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MORPHOLOGY OF THE EPIPHARYNX OF THE TUMBLING FLOWER BEETLE LARVAE (COLEOPTERA: MORDELLIDAE)

The larvae of tumbling flower beetles are described for a small number of species. In most cases works devoted to them do not have any data on morphological characteristics of the epipharynx. This morphological structure is poorly studied. The aim of the present work is first of all to lay the foundation for further study of the epipharynx of the Mordellidae larvae. The morphological features of the epipharynx of the mature larvae of tumbling flower beetles were analyzed on the example of 8 species: *Mordella holomelaena* Apfelbeck, 1914; *Mordellaria aurofasiata* (Comolli, 1837); *Natirrica humeralis* (Linnaeus, 1758); *Mordellistena pumila* (Gyllenhal, 1810); *M. secreta* Horák, 1983; *M. kraatzi* Emery, 1876; *M. weisei* Schilsky, 1895 and *M. falsoparvula* Ermisch, 1956. Photographs of the epipharynx of these species and the patterns of its setae are given. The morphological variability of the epipharynx of larvae of some species is pointed out. Terminology for describing the epipharynx of the Mordellidae larvae is proposed. It is shown that the epipharynx of larvae of various species of tumbling flower beetles is characterized by a wide range of morphological features including the length of distal portion of median projection; the length and density of elongated setiform microtrichia on its apex; the shape and location of the processes of tormae; the shape, location, number and size of setae; the presence or absent of microtrichia on its lateral portions. Along with the characters of apical processes, antennae, maxillolabial complex and some other structures, morphological features of the epipharynx can be considered as one of the most significant for the identification of the tumbling flower beetle larvae. Therefore, the morphology of the epipharynx should be used to describe the larvae of Mordellidae and develop keys for their identification.

Key words: Mordellidae; morphological features; mature larvae; epipharynx; diagnostic characters.

Fig. 16. Ref.: 15 titles.

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МОРФОЛОГИЯ ЭПИФАРИНКСА ЛИЧИНОК ЖУКОВ-ГОРБАТОК (COLEOPTERA: MORDELLIDAE)

Личинки описаны для небольшого числа видов жуков-горбатов. В большинстве случаев какая-либо морфологическая характеристика эпифаринкса в посвященных им работах отсутствует. Данная морфологическая структура является малоизученной. Целью данной работы является, прежде всего, заложение основы для последующего изучения эпифаринкса личинок Mordellidae. Проанализированы морфологические особенности эпифаринкса личинок жуков-горбатов последнего возраста на примере 8 видов: *Mordella holomelaena* Apfelbeck, 1914; *Mordellaria aurofasiata* (Comolli, 1837); *Natirrica humeralis* (Linnaeus, 1758); *Mordellistena pumila* (Gyllenhal, 1810); *M. secreta* Horák, 1983; *M. kraatzi* Emery, 1876; *M. weisei* Schilsky, 1895 и *M. falsoparvula* Ermisch, 1956. Приведены фотографии эпифаринкса для указанных видов и схемы расположения его щетинок. Указана морфологическая изменчивость эпифаринкса личинок некоторых видов. Предложена терминология для описания эпифаринкса личинок Mordellidae. Показано, что эпифаринкс личинок различных видов жуков-горбатов характеризуется широким спектром морфологических признаков, включающих длину дистальной части медиального выступа; длину и густоту удлинённых щетинковидных микротрихий на его вершине; форму и расположение отростков торм; форму, расположение, число и величину щетинок; наличие или отсутствие микротрихий на его боковых краях. Наряду с признаками опорных отростков, антенн, лабио-максиллярного комплекса и ряда других структур, указанные морфологические особенности эпифаринкса можно рассматривать в качестве одних из наиболее значимых для идентификации личинок жуков-горбатов. Следовательно, морфологию эпифаринкса следует использовать для описания личинок Mordellidae и разработки определительных ключей для их идентификации.

Ключевые слова: Mordellidae; морфологические особенности; личинки последнего возраста; эпифаринкс; диагностические признаки.

Рис. 16. Библиогр.: 15 назв.

Introduction. The larvae for the vast majority of species of Mordellidae remain unknown. In order to obtain a most detailed description of them the maximum number of morphological characters is needed. The body shape, size and coloration of the larvae of tumbling flower beetles, the morphology of their antennae, maxillolabial complex, mandibles, prothoracic tergum, spiracles, the types of protuberances on abdominal segments, the shape of abdominal segment IX, the morphological features of apical processes and some other characters were primarily used to describe Mordellidae larvae.

Despite an epipharynx is an important structure for determination of the beetle larvae, in most cases, works that deal with the Mordellidae larvae do not include any data on its morphology. However, there are some exceptions. First of all, this is the work of N. Hayashi, in which figures of the epipharynx of *Glipostena pelecotomoidea* (Pic, 1911), *Glipa fasciata* Kôno, 1928 and *Hoshihananomia perlata* (Sulzer, 1776) are given [1]. Besides, brief characteristic of the epipharynx of the mature larva of *Tomoxia lineella* LeConte, 1862 is pointed out by A. Lisberg and D. K. Young [2]. Finally, some morphological features of the epipharynx of the Mordellidae larvae are analyzed in own thesis [3].

The article is dedicated to the memory of E. I. Khotko who was a scientific supervisor of my PhD thesis and carefully supported me for many years.

Material and methods. The work is based on the study of the mature larvae that were collected from 2004 to 2023 on the territory of Belarus. A total of 138 specimens were checked, of which 41 specimens of *Mordella holomelaena* Apfelbeck, 1914; 2 specimens of *Mordellaria aurofasciata* (Comolli, 1837); 12 specimens of *Natirrica humeralis* (Linnaeus, 1758); 15 specimens of *Mordellistena pumila* (Gyllenhal, 1810); 17 specimens of *M. secreta* Horák, 1983; 19 specimens of *M. kraatzi* Emery, 1876; 14 specimens of *M. weisei* Schilsky, 1895; 18 specimens of *M. falsoparvula* Ermisch, 1956.

The mature larvae of the species under consideration have been previously described [4—11]. Photographs of the *M. falsoparvula* larvae were taken in 2023 [12].

In order to study the epipharynx of the Mordellidae larvae was separated and cleaned in KOH. Its morphological characters were studied with an Optek BK6000 microscope with Optec DV320 ½" CMOS USB 2.0 Digital Color Camera 2592 × 1944.

When developing the terminology for description of the epipharynx, works related to the morphology of the Curculionidae larvae were taken as an example [13—15].

Abbreviations used in the article: *mp* — median projection; *ep* — epipharyngeal processes; *ls* — lateral setae; *eams* — epipharyngeal anteromedian setae; *ms* — median setae; *ps* — posterior setae; *mamp* — microtrichia of the apex of median projection; *lrams* — labral anteromedian setae.

The examined specimens are deposited in the author's collection.

Research results and discussion. The epipharynx of tumbling flower beetles with median projection (*mp*) posteriorly that is partially supported by tormae and free in distal portion; epipharyngeal processes of tormae (*ep*) in form of teeth or sticks, located laterally or displaced to median projection; lateral portions with three pairs of setae (*ls₁₋₃*). Median epipharyngeal portion with three clusters of setae: anteromedian cluster of two reduced setae (*eams*) with well-developed socket; median epipharyngeal cluster of two pairs of setae (*ms₁₋₂*); posterior epipharyngeal cluster of from two to four pairs of reduced setae (*ps₁₋₄*). Microtrichia numerous on median portion, present or absent on lateral portions, located around or ended in front of anteromedian pair of labrum setae (*lrams*), in form of more or less long truncated setae on apex of median projection (*mamp*).

Mordella holomelaena Apfelbeck, 1914

Distal portion of *mp* short; *ep* medium-sized, tooth-shaped, displaced to *mp*; *ls₁₋₃* approximately equal in length. Median epipharyngeal portion with short and stout *ms₁₋₂*; distance between *ms₁* and *ms₂* clearly more than between setae of each pair; setae from each pair of *ps₁₋₃* partly fused; distance between *ps₁₋₃* and *ms₂* clearly less than between *ms₁* and *ms₂*. Microtrichia present on lateral portions, *mamp* short and sparse (Figures 1, 2).

Mordellaria aurofasiata (Comolli, 1837)

Distal portion of *mp* short; *ep* medium-sized, tooth-shaped, displaced to *mp*; *ls*₁₋₃ approximately equal in length. Median epipharyngeal portion with short and sharp *ms*₁₋₂; distance between *ms*₁ and *ms*₂ more than between setae of each pair; setae from each pair of *ps*₁₋₂ partly fused; distance between *ps*₁₋₂ and *ms*₂ approximately equal to that between *ms*₁ and *ms*₂. Microtrichia present on lateral portions; *mamp* relatively long and rather dense (Figures 3, 4).

Natirrica humeralis (Linnaeus, 1758)

Distal portion of *mp* short; *ep* long, stick-shaped, located laterally; *ls*₃ shorter than *ls*₁₋₂. Median epipharyngeal portion with short and stout *ms*₁₋₂; distance between *ms*₁ and *ms*₂ slightly more than between setae of each pair; *ps*₁₋₃ separated; distance between *ps*₁ and *ms*₂ clearly more than between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* short and rather sparse (Figures 5, 6).

Morphological variability: only one seta socket of *eams* can be visible.

Mordellistena pumila (Gyllenhal, 1810)

Distal portion of *mp* medium-sized; *ep* medium-sized, stick-shaped, located laterally; *ls*₁₋₃ stout, *ls*₂₋₃ clearly shorter than *ls*₁. Median epipharyngeal portion with short and stout *ms*₁₋₂; distance between *ms*₁ and *ms*₂ clearly more than between setae of each pair; *ps*₁₋₃ separated; distance between *ps*₁ and *ms*₂ less than between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* long and rather dense (Figures 7, 8).

Mordellistena secreta Horák, 1983

Distal portion of *mp* medium-sized; *ep* medium-sized, stick-shaped, located laterally; *ls*₁₋₃ rather stout, *ls*₂₋₃ clearly shorter than *ls*₁. Median epipharyngeal portion with short and stout *ms*₁ and long and sharp *ms*₂; distance between *ms*₁ and *ms*₂ clearly more than between setae of each pair; setae from each pair of *ps*₁₋₄ separated; distance between *ps*₁ and *ms*₂ clearly less than between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* long and dense (Figures 9, 10).

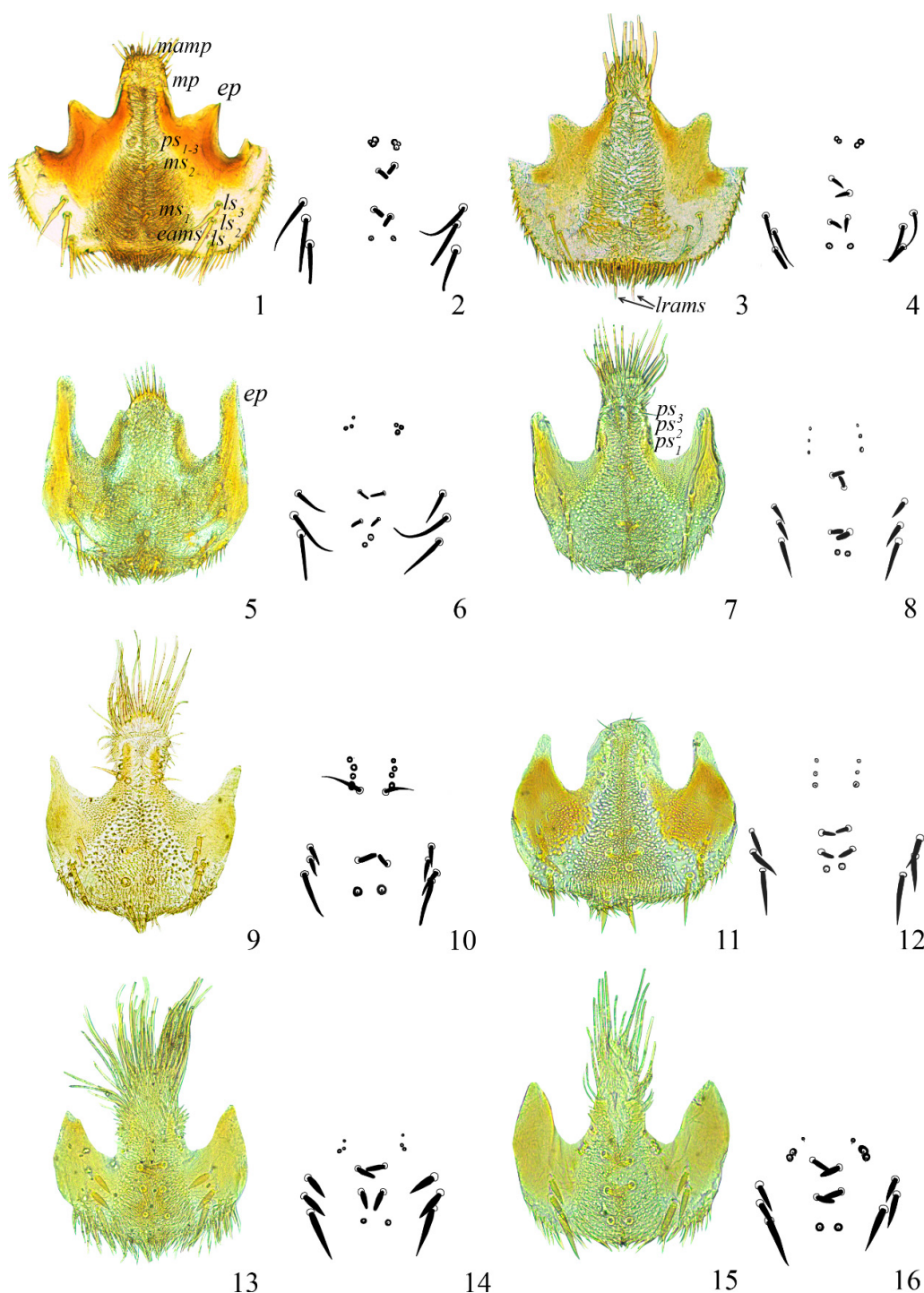
Morphological variability: additional seta on the lateral portion may be present.

Mordellistena kraatzi Emery, 1876

Distal portion of *mp* short; *ep* medium-sized, stick-shaped, located laterally; *ls*₁₋₃ rather stout, *ls*₂₋₃ slightly shorter than *ls*₁. Median epipharyngeal portion with short and stout *ms*₁₋₂; distance between *ms*₁ and *ms*₂ approximately equal to that between setae of each pair; *ps*₁₋₃ separated; distance between *ps*₁ and *ms*₂ clearly more than between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* short and sparse (Figures 11, 12).

Mordellistena weisei Schilsky, 1895

Distal portion of *mp* medium-sized; *ep* medium-sized, tooth-shaped, extended, located laterally; *ls*₁₋₃ stout, *ls*₂₋₃ shorter than *ls*₁. Median epipharyngeal portion with short and stout *ms*₁₋₂; distance between *ms*₁ and *ms*₂ approximately equal to that between setae of each pair; *ps*₁₋₃ separated; distance between *ps*₁ and *ms*₂ approximately equal to that between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* long and very dense (Figures 13, 14).



Figures 1—16. — The epipharynx of the larvae of tumbling flower beetles and the pattern of the epipharyngeal setae: 1, 2 — *Mordella holomelaena* Apfelbeck, 1914; 3, 4 — *Mordellaria aurofasiata* (Comolli, 1837); 5, 6 — *Natirrica humeralis* (Linnaeus, 1758); 7, 8 — *Mordellistena pumila* (Gyllenhal, 1810); 9, 10 — *Mordellistena secreta* Horák, 1983; 11, 12 — *Mordellistena kraatzi* Emery, 1876; 13, 14 — *Mordellistena weisei* Schilsky, 1895; 15, 16 — *Mordellistena falsoparvula* Ermisch, 1956

Рисунки 1—16. — Эпифаринкс личинок жуков-горбатов и схема расположения его щетинок: 1, 2 — *Mordella holomelaena* Apfelbeck, 1914; 3, 4 — *Mordellaria aurofasiata* (Comolli, 1837); 5, 6 — *Natirrica humeralis* (Linnaeus, 1758); 7, 8 — *Mordellistena pumila* (Gyllenhal, 1810); 9, 10 — *Mordellistena secreta* Horák, 1983; 11, 12 — *Mordellistena kraatzi* Emery, 1876; 13, 14 — *Mordellistena weisei* Schilsky, 1895; 15, 16 — *Mordellistena falsoparvula* Ermisch, 1956

Mordellistena falsoparvula Ermisch, 1956

Distal portion of *mp* medium-sized; *ep* medium-sized, tooth-shaped, extended, located laterally; *ls*₁₋₃ stout, *ls*₂₋₃ shorter than *ls*₁. Median epipharyngeal portion with short and stout *ms*₁₋₂; distance between *ms*₁ and *ms*₂ approximately equal to that between setae of each pair; setae from each pair of *ps*₁₋₂ partly fused, setae of *ps*₃ separated; distance between *ps*₁₋₂ and *ms*₂ approximately equal to that between *ms*₁ and *ms*₂. Microtrichia absent on lateral portions; *mamp* long and dense (Figures 15, 16).

Thus, the epipharynx of larvae of various species of tumbling flower beetles differs by the length of distal portion of *mp*; the length and density of *mamp*; the shape and location of *ep*; the shape, location, number and size of setae; the presence or absent of microtrichia on its lateral portions.

Conclusion. The epipharynx of the larvae of tumbling flower beetles is characterized by a complex of important morphological features. It significantly supplements the list of diagnostic characters that should be used when describing the Mordellidae larvae. In addition, the accumulation of data on the morphology of the epipharynx of various species of tumbling flower beetles will make it possible to use its features to develop keys for their identification as well as to study the phylogeny of the family.

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