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The Male and Female Genital Structure of Some Tribe Lebiini (Coeoptera, Carabidae) Species and Their Systematic Importance

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Abstract

In this study, the male and female genital organ structure of ***Cymindis lineata*** (Quensel), ***C. scapularis*** Schaum, ***C. vaporarium*** (Linnaeus), ***C. variolosa*** (Fabricius), ***Lebia cyanocephala*** (Linnaeus), ***L. festiva*** Faldermann, ***L. trimaculata*** (Villers) species belonging to tribe Lebiini were examined. The part in which includes important systematic characters like aedeagus, inner sac, parameres, hemisternites, basal and apical segment of styluses were described in detail with supplied figures. Also, differences in these structures were discussed at the generic and species level.

Key words: Carabidae- Lebiini- Male and female genital structure

INTRODUCTION

Genital morphology of Carabidae has long been recognized by taxonomists as an important characteristic for distinguishing closely related species. Not only male genitalia, but also female genitalia are important for the systematic studies because of maintaining reproductive isolation between species. Not all genital parts are of functional importance for the purpose of genital coupling and sperm transfer, and hence may not always be subject to direct selection [1] but all these parts have systematic importance.

In males, 10 th abdominal segment is formed of a penis (aedeagus) flanked at its base by two sclerified stalklets called parameres. The aedeagus lobe bears inside, mostly at the distal end, the internal sac into which opens the ductus ejaculatorius, and which is everted during copulation. The inner sac bears various sclerotized structures that are specific and diagnostic. In the derived groups, the right and left paramere are of different shape, and one of them may even become vestigial. In females, 9th ventrite is composed of two pleurite which remain slightly lateral and don't join together in the middle and the external genitalia, or styluses, which correspond to the appendix of the 9th segment. Each stylus is formed by two segments, the basal segment (subcoxite) and the apical segment (coxite).

In the limited studies on this tribe genital organ structure, different points have been analyzed: the shape of aedeagus, pattern of parameres, position of armatures in inner sac, structure of the stylomeres [2,3,4,5]. Although these studies have tried to show the systematic characters of male and female genitalia, they haven't given any information about characters' level, especially female genitalia. The aim of this study is to put out characters' level, to give additional information about the male and female genitalia. Significant differences of this study are the examination of the hemisternites in addition to stylus in female genitalia and evaluating male and female genitalia together.

MATERIALS AND METHODS

A couple of specimens of each species was dissected to prevent variability within species. For the preparation of male and female genitalia, organs dissected. After about 12 hours in cold %15 KOH, organs were carefully washed in water and then in absolute alcohol, transferred to a drop of glycerine [6]. For the terminology, that of theTuxen [7] was used.Those segments which are systematically significant in the structure of male and female genitalia (aedeagus, parameres, hemisternites, basal and apical segments of styluses) were illustrated and defined. For drawings, Nikon SMZ-U stereoscopic microscope and drawing tool were used.

RESULTS

Genus: *Cymindis* Latreille, 1806

Cymindis lineata (Quensel, 1806)

Male genitalia- In lateral view aedeagus curved, apical plate chitinized and gently curved. In dorsal view aedeagus strongly narrowed at proximal, apical plate triangular; armature of inner sac with two amorphous sclerites covered with spicules at medial, sclerites located near to each other [Figs. 1-2]; parameres ovoid, left paramere half length to right paramere [Figs. 3-4].

Female genitalia- Hemisternites rectangular, concave at proximal, distal part narrowed forming a triangular; basal segment of styluses carinate from proximal to medial; apical segment of styluses strongly narrowed towards apex, sharp and curved apically, with one big seta on medio-ventral [Fig. 5].

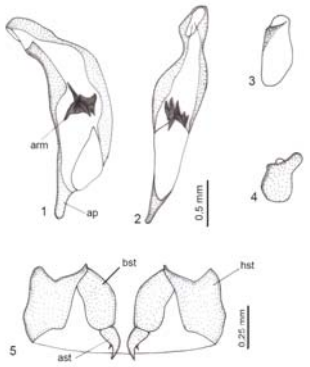


Figure 1-5. *Cymindis lineata* (Quensel, 1806): aedeagus, lateral side (1), dorsal side (2), right paramere (3), left paramere (4), female genitalia (5).

Cymindis scapularis **Schaum, 1857**

Male genitalia- In lateral view aedeagus curved. In dorsal view aedeagus strongly narrowed at proximal, lateral sides sinuate, apical plate smooth; armature of inner sac with two spicules groups, one at medial and other at medio-apical [Figs. 6-7]; right paramere two times left paramere, oval shaped, left paramere spatula-shaped [Figs. 8-9].

Female genitalia- Hemisternites strongly concave at proximal, almost equilateral shaped, joining part to basal segment of styluses narrow; basal segment of styluses strongly concave at medial, apical edge truncate; apical segment of styluses finger shaped, gently curved, with one big seta on medio-ventral [Fig. 10].

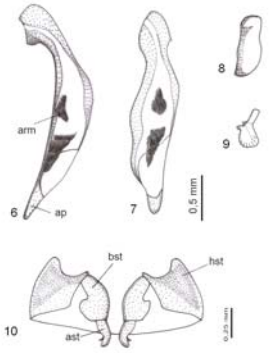


Figure 6-10. *Cymindis scapularis* Schaum, 1857: aedeagus, lateral side (6), dorsal side (7), right paramere (8), left paramere (9), female genitalia (10).

Cymindis vaporarium **(Linnaeus, 1758)**

Male genitalia- In lateral view aedeagus gently curved. In dorsal view strongly narrowed at proximal, broadened at medial, apical plate triangular at apex; armature of inner sac with crescent shaped amorphous sclerite covered with spins sparsely [Figs. 11-12]; right paramere as twice as left paramere, almost oval shaped, with spines sparsely at distal and latero-medial, left paramere spatula shaped, with spines densely at distal and latero-medial [Figs. 13-14].

Female genitalia- Hemisternites almost square, slightly concave at base; basal segment of styluses narrow at proximal, broad and blunt at apex, with few setae; apical segment of styluses weakly curved at apex, with sparsely setae on dorsal surface, medio-ventral depression with two setae [Fig. 15].

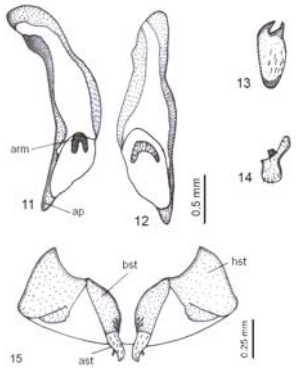


Figure 11-15. *Cymindis vaporarium* (Linnaeus, 1758): aedeagus, lateral side (11), dorsal side (12), right paramere (13), left paramere (14), female genitalia (15).

Cymindis variolosa **(Fabricius, 1794)**

Male genitalia- In lateral view apical part of aedeagus slightly curved. In dorsal view weakly narrowed at proximal, strongly broadened at medial, apical plate narrow, short and densely punctured on dorsal side; armature of inner sac with spicules forming an oval shaped group at medio-apical [Figs. 16-17]; right paramere oval and two times as long as left paramere, left paramere spatula shaped [Figs. 18-19].

Female genitalia- Hemisternites triangular, distal margin that near to basal segment of styluses with several short setae; basal segment of styluses oval, carinate from base to medial; apical segment of styluses cylindrical, medio-ventral depression with a short spin [Fig. 20].

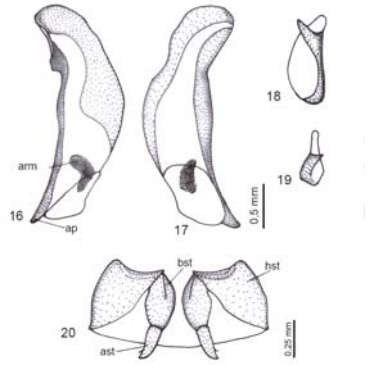


Figure 16-20. *Cymindis variolosa* (Fabricius, 1794): aedeagus, lateral side (16), dorsal side (17), right paramere (18), left paramere (19), female genitalia (20).

Genus: *Lebia* **Latreille, 1802**

Lebia cyanocephala **(Linnaeus, 1758)**

Male genitalia- In lateral view aedeagus curved weakly, ventral margin sinuate. In dorsal view broad at basal part, strongly narrowed proximally, from apical orifice to apical narrowed, apical plate long; armature of inner sac with spicules forming V shape and left arm longer than the right arm at medio-distal [Figs. 21-22]; right paramere spatula shaped, left paramere oval shaped and 0,5 times longer than the right paramere [Figs. 23-24].

Female genitalia- Hemisternites triangular and basal part with a process, joining part to basal segment of styluses narrow; basal segment of styluses deeply emarginated, narrow at proximal, broad at medial, narrowed strongly towards distal part; apical segment of styluses short and ovoid [Fig. 25].

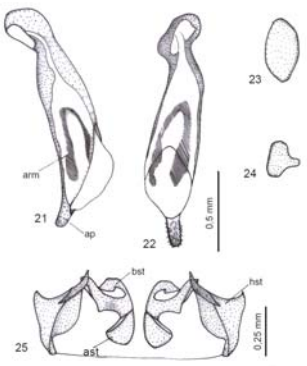
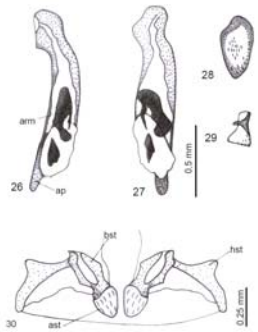


Figure 21-25. *Lebia cyanocephala* (Linnaeus, 1758): aedeagus, lateral side (21), dorsal side (22), right paramere (23), left paramere (24), female genitalia (25).

Lebia festiva **Faldermann, 1836**

Male genitalia- In lateral view aedeagus not curved. In dorsal view aedeagus slender and long, narrow at proximal, parallel sided between medial to medio-apical, narrowed apically, densely haired apically; armature of inner sac with two armed amorphous sclerite covered with spicules and left arm broaden, in addition in front of with another equilateral amorphous sclerite [Figs. 26-27]; right paramere about two times as long as left paramere and ovoid, with sparsely setae at medial and distal, left paramere narrow at base, broadened towards apical, apical mar gin truncate, trapezoid shape, with setae apically [Figs. 28-29].

Female genitalia- Hemisternites triangular , narrow at base and apex; basal segment of styluses with two arms and arms stay together with a membrane, inner arm with dense setae apically; apical segment of styluses short and almost semi-circle, sparsely punctured setae [Fig. 30].



Figsure 26-30. *Lebia festiva* Faldermann, 1836 : aedeagus, lateral side (26), dorsal side (27), right paramere (28), left paramere (29), female genitalia (30).

Lebia trimaculata **(Villers, 1789)**

Male genitalia- In lateral view aedeagus curved gently . In dorsal view weakly narrow at proximal, parallel sided towards medio-apical, narrow apically , apical plate ovoid at apex; armature of inner sac with a half moon shaped amorphous sclerite covered with dense spins [Figs. 31-32]; right paramere two times left paramere and ovoid, left paramere spatula shaped [Figs. 33-34].

Female genitalia- Hemisternites strongly narrowed at base and apex, medially broad, lateral sides with processes; basal segment of styluses with two arms, the part joining the hemisternites with a process as a hook; apical segment of styluses ovoid shape and with sparsely setae [Fig. 35].

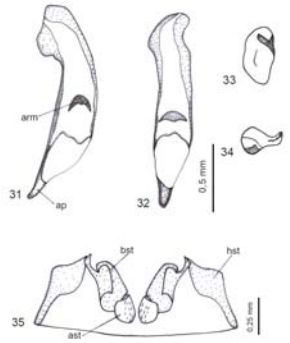


Figure 31-35. *Lebia trimaculata* (Villers, 1789): aedeagus, lateral side (31), dorsal side (32), right paramere (33), left paramere (34), female genitalia (35).

DISCUSSION

The most remarkable feature of this tribe is, parameres are smaller than aedeagus and the left paramere is smaller than the right one. Of the species analyzed, it has found that, structure of parameres can be used in generic level for male genitalia. Any distinctive feature has not been reported for distinguishing female genitalia from other tribes up to now . For female genitalia, the structure of the stylomeres is important while determining genera belonging to tribes [3]. We have found that not only stylomeres, but also hemisternites had been variable in shape and distribution of setae, both within and between the genera of Lebiini.

In *Cymindis*, *C. lineata* and *C. variolosa* have ventral margin of aedeagus sinuate. It is f at in *C. scapularis* and *C. vaporarium*. Inner sac armatures are consisted of spicule clusters in *C. scapularis* and *C. variolosa*. They include amorphous sclerites covered by spicules in *C. lineata*. In *C. vaporarium*, it consists of amorphous sclerite covered by spines. Of the species analyzed, only *C.vaporarium* has setae on parameres. In *C. lineata, C. scapularis* and *C. vaporarium*, hemisternites are quadrangle. Hemisternites are triangular in *C.variolosa.* Apical of inner mar gin in apical segment of styluses is covered by rare setae only in *C.vaporarium.* In *C.variolosa* apical segment of styluses is f at. In other species it is curved. There is one big setae in medio-ventral region in *C. lineata, C. scapularis* and *C. variolosa*. There are two setae in the same region in *C. vaporarium*. The shape of aedeagus, type and distribution of inner sac armatures and the structure of parameres are the distinguishing factors of male genitalia for this genus. The shape of basal and apical segments of styluses and the position of setae are the distinctive features for female genitalia for this genus.

In *Lebia*, inner sac armatures have medio-distal position and left arm is longer in*L. cyanocephala*. It consists of a spicule cluster. In *L. festiva*, inner sac armatures have distal position and left arm of amorphous sclerite is wider . It is armed with spicules. In addition to this there is a square shaped amorphous sclerite in front of this. In *L. trimaculata*, there is a half moon shaped amorphous sclerite covered with dense spines in medial. Similar with *Cymindis* genus, the right paramere is as twice as the left one and is oval. While the left paramere is oval in *L. cyanocephala,* it is trapezoid in *L. festiva* and spatula shaped in *L. trimaculata*. In *L. cyanocephala* and *L. festiva*, basal segments of styluses are separated from each other . In *L. trimaculata*, parts are not separated. Only in*L. festiva* the apical part of the outer mar gin is with setae. Furthermore, the dorsal region of apical segment of styluses is covered by rare setae in *L. festiva* and *L.trimaculata*. Type and distribution of inner sac armatures are the distinguishing factors for male genitalia [8] in genus *Lebia*. The distinctive features for female genitalia are the structure of basal segment of styluses and the position of setae. For female genitalia, triangular shape of hemisternites, two-layered basal segments of styluses and semi-cylindrical shape of apical segments of styluses are the distinguishing features.

From this study it is concluded that the male and female genitalia of tribe Lebiini provides valuable characters for separating genera and species. These include the shape

and inner sac armature of aedeagus, the length and shape of parameres for male genitalia and the shape and position of setae of the hemisternite and stylomeres for female genitalia. Further studies must be done on other genera and species of this tribe to put forward importance of these features.

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