive system; B. female reproductive system (ovary and lateral oviducts absent). Scale bars: 1.0 mm.

**3.3 *Cantharis* (s.str.) *minutemaculata* Wittmer, 1997**

Fig. 2A

Material. 1♀ (MHBU): China, Hebei, Yuxian, Red cliff fort ditch, 23.VI. 2009, leg. J.T. Lang & Z.H. Gao.

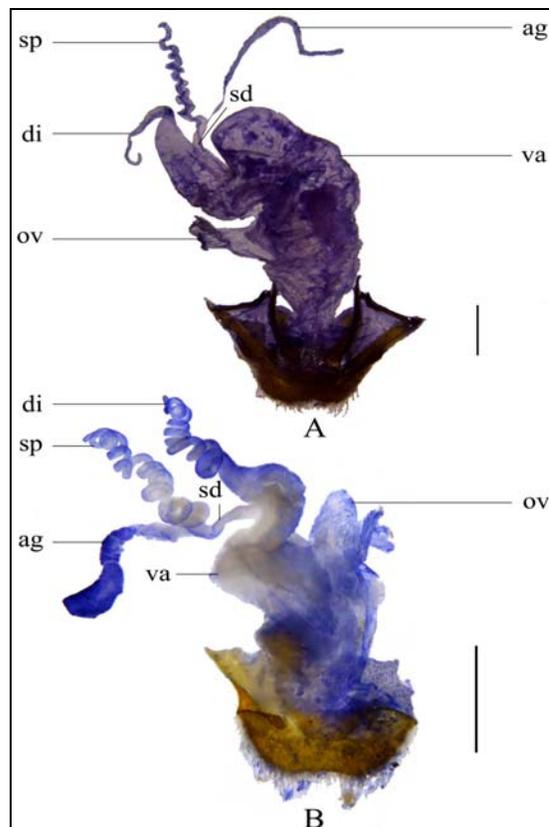
Description. Vagina abruptly thinned at ventroapical portion and extended into a stout and short duct. Diverticulum and spermathecal duct arising from the end of the duct of vagina. Diverticulum slightly long, stout at basal portion and abruptly thinned apically, seeming short, spiral tube-shaped at apical two-thirds portion. Spermathecal duct short, distinctly thinner than basal portion of diverticulum. Spermatheca nearly even in width along the whole length and slightly longer than diverticulum. Accessory gland nearly as long as the spiral tube of spermatheca. Common oviduct situated near middle of vagina.

**3.4 *Cantharis* (s. str.) *knizeki* Švihla, 2004**

Fig. 2B

Material. 1♀(MHBU): China, Shanxi, Shiquan, 25.VI.1980, leg. L.C. Xiang & N. Ma.

Description. Vagina abruptly thinned at ventroapical portion and extended into a stout and short duct. Diverticulum and spermathecal duct arising from the end of the duct of vagina. Diverticulum moderately long, stout at basal portion and abruptly thinned apically, seeming long, spiral tube-shaped at apical four-fifths portion. Spermathecal duct short, distinctly thinner than basal portion of diverticulum. Spermatheca slightly thinned apically and nearly as long as diverticulum. Accessory gland much shorter than the spiral tube of spermatheca. Common oviduct situated at apical portion of vagina.



**Fig 2:** Female reproductive system (ovary and lateral oviducts absent): A. *Cantharis* (s.str.) *rufa* Linnaeus, 1758; B. *C.* (s.str.) *minutemaculata* Wittmer, 1997. Scale bars: 1.0 mm.

### 3.5 *Cantharis* (s.str.) *rufa* Linnaeus, 1758

Fig. 3A

Material. 1♀ (IZAS): China, Beijing, Xizhimen, 30.IV.1952, leg. Y.R. Zhang.

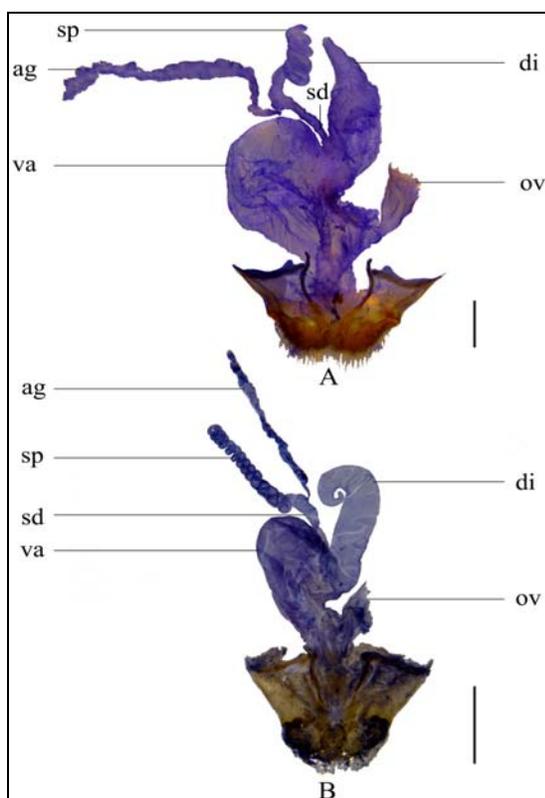
Description. Diverticulum and spermathecal duct arising from ventroapical portion of vagina. Diverticulum moderately long, stout at basal portion and gradually thinned apically, seeming bottle-shaped in the whole. Spermathecal duct short, distinctly thinner than basal portion of diverticulum. Spermatheca slightly thinned apically and slightly longer than diverticulum. Accessory gland nearly as long as the spiral tube of spermatheca. Common oviduct situated at basal portion of vagina.

### 3.6 *Cantharis* (*Cyrtomoptila*) *plagiata* Heyden, 1889

Fig. 3B

Material. 1♀ (IZAS): China, Shaanxi, Foping, Shawo village, 1170-1215m, 33.59°N, 108.02°E, 29.V.2007, leg. H.L. Shi.

Description. Diverticulum and spermathecal duct arising from ventroapical portion of vagina. Diverticulum moderately long, evenly stout at basal two-thirds portion and gradually thinned apically at apical one-third portion, seeming horn-shaped in the whole. Spermathecal duct short, distinctly thinner than basal portion of diverticulum. Spermatheca slightly thinned apically and much longer than diverticulum. Accessory gland shorter than the spiral tube of spermatheca. Common oviduct situated at basal portion of vagina.



**Fig 3:** Female reproductive system (ovary and lateral oviducts absent): A. *Cantharis* (s.str.) *knizeki* Švihla, 2004; B. *C. (Cyrtomoptila) plagiata* Heyden, 1889. Scale bars: 1.0 mm.

### 4. Discussion

Based on the results of the present study and the related literature [9], the morphology of female reproductive system is proved to be a useful structure in the taxonomy of *Cantharis*

species, as those in other cantharid genera, *Lycocerus*, *Fissocantharis* and *Themus*. They have common characters, which are summarized into the generic diagnosis. Within the genus, the species of *Cantharis* could be differentiated from one another by the shape of diverticulum, relative length of diverticulum and the spiral tube of spermatheca, and situation of the common oviduct.

Considering the usefulness of the female reproductive system, especially the internal organ, in the discrimination of *Cantharis* species, we suggest to include the characters of this structure in the specific description, which also will be helpful to make comparative morphological study among the genera of Cantharinae in the future study.

### 5. Acknowledgment

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