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A significance of the tegmen structure for classification of the genus *Psylliodes* Latreille, 1829 (Coleoptera: Chrysomelidae: Psylliodina)

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Значение строения тегмена для классификации рода *Psylliodes* Latreille, 1829 (Coleoptera: Chrysomelidae: Psylliodina)

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Abstract. Structure of the tegmen in 50 species of the genus *Psylliodes* Latr. is investigated. Typical Y-shaped and modified tegmens are discovered. The importance of the tegmen structure for purposes ofclassification of *Psylliodes* is shown. The species-groups composition is reconsidered, new groups are established and proved. Interspecific differences in the tegmen structure allow using it for species identification.

Key words. *Psylliodes*, tegmen, classification, species-groups.

Резюме. Исследовано строение тегмена у 50 видов рода *Psylliodes* Latr. Выявлены типичная Y-образная и модифицированная формы тегмена. Показана важность учета строения тегмена для уточнения классификации рода *Psylliodes*. Пересмотрен состав групп видов, выделены и обоснованы новые группы. Межвидовые различия в строении тегмена позволяют использовать его для идентификации видов.

Ключевые слова. *Psylliodes*, тегмен, классификация, группы видов.

Introduction

The genus *Psylliodes* Latr. is one of the most species-rich and taxonomically obscure genera in the tribe Alticini. No appropriate classification of this genus exists. The subgenera and species-groups were erected at different times and are based on different features. The only classification by Leonardi (1970) is based mainly on the structure of the spermatheca in 47 species and uses a small number of other characters. Spermatheca provides valuable characters for classifying *Psylliodes* species, however species-groups based exclusively on this structure are artificial (Nadein, 2005). It is obvious that classification ought to be based on a number of features. This paper attempts to use tegmen in combination with other internal and external morphological structures for the purposes of developing the taxonomy of the genus *Psylliodes*.

This paper is dedicated to my scientific advisor, Prof. G.S. Medvedev, on the occasion of his 75th birthday.

Material and discussion

There are a few works where tegmen of flea beetles is figured (LeSage, 1995; Furth, Suzuki, 1998; Lingafelter et al., 1998; Duckett, 1999; Duckett, Moyá, 1999) and a single paper where it is used for species identification (Prathapan, Konstantinov, 2003). I investigated the tegmen in 50 species of the genus *Psylliodes* from the Palaearctic Region. It is generally believed that Alticini have a simple Y-shaped tegmen not subjected to considerable modifications. It consists of one long basal part and two short apical branches forming a fork at basal orifice of the penis. This shape is considered ancestral and plesiomorphic for the flea beetles taking into account its prevalence in this group and in the subfamily Galerucinae. As a rule, tegmen is considered a conservative structure. The genus *Psylliodes* demonstrates an exception from this rule. Some species and species-groups have deviations in the tegmen shape. There are species with typical Y-shaped tegmen and species with extremely modified one, with a transitional series between extreme forms. The modifications are: reduction of apical branches up to their total loss, flattening and widening of the basal part dorsoventrally, development of small flat blade perpendicular to basal part at the end of the tegmen. There are variants of tegmen shape where all or some listed modifications may be present (Figs 1–21). It is noted that reduction of the apical branches corresponds with the widening of the basal part.

Using various morphological characters including male and female genitalia I divided *Psylliodes* into species-groups. A few species-groups are well separated, e.g., the *glaber* (*P. glaber* Duft., *P. frivaldszkyi* Wse., *P. sturanyi* Apf., *P. longicollis* Wse., *P. rubroaeneus* Hktg., *P. schwarzi* Wse., *P. danieli* Wse., *P. solarii* Leon., *P. dogueti* Warch., and *P. petasatus* Foudr.); *gibbosus* (*P. gibbosus* All., *P. inflatus* Reiche & Saulcy, *P. kiesenwetteri* Kutsch., and *P. ruffoi* Leon.); *cucullatus* (*P. cucullatus* Ill. and *P. pyrenaeus* Hktg.); *saulcyi* (*P. saulcyi* All., *P. dilutellus* Hktg., *P. grigorievi* Jcbs., *P. analogicus* Nadein, *P. infandus* Nadein, and *P. astenicus* Nadein), and *chalcomerus* groups (*P. chalcomerus* Ill., *P. hyosciamis* L., and *P. dulcamarae* Koch). These groups are based on the following features: shape of the body, shape and structure of the head, structure of the prothorax, sculpture of the body surface, structure of the male and female genitalia, etc. A special study of the tegmen has confirmed the composition of these groups.

The *glaber*, *cucullatus* and *gibbosus* species-groups have modified tegmen (Figs 1–4, 20). They also share the shape of the prothorax (especially the prosternum) and a structure of the head (especially the labrum); most of the species are wingless.

The *saulcyi* species-group reviewed by me (Nadein, 2005) is quite distinct. It is characterized by a unique structure of the penis apex (trilobate), a shape of the spiculum ventrale, and a complex, coiled ductus of spermatheca. This group has a typical shape of the tegmen (Fig. 6). A little known species *P. aeneolus* Hktg. from Middle Asia in most of characters (except for the penis shape) is similar to the *saulcyi* group and has a typical tegmen (Fig. 5). *P. aeneolus* is considered here to constitute a separate species-group closely related to the *saulcyi* group.

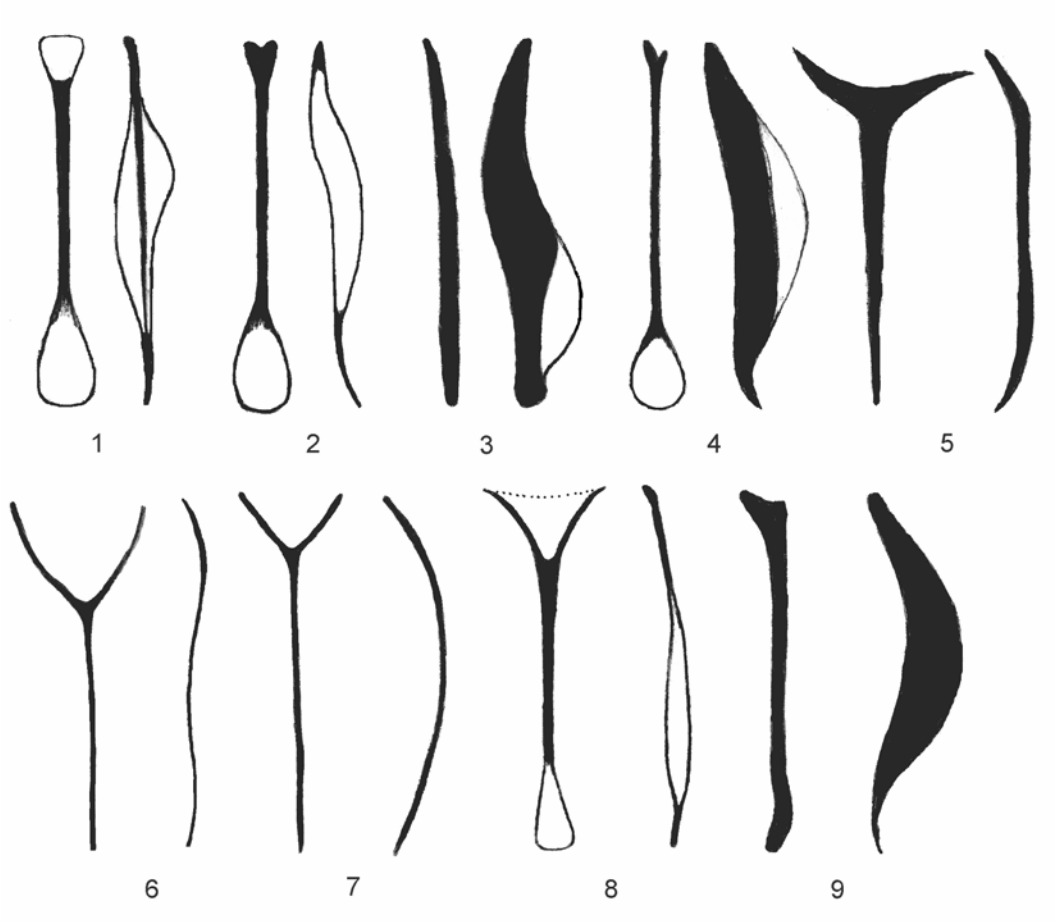
The *chalcomerus* group has the typical form of the tegmen and is characterized by a wide and convex body, well delineated frontal calli, nearly sabre-shaped metatibia, etc.

In these groups the tegmen shape corresponds with other characters. There is no species within listed groups differing from the rest in the tegmen shape. It is clear that at the species-group level the type of tegmen is conservative, though there is considerable variability in the tegmen shape at the generic level. The structure of spermatheca within groups is as stable as that of tegmen.

The following species-groups are not very well separated. They are the *napi*, *picinus*, *persicus*, *pyritosus*, and *chrysocephalus* species-groups, established by Leonardi (1970). Many of them may be partly re-arranged.

The *napi* group is subdivided into two groups. Here, I combine *P. isatidis* Hktg., *P. cupreus* Koch, *P. crambicola* Lohse, *P. wrasei* Leon. & Arnold, *P. ozisiki* Leon. & Arnold, and *P. thlaspis* Foudr. in the new *cupreus* group. Species of this group possess large, elongated, more or less flattened body with strongly shagreened surface and modified tegmen (Figs 9, 10). *P. napi* F., *P. toelgi* Hktg., *P. brisouti* Bedel, and *P. vindobonensis* Hktg. constitute the *napi* group characterised by size smaller than in the *cupreus* species-group , body rather convex, surface more or less shagreened, punctures in elytral striae deeper and larger, interspaces more convex, head small, and tegmen typical, Y-shaped (Fig. 12).

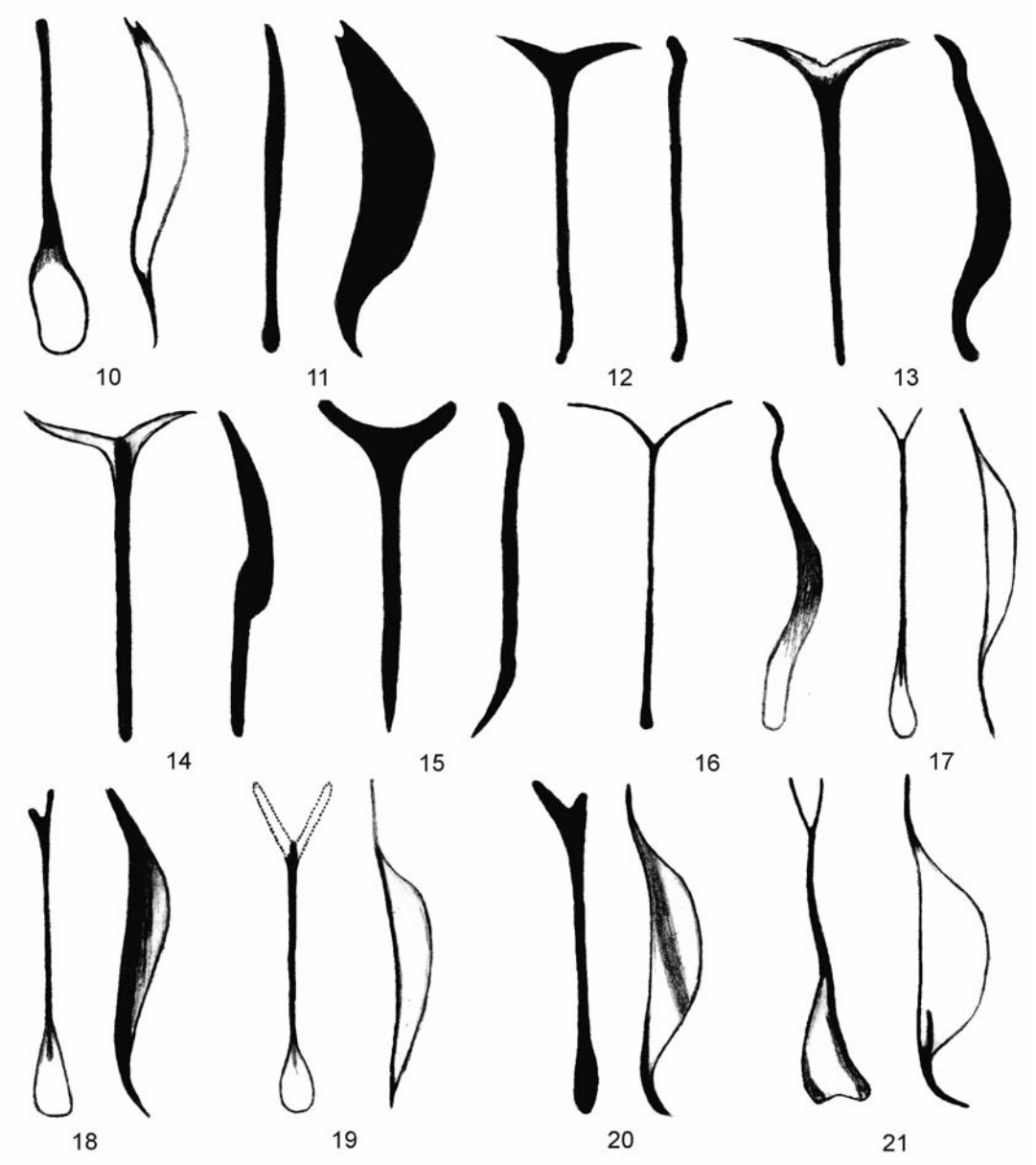
The *picinus* species-group, according to Leonardi (1970), includes *P. attenuatus* Koch, *P. algiricus* All., *P. leonhardi* Hktg., *P. puncticollis* Rosnh., *P. luteolus* Müll., *P. picinus* Marsh., *P. petasatus* Foudr., *P. danieli* Wse., *P. schwarzi* Wse., *P. glaber* Duft., *P. frivaldszkyi* Wse., *P. sturanyi* Apf., and *P. rambouseki* Hktg. Later, Leonardi added to this group *P. leavifrons* Kutsch., *P. creticus* Wse., *P. feroniae* Leon., *P. fiorellae* Leon., and *P. illyricus* Leon. & Gruev. This group is very heterogeneous morphologically and includes species with different shape of the tegmen. In my opinion, this group should be subdivided into several distinct groups. To the *picinus* group are included *P. picinus*, *P. leavifrons*, *P. creticus*, *P. feroniae*, *P. fiorellae*, and *P. illyricus, P. libanicola* Pic, *P. drusei* Furth, *P. obscuroaeneus* Rosenh. characterised by convex and rounded body, sabre-shaped metatibia, elongate frontal calli not separated from eyes by furrow, and modified tegmen (Figs 17–19). I propose to combine *P. luteolus* with *P. wachsmanni* Csiki, *P. algiricus* All., *P. maculatipes* Pic, *P. pallidicolor* Pic and *P. ruficolor* Doguet in the new *luteolus* group. These species have less convex and larger, more elongated body and Y-shaped tegmen (Figs 7, 8). Undoubtedly, these groups are very close and may be considered the subgroups of a single group. *P. attenuatus* forms a group with the single species characterised by a modified tegmen. *P. leonhardi* is unknown to me. Other species except for *P. puncticollis* should be included in the *glaber* group.



Figs 1–9. Tegmen, dorsal and lateral views. 1 – *Psylliodes gibbosus* All., 2 – *P. kiesenwetteri* Kutsch., 3 – *P. glaber* Duft., 4 – *P. frivaldszkyi* Wse., 5 – *P. aeneolus* Hktg., 6 – *P. saulcyi* All., 7 – *P. luteolus* Müll., 8. – *P. wachsmanni* Csiki, 9 – *P. cupreus* Koch.

The *pyritosus* species-group includes *P. cupreatus* Duft., *P. instabilis* Foudr. and *P. pyritosus* Kutsch. with small, more or less flattened body; small, narrowed anteriorly prothorax; fine, moderately shagreened, often smooth sculpture of the body surface, and a typical tegmen (Figs 13, 15, 16). *P. subaeneus* Kutsch. and *P. validus* Wse. form groups with a single species possessing the typical and modified tegmens accordingly.

In the *persicus* species-group [which Leonardi (1970) considered monotypic] I include also *P. hospes* Woll., *P. heikertingeri* Jcbs., *P. deplanatus* L. Medv., *P. aristus* Khnz., *P. kasyi* Lop., *P. coeles*



Figs 10–21. Tegmen, dorsal and lateral views. 10 – *Psylliodes crambicola* Lohse, 11 – *P. chrysocephalus* L., 12 – *P. napi* F., 13 – *P. pyritosus* Kutsch., 14 – *P. milleri* Kutsch., 15 – *P. cupreatus* Duft., 16 – *P. instabilis* Foudr., 17 – *P. picinus* Marsh., 18 – *P. laevifrons* Kutsch., 19 – *P. creticus* Wse., 20 – *P. cucullatus* Ill., 21 – *P. ellipticus* All.

tes Warch., *P. littoralis* Biondi and *P. milleri* Kutsch. which have moderately flattened and elongate body, small head, narrow frontal ridge, weakly shagreened surface, and typical tegmen (Fig. 14).

The *chrysocephalus* group, in my opinion, includes *P. chrysocephalus* (L.), *P. tricolor* Wse., *P. rhaicus* Jcbs., and *P. marcidus* (Ill.) The body is rather large, moderately convex, distinctly shagreened; orbital sulci deep and parallel; distal third of metatibia wide, and tegmen modified (Fig. 11).

Tegmen also can be used to separate closely related species. Figures 1 and 2 show examples of tegmens of close species. For example, *P. gibbosus* is very similar to *P. kiesenwetteri* in the most of characters. *P. cupreus* is similar to *P. crambicola* in external characters and penis shape but well differs in the shape of tegmen (Figs 9, 10).

All the four possible variants of correspondence between the tegmen structure and other morphological characters occur in the genus *Psylliodes*. 1. Morphologically uniform groups have uniform tegmen structure. 2. Morphologically uniform groups have varying tegmen structure. 3. Morphologically variable groups have uniform tegmen structure. 4. Morphologically variable groups have varying tegmen structure. This fact presumes a considerable lability of the tegmen structure and an independent character of its evolutionary trends. Probably, tegmen is not incorporated in any complex of structures evolving together in the same direction. A similar structure of the tegmen in rather different groups testifies its parallel development. Thus, it is not always that tegmen structure may be used as an exact criterion for clarifying relationship of groups although in some cases (the *glaber*, *gibbosus*, *cucullatus* and *saulcyi*, *aeneolus* groups) the tegmen structure is conformed to the other characters very well and confirms the relationship of the groups. Taking into account its stability within groups in a number of cases (the *napi*, *cupreus*, *luteolus*, and *picinus* groups) it may be considered a rather reliable criterion for grouping similar species.

Conclusions

The shape of tegmen together with other morphological characters provides an opportunity for distinguishing species-groups, although some otherwise morphologically different groups possess tegmen of a similar shape. Interspecific differences even between close species in the tegmen structure allow using it for species identification.

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